

Order of the Servants of Mary Incorporated
Section 38 Referral Supporting Documentation

1000 (Lot 9000) Wanneroo Road Sinagra

14 September 2020

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JBS&G Australia Pty Ltd T/A Strategen-JBS&G

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- Appendix A Flora Vegetation and Black Cockatoo Survey Report
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Executive Summary

The Order of the Servants of Mary Incorporated (the Proponent), are proposing to develop a portion of Lot 9000 on Plan 47802, at 1000 Wanneroo Road Sinagra (the Development Envelope) in the City of Wanneroo, Western Australia (Figure 1.1). Under the Metropolitan Region Scheme, the Development Envelope is zoned 'Urban Deferred' and the City of Wanneroo Local Planning Scheme No 2. defines the Development Envelope as 'Centre'.

The purpose of the clearing is to facilitate the construction of medium and high density residential and mixed use commercial development, with associated infrastructure such as roads, drainage and pedestrian pathways (the proposal) as part of the Wanneroo Town Centre. The CoW have previously submitted the draft Activity Centre Plan No. 90 (draft ACP) to the Western Australian Planning Commission (WAPC) in early 2019, which encompasses the CoW Town Centre and includes the Development Envelope (TBB 2018; Figure 1.2). The draft ACP is a local planning document developed under the Local Planning Scheme No 2 framework to guide the subdivision and development across the Wanneroo Town Centre area and define the land use zoning intensity and classifications. The draft ACP area has designated the Wanneroo Town Centre a high density urbanised area and provides planning guidance for commercial zones, medium and high density residential dwellings, mixed used areas, regional road infrastructure, public open space and the retention of remnant vegetation for conservation.

The proponent will retain 2.03 ha of public open space for conservation purposes located in the north eastern and the north western portion of the Development Envelope. The conservation outcome across the Development Envelope is 1.76 ha of vegetation and habitat retention. The Eastern Conservation Area comprises 1.45 ha (1.26 ha of remnant vegetation) in total, while the Western Conservation Area is 0.57 ha (0.50 ha of remnant vegetation).

Table ES 1 and table ES 2 below, provide a summary of the proposal and the extent of its physical and operational elements.

The key environmental factors relevant to this proposal are considered to be:

- Flora and vegetation
- Terrestrial fauna.

Table ES 3 provides a summary of potential impacts, proposed mitigation and outcomes for the proposal.

Table ES.1: Proposal summary table

Subject	Detail
Proposal title	1000 (Lot 9000) Wanneroo Road Sinagra.
Proponent name	The Order of the Servants of Mary Incorporated.
Short description	<p>The proposal is to clear native vegetation to enable Urban development within Lot 9000 Wanneroo Road, 28 km north-west of the Perth CBD, WA.</p> <p>The proposal includes the following land uses:</p> <ul style="list-style-type: none"> • mixed use development (commercial and residential) • internal public road network • public open space, including conservation public open space (POS).

Table ES.2: Physical and operational elements

Element	Location	Proposed extent
Physical elements		
Urban development, including: <ul style="list-style-type: none"> • mixed use commercial and residential development • internal public road network • power and water infrastructure. 	Refer to Figure 1.3.	No more than 27.3 ha, within a development envelope of 29.33 ha.
Conservation Public Open Space.	Refer to Figure 1.3.	No more than 2.03 ha, within a development envelope of 29.33 ha.

Table ES.3: Summary of potential impacts, proposed mitigation and outcomes

Element	Description
Flora and vegetation	
EPA objective	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.
Policy and guidance	Flora and vegetation surveys to inform planning for the proposal have been conducted in accordance with the <i>Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment</i> (EPA 2016a) and the <i>Environmental Factor Guideline: Flora and Vegetation</i> (EPA 2016b).
Potential impacts	<p>Direct impacts will result in the complete clearing of no more than 24.58 ha of native vegetation. Consisting predominately of Banksia/ Jarrah (14.11 ha) native vegetation (Floristic Community Type 28) which is a sub-community of the state listed Banksia Dominated Woodlands of the Swan Coastal Plain Priority 3 ecological community. A Jarrah/Marri woodland (10.47) native vegetation type also occurs across the Development Envelope. This community is also identified as FCT 28, but does not support Banksia species.</p> <p>FCT 28 is not listed separately by the State as a Threatened or Priority ecological community in its own right and is known from 80 point locations over a range of about 150 km from Red Gully to Leda (Gibson <i>et al.</i> 1994). Gibson <i>et al.</i> (1994) identified this FCT as having a medium-high species richness of 56 species per 100 m² however, average species richness recorded across the Development Envelope was 19.5 species per 100 m² (based on data collected from eight 10 m x 10 m quadrats). Given the species richness recorded, vegetation within the Development Envelope is not considered a high diversity example of this FCT.</p> <p>Vegetation within the Development Envelope is listed as a Threatened Ecological Community under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act); being "Banksia Woodlands of the Swan Coastal Plain". A total of 15.86 ha of Banksia Woodland Threatened Ecological Community occurs within the Development Envelope (Figure 4.2). A total of 14.11 ha of Banksia Woodland Threatened Ecological Community will be impacted within the Development Envelope.</p> <p>A total of nine Tuart Trees occur across the Development Envelope. Only seven of these meet the definition for Tuart Woodlands of the Swan Coastal Plain Priority Ecological Community Priority 3 totalling 1.2 ha (Figure 4.2). In total two Tuarts will be impacted by the Proposal and 0.7 ha of Tuart Woodland priority ecological community will be cleared.</p> <p>The Tuart woodlands (1.2 ha) within the Development Envelope, is listed as Tuart Woodlands and Forests of the Swan Coastal Plain Threatened Ecological Community under the <i>Environment Protection and Biodiversity Conservation Act 1999</i>.</p> <p>Potential indirect impacts may be associated with uncontrolled access, dust deposition, and through the spread of weeds and dieback.</p> <p>Surveys of the Development Envelope have identified the proposal does not involve:</p> <ul style="list-style-type: none"> • impacts to any listed Threatened flora under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> or Biodiversity Conservation Act 2016 • impacts to priority species as identified by the Department of Biodiversity Conservation and Attractions • impacts to any vegetation that has 10% or less of its pre-European extent remaining (noting the Development Envelope is within a constrained area)

Element	Description
	<ul style="list-style-type: none"> reducing a vegetation complex/ association to 10% or less of its pre-European extent impacts to any riparian vegetation impact to any areas reserved under statute or managed for the purpose of conservation impacts to any of the 15 national biodiversity hotspots identified by the Threatened Species Scientific Committee.
Mitigation	Avoid:
	<ul style="list-style-type: none"> A total of 1.76 ha (5.97%) of native vegetation within the Development Envelope is proposed to be set aside as conservation Public Open Space across two separate areas. In the current Concept Plan, both areas have been strategically located to retain: <ul style="list-style-type: none"> areas of better quality vegetation and communities 1.76 ha of Banksia Woodland Priority Ecological Community under the <i>Biodiversity Conservation Act 2016</i> and Threatened Ecological Community under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> 0.5 ha (5 trees) of Tuart Woodlands priority ecological community under the <i>Biodiversity Conservation Act 2016</i> and Threatened Ecological Community under the <i>Environment Protection and Biodiversity Conservation Act 1999</i>.
	Minimise:
	<ul style="list-style-type: none"> During future subdivision stages, a Vegetation and Fauna Management Plan to the satisfaction of the City of Wanneroo will be prepared, for the management of vegetation during and post construction. The Vegetation and Fauna management Plan will include (but not limited to): <ul style="list-style-type: none"> measures to avoid and mitigate impacts to retained native vegetation and Priority communities following commencement of the action (during construction), including: <ul style="list-style-type: none"> hygiene requirements to prevent the introduction or spread of <i>Phytophthora</i> dieback clearing and access control measures (such as demarcation of clearing boundaries) erosion and sediment control topsoil management dust control waste and fire management performance indicators that measure the effectiveness of avoidance and mitigation measures contingency measures that will be undertaken if performance targets are not met roles and responsibilities of personnel associated with implementing mitigation measures. A Conservation Management Plan to the satisfaction of the City of Wanneroo to guide the management of the Conservation Public open space during and post construction, will also be developed at the sub-division stage. The Conservation Management Plan will include (but not limited to): <ul style="list-style-type: none"> native vegetation condition targets weed density targets weed control actions maintenance schedule monitoring schedule contingency measures that will be undertaken if performance targets are not met roles and responsibilities of personnel associated with implementing mitigation measures.
Outcomes	Rehabilitate:
	While formal rehabilitation is not proposed within the site, landscaping will utilise native species that occur within the Banksia Woodlands PEC where possible.
	Significant residual impact:
	<p>In consideration of the <i>WA Environmental Offset Guidelines</i> Residual Impact Significance Model, an offset will likely be required for significant residual impacts to 14.11 ha of Commonwealth EPBC Act listed Banksia Woodlands of the Swan Coastal Plain TEC. It is however noted, that at a State level, this is a Priority 3 Ecological Community, which are not afforded formal statutory protection.</p> <p>The clearing of Banksia Woodlands of the Swan Coastal Plain TEC has been referred to the Department of Agriculture, Water and the Environment under the EPBC Act. The proponent is seeking for the proposal to be assessed via an accredited assessment.</p>

Element	Description
	<p>Offset:</p> <p>The proponent considers that an offset will be required for significant residual impacts to the Commonwealth EPBC Act listed Banksia Woodlands of the Swan Coastal Plain TEC. Offsets area anticipated to be required for significant residual impacts to 14.11 ha of Banksia Woodland TEC. This offset will be determined in consultation with the Department of Agriculture, Water and the Environment through the assessment of the proposal.</p> <p>The proponent will resolve an offset strategy with the Environmental Protection Agency and the Department of Agriculture, Water and the Environment during assessment of the proposal.</p>
Terrestrial fauna	
EPA objective	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained
Policy and guidance	Terrestrial fauna surveys that have informed planning for the proposal have been conducted in accordance with the <i>Technical Guidance – Terrestrial Fauna Surveys for Environmental Impact Assessment</i> (EPA 2016c) and the <i>Environmental Factor Guideline: Terrestrial Fauna</i> (EPA 2016d).
Potential impacts	<p>Direct impacts will be confined to the development envelope (Figure 1.1) and will involve clearing of habitat for conservation significant species including:</p> <ul style="list-style-type: none"> • 24.58 ha of Excellent quality foraging habitat for Carnaby Black Cockatoo • 24.58 ha of Moderate quality foraging habitat for Forest Red-tailed Black Cockatoo comprised of 10.47 ha of Good to Moderate quality foraging habitat and 14.11 ha of poor quality foraging habitat • a maximum of 85 potential breeding (DBH ≥500 mm) trees for Black Cockatoos, none of which contain hollows suitable for breeding by Black Cockatoos • 24.58 ha of native vegetation providing potential habitat for Priority species Quenda, Shield backed Trapdoor Spider and Black-striped snake. Given the broad range of these species and their status as Priority 3 and Priority 4 fauna, (DBCA n.d.), this impact is not considered to be significant. Furthermore, the Short Tongued-bee (Priority 3) is considered to potentially be present within the Development Envelope; however, habitat information for this species is limited. <p>Construction activities have the potential to impact indirectly on adjacent fauna habitat through uncontrolled access, dust deposition and through the spread of weeds and dieback.</p>
Mitigation	<p>Avoid:</p> <ul style="list-style-type: none"> • 1.76 ha of remnant native vegetation is proposed to be set aside as conservation public open space within which native vegetation (and by extension terrestrial fauna habitat) will be retained • 1.76 ha of Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo foraging habitat • Retention of 5 significant trees within the western conservation public open space (based on the current Concept Plan). These trees will also provide foraging habitat for Black Cockatoos. <p>Minimise:</p> <ul style="list-style-type: none"> • Development of a Vegetation and Fauna Management Plan including: <ul style="list-style-type: none"> ◦ fauna trapping and relocation measures prior to clearing ◦ measures to avoid and mitigate impacts to CBC and FRTBC and their habitat (during construction) ◦ performance indicators that measure the effectiveness of avoidance and mitigation measures ◦ monitoring, reporting and contingency measures that will be undertaken if performance targets are not met ◦ timeframes for the implementation of avoidance and mitigation measures ◦ roles and responsibilities of personnel associated with implementing avoidance and mitigation measures. <p>Rehabilitate:</p> <ul style="list-style-type: none"> • while formal rehabilitation is not proposed within the site, landscaping will utilise native vegetation where possible.

Element	Description
Outcomes	Significant residual impact:
	In consideration of the WA Environmental Offset Guidelines Residual Impact Significance Model, an offset will likely be required for significant residual impacts to:
	<ul style="list-style-type: none"> • 24.58 ha of Excellent quality foraging habitat for Carnaby's Black Cockatoo • 24.58 ha of Moderate quality foraging habitat for Forest Red-tailed Black Cockatoo comprised of 10.47 ha of Good to Moderate quality foraging habitat and 14.11 ha of poor quality foraging habitat • a maximum of 85 potential breeding and roosting (DBH ≥500 mm) trees for Black Cockatoos, none of which contain hollows suitable for breeding by Black Cockatoos.
	Offset:
	<ul style="list-style-type: none"> • Acquisition of land containing habitat for Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo.

1. Introduction

1.1 Purpose and scope

The Order of the Servants of Mary Incorporated (the Proponent), are proposing to develop a portion of Lot 9000 on Plan 47802, at 1000 Wanneroo Road Sinagra (the Development Envelope; Figure 1.1) in the City of Wanneroo (CoW), Western Australia. Under the Metropolitan Region Scheme (MRS) the Development Envelope is zoned 'Urban Deferred', the CoW Local Planning Scheme No 2. defines the Development Envelope as 'Centre'.

The Development Envelope is located approximately 28 km north of the Perth central business district.

The Development Envelope's MRS zone of Urban Deferred is a result of the adjacent operations of Ingham's Poultry Facility, which includes a chicken hatchery, broiler farm and feed mill. The buffer associated with this activity has impeded development of the Development Envelope. The sale of the Ingham's site for urban development in 2017 and planned closure of Ingham's operations will remove the development constraint from the Development Envelope.

The Development Envelope occurs within the East Wanneroo Cell 2 structure Plan No. 4, which was updated on June 2004 and forms part of the LPS No. 2 framework. Structure Plan No. 4 identified the requirement for the Development Envelope to act as an odour buffer for the Poultry Sheds operating directly to the north (WAPC 2004). The Structure Plan also identified a portion or all of the Development Envelope may be incorporated into the residential precinct upon the cessation of operations of the poultry sheds (WAPC 2004).

The CoW have previously submitted the draft Activity Centre Plan No. 90 (draft ACP) to the Western Australian Planning Commission (WAPC) in early 2019, which encompasses the CoW Town Centre and includes the Development Envelope (TBB 2018; Figure 1.2). The draft ACP is a local planning document developed under the Local Planning Scheme No 2 framework to guide the subdivision and development across the Wanneroo Town Centre area and define the land use zoning intensity and classifications. The draft ACP area has designated the Wanneroo Town Centre a high density urbanised area and provides planning guidance for commercial zones, medium and high density residential dwellings, mixed used areas, regional road infrastructure, public open space and the retention of remnant vegetation for conservation.

The Development Envelope encompasses 29.33 ha in total and contains 26.33 ha of remnant vegetation. To facilitate development, the proponent is proposing to clear 24.58 ha of native vegetation within the Development Envelope. The purpose of clearing is to facilitate the construction of medium and high density residential and mixed use commercial development, with associated infrastructure such as roads, drainage, public open space and pedestrian pathways (the proposal) as part of the Wanneroo Town Centre. The clearing footprint has been guided by the draft ACP and the values identified within the Development Envelope. The proponent will retain 2.03 ha of public open space for conservation purposes located in the north eastern and the north western portion of the Development Envelope (Figure 1.3). The retained vegetation outcome across the Development Envelope is 1.76 ha due to currently cleared fire access tracks along the eastern and northern boundaries of the proposed conservation POS areas. The Eastern Conservation Area is 1.45 ha (1.26 ha of remnant vegetation) in total, while the Western Conservation Area is 0.57 ha (0.50 ha of remnant vegetation) (Figure 1.3).

This supporting document has been prepared in accordance with Environmental Protection Authority (EPA) *Instructions on how to prepare an Environmental Review Document* (EPA 2018) to support referral of the Proposal under section 38 of the *Environmental Protection Act 1986* (EP Act).

1.1 Proponent

Table 1.1 below provides the details of the Proponent.

Table 1.1: Proponent and key contact details

Subject	Details
Proponent name	Order of the Servants of Mary Incorporated
ABN	38 167 128 281
Postal address	2 Morgans Street Tuart Hill, Western Australia 6060
Proponent contact	Stephen Barker

1.2 Environmental impact process

This supporting document aims to provide information for the EPA to determine the level of assessment of the proposal. This includes information and level of detail on:

- the proposal
- potential impacts
- mitigation measures
- environmental outcomes
- stakeholder consultation.

The Proponent has also submitted a referral to the Australian Government Department of Agriculture, Water and the Environment (DAWE) in relation to potential impacts to Matters of National Environmental Significance (MNES), under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). These include:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)
- Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community
- Tuart Woodlands and Forests of the Swan Coastal Plain.

Should DAWE determine that the proposal is a controlled action, the Proponent has requested the proposal is assessed via an accredited assessment (see section 1.3).



Legend:

- Development envelope
- Cadastral boundary
- Roads (MRWA)

Job No: 57868

Client: Woodsome Management

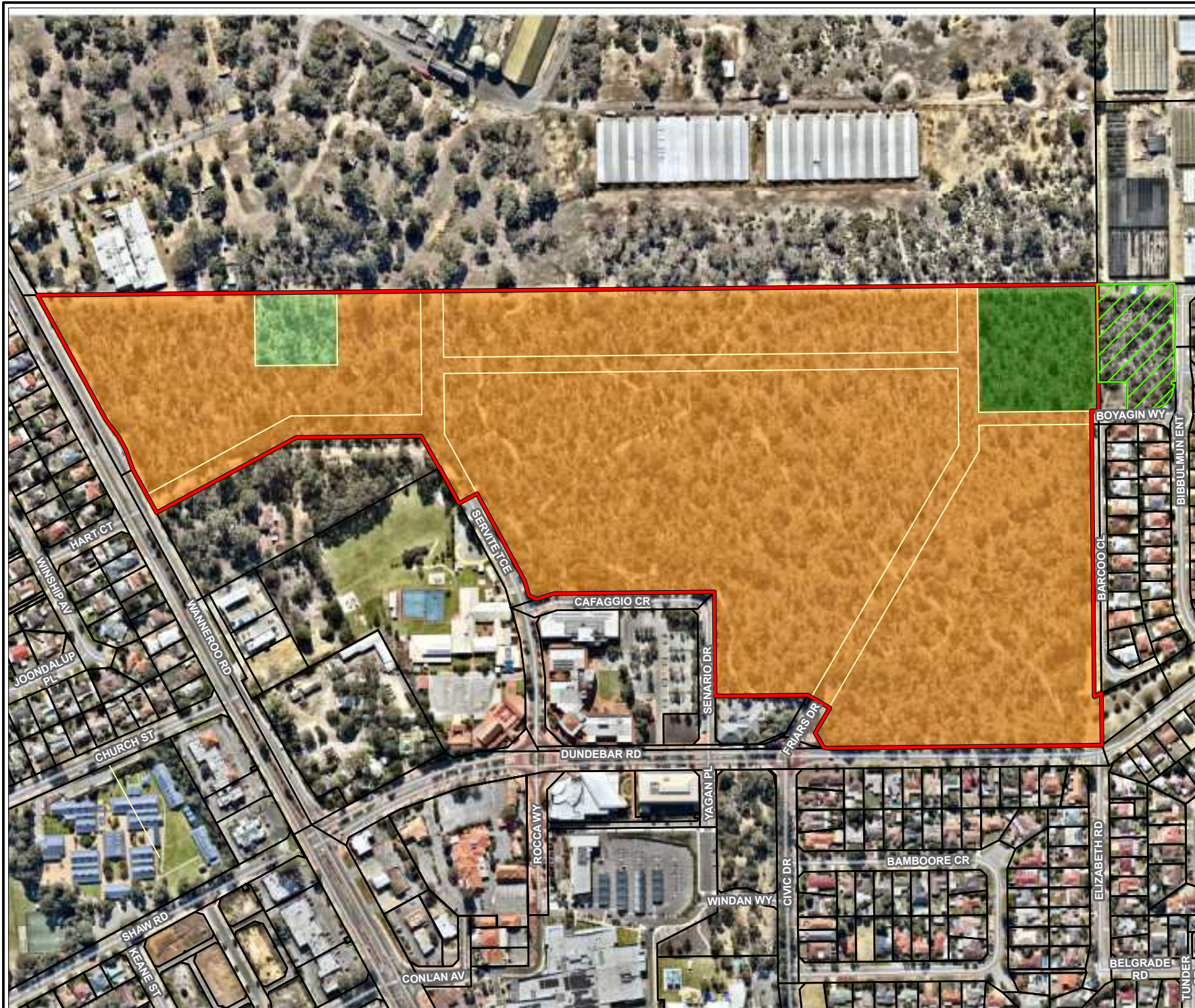
Version: A	Date 16/07/2020
Drawn By: cthatcher	Checked By: HS

Scale 1:4,750

**Lot 9000 Wanneroo Rd
Perth, WA**

DEVELOPMENT ENVELOPE

FIGURE 1.1



Legend:

- Development envelope (29.33 ha)
- Boyanup Park (0.84ha)
- Cadastral boundary
- Concept design
- Eastern conservation area (1.45ha)
- Development area (27.30ha)
- Western conservation area (0.57ha)
- Structure plan
- Roads (MRWA)



Job No: 57868

Client: Woodsome Management

Version: A

Date 17/07/2020

Drawn By: cthatcher

Checked By: HS

Scale 1:5,000



0 50 100
metres

**Lot 9000 Wanneroo Rd
Perth, WA**

CONCEPT DESIGN

FIGURE 1.3

1.3 Other approvals and regulation

The development envelope is currently zoned 'Urban Deferred' under the Metropolitan Region Scheme (MRS) and as 'Centre' under the CoW LPS No.2. The Urban Deferred status across the Development Envelope is a result of the Inghams Poultry Facility adjacent to the north. Currently, development of the Development Envelope is impeded by a buffer associated with the Inghams operations. As Inghams is in the process of relocating its operations, the proponent will seek to lift the Urban Deferred status across the Development Envelope as other land owners have done.

Table 1.2 provides a summary of the key environmental approval and regulations relevant to the proposal. Decision-making authorities (DMA's) relevant to the proposal include the DAWE and Minister for Planning.

Table 1.2: Other approvals

Proposal activities	Land tenure/access	Type of approval	Legislation regulating the activity
Clearing of native vegetation	Freehold	Assessment of impacts on Matters of National Environmental Significance	EPBC Act
Land use and development planning	Freehold	Rezoning approval by the WAPC/ CoS	<i>Planning and Development Act 2005</i>
	Freehold	Structure Plan approval by the WAPC/ CoS	<i>Planning and Development Act 2005</i>
Subdivision (development including clearing of native vegetation)	Freehold	Subdivision approval by the WAPC/ CoS	<i>Planning and Development Act 2005</i>

1.3.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Department of Agriculture, Water and the Environment (DAWE). The EPBC Act aims to protect and manage Matters of National Environmental Significance (MNES) throughout Australia including:

- World Heritage Properties
- National Heritage Places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species and ecological communities
- migratory species protected under international agreements
- Commonwealth Marine Areas
- The Great Barrier Reef Marine Park
- nuclear actions (including uranium mines).

A referral to DAWE for assessment under EPBC Act, has been submitted concurrently with this referral to DWER. Should both DWER and DAWE determine that the proposal requires formal assessment, the proponent requests that the proposal is considered via an accredited assessment under the bilateral agreement.

2. The proposal

2.1 Background and justification

Lot 9000 Wanneroo Road has been identified by the Wanneroo Town centre draft ACP for mixed use urban development and includes high and medium density residential and commercial land uses. Currently the land within the Development Envelope is zoned “Urban Deferred” under the MRS and ‘Centre’ under the CoW LPS No. 2.

The Urban Deferred status of the Development Envelope is due to the Inghams Poultry Farm and processing operations on Lot 1665 directly to the north. The Development Envelope acts as an odour buffer from the poultry farm to nearby residence. The poultry farm and processing facility will shortly cease operations and a residential development will be constructed across the Lot. In preparation for urban development, Lot 1664 has recently undergone an MRS amendment to change the zoning to Urban. Additionally, the current owner of Lot 1664, has been provided an EPBC approval (EPBC 2017/7921), for impacts to matters of national environmental significance during the construction of a proposed residential development.

Prior to the construction activity commencing across the Development Envelope, the proponent will submit an application to the Western Australian Planning Commission (WAPC), to lift the Urban Deferred status of the Development Envelope. The zoning of the Development Envelope under the LPS No. 2 is commensurate with urban development.

As noted earlier, the City of Wanneroo Structure Plan No. 4 (adopted in 2004) identifies the Development Envelope as Centre land use zoning and recognises the intended land use following the lifting of Urban Deferred is Residential (CoW 2004).

The proposed land uses across the Development Envelope identified in Figure 1.3, have been guided by the draft ACP currently under consideration by the WAPC. The draft ACP has been prepared by the City of Wanneroo, to provide guidance on land use zoning and details permissible density across the draft ACP area. The purpose of the document is to facilitate land use planning and development corresponding with the proximity of the Development Envelope to the Wanneroo Town Centre. Additionally, the draft ACP considers modern design principles and development controls to ensure commercial and residential land uses, are commensurate with the existing and future Town Centre requirements.

The draft ACP places a high degree of importance on employment creation within the Wanneroo Town Centre which will be supported by maximising the availability of land for residential and mixed use development. Establishing a residential presence in the town centre will go to supporting the service and employment demand of the town centre.

The draft ACP acknowledges that the only residential land within the Wanneroo Town Centre is the Development Envelope. The development of this land to provide a range of medium to high residential densities, is critical to support the generation of new employment opportunities as well as creating a more vibrant, prosperous and progressive town centre.

The City of Wanneroo Local Biodiversity Plan identifies local and regionally important remnant bushland within the City of Wanneroo (CoW 2018). The City has identified six biodiversity planning precincts and provides targets for management and retention of locally important natural areas (CoW 2018). While the Local Biodiversity Plan does identify the Development Envelope as a Local Natural Area (LNA), the Development Envelope has not been identified for retention or priority management as per Figure 9: Priority LNAs (CoW 2018). The lack of biodiversity priority status for the Development Envelope, is reflective of the long term planning strategy for the Wanneroo Town Centre, and the strategic importance of the Development Envelope for urban growth within the City of Wanneroo.

The Development Envelope has not been identified for conservation protection under Western Australian legislation. Additionally, the Development Envelope has not been identified as part of a green network within the Perth and Peel sub-regional frameworks (WAPC 2018), a Bush Forever site (GoWA 2000) or a priority management area City of Wanneroo Biodiversity Plan (CoW 2018).

2.2 Proposal description

2.2.1 Key proposal characteristics

Key proposal characteristics and elements are presented below in Table 2.1 and Table 2.2.

Table 2.1: Summary of the proposal

Subject	Detail
Proposal title	1000 (Lot 9000) Wanneroo Road Sinagra.
Proponent name	The Order of the Servants of Mary Incorporated.
Short description	<p>The proposal is to clear native vegetation to enable Urban development within Lot 9000 Wanneroo Road, 28 km north-west of the Perth CBD, WA.</p> <p>The proposal includes the following land uses:</p> <ul style="list-style-type: none"> • mixed use urban development (residential and commercial) • internal public road network • public open space, including conservation public open space (POS).

Table 2.2: Location and proposed extent of physical and operational elements

Element	Location	Proposed extent
Physical elements		
Urban development, including: <ul style="list-style-type: none"> • mixed use urban development • internal public road network • power and water infrastructure. 	Refer to Figure 1.3.	No more than 27.3 ha, within a Development Envelope of 29.33 ha.
Conservation Public Open Space.	Refer to Figure 1.3.	No more than 2.03 ha, within a Development Envelope of 29.33 ha.

2.3 Local and regional context

The Development Envelope is located in Sinagra within the City of Wanneroo. Figure 1.1 represents the local context of the proposal.

The Development Envelope experiences a Mediterranean climate characterised by mild, wet winters and warm to hot, dry summers. The nearest Bureau of Meteorology (BoM) weather station at Wanneroo (Station No. 9105) provides average monthly rainfall statistics for the Proposal Area. Average annual rainfall recorded at Wanneroo since 1905 is 801 mm (BoM 2017). Rainfall may occur at any time of year; however, most occurs in winter in association with cold fronts from the southwest. The BoM weather station at Perth (Station No. 9225) provides the most representative monthly temperature data for the Proposal Area. Highest temperatures occur between December and March, with average monthly maximums ranging from 29.1°C in December to 31.6°C in February (BoM 2017). Lowest temperatures occur between June and August, with average monthly minimums ranging from 18.4 °C in July to 19.5 °C in June (BoM 2017).

Topographically, the Development Envelope slopes east to west with the natural surface ranging from approximately 71 m Australian Height Datum (AHD) along the eastern boundary, to 12 m AHD along the western boundary (Figure 2.1).

Figure 2.1 indicates two landform soil units within the Development Envelope, which are described below.

- 211Sp_Sp Spearwood Sand Phase - Irregular banks of karst depressions with some limestone outcrop and shallow brown sands
- 211Sp_Ky Karrakatta Sand Yellow Phase - Low hilly to gently undulating terrain with yellow sand over limestone at 1-2 m (DPIRD 2019).

The Development Envelope is underlain by three aquifers, in descending order from proximity to surface these are:

- Superficial Swan - unconfined
- Leederville - confined
- Yarragadee – confined.

There are no groundwater licences issued across the Development Envelope, all groundwater resources within the local area are fully allocated (DWER 2019a).

The Perth Groundwater Atlas demonstrates the depth of the superficial groundwater aquifer ranges from 12 m below ground level (mbgl), to 37.5 mbgl (DoW 1997). Regional groundwater contours indicate that groundwater flows east to west across the Development Envelope towards Lake Joondalup (DWER 2019b; CSIRO 2009).

The Development Envelope is not within the Public Drinking Water Source Area (PDWSA); however, a Priority 3 (P3) PDWSA occurs directly adjacent to the western boundary of the Development Envelope (Figure 2.2). The P3 PDWSA is part of the Perth Coastal Gwelup Underground Water Pollution Control Area.

There are no surface water features within the Development Envelope. Lake Joondalup is the closest surface water feature and is 560 m to the west. Mariginiup Lake and Lake Jandabup occur approximately 1.9 km to the north east and 2.2 km to the east respectively. Both ephemeral lakes are hydrologically up gradient from the Development Envelope. There are no declared Ramsar wetlands present within the Development Envelope or within 3 km of the Development Envelope (WALGA 2019).

No Bush Forever sites are located within the Development Envelope, the closest Bush Forever site is Yellagonga Regional Park (site 299), located 380 m to the west.

At a local level, the Development Envelope is surrounded by:

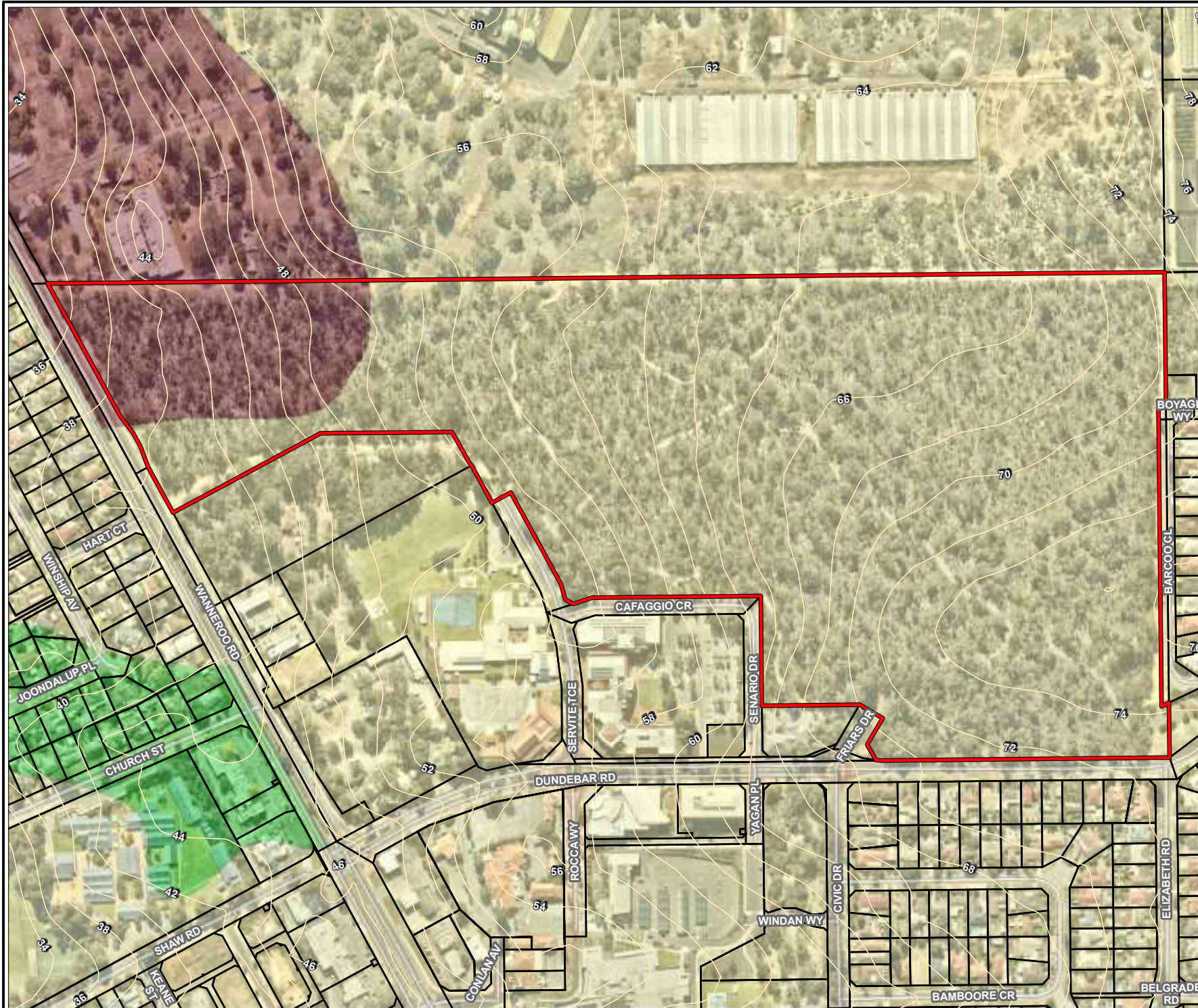
- Wanneroo Road and residential dwellings to the West
- a poultry farm to the north which will be developed for a residential development post decommissioning, this land will be developed by Stockland
- residential dwellings and Barcoo Close to the east
- fuel Station, school, council buildings and carpark, shopping centre and various commercial developments, Dundobar Road and residential dwellings to the south.

Substantial extents of remnant vegetation occur locally across several local and regional parks (Figure 2.3) including:

- Edgar Griffin Park 1.4 km to the north east approximately 5.2 ha
- Coogee Park 1.4 km to the north approximately 10 ha
- Ashley Park 1.5 km to the north approximately 19.8 ha
- Lake Joondalup Nature Reserve 560 m to the west >100 ha
- Franklin Park 1.7 km to the east approximately 7.2 ha.

At a regional level, numerous conservation reserves of significant value exist within 12 km of the Development Envelope(Figure 2.3). These include:

- Neerabup National Park
- Whiteman Park
- Yellagonga Regional Park
- Koondoola Regional Bushland
- Warwick Open Space
- Joondalup Foreshore Reserve.



Legend:

- Development envelope (29.33 ha)
- Cadastral boundary
- Soil landscape (DPIRD)
 - 211Sp, Karakatta sand yellow phase
 - 211Sp, Karakatta shallow soils phase
 - 211Sp, Spearwood sand phase
- Topographic contours (mAHD)
- Roads (MRWA)



Job No: 57868

Client: Woodsome Management

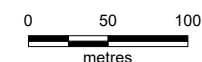
Version: A

Date 16/07/2020

Drawn By: cthatcher

Checked By: HS

Scale 1:4,750



Lot 9000 Wanneroo Rd
Perth, WA

TOPOGRAPHY AND SOILS

FIGURE 2.1



Legend:

- Development envelope (29.33 ha)
- Geomorphic Wetlands (DBCA)
 - Conservation
- Public drinking water source areas
 - P3
- Groundwater contours (max; mAHD)



Job No: 57868

Client: Woodsome Management

Version: A

Date 17/07/2020

Drawn By: cthatcher

Checked By: HS

Scale 1:10,000

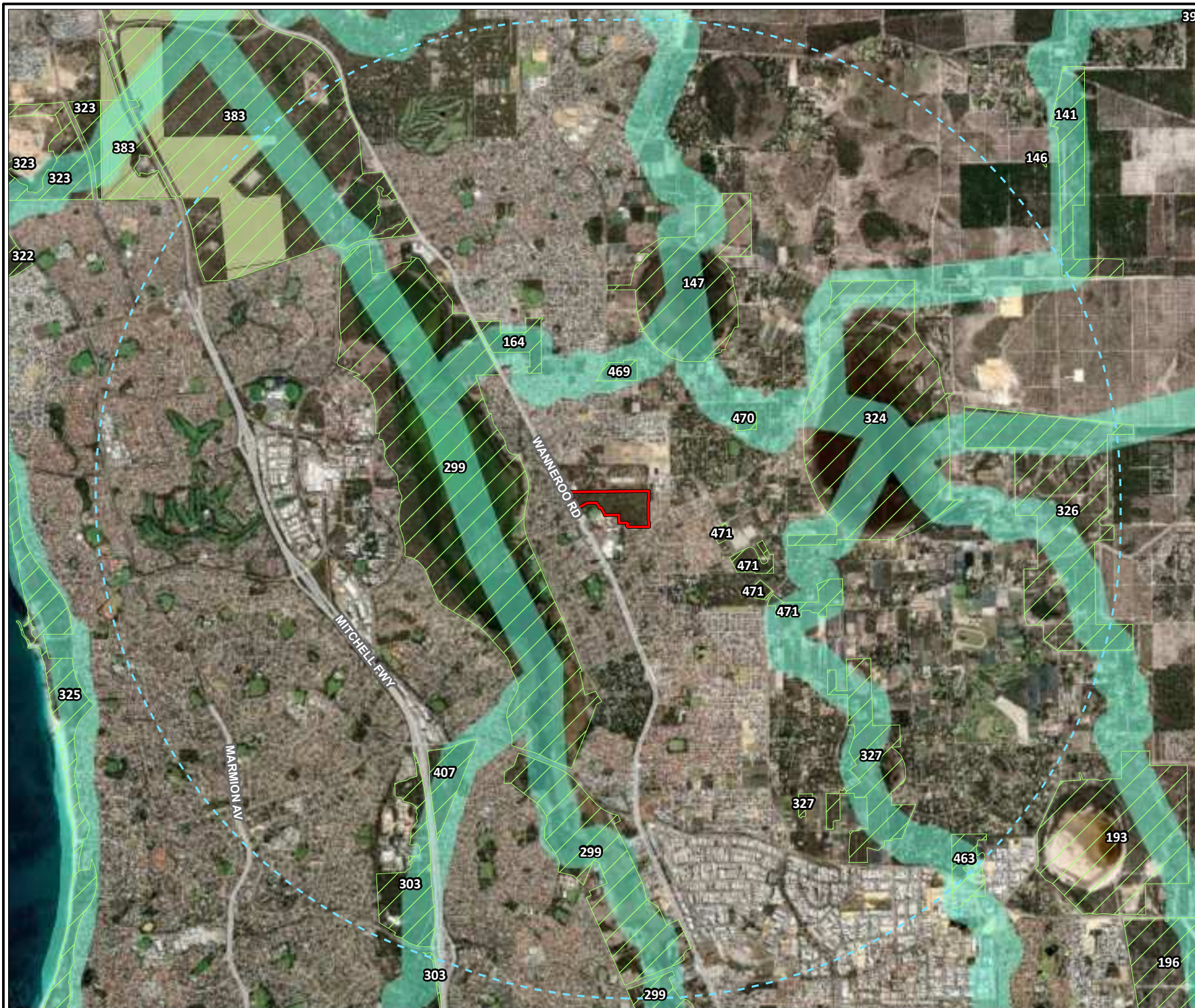


0 100 200
metres

**Lot 9000 Wanneroo Rd
Perth, WA**

HYDROLOGY

FIGURE 2.2



Legend:

- Development envelope
- 6km buffer area
- Bush Forever site (DOP)
- Regional ecological linkages
- Neerabup National Park
- State roads (MRWA)

strategen JBS&G

Job No: 57868

Client: Woodsome Management

Version: A	Date 19/08/2020
Drawn By: cthatcher	Checked By: HS

Scale 1:65,000

0 1 2
Kilometres

**Lot 9000 Wanneroo Rd
Perth, WA**

REGIONAL CONSERVATION

FIGURE 2.3

3. Stakeholder Engagement

The following key stakeholders have been identified in relation to the proposal:

- Department of Agriculture, Water and the Environment (DAWE)
- Department of Water and Environmental Regulation (DWER)
- Department of Biodiversity, Conservation and Attractions (DBCA)
- City of Wanneroo
- DPLH/ WAPC
- local residents.

3.1 Stakeholder engagement process

Prior to the development of the referral documentation, the Environmental Protection Agency (EPA) were engaged to understand the referral history of the Development Envelope. Town Planning Scheme Amendment 841 was initiated in 1998, correspondence from the EPA identified the amendment was later withdrawn prior to the completion of the EPAs assessment process.

In preparation for the submission of the Section 38 referral of the proposal, a pre-referral meeting with DWER staff was held on 30 June 2020. The purpose of the meeting was to communicate the proposal to the agency and receive feedback on the information required to support a referral of the Proposal.

During the preparation of the Wanneroo Town Centre draft Activity Centre Plan developed by the CoW, the CoW formed the Wanneroo Town Centre Advisory Group (WTCAG). The WTCAG provided input to the draft ACP and undertook a public and government agency consultation process.

Following completion, the draft ACP was advertised for public comment in January and February 2019. A total of 17 submission from government agencies and local landowners were received on the Draft ACP during the 2019 advertisement period. No environmental issues were raised as part of the 2019 comment period, one agency submission (DWER) requested the ACP includes text to ensure significant development proposals are referred to the EPA for assessment (CoW 2019).

Other issues raised during the 2019 comment period on the Draft ACP include concerns with land use planning zones and density, the road network and traffic signalling, nearby state and aboriginal heritage sites and bushfire management.

Further agency and public consultation on the proposal, will be undertaken through the Commonwealth and State environmental assessment processes.

4. Environmental principles and factors

4.1 Principles

The EP Act identifies a series of principles for environmental management. The environmental principles are the highest-level goals that a proposal must meet in order to be found environmentally acceptable by the EPA. The Proponent has considered these principles in relation to the development and implementation of the proposal. Table 4.1 outlines how the principles relate to the proposal.

Table 4.1: EP Act principles

Principle	Consideration
<p><u>The precautionary principle</u></p> <p>Where there are threats of serious irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</p> <p>In the application of the precautionary principle, decisions should be guided by:</p> <ol style="list-style-type: none"> careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and an assessment of the risk-weighted consequences of various options. 	<p>The Proponent has used existing environmental data for the Swan Coastal Plain and has supplemented it with additional site specific studies - flora, vegetation surveys and fauna habitat assessments.</p> <p>Consultation has been undertaken with key stakeholders to identify potential environmental impacts, further consultation will be undertaken through the State and Commonwealth environmental assessment process.</p> <p>As such, it is considered that the precautionary principal will be met, on the grounds that there is full scientific certainty on the environmental values present within the site, and the extent of environmental impact from the proposal.</p> <p>The proposal involves the direct (complete) clearing of up to 24.58 ha of native vegetation, which contains no threatened flora, but which comprises the EPBC Act listed Banksia Woodlands of the Swan Coastal Plain TEC. The TEC is representative of Floristic Community Type (FCT) 28 which is well distributed regionally, at the State level FCT 28 is a sub-community of the state listed Banksia Dominated Woodlands of the Swan Coastal Plain Priority 3 ecological community. The impacted vegetation comprises relatively lower species richness compared to better examples of the FCT.</p> <p>A total of nine Tuart Trees occur across the Development Envelope. Only seven of these meet the definition for Tuart Woodlands of the Swan Coastal Plain Priority Ecological Community Priority 3 totalling 1.2 ha (Figure 4.2). In total two Tuarts will be impacted by the Proposal and 0.7 ha of Tuart Woodland priority ecological community will be cleared.</p> <p>The Tuart woodlands (1.2 ha) within the Development Envelope, is listed as Tuart Woodlands and Forests of the Swan Coastal Plain Threatened Ecological Community under the <i>Environment Protection and Biodiversity Conservation Act 1999</i>.</p> <p>Additionally, the impacted vegetation provides foraging habitat for CBC, of which 24.58 ha is Excellent quality. The impacted vegetation provides 10.47 ha of Good to Moderate quality foraging habitat and 14.11 ha of Poor quality foraging habitat for FRTBC.</p> <p>A total of 85 potential breeding and roosting trees (DBH ≥500 mm) suitable for Black Cockatoos will be impacted by the proposal, none of which contain hollows suitable for breeding by Black Cockatoos. The impacted vegetation provides potential habitat for the Priority fauna – Quenda (P4), Swan Coastal Plain Shield-backed Trapdoor Spider (P3) and Black-striped Snake (P3).</p> <p>A total of 2.03 (6.92%) of the Development Envelope be set aside as conservation, which contains approximately 1.76 ha (6%) of remnant native vegetation.</p>

Principle	Consideration
	<p>In total five potential breeding trees will be retained within the Western Conservation Area.</p> <p>Significant residual environmental impacts will be offset locally through the preservation and protection of 1.76 ha of remnant vegetation within the Development Envelope, which will be protected as conservation. Additionally, other direct and indirect offsets including but not limited to acquisition and provision of funds for research will be made. Any acquisition site will be preserved under conservation covenant or State Government conservation reserve within the wider Swan Coastal Plain, or adjacent region.</p> <p>The proposal will not itself or cumulatively generate a risk of serious or irreversible damage to conservation significant environmental features. Consequently, the precautionary principle will not be engaged by the proposal.</p>
<p><u>The principle of intergenerational equity</u> The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.</p>	<p>The proposal has been designed to address and comply with the principle of intergenerational equity.</p> <p>As stated above regarding the precautionary principle, the proposal will not generate a risk of serious or irreversible damage, and residual environmentally significant impacts will be entirely offset.</p> <p>Environmental offsets are available for the proposed action to address environmentally significant impacts. Offsets will comprise the acquisition of private land which will be ceded to the State Government to be secured through conservation mechanisms / instruments. Additionally, through the use of the EPBC Act offsets calculator, offsets have been factored for vegetation quality, timing and other risk uncertainties to ensure complete offsets are provided.</p> <p>All impacts to the health, diversity and productivity of the environment are expected to be appropriately avoided, minimised, or offset, ensuring that in no intergenerational inequity is caused by the proposal.</p> <p>Accordingly, no decline in intergenerational equity is expected from the proposal into the future.</p> <p>Additionally, the proposal will facilitate the release of residential and mixed use commercial land and conservation public open space that will be available for use by future generations and is located in an environmentally constrained area to assist in reducing development pressures on the urban fringe and potentially more significant and wider environmental impacts.</p>
<p><u>Principles related to improved valuation, pricing and incentive mechanisms</u></p> <ol style="list-style-type: none"> 1. Environmental factors should be included in the valuation of assets and services. 1. The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. 2. The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. <p>Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing</p>	<p>Environmental constraint avoidance and management costs have been considered in the planning and design of the proposal.</p> <p>The Proponent will be responsible for funding the cost of environmental avoidance and management measures.</p>

Principle	Consideration
incentive structures, including market mechanisms, which benefit and/or minimise costs to develop their own solutions and responses to environmental problems.	
<u>Conservation of biological diversity and ecological integrity</u> Conservation of biological diversity and ecological integration should be a fundamental consideration.	<p>The proposal has been designed to address and comply with the principle of conservation of biological integrity and ecological diversity.</p> <p>Extensive surveying has been used to identify and confirm the range and condition of environmental factors within and surrounding the Development Envelope.</p> <p>The western conservation area was specifically positioned to capture the five Tuart Trees (<i>Eucalyptus gomphocephala</i>) and most of their 30 m buffer. , Native vegetation similar to that found in the Development Envelope exists within Boyagin Park, Edgar Griffin Park, Coogee Park, Ashley Park, Lake Joondalup Nature Reserve and Franklin Park. In total approximately 140 ha of similar vegetation occurs within 2 km of the Development Envelope in CoW reserves and State Conservation Estates.</p> <p>The proposal has been designed to include 2.03 ha across two conservation areas, within which approximately 1.76 ha of native vegetation will be retained. Of this vegetation, 73% (1.26 ha) is in Excellent condition and the remainder (0.50 ha) is in Very Good condition. The western conservation area was located to retain the five Tuarts trees and most of their 30 m buffer. Both conservation areas will be conserved under a legally binding conservation mechanism.</p> <p>Prior to clearing within the Development Envelope, fauna trapping and translocations will be undertaken to ensure fauna species do not migrate into the adjacent residential areas during construction.</p> <p>The findings indicate that with appropriate design, construction management and offset acquisition, all impacts to biodiversity or ecology at a local and regional scale will effectively mitigated and managed.</p> <p>As such, it is considered that the proposal will satisfy this environmental principal, and there will be no net reduction in diversity or ecological integrity.</p>
<u>Waste minimisation</u> All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Waste will be minimised by adopting the hierarchy of waste controls; avoid, minimise, reuse, recycle and safe disposal.

4.2 Key Environmental Factor 1 – Flora and Vegetation

4.2.1 EPA objectives

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2018b) identifies the following objective for flora and vegetation:

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

4.2.2 EPA policy and guidelines

Flora and vegetation surveys that have informed planning for the proposal have been conducted in accordance with the *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a) and the *Environmental Factor Guideline: Flora and Vegetation* (EPA 2016b).

4.2.3 Receiving environment

4.2.3.1 Overview

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) which led to the delineation of botanical districts as described in Beard (1990); the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia, IBRA) for Western Australia (DotEE 2017a) and System 6 Vegetation Complex mapping undertaken by Heddle et al. (1980).

Heddle et al. (1980) identifies the Development Envelope occurs within the 'Karrakatta complex – central and south' which is described as:

- predominantly open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) and woodland of *Eucalyptus marginata* (Jarrah) - *Banksia* species.

At a finer scale, the site falls within the Spearwood_6 vegetation system association (i.e. Medium woodland; tuart & jarrah) as defined by Beard (1990).

Table 4.2 presents DBCA (2018) Southwest Vegetation Complex Statistics Report for the Karrakatta complex – central and south. In terms of biodiversity conservation targets, the National Objectives and Targets for Biodiversity Conservation 2001 – 2005 aims to (Environment Australia 2001):

- prevent clearing of ecological communities with less than 30% of the original extent remaining
- recover ecological communities with less than 10% of the original extent remaining.

These national targets are reflected in state government policy for Western Australia and generally, are used to guide planning and decision-making (WAPC 2010). However, in relation to bushland conservation within the Perth Metropolitan Region portion of the Swan Coastal Plain, which is recognised as a constrained area, State Planning Policy 2.8 – Bushland Policy for the Perth Metropolitan Region and Bush Forever seeks to protect a target of at least 10% of the original extent of each vegetation complex (WAPC 2010).

Table 4.2: Southwest Vegetation Complex Statistics Report (2018)

Vegetation Complex / association	Swan Coastal Plain			
	Pre-European Extent (ha)	Current extent (ha)	% remaining	% remaining within the State conservation estate
Karrakatta complex – central and south	53,081	12,467.20	23.5%	8%
Spearwood_6 vegetation system association	54,427	13287.64	24.41%	3.42%

The Karrakatta complex – central and south vegetation complex has 23.5 % of its pre-European extent remaining within the Swan Coastal Plain bioregion, which is above the 10% retention objective for constrained areas. (Government of Western Australia 2019a).

At a finer scale, the survey area falls within the Spearwood 6 vegetation system association (i.e. jarrah, marri and wandoo woodland) as defined in Government of Western Australia (2019b). This system association has 24.41% of its pre-European extent remaining within the Swan Coastal Plain bioregion, which is also above the 10% retention objective for constrained areas (Government of Western Australia 2019b).

4.2.3.2 Field survey

An assessment of flora and vegetation within the Development Envelope was completed by a senior ecologist from Strategen (now Strategen-JBS&G) on 8 September 2017. In response to the listing of Tuart Woodlands and Forests of the Swan Coastal Plain as Critically Endangered under the EPBC Act in 2019, the Proponent commissioned a review of the Development Envelope using the results of the Detailed Flora Survey and supplementary site visit, to identify the extent of Tuart Woodlands Threatened Ecological Community (TEC) within the Development Envelope.

The field survey was conducted according to standards set out in the *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a) to identify the vegetation and flora values on site and to confirm the presence of priority threatened and priority flora species.

Refer to Appendix A and Appendix B for the Detailed flora, vegetation and Black Cockatoo Survey Report and the Tuart Woodlands TEC analysis report respectively.

Native flora

A total of 69 native vascular plant taxa from 51 plant genera and 32 plant families were recorded from quadrats within the Development Envelope. The majority of taxa were recorded within the Fabaceae (nine taxa) and Proteaceae (five taxa) families (Strategen JBS&G 2019).

An average species richness of 19.5 species per 100 m² was recorded within the development envelope (based on data collected from eight 10 m x 10 m quadrats).

Threatened and Priority flora

A review of the DBCA *Naturemap* database identified several known locations of Priority flora within 5 km of the Development Envelope (Figure 4.1).

No Threatened flora species as listed under section 178 of the EPBC Act were recorded within the Development Envelope. No Threatened flora species pursuant to Schedule 1 of the WC Act and as listed by Parks and Wildlife (2015), also no Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the Development Envelope.

Vegetation types

A total of two native vegetation types (VTs) were defined and mapped within the Development Envelope (Figure 4.3) and are described below in Table 4.

Table 4.3: Vegetation types within the Development Envelope

Vegetation type	Description	Area (ha)	Percentage of the Development Envelope
VT1	<i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> mid woodland over <i>Xanthorrhoea preissii</i> and <i>Macrozamia riedlei</i> sparse mid shrubland over <i>Hibbertia hypericoides</i> and <i>Mesomelaena pseudostygia</i> low shrubland.	10.47	35.7
VT2	<i>Eucalyptus marginata</i> open mid woodland over <i>Banksia attenuata</i> , <i>Banksia menziesii</i> and <i>Allocasuarina fraseriana</i> low woodland over <i>Jacksonia sternbergiana</i> , <i>Hibbertia hypericoides</i> and <i>Mesomelaena pseudostygia</i> open low to mid shrubland.	15.86	54.1
C	Cleared area.	3	10.2
Total		29.33	100

Statistical analysis of the species composition of VTs within the Development Envelope showed strong linkage to FCT 28, which is described as Spearwood *Banksia attenuata* or *Banksia attenuata* - *Eucalyptus* woodlands (Strategen JBS&G 2019). FCT 28 is well represented with a range of approximately 105 km (linear distance); the community has been recorded from Thompsons Lake

north to Seabird (Gibson *et al.* 1994). FCT 28 is well represented locally and has been mapped or inferred to occur in nine Bush Forever Sites within 6 km of the Development Envelope. As a consequence of the local and regional representation of this FCT, it is not listed as a State listed Threatened Ecological Community (TEC) or Priority Ecological Community (PEC) in its own right. FCT 28 is however, a sub-community of the state listed Banksia Dominated Woodlands of the Swan Coastal Plain, which is listed as a PEC Priority Three (P3) by the DBCA (2019) (Figure 4.2).

Gibson *et al.* (1994) identified this FCT as having a medium-high species richness of 55 species per 100 m², however, it is noted that average species richness recorded at the site (Strategen-JBS&G 2019) was 24.5 species per 100 m² (based on data collected from nine 10 x 10 m quadrats). Given the species richness recorded within the Development Envelope, the vegetation is not considered a high diversity example of this FCT.

The flora survey identified a total of nine *Eucalyptus gomphocephala* (Tuart trees) within the Development Envelope. A review of the approved conservation advice for Tuart Woodlands (TSSC 2019), identified that seven of the nine Tuarts trees met the criteria for Tuart Woodlands under the EPBC Act and therefore, also as Tuart Woodlands PEC Priority 3 under the *Biodiversity Conservation Act 2016* (BC Act). In total, 1.2 ha of Tuart Woodlands PEC occurs across the Development Envelope in two patches (Figure 4.2). The southern patch of Tuart Woodlands PEC is in direct connection to a larger patch outside of the Development Envelope.

Vegetation condition

The Development Envelope comprises both disturbed and undisturbed vegetation. Weed invasion is the principle disturbance with heavier infestations present at the Development Envelope boundaries. Potential causes of degradation to the Development Envelope include the effects from introduced species and edge effects of urbanisation.

Based on the Keighery (1994) scale (Table 4.4), vegetation condition within the development envelope ranged from Excellent to completely degraded (Table 4.5; Appendix A).

Table 4.4: 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 4.5: Vegetation condition within the Development Envelope by area

Vegetation Condition	Area (ha)	Percentage of the development envelope
Excellent	5.65	19.3%
Very Good - Excellent	11.41	38.9%
Very Good	8.86	30.2%
Good	0.35	1.2%
Good Degraded	0.01	0.0%
Degraded	0.05	0.2%
Completely Degraded	3	10.2%
Total	29.33	100%

Introduced (exotic) taxa

A total of 15 introduced (exotic) taxa were recorded within the Development Envelope.

- *Arctotheca calendula*
- *Avena barbata*
- *Briza maxima*
- *Briza minor*
- *Cenchrus clandestinus*
- *Conyza bonariensis*
- *Ehrharta calycina*
- *Gladiolus caryophyllaceus*
- *Hypochaeris glabra*
- *Lysimachia arvensis*
- *Oxalis pes-caprae*
- *Romulea rosea*
- *Solanum nigrum*
- *Sonchus oleraceus*
- *Ursinia anthemoides*.

None of these species are Declared Plant species in Western Australia pursuant to section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act), according to the Western Australian Department of Agriculture and Food (DPIRD 2017).

4.2.3.3 Conservation areas and ecological linkages

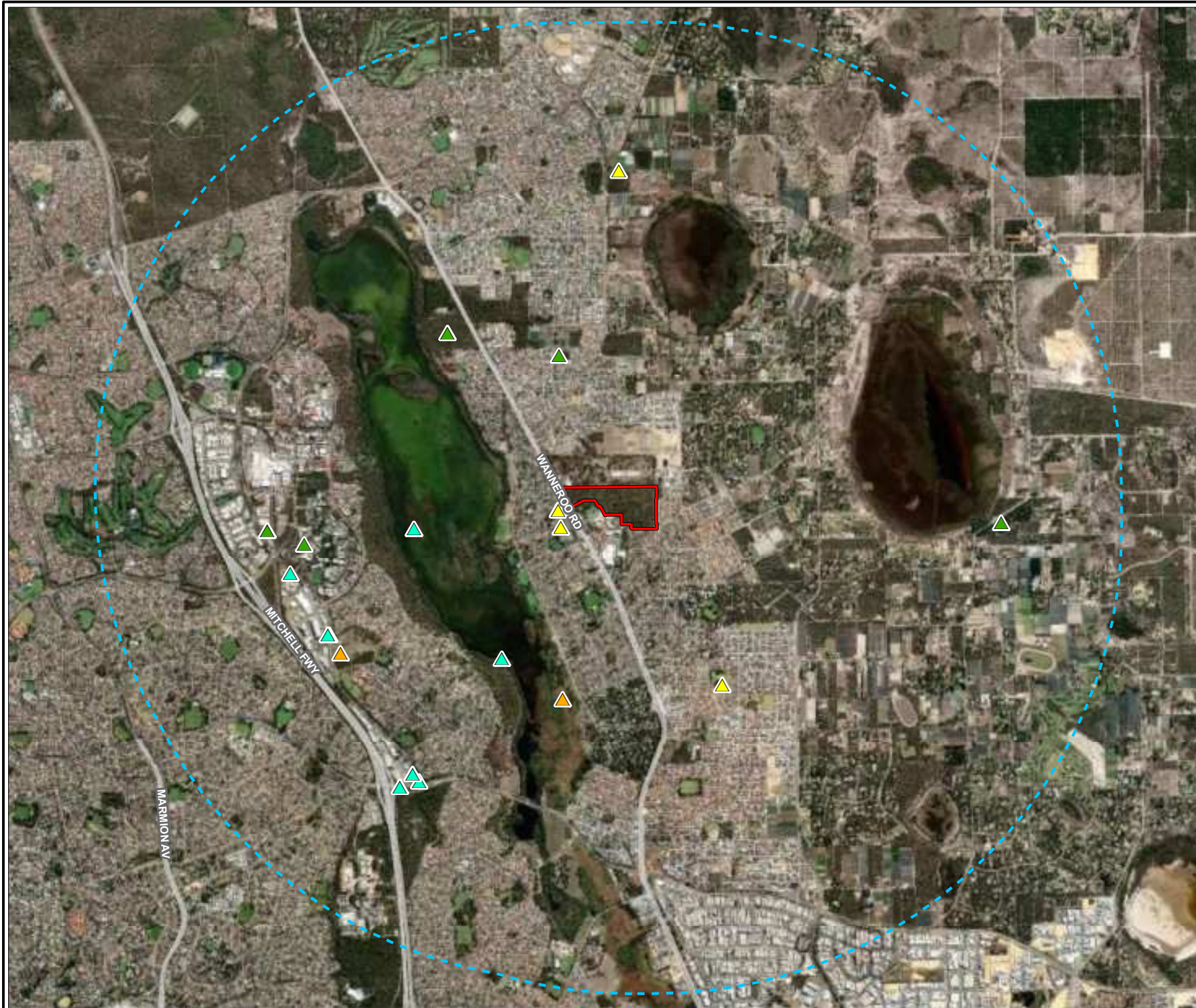
A review of the City of Wanneroo Local Biodiversity Plan identified the Development Envelope is not a Priority Local Natural Area (CoW 2018); furthermore, the Development Envelope is not as a Bush Forever Site (GoWA 2000). The North West Sub-regional Framework confirms the Development Envelope is not identified as part of the green network (DPLH 2018), further reiterating the land use planning strategy for the Wanneroo Town Centre as a high density area. Several Bush Forever Sites occur within 2 km of the Development Envelope (Figure 2.3; Table 4.6).

Table 4.6: Bush Forever sites within 2 km of the Development Envelope (GoWA 2000)

Bush Forever Site No.	Name	Vegetation Description	Area (ha)	Distance and direction from Development Envelope
469	Caphorn Street, Mariginiup	<i>Banksia attenuata</i> , <i>B. menziesii</i> and <i>B. ilicifolia</i> Low Open Forest to Low Woodland with emergent <i>Eucalyptus marginata</i> ; <i>E. marginata</i> , <i>B. attenuata</i> and <i>B. menziesii</i> Low Open Forest to Woodland, <i>Corymbia calophylla</i> Open Forest to Woodland.	10	1.4 km north
147	Mariginiup Lake and adjacent bushland	Uplands of <i>Eucalyptus marginata</i> Open Woodland to Open Forest; <i>Banksia attenuata</i> and <i>B. menziesii</i> Low Open Woodland to Low Open Forest.	53	1.7 km north
470	Garden Park Bushland, Wanneroo	Uplands of <i>Banksia attenuata</i> , <i>B. menziesii</i> and <i>B. ilicifolia</i> Low Open Forest to Low Woodland with emergent <i>Eucalyptus marginata</i> ; <i>E. marginata</i> , <i>B. attenuata</i> and <i>B. menziesii</i> Low Open Forest to Woodland, <i>E. calophylla</i> Open Forest to Woodland.	5	1.3 Km north
164	Conti road Bushland, Wanneroo	Mixed <i>Banksia attenuata</i> , <i>B. menziesii</i> and <i>Eucalyptus marginata</i> Woodland, <i>Corymbia calophylla</i> Woodland, <i>E. gomphocephala</i> Woodland.	27	1.5 km north
471	High road Bushland, Wanneroo	Uplands of <i>Banksia ilicifolia</i> , <i>B. attenuata</i> Low Open Woodland; <i>B. attenuata</i> <i>B. menziesii</i> and <i>Allocasuarina fraseriana</i> Low Open Woodland to Open Low Forest sometimes with scattered emergent trees of <i>Eucalyptus marginata</i> ; <i>B. attenuata</i> Low Open Woodland with emergent trees of <i>E. gomphocephala</i> .	41	800 m east
299	Yellagonga Regional Park, Wanneroo	Uplands of <i>Eucalyptus gomphocephala</i> Closed Forest to Woodland, <i>E. gomphocephala</i> tall open forest over <i>Banksia grandis</i> Low Open Forest, <i>E. calophylla</i> Closed to Open Forest, <i>B. attenuata</i> and <i>E. marginata</i> Woodland, Mixed <i>E. marginata</i> , <i>Corymbia calophylla</i> and <i>B. attenuata</i> Open Forest.	>100	560 m west

According to Del Marco *et al.* (2004) the importance of ecological linkage is to connect natural areas, preferably with continuous corridors of native vegetation, which assists in fauna movement between the areas to access resources and habitats. The protection, management and buffering of existing natural areas within an ecological linkage is a higher priority than revegetation of cleared portions of the link. Wood *et al.* (2009), states that patches of vegetation in the urban environment within a Regional Ecological Linkage, provide stepping stones between regionally significant areas of bushland. Ultimately the purpose of Regional Ecological Corridors is to increase the ecological viability of each extent of remnant patch of vegetation.

The Development Envelope is not within a Regional Ecological Linkage, however, a Regional Ecological Linkage occurs approximately 950 m to the west of the Development Envelope (Figure 2.3). The Regional Ecological Linkage (Link ID 6) is part of the Lake Joondalup Bush Forever Site, of which the fringing vegetation is approximately 560 m to the west of the Development Envelope. Significant urbanised infrastructure separate the Development Envelope from the fringing vegetation of Lake Joondalup, representing a substantial barrier to non-avian fauna.



Legend:

Development envelope

5km survey area buffer

Threatened & Priority Flora

▲ (T) Threatened Rare Flora - Extant Taxa; T

▲ Priority 1 - Poorly Known Taxa

▲ Priority 2 - Poorly Known Taxa

▲ Priority 3 - Poorly Known Taxa

▲ Priority 4 - Rare, Near Threatened and other species in need of monitoring

— State roads (MRWA)



Job No: 57868

Client: Woodsome Management

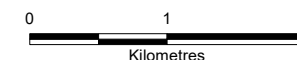
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Scale 1:55,000



**Lot 9000 Wanneroo Rd
Perth, WA**

**PRIORITY FLORA WITHIN 5 KM
OF THE DEVELOPMENT ENVELOPE**

FIGURE 4.1



Legend:

- Development envelope
- Cadastral boundary
- Tuart woodlands PEC (1.21ha)
- Banksia woodland PEC (15.86ha)
- Black Cockatoo habitat trees
 - Eucalyptus gomphocephala* - Tuart (7)
- Roads (MRWA)



Job No: 57868

Client: Woodsome Management

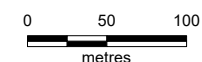
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Lot 9000 Wanneroo Rd
Perth, WA

PRIORITY ECOLOGICAL COMMUNITIES
WITHIN THE DEVELOPMENT ENVELOPE

FIGURE 4.2



Legend:

- Development envelope
- Cadastral boundary
- Vegetation type
 - VT1 (10.47 ha)
 - VT2 (15.86 ha)
 - Cleared (3.00 ha)
 - Roads (MRWA)



Job No: 57868

Client: Woodsome Management

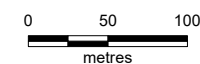
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**Lot 900 Wanneroo Rd
Perth, WA**

VEGETATION TYPES

FIGURE 4.3



Legend:

- Development envelope
- Cadastral boundary
- Vegetation condition
 - Excellent (5.649 ha)
 - Very Good - Excellent (11.417 ha)
 - Very Good (8.86 ha)
 - Good (0.349 ha)
 - Good- Degraded (0.046 ha)
 - Degraded (0.009 ha)
 - Completely Degraded (3.0 ha)
- Roads (MRWA)



Job No: 57868

Client: Woodsome Management

Version: A

Date 16/07/2020

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Checked By: HS

Scale 1:4,750



0 50 100
metres

Lot 9000 Wanneroo Rd
Perth, WA

VEGETATION CONDITION

FIGURE 4.4

4.2.4 Potential impacts

4.2.4.1 Direct impacts

Clearing within the Development Envelope will result in the loss of 24.58 ha of remnant native vegetation across two vegetation types within the Karrakatta Complex - Central and South and Spearwood_6 System Association.

- VT1 - *Eucalyptus marginata*, *Corymbia calophylla* mid woodland over *Xanthorrhoea preissii* and *Macrozamia riedlei* sparse mid shrubland over *Hibbertia hypericoides* and *Mesomelaena pseudostygia* low shrubland
- VT2 - *Eucalyptus marginata* open mid woodland over *Banksia attenuata*, *Banksia menziesii* and *Allocasuarina fraseriana* low woodland over *Jacksonia sternbergiana*, *Hibbertia hypericoides* and *Mesomelaena pseudostygia* open low to mid shrubland.

A statistical analysis of the vegetation within the Development Envelope has shown, both vegetation types have a strong affiliation to FCT 28. A breakdown of the areas to be cleared by vegetation type and condition is provided in Table 4.7.

Table 4.7: Proposed areas to be cleared by vegetation type and condition

Vegetation Type	Vegetation Condition	Extent cleared (ha)	Total clearing (ha)
VT1	Very Good - Excellent	9.22	10.47
	Very Good	1.17	
	Good Degraded	0.05	
VT2	Excellent	4.39	14.11
	Very Good - Excellent	2.20	
	Very Good	7.19	
	Good	0.35	
	Degraded	0.01	
Total area			24.58

Clearing of 24.58 ha of native vegetation across the Development Envelope, represents 0.05% of the remaining extent of both the Karrakatta Complex – Central and South and the Spearwood_6 System Association. The proposed clearing will not reduce the pre-European extent of either the Karrakatta Complex – Central and South or the Spearwood_6 System Association, to 10% or less of the remaining extent.

VT 2 comprises Banksia Dominated Woodlands of the Swan Coastal Plain and is listed as a priority ecological community (PEC) Priority 3 by the DBCA.

As noted earlier in Section 4.2.3.2, FCT 28 is well represented locally and regionally and is not considered a significant FCT, consequently FCT 28 is not listed by the State as a TEC or PEC; however, the *Banksia sp.* component of the community forms part of the broader Banksia Dominated Woodlands of the Swan Coastal Plain listed by the State as a PEC P3. FCT 28 is known from 80 point locations over a range of about 150 km from Red Gully to Leda (Gibson *et al.* 1994). As outlined in Section 4.2.3.2, Gibson *et al.* (1994) identified this FCT as having a medium-high species richness of 56 species per 100 m², however, Strategen JBS&G (2019) notes that average species richness recorded within the Development Envelope was 19.5 species per 100 m² (based on data collected from eight 10 x 10 m quadrats). Given the species richness recorded within the Development Envelope, the vegetation is not considered a high diversity example of this FCT.

The proposal will clear 0.7 ha of Tuart Woodlands PEC (Priority 3) which equates to two trees and their 30 m buffer. The loss of 0.7 ha of Tuart Woodlands PEC within the Development Envelope does not reduce the remaining Tuart Woodlands TEC to the south of the Development Envelope, to below the threshold of being considered a PEC.

No evidence of Tuart recruitment was observed within the Development Envelope (Strategen JBS&G 2019), indicating the patches within the Development Envelope and directly adjacent may not be viable long term. Furthermore, given the low species richness and no threatened or priority flora species are present in the understorey, the patches are not an example of a unique ecological community.

The DBCA has provided broad scale mapping of remnant extents of Tuart Woodlands across the known range of the community (DBCA 2010). None of the DBCA mapping provided has been confirmed as Tuart Woodland PEC, however, the mapping is highly likely to be representative of Tuart Woodlands PEC. Locally, the DBCA has identified approximately 86.2 ha of Tuart Woodlands to occur within Lake Joondalup approximately 500 m to the west of the Proposal Area; a further 16.9 ha of Tuart Woodlands are mapped within local street scapes, approximately 530 m north east of the Proposal Area (DBCA 2010). Further extents of 1.4 ha and 7.9 ha are mapped 370 m to the south and 840 m to the south west respectively (DBCA 2010). According to the DBCA mapping, further extents of Tuart Woodland are available within the Neerabup National Park approximately 4.7 km north, totalling approximately 350 ha (DBCA 2010).

Clearing 0.7 ha of Tuart Woodland within the Proposal Area represents approximately 0.6% of what is available locally and approximately 0.1% the mapped regional extent, indicating the loss is not significant to the local or regional extents.

A total of 14.11 ha of Vegetation within the Development Envelope impacted by the proposal, is Commonwealth EPBC Act listed "Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community" (TEC). Furthermore, 0.7 ha of the vegetation to be impacted is identified as, Tuart Woodland and Forest of the Swan Coastal Plain TEC. Consequently, the proposal has also been referred to DAWE under the EPBC Act, concurrent with the referral to the EPA.

4.2.4.2 Indirect impacts

Construction activities have the potential to impact on adjacent native vegetation through accidental clearing of vegetation outside of the Development Envelope, erosion, uncontrolled access, dust deposition and through the spread of weeds and dieback.

Alteration of hydrological regimes as a result of development of the site has the potential to impact adjacent vegetation, however this is not anticipated to be significant.

The proposal will result in the loss of a Level 3 patch of remnant vegetation relevant to a Regional Ecological Linkage (Wood *et al* 2009); however, substantial urban and commercial development immediately surrounds the Development Envelope. Consequently, the ecological connection for non-avian fauna to the Regional Ecological Linkage (link ID 6) has been severed. Ecological gaps of >500 m represent a significant barrier to many fauna species (Woods *et al.* 2009). The ecological viability of Link ID 6 is maintained via the extensive north/south linkage through Bush Forever Site 299, the direct connection to Bush Forever Site 383 to the north and Bush Forever Site 164 to the east (Figure 2.3). Significant extents of bushland occurs across both Bush Forever Sites 299 and 383 (Figure 2.3), therefore, the ecological viability of Link ID 6 is not significantly impaired due to the clearing within the Development Envelope.

4.2.4.3 Cumulative impacts

A broad analysis of the potential cumulative impacts to flora and vegetation has identified that the proposed clearing of 24.58 ha within the Karrakatta complex – central and south represents 0.05% of its current extent on the Swan Coastal Plain (GoWA 2019a). Similarly, clearing of 24.58 ha of the Spearwood 6 vegetation association represents 0.05% of the current extent (GoWA 2019b) of this association in the Swan Coastal Plain IBRA region. The proposed clearing will not reduce the extent remaining of the above pre-European vegetation complex/ association, to 10% or less.

Given the above, it is considered that the proposed clearing of Karrakatta Complex – central and south will not significantly increase the cumulative loss of this vegetation complex at a regional (Swan Coastal Plain) scale.

Significant extents of State listed Banksia Woodland PEC remain within the Swan Coastal Plain. Figure 4.5 illustrates the extent of Banksia Woodland PEC broadly mapped within the 5 km (1,653 ha) and 50 km (137,623 ha) of the Development Envelope. Clearing 14.11 ha of Banksia Woodland PEC represents 0.86% of the extent within 5 km and 0.01% of the extent within 50 km of the Development Envelope.

Clearing 0.86% and 0.01% of the local and regional extent of Banksia Woodland PEC does not represent a significant loss.

The Department of Biodiversity Conservation and Attractions (DBCA) has provided broad scale mapping of remnant extents of Tuart Woodlands across the known range of the community (DBCA 2010). None of the DBCA mapping provided has been confirmed as Tuart Woodland PEC, however, the mapping is highly likely to be representative of Tuart Woodlands PEC. Locally, the DBCA has identified approximately 86.2 ha of Tuart Woodlands to occur within Lake Joondalup approximately 560 m to the west of the Development Envelope; a further 16.9 ha of Tuart Woodlands are mapped within local street scapes, approximately 530 m north east of the Development Envelope (DBCA 2010). Further extents of 1.4 ha and 7.9 ha are mapped 370 m to the south and 840 m to the south west respectively (DBCA 2010). According to the DBCA mapping, further extents of Tuart Woodland are available within the Neerabup National Park approximately 4.7 km north, totalling approximately 350 ha (DBCA 2010).

Clearing 0.7 ha of Tuart Woodland within the Development Envelope represents approximately 0.6% of what is available locally and approximately 0.1% the mapped regional extent, indicating the loss is not significant at the local or regional level.

4.2.5 Assessment of impacts

The proposal is not expected to cause significant impacts to flora and vegetation, based on the following:

- no proposed impact to any listed Threatened flora under the BC Act or EPBC Act
- no proposed impact to any vegetation that has 10% or less of its pre-European extent remaining (noting the site is in a constrained area)
- clearing associated with this proposal will not reduce any vegetation complex/ association to 10% or less of its pre-European extent
- no proposed impact to any riparian vegetation
- no proposed impact to any areas reserved under statute or managed for the purpose of conservation
- no proposed impact to any of the 15 national biodiversity hotspots identified by the Threatened Species Scientific Committee
- no clearing of State listed TEC's, or Priority 1 and 2 ecological communities - noting that Priority 3 ecological community vegetation within the site does not indicate that the community is poorly represented, this category suggests that the community may be well known from several localities but may not meet adequate survey requirements and/or are not well defined
- clearing 14.11 ha of Banksia Woodland PEC P3 (State) TEC (Commonwealth), represents 0.86% and 0.01% of the remaining extent broadly mapped within 5 km and 50 km of the Development Envelope

- FCT 28 has a broad distribution having been recorded from 80 point locations from Red Gully to Leda (Gibson *et al.* 1994), approximately 105 km (linear distance), and species richness recorded within the site was comparatively low when compared to quality representations of this FCT
- clearing 0.7 ha of Tuart Woodland PEC will result in the loss of 0.1% of the mapped regional extent; furthermore, flora and vegetation studies of the Development Envelope did not observed evidence of Tuart recruitment
- no dewatering is anticipated at any stage of the proposed development
- application of mitigation measures to minimise direct and indirect impacts (see Section 4.2.6).

4.2.6 Mitigation

The environmental objective for flora and vegetation is to protect flora and vegetation so that biological diversity and ecological integrity are maintained. This objective will be attained through the implementation of the impact mitigation hierarchy (avoid, minimise, rehabilitate). These mitigation measures are discussed below.

4.2.6.1 Avoid

A total of 2.03 ha is proposed to be set aside as Conservation Public Open Space (POS) across two conservation areas, the Eastern Conservation Area (1.45 ha) and the Western Conservation Area (0.57 ha; Figure 1.3). Due to the presence of currently cleared firebreak track along the perimeter of the Development Envelope, the total remnant native vegetation extent retained across both areas is 1.76 ha, 1.26 ha in the Eastern Conservation Area and 0.5 ha in the Western Conservation Area. Following construction, both conservation areas will be ceded to the Crown with the City of Wanneroo responsible for retaining and conserving native vegetation and fauna habitat therein.

The Western Conservation Area has been located to retain the largest volume of Tuart Woodland PEC P3. In total, five Tuart trees are retained in the Western Conservation Area, which represent the largest concentration of Tuarts across the Development Envelope. In total 0.5 ha of the buffer associated with the Tuart trees will be retained, which includes all of the remnant native vegetation as part of the understorey Western Conservation Area, ensuring the quality of the Tuart Woodlands PEC is maintained.

The location of the Eastern Conservation Area was positioned to maintain direct ecological connection with Boyagin Park (0.71 ha) to the east of the Development Envelope (Figure 1.3). Maintaining a direct connection to Boyagin Park which has similar vegetation to the Western Conservation Area, provides a total conservation outcome of 1.97 ha in the eastern portion of the Development Envelope.

Both conservation areas have retained the best quality vegetation for each vegetation type, for example the Eastern Conservation Area (1.26 ha in VT1) is in Excellent condition and the Western Conservation Area (0.50 ha in VT2) is in very good condition.

4.2.6.2 Minimise

Prior to ground disturbing works commencing within the Development Envelope, a Vegetation and Fauna Management Plan (VFMP) will be developed to the satisfaction of the City to support subdivision approval. The VFMP will provide measures for the protection of retained vegetation and ensure fauna are appropriately managed during construction. The VFMP will include the following (but not limited to):

- measures to avoid and mitigate impacts to native vegetation and Priority communities following commencement of the action (during construction), including:
 - hygiene requirements to prevent the spread of weeds and *Phytophthora* dieback
 - clearing and access control measures (such as demarcation of clearing boundaries)
 - erosion and sediment control
 - topsoil management
 - dust control
 - waste and fire management
- performance indicators that measure the effectiveness of avoidance and mitigation measures
- contingency measures that will be undertaken if performance targets are not met
- roles and responsibilities of personnel associated with implementing avoidance and mitigation measures.

The sub-division stage will also require the development of a Conservation Management Plan (CMP) to the satisfaction of the City to guide the management of the western and eastern conservation POS. The CMP will include (but not limited to):

- native vegetation condition targets
- weed density targets
- weed control actions
- maintenance schedule
- monitoring schedule
- contingency measures that will be undertaken if performance targets are not met
- roles and responsibilities of personnel associated with implementing mitigation measures.

Additionally, consideration will be given to of translocation of Priority species on advice from the Department of Biodiversity, Conservation and Attractions.

4.2.6.3 Rehabilitate

While no formal rehabilitation is proposed, streetscaping associated with road reserves and POS throughout the development will utilise native species where possible.

4.2.7 Predicted outcome

The proposal will result in the clearing of a maximum of 24.58 ha.

The proposed clearing will not reduce the pre-European extent of either the Karrakatta vegetation complex – central and south or the Spearwood_6 system association, to 10% or less remaining.

No state-listed TEC's, riparian vegetation, Threatened or Priority flora species are expected to be impacted by the proposal. Additionally, the proposal will not impact upon any conservation areas which are protected under statute.

The proposal will result in the clearing of a maximum of 14.11 ha of State-listed PEC P3 in Degraded to Excellent condition. Impacts to this PEC will be effectively mitigated and regulated through the EPBC referral and approval process, as the PEC coincides with Banksia Woodlands of the Swan Coastal Plain TEC (Commonwealth), noting that proposal has been referred to DAWE concurrent to the referral under Section 38 of the EP Act. Given the quantum of impact and the geographic range of this TEC, an offset will likely be required within the SCP IBRA region comprising similar vegetation to that within the Development Envelope.

The remnant vegetation within the Eastern Conservation Area (1.26 ha) and the Western Conservation Area (0.50 ha) coupled with the direct connection of the eastern conservation area to Boyagin Park (0.71 ha) to the east of the Development Envelope, results in a combined conservation outcome of 2.48 ha. The proponent will also retain mature trees within unrestricted POS and road reserves, where development constraints permit. Landscaping will be undertaken with native species of local provenance.

Through retention of vegetation within the proposed conservation areas within the Development Envelope, as well as retention of vegetation and landscaping with native species within POS, green linkages will be maintained which connect to vegetation within the Development Envelope to the adjacent Boyagin Park.

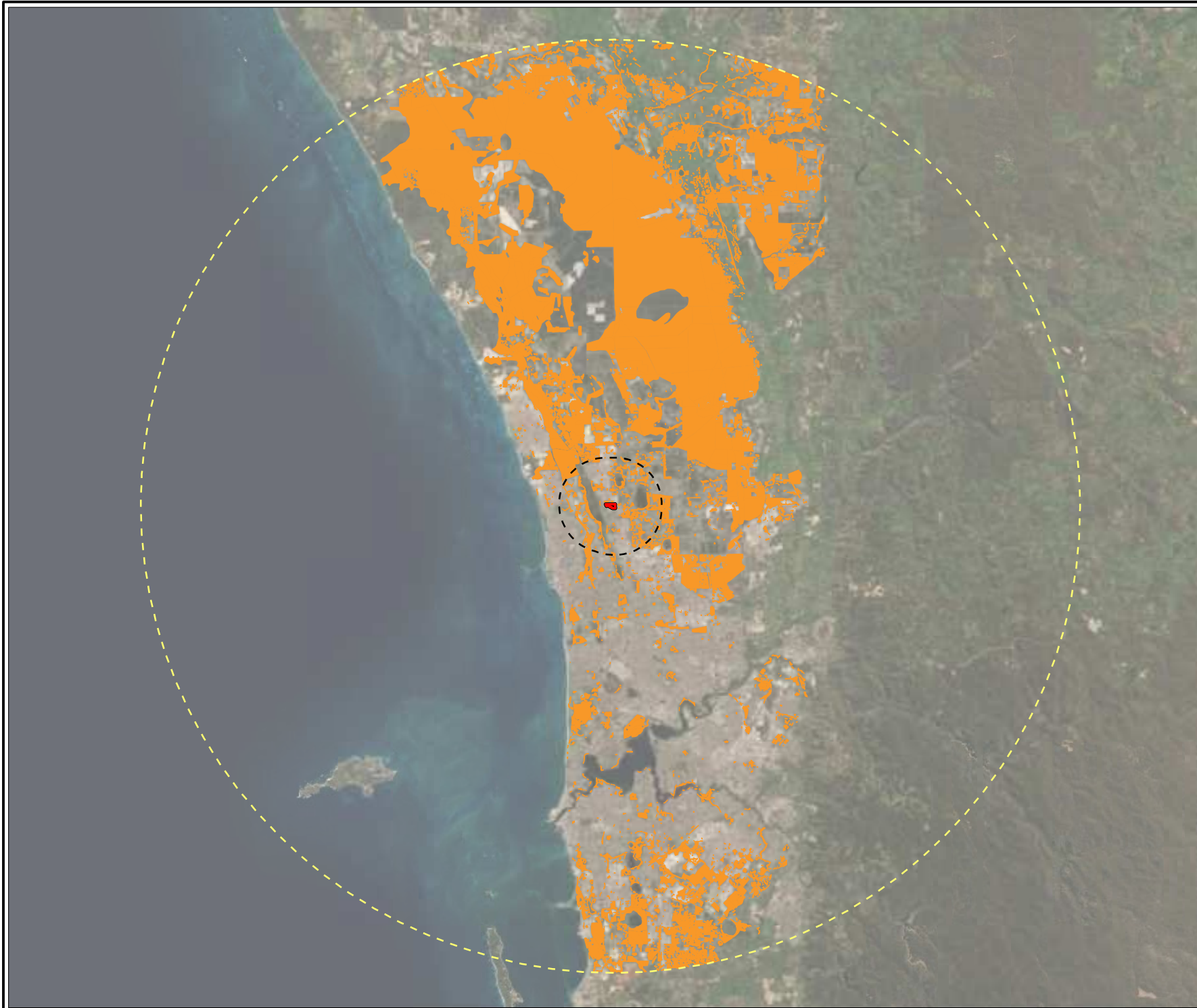
In the longer term, following a maintenance period both the Eastern and the Western Conservation Areas will be ceded to the City.

The Proponent will implement a VFMP to minimise direct and indirect impacts to flora and vegetation during the construction stage of development. Furthermore, a CMP will be developed to manage the vegetation with the Conservation Areas.

Based on the scale and nature of the impacts, the location away from sensitive environmental areas, the mitigation measures to be implemented, as well as the State planning process and EPBC approval process, the proposal is not expected to cause significant impacts to flora and vegetation.

Based on the scale and nature of the impacts, the location away from sensitive environmental areas, the mitigation measures to be implemented, as well as the State planning process and EPBC approval process, the proposal is not expected to cause significant impacts to flora and vegetation.

Accordingly, it is expected that the EPA objective for flora and vegetation will be met.



Legend:

- Development envelope
- 5km buffer area
- 50km buffer area
- Banksia Woodland PEC



Job No: 57868

Client: Woodsome Management

Version: A

Date 16/07/2020

Drawn By: cthatcher

Checked By: HS

Scale: 1:550,000



0 5 10
Kilometres

**Lot 9000 Wanneroo Rd
Perth, WA**

**BANKSIA WOODLAND PEC WITHIN 50 KM
OF THE DEVELOPMENT ENVELOPE**

FIGURE 4.5

4.3 Key Environmental Factor 2 – Terrestrial Fauna

4.3.1 EPA objectives

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2018b) identifies the following objective for terrestrial fauna:

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

4.3.2 EPA policy and guidance

Terrestrial fauna surveys that have informed planning for the proposal have been conducted in accordance with the *Technical Guidance – Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA 2016c) and the *Environmental Factor Guideline: Terrestrial Fauna* (EPA 2016d).

4.3.3 Receiving environment

4.3.3.1 Overview

A desktop search of the DBCA *Naturemap* and EBPC Act *Protected Matters* databases identified a number of conservation significant fauna that have a potential to occur within the vicinity of the Development Envelope (Figure 4.6). Excluding migratory wetland bird species (on the basis that there are no geomorphic wetlands or open water bodies within the Development Envelope), the desktop fauna assessment identified seven conservation significant fauna that could potentially occur within the development envelope. Based on habitat requirements, five of these species were considered either possible or likely to utilise the development envelope. These species are listed below in Table 4.8 and include:

- two threatened species
- one Priority 3 species
- two Priority 4 species.

Priority 3 species are those which are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

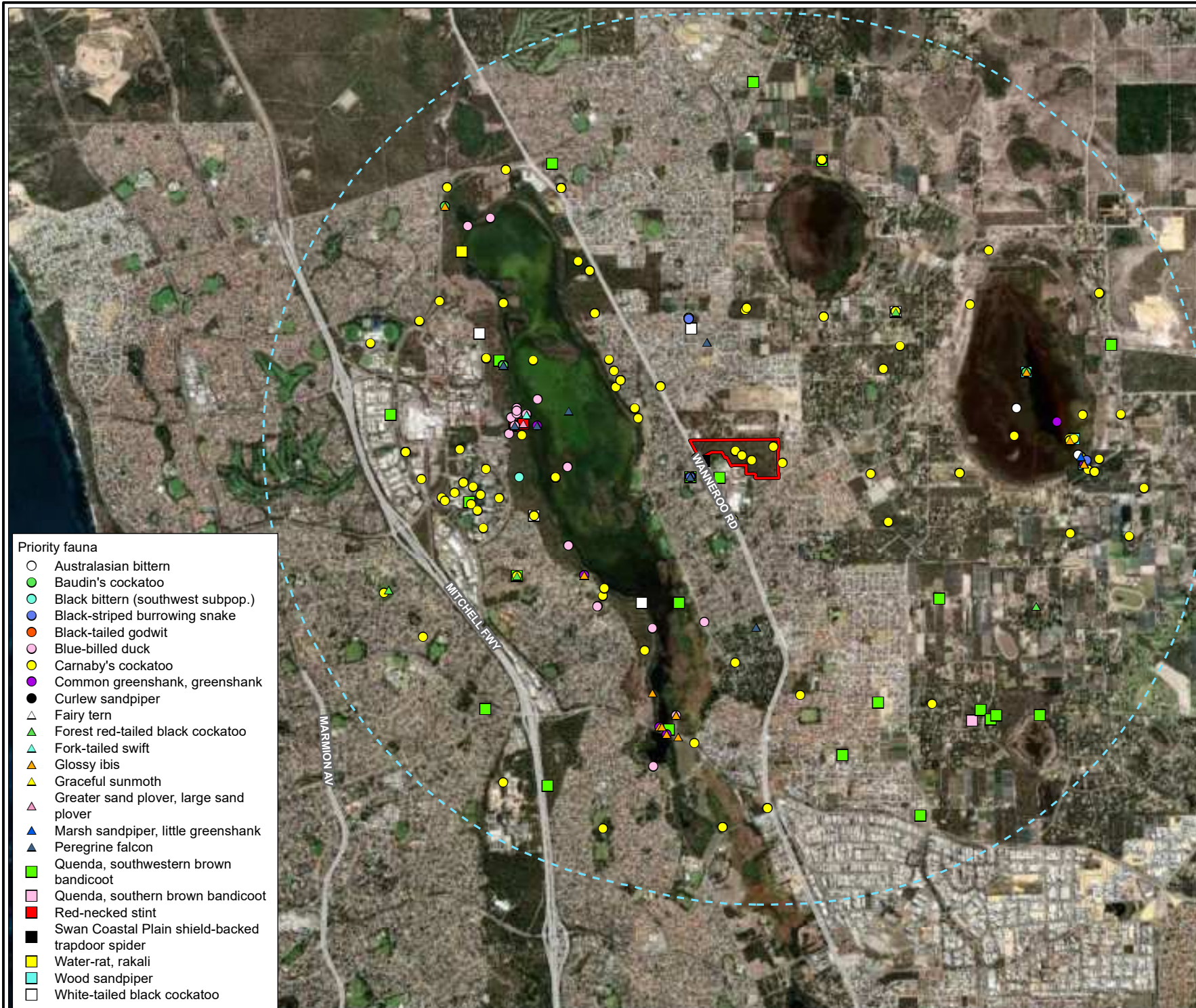
Priority 4 species are those which are adequately known, are rare but not threatened, or meet criteria for near threatened. Alternatively, Priority 4 species may have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons.

Table 4.8: Conservation significant fauna species likely to occur within the development envelope

Species	Conservation status		Habitat	Likelihood of presence within the Development Envelope
	BC Act	EPBC Act		
Carnaby's Cockatoo (CBC) (<i>Calyptrorhynchus latirostris</i>)	T	E	Typically occurs in woodlands and scrubs of semiarid interior of Western Australia, in non-breeding season wandering in flocks to coastal areas, especially pine plantations and Banksia woodlands. Food includes the flowers, nectar and seeds of Banksia, Dryandra, Hakea, Eucalyptus, Corymbia, Grevillea, also seeds of Pinus.	Confirmed. Evidence of foraging by CBCs was observed during the Strategen Black Cockatoo 2017 survey. A total of 26.33 ha of Excellent quality foraging habitat was observed with the Development Envelope, based on the vegetation species and condition. A total of 90 potential roosting and 1 breeding trees were recorded across the Development Envelope; however,

Species	Conservation status		Habitat	Likelihood of presence within the Development Envelope
	BC Act	EPBC Act		
				no trees contain hollows suitable for CBCs (Figure 4.7).
Forest Red-tailed Black Cockatoo (FRtBC) (<i>Calyptrorhynchus banksii</i> subsp. <i>naso</i>)	T	V	The species inhabits the dense Eucalyptus marginata (Jarrah), E. diversicolor (Karri) and Corymbia calophylla (Marri) forests receiving more than 600mm of annual average rainfall.	<p>Confirmed.</p> <p>Evidence of foraging by FRtBCs was observed during the Strategen 2017 Black Cockatoo survey.</p> <p>The modelled distribution for FRBC as per DSEWPaC (2012) indicates that the Development Envelope is outside the known distribution for the species; however, evidence of FRtBC foraging was recorded within the Development Envelope. A total of 26.33 ha of Moderate quality foraging habitat was observed, which can be described as</p> <ul style="list-style-type: none"> • 10.47 Good to Moderate quality • 15.86 Poor quality (Figure 4.8). <p>A total of 90 potential roosting trees were recorded within the Development Envelope.</p>
Quenda, southwestern brown bandicoot (<i>Isodon fusciventer</i>)	P4	Not Listed	Quenda have a patchy distribution through the Jarrah and Karri forest, the Swan Coastal Plain. Scrubby, often swampy, vegetation with dense cover up to 1 m high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover.	<p>Possible.</p> <p>This species has a broad range and suitable habitat is present within the Development Envelope, the closest recorded location in the DBCA database is approximately 160 m to south west of the Development Envelope, a dead individual found in 2012.</p> <p>The east south and west of the Development Envelope are heavily urbanised and the north provides no foraging habitat or cover. Dogs and cats around residential areas are recognised as one of the main threats to this species (DEC 2012); therefore, this species is likely to have been heavily preyed on by local domestic animals.</p>
Swan Coastal Plain shield-backed trapdoor spider (<i>Idiosoma sigillatum</i>)	P3	Vulnerable	On the Swan Coastal Plain, the species typically inhabits usually occurs in Banksia Woodland and heathland on sandy soils (Rix et al. 2018).	<p>Possible.</p> <p>Suitable habitat occurs within the Development Envelope.</p>
<i>Leioproctus contrarius</i> (a short-tongued bee)	P3	Not Listed	The closest known location occurs approximately 7 km to the north east. There is no habitat available information available for this species, known location occur across sands (generally Bassendean Sands) with native vegetation.	<p>Possible.</p> <p>There is little information on the habitat preference of this species, therefore, this species may be present across the Development Envelope.</p>
Black-striped Snake (<i>Neelaps calonotos</i>)	P3	Not Listed	Banksia woodlands and sandy areas of the Perth region (WA Museum 2017).	Possible.

Species	Conservation status		Habitat	Likelihood of presence within the Development Envelope
	BC Act	EPBC Act		
				This species has a broad range and the site contains suitable habitat (i.e. Banksia Woodland).
Graceful Sunmoth (<i>Synemon gratiosa</i>)	P4	Not Listed	Sun-moths are most common in sedgeland, heathlands, woodlands and sometimes in open parts of the forest where their 'foodplants' (various grasses, sedges and mat-rushes) are found. Most sun-moths only breed on one or two plant species - their caterpillars are adapted to feed only on these particular plants. The graceful sun-moth breeds on two species of <i>Lomandra</i> mat-rushes (<i>L. maritima</i> and <i>L. hermaphrodita</i>).	Unlikely. <i>Lomandra maritima</i> and <i>L. hermaphrodita</i> which provides habitat for the Graceful Sun Moth were not observed within the Development Envelope.



Legend:

- Development envelope
- 5km survey area buffer
- State roads (MRWA)



Job No: 57868

Client: Woodsome Management

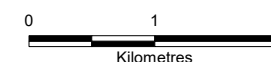
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Date 16/07/2020

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Checked By: HS

Scale 1:60,000



**Lot 9000 Wanneroo Rd
Perth, WA**

**THREATENED AND PRIORITY FAUNA
SPECIES WITHIN 5 KM OF THE
DEVELOPMENT ENVELOPE**

FIGURE 4.6

4.3.3.2 Black Cockatoos

The Development Envelope is located within the modelled foraging distribution of CBCs but outside the modelled foraging distribution of FRtBCs (ERIN 2016a; ERIN 2016b); however, FRtBC are increasingly observed foraging within the Swan Coastal Plain (Johnstone *et al.* 2017) and foraging evidence for FRtBCs was observed within the Development Envelope (Strategen JBS&G 2019).

The Development Envelope is outside the modelled breeding range for both CBCs and FRtBCs; however, the nearest known CBC breeding sites are:

- the Yanchep Nation Park approximately 13 km to the north
- within the Bullsbrook Area, 15 km to the north east.

Given the Proximity to known breeding locations and the availability of potentially suitable breeding habitat, the Development Envelope is considered to contain potential breeding habitat for CBCs.

While FRtBC foraging within the Swan Coastal Plain has been observed, there have only been two recorded occurrences of FRtBC breeding activity on the Swan Coastal Plain. Johnstone *et al.* (2017), observed two pairs of FRtBC breeding in artificial hollows at Murdoch University in 2012, no observations of FRtBC breeding on the Swan Coastal Plain have been recorded since. Murdoch University occurs 35 km south of the Development Envelope and the closest known FRtBC breeding Site is in Parkerville, approximately 22 km to the east of the Development Envelope (Birdlife 2019). Due to the distance to known breeding sites, the Development Envelope does not contain suitable breeding habitat for FRtBCs.

The Development Envelope is located outside the modelled distribution of Baudin's black cockatoo and therefore, vegetation within the Development Envelope does not provide habitat for this species, based on the current known distribution (ERIN 2016c).

Survey effort

A Black Cockatoo habitat assessment was undertaken across the Development Envelope in September 2017, to determine the with the objective of assessing Black Cockatoo foraging, roosting and breeding habitat (Strategen JBS&G 2019). The Development Envelope was assessed by an experienced Zoologist according to standards set out in the *Technical Guidance: Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA 2016c) and the EPBC Act *Referral Guidelines for Three Threatened Species of Black Cockatoo* (DSEWPac 2012). A summary of these surveys is provided in the following sections.

Foraging habitat

A total of 26.33 ha of foraging habitat for CBCs and FRtBCs, occurs within the Development Envelope, which can be characterised as:

- 26.33 ha of Excellent quality CBC foraging habitat (Figure 4.7)
- 10.47 ha of Good to Moderate quality FRtBC foraging habitat (Figure 4.8)
- 15.86 ha of Poor quality FRtBC foraging habitat (Figure 4.8).

Evidence of foraging for both species was observed across the Development Envelope.

- CBC foraging species consists of *Eucalyptus marginata*, *E. calophylla* and, *Banksia attenuata*, *Banksia menziesii*, *Mesomelaena pseudostygia* and *Xanthorrhoea preissii*
- FRtBC foraging habitat species consists of *Eucalyptus marginata*, *E. calophylla*, *E. gomphocephala*, *Allocasuarina fraseriana* and (Strategen JBS&G 2019).

Habitat foraging quality of each vegetation type is shown in Table 4.10 and was determined using the scale described in Table 4.9. Areas of Black Cockatoo habitat by habitat quality is shown within Table 4.11.

Table 4.9: Definitions of Black Cockatoo foraging habitat quality

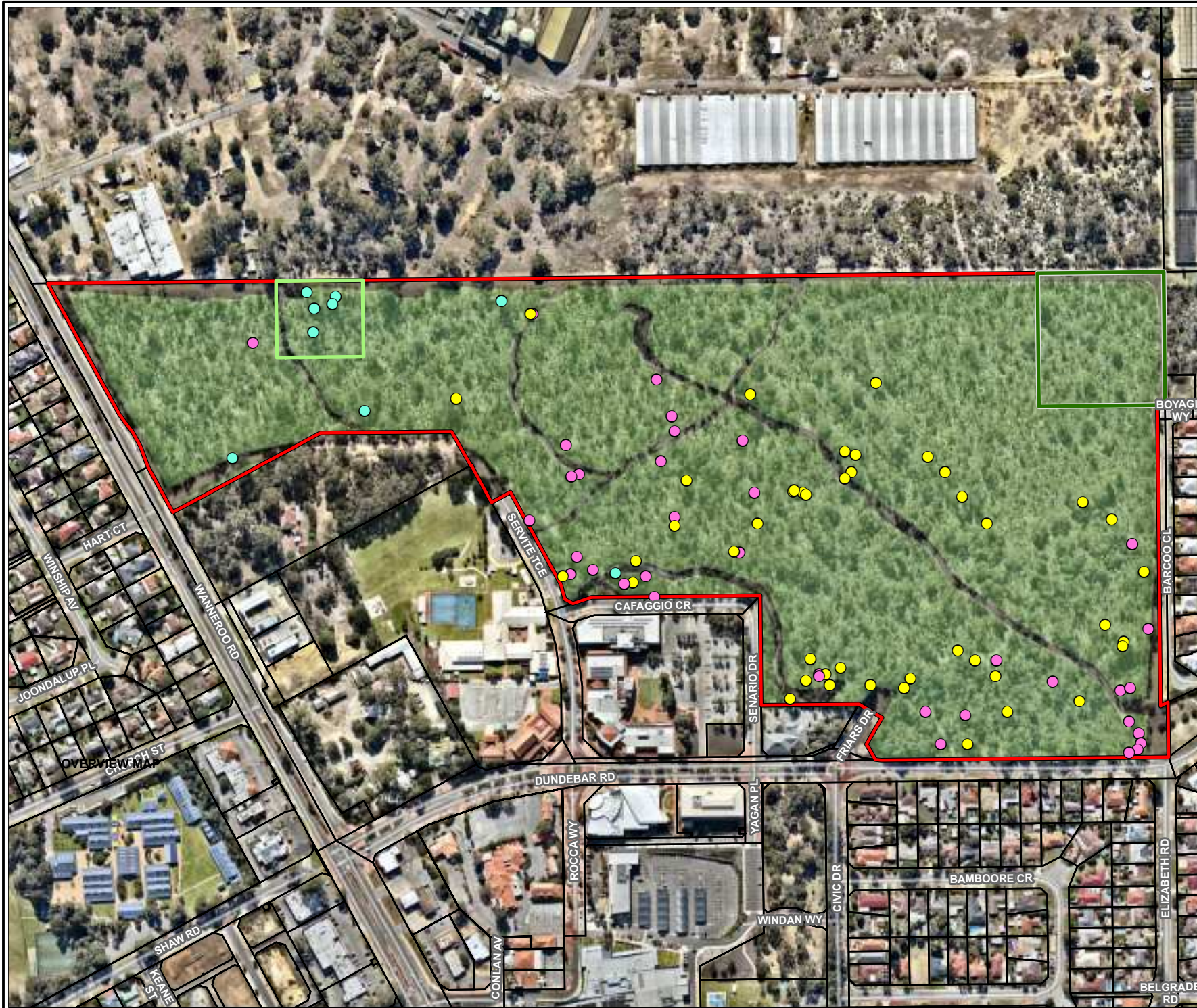
Foraging quality	Justification
Excellent	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) and presence of food sources at several strata (i.e. canopy, midstorey and understorey).
Good	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) but food sources only present at one or two strata (i.e. canopy and midstorey).
Moderate	Moderate foraging value density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 20-40%) and food sources only present at one or two strata (i.e. canopy and midstorey).
Poor	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (i.e. canopy).
Very poor	Very low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species <10%) and presence of food sources at only one stratum (i.e. canopy).
Nil	Cleared areas - no suitable vegetation present.

Table 4.10: Vegetation types and Black Cockatoo foraging species within the Development Envelope

Vegetation type	Black cockatoo foraging species	Foraging quality
VT1	<u>CBC</u> – <i>Banksia attenuata</i> , <i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> , <i>Mesomelaena pseudostygia</i> , <i>Xanthorrhoea preissii</i> <u>FRTBC</u> – <i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> Foliage cover of black cockatoo foraging species: 20% - 60+%	Excellent (CBC) Moderate (FRTBC)
VT2	<u>CBC</u> – <i>Banksia attenuata</i> , <i>B. menziesii</i> , <i>Eucalyptus marginata</i> , <i>E. gomphocephala</i> , <i>Mesomelaena pseudostygia</i> <u>FRTBC</u> – <i>Eucalyptus marginata</i> , <i>E. gomphocephala</i> , <i>Allocasuarina fraseriana</i> Foliage cover of black cockatoo foraging species: 30% - 60+%	Excellent (CBC) Poor (FRTBC)
C	Cleared	<u>CBC</u> – Nil <u>FRTBC</u> – Nil

Table 4.11: Black Cockatoo foraging habitat

Black cockatoo habitat	Area (ha)
Excellent (CBC only)	26.33
Good to Moderate (FRTBC only)	10.47
Poor (FRTBC only)	15.86



Legend:

- Development envelope
- Eastern conservation area (1.45ha)
- Western conservation area (0.57ha)
- Cadastral boundary
- Excellent quality foraging habitat
- Cleared (3.00ha)
- Black Cockatoo habitat trees
 - *Corymbia calophylla* (44)
 - *Eucalyptus gomphocephala* (9)
 - *Eucalyptus marginata* (37)
- Roads (MRWA)



Job No: 57868

Client: Woodsome Management

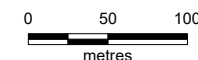
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Date 16/07/2020

Drawn By: cthatcher

Checked By: HS

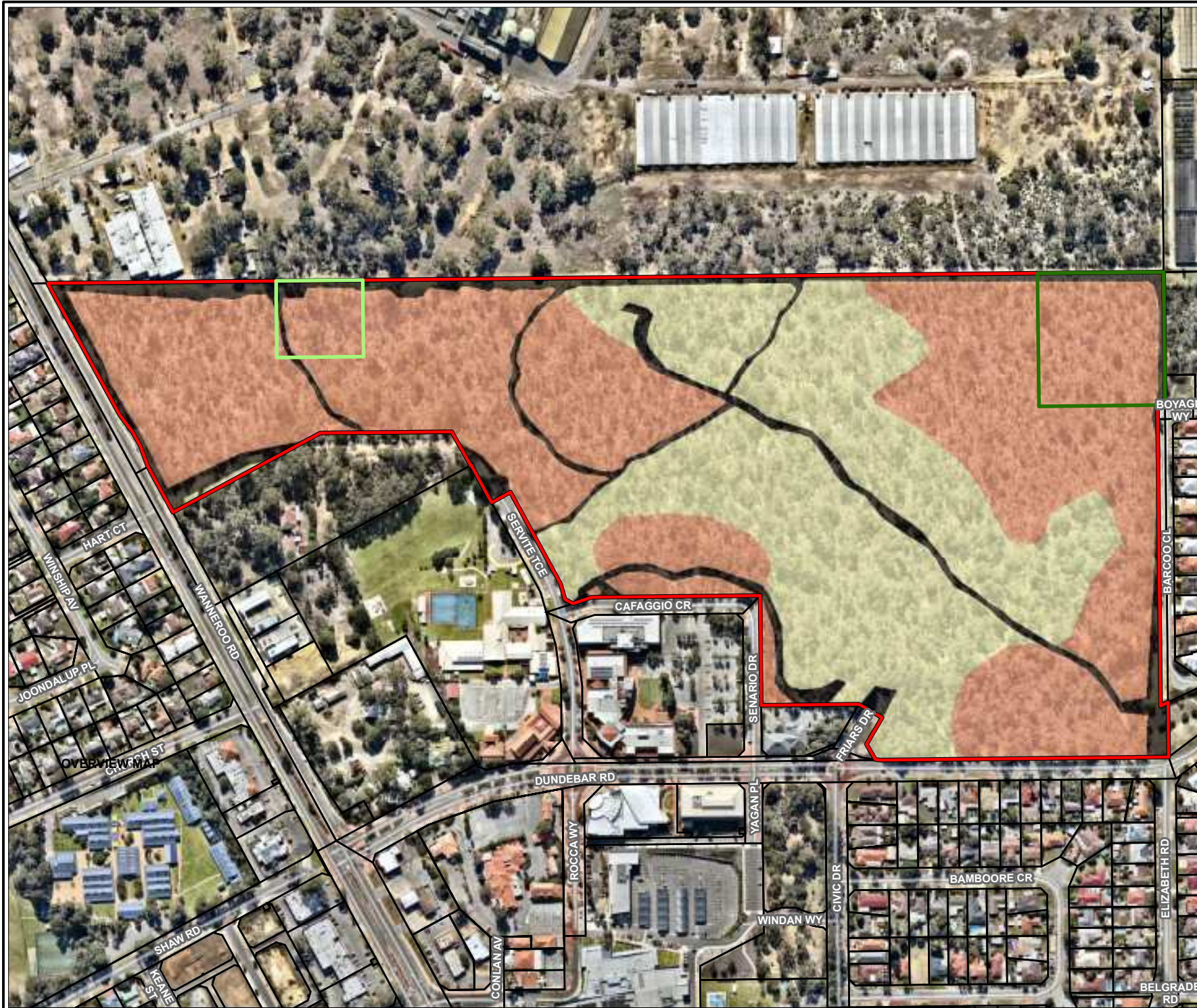
Scale 1:4,750



**Lot 900 Wanneroo Rd
Perth, WA**

**CARNABYS BLACK COCKATOO
HABITAT**

FIGURE 4.7



Legend:

- Development envelope
- Eastern conservation area (1.45ha)
- Western conservation area (0.57ha)
- Cadastral boundary
- Good to Moderate quality foraging habitat (10.47ha)
- Poor quality foraging habitat (15.86ha)
- Cleared (3.00 ha)
- Roads (MRWA)



Job No: 57868

Client: Woodsome Management

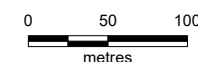
Version: A

Date 16/07/2020

Drawn By: cthatcher

Checked By: HS

Scale 1:4,750



**Lot 900 Wanneroo Rd
Perth, WA**

**FOREST RED TAILED BLACK
COCKATOO FORAGING HABITAT**

FIGURE 4.8

Roosting habitat

A total of 90 potential roosting trees occur within the Development Envelope consisting of three species of trees:

- *Corymbia calophylla* (44)
- *Eucalyptus marginata* (37)
- *Eucalyptus gomphocephala* (9) (Figure 4.7).

Within 6 km of the Development Envelope There are five confirmed roosts sites and a further 10 unconfirmed roost sites (Figure 4.9). The three nearest sites are within 2 km of the Development Envelope:

- JOOEDGR001 – 1.5 km to the west on Lake Joondalup (unconfirmed)
- WANWANR001 – 1.8 km to the north on Lake Joondalup (confirmed)
- WANMARR002 – 1.5 km north-east (unconfirmed; Birdlife Australia 2019).

A total of 40 CBCs have been observed at JOOEDGR001 and WANWANR001 from 2010 – 2015 (Birdlife Australia 2019). No birds have been observed at either site during the last four events. Results of the great cocky count indicate low numbers of CBCs may be accessing the resources across the Development Envelope infrequently.

Great cocky count data demonstrates a total of eight FRtBCs have been observed at the unconfirmed roost site WANMARR002, additionally, no FRtBCs have been observed during the last five events (Birdlife Australia 2019). The Great Cocky count results indicate that the Wanneroo area is unlikely to be contributing significant foraging and roosting habitat for the FRtBCs.

Black Cockatoo Breeding habitat assessment

The Development Envelope supports 90 potential breeding trees across three species of Eucalypts:

- Marri (*Corymbia calophylla* 44)
- Jarrah (*Eucalyptus marginata* 37)
- Tuart (*Eucalyptus gomphocephala* 9; Figure 4.7).

None of the potential breeding trees contain hollows suitable for Black Cockatoos (Strategen JBS&G 2019).

The nearest recorded CBC breeding activity occurs approximately 13 km to the north of the Development Envelope as part of the Yanchep National Park Roost site (Birdlife Australia 2019). Furthermore, a review of the CBC distribution maps identify the Development Envelope is outside the current modelled distribution of the species (DEE 2016). Given the Development Envelopes proximity to known breeding areas and Lake Joondalup as a water resource (500 m to the west), the Development Envelope is considered to have the potential to host breeding habitat in the future, once mature trees develop suitable hollows.

The Development Envelope occurs on the Swan Coastal Plain. Breeding activity for FRtBCs within the Swan Coastal Plain has been limited to one observation in two artificial breeding tubes on Murdoch University grounds in 2012 (Johnstone *et al.* 2017). Since this observation no further evidence of FRtBCs breeding on the Swan Coastal Plain has been recorded (Johnstone *et al.* 2017). Murdoch University occurs 36 km south of the Development Envelope, The closest FRtBC confirmed breeding location is in Parkerville approximately 22 km to the east of the Development Envelope (Birdlife 2019). Therefore, the Development Envelope is outside the breeding range for FRtBCs and does not contain breeding habitat for the species.

Local and regional context

The following provides a broad description of Black Cockatoo foraging habitat available within a 6 km to 12 km radius from the Development envelope, based on publicly available spatial information. These distances have been nominated due to the knowledge that whilst breeding, Black Cockatoos will generally forage within 6 to 12 km from their nesting site (DWSEPaC 2012). As a result of this mobility range, the potential for reduced flowering and seed set due to drought, as well as the irregular or infrequent flowering and fruit patterns of many of their food sources, large areas of foraging habitat are required to support black cockatoo populations (DSWEPaC 2012).

Figure 4.9 below depicts the potential Black Cockatoo foraging habitat within 6 km and 12 km of the Development Envelope. A spatial analysis of the remaining extent of Black Cockatoos foraging habitat available from DBCA vegetation mapping (GoWA 2019b), has identified that within a 6 km radius of the development envelope there is approximately 1,681 ha of potential foraging habitat, of which approximately 1,071 ha is protected within conservation areas (legislated lands and Bush Forever sites (WALGA 2018).

Within a 12 km radius of the development envelope, there is approximately 8,234 ha of potential foraging habitat (GoWA 2019b), of which approximately 6,565 ha is protected within conservation reserves (legislated lands, Bush forever, Conservation/ Resource Enhancement Wetlands; WALGA 2018). Large, intact areas of potential black cockatoo habitat are mapped within 12 km of the site, associated with Bush Forever Sites in Neerabup National Park Cullacabardee, Gnangara and Whiteman.

There are no permanent standing bodies of water within the Development Envelope that would provide drinking water for Black Cockatoos. The closest water source is Lake Joondalup, located approximately 560 m west of the Development Envelope.

4.3.3.3 Other conservation significant fauna

A search of the *Naturemap* database identified a total of 21 other conservation significant species with 5 km of the Development Envelope (Figure 4.9). Due to the habitat present with in the Development Envelope, three are considered possible to occur (Quenda, Trapdoor Spider and Black Striped Snake). Another (Short Tongued-bee) is unknown and considered to potentially occur.

4.3.3.4 Ecological linkages

As noted earlier in Section 4.2.3.3, Development Envelope has not been identified for conservation as part of a local or regional conservation strategy (CoW 2018; GoWA 2000; DPLH 2018).

According to Del Marco *et al.* (2004) the importance of ecological linkage is to connect natural areas, preferably with continuous corridors of native vegetation, which assists in fauna movement between the areas to access resources and habitats. The protection, management and buffering of existing natural areas within an ecological linkage is a higher priority than revegetation of cleared portions of the link.

There is no Regional Ecological Linkage within or directly adjacent to the Development Envelope. The closest Regional Ecological Linkage occurs 950 m to the west (Link ID 6), which is part of Lake Joondalup. The fringing vegetation of Lake Joondalup occurs approximately 560 m to the west of the Development Envelope. The area surrounding the Development Envelope has been heavily urbanised and consequently, the Development Envelope is isolated from the Regional Ecological Linkage and surrounding remnant bushlands, thus the Development Envelope provides no function as a Regional Ecological Linkage for terrestrial fauna.



Legend:

- Development envelope
- 6km buffer area
- 12km buffer area
- Potential Black Cockatoo foraging habitat

Black Cockatoo habitat

- Roost areas unconfirmed
- Roost areas confirmed
- State roads (MRWA)

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Scale: 130,000

**Lot 9000 Wanneroo Rd
Perth, WA**

REGIONAL BLACK COCKATOO HABITAT

FIGURE 4.9

4.3.4 Potential impacts

4.3.4.1 Direct impacts

The proposal will result in the clearing of a maximum of 24.58 ha of remnant vegetation within the Development Envelope. The clearing will impact foraging habitat for CBC and FRtBC and potential breeding habitat for the CBC.

A breakdown of the areas to be cleared by black cockatoo habitat quality is provided in Table 4.12.

Table 4.12: Proposed areas to be cleared by Black Cockatoo foraging habitat quality

Black Cockatoo foraging habitat quality	Total (ha)	Total CBC habitat clearing	Total FRtBC habitat clearing
Excellent (CBC)	24.58	24.58	
Good to Moderate (FRtBC)	10.47		24.58
Poor (FRtBC)	14.11		

A total of 85 potential breeding trees for CBCs and roosting trees for CBCs and FRtBCs are proposed to be cleared across the Development Envelope. None of the trees contain hollows suitable for use by Black Cockatoos (Strategen JBS&G 2019).

Clearing within the Development Envelope will also impact 24.58 ha of potential habitat for the Quenda, Swan Coastal Plain Shield-backed Trapdoor Spider, the Black Striped Snake and potentially the short tongued-bee.

4.3.4.2 Indirect impacts

Construction activities have the potential to impact on proposed retrained habitat and adjacent fauna habitat through erosion, uncontrolled access, dust deposition, and through the spread of weeds and dieback. Higher traffic volumes within the Development Envelope following completion of the development also has the potential to increase the risk of fauna strikes.

4.3.4.3 Cumulative impacts

The following provides a broad analysis of cumulative impacts to Black Cockatoo foraging habitat within a 6 to 12 km radius from the Development Envelope. This is based on the knowledge that breeding Black Cockatoos will generally forage within 6 to 12 km from their nesting site (DSEWPac 2012). As a result of this mobility range, the potential for reduced flowering and fruit patterns of many of their food sources, large areas of foraging habitat are required to support black cockatoo populations (DSWEPaC 2012).

In the context of the Development Envelope, known breeding locations are greater than 12 km away, therefore, Black Cockatoos are considered to utilise the foraging habitat with the Development Envelope opportunistically, rather than a reliance the Development Envelope as an important food source. Clearing 24.58 ha of Black Cockatoo foraging habitat with the Development Envelope represents 1.46% of what is potentially available within 6 km and 0.3% of what is potentially available within 12 km of the Development Envelope. Clearing 24.58 ha of Black Cockatoo foraging habitat for CBC and FRtBC is considered unlikely to significantly increase the cumulative impact at a regional or local scale.

4.3.5 Assessment of impacts

The proposal will result in the clearing of a maximum of 24.58 ha of Black Cockatoo foraging habitat including:

- 24.58 ha Excellent quality CBC foraging habitat
- 10.47 ha of Moderate quality FRtBC foraging habitat which is comprised of:
 - 10.47 ha of Good to Moderate quality foraging habitat
 - 14.11 ha of Poor quality foraging habitat.

The proposal will result in clearing a maximum of 85 potential breeding trees for CBCs and potential roosting trees for CBCs and FRtBCs, none of which contain hollows suitable for breeding by Black Cockatoos. During detailed design, opportunities for additional retention of potential habitat trees in street scapes and road reserves will be assessed.

Additionally, the clearing will result in a maximum of 24.58 ha of potential habitat for the following Priority fauna species:

- Quenda (P4)
- Swan Coastal Plain Shield-backed Trapdoor Spider (P3)
- Black Striped Snake (P3).

The Concept Plan in Figure 1.3, identifies that 1.76 ha of remnant vegetation will be retained within the Development Envelope, which comprises Black Cockatoo foraging, roosting and potential breeding habitat, as well as potential habitat for the Quenda, Swan Coastal Plain Shield-backed Trapdoor Spider, the Black Striped Snake and potentially the short tongued-bee. Additionally, there are a number of Bush Forever sites located within 6 km of the Development Envelope which are likely to provide foraging, roosting and potential breeding habitat for Black Cockatoos (Figure 2.3).

With the exception of the clearing of Black Cockatoo habitat, the proposal is not expected to cause significant impacts to terrestrial fauna, based on the following:

- clearing of approximately 24.58 ha of potential habitat for the Quenda, Swan Coastal Plain Shield-backed Trapdoor Spider and Black-striped Snake, which are Priority species only. It is noted that ground-dwelling native fauna can be translocated, prior to clearing of fauna habitat, in accordance with an anticipated future subdivision condition to this effect
- no clearing of “Regionally Significant Linkage of Bushland/ Wetland Areas” as mapped within Bush Forever Volume 2 (GoWA 2000)
- no clearing of wetland/ riparian habitat, or conservation areas protected under statute
- habitat within the Development Envelope is unlikely to provide favourable habitat for migratory species, due to lack of available surface water
- application of mitigation measures to minimise direct and indirect impacts.

4.3.6 Mitigation

The environmental objective for terrestrial fauna will be attained through the implementation of the impact mitigation hierarchy (avoid, minimise, rehabilitate). These mitigation measures are discussed below.

4.3.6.1 Avoid

A total of 2.03 ha is proposed to be set aside as conservation public open space (POS) across two conservation areas, the Eastern Conservation Area (1.45 ha) and the Western Conservation Area (0.57 ha; Figure 1.3). Due to the presence of currently cleared firebreak track along the perimeter of the Development Envelope, the total remnant native vegetation extent retained across both areas is 1.76 ha, 1.26 ha in the Eastern Conservation Area and 0.5 ha in the Western Conservation Area. Following construction, both conservation areas will be ceded to the Crown with the City of Wanneroo responsible for retaining and conserving native vegetation and fauna habitat therein.

The Western Conservation Area will retain 0.5 ha of remnant vegetation encompassing Excellent quality CBC and Moderate quality FRtBC foraging habitat. Additionally the Western Conservation Area will retain five potential breeding trees (Tuarts) for CBCs, which are also potential roosting trees for CBCs and FRtBCs. All of the Western Conservation Area is considered to contain potential

habitat for the Quenda, Swan Coastal Plain Shield-backed Trapdoor Spider, the Black Striped Snake and the short tongued-bee.

The Eastern Conservation Area retains 1.26 ha of Excellent quality and Moderate quality foraging habitat for CBCs and FRtBCs respectively. The location of the Eastern Conservation Area was positioned to maintain direct ecological connection with Boyagin Park (0.71 ha) to the east of the Development Envelope (Figure 1.3). Maintaining a direct connection to Boyagin Park which has similar vegetation to the Western Conservation Area, provides a total conservation outcome of 1.97 ha in the eastern portion of the Development Envelope. The direct connection with Boyagin Park results in a greater ecological outcome. All of the eastern conservation area and Boyagin Park may provide habitat for the Quenda, Swan Coastal Plain Shield-backed Trapdoor Spider, the Black Striped Snake and the short tongued-bee.

Both conservation areas have retained the best quality vegetation for each vegetation type, for example the Eastern Conservation Area (1.26 ha in VT1) is in Excellent condition and the Western Conservation Area (0.50 ha in VT2) is in very good condition.

4.3.6.2 Minimise

Prior to ground disturbing works commencing within the Development Envelope, fauna trapping and translocations will be undertaken to ensure non-avian fauna are removed from the Development Envelope prior to clearing. During clearing, the contractors will implement the following measures to reduce fauna impacts:

During future subdivision approval, a Vegetation and Fauna Management Plan (VFMP) will be developed and implemented during the clearing and construction process. The VFMP will include the following measures to avoid and mitigate impacts to CBC, FRtBC and other relevant conservation significant fauna:

- contractor fauna education inductions
- procedures for injured fauna
- avoid clearing within Black Cockatoo breeding season, where possible.
- where clearing is proposed during Black Cockatoo breeding season potential breeding trees will be inspected by a suitably qualified ecologist prior to clearing
- pre-clearing fauna relocation
- strict enforcement of speed limits within the development envelope and along local minor roads.

4.3.6.3 Rehabilitate

While formal rehabilitation is not proposed, streetscaping associated with road reserves and POS throughout the development will utilise native species where possible, with a particular focus on known foraging species for CBC (DSEWPac 2012). It is expected that this landscaping will reinstate some fauna habitat post-construction, including for the Black-striped Snake, and will assist with maintaining ecological linkages for avian species. The Proponent will also consider utilisation of any felled trees/ logs for fauna habitat creation in conservation areas and/ or POS.

4.3.7 Predicted outcome

The proposal will not result in the clearing of any potential breeding trees, that currently contain hollows with suitable dimensions for breeding. Based on the absence of breeding hollows, the distance to known breeding locations (> 13 km) for CBCs and 22 km for FRtBCs, the Development Envelope does not support breeding habitat for Black Cockatoos. As such, the proposal will not clear habitat currently used by Black Cockatoos for breeding purposes.

The proposal will result in the clearing of a maximum of 24.58 ha of foraging habitat for Black Cockatoos, which can be described as:

- 24.58 ha of Excellent quality CBC foraging habitat
- 24.58 ha Moderate quality FRtBC foraging habitat:
 - 10.47 ha of Good to Moderate foraging quality
 - 14.11 ha of Poor foraging quality.

Additionally, a total of 85 trees potentially suitable for breeding by CBCs and Roosting by CBCs and FRtBCs, are proposed to be cleared by the proposal.

The Proponent will demonstrate mitigation through retention of habitat within Conservation and useable POS and road reserves, habitat creation through landscaping with native species, and through implementation of a fauna trapping and translocation program and pre-clearing fauna inspections and relocation.

Despite the application of the mitigation hierarchy as detail above, the proposal may result in significant residual impacts to foraging habitat for CBCs and FRtBCs.

Due to the predicated significant residual impacts of clearing:

- 24.58 ha of Excellent quality CBC foraging habitat
- 24.58 ha Moderate quality FRtBC foraging habitat:
 - 10.47 ha of Good to Moderate foraging quality
 - 14.11 ha of Poor foraging quality
- 85 potential breeding trees for CBCs and potential Roosting trees for CBCs and FRtBCs.

The proponent predicts the proposal will require offsets for significant residual impact to the environmental values noted above. Section 6 further discusses the offset requirements for the Proposal.

5. Other environmental factors or matters

No other environmental factors established by the EPA for the purposes of environmental impact assessment were considered significant for the proposal, as presented in Table 5.1.

Table 5.1: Assessment of other environmental factors

Environmental factor	Significance of impact
Benthic Communities and Habitat	The proposal is not located adjacent or nearby coastal areas.
Coastal Processes	The proposal is not located adjacent or nearby coastal areas.
Marine Environmental Quality	The proposal is not located adjacent or nearby marine areas.
Marine Fauna	The proposal is not located adjacent or nearby marine areas.
Landforms	The proposal is not associated with landforms of high landscape value.
Subterranean Fauna	No dewatering is anticipated to be required as part of the proposed development. As such, there will be no significant impacts to subterranean fauna as a result of the proposed development.
Terrestrial Environmental Quality	<p>The proposal is not expected to cause significant impact to terrestrial environmental quality. Localised erosion and sedimentation may occur during construction, however these impacts will be restricted to the site and can be effectively managed through appropriate construction measures. Topography and soils are not a constraint to the proposed development.</p> <p>A search of the Swan Coastal Plain Acid Sulphate Soils risk map (DWER 2019b) indicates that there is no known risk of Acid Sulfate Soils (ASS) occurring within 3 m of the natural soil surface across the Development Envelope. The nearest high to moderate ASS disturbance risk within 3 m of the natural soils surface is located approximately 560 m to the west of the Development Envelope. ASS is not considered a constraint to development.</p>
Inland Water	<p>Groundwater is estimated to be encountered approximately 12 to 33 m below ground level [bgl] (DWER 2019), thus appropriate separation from the construction to groundwater is anticipated.</p> <p>The Development Envelope is not within a PDWSA; however, a P3 PDWSA occurs directly adjacent to the west of the Development Envelope as part of the Perth Coastal Gwelup Underground Water Pollution Control Area. For urban (residential) developments in P3 areas it is recommended that there is deep sewerage connection and the implementation of urban water sensitive design practices. The proposal will provide deep sewer connection and therefore is considered compatible with the P3 PDWSA.</p> <p>No natural surface water expressions or geomorphic wetlands are present on site, or located adjacent to the site.</p> <p>There are no declared Ramsar wetland (Wetlands of International Importance) present within the site or within 3 km of the site (WALGA 2017).</p> <p>Given the absence of surface water features, and the anticipated separation to groundwater, the potential for impacts to inland waters is limited. Additionally, dewatering is not anticipated as part of the proposed development.</p> <p>Potential temporary impacts to water quality may be associated with construction activities, and include:</p> <ul style="list-style-type: none"> • localised (on-site) erosion and sedimentation during construction • accidental spills of fuels or chemicals during construction • stormwater runoff from roads and housing following completion of the development. <p>In order to address the above potential impacts associated with construction, standard construction management measures will be included in the CEMP, such as:</p> <ul style="list-style-type: none"> • spill response procedures • no below-ground fuel or chemical storage

Environmental factor	Significance of impact
	<ul style="list-style-type: none"> clearing and access control measures (such as demarcation of clearing boundaries) erosion and sediment control dust control waste and fire management. <p>The hydrological regime and water quality of the Development Envelope will be maintained, and will be required to be demonstrated through the preparation of a Local Water Management Strategy (LWMS) and Urban Water Management Plan (UWMP) as part of the standard planning and development process.</p> <p>Additionally, the proposal may require abstraction of groundwater for irrigation of POS. The Proponent will limit the requirement for groundwater abstraction where possible through use of native species in landscaping. If groundwater abstraction is required, the Proponent will seek a groundwater abstraction licence. Groundwater licencing is regulated by DWER and the allocation per hectare of POS will be consistent with DWER requirements for the region.</p> <p>Based on the anticipated absence of dewatering, the location of the Development Envelope away from Conservation Category and Ramsar wetlands, as well as the adequate depth to groundwater, the proposal is not expected to cause significant impacts to the hydrological regime or quality of groundwater and surface water. Additionally, all anticipated impacts are anticipated to be effectively managed through the development and implementation of the LWMS/ UWMP and through the groundwater licencing process.</p> <p>Accordingly, it is expected that the EPA objective for inland waters will be met.</p>
Air Quality	<p>The Proposal has the potential to result in minor air (dust) emissions during construction which will be managed through appropriate construction measures, and will not result in long term increased vehicle emissions in the local area.</p>
Social surroundings	<p>As presented in Figure 2.3, the Development Envelope is surrounded by predominately urban residential and commercial land uses. The urban residential areas surrounding the Development Envelope have aesthetic surroundings typical of residential areas within the Perth Metropolitan region, with a strong visual and acoustic influences associated with commuter activities along Wanneroo Road.</p> <p>The proposal is expected to provide a compatible extension of the existing land use of the local area and improve economic and social values in the vicinity, by increasing the availability of affordable housing, access to commercial activities and providing conservation Public Open Space.</p> <p>A search of the Department of Planning Land and Heritage <i>Aboriginal Heritage Inquiry System</i> (DPLH 2019) (search conducted March 2020) identified no Registered Sites within the Development Envelope. The closest Registered Site occurs approximately 560 m to the west (Lake Joondalup).</p> <p>A search of the Heritage Council of Western Australia (HCWA) <i>inherit</i> website identified there are no European heritage places within the Development Envelope. The Inherit register identified three European heritage listed places approximately 250 m to the south east of the Development Envelope:</p> <ul style="list-style-type: none"> CALM School Classroom (Place Number: 17526) CALEM Forestry House (Place number 17525) Wanneroo School (fmr) site (Place Number 17947). <p>Potential indirect impacts to social surrounds are expected to be temporary and associated with construction. These include:</p> <ul style="list-style-type: none"> dust emissions and deposition noise and vibration from machinery

Environmental factor	Significance of impact
	<ul style="list-style-type: none"> • construction waste such as litter and debris • construction vehicle traffic including heavy vehicles supplying materials. <p>The above potential impacts will be managed through the implementation of appropriate construction methods and control, which will be prepared prior to ground disturbing works commencing within the Development Envelope through the sub-division planning process.</p> <p>The proposal may cause ongoing potential impacts on aesthetic and social values due to an increase in traffic volumes along local and minor roads. Traffic considerations are required to be addressed through the standard planning and development process and it is anticipated that the development of the site may provide opportunities to improve traffic flow in the local area.</p> <p>The proposal is not expected to cause a significant impact to social surrounds due to the following:</p> <ul style="list-style-type: none"> • no Aboriginal or European heritage places have been identified within the Development Envelope • all anticipated impacts will be managed and mitigated through the implementation of appropriate construction controls • in the longer term, anticipated impacts to the local area are expected to be positive, due to the increase in affordable housing • landscaping and streetscaping will include native vegetation where possible to maintain and enhance the visual character of the area • shared use paths will be provided to maintain and enhance existing access networks • approximately 2.03 ha of Conservation Public Open Space will be developed for the benefit of the wider community. <p>Accordingly, it is expected that the EPA's objective for social surrounds will be met.</p>
Human Health	<p>The Proposal will not result in significant impacts to human health. Noise is not expected to be severe and consistent with EPA guidance (EPA 2016f) is addressed under Social Surroundings.</p>

6. Offsets

Based on the application of the mitigation hierarchy illustrated below in Plate 1 and the outcomes of this impact assessment, it is anticipated that significant residual impacts to CBC foraging and potential breeding habitat, FRtBC foraging roosting habitat and Banksia Woodland PEC P3 (State) and TEC (Commonwealth) will be required to be offset.

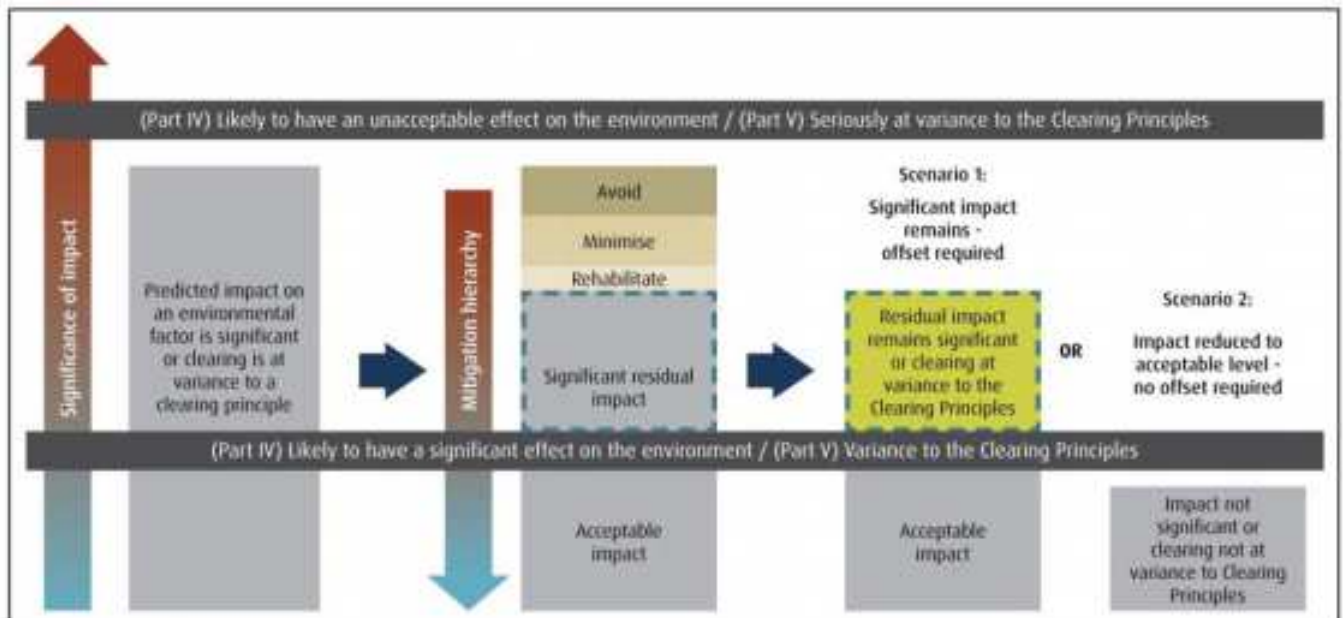


Plate 1: Mitigation hierarchy (Government of Western Australia (GoWA) 2014)

During the assessment of the proposal, the proponent will develop and execute an offsets acquisition strategy consistent with State and Commonwealth approval requirements. The proponent anticipates that offsets will be required for listed threatened species (CBC and FRtBC) and communities (Banksia woodland TEC). The offset strategy will be prepared in accordance with following key policies and guidelines:

- *WA Environmental Offsets Policy* (GoWA 2011)
- *WA Environmental Offsets guidelines* (GoWA 2014)
- EPBC Act Environmental Offsets Policy (DSEWPaC 2012b).

The proponent intends to align the offset requirements of the State and Commonwealth through provision of an offset package which demonstrates no significant residual impacts to:

- CBC foraging and potential breeding habitat
- FRtBC foraging habitat
- Banksia Woodlands of the Swan Coastal Plain (PEC P3 and TEC).

Based on the quantum of impact to the environmental matters identified above, offsets are anticipated to be required by the State and Commonwealth for significant residual impacts to:

- 24.58 ha of CBC Excellent quality foraging habitat
- 24.58 ha of FRtBC Moderate quality foraging habitat
- 85 potential breeding trees for CBCs and potential roosting trees for CBCs and FRtBCs
- 14.11 ha of Banksia woodlands of the Swan Coastal Plain TEC/PEC 3.

Throughout the State and Commonwealth environmental assessment process, the proponent will identify offset sites for acquisition and liaise with both the State and Commonwealth agencies for the provision of offsets that result in no significant residual impacts for the proposal.

Limitations

Scope of services

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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.

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7. References

- Beard JS. (1981). *Swan, 1:1000000 vegetation series: explanatory notes to sheet 7: the vegetation of the Swan area*. University of Western Australia Press, Nedlands, Western Australia.
- Beard JS. (1990). *Plant Life of Western Australia*. Kangaroo Press, Kenthurst, New South Wales.
- Birdlife WA. 2019. *Great Cocky Count Dataset*. Available online via the Environmental Planning Tool.
- Churchward HM & McArthur WM (1980), 'Landforms and Soils of the Darling System', in Atlas of Natural Resources, Darling System, Western Australia, eds Department of Conservation and Environment, Perth, pp. 25-33.
- CSIRO. (2009). Groundwater yields in south-west Western Australia, A report to the Australian Government from the CSIRO South-West Western Australia Sustainable Yields Project. CSIRO Water for a Healthy Country Flagship, Australia.
- Dal Marco A Taylor R Clarke K Savage K Cullity J and Miles C (2004). Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region. Perth Biodiversity Project. Western Australian Local Government Association, Perth.
- Department of Biodiversity Conservation and Attractions (DBCA). n.d. *Naturemap: Mapping Western Australia's Biodiversity*. Government of Western Australia.
- Department of Biodiversity Conservation and Attractions (DBCA). (2018). *2018 South West Vegetation Complex Statistics. Current as of March 2019*. Government of Western Australia.
- Department of Biodiversity Conservation and Attractions (DBCA). (2018). *2018 South West Vegetation Complex Statistics. Current as of March 2019*. Government of Western Australia.
- Department of Biodiversity, Conservation and Attractions (DBCA). (2019). *Priority ecological communities for Western Australia Version 28*. Government of Western Australia, Perth.
- Department of Environment and Conservation (DEC). (2012). Fauna Profiles - Quenda Isododon obesulus (Shaw, 1797). Government of Western Australia. Perth.
- Department of Environment and Energy (DEE). (2016) Map 3: Modelled distribution for Carnaby's Cockatoo (*Calyptorhynchus latirostris*) [Online], Australian Government, Available from: <https://www.environment.gov.au/system/files/consultations/1a21997c-5542-4cd6-ace9-561865bbff29/files/map-3-modelled-distribution-carnabys-cockatoo.pdf> [21 July 2020].
- Department of Environment and Energy (DEE). (2017a). *Interim Biogeographic Regionalisation for Australia, Version 7*. [Online], Australian Government, Available from: <http://www.environment.gov.au/topics/land/national-reserve-system/science-maps-and-data/australias-bioregions-ibra> [21 July 2020].
- Department of Environment and Energy (DEE). 2017b. *Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) Calyptorhynchus latirostris, Baudin's Cockatoo (Vulnerable) Calyptorhynchus baudinii, Forest Red-tailed Black Cockatoo (Vulnerable) Calyptorhynchus banksii naso*, Available from: <https://www.environment.gov.au/system/files/consultations/1a21997c-5542-4cd6-ace9-561865bbff29/files/draft-revised-referral-guideline-black-cockatoos.pdf>.
- Department of Planning Lands and Heritage (DPLH). (2018). North-West sub-regional planning framework. Government of Western Australia.
- Department of Planning Lands and Heritage (DPLH). (2019). *Aboriginal Heritage Inquiry System*. Available online via <https://maps.daa.wa.gov.au/AHIS/>.

- Department of Primary Industries and Regional Development (DPIRD). (2019). Natural resources Information Western Australia Mapping Tool. Available online at: <https://maps.agric.wa.gov.au/nrm-info/>.
- Department of Sustainability Environment Water Population and Communities (DSEWPoC). (2012). EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris* Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii* Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*. Commonwealth Government of Australia.
- Department of Water and Environmental Regulation (2019a). Perth Water Register. Available online at: <https://www.water.wa.gov.au/maps-and-data/maps/water-register>.
- Department of Water and Environmental Regulation (2019b). Perth Groundwater Atlas. Available online via: <https://maps.water.wa.gov.au/#/webmap/gwm>.
- Environmental Protection Authority (EPA). (2016a). *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. EPA, Western Australia, Perth.
- Environmental Protection Authority (EPA). (2016b). *Environmental Factor Guideline: Flora and Vegetation*, EPA, Western Australia, Perth.
- Environmental Protection Authority (EPA). (2018a). *Instructions on how to prepare an Environmental Review Document*, EPA, Western Australia.
- Environmental Protection Authority (EPA). (2018b). *Statement of Environmental Principles, Factors and Objectives*, EPA, Western Australia.
- Environmental Protection Authority (EPA). (2018c). *Environmental Factor Guideline: Inland Waters*. EPA, Western Australia.
- Environmental Resources Information Network (ERIN) (2016a), *Map 4: Modelled distribution for Forest Red-tailed Black-Cockatoo (Calyptorhynchus banksii naso)*, Australian Government, Canberra. Available via: <https://www.environment.gov.au/epbc/comment/draft-revised-referral-guideline-black-cockatoo>.
- Environmental Resources Information Network (ERIN) (2016b), *Map 3: Modelled distribution for Carnaby's Cockatoo (Calyptorhynchus latirostris)*, Australian Government, Canberra. Available via: <https://www.environment.gov.au/epbc/comment/draft-revised-referral-guideline-black-cockatoo>.
- Environmental Resources Information Network (ERIN) (2016c), *Map 2: Modelled distribution for Baudin's Cockatoo (Calyptorhynchus baudinii)*, Australian Government, Canberra. Available via: <https://www.environment.gov.au/epbc/comment/draft-revised-referral-guideline-black-cockatoo>.
- Gibson N Keighery B Keighery G Burbidge A and Lyons M. (1994). *A Floristic Survey of the Southern Swan Coastal Plain*. Department of Conservation and Land Management, Perth.
- Government of Western Australia (GoWA) 2000, *Bush Forever Volume 2*, Department of Environmental Protection, Perth.
- Government of Western Australia. (2011). *WA Environmental Offsets Policy*. Government of Western Australia, Perth.
- Government of Western Australia. (2014). *WA Environmental Offsets Guidelines*. Government of Western Australia, Perth.
- Government of Western Australia. (GoWA) 2019a, 2018 South West Vegetation Complex Statistics, Current as of December 2016, WA Department of Parks and Wildlife, Perth.

- Government of Western Australia (GoWA) 2019b, 2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report), Current as of May 2016, Department of Parks and Wildlife, Perth.
- Hedde EM, Loneragan OW & Havel JJ. (1980). *Darling System, Vegetation Complexes*, Forest Department, Perth.
- Heritage Council of Western Australia (HCWA) & State Heritage Office (SHO). (2019). *InHerit Heritage Enquiry System*. Available online via: <http://inherit.stateheritage.wa.gov.au/Public/>.
- Johnstone RE Kirkby T & Sarti K. (2017). The distribution, status movement and diet of the Forest Red-tailed Black Cockatoo on the south-west with an emphasis on the greater Perth Region, Western Australia. *The Western Australian Naturalist* 30(4).
- Rix MG Huey JA Cooper SJB Austin AD & Harvey MS (2018) Conservation systematics of the shield-backed trapdoor spiders of the nigrum-group (Mygalomorphae, Idiopidae, Idiosoma): integrative taxonomy reveals a diverse and threatened fauna from southwestern Australia. *ZooKeys* 756: 1–121. <https://doi.org/10.3897/zookeys.756.24397>.
- Strategen JBS&G. (2019). Lot 9000 Corner Wanneroo and Dundee Roads, Sinagra Flora, Vegetation and black Cockatoo habitat survey – Prepared for the Order of the Servants of Mary Incorporated C/- Woodsome Management Pty Ltd. Perth Western Australia.
- Threatened Species Scientific Committee (TSSC). (2016). *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community*. Available online via: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/131-conservation-advice.pdf>.
- Taylor Burrell Barnett (TBB). (2018). Wanneroo Town Centre Draft Activity Centre Plan No. 90. Prepared for the City of Wanneroo. Perth Western Australia.
- Threatened Species Scientific Committee (TSSC). (2019). *Approved Conservation Advice (incorporating listing advice) for the Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community*. Available on -line at: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/153-conservation-advice.pdf>.
- Western Australian Local Government Authority (WALGA). (2018). Bush Forever Areas and Regional Open Space (Perth and Peel). Government of Western Australia.
- Western Australian Local Government Authority (WALGA). (2019). *Environmental Planning Tool*. Available online.
- Western Australian Planning Commission (WAPC). (2010). *State Planning Policy 2.5: Bushland policy for the Perth Metropolitan Region*. Prepared under section 26 of the *Planning and Development Act 2005*.
- Western Australian Herbarium (WAH). (1998). *Florabase: the Western Australian flora*. Available online via: <https://florabase.dpaw.wa.gov.au/>.
- Western Australian Local Government Authority (WALGA) (2004), *Regional Ecological Linkages for the Perth Metropolitan Region*. Accessed via: WALGA Environmental Planning Tool.
- Western Australian Museum (WA Museum). (2017). Meet the Black-striped Snake. Available online at: <http://museum.wa.gov.au/explore/articles/meet-black-striped-snake>.
- Wood S Hall S Wallrodt S & Whisson G. (2009). South west regional Ecological Linkages Technical Report – prepared for the Western Australian Local Government Association and the Department of Environment and Conservation. Perth Western Australia.

Appendix A Flora Vegetation and Black Cockatoo Survey Report



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JBS&G

Lot 9000 Corner Wanneroo and Dundobar Roads, Sinagra

**Flora, vegetation and Black
Cockatoo habitat survey**

Prepared for
The Order of the Servants of Mary Incorporated
C/- Woodsome Management Pty Ltd
by Strategen-JBS&G

February 2020

Lot 9000 Corner Wanneroo and Dundobar Roads, Sinagra

Flora, vegetation and Black Cockatoo habitat survey

Strategen-JBS&G is a trading name of
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Level 1, 50 Subiaco Square Road Subiaco WA 6008
ABN: 62 100 220 479

February 2020

Limitations

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Client: The Order of the Servants of Mary Incorporated C/- Woodsome Management Pty Ltd

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Appendix 3 Desktop assessment results (Parks and Wildlife 2007-, DEE 2017c)
Appendix 4 Vascular plant taxa recorded within the survey area
Appendix 5 Raw quadrat data
Appendix 6 Black Cockatoo habitat tree locations

1. Introduction

This report presents the findings of a detailed flora and vegetation survey and black cockatoo habitat assessment undertaken for Lot 9000 Wanneroo Road Sinagra. (survey area).

1.1 Background

Woodsome Management is assisting The Order of the Servants of Mary Incorporated (Servite Order) to assess the development potential for the subject site (Figure 1).

The proposed development of the site has the potential to impact approximately 31 ha of native vegetation and as such, a flora and vegetation survey was deemed necessary to determine the environmental values of the potential clearing area.

Clearing of vegetation may result in the removal of vegetation potentially containing habitat for Forest Red-tailed Black-Cockatoos (FRTBC), Baudin's Black Cockatoos (BBC) and Carnaby's Black-Cockatoos (CBC). All three species of black cockatoos are listed as Threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Wildlife Conservation Act 1950* (WC Act). Given this, an assessment of the habitat values is required to support potential future assessment and approval requirements and to inform development design.

1.2 Scope

The scope of this flora and vegetation survey and black cockatoo habitat assessment was to undertake a desktop assessment and field assessment within the survey area (Figure 1).

The objectives were to:

- conduct a desktop survey for Threatened and Priority flora which have been identified as being present in or around the survey area
- collect and identify the vascular plant species present within the survey area
- search areas of suitable habitat for Threatened and/or Priority flora
- define and map the native vegetation communities present within the survey area
- map vegetation condition within the survey area
- provide recommendations on the local and regional significance of the vegetation communities
- define and map black cockatoo habitat within the survey area
- prepare a report summarising the findings.



Figure 1: Survey area

Scale 1:4,000 at A4
 0 40 80 120 Metres
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 18/01/2018
 Author: vdnih
 Source: Neamap: Aerial Imagery - August 2017.
 Path: G:\Consult\2017\MPG\MPG17391\01_GIS_documents\ArcMap_documents\MPG17391_G002_RevB.mxd

Legend
 Survey area

2. Context

2.1 Legislative context

This biological survey has been conducted with reference to the following Australian and Western Australian legislation:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – Australian Government
- *Wildlife Conservation Act 1950* (WC Act) – State
- *Environmental Protection Act 1986* (EP Act) – State
- *Biosecurity and Agriculture Management Act 2007* (BAM Act) – State.

2.1.1 Conservation significant flora and ecological communities

Conservation significant flora and ecological communities are determined at a state and federal legislative level.

Flora within Western Australia that is considered to be under threat may be classed as either Threatened flora or Priority flora. Where flora has been gazetted as Threatened flora under the WC Act, the taking of such flora without the written consent of the Minister is an offence. The WC Act defines “to take” flora as to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means. The Department of Biodiversity, Conservation and Attractions (DBCA) (2017a) contains the current list of Threatened flora in Western Australia.

Priority flora are considered to be species which are potentially under threat, but for which there is insufficient information available concerning their distribution and/or populations to make a proper evaluation of their conservation status. Parks and Wildlife categorises Priority flora according to their conservation priority using five categories, P1 (highest conservation significance) to P5 (lowest conservation significance), to denote the conservation priority status of such species. Priority flora species are regularly reviewed and may have their priority status changed when more information on the species becomes available. Appendix 1 defines levels of Threatened and Priority flora (Western Australian Herbarium 1998-).

At the national level, the EPBC Act lists Threatened species as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent. Appendix 1 defines each of these categories of Threatened species. The EPBC Act prohibits an action that has or will have a significant impact on a listed Threatened species without approval from the Australian Government Minister for the Environment. The current EPBC Act list of Threatened flora may be found on the DEE (2017d) website.

Threatened Ecological Communities (TECs) are listed under both the EPBC Act and EP Act (Appendix 1). Priority Ecological Communities (PECs) are listed by Parks and Wildlife and include species of significant conservation value (Appendix 1).

A TEC is defined under the EP Act as an ecological community listed, designated or declared under a written law or a law of the Australian Government as Threatened, Endangered or Vulnerable. There are four State categories of TECs (DEC 2013)¹:

- presumed totally destroyed (PD)
- critically endangered (CR)
- endangered (EN)
- vulnerable (VU).

¹The Department of Environment and Conservation is still listed as the author of all TEC and PEC databases and have been referred to as such in this document instead of the Department of Department of Biodiversity, Conservation and Attractions (DBCA).

A description of each of these TEC categories is presented in Appendix 1. TECs are gazetted as such (Parks and Wildlife 2016) and some Western Australian TECs listed by Parks and Wildlife (2016) are also listed as Threatened under the EPBC Act.

Under the EPBC Act, a person must not undertake an action that has or will have a significant impact on a listed TEC without approval from the Australian Government Minister for the Environment, unless those actions are not prohibited under the EPBC Act. A description of each of these categories of TECs is presented in Appendix 1. The current EPBC Act list of TECs can be located on the DEE (2017e) website.

Ecological communities identified as Threatened, but not listed as TECs, are classified as Priority Ecological Communities (PECs). These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. Parks and Wildlife categorises PECs according to their conservation priority, using five categories, P1 (highest conservation significance) to P5 (lowest conservation significance), to denote the conservation priority status of such ecological communities. Appendix 1 defines PECs (DEC 2013). Parks and Wildlife (2017) contains a list of current PECs.

2.1.2 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under section 51B of the Act. ESAs are relevant in the context of exemptions in the Clearing Regulations which do not apply in ESAs. The following areas are considered ESAs:

- World Heritage areas
- areas included on the National Estate Register
- defined wetlands and associated buffers
- vegetation within 50 m of a listed Threatened species
- TECs.

2.1.3 Protection of native vegetation

Native vegetation is defined under the EP Act as “indigenous aquatic or terrestrial vegetation, and includes dead vegetation unless that dead vegetation is of a class declared by regulation to be excluded from this definition but does not include vegetation in a plantation”.

This definition of native vegetation does not include vegetation that was intentionally sown, planted or propagated unless either of the following applies:

- (a) the vegetation was sown, planted or propagated as required under the EP Act or another written law
- (b) the vegetation is declared to be native under Regulation 4 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Regulation 4 prescribes the kinds of intentionally planted indigenous vegetation that are “native vegetation” and which therefore require a clearing permit or exemption to clear and includes:

- (c) planting that was funded (fully or partly)
 - i. by a person who was not the owner of the land
 - ii. for the purpose of biodiversity conservation or land conservation
- (d) intentionally planted vegetation that has one of the following:
 - i. a conservation covenant or agreement to reserve under section 30B of the *Soil and Land Conservation Act 1945*
 - ii. a covenant to conserve under section 21A of the *National Trust of Australia (WA) Act 1964*
 - iii. restrictive covenant to conserve under section 129B of the *Transfer of Land Act 1983*
 - iv. some other form of binding or undertaking to establish and maintain, or maintain, the vegetation.

Native vegetation can only be cleared with a clearing permit, unless for some circumstances where exemptions apply pursuant to the EP Act and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (the Regulations). Clearing permits issued pursuant to the Regulations may be issued as area permits or purpose permits. Exemptions for clearing under Regulation 5 of the Regulations do not apply within ESAs.

2.1.4 Introduced species

The BAM Act provides for management and control of listed organisms, including introduced flora species (weeds). Species listed as declared pests under the BAM Act are classified under three categories:

- C1 Exclusion: Pests assigned under this category are not established in Western Australia, and control measures are to be taken to prevent them entering and establishing in the State
- C2 Eradication: Pests assigned under this category are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility
- C3 Management: Pests assigned under this category are established in Western Australia, but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area that is currently free of that pest.

Under the BAM Act, land managers are required to manage populations of declared pests as outlined under the relevant category.

2.1.5 Fauna

DBCA Priority Lists

The DBCA lists 'Priority' fauna that have not been assigned statutory protection as Declared Rare or 'Scheduled' under the WC Act, but which are under consideration for declaration as 'Scheduled' fauna. Fauna assessed as Priority 1-3 are in urgent need of further survey. Priority 4 fauna require monitoring every 5-10 years and Priority 5 fauna are subject to a specific conservation programme (Appendix 1).

2.2 Environmental setting

2.2.1 Soils and topography

The survey area is located within the Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion) of Western Australia (Mitchell *et al.* 2002). The subregion 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 survey area is located on the Karrakatta landform unit, on Spearwood dunes and can be described as an undulating landscape with deep yellow sands over limestone (aeolian deposits) (Churchward & McArthur 1980).

2.2.2 Climate

The survey area experiences a Mediterranean climate characterised by mild, wet winters and warm to hot, dry summers. The nearest Bureau of Meteorology (BoM) weather station at Wanneroo (Station No. 9105) provides average monthly rainfall statistics for the survey area (Figure 2). Average annual rainfall recorded at Wanneroo since 1905 is 801 mm (BoM 2017). Rainfall may occur at any time of year; however, most occurs in winter in association with cold fronts from the southwest. The BoM weather station at Perth (Station No. 9225) provides the most representative monthly temperature data for the survey area. Highest temperatures occur between December and March, with average monthly maximums ranging from 29.1°C in December to 31.6°C in February (BoM 2017). Lowest temperatures occur between June and August, with average monthly minimums ranging from 18.4 °C in July to 19.5 °C in June (BoM 2017).

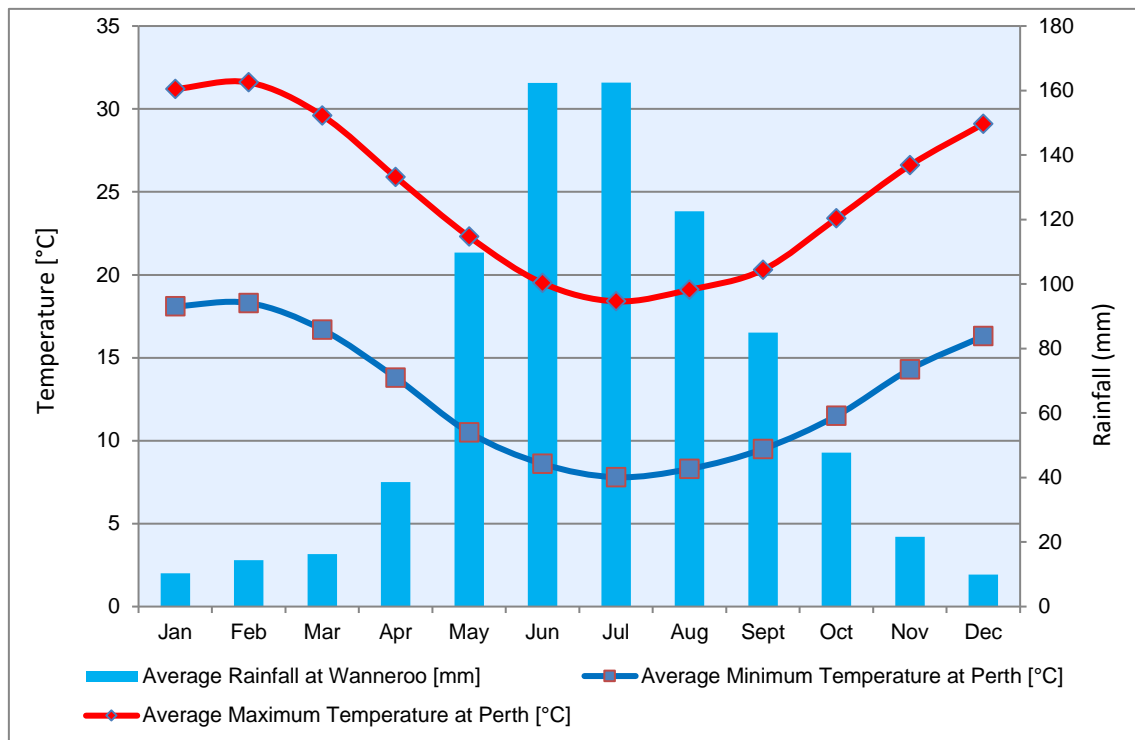


Figure 2: Mean monthly temperature for Perth Metro (Station No. 09225) and rainfall for Wanneroo (Station No. 09105)

2.2.3 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) which led to the delineation of botanical districts as described in Beard (1990); the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia, IBRA) for Western Australia (DEE 2017a) and System 6 Vegetation Complex mapping undertaken by Heddlé et al. (1980).

Beard (1990) Botanical Subdistrict

The survey area occurs within the Drummond Botanical Subdistrict which is characterised by low *Banksia* woodlands on leached sands; *Melaleuca* swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) woodlands on less leached soils (Beard 1990).

IBRA subregion

IBRA describes a system of 85 'biogeographic regions' (bioregions) and 403 subregions covering the entirety of the Australian continent (Thackway & Cresswell 1995). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

The survey area occurs within the Swan Coastal Plain 2 IBRA subregion which is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark (*Melaleuca*) in swampy areas (Mitchell et al. 2002).

System 6 and vegetation system association mapping

System 6 mapping refers to vegetation mapping undertaken at a Vegetation Complex scale by Heddlé et al. (1980). This is the primary source of information used to calculate potential impacts of proposals to clear native vegetation on the Swan Coastal Plain. The survey area occurs within the 'Karrakatta complex – central and south' (Figure 3) which is described as:

Predominantly open forest of Eucalyptus gomphocephala (Tuart) - Eucalyptus marginata (Jarrah) - Corymbia calophylla (Marri) and woodland of Eucalyptus marginata (Jarrah) - Banksia species. Agonis flexuosa (Peppermint) is co-dominant south of the Capel River.

This vegetation complex has 23.61 % of its pre-European extent remaining within the Swan Coastal Plain bioregion (Government of Western Australia 2017b).

At a finer scale, the survey area falls within the Spearwood 6 vegetation system association (i.e. jarrah, marri and wandoo woodland) as defined in Government of Western Australia (2017a). This system association has 24.40% of its pre-European extent remaining within the Swan Coastal Plain bioregion (Government of Western Australia 2017a).



Figure 3A: Regional vegetation mapping - Vegetation class

Scale 1:20,000 at A4

0 200 400 600 Metres

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 18/01/2018
Author: vdnih

Source: Neatmap: Aerial imagery - August 2017.

Path: G:\Consult\2017\MPG\MPG17391\01_GIS_documents\ArcMap_documents\MPG17391_G003_RevB.mxd

Legend

Survey area

Vegetation Class (Heddle)

Cottesloe complex - central and south

Herdsman Complex

Carrakatta complex - central and south

Pinjar complex

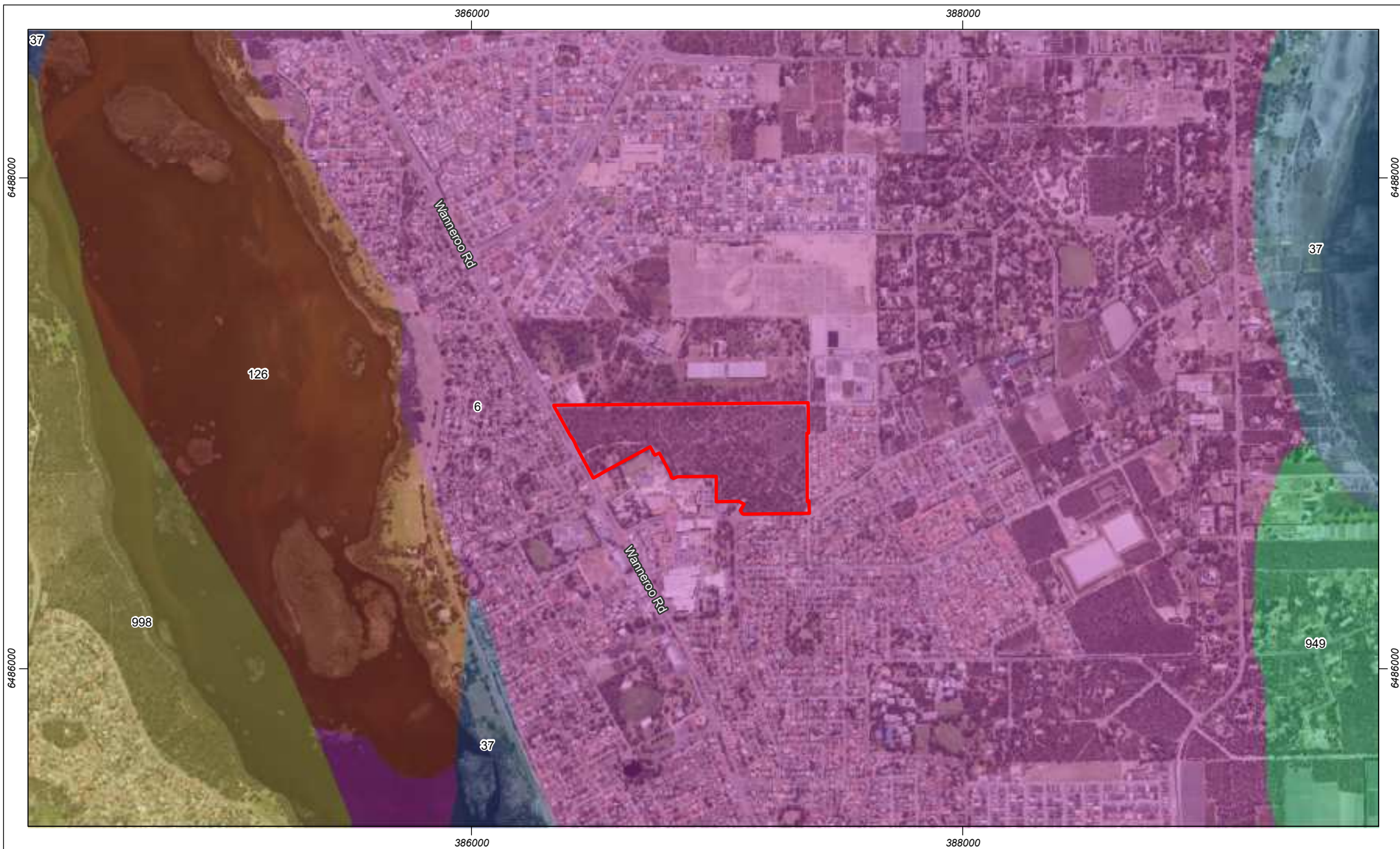


Figure 3B: Regional vegetation mapping - Vegetation association

Scale 1:20,000 at A4
 0 200 400 600 Metres
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 18/01/2018
 Author: vdnh
 Source: Neemap: Aerial imagery - August 2017.
 Path: G:\Consult\2017\MPG\MPG17391\01_GIS_documents\ArcMap_documents\MPG17391_G004_RevA.mxd

Legend

Survey area

System association

Bassendean 126
 Bassendean 37

Guilderton 1007
 Spearwood 126

Bassendean 949
 Spearwood 949

Spearwood 37
 Spearwood 6

Spearwood 998

2.2.4 Black cockatoo habitat

Background Ecological Information for Black Cockatoos

All three species of Black Cockatoo (Carnaby's Cockatoo, Baudin's Cockatoo and FRTBC) could potentially occur in the Survey Area. The distribution of all three species can be seen in the 2017 DEE distribution maps in Appendix 2.

Carnaby's Black Cockatoo

Carnaby's Cockatoo is endemic to south-west WA, and is distributed from the Murchison River to Esperance and inland to Coorow, Kellerberrin and Lake Cronin (Cale 2003). The species was once common, but the population has declined significantly in the last half century, and is now locally extinct in some areas (Johnstone & Storr 1998; Shah 2006). In the last 45 years (prior to Cale 2003) the species has suffered a 50% reduction in its abundance (Cale 2003). More recent information suggests this decline has continued. This reduction is due to the clearing of core breeding habitat in the wheatbelt, the deterioration of nesting hollows, and clearing of food resources on the Swan Coastal Plain (SCP) (Cale 2003). The total population of Carnaby's Cockatoo was estimated to be 40,000 (Johnstone & Kirkby 2008) in 2008. Since then, trend analyses of the seven Great Cocky Counts 2010 – 2016 identified strong indications that the population of Carnaby's Black-Cockatoo inhabiting the Perth-Peel Coastal Plain continues to decline.

Carnaby's Cockatoos feed on seeds, nuts and flowers of a variety of native and exotic plants. Food plants include a variety of Eucalyptus species, such as Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*), Swan River Blackbutt (*Eucalyptus patens*), Coastal Blackbutt (*Eucalyptus tottiana*), Caesia (*Eucalyptus caesia*) and Salmon Gum (*Eucalyptus salmonophloia*), as well as Pine trees (*Pinus* sp.), Grevillea, Allocasuarina, and Hakea species (Shah 2006). Marri nuts that are damaged extensively, especially on the main body of the nut, are likely to have been chewed by Carnaby's Cockatoo. The 'levering' of Marri nuts by Carnaby's Cockatoos tends to leave different marks on the fruit casings, particularly in the location of indentations by the lower mandible and in the amount of damage caused to the rim of the fruit casing. Carnaby's Cockatoos also generally feed on green Marri nuts that are soft enough for their beaks to manipulate. The seeds from a variety of Banksia species and the cones of Pine trees provide the highest energetic yield (Cooper *et al.* 2002).

Breeding has been recorded from early July to mid-December, and primarily occurs in the wheatbelt in the semi-arid and subhumid interior (Johnstone & Storr 1998). However, this species is currently expanding its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp (e.g. Wungong Dam Catchment) and into the Tuart (*Eucalyptus gomphocephala*) forests of the SCP including Yanchep, Baldivis, Lake Clifton and near Bunbury (Johnstone & Kirkby 2011).

Carnaby's Cockatoo display strong pair bonds and mate for life. They nest in hollows of smooth-barked eucalypts particularly Salmon Gum and Wandoo (*Eucalyptus wandoo*) but nests have also been found in other Eucalypt species including York Gum (*Eucalyptus loxophleba*), Flooded Gum (*Eucalyptus rudis*), the rough-barked Marri and Tuart (Johnstone & Kirkby 2011). In most nests in Tuart, eggs are laid on a mat of wood chips at the bottom of a large hollow (mostly top entry hollows) ranging from a few cm's to five m deep (Johnstone & Kirkby 2011). Clutch size is 1–2 eggs, more typically two; only one young is reared (Saunders 1986). Incubation lasts for 29 days and only the female incubates and broods. The nestling is brooded by the female during which time both rely on food from the male. Once brooding is complete, the female then leaves the nest each day at dawn, sometimes returning mid-morning (with the male) to feed the chick (Johnstone & Kirkby 2011). After approximately three weeks she ceases to brood and the chick is fed by one or both parents in the morning and in the late evening (Johnstone & Kirkby 2011).

Approximately 87% (525,732 ha) of potential Carnaby's Cockatoo habitat (i.e. areas of vegetation that contain flora species and vegetation types that could support the species' breeding, feeding and night roosting activities) has been cleared in the wheatbelt since European settlement (DEC 2012). The south-west region is now a severely fragmented landscape and the further loss of foraging habitat, the lack of suitable breeding sites, climate change, alterations in the landscape, changing forest structure with almost every part of the Jarrah-Marri forest logged in the past and with most trees too young to form hollows, and competition with exotic species, exacerbate the future conservation of Carnaby's Cockatoo (Johnstone & Kirkby 2011).

Baudin's Black Cockatoo

This species is distributed through the south-western humid and subhumid zones, from the northern Darling Range and adjacent far east of the SCP (south of the Swan River), south to Bunbury and across to Albany (Johnstone & Kirkby 2011). Baudin's Cockatoo rarely occurs near the coast north of Mandurah, and rarely occurs north of the Swan River (Johnstone & Kirkby 2008, Johnstone & Storr 1998). Baudin's Cockatoo usually occur in small flocks of up to 30, or occasionally up to 50 and rarely in aggregations of up to 1200 (Johnstone & Kirkby 2008). Baudin's Cockatoo is distinguished from Carnaby's Cockatoo by its longer bill and slightly different call.

This species forages primarily in Eucalypt forest, where it feeds on Marri seeds, flowers, nectar and buds. They also feed on a wide range of seeds of Eucalyptus, Banksia, Hakea and Pines (*Pinus* sp.) as well as fruiting apples and pears and beetle larvae from under the bark of trees (Johnstone & Kirkby 2008, Johnstone & Storr 1998). Baudin's Cockatoo forages at all levels of the forest, from the canopy to the ground, often feeding in the understorey on proteaceous trees and shrubs, especially Banksia, and in orchards both in trees and on dropped or fallen fruit on the ground.

The breeding biology of this species is poorly known. It has been recorded breeding in deep south-west, north to the Whicher Range and Lowden and also isolated records at Wungong Catchment, Serpentine (hills area) and east to Kojonup and near Albany (Johnstone & Kirkby 2008). They nest in large, mostly vertical, hollows of Karri (*E. diversicolor*), Marri, Wandoo, and Bullich (*E. megacarpa*). Baudin's Cockatoos display strong pair bonds are monogamous and most likely mate for life (Johnstone & Kirkby 2008). The pair remains together all year round except when the female is incubating and brooding. Both adults play a part in selecting the nest hollow, but only the female is responsible for renovation and preparing the hollow for breeding. Preparation of the hollow consists of chewing around the entrance of the hollow and down one part of the interior wall. Pairs have also been recorded prospecting for hollows in most months and outside the breeding range (Johnstone & Kirkby 2008).

Forest Red-tailed Black Cockatoo

The FRTBC is distributed through the humid and subhumid south-west of WA from Gingin through the Darling Ranges to the south-west from Bunbury to Albany (primarily in the hilly interior) (Johnstone & Storr 1998, Johnstone et al. 2013a). In these areas, the FRTBC inhabits dense Jarrah, Karri, and Marri forests that receive more than 600 mm average annual rainfall (Johnstone & Storr 1998). However, in recent years the FRTBC has moved on to the SCP to forage in the Perth metropolitan area (Johnstone & Kirkby 2011). The FRTBC occurs in pairs or small flocks, or occasionally large flocks of up to 200 birds (Johnstone & Storr 1998).

The FRTBC feeds primarily on Marri and Jarrah fruit, but also Tuart and to a lesser extent on Blackbutt, Albany Blackbutt (*E. staeri*), Karri, 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 the majority of their diet (Johnstone et al. 2013b).

FRTBC shear the base of Marri nuts at a 45° angle to remove seeds (the 'bottom slice' method), while Baudin's Cockatoos use their elongated upper mandible to pry seeds out, leaving the nut intact (the 'lever') (Johnstone & Kirkby 1999, Cooper et al. 2002). Carnaby's Cockatoos may use either technique to feed on Marri nuts, but generally with some modification, e.g. the 'slicing' of fruits may occur along the side of the fruit casing.

The FRTBC is monogamous and pairs nest in tree hollows from 6.5 – 33 m above ground and most nests are in large and old mature Marri, and these trees are the most important nesting tree throughout the FRTBC range (Johnstone et al. 2013a). Nest trees of the FRTBC have a mean circumference at breast height of 2.79 m, a mean estimated age of 222 years and a mean overall height of 20.24 m (Johnstone et al. 2013a).

Breeding has been recorded in all months, with peaks in April-June and August-October. Only one egg is laid, which the female incubates for 29 to 31 days, before a nestling hatches and weighs between 27 and 32 g. The female remains in the hollow during incubation and only leaves for a short period in the evening to be fed by the male, usually at dusk (Johnstone *et al.* 2013b). Brooding is for up to 10 days, after which the female leaves the nest between dawn and dusk. Pairs of birds appear to recognise each other by calls, not responding to calls by others in the area. Chicks only respond when the parent is heard and are fully feathered at 48 days (Johnstone *et al.* 2013b).

3. Methods

3.1 Flora and vegetation

3.1.1 Desktop assessment

A desktop assessment was conducted using FloraBase, Parks and Wildlife, and Department of the Environment and Energy (DEE) databases to identify the possible occurrence of TECs, PECs and Threatened and Priority flora potentially occurring within the survey area. Reports that document regional flora, vegetation and fauna within the surrounds of the survey area were also reviewed prior to the field assessment.

3.1.2 Field assessment

The field survey was conducted according to standards set out in the Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016). The assessment of flora and vegetation within the survey area was undertaken by one ecologist from Strategen (now Strategen-JBS&G) on 8 September 2017. Table 1 identifies staff involved in the field surveys, their role and qualifications.

Table 1: Personnel

Name	Role	Flora collection permit
Mr. T. Sleight Strategen-JBS&G (Senior Ecologist)	Planning, fieldwork, plant identification, data interpretation and report preparation	SL012160

The survey area was traversed on foot to record changes in vegetation structure and type. Six vegetation quadrats and two opportunistic sites were surveyed to identify vegetation types. Site selection for vegetation mapping was determined from aerial photographs and based on differences in structure and species composition of the communities present within the survey area.

Flora and vegetation was described and sampled systematically at each quadrat and additional opportunistic collecting was undertaken wherever previously unrecorded plants were observed. At each site the following floristic and environmental parameters were noted:

- GPS location
- topography
- soil type and colour
- outcropping rocks and their type
- percentage cover and average height of each vegetation stratum.

For each vascular plant species, the average height, number of plants and percent cover were recorded.

All plant specimens collected during the field surveys were identified using appropriate reference material or through comparisons with pressed specimens housed at the Western Australian Herbarium where necessary. Nomenclature of the species recorded is in accordance with Western Australian Herbarium (1998-).

3.1.3 Data analysis and vegetation mapping

Due to the uniform distribution of vegetation within the survey area; quadrat data were grouped into a species by site matrix to delineate individual vegetation types (VTs) present within the survey area. Aerial photography interpretation and field notes taken during the survey were then used to develop VT mapping polygon boundaries over the survey area. These polygon boundaries were then digitised using Geographic Information System (GIS) software.

VT descriptions (though floristic in origin) have been adapted from the National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual Version 6.0 (ESCAVI 2003), a system of describing structural vegetation units (based on dominant taxa). This model follows nationally-agreed guidelines to describe and represent vegetation types, so that comparable and consistent data is produced nation-wide. For the purposes of this report, a VT is considered equivalent to a NVIS sub-association as described in ESCAVI (2003).

Vegetation condition was recorded at all quadrats, and also opportunistically within the survey area during the field assessment where required. Vegetation condition was described using the vegetation condition scale for the South West Botanical Province (Keighery 1994). Vegetation condition polygon boundaries were developed using this information in conjunction with aerial photography interpretation, and were digitised as for vegetation type mapping polygon boundaries.

To identify possible TECs and PECs in the survey area, vegetation quadrats (and subsequently, Vegetation Types) were compared to Floristic Community Types (FCTs) defined by Gibson *et al.* (1994). Remnant vegetation of the southern Swan Coastal Plain was surveyed and mapped by Gibson *et al.* (1994) to provide an understanding of the major floristic types and transitions across the region. The major FCTs were defined by classifying the data collected according to the similarities in species composition between plots. When determining the FCT of a new record, a floristic analysis of species composition provides the most robust method that is consistent with the original classification.

The following multivariate analyses were used to analyse the data collected from the survey area, the results of which were compared to determine the most likely result:

- Hierarchical agglomerative clustering
- nearest neighbour.

Hierarchical agglomerative clustering is the first stage in classifying vegetation data into community types. This involves calculating the similarity (or more often, the dissimilarity) between plots within the dataset and then sequentially fusing the plots into groups according to their similarity.

Nearest neighbour analysis involves calculating a similarity or dissimilarity matrix for the combined new dataset and simply allocating each new plot to the FCT of the plot from the original dataset that shares the greatest similarity.

An averaged randomised Species Accumulation Curve, based on accumulated species compared against sites surveyed was used to provide an indication as to the level of adequacy of the survey effort. As the number of survey sites, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. As the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered to be adequate.

3.1.4 Survey limitations and constraints

Table 2 displays the evaluation of the flora and vegetation assessment against a range of potential limitations that may have an effect on that assessment. Based on this evaluation, the assessment has not been subject to constraints that would affect the thoroughness of the assessment and the conclusions reached.

Table 2: Flora and vegetation survey potential limitations and constraints

Potential limitation	Impact on assessment	Comment
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	Not a constraint.	The survey has been undertaken in the Drummond Botanical Subdistrict on the Swan Coastal Plain which has been well studied and documented with ample literature available (Beard 1990).
Scope (i.e. what life forms, etc., were sampled).	Not a constraint.	Due to the uniform distribution of vegetation within the survey area and timing of the survey (i.e. spring); most life forms are likely to have been sampled adequately during the time of the survey.
Proportion of flora/fauna collected and identified (based on sampling, timing and intensity).	Not a constraint.	The proportion of flora surveyed was adequate. The entire survey area was traversed and flora species were recorded systematically.
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	Not a constraint.	The information collected during the survey was sufficient to assess the vegetation that was present during the time of the survey.
Mapping reliability.	Not a constraint.	Aerial photography of a suitable scale was used to map the survey area and identify potential fauna habitat. Sites were chosen from these aerials to reflect changes in community structure. Opportunistic sites were also used if differences were observed during on ground reconnaissance. Vegetation types were assigned to each site based on topography, soil type and presence/absence and percent foliage cover of vegetation.
Timing, weather, season, cycle.	Not a constraint.	Flora and vegetation surveys are normally conducted following winter rainfall in the South-West Province, ideally during spring (EPA 2004). The field assessment was conducted in September (i.e. spring) in fine weather conditions and therefore these factors are not deemed to be constraints.
Disturbances (fire flood, accidental human intervention, etc.).	Not a constraint.	The survey area and regional surrounds have been subject to disturbance over a significant period of time. Given the wide range of this disturbance, this is not considered to be a limitation within the survey area.
Intensity (in retrospect, was the intensity adequate).	Not a constraint.	The survey area was traversed on foot and all differences in vegetation structure were recorded appropriately.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	Not a constraint.	The available resources were adequate to complete the survey.
Access problems (i.e. ability to access survey area).	Not a constraint.	Existing tracks enabled adequate access to survey the vegetation and fauna within the survey area. Where access was not available by car, the area was easily traversed by foot.
Experience levels (e.g. degree of expertise in species identification to taxon level).	Not a constraint.	All survey personnel have the appropriate training in sampling and identifying the flora of the region.

3.2 Black cockatoo habitat assessment

The survey area was inspected on 8 September 2017 by Strategen-JBS&G personnel with relevant experience as specified by the *EPBC Act Referral guidelines for three threatened black cockatoo species* (DSEWPaC 2012). The habitat assessment involved traversing the Survey Area by foot. Any trees meeting the following criteria for potential breeding and foraging habitat were recorded, marked and electronically logged using a hand held Global Positioning System (GPS) unit:

- * native trees (e.g. Jarrah, Tuart, Marri)
- * diameter at breast height (DBH) > 500 mm (300 mm for Wandoo and Salmon Gum)
- * hollows > 120 mm diameter
- * evidence of feeding (chewed cones, seed and nut material)
- * opportunistic observations of Black Cockatoos in the Survey Area.

The Black Cockatoo habitat assessment considered the recently revised Draft Referral Guidelines for Three Threatened Black Cockatoo Species (DEE 2017f). These draft guidelines include an assessment of Black Cockatoo foraging habitat quality, by attributing a habitat quality score.

It is important to note that these guidelines are currently in draft form. As such, the foraging habitat quality score has the potential to be altered in the future, if the final guidelines change considerably. At present the quality score included the elements above as well as the following:

- * the presence of all plant species that provide foraging, including non-native food sources used by Black Cockatoos
- * use as a roosting site
- * the vegetation present in the surrounding area (i.e. at least 12 km from the impact area, including proximity to any breeding habitat, roosting sites or watering points)
- * numbers of any known nesting trees
- * presence of disease, such as *Phytophthora cinnamomi*.

4. Results

4.1 Flora and vegetation

4.1.1 Desktop assessment results

A total of 295 native vascular plant taxa from 64 plant families have the potential to occur within the survey area (Parks and Wildlife 2007-; DEE 2017c). The majority of taxa were from within the Fabaceae (35 taxa), Myrtaceae (28 taxa) and Cyperaceae (23 taxa) families.

Threatened and Priority flora

The desktop assessment identified ten Threatened flora and 12 Priority flora species that have been recorded in the regional area (Table 3; Appendix 3). Of these, based on specific habitat requirements, two Threatened flora species and three Priority flora species were considered to have the potential to occur within the survey area:

- * *Caladenia huegelii* (T)
- * *Drakaea micrantha* (T)
- * *Thelymitra variegata* (P2)
- * *Styphelia filifolia* (P3)
- * *Jacksonia sericea* (P4).

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

Species	Conservation status		Source of Location Data	Description	Potential to occur
	EPBC Act	WC Act			
<i>Andersonia gracilis</i>	Endangered	Threatened	PMST	A slender, erect or open straggly shrub, 10 to 100 cm high. Flowers are white to pink to purple from September to November. Habitat for this species occurs in white/grey sand, sandy clay, gravelly loam within winter-wet areas and near swamps (Western Australian Herbarium 1998-). The species occurs in damp black, sandy clay flats near swamps in open low heath with <i>Calothamnus hirsutus</i> (hairy clawflower), <i>Verticordia densiflora</i> (compact featherflower), <i>Kunzea recurva</i> (recurved Kunzea) and <i>Banksia telmatiaea</i> over sedges.	Unlikely due to absence of preferred habitat.
<i>Caladenia huegelii</i>	Endangered	Threatened	PMST	A slender orchid from 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 <i>Banksia</i> , <i>Allocasuarina</i> and Jarrah woodlands (Western Australian Herbarium 1998-, DEE 2017b).	Possible due to presence of preferred habitat.
<i>Diuris purdiei</i>	Endangered	Threatened	PMST	A slender orchid to 45 cm tall. Unusually flattened flowers, marked with brown blotches on their under surface. Habitat for this species occurs in areas subject to winter inundation within dense heath with scattered Myrtaceous trees (DEE 2017b).	Unlikely due to absence of preferred habitat.
<i>Drakaea elastica</i>	Endangered	Threatened	PMST	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 (DEE 2017b).	Unlikely due to absence of preferred habitat.
<i>Lepidosperma rostratum</i>	Endangered	Threatened	PMST	A rhizomatous sedge to 30 cm in diameter. Stems are circular in cross section and flowers are spike-like and up to 4 cm long. Habitat for this species occurs in sandy soils among low heath comprised of <i>Banksia telmatiaea</i> and <i>Calothamnus hirsutus</i> in winter-wet swamps (Western Australian Herbarium 1998-, DotE 2015d).	Unlikely due to absence of preferred habitat.
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	Vulnerable	Threatened	PMST	A small rhizomatous herb with narrow leaves 5–20 cm long and 0.1–0.2 mm wide, that are almost semi-circular in cross-section. The flowering stem is 10–15 cm tall and is held at a 45o to 80o angle, with the curved, paw-like flowers opening away from the stalk. This species occurs in winter-wet depressions where it grows on grey sandy clay loam, or grey sand, in low post-fire regenerating heath. It is associated with species such as Slender-leaved <i>Banksia</i> (<i>Banksia leptophylla</i>), <i>melaleucas</i> , Compact Featherflower (<i>Verticordia densiflora</i>), coneflowers (<i>Conostylis</i> spp.) and sedges (DotE 2015d).	Unlikely due to absence of preferred habitat.
<i>Diuris micrantha</i>	Vulnerable	Threatened	PMST	A slender orchid to 60 cm tall. Yellow flowers with reddish-brown markings measuring 1.3 cm across. Habitat for this species occurs within clay-loam substrates in winter-wet depressions or swamps (DEE 2017b).	Unlikely due to absence of preferred habitat.
<i>Drakaea micrantha</i>	Vulnerable	Threatened	PMST	A tuberous, terrestrial orchid to 30 cm tall. Silvery-grey heart shaped leaf with prominent green veins. Red and yellow singular flower. Habitat for this species occurs within cleared, open sandy patches (Brown <i>et al.</i> 1998).	Possible due to presence of preferred habitat.

Species	Conservation status		Source of Location Data	Description	Potential to occur
	EPBC Act	WC Act			
<i>Eleocharis keigheryi</i>	Vulnerable	Threatened	PMST	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.
<i>Marianthus paralius</i>	Nominated for Endangered	Threatened	DBCA Database	Prostrate, scandent woody shrub. Flowers are red, visible from September to November. Habitat for this species occurs on white sand over limestone on low coastal cliffs.	Unlikely due to absence of preferred habitat.
<i>Baeckea</i> sp. Limestone (N. Gibson & M.N. Lyons 1425)	Not listed	P1	DBCA Database; NatureMap	Habitat for this species occurs on white sand over limestone	Unlikely due to absence of preferred habitat.
<i>Acacia benthamii</i>	Not listed	P2	DBCA Database	Shrub to 1 m tall. Flowers are yellow, visible from August to September. Habitat for this species is sand overlying limestone breakaways (Western Australian Herbarium 1998-).	Unlikely due to absence of preferred habitat.
<i>Tetaria</i> sp. Chandala (G.J. Keighery 17055)	Not listed	P2	DBCA Database; NatureMap	No species specific information available	Unlikely due to absence of preferred habitat.
<i>Thelymitra variegata</i>	Not listed	P2	DBCA Database; NatureMap	A tuberous, perennial orchid between 10-35 cm tall. Flowers are orange-red-purple & pink and visible from June to September. Habitat for this species occurs on sandy clay, sand and laterite (Western Australian Herbarium 1998-).	Possible due to presence of preferred habitat.
<i>Austrostipa mundula</i>	Not listed	P3	DBCA Database	No species specific information available. The <i>Austrostipa</i> genus is known to occur throughout the southwest of Western Australia and species are mainly winter-active, perennial grasses (Bell 2008).	Unknown as there is no habitat description available, however the nearest location is 3 km from the project area.
<i>Conostylis bracteata</i>	Not listed	P3	DBCA Database; NatureMap	A rhizomatous, tufted or shortly proliferous perennial, grass-like or herb, 0.2-0.45 m high. Flowers are yellow, occurring in August to September. Habitat for this species includes sand or limestone on consolidated sand dunes (Western Australian Herbarium 1998-).	Unlikely due to absence of preferred habitat.
<i>Cyathochaeta teretifolia</i>	Not listed	P3	DBCA Database	A rhizomatous, clumped, robust perennial, grass-like or herb (sedge), to 2 m high and to 1.0 m wide. Flowers are brown. Habitat for this species includes grey sand or sandy clay within swamps or creek edges (Western Australian Herbarium 1998-).	Unlikely due to absence of preferred habitat.
<i>Leucopogon</i> sp. Yanchep (M. Hislop 1986)	Not listed	P3	DBCA Database; NatureMap	An erect shrub, 0.15-1 m tall, to 0.6 m wide. Flowers are white/pink, occurring from April to June or September. This species occurs in light grey-yellow sand, brown loam, limestone, laterite or granite on coastal plain, breakaways, valley slopes or low hills (Western Australian Herbarium 1998-).	Unlikely due to absence of preferred habitat.
<i>Pimelea calcicola</i>	Not listed	P3	DBCA Database	An erect to spreading shrub to 1 m tall. Flowers are pink and visible from September to November. Habitat for this species occurs in sand on coastal limestone ridges (Western Australian Herbarium 1998-).	Unlikely due to absence of preferred habitat.

Species	Conservation status		Source of Location Data	Description	Potential to occur
	EPBC Act	WC Act			
<i>Stylidium paludicola</i>	Not listed	P3	DBCA Database; NatureMap	Reed-like perennial, herb, 35 to 100 cm tall. Leaves are tufted, linear or subulate or narrowly oblanceolate. Flowers are pink and occur in October to December. Habitat for this species occurs in peaty sand over clay and winter wet areas, often in Marri and Melaleuca woodland or Melaleuca shrubland (Western Australian Herbarium 1998-).	Unlikely due to absence of preferred habitat.
<i>Styphelia filifolia</i>	Not listed	P3	DBCA Database; NatureMap	Erect shrub to 90 cm tall. Leaves are linear to narrowly ovate. Flowers are white and occur in March to May. Habitat for this species includes sandy soils, usually in Banksia or Jarrah woodland and in low-lying situations.	Possible due to presence of preferred habitat.
<i>Jacksonia sericea</i>	Not listed	P4	DBCA Database; NatureMap	Low spreading shrub, to 0.6 m high. Flowers are orange, occurring usually in December or January to February. Habitat for this species includes calcareous & sandy soils.	Highly likely – has previously been recorded within the survey area (ENV 2004)

Threatened and Priority Ecological Communities

Two TECs and two PECs were identified within 10 km of the survey area (Figure 4). The closest TEC identified was *Banksia woodlands of the Swan Coastal Plain* which is listed as Endangered under the EPBC Act. Mapping of the extent of this TEC shows a number of occurrences within the survey area.

The closest PEC identified in proximity to the survey area was SCP 25 – *Southern Eucalyptus gomphocephala-Agonis flexuosa woodlands* which is located approximately 1.5 km from the survey area.

In addition to mapped location of the above TECs and PECs, one ecological community, *Tuart woodlands and forests of the Swan Coastal Plain*, is currently being considered for listing as a TEC under the EPBC Act. While no mapped extents of this community are currently available, the landforms and soils within the survey area are likely to support this community. Given the listing of this community is likely to occur by the middle of 2018, the potential for its occurrence within the survey area has been assessed.



Figure 4: Location of Threatened and Priority Ecological Communities within 5 km of the Survey Area

Scale 1:70,000 at A4
 0 700 1,400 2,100 Metres
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 18/01/2018
 Author: vdiinh
 Source: Neamap: Aerial imagery - August 2017.
 Path: G:\Consult\2017\MPG\MPG17391\01_GIS_documents\ArcMap_documents\MPG17391_G005_RevB.mxd

Legend

Survey area

5km survey area buffer

Threatened & Priority ecological communities

Banksia Woodlands of the Swan Coastal Plain

SCP20a

SCP24

SCP25

Wetlands

No wetlands are mapped as occurring within the survey area. The closest mapped wetland is Lake Joondalup, a conservation category wetland, located 560 m west of the survey area.

Bush Forever

No Bush Forever sites are located within the survey area. The closest Bush Forever site is Yellagonga Regional Park (site 299), located 380 m west of the survey area

4.1.2 Field survey results

Native flora

A total of 69 native vascular plant taxa from 51 plant genera and 32 plant families were recorded from quadrats within the survey area. The majority of taxa were recorded within the Fabaceae (nine taxa) and Proteaceae (five taxa) families (Appendix 4; Appendix 5).

Threatened and Priority flora

No Threatened flora species as listed under section 178 of the EPBC Act were recorded within the survey area. No Threatened flora species pursuant to Schedule 1 of the WC Act and as listed by Parks and Wildlife (2015) and no Priority flora species as listed by Western Australian Herbarium (1998-) were also recorded within the survey area

Introduced (exotic) taxa

A total of 15 introduced (exotic) taxa were recorded within the survey area (Appendix 4):

- *Arctotheca calendula*
- *Avena barbata*
- *Briza maxima*
- *Briza minor*
- *Cenchrus clandestinus*
- *Conyza bonariensis*
- *Ehrharta calycina*
- *Gladiolus caryophyllaceus*
- *Hypochaeris glabra*
- *Lysimachia arvensis*
- *Oxalis pes-caprae*
- *Romulea rosea*
- *Solanum nigrum*
- *Sonchus oleraceus*
- *Ursinia anthemoides*.



Figure 5: Location of Threatened and Priority Flora within 5 km of the Survey Area

Scale 1:70,000 at A3
 0 700 1,400 2,100 Metres
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 18/01/2018
 Author: vdnih
 Source: Neamap: Aerial Imagery - August 2017.
 Path: G:\Consult\2017\MPG\MPG17391\01_GIS_documents\ArcMap_documents\MPG17391_G006_RevB.mxd

Legend

Survey area

5km survey area buffer

Threatened & Priority Flora

▲ Priority 2 - Poorly Known Taxa

▲ Priority 3 - Poorly Known Taxa

▲ Priority 4 - Rare, Near Threatened and other species in need of monitoring

Accumulated species – sites surveyed (species-area curve)

The species-area curve (Figure 6) based on a species accumulation analysis was used to evaluate the adequacy of sampling (Colwell 2013). The asymptotic value was determined using Michaelis-Menten modelling. Using this analysis, the incidence based coverage estimator of species richness (ICE) was calculated to be 87.68 (Chao 2005). Based on this value, and the total of 68 species recorded during the survey, approximately 78% of the native flora species potentially present within the survey area were recorded.

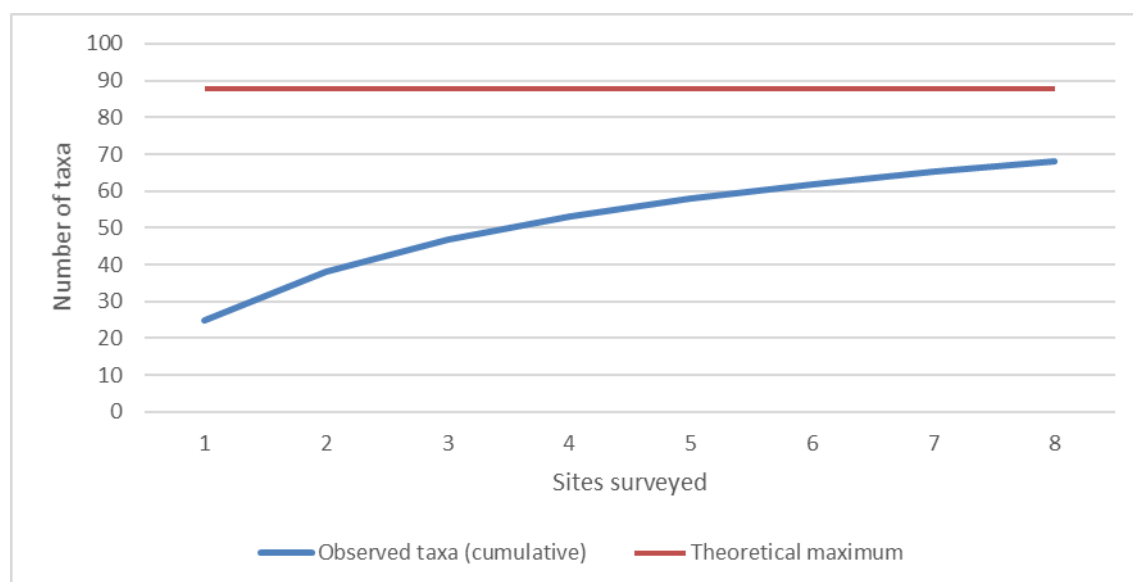


Figure 6: Averaged randomised species accumulation curve

Vegetation types

Two native vegetation types (VTs) were defined and mapped within the survey area (Appendix 5; Figure 7) and are summarised in Table 4. Areas containing vegetation in parkland cleared or highly degraded state have not been counted as unique native VTs but have been included in Table 4 for area calculation purposes.

The total area mapped within the survey area was 31.5 ha which includes fully cleared areas (Table 4). The dominant native VT within the survey area was VT 2 which can be broadly described as a woodland of *Banksia attenuata* and *Banksia menziesii* with emergent *Eucalyptus marginata*.

Table 4: Vegetation Types

Vegetation Type	Description	Area (ha)	Percentage of the Survey area
VT1	<i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> mid woodland over <i>Xanthorrhoea preissii</i> and <i>Macrozamia riedlei</i> sparse mid shrubland over <i>Hibbertia hypericoides</i> and <i>Mesomelaena pseudostygia</i> low shrubland.	11.77	37.38
VT2	<i>Eucalyptus marginata</i> open mid woodland over <i>Banksia attenuata</i> , <i>Banksia menziesii</i> and <i>Allocasuarina fraseriana</i> low woodland over <i>Jacksonia sternbergiana</i> , <i>Hibbertia hypericoides</i> and <i>Mesomelaena pseudostygia</i> open low to mid shrubland.	15.92	50.57
C	Cleared areas.	3.80	12.05
Total		31.49	100



Figure 7: Vegetation Types (VTs) mapped within the survey area

Scale 1:4,000 at A4
 0 40 80 120 Metres
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 18/01/2018
 Author: vdnih
 Source: Neatmap: Aerial Imagery - August 2017.
 Path: G:\Consult\2017\MPG\MPG17391\01_GIS_documents\ArcMap_documents\MPG17391_G007_Rev8.mxd

Legend
 [Red Outline] Survey area
 [Light Green] VT2
 [Dark Green] VT1
 [Grey] Cleared

Vegetation condition

The survey area comprises both disturbed and undisturbed vegetation. Weed invasion is the principle evidence of disturbance with heavier infestations present at the survey area boundaries and have likely occurred due to edge effects. A number of tracks occur within the survey area which appear to be regularly used by vehicles. As such, vegetation condition within the survey area ranged from excellent to completely degraded (Keighery 1994; Figure 8; Table 5).

Table 6 gives a numerical breakdown of the area occupied by each vegetation condition rating within the survey area.

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: Area (ha) covered by each vegetation condition category within the survey area

Vegetation Condition	Area (ha)	Percentage of the survey area
Excellent	5.65	17.94
Very Good - Excellent	11.42	36.26
Very Good	8.93	28.35
Good	0.35	1.11
Degraded	1.35	4.29
Completely Degraded	3.80	12.05
Grand Total	31.49	100



Figure 8: Vegetation Types (VTs) mapped within the survey area

Scale 1:4,000 at A4
 0 40 80 120 Metres
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 18/01/2018
 Author: vdnh
 Source: Neatmap: Aerial imagery - August 2017.
 Path: G:\Consult\2017\MPG\MPG17391\01_GIS_documents\ArcMap_documents\MPG17391_G008_RevA.mxd

Legend

 Survey area

Vegetation condition

Excellent

Very Good - Excellent

Very Good

Good

Degraded

Completely Degraded

4.1.3 FCT similarity analysis

The results for the hierarchical clustering analysis show quadrats from both vegetation types fusing with FCT28 (Table 7). Site Q05 produced undetermined results which was likely due to the degraded nature and high density of weed species recorded.

The three nearest neighbours for each site using the Bray-Curtis distance are shown in Table 8, respectively. The nearest neighbour assignment for both vegetation types is consistent with the results from the hierarchical clustering analysis with both vegetation types showing affinities to FCT28.

Given the results of the analysis, one FCT (FCT28) was identified within the survey area. FCT28 can be described as *Spearwood Banksia attenuata* or *Banksia attenuata* – *Eucalyptus* woodlands (Gibson 1994).

Table 7: Results of hierarchical analysis for plots from the survey area

Site	VT	FCT First fusion	FCT of nearest main group fusion	Likely FCT
Q01	VT1	28	28	28
Q022	VT2	28	28	28
Q03	VT2	28	28	28
Q04	VT2	28	28	28
Q05	VT1	30a2	24	Undetermined – high density of weed species
Q06	VT2	28	28	28

Table 8: Results of Nearest Neighbour analysis using the Bray-Curtis dissimilarity coefficient

Site	VT	Nearest Neighbour (FCT)	2nd Nearest Neighbour (FCT)	3rd Nearest Neighbour (FCT)
Q01	VT1	Depot-1 (28)	Trig-3 (28)	Kero-2 (24)
Q02	VT2	Harry-5 (21a)	King-2 (28)	Depot-1 (28)
Q03	VT2	Wari-2 (28)	Neer-2 (28)	King-2 (28)
Q04	VT2	Depot-1 (28)	King-2 (28)	Harry-2 (28)
Q05	VT1	Depot-1 (28)	Neer-3 (28)	Trig-3 (28)
Q06	VT2	King-2 (28)	Wari-2 (28)	Low04 (21a)

Limitations are associated with determining and mapping the presence of FCTs within the survey area. Species richness (per quadrat) in the current survey was markedly lower than that recorded by Gibson *et al.* (1994). In addition, vegetation mapping requires the extrapolation of quadrat data to generalise vegetation communities and map 'like' vegetation over relatively small spatial scales. Significant groupings of quadrats and resultant delineation of vegetation communities are primarily determined *a-priori*. Comparing this type of data with that of Gibson *et al.* (1994), which contains accumulated species data over successive seasons within known vegetation communities across the Swan Coastal Plain, is problematic.

The degraded nature of parts of the survey area coupled with the broad nature of FCTs lead many vegetation types to characterise admixtures and transition zones between FCTs. In addition, the survey area was mapped based on extrapolated quadrat data from a single flora assessment, rather than accumulated species data over successive seasons within known vegetation community types as per Gibson *et al.* (1994). Consequently, assigned FCTs within the survey area are inferred and not absolute; i.e. a vegetation code assigned to an FCT is inferred to resemble floristic aspects of that FCT as defined by Gibson *et al.* (1994).

Threatened and Priority Ecological Communities

Site observations and quadrat data collected during the survey indicated that one TEC is potentially represented by vegetation types within the project area. This is:

- * *Banksia woodlands of the Swan Coastal Plain* TEC potentially represented by VT2.

The TEC/PEC database search (DBCA 2017c) identified the entire project area as comprising *Banksia woodlands of the Swan Coastal Plain* TEC or the associated buffer. Vegetation within the study area was assessed against the key diagnostic criteria for the *Banksia woodlands of the Swan Coastal Plain* TEC (TSSC 2016). One vegetation type within the project area, VT2, was found to meet the diagnostic criteria provided in the approved conservation advice for the *Banksia woodlands of the Swan Coastal Plain* TEC (Table 9; Figure 9).

Table 9: Characteristics of the Banksia woodland within the survey area compared to the key diagnostic criteria as per TSSC (2016)

Key diagnostic criteria (TSSC 2016)	Banksia woodlands within the project area
<u>Location:</u> Occurs in the Swan Coastal Plain or Jarrah Forest IBRA bioregions.	Yes. Banksia woodlands within the project area occur on the Swan Coastal Plain.
<u>Soils and landform:</u> Occurs on: <ul style="list-style-type: none"> • 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 the project area occur on Spearwood sands.
<u>Structure:</u> Low woodland to forest with: <ul style="list-style-type: none"> • 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. <i>Eucalyptus</i> or <i>Allocasuarina</i> species may sometimes be present above the banksia canopy • an often highly species-rich understorey. 	Yes. VT2 represents a low woodland structure.
<u>Composition:</u> Contains at least one of the following species: <ul style="list-style-type: none"> • <i>Banksia attenuata</i> • <i>Banksia menziesii</i> • <i>Banksia prionotes</i> • <i>Banksia ilicifolia</i>. 	Yes. VT2 contains <i>Banksia attenuata</i> and/or <i>Banksia menziesii</i> .
<u>Condition (Keighery 1994):</u> 'Pristine': no minimum patch size 'Excellent': 0.5 ha 'Very Good': 1 ha 'Good': 2 ha.	Yes. Banksia woodlands within the project area are in Degraded to Excellent condition. One patch of Banksia woodland in the project area comprises 8.90 ha in Degraded to excellent. Another patch in the eastern part of the project area comprises 7.13 ha of Banksia woodland very good to excellent condition. Both patches meet the criteria.

One ecological community, *Tuart woodlands and forests of the Swan Coastal Plain*, has the potential to occur given the landforms, soils and vegetation within the survey area. This community is currently under consideration for listing as a TEC under the EPBC Act. Given this, vegetation within the study area was assessed against the draft diagnostic criteria for the *Tuart woodlands and forests of the Swan Coastal Plain* (TSSC 2017). This assessment concluded the survey area was unlikely to contain the community as defined by the draft diagnostic criteria (Table 10).

Table 10: Characteristics of the *Tuart woodlands and forests of the Swan Coastal Plain* within the survey area compared to the draft key diagnostic criteria as per TSSC (2017)

Key diagnostic criteria (TSSC 2016)	Survey area
<u>Location:</u> Occurs in the Swan Coastal Plain Bioregion within the State of Western Australia	Yes. The survey area is located within the Swan Coastal Plain Bioregion.
<u>Soils and landform:</u> Can occur on: <ul style="list-style-type: none"> • Spearwood and Quindalup dune systems • Bassendean dunes and Pinjarra Plain • below the Darling and Whicher escarpments where they define a plateau to the east of the Swan Coastal Plain • banks of rivers and wetlands. 	Yes. The survey area occurs on Spearwood dune systems
<u>Structure:</u> Often occurs as a woodland but can occur in a variety of structural forms, including closed forest, open forest, woodland, open woodland, closed mallee forest, open mallee forest, mallee woodland and open mallee woodland	Yes. Vegetation containing tuarts occurs as a woodland.
<u>Composition:</u> The dominant canopy species is tuart (<i>Eucalyptus gomphocephala</i>), being the most abundant tree species in the canopy.	Potentially. Established tuarts are the dominant or co-dominant canopy species in isolated areas within the vegetation
<u>Condition (Keighery 1994):</u> 'Pristine' to 'Excellent': 0.5 ha 'Very Good' to 'Good': 1 ha 'Degraded' but retain important habitat, regeneration or landscape features: 2 ha.	Unlikely. Vegetation containing established tuarts ranges in condition from 'Good' to 'Very Good'. However both patch sizes are less than 1 ha in size and as such so not meet the draft criteria.



Figure 9: Extent of Banksia woodlands of the Swan Coastal Plain TEC within the survey area

Scale 1:4,000 at A4
 0 40 80 120 Metres
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 18/01/2018
 Author: vdnih
 Source: Neamap: Aerial imagery - August 2017.
 Path: G:\Consult\2017\MPG\MPG17391\01_GIS_documents\ArcMap_documents\MPG17391_G009_RevB.mxd

Legend

- Survey area
- Banksia woodland TEC

4.2 Black cockatoo habitat

During the habitat assessment, no Black Cockatoos were observed in or flying over the Survey Area.

4.2.1 Potential Breeding Habitat

Three species of Eucalypts, Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*) and Tuart (*Eucalyptus gomphocephala*) recorded in the Survey Area are considered Black Cockatoo potential breeding habitat when their DBH are >500 mm. The Survey Area contains 125 potential breeding trees with a DBH > 500 mm - Marri (61), Jarrah (47) and Tuart (17). The dimensions and the locations of the potential breeding trees are displayed in Figure 10 and Appendix 6. There were very few observable hollows from the ground present in these trees and none had hollow entrances considered large enough.

4.2.2 Foraging Habitat

Within the Survey Area, 27.7 ha is considered foraging habitat (Figure 2). Foraging species in the Survey Area consist of *Banksia attenuata*, *Banksia menziesii*, *Allocasuarina fraseriana* and *Xanthorrhoea preissii*, Marri, Jarrah and Tuart and includes trees that are of various sizes, however, all are considered mature (i.e. had fruit or large enough to produce fruit). The same potential breeding trees (above) are also considered foraging species. Chewed Marri nuts with markings from FRTBC were observed throughout the site, particularly under Marri trees throughout the Survey Area.

4.2.3 Foraging Habitat Quality Score

The Draft Black Cockatoo foraging habitat scoring tool (DEE 2017f) was used to determine the quality of Black Cockatoo foraging habitat in the Survey Area. As per the scoring tool, the Survey Area has an overall score of 14 (Table 11). Only aspects of the table that are applicable to the Survey Area have been included. Consequently, none of the subtractions from the table have been included as none are relevant.

As previously stated, it is important to note that these guidelines are currently in draft form. As such, the foraging habitat quality score has the potential to be altered in the future, if the final guidelines change considerably.

While all three Black Cockatoo species were considered in the scoring, due to its location on the Swan Coastal Plain, it was focused mainly on Carnaby's Black Cockatoo and FRTBC (FRTBC foraging evidence in the form of chewed Marri nuts was recorded throughout the Survey Area [Plate 1]). However, it is important to note that although the Survey Area is on the edge of the known distribution of Baudin's Black Cockatoo, the species is highly mobile and as such has been included in the assessment.

Table 11: DEE Black Cockatoo foraging habitat scoring tool (DEE 2017f).

Starting Score	Foraging habitat for Carnaby's Cockatoo	Foraging habitat for Baudin's Cockatoo	Foraging habitat for FRTBC
7 (High quality)	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as <i>Banksia</i> spp. (including <i>Dryandra</i> spp.), <i>Hakea</i> spp. And <i>Grevillea</i> spp., as well as native eucalypt woodland and forest that contains foraging species, including roadsides.	Native eucalypt woodlands and forest and proteaceous woodland and heath, particularly Marri, including along roadsides.	Jarrah and Marri woodlands and forest and edges of Karri forests, including Wandoo and Blackbutt, within the range of the subspecies, including along roadsides.
Additions	Context adjustor – attributes improving functionality of foraging habitat.	Context adjustor – attributes improving functionality of foraging habitat.	Context adjustor – attributes improving functionality of foraging habitat.
+3	Is within the Swan Coastal Plain (important foraging area).		Jarrah and/or marri show good recruitment (i.e. evidence of young trees).
+2	Primarily contains Marri.	Primarily contains Marri.	Primarily contains Marri and/or jarrah.

Starting Score	Foraging habitat for Carnaby's Cockatoo	Foraging habitat for Baudin's Cockatoo	Foraging habitat for FRTBC
+2	Contains trees with potential to be used for breeding (DBH > 500 mm).	Contains trees with potential to be used for breeding (DBH > 500 mm).	Contains trees with potential to be used for breeding (DBH > 500 mm).



Plate 1: Evidence of foraging on marri nuts by FRTBC in the survey area



Figure 10: Black Cockatoo habitat and potential breeding trees

Scale 1:4,000 at A4
 0 40 80 120 Metres
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 18/01/2018
 Author: vdnh
 Source: Nearmap: Aerial imagery - August 2017.
 Path: G:\Consult\2017\MPG\MPG17391\01_GIS_documents\ArcMap_documents\MPG17391_G010_RevB.mxd

Legend

 Survey area

Black Cockatoo foraging habitat
 High quality

Black cockatoo tree
 Corymbia calophylla (Marri)

● *Eucalyptus gomphocephala* (Tuart)
● *Eucalyptus marginata* (Jarrah)

5. Discussion

5.1 Flora and vegetation

The flora and vegetation assessment of the survey area was conducted during September 2017, which was prime flowering time for the majority of species within the region. The field survey focussed on traversing the entire survey area to delineate vegetation types and is consistent with the requirements of a detailed flora and vegetation survey as specified in *Technical Guidance: Flora and Vegetation surveys for Environmental Impact Assessment* (EPA 2016).

One broad-scale vegetation association falls within the survey area, Spearwood 6, of which 24.40% of its pre-European extent remains, as at the most recent assessment in 2016 (Government of Western Australia 2017a). The survey area occurs within the 'Karrakatta complex – central and south' vegetation complex of which 23.61 % of its pre-European extent remains within the Swan Coastal Plain bioregion (Government of Western Australia 2017b). Two native VTs were mapped within the survey area, as well as cleared areas. The survey area was dominated by woodland of *Banksia attenuata* and *Banksia menziesii* with emergent *Eucalyptus marginata*.

Statistical analyses of vegetation data from the survey area determined one broad FCT (FCT28), was present. FCT28 is included as one of the FCTs constituting the *Banksia woodlands of the Swan Coastal Plain* TEC, which is listed as Endangered under the EPBC Act. While both vegetation types aligned with FCT28, only vegetation comprising VT2 contained distinctive *Banksia* woodland and was considered to constitute the *Banksia woodlands of the Swan Coastal Plain* TEC (TSSC 2016), meeting all of the diagnostic characteristics of the TEC (Table 9). As such, areas mapped as VT2 should be considered to be part of the *Banksia woodlands of the Swan Coastal Plain* TEC.

Vegetation within the survey area was also assessed against the draft diagnostic criteria of the Tuart woodlands of the Swan Coastal Plain ecological community, current under consideration for listing as a TEC. The assessment showed vegetation within the survey area was unlikely to meet the draft criteria of the community and would not be considered to constitute the ecological community as currently described. Changes to the listing and criteria would require reassessment to confirm presence or absence of the ecological community.

Vegetation condition within the survey area ranged from Completely Degraded to Excellent (Keighery 1994), with the majority of vegetation (>70%) rated as Good – Very Good or better. Areas rated as Completely Degraded corresponded with cleared tracks and the residence fronting Wanneroo Road.

Sixty-nine native vascular plant taxa from 51 plant genera and 32 plant families as well as 15 exotic taxa were recorded within the survey area. No Declared Plant species pursuant to section 22 of the BAM Act were recorded within the survey area.

The following Threatened and Priority Flora species have the potential to occur within the survey area based on habitat requirements:

- * *Caladenia huegelii* (T)
- * *Drakaea micrantha* (T)
- * *Thelymitra variegata* (P2)
- * *Styphelia filifolia* (P3)
- * *Jacksonia sericea* (P4).

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by Parks and Wildlife (2015) were recorded within the survey area. Additionally, no Priority flora species as listed by Western Australian Herbarium (1998-), including those listed above, were recorded. *Jacksonia sericea* was previously recorded within the survey area from a single location. While not recorded during this survey, given it is a perennial species it is likely that it remains within the survey area. *Jacksonia sericea* is well represented both locally (25 records within 10km) and regionally within the Swan Coastal Plain bioregion (83 records). Given this, the population within the survey area is not considered significant in a local or regional context.

Of the remaining four conservation significant flora species with potential to occur in the survey area, three have flowering periods coinciding with the time of survey. The remaining species, *Styphelia filifolia*, is unlikely to have been flowering at the time of survey; however, it is a perennial species and would have been visible and identifiable if present. Given the above four conservation significant species would have been identifiable during the time of survey, and they were not recorded during this survey, it is unlikely that they occur within the survey area.

5.2 Black cockatoo habitat

During the Black Cockatoo habitat assessment, potential foraging and breeding habitat was identified in the Survey Area.

Black Cockatoos breed in large hollow-bearing trees, generally within woodlands or forests (Johnstone et al. 2013). The size of the tree can be a useful indication of the hollow-bearing potential of the tree. Trees of suitable DBH are potentially important for maintaining breeding in the long-term, through maintaining the integrity of the habitat and allowing trees to provide future nest hollows. Maintaining the long-term supply of trees of a size to provide suitable nest hollows is particularly important in woodland stands that are known to support Black Cockatoo breeding (DSEWPac 2012).

The Black Cockatoo habitat assessment revealed that the Survey Area contains Marri, Jarrah and Tuart trees which have reached a size that are potential future hollow bearing trees, therefore potential breeding trees (i.e. >500 mm) according to the EPBC Act Black Cockatoo draft revised referral guideline.

In total, 125 trees were recorded which met the criteria to be classed as a potential breeding tree. This suggests that these trees may develop hollows and have the potential to be used for breeding in the future. To be suitable for Black Cockatoos, the hollow entrances need to be greater than 120 mm diameter. None of these potential breeding trees contained any observable hollows from the ground which would be considered suitable for nesting.

There were other Marri, Jarrah and Tuart trees in the Survey Area, however they all had a DBH of < 500 mm and therefore are not considered as potential breeding trees. These trees, however, are all considered to be foraging habitat. The Survey Area also contained other known foraging species including *Banksia attenuata*, *Banksia menziesii*, *Allocasuarina fraseriana* and *Xanthorrhoea preissii*.

All three Black Cockatoo species leave unique feeding patterns on Marri nuts as they extract the seeds. Each species has a different style – from the inelegant “chomp-chomp” style of the FRTBC and Carnaby's Cockatoo to the delicate style of the Baudin's Cockatoo which use their long upper beak to extract the Marri seeds (WAM 2013).

Evidence of FRTBC foraging was recorded throughout the Survey Area, with many chewed Marri nuts observed.

The DEE foraging habitat scoring tool was used to determine the quality of the habitat. Again, it is important to note that these guidelines are currently in draft form. As such, the foraging habitat quality score has the potential to be altered in the future, if the final guidelines change considerably.

The Survey Area was given a quality score of 14, which is high quality foraging habitat. Foraging habitat with a score of seven or above is considered high quality and is important for the long-term survival of Black Cockatoos. This score was attributed to the Survey Area because it contained both potential breeding habitat, including Marri, Jarrah and Tuart (which are also considered foraging habitat), as well as other foraging species including *Banksia attenuata*, *Allocasuarina fraseriana* and *Xanthorrhoea preissii*.

The Survey Area was also scored on its proximity to other elements such as roosting and water points. There are numerous Black Cockatoo roosting locations within a 12 km radius of the Survey Area. The Survey Area is also located approximately 1 km from Lake Joondalup, 2 km from Lake Mariginiup, 3 km from Lake Jandabup and 8 km from Lake Gnaragar, all of which are important wetlands in the East Wanneroo area, particularly for Carnaby's Black Cockatoo and FRTBC (Johnstone & Kirkby 2011).

6. Conclusion

One FCTs encompassing two native vegetation types, were recorded within the survey area. The entire survey area comprised conservation significant vegetation, as follows:

- * one TEC, *Banksia Woodlands of the Swan Coastal Plain*, as listed under the EPBC Act.

Two Threatened flora and three Priority flora species have the potential to be present within the survey area. None of these species were observed during the September 2017 survey.

Within the survey area, 125 potential breeding trees were recorded; however, none were considered suitable for nesting as no hollows were observed to be of suitable size. The entire survey area contains high quality foraging habitat.

7. References

- Beard JS 1981, *Swan, 1:1000000 vegetation series: explanatory notes to sheet 7: the vegetation of the Swan area*, University of Western Australia Press, Nedlands, Western Australia.
- Beard JS 1990, *Plant Life of Western Australia*. Kangaroo Press, Kenthurst, New South Wales.
- Brown A, Thomson-Dans C & Marchant N 1998, *Western Australia's Threatened Flora*, Department of Conservation and Land Management, Perth.
- Bureau of Meteorology (BOM) 2017, *Climatic Statistics for Australian Locations: Monthly climate statistics for Wanneroo*, [Online], Australian Government, Available from: http://www.bom.gov.au/climate/averages/tables/cw_009105.shtml [15 November 2017].
- Cale, B. 2003, Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan. Perth: Department of Conservation and Land Management.
- Chao A 2005, 'Species richness estimation', in *Encyclopaedia of Statistical Sciences*, eds N Balakrishnan, CB Read & B Vidakovic, Wiley, New York, pp. 7909-7916.
- Churchward HM & McArthur WM 1980, 'Landforms and Soils of the Darling System', in *Atlas of Natural Resources, Darling System, Western Australia*, eds Department of Conservation and Environment, Perth, pp. 25-33.
- Colwell RK 2013, *EstimateS: Statistical estimation of species richness and shared species from samples. Version 9*, [Online], Available from: <http://purl.oclc.org/estimates>.
- Cooper, C. E., Withers, P. C., Mawson, P. R., Bradshaw, S. D., Prince, J., & Robertson, H. 2002, Metabolic ecology of cockatoos in the south-west of Western Australia. *Australian Journal of Zoology* 50, 67–76.
- Department of Biodiversity, Conservation and Attractions (DBCA) 2017a, *Wildlife Conservation (Threatened Flora) Notice 2016*, [Online], Government of Western Australia, https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/flora_notice.pdf [2 November 2017].
- Department of Environment and Energy (DEE) 2017a, *Interim Biogeographic Regionalisation for Australia, Version 7*, [Online], Australian Government, Available from: <http://www.environment.gov.au/topics/land/national-reserve-system/science-maps-and-data/australias-bioregions-ibra> [15 NOVEMBER 2017].
- Department of Environment and Energy (DEE) 2017b, *Species Profiles and Threats Database*, [Online], Australian Government, available from: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl> [15 NOVEMBER 2017].
- Department of Environment and Energy (DEE) 2017c, *EPBC Act Protected Matters Search Tool*, [Online], Australian Government. Available from: <http://www.environment.gov.au/epbc/pmst/index.html> [15 NOVEMBER 2017].
- Department of Environment and Energy (DEE) 2017d, *EPBC Act List of Threatened Flora*, [Online], Australian Government, Available from: <http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora> [15 NOVEMBER 2017].
- Department of Environment and Energy (DEE) 2017e, *EPBC Act List of Threatened Ecological Communities*, [Online], Australian Government, Available from: <http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl> [15 NOVEMBER 2017].
- Department of Energy and Environment (DEE) 2017f, Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo. Commonwealth of Australia, 2017.

- Department of Environment and Conservation (DEC) 2013, *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*, [Online], Government of Western Australia, Available from: https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/definitions_categories_and_criteria_for_threatened_and_priority_ecological_communities.pdf [15 November 2017].
- Department of Parks and Wildlife (Parks and Wildlife) 2007-, *NatureMap, Mapping Western Australia's Biodiversity*, [Online], Government of Western Australia, Available from: <http://naturemap.dec.wa.gov.au/> [15 November 2017].
- Department of Parks and Wildlife (Parks and Wildlife) 2016, *List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment (Correct as at 6 October 2016)*, Government of Western Australia, Perth.
- Department of Parks and Wildlife (Parks and Wildlife) 2017, *Priority Ecological Communities for Western Australia Version 24 (30 June 2017)*, Government of Western Australia, Perth.
- Department of Parks and Wildlife (Parks and Wildlife) 2017, *Conservation Codes for Western Australian Flora and Fauna*, current as of 23 May 2017, Government of Western Australia, Perth.
- Department of Primary Industries and Regional Development (DPIRD) 2017, *Declared Pests (s22) list*, [Online], Government of Western Australia, Available from: <https://www.agric.wa.gov.au/organisms> [15 November 2017].
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPac) 2012 *Environment Protection and Biodiversity Conservation Act 1999 referral guidelines for three black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso**, Australian Government, Canberra.
- Environmental Protection Authority (EPA) 2016, *Technical Guidance (in accordance with the Environmental Protection Act 1986) – Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia*. Government of Western Australia, Perth.
- ENV 2008, *Flora, Vegetation and Fauna of Wanneroo Town Centre Structure Plan Area – City of Wanneroo*, report prepared for TPG Town Planning & Urban Development.
- Executive Steering Committee for Australian Vegetation Information (ESCAVI) 2003, *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0*, Department of the Environment and Heritage, Australian Capital Territory.
- Gibson N, Keighery B, Keighery G, Burbidge A & Lyons M 1994, *A Floristic survey of the southern Swan Coastal Plain*, report prepared for the Australian Heritage Commission, 1994.
- Government of Western Australia (GoWA) 2017a, *2016 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report), Current as of May 2016*, Department of Parks and Wildlife, Perth.
- Government of Western Australia. (GoWA) 2017b, *2016 South West Vegetation Complex Statistics*, Current as of December 2016, WA Department of Parks and Wildlife, Perth.
- Hedde EM, Loneragan OW & Havel JJ 1980, *Darling System, Vegetation Complexes*, Forest Department, Perth.
- Johnstone, R. E., Kirkby, T., & Sarti, K. 2013a, The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. I. Characteristics of nest trees and nest hollows. *Pacific Conservation Biology* 19, 121-142.
- Johnstone, R. E., Kirkby, T., & Sarti, K. 2013b, The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. II. Breeding behaviour and diet. *Pacific Conservation Biology* 19, 143-155.

- Johnstone, R. E., & Kirkby, T. 1999, Food of the forest red-tailed black cockatoo *Calyptorhynchus banksii naso* in south-west Western Australia. *Western Australian Naturalist* 22, 167–177.
- Johnstone, R. E., & Kirkby, T. (2008). Distribution, status, social organisation, movements and conservation of Baudin's Cockatoo (*Calyptorhynchus baudinii*) in south-west WA. *Records of the Western Australian Museum* 25, 107-118.
- Johnstone, R. E., & Kirkby, T. 2011, Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) on the Swan Coastal Plain (Lancelin–Dunsborough), Western Australia. Studies on distribution, status, breeding, food, movements and historical changes. Perth: Department of Planning.
- Johnstone, R. E. & Storr, G. M. (1998). *Handbook of Western Australian Birds*. Volume 1 - Non-Passerines (Emu to Dollarbird). Oxford University Press.
- Keighery B 1994, *Bushland Plant Survey: A Guide to Plant Community Survey for the Community*, Wildflower Society, Floreat.
- Mitchell D, Williams K & Desmond A 2002, 'Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion)', in *A biodiversity audit of Western Australia's 53 Biogeographical Subregions in 2002*, eds Department of Conservation and Land Management, Perth, pp. 606-623.
- Saunders, D.A. (1986) Breeding season, nesting success and nestling growth in Carnaby's Cockatoo, over 16 years at Coomallo Creek, and a method for assessing the viability of population in other areas. *Australian Wildlife Research*, 13, 261-73.
- Semeniuk V 1990, 'The geomorphology and soils of Yoongarillup Plain, in the Mandurah-Bunbury coastal zone, southwestern Australia: a critical appraisal', *Journal of the Royal Society of Western Australia*, vol. 73, pp. 1-7.
- Shah, B. 2006, Conservation of Carnaby's Black Cockatoo on the Swan Coastal Plain, WA. Perth: Birds Australia.
- Thackway & Cresswell 1995, *An Interim Biogeographic Regionalisation for Australia: A framework for setting priorities in the National Reserves System Cooperative Program Version 4*, Australian Nature Conservation Agency, Canberra.
- Threatened Species Scientific Committee (TSSC) 2016 *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community* [Online], Department of the Environment and Energy, Available from: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/131-conservation-advice.pdf>. In effect under the EPBC Act from 16-Sep-2016.
- Threatened Species Scientific Committee (TSSC) 2017 *Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community Draft conservation advice including draft listing advice* [Online], Department of the Environment and Energy, Available from: <http://www.environment.gov.au/system/files/consultations/6c733160-9b7f-41f9-b47e-02ca095737e6/files/draft-conservation-advice-tuart-woodlands-ec.pdf> [15 November 2017].
- Western Australian Herbarium 1998-, *FloraBase – the Western Australian Flora*, [Online], Government of Western Australia, Available from: <http://florabase.dpaw.wa.gov.au/> [15 November 2017].

Appendix 1
Conservation significant flora and
ecological community definitions

Conservation Codes for Western Australian Flora and Fauna (Parks and Wildlife 2017)

Specially protected fauna or flora are species which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

Categories of specially protected fauna and flora are:

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 and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

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.

Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) 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

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 and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EN Endangered species

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 and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

VU Vulnerable species

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 and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EX Presumed extinct species

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 and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

IA Migratory birds protected under an international agreement

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

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

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.

Priority Flora and Fauna

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora 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 flora or 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.

1 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.

2 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.

3 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.

4 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.

Definition of Threatened Ecological Communities (DEC 2013)

A threatened ecological community (TEC) is one which is found to fit into one of the following categories; "presumed totally destroyed", "critically endangered", "endangered" or "vulnerable".

Presumed Totally Destroyed (PD)

An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):

- A)** Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats, or
- B)** All occurrences recorded within the last 50 years have since been destroyed.

Critically Endangered (CR)

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):

- A)** The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply:
 - * geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years)
 - * modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.
- B)** Current distribution is limited, and one or more of the following apply:
 - * geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years)
 - * there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes
 - * there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.
- C)** The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C):

A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply:

- * the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years)
- * modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, and one or more of the following apply"

- * geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years)
- * there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes
- * there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium (within approximately 50 years) to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Definition of Priority Ecological Communities (DEC 2013)

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List under priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly-known ecological communities

Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities

Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

- Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation
- communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat
- communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four

Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. These include:

a) Rare. Ecological communities known from few occurrences 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 communities are usually represented on conservation lands.

b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

c) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

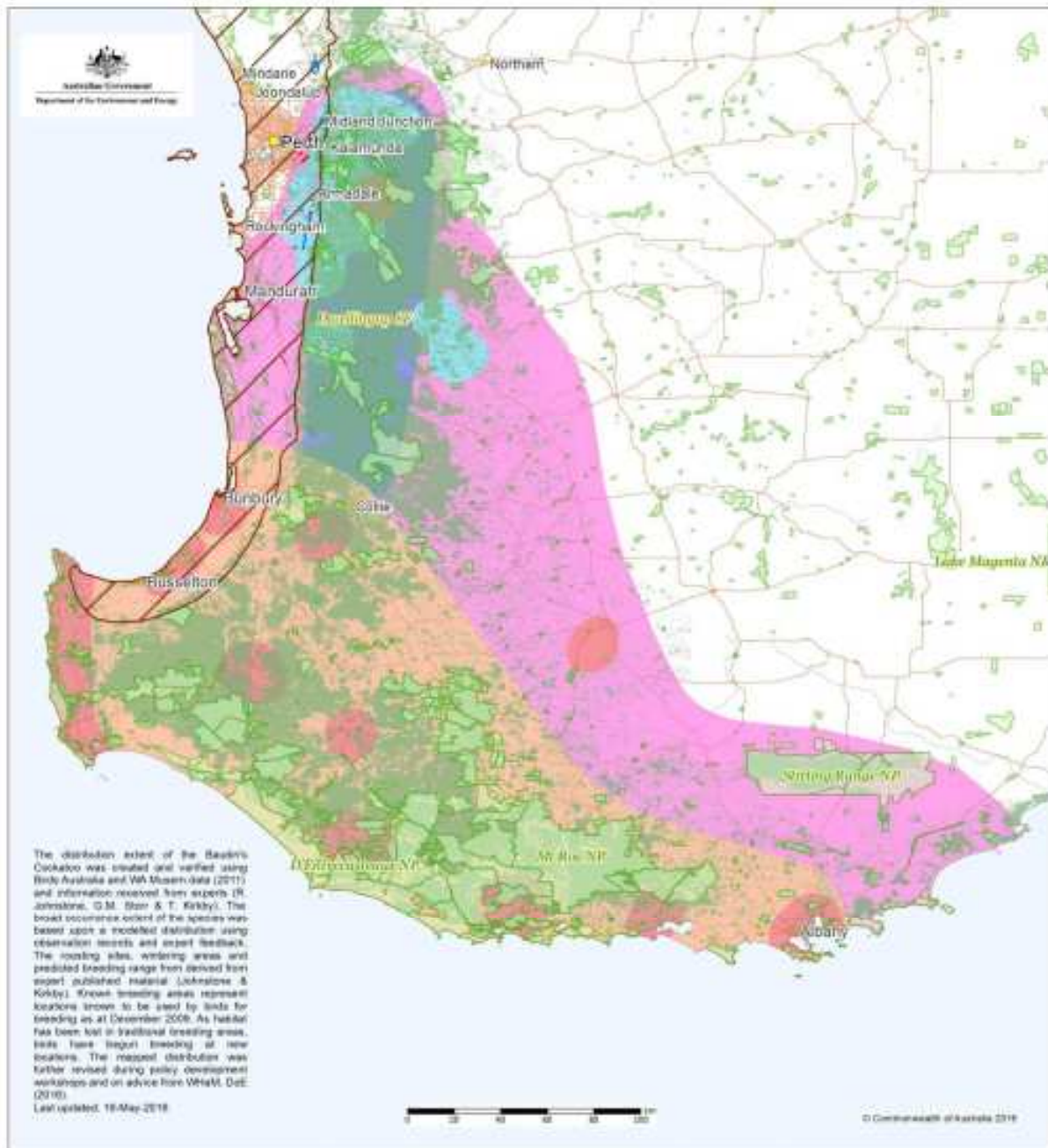
Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Appendix 2

Black Cockatoo distribution maps

Appendix A – Distribution maps for the three black cockatoos

Map 2: Modelled distribution for Baudin's Cockatoo
(*Calyptorhynchus baudinii*)



RESERVE MAP ONLY: For the latest departmental information, please refer to the Protected Matters Search Tool and the Species Profiles & Threats Database at

Prepared by:
Environmental Resources Information Network 2018

Cartographic data sources:
National Information System (NIMS) 4.2i 2016
National Biogeographic Regionalisation for Australia (NBSRA) version 7 2012
Collaborative Australian Protected Area Database (CAPAD) 2014
Geoscience Australia GEODATA TOPO 25M Topographic Data Series 3 2008

Projection: Geographic
Datum: GDA94

Ecological Communities

- *Corymbus* (corymbus) - North-western coastal woodlands and shrublands of the Swan Coastal Plain
- *Corymbus* (corymbus) - Middle southern woodlands on heavy soils of the Swan Coastal Plain
- *Corymbus* (corymbus) - Middle southern woodlands on heavy soils of the Swan Coastal Plain
- *Corymbus* (corymbus) - Middle southern woodlands on heavy soils of the Swan Coastal Plain
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- *Corymbus* (corymbus) - Middle southern woodlands on heavy soils of the Swan Coastal Plain
- *Corymbus* (corymbus) - Middle southern woodlands on heavy soils of the Swan Coastal Plain

Legend: Main and Sub (2018 & 2)

Species

- Current breeding areas
- Predicted breeding range
- Current foraging areas
- Main roosting areas
- Species likely to occur

Cities & Towns

- Roads (sealed)
- Roads (unsealed)
- State Border
- Major Rivers
- Lakes/Reservoirs
- Non-perennial Lakes

DISCUSSIVE 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/indigenous/indigenous.html>

Confidential data source:
National Vegetation Information System (NVIS) v21 (2016)
Interim Biogeographic Regionalisation for Australia (IBRA) version 7 (2012)
Collaborative Australian Protected Area Database (CAPAD) (2014)
Geoscience Australia (GDA) Data IDAQ-2008; Topographic Data Series 2 (2008)

Conservation Area
 western North Island Eastern Gulf of Mexico Seaboard Southeastern and Florida panhandle

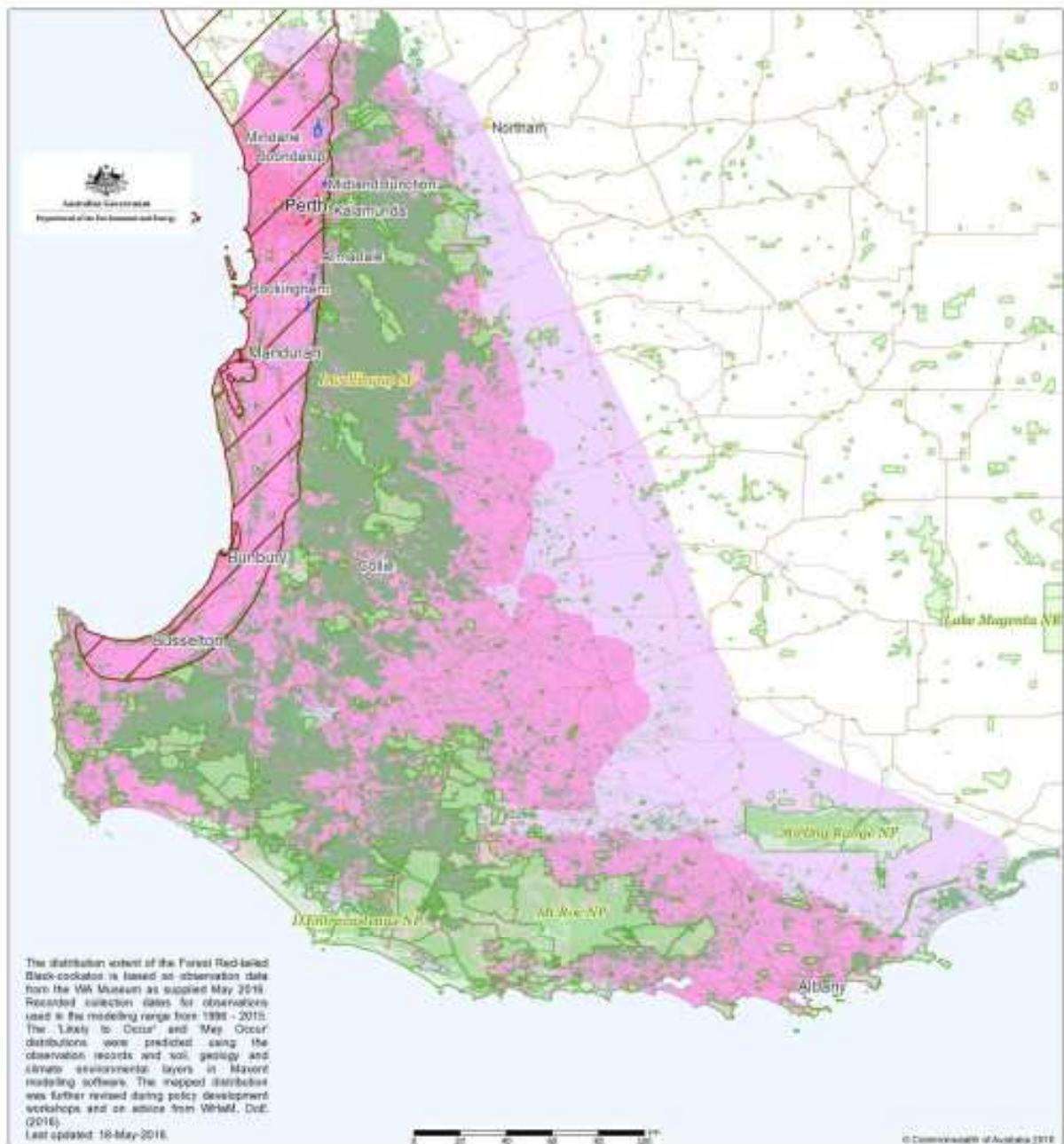
Species
 Breeding Range
 Non-breeding Range

Ecological Communities
 Coastal prairie - terrestrial grasslands are widespread in the Eastern Coastal Plain
 Coastal prairie - fringe wetlands are common in many parts of the Southeastern Plain
 Marshes of the Gulf of Mexico

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Map 4: Modelled distribution for Forest Red-tailed Black-Cockatoo
(*Calyptorhynchus banksii naso*)



POCKET-PRINT 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/threats/index.html>

Produced by:
Governmental Resource Information Network 2018

Cartographic data source:
National Vegetation Information System (NVIS) 4.25, 2016
Terrestrial Biogeographic Reorganisation for Australia (GBRA) version 7, 2012
Collaborative Australia Protected Area Database (CAPAD) 2014
Geoscience Australia GSDATA TOPPO 1:50K Topographic Data Series 3 2008

Projection: Geostatic
Datum: GDA84

Conservation Areas
Jerram, Kari and Mann (NVIS 4.25)

Species

Likely to Occur

May Occur

Ecological Communities

Corymbia calophylla - Karriburns forest woodlands and shrublands of the Swan Coastal Plain

Corymbia calophylla - Kingia aculeata 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

Appendix 3
Desktop assessment results (Parks and
Wildlife 2007-, DEE 2017c)



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: 22/08/17 15:14:20

[Summary](#)

[Details](#)

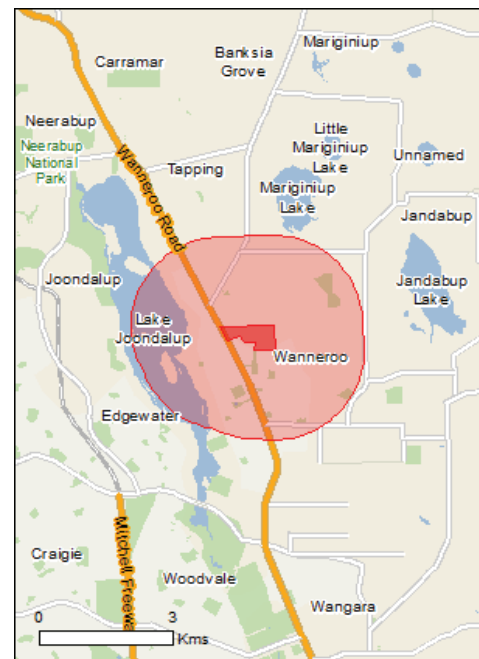
[Matters of NES](#)

[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: 2.0Km



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:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	17
Listed Migratory Species:	11

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:	19
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	34
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

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

[Calidris canutus](#)

Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
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[Calidris ferruginea](#)

Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
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[Calyptorhynchus banksii naso](#)

Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	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 [77037]	Endangered	Species or species habitat may occur within area
----------------------------------	------------	--

Mammals

[Dasyurus geoffroii](#)

Chuditch, Western Quoll [330]	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
----------------------------	------------	--

[Anigozanthos viridis subsp. terraspectans](#)

Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat may occur within area
---------------------------------	------------	--

Name	Status	Type of Presence
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat may occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may 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 may 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 may occur within area
Calidris ruficollis Red-necked Stint [860]		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

Name	Threatened	Type of Presence
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		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 habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat 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 may 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 may occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur

Name	Threatened	Type of Presence
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		within area Species or species habitat known to occur within area
Himantopus himantopus Black-winged Stilt [870]		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 known to occur within area
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 may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Lake Joondalup	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 Resources Audit, 2001.	

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
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 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
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		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur

Name	Status	Type of Presence
Brachiaria mutica Para Grass [5879]		within area Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands		[Resource Information]
Name		State
Joondalup 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

-31.746149 115.800048,-31.746149 115.800048,-31.746149 115.800048,-31.745906 115.810818,-31.750268 115.811022,-31.750198 115.806935,-31.748895 115.806996,-31.74893 115.804932,-31.747765 115.804094,-31.748634 115.801519,-31.748061 115.801111,-31.746149 115.800048

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](#)
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- [-State Herbarium of South Australia](#)
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- [-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.

NatureMap Species Report

Created By Guest user on 22/08/2017

Kingdom Plantae
Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 48' 22" E, 31° 44' 51" S
Buffer 3km

	Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1.	3237	<i>Acacia benthamii</i>		P2	
2.	34161	<i>Baeckea</i> sp. Limestone (N. Gibson & M.N. Lyons 1425)		P1	
3.	1425	<i>Conostylis bracteata</i>		P3	
4.	4027	<i>Jacksonia sericea</i> (Waldjumi)		P4	
5.	5237	<i>Pimelea calcicola</i>		P3	
6.	48297	<i>Styphelia filifolia</i>		P3	
7.	35581	<i>Tetraria</i> sp. Chandala (G.J. Keighery 17055)		P2	
8.	1717	<i>Thelymitra variegata</i> (Queen of Sheba)		P2	

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 wholly 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.

Appendix 4
Vascular plant taxa recorded within the
survey area

Family	Taxa
Amaranthaceae	<i>Ptilotus manglesii</i>
	<i>Ptilotus polystachyus</i>
Anarthriaceae	<i>Anarthria gracilis</i>
Araliaceae	<i>Trachymene pilosa</i>
Asparagaceae	<i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>
	<i>Lomandra caespitosa</i>
	<i>Sowerbaea laxiflora</i>
Asteraceae	* <i>Arctotheca calendula</i>
	* <i>Hypochaeris glabra</i>
	* <i>Sonchus oleraceus</i>
	* <i>Ursinia anthemoides</i>
	* <i>Conyza bonariensis</i>
	<i>Asteraceae</i> sp.
	<i>Lagenophora huegelii</i>
Brassicaceae	<i>Brassicaceae</i> sp.
Campanulaceae	<i>Lobelia tenuior</i>
Casuarinaceae	<i>Allocasuarina fraseriana</i>
Celastraceae	<i>Tripterococcus brunonis</i>
Colchicaceae	<i>Burchardia congesta</i>
Cupressaceae	<i>Callitris preissii</i>
Cyperaceae	<i>Lepidosperma leptostachyum</i>
	<i>Mesomelaena pseudostygia</i>
Dasypogonaceae	<i>Calectasia grandiflora</i>
Dilleniaceae	<i>Hibbertia commutata</i>
	<i>Hibbertia huegelii</i>
	<i>Hibbertia hypericoides</i>
Droseraceae	<i>Drosera erythrorhiza</i>
	<i>Drosera macrantha</i>
Ericaceae	<i>Leucopogon propinquus</i>
Fabaceae	<i>Acacia applanata</i>
	<i>Bossiaea eriocarpa</i>
	<i>Bossiaea ornata</i>
	<i>Daviesia triflora</i>
	<i>Fabaceae</i> sp.
	<i>Gompholobium tomentosum</i>
	<i>Hardenbergia comptoniana</i>
	<i>Jacksonia sternbergiana</i>
	<i>Kennedia coccinea</i>
Goodeniaceae	<i>Scaevola repens</i>
Haemodoraceae	<i>Anigozanthos manglesii</i>
	<i>Conostylis setigera</i> subsp. <i>Setigera</i>
	<i>Haemodoraceae</i> sp.
	<i>Haemodorum laxum</i>

Family	Taxa
	<i>Haemodorum</i> sp.
Hemerocallidaceae	<i>Corynotheca micrantha</i>
	<i>Dianella revoluta</i>
	<i>Tricoryne elatior</i>
Iridaceae	* <i>Gladiolus caryophyllaceus</i>
	* <i>Romulea rosea</i>
	<i>Orthrosanthus laxus</i> var. <i>laxus</i>
Loranthaceae	<i>Amyema miquelii</i>
Myrtaceae	<i>Corymbia calophylla</i>
	<i>Eucalyptus gomphocephala</i>
	<i>Eucalyptus marginata</i>
	<i>Hypocalymma angustifolium</i>
Orchidaceae	<i>Caladenia arenicola</i>
	<i>Caladenia flava</i>
	<i>Caladenia</i> sp.
	<i>Cyanicula gemmata</i>
	<i>Diuris</i> sp.
	<i>Pyrorchis nigricans</i>
Oxalidaceae	* <i>Oxalis pes-caprae</i>
Phyllanthaceae	<i>Phyllanthus calycinus</i>
Poaceae	* <i>Avena barbata</i>
	* <i>Briza maxima</i>
	* <i>Briza minor</i>
	* <i>Cenchrus clandestinus</i>
	* <i>Ehrharta calycina</i>
	<i>Poaceae</i> sp.
Primulaceae	* <i>Lysimachia arvensis</i>
Proteaceae	<i>Banksia attenuata</i>
	<i>Banksia dallanneyi</i>
	<i>Banksia menziesii</i>
	<i>Petrophile linearis</i>
	<i>Stirlingia latifolia</i>
Restionaceae	<i>Alexgeorgea nitens</i>
	<i>Desmocladus fasciculatus</i>
	<i>Desmocladus flexuosus</i>
Rutaceae	<i>Philotheca spicata</i>
Solanaceae	* <i>Solanum nigrum</i>
Stylidiaceae	<i>Stylidium piliferum</i>
Xanthorrhoeaceae	<i>Xanthorrhoea gracilis</i>
	<i>Xanthorrhoea preissii</i>
Zamiaceae	<i>Macrozamia riedlei</i>

Appendix 5

Raw quadrat data

Q01

GPS Co-ordinate 50H 387095mE; 6486792mN



Landform Undulating plain
Slope Mid-slope
Aspect west
Soils Grey white sand
Coarse surface particles N/A
Ground Cover (%) Bare soil 1%
Litter 40%
Condition Very good to excellent
Fire age 3-5 years
Disturbance weeds

Vegetation *Eucalyptus marginata* and *Corymbia calophylla* mid woodland over *Xanthorrhoea preissii* and *Macrozamia riedlei* sparse mid shrubland over *Hibbertia hypericoides* and *Mesomelaena pseudostygia* low shrubland.

Species List

Taxon	Height (cm)	Cover (%)
<i>Bossiaea eriocarpa</i>	20	1
* <i>Briza minor</i>	10	0.3
<i>Burchardia congesta</i>	40	1
* <i>Cenchrus clandestinus</i>	10	0.5
<i>Conostylis setigera</i> subsp. <i>setigera</i>	20	1
<i>Corymbia calophylla</i>	20	50
<i>Desmocladius flexuosus</i>	15	2
<i>Diuris</i> sp.	20	0.2
* <i>Ehrharta calycina</i>	60	30
<i>Eucalyptus marginata</i>	20	3
* <i>Gladiolus caryophyllaceus</i>	30	0.1
<i>Gompholobium tomentosum</i>	10	+
<i>Haemodorum</i> sp.	30	0.1
<i>Hardenbergia comptoniana</i>	-	3
<i>Hibbertia hypericoides</i>	40	10
* <i>Hypochaeris glabra</i>	-	0.5
<i>Jacksonia sternbergiana</i>	30	+
<i>Lepidosperma leptostachyum</i>	20	0.1
<i>Leucopogon propinquus</i>	20	0.5

Q01

<i>Lomandra caespitosa</i>	15	+
* <i>Lysimachia arvensis</i>	5	0.1
<i>Macrozamia riedlei</i>	150	5
<i>Mesomelaena pseudostygia</i>	30	5
<i>Phyllanthus calycinus</i>	20	0.2
<i>Poaceae</i> sp.	10	5
* <i>Solanum nigrum</i>	60	0.3
* <i>Sonchus oleraceus</i>	20	+
<i>Trachymene pilosa</i>	5	+
<i>Tripterococcus brunonis</i>	40	+
<i>Xanthorrhoea gracilis</i>	100	0.5
<i>Xanthorrhoea preissii</i>	150	2

Q02**GPS Co-ordinate** 50H 387234mE; 6486876mN**Landform** Undulating plain**Slope** Upper-slope**Aspect** North-west**Soils** Grey white sand**Coarse surface particles** N/A**Ground Cover (%)** Bare soil 20%

Litter 10%

Condition Very good**Fire age** 3-5 years**Disturbance** weeds**Vegetation** *Eucalyptus marginata* open mid woodland over *Banksia attenuata*, *Banksia menziesii* and *Allocasuarina fraseriana* low woodland over *Jacksonia sternbergiana*, *Hibbertia hypericoides* and *Mesomelaena pseudostygia* open low to mid shrubland.**Species List**

Taxon	Height (cm)	Cover (%)
<i>Allocasuarina fraseriana</i>	700	4
<i>Anarthria gracilis</i>		0.2
<i>Anigozanthos manglesii</i>	40	0.2
* <i>Arctotheca calendula</i>	20	0.1
<i>Banksia attenuata</i>	800	10
<i>Bossiaea ornata</i>		+
* <i>Briza maxima</i>	10	0.5
* <i>Briza minor</i>		1
<i>Burchardia congesta</i>	30	0.5
<i>Caladenia flava</i>		+
<i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>	20	0.1
<i>Conostylis setigera</i> subsp. <i>Setigera</i>		0.2
<i>Cyanicula gemmata</i>		+
<i>Desmocladius flexuosus</i>	10	1.5
<i>Diuris</i> sp.	40	+
* <i>Ehrharta calycina</i>	50	2
* <i>Gladiolus caryophyllaceus</i>	60	1
<i>Gompholobium tomentosum</i>		+
<i>Haemodoraceae</i> sp.		+
<i>Haemodorum</i> sp.	60	0.5

Q02		
<i>Hardenbergia comptoniana</i>		0.1
<i>Hibbertia hypericoides</i>	50	15
<i>Hypocalymma angustifolium</i>	60	1
* <i>Hypochaeris glabra</i>		2
<i>Jacksonia sternbergiana</i>	180	2
<i>Lagenophora huegelii</i>		+
<i>Lepidosperma leptostachyum</i>	30	+
<i>Leucopogon propinquus</i>	20	0.2
<i>Lobelia tenuior</i>	20	2
<i>Lomandra caespitosa</i>		+
<i>Macrozamia riedlei</i>	100	4
<i>Mesomelaena pseudostygia</i>	40	3
<i>Petrophile linearis</i>	4	2
<i>Phyllanthus calycinus</i>	20	+
<i>Poaceae</i> sp.	20	1
<i>Pyrorchis nigricans</i>		0.1
<i>Scaevola repens</i>	10	0.6
<i>Sowerbaea laxiflora</i>	20	+
<i>Stirlingia latifolia</i>	50	0.1
<i>Stylidium piliferum</i>		+
<i>Trachymene pilosa</i>	10	0.3
* <i>Ursinia anthemoides</i>	10	2
<i>Xanthorrhoea preissii</i>	150	2

Q03**GPS Co-ordinate** 50H 387309mE; 6487022mN**Landform** Undulating plain**Slope** Flat**Aspect** N/A**Soils** Grey white sand**Coarse surface particles** N/A**Ground Cover (%)** Bare soil 2%

Litter 30%

Condition Very good to excellent**Fire age** 3-5 years**Disturbance** weeds**Vegetation** *Eucalyptus marginata* open mid woodland over *Banksia attenuata*, *Banksia menziesii* and *Allocasuarina fraseriana* low woodland over *Jacksonia sternbergiana*, *Hibbertia hypericoides* and *Mesomelaena pseudostygia* open low to mid shrubland.**Species List**

Taxon	Height (cm)	Cover (%)
<i>Alexgeorgea nitens</i>		0.3
<i>Allocasuarina fraseriana</i>		3
* <i>Arctotheca calendula</i>		0.2
<i>Banksia attenuata</i>		4
<i>Banksia menziesii</i>		4
* <i>Briza maxima</i>		1.5
<i>Burchardia congesta</i>		1
<i>Caladenia arenicola</i>		+
<i>Caladenia flava</i>		+
<i>Caladenia</i> sp.		+
<i>Conostylis setigera</i> subsp. <i>setigera</i>		1
* <i>Conyza bonariensis</i>		+
<i>Corynotheca micrantha</i>		+
<i>Cyanicula gemmata</i>		+
<i>Daviesia triflora</i>		1
<i>Desmocladius fasciculatus</i>		+
<i>Desmocladius flexuosus</i>		1.5
<i>Fabaceae</i> sp.		0.1
* <i>Gladiolus caryophyllaceus</i>		0.1
<i>Haemodorum laxum</i>		+

Q03	
<i>Hardenbergia comptoniana</i>	0.1
<i>Hibbertia huegelii</i>	0.3
<i>Hibbertia hypericoides</i>	25
<i>Hypocalymma angustifolium</i>	1
* <i>Hypochaeris glabra</i>	2
<i>Lagenophora huegelii</i>	0.3
<i>Lepidosperma leptostachyum</i>	+
<i>Lobelia tenuior</i>	0.3
<i>Lomandra caespitosa</i>	0.1
<i>Mesomelaena pseudostygia</i>	10
<i>Poaceae</i> sp.	2
<i>Ptilotus manglesii</i>	+
<i>Sowerbaea laxiflora</i>	+
<i>Stirlingia latifolia</i>	3
* <i>Ursinia anthemoides</i>	2
<i>Xanthorrhoea preissii</i>	1

Q04**GPS Co-ordinate** 50H 386483mE; 6486988mN**Landform** Undulating plain**Slope** Mid-slope**Aspect** North west**Soils** Grey white sand**Coarse surface particles** N/A**Ground Cover (%)** Bare soil 15%

Litter 10%

Condition Very good to excellent**Fire age** > 5 years**Disturbance** weeds**Vegetation** *Eucalyptus marginata* open mid woodland over *Banksia attenuata*, *Banksia menziesii* and *Allocasuarina fraseriana* low woodland over *Jacksonia sternbergiana*, *Hibbertia hypericoides* and *Mesomelaena pseudostygia* open low to mid shrubland.**Species List**

Taxon	Height (cm)	Cover (%)
<i>Alexgeorgea nitens</i>	10	+
<i>Allocasuarina fraseriana</i>	1000	3
<i>Amyema miquelii</i>		0.5
<i>Asteraceae</i> sp.		0.2
<i>Banksia attenuata</i>	800	8
<i>Banksia menziesii</i>	800	5
* <i>Briza maxima</i>	30	5
<i>Burchardia congesta</i>	40	1
<i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>	20	0.5
<i>Conostylis setigera</i> subsp. <i>setigera</i>	20	0.2
<i>Desmocladus flexuosus</i>	10	1.5
<i>Drosera erythrorhiza</i>		0.2
<i>Drosera macrantha</i>		+
<i>Eucalyptus marginata</i>	1500	5
* <i>Gladiolus caryophyllaceus</i>	30	0.3
<i>Gompholobium tomentosum</i>	10	0.1
<i>Haemodorum</i> sp.	60	0.1
<i>Hardenbergia comptoniana</i>		0.1
<i>Hibbertia hypericoides</i>	60	15
<i>Hypocalymma angustifolium</i>	50	0.5

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<i>*Hypochaeris glabra</i>		0.5
<i>Mesomelaena pseudostygia</i>	50	15
<i>*Oxalis pes-caprae</i>	20	0.1
<i>Petrophile linearis</i>	40	0.1
<i>Ptilotus polystachyus</i>	60	1
<i>*Romulea rosea</i>	20	1
<i>Scaevola repens</i>	20	0.6
<i>*Sonchus oleraceus</i>		+
<i>Trachymene pilosa</i>		+
<i>Tripterococcus brunonis</i>	10	0.1
<i>*Ursinia anthemoides</i>	10	0.5

Q05**GPS Co-ordinate** 50H 386937mE; 6487051mN

Landform Undulating plain
Slope Undulating
Aspect N/A
Soils Grey white sand
Coarse surface particles N/A
Ground Cover (%) Bare soil 0%
 Litter 40%
Condition Good to very good
Fire age 2-3 years
Disturbance weeds

Vegetation *Eucalyptus marginata* and *Corymbia calophylla* mid woodland over *Xanthorrhoea preissii* and *Macrozamia riedlei* sparse mid shrubland over *Hibbertia hypericoides* and *Mesomelaena pseudostygia* low shrubland.

Species List

Taxon	Height (cm)	Cover (%)
* <i>Avena barbata</i>	30	15
* <i>Briza maxima</i>	20	3
* <i>Conyza bonariensis</i>	30	+
<i>Corymbia calophylla</i>	1600	13
<i>Desmocladius flexuosus</i>		1
* <i>Ehrharta calycina</i>	60	10
<i>Eucalyptus marginata</i>	1800	7
<i>Haemodorum</i> sp.	60	0.3
<i>Hardenbergia comptoniana</i>		0.5
* <i>Hypochaeris glabra</i>		1
<i>Leucopogon propinquus</i>	30	0.2
<i>Macrozamia riedlei</i>	180	5
<i>Mesomelaena pseudostygia</i>	50	10
<i>Phyllanthus calycinus</i>	60	0.2
* <i>Sonchus oleraceus</i>		0.2
<i>Trachymene pilosa</i>		0.2
* <i>Ursinia anthemoides</i>	10	0.1
<i>Xanthorrhoea preissii</i>	160	20

Q06**GPS Co-ordinate** 50H 387258mE; 6486693mN

Landform Undulating plain
Slope Undulating
Aspect N/A
Soils Grey white sand
Coarse surface particles N/A
Ground Cover (%) Bare soil 10%
 Litter 10%
Condition Very good to excellent
Fire age 3 to 5 years
Disturbance weeds

Vegetation *Eucalyptus marginata* open mid woodland over *Banksia attenuata*, *Banksia menziesii* and *Allocasuarina fraseriana* low woodland over *Jacksonia sternbergiana*, *Hibbertia hypericoides* and *Mesomelaena pseudostygia* open low to mid shrubland.

Species List

Taxon	Height (cm)	Cover (%)
<i>Acacia applanata</i>		0.2
<i>Allocasuarina fraseriana</i>		2
<i>Anigozanthos manglesii</i>		0.3
<i>Banksia attenuata</i>	800	15
<i>Banksia dallanneyi</i>		0.5
<i>Bossiaea eriocarpa</i>		0.5
<i>Brassicaceae</i> sp.		+
* <i>Briza maxima</i>		5
<i>Burchardia congesta</i>		0.2
<i>Calectasia grandiflora</i>		0.2
<i>Conostylis setigera</i> subsp. <i>setigera</i>		1.2
<i>Corymbia calophylla</i>	1200	3
<i>Daviesia triflora</i>		0.5
<i>Desmocladius flexuosus</i>		0.5
<i>Dianella revoluta</i>		0.1
<i>Drosera erythrorhiza</i>		0.2
<i>Eucalyptus marginata</i>	1500	2
* <i>Gladiolus caryophyllaceus</i>		0.3
<i>Gompholobium tomentosum</i>		0.2
<i>Haemodorum laxum</i>		0.2

Q06	
<i>Haemodorum</i> sp.	0.5
<i>Hibbertia huegelii</i>	0.1
<i>Hibbertia hypericoides</i>	5
<i>Hypocalymma angustifolium</i>	+
* <i>Hypochaeris glabra</i>	1
<i>Jacksonia sternbergiana</i>	3
<i>Kennedia coccinea</i>	1.5
<i>Lepidosperma leptostachyum</i>	0.5
<i>Lomandra caespitosa</i>	0.2
<i>Macrozamia riedlei</i>	4
<i>Orthrosanthus laxus</i> var. <i>laxus</i>	0.2
<i>Petrophile linearis</i>	0.2
<i>Philotheca spicata</i>	0.1
<i>Poaceae</i> sp.	0.3
<i>Ptilotus manglesii</i>	0.1
<i>Pyrorchis nigricans</i>	0.1
<i>Sowerbaea laxiflora</i>	+
<i>Stirlingia latifolia</i>	5
<i>Stylidium piliferum</i>	0.1
<i>Tricoryne elatior</i>	0.3
* <i>Ursinia anthemoides</i>	0.5
<i>Xanthorrhoea preissii</i>	4

R01

GPS Co-ordinate 50H 386693mE; 6486995mN



Landform Undulating plain

Slope Undulating

Aspect N/A

Soils Grey white sand

Coarse surface particles N/A

Ground Cover (%) Bare soil 2%

Litter 15%

Condition Very good

Fire age 1 to 2 years

Disturbance weeds; fire

Vegetation *Eucalyptus marginata* open mid woodland over *Banksia attenuata*, *Banksia menziesii* and *Allocasuarina fraseriana* low woodland over *Jacksonia sternbergiana*, *Hibbertia hypericoides* and *Mesomelaena pseudostygia* open low to mid shrubland.

Species List

Taxon	Height (cm)	Cover (%)
<i>Allocasuarina fraseriana</i>		2
* <i>Arctotheca calendula</i>		0.1
<i>Banksia attenuata</i>		3
* <i>Briza maxima</i>		2
<i>Burchardia congesta</i>		1
<i>Callitris preissii</i>		1
<i>Corymbia calophylla</i>		8
<i>Desmocladius flexuosus</i>		2
<i>Eucalyptus marginata</i>		5
* <i>Gladiolus caryophyllaceus</i>		0.1
<i>Haemodorum laxum</i>		0.1
<i>Haemodorum sp.</i>		0.1
<i>Hibbertia commutata</i>		15
<i>Hypocalymma angustifolium</i>		0.5
* <i>Hypochaeris glabra</i>		0.5
<i>Macrozamia riedlei</i>		5
<i>Mesomelaena pseudostygia</i>		1
* <i>Sonchus oleraceus</i>		0.1
<i>Tripterococcus brunonis</i>		0.1
<i>Xanthorrhoea preissii</i>		8

R02**GPS Co-ordinate** 50H 387068mE; 6486948mN**Landform** Undulating plain**Slope** Undulating**Aspect** N/A**Soils** Grey white sand**Coarse surface particles** N/A**Ground Cover (%)** Bare soil 40%

Litter 10%

Condition Very good**Fire age** 2 to 3 years**Disturbance** weeds**Vegetation**

Eucalyptus marginata and *Corymbia calophylla* mid woodland over *Xanthorrhoea preissii* and *Macrozamia riedlei* sparse mid shrubland over *Hibbertia hypericoides* and *Mesomelaena pseudostygia* low shrubland.

Species List

Taxon	Height (cm)	Cover (%)
<i>Anigozanthos manglesii</i>		+
<i>Banksia attenuata</i>		2
* <i>Briza maxima</i>		2
<i>Burchardia congesta</i>		0.5
<i>Caladenia flava</i>		+
<i>Caladenia</i> sp.		+
<i>Corymbia calophylla</i>		12
<i>Cyanicula gemmata</i>		+
<i>Drosera erythrorhiza</i>		+
* <i>Ehrharta calycina</i>		3
<i>Eucalyptus marginata</i>		8
* <i>Gladiolus caryophyllaceus</i>		0.1
<i>Haemodorum</i> sp.		0.1
<i>Hibbertia huegelii</i>		0.3
<i>Hibbertia hypericoides</i>		10
<i>Hypocalymma angustifolium</i>		0.2
* <i>Hypochaeris glabra</i>		5
<i>Jacksonia sternbergiana</i>		1
<i>Leucopogon propinquus</i>		0.3

R02		
<i>Macrozamia riedlei</i>		7
<i>Mesomelaena pseudostygia</i>		5
<i>Poaceae</i> sp.		1.5
* <i>Solanum nigrum</i>		0.1
<i>Stirlingia latifolia</i>		2
<i>Stylidium piliferum</i>		+
<i>Trachymene pilosa</i>		0.2

Appendix 6
Black Cockatoo habitat tree locations

Tree No.	Species	DBH	Easting	Northing	Comments
1	Jarrah	54	386977	6486823	Forks at 3m
2	Marri	77	386972	6486824	
3	Marri	55	386994	6486850	Forks at 6m
4	Jarrah	77	386991	6486879	Forks at 1.5m
5	Marri	56	387027	6486880	Forks at 4m
6	Marri	70	387036	6486879	
7	Jarrah	98	386980	6486927	Forks at 3m
8	Marri	50	386987	6486970	
9	Jarrah	80	386998	6486043	Forks at 3m
10	Jarrah	62	386971	6486044	Forks at 4m
11	Jarrah	90	386921	6486002	
12	Jarrah	93	386900	6486984	Forks at 3m
13	Jarrah	70	386914	6486950	Forks at 4m
14	Jarrah	73	386917	6486936	
15	Jarrah	57	386904	6486908	Forks at 3m
16	Marri	54	386928	6486890	
17	Jarrah	74	386917	6486856	
18	Marri	65	386917	6486848	
19	Jarrah	52	386898	6486782	Forks at 5m
20	Jarrah	63	386890	6486801	Forks at 3m
21	Marri	60	386881	6486815	
22	Marri	54	386878	6486795	
23	Tuart	127	386862	6486804	
24	Jarrah	80	386870	6486794	Bees
25	Jarrah	56	386841	6486807	
26	Jarrah	73	386820	6486803	Forks at 2m
27	Marri	56	386813	6486801	
28	Jarrah	89	386826	6486819	Forks at 4m
29	Jarrah	99	386782	6486853	Forks at 2m
30	Marri	58	386778	6486851	Forks at 5m
31	Jarrah	60	386828	6486896	Forks at 2m
32	Jarrah	57	386821	6486894	Forks at 2m
33	Jarrah	90	386816	6486923	Forks at 2m
34	Jarrah	54	386785	6487045	Forks at 2m & 5m
35	Marri	60	386783	6487045	
36	Tuart	62	386756	6487057	
37	Marri	51	386714	6486966	
38	Jarrah	63	386688	6486928	Forks at 4m
39	Jarrah	72	386713	6486899	A few small hollows
40	Marri	55	386674	6486897	Forks at 3m
41	Jarrah	70	386664	6486908	
42	Jarrah	100	386657	6486909	
43	Marri	78	386669	6486086	Forks at 4m

Tree No.	Species	DBH	Easting	Northing	Comments
44	Jarrah	82	386668	6486887	Forks at 3m
45	Marri	56	386662	6486889	
46	Marri	54	386666	6486882	
47	Marri	75	386652	6486873	Forks at 8m
48	Marri	106	386649	6486862	
49	Marri	60	386649	6486808	
50	Marri	64	386635	6486874	
51	Marri	90	386630	6486862	
52	Marri	70	386621	6486855	
53	Marri	57	386621	6486856	Forks at 3m
54	Marri	67	386615	6486853	Forks at 5m
55	Marri	56	386618	6486847	
56	Tuart	162	386599	6486892	
57	Tuart	107	386575	6486902	
58	Tuart	92	386562	6486891	
59	Tuart	90	386544	6486875	
60	Tuart	120	386507	6486851	
61	Marri	65	386507	6486821	
62	Marri	57	386472	6486825	
63	Jarrah	127	386495	6486877	Forks at 1m
64	Tuart	128	386506	6486911	Forks at 2m
65	Jarrah	110	386525	6487018	Bees in hollow
66	Tuart	87	386575	6487065	
67	Tuart	106	386602	6487061	
68	Tuart	62	386582	6487050	Forks at 5m
69	Tuart	90	386581	6487028	Forks at 2m
70	Tuart	69	386599	6487054	
71	Tuart	58	386629	6486955	
72	Jarrah	61	386689	6486928	
73	Marri	52	387024	6486687	
74	Marri	62	387039	6486704	
75	Marri	87	387043	6486724	Forks at 6m
76	Jarrah	54	387051	6486710	Forks at 3m
77	Marri	62	387057	6486710	Forks at 5m
78	Marri	55	387061	6486700	Forks at 5m
79	Jarrah	52	387051	6486708	Forks at 6m
80	Marri	60	387071	6486716	Forks at 6m
81	Marri	60	387099	6486700	
82	Marri	51	387136	6486706	Forks at 4m
83	Jarrah	52	387150	6486675	
84	Jarrah	58	387164	6486645	Forks at 7m
85	Marri	52	387189	6486645	
86	Jarrah	64	387187	6486672	

Tree No.	Species	DBH	Easting	Northing	Comments
87	Marri	56	387098	6486670	
88	Marri	72	387226	6486675	
89	Marri	109	387215	6486708	
90	Marri	56	387196	6486723	
91	Marri	60	387180	6486732	
92	Jarrah	63	387216	6486723	
93	Jarrah	50	387268	6486703	Forks at 3m
94	Marri	62	387293	6486685	
95	Jarrah	63	387331	6486695	
96	Jarrah	70	387340	6486697	
97	Jarrah	58	387339	6486666	
98	Jarrah	70	387348	6486655	
99	Jarrah	59	387350	6486646	
100	Jarrah	56	387347	6486640	Forks at 3m
101	Jarrah	98	387339	6486637	
102	Marri	79	387317	6486756	Forks at 3m
103	Marri	70	387334	6486740	
104	Marri	57	387333	6486736	
105	Jarrah	87	387357	6486752	
106	Marri	73	387353	6486805	
107	Jarrah	56	387342	6486831	Forks at 2.5m
108	Jarrah	60	387342	6486831	Forks at 6m
109	Marri	62	387323	6486854	
110	Marri	69	387296	6486870	
111	Marri	58	387207	6486850	
112	Marri	59	387184	6486875	
113	Marri	111	387168	6486898	
114	Marri	107	387152	6486912	
115	Marri	71	387130	6486697	
116	Marri	56	387104	6486981	
117	Marri	55	387085	6486914	
118	Marri	56	387075	6486917	
119	Marri	95	387081	6486898	
120	Marri	64	387075	6486892	
121	Marri	72	387039	6486877	
122	Marri	56	387028	6486881	
123	Tuart	70	386542	6486869	
124	Tuart	100	386518	6486849	
125	Tuart	90	386544	6486836	

Appendix B Tuart Woodlands and Forests assessment

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Assessment of Tuart Woodlands and Forests of the Swan Coastal Plain TEC

1. Introduction

A detailed flora and vegetation survey was conducted over Lot 9000 Wanneroo Road, Sinagra (Project Area) in spring 2017 (Strategen 2017). Since the completion of the survey and reporting, the ecological community Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain, has been listed as a Threatened Ecological Community (Critically Endangered) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This community is considered to have the potential to occur within the Project Area. Given this, an assessment against the diagnostic criteria in the *Approved Conservation Advice (incorporating listing advice) for the Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community* (DoEE 2019) has been undertaken, using data collected in the 2017 survey (Strategen 2017).

2. Results

An assessment against the diagnostic criteria has been undertaken, Table 1 and Table 2. This assessment concludes that Tuart woodlands are present within the Survey Area, occurring across two separate patches (Figure 3.1). The total area of TEC within the Project area is 2.60 ha.

Areas mapped as Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain TEC, are also considered to represent the state level community Banksia Woodlands of the Swan Coastal Plain PEC. This listing is not subject to condition criteria. Given this, there is a total area of 2.60 ha within the survey area.

Table 1: Assessment of vegetation within the Survey Area against key diagnostic criteria for Tuart Woodlands of the Swan Coastal Plain TEC

Key diagnostic criteria (TSSC 2019)	Assessment of vegetation within the Survey Area
Location: Occurs in the Swan Coastal Plain Bioregion, Western Australia (IBRA v7. Department of the Environment 2012).	Yes. The Survey area is located within the Swan Coastal Plain Bioregion.
Soils and landform: Primarily occurs on the Spearwood and Quindalup dune systems, but can also occur on the Bassendean dunes and Pinjarra Plain. It can occur on the banks of rivers and wetlands.	Yes. The Survey area occurs on Spearwood dune system.
Structure and composition: Defining features include: <ul style="list-style-type: none"> the presence of at least two living established <i>Eucalyptus gomphocephala</i> (Tuart) trees in the uppermost canopy layer, although they may co-occur with trees of other species. a gap of no more than 60 m between the outer edges of the canopies of adjacent Tuart trees. These trees may occur either as single stemmed trees or as a mallee growth form. woodland structure, or other structural forms such as forest, open forest, woodland, open woodland, and various mallee forms an understorey of native plants which may include grasses, herbs and shrubs; though this is typically present, it is often modified by disturbance other tree species may be present in the canopy or sub-canopy, commonly including: <i>Agonis flexuosa</i> (Peppermint) and <i>Banksia grandis</i> (Bull Banksia) (both in the southern part of the range), <i>Banksia attenuata</i> (Candlestick Banksia), <i>Eucalyptus marginata</i> (Jarrah); and less commonly, <i>Corymbia calophylla</i> (Marri), <i>Banksia menziesii</i> (Firewood Banksia) and <i>Banksia prionotes</i> (Acorn Banksia). 	Yes. Vegetation within patches occur as a woodland to open woodland with at least two living established <i>Eucalyptus gomphocephala</i> (Tuart) trees in the uppermost canopy layer.

Table 2: Assessment of Tuart Woodlands patches against condition thresholds

Patch	Criteria						Result
	Assessment Sites	Area (ha)	Native Species Richness per 0.01ha	Proportion of native understorey cover per 0.01 ha	Density of large trees per 0.5ha	Condition (TSSC 2019)*	
1	Q04, R01 (not within patch but adjacent)	1.98 ha within Survey Area; patch extends beyond boundary of Survey Area to total area of 2.00 ha	19	90%	2.25	Very High	TEC present: <ul style="list-style-type: none"> Very high condition Patch has a habitat role Patch size ≥ 2 ha
2	Q04, R01 (not within patch but adjacent)	0.62 ha within survey area; patch extends beyond boundary of Survey Area to total area of 0.78 ha .	19	90%	4	Very High	TEC present: <ul style="list-style-type: none"> Very high condition Patch has a habitat role Patch size ≥ 2 ha

* Condition is based on criteria set out in Table 2 of Approved Conservation Advice (incorporating listing advice) for the Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain ecological community (DoEE 2019)

3. Conclusions

The project area contains 2.60 ha of the EPBC Act listed Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain TEC, a matter of national environmental significance (MNES). Should a proposal have the potential to have a significant impact on this community, a referral to the Department of the Environment and Energy should be considered. The recent listing of this community limits the ability to recommend likely significance of an action impact the Tuart Woodlands TEC, given the lack of preceding projects needing to consider the TEC. As such, it is difficult to determine the likely implications for the approval process.



Legend:

- Survey area
- Tuart woodlands TEC
- Cadastral boundary
- Roads (MRWA)



Job No: 57868

Client: Woodsome Management

Version: A

Date 12/12/2019

Drawn By: cthatcher

Checked By: TS

Scale 1:4,750



0 50 100
metres

**Lot 900 Wanneroo Rd
Perth, WA**

EXTENT OF TUART WOODLANDS TEC

FIGURE 1

4. References

Department of the Environment and Energy (DoEE), 2019, *Approved Conservation Advice (incorporating listing advice) for the Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community*, Canberra: Department of the Environment and Energy. Available from:
<http://www.environment.gov.au/biodiversity/threatened/communities/pubs/153-conservation-advice.pdf>.

Strategen Environmental (Strategen), 2017, *Lot 9000 Corner Wanneroo and Dundobar Roads, Sinagra – Flora, vegetation and Black Cockatoo habitat survey*, unpublished report prepared for The Order of the Servants of Mary Incorporated C/- Woodsome Management Pty Ltd.



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