Department of Education

Wellard Village Primary School

Environmental Offset Plan (EPBC 2020/8732)

6 October 2021

59050-134903 (Rev 2)

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

www.jbsg.com.au

Table of Contents

List of Tables

List of Figures

Appendices

1. Introduction

1.1 Project background

The Western Australian Department of Education (DoE; the Proponent) is proposing to develop part of Lot 9074 Lambeth Circle, Wellard as a primary school (the Proposed Action). The site is located within the City of Kwinana, approximately 35 km south of Perth.

The proposed primary school will include the following elements:

- Playing courts
- Teaching blocks
- Administration buildings
- Sporting oval
- Car parking.

The site is currently zoned as both "Urban" and "Public purposes – high school" under the Metropolitan Region Scheme (MRS), and as both "Residential" and "Public purposes – high school" under the City of Kwinana Local Planning Scheme (LPS) No. 2.

The Proposed Action was referred to the Department of Agriculture, Water and the Environment (DAWE) under the *Environmental Protection and Biodiversity Act 1999* (EPBC Act) in July 2020 (referral number 2020/8732). The Proposed Action has been determined by DAWE to be a controlled action and is currently being assessed through preliminary documentation.

While the primary school footprint will cover a total area of 5 ha (the Proposed Action Area; Figure 1.1), the area of impact to Matters of National Environment Significance (MNES) is limited to the portion of the footprint containing black cockatoo habitat and the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community (Tuart Woodlands TEC).

In addition, engineering works along the north-eastern site boundary may result in indirect impacts to adjacent vegetation within the balance of Lot 9074 and within the adjacent road reserves (Lambeth Circle and Brentford Parade). As such, a buffer has been applied to the impact area, to include these additional potential indirect impact areas.

In total, the potential area of impact to MNES is 3.56 ha. This area assumes complete loss and does not take into account the 0.26 ha of MNES potentially retained (avoided) as mature trees within the primary school development, thus the impact area is likely overstated. A breakdown of the impacts to MNES in provided in Table 1.1.

Table 1.1: Breakdown of MNES potentially impacted by the Proposed Action

MNES	Directly impacted	Potentially impacted/ retained	Total
Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain Threatened Ecological Community (TEC).	2.723 ha	0.316 ha	3.039 ha
Black cockatoo foraging/ roosting habitat	2.556 ha	0.529 ha	3.085 ha
Black cockatoo significant trees	36	8	44 (including two potentially suitable black cockatoo hollows)

1.2 Offset for impacts to Matters of National Environmental Significance

Based on the outcomes of the environmental impact assessment undertaken to support the Proposed Action including application of the mitigation hierarchy, it is anticipated that the following significant residual impacts will be required to be offset:

- 3.039 ha of Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community (Tuart Woodlands TEC) - listed as Critically Endangered
- Two potentially suitable black cockatoo breeding hollows
- 3.085 ha confirmed roosting habitat for the Forest Red-tailed Black Cockatoo (FRTBC).

Given the known distribution of each south-western black cockatoo species, and the large expanses of quality habitat in nearby conservation areas, most important of which is the Leda Nature Reserve (located approximately 500 m from the Proposed Action Area), it is highly unlikely that there will be significant residual impacts to black cockatoo foraging habitat following implementation of the Proposed Action. The Leda Nature Reserve covers a total area of 1,133 ha (much of which is vegetated with suitable habitat for all three species) and is protected as a Bush Forever area (Site: 349).

1.3 Purpose and scope of this plan

The purpose of this Environmental Offset Plan (EOP) is to detail the proposed strategy to offset significant impacts to the MNES listed in Section 1.2.

This EOP outlines the conservation and management commitments associated with the proposed offset strategy, to assist with facilitating approval under the EPBC Act.

This EOP has been prepared in accordance with *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012; see Table 4.1) and with consideration of the following documents:

- *Approved Conservation Advice (incorporating listing advice) for the Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community* (DoEE 2019)
- *Approved Conservation Advice for Calyptorhynchus banksii naso (Forest Red-tailed Black Cockatoo)* (Department of the Environment, Water, Heritage and the Arts 2009)
- *Forest Black Cockatoo (Baudin's Cockatoo Calyptorhynchus baudinii and Forest Red-tailed Black Cockatoo Calyptorhynchus banksii naso) Recovery Plan* (DEC 2008)

It is noted that this offset strategy is draft only and is subject to endorsement by the Commonwealth Minister for the Environment and State Minister for Education and Training, prior to this document being finalised.

388700 388800 388900 389000

6429200 6429100 6429000 6428900 6428800

BRENTFORD PDE
HORNSBY L
HENDON VSTA
LEDA BVD
ENFIELD L
FINCHLEY WY
POTTERS L
LAMBETH CIR
ANCROFT RD
AMBLE L
SOMERFORD PROM
WOOLER L

Legend

- Proposed action area
- Cadastral boundary
- Potential indirect impact area
- Roads (MRWA)

strategen JBS&G

0 50
metres

Wellard Village Primary School
Perth, WA

PROPOSED ACTION AREA

Job No: 59050		Scale 1:1,500 at A3		
Client: Department of Education		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: jcrute	Checked By: CT	Version: A	Date: 14-Apr-2021	**FIGURE: 1.1**

Document Path: W:\Projects\1)Open\Dept of Education\59050 Wellard Village Primary School EPBC Referral\GIS\Maps\R04_Rev_A\59050_01_01_A3_ActionArea.mxd
Image Reference: www.nearmap.com© - Imagery Date: 09. March 2021.

2. Proposed offset

This offset strategy has been developed based on advice from DAWE (including feedback provided to DAWE from Murdoch University), consultation with the City of Kwinana and the Department of Planning, Lands and Heritage.

The extent of the proposed offset relative to Tuart Woodland TEC and FRTBC roosting habitat has been determined using DAWE's offset calculator (see Section 2.6) which concluded that the proposed offset strategy will directly offset 98 % and 96% of the impact to Tuart Woodland TEC and FRBCT roosting habitat, respectively.

The offset ratio (3:1) for the loss of two potentially suitable hollows for black cockatoo breeding has been determined based on advice from DAWE.

The offset strategy being proposed includes four components:

1. Rehabilitation and protection of 8.5 ha of Reserve 39964, adjacent to Thomas Road and west of the Spectacles Wetlands (Section 2.2)
2. Protection of 4 ha of vegetation within Lot 164 on Plan 055190 (the Department of Education's landholding) via a conservation covenant (if required) and transfer to the City of Kwinana for inclusion in the conservation estate (Section 2.3)
3. Installation of six artificial black cockatoo breeding hollows, within a known breeding location of the FRTBC, as determined in consultation with Birdlife and/ or DBCA (Section 2.4)
4. Rehabilitation and protection of (an) additional site/s, to account for all remaining significant residual imapcts to FRTBC habitat, and Tuart Woodlands TEC, up to the 100% requirement (Section 2.5).

The location of the offset sites associated with components 1 and 2 above, are presented in Figure 2.1, along with the location of Conservation Category and Resource Enhancement geomorphic wetlands, mapped regional ecological linkages for contextual purposes.

Additionally, potentially suitable offset sites that may meet the requirements of component 4 have been presented in Figure 2.1 and Figure 2.3.

2.1 Local conservation outcome

The proposed offset sites listed above are located approximately 4.5 km and 1 km of the Proposed Action Area, respectively, and thus provide a local conservation outcome through the protection and enhancement of Tuart Woodland TEC and potential FRTBC roosting habitat that is otherwise not afforded formal protection.

It is noted that as a result of the confirmed FRTBC roost site located within the Proposed Action Area, DAWE have advised that a local offset must be provided (within 5 – 10 km of the Proposed Action Area), based on advice received from Murdoch University.

The proposed offset sites are located within the City of Kwinana local government area (LGA) and thus contribute toward achieving local biodiversity and urban forest objectives/ targets within the same LGA as the Proposed Action Area.

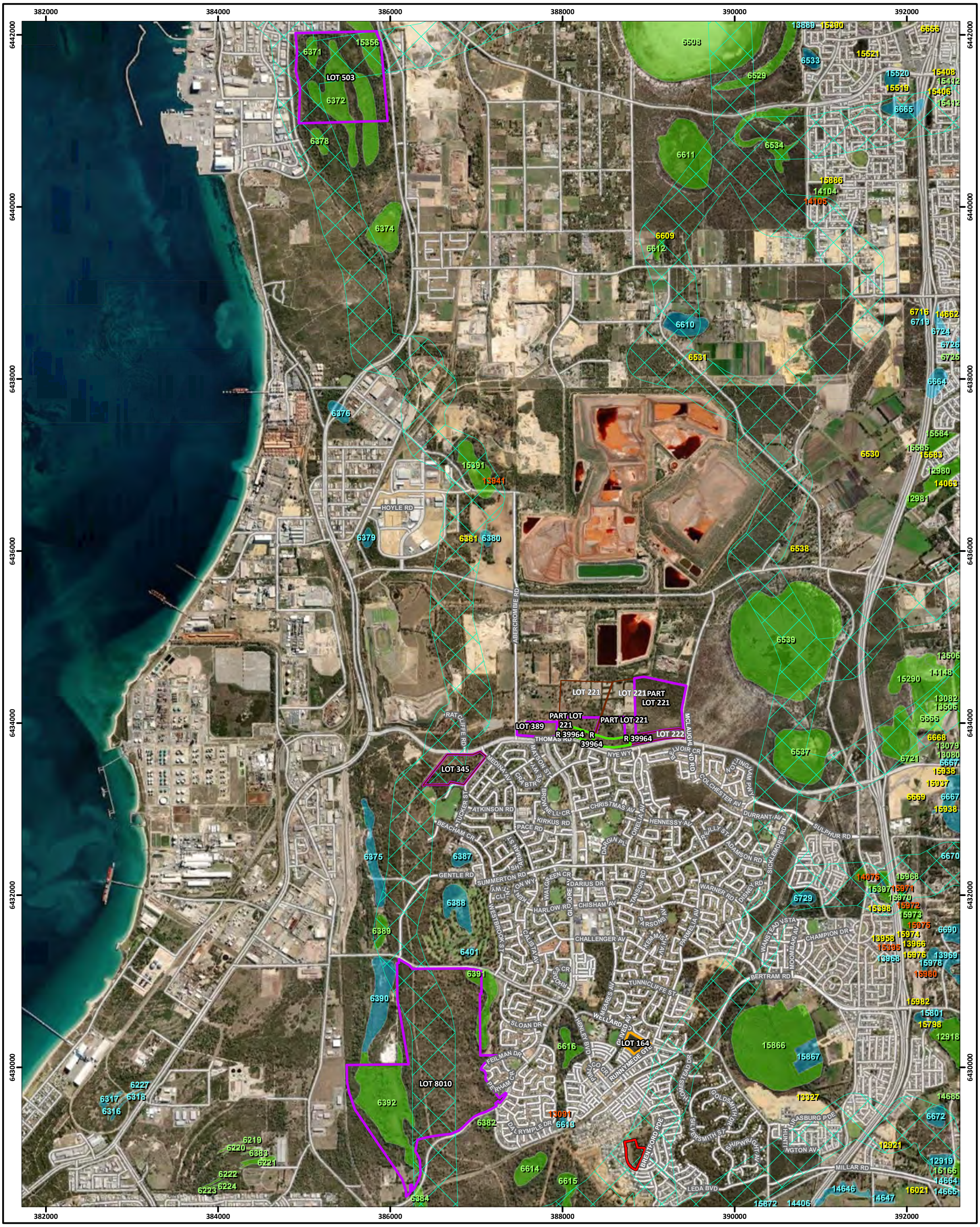
The City of Kwinana have expressed a desire to form an ecological corridor north of, and parallel to Thomas Road, which connects the two mapped regional ecological linkages (see Figure 2.1). The connection of these two mapped regional ecological linkages was identified in *Towards Establishing a Green Network* (WALGA 2014), which outlines that the establishment of effective east-west linkages within the study area (six LGAs, south of the Swan River) should be a high priority (WALGA 2014). WALGA (2014) specifically identified vegetation within Parks and Recreation reserves and

other lands adjoining Thomas Road between Bush Forever Site 349 and Bush Forever Site 269 as providing the first good opportunity for the east-west connection between protected areas south of the Swan River (WALGA 2014).

Through connecting these linkages, fauna will be able to travel east-west between Bush Forever Site 269 (the Spectacles Wetlands which is part of a chain of wetlands that form the Beeliar Regional Park) and Bush Forever Site 349 (which connects to Leda Nature Reserve). The proposed rehabilitation and protection of Reserve 39964 will assist in enhancing a portion of this proposed ecological corridor. Additionally, the City of Kwinana have advised that they do not currently have adequate resources to undertake rehabilitation works of Reserve.

The Proponent will consider opportunities to involve community and school groups in the rehabilitation works of Reserve 39964. This will require safety considerations, as well as consultation with the City of Kwinana. Following consultation, any community/ school group involvement can be documented within a future rehabilitation management plan and/ or management agreement.

In addition, the proposed offset sites are located in close proximity to known black cockatoo roosting sites. The protection and rehabilitation of the proposed offset sites will ensure that potential roosting and foraging habitat is available, protected and enhanced within the local area in perpetuity.



Legend

- Proposed action area
- Lot boundary
- Potential offset sites – to be confirmed
- Proposed offset site 1
- Proposed offset site 2
- Regional ecological linkages

Geomorphic Wetlands (DBCA)
- Conservation
- Resource enhancement

Roads (MRWA)

strategen JBS&G

0 1 Kilometres

Wellard Village Primary School
Perth, WA

LOCATION OF PROPOSED OFFSET SITES

Job No: 59050		Scale 1:40,000 at A3	
Client: Department of Education		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: jcrute	Checked By: CT	Version: A	Date: 25-Aug-2021

FIGURE: 2.1

Document Path: W:\Projects\1)Open\Dept of Education\59050 Wellard Village Primary School EPBC Referral\GIS\Maps\R04_Rev_A\59050_02_01_A3_OffsetSites.mxd

Image Reference: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

2.2 Offset component 1: Part of Reserve 39964

2.2.1 Location, ownership and tenure

Reserve 39964 is located approximately 4.5 km, directly north the Proposed Action Area and is currently zoned "Public Purposes- Special Use" under the Metropolitan Region Scheme. The Department of Planning, Lands and Heritage (DPLH) are the Responsible Authority of the reserve, which is managed by the City of Kwinana in accordance with a management order. Reserve 39964 is not afforded any formal protection (i.e. conservation zoning or conservation covenant). Both DPLH and the City of Kwinana have provided in principle support for rehabilitation and protection of Reserve 39964 (see Appendix A).

Due to limited funding and resources, the City of Kwinana currently only actively managed the eastern portion of the reserve and are not in a position to rehabilitate degraded parts of the reserve. The proposed offset site comprises approximately 8.5 ha of the western portion of the reserve (see Figure 2.2).

2.2.2 Surrounding context

Reserve 39964 is located immediately west of The Spectacles conservation category wetlands (CCWs) which are sumplands and thus are seasonally inundated. A number of additional CCWs and Resource Enhancement Wetlands (REWs) occur within 5 km of the proposed offset site.

As outlined in Section 2.1, the proposed offset site is located between Bush Forever Site 269 (the Spectacles Wetlands) and Bush Forever Site 349 (which connects to Leda Nature Reserve).

Reserve 39964 is located within the known range of the Tuart Woodland TEC and the FRTBC.

The nearest confirmed roost sites for the FRTBC are located approximately 3 km south and also 3.7 km east of the proposed offset site.

2.2.3 Existing environment

Regional vegetation mapping identifies Reserve 39964 as comprising the Spearwood 998 vegetation association, which is characterised by medium woodland; tuart (GoWA 2019; refer Figure 2.3). Additionally, broad scale mapping of the Tuart Woodland TEC (DBCA 2018) identifies the Tuart Woodland TEC as likely to occur within the proposed offset site (see Figure 2.3).

While a formal ecological survey has not yet been undertaken, the City of Kwinana have confirmed that the proposed offset site contains Tuart woodland vegetation in a degraded condition (see City of Kwinana mapping at Appendix B). Plate 1 below shows an image of the vegetation structure which comprises mature Tuart trees over an understorey with assumably low native species diversity and a high density of weeds (Google Maps 2017).

A formal flora, vegetation and black cockatoo habitat survey will be undertaken prior to rehabilitation works commencing.

Plate 1: Image of vegetation structure within western portion of Reserve 39964

2.2.4 Threatening processes

As outlined in Section 2.2.1, the proposed offset site within Reserve 39964 is not currently zoned for conservation purposes, nor is there a conservation covenant applicable to the land. As such, there is a threat to vegetation and habitat associated with clearing for land uses permissible under the current zoning, as is evident within Lot 221 immediately north of Reserve 39964 which has been cleared for agricultural and market gardening purposes.

The site appears to be heavily dominated by weeds which are likely outcompeting native species and preventing any natural generation. As a result, the native species diversity of the understorey vegetation appears low.

There is a risk to vegetation and habitat within the proposed offset site associated with unauthorised pedestrian and vehicular access, which increases the risk of degradation through trampling and the spread of weeds and dieback.

2.2.5 Rationale of selection of the offset site

Reserve 39964 is located within 5 km of the Proposed Action Area, within the City of Kwinana and the Swan Coastal Plain region, consistent with the Proposed Action Area. Additionally, the proposed offset site is located within the same mapped pre-European vegetation complex and association, being broadly classified as “medium woodland; tuart” (GoWA 2019) and “mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri); closed heath on the Limestone outcrops”.

The proposed offset site is located within the mapped distribution of both the Tuart Woodland TEC and the FRTBC.

Given the above, the proposed offset site provides a like-for-like offset with consideration of the geographical context and environmental values of the Proposed Action Area.

The proposed offset site is known to contain Tuart woodland and highly likely to contain Tuart Woodland TEC. Through implementing a conservation covenant and rehabilitation works across the site, the offset strategy provides the opportunity to protect and enhance the existing Tuart Woodland vegetation. As a result of the likely high weed density and low native species diversity of the proposed offset site, it is anticipated that rehabilitation will improve the Tuart Woodland TEC condition from assumably Poor quality to a higher quality, consistent with the *Approved*

Conservation Advice (incorporating listing advice) for the Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community (DoEE 2019).

The proposed rehabilitation works will also enhance understorey FRTBC foraging habitat through increasing the diversity and density of FRTBC foraging species. The rehabilitation works will include an increase in the density of Tuart trees which will also provide future potential breeding and roosting habitat.

It is anticipated that improving the quality of FRTBC foraging habitat will increase the likelihood of the FRTBC roosting in the existing mature Tuart trees within the reserve. This assumption is supported by the fact that black cockatoos rely upon the availability of suitable night roosting sites in proximity to foraging resources, and particularly on access to water, which are usually within 2 km of the roost (DoEE 2017).

Given that the FRTBC is known to roost and forage in the local area, rehabilitation of the proposed offset site will provide a higher density and diversity of foraging habitat for black cockatoos roosting in close proximity to the proposed offset site and surrounding wetlands, and thus will increase the value of surrounding roost sites to the FRTBC, in addition to the proposed offset site itself.

Additionally, Rehabilitation will include suitable roosting and breeding species for the FRTBC and therefore may provide additional roosting and breeding habitat in the future.

As outlined in Section 2.1, the establishment of effective east-west linkages should be a high priority (WALGA 2014). WALGA (2014) specifically identified vegetation within Parks and Recreation reserves and other lands adjoining Thomas Road between BF349 and BF269 as providing the first good opportunity for the east-west connection between protected areas south of the Swan River (WALGA 2014). Fauna will be able to travel east-west between Bush Forever Site 269 (the Spectacles Wetlands) and Bush Forever Site 349 (which connects to Leda Nature Reserve).

The proposed rehabilitation and protection of Reserve 39964 will assist in enhancing and protecting a portion of this proposed ecological corridor. Additionally, the City of Kwinana have advised that they do not have adequate resources to undertake rehabilitation works of Reserve 39964 without the assistance of the Proponent.

Legend

- Reserve 39964
- Proposed offset site 1- Part Reserve 39964 (8.5 ha)
- Roads (MRWA)

strategen JBS&G

0 100 metres

Job No: 59050		Scale 1:6,000 at A3		**Wellard Village Primary School Perth, WA**
Client: Department of Education		Coord. Sys. GDA 1994 MGA Zone 50		**PROPOSED OFFSET SITE 1 - PART RESERVE 39964**
Drawn By: jcrute	Checked By: CT	Version: A	Date: 14-Apr-2021	**FIGURE: 2.2**

Document Path: W:\Projects\1)Open\Dept of Education\59050 Wellard Village Primary School EPBC Referral\GIS\Maps\R04_Rev_A\59050_02_02_A3_OffsetSite1.mxd

Image Reference: www.nearmap.com© - Imagery Date: 09. March 2021.

382000 384000 386000 388000 390000 392000

6442000 6440000 6438000 6436000 6434000 6432000 6430000

LOT 503
LOT 222
PART LOT 221
PART LOT 221
LOT 389
R 39964
R 39964
R 39964
PART LOT 221
LOT 345
LOT 164
LOT 8010

Legend

- Proposed action area
- Lot boundary
- Potential offset sites – to be confirmed
- Proposed offset site 1
- Proposed offset site 2
- Tuart woodland TEC mapping

Vegetation association

- Bassendean_1001
- Pinjarra_968
- Rockingham_3048
- Spearwood_1001
- Spearwood_51
- Spearwood_6
- Spearwood_998

strategen JBS&G

0 1 Kilometres

Wellard Village Primary School
Perth, WA

BROAD SCALE VEGETATION MAPPING

Job No: 59050		Scale 1:40,000 at A3		
Client: Department of Education		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: jcrute	Checked By: CT	Version: A	Date: 25-Aug-2021	**FIGURE: 2.3**

Document Path: W:\Projects\1)Open\Dept of Education\59050 Wellard Village Primary School EPBC Referral\GIS\Maps\R04_Rev_A\59050_02_03_A3_Veg.mxd

Image Reference: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

2.3 Offset component 2: Lot 164 on Plan 055190

2.3.1 Location, ownership and tenure

Lot 164 is located less than 1 km, directly north the Proposed Action Area and is currently zoned "Urban" under the Metropolitan Region Scheme. This site is owned by the Department of Education and was previously identified as a potential school development site. This site is not currently afforded any formal protection (i.e. conservation zoning or conservation covenant) and is not actively managed.

The proposed offset site is approximately 4 ha in size (see Figure 2.4).

2.3.2 Surrounding context

Lot 164 is located less than 500m east of Henley Bushland which is a known FRTBC and "white tail" roost site (Birdlife code: KWIWELR001). Additionally, Lot 164 is located approximately 850 m north-east of Runnymede Bushland, which is a known "white tail" roost site (Birdlife code: KWIWELR002). It is possible therefore that parts of the proposed offset area may be used as a staging site for these roosts, as black cockatoos gather at dusk in preparation for roosting.

Henley Bushland contains a conservation category wetland (CCW) which is a sumpland and thus is seasonally inundated. A number of additional CCWs and Resource Enhancement Wetlands (REWs) occur within 5 km of the proposed offset site.

Lot 164 is located within the known range of the Tuart Woodland TEC and the FRTBC.

2.3.3 Existing environment

A formal flora, vegetation and black cockatoo habitat assessment was undertaken on 11 September 2020 by Strategen-JBS&G (see Appendix C).

The assessment identified that the proposed offset site contains:

- 3.13 ha of the Tuart woodland TEC in a Very High condition (in accordance with DoEE 2019);
- 2.91 ha of the EPBC Act listed Banksia Woodlands of the Swan Coastal Plan TEC; and
- 2.91 ha of low- moderate foraging habitat for the FRTBC
- FRTBC roosting habitat in the form of tall Jarrah, Marri and Tuart trees
- 77 significant trees with a suitable diameter at breast height (≥ 500 mm); 21 Jarrah, 32 Marri and 24 Tuart, of which, five trees contained hollows potentially suitable for black cockatoo breeding.

2.3.4 Threatening processes

As outlined in Section 2.3.1, the proposed offset site is not currently zoned for conservation purposes, nor is there a conservation covenant applicable to the land. As such, there is a threat to vegetation and habitat associated with clearing for future development of this land, which may occur as a result of Urban development.

There is also a risk to vegetation and habitat within the proposed offset site associated with unauthorised access, which increases the risk of degradation through trampling, bushfire and the spread of weeds and dieback.

2.3.5 Rationale of selection of the offset site

The proposed offset site is located within 5 km of the Proposed Action Area, within the City of Kwinana boundary and is located upon the Swan Coastal Plain, consistent with the Proposed Action Area. The proposed offset site is located within the mapped distribution of both the Tuart Woodland TEC and the FRTBC.

Additionally, the proposed offset site has been confirmed to contain the Tuart Woodland TEC in a very high condition based on the condition categories outlined in DoEE 2019. The site also contains FRTBC foraging, potential roosting and potential breeding habitat.

Given the geographical context and environmental values, the proposed offset site provides a suitable offset with consideration of the residual impacts associated with the Proposed Action.

Through vesting of the site with the City of Kwinana for conservation purposes (and/or the implementation of a legally binding conservation covenant) and conservation fencing around the vegetation within the site, there is opportunity to protect the existing Tuart Woodland TEC and black cockatoo habitat.

Additionally, the proposed offset site offers higher vegetation conservation value than the Proposed Action Area, not only due to the higher quality of the Tuart Woodland TEC but due to the presence of the Banksia Woodlands of the Swan Coastal Plain TEC.

Black cockatoos rely upon the availability of suitable night roosting sites in proximity to foraging resources, and particularly on access to water, which are usually within 2 km of the roost (DoEE 2017). Given the close proximity of the proposed offset site to known roost sites, it is possible that parts of the proposed offset area may be used as a staging site, as black cockatoos gather at dusk in preparation for roosting. Additionally, given that the FRTBC is known to roost and forage in the local area, protection of the proposed offset site will ensure that foraging habitat for black cockatoos roosting in close proximity to the proposed offset site and surrounding wetlands, will be secured in perpetuity.

2.4 Offset component 3: Installation of artificial black cockatoo breeding hollows

The Proponent will fund and coordinate the installation of a minimum of six artificial black cockatoo hollows (3:1 ratio). These hollows will be installed at a location within the known breeding range of the FRTBC, determined in consultation with Birdlife and/ or DBCA.

The six artificial black cockatoo hollows will be monitored on an annual basis for ten years to determine if successful black cockatoo breeding has occurred within the hollows. Results of the monitoring events will be provided to DAWE, annually.

Should the artificial nesting hollows show signs of use by black cockatoos in the ten year period, then monitoring and maintenance should be increased for an additional five years.

2.5 Offset component 4: Additional local rehabilitation and protection

Following the implementation of offset components 1 and 2 as detailed above, it is anticipated that 72.54% and 88.42% of significant residual impacts to Tuart Woodlands TEC, and FRTBC, will be offset respectively (Table 2.2 and Table 2.3). As such, additional offsets will be required to ensure that 100% of significant residual impacts are offset.

To this end, the DPLH, Department of Primary Industries and Regional Development (DPIRD), and DBCA were each consulted with the objective of identifying a suite of sites within the City of Kwinana local government area that could be formally protected and/or rehabilitated, to offset the remaining 27.46% and 11.58% of imapcts to Tuart Woodlands and FRTBC, respectively. A total of six sites were identified, all of which are located within the City of Kwinana. These are displayed in Figure 2.1 and Figure 2.3, and are listed in Table 2.1 below.

Table 2.1: Potential additional offset sites

Lot no.	Address	Area	Title	Crown Reserve	Reserve Purpose	Management Order
Lot 503	UCL – West of Rockingham Rd	~104 ha	LR3156/911	N/A	Unallocated crown land	N/A – managed by Dept of Planning Lands and Heritage
Lot 345	UCL – South of Thomas Rd	~17 ha	LR3151/582	N/A	Unallocated crown land	N/A -managed by Dept of Planning Lands and Heritage
Lot 8010	UCL – North of Gilmore Av	~250 ha	LR3164/415	N/A	Unallocated crown land	N/A -managed by Dept of Planning Lands and Heritage
Part Lot 221	45 McLaughlan Road, POSTANS	~30 ha on eastern side of lot	LR3120/385	Part Reserve 26294	For the purpose of Biosecurity and Agricultural Management Act 2007	WESTERN AUSTRALIAN AGRICULTURE AUTHORITY
Part Lot 221	45 McLaughlan Road, POSTANS	~15 ha in south - west corner of lot	LR3120/385	Part Reserve 26294	For the purpose of Biosecurity and Agricultural Management Act 2007	WESTERN AUSTRALIAN AGRICULTURE AUTHORITY
Lot 389	10 Abercrombie Road, POSTANS	~7 ha	LR3137/395	Part Reserve 28564	For the purpose of Biosecurity and Agricultural Management Act 2007	WESTERN AUSTRALIAN AGRICULTURE AUTHORITY

In order to incorporate the above sites into the offsets package, site specific ecological assessments will need to be undertaken, and agreements must be reached between the Proponent and the relevant land owner and management authority. Noting that additional time is required to undertake these tasks, a second EOP is proposed to be developed as a condition of the EPBC approval, which will detail how these offsets will be implemented. It is anticipated that rehabilitation will also be required for this offset component, and as such a second RMP will be developed to guide how this rehabilitation will be undertaken.

Both the second EOP and RMP will submitted for approval within 12 months after commencement of the action, and will be subject to annual auditing in accordance with the conditions of approval.

388700 388800 388900 389000 389100

6430500 6430400 6430300 6430200 6430100 6430000

DARKINS RTT
CONELLAN TCE
SKOTTOWE PWY
CAMBEY MEWS
MCGOLDRICK PL
PARMELIA AV
THE RAMBLE
LOT 164
WELLARD RD
CLIVEDEN AV
HURLEY WY
WELLARD VILLAGE ROW 1
COOKHAM GRN
SONNING L
WELLARD VILLAGE ROW 2
CHARVIL MEWS
RUNNYMEDE GTE
ESHER L
DITTON CNR
SHEPPERTON ST
WEYBRIDGE DR
SPELTHORNE WY
ADDLESTONE BR
EGHAM L
SURBITON APP
WELLARD VILLAGE ROW 3
OATLANDS VSTA
SUNBURY LINK

388700 388800 388900 389000 389100

Legend

- Cadastral boundary
- Proposed offset site 2
- Roads (MRWA)

strategen JBS&G

0 50 metres

Wellard Village Primary School
Perth, WA

Job No: 59050		Scale 1:1,800 at A3		**PROPOSED OFFSET SITE 2 - LOT 164 ON PLAN 055190**
Client: Department of Education		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: jcrute	Checked By: CT	Version: A	Date: 06-Apr-2021	**FIGURE: 2.4**

Document Path: W:\Projects\1)Open\Dept of Education\59050 Wellard Village Primary School EPBC Referral\GIS\Maps\R04_Rev_A\59050_02_04_A3_OffsetSite2.mxd
Image Reference: www.nearmap.com© - Imagery Date: 09. March 2021.

2.6 Offset assessment guide

The *Offsets Assessment Guide* and the associated offset calculator (Appendix D) was used to assess the suitability of the selected offset sites to compensate for the loss of Tuart Woodland TEC and FRTBC roosting habitat.

Justification of the values utilised in the offset calculations (Appendix D), are included in Table 2.2 for Tuart Woodland TEC and Table 2.3 for FRTBC roosting habitat. Using these input values, the offset calculator determined that vesting Lot 164 with the City of Kwinana for conservation purposes, as well as rehabilitating 8.5 hectares of vegetation/ habitat within Reserve 39964, will account for 72.74% and 88.42% of the impact to Tuart Woodland TEC and FRBCT roosting habitat (respectively), required to be directly offset under the EPBC Act *Environmental Offsets Policy* (DSEWPaC 2012).

This section does not include calculations or justification for offsetting black cockatoo breeding hollows, as the offset ratio for this habitat was determined by DAWE (3:1 ratio).

Table 2.2: Tuart Woodland TEC Offset Calculator inputs

Criteria	Response
Impact site (Proposed Action Area)	
Area	3.039 ha.
Quality	A quality score of 4 has been nominated based on: • The native species richness recorded within the patch (6 native understory species per 0.01 ha) • The TEC is considered to be in a Moderate condition, as per the approved conservation advice • The vegetation has been mapped as being in a Degraded condition according to the Keighery (1994) scale. In consideration of Keighery (1994) and Trudgen (1988) systems of vegetation condition classification, a scoring tool has been developed (provided at Appendix E) which endeavours to align these vegetation condition classifications, with the Tuart TEC condition thresholds presented in the Approved Conservation Advice, and those values available within the offset calculator. The quality of the impact site is considered to be "4", which represents a Moderate TEC condition, and a Degraded to Good vegetation condition.
Offset component 1: transfer of Lot 164 on Plan 055190 to City of Kwinana for purpose of conservation	
Risk-related time horizon	A value of 20 years has been nominated, as this is the timeframe associated with a conservation covenant.
Start area (ha)	3.13 ha
Risk of loss without offset.	A value of 10% has been nominated as this site is located within a built-up residential area, is zoned Urban under the Metropolitan Region Scheme and is owned by the Department of Education. The current ownership, zoning and (lack of) protection of the site does not preclude the proposed offset site from being subject to future subdivision and development. The Department of Education are currently assessing options for development of the site and therefore there is a high risk of loss, without the offset. It is noted that incremental development of the site for different purposes may avoid a future EPBC Act referral or subsequent controlled action decision, and thus avoid the impacts to MNES being offset.
Risk of loss with offset.	A value of 0% has been nominated based on the anticipated application of a legal conservation covenant.
Confidence in result (top row)	80% has been nominated as: • The site will be protected via a conservation covenant and managed by the local government (pending their approval/ acceptance) • The site has been subject to a flora and vegetation assessment, and the area of Tuart TEC has been quantified.

Criteria	Response
Time until ecological benefit.	2 years to allow for application of conservation covenant, transfer of the site to the City of Kwinana, and provision of funding to the City.
Start quality	A quality of 7 has been nominated, as the offset contains Tuart Woodland TEC of High quality (as per the criteria outlined in the TEC conservation advice).
Future quality without offset.	A value of 6 has been nominated for the future quality without the offset, as the habitat could be degraded through undesirable pedestrian / domestic pet access, as well as further spread of weeds and potential dieback spread, without access management.
Future quality with offset	A ''future quality with offset'' value of 7 is nominated as it is anticipated that the condition of the TEC will remain the same, and further degradation will be prevented through the implementation of onfoinf management initiatives, as detailed in Section 3.2.2
Confidence in result (bottom row)	A value of 80% has been nominated based on: • Confidence that a conservation mechanism will be in place within 2 years based on landowner support/ permission • A site specific, scientific survey has been undertaken to confirm vegetation/ TEC quality.
% of impact offset	20.12 %
Offset component 2- Rehabilitation of DPLH land management by the City of Kwinana, north of Thomas Road and west of the Spectacles wetland	
Risk-related time horizon	A value of 20 years has been nominated, as this is the timeframe associated with a conservation covenant.
Start area (ha)	8.5 ha
Risk of loss without offset.	A value of 10% has been nominated as this site is zoned Special Use under the Metropolitan Region Scheme and is not currently afforded formal protection. Although this site is currently under a management order (responsibility of the City of Kwinana), the current zoning and (lack of) protection of the site does not preclude the proposed offset site from being subject to future development/ destruction. It is also noted that while the City actively manage vegetation to the west of the proposed offset site, the City does not have the funding/ resources to manage/ rehabilitate the area that has been nominated as an offset site. Tuart TEC has been confirmed to be present within the site. A memorandum detailing the methodology and results of an ecological assessment across the site is presented in Appendix H.
Risk of loss with offset.	A value of 0% has been nominated based on the anticipated application of a legal conservation covenant.
Confidence in result (top row)	75% has been nominated as: • The site is currently under a management order, however the City do not have the resources/ funding to undertake rehabilitation or actively manage the site • While the site is currently a "Reserve" under the MRS, there is no formal conservation protection in place • The site will be protected via a conservation covenant (if required) • There is high confidence in the top row values of the offset calculator.
Time until ecological benefit.	20 years to allow for establishment of planted native vegetation and to achieve a higher TEC quality, as per the criteria outlined in the conservation advice.
Start quality	A quality of 2 has been nominated, as the offset contains Tuart Woodland TEC of Poor quality (as per the criteria outlined in the TEC conservation advice), noting the understory is dominated by weeds and contains very few native species. This value has also been determined based on the Keighery (1994) and Trudgen (1988) methodology for assessing vegetation condition. A breakdown of the quality

Criteria	Response
	assessment methodology is provided in Appendix E. In this case, a quality score of 2 represents a Poor Tuart TEC condition threshold, and a Degraded vegetation condition.
Future quality without offset	A value of 2 has been nominated for the future quality without the offset, as the overstorey of mature trees is established and the quality of the TEC (as per the conservation advice) is "Poor" at a minimum based on the size of the TEC patch (being >5 ha). Without any active management or rehabilitation, the quality of the offset site is highly unlikely to improve.
Future quality with offset	A ''future quality with offset'' value of 6 is nominated as it is anticipated that the rehabilitation will achieve a quality of "High" consistent with the Tuart TEC conservation advice through increasing native understorey species diversity as per the measures and completion criteria detailed in Section 3.1.
Confidence in result (bottom row)	A value of 65% has been nominated based on: • Confidence that a conservation mechanism will be in place within 2 years based on landowner support/ permission • A site specific, scientific survey has now been undertaken to confirm vegetation/ Tuart TEC quality • Rehabilitation works will be required to achieve completion criteria in accordance with an approved management plan.
% of impact offset	52.42 %
Total % of impact offset (Offset 1 + Offset 2)	**72.54%**

Table 2.3: FRTBC roosting habitat Offset Calculator inputs

Criteria	Response
Impact site (Proposed Action Area)	
Area	3.085 ha.
Quality	• A quality score of 8 has been nominated based on the habitat being a confirmed roost site.
Offset component 1- transfer of Lot 164 on Plan 055190 to City of Kwinana for purpose of conservation	
Risk-related time horizon	A value of 20 years has been nominated, as this is the timeframe associated with a conservation covenant.
Start area (ha)	3.73 ha
Risk of loss without offset.	A value of 10% has been nominated as this site is located within a built-up residential area, is zoned Urban under the Metropolitan Region Scheme and is owned by the Department of Education. The current ownership, zoning and (lack of) protection of the site does not preclude the proposed offset site from being subject to future subdivision and development. The Department of Education are currently assessing options for development of the site and therefore there is a high risk of loss, without the offset.
Risk of loss with offset.	A value of 0% has been nominated based on the anticipated application of a legal conservation covenant.
Confidence in result (top row)	80% has been nominated as: • The site will be protected via a conservation covenant and managed by the local government (pending their approval/ acceptance) • The site has been subject to a flora and vegetation assessment, and the area of black cockatoo habitat has been quantified.
Time until ecological benefit.	2 years to allow for application of conservation covenant and installation of conservation fencing.

Criteria	Response
Start quality	A quality of 6 has been nominated, as the offset site contains mature trees that provide potential roosting habitat for FRTBC. The site is located close to protected conservation category wetlands and is located <1km from a confirmed FRTBC roosting site.
Future quality without offset.	A value of 5 has been nominated for the future quality without the offset, as the habitat could be degraded through undesirable pedestrian / domestic pet access, as well as further spread of weeds and potential dieback spread, without access management.
Future quality with offset	A ''future quality with offset'' value of 6 is nominated as it is anticipated that the condition of the potential roosting habitat will remain the same, and further degradation will be prevented through the installation of fencing around the perimeter of the site. Following the transfer of the site to the City of Kwinana or other land management authority (such as the DBCA), the site may be subject to broader, regional conservation initiatives, such as feral and pest animal management initiatives and ongoing weed control works.
Confidence in result (bottom row)	A value of 80% has been nominated based on: • Confidence that a conservation mechanism will be in place within 2 years based on landowner support/ permission • A site specific, scientific survey has been undertaken to confirm vegetation types and quality.
% of impact offset	16.45 %
Offset component 2- Rehabilitation of DPLH land management by the City of Kwinana, north of Thomas Road and west of the Spectacles wetland	
Risk-related time horizon	A value of 20 years has been nominated, as this is the timeframe associated with a conservation covenant.
Start area (ha)	8.5 ha
Risk of loss without offset.	A value of 10% has been nominated as this site is zoned Special Use under the Metropolitan Region Scheme and is not currently afforded formal protection. Although this site is currently under a management order (responsibility of the City of Kwinana), the current zoning and (lack of) protection of the site does not preclude the proposed offset site from being subject to future development/ destruction. It is also noted that while the City actively manage vegetation to the west of the proposed offset site, the City does not have the funding/ resources to manage/ rehabilitate the area that has been nominated as an offset site.
Risk of loss with offset.	A value of 0% has been nominated based on the anticipated application of a legal conservation covenant.
Confidence in result (top row)	75% has been nominated as: • The site is currently under a management order, however the City do not have the resources/ funding to undertake rehabilitation or actively manage the site • While the site is currently a "Reserve" under the MRS, there is no formal conservation protection in place • The site will be protected via a conservation covenant (if required)
Time until ecological benefit.	20 years to allow for establishment of planted native vegetation as foraging habitat (thus increasing the value of the site for roosting).
Start quality	A quality of 4 has been nominated, as the offset contains mature native trees which are species that are known to provide roosting value. The understory is dominated by weeds and contains very few native species, thus the current foraging value provided by the understorey is poor.
Future quality without offset	A value of 4 has been nominated for the future quality without the offset, as the overstorey of mature trees is established and the quality of the understorey as foraging habitat is poor. The quality of the habitat is expected to remain the same in the absence of an offset being implemented.
Future quality with offset	A ''future quality with offset'' value of 6 is nominated as it is anticipated that the rehabilitation will achieve a higher density of foraging habitat, thus increasing the "attractiveness" of the site as a roost site. This value has also considered the

Criteria	Response
	proximity of the site to protected wetlands (which is a constant between the above value and this value).
Confidence in result (bottom row)	A value of 65% has been nominated based on: • Confidence that a conservation mechanism will be in place within 2 years based on landowner support/ permission • A site specific, scientific survey will be undertaken to confirm vegetation/ habitat quality • Rehabilitation works will be required to achieve completion criteria in accordance with an approved management plan.
% of impact offset	71.97 %
Total % of impact offset (Offset 1 + Offset 2)	**88.42 %**

3. Conservation and Management Commitments

3.1 Offset component 1; part of Reserve 39964

3.1.1 Offset objectives

The objectives of the offset strategy, relevant to offset site 1, include:

- Improve the condition of Tuart Woodland TEC by enhancing diversity and density of native flora species which form part of the TEC
- Improve the density of native flora species which provide foraging and roosting habitat for the FRTBC
- Facilitate protection of the offset site through implementation of a legally binding conservation covenant.

3.1.2 Management measures

The Proponent will facilitate a conservation covenant, under one of the following legal mechanisms:

- *Soil and Land conservation Act 1945*
- *The National Trust of Australia (WA) Act 1964*
- *Transfer of Land Act 1893*
- *Biodiversity Conservation Act 2016.*

The conservation covenant is anticipated to be applied within 12 months of commencement of the action.

The management measures associated with the rehabilitation of the proposed offset site will be determined following a formal flora, vegetation and black cockatoo habitat assessment of the site and will be detailed within Rehabilitation Management Plan (RMP). At a minimum, the RMP will include the following management measures:

- Establishment of a suitable planting list, comprising locally occurring, native species consistent with the Tuart Woodland TEC (see comprehensive native species list at Appendix F) and FRTBC foraging and roosting habitat (including but not limited to Jarrah and Marri trees which comprise 90 % of the FRTBC diet [Johnstone & Kirkby 1999] and provide suitable roosting habitat in addition to Tuart trees [DSEWPaC 2012])
- Pre-planting weed control
- Winter planting
- Signage notifying the public of rehabilitation works
- Access control (where necessary)
- Pest control (such as tree guards)
- Watering (as required).

To ensure the ongoing management needs of part of Reserve 39964 are met, the proponent will provide a lump sum payment to the City of Kwinana following completion of the revegetation program, manage the site in the long term. While both the quantum of this funding, as well as the conservation management actions that will be initiated associated with it are unknown at this stage, it is anticipated that the scope will be similar to that agreed to for Lot 164 (see Section 3.2.2). The site's management requirements and associated funding, will be determined in consultation nwiht the City of Kwinana, with the objective of ensuring no degradation to the Tuart Woodlands TEC or

FRTBC habitat on-site. Funding and management arrangements associated with the site will be detailed within the RMP, which will be provided to the DAWE as a condition of the approval.

3.1.3 Completion criteria

The RMP will include completion criteria relating to native plant and FRTBC habitat density and diversity. It is noted that while weed control will be undertaken within Reserve 39964, weed density targets are not proposed to be included given the extent of weeds within the proposed offset site.

The completion criteria will be consistent with the Tuart Woodland TEC condition categories and thresholds for Moderate or High condition (DoEE 2019), dependent on the results of the site specific flora and vegetation assessment. These condition categories and thresholds require a minimum of 4 native understorey species per 0.01 ha for Moderate condition, and 8 native understorey species per 0.01 ha for High condition.

3.1.4 Monitoring

The RMP will include the following monitoring commitments:

- Baseline monitoring of the existing vegetation/ habitat quality
- Quarterly informal monitoring to inform rehabilitation actions
- Annual formal Spring monitoring against completion criteria.

3.1.5 Contingency measures

The RMP will include contingency measures to be implemented in the event that the completion criteria are not being achieved. Contingency measures may include infill planting, watering, weed control, access control and/ or pest control.

3.1.6 Implementation

The Proponent will be responsible for the implementation of the RMP and will be assisted by an experience revegetation contractor. The Proponent will consider the opportunity for school groups and community groups to be involved in the rehabilitation works, where appropriate.

The RMP will be implemented for a period of five years, unless failure to achieve completion criteria warrants additional contingency measures to be implemented. In the event that completion criteria have not been achieved after five years, contingency measures will continue to be implemented until the completion criteria have been achieved, or DAWE are otherwise satisfied with the rehabilitation works undertaken.

3.1.7 Reporting

Annual monitoring reports will be prepared by the Proponent and provided to DAWE, detailing the rehabilitation status/ actions completed, monitoring results and any contingency actions implemented.

This report will be in addition to any annual compliance report (ACR) required by the anticipated EPBC Act approval. The details of the status of the conservation covenant can be documented within the ACR.

3.2 Offset component 2: Lot 164 on Plan 39964

3.2.1 Offset objectives

The objectives of the offset strategy, relevant to offset site 2, include:

- Maintain the very high condition of Tuart Woodland TEC by installing conservation fencing and education signage to prevent degradation caused by unauthorised access
- Facilitate protection of the offset site through a conservation covenant (if required)

- Vesting the site with the City of Kwinana for ongoing management including maintenance of fencing and signage (subject to the City of Kwinana and DoE discussions).

3.2.2 Management measures

The Proponent will facilitate protection of the offset site through a conservation covenant (if required), under one of the following legal mechanisms:

- *Soil and Land conservation Act 1945*
- *The National Trust of Australia (WA) Act 1964*
- *Transfer of Land Act 1893*
- *Biodiversity Conservation Act 2016.*

It is anticipated that the conservation covenant will be applied within 12 months of commencement of the action.

To ensure the ongoing management needs of Lot 164 are met following the transfer of the site to the City of Kwinana, a meeting was held with City representatives on the 16th of September 2021. It was subsequently agreed that a provision of funding would be made to the City of Kwinana, for the following conservation initiatives to be implemented over five years. These initiatives are anticipated to prevent further degradation of the Tuart Woodlands TEC and FRTBC habitat that would otherwise occur.

- Site preparation and construction of appropriate fencing around the perimeter of the site, including firebreak reinstatement and gate access
- One round of grass specific herbicide per year
- One round of geophyte specific herbicide per year (Metsulfuron only)
- One round of geophyte specific herbicide per year (Metsulfuron + Glyphosate) to target Arum Lily (*Zantedeschia aethiopica*) and Gladioli (*Gladiolus undulatus*)
- Maintenance of a single firebreak, by contracted Harley rake, once per year
- Regular light maintenance tasks by the City's Natural Area team, including litter/dumping removal, annual firebreak pruning to City standards and contractor project management.

The provision of funding is proposed to be made as a lump sum payment to the City prior to transfer of the site, amounting to no more than [redacted] (excluding GST)

It is anticipated that fencing will be constructed to a "Rural" style, representative of (or similar to) standards developed by the DBCA for any new agricultural fencing within Regional Parks managed lands. This standard (provided in Appendix G), is considered sufficient to both demarcate the site as a conservation reserve, and to prevent and discourage unauthorised ingress by members of the public, thereby ensuring no additional environmental degradation.

A letter of in-principle support from the City of Kwinana for the above arrangement is provided at Appendix A.

3.2.3 Reporting

An Annual Compliance Report (ACR) is anticipated to be required by the EPBC Act approval. The details of the status of the conservation covenant and installation of fencing can be documented within the ACR.

3.3 Offset component 3: installation of artificial black cockatoo breeding hollows

3.3.1 Offset objectives

The objective of the offset strategy relevant to black cockatoo breeding hollows, is to provide a net increase in the availability of suitable black cockatoo breeding hollows within the known breeding range of the FRTBC.

3.3.2 Management measures

The Proponent will fund and coordinate the installation of a minimum of six artificial black cockatoo hollows (3:1 ratio). These hollows will be installed at a location within the known breeding range of the FRTBC, determined in consultation with Birdlife and/ or DBCA.

3.3.3 Reporting

An ACR is anticipated to be required by the EPBC Act approval. The details of the status of the funding and installation of artificial black cockatoo breeding hollows can be documented within the ACR.

The six artificial black cockatoo hollows will be monitored on an annual basis for ten years to determine if successful black cockatoo breeding has occurred within the hollows. Results of the monitoring events will be provided to DAWE, annually.

Should the artificial nesting hollowing show signs of use by black cockatoos within the ten year period, then monitoring and maintenance will be increased for an additional five years.

4. Consistency with the EPBC Act Environmental Offsets Policy principles

The strategy for compensating significant residual impacts to MNES resulting from the proposed action is consistent with the ten offset principles as outlined in the Commonwealth *Environmental Offsets Policy* (DSEWPaC 2012).

Table 4.1 summarised how the ten principles were considered in the development of the EOP for both Tuart Woodlands TEC, and FRTBC habitat.

Table 4.1: Consideration of proposed offset against *EPBC Act Environmental Offset Policy* (DSEWPaC 2012) principles

Offset Principle	Consideration
1. Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter	Offset components 1, 2, and 3 will provide protection for a total of 11.63 ha of Tuart Woodland TEC and FRTBC habitat that is otherwise afforded no formal protection or management. Additionally, the quality of 8.5 ha of the Tuart Woodland TEC and FRTBC foraging and roosting habitat will be improved through increasing the density and diversity of native flora species, consistent with the Tuart Woodland TEC species list (DoEE 2019) and suitable species for the FRTBC. The proposed offset strategy will improve the ecological linkage value between two large conservation areas (Bush Forever Sites 269 and 349). Offset component 3 will also provide a net gain in the availability of suitable black cockatoo breeding hollows, at a ratio of 3:1. Further, all remaining significant residual impacts remaining following the consideration of offset components 1, 2 and 3, will be offset through the formal protection and / or rehabilitation of additional sites within the City of Kwinana local government area, thereby maintaining the viability of MNES at a local and regional level.
2. Suitable offsets must be built around direct offsets but may include other compensatory measures	Section 4.2.1 of the Environmental Offsets Policy requires a minimum of 90% of significant residual impacts to be offset directly. However, each of the offset components proposed herein are considered to provide a measurable conservation gain for both Tuart Woodlands TEC, and FRTBC, and as such can be considered direct offsets. Therefore, the offsets proposed go beyond the minimum requirements set out in the Environmental Offsets Policy, to offset 100% of significant residual impacts resulting from the proposed action.
3. Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter	This EOP has been developed through the use of the *Offsets Assessment Guide* calculator, which takes into account the conservation status of the MNES (Tuart Woodlands TEC: Critically Endangered; FRTBC: Vulnerable). In the context of Tuart Woodlands, offset components 1 and 2 involve the protection and/or rehabilitation of 11.63 ha. Given this area is considered sufficient to offset 72.54% of significant residual impacts to this MNES, a total area of approximately 17 ha is anticipated to be required, to offset 100%. This equates to an offset ratio of over 5:1. It should also be considered that a significant component of the offset involves rehabilitation, implementation of the proposed action and this EOP would result in a net gain of Tuart Woodlands TEC and FRTBC habitat. Further, offset component 3 will provide a net gain in the availability of suitable black cockatoo breeding hollows, at a ratio of 3:1.
4. Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter	
5. Suitable offsets must effectively account for and manage the risk of the offset not succeeding	Two RMP's will be prepared; for the Reserve 39964 offset site, and for any additional sites identified for rehabilitation as per offset component 4. Each RMP will include completion criteria and contingency measures to ensure successful rehabilitation. The protection of the two proposed offset sites provides certain and permanent protection for the significant values contained within the sites.

Offset Principle	Consideration
6. Suitable offsets must be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)	The proposed offset strategy is not required by any other legal/ planning instrument and has been developed purely to satisfy the Proponent's obligations under the EPBC Act. It is anticipated that, if not required for offsetting purposes, Lot 164 may be subject to clearing and development by the Department of Education. The City of Kwinana have advised that they do not have the funding or resources to undertaken rehabilitation of Reserve 39964.
7. Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	It is anticipated that conservation covenants across both of the prosed offset sites will be implemented within 12 months of commencement of the action. Preparation of both RMP's will commence immediately following EPBC Act approval. Implementation of each RMP is anticipated to commence within one year of the RMP being approved. The selection of the offset sites is based on both desktop and site specific scientific information, with a site specific flora, vegetation and black cockatoo habitat survey of Reserve 39964 proposed prior to the RMP being approved. The location of the artificial black cockatoo breeding hollows will be determined in consultation with Birdlife and/ or DBCA, based on known breeding areas of the FRTBC. Development of a secondary EOP and associated RMP (if required) to support offset component 4 will be undertaken in consideration of the determined site's environmental values. Accordingly, a site specific flora, vegetation and black cockatoo habitat survey of the potential offset site/s will be undertaken prior to submission of the EOP and RMP for approval. The details of the proposed offset strategy, including the status of implementation of the strategy will be made available in accordance with any approval conditions, such as provision of an ACR on the Proponents website, to ensure transparency for stakeholders/ interested parties.
8. Suitable offsets must have transparent governance arrangements, including being able to be readily measured, monitored, audited and enforced	Reserve 39964 is owned by DPLH and managed by the City of Kwinana. The Proponent will liaise with these agencies during the planning and implementation of the RMP. The RMP will include annual monitoring against completion criteria and reporting of results/ contingency actions. Lot 164 will likely be transferred to the City of Kwinana, to be managed as a local conservation area. The Proponent will be responsible for coordinating legal protection via conservation covenants, over both landholdings. The six artificial black cockatoo hollows will be monitored on an annual basis for ten years to determine if successful black cockatoo breeding has occurred within the hollows. Results of the monitoring events will be provided to DAWE, annually. Should the artificial nesting hollows show signs of breeding in the ten year period, then monitoring and maintenance will be increased for an additional five years. With regard to offset component 4, each of the potential sites identified are currently managed by either the DPLH, or the Western Australian Agriculture Authority. Both a EOP and RMP will be developed for the final additional offset sites, which will include requirements for annual monitoring against completion criteria and reporting of results / contingency actions. All EOPs and RMPs will be subjected to annual audits, by independent auditors.

5. Limitations

Scope of services

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

Reliance on data

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

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

Environmental conclusions

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

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

Strategen-JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by Strategen-JBS&G, and should not be relied upon by other parties, who should make their own enquiries.

6. References

Department of Biodiversity, Conservation and Attractions (DBCA) 2018, *Tuart Woodlands* spatial data layer, Government of Western Australia, Kensington.

Department of Environment and Conservation (DEC) 2008, *Forest Black Cockatoo (Baudin's Cockatoo Calyptorhynchus baudinii and Forest Red-tailed Black Cockatoo Calyptorhynchus banksii naso) Recovery Plan,* Australian Government, Canberra. Available from: https://www.environment.gov.au/resource/forest-black-cockatoo-baudin%E2%80%99s-cockatoo-calyptorhynchus-baudinii-and-forest-red-tailed

Department of the Environment and Energy (DoEE) 2017, *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.* Canberra: Department of the Environment and Energy. 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 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.

Department of the Environment, Water, Heritage and the Arts (2009). *Approved Conservation Advice for Calyptorhynchus banksii naso (Forest Red-tailed Black Cockatoo).* Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/67034-conservation-advice.pdf

Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) 2012, *EPBC Act environmental offsets policy,* Australian Government, Canberra.

Government of Western Australia (GoWA) 2019. *2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report).* Current as of March 2019. WA Department of Biodiversity, Conservation and Attractions, Perth. https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics

Johnstone & Kirkby 1999, 'Food of the Forest Red-tailed Black Cockatoo Calyptorhynchus banksii naso in south-west Western Australia', *Western Australian Naturalist*. 22:167-177.

Western Australian Local Government Association (WALGA) 2014, *Towards Establishing a Green Network, Vegetation connectivity modelling - Testing the effectiveness of a proposed green network for the South West Group member Local Governments,* WALGA, West Leederville. Available via: http://www.southwestgroup.com.au/wp-content/uploads/2016/05/Towards-Establishing-A-Green-Network-lr.pdf

Appendix A Evidence of agency support (in principle)

17 August, 2021

Our Ref.: D21/43466

MR Matt Turnbull
Manager Land and Property
Asset Planning and Services
Department of Education151 Royal Street
EAST PERTH WA 6004

Dear MR Turnbull

DRAFT ENVIRONMENTAL OFFSET PLAN (EPBC 2020/8732) – CITY OF KWINANA IN PRINCIPLE SUPPORT

I refer to recent and ongoing discussions between the City of Kwinana (City) and the Department of Education (DoE) regarding a proposal to develop part of Lot 9074 Lambeth Circle in Wellard and subsequent environmental offset requirements. The City notes that the proposal has been determined a controlled action (EPBC 2020/8732) by the Department of Agriculture, Water and the Environment (DAWE) under the Environmental Protection and Biodiversity Act 1999 (EPBC Act) requiring offsets to mitigate impacts on Matters of National Environmental Significance. As such, the Department of Education Wellard Village Primary School Draft Environmental Offset Plan (April, 2021) has been developed by consultants Strategen-JBS&G.

The offset strategy proposal to rehabilitate and protect 8.5 ha of Reserve 39964, Lot 222 (DP:216516) Thomas Road, Postans, currently managed by the City, and the protection of 4 ha of vegetation within Lot 164 (DP:55190) Wellard Road, Wellard, currently owned by the Department of Education, has been considered by the City. It is understood that following approval of the Environmental Offset Plan by DAWE that:

- Both proposed sites will be rehabilitated to good condition or higher and maintained for a period of 5 years by the DoE
- Management plans will be developed for each site
- Both sites will most likely be formally reserved under the MRS for conservation and/or a conservation covenant on titles

- That, following the 5-year rehabilitation and maintenance period, the City will take over active management of the sites by management order or other such instrument
- The sites will subsequently form part of the City of Kwinana conservation estate

It is acknowledged that due to limited municipal funding and resources, the City strategically manages only those areas in good condition in the eastern portion of the Reserve 39964, and, is currently not able to rehabilitate degraded parts of the reserve. The proposed offset site of approximately 8.5ha of the western portion of the reserve would complement work undertaken by the City and increase the overall ecological value of the Reserve.

Having considered the above, the City of Kwinana hereby provides in principle support at officer level for the Department of Education Wellard Village Primary School Draft Environmental Offset Plan (2021). Note that this advise is provided without prejudice as City Officers intend to present this matter to the Council for its consideration and support.

Should this be of concern or if you have any queries in regards to this matter please contact Christine Burtenshaw, Senior Environmental Planner, by telephone on 08 9439 0206, or email Christine.Burtenshaw@kwinana.wa.gov.au

Yours sincerely

Paul Neilson
Manager Planning & Development

21 September 2021

Our Ref.: D21/50369

Mr William Oversby
Associate
Strategen-JBS&G
Level 1, 50 Subiaco Square Road
SUBIACO WA 6008

Dear Mr Oversby

DEPARTMENT OF EDUCATION – OFF-SET SITE – LOT 164 ON PLAN 39964

This letter is further to, and should be read in conjunction with, previous correspondence dated 17 August 2021 (our Ref: D21/43466) to confirm the City of Kwinana's (the City) position on the proposed environmental offset strategy associated with the development of part of Lot 9074 Lambeth Circle in Wellard into the Wellard Village Primary School.

A meeting was held on 16 September 2021 between representatives from the Department of Education (DoE), Department of Finance, (DoF) Strategen-JBS&G and the City's Environmental Planning and Bush Care Officers. Reserve 39964 (Thomas Rd, Postans) and Lot 164 Wellard Rd, Wellard were briefly inspected during the meeting, and management issues subsequently discussed.

The City understands the DoE will provide the City with funds as a single lump sum to cover the cost of managing Lot 164 on DP: 55190 (Wellard Rd, Wellard) over a five-year period, prior to gifting the site to the City. It should be noted that this

particular site has been impacted significantly, and rehabilitation will require intensive weed management over the five-year period. Additionally, fence installation will be necessary to deter illegal dumping, trespassing and firewooding. An internal firebreak is also required to be reinstated to approximately correspond to the proposed perimeter fence.

Department of Agriculture Water and the Environment (DAWE) considers Lot 164 as suitably vegetated in order to support Black Cockatoo foraging and roosting habitat (a key condition of this offset plan), therefore revegetation costs are not to be included in the five-year management plan.

It is understood by the City that funding for management of Lot 164 by DoE will include:

- Site preparation and construction of appropriate fencing around the perimeter, including firebreak reinstatement and gate access.
- One round of grass specific herbicide per year.
- One round of geophyte specific herbicide per year (Metsulfuron only).
- One round of geophyte specific herbicide per year (Metsulfuron + Glyphosate) to target Arum Lily and Gladioli.
- Maintenance of a single firebreak, by contracted Harley rake, once per year.
- Regular light maintenance tasks by the City's Natural Area team, including litter/dumping removal, annual firebreak pruning to City standards and contractor project management.

The City is currently in the process of obtaining quotes for weed management, firebreak installation and fence construction.

The City understands formal Council Approval for the proposed transfer process of Lot 164 is not required at this stage and in-principle support, in the form of this letter, is sufficient.

If you have any queries in regards to this matter please contact Tim Scott, A/Senior Environmental Planner, by telephone on 08 9439 0206, or email tim.scott@kwinana.wa.gov.au

Yours sincerely

Paul Neilson

Manager Planning & Development

From: Tracey Scroop
To: Carli O"Brien
Cc: Jaimie Eidsvold
Subject: RE: Thomas Road offset site
Date: Monday, 1 February 2021 9:11:40 AM
Attachments: image003.png
image004.png
Thomas Road - Vegetation Condition Mapping.png

Hi Carli

Sorry for the delay in responding. My manager has been acting director so it was difficult to find an opening in her diary to discuss.

Thank you for the discussion on 14 January and subsequent emails about the proposal to potentially use Reserve 39964 as an offset for EPBC Act referral (EPBC 2020/8732) if the Commonwealth consider the offset satisfactory. The City of Kwinana's support is noted and thanks for providing that correspondence. I have discussed this with the Land Use Management team who provided me with the relevant advice, and would further the request if required.

Should the subject land be deemed as a suitable offset, outlined below is the suggested process to protect the subject land:

- the City of Kwinana as Management Body put in a request to change the purpose of the Reserve to 'Conservation' or a similar purpose i.e. 'Conservation of Flora and Fauna'. The City may also request the Reserve is classified as a Class A Reserve which would give the reserve greater protection.
- It would also be suggested to identify on the title that the land has been used as an offset –this could be achieved via a Restrictive Covenant or a Memorial however would need to seek further advice on this, if required.
- In principle the Department would likely support the request however we would be required to undertake our due diligence including referral to DMIRS, DPIRD as the adjacent land Management Body, further internal consultation with respect to Land Use Planning, Native Title investigations and any other relevant referrals. This process can only take place if there is a formal request from the City of Kwinana as the Management Body and the Department cannot pre-empt the outcome of this assessment.

Please note this is officer level advice on the process to change the reserve purpose. The Department does not provide any advice or support on if the proposed offset is suitable to fulfil the requirements under EPBC 2020/8732.

If you require any further assistance or clarification please let me or Jaimie from our Land Use Management team know (cc'ed).

Many Thanks
Tracey

Tracey Scroop | Senior Planning Officer | Strategy and Engagement
140 William Street, Perth WA 6000

Appendix B City of Kwinana vegetation condition mapping


uthority
erial Photography
uilding
uilding Assets
ommunity
ustomer Service
mergency Management
nvironmental
LAYERS
51-75%
76-100%
Geraldton Carnation Cover
Bushland Condition
No Condition Specified
Excellent
Very Good
Good
Degraded
Completely Degraded
E1 Precinct Area
Elevation Data
Conservation
Local Natural Areas
Vegetated areas by complex
Bush Forever Sites
267
268
269
AERIAL IMAGERY
R29336
R28294
R29564
R39964
R53313
R30067
R38747
R30068
R27947
R24571
RESERVES
1 OF 1
Area 14.9047
Reserve Number 39964
Purpose PARK
Vesting TOWN OF KWINANA
Responsibility DEPARTMENT OF PLANNING, LANDS AND HERITAGE (SLSD)
Management Order TOWN OF KWINANA

Appendix C Flora, vegetation and black cockatoo habitat assessment

Department of Education

Future Wellard School Site – Ecological Surveys

Lot 164 Wellard Road, Wellard

27 April 2021

JBS&G58917 – 135563 (Rev 0)

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

www.jbsg.com.au

Table of Contents

List of Tables

List of Figures

Appendices

1. Introduction

1.1 Background

The Department of Education (the Department) has identified the area of Lot 164 Wellard Road (the Project Area) as a future school site. The Project Area is located approximately 30km south of the Perth Central Business District in the City of Kwinana. It is zoned as Urban under the Metropolitan Region Scheme and is 4.01 ha in size. The location and extent of the Project Area is shown in Figure 1.1.

The proposed works may impact native vegetation and as such, a flora and vegetation survey, desktop fauna survey, and targeted Black Cockatoo habitat survey are required to determine the environmental values within these areas of native vegetation.

1.2 Purpose and Scope

The Department is seeking to understand the ecological values of the Project Area and associated conservation significance, to identify any State and Commonwealth environmental approval requirements and support future planning applications.

Strategen JBS&G were engaged by the Department to provide the following environmental consulting services:

- Undertake a flora and vegetation survey of areas of native vegetation within, and adjacent to, areas that may be impacted by clearing in accordance with *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).
- Undertake a desktop fauna and targeted black cockatoo habitat survey of vegetation within, and adjacent to, areas that may be impacted by clearing in accordance with *Technical Guidance - Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020) and *EPBC Act referral guidelines for three threatened black cockatoo species* (DSEWPaC 2012).
- Prepare a biological survey report incorporating the results of the flora, vegetation, and fauna surveys.

This report presents the findings of this work.

Legend

- Project area
- Cadastral boundary
- Roads (MRWA)

Scale 1:2,500 at A4

0 25 50 metres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 58917

Client: Department of Education

Version: A | Date: 05-Feb-2021

Drawn By: cthatcher | Checked By: TS

Lot 164 Wellard Road
Wellard, WA 6170

PROJECT AREA

FIGURE 1.1

strategen JBS&G

File Name: W:\Projects\1)Open\Dept of Education\58917 Wellard Village School Site Ecology Surveys\GIS\Maps\R01_Rev_A\58917_01_1_ProjectArea.mxd
Image Reference: www.nearmap.com© - Imagery Date: 19 November 2020

2. Context

2.1 Legislative context

Flora and fauna in WA are protected formally and informally by various legislative and non-legislative measures, which are as follows:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – Australian Government
- *Biodiversity Conservation Act 2016* (BC Act) – State
- *Environmental Protection Act 1986* (EP Act) – State
- *Biosecurity and Agriculture Management Act 2007* (BAM Act) – State.

Non-legislative measures:

- WA Department of Biodiversity, Conservation and Attractions (DBCA) Priority lists for flora, ecological communities and fauna
- Weeds of National Significance
- Recognition of locally significant populations by the DBCA.

A short description of each legislative measure is given below. Other definitions, including species conservation categories, are provided in Appendix A.

2.1.1 EPBC Act

The EPBC Act aims to protect matters of national environmental significance, which are detailed in Appendix A. Under the EPBC Act, the Commonwealth Department of Agriculture, Water and the Environment (DAWE) lists protected species and Threatened Ecological Communities (TECs) by criteria set out in the Act. Species are conservation significant if they are listed as Threatened (i.e. Critically Endangered, Endangered and Vulnerable) or Migratory.

Bird species protected as Migratory under the EPBC Act include those listed under international migratory bird agreements relating to the protection of birds which migrate between Australia and other countries, for which Australia has agreed. This includes the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA), the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Some marine fauna or terrestrial fauna that use marine habitats are listed as Marine under the EPBC Act. These species are only considered conservation significant when a proposed development occurs in a Commonwealth marine area (i.e. any Commonwealth Waters or Commonwealth Marine Protected Area). Outside of such areas, the EPBC Act does not consider these species to be matters of national environmental significance so are not protected under the Act.

2.1.2 BC Act

DBCA lists taxa (flora and fauna) under the provisions of the BC Act as protected and are classified as according to their need for protection (see Appendix A). The BC Act makes it an offence to 'take' threatened species without an appropriate licence. There are financial penalties for contravening the BC Act.

2.1.3 EP Act

Threatened flora, fauna (and significant habitat necessary for the maintenance of indigenous fauna) and Threatened Ecological Communities (TECs) are given special consideration in environmental impact assessments and have special status as Environmentally Sensitive Areas (ESAs) under the EP

Act and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Exemptions for a clearing permit do not apply in an ESA.

2.1.4 BAM Act

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.

2.2 Environmental setting

2.2.1 Soils and topography

The Project area is located within the Swan Coastal Plain 1 (SWA01 – Spearwood Dune system) of Western Australia (Mitchell et al. 2002). The Swan Coastal Plain comprises five major geomorphologic systems that lie parallel to the coast, namely (from west to east) the Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward & McArthur 1980; Gibson *et al*. 1994). Each major system is composed of further subdivisions in the form of detailed geomorphologic units (Churchward & McArthur 1980; Semeniuk 1990; Gibson *et al*. 1994). Beard (1990) describes the Swan Coastal Plain as a low-lying coastal plain, often swampy, with sandhills also containing dissected country rising to the duricrusted Dandaragan plateau on Mesozoic, mainly sandy, yellow soils.

Specifically, the Project area is located within the Spearwood S2a Phase (211Sp_S2a), which is characterised as: Lower slopes (1-5%) of dune ridge with moderately deep to deep siliceous yellow-brown sands or pale sands with yellow-brown subsoils and minor limestone outcrop (Smolinski & Scholz, 1997; McPherson & Jones, 2005).

2.2.2 Climate

The Perth Metropolitan Region has a Mediterranean climate consisting of hot, dry summers and cool, wet winters. The nearest weather station which records both temperature and rainfall data is the Garden Island weather station (station 009256), approximately 12.8 km from the survey site. The average annual rainfall from 2002-2020 was 596.4 mm with the highest monthly rainfall occurring from May to September (Figure 2.1). The wettest year on record was 2005, with an annual rainfall of 848.6 mm, 699.1 mm of which fell during the May to September period (BOM, 2020). Rainfall for the twelve months prior to survey was 526.2 mm. This is below the long-term average for the area.

The average maximum temperatures range from 17.9°C in July to 28.3°C in February. The average minimum temperatures range from 11.2°C in August to 19.4°C in February.

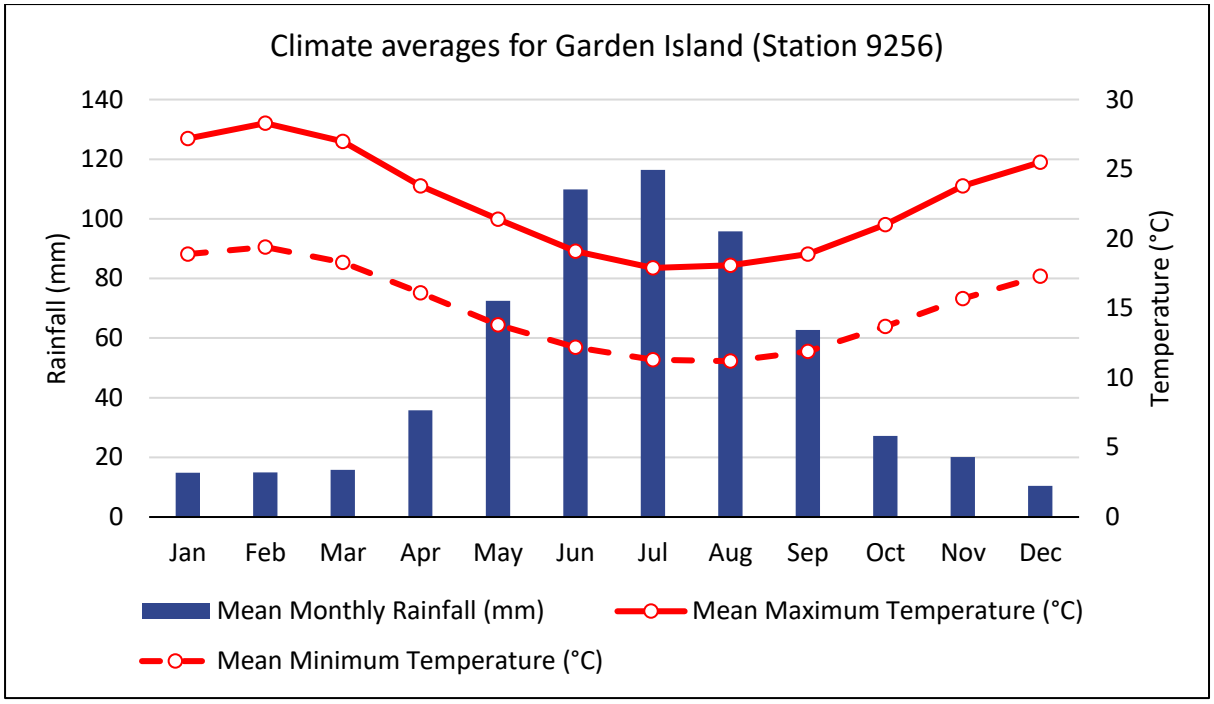


Figure 2.1: Monthly average rainfall and temperature at Garden Island WA (Station 009256)

2.2.3 Hydrology

Mapping of the geomorphic wetlands of the Swan Coastal Plain indicates no geomorphic wetlands are occurring within the Project Area. Nine wetlands are mapped as occurring within 2 km of the Project Area which include: six Conservation Category Wetlands (CCW), two Resource Enhancement Wetlands (REW), and one Multiple Use Wetland (MUW).

2.2.4 Conservation areas

No DBCA managed lands occur within the Project Area. One Conservation Area occurs within 2 km of the Project Area; Leda Nature Reserve is located approximately 1.4 km south of the Project Area.

2.2.5 Land use

The primary land uses within the Swan Coastal Plain region are urban, rural residential, agriculture, conservation, and infrastructure. Surrounding the Project Area, historical land uses principally include residential housing and public open space.

2.2.6 Regional vegetation

Beard (1990) Botanical Subdistrict

The Project 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 89 'biogeographic regions' (bioregions) and 419 subregions covering the entirety of the Australian continent (Department of the Environment and Energy, 2019). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

The Project 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).

Vegetation system association and System 6 mapping

Vegetation occurring within the region was initially mapped at a broad scale (1: 1 000 000) by Beard during the 1970s. This dataset formed the basis of several regional mapping systems, including the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia) for Western Australia (DEE 2017), physiographic regions defined by Beard (1981), and System 6 Vegetation Complex mapping undertaken by Heddle et al. (1980).

The Project Area comprises one Beard (1981) vegetation association (Figure 2.2). Percentage remaining of the vegetation association is provided in Table 2.1 (GoWA 2019a).

Table 2.1: Beard (1981) vegetation associations within the Project area

Vegetation Association	Description	Percent remaining in IBRA Region
Spearwood 998	Medium woodland; tuart	36.35

Based on regional vegetation complex mapping (Heddle et al. 1980) the Project Area comprises one vegetation complex, (Table 2.2, Figure 2.2). Percentage of original extent remaining in the IBRA bioregion is provided in Table 2.2 (GoWA 2019b).

Table 2.2: Heddle et al. (1980) vegetation complexes within the Project area

Vegetation Complex	Description	Percent remaining in IBRA Region
Cottesloe Complex - Central and South	Mosaic of woodland of Eucalyptus gomphocephala (Tuart) and open forest of Eucalyptus gomphocephala (Tuart) - Eucalyptus marginata (Jarrah) - Corymbia calophylla (Marri); closed heath on the Limestone outcrops.	32.16

Legend

- Project area
- Cadastral boundary

Pre-European vegetation (DPIRD)

- SPEARWOOD_998

Vegetation complexes (DBCA)

- Cottesloe Complex - Central and South

Scale 1:2,500 at A4	0 25 50 metres
Coord. Sys. GDA 1994 MGA Zone 50	
Job No: 58917	
Client: Department of Education	
Version: A	Date: 05-Feb-2021
Drawn By: cthatcher	Checked By: TS

Lot 164 Wellard Road
Wellard, WA 6170

REGIONAL VEGETATION

FIGURE 2.2

strategen JBS&G

File Name: W:\Projects\1)Open\Dept of Education\58917 Wellard Village School Site Ecology Surveys\GIS\Maps\R01_Rev_A\58917_02_1_RegVeg.mxd
Image Reference: www.nearmap.com© - Imagery Date: 19 November 2020

2.2.7 Black cockatoo habitat

Carnaby's Black-Cockatoos, listed as Endangered under the EPBC Act, feed on the seeds, nuts and flowers, of a variety of native and introduced plant species and insect larvae (DEE 2019b). Food plants generally occur within proteaceous genera such as *Banksia*, *Hakea* and *Grevillea*, though are known to forage on eucalypt species in woodland areas. Carnaby's Black-Cockatoos have also adapted to feeding on exotic species such as pines and cape lilac and weeds such as wild radish and wild geranium (DEE 2019b). Carnaby's Black-Cockatoos usually breed between July and December in the hollows of live or dead eucalypts; primarily in Salmon Gum and Wandoo, but also within Jarrah, Marri and other eucalypt species (Johnstone 2010a). Hollows are usually at least 2 m above ground, sometimes over 10 m and the depth of the hollow varies from 0.25 m to 6 m (DEE 2019b). Mapping of Carnaby's Black Cockatoo distribution (Johnstone and Kirkby undated) identifies the Project area as occurring within the range of the species.

Forest Red-tailed Black-Cockatoos, listed as Vulnerable under the EPBC Act, depend primarily on Marri and Jarrah trees for both foraging and nesting. The seeds of both eucalypts are the favoured food source of the birds and hollows within live or dead individual trees are utilised for nesting purposes (Johnstone 2010b). Breeding varies between years and occurs at times of Jarrah and Marri fruiting. These black cockatoos breed in woodland, forest or artificial nest boxes, but may also breed in former woodland or forest that has been reduced to isolated trees (DEE 2019b). Mapping of the Forest Red-tailed Black Cockatoo distribution (Johnstone and Kirkby undated) identifies the species as likely to occur in the Project Area.

Baudin's Black-Cockatoos primarily occur in eucalypt forests and forage at all strata levels within the forests with a tendency to favour areas containing Marri (Johnstone and Kirkby 2008, DEE 2017b). Breeding generally occurs in the Jarrah, Marri and Karri forests of the southwest of Western Australia in areas averaging more than 750 mm of rainfall annually (DEE 2019b). As with the other two species of Threatened black cockatoos in Western Australia, breeding habitat also occurs in former woodland or forest that has been reduced to isolated trees (DEE 2019b). Mapping of the Baudin's Black-Cockatoos distribution (Johnstone and Kirkby undated) identifies the species as unlikely to occur in the Project Area, and as such this species will not be discussed further.

3. Methods

3.1 Desktop assessment

Database searches were undertaken to generate a list of vascular flora and vertebrate fauna, and Threatened and Priority Ecological Communities previously recorded within, and nearby the Project Area – with an emphasis on species and communities of conservation significance and introduced species (Table 3.1). Database searches were conducted within a 10 km buffer of the Project Area.

Table 3.1: Database searches conducted for the desktop assessment

Custodian	Database	Taxonomic group	Buffer
DBCA	NatureMap	Flora and Fauna	10km
DBCA	WA Herb	Flora	10km
DBCA	TPFL	Flora	10km
DBCA	TFauna	Fauna	10km
DBCA	Communities	Ecological Communities	10km
DoE	PMST	Flora, Fauna and Communities	5km

Reports that document regional flora, vegetation, and fauna within the surrounds of the Project Area were also reviewed prior to the field assessment.

3.2 Field assessment

3.2.1 Flora and vegetation

The field assessment of the Survey was conducted by one ecologist from Strategen JBS&G on 11 September 2020. The survey was conducted in accordance with guidelines provided in *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

Table 3.2: Personnel

Name	Role	Flora collection permit
Tristan Sleigh Senior Ecologist	Planning, fieldwork, plant identification, data interpretation and report preparation	FB62000128 TFL 28-1920

3.2.1.1 Data collection

Non-permanent quadrats (10m x 10m) and unconstrained relevés were sampled to characterise vegetation types and condition and ensure appropriate representation of the flora and vegetation present. Indicative site locations were identified prior to commencement of the field survey using aerial photography, topographic maps, and existing vegetation maps, to ensure that all broad vegetation types and landforms within the Project area would be sampled.

At each quadrat the following information was recorded:

- Name of recorder
- Date
- Quadrat dimensions
- GPS co-ordinates (recorded in GDA94 UTM 50H)
- Photograph of the vegetation from north-west corner
- Vegetation condition
- Brief vegetation description
- Vascular flora taxa present (with average height and total percentage foliage cover of each taxon)

- Topography
- Soil type and colour
- Geology (type, size and cover of any rocks, stones, gravel or outcropping)
- Average percentage cover of leaf litter and bare ground
- Disturbance details including fire history (time since last fire), and physical disturbance including evidence of erosion, grazing, and weed invasion

Any flora taxa observed opportunistically around quadrats or while traversing on foot within the Project Area were recorded. For any populations of taxa known to be conservation significant or introduced flora observed, a GPS location and a count of the individuals present, or percentage foliar cover for a given area for the species, were recorded.

3.2.1.2 Conservation significant flora

Prior to the survey, a list of conservation significant flora with the potential to occur within the Project Area was compiled. Field personnel familiarised themselves with photographs, reference samples and descriptions of these taxa before conducting the survey and once on the ground systematically searched for them along all proposed clearing areas.

3.2.1.3 Flora identification and nomenclature

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-).

3.2.1.4 Vegetation condition

Vegetation condition was recorded at all quadrats, and opportunistically within the Project Area during the field assessment where required. Vegetation condition was described using the vegetation condition scale for the South West Botanical Province (EPA 2016; Table 3.3). 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.

Table 3.3: Vegetation condition scale for South West and Interzone Botanical Provinces (EPA 2016)

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

3.2.1.5 Data analysis and vegetation mapping

Due to the uniform distribution of vegetation within the Project Area; quadrat data were grouped into a species by site matrix to delineate individual vegetation types (VTs) present within the Project Area. Aerial photography interpretation and field notes taken during the survey were then used to develop VT mapping polygon boundaries over the Project 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 opportunistically within the Project 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 Project 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 Project 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.

3.3 Basic fauna survey

3.3.1 Field survey

The field survey was conducted by one senior ecologist, Tristan Sleigh, on 23 October 2020. The field assessment was consistent with standard protocols for the region, relevant EPA Guidance Statements and EPBC Act Survey Guidelines (where relevant and practical) as outlined below:

- *Technical Guidance – Sampling methods for terrestrial vertebrate fauna* (EPA 2010)
- *Technical Guidance – Terrestrial Vertebrate Fauna Surveys* (EPA 2020).

3.3.1.1 Habitat assessment

Habitat assessments were undertaken throughout the Project Area. These fauna habitats were assessed for their potential to support species of conservation significance and the quality of habitat they provide to a wider suite of fauna. At each habitat assessment point, the following information was recorded:

- location of the broad habitat type within the Project area (GPS co-ordinate) and its relative percentage
- habitat condition was assessed at each assessment site as 'completely degraded' through to 'pristine', based on the scale given in Keighery (1994)
- landscape position
- dominant vegetation and structure (e.g. number of vegetation strata)
- hollow-bearing trees and dead stags (e.g. average size and abundance of hollows)
- description of any rock and rocky outcrops
- logs (e.g. abundance and size)
- substrate (e.g. leaf litter)
- wetlands, creeks, rivers, dams and other water bodies
- description of any observed nests and roosts (if present)
- subterranean roosts (e.g. caves, disused mineshafts and/or adits)
- associated fauna species observed using the habitat
- disturbance (e.g. cattle grazing, fire)
- photo showing a typical example of the broad habitat type.

3.3.2 Black cockatoo habitat assessment

The Project Area was inspected on 23 October 2020 by one ecologist from Strategen JBS&G with relevant experience as specified by the *EPBC Act Referral guidelines for three threatened black cockatoo species* (DSEWPaC 2012).

3.3.3 Vegetation and foraging assessment

The Survey Area was traversed on foot to record any flora species with the potential to provide a food source for black cockatoos. In addition to data collected at six flora relevés, a further six data points were surveyed to collect data to inform Black Cockatoo foraging habitat mapping. Following the assessment, vegetation units defined as part of the flora and vegetation survey were assigned a foraging value based on the presence and quantity of potential food species and any evidence of foraging by black cockatoos.

3.3.3.1 Habitat Scoring Method

The Department of Agriculture, Water and the Environment (DAWE) have recognised that the scoring tool to determine the value of Black Cockatoo habitat, contained in the 2017 *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* (DEE 2017), is flawed and as such have recommended against the use of this tool.

Bamford Consulting Ecologists (BCE 2018) have developed a Black Cockatoo foraging habitat scoring system (Attachment A), which has been previously accepted by the DAWE for projects subject to EPBC Act assessment. The BCE (2018) scoring system comprises of the following components to determine an overall score out of 10:

- Step 1: A score out of 6 for the vegetation composition, condition and structure. This represents the condition of the site in relation to the ecological requirements of the Threatened species and includes considerations of vegetation condition and structure and the density of foraging species present.
- Step 2: A score out 3 for the context of the site, where consideration is given to the extent of native vegetation remaining within 15km of the Project Area and the percentage of that extent that the Project Area represents, and if breeding is known/likely or unlikely to occur within 15km. This represents the relative importance to the site with regard to its position in the landscape including connectivity needs of the Threatened species. This includes considerations of the proximity of the site in relation to breeding and roosting habitat, and the importance of the role the site may plater in relation to the overall species population.

Site context scoring is applied as outlined below in Table 3.4.

Table 3.4: Site context scoring

Site context score / 3	Percentage of the existing native vegetation within the 'local' area that the study site represents	
	Local (within 15km) breeding known/likely	Local (within 15km) breeding unlikely
3	>5%	>10%
2	1-5%	5-10%
1	0.1-1%	1-5%
0	<0.1%	<0.1%

- Step 3: A species density score out of 1, where consideration is given to any sightings or foraging evidence recorded within the Project Area. If foraging evidence or sightings have been made within the Project Area, a score of 1 is assigned.
- Step 4: Determining the total score out of 10, which may require moderation where a score of 2 of lower has been ascribed at Step 1.

Where a raw foraging score of 2 or less out of 6 has been assigned, a site context score and species density score of 0 has been applied, so as not to overstate foraging value (Bamford Consulting Ecologists 2018).

This method was devised to achieve a score out of 10 to describe habitat quality when using the DAWE Offset Calculator. However, Step 1 alone has been used to inform Black Cockatoo habitat mapping of the Survey Area, as this step provides sufficient information to distinguish the habitat quality of each VT. Total scores were also calculated, should they be required for future reference.

3.3.4 Significant tree assessment

Significant trees are defined as trees of suitable species with a diameter at breast height (DBH) greater than 500 mm (> 300 mm for salmon gum and wandoo) (DSEWPaC 2012). Tree species which

are considered to be potential breeding or roosting trees are outlined in Table 3.5. Trees with a DBH greater than 500 mm (or >300 mm for salmon gum and wandoo) are large enough to potentially contain hollows suitable for nesting black cockatoos, or have the potential to develop suitable hollows over the next 50 years. Trees of this size may also be large enough to provide roosting habitat (i.e. trees which provide a roost or rest area for the birds). The locations of such trees within the Survey Area were recorded using a GPS. In addition to the location and DBH, the species, health and estimated DBH of each tree was also recorded, along with the presence of any hollows.

Table 3.5: Black cockatoo potential breeding and roosting tree species

Scientific name	Common name	Breeding	Roosting
Corymbia calophylla	Marri	Yes	Yes
Corymbia maculata	Spotted Gum		Yes
Eucalyptus accedens	Powderbark	Yes	
Eucalyptus camaldulensis	River Red Gum		Yes
Eucalyptus citriodora	Lemon Scented Gum		Yes
Eucalyptus diversicolor	Karri	Yes	
Eucalyptus globulus	Tasmania Blue Gum		Yes
Eucalyptus gomphocephala	Tuart	Yes	Yes
Eucalyptus grandis	Flooded Gum, Rose Gum		Yes
Eucalyptus longicornis	Red Morrell	Yes	
Eucalyptus loxophleba	York Gum	Yes	
Eucalyptus marginata	Jarrah	Yes	Yes
Eucalyptus megacarpa	Bullich	Yes	Yes
Eucalyptus occidentalis	Swamp Yate	Yes	
Eucalyptus patens	Blackbutt	Yes	Yes
Eucalyptus robusta	Swamp Mahogany		Yes
Eucalyptus rudis	Flooded Gum	Yes	Yes
Eucalyptus salmonophloia	Salmon Gum	Yes	
Eucalyptus salubris	Gimlet	Yes	
Eucalyptus wandoo	Wandoo	Yes	Yes
Pinus pinaster	Pinaster, Maritime Pine		Yes
Pinus radiata	Monterey, Radiata Pine		Yes

Source: Groom 2011, DSEWPaC 2012

3.4 Survey limitations and constraints

There are possible limitations and constraints that can impinge on the adequacy of vegetation, flora and fauna surveys. The flora and vegetation assessment has been evaluated against a range of potential limitations (Table 3.6). Based on this evaluation, the assessment has been subject to limitations or constraints that have affected the thoroughness of the assessment and the conclusions reached.

Table 3.6: 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.**	Number of species recorded, number of quadrats sampled and timing of the survey (i.e. spring) were adequate for this level of 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 Project Area was traversed, and flora species were recorded systematically. Over 76% of the taxa potential present was sampled within quadrats.

Potential Limitation	Impact on assessment	Comment
Completeness and further work which might be needed (i.e. was the relevant Project area fully surveyed).	**Not a constraint.**	The information collected during the survey was sufficient to assess the flora and 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 Project Area and identify potential fauna habitat. Sites were chosen from these aerials to reflect changes in community structure. 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.	**Minor constraint (flora).**	Flora and vegetation surveys are normally conducted following winter rainfall in the South-West Interzone Province, ideally during spring (EPA 2016). The field assessments were conducted in September and October (i.e. spring) in fine weather conditions. Winter rainfall prior to the survey was less than the long-term average. This may have impacted the presence of annual species which presents a minor survey constraint.
Disturbances (fire flood, accidental human intervention, etc.).	**Not a constraint.**	The Project Area was not subject to recent disturbances that would impact the outcomes of the survey.
Intensity (in retrospect, was the intensity adequate).	**Not a constraint.**	The Project 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 Project area).	**Not a constraint.**	Existing tracks enabled adequate access to survey the vegetation within the Project Area.
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 and vegetation of the region.

4. Results

4.1 Flora and Vegetation

4.1.1 Desktop assessment

4.1.1.1 Threatened and Priority flora

A desktop survey for Threatened and Priority flora that may potentially occur within the Project Area was undertaken using NatureMap (Parks and Wildlife 2007-), the Western Australian Herbarium (Western Australian Herbarium 1998-), and the EPBC Protected Matters Search Tool (PMST) (DEE 2017c) (Appendix A).

The desktop assessment identified nine Threatened flora and 58 Priority flora species that have been recorded in the local area. Of these, based on general habitat requirements (Appendix C), three Threatened and 14 Priority flora species were considered to have potential to occur within the Project Area. As a result, a targeted survey was undertaken to determine the potential occurrence of any Threatened or Priority species within the Project Area.

4.1.1.2 Threatened and Priority Ecological Communities

The desktop assessment identified 11 TECs listed under the EPBC Act, seven TECs listed under the BC Act, and seven communities listed as a PEC by DBCA within the Project Area (Table 4.1). Based on site location, regional vegetation and landforms, Banksia Woodlands of the Swan Coastal Plain community was considered likely to occur within the Project area. The Critically Endangered Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain community was considered possible to occur as were two PECs (which form components the Banksia Woodlands of the Swan Coastal Plain community).

Table 4.1: TECs and PECs identified within and near the Project area

Community	Conservation Status		Likelihood of occurrence
	EPBC Act	BC Act	
Banksia Woodlands of the Swan Coastal Plain	Endangered	Priority 3	Likely
Banksia ilicifolia woodlands	Endangered[1]	Priority 3	Unlikely
Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)	Endangered	Critically Endangered	Unlikely
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands, Swan Coastal Plain (floristic community type 3c as originally described in in Gibson et al. (1994))	Endangered	Critically Endangered	Unlikely
Dense shrublands on clay flats (floristic community type 9 as originally described in Gibson et al. (1994))	Critically Endangered	Vulnerable	Unlikely
Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson et al. (1994))	Critically Endangered	Vulnerable	Unlikely
Low lying *Banksia attenuata* woodlands or shrublands	Endangered[1]	Priority 3	Possible
Microbial community of a coastal saline lake (Lake Walyungup)	Not listed	Priority 1	Unlikely
Northern Spearwood shrublands and woodlands	Not listed	Priority 3	Possible
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain (floristic community type 19 as originally described in in Gibson et al. (1994))	Endangered	Critically Endangered	Unlikely
Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands	Not listed	Priority 3	Unlikely
Stromatolite like microbialite community of coastal freshwater lakes (Lake Richmond)	Endangered	Critically Endangered	Unlikely
Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain	Critically Endangered	Priority 3	Likely
Woodlands over sedgelands in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Endangered	Critically Endangered	Unlikely

Note: 1: A component of the Banksia woodland of the Swan Coastal Plain TEC

4.1.2 Field survey

4.1.2.1 Native flora

A total of 44 native vascular plant taxa from 20 plant families and 32 genera were recorded within the Project area (Appendix E; Appendix F).

Accumulated species – sites surveyed (species-area curve)

The species-area curve (Figure 4.1) 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 53 (Chao 2005). Based on this value, and the total of 39 species recorded in quadrats across both the Project area and Referral Area, approximately 74% of the flora species potentially present within the Project Area were recorded. An additional five native taxa were collected opportunistically across the Project Area, further increasing the taxa collected. Given this, an appropriate percentage of the flora has been sampled. Survey Area coverage is also shown in Figure 4.2.

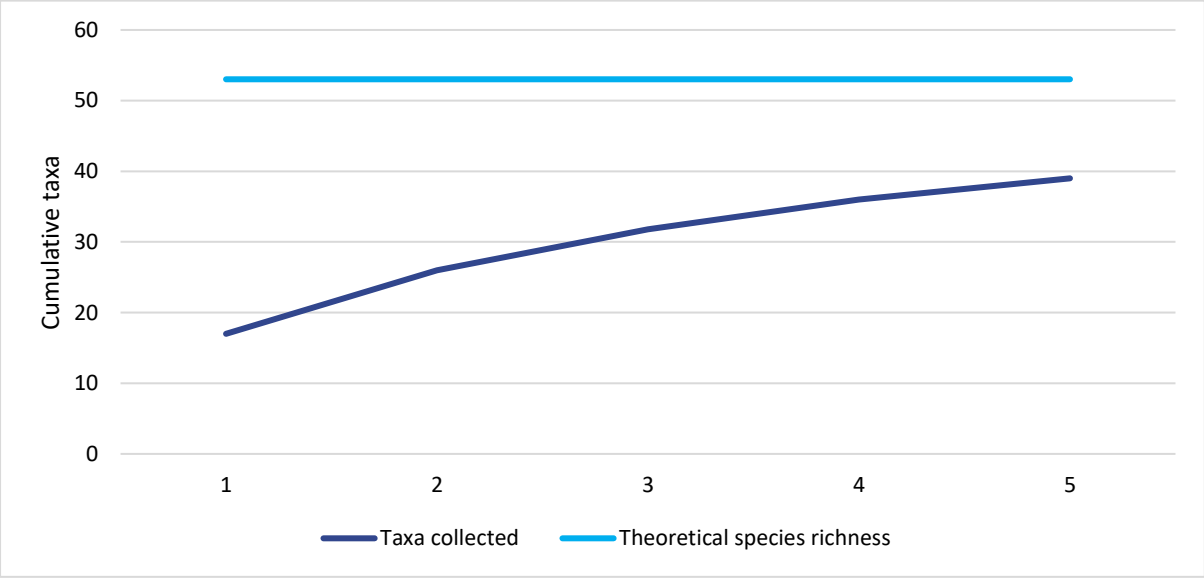


Figure 4.1: Averaged randomised species accumulation curve

Conservation significant flora

No Threatened flora species as listed under section 178 of the EPBC Act or section 19(1) of the BC Act were recorded within the Project area. In addition, no Priority flora species were recorded within the Project area.

The survey was conducted during the main flowering season for flora of the southwest botanical region (i.e. spring), including the Threatened and Priority species with potential to occur in the Project area; as such, this is the optimal time to detect the majority of species present. Given this, the conservation significant flora species with potential to occur within the Project area (nine Threatened and 58 Priority flora species) were considered unlikely to occur within the areas surveyed.

Introduced (exotic) taxa

A total of nine introduced (exotic) taxa were recorded within the Project Area, as follows:

- **Acacia iteaphylla*
- *Asteraceae sp.

- *Briza maxima*
- *Ehrharta calycina*
- *Ehrharta longiflora*
- *Euphorbia peplus*
- *Fumaria capreolata*
- *Geranium molle*
- *Gladiolus caryophyllaceus*
- *Hypochaeris glabra*
- *Iridaceae sp.
- *Lupinus cosentinii*
- *Lysimachia arvensis*
- *Olea europaea subsp. europaea*
- *Oxalis pes-caprae*
- *Pelargonium capitatum*
- *Solanum nigrum*
- *Ursinia anthemoides*
- *Zantedeschia aethiopica*.

One of these species, *Zantedeschia aethiopica, is a 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 (DAFWA 2017).

Legend

- Project area
- Cadastral boundary
- Quadrat
- Roads (MRWA)

Scale 1:2,500 at A4 — 0 25 50 metres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 58917

Client: Department of Education

Version: A | Date: 05-Feb-2021

Drawn By: cthatcher | Checked By: TS

Lot 164 Wellard Road
Wellard, WA 6170

SURVEY EFFORT

FIGURE 4.2

strategen JBS&G

File Name: W:\Projects\1)Open\Dept of Education\58917 Wellard Village School Site Ecology Surveys\GIS\Maps\R01_Rev_A\58917_04_2_SurveyEffort.mxd
Image Reference: www.nearmap.com© - Imagery Date: 19 November 2020

4.1.2.2 Vegetation

Three vegetation types (VT) (Table 4.2) were defined and mapped within the Project Area (Figure 4.3). The total area mapped within the Project Area was 4.02 ha.

Table 4.2: Vegetation types

Vegetation Type	Description	Area (ha)	Percentage of the Project area
VT1	*Banksia attenuata* and *Eucalyptus marginata* woodland over *Acacia pulchella, Macrozamia riedlei* and *Hakea lissocarpha shrubland* over *Hibbertia hypericoides, Mesomelaena pseudostygia and *Ehrharta calycina* herbland / grassland. .	2.91	72.37%
VT2	*Eucalyptus gomphocephala* scattered trees over *Acacia rostellifera* tall shrubland over *Hibbertia hypericoides*, *Conostylis aculeata* and **Ehrharta calycina* herbland / grassland.	0.82	20.48%
CL	Cleared; non-native vegetation	0.29	7.16%
Total		4.02	100%

Vegetation condition

Historical disturbance from partial clearing and weed invasion are the two most prominent disturbances within the Project Area. These disturbances were found throughout the Project area. As such, vegetation condition within the Project Area ranged from Completely Degraded to Good (EPA 2016; Figure 4.4).

Table 4.3 provides a numerical breakdown of the area occupied by each vegetation condition rating within the Project Area.

Table 4.3: Vegetation condition within the Project Area

Vegetation Condition	Area (ha)	Percentage of the Project area
Good	2.80	69.72%
Degraded	0.89	22.24%
Completely Degraded	0.33	8.04%

Legend

- Project area

Vegetation type

- *Acacia rostellifera* shrubland
- *Eucalypt / Banksia* woodland
- Cleared

Scale 1:1,750 at A4

0 10 20
Metres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 58917

Client: Department of Education

Version: A | Date: 05-Feb-2021

Drawn By: cthatcher | Checked By: TS

Lot 164 Wellard Road
Wellard, WA 6170

VEGETATION TYPES

FIGURE 4.3

strategen JBS&G

File Name: W:\Projects\1)Open\Dept of Education\58917 Wellard Village School Site Ecology Surveys\GIS\Maps\R01_Rev_A\58917_04_3_VegTypes.mxd
Image Reference: www.nearmap.com© - Imagery Date: 19 November 2020

Legend

- Project area

Vegetation condition

- Good
- Degraded
- Completely degraded

Scale 1:1,750 at A4

0 10 20

Metres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 58917

Client: Department of Education

Version: A | Date: 05-Feb-2021

Drawn By: cthatcher | Checked By: TS

Lot 164 Wellard Road
Wellard, WA 6170

VEGETATION CONDITION

FIGURE 4.4

strategen JBS&G

File Name: W:\Projects\1)Open\Dept of Education\58917 Wellard Village School Site Ecology Surveys\GIS\Maps\R01_Rev_A\58917_04_4_VegCond.mxd
Image Reference: www.nearmap.com© - Imagery Date: 19 November 2020

FCT similarity analysis

The results for the hierarchical clustering analysis show quadrats fused with representative sites from SCP28 (Table 4.4). The three nearest neighbours for each site using the Bray-Curtis distance are shown in Table 4.5, respectively. The nearest neighbour assignment is largely consistent with the results from the hierarchical clustering analysis with quadrats in VT1 showing affinities to SCP28. Quadrat 2 mapped as VT2 did not produce interpretable results. This is largely due to the low native species richness recorded, resulting from high weed infestation.

Given the results of the analysis, one FCT (SCP28) were identified within the Project area. SCP28 can be described as Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* woodlands (Gibson 1994).

Table 4.4: Results of hierarchical analysis for plots from the Project Area

Site	VT	FCT First fusion	FCT of nearest main group fusion	Likely FCT
Q1	VT1	28 / 6	28 / 6	degraded – likely 28
Q2	VT2	30a	30a/30b	Too degraded
Q3	VT1	6/11	6/11	degraded – likely 28
Q4	VT1	28/21a	28/21a	28
Q5	VT1	28	28	28

Table 4.5: Results of Nearest Neighbour analysis using the Bray-Curtis dissimilarity coefficient

Site	VT	Nearest Neighbour (FCT)	2nd Nearest Neighbour (FCT)	3rd Nearest Neighbour (FCT)
Q1	VT1	28_TRIG-3	28_WOODV-2	28_NEER-21
Q2	VT2	21c_FL-5	30a2_MHEY-2	21c_FL-6
Q3	VT1	24_KERO-2	28_TRIG-3	21c_FL-5
Q4	VT1	28_NEER-3	28_SHENT-1	28_WOODV-2
Q5	VT1	21c_FL-6	28_SHENT-1	28_TRIG-3

Limitations are associated with determining and mapping the presence of FCTs within the Project 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. Consequently, assigned FCTs within the Project 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

The desktop survey identified two TECs and three PECs as having the potential to occur within the Project Area. Based on the results of the field survey, two TECs (and two PECs) are considered to occur within the Project Area:

- Banksia Woodlands of the Swan Coastal Plain (TEC listed under EPBC Act and P3 PEC listed by DBCA)
- Tuart woodlands and forests of the Swan Coastal Plain (TEC listed under EPBC Act and P3 PEC listed by DBCA)

The EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' threatened ecological community and Priority 3 BC Act listed PEC was recorded and mapped in the Project Area. This TEC is listed as Endangered under the EPBC Act and as a P3 PEC at the state level. The WA PEC listing is analogous to the EPBC listed TEC.

Banksia Woodlands of the Swan Coastal Plain TEC

An analysis of the quadrat data was undertaken to determine the extent of the Banksia Woodlands of the Swan Coastal Plain TEC (Table 4.6). The determination of patches was made using the key diagnostic criteria as per the Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community (TSSC 2016). All five quadrats were included in the assessment.

Four quadrats met the key diagnostic criteria for the Banksia Woodlands of the Swan Coastal Plain ecological community and correspond with one patch of the ecological community (Figure 4.5), representing a total area within the Project Area of 2.91 ha. Of these patches, none are fully confined to the Project Area, with vegetation adjacent being considered part of each patch. Average vegetation condition across the patch within the Project Area is Very Good. This patch is confined to the Project Area.

Banksia Woodlands of the Swan Coastal Plain PEC

Areas mapped as Banksia Woodlands of the Swan Coastal Plain TEC are also considered to represent the state level community Banksia Woodlands of the Swan Coastal Plain PEC. Given this, there is a total area of 2.91 ha within the Project Area.

Table 4.6: Banksia woodlands of the Swan Coastal Plain – assessment against key diagnostic criteria (TSSC 2016)

Key diagnostic criteria (TSSC 2016)	Quadrat				
	1	2	3	4	5
Area within Project Area	2.91 ha				
Total patch size	2.91 ha				
Location: Occurs in the Swan Coastal Plain or Jarrah Forest IBRA bioregions.	YES	YES	YES	YES	YES
Soils and landform: Occurs on: • well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands • sandy colluviums and aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau • transitional substrates and sandflats.	YES - sandy colluviums and aeolian sands	YES - sandy colluviums and aeolian sands	YES - sandy colluviums and aeolian sands	YES - sandy colluviums and aeolian sands	YES - sandy colluviums and aeolian sands
Structure: Low woodland to forest with: • a distinctive upper sclerophyllous layer of low trees (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the banksia species identified below • emergent trees of medium or tall (>10 m) height. *Eucalyptus* or *Allocasuarina* species may sometimes be present above the banksia canopy • an often highly species-rich understorey.	YES – occurs as a low woodland with an upper layer of Banksia spp. and emergent Eucalyptus species	No – No Banksia species are present	YES – occurs as a low woodland with an upper layer of Banksia spp. and emergent Eucalyptus species	YES – occurs as a low woodland with an upper layer of Banksia spp. and emergent Eucalyptus species	YES – occurs as a low woodland with an upper layer of Banksia spp. and emergent Eucalyptus species
Composition: Contains at least one of the following species: • Banksia attenuata • Banksia menziesii • Banksia prionotes • Banksia ilicifolia.	YES – contains *Banksia attenuata*	n/a	YES – contains *Banksia attenuata*	YES – contains *Banksia attenuata*	YES – contains *Banksia attenuata*
Condition (Keighery 1994): 'Pristine': no minimum patch size	Good	n/a	Good	Good	Good

'Excellent': 0.5 ha 'Very Good': 1 ha 'Good': 2 ha.					

Tuart Woodlands and Forests of the Swan Coastal Plain TEC

An analysis of the quadrat data, tree data, site notes and historical reports was undertaken to determine the presence and extent of the Tuart Woodlands and Forests of the Swan Coastal Plain TEC (Table 4.7; Table 4.8). The determination of patches was made using the key diagnostic criteria as per the Approved Conservation Advice (incorporating listing advice) for the Tuart Woodlands and Forests of the Swan Coastal Plain ecological community (TSSC 2019). Vegetation within VT1 and VT2 met the key diagnostic criteria for the Tuart Woodlands and Forests of the Swan Coastal Plain ecological community, representing a total area within the Project Area of 3.13 ha which includes areas of bare ground surrounding the Tuart canopy. The patch extends outside of the Project Area.

Based on the assessment presented within Table 4.7 and Table 4.8, Tuart Woodlands and Forests of the Swan Coastal Plain TEC is considered to be present within the Project Area. The extent of this TEC is shown in Figure 4.5.

Table 4.7: Assessment of vegetation within the Project area against key diagnostic criteria for Tuart Woodlands of the Swan Coastal Plain TEC

Key diagnostic criteria (TSSC 2019)	Assessment of vegetation within the Project area
Location: Occurs in the Swan Coastal Plain Bioregion, Western Australia (IBRA v7. Department of the Environment 2012).	**Yes.** The Project 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 Project Area occurs on Spearwood dune systems.
Structure and composition: Defining features include: • the presence of at least two living established *Eucalyptus gomphocephala* (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: *Agonis flexuosa* (Peppermint) and *Banksia grandis* (Bull Banksia) (both in the southern part of the range), *Banksia attenuata* (Candlestick Banksia), *Eucalyptus marginata* (Jarrah); and less commonly, *Corymbia calophylla* (Marri), *Banksia menziesii* (Firewood Banksia) and *Banksia prionotes* (Acorn Banksia).	**Yes**. Vegetation within patches occur as a woodland to open woodland living established *Eucalyptus gomphocephala* scattered throughout.

Table 4.8: Assessment of Tuart Woodlands patches against condition thresholds

Patch	Criteria					
	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)	Result
1	3.13 ha	12.4	32%	4.3	Very High	**TEC present.** Patch ≥0.5ha with a very high condition understorey, and a habitat role (≥2 very large trees per 0.5 ha)

Legend

Project area

Threatened ecological communities

Banksia woodlands of the Swan Coastal Plain

Tuart woodlands of the Swan Coastal Plain

Scale 1:1,750 at A4

0 10 20
Metres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 58917

Client: Department of Education

Version: A | Date: 19-Feb-2021

Drawn By: cthatcher | Checked By: TS

Lot 164 Wellard Road
Wellard, WA 6170

THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

FIGURE 4.5

strategen JBS&G

File Name: W:\Projects\1)Open\Dept of Education\58917 Wellard Village School Site Ecology Surveys\GIS\Maps\R01_Rev_A\58917_04_5_TECPEC.mxd
Image Reference: www.nearmap.com© - Imagery Date: 19 November 2020

4.2 Fauna

4.2.1 Desktop Assessment

Results of the databases searches identified a total of 49 conservation significant vertebrate species (including Priority species) were identified during the desktop review of the database searches (Appendix B). These were comprised of seven reptiles, 31 birds, and eight mammals.

4.2.1.1 Waterbirds

Wetland avifauna such as wading birds, including Plovers, Sandpipers and Stilts inhabit estuaries, mudflats, saltmarshes, sandflats and beaches, with shallow water edges, where they feed on invertebrates such as worms, molluscs, insects and crustaceans (Garnett *et al.* 2011) and these habitats for these species are not present in the Project area. A number of seabirds including Shearwaters, Petrels and Albatross were also recorded. These species spend most of their time far offshore (Slater *et al.* 2009, Garnett *et. al*. 2011). Wetland habitat with shallow water and sand or mud flats or marine waters are not present in the Project Area; therefore, these species have been omitted from any further discussion.

4.2.1.2 Marine mammals

A number of marine mammals were also returned in the database searches, mainly from the EPBC PMST. The Project Area is inland from the ocean and so does not contain marine habitat, as such, these species have been omitted from any further discussion.

4.2.1.3 Database errors and anomalies

It is important to note that the EPBC PMST is not entirely based on point records, but also on broader information, including bioclimatic distribution models. Consequently, the results of the EPBC PMST are in some cases less accurate, particularly at a local scale (e.g. the Malleefowl [*Leipoa ocellata*]). As a result, the EPBC PMST can include species that do not occur in the Project Area because, for example, there is no habitat available or they are now known to be locally extinct. These species have therefore been omitted from any further discussion. In addition, when the DBCA threatened fauna database results return three or less records and the records are more than 30 years old, these species are also omitted from further discussion.

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

4.2.2 Conservation Significant Fauna

With the aforementioned wading birds and locally/regionally extinct and database errors species removed, a total of seven conservation significant species retrieved from the database searches are considered as either likely or possible to occur in the Project Area (Table 4.9).

The Likelihood of each species is based on the following criteria:

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

Table 4.9: Conservation significant fauna potentially occurring in the Project Area

Species	Common Name	Conservation Status	Likelihood
Birds			
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	VU	Possible
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	EN	Likely
Mammals			
Isoodon fusciventer	Quenda	P4	Recorded
Reptiles			
Lerista lineata	Perth slider	P3	Possible
Neelaps calonotos	Black-striped snake	P3	Possible
Pletholax gracilis subsp. *edelensis*	Keeled legless lizard	P3	Possible
Invertebrates			
Idiosoma sigillatum	Shield-backed Trapdoor Spider	-	Possible

CR = Listed as Critically Endangered under the EBPC Act and BC Act, EN = Listed as Endangered under the EBPC Act and BC Act, VU = Listed as Vulnerable under the EBPC Act and BC Act, Mi = Listed as Migratory under the EBPC Act, Ma = Listed as Marine under the EBPC Act, , and P = Listed as Priority by the DBCA.

4.2.3 Field survey

4.2.3.1 Fauna habitat

A total of four fauna habitat assessments were undertaken and two fauna habitat types were defined and mapped for the Project area based on the results of the field assessment (Table 4.10; Figure 4.6).

Table 4.10: Fauna habitat extent in the Project Area

Fauna habitat	Description of dominant flora species	Extent in the Project area (Ha)	Extent in the Project area (%)
Eucalypt/ Banksia Woodland	*Jarrah, Banksia attenuata*	2.91	72.37%
Shrubland	*Acacia rostellifera*	0.82	20.48%
Cleared	No habitat present	0.29	7.16%

4.2.3.2 Opportunistic sightings

Reptiles

During the field survey, one reptile species was recorded; Bobtail (*Tiliqua rugosa*) was recorded directly.

Birds

From the database searches, a total of 117 bird species from 52 families have been previously recorded in the surrounding area (including earlier dismissed species). During the field survey nine bird species were recorded from six families, none of which have any conservation significance.

Mammals

During the field survey one non-native mammal species was recorded from secondary evidence; Domestic Cat (*Felis catus*).

Legend

Project area

Fauna habitat

Eucalypt woodland over *Banksia* woodland

Shrubland

Scale 1:1,750 at A4

0 10 20

Metres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 58917

Client: Department of Education

Version: A | Date: 05-Feb-2021

Drawn By: cthatcher | Checked By: TS

Lot 164 Wellard Road
Wellard, WA 6170

FAUNA HABITAT

FIGURE 4.6

strategen JBS&G

File Name: W:\Projects\1)Open\Dept of Education\58917 Wellard Village School Site Ecology Surveys\GIS\Maps\R01_Rev_A\58917_04_6_FaunaHabitat.mxd
Image Reference: www.nearmap.com© - Imagery Date: 19 November 2020

4.2.3.3 Black Cockatoo Assessment

Foraging habitat

Foraging habitat quality identified within the Survey Area is shown in Figure 4.6. Table 4.11 to Table 4.13 outline the vegetation types and associated foraging habitat value scores.

Vegetation within the Survey Area were considered to have low to moderate foraging habitat value for Carnaby's Black Cockatoo and Baudin's Black Cockatoo, and low foraging value for Forest Red-tailed Black Cockatoo, based on density of suitable foraging species.

The site represents <0.1% of the existing native vegetation within the local area (15 km radius) and Carnaby's Black Cockatoo breeding sites are known from within a 15 km radius, therefore was assigned a context score of 1.

Evidence of foraging in the way of chewed Banksia cones was recorded in the Project Area, and therefore a score of 1 was assigned.

Table 4.11: Carnaby's Black Cockatoo foraging habitat quality within Survey Area

Foraging species	Vegetation composition score	Site Context score	Species density	Total score
Banksia attenuata *Banksia menziesii* *Eucalyptus marginata* *Eucalyptus gomphocephala* *Corymbia calophylla*	4 – Moderate	1	1	6
Eucalyptus gomphocephala	2 – Low foraging value	n/a	n/a	2
Nil	0 – No foraging value	n/a	n/a	0

Table 4.12: Forest Red-tailed Black Cockatoo foraging habitat quality within Survey Area

Foraging species	Vegetation composition score	Site Context score	Species density	Total score
Eucalyptus marginata *Eucalyptus gomphocephala* *Corymbia calophylla*	3 – Low to moderate	1	1	5
Eucalyptus gomphocephala	1 – Negligible foraging value	n/a	n/a	1
Nil	0 – No foraging value	n/a	n/a	0

Table 4.13: Black cockatoo habitat

Black cockatoo habitat	Area (ha)
Carnaby's Black Cockatoo	
Moderate foraging value	2.91
Low foraging value	0.82
Total area of foraging habitat	**3.73**
Forest Red-tailed Black Cockatoo	
Low to Moderate foraging value	2.91
Negligible foraging value	0.82
Total area of foraging habitat	**3.73**

Breeding Habitat

Within the Project Area, 77 trees were recorded with a suitable DBH (≥ 500 mm); 21 Jarrah, 32 Marri and 24 Tuart (Appendix G; Figure 4.7). Of these, five trees contained hollows potentially suitable for black cockatoo breeding.

Roosting Habitat

No roosts were identified during the assessment, however, the Project Area contained potential roosting habitat in the form of tall Jarrah, Marri and Tuart trees throughout the site.

Legend

- Project area
- Black Cockatoo habitat
  - CBC: Moderate
  - FRTBC: Low to moderate
  - CBC: Low;
  - FRTBC: Negligible
- Black Cockatoo breeding trees
  - *Corymbia calophylla*
  - *Eucalyptus gomphocephala*
  - *Eucalyptus marginata*
  - Hollows present

Scale 1:1,750 at A4 — 0 10 20 Metres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 58917

Client: Department of Education

Version: A | Date: 10-Feb-2021

Drawn By: cthatcher | Checked By: TS

Lot 164 Wellard Road
Wellard, WA 6170

BLACK COKATOO HABITAT

FIGURE 4.7

strategen JBS&G

File Name: W:\Projects\1)Open\Dept of Education\58917 Wellard Village School Site Ecology Surveys\GIS\Maps\R01_Rev_A\58917_04_7_BCHabitat.mxd
Image Reference: www.nearmap.com© - Imagery Date: 19 November 2020

5. Discussion

5.1 Flora and vegetation

No records of Threatened or Priority flora occur within the Project Area. This was confirmed by targeted flora surveys conducted within vegetation considered as potential habitat. The low flora species richness present was expected due to the relatively uniform nature of the vegetation and the moderate level of disturbance within the Project Area.

Two vegetation types were defined within the Project Area, which can be broadly described as *Banksia attenuata*, *Banksia menziesii* and *Allocasuarina fraseriana* low open woodland and *Acacia rostellifera* shrubland.

Statistical analysis of the quadrat data determined that the vegetation within the Project Area showed an affinity to SCP28 – Spearwood *Banksia attenuata* or B*anksia attenuata* – Eucalyptus woodlands (Gibson *et al.* 1994). This FCT is known from 80 locations across the Swan Coastal Plain and over a range of 150km north-south (TSCC 2016). This FCT is not listed as a PEC, and is well represented within the Swan Coastal Plain.

The TEC "Banksia woodlands of the Swan Coastal Plain" was identified in the desktop assessment as occurring within the Project Area. This TEC is listed as Endangered under the EPBC Act and as a P3 PEC at the state level. An assessment of quadrat data, against published diagnostic criteria determined that vegetation mapped as VT1 represents the TEC. This vegetation is present in one contiguous patch meeting the diagnostic criteria over an area of 2.91 ha within the Project Area. This patch is constrained within the boundaries of the Project Area. Average vegetation condition ranged from Good to Very Good. Within the local area (10km radius), approximately 5,491.76 ha of Banksia woodland remains as remnant vegetation. Given this, the Banksia woodland TEC mapped within the Project Area represents 0.05% of the local extent of this community.

The TEC "Tuart woodlands and forests of the Swan Coastal Plain" was identified in the desktop assessment as occurring within the Project Area. This TEC is listed as Critically Endangered under the EPBC Act and as a P3 PEC at the state level. An assessment of quadrat tree data, against published diagnostic criteria determined a portion of vegetation mapped in VT1 and VT2 represents the TEC. This vegetation is present in one contiguous patch meeting the diagnostic criteria over an area of 3.13 ha within the Project Area. This patch extends slightly outside of the Project Area (0.25ha). Vegetation condition as defined by the conservation advice is very high. Within the local area (10km radius), approximately 1,929 ha of Tuart woodland remains as remnant vegetation. Given this, the Tuart woodland TEC mapped within the Project Area represents 0.16% of the local extent of this community.

5.2 Fauna

The depauperate nature of the mammal assemblages reflects the isolated nature of the Project Area being surrounded by urban development, major roads, limiting ingress of native fauna species.

This habitat consists of an overstorey of *Banksia attenuata, Banksia menziesii*, with scattered Jarrah over a mixed shrubland and mixed herbland with weedy grass species. This habitat provides vegetation in multiple strata (canopy, midstorey and understorey) and so provides habitat for a suite of fauna, particularly for small reptiles, birds and mammals.

The Jarrah and Banksia also provide foraging habitat for all three species of Black Cockatoo, while the large Jarrah trees also provide potential breeding habitat.

5.2.1 Fauna of Conservation Significance

A total of 14 conservation significant species retrieved from the database searches were considered potential to occur in the Project Area from the results of the desktop assessment. Of these 14 conservation significant species, two were recorded, four species are considered Likely to occur, one

species is considered Possible and seven species are considered Unlikely to occur and in the Project area. The conservation significant species considered possible or likely to occur are discussed further below.

Quenda (*Isoodon obesulus fusciventer*)

Potentially suitable habitat is present throughout the Project area and is within the known distribution of the species. Evidence of recent habitation from this species was recorded within the Project Area by way of diggings. Within the Swan Coastal Plain, this species is commonly associated with wetlands with dense vegetation. While a direct connection to a watercourse or wetland is not present, modified vegetation including parkland provides potential habitat for this species to travel and forage within the Project Area. While not considered primary habitat, the vegetation within the Project Area likely provides a foraging resource for this species.

Perth Lined Skink (*Lerista lineata*)

Potentially suitable habitat is present throughout the Project Area for this species. While this species was not recorded during the basic fauna survey, given the fact that the majority of the Project Area has deep sandy soils considered suitable for the Perth Slider, the species is considered Likely to occur.

Black-striped Snake (*Neelaps calonotos*)

Potentially suitable habitat is present throughout the Project Area for this species. While this species was not recorded during the basic fauna survey, the majority of the Project Area has deep sandy soils, providing suitable habitat for the Black Striped Snake, and its preferred food source, the genus *Lerista*, is likely present. While habitat is present, a lack of recent records within the local area results in the Black-striped Snake being considered as Possibly occurring in the Project Area.

Keeled legless lizard (*Pletholax gracilis* subsp. *edelensis*)

Potentially suitable habitat is present throughout the Project Area for this species. While this species was not recorded during the basic fauna survey, the majority of the Project Area has deep sandy soils, providing suitable habitat for the Keeled legless lizard. While habitat is present, a lack of recent records within the local area results in the Keeled legless lizard being considered as Possibly occurring in the Project Area.

Carnaby's Black Cockatoo

Carnaby's Cockatoo is listed as Endangered (EN) under the EPBC Act and BC Act and was returned from all three database searches. While no direct observations were recorded during the survey, feeding evidence was recorded in the form of chewed Banksia cones.

The Project Area is located within the known distribution of this species and the vegetation contains species which provide suitable foraging, roosting and potential breeding habitat.

The DBCA threatened fauna database returned 273 records of Carnaby's Cockatoo from the vicinity of the Project Area (10 km), while records from the Great Cocky Count (2017) show that the closest roost is approximately 3.2 km to the south-east of the Project Area.

There are extensive areas of foraging habitat within 2km to the west, particularly to the south west and east of the Project Area. Within the local area (12km radius), 10,159 ha of potential foraging habitat is present. The foraging habitat within the Project Area represents 0.04% of the local extent.

Forest Red-tailed Black Cockatoo (FTRBC)

The FRTBC is listed as Vulnerable (VU) under the EPBC Act and BC Act and was returned from all three database searches.

The Project Area is within FRTBC distribution and the vegetation contains species, such as Tuart and Jarrah which provide suitable foraging, roosting and breeding habitat.

The DBCA threatened fauna database returned 30 records of FRTBC in the vicinity of the Project Area. Given the preferred food source of the FRTBC is Marri, which is present in the Project Area, it is therefore considered likely that the FRTBC would potentially utilise the Project Area.

There are extensive areas of foraging habitat within 2km to the west, particularly to the south west and east of the Project area. Within the local area (12km radius), 10,159 ha of potential foraging habitat is present. The foraging habitat within the Project Area represents 0.04% of the local extent.

Black cockatoo Breeding Habitat

The potential breeding habitat, as defined in the Black Cockatoo referral guidelines (DSEWPaC 2012) within the Project Area consisted of Tuart and Jarrah trees.

In total, 77 trees were recorded as having a suitable DBH. Of these, five trees with hollows potentially supporting black cockatoo breeding were recorded during the survey.

Black cockatoo Roosting Habitat

No roosts were identified in the Project Area during the assessment, however roosting habitat in the form of tall Jarrah, Marri and Tuart trees was present throughout the Project Area. The nearest confirmed roosting site is located 600 m west of the Project Area (KWIWELR001). It is possible therefore that parts of the Project Area may be used as a staging site for this roost, as Black Cockatoos gather at dusk in preparation for roosting.

6. Conclusion

The key results and outcomes of the flora and vegetation survey and desktop fauna and targeted Black cockatoo survey were:

- Two native vegetation types were mapped within the Project Area
- Two TECs and two PECs were recorded and mapped within the Project Area:
  - Banksia woodland of the Swan Coastal Plain (TEC [EPBC Act] and PEC [DBCA listing])
  - Tuart woodlands and forests of the Swan Coastal Plain (TEC [EPBC Act] and PEC [DBCA listing])
- no Threatened or Priority flora species were recorded within the Project Area
- no Weeds of National Significance or no Declared Pests as listed under the BAM Act were recorded within the Project area
- two fauna habitats were identified within the Project Area
- 3.73 ha of Black cockatoo foraging habitat was mapped within the Project Area
- 77 Suitable DBH Trees, which have the potential to form black cockatoo breeding habitat, were recorded within the Project Area; five contained hollows potentially suitable for breeding.

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) 2019, Climatic Statistics for Australian Locations: Monthly climate statistics, [Online], Australian Government, Available from: http://www.bom.gov.au/climate/averages/tables/.

Chao A 2005, 'Species richness estimation', in Encyclopaedia of Statistical Sciences, eds N Balakrisnan, 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.

Department of Biodiversity Conservation and Attractions (DBCA) 2019b, Priority Ecological Communities for Western Australia Version 28 (17 January 2019), Government of Western Australia, Perth.

Department of Biodiversity Conservation and Attractions (DBCA) 2018a, List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment (Correct as at 28 June 2018), Government of Western Australia, Perth.

Department of Biodiversity Conservation and Attractions (DBCA), 2018b, Threatened Fauna Database.

Department of Biodiversity Conservation and Attractions (DBCA) 2018c, Wildlife Conservation (Rare Flora) Notice 2018, [Online], Government of Western Australia, https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/flora_notice.pdf [21 December 2018].

Department of Biodiversity Conservation and Attractions (DBCA) 2019a, Conservation Codes for Western Australian Flora and Fauna, current as of 08 January 2019, Government of Western Australia, Perth.

Department of Environment and Conservation (DEC) 2009, Grand Spider Orchid (Caladenia huegelii) Recovery Plan. Commonwealth Department of the Environment, Water, Heritage and the Arts, Canberra.

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 [08 January 2019].

Department of Environment and Energy (DEE) 2017, 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.

Department of Environment and Energy (DEE) 2019a, EPBC Act Protected Matters Search Tool, [Online], Australian Government. Available from: http://www.environment.gov.au/epbc/pmst/index.html.

Department of Environment and Energy (DEE) 2019b, EPBC Act List of Threatened Flora, [Online], Australian Government, Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora.

Department of Environment and Energy (DEE) 2019c, EPBC Act List of Threatened Ecological Communities, [Online], Australian Government, Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl.

Department of Environment and Energy (DEE) 2019a, Species of National Environmental Significance Database. https://www.environment.gov.au/science/erin/databases-maps/snes

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/ [08 January 2019].

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 [08 January 2019].

Department of Sustainability Environment Water Population and Communities (DSEWPAC) 2012, *EPBC Act referral guidelines for three threatened black cockatoo species*. Available from: http://www.environment.gov.au/system/files/resources/895d4094-af63-4dd3-8dff-ad2b9b943312/files/referral-guidelines-wa-black-cockatoo.pdf.

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.

Environmental Protection Authority (EPA) 2020, Technical Guidance - Terrestrial vertebrate fauna surveys for environmental impact assessment. Available from: https://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/2020.09.17 - EPA Technical Guidance - Vertebrate Fauna Surveys - Final.pdf

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), 2019a, 2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report), Current as of October 2018, Department of Parks and Wildlife, Perth.

Government of Western Australia. (GoWA), 2019b, 2018 South West Vegetation Complex Statistics, Current as of October 2018, WA Department of Parks and Wildlife, Perth.

Heddle EM, Loneragan OW & Havel JJ 1980, Darling System, Vegetation Complexes, Forest Department, Perth.

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.

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., & 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.

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., Smith, G. T. & Rowley, I., 1982, The availability and dimensions of tree hollows that provide nest sites for cockatoos (Psittaciformes) in Western Australia, Australian Wildlife Research 9, 541-56.

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.

Smolinski, H, and Scholz, G. 1997, Soil assessment of the west Gingin area, Department of Agriculture and Food, Western Australia, Perth, Report 15.

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.

Western Australian Herbarium, 1998-, FloraBase – the Western Australian Flora, [Online], Government of Western Australia, Available from: http://florabase.dpaw.wa.gov.au/ [08 January 2019].

Limitations

Scope of services

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

Reliance on data

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

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

Environmental conclusions

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

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

Strategen-JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by Strategen-JBS&G, and should not be relied upon by other parties, who should make their own enquiries.

Appendix A Conservation significant flora and ecological community definitions

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

CONSERVATION CODES

For Western Australian Flora and Fauna

Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016.*

Categories of Threatened, Extinct and Specially Protected fauna and flora are:

T **Threatened species**

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora.

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 in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.

EN **Endangered species**

Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.

VU **Vulnerable species**

Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.

Extinct species

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.

EX Extinct species

Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).

Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.

EW Extinct in the wild species

Species that *"is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).

Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

MI Migratory species

Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).

Includes 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 fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.

Published as migratory birds protected under an international agreement under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

CD Species of special conservation interest (conservation dependent fauna)

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).

Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

OS Other specially protected species

Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Published as other specially protected fauna under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

P Priority species

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 fauna or flora.

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.

[1] The definition of flora includes algae, fungi and lichens
[2]Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Appendix B Desktop assessment results

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Tristan Sleigh on 27/06/2020

Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)
Current Names Only Yes
Method 'By Circle'
Centre 115° 49' 12" E,32° 15' 31" S
Buffer 10km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	14932	*Acacia lasiocarpa var. bracteolata long peduncle variant (G.J. Keighery 5026)*		P1	
2.	48762	*Acacia sp. Binningup (G. Cockerton et al. WB 37784)*		P1	
3.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
4.	48332	*Amanita preissii (Cinnamon-ring Lepidella)*		P3	
5.	141	*Aponogeton hexatepalus (Stalked Water Ribbons)*		P4	
6.	25554	*Apus pacificus (Fork-tailed Swift, Pacific Swift)*		IA	
7.	48573	*Ardenna pacifica (Wedge-tailed Shearwater)*		IA	
8.	25736	*Arenaria interpres (Ruddy Turnstone)*		IA	
9.	35317	*Austrostipa mundula*		P3	
10.	16633	*Boronia juncea subsp. juncea*		P1	
11.	24345	*Botaurus poiciloptilus (Australasian Bittern)*		T	
12.	1596	*Caladenia huegelii (Grand Spider Orchid)*		T	
13.	24779	*Calidris acuminata (Sharp-tailed Sandpiper)*		IA	
14.	24780	*Calidris alba (Sanderling)*		IA	
15.	25738	*Calidris canutus (Red Knot, knot)*		IA	
16.	24784	*Calidris ferruginea (Curlew Sandpiper)*		T	
17.	24786	*Calidris melanotos (Pectoral Sandpiper)*		IA	
18.	24788	*Calidris ruficollis (Red-necked Stint)*		IA	
19.	24789	*Calidris subminuta (Long-toed Stint)*		IA	
20.	24790	*Calidris tenuirostris (Great Knot)*		T	
21.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black Cockatoo)*		T	
22.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo, White-tailed Long-billed Black Cockatoo)*		T	
23.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)*		T	
24.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		T	
25.	25335	*Caretta caretta (Loggerhead Turtle)*		T	
26.	25575	*Charadrius leschenaultii (Greater Sand Plover)*		T	
27.	25336	*Chelonia mydas (Green Turtle)*		T	
28.	41332	*Chlidonias leucopterus (White-winged Black Tern, white-winged tern)*		IA	
29.	1870	*Conospermum eatoniae*		P3	
30.	16245	*Cyathochaeta teretifolia*		P3	
31.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
32.	12938	*Diuris micrantha*		T	
33.	1637	*Diuris purdiei (Purdie's Donkey Orchid)*		T	
34.	4763	*Dodonaea hackettiana (Hackett's Hopbush)*		P4	
35.	1639	*Drakaea elastica (Glossy-leaved Hammer Orchid)*		T	
36.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
37.	47956	*Gelochelidon nilotica subsp. macrotarsa (Gull-billed Tern)*		IA	
38.	24215	*Hydromys chrysogaster (Water-rat, Rakali)*		P4	
39.	48587	*Hydroprogne caspia (Caspian Tern)*		IA	
40.	48935	*Idiosoma sigillatum (Swan Coastal Plain shield-backed trapdoor spider)*		P3	
41.	48588	*Isoodon fusciventer (Quenda, southwestern brown bandicoot)*		P4	
42.	20462	*Jacksonia gracillima*		P3	
43.	4027	*Jacksonia sericea (Waldjumi)*		P4	
44.	19272	*Johnsonia pubescens subsp. cygnorum*		P2	
45.	25147	*Lerista lineata (Perth Slider, Lined Skink)*		P3	
46.	30932	*Limosa lapponica (Bar-tailed Godwit)*		IA	
47.	25741	*Limosa limosa (Black-tailed Godwit)*		IA	
48.	24690	*Macronectes giganteus (Southern Giant Petrel)*		IA	
49.	25249	*Neelaps calonotos (Black-striped Snake, black-striped burrowing snake)*		P3	
50.	48022	*Notamacropus irma (Western Brush Wallaby)*		P4	
51.	25196	*Notoscincus butleri (lined soil-crevice skink (Dampier))*		P4	

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
52.	24798	*Numenius madagascariensis (Eastern Curlew)*		T	
53.	25742	*Numenius phaeopus (Whimbrel)*		IA	
54.	41347	*Onychoprion anaethetus (Bridled Tern)*		IA	
55.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
56.	48591	*Pandion cristatus (Osprey, Eastern Osprey)*		IA	
57.	48070	*Phascogale tapoatafa subsp. wambenger (South-western Brush-tailed Phascogale, Wambenger)*		S	
58.	5237	*Pimelea calcicola*		P3	
59.	8163	*Pithocarpa corymbulosa (Corymbose Pithocarpa)*		P3	
60.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
61.	25006	*Pletholax gracilis subsp. edelensis (Keeled Legless Lizard (Shark Bay))*		P3	
62.	24383	*Pluvialis squatarola (Grey Plover)*		IA	
63.	20348	*Sphaerolobium calcicola*		P3	
64.	48116	*Stercorarius antarcticus (Brown Skua)*		P4	
65.	24517	*Stercorarius parasiticus (Arctic jaeger, Arctic Skua)*		IA	
66.	25640	*Sterna dougallii (Roseate Tern)*		IA	
67.	25642	*Sterna hirundo (Common Tern)*		IA	
68.	48593	*Sternula albifrons (Little Tern)*		IA	
69.	48595	*Sternula nereis subsp. nereis (Fairy Tern)*		T	
70.	17850	*Stylidium ireneae*		P4	
71.	7756	*Stylidium longitubum (Jumping Jacks)*		P4	
72.	25800	*Stylidium paludicola*		P3	
73.	7803	*Stylidium striatum (Fan-leaved Triggerplant)*		P4	
74.	28354	*Synaphea sp. Serpentine (G.R. Brand 103)*		T	
75.	33992	*Synemon gratiosa (Graceful Sunmoth)*		P4	
76.	35581	*Tetraria sp. Chandala (G.J. Keighery 17055)*		P2	
77.	34007	*Thalassarche chlororhynchos (Atlantic Yellow-nosed Albatross)*		T	
78.	48597	*Thalasseus bergii (Crested Tern)*		IA	
79.	1717	*Thelymitra variegata (Queen of Sheba)*		P2	
80.	48135	*Thinornis rubricollis (Hooded Plover, Hooded Dotterel)*		P4	
81.	24803	*Tringa brevipes (Grey-tailed Tattler)*		P4	
82.	24806	*Tringa glareola (Wood Sandpiper)*		IA	
83.	24808	*Tringa nebularia (Common Greenshank, greenshank)*		IA	
84.	24809	*Tringa stagnatilis (Marsh Sandpiper, little greenshank)*		IA	
85.	34113	*Westralunio carteri (Carter's Freshwater Mussel)*		T	

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

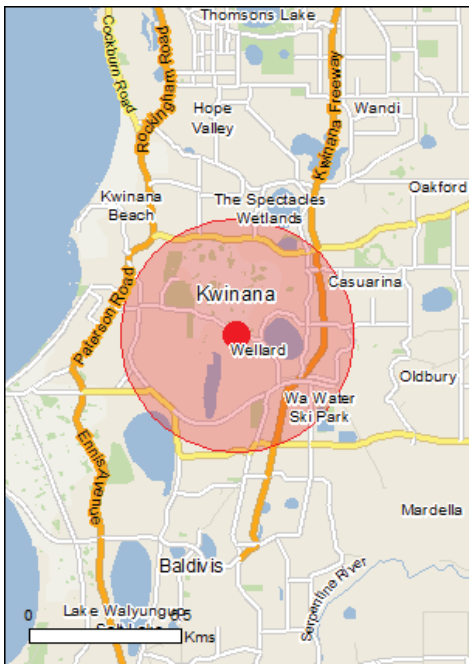
EPBC Act Protected Matters Report

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

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

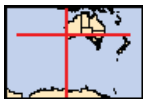
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 01/09/20 16:09:31



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 5.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	23
Listed Migratory Species:	19

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:	28
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	36
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Becher point wetlands	Within 10km of Ramsar
Forrestdale and thomsons lakes	Within 10km of Ramsar
Peel-yalgorup system	20 - 30km upstream

Listed Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	Endangered	Community known to occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely 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
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area
Other		
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to 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 likely to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat likely to occur within area
Synaphea sp. Serpentine (G.R. Brand 103) [86879]	Critically Endangered	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour 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 known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur

Name	Threatened	Type of Presence 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 known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely 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 likely to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Leda	WA
Unnamed WA51658	WA

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species

Name	Status	Type of Presence
		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 within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Spectacles Swamp	WA

Caveat

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

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

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

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

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-32.25874 115.81992

Acknowledgements

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

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

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

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

Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

Appendix C Conservation significant flora likelihood assessment

Table C.1: Conservation significant flora likelihood assessment

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
Acacia lasiocarpa var. *bracteolata* long peduncle variant (G.J. Keighery 5026) FABACEAE		P1	Shrub, 0.4-1.5 m high. Flowers yellow, May or Aug. Grey or black sand over clay. Swampy areas, winter wet lowlands.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Acacia sp. Binningup (G. Cockerton et al. WB 37784) FABACEAE		P1	No description available.	**Unknown**	**Unlikely**
Amanita fibrillopes AMANITACEAE		P3	Solitary or gregarious, in sandy or gravelly soil in dry sclerophyll forest and Banksia woodland, or in humus rich soil in seasonally wet eucalypt and paperbark woodland, often associated with *Eucalyptus marginata, E. jacksonii, Allocasuariana fraseriana, Corymbia calophylla, Melaleuca preissiana* and *Agonis* sp. *Amanita fibrillopes* is a distinctive species that is widely distributed and common. It occurs in the Swan Coastal Plain, Jarrah Forest and Warren bioregions (Department of the Environment 2013). It has not been recorded in South Australia (Grgurinovic 1997) or eastern Australia (Wood 1997). Fruiting period April to July.	**Possible** based on presence of preferred habitat	**Unlikely**
Amanita preissii AMANITACEAE Cinnamon-ring Lepidella		P3	Fungi widespread in Perth region. Solitary to gregarious in sandy soil and lateritic gravel, in native vegetation; nearby plants include *Allocasuarina fraseriana, Acacia pulchella, Corymbia calophylla, Callitris* sp., *Eucalyptus gomphocephala, E. marginata, Macrozamia fraseri* and *Pinus pinaster*. Occurs in the Swan Coastal Plain SWA2 Perth and JAF01 Northern Jarrah Forest IBRA subregions (as defined in Department of the Environment 2013).	**Possible** based on presence of preferred habitat	**Unlikely**
Andersonia gracilis ERICACEAE Slender Andersonia	EN		*Andersonia gracilis* is currently known from the Badgingarra, Dandaragan and Kenwick areas where it is found on seasonally damp, black sandy clay flats near or on the margins of swamps, often on duplex soils supporting low open heath vegetation with species such as *Calothamnus hirsutus, Verticordia densiflora* and *Kunzea recurva* over sedges (DEC 2006).	**Unlikely** due to absence of preferred habitat	**Unlikely**
Angianthus drummondii ASTERACEAE		P3	Annual herb, flowering in late spring, from October to December. Mature fruits and seeds are found in late December to January. Seeds are held in the inflorescence on the dried dead plants until the rains of the following winter. Occurs on fresh seasonally wet clay soils either grey or brown under *Melaleuca uncinata /Melaleuca viminea* shrubland or rarely under *Melaleuca cuticularis* low woodland. Recorded from the Swan Coastal Plain IBRA Bioregion (Environment Australia, 2000).	**Possible** based on presence of preferred habitat	**Unlikely**

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
Aponogeton hexatepalus APONOGETONACEAE Stalked Water Ribbons		P4	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Flowers green-white in July to October. Found in mud, freshwater: ponds, rivers, claypans.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Austrostipa mundula POACEAE		P3	Tufted perennial with a shortly creeping rhizome, culms erect, to 60 cm high, nodes pubescent. Leaves smooth and glabrous or scabrous. Occurring on sandy soils in mallee-scrub and in low woodland.	**Possible** based on presence of preferred habitat	**Unlikely**
Babingtonia urbana MYRTACEAE Coastal Plain Babingtonia		P3	Shrub, 0.4-0.7 m high with erect slender stems and antrorse to widely spreading leaves. Flowers pink, in January-March, fruits recorded from January to July. Extends from near Badgingarra National Park south to Mundijong, but there is also a record of the species further south from the Mandurah area (Bronwen Keighery pers. comm.). *Babingtonia urbana* is associated with wetlands on the Swan Coastal Plain. In the Perth area the species occurs on the eastern side of the plain. The only spot on the map that is right on the coast is for the locality given as 'Lancelin' on H. Demarz 2121; it might actually have been collected somewhat further inland (Rye 2015).	**Possible** based on presence of preferred habitat	**Unlikely**
Boronia juncea subsp. *juncea* RUTACEAE		P1	Slender or straggly shrub, pedicels and sepals glabrous. Flowers pink in April. Found in sand and low scrub.	**Possible** based on presence of preferred habitat	**Unlikely**
Byblis gigantea BYBLIDACEAE Rainbow Plant		P3	Small, branched perennial, herb (or sub-shrub), to 0.45 m high. Flowers pink-purple/white, in September to December or January. Found in sandy-peat swamps. Seasonally wet areas.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Caladenia huegelii ORCHIDACEAE King Spider-orchid	CR	T	The King Spider-orchid grows in well-drained, deep sandy soils in low mixed woodlands of Coast Banksia (*Banksia attenuata*), Firewood Banksia (*B. menziesii*), Holly-leaved Banksia (*Banksia ilicifolia*), Western Sheoak (*Allocasuarina fraseriana*) and Jarrah (*Eucalyptus marginata*). It tends to favour areas of lush undergrowth (DotE 2017)	**Possible** based on presence of preferred habitat	**Unlikely**
Calectasia grandiflora DASYPOGONACEAE Blue Tinsel Lily		P2	Rhizomatous, perennial, herb (or undershrub), to 0.65 m high, without stilt roots. Flowers blue/purple, from June to November. White, grey or yellow sand, sandy clay, gravel, laterite, granite. Found in swampy areas, rock outcrops, flats, slopes, ridges.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Carex tereticaulis CYPERACEAE		P3	Monoecious, rhizomatous, tufted perennial, grass-like or herb (sedge), 0.7 m high. Flowers brown, in September to October. Found in black peaty sand.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Cyathochaeta teretifolia CYPERACEAE		P3	Rhizomatous, clumped, robust perennial, grass-like or herb (sedge), to 2 m high, to 1.0 m wide. Flowers brown. Found in grey sand, sandy clay, swamps, creek edges.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Dillwynia dillwynioides FABACEAE		P3	Decumbent or erect, slender shrub, 0.3-1.2 m high. Flowers red & yellow/orange, from August to December. Found in sandy soils and winter-wet depressions.	**Unlikely** due to absence of preferred habitat	**Unlikely**

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
Diuris drummondii ORCHIDACEAE Tall Donkey Orchid	VU	T	Tuberous, perennial, herb, 0.5-1.05 m high. Flowers yellow, from November to December or January. Found in low-lying depressions, swamps.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Diuris micrantha ORCHIDACEAE Dwarf Bee Orchid	VU	T	Tuberous, perennial, herb, 0.3-0.6 m high. Flowers yellow & brown, Sep to Oct. Found in brown loamy clay, winter-wet swamps and in shallow water.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Diuris purdiei ORCHIDACEAE Purdie's Donkey Orchid	EN	T	It grows on sand to sandy clay soils, in areas subject to winter inundation, and amongst native sedges and dense heath with scattered emergent *Melaleuca preissiana, Eucalyptus calophylla, E. marginata* and *Nuytsia floribunda* (DotE 2016).	**Unlikely** due to absence of preferred habitat	**Unlikely**
Dodonaea hackettiana SAPINDACEAE		P4	Erect shrub or tree, 1-5 m high. Flowers yellow-green/red, mainly July to October. Found in sand, outcropping limestone.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Drakaea elastica *ORCHIDACEAE* Glossy-leaved Hammer Orchid	CR	T	The species grows on bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps, typically in banksia (*Banksia menziesii, B. attenuata* and *B. ilicifolia*) woodland or spearwood (*Kunzea glabrescens*) thicket vegetation. *D. elastica* often occurs with other orchid species such as *Drakaea glyptodon* (king-in-his-carriage), *D. livida* (warty hammer orchid) and *Paracaleana nigrita* (flying duck orchid). The increased rates of survival in sites with relatively little direct sun exposure (Carstairs and Coates 1994) indicate a requirement for shady canopy cover to be present.	**Possible** based on presence of preferred habitat	**Unlikely**
Drakaea micrantha ORCHIDACEAE Dwarf Hammer Orchid	VU	T	The Dwarf Hammer-orchid is usually found on cleared firebreaks or open sandy patches that have been disturbed, where competition from other plants has been removed (Brown et al. 1998; Hearn et al. 2006). This suggests that the plants may need a disturbance event at some point, and that plants regenerate from soil stored seed after such an event (DEC 2007). White-grey sands.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Drosera occidentalis DROSERACEAE Western Sundew		P4	Fibrous-rooted, rosetted perennial, herb, to 0.025 m high. Flowers pink/white, in October to December or January. It is found in creek beds of ephemeral streams on the flanks of granite hills, often amongst woodland, on top of rock and sand lenses on hill slopes and abundantly in the wetter parts of coastal heaths, swamps, and lake margins (Gibson, 1994).	**Unlikely** due to absence of preferred habitat	**Unlikely**
Eleocharis keigheryi CYPERACEAE	VU	T	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Flowers green, from August to November. Found in clay, sandy loam. Emergent in freshwater: creeks, claypans.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Eucalyptus rudis subsp. *cratyantha* MYRTACEAE Large-flowered Flooded Gum		P4	Tree, 5-20 m high, bark rough, box-type. Flowers white, from July to September. Always found on stream banks or floodplains, on silty soils with clay subsoil.	**Unlikely** due to absence of preferred habitat	**Unlikely**

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
Eucalyptus x balanites MYRTACEAE Cadda Road Mallee	EN	T	*Eucalyptus balanites* is found on light coloured sandy soils over laterite. Habitat consists of gently sloping heathlands; open mallee woodland over shrubland (Population 2) or heathland with emergent mallees (Population 1) (DotE 2017).	**Possible** based on presence of preferred habitat	**Unlikely**
Grevillea olivacea PROTEACEAE Olive Grevillea		P4	Erect, non-lignotuberous shrub, 1-4.5 m high. Flowers red/red-pink, from June to September. Found in white or grey sand on coastal dunes, limestone rocks.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Hibbertia leptotheca (formerly known as *Hibbertia spicata* subsp. *leptotheca*) DILLENIACEAE		P3	Erect or spreading shrub, 0.2-0.5 m high. Flowers yellow, from July to October. Found in sand near-coastal limestone ridges, outcrops & cliffs.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Jacksonia gracillima FABACEAE		P3	Prostrate, spreading shrub. Flowers pink and orange, in October and November. This species grows in sandy soils, sandplains, rises and swampy depressions.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Jacksonia sericea FABACEAE Waldjumi		P4	Low spreading shrub, to 0.6 m high. Flowers orange, usually December or January to February. Found in calcareous & sandy soils.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Johnsonia pubescens subsp. *cygnorum* HEMEROCALLIDACEAE		P2	Tufted perennial, herb, 0.15-0.25 m high. Flowers white-green, in September. Found in grey-white-yellow sand on flats, seasonally-wet sites.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Kennedia beckxiana FABACEAE Cape Arid Kennedia		P4	Prostrate or twining shrub or climber. Flowers red, from September to December. Found in sand, loam on granite hills & outcrops.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Lachnagrostis nesomytica subsp. *paralia* POACEAE		P1	Loosely tufted, weakly ascending, short-lived perennial or annual, herb (grass), to 0.5 m high. Flowers purple-green. Found in calcareous sands. On coastal dunes and swales.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Lepidium puberulum BRASSICACEAE		P4	Erect annual, herb, 0.1-0.35 m high. Flowers white-green, from July to August or October to November. Found in sandy soils.	**Possible** based on presence of preferred habitat	**Unlikely**
Lepidosperma rostratum CYPERACEAE	EN	T	Rhizomatous, tufted perennial, grass-like or herb (sedge), 0.5 m high. Flowers brown. Found in peaty sand, clay.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Meionectes tenuifolia HALORAGACEAE		P3	Annual herb grows to 0.2 m. Grows in seasonally wet flats and swamps.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Microtis quadrata (Previously known as *Microtis media subsp. quadrata*) ORCHIDACEAE		P4	Rock outcrops through the Wheatbelt and adjacent interior of Western Australia; also along edges of ephemeral watercourses and drainage lines. Less common in woodland, mallee, and along roadsides, rarely in swales between semi-arid sandhills or on the edge of salt lakes.	**Unlikely** due to absence of preferred habitat	**Unlikely**

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
Ornduffia submersa MENYANTHACEAE		P4	The species occurs near freshwater lakes, swamps and claypans (DEC 2009).	**Unlikely** due to absence of preferred habitat	**Unlikely**
Parsonsia diaphanophleba APOCYNACEAE		P4	Woody climber, to 10 m high. Flowers white/cream & pink, from January to February or April to June or September. Found in alluvial soils and along rivers.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Phlebocarya pilosissima subsp. *pilosissima* HAEMODORACEAE		P3	Shortly rhizomatous, compactly tufted perennial, grass-like or herb, 0.15-0.4 m high. Flowers cream-white, in August to October. Found in white or grey sand, lateritic gravel.	**Possible** based on presence of preferred habitat	**Unlikely**
Pimelea calcicola THYMELAEACEAE		P3	This species is described as an erect to spreading shrub growing to 1m high, producing pink flowers from September to November. Generally growing in grey/yellow sand, often associated with limestone, on ridges and flats near the coast.	**Possible** based on presence of preferred habitat	**Unlikely**
Pithocarpa corymbulosa ASTERACEAE Corymbose Pithocarpa		P3	This species is described as an erect to scrambling perennial herb growing to 1 m high, producing white flowers from January to April. Generally growing on gravelly or sandy loam amongst granite outcrops near the coast.	**Possible** based on presence of preferred habitat	**Unlikely**
Schoenus capillifolius CYPERACEAE		P3	Semi-aquatic tufted annual, grass-like or herb (sedge), 0.05 m high. Flowers green, in October to November. Found in brown mud in claypans.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Schoenus sp. Waroona (G.J. Keighery 12235) CYPERACEAE		P3	Tufted annual, grass-like or herb (sedge), 0.02-0.06 m high. Flowers brown-red-green, in October to November. Found in clay or sandy clay on winter-wet flats.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Sphaerolobium calcicola FABACEAE		P3	Slender, multi-stemmed, scandent or erect shrub, to 1.5 m high. Flowers orange-red, Jun or Sep to Nov. White-grey-brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Stylidium aceratum STYLIDIACEAE		P3	Fibrous rooted annual, herb, 0.05-0.09 m high, leaves spathulate. Flowers pink/white, in October to November. Found in sandy soils on swamp heathland.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Stylidium ireneae STYLIDIACEAE		P4	Lax perennial, herb, (0.06-)0.1-0.28 m high, Leaves oblanceolate, 0.4-2 cm long, 1-3 (-5) mm wide, apex subacute to acuminate, margin entire, glandular. Scape glandular. Inflorescence racemose. Flowers pink, October to December. Found in sandy loam, valleys near creek lines, woodland, often associated with Agonis.	**Possible** based on presence of preferred habitat	**Unlikely**
Stylidium longitubum STYLIDIACEAE Jumping Jacks		P4	Erect annual (ephemeral), herb, 0.05-0.12 m high. Flowers pink, October to December. Found in sandy clay, clay, and seasonal wetlands.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Stylidium paludicola STYLIDIACEAE		P3	Reed-like perennial herb (35–)50–100 cm high, with a shallowly buried, compact, lignotuber-like stem; stilt roots absent. Occurs in seasonally wet localities in grey to black peaty sand over clay	**Unlikely** due to absence of preferred habitat	**Unlikely**

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
Stylidium striatum STYLIDIACEAE Fan-leaved Triggerplant		P4	Rosetted perennial, herb, 0.15-0.55 m high, Inflorescence racemose. Flowers yellow, October to November. Found in brown clay loam over laterite. Hillslopes. Jarrah/Marri forest, Wandoo woodland.	**Possible** based on presence of preferred habitat	**Unlikely**
Synaphea sp. Fairbridge Farm (D. Papenfus 696) PROTEACEAE Selena's Synaphea	CR	T	Selena's Synaphea occurs on grey, clayey sand with lateritic pebbles in low woodland areas near winter flats (DEC, 2007). Selena's Synaphea is endemic to the Pinjarra Plain of Western Australia (DEC, 2007). It is known from five subpopulations from Serpentine to Dardanup (a range of approximately 120 km north to south), south of Perth, Western Australia (DEC, 2009). The extent of occurrence of the species is approximately 950 km2 and the area of occupancy is estimated to be less than 10 km2 (DEC, 2009).	**Unlikely** due to range is outside of local area	**Unlikely**
Synaphea sp. Pinjarra Plain (A.S. George 17182) PROTEACEAE	EN	T	Erect, clumped shrub (sub-shrub), to 0.8 m high. Flowers yellow, from September to November. Found in grey sandy loam or clay, grey-brown clayey sand, brown clayey loam, laterite. Flats, seasonally wet areas, railroad reserves often with wet depressions or drains.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Synaphea sp. Serpentine (G.R. Brand 103) PROTEACEAE	CR	T	Occurs over a narrow geographic range from west of Byford to south of Serpentine, growing predominantly in grey-brown sandy-loam or clay in seasonally wet areas. Associated with mid to tall shrubland, chiefly dominated by *Xanthorrhoea preissii* and *Kingia australis* over mixed shrubs, sedges and grasses, on sandy clays and loams, on dry to seasonally inundated flats.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Tetraria australiensis CYPERACEAE	VU	T	Rhizomatous, tufted perennial, grass-like or herb (sedge), to 1 m high. Flowers brown, from November to December.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Tetraria sp. Chandala (G.J. Keighery 17055) CYPERACEAE		P2	Found in mound spring, black peat over clay & humic sand. Associated with *Melaleuca rhaphiophylla* forest over sedges.	**Possible** based on presence of preferred habitat	**Unlikely**
Thelymitra variegata ORCHIDACEAE Queen of Sheba		P2	Tuberous, perennial, herb, 0.1-0.35 m high. Flowers orange & red & purple & pink, from June to September. Found in sandy clay, sand, laterite.	**Possible** based on presence of preferred habitat	**Unlikely**
Tripterococcus sp. Brachylobus (A.S. George 14234) CELASTRACEAE		P4	Erect perennial herb to 0.7 m high; flowers tiny, yellow. Known to occur on gentle slopes in grey sand.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Verticordia lindleyi subsp. *lindleyi* MYRTACEAE		P4	Erect shrub, 0.2-0.75 m high. Flowers pink, in May or November to December or January. Found in sand, sandy clay. Winter-wet depressions.	**Unlikely** due to absence of preferred habitat	**Unlikely**

Appendix D Conservation significant fauna likelihood assessment

Table D.1: Conservation significant fauna likelihood assessment

Species Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
Actitis hypoleucos Common Sandpiper	IA		Migratory seabird. The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags (DotE 2017).	**Unlikely** due to absence of preferred habitat	**Unlikely**
Apus pacificus Fork-tailed Swift	IA		Migratory seabird. In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. The sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines (DotE 2017).	**Unlikely** due to absence of preferred habitat	**Unlikely**
Arenaria interpres Ruddy Turnstone	IA		Migratory seabird. The Ruddy Turnstone is found singly or in small groups along the coastline and only occasionally inland. They are mainly found on exposed rocks or reefs, often with shallow pools, and on beaches. In the north, they are found in a wider range of habitats, including mudflats.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Calidris acuminata Sharp-tailed Sandpiper	IA		Migratory seabird. The Sharp-tailed Sandpiper prefers the grassy edges of shallow inland freshwater wetlands. It is also found around sewage farms, flooded fields, mudflats, mangroves, rocky shores and beaches. Its breeding habitat in Siberia is the peat-hummock and lichen tundra of the high Arctic.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Calidris melanotos Pectoral sandpiper	IA		Migratory. Nests in wet, grassy tundra, usually near coastal areas. Migrants and wintering birds select grassy wetlands of many types, both natural and artificial (such as sod farms, rice fields, wet pastures).	**Unlikely** due to absence of preferred habitat	**Unlikely**
Calidris ruficollis Red-necked stint	IA		Migratory seabird. In Australia, Red-necked Stints are found on the coast, in sheltered inlets, bays, lagoons, estuaries, intertidal mudflats and protected sandy or coralline shores. They may also be seen in saltworks, sewage farms, saltmarsh, shallow wetlands including lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats, flooded paddocks or damp grasslands. They are often in dense flocks, feeding or roosting.	**Unlikely** due to absence of preferred habitat	**Unlikely**

Species Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
Calidris subminuta Long-toed stint	IA		Migratory	**Unlikely** due to absence of preferred habitat	**Unlikely**
Chlidonias leucopterus White-winged Black Tern	IA		Migratory seabird. White-winged Black Terns are found in small to large flocks on mostly coastal or sub-coastal wetlands including tidal estuaries, lagoons, grassy swamps, and sewage ponds.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Hydroprogne caspia Caspian Tern	IA		Migratory seabird. They are widespread around virtually the entire Australian coastline, and also occur inland along major rivers, especially in the Murray–Darling and Lake Eyre drainage basins, preferring wetlands.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Limosa limosa Black-tailed godwit	IA		Migratory seabird. Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Macronectes giganteus Southern Giant-Petrel	IA		Migratory seabird	**Unlikely** due to absence of preferred habitat	**Unlikely**
Onychoprion anaethetus Bridled tern	IA		Migratory seabird. The species inhabits offshore tropical and subtropical seas (Higgins and Davies 1996, del Hoyo et al. 1996). Breeding It breeds on the periphery of vegetated coastal and continental coral, rock or rubble islands and beaches, volcanic stacks and exposed reefs, foraging inshore and up to 50 km offshore (although mostly within 15 km of land) and feeding from the surface of the water or up to 20 cm below it (Higgins and Davies 1996, del Hoyo et al. 1996, Haney et al. 1999). Non-breeding Away from the breeding grounds, the species is entirely pelagic and often associates with patches of macroalgae (e.g. Sargassum spp.) or flotsam which it uses for perching (del Hoyo et al. 1996, Haney et al. 1999). Its marine distribution is therefore linked to small- and medium-scale oceanographic features where water circulation aggregates such floating matter into patches (Haney et al. 1999).	**Unlikely** due to absence of preferred habitat	**Unlikely**
Pandion cristatus Eastern osprey	IA		Eastern Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They favour coastal areas, especially the mouths of large rivers, lagoons and lakes.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Plegadis falcinellus Glossy ibis	IA		Migratory. The Glossy Ibis requires shallow water and mudflats, so is found in well-vegetated wetlands, floodplains, mangroves and ricefields.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Pluvialis squatarola Grey plover	IA		Migratory seabird. The Grey Plover is almost entirely coastal, being found mainly on marine shores, inlets, estuaries and lagoons with large tidal mudflats or sandflats for feeding, sandy beaches for roosting, and also on rocky coasts.	**Unlikely** due to absence of preferred habitat	**Unlikely**

Species Common name (if applicable)	Conservation status EPBC Act	 BC Act	Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
Thalasseus bergii Greater crested tern	IA		Migratory seabird	**Unlikely** due to absence of preferred habitat	**Unlikely**
Tringa glareola Wood sandpiper	IA		Migratory seabird. Wood Sandpipers are seen in small flocks or singly on inland shallow freshwater wetlands, often with other waders. They prefer ponds and pools with emergent reeds and grass, surrounded by tall plants or dead trees and fallen timber.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Tringa nebularia Common greenshank	IA		Migratory seabird. Common Greenshanks are found both on the coast and inland, in estuaries and mudflats, mangrove swamps and lagoons, and in billabongs, swamps, sewage farms and flooded crops.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Tringa stagnatilis Marsh sandpiper	IA		Migratory seabird. Marsh Sandpipers are commonly seen singly, or in small to large flocks in fresh or brackish (slightly salty) wetlands such as rivers, water meadows, sewage farms, drains, lagoons and swamps.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Xenus cinereus Terek sandpiper	IA		Migratory seabird. Terek Sandpipers are found on the coast in mangrove swamps, tidal mudflats and the seashore.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Lerista lineata Perth slider	Not listed	P3	Restricted to the Swan Coastal Plain south of the Swan River including Garden and Rottnest Islands, extending south to Binningup (near Bunbury), with a single, old record from Busselton. The majority of L. lineata records are from the southern suburbs of the Perth metropolitan area(Figure 2) on the Bassendean and Spearwood Dune systems, with the most northerly being East Fremantle (R26813–14) and Alfred Cove (R49285) that are immediately adjacent to the south side of the Swan River	**Possible**	**Possible**
Neelaps calonotos Black-striped snake	Not listed	P3	A burrowing species endemic to the Perth region. It forages for other sand-loving species such as Worm Lizards (Aprasia and Lerista species). Occurs in Banksia woodlands and sandy areas.	**Possible**	**Possible**
Pletholax gracilis subsp. *edelensis* Keeled legless lizard	Not listed	P3	An inhabitant of heaths and woodlands, particularly Banksia-dominated associations, on sandy substrates.	**Possible**	**Possible**
Falsistrellus mackenziei Western false pipistrelle	Not listed	P4	An insectivorous bat associated with old growth forest. The range is dominated by wet sclerophyll eucalypt forest and semi woodland of the southwest, bounded by arid and agricultural regions to the centre and north. The ecoregion and forest type is jarrah-karri named for the tall trees karri *Eucalyptus diversicolor* and jarrah *Eucalyptus marginata*. The usual roosting sites are in eucalypt tree species old enough to provide hollows, although they have also been recorded in branches or tree stumps. The bats have also been noted as finding accommodation in abandoned buildings.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Hydromys chrysogaster Rakali	Not listed	P4	Widespread in permanent water bodies of Australia, New Guinea and offshore Islands. Occurs in fresh, salt and brackish wetlands.	**Unlikely** due to absence of preferred habitat	**Unlikely**

Species Common name (if applicable)	Conservation status EPBC Act	 BC Act	Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
Isoodon fusciventer Quenda	Not listed	P4	Widely distributed near the south west coast from Guilderton north of Perth to east of Esperance. Quenda have a patchy distribution through the Jarrah and Karri forest, the Swan Coastal Plain, and inland as far as Hyden. Quenda have been translocated to Julimar State Forest, Hills Forest near Mundaring, Tutanning Nature Reserve, Boyagin Nature Reserve, Dongolocking Nature Reserve, Leschenault Conservation Park, Karakamia Sanctuary, Paruna Sanctuary, Yalgorup National Park, Creery Wetlands, Avon Valley National Park, Nambung National Park, Francois Peron National Park and Thomson's Lake Nature Reserve. Occurs in 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. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses. Quenda will thrive in more open habitat subject to introduced predator control. On the Swan Coastal Plain, Quenda are often associated with wetlands.	Possible	**Recorded**
Ixobrychus dubius Black-backed bittern	Not listed	P4	The birds are mainly found in freshwater wetlands, where they inhabit dense emergent vegetation of reeds and sedges, and inundated shrub thickets. They are also occasionally found in brackish and saline wetlands such as mangrove swamps, Juncus-dominated salt marsh and the wooded margins of coastal lagoons. In Australia the bittern is found in the south-east of the continent, with most records deriving from the Murray-Darling Basin, as well as patchily along the east coast, and in south-west Western Australia where it is locally common on the Swan Coastal Plain. Some scattered records are given from elsewhere, including coastal locations in the Kimberley region, the Top End, and the Torres Strait islands, with vagrants occasionally reaching Lord Howe Island and New Zealand.	**Unlikely** due to absence of preferred habitat	**Unlikely**

Species Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
Notamacropus eugenii subsp. *derbianus* Tammar wallaby	Not listed	P4	Dense, low vegetation for daytime shelter and open grassy areas for feeding. This species inhabits coastal scrub, heath, dry sclerophyll forest and thickets in mallee and woodland. The Western Australian subspecies of the Tammar Wallaby was previously distributed throughout most of the south-west of Western Australia from Kalbarri National Park to Cape Arid on the south coast and extending to western parts of the Wheatbelt. The Tammar Wallaby is currently known to inhabit three islands in the Houtman Abrolhos group (East and West Wallabi Island, and an introduced population on North Island), Garden Island near Perth, Middle and North Twin Peak Islands in the Archipelago of the Recherche, and several sites on the mainland - including, Dryandra, Boyagin, Tutanning, Batalling (reintroduced), Perup, private property near Pingelly, Jaloran Road timber reserve near Wagin, Hopetoun, Stirling Range National Park, and Fitzgerald River National Park. The Tammar Wallaby remains relatively abundant at these sites which are subject to fox control. They have been reintroduced to the Darling scarp near Dwellingup, Julimar Forest near Bindoon, state forest east of Manjimup, Avon Valley National Park, Walyunga National Park, Nambung National Park and to Karakamia and Paruna Sanctuaries.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Notamacropus irma Western Brush Wallaby	Not listed	P4	The western brush wallaby is now distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid. The western brush wallaby's optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest.	**Unlikely** due to absence of preferred habitat / locally extinct	**Unlikely**
Notoscincus butleri Lined Soil-Crevice Skink	Not listed	P4	*Notoscincus butleri* occurs in arid, rocky near-coastal Pilbara.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Oxyura australis Blue-billed Duck	Not listed	P4	The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Phaethon rubricauda Red-tailed tropicbird	Not listed	P4	Migratory seabird. Breeds in coastal cliffs and under bushes in tropical Australia.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Thinornis rubricollis Hooded Plover	Not listed	P4	Migratory seabird. The Hooded Plover occurs on sandy beaches between Jervis Bay, New South Wales and the Eyre Peninsula, South Australia, as well as in Tasmania and between Esperance and Perth in south-west Western Australia. They also occur on inland salt lakes.	**Unlikely** due to absence of preferred habitat	**Unlikely**

Species Common name (if applicable)	Conservation status EPBC Act	 BC Act	Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
Phascogale tapoatafa subsp. *wambenger* Brush-tailed Phasogale	CD	S	Occurs in woodland and open forest. Known to occur in the south west between Perth and Albany. It occurs at low densities in the northern Jarrah forest. Highest densities occur in the Perup/Kingston area, Collie River valley, and near Margaret River and Busselton	**Unlikely** due to absence of preferred habitat	**Unlikely**
Falco peregrinus Peregrine Falcon	OS	S	The Peregrine Falcon is found in most habitats, from rainforests to the arid zone, and at most altitudes, from the coast to alpine areas. It requires abundant prey and secure nest sites, and prefers coastal and inland cliffs or open woodlands near water, and may even be found nesting on high city buildings.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Calidris ferruginea Curlew Sandpiper	CR	T	Migratory seabird. The Curlew Sandpiper is a small (18-23 cm), highly-gregarious, migratory shorebird with a medium-length, down-curved bill and longish black legs. Most commonly found in intertidal mudflats of sheltered coasts.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Calidris tenuirostris Great Knot	CR	T	Migratory seabird. A medium-sized bulky wader with a straight, dark-brown bill and yellowish-brown legs. Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Numenius madagascariensis Eastern Curlew	CR	T	Migratory seabird. During the non-breeding season in Australia, the eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (Zosteraceae). Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes within the mangroves. The birds are also found in coastal saltworks and sewage farms. The eastern curlew mainly forages during the non-breeding season on soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass, often near mangroves, on saltflats and in saltmarsh, rockpools and among rubble on coral reefs, and on ocean beaches near the tideline. The birds are rarely seen on near-coastal lakes or in grassy areas (DotE 2017).	**Unlikely** due to absence of preferred habitat	**Unlikely**
Calyptorhynchus baudinii Baudin's Black Cockatoo	EN	T	Baudin's Cockatoo mainly occurs in eucalypt forests, especially jarrah, marri and karri forest. The species is less frequently in woodlands of wandoo (E. wandoo), blackbutt (Eucalyptus patens), flooded gum (Eucalyptus rudis), yate (Eucalyptus cornuta), partly cleared farmlands and urban areas, including roadside trees and house gardens (Johnstone & Kirkby 2008). This 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 banksias, and in orchards (both in trees and on dropped or fallen fruit on the ground) (Johnstone & Kirkby 2008).	**Unlikely** – outside of known range	**Unlikely**

Species Common name (if applicable)	Conservation status EPBC Act	 BC Act	Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
Calyptorhynchus latirostris Carnaby's Black Cockatoo	EN	T	Carnaby's Cockatoo occurs in uncleared or remnant native eucalypt woodlands, especially those that contain salmon gum and wandoo, and in shrubland or kwongan heathland dominated by hakea, dryandra, banksia and grevillea species. It also occurs in remnant patches of native vegetation on land otherwise cleared for agriculture. The species forages seasonally in pine plantations in areas that receive high rainfall, e.g. the Swan Coastal Plain and around the Perth metropolitan area on both native and non-native plants, such as liquid amber. It also forages in forests containing marri, jarrah or karri (DotE 2017).	**Likely**	**Likely**
Caretta caretta Loggerhead Sea Turtle	EN	T	Loggerhead turtles have a worldwide tropical and subtropical distribution. In Australia, they occur in coral reefs, bays and estuaries in tropical and warm temperate waters off the coast of Queensland, Northern Territory, Western Australia and New South Wales.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Myrmecobius fasciatus Numbat	EN	T	The species was previously found to inhabit a wide range of habitats, including Mulga woodland, spinifex sandplains and Eucalypt forests and woodlands. In WA, their habitat is generally woodland dominated by Eucalyptus species, with abundant hollow logs and branches for shelter and termites for food. Currently, numbats are only known to be surviving in a small area of WA's Jarrah forest and Wheatbelt, notably at Dryandra Woodland and the Upper Warren area. They have been successfully reintroduced to other locations within the Jarrah forest and Wheatbelt, and to sites in South Australia and New South Wales	**Unlikely** due to absence of preferred habitat	**Unlikely**
Calyptorhynchus banksii subsp. *naso* Forest Red-tailed Black Cockatoo	VU	T	The Forest Red-tailed Black Cockatoo inhabits the dense jarrah, karri (Eucalyptus diversicolor) and marri forests receiving more than 600 mm average rainfall annually, mainly in the hilly interior (Johnstone et al. 2013a). Although most records are in jarrah-marri forests, the subspecies has been observed in a range of other forest and woodland types, including blackbutt (E. patens), wandoo (E. wandoo), tuart (E. gomphocephala), Albany blackbutt (E. staeri), yate (E. cornuta) and flooded gum (E. rudis). This subspecies is also now seen feeding in more open agricultural areas and in the Perth metropolitan area, where it will also breed.	**Possible**	**Possible**
Chelonia mydas Green sea turtle	VU	T	Green turtles occur in seaweed-rich coral reefs and inshore seagrass pastures in tropical and subtropical areas of the Indo-Pacific region.	**Unlikely** due to absence of preferred habitat	**Unlikely**
Dasyurus geoffroii Chuditch, Western Quoll	VU	T	The major portion of the remaining natural populations in Western Australia occur in varying densities in jarrah (Eucalyptus marginata) forests and woodlands in the south-west corner of WA, and in woodlands, mallee shrublands and heaths along the south coast, east to the Ravensthorpe area. There are also occasional records from drier woodland and mallee shrubland in the Wheatbelt and Goldfield Regions (DEC 2012).	**Unlikely** due to absence of preferred habitat	**Unlikely**

Species Common name (if applicable)	Conservation status EPBC Act	 BC Act	Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
Dermochelys coriacea Leatherback sea turtle	VU	T	In Australia, leatherback turtles occur in tropical and temperate waters. Leatherback turtles are most commonly reported feeding in coastal waters in central eastern Australia (from the Sunshine Coast in southern Queensland to central New South Wales); south-east Australia (from Tasmania, Victoria and eastern South Australia) and in south-western Western Australia. They are also regularly seen in southern Australian. Most leatherback turtles living in Australian waters migrate to breed in neighbouring countries, particularly in Indonesia, Papua New Guinea and the Solomon Islands. No large rookeries have been recorded in Australia.	**Unlikely** due to absence of preferred habitat	**Unlikely**

Appendix E Native plant taxa recorded within the Project area

Family	Taxa
Amaranthaceae	Ptilotus polystachyus
Anarthriaceae	Lyginia barbata
Apiaceae	Trachymene pilosa
Araceae	* Zantedeschia aethiopica
Asparagaceae	Lomandra caespitosa
	Lomandra hermaphrodita
	Lomandra maritima
	Sowerbaea laxiflora
Asteraceae	* Hypochaeris glabra
	* Ursinia anthemoides
	* Asteraceae sp.
Colchicaceae	Burchardia congesta
Cyperaceae	Lepidosperma calcicola
	Lepidosperma sp.
Dilleniaceae	Hibbertia hypericoides
Droseraceae	Drosera sp.
Ericaceae	Conostephium pendulum
Euphorbiaceae	* Euphorbia peplus
Fabaceae	* Acacia iteaphylla
	Acacia pulchella
	Acacia rostellifera
	Acacia saligna
	Gompholobium tomentosum
	Hardenbergia comptoniana
	Hovea trisperma var. trisperma
	Jacksonia furcellata
	Kennedia prostrata
	* Lupinus cosentinii
Geraniaceae	* Geranium molle
	* Pelargonium capitatum
Haemodoraceae	Conostylis serrulata
Hemerocallidaceae	Dianella revoluta var. divaricata
Iridaceae	* Gladiolus caryophyllaceus
	* Iridaceae sp.
Myrtaceae	Corymbia calophylla
	Eucalyptus gomphocephala
	Eucalyptus marginata
Oleaceae	* Olea europaea subsp. europaea
Orchidaceae	Caladenia flava subsp. flava
	Caladenia latifolia
	Diuris longifolia
Oxalidaceae	* Oxalis pes-caprae
Papaveraceae	* Fumaria capreolata
Poaceae	* Briza maxima
	* Ehrharta calycina
	* Ehrharta longiflora
Primulaceae	* Lysimachia arvensis
Proteaceae	Banksia attenuata
	Banksia dallanneyi
	Banksia grandis
	Banksia sessilis var. sessilis
	Grevillea vestita
	Hakea lissocarpha
	Hakea prostrata
Ranunculaceae	Clematis pubescens
Restionaceae	Desmocladus flexuosus
	Mesomelaena pseudostygia
Solanaceae	* Solanum nigrum
Thymelaeaceae	Pimelea rosea subsp. rosea

Family	Taxa
Xanthorrhoeaceae	Chamaescilla corymbosa var. corymbosa
	Xanthorrhoea gracilis
	Xanthorrhoea preissii
Zamiaceae	Macrozamia riedlei

Appendix F Quadrat data

Site Q01

GPS Coordinate 50H 388853 mE; 6430215 mN

Soil sand; white-grey

Bare ground (%) 0 Litter (%) 10

Vegetation Condition Good Years since fire 5

Vegetation Description

Jarrah marri woodland over open banksia low woodland over mixed low shrubs

Taxa	Height (m)	% Cover
Acacia iteaphylla	300	2
Acacia pulchella	150	5
Banksia attenuata	800	10
Banksia dallanneyi	30	+
Banksia grandis	250	1
Briza maxima	10	+
Burchardia congesta	30	+
Caladenia flava subsp. flava	15	+
Chamaescilla corymbosa var. corymbosa	25	+
Conostephium pendulum	25	+
Conostylis serrulata	20	+
Corymbia calophylla	1000	2
Dianella revoluta var. divaricata	50	+
Drosera sp.	5	+
Ehrharta calycina	60	25
Ehrharta longiflora	60	+
Eucalyptus marginata	1000	15
Euphorbia peplus	50	+
Gompholobium tomentosum	40	+
Hakea lissocarpha	100	3
Hardenbergia comptoniana	50	+
Hibbertia hypericoides	50	2
Hypochaeris glabra	5	+
Iridaceae sp.	25	5
Lepidosperma sp.	40	+
Lomandra caespitosa	30	+
Lysimachia arvensis	5	+
Macrozamia riedlei	100	5
Mesomelaena pseudostygia	30	+
Pelargonium capitatum	20	+
Sowerbaea laxiflora	30	+
Trachymene pilosa	5	+
Zantedeschia aethiopica	30	+

Site Q02

GPS Coordinate 50H 388885 mE; 6430282 mN

Soil sand; white-grey

Bare ground (%) 0 Litter (%) 10

Vegetation Condition Good,Degrad Years since fire 5

Vegetation Description

Acacia rostellifera tall shrubland

Taxa	Height (m)	% Cover
Acacia pulchella	100	1
Acacia rostellifera	400	20
Briza maxima	10	+
Chamaescilla corymbosa var. corymbosa	25	+
Clematis pubescens	50	5
Conostylis serrulata	20	1
Desmocladus flexuosus	20	+
Dianella revoluta var. divaricata	50	+
Ehrharta calycina	60	40
Fumaria capreolata	50	+
Grevillea vestita	200	1
Hibbertia hypericoides	50	5
Lyginia barbata	40	+
Macrozamia riedlei	130	+
Oxalis pes-caprae	20	+
Pimelea rosea subsp. rosea	40	+
Zantedeschia aethiopica	30	+

Site Q03

GPS Coordinate 50H 388801 mE; 6430351 mN

Soil sand; white-grey

Bare ground (%) 0 Litter (%) 10

Vegetation Condition Good,Degrad Years since fire 5

Vegetation Description

Jarrah marri woodland over open banksia low woodland over mixed low shrubs

Taxa	Height (m)	% Cover
Acacia pulchella	130	5
Banksia attenuata	500	15
Banksia grandis	200	+
Banksia sessilis var. sessilis	300	+
Briza maxima	10	+
Burchardia congesta	30	+
Caladenia flava subsp. flava	15	+
Chamaescilla corymbosa var. corymbosa	25	+
Conostylis serrulata	20	+
Corymbia calophylla	1200	5
Drosera sp.	5	+
Ehrharta calycina	60	30
Ehrharta longiflora	60	+
Eucalyptus marginata	1200	15
Hardenbergia comptoniana	50	+
Hypochaeris glabra	5	+
Iridaceae sp.	25	+
Lepidosperma calcicola	40	+
Lomandra caespitosa	30	+
Lyginia barbata	40	+
Lysimachia arvensis	5	+
Macrozamia riedlei	130	3
Xanthorrhoea preissii	100	+
Zantedeschia aethiopica	30	+

Site Q04

GPS Coordinate 50H 388812 mE; 6430267 mN

Soil sand; white-grey

Bare ground (%) 0 Litter (%) 30

Vegetation Condition Degraded Years since fire 5

Vegetation Description

Jarrah marri woodland over open banksia low woodland over mixed low shrubs

Taxa	Height (m)	% Cover
Acacia pulchella	100	2
Acacia saligna	150	+
Asteraceae sp.	10	+
Banksia attenuata	600	20
Briza maxima	10	+
Burchardia congesta	30	+
Caladenia flava subsp. flava	15	+
Conostylis serrulata	20	+
Desmocladus flexuosus	20	+
Drosera sp.	5	+
Ehrharta calycina	60	35
Eucalyptus marginata	1000	5
Geranium molle	50	+
Hardenbergia comptoniana	50	+
Hibbertia hypericoides	50	+
Hovea trisperma var. trisperma	100	+
Hypochaeris glabra	5	+
Sowerbaea laxiflora	30	+
Ursinia anthemoides	10	+

Site Q05

GPS Coordinate 50H 388747 mE; 6430272 mN

Soil sand; white-grey

Bare ground (%) 2 Litter (%) 35

Vegetation Condition Good,Degrad Years since fire 5

Vegetation Description

Jarrah marri woodland over open banksia low woodland over mixed low shrubs

Taxa	Height (m)	% Cover
Acacia pulchella	130	10
Banksia attenuata	300	1
Banksia sessilis var. sessilis	400	2
Burchardia congesta	30	+
Caladenia flava subsp. flava	15	+
Clematis pubescens	50	+
Conostephium pendulum	50	+
Conostylis serrulata	20	+
Ehrharta calycina	60	20
Eucalyptus gomphocephala	2000	2
Eucalyptus marginata	1000	5
Euphorbia peplus	50	+
Gladiolus caryophyllaceus	100	2
Gompholobium tomentosum	40	+
Hakea prostrata	200	2
Hibbertia hypericoides	50	+
Hypochaeris glabra	5	+
Jacksonia furcellata	200	5
Lepidosperma sp.	40	+
Lomandra hermaphrodita	20	+
Lomandra maritima	20	+
Macrozamia riedlei	130	+
Sowerbaea laxiflora	30	+
Trachymene pilosa	5	+
Ursinia anthemoides	10	+

Appendix G Black cockatoo breeding trees

Table G.1: Black cockatoo breeding habitat trees

latitude	longitude	Taxa	DBH (mm)	Condition	Suitable hollows
-32.2621332	115.8270721	Eucalyptus gomphocephala	890	slightly stressed	
-32.2597511	115.8198807	Corymbia calophylla	950	healthy	
-32.2596425	115.8201925	Eucalyptus marginata	560	stressed	
-32.2596312	115.8196943	Eucalyptus marginata	600	slightly stressed	
-32.2595850	115.8198663	Corymbia calophylla	680	slightly stressed	
-32.2595841	115.8201399	Corymbia calophylla	560	slightly stressed	
-32.2595705	115.8198566	Eucalyptus marginata	700	slightly stressed	
-32.2595229	115.8195072	Eucalyptus marginata	510	stressed	
-32.2595212	115.8200695	Eucalyptus marginata	630	slightly stressed	
-32.2595110	115.8195438	Eucalyptus marginata	540	stressed	
-32.2595021	115.8204087	Eucalyptus marginata	590	slightly stressed	
-32.2594216	115.8197991	Corymbia calophylla	610	healthy	
-32.2594082	115.8200394	Eucalyptus marginata	600	very stressed	
-32.2594046	115.8195475	Corymbia calophylla	590	slightly stressed	
-32.2593111	115.8200963	Corymbia calophylla	510	stressed	
-32.2592435	115.8192271	Eucalyptus marginata	600	slightly stressed	
-32.2592325	115.8203662	Corymbia calophylla	650	slightly stressed	
-32.2592245	115.8196032	Eucalyptus marginata	630	very stressed	
-32.2592029	115.8206260	Eucalyptus gomphocephala	790	slightly stressed	
-32.2591897	115.8199149	Eucalyptus marginata	530	stressed	
-32.2591693	115.8199518	Eucalyptus gomphocephala	570	slightly stressed	
-32.2591662	115.8205218	Eucalyptus marginata	640	slightly stressed	
-32.2591569	115.8191436	Corymbia calophylla	690	healthy	
-32.2590890	115.8204327	Corymbia calophylla	520	slightly stressed	
-32.2590874	115.8202207	Eucalyptus gomphocephala	1210	slightly stressed	
-32.2590683	115.8189091	Eucalyptus gomphocephala	950	slightly stressed	
-32.2590671	115.8209271	Eucalyptus gomphocephala	810	slightly stressed	
-32.2590508	115.8186935	Eucalyptus gomphocephala	980	healthy	
-32.2590400	115.8205141	Eucalyptus gomphocephala	780	slightly stressed	
-32.2590381	115.8211177	Eucalyptus gomphocephala	630	slightly stressed	
-32.2590325	115.8209469	Eucalyptus gomphocephala	580	slightly stressed	
-32.2590069	115.8201329	Eucalyptus marginata	570	dead old	
-32.2589959	115.8203814	Corymbia calophylla	510	slightly stressed	
-32.2589822	115.8185302	Eucalyptus gomphocephala	840	slightly stressed	
-32.2589521	115.8187592	Eucalyptus marginata	760	stressed	
-32.2589012	115.8192226	Corymbia calophylla	560	slightly stressed	
-32.2588730	115.8216232	Eucalyptus gomphocephala	900	slightly stressed	
-32.2588407	115.8211273	Eucalyptus gomphocephala	850	slightly stressed	
-32.2588082	115.8193073	Corymbia calophylla	540	healthy	
-32.2587578	115.8204806	Eucalyptus gomphocephala	620	slightly stressed	
-32.2587531	115.8189564	Eucalyptus gomphocephala	670	slightly stressed	
-32.2587080	115.8191917	Corymbia calophylla	950	stressed	yes
-32.2587015	115.8206912	Eucalyptus gomphocephala	750	slightly stressed	
-32.2586476	115.8188689	Eucalyptus gomphocephala	1320	slightly stressed	yes
-32.2586065	115.8189859	Corymbia calophylla	800	healthy	
-32.2585651	115.8187939	Eucalyptus gomphocephala	540	healthy	
-32.2585577	115.8209714	Eucalyptus gomphocephala	570	slightly stressed	
-32.2585481	115.8198629	Eucalyptus gomphocephala	830	slightly stressed	
-32.2585429	115.8197345	Eucalyptus gomphocephala	570	healthy	
-32.2585156	115.8198346	Eucalyptus gomphocephala	540	slightly stressed	
-32.2584733	115.8191944	Corymbia calophylla	620	healthy	
-32.2584388	115.8199553	Eucalyptus marginata	640	dead old	
-32.2584052	115.8193975	Corymbia calophylla	690	slightly stressed	
-32.2583801	115.8195549	Corymbia calophylla	640	slightly stressed	
-32.2583463	115.8194424	Corymbia calophylla	640	slightly stressed	
-32.2583380	115.8188488	Eucalyptus marginata	730	slightly stressed	yes

latitude	longitude	Taxa	DBH (mm)	Condition	Suitable hollows
-32.2583054	115.8188927	Eucalyptus gomphocephala	770	healthy	
-32.2582768	115.8198788	Eucalyptus marginata	730	stressed	
-32.2582516	115.8192668	Corymbia calophylla	550	slightly stressed	
-32.2582257	115.8189420	Eucalyptus marginata	590	slightly stressed	
-32.2582018	115.8198410	Eucalyptus marginata	570	very stressed	
-32.2581999	115.8196412	Eucalyptus gomphocephala	830	slightly stressed	
-32.2581821	115.8190734	Corymbia calophylla	510	slightly stressed	
-32.2581538	115.8191209	Corymbia calophylla	830	slightly stressed	
-32.2581001	115.8190677	Eucalyptus marginata	530	stressed	
-32.2580667	115.8191287	Corymbia calophylla	510	healthy	
-32.2580610	115.8189571	Corymbia calophylla	510	slightly stressed	
-32.2580536	115.8189899	Corymbia calophylla	530	slightly stressed	
-32.2579525	115.8197544	Corymbia calophylla	540	slightly stressed	
-32.2579425	115.8191901	Corymbia calophylla	850	slightly stressed	
-32.2579177	115.8194621	Corymbia calophylla	760	healthy	
-32.2578607	115.8195891	Corymbia calophylla	670	slightly stressed	
-32.2578432	115.8194193	Corymbia calophylla	520	healthy	
-32.2577905	115.8191649	Eucalyptus marginata	640	dead	
-32.2577690	115.8194708	Corymbia calophylla	600	healthy	
-32.2577613	115.8192980	Corymbia calophylla	630	healthy	yes
-32.2576984	115.8194117	Corymbia calophylla	950	dead old	yes

Document Distribution

Rev No.	Copies	Recipient	Date
A	Electronic	M Turnbull	19/02/2021
B	Electronic	M Turnbull	03/03/2021
0	Electronic	DAWE	27/04/2021

Document Status

Rev No.	Author	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	T Sleigh	K Moyle	D Newsome		19/08/2021
B	C O'Brien	D Newsome	D Newsome		03/03/2021
0	C O'Brien	D Newsome	D Newsome		27/04/2021

www.jbsg.com.au

Appendix D Offset calculator

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes		**Area**	3.085	Hectares	
			Quality	**8**	Scale 0-10	
			Total quantum of impact	2.47	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**			80%						
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**			70%						
Threatened species habitat																				
Area of habitat	Yes	2.47	Adjusted hectares		**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	3.73	**Risk of loss (%) without offset**	10%	**Risk of loss (%) with offset**	0%	0.37	80%	0.30	0.29	0.41	16.45%	No	
									Future area without offset (adjusted hectares)	3.4	**Future area with offset (adjusted hectares)**	3.7								
					Time until ecological benefit	2	**Start quality (scale of 0-10)**	**6**	**Future quality without offset (scale of 0-10)**	**5**	**Future quality with offset (scale of 0-10)**	**6**	1.00	70%	0.70	0.70				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	2.468	0.41	16.45%	**No**	$0.00	#DIV/0!	#DIV/0!
Area of community	0				$0.00		$0.00
					$0.00	**#DIV/0!**	**#DIV/0!**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes		**Area**	3.085	Hectares	
			Quality	**8**	Scale 0-10	
			Total quantum of impact	2.47	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**			80%						
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**			70%						
Threatened species habitat																				
Area of habitat	Yes	2.47	Adjusted hectares		**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	8.5	**Risk of loss (%) without offset**	10%	**Risk of loss (%) with offset**	2%								
									Future area without offset (adjusted hectares)	7.7	**Future area with offset (adjusted hectares)**	8.3	0.68	75%	0.51	0.49	1.78	71.97%	No	
					Time until ecological benefit	20	**Start quality (scale of 0-10)**	**4**	**Future quality without offset (scale of 0-10)**	**4**	**Future quality with offset (scale of 0-10)**	**7**	3.00	65%	1.95	1.87				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	2.468	1.78	71.97%	**No**	$0.00	#DIV/0!	#DIV/0!
Area of community	0				$0.00		$0.00
					$0.00	**#DIV/0!**	**#DIV/0!**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	**6.8%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	Yes		**Area**	3.039	Hectares	
			Quality	**4**	Scale 0-10	
			Total quantum of impact	1.22	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	Yes	1.22	Adjusted hectares		**Risk-related time horizon (max. 20 years)**	20	**Start area (hectares)**	3.13	**Risk of loss (%) without offset**	10%	**Risk of loss (%) with offset**	0%	0.31	80%	0.25	0.07	0.24	20.12%	No		
									Future area without offset (adjusted hectares)	2.8	**Future area with offset (adjusted hectares)**	3.1								
					Time until ecological benefit	2	**Start quality (scale of 0-10)**	**7**	**Future quality without offset (scale of 0-10)**	**6**	**Future quality with offset (scale of 0-10)**	**7**	1.00	80%	0.80	0.70				
Threatened species habitat																				
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0				$0.00		$0.00
Area of community	1.2156	0.24	20.12%	**No**	$0.00	#DIV/0!	#DIV/0!
					$0.00	**#DIV/0!**	**#DIV/0!**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	**6.8%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	Yes		**Area**	3.039	Hectares	
			Quality	**4**	Scale 0-10	
			Total quantum of impact	1.22	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)		% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																					
Area of community	Yes	1.22	Adjusted hectares		**Risk-related time horizon (max. 20 years)**	20	**Start area (hectares)**	8.5	**Risk of loss (%) without offset**	10%	**Risk of loss (%) with offset**	0%	0.87	75%	0.65	0.17	0.64	52.42%	No		
									Future area without offset (adjusted hectares)	7.6	**Future area with offset (adjusted hectares)**	8.5									
					Time until ecological benefit	20	**Start quality (scale of 0-10)**	**2**	**Future quality without offset (scale of 0-10)**	**2**	**Future quality with offset (scale of 0-10)**	**6**	4.00	65%	2.60	0.70					
Threatened species habitat																					
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**										
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0									
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**										
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**		**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																				
Condition of habitat Change in habitat condition, but no change in extent	No																				
Threatened species																					
Birth rate e.g. Change in nest success	No																				
Mortality rate e.g Change in number of road kills per year	No																				
Number of individuals e.g. Individual plants/animals	No																				

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0				$0.00		$0.00
Area of community	1.2156	0.64	52.42%	**No**	$0.00	#DIV/0!	#DIV/0!
					$0.00	**#DIV/0!**	**#DIV/0!**

Appendix E Offset calculator quality values

Offset calculator value	Tuart TEC Conservation Advice Condition Thresholds	Keighery 1994 and Trudgen 1988	Characteristics (adapted from Tuart TEC conservation advice, Keighery 1994 and Trudgen 1988
0	N/A	Completely degraded	• No TEC present • The structure of the vegetation is no longer intact and the area is completely or almost completely without native species
1≤2	Poor	Degraded	• Minimal or no native cover and species richness • <50 % of all understorey^ vegetation cover is native and Less than 4 native understorey^ species per 0.01 ha • Basic vegetation structure severely impacted by disturbance (very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing). • Scope for regeneration but not to a state approaching good condition without intensive management.
3≤4	Moderate	Degraded- Good	• ≥50 % of all understorey vegetation cover is native or at least 4 native understorey species per 0.01 ha • Basic vegetation structure severely or significantly impacted by disturbance (very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing). • Scope for regeneration but not to a state approaching good condition without intensive management or; • there is some ability for regeneration.
5≤6	High	Good or Good-Very Good	• ≥60 % of all understorey vegetation cover is native or at least 8 native understorey species per 0.01 ha • Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing, or; • Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

Offset calculator value	Tuart TEC Conservation Advice Condition Thresholds	Keighery 1994 and Trudgen 1988	Characteristics (adapted from Tuart TEC conservation advice, Keighery 1994 and Trudgen 1988
7≤8	Very High	Very Good or Excellent	• ≥80 % of all understorey vegetation cover is native or At least 12 native understorey species per 0.01 ha • Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing, or; • Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
9≤10		Pristine	• ≥80 % of all understorey vegetation cover is native or At least 12 native understorey species per 0.01 ha • Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.

Appendix F Tuart Woodland TEC native species list

APPENDIX E – SPECIES LISTS

E.1 Native Flora

Table 9. Native plants, Noongar names and traditional uses

Native plants likely to occur as part of the ecological community and notes on traditional uses.

Sources: Abbott 1983; Bindon and Walley 1998; Keighery 2002; City of Joondalup 2011; Hansen and Horsfall 2017. Scientific names current at May 2018.

^The majority of the information on traditional uses presented here is summarised from Hansen and Horsfall (2017). Use of these plants as food or medicine should only be made with expert knowledge. Some Noongar names for species are presented where these are known, but their use can vary with location.

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Aizoaceae	*Carpobrotus modestus*	Inland Pigface		
Aizoaceae	*Carpobrotus virescens*	Coastal Pigface	*bain, kolbolgo*	Succulent creeper. Flowers Makuru - Birak (Winter- Summer). Leaves used for medicine for various problems with digestive system and, as antiseptic and a variety of skin conditions. Fruit also edible.
Aizoaceae	*Tetragonia tetragonoides*	New Zealand Spinach		
Asparagaceae	*Acanthocarpus preissii*			
Asparagaceae	*Chamaescilla corymbosa var. corymbosa*	Blue Squill		
Asparagaceae	*Dichopogon capillipes*			
Asparagaceae	*Lomandra caespitosa*	Tufted Mat-rush		
Asparagaceae	*Lomandra hermaphrodita*			
Asparagaceae	*Lomandra maritima*	Coastal Mat-rush		
Asparagaceae	*Lomandra micrantha* subsp. *micrantha*	Small-flower Mat-rush		
Asparagaceae	*Lomandra preissii*			

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Asparagaceae	*Lomandra purpurea*	Purple Mat-rush		
Asparagaceae	*Lomandra sericea*	Silky Mat-rush		
Asparagaceae	*Lomandra suaveolens*			
Asparagaceae	*Sowerbaea laxiflora*	Purple Tassels		
Asparagaceae	*Thysanotus arenarius*			
Asparagaceae	*Thysanotus dichotomus*	Branched Fringe Lily		
Asparagaceae	*Thysanotus manglesianus*	Fringe Lily		
Asparagaceae	*Thysanotus manglesianus/ patersonii*			
Asparagaceae	*Thysanotus multiflorus*	Many-flowered Fringe Lily		
Asparagaceae	*Thysanotus patersonii*	Twining Fringe Lily		
Asparagaceae	*Thysanotus sparteus*			
Asparagaceae	*Thysanotus thyrsoideus*			
Asparagaceae	*Tricoryne elatior*	Yellow Autumn Lily		
Asparagaceae	*Tricoryne tenella*			
Amaranthaceae	*Ptilotus drummondii*	Narrowleaf Mulla Mulla		
Amaranthaceae	*Ptilotus manglesii*	Pom Poms		
Amaranthaceae	*Ptilotus polystachyus*	Prince of Wales Feather		
Amaranthaceae	*Ptilotus sericostachyus*			
Amaranthaceae	*Ptilotus stirlingii*	Stirling's Mulla Mulla		
Apiaceae	*Apium prostratum*	Sea Celery		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Apiaceae	*Centella asiatica*			
Apiaceae	*Daucus glochidiatus*	Australian Carrot		
Apiaceae	*Eryngium pinnatifidum*	Blue Devils		
Apiaceae	*Homalosciadium homalocarpum*			
Apiaceae	*Hydrocotyle alata*			
Apiaceae	*Hydrocotyle callicarpa*	Small Pennywort		Leaves burnt and inhaled to treat pain. Vapour from crushed leaves used to treat headaches and cold symptoms.
Apiaceae	*Hydrocotyle capillaris*	Thread Pennywort		
Apiaceae	*Hydrocotyle diantha*			
Apiaceae	*Hydrocotyle hispidula*			
Apiaceae	*Hydrocotyle pilifera* var. *glabrata*			
Apiaceae	*Hydrocotyle tetragonocarpa*			
Apiaceae	*Trachymene coerulea*	Blue Lace Flower		Thrives in limestone areas. Bulbs and leaves used externally for aches and pains. Leaves crushed to help with headaches.
Apiaceae	*Trachymene pilosa*	Native Parsnip		
Apocynaceae	*Alyxia buxifolia*	Dysentery Bush		Flowers Djeran - Birak (Autumn- Summer) Fruits Birak-Bunuru (Summer). Crushed bark used to make medicine for diarrhorea and dysentery.
Asphodelaceae	*Bulbine semibarbata*	Leek Lily		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Asteraceae	*Asteridea pulverulenta*	Common Bristle Daisy		
Asteraceae	*Brachyscome iberidifolia*	Swan River Daisy		
Asteraceae	*Bracteanthum macranthum*			
Asteraceae	*Cotula australis*	Common Cotula		
Asteraceae	*Craspedia* sp. Yalgorup National Park (G.J. Keighery 14449)			
Asteraceae	*Euchiton gymnocephalus*			
Asteraceae	*Euchiton sphaericus*	Star Cudweed		
Asteraceae	*Gnaphalium indutum*			
Asteraceae	*Ixiolaena viscosa*	Sticky Ixiolaena		
Asteraceae	*Lagenophora huegelii*	Coarse Lagenophora		
Asteraceae	*Millotia myosotidifolia*			
Asteraceae	*Millotia tenuifolia*	Soft Millotia		
Asteraceae	*Olearia axillaris*	Coastal Daisybush		
Asteraceae	*Olearia rudis*	Rough Daisybush		
Asteraceae	*Picris squarrosa*			
Asteraceae	*Pithocarpa cordatua*	Tangle Bush		
Asteraceae	*Pithocarpa pulchella*	Beautiful Pithocarpa		
Asteraceae	*Podolepis canescens*			
Asteraceae	*Podolepis gracilis*	Slender Podolepis		
Asteraceae	*Podolepis lessonii*			

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Asteraceae	*Podotheca angustifolia*	Sticky Longheads		
Asteraceae	*Podotheca chrysantha*	Yellow Podotheca		
Asteraceae	*Podotheca gnaphalioides*	Golden Longheads		
Asteraceae	*Pterochaeta paniculata*	Woolly Waitzia		
Asteraceae	*Quinetia urvillei*			
Asteraceae	*Rhodanthe citrina*			
Asteraceae	*Rhodanthe corymbosa*			
Asteraceae	*Senecio hispidulus*	Hispid Fireweed		
Asteraceae	*Senecio pinnatifolius* subsp. *maritimus*	Variable Groundsel	*yoont djet*	
Asteraceae	*Senecio quadridentatus*	Cotton Fireweed		
Asteraceae	*Senecio ramosissimus*	Auricled Groundsel		
Asteraceae	*Siloxerus humifusus*	Procumbent Siloxerus		
Asteraceae	*Sonchus hydrophilus*	Native Sowthistle		
Asteraceae	*Waitzia nitida*	Golden Waitzia		
Asteraceae	*Waitzia suaveolens* var. *suaveolens*	Fragrant Waitzia		
Brassicaceae	*Lepidium pseudohyssopifolium*			
Brassicaceae	*Lepidium rotundum*	Veined Peppercress		
Brassicaceae	*Stenopetalum gracile*			
Brassicaceae	*Stenopetalum robustum*			

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Caesalpiniaceae	*Labichea cassioides*			
Campanulaceae	*Isotoma hypocraterifor mis*	Woodbridge Poison		
Campanulaceae	*Lobelia anceps*	Angled Lobelia		
Campanulaceae	*Lobelia gibbosa*	Tall Lobelia		
Campanulaceae	*Lobelia heterophylla*	Wing-seeded Lobelia		
Campanulaceae	*Lobelia tenuior*	Slender lobelia		
Campanulaceae	*Wahlenbergia multicaulis*			
Campanulaceae	*Wahlenbergia preissii*			
Casuarinaceae	*Allocasuarina humilis*	Scrub She-oak		
Celastraceae	*Stackhousia huegelii*			
Celastraceae	*Tripterococcus brunonis*	Winged Stackhousia		
Centrolepidaceae	*Centrolepis aristata*	Pointed Centrolepis		
Centrolepidaceae	*Centrolepis drummondiana*			
Chenopodiaceae	*Enchylaena tomentosa var. tomentose*	Barrier Saltbush		
Chenopodiaceae	*Rhagodia baccata* subsp. *baccata*	Berry Saltbush		
Chenopodiaceae	*Rhagodia baccata* subsp. *dioica*	Berry Saltbush		
Chenopodiaceae	*Threlkeldia diffusa*	Coast Bonefruit		
Colchicaceae	*Burchardia congesta*	Milkmaids		Roots eaten
Colchicaceae	*Wurmbea monantha*			
Colchicaceae	*Wurmbea tenella*			

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Commelinaceae	*Cartonema philydroides*			
Convolvulaceae	*Dichondra repens*	Kidney Weed		
Crassulaceae	*Crassula colorata* var. *colorata*	Dense Stonecrop		
Crassulaceae	*Crassula exserta*			
Crassulaceae	*Crassula peduncularis*	Purple Stonecrop		
Cupressaceae	*Callitris preissii*	Rottnest Island Pine	*marro*	Medium sized tree with round woody cones. Leaves, bark and stems used to make smoke to treat respiratory problems. Infusions of leaves used for respiratory and sius conditions. Nuts pounded and used to treat skin problems.
Cyperaceae	*Baumea articulata*	Jointed Rush		
Cyperaceae	*Baumea juncea*	Baumea Twigrush		
Cyperaceae	*Baumea vaginalis*	Sheath Twigrush		
Cyperaceae	*Carex appressa*	Tall Sedge		
Cyperaceae	*Carex thecata*			
Cyperaceae	*Cyperus polystachyos*	Bunchy Sedge		
Cyperaceae	*Ficinia nodosa*	Knotted Club-rush		
Cyperaceae	*Gahnia trifida*	Coast Saw-sedge		
Cyperaceae	*Isolepis cernua*	Nodding Club-rush		
Cyperaceae	*Isolepis cyperoides*			
Cyperaceae	*Isolepis stellata*	Star Club-rush		
Cyperaceae	*Lepidosperma gladiatum*	Coast Sword-sedge, Kerbin		
Cyperaceae	*Lepidosperma leptostachyum*			

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Cyperaceae	*Lepidosperma longitudinale*	Pithy Sword-sedge		
Cyperaceae	*Lepidosperma sp.* (Coastal terete BJK & NG231)			
Cyperaceae	*Lepidosperma squamatum*			
Cyperaceae	*Mesomelaena preissii*			
Cyperaceae	*Mesomelaena stygia*			
Cyperaceae	*Schoenoplectus tabernaemontani*			
Cyperaceae	*Schoenus clandestinus*			
Cyperaceae	*Schoenus curvifolius*			
Cyperaceae	*Schoenus grandiflorus*	Large-flowered Bog-rush		
Cyperaceae	*Schoenus humilis*			
Cyperaceae	*Schoenus nitens*	Shiny Bog-rush		
Cyperaceae	*Schoenus subflavus*	Yellow Bog-rush		
Cyperaceae	*Tetraria octandra*			
Cyperaceae				
Dasypogonaceae	*Dasypogon bromeliifolius*	Pineapple Bush		
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	*munda*	Leaf tips and roots prepared as food. Crushed leaves used as wash for sores and to relieve arthritis, also used to make medicine to treat intestinal worms.
Dilleniaceae	*Hibbertia cuneiformis*	Cutleaf Hibbertia		
Dilleniaceae	*Hibbertia hypericoides*	Yellow Buttercups		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Dilleniaceae	*Hibbertia racemosa*	Stalked Guinea Flower		
Dilleniaceae	*Hibbertia subvaginata*			
Droseraceae	*Drosera erythrorhiza*	Red-ink Sundew		
Droseraceae	*Drosera glanduligera*	Pimpernel Sundew		
Droseraceae	*Drosera menziesii* subsp. *penicillaris*	Pink Rainbow		
Droseraceae	*Drosera pallida*	Pale Rainbow		
Droseraceae	*Drosera stolonifera*	Leafy Sundew		
Ericaceae	*Astroloma ciliatum*	Candle Cranberry	*cadgeegurrup*	Berries eaten
Ericaceae	*Astroloma pallidum*	Kick Bush	*cadgeegurrup*	Berries eaten
Ericaceae	*Conostephium pendulum*	Pink-tipped Pearl		
Ericaceae	*Conostephium preissii*			
Ericaceae	*Leucopogon capitellatus*			
Ericaceae	*Leucopogon oxycedrus*			
Ericaceae	*Leucopogon parviflorus*	Coast Beard-heath		
Ericaceae	*Leucopogon propinquus*			
Ericaceae	*Leucopogon racemulosus*			
Euphorbiaceae	*Adriana quadripartita*	Bitter Bush		
Euphorbiaceae	*Beyeria cinerea*			
Euphorbiaceae	*Euphorbia australis*	Namana		
Euphorbiaceae	*Monotaxis grandiflora*	Diamond of the Desert		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Euphorbiaceae	*Ricinocarpus glaucus*	Wedding Bush		
Fabaceae	*Bossiaea eriocarpa*	Common Brown Pea		
Fabaceae	*Chorizema diversifolium*	Yellow-eyed Flame Pea		
Fabaceae	*Daviesia divaricata*	Marno		
Fabaceae	*Daviesia preissii*			
Fabaceae	*Gastrolobium praemorsum*			
Fabaceae	*Gompholobium confertum*			
Fabaceae	*Gompholobium tomentosum*	Hairy Yellow Pea		
Fabaceae	*Hardenbergia comptoniana*	Native Wisteria		
Fabaceae	*Hovea chorizemifolia*	Prickly Hovea		
Fabaceae	*Hovea stricta*	Hovea		
Fabaceae	*Hovea trisperma* var. *trisperma*	Common Hovea		
Fabaceae	*Isotropis cuneifolia subsp. cuneifolia*	Granny Bonnets		
Fabaceae	*Jacksonia calcicola*			
Fabaceae	*Jacksonia furcellata*	Grey Stinkwood		
Fabaceae	*Jacksonia horrida*			
Fabaceae	*Jacksonia sericea*	Waldjumi		
Fabaceae	*Jacksonia sternbergiana*	Stinkwood, Kapur		
Fabaceae	*Kennedia coccinea*	Coral Vine		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Fabaceae	*Kennedia prostrata*	Scarlet Runner, Running Postman	*Wollung*	Creeping groundcover with red pea flowers in Djeran-Kambarang (Autumn- Spring). Responds well to rain. Nectar used for sore throats, leaves infused to make a drink. Stems used to make twine.
Fabaceae	*Nemcia reticulata*			
Fabaceae	*Sphaerolobium medium*			
Fabaceae	*Templetonia retusa*	Cockies Tongues		
Geraniaceae	*Erodium cygnorum*	Blue Heronsbill		
Geraniaceae	*Geranium retrorsum*			
Geraniaceae	*Geranium solanderi*	Native Geranium		Low herb. Roots used to treat diarrhoea.
Geraniaceae	*Pelargonium littorale*			
Goodeniaceae	*Dampiera linearis*	Common Dampiera		
Goodeniaceae	*Lechenaultia floribunda*	Free-flowering Leschenaultia		
Goodeniaceae	*Lechenaultia linarioides*	Yellow Leschenaultia		
Goodeniaceae	*Scaevola crassifolia*	Thick-leaved Fanflower		
Goodeniaceae	*Scaevola nitida*	Shining Fanflower		
Goodeniaceae	*Scaevola thesioides*			
Gyrostemonaceae	*Tersonia cyathiflora*	Button Creeper		
Haemodoraceae	*Anigozanthos humilis*	Cat's Paw		Starchy roots eaten
Haemodoraceae	*Anigozanthos manglesii*	Mangles Kangaroo Paw	*kurulbrang,nollamara, yonga marra).*	Starchy roots eaten
Haemodoraceae	*Conostylis aculeata*	Prickly Conostylis		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Haemodoraceae	*Conostylis candicans*	Grey Cottonhead		
Haemodoraceae	*Conostylis pauciflora* subsp. *pauciflora*	Dawesville conostylis		
Haemodoraceae	*Conostylis setigera*	Bristly Cottonhead		
Haemodoraceae	*Haemodorum spicatum*	Bloodroot	*mardja, bohn, mardje*	Root roasted and pounded as spice. Pounded with clay from termites' nests to reduce diarrhoea. Bulbs used as part of arthritis treatment. Colour used as a dye.
Haemodoraceae	*Phlebocarya ciliata*			
Haloragaceae	*Haloragis aculeolata*			
Hemerocallidaceae	*Caesia micrantha*	Pale Grass-lily		
Hemerocallidaceae	*Corynotheca micrantha var. micrantha*	Sand Lily		
Hemerocallidaceae	*Dianella brevicaulis*			
Hemerocallidaceae	*Dianella revoluta*	Blueberry Lily	*mangard*	Flowering Kambarang-Birak (late Spring-Summer). Fruits eaten, roots roasted and eaten. Leaves used for string. Medicine for headaches used from leaves and from roots for colds.
Hemerocallidaceae	*Stypandra glauca*	Blind Grass		
Hypoxidaceae	*Pauridia glabella*	Tiny Star		
Iridaceae	*Orthrosanthus laxus*	Morning Iris		
Iridaceae	*Patersonia juncea*	Rush-leaved Patersonia		
Iridaceae	*Patersonia occidentalis*	Purple Flag, Koma		
Juncaceae	*Luzula meridionalis*	Field Woodrush		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Juncaginaceae	*Triglochin centrocarpum*	Dwarf ArrowGrass		
Juncaginaceae	*Triglochin muelleri*			
Juncaginaceae	*Triglochin* sp. A Flora of Australia (G.J.Keighery 2477*)*			
Juncaginaceae	*Triglochin trichophorum*			
Lamiaceae	*Hemiandra pungens*	Snakebush		
Lauraceae	*Cassytha flava*	Dodder Laurel		Parasitic climber with no leaves. Climbs over other plants with wiry stems. Fruits used as a laxative and applied to cuts and sores.
Lauraceae	*Cassytha glabella*	Tangled Dodder Laurel		Parasitic climber with no leaves. Climbs over other plants with wiry stems. Fruits used as a laxative and applied to cuts and sores.
Lauraceae	*Cassytha pubescens*	Downy Dodder Laurel		
Lauraceae	*Cassytha racemosa*	Dodder Laurel		Parasitic climber with no leaves. Climbs over other plants with wiry stems. Fruits used as a laxative and applied to cuts and sores.
Linaceae	*Linum marginale*	Wild Flax		
Lindsaeaceae	*Lindsaea linearis*	Screw-fern		
Loganiaceae	*Logania serpyllifolia*			
Loganiaceae	*Logania vaginalis*	White Spray		
Loganiaceae	*Phyllangium paradoxum*	Wiry Mitrewort		
Loranthaceae	*Amyema miquelii*	Stalked Mistletoe		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Loranthaceae	*Nuytsia floribunda*	Christmas Tree	*mudja, modya*	
Malvaceae	*Alyogyne huegelii*			
Malvaceae	*Androcalva luteiflora*			
Malvaceae	*Guichenotia ledifolia*			
Malvaceae	*Lasiopetalum membranaceum*			
Malvaceae	*Thomasia cognata*			
Malvaceae	*Thomasia purpurea*			
Malvaceae	*Thomasia triphylla*			
Mimosaceae	*Acacia alata* var. *tetrantha*		*kunart - Wattle tree gum*	
Mimosaceae	*Acacia cochlearis*	Rigid Wattle		
Mimosaceae	*Acacia cyclops*	Coastal Wattle, Red-eyed Wattle	*munyuret, woolya wah, wilyawa*	Dense shrub to tree. Yellow flowers Djilba-Birak-Djeran (Spring-Autumn). Seed pods twisted. Seeds ground to make flour and baked. Juice of leaves used as soap, to treat eczema, insect repellant and sunscreen. Gum edible and used to create glue. Hosts edible grubs.
Mimosaceae	*Acacia huegelii*			
Mimosaceae	*Acacia lasiocarpa*	Panjang	*panjang*	
Mimosaceae	*Acacia pulchella* var. *glaberrima*	Prickly Moses		
Mimosaceae	*Acacia rostellifera*	Summer-scented Wattle		
Mimosaceae	*Acacia saligna*	Orange Wattle	*kudjong, cujong*	Edible seeds

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Mimosaceae	*Acacia stenoptera*	Narrow Winged Wattle		
Mimosaceae	*Acacia truncata*			
Mimosaceae	*Acacia willdenowiana*	Grass Wattle		
Mimosaceae	*Paraserianthes lophantha*	Albizia		
Myrtaceae	*Agonis flexuosa*	Peppermint, Willow Myrtle	*wonil*	Medium sized tree with weeping habit. White flowers in Djilba-Bunuru (Spring-Summer).Common sub-canopy beneath Tuart trees south of Perth. Crushed leaves used to relieve nasal congestion in babies. Leaves used to make mouthwash and antiseptic. Smoke used to treat respiratory problems. Ash mixed with fat for a poultice. Smoke used ceremonially.
Myrtaceae	*Calothamnus quadrifidus*	One-sided Bottlebrush	*kwowdjard,queitjat*	Nectar drunk directly, or flowers soaked to produce sweet drink, sometimes fermented.
Myrtaceae	*Calytrix angulata*	Yellow Starflower		
Myrtaceae	*Chamelaucium uncinatum*	Geraldton Wax		
Myrtaceae	*Corymbia calophylla*	Marri, Mari	*Marri,conric k, mnkar (red sap)*	Large tree, cream-pink flowers Biral-Djeran (Summer-Autumn), frequently grows with Jarrah. Large fruits. Leaves have antiseptic, decongestant and anti-inflammatory properties. Leaves used in steam pits, crushed or used to produce smoke. Sap or resin used as disinfectant and as part of medicine for dysentry. Flowers soaked for a sweet drink. Leaves used for bedding.

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Myrtaceae	*Eremaea pauciflora*			
Myrtaceae	*Eucalyptus cornuta*	Yate		
Myrtaceae	*Eucalyptus decipiens*	Redheart	*moit*	Mallee or small tree. Leaves have antiseptic, decongestant and anti-inflammatory properties. Leaves used in steam pits or crushed. Sap used as disinfectant and as part of medicine for dysentry. Leaves used for bedding.
Myrtaceae	*Eucalyptus gomphocephala*	Tuart	*duart, morrol, mooarn, moorun, mouarn.*	Straight, tall tree with rough bark growing particularly on sand over limestone. Also appears as a smaller tree or mallee. White Birak-Djeran (Summer-Autumn). Leaves have antiseptic, decongestant and anti-inflammatory properties. Leaves used in steam pits or crushed. Sap used as disinfectant and as part of medicine for dysentry. Gum also sometimes used to fill dental cavities. Bark used for roofing shelters.
Myrtaceae	*Eucalyptus marginata* subsp. *marginata*	Jarrah	*djara, cherring*	Straight, tall tree growing on various soils in the South -west. White-pink flowers Makuru- Birak (Winter- Summer). Leaves have antiseptic, decongestant and anti-inflammatory properties. Leaves used in steam pits or crushed. Sap as disinfectant and to treat dysentry. Gum sometimes used to fill cavities in teeth. Leaves used for bedding, bark for waterproof roofing of shelters. Wood for spears, digging sticks, spear throwers.

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Myrtaceae	*Eucalyptus rudis* subsp. *rudis*	Flooded Gum, Kulurda	*moich*	Grows on sand in wet areas, white flowers from Makuru-Djilba (Winter-Spring). Leaves have antiseptic, decongestant and anti-inflammatory properties. Leaves used in steam pits or crushed. Sap used as disinfectant and as part of medicine for dysentry. Manna on leaves eaten. Leaves used for bedding.
Myrtaceae	*Eucalyptus xmundijongensis*			
Myrtaceae	*Hypocalymma robustum*	Swan River Myrtle		
Myrtaceae	*Leptospermum spinescens*			
Myrtaceae	*Melaleuca huegelii*	Chenille Honey-myrtle		Melaleucas commonly used for antibacterial properties of oil. Leaves used for smoking ceremony. Flowers used to create drink.
Myrtaceae	*Melaleuca preissiana*	Moonah	*moonah*	Shrub or tree with papery bark in swampy areas. Young leaves crushed and vapours inhaled to treat colds, sinusitis and headaches. Bark used for wrapping food, toilet paper and bandages.
Myrtaceae	*Melaleuca rhaphiophylla*	Swamp Paperbark	*yowarl, bibool boorn, yiembak*	Bark used for roofing, to carry water or wrap food to carry or for cooking. Bark also used as a torch.
Myrtaceae	*Melaleuca systena*	Coastal Honeymyrtle		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Myrtaceae	*Melaleuca teretifolia*	Banbar		Shrub or small tree with needle-like leaves. Grows in wet and swampy areas. Leaves and bark used to treat colds and headaches. Bark used as an anti-inflammatory bandage.
Myrtaceae	*Melaleuca thymoides*			
Olacaceae	*Olax benthamiana*			
Orchidaceae	*Acianthus reniformis*	Mosquito Orchids		
Orchidaceae	*Caladenia arenicola*	Carousel Spider Orchid	*karrar, kar*	
Orchidaceae	*Caladenia chapmanii*		*karrar, kar*	
Orchidaceae	*Caladenia crebra*	Arrowsmith Spider Orchid	*karrar, kar*	
Orchidaceae	*Caladenia flava* subsp. *flava*	Cowslip Orchid	*karrar, kar*	
Orchidaceae	*Caladenia georgei*	Tuart Spider Orchid	*karrar, kar*	
Orchidaceae	*Caladenia hirta*	Sugar Candy Orchid	*karrar, kar*	
Orchidaceae	*Caladenia latifolia*	Pink fairy Orchid	*karrar, kar*	
Orchidaceae	*Caladenia longicauda*	Common White Spider Orchid	*karrar, kar*	
Orchidaceae	*Caladenia marginata*	White Fairy Orchid	*karrar, kar*	
Orchidaceae	*Caladenia speciosa*	Sandplain White Spider Orchid	*karrar, kar*	
Orchidaceae	*Caladenia vulgata*	Spider Orchid	*karrar, kar*	
Orchidaceae	*Corybas recurvus*	Helmet Orchid		
Orchidaceae	*Cryptostylis ovata*	Slipper Orchid		
Orchidaceae	*Cyanicula gemmata*	Blue China Orchid		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Orchidaceae	*Cyanicula sericea*	Silky Blue Orchid		
Orchidaceae	*Cyrtostylis huegelii*	Mosquito Orchid		
Orchidaceae	*Diuris amplissima*			
Orchidaceae	*Diuris corymbosa*	Common Donkey Orchid		
Orchidaceae	*Elythranthera brunonis*	Purple Enamel Orchid		
Orchidaceae	*Elythranthera emarginata*	Pink Enamel Orchid		
Orchidaceae	*Eriochilus dilatatus*	White Bunny Orchid		
Orchidaceae	*Leporella fimbriata*	Hare Orchid		
Orchidaceae	*Leptoceras menziesii*	Rabbit Orchid		
Orchidaceae	*Lyperanthus nigricans*	Red Beak Orchid		
Orchidaceae	*Microtis media*	Tall Mignonette Orchid		
Orchidaceae	*Prasophyllum calcicola*			
Orchidaceae	*Prasophyllum elatum*	Tall Leek Orchid		
Orchidaceae	*Pterostylis* aff. *nana*	Dwarf Snail Orchid		
Orchidaceae	*Pterostylis* aff. *vittata*	Grey Banded Greenhood		
Orchidaceae	*Pterostylis aspera*	Brown-veined Shell Orchid		
Orchidaceae	*Pterostylis brevisepala ms*			
Orchidaceae	*Pterostylis recurva*	Jug Orchid		
Orchidaceae	*Pterostylis rogersii*			
Orchidaceae	*Pterostylis sanguinea*	Dark-banded Greenhood		
Orchidaceae	*Pterostylis vittata*	Banded Greenhood		Roots eaten

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Orchidaceae	*Thelymitra benthamiana*	Cinnamon Sun Orchid		
Orchidaceae	*Thelymitra crinita*	Blue Lady Orchid		
Oxalidaceae	*Oxalis perennans*			
Phyyllantheaceae	*Phyllanthus calycinus*	False Boronia		
Phyyllantheaceae	*Poranthera microphylla*	Small Poranthera		
Pittosporaceae	*Billardiera heterophylla*	Australian bluebell		
Pittosporaceae	*Billardiera variifolia*			
Pittosporaceae	*Pittosporum ligustrifolium*	Weeping Pittosporum	*wongin*	Weeping shrub or small tree that grows near watercourses.White flowers and yellow-orange fruits. Various parts of the plant used cautiously to relieve pain and cramps, also for treating skin conditions.
Plantaginaceae	*Plantago debilis*	Native Plantain		Low herb. Crushed leaves used to treat sprains, and skin problems.
Poaceae	*Amphipogon turbinatus*			
Poaceae	*Austrostipa compressa*			
Poaceae	*Austrostipa elegantissima*	Feather Speargrass		
Poaceae	*Austrostipa flavescens*			
Poaceae	*Austrostipa pycnostachya*			
Poaceae	*Austrostipa semibarbata*	Bearded Speargrass		
Poaceae	*Bromus arenarius*	Sand Brome		
Poaceae	*Dichelachne crinita*	Long Hair Plume Grass		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Poaceae	*Hemarthria uncinata*	Mat Grass		
Poaceae	*Microlaena stipoides*	Weeping Grass		
Poaceae	*Poa drummondiana*	Knotted Poa		
Poaceae	*Poa poiformis*	Coastal Poa		
Poaceae	*Poa porphyroclados*			
Poaceae	*Polypogon tenellus*			
Poaceae	*Rytidosperma occidentale*			
Poaceae	*Rytidosperma pilosa*	Smoothflower Wallaby Grass		
Polygalaceae	*Comesperma confertum*	Milkwort		
Polygalaceae	*Comesperma integerrimum*	Milkwort		
Polygonaceae	*Muehlenbeckia adpressa*	Climbing Lignum		
Polygonaceae	*Muehlenbeckia polybotrya*			
Portulacaceae	*Calandrinia brevipedata*	Short-stalked Purslane		
Portulacaceae	*Calandrinia calyptrate*	Pink Purslane		
Portulacaceae	*Calandrinia corrigioloides*	Strap Purslane		
Portulacaceae	*Calandrinia granulifera*	Pygmy Purslane		
Portulacaceae	*Calandrinia liniflora*	Parakeelia		
Primulaceae	*Samolus repens*	Creeping Brookweed		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Proteaceae	*Banksia attenuata*	Candlestick Banksia, Slender Banksia	*Piara, piara bealwara,ngong-yang-flower nectar*	Shrub or tree with bright yellow cylindrical flowers in Djilba- Bunuru (Spring-Summer). Nectar of Banksia flowers used to make a sweet drink and relieve sore throats and coughs. Regenerates after fire. Cones used as torch to carry fire.
Proteaceae	*Banksia dallaneyi* (formerly *Dryandra lindleyana*)	Couch Honeypot	*bullgalla*	Flowers Makuru - Kambarang (Winter-Spring). Regenerates after fire. Flowers soaked for sweet drink, also used to relieve sore throats and coughs.
Proteaceae	*Banksia grandis*	Bull Banksia	*boogalla, purgarla, mungite*	Flowers Djilba- Birak (Spring- early Summer). Flowers soaked for sweet drink, also used to relieve sore throats and coughs. Branch with cones wrapped in paperbark and used to carry fire.
Proteaceae	*Banksia leptophylla* var. *leptophylla*			
Proteaceae	*Banksia littoralis*	Swamp Banksia	*Pungura, hoongura, gwangia*	Large shrub or tree. Bright orange or yellow flowers Bunuru-Djilba (Autumn-Winter).
Proteaceae	*Banksia menziesii*	Firewood Banksia	*bulgalla*	Flowers Bunuru- Djilba (Autumn- Winter). Regrows from lignotuber after fire.Infusions of flowers for sore throats and coughs, as well as refreshing drink.
Proteaceae	*Banksia prionotes*	Acorn Banksia	*manyret*	Flowering Bunuru-Djilba (Autumn and Winter). Fire sensitive. Infusions of flowers for sore throats and coughs, as well as refreshing drink.

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Proteaceae	*Banksia sessilis* (formerly *Dryandra sessilis)*	Parrot Bush,	*pulgart , pudjak*	Shrub or small tree with spiky leaves. Small flowers Djeran-Kambarang (Autumn-Spring). Branches used to drive fish into traps.
Proteaceae	*Conospermum stoechadis x triplinervium*	Common Smokebush		
Proteaceae	*Conospermum triplinervium*	Tree Smokebush		
Proteaceae	*Grevillea crithmifolia*		*berrung*	Nectar used to create sweet drink
Proteaceae	*Grevillea preissii*	Spider Net Grevillea	*berrung*	Nectar used to create sweet drink
Proteaceae	*Grevillea vestita*		*berrung*	Nectar used to create sweet drink
Proteaceae	*Hakea lissocarpha*	Honey Bush	*berrung*	Nectar used to create a sweet drink
Proteaceae	*Hakea prostrata*	Harsh Hakea	*pulgur*	Branches used to drive fish into traps
Proteaceae	*Hakea trifurcata*			
Proteaceae	*Persoonia longifolia*	Snottygobble, Wild Pear	*cadgeegurrup, kadgeegurr*	Shrub or tree with green-yellow fruits, which can be eaten and keep the mouth moist. Bark used to make medication for skin and eye problems. Leaves used to make medication for colds and sore throats.
Proteaceae	*Persoonia saccata*	Snottygobble, Wild Pear	*cadgegurrup*	Fruits eaten
Proteaceae	*Petrophile linearis*	Pixie Mops		
Proteaceae	*Petrophile serruriae*			
Proteaceae	*Petrophile striata*			
Proteaceae	*Stirlingia latifolia*	Blueboy		
Proteaceae	*Synaphea floribunda*			

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Proteaceae	*Synaphea polymorpha*	Albany Synaphea, Pinda		
Proteaceae	*Xylomelum occidentale*	Woody Pear	*djandjin, danja*	Shrub to small tree with oak-like leaves. Grows on near coastal sands. Pear-shaped fruits with large woody seeds. Infusions of leaves and bark used to relieve pain. Seeds roasted and eaten.
Pteridaceae	*Adiantum aethiopicum*	Common Maidenhair	*karbarra*	Low fern, found in damp areas. Used to make medicines to relieve respiratory tract problems.
Pteridaceae	*Cheilanthes austrotenuifolia*	Rock Fern		
Ranunculaceae	*Clematis linearifolia*	Slender Clematis	*taaruk*	Climbing plant with white star-shaped flowers Makuru-Kambarang (Winter-Spring). Leaves used cautiously to treat skin irritation.
Ranunculaceae	*Clematis pubescens*	Common Clematis		
Ranunculaceae	*Ranunculus colonorum*	Common Buttercup		
Ranunculaceae	*Ranunculus pumilio*	Smallflower Buttercup		
Restionaceae	*Desmocladus aspera*			
Restionaceae	*Hypolaena exsulca*			
Restionaceae	*Hypolaena pubescens*			
Rhamnaceae	*Cryptandra arbutiflora*	Waxy Cryptandra		
Rhamnaceae	*Cryptandra mutila*			
Rhamnaceae	*Spyridium globulosum*	Basket Bush		
Rhamnaceae	*Stenanthemum tridentatum.*			

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Rhamnaceae	*Trymalium ledifolium* var. *ledifolium*			
Rubiaceae	*Opercularia hispidula*	Hispid Stinkweed		
Rubiaceae	*Opercularia vaginata*	Dog Weed		
Rutaceae	*Boronia alata*	Winged Boronia		
Rutaceae	*Diplolaena dampieri*	Southern Diplolaena		
Santalaceae	*Exocarpos sparteus*	Broom Ballart	*djuk*	Suited to calcareous sand over limestone. Fruits are edible. Leaves and twigs burnt to repel insects. Crushed leaves used to treat headaches.
Santalaceae	*Leptomeria cunninghamii*			
Santalaceae	*Leptomeria preissiana*			
Santalaceae	*Santalum acuminatum*	Quandong, Sandalwood, Native Peach	*dumbari, wonil, warnga*	Semi-parasitic small tree, small white flowers at several times of the year, followed by bright red fruits. Seeds mixed with animal fat used on sore muscles. Infusions of leaves used to treat diabetes. Fruits are high in vitamin C and eaten fresh or dried.
Sapindaceae	*Diplopeltis huegelii* subsp. *subintegra*			
Sapindaceae	*Dodonaea aptera*	Coast Hop Bush		
Sapindaceae	*Dodonaea hackettiana*	Hackett's Hop Bush		
Scrophulariaceae	*Eremophila glabra*	Tar Bush		
Scrophulariaceae	*Myoporum caprarioides*	Slender Myoporum		
Scrophulariaceae	*Myoporum insulare*	Native Juniper		

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Solanaceae	*Anthocercis ilicifolia*			
Solanaceae	*Anthocercis littorea*	Yellow Tailflower		
Solanaceae	*Solanum symonii*			
Stylidiaceae	*Stylidium bulbiferum*			
Stylidiaceae	*Stylidium calcaratum*	Book Triggerplant		
Stylidiaceae	*Stylidium glaucum*	Dotted Triggerplant		
Stylidiaceae	*Stylidium junceum*	Reed Triggerplant		
Stylidiaceae	*Stylidium repens*	Matted Triggerplant		
Thymelaeaceae	*Pimelea argentea*	Silvery Leaved Pimelea		
Thymelaeaceae	*Pimelea calcicola*			
Thymelaeaceae	*Pimelea rosea*	Rose Banjine		
Tremandraceae	*Tetratheca hirsuta* (glabrous)	Black-eyed Susan		
Typhaceae	*Typha domingensis*	Bulrush, Djandjid	*yanjet*	Found near water sources. Bulbs pounded and cooked as damper. Crushed flowers used as antiseptic. Leaves used to weave mats and baskets.
Urticaceae	*Parietaria debilis*	Pellitory		
Verbenaceae	*Phyla nodiflora*	Pogfruit		
Violaceae	*Hybanthus calycinus*	Wild Violet		
Xanthorrhoeaceae	*Xanthorrhoea brunonis*			

Family	Plant taxa	Common names	Noongar name(s)	Notes, including some traditional uses^
Xanthorrhoeaceae	*Xanthorrhoea preissii*	Balga, Grasstree, Blackboy	*balga, balka, baaluk, balka, barro, kooryoop, paaluc, palga, yarrlok; bigo (resin from stem)*	Widespread, particularly near watercourses. Tall flower spike Makuru to Birak (Winter-Summer). Many uses- flower stems used as spears, fire drills and torches, witchetty grubs (bardi) found in stems, fresh leaves eaten, resin used as glue and for tanning kangaroo and possum skins, for firelighters, as well as in medicine, flowers soaked to use drink. Leaves use to cover *mia mia* shelters and for bedding. Young leaf bases were also eaten. The pattern of flower opening used to determine direction.
Zamiaceae	*Macrozamia riedlei*	Zamia, Djiridji	*djiridji,dyergee, girijee, jeerajee; baio (fruit)*	Fruits were buried and soaked to remove toxins before roasting and eating the skin. Leaves used for shade or to make string.
Zygophyllaceae	*Zygophyllum apiculatum*			
Zygophyllaceae	*Zygophyllum fruticulosum*	Shrubby Twinleaf		

E.2 Invasive flora

Table 10. Weeds that are widespread in the ecological community

Source: Keighery (1999 cited in Keighery 2002) identified 23 non-woody species that occurred at more than 70% of surveyed Tuart woodland sites. Scientific names current at May 2018.

Plant taxon	Common name
Monocotyledons	
Grasses	
Briza maxima	Large Quaking Grass
Briza minor	Lesser Quaking Grass, Shivery Grass
Cynodon dactylon	Couch Grass
Ehrharta longiflora	Annual Veldt Grass

Appendix G DBCA Regional Parks Field Construction Standards

Regional Parks
Field Construction Standards

Agricultural Fence (Ringlock style)

The Department of Parks and Wildlife Regional Parks Unit has devised the following as a standard for any new agricultural fencing within Regional Parks Unit managed land.

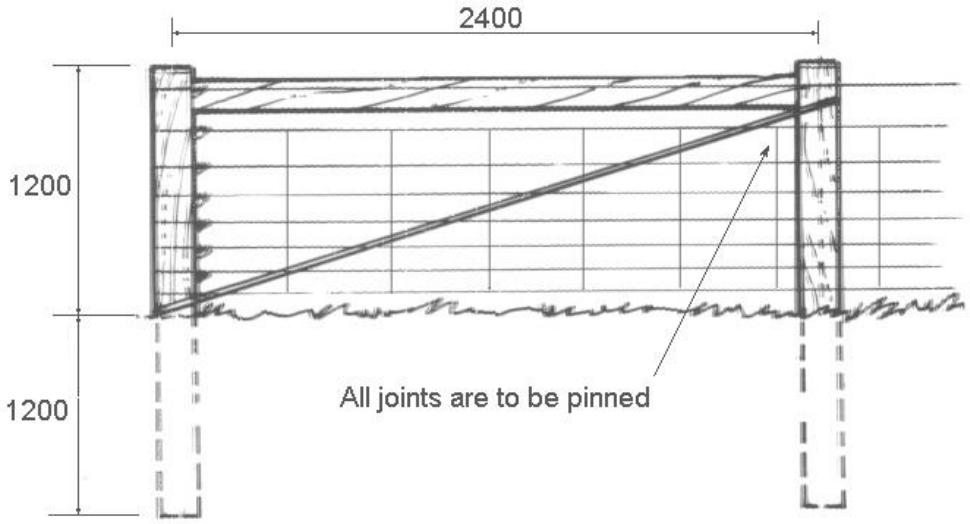
Material Specifications

- Galvanized 7/90/30 Ring lock or equivalent (eg Stocklock), agricultural fence (**NOT** Griplock),
- Galvanized 2.5 mm∅ single strand High Tensile Plain Wire,
- 100-125 mm∅ x 2.1 m CCA H4 treated pine log (for uprights),
- 150-175 mm∅ x 2.4 m CCA H4 treated pine log (for box strainers),
- 1.8 m GalStar Pickets, BHP Warratah preferred (ensure holes match up with agricultural fencing wire),
- Short, **white** PVC Star Picket Caps allowing wire to be strung through them and through the top hole of the star picket,
- 3.6 m x 1200 mm high galvanized Weldmesh agricultural farm gate (with Brooker threaded hinges),
- 1.57 mm∅ galvanized Tie Wire.

Construction Specifications

- Box strainers are to be constructed out of treated pine logs and pinned,
- Box strainers to be placed on both sides of agricultural gates,
- Double box strainers at all corners and change in direction of fence,
- Box strainers to be placed at maximum distance of 200m intervals along fence,
- Ringlock to be fastened 50mm above ground level,
- All strands on Ringlock to be stapled to box strainers,
- Four strands on Ringlock to be stapled evenly to pine uprights,
- Four horizontal strands of Ringlock to be tied evenly to star pickets,
- Ratio of star pickets to pine uprights is one in four (i.e. one pine upright to three star pickets) at spacing of 4 m,
- All ends, joins and ties to be finished neatly with no wire protrusions,
- Wire to be wrapped around pine posts twice, then wound back around wire three times and cut off flush,
- All pine uprights to be buried to a depth of 900 mm,
- All box strainers to be buried to a depth of 1200 mm,
- All star pickets to be capped, with wire running through the white star picket caps and through the top hole of the star pickets,
- Fencing wire to be fixed to outside of posts and pickets at all times (i.e. on side facing outside Regional Parks Unit managed land),
- Fence to smoothly follow the overall contours of the land (not to have sudden dips and rises),
- Use 10 mm x 900 mm long High Tensile locking chain (non rusting) for Agricultural Gates and 600 mm long chain for Low Vehicle Gates,
- Use Silver coloured Abus 83/50 padlocks (or equivalent) with No 51 key barrels,
- Don’t over tension fence, ensuring all vertical wires are in line,
- Gate nuts on hinges to be tack welded, not bent or burred over.

Box Strainer Detail



Appendix H Reserve 39964 ecological assessment

M07 Offset site assessment (Rev A).docx

Name:	Matt Turnbull	Date:	24 August 2021
Company:	Department of Education	Job/Doc. No.:	59850/130794
Email:	matt.turnbull@education.wa.edu.au	Inquiries:	William Oversby

Proposed Offset site - Flora, vegetation and Black cockatoo habitat assessment

1. Background

The Western Australian Department of Education (DoE; the Proponent) is proposing to develop part of Lot 9074 Lambeth Circle, Wellard as a primary school (the Proposed Action). The site is located within the City of Kwinana, approximately 35 km south of Perth.

The Proposed Action was referred to the Department of Agriculture, Water and the Environment (DAWE) under the Environmental Protection and Biodiversity Act 1999 (EPBC Act) in July 2020 (referral number 2020/8732). The Proposed Action has been determined by DAWE to be a controlled action and is currently being assessed through preliminary documentation.

Based on the outcomes of the environmental impact assessment undertaken to support the Proposed Action including application of the mitigation hierarchy, it is anticipated that the following significant residual impacts will be required to be offset:

- 3.039 ha of Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community (Tuart Woodlands TEC) - listed as Critically Endangered
- Two potentially suitable black cockatoo breeding hollows
- 3.085 ha confirmed roosting habitat for the Forest Red-tailed Black Cockatoo (FRTBC).

2. Purpose of this document

Given the values listed above, the Department of Education requested Strategen-JBS&G undertake a reconnaissance survey to determine the extent and quality of State and Federally protected flora, vegetation and black cockatoo habitat within a proposed offset site, Reserve 39964, the survey area (Figure 1).

To this end, Strategen-JBS&G:

- Undertook a reconnaissance flora and vegetation survey in May 2021 to determine the extent of Tuart Woodland TEC present on site
- Undertook a black cockatoo habitat assessment in May 2021 to determine the extent of Black cockatoo habitat present on site.

Legend

- Project area
- Cadastral boundary
- Roads (MRWA)

Scale 1:15,000 at A4	0 100 200 metres	**Thomas Rd, Medina Perth, WA**
Coord. Sys. GDA 1994 MGA Zone 50		**PROJECT AREA**
Job No: 59050		
Client: Department of Education		**FIGURE 1**
Version: A	Date: 19-Aug-2021	strategen JBS&G
Drawn By: cthatcher	Checked By: TS	

File Name: W:\Projects\1)Open\Dept of Education\59050 Wellard Village Primary School EPBC Referral\GIS\Maps\M07_Rev_A\59050_01_ProjectArea.mxd
Image Reference: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

3. Methods

3.1 Flora and Vegetation Assessment

The site was visited by a senior Strategen-JBS&G ecologist in May 2021.

Notes were made on the locations and floristic composition of remnant vegetation at the site and data was collected from three relevés. At each relevé, the following data was collected:

- GPS location
- topography
- soil type and colour
- outcropping rocks and their type
- description of vegetation present
- average height, number of plants and percent cover for each vascular plant species

All plant specimens recorded during the field surveys were identified on site, and as such any species lists provided should not be considered a comprehensive list of species present at the site. Nomenclature of the species recorded is in accordance with Western Australian Herbarium (1998-).

3.2 Black Cockatoo Habitat Assessment

Ecological values for black-cockatoos within the site were based on the definitions of breeding, foraging and roosting habitat as per the EPBC Act referral guidelines for black-cockatoos (DSEWPaC 2012), with foraging and nesting values assessed using systems developed by Bamford Consulting.

3.2.1 Foraging habitat assessment

A foraging habitat assessment was conducted across the site by inspecting the vegetation and reviewing vegetation descriptions, and calculating a foraging score as outlined in Attachment A. The foraging score provides a numerical value that reflects the significance of vegetation as foraging habitat for black-cockatoos. This value is used during the assessment of impact significance and offset requirements. The foraging value of the vegetation depends upon the type, density and condition of trees and shrubs in an area and can be influenced by the context such as the availability of foraging habitat nearby. The Bamford (2020) scoring system for value of foraging habitat has three components as detailed in Attachment A. These three components are drawn from the DAWE offset calculator but with the scoring approach developed by Bamford:

- A score out of six for the vegetation composition, condition, and structure.
- A score out of three for the context of the site.
- A score out of one for species density.

3.2.2 Breeding habitat assessment

Vegetation containing potential breeding trees was traversed and all trees with a diameter at breast height (DBH) of greater than 500 mm were recorded by GPS. Notes on tree structural formation and hollows were made for any trees greater than 500 mm DBH. All observations were made from the ground.

3.2.3 Roosting habitat assessment

Vegetation was assessed for roosting habitat potential based on tree species present and on the occurrence of local confirmed or potential roosting sites (based upon records from the Great Cocky Count.

4. Results

4.1 Flora and Vegetation

The survey recorded 18 vascular flora taxa, including four introduced taxa. No conservation significant flora taxa were identified during the survey. Based on the level of disturbance within the survey area, no Threatened flora species are considered likely to occur.

This field survey is not considered to represent a complete census of the vascular flora within the site; however, for the purposes of this survey, confirming the vegetation types and condition is considered to be sufficient.

Approximately 7.64 ha of remnant vegetation was present within the site. One intact vegetation type was identified within this area (EgXp; Table 1; Figure 2). The remaining native vegetation was highly modified and included scattered native shrubs and scatter trees (parkland cleared). Vegetation condition (Good to Completely Degraded) reflected the highly modified nature of the site (Table 1).

Table 1: Vegetation types and Condition within the survey area

Code	Vegetation Type	Area (ha)				
		Good	Degraded	Completely Degraded	n/a	Total
EgXp	Open woodland of *Eucalyptus gomphocephala* over open shrubland of *Xanthorrhoea preissii*	1.13	3.70	-	-	4.82
Scattered shrubs	Scattered *Xanthorrhoea preissii*	-	-	1.57	-	1.57
PC	Parkland cleared	-	-	1.24	-	1.24
CL	Cleared	-	-	-	0.95	0.95
Total		1.13	3.70	2.82	0.95	8.59

Legend

- Project area

Vegetation type
- Cleared
- EgXp
- Parkland Cleared
- Scattered Shrubs

Vegetation condition
- Completely Degraded
- Degraded
- Good
- n/a
- Roads (MRWA)

Scale 1:5,000 at A4 (0, 50, 100 metres)	**Thomas Rd, Medina Perth, WA**
Coord. Sys. GDA 1994 MGA Zone 50	**VEGETATION AND CONDITION**
Job No: 59050	
Client: Department of Education	**FIGURE 2**
Version: A — Date: 19-Aug-2021	strategen JBS&G
Drawn By: cthatcher — Checked By: TS	

File Name: W:\Projects\1)Open\Dept of Education\59050 Wellard Village Primary School EPBC Referral\GIS\Maps\M07_Rev_A\59050_02_VegTypesCond.mxd
Image Reference: www.nearmap.com© - Imagery Date: 5 August 2021

4.1.1 Threatened and Priority Ecological Communities

From the results of the field survey, one TEC (and one PEC) are considered to have potential to occur within the Survey area based on vegetation condition and structure:

- Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community (listed as a TEC [Critically Endangered] under EPBC Act and Priority 3 PEC listed by DBCA)

Tuart Woodlands and Forests of the Swan Coastal Plain TEC

An analysis of the quadrat data, site notes and historical reports was undertaken to determine the presence and extent of the Tuart Woodlands and Forests of the Swan Coastal Plain TEC (Table 2; Table 3). The determination of patches was made using the key diagnostic criteria as per the Approved Conservation Advice (incorporating listing advice) for the Tuart Woodlands and Forests of the Swan Coastal Plain ecological community (TSSC 2019). Vegetation within the site met the key diagnostic criteria for the Tuart Woodlands and Forests of the Swan Coastal Plain ecological community, representing a total area within the survey area of 6.91 ha which includes areas of bare ground surrounding the Tuart canopy. The patch is not fully confined to the site, with a minimum total area of 9.88 ha mapped.

Based on the assessment presented within Table 2 and Table 3, Tuart Woodlands and Forests of the Swan Coastal Plain TEC is considered to be present within the site. The extent of this TEC is shown in Figure 3.

Table 2: 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 systems.
Structure and composition: Defining features include: the presence of at least two living established *Eucalyptus gomphocephala* (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: *Agonis flexuosa* (Peppermint) and *Banksia grandis* (Bull Banksia) (both in the southern part of the range), *Banksia attenuata* (Candlestick Banksia), *Eucalyptus marginata* (Jarrah); and less commonly, *Corymbia calophylla* (Marri), *Banksia menziesii* (Firewood Banksia) and *Banksia prionotes* (Acorn Banksia).	**Yes**. Vegetation within patches occur as a woodland to open woodland dominated by *Eucalyptus gomphocephala*.

Table 3: Assessment of Tuart Woodlands patches against condition thresholds

Patch	Assessment Site (Quadrat)	Criteria							
		Area (ha)	Native Species Richness per 0.01ha	Proportion of native understorey cover per 0.01 ha	Weed cover %	Density of large trees per 0.5ha	Condition (TSSC 2019)	Condition (Keighery 1994)	Result
1	1	9.88 ha (6.91 ha within offset site)	11	85%	7%	4.7	Very High	Good	**TEC present.** Patch ≥5ha. Average condition Poor (TSSC 2019) and Degraded (Keighery 1994)
	2		2	40%	45%		Poor	Degraded	
	3		3	38%	7%		Poor	Degraded	
	4		2	33%	10%		Poor	Degraded	
	5		3	38%	24%		Poor	Degraded	

Tuart Woodlands and Forests of the Swan Coastal Plain PEC

In the absence of specific diagnostic criteria and condition thresholds, the state listed Tuart Woodlands and Forests of the Swan Coastal Plain PEC is considered to be analogous to all defined patches of the Commonwealth listed Tuart Woodlands and Forests of the Swan Coastal Plain TEC.

4.2 Black cockatoo habitat assessment

4.2.1 Potential breeding habitat

Based on diameter at breast height, 88 trees suitable for use by black cockatoos were identified in the survey area, including 34 jarrah, and 54 tuart. Observations indicated four trees contained hollows of a size and orientation potentially suitable for nesting by black cockatoo species. The locations of the potential breeding trees are displayed in Figure 3.

4.2.2 Foraging Habitat

There was approximately 7.64 ha of habitat recorded within the Survey area (Figure 3). Foraging species dominant within the Survey area were, *Eucalyptus marginata*, *Banksia attenuata, Banksia menziesii*, and *Xanthorrhoea preissii*. Examples photographs of the foraging habitat are provided in Plates 1 and 2.

Based on the composition, structure and condition of the vegetation assessed, the foraging habitat identified within the Survey area was classified as moderate foraging value. Using the scoring system developed by Bamford (2018), adding in site context and species presence, this habitat rates as a quality of 5 out of a maximum score of 10, in Table 4. Table 5 provides areas of habitat in each condition rating recorded within the survey area.

Table 4: Foraging habitat score

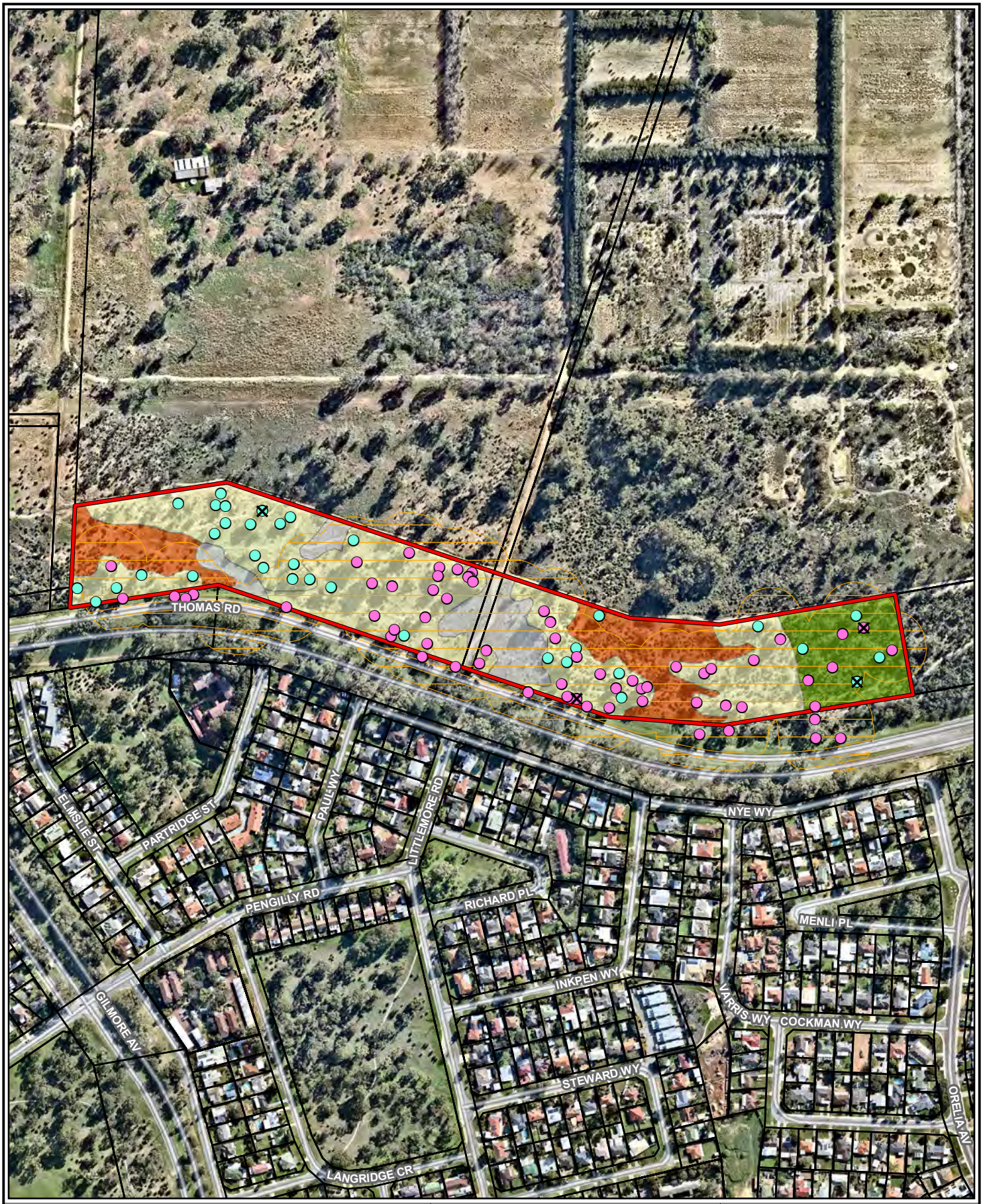
Site	Vegetation	Composition, structure and condition	Site Context	Species density	Score /10
Q1	EgXp	3	2	1	5
Q2	EgXp	2	n/a	n/a	2
Q3	EgXp	2	n/a	n/a	2
Q4	Scattered shrubs	2	n/a	n/a	2
Q5	Scattered shrubs	1	n/a	n/a	1

Table 5: Black cockatoo habitat

Black cockatoo habitat	Area (ha)
Moderate (5)	1.13
low to moderate (2)	4.94
negligible to low (1)	1.57
nil	0.95
Total (not including areas rated "Nil")	7.64

Plate 1

Plate 2



Legend

- Project area
- Tuart woodland TEC

Vegetation type

- Moderate
- Low to moderate
- Negligible to low
- Nil

Significant Black Cockatoo habitat trees

- *Eucalyptus gomphocephala* (64)
- *Eucalyptus marginata*(34)
- Suitable hollows (4)
- Roads (MRWA)

Scale 1:5,000 at A4 (0 50 100 metres)		**Thomas Rd, Medina Perth, WA**
Coord. Sys. GDA 1994 MGA Zone 50		**MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE**
Job No: 59050		
Client: Department of Education		**FIGURE 3**
Version: A	Date: 19-Aug-2021	strategen JBS&G
Drawn By: cthatcher	Checked By: TS	

File Name: W:\Projects\1)Open\Dept of Education\59050 Wellard Village Primary School EPBC Referral\GIS\Maps\M07_Rev_A\59050_03_MNES.mxd
Image Reference: www.nearmap.com© - Imagery Date: 5 August 2021

5. References

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.

Johnstone, R. E, Kirkby, T., and Sarti, K. (2013). 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.

Attachment A: Bamford 2020

Scoring system for the assessment of foraging value of vegetation for Black-Cockatoos. Revised 5th June 2020

Bamford Consulting Ecologists

Introduction

Application of the Offset Assessment Guide (offsets guide) developed by the federal environment department for assessing Black-Cockatoo foraging habitat requires the calculation of a score out of 10. The following system has been developed by Bamford Consulting Ecologists (BCE) with assistance from Quessentia Consulting to provide an objective scoring system that is practical and can be used by trained field zoologists with experience in the environments frequented by the species.

The foraging value score provides a numerical value that reflects the significance of vegetation as foraging habitat for Black-Cockatoos, and this numerical value is designed to provide the information needed by the Federal Department of Agriculture, Water and the Environment (DAWE) to assess impact significance and offset requirements. The foraging value of the vegetation depends upon the type, density and condition of trees and shrubs in an area and can be influenced by the context such as the availability of foraging habitat nearby. The BCE scoring system for value of foraging habitat has three components as detailed above. These three components are drawn from the DAWE offsets guide but the scoring approach was developed by BCE and includes a fourth (moderation) component.

Calculating the total score (out of 10) requires the following steps:

A Site condition. Determining a score out of six for the vegetation composition, condition and structure; plus

B Site context. Determining a score out of three for the context of the site; plus

C Species stocking rate. Determining a score out of one for species density.

D Determining the total score out of 10, which may require moderation for context and species density with respect to the site condition (vegetation) score. Moderation also includes consideration of pine plantations as a special case for foraging value.

Calculation of scores and the moderation process are described in detail below.

A. Site condition. Vegetation composition, condition and structure scoring

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**Forest Red-tailed Black-Cockatoo**
0	No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples: • Water bodies (e.g. salt lakes, dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits) or with vegetation of no food value, such as some suburban landscapes. • Mown grass	No foraging value. No eucalypts or other potential sources of food. Examples: • Water bodies (e.g. dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).	No foraging value. No eucalypts or other potential sources of food. Examples: • Water bodies (e.g. dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).
1	Negligible to low foraging value. Examples: • Scattered specimens of known food plants but projected foliage cover of these is < 2%. This could include urban areas with scattered foraging trees; • Paddocks that are lightly vegetated with melons or other known food-source weeds (e.g. *Erodium* spp.) that represent a short-term and/or seasonal food source; • Blue Gum plantations (foraging by Carnaby's Black-Cockatoos has been reported but appears to be unusual).	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these < 1%. This could include urban areas with scattered foraging trees.	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these < 1%. Could include urban areas with scattered foraging trees.

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**Forest Red-tailed Black-Cockatoo**
2	Low foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, have < 10% projected foliage cover; • Woodland with tree banksias 2-5% projected foliage cover; • Open eucalypt woodland/mallee of small-fruited species; • Paddocks that are densely vegetated with melons or other known food-source weeds (e.g. *Erodium* spp.) that represent a short-term and/or seasonal food source.	Low foraging value. Examples: • Woodland with scattered specimens of known food plants (e.g. Marri and Jarrah) 1-5% projected foliage cover; • Urban areas with scattered foraging trees.	Low foraging value. Examples: • Woodland with scattered specimens of known food plants (e.g. Marri, Jarrah or Sheoak) 1-5% projected foliage cover; • Urban areas with scattered food plants such as Cape Lilac, *Eucalyptus caesia* and *E. erythrocorys*.
3	Low to Moderate foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, have 10-20% projected foliage cover; • Woodland with tree banksias 5-20% projected foliage cover; • Eucalypt Woodland/Mallee of small-fruited species; • Eucalypt Woodland with Marri < 10% projected foliage cover.	Low to Moderate foraging value. Examples: • Eucalypt Woodland with known food plants (especially Marri) 5-20% projected foliage cover; • Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management); • Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).	Low to Moderate foraging value. Examples: • Eucalypt Woodland with known food plants (especially Marri and Jarrah) 5-20% projected foliage cover; • Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management); • Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**Forest Red-tailed Black-Cockatoo**
4	Moderate foraging value. Examples: • Woodland/low forest with tree banksias (of key species *B. attenuata* and *B. menziesii*) 20-40% projected foliage cover; • Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover; • Eucalypt Woodland/Forest with Marri 20-40% projected foliage cover.	Moderate foraging value. Examples: • Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover; • Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths. • Eucalypt Woodland/Forest with diverse, healthy understorey and known food trees (especially Marri) 10-20% projected foliage cover. • Orchards with highly desirable food sources (e.g. apples, pears, some stone fruits).	Moderate foraging value. Examples: • Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover; • Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Sheoak Forest with 40-60% projected foliage cover.
5	Moderate to High foraging value. Examples: • Banksia Low Forest (of key species *B. attenuata* and *B. menziesii*) with 40-60% projected foliage cover; • Banksia Low Forest (of key species *B. attenuata* and *B. menziesii*) with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Pine plantations with trees more than 10 years old (but see pine note below in moderation section).	Moderate to High foraging value. Examples: • Marri-Jarrah Forest with 40-60% projected foliage cover; • Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths.	Moderate to High foraging value. Examples: • Marri-Jarrah Forest with 40-60% projected foliage cover; • Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths. • Sheoak Forest with > 60% projected foliage cover.

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**Forest Red-tailed Black-Cockatoo**
6	High foraging value. Example: • Banksia Low Forest (of key species *B. attenuata* and *B. menziesii*) with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).	High foraging value. Example: • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).	High foraging value. Example: • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).

Vegetation structural class terminology follows Keighery (1994).

B. Site context.

Site Context is a function of site size, availability of nearby habitat and the availability of nearby breeding areas. Site context includes consideration of connectivity, although Black-Cockatoos are very mobile and will fly across paddocks to access foraging sites. Based on BCE observations, Carnaby's are unlikely to regularly go over open ground for a distance of more than a few kilometres and prefer to follow tree-lines.

The maximum score for site context is 3, and because it is effectively a function of presence/absence of nearby breeding and the distribution of foraging habitat across the landscape, the following table, developed by Bamford Consulting in conjunction with DEE, provides a *guide* to the assignation of site context scores. Note that 'local area' is defined as within a 15 km radius of the centre point of the study site. This is greater than the maximum distance of 12km known to be flown by Carnaby's Black-Cockatoo when feeding chicks in the nest.

Site Context Score	**Percentage of the existing native vegetation within the 'local' area that the study site represents.**	
	'Local' breeding known/likely	**'Local' breeding unlikely**
3	> 5%	> 10%
2	1 - 5%	5 - 10%
1	0.1 - 1%	1 - 5%
0	< 0.1%	< 1%

The table above provides weighting for where nearby breeding is known (or suspected) and for the proportion of foraging habitat within 15km represented by the site being assessed. Some adjustments may be needed based on the judgement of the assessor and in relation to the likely function of the site. For example, a small area of foraging habitat (eg 0.5% of such habitat within 15km) could be upgraded to a context of 2 if it formed part of a critical movement corridor. In contrast, the same sized area of habitat, of the same local proportion, could be downgraded if it were so isolated that birds could never access it.

C. Species density (stocking rate).

Species stocking rate is described as "the usage and/or density of a species at a particular site" in the offsets guide. The description also implies that a site supports a discrete population, which is unlikely in the case of very mobile black-cockatoos. Assignation of the species density score (0 or 1) is based upon the black-cockatoo species being either abundant or not abundant. A score of 1 is used where the species is seen or reported regularly and/or there is abundant foraging evidence. Regularly is when the species is seen at intervals of every few days or weeks for at least several months of the year. A score of 0 is used when the species is recorded or reported very infrequently and there is little or no foraging evidence. Where information on actual presence of birds is lacking, a species density score can be assigned by interpreting the landscape and the site context. For example, a site with a moderate condition score that is part of a network of such habitat where a black-cockatoo species is

known would get a species density score of 1 even without clear presence data, while a species density score of 0 can be assigned to a site where the level of usage can confidently be predicted to be low.

D. Moderation of scores for the calculation of a value out of 10.

The calculation out of 10 requires the vegetation characteristics (out of 6) to be combined with the scores given for context and species density. It is considered that the context and density scores are not independent of vegetation characteristics; otherwise habitat of absolutely no value for black-cockatoo foraging (such as concrete or a wetland) could get a foraging score out of 10 as high as 4 if it occurred in an area where the species breed (context score of 3) and are abundant (species density score of 1). Similarly, vegetation of negligible or low characteristics which could not support black-cockatoos could be assigned a score as high as 6 out of 10. In that case, the score of 6 would be more a reflection of nearby vegetation of high characteristics than of the foraging value of the negligible to low scoring vegetation. The Black-Cockatoos would only be present because of vegetation of high characteristics, so applying the context and species density scores to vegetation of low characteristics would not give a true reflection of their foraging value.

For this reason, the context and species density scores need to be moderated for the vegetation characteristic score to prevent vegetation of little or no foraging value receiving an excessive score out of 10. A simple approach is to assign a context and species density score of zero to sites with a Condition score of low (2), negligible (1) or none (0), on the basis that birds will not use such areas unless they are adjacent to at least low-moderate quality foraging habitat ($\geq$3). The approach to calculating a score out of 10 can be summarised as follows:

vegetation composition, condition and structure score (out of 6)	context score	Species density score
3-6 (low/moderate to high value)	Assessed as per B above	Assessed as per C above
0-2 (no to low value)	0	0

Note that this moderation approach may require interpretation depending on the context. For example, vegetation with a condition score of 2 could be given a context score of 1 under special circumstances. Such as when very close to a major breeding area or if strategically located along a movement corridor.

Pine plantations

Pine plantations are an important foraging resource for Carnaby's Black-Cockatoo (only) but are not directly comparable with native vegetation. In comparing native vegetation with pine plantations for the purpose of calculating offsets, the following should be noted:

- Pine plantations are a commercial crop established with the intention of being harvested and thus have short-term availability (30-50 years), whereas native vegetation is available indefinitely if protected. Due to the temporary nature of pines as a food source, site condition and context differs between pines and native vegetation.
- Although pines provide a high abundance of food in the form of seeds, they are a limited food resource compared with native vegetation which provides seeds, insect larvae, flowers and nectar. The value of insect larvae in the diet of Carnaby's Black-Cockatoo has not been quantified, but in the vicinity of Perth, the birds forage very heavily on insect larvae in young cones of *Banksia attenuata* in winter, ignoring the seeds in these cones and seeds in older cones on the same trees (Scott and Black 1981; M. Bamford pers. obs.). This suggests that insect larvae are of high nutritional importance immediately prior to the breeding season.
- Pine plantations have very little biodiversity value other than their importance as a food source for Carnaby's Black-Cockatoos. They inhibit growth of other flora. While this is not a factor for direct consideration with respect to Carnaby's Black-Cockatoo, it is a factor in regional conservation planning of which offsets for the cockatoos are a part.

Taking the above points into consideration, it is possible to assign pine plantations a foraging value as follows:

- Site condition. The actual foraging value of pines is high. Stock *et al.* (2013) report that it takes nearly twice as many seeds of *Pinus pinaster* to meet the daily energy requirements for Carnaby's Black-Cockatoo compared with Marri, and three times as many *P. pinaster* seeds compared with Slender Banksia. However, pines are planted at a high density so the food supply per hectare can be high. Taking account of the lack of variety of food from pines, this suggests a site condition score of 4 or 5 out of 6 (5 is used in Section A above). As a source of food, pines are thus comparable to the best banksia woodland. This site condition score then needs to be adjusted to take account of the short-term nature of the food supply (for pine plantations to be harvested. Where pines are 'ornamental, such as in some urban contexts, they can be treated as with other trees in urban landscapes). The foraging value of a site after pines are harvested will effectively be 0, or possibly 1 if there is some retention. It is proposed that this should approximately halve the site condition score; young pine plantations could be redacted slightly less than old plantations on the basis that a young plantation provides a slightly longer term food supply. If a maximum site condition score of 5 is given, then a young plantation (>10 but <30 years old) could be assigned a score of 3, and an old plantation (>30 years old) could be assigned a score of 2. Plantations <10 years old and thus not producing large quantities of cones could also get a score of 2, but recognising they may increase in value.
- Site context. Although a temporary food source, pines can be very important for Carnaby's Black-Cockatoo in some contexts; they could be said to carry populations in areas where there

is little native vegetation. The system for assigning a context score as outlined above (Section B) also applies to pines. Thus, a context score of 3 can be given where pines are a significant proportion of foraging habitat (>5% if breeding occurs; >10% if no breeding), but where pines are a small part of the foraging landscape they will receive a context score of less than this.

- Species density. As outlined above (Section C), pines will receive a species density score of 1 where Carnaby's Black-Cockatoo are regular visitors. This is irrespective of an old plantation having a moderated condition score of 2.

Based on the above, pine plantations that represent a substantial part of the foraging landscape, such as in the region immediately north of Perth, would receive a total score (out of 10) of 6; young plantations in this area would receive a score of 7. In contrast, isolated and small plantations in rural landscapes could receive a score of just 2 if they are only a small proportion of foraging habitat and Carnaby's Black-Cockatoos are not regularly present.

Keighery (1994).

Scott, J. K. and Black, R. (1981). Selective Predation by White-Tailed Black Cockatoos on Fruit of *Banksia attenuata* Containing the Seed-Eating Weevil *Alphitopis nivea*. *Australian Wildlife Research* **8(2)**, 421-430.

Stock, W.D., Finn, H., Parker, J. and Dods, K. (2013). Pine as Fast Food. Foraging Ecology of an Endangered Cockatoo in a Forestry Landscape. PlosOne 8: issue 4.

Document Distribution

Rev No.	Copies	Recipient	Date
A	1 – Electronic (Draft)	Department of Education (Client)	13/04/2021
0	1 – Electronic (Draft)	Department of Agriculture Water and the Environment	27/04/2021
1	1 – Electronic	Department of Agriculture Water and the Environment	25/08/2021
2	1 - Electronic	Department of Agriculture Water and the Environment	06/10/2021

Document Status

Rev No.	Author	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	C O'Brien	T Bowra	T Bowra		13/04/2021
0	C O'Brien / W Oversby	T Bowra	T Bowra		27/04/2021
1	W Oversby	T Bowra	T Bowra		25/08/2021
2	W Oversby	T Bowra	T Bowra		06/10/2021

www.jbsg.com.au