

Questdale Holdings Pty Ltd
Environmental Offsets Strategy

Lots 2 and 10 Rowley Road, Mandogalup
Assessment Number 2197

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

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Abbreviations

Term	Definition
BC Act	Biodiversity Conservation Act 2016
CAMP	Conservation Area Management Plan
CoK	City of Kwinana
DMP	Dust Management Plan
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EMP	Environmental Management Plan
ha	Hectares
LGA	Local Government Authority
LPS	Local Planning Scheme
PEC	Priority Ecological Community
RISM	Residual Impact Significant Model
SoG	Shire of Gingin
TEC	Threatened Ecological Community

1. Project and Offset Summary

1.1 Proposal Background

Questdale Holdings Pty Ltd (the Proponent) proposes to extend the operation of an existing sand quarry at Lots 2 and 10 Rowley Road, Mandogalup (the Proposal). The Proposal will require the clearing of approximately 26.2 ha of native vegetation within the Proposal area (Figure 1.1). The Proposal area is located approximately 33 km south of the Perth CBD within the City of Kwinana (CoK) and is bounded by Rowley Road to the north, the existing sand quarry to the west, a Western Power powerline corridor to the south, and residential development to the east.

1.2 Purpose of this strategy

The Proposal has been designed in accordance with the mitigation hierarchy whereby impacts are first avoided, minimised where avoidance is not possible, rehabilitated, and finally offset where significant residual impacts persist. This Offsets Strategy has been prepared to address the significant residual impacts of the Proposal after all practicable measures to avoid, minimise and rehabilitate impacts were exhausted.

This Offset Strategy has been prepared to achieve the following objectives:

- Identify, describe, and quantify the potential residual impacts on the identified key environmental factors (Flora and Vegetation and Terrestrial Fauna) that will occur following implementation of the Proposal after consideration and applying avoidance and minimisation measures, and
- Propose an offset package to counterbalance the residual impacts of the proposal that is consistent with the WA Environmental Offsets Policy (GoWA 2011), WA Environmental Offset Guidelines (GoWA 2014a) and, where residual impacts relate to threatened species or communities, the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) Environmental Offsets Policy (DSEWPaC 2012a).

1.3 Policies, plans and guidelines

As the proposal will impact matters that are protected under State and Commonwealth legislation, the offset requirements have been determined in accordance with the following policies, plans and guidelines.

1.3.1 Commonwealth legislation and policies

- EPBC Act Environmental Offsets Policy (DSEWPaC 2012a),
- Offset Assessment Guide (DSEWPaC 2012b),
- Offset Calculator Guidelines (DSEWPaC 2012c),
- Guidance for delivering 'risk of loss' estimates when evaluating biodiversity offset proposals under the EPBC Act (TSRH 2017),
- EPBC Act referral guidelines for three threatened black cockatoo species (DSEWPaC 2012d).

1.3.2 State legislation and policies

- Western Australian Environmental Offsets Policy (GoWA 2011),
- Western Australian Environmental Offsets Guidelines (GoWA 2014a),
- WA Environmental Offsets Template (GoWA 2014b),
- EPA Advice: Carnaby's Cockatoo in Environmental Impact Assessment in the Perth and Peel Region in accordance with section 16(j) of the *Environmental Protection Act 1986* (EP Act).

1.3.3 Recovery plans and/or conservation advice

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan (DPaW 2013),
- Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*) Recovery Plan (DEC 2008).

In developing the proposed offset package, the Proponent has taken into account to Principles of the WA Environmental Offsets Policy (GoWA 2011) and the EPBC Act Environmental Offsets Policy (DSEWPac 2012a) as summarized in Table 1.1 and Table 1.2, respectively.

Table 1.1: Assessment of Offsets against the Principles of the WA Environmental Offsets Policy (2011)

Principle	Assessment
Environmental offsets will only be considered after avoidance and mitigation options have been pursued	<p>The potential impacts from the Proposal have been reduced wherever possible, with measures applied during the design phase and the environmental assessment process.</p> <p>Measures to avoid and mitigate impacts of the Proposal include the establishment of a Conservation Area within the Proposal area. This Conservation Area was located in such a way as to retain and protect a substantial portion of the environmental values within the site in a concentrated manner.</p> <p>Additionally, measures to mitigate impacts on retained environmental matters have been implemented through the application of local, technical expertise relating to key species and habitats to ensure their efficacy. These measures include practices relating to weed and disease management, dust suppression, and hydrological management.</p>
Environmental offsets are not appropriate for all projects	<p>The Proposal has been designed in accordance with the mitigation hierarchy and, as such, has considered and implemented measures to avoid and minimise impacts prior to considering environmental offsets.</p> <p>Avoidance measures have included the delineation of a Conservation Area to entirely avoid impacts to a substantial portion of the Proposal area. Mitigation measures include the implementation of an Environmental Management Plan (EMP) and Conservation Area Management Plan (CAMP) to manage direct and indirect impacts of the construction and operational phases of the Proposal.</p> <p>Finally, this Offsets Strategy has been prepared to manage the significant residual impacts that persist following the implementation of these measures. Environmental offsets are considered appropriate for the Proposal given that an overall net conservation benefit is achievable for the impacted matters: Banksia Woodlands TEC, Carnaby's Cockatoo, and Forest Red-tailed Black Cockatoo. The offset ratios applied, ability to secure of comparable vegetation and habitat within the region, and demonstrated success in habitat creation allow the proposed offsets to adequately compensate for the residual impacts of the Proposal.</p>
Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted	<p>The Proponent has considered a number of options through the process of developing an Offsets Strategy and package to counterbalance the significant residual impacts of the Proposal.</p> <p>The proposed offsets package is cost-effective through the ability to achieve the required offset quantum for numerous values (i.e. Banksia Woodland TEC and Carnaby's Cockatoo habitat) within a single offset site, maximising cost-effectiveness.</p> <p>The offsets are considered relevant and proportionate to the significance of the impact as the required offset quantum was derived through the use of the EPBC Offsets Calculator and WA Offsets Template. This has ensured the offsets are relevant, in that the same matter that is impacted will be secured and/or rehabilitated through the offsetting process, and in proportion to the significance of the matter given the ratio has been determined through the conservation status of the matter as well as the extent and quality of the matter to be impacted.</p>

	As such, the offset package comprises acquisition of land providing Carnaby's Cockatoo habitat and vegetation representative of the Banksia Woodland TEC, and the creation of fauna habitat through rehabilitation/revegetation, and installation of artificial nest boxes.
Environmental offsets will be based on sound environmental information and knowledge	<p>The location of the proposed offsets has been determined based on best available scientific knowledge of the values on site, derived through flora, vegetation fauna surveys undertaken by experienced professionals. Further investigations are proposed to confirm the extent and quality of Banksia Woodland TEC and Carnaby's Cockatoo foraging habitat is still consistent with that identified in earlier assessments.</p> <p>The proposed rehabilitation of the Conservation area to offset impacts to Forest Red-tailed Black Cockatoos was selected to ensure natural values, suitable for the species, are retained within the local area. In addition, the site was identified as the preferred option following no other suitable area within the City of Kwinana being identified to date. Opportunities to undertake revegetation in other localities important to the species will continue to be explored. The proposed revegetation methodology and projected survival rates are based on previous revegetation success of Jarrah Woodland as reported by revegetation trials by Alcoa and advice from experienced revegetation professionals from Tranen.</p>
Environmental offsets will be applied within a framework of adaptive management	<p>The Offsets Strategy is based on outcome-based completion criteria with specified monitoring requirements, and contingency measures to be applied where monitoring indicates a potential failure to meet those completion criteria through early indicators and triggers. As such, the proposed offsets will be based on an adaptive cycle of actions, monitoring, review of measures, and adoption of revised actions where monitoring learnings show potential failure. The specification of outcome-based completion criteria mean actions will be adaptive, to be amended where necessary to achieve the desired outcome and effectively achieve the required offset.</p> <p>Additionally, the Offset Strategy includes reporting requirements to both government agencies and the public. Where this reporting identifies any potential inadequacies in the strategy, consultation will be undertaken with DBCA and other relevant stakeholders to obtain advice and implement any required amendments to achieve more desirable outcomes.</p>
Environmental offsets will be focussed on longer term strategic outcomes.	<p>The proposed Offset Strategy is focused on longer-term strategic outcomes through the securement of high-quality vegetation representative of Banksia Woodlands TEC as well as habitat for Carnaby's Cockatoo. This will ensure habitat linkage is maintained in the local area and will contribute to the conservation estate due to the site's proximity to Mogumber Nature Reserve and Lake Wannamal Nature Reserve.</p> <p>Additionally, the creation of habitat for Forest Red-tailed Black Cockatoos within the Conservation Area, in the City of Kwinana, contributes to longer-term strategic outcomes through improving the availability of habitat within a constrained area within the Swan Coastal Plain. The offset is located within an area highlighted as a potential south-west ecological linkage as identified in the Latitude 32 Biodiversity Strategy and seeks to increase the density of vegetation within the site substantially.</p>

Table 1.2: Assessment of the proposed offsets against the principles of the EPBC Act Environmental Offsets Policy

Principle	Discussion
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter	The offsets will provide a conservation outcome that maintains or improves the viability of the Banksia Woodlands TEC, Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo. The offset strategy provides at least 100% offset for all three protected matters.
Suitable offsets must be built around direct offsets but may include other compensatory measures	The conservation outcome will be achieved through protecting the protected matters through transfer of land containing Banksia Woodlands TEC, Carnaby's Cockatoo habitat to DBCA. Forest Red-tailed Habitat will be planted within areas that will be either reserved by Local Government Areas or managed by DBCA

Principle	Discussion
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter	The offset strategy is built around direct offsets, involving a package of suitable offset properties and revegetation to provide at least 100% direct offsets for Banksia Woodland TEC and Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo habitat.
Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter	All land acquisition offsets will be transferred to DBCA. DBCA and the Conservation and Parks Commission are then responsible for the management of the land and creation of the conservation reserve, providing in perpetuity protection and management.
Suitable offsets must effectively account for and manage the risks of the offset not succeeding	The quantum of offsets proposed are in proportion to the level of statutory protection applied to the Banksia Woodlands TEC (Endangered), Carnaby's Cockatoo (Endangered), and Forest Red-tailed Black Cockatoo (Vulnerable) as presented in the preliminary offset calculations.
Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under schemes or programs	The offsets will be of a size and scale proportional to the residual impacts on Banksia Woodlands TEC, Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo. The offset strategy provides at least 100% offset for all three protected matters.
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	The provision of direct offsets is based on completed offset assessment guide calculations, incorporating evidence-based justification for all inputs.
Suitable offsets must have transparent governance arrangements, including being able to be readily measured, monitored, audited and enforced.	The estimation of direct offsets is based on completed offset assessment guide calculations, incorporating a conservative assessment of risk of the offset not succeeding.

1.4 Impact avoidance

The WA Environmental Offsets Policy notes that environmental offsets will only be considered after avoidance and mitigation options have been pursued. Avoidance and mitigation measures applied to the proposal are summarised in Table 1.1.

1.5 Residual Significant Environmental Impacts

Environmental offsets will only be applied where the residual impacts of a project are determined to be significant after avoidance, minimisation and rehabilitation have been pursued (Australian Government 2012; Government of Western Australia 2014)

Significant residual impacts to environmental values are summarised in Table 1-1 and were determined in accordance with the Residual Impact Significant Model (RISM) (Table 1.3) and the WA Offsets template in the WA Environmental Offsets Guidelines (GoWA 2014). Significant impacts for MNES have also been presented in Table 1.1 under their respective State environmental factor. The Commonwealth Offsets Calculator is provided in Appendix A.

The RISM defines four levels of impact in the context of determining whether offsets are required for State environmental values (GoWA 2014):

- Unacceptable impacts – those impacts which are environmentally unacceptable or where no offset can be applied to reduce the impact. Offsets are not appropriate in all circumstances, as some environmental values cannot be offset.
- Significant impacts requiring an offset – any significant residual impact of this nature will require an offset. These generally relate to any impacts to species, ecosystems, or reserve areas protected by statute or where the cumulative impact is already determined to be at a critical level.
- Potentially significant impact which may require an offset – the residual impact may be significant depending on the context and extent of the impact. These relate to impacts that are likely to result in a species or ecosystem requiring protection under statute or increasing the cumulative impact to a critical level. Whether these impacts require an offset will be

determined by the decision-maker based on information provided by the proponent or applicant and expert judgement; and

- Impacts which are not significant – impacts which do not trigger the above categories are not expected to have a significant impact on the environment and therefore do not require an offset.

Following measures to avoid, mitigate and rehabilitate the environmental impacts associated with the proposal, including the preparation of an Environmental Management Plan (EMP), Dust Management Plan (DMP) and Conservation Area Management Plan (CAMP), the following significant residual impacts are expected:

- Permanent loss of:
 - 26.2 ha of the Commonwealth-listed Banksia Woodlands TEC and PEC,
 - 26.2 ha of 'moderate' quality foraging habitat for Carnaby's Cockatoo,
 - 26.2 ha of 'low to moderate' quality Forest Red-tailed Black Cockatoo foraging habitat, and
 - 42 significant Black Cockatoo trees (>500 mm DBH, *Eucalyptus marginata*) of which 17 contain hollows however all were identified as unsuitable for Black Cockatoos.

Given the above, the proposal is considered to result in significant residual impacts to matters listed under the EPBC Act and EP Act, the proposed offset strategy has been prepared in accordance with the EPBC Act Offsets Policy (DSEWPaC 2012a) and WA Offsets Policy (GoWA 2011) and associated guidelines.

Figure 1.1: Proposal area

Table 1.3: Residual Impact Significance Model

RESIDUAL IMPACT SIGNIFICANCE MODEL						
Environmental Factor	Existing environment / Impact	Mitigation			Significant Residual Impact	Non-significant impacts that will not be offset
		Avoid and minimise	Rehabilitation Type	Likely rehabilitation success		
Flora and Vegetation	Permanent loss of 26.2 ha of Banksia Woodlands TEC/PEC in good to excellent condition.	<p>Avoid:</p> <ul style="list-style-type: none"> 3.74 ha of Banksia Woodlands TEC/PEC in good to excellent condition that will be set aside for conservation along with implementation of CAMP. Accidental clearing through implementation of an EMP. <p>Minimise</p> <ul style="list-style-type: none"> Impacts caused by construction and operation (such as dust, weeds and pathogens, waste, etc) through implementation of EMP and DMP. 	<p>No rehabilitation of the quarried areas is proposed as the site is to be utilised for urban or industrial land uses, consistent with the surrounding land uses and as illustrated by the South Metropolitan Peel sub regional plan.</p> <p>However, revegetation within the onsite conservation area is proposed. The conservation area is approximately 4.1 ha, of which 3.74 ha is currently vegetated. Revegetation is proposed to be undertaken in all areas currently designated as “cleared”; a total area of 0.36 ha.</p> <p>Implementation of the CAMP will include the following revegetation measures:</p>	80%	<p>Extent</p> <p>26.2 ha of Banksia Woodlands TEC/PEC within the Proposal Area.</p> <p>Quality</p> <p>Vegetation is good to excellent condition.</p> <p>Conservation Significance</p> <p>Banksia dominated Woodlands of the Swan Coastal Plan is listed as Endangered under the EPBC Act and listed as Priority 3 ecological community by the DBCA.</p> <p>According to the agreed significance framework, the impact to Banksia Woodlands TEC/PEC is considered significant requiring an offset as the ecological community is listed as Endangered under the EPBC Act.</p>	<ul style="list-style-type: none"> No residual impacts to conservation areas are expected from the Proposal. Clearing of 26.2 ha of vegetation associated within the Bassendean Complex - central and south, is above the minimum threshold of 10% target for the retention of vegetation complexes in constrained areas on the Swan Coastal Plain (EPA, 2015). Therefore, the residual impact is not significant.
Terrestrial Fauna	Permanent loss of 26.2ha of moderate quality Black Cockatoo (Carnaby's) foraging habitat.	<p>Avoid:</p> <ul style="list-style-type: none"> 3.74 ha of moderate quality Carnaby's Black Cockatoo foraging habitat including 9 significant Black Cockatoo trees (of which 5 were identified as having hollows but none were assessed as being suitable for Black Cockatoo) that will be set aside for conservation along with implementation of CAMP. Accidental clearing through implementation of an EMP. <p>Minimise</p> <ul style="list-style-type: none"> Impacts caused by construction and operation (such as dust, weeds and pathogens, waste, etc) through implementation of EMP and DMP. 	<ul style="list-style-type: none"> transfer of topsoil from the wider Proposal Area in combination with broadcast seeding is proposed as the primary means by which revegetation will be undertaken. Topsoil cuts for transfer purposes will be limited to depths of up to 10 cm to maximise the potential value of transferred topsoil (deeper cuts lead to many seeds being buried too deep for emergence in transfer sites due to mixing during collection, transport and redistribution). Topsoil and native seed will be collected from VT1, within areas mapped as being in Very Good to Excellent condition. This will ensure a species assemblage consistent with the Black Cockatoo foraging habitat. Should revegetation not meet the completion criteria within two years of revegetation commencing, then infill planting using native seedlings will be undertaken. 		<p>Extent</p> <p>26.2 ha of moderate quality foraging habitat for Carnaby's Black Cockatoo within the Proposal Area</p> <p>Quality</p> <p>Foraging habitat is identified as being moderate quality for Carnaby's Black Cockatoo</p> <p>Conservation Significance</p> <p>Carnaby's Black Cockatoo is listed as Endangered under the EPBC Act and BC Act.</p> <p>According to the agreed significance framework, Significant Residual Impact is considered to be <u>significant impacts</u> requiring an offset as the ecological community to be impacted is listed as Endangered under the EPBC Act and BC Act.</p>	<ul style="list-style-type: none"> Permanent loss of 26.2 ha of terrestrial fauna habitat. Potential injury and/or mortality of fauna during clearing activities and construction and operation of Proposal.
Terrestrial Fauna	<p>Permanent loss of 26.2 ha of low to moderate quality Forest Red-tailed Black Cockatoo foraging habitat.</p> <p>It is recognised that foraging habitat for Forest Red-tailed Black Cockatoo within the Proposal Area is primarily due to the presence of scattered <i>Eucalyptus marginata</i> (Jarrah) foraging trees on site, which is known to constitute 90% of its</p>	<p>Avoid:</p> <ul style="list-style-type: none"> 3.74 ha of low to moderate quality Forest Red-tailed Black Cockatoo foraging habitat including 9 significant Black Cockatoo trees (of which 5 were identified as having hollows but none were assessed as being suitable for Black Cockatoo) that will be set aside for conservation along with implementation of CAMP Accidental clearing through implementation of an EMP <p>Minimise</p>	<p>No rehabilitation of the quarried areas is proposed as the site is to be utilised for urban or industrial land uses, consistent with the surrounding land uses and as illustrated by the South Metropolitan Peel sub regional plan.</p> <p>However, revegetation within the onsite conservation area is proposed. See above for further detail on outcomes to be achieved for onsite revegetation within proposed conservation area.</p>	80%	<p>Extent</p> <p>26.2 ha of low to moderate quality foraging habitat for Forest Red-tailed Black Cockatoo within the Proposal Area.</p> <p>Quality</p> <p>Foraging habitat is identified as being moderate quality for Carnaby's Black Cockatoo.</p> <p>Conservation Significance</p> <p>Carnaby's Black Cockatoo is listed as Endangered under the EPBC Act and BC Act.</p>	

RESIDUAL IMPACT SIGNIFICANCE MODEL						
Environmental Factor	Existing environment / Impact	Mitigation			Significant Residual Impact	Non-significant impacts that will not be offset
		Avoid and minimise	Rehabilitation Type	Likely rehabilitation success		
	<p>diet along with <i>Corymbia calophylla</i> (Marri) (DBCA 2017). They may also feed on <i>Allocasuarina fraseriana</i> which is scattered through the site; however the remaining vegetation provides limited to no value in foraging habitat for Forest Red-tailed Black Cockatoo.</p> <p>It is proposed to offset the residual impacts to Forest Red-tailed Black Cockatoo (including 42 significant Black Cockatoo foraging trees) by revegetating <i>Eucalyptus marginata</i> (Jarrah) and <i>Corymbia calophylla</i> (Marri) trees within conservation areas located locally on DBCA or City of Kwinana managed land.</p>	<ul style="list-style-type: none"> Impacts caused by construction and operation (such as dust, weeds and pathogens, waste, etc) through implementation of EMP and DMP 			<p>Forest Red-tailed Black Cockatoo is listed as Vulnerable under the EPBC Act and BC Act.</p> <p>According to the agreed significance framework, Significant Residual Impact is considered to be <u>significant impacts</u> requiring an offset as the species to be impacted is listed as Vulnerable under the EPBC Act and BC Act.</p>	
	<p>Permanent loss of 42 significant Black Cockatoo trees, of which 17 were identified as having hollows but none were assessed as being suitable for Black Cockatoos</p>	<p>Avoid:</p> <ul style="list-style-type: none"> 9 significant Black Cockatoo trees, of which 5 were identified as having hollows but none were assessed as being suitable for Black Cockatoo, that will be site aside for conservation along with the implementation of CAMP Accidental clearing through implementation of an EMP <p>Minimise</p> <ul style="list-style-type: none"> Impacts caused by construction and operation (such as dust, weeds and pathogens, waste, etc) through implementation of EMP and DMP 	<p>No rehabilitation of the quarried areas is proposed as the site is to be utilised for urban or industrial land uses, consistent with the surrounding land uses and as illustrated by the South Metropolitan Peel sub regional plan.</p> <p>However, revegetation within the onsite conservation area is proposed. See above for further detail on outcomes to be achieved for onsite conservation area.</p>	80%	<p>Extent 42 significant Black Cockatoo trees</p> <p>Quality 17 were identified as having hollows but none were assessed as being suitable for Black Cockatoos</p> <p>Conservation Significance Forest Red-tailed Black Cockatoo is listed as Vulnerable under the EPBC Act and BC Act.</p> <p>According to the agreed significance framework, Significant Residual Impact is considered to be <u>significant impacts</u> requiring an offset as the species to be impacted is listed as either Endangered or Vulnerable under the EPBC Act and BC Act.</p>	

2. Environmental Offsets

Environmental offsets are actions that provide environmental benefits intended to counterbalance the significant residual environmental impacts associated with a proposal (GoWA 2014a). The Proponent intends to counterbalance the residual impact of the Proposal through implementation of an environmental offset.

The offset strategy has been prepared in accordance with the EPBC Act Environmental Offset Policy (DSEWPaC 2012a), the WA Government's Environmental Offset Policy (GoWA 2011), and the WA Offset Guidelines (GoWA 2014a). As such, the proposed offset is proportionate to the level of impact and significance of the environmental impact.

The Proponent has pursued a number of options in developing a package of offsets to counterbalance these residual impacts. The options investigated have comprised acquisition of land providing TEC / PEC vegetation, fauna habitat, creation of fauna habitat by on-ground rehabilitation. Numerous attributes will be offset within a single offset site (i.e. Banksia Woodland TEC and Carnaby's Cockatoo habitat) to better equate to the values present at the impact site.

Table 2.1 provides an overview of the offset package under consideration, with offset property location presented in Figure 2-1.

Table 2.1: Overview of the proposed offset package

No	Offset Type	Offset Summary	Property Location	Existing Tenure
1	Land acquisition	Acquisition of 180 ha of Banksia Woodland TEC/PEC (FCT SCP 28) and Carnaby's Cockatoo habitat of moderate quality.	Portion of Lot 310 and Lot 300 Neaves Road Mogumber.	Freehold land zoned for general rural purposes under the Shire of Gingin Local Planning Scheme No 9.
2	Rehabilitation/on-ground management	Rehabilitation of land currently managed by DBCA or LGA. Rehabilitation actions will include the establishment of 180 trees (90 Marri and 90 Jarrah) to achieve a minimum survival of 126 trees constituting foraging habitat for Forest Red-tailed Black Cockatoos.	Pending. Discussions are being undertaken with relevant authorities to identify suitable areas for revegetation.	TBC
3	On-ground management	Establishment of three artificial nesting boxes within the on-site conservation area within the Proposal Area.	Conservation area located within the Proposal Area.	Proponent-owned land currently zoned for rural use.

2.1 Description of Offsets

The Proponent is proposing two offset sites to counterbalance the significant residual impacts to Banksia Woodlands TEC and habitat for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo. These sites have been identified by the Department of Biodiversity, Conservation and Attractions (DBCA) as containing the required MNES that would benefit from acquisition, enhancement or revegetation, and inclusion in the conservation estate and/or additional management activities funded by the Proponent. The first site identified is herein referred to as 'Mogumber' which will be a land acquisition offset containing Banksia Woodlands TEC and habitat for Carnaby's Cockatoo. The second site, which is pending, will be a revegetation/on-ground management offset to be managed for the establishment of habitat for Forest Red-tailed Black Cockatoo.

The 'Mogumber' site is shown on Figure 2-1. A description of each site based on information from preliminary investigations at each site is provided in the following sections.

Figure 2.1: Mogumber Offset Location

2.1.1 Mogumber Offset Site

A package of suitable land has been identified and that may be added to the State's conservation system to offset any residual impact to Banksia Woodland TEC/PEC and Carnaby's Cockatoo from the proposed development. The proposed offset has been developed and identified in-line with the following key policies and guidelines:

- Principles of the WA Environmental Offsets Policy (GoWA 2011),
- WA Environmental Offsets and Guidelines (GoWA 2014),
- EPBC Act Environmental Offsets Policy (DSEWPaC 2012a), and
- EPBC Act Environmental Offsets Guidance (DSEWPaC 2012b).

Based on the results of the determination of offset requirements provided in section 5 the calculated area and condition of the required offsets for Banksia Woodlands TEC and Carnaby's Cockatoo are as follows:

- Banksia Woodland TEC/PEC: 180 ha with a start quality of 8, and
- Carnaby's Cockatoo foraging habitat: 180 ha with a start quality of 7.

Identification of offset site

The proposed land acquisition offset is a portion of Lot 310 and Lot 300 Neames Road Mogumber. The Lots comprise a total land area of approximately 912 ha, of which 180 ha is proposed for acquisition.

The offset site is located 127 km north of Perth within the Shire of Gingin. Offsetting actions associated with this site will be based on land acquisition and passive enhancement through the placing of a conservation covenant or inclusion in the conservation estate, and the restriction and management of access.

Environmental Attributes

A comparison of the vegetation present within the Mogumber Offset Site to that within the Proposal area was undertaken by Del Botanics (2019) inclusive of a Floristic Community Type (FCT) analysis for the Banksia Woodland vegetation. The results of the assessment, as applicable to the proposed offsets package, is summarised in Table 2.2.

Table 2.2: Environmental attributes of the Mogumber offset site

Environmental Attribute	Description
Vegetation system associations	<p>The proposed offset site is located within the Drummond Botanical Subdistrict within the Southwest Botanical Province as described by Beard (1990).</p> <p>Mapped vegetation system associations within the site are:</p> <ul style="list-style-type: none"> • 949: Low Banksia woodland, • 1015: Mosaic of mixed scrub/heath/shrublands and Dryandra thickets, • 1017: Medium open Jarrah and Marri woodland over a low woodland of <i>Banksia</i> species, and • 37: Shrublands and Teatree thicket. <p>Mapped vegetation complexes within the site (Hedde et al. 1980) are:</p> <ul style="list-style-type: none"> • Cullula Complex: mixture of low open forest of Banksia species, <i>Eucalyptus tottiana</i> (Prickly bark) and open woodland of <i>Corymbia calophylla</i> (Marri) with second storey of <i>Eucalyptus tottiana</i>, <i>Banksia attenuata</i>, <i>Banksia menziesii</i>, and <i>Banksia ilicifolia</i>. • Mogumber Complex North: open to closed heath of <i>Banksia</i> species and <i>Allocasuarina humilis</i>.
Banksia Woodlands TEC	<p>Vegetation within the proposed offset site was determined to align with FCT SCP S9 which differ from the FCT SCP28 recorded within the Proposal Area. This is considered a separate subcommunity of the Banksia Woodlands TEC/PEC and is considered to be within a separate FCT Super Group as identified by Gibson et al. (1994) and in the System 6 and</p>

Environmental Attribute	Description
	<p>Part I update (DEP 996). FCT SCP S9 is also considered to have a lower mean species richness (MSR) (38.8) compared to SCP28 (55.1) (GoWA 2000). Within quadrats scored during the 2017 assessment of the Proposal Area, the MSR within VT1 was 32.5, comparable to the MSR of SCP S9 reference quadrats. In addition, the MSR of quadrats scored within the offset site was 29.5. The MSR of the offset site has been calculated from a survey conducted outside of the prime survey period for the bioregion. As such, it is expected that greater species richness is present within the offset site than was recorded during the 2019 assessment.</p> <p>Whilst statistically different from the vegetation within the Proposal Area, the Banksia woodland vegetation within the proposed offset site represents a similar species richness and higher vegetation condition.</p> <p>Full details of the proposed offset site's flora and vegetation assessment are provided in Appendix B.</p> <p>The proposed area of acquisition contains 180 ha of Banksia Woodland TEC.</p>
Carnaby's Cockatoo habitat	<p>Similarly, an assessment of the proposed offset site's Black Cockatoo habitat has been undertaken. The key results from the Black cockatoo habitat survey were (appendix C):</p> <ul style="list-style-type: none"> • 317 ha of moderate to high quality Carnaby's Black Cockatoo foraging habitat recorded within the Survey area • 26 significant Black Cockatoo trees recorded within the survey area: <ul style="list-style-type: none"> ○ two potentially suitable hollows. <p>Black cockatoo habitat quality was scored for the site as per Bamford (2018). Foraging species dominant within the Survey area were, <i>Eucalyptus marginata</i>, <i>Banksia attenuata</i>, <i>Banksia menziesii</i>, and <i>Xanthorrhoea preissii</i>. 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 ranging from a score of 3 to 5 across the site. A site context score of 2 was applied across the site given that local breeding is likely. A species density score of 1 applies given that Black Cockatoos were observed in the area. Overall habitat quality therefore ranges from 6 to 8 across the site.</p>
Black Cockatoo breeding trees	<p>Twenty-six significant black cockatoo habitat trees were identified in the survey area, comprising of 25 <i>Eucalyptus marginata</i> (Jarrah) and one <i>Corymbia calophylla</i> (Marri) (Strategen-JBS&G 2020). Observations indicated two trees contained hollows of a size and orientation suitable for nesting by black cockatoo species.</p> <p>Full details of the proposed offset site's targeted Black Cockatoo habitat assessment are provided in appendix C.</p>

It is also worth noting, that the *Forest Black Cockatoo (Baudin's Cockatoo Calyptorhynchus baudinii and Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) Recovery Plan* (DEC 2008), states that the Forest Red-tailed Black Cockatoo once occurred as far north as Dandaragan. Whilst the current distribution is just south of the Proposed offset site, it contains key foraging species for the Forest Red-tailed Black Cockatoo (i.e. Jarrah and Marri), so may also provide benefit for this species.

Discussion of alternative sites

It is noted that the proposed offset site identified in this section is a considerable distance from the proposal site. This is based on there being little suitable land available for acquisition with the necessary values present within the area of the Proposal.

Within 12 km of the Proposal area, most Black Cockatoo foraging habitat is already vested with an agency that precludes it from being suitable as a land acquisition offset due to the inability for the offsetting process to provide protection additional to what is already provided. The acquisition of a set of smaller sites was considered, in order to provide the required offset quantum over a series of smaller patches, however the protection of a large habitat node with vegetation / habitat in Good to Excellent condition (Del Botany 2019) is considered to constitute a greater ecological benefit.

The proposed offset will protect a 180 ha node of Banksia Woodland TEC/PEC with a low perimeter to area ratio with a high level of long-term viability so as to be minimally affected by edge effects

over the long term. This will contribute to the patch having a higher propensity to support fauna assemblages and maintain high biodiversity. Because of the above, the Mogumber Offset Site is considered to better fulfil Principle 3 of the WA Environmental Offsets Policy (GoWA 2014a) which states that offsets should be cost-effective and proportionate to the impact.

2.1.2 Revegetation/on-ground management Offset Site

Identification of offset site

As part of the on-ground management component of the offset, a Conservation Area (CA) will be established within the Proposal area. The CA is approximately 4.1 ha of which 3.74 ha is currently vegetation. Revegetation is proposed to be undertaken in all areas of the CA currently designated as cleared (total area of 0.36 ha) (see CAMP). This will provide benefit to both black cockatoo species. As part of the Proposal, the establishment of three artificial nesting boxes within the on-site conservation area has also been proposed. However, the artificial nesting boxes may provide a greater benefit to the species if placed in other areas outside of the CA, and the final placement will be decided in consultation with DBCA.

In addition, a contribution of funding towards the revegetation component will be provided by the proponent. This component of the offset will involve the replanting of *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) seedlings within additional DBCA managed lands / or a Local Natural Areas with Forest Red-tailed black cockatoo habitat will be considered in consultation with the EPA, the DBCA and relevant Local Government Authorities (LGA).

The additional rehabilitation offset site(s) for Forest Red-tailed Black Cockatoo habitat is in the process of being identified. The proposed site will be contained within the known distribution of the species and will be assessed to confirm presence of the species. A number proposed sites will be identified via desktop assessment and provided to the DBCA for review. Further consultation with relevant LGA's will be undertaken to gain agreement for the revegetation to occur and for the site to be managed for conservation.

3. Management and/or rehabilitation actions

3.1 Objectives, Targets and Completion Criteria

Table 3.1 provides the objectives, targets and completion criteria for the proposed offsets strategy. The completion criteria in Table 3.1 are also linked to the relevant management actions described in section 3.2 and Table 3.2.

Table 3.1: Objectives, targets and completion criteria

Objective	Target	Completion criteria
Counterbalance the significant residual impact to 26.2 ha of the Banksia Woodlands TEC.	To conserve, maintain and/or enhance 180 ha of Banksia Woodland TEC (SCP 29) within the Mogumber Offset Site.	Land purchase completed.
		Transfer to conservation estate completed.
		Transfer of funds to DBCA for management completed.
		Baseline dieback mapping completed
		<i>Phytophthora</i> management plan completed.
		Signage installation completed.
		Installation of fencing completed.
Counterbalance the significant residual impact to 26.2 ha of 'moderate' quality Carnaby's Cockatoo habitat.	To conserve, maintain and/or enhance 180 ha of habitat for Carnaby's Cockatoo (with a quality rating of 7/10) within the Mogumber Offset Site.	Installation of access/firebreaks.
		Land purchase completed.
		Transfer to conservation estate completed.
		Transfer of funds to DBCA for management completed.
		Baseline dieback mapping completed
		<i>Phytophthora</i> management plan completed.
		Signage installation completed.
Counterbalance the significant residual impact to 26.2 ha of 'low to moderate' quality Forest Red-tailed Black Cockatoo habitat (equivalent to 42 significant Black Cockatoo trees).	To establish of high-quality Forest Red-tailed Black Cockatoo habitat through the planting of 126 Jarrah (<i>Eucalyptus marginata</i>) and Marri (<i>Corymbia calophylla</i>) trees.	Installation of fencing completed.
		Installation of access/firebreaks.
		Transfer to conservation estate completed/conservation covenant in space/zoning change completed
		Baseline weed mapping completed.
		Weed monitoring and mapping completed.
		60% reduction of WONS, declared plants and invasive grasses from the baseline survey.
		Baseline dieback mapping completed.
		<i>Phytophthora</i> management plan completed.
		Signage installation completed.
		Planting of 126 trees completed..
		Annual monitoring of vegetation and tree survival.
	To conserve 26 significant Black Cockatoo trees (25 Jarrah and 1 Marri) including two containing suitable hollows for Black Cockatoos within the Mogumber Offset Site.	Survival of trees as per the below indicators:
		<ul style="list-style-type: none"> Survival of a minimum of 85% of trees after 10 years Survival of a minimum of 80% trees after 15 years Survival of a minimum of 126 trees after 20 years.
		Installation of nature reserve signage.
		Reserve information board installed.
		Land purchase completed.
		Transfer to conservation estate completed.
		Transfer of funds to DBCA for management completed.
		Baseline dieback mapping completed
		<i>Phytophthora</i> management plan completed.
		Signage installation completed.
		Installation of conservation fencing completed (specify type i.e. to allow fauna to move in and out of site)
		Installation of limestone paths.

3.2 Management Actions

The following management actions will be undertaken at the Mogumber Offset Site and Revegetation/On-ground management Offset Site:

- **Phytophthora management plan:** A *Phytophthora* management plan will document the *Phytophthora* mapping and set out actions to enable DBCA to target ongoing management. The implementation of this management plan is outside of the scope of the management actions in this offset strategy, however, will be undertaken as part of the ongoing management by DBCA.
- **Bushland condition mapping:** baseline and, subsequently annual, condition mapping will be undertaken to demonstrate a change in vegetation condition over time in response to the management actions undertaken.
- **Installation of signage:** Installation of signage is important for raising awareness within the community regarding the values being protected including key threats to Banksia Woodlands TEC and Black Cockatoo species. The installation of signage is consistent with the recovery plans.

In addition to those outlined above, the following management actions will also be implemented at the Revegetation/On-ground management Offset Site (TBC):

- **Baseline weed mapping:** Weed mapping will enable effective weed control to be undertaken and contribute to higher establishment and survival rates for planted trees.
- **Weed control program:** A weed control program will be prepared and implemented based on the results of baseline weed mapping, to target a reduction in weeds.
- **Planting of Jarrah and Marri tubestock:** The offset site contains considerable degraded areas that will benefit from planting of trees to establish habitat for Forest Red-tailed Black Cockatoos. A suitable area will need to be identified for the proposed revegetation, allowing trees to be planted at a density agreed to in consultation with relevant parties.
- **Reserve environmental management plan:** The development of an environmental management plan will assist DBCA in its long-term management for conservation purposes, given the offset will take a period of 20 years to achieve the specified ecological gain provided.

Table 3.2 provides a detailed overview of the specific activities to be undertaken within the offset sites, including timeframes and completion criteria. Additional on ground management measures for the CA can be seen in the CAMP.

Table 3.2: Activities, timeframes, roles and responsibilities, and completion criteria for each offset site

Activity	Actions	Timeframe	Roles and responsibility	Funding arrangement	Completion criteria
Mogumber Offset Site					
Acquisition of site.	Purchase site and provide proof of ownership.	To be acquired prior to final environmental approval	The proponent.	The proponent will arrange and fund this activity directly.	Confirmation of land purchase demonstrated through the supply of the land title.
Transfer of site to the conservation estate.	Transfer site to the conservation estate to be managed by DBCA.	To be initiated within three months of land purchase.	The proponent and DBCA.		Confirmation of transfer of land to the conservation estate.
Baseline <i>Phytophthora</i> dieback mapping.	Site assessment to identify and map any occurrence of <i>Phytophthora</i> dieback within the site.		Proponent	The proponent to provide funding as per the MoU.	Baseline dieback mapping completed.
<i>Phytophthora</i> management plan.	Develop a <i>Phytophthora</i> management plan for the site.		Proponent, accepted by DBCA		<i>Phytophthora</i> management plan completed.
Installation of signage.	Install signage detailing the values of the reserve particularly Banksia Woodland TEC and Carnaby's Cockatoo to educate the public on the values of the bushland.		DBCA		Signage installation completed.
Installation of pathways.	Install xx km of paths.		DBCA		Pathway installation completed.
Installation of fencing.	Install conservation fencing of this type around the boundary of the acquired land.		DBCA		Installation of conservation fencing completed.
Revegetation/On-ground management Offset Site					
Baseline weed mapping.	Site assessment to identify the presence of and densities of weed species within the site.	Prior to undertaking revegetation.	TBC subject to land identification and agreement with relevant parties	The proponent will arrange and fund this activity directly.	Baseline weed mapping completed.

Activity	Actions	Timeframe	Roles and responsibility	Funding arrangement	Completion criteria
Weed control program	A weed control and monitoring program will be established.	Established upon completion of baseline weed mapping. Intensity and duration TBC from the result of weed mapping. Anticipate annual monitoring.	TBC, subject to land identification and agreement with relevant parties		
Revegetation	Planting of 126 trees using locally sourced tubestock with a 50/50 split of Jarrah and Marri in accordance with the methodology agreed to, in consultation with relevant parties.	Ongoing. To commence: And ongoing until:	TBC, subject to land identification and agreement with relevant parties		Planting of 126 trees (50/50 Jarrah and Marri) completed.
	Monitoring of revegetation.	Annual monitoring to be undertaken.			Survival of a minimum of 126 trees over the life of monitoring. Intermediate completion criteria and early indicators are provided in the monitoring overview detailed in section 3.1.

4. Monitoring and Reporting

4.1 Mogumber Offset Site

The Mogumber Offset Site will be managed under the MoU with DBCA. The Revegetation/on-ground management Offset Site will be managed by the proponent for a period of five years before being transferred to the DBCA for ongoing management under the MoU with DBCA.

Monitoring of the Mogumber Offset Site will be undertaken by DBCA under the MoU, with a report detailing the activities undertaken at the offset site and completion criteria as applicable. The proponent will monitor the implementation of the management actions set out in section 3 and Table 3.2 and progress towards achievement of the completion criteria in Table 3.2 through the report provided by DBCA.

4.2 Revegetation/on-ground management Offset Site

For the revegetation component of the Offset Strategy, it is anticipated additional reporting obligations will be required as part of any approvals received to ensure success of the proposed offset.

Annual monitoring by the proponent is proposed to be undertaken at the revegetation offset site to ensure the completion criteria is achieved (see Table 3.1). Throughout this time, monitoring may trigger additional management actions such as weed control. Should revegetation not meet the completion criteria, contingency actions including additional reporting will be triggered.

It is anticipated an Annual Monitoring report would be provided to the regulators following each annual survey. Upon completion of the monitoring program, a Completion Report would be provided.

5. Offset Guide Inputs and Justification

5.1.1 Commonwealth Offsets Assessment Guide

In support of the Proposal's referral under the EPBC Act (EPBC 2018/8324), the DoEE offset calculator was consulted to provide an offset assessment guide (parameters) associated with the clearing of the Proposal Area. The relevant Matters of National Environmental Significance (MNES) and the likely offset requirements are provided in Table 5.1, Table 5.2 and Table 5.3.

- Banksia Woodlands TEC/PEC
- Carnaby's Black Cockatoo foraging habitat
- Forest Red-tailed Black Cockatoo foraging habitat.

It is proposed to offset the residual project impacts through the acquisition of land that contains Banksia Woodland TEC/PEC and Carnaby's Black Cockatoo habitat, and which will be added to the State's conservation estate.

Whilst the Forest Red-tailed Black Cockatoo foraging habitat within the Proposal Area was scored as low to moderate quality, it is recognised that foraging habitat for Forest Red-tailed Black Cockatoo within the Proposal Area is primarily due to the presence of scattered *Eucalyptus marginata* (Jarrah) foraging trees on site, which is known to constitute 90% of its diet along with *Corymbia calophylla* (Marri) (DBCA 2017). They may also feed to a lesser extent on *Allocasuarina fraseriana* which is scattered through the site; however, the remaining vegetation provides limited to no value in foraging habitat for Forest Red-tailed Black Cockatoo.

Therefore, it is proposed to offset the residual impacts to Forest Red-tailed Black Cockatoo (including 42 significant Black Cockatoo foraging trees) by revegetating *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) trees within conservation areas located locally on DBCA or LGA managed land.

The following provides a description and the basis of the offset parameters outlined in Table 5.1, Table 5.2 and Table 5.3.

- **Area of impact** – The area of habitat/community impacted
- **Quality of impacted area** - The quality score for area of habitat/community being impacted - a measure of how well a particular site supports a particular threatened species or ecological community and contributes to its ongoing viability
- **Time over which loss is averted** - This describes the timeframe over which changes in the level of risk to the proposed mitigation site can be considered and quantified
- **Risk of loss (%) without offset** - This describes the chance that the habitat/community on the proposed offset will be completely lost (i.e. no longer hold any value for the protected matter of concern) over the foreseeable future without an offset
- **Risk of loss (%) with offset** - This describes the chance that the habitat/community on the proposed offset will be completely lost (i.e. no longer hold any value for the protected matter of concern) over the foreseeable future with an offset
- **Confidence in result** - The level of certainty about the successful achievement of the proposed change in quality (habitat/community) or value (features/individuals)
- **Time until ecological benefit** - This describes the estimated time (in years) that it will take for the main benefit of the quality (habitat/community) improvement of the proposed offset to be realised

- **Start quality** - The quality score for the area of habitat/community proposed as an offset - a measure of how well a particular site supports a particular threatened species or ecological community and contributes to its ongoing viability
- **Future quality without offset** - The predicted future quality score (habitat/community) of the proposed offset without the offset
- **Future quality with offset** - The predicted future quality score (habitat/community) of the proposed offset with the offset

Table 5.1: EPBC Act Offset Calculator for Banksia Woodlands TEC/PEC

Offset Criteria	Response	Justification
Impact site		
Area of impact	26.2 ha	
Quality of impacted area	8	Based 26.2 ha of native vegetation representing Banksia Woodlands TEC in Very Good to Excellent condition (Keighery 1994) rendering a score of 8/10.
Offset site		
Time over which loss is averted.	20	A value of 20 years has been nominated as this is the timeframe associated with a conservation covenant, noting that the site will be transferred into DBCA's conservation estate.
Start area (ha) and quality	180 ha with a quality of 8.	
Offset location	Offset site located within Shire of Gingin.	Offset site confirmed to contain Banksia Woodlands TEC/PEC.
Risk of loss (%) without offset.	8%	<p>The offset site is currently zoned for general rural uses within the Shire of Gingin as per the Local Planning Scheme No. 9 (SoG 2012). Objectives of land within the general rural zone include the encouragement and protection of agricultural activities as well as environmental qualities (SoG 2012).</p> <p>A number of Part V EP Act clearing permit exemptions apply for agricultural/ private uses (up to 5 ha per year), including:</p> <ul style="list-style-type: none"> • Clearing to construct a building (Regulation 5, Item 1) • Clearing to collect firewood (Regulation 5, Item 5) • Clearing to obtain fencing or farming materials (Regulation 5, Item 6) • Clearing for woodwork (Regulation 5, Item 7) • Clearing for fence lines (Regulation 5, Item 10) • Clearing for vehicular tracks (Regulation 5, Item 12) • Clearing for walking tracks (Regulation 5, Item 13) • Clearing isolated trees (Regulation 5, Item 19) <p>The offset site could be subject to clearing of up to 5 ha per year, without the need for formal clearing approval.</p> <p>The site is currently under private ownership which does not preclude the proposed offset site from being subject to future scheme amendments and subdivision, and without a formal protection mechanism, the risk of loss of the offset site is considered to be increased.</p> <p>In addition, the risk of loss value of 8% has been applied as per the <i>Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act</i> (University of Queensland 2017). This study highlights that vegetation within the Shire of Gingin has a risk of loss of 8.17% over the next twenty years.</p>
Risk of loss (%) with offset.	1%	The offset site is to be secured and protected in perpetuity via placement into DBCA's conservation estate. However, there remains a potential that stochastic events or disease could impact the site into the future (therefore a 1% risk has been allocated).
Confidence in result	90%	<p>90% has been nominated as:</p> <ul style="list-style-type: none"> • the site will be added to DBCA conservation estate • a minimum of 180 ha will be provided as an offset (unless other value is determined throughout the assessment process)

Offset Criteria	Response	Justification
Impact site		
		<ul style="list-style-type: none"> Confidence that a conservation mechanism will be in place within 3 years based on landowner support/ permission Site specific, scientific surveys have been undertaken confirming Banksia Woodlands TEC/PEC occur on site and vegetation condition rating is matches calculator inputs <p>Confidence that management of the offset site will prevent habitat degradation and encourage regeneration.</p>
Time until ecological benefit.	0 years	As the proposed offset will be provided through direct land acquisition, the time until ecological benefit will be instant (0 years).
Start quality	8	The offset site contains vegetation condition of similar quality as the impact site (ranging from good to excellent) as per have any ecological surveys been undertaken within the site?
Future quality without offset.	7	<p>Given the current zoning of the land under Shire of Gingin LPS No. 9 and permissible land uses, the habitat could be degraded through undesirable vehicle/ pedestrian access, as well as bushfire, without appropriate management.</p> <p>Additionally, a number of Part V EP Act clearing permit exemptions apply for agricultural/ private uses (up to 5 ha per year), including:</p> <ul style="list-style-type: none"> Clearing to construct a building (Regulation 5, Item 1) Clearing to collect firewood (Regulation 5, Item 5) Clearing to obtain fencing or farming materials (Regulation 5, Item 6) Clearing for woodwork (Regulation 5, Item 7) Clearing for fence lines (Regulation 5, Item 10) Clearing for vehicular tracks (Regulation 5, Item 12) Clearing for walking tracks (Regulation 5, Item 13) Clearing isolated trees (Regulation 5, Item 19) <p>The offset site could be subject to clearing of up to 5 ha per year, without the need for formal clearing approval.</p> <p>The site is currently under private ownership which does not preclude the proposed offset site from being subject to future scheme amendments and subdivision, and without a formal protection mechanism, the risk of loss of the offset site is considered to be increased.</p>
Future quality with offset	8	Future management by DBCA will prevent the degradation of habitat and vegetation through measures such as controlling access, undertaking firebreak maintenance, and potential installation of conservation fencing etc.
% of impact offset	105.20%	

Table 5.2: EPBC Act Offset Calculator for Carnaby's Black Cockatoo foraging habitat

Offset Criteria	Response	Justification
Impact Site		
Area	26.2 ha	
Quality	6	A quality of 6 has been nominated, as the site contains foraging habitat scored 6 out of 10 following the methodology of Bamford (2018).
Offset site		
Time over which loss is averted.	20	A value of 20 years has been nominated, as this is the timeframe associated with a conservation covenant, noting that the site will be transferred into DBCA's conservation estate.
Start area (ha)	180 ha moderate quality Carnaby's Black Cockatoo foraging habitat required	

Offset Criteria	Response	Justification
Offset location	Offset site located within Shire of Gingin.	Offset site confirmed to contain moderate quality Carnaby's Black Cockatoo foraging habitat
Risk of loss without offset.	8%	<p>The offset site is currently zoned for general rural uses within the Shire of Gingin as per the Local Planning Scheme No. 9 (SoG 2012). Objectives of land within the general rural zone include the encouragement and protection of agricultural activities as well as environmental qualities (SoG 2012).</p> <p>A number of Part V EP Act clearing permit exemptions apply for agricultural/ private uses (up to 5 ha per year), including:</p> <ul style="list-style-type: none"> • Clearing to construct a building (Regulation 5, Item 1) • Clearing to collect firewood (Regulation 5, Item 5) • Clearing to obtain fencing or farming materials (Regulation 5, Item 6) • Clearing for woodwork (Regulation 5, Item 7) • Clearing for fence lines (Regulation 5, Item 10) • Clearing for vehicular tracks (Regulation 5, Item 12) • Clearing for walking tracks (Regulation 5, Item 13) • Clearing isolated trees (Regulation 5, Item 19) <p>The offset site could be subject to clearing of up to 5 ha per year, without the need for formal clearing approval.</p> <p>The site is currently under private ownership which does not preclude the proposed offset site from being subject to future scheme amendments and subdivision, and without a formal protection mechanism, the risk of loss of the offset site is considered to be increased.</p> <p>In addition, the risk of loss value of 8% has been applied as per the <i>Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act</i> (University of Queensland 2017). This study highlights that vegetation within the Shire of Gingin has a risk of loss of 8.17% over the next twenty years.</p>
Risk of loss with offset.	1%	The offset site is to be secured and protected in perpetuity via placement into DBCA's conservation estate. However, there remains a potential that stochastic events or disease could impact the site into the future (therefore a 1% risk has been allocated).
Confidence in result (top row)	90%	<p>90% has been nominated as:</p> <ul style="list-style-type: none"> • the site will be added to DBCA conservation estate • a minimum of 180 ha will be provided as an offset (unless other value is determined throughout the assessment process)
Time until ecological benefit.	0 years	As the proposed offset will be provided through direct land acquisition, the time until ecological benefit will be instant (0 years).
Start quality	7	The offset site contains foraging habitat scored 7 out of 10 according to the methodology of Bamford (2018).
Future quality without offset.	6	<p>Given the current zoning of the land under Shire of Gingin LPS No. 9 and permissible land uses, the habitat could be degraded through undesirable vehicle/ pedestrian access, as well as bushfire, without appropriate management.</p> <p>Additionally, a number of Part V EP Act clearing permit exemptions apply for agricultural/ private uses (up to 5 ha per year), including:</p> <ul style="list-style-type: none"> • Clearing to construct a building (Regulation 5, Item 1) • Clearing to collect firewood (Regulation 5, Item 5) • Clearing to obtain fencing or farming materials (Regulation 5, Item 6) • Clearing for woodwork (Regulation 5, Item 7) • Clearing for fence lines (Regulation 5, Item 10) • Clearing for vehicular tracks (Regulation 5, Item 12) • Clearing for walking tracks (Regulation 5, Item 13) • Clearing isolated trees (Regulation 5, Item 19) <p>The offset site could be subject to clearing of up to 5 ha per year, without the need for formal clearing approval.</p> <p>The site is currently under private ownership which does not preclude the proposed offset site from being subject to future scheme amendments and subdivision, and</p>

Offset Criteria	Response	Justification
		without a formal protection mechanism, the risk of loss of the offset site is considered to be increased.
Future quality with offset	7	Future management by DBCA will prevent habitat/ vegetation degradation through measures such as, controlling of access and firebreak maintenance, potential installation of conservation fencing etc.
Confidence in result	90%	A value of 90% has been nominated based on: <ul style="list-style-type: none"> Confidence that a conservation mechanism will be in place within 3 years based on landowner support/ permission Site specific, scientific surveys have been undertaken confirming Banksia Woodlands TEC/PEC occur on site and vegetation condition rating is matches calculator inputs Confidence that management of the offset site will prevent habitat degradation and encourage regeneration.
% of impact offset	134.59%	

Table 5.3: EPBC Act Offset Calculator for significant Black Cockatoo trees and Forest Red-tailed Black cockatoo foraging trees

Offset Criteria	Response	Justification
Impact Site		
Quantum of impact	42 significant Black Cockatoo trees and Forest Red-tailed Black cockatoo foraging trees	
Offset		
Proposed offset	126 Black Cockatoo foraging and breeding trees	Based on an offset multiplier of 3:1; 63 <i>Eucalyptus marginata</i> (Jarrah) and 63 <i>Corymbia calophylla</i> (Marri)
Offset location		Offset revegetation site located locally on DBCA and/or Local Government managed land.
Time Horizon	7	A value of 7 years has been nominated to allow for revegetation of site and establishment of trees to provide foraging habitat to Black Cockatoos.
Start value and future value without offset	0	A value of 0 has been nominated (assumes the nominated site has no significant Black Cockatoo trees).
Confidence in result	80% has been nominated	Based on likely revegetation success as per evidence presented by Lee et al. (2010)
% of impact offset	220.77%	

Offset requirements under the State Environmental Offsets Policy (GoWA 2014a) were calculated using the Environmental Offsets Template. The application of the template to the residual impacts determined in section 1.5 is provided in Table 5.4.

Table 5.4: Application of the Environmental Offsets Template to determine required offset quantum

Type	Risk	Likely offset success	Time lag	Offset quantification
Permanent loss of 26.2 ha of Banksia Woodlands TEC/PEC in Good to Excellent condition				
Land acquisition - Offset site has been identified for purchase	Low – land to be ceded to DBCA	High – land acquisition and management in the wheatbelt is well understood and has been previously implemented by DBCA an offset for other proposals.	0 years. The transfer of land to the conservation estate will be completed within 12 months. On-ground management to achieve the specified increase in quality will require additional management of three years.	The ratio of land proposed to offset compared to that cleared (7.56:1) was determined using the Commonwealth Calculator as a guide to provide a greater than 100% impact of offset (refer to Table 5.1 and Table 5.2)
Permanent loss of 26.2 ha of moderate quality Black Cockatoo (Carnaby's) foraging habitat				
Land acquisition - Offset site has been identified for purchase	Low – land to be ceded to DBCA	High – land acquisition and management in the wheatbelt is well understood and has been previously implemented by DBCA an offset for other proposals.	0 years. The transfer of land to the conservation estate will be completed within 12 months. On-ground management to achieve the specified increase in quality will require additional management of three years.	The ratio of land proposed to offset compared to that cleared (7.56:1) was determined using the Commonwealth Calculator as a guide to provide a greater than 100% impact of offset (refer to Table 5.1 and Table 5.2)
Permanent loss of up to 26.2 ha of low to moderate quality Forest Red-tailed Black Cockatoo foraging habitat				
Replanting Jarrah/Marri trees / on ground management	Possible sites/conservation areas located locally on DBCA or LGA managed land (low risk) and others on freehold land (higher risk)	High – revegetation of Jarrah/Marri trees to create foraging habitat suitable for Forest Red-tailed Black Cockatoo is well understood and has been previously undertaken as a Black Cockatoo offset for other proposals. To ensure success, the following measures will be undertaken: <ul style="list-style-type: none"> • Site preparation, such as ground preparation and weed management • Vegetation establishment through planting of seedlings comprising of Jarrah and Marri 	7 years to allow for sufficient growth to provide an adequate foraging resource for Forest Red-tailed Black Cockatoos.	The ratio of trees proposed to be replanted to offset compared to that cleared (3:1) was determined using the Commonwealth Calculator as a guide to provide a greater than 100% impact of offset (220.77%) (refer to Table 5.3)

Type	Risk	Likely offset success	Time lag	Offset quantification
		<ul style="list-style-type: none"> Fencing of the offset area. Monitoring of seedling survival rates Maintenance, such as replanting and weed control <p>Completion criterion of 80% survival rate after 5 years.</p>		
Permanent loss of 42 significant Black Cockatoo trees including 17 with hollows (all unsuitable)				
Replanting Jarrah/Marri trees / on ground management	Possible sites/conservation areas located locally on DBCA or LGA managed land (low risk) and others on freehold land (higher risk)	<p>High – revegetation of Jarrah/Marri trees to create foraging habitat suitable for Forest Red-tailed Black Cockatoo is well understood and has been previously undertaken as a Black Cockatoo offset for other proposals.</p> <p>To ensure success, the following measures will be undertaken:</p> <ul style="list-style-type: none"> Site preparation, such as ground preparation and weed management Vegetation establishment through planting of seedlings comprising of Jarrah and Marri Fencing of the offset area. Monitoring of seedling survival rates Maintenance, such as replanting and weed control <p>Completion criterion of 80% survival rate after 5 years.</p>	7 years to allow for sufficient growth to provide an adequate foraging resource for Black Cockatoos.	The ratio of trees proposed to be replanted to offset compared to that cleared (3:1) was determined using the Commonwealth Calculator as a guide to provide a greater than 100% impact of offset (220.77 %) (refer to Table 5.3)

5.1.2 WA Offsets Template

The WA Offset Template considers the same general offset concepts as the Commonwealth Offsets Assessment Guide, although takes a less formulaic approach. The assumptions used in the Commonwealth Offsets Assessment Guide as described in section 2 remain relevant for the implementation of the WA Offset Template.

Section 4 of the WA Environmental Offsets Guideline (GoWA 2014b) provides guidance for determining the suitability of offsets under the Policy. Table 5.5 provides a summary of the application of the WA Offsets Template to the Proposal for each environmental value.

Table 5.5: Application of the WA Offsets Template

Environmental Factor	Significant Residual Impact	Offset Calculation Methodology				
		Type	Risk	Likely Offset Success	Time Lag	Offset Quantification
Flora and Vegetation	26.2 ha of Banksia Woodlands TEC	Land acquisition - Offset site has been identified for purchase	Low – land to be ceded to DBCA	High – land acquisition and management in the wheatbelt is well understood and has been previously implemented by DBCA an offset for other proposals.	0 yrs	The ratio of land proposed to offset compared to that cleared (7.56:1) was determined using the Commonwealth Calculator as a guide to provide a greater than 100% impact of offset (refer to Table 5.1 and Table 5.2)
Terrestrial Fauna	26.2 ha of moderate quality foraging habitat for Carnaby's Cockatoo.					
Terrestrial Fauna	26.2 ha of low to moderate quality foraging habitat for Forest Red-tailed Black Cockatoo.	Replanting Jarrah/Marri trees / on ground management	Possible sites/conservation areas located locally on DBCA or City of Kwinana managed land (low risk) and others on freehold land (higher risk)	High – revegetation of Jarrah/Marri trees to create foraging habitat suitable for Forest Red-tailed Black Cockatoo is well understood and has been previously undertaken as a Black Cockatoo offset for other proposals. To ensure success, the following measures will be undertaken: <ul style="list-style-type: none"> • Site preparation, such as ground preparation and weed management • Vegetation establishment through planting of seedlings comprising of Jarrah and Marri • Fencing of the offset area. • Monitoring of seedling survival rates • Maintenance, such as replanting and weed control • Completion criterion of 80% survival rate after 5 years. 	7 yrs	The ratio of trees proposed to be replanted to offset compared to that cleared (3:1) was determined using the Commonwealth Calculator as a guide to provide a greater than 100% impact of offset (220.77%) (refer to Table 5.3)

6. 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.

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Appendix A Offsets Calculators

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	Banksia Woodland TEC
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	1.2%

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

Impact calculator							
Impact calculator	Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
	Ecological communities						
	Area of community	Yes	Banksia Woodlands of the Swan Coastal Plain TEC	Area	26.2	Hectares	Strategen-JBS&G (2019)
				Quality	8	Scale 0-10	
				Total quantum of impact	20.96	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																						
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	20.96	Adjusted hectares	Land acquisition Mogumber	Risk-related time horizon (max. 20 years)	20	Start area (hectares)	180	Risk of loss (%) without offset	8%	Risk of loss (%) with offset	1%	12.60	90%	11.34	8.93	22.05	105.20%	Yes		
						Future area without offset (adjusted hectares)	165.6	Future area with offset (adjusted hectares)	178.2													
						Time until ecological benefit	0	Start quality (scale of 0-10)	8	Future quality without offset (scale of 0-10)	7	Future quality with offset (scale of 0-10)	8									
	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							
Summary	Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)	
						Direct offset (\$)	Other compensatory measures (\$)
	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	20.96	22.05	105.20%	Yes	\$0.00	N/A
						\$0.00	\$0.00

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	Carnaby's Cockatoo
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	1.2%

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

Impact calculator							
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	Carnaby's Cockatoo foraging habitat	Area	26.2	Hectares	Strategen-JBS&G (2019)
				Quality	6	Scale 0-10	
				Total quantum of impact	15.72	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																						
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			Land acquisition and on ground management	Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset										
										0.0		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)										
	Threatened species habitat																					
	Area of habitat	Yes	15.72	Adjusted hectares	Land acquisition - Mogumber	Time over which loss is averted (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset		17.85	90%	16.07	12.66	29.97	190.67%	Yes		
										8%		1%										
						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								
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	15.72	29.97	190.67%	Yes	\$0.00	N/A	\$0.00
	Area of community	0				\$0.00		\$0.00
							\$0.00	\$0.00

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	Carnaby's Cockatoo
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	1.2%

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

Impact calculator							
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	FRTBC foraging habitat	Area	26.2	Hectares	Strategen-JBS&G (2019)
				Quality	5	Scale 0-10	
				Total quantum of impact	13.10	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	Yes	Habitat trees	42		Count	
	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																				
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			Land acquisition and on ground management	Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset								
									0.0		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)								
	Threatened species habitat																			
	Area of habitat	No	13.10		Revegetation	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	180	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	5%							
									162.0		171.0									
						Time until ecological benefit	3	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		90%					
	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	Yes	42	Count	126	7	0		0		126		126	80%	100.80	92.73	220.77%	Yes		
	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							
Summary	Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)	
						Direct offset (\$)	Other compensatory measures (\$)
	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	42	92.73	220.77%	Yes	\$0.00	N/A
	Condition of habitat	0				\$0.00	\$0.00
	Area of habitat	13.1				\$0.00	\$0.00
	Area of community	0				\$0.00	\$0.00
						\$0.00	\$0.00

Appendix B Mogumber Offset Site Flora and Vegetation Values

**Offset Assessment
Lot 310 and Lot 300 Neames Road
Mogumber**



Prepared for:

Strategen-JBS&G

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December 2019

EXECUTIVE SUMMARY

This report has been prepared by Del Botanics on behalf of Strategen-JBS&G to review the remnant *Banksia* woodland vegetation on Lot 310 and Lot 300 Neames Road, Mogumber and compare to the data previously recorded from Lot 10 & 12 Rowley Rd, Mandogolup. This report is the result of a spring botanical survey of the flora and vegetation within the *Banksia* woodland areas of the site only. Broad vegetation type and condition mapping was also undertaken across the whole survey area. The location of the survey area is shown on **Figure 1 & 2**.

The recent Flora and Vegetation Assessment undertaken in the area described above identified a number of flora species. The vegetation condition varies across the site ranging from “Completely Degraded” to “Excellent”.

Five vegetation communities were recorded at a local level during the survey. No species of Threatened (T), or Priority Flora pursuant to the *Biodiversity Conservation Act* 2016 were located during the time of the survey. One Threatened Ecological Community (TEC) was recorded during the survey.

The Floristic Community Type (FCT) determined the two sites currently consist of *Banksia* woodlands, the impact site in Mandogalup is confirmed as FCT 28 and the offset site in Mogumber has been identified as SCP S09, which is described as *Banksia attenuata* woodlands over dense low shrublands. The species composition/floristics between the Mandogalup and Mogumber sites are statistically distinct with very little similarity.

STATEMENT OF LIMITATIONS

This environmental report has been prepared in accordance with the scope of services set out in the original quotation. In preparing the report, Del Botanics has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Del Botanics 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 are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Del Botanics will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed.

In accordance with the scope of services, Del Botanics has relied on the data and have conducted environmental field monitoring in the preparation of the report. The nature and extent of monitoring conducted is described in the report. Within the limitations imposed by the scope of services, the monitoring and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care. No other warranty, express or implied, is made.

The report has been prepared for the benefit of the Client and for no other party. Del Botanics assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report. Other parties should not rely upon the report or the accuracy or completeness of any conclusions, and should make their own enquiries and obtain independent advice in relation to such matters.

Photographs © Del Botanics.

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1. INTRODUCTION

1.1 BACKGROUND

This report has been prepared by Del Botanics on behalf of Strategen-JBS&G to survey remnant Banksia woodland vegetation on Lot 310 and Lot 300 Neames Road, Mogumber and compare to data collected from Lot 10 & 12 Rowley Rd, Mandogolup. A botanical survey of the flora species and vegetation was undertaken on 24th November 2019. The site is approximately 912 ha in size and is situated 127 kilometres north, north east of the Perth central area, in the Shire of Gingin. The site location is shown on **Figure 1 & 2**.

1.2 PURPOSE OF THIS REPORT

This report was prepared primarily to document the Banksia woodland vegetation that occurs within the area described above and to compare this site to Lots 10 & 12 Rowley Rd, Mandogolup to assess the suitability of this site as an Offset.

In summary this report provides:

- A spring botanical survey of the Banksia woodland of the site;
- A broad assessment of vegetation communities and condition;
- Observations of suitability of Black Cockatoo habitat within the site; and
- A statistical comparison of data from both sites described above.

2. EXISTING ENVIRONMENT

2.1 SOILS AND GEOLOGY

The site occurs on the Swan Coastal Plain – Dandaragan Plateau subregion (SWA1). The plateau is bordered by the Derby and Dandaragan Faults. It exists of Cretaceous marine sediments mantled by sands and laterites. The site is characterised by Banksia low woodland, Jarrah - Marri woodland, Marri woodland, and by scrub-heaths on laterite pavement and on gravelly sandplains.

The Dandaragan Plateau represents a wedge shaped raised section of the sedimentary rocks of the Swan Coastal Plain. This plateau lies between the Darling Scarp to the east and the Gingin Scarp to the west, and rises from 130m above sea level in the south near Bullsbrook to 230m above sea level in the north near Moore River. The plateau is generally sand and laterite plain that overlies flat-lying cretaceous rocks.

2.2 CLIMATE

The Survey Area is located on the Swan Coastal Plain, in a region with a Mediterranean climate of cool, wet winters and warm to hot, dry summers.

The nearest weather station with a complete set of data to the site is located in Walebing (approximately 40km north east of the Survey Area). The long term average annual rainfall in Walebing is 475.4mm. Rain is frequent and heaviest through the winter months. The average maximum temperature is 24.9°C, the average minimum temperature is 10.8 °C.

In the 12 months prior to this survey (November 2018 – October 2019) Walebing weather station recorded 259.8mm of rain, 215.6mm lower than the long term average annual rainfall.

3. FLORA AND VEGETATION

The survey area lies in the Drummond Botanical Subdistrict within the Southwest Botanical Province as described by Beard (1990). Four vegetation types mapped by Beard cover the Survey Area. These are a part of the Dandaragan Plateau, 949 - Low *Banksia* woodland; 1015 - Mosaic of mixed scrub/heath/shrublands and *Dryandra* thickets; 1017 - medium open Jarrah and Marri woodland over a low woodland of *Banksia* species and 37 - Shrublands and Teatree thicket.

The Dandaragan Plateau is largely covered by open forest of Jarrah, Marri, Tuart, Blackbutt and Flooded Gum with some Wandoo in the north near to the Moore River. The secondary storey of vegetation consists of varieties of *Banksia*, Prickly Bark and Sheoak. Towards the north-eastern part of the plateau, the *Eucalyptus* forests largely disappear, except in the low lying valleys adjacent to the Moore River.

Two vegetation complexes are mapped as occurring within the Survey Area:

3.1.1 *Cullula Complex*

This vegetation is described as a mixture of low open forest of *Banksia* species - *Eucalyptus tottiana* (Pricklybark) and open woodland of *Corymbia calophylla* (Marri) with second storey of *Eucalyptus tottiana* (Pricklybark) - *Banksia attenuata* (Candlestick Banksia) - *Banksia menziesii* (Firewood Banksia) - *Banksia ilicifolia* (Holly-leaved Banksia) (Heddlé *et al*, 1980).

3.1.2 *Mogumber Complex North*

This vegetation is described as an open to closed heath of *Banksia* species and *Allocasuarina humilis* (Dwarf Sheoak) (Heddlé *et al*, 1980).

3.2 VEGETATION METHODS

A botanical survey was undertaken on the 24th November 2019. The site was surveyed to map broad vegetation communities and record vegetation condition. A detailed survey was undertaken in the *Banksia* woodland areas of the site only. This vegetation type was recorded with five 10 metre by 10 metre quadrats. Data was recorded to statistically determine the vegetation community and its condition. Each quadrat recorded flora species, heights, percentage cover and percentage dead and alive. Quadrats were not assembled permanently; quadrat data is available in **Appendix B**.

Although a targeted search for conservation significant flora including Threatened (T) and Priority Flora (P) was not undertaken, flora was sampled opportunistically during the survey as the site was traversed and during quadrat sampling.

The survey methodology was undertaken in accordance with EPA Position Statement No.3: *Terrestrial Biological Surveys as an Element of Biodiversity Protection* and Technical Guidance – *Flora and Vegetation Surveys for Environmental Impact Assessment* (Environmental Protection Authority, 2016).

All plant specimens collected during the field survey were dried, pressed and then sorted in accordance with the requirements of the Western Australian State Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys.

The use of standard data collection forms ensured the data was collected in a systematic and consistent manner. At each quadrat the following information was recorded:

- Vegetation condition;
- Vegetation community;
- Flora species;
- Local disturbances;
- Topography;
- Soils; and
- Age since fire.

The vegetation communities occurring across the rest of the site were described broadly. Aerial photography was used to extrapolate and map plant communities in combination with running notes made during the course of the survey.

3.3 DECLARED RARE AND PRIORITY FLORA

Species of Flora acquire “Threatened” “Presumed Extinct” or “Priority” conservation status where populations are restricted geographically or threatened by local processes. The Department of Biodiversity, Conservation and Attractions (DBCA) recognise these threats and subsequently applies regulations towards population protection and species conservation. The DBCA enforces regulations under the *Biodiversity Conservation (BC) Act 2016* to conserve Threatened species and protect significant populations. Priority Flora species are potentially rare or threatened and are classified in order of threat. Threatened and Priority Flora category definitions are listed in **Table 1**.

Table 1: Definition of Rare and Priority Flora Species *Biodiversity Conservation Act 2016*.

Conservation Code	Category
T	<p>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).</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p>
X	<p>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.</p> <p>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.</p>
P1	<p>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.</p>
P2	<p>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</p>

P3	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.
P4	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.

A search of the Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap database identified 21 Threatened (T), five Priority 1 (P1), 11 Priority 2 (P2), 40 Priority 3 (P3) and 26 Priority 4 (P4) species, likely to occur within a 20km radius of the Survey Area. These species are listed in **Table 2** below.

Determination of the likelihood of these species to occur was only considered in the Banksia woodland vegetation within the Survey Area and was based purely on available habitat information for each species.

Table 2: NatureMap listed species

Species Name	Conservation Code		Likely to occur onsite	Survey undertaken in flowering time
	BC Act	EPBC Act		
<i>Acacia splendens</i>	T	En	No	No
<i>Andersonia gracilis</i>	T	En	No	Yes
<i>Banksia fuscobracea</i>	T	En	Yes	No
<i>Banksia mimica</i>	T	En	Yes	No
<i>Banksia serratuloides</i> subsp. <i>serratuloides</i>	T	Vn	No	No
<i>Conospermum densiflorum</i> subsp. <i>unicephalatum</i>	T	En	No	Yes
<i>Conostylis wonganensis</i>	T	En	No	No
<i>Darwinia acerosa</i>	T	En	Yes	Yes
<i>Darwinia carnea</i>	T	En	No	No
<i>Eleocharis keigheryi</i>	T	Vu	No	Yes
<i>Eremophila glabra</i> subsp. <i>chlorella</i>	T	En	No	Yes
<i>Eucalyptus pruinarum</i>	T	En	No	No
<i>Glyceria drummondii</i>	T	En	No	No
<i>Goodenia arthrotricha</i>	T	En	No	Yes
<i>Grevillea bracteosa</i> subsp. <i>bracteosa</i>	T	CE	Yes	No
<i>Grevillea</i> sp. Gillingarra	T	CE	unknown	unknown
<i>Lepidosperma rostratum</i>	T	En	No	unknown
<i>Spirogardnera rubescens</i>	T	En	No	Yes
<i>Stylidium semaphorum</i>	T	CE	No	No
<i>Thomasia</i> sp. Green Hill	T	En	No	No
<i>Trithuria occidentalis</i>	T	En	No	No
<i>Baeckea</i> sp. Youndeggin Hill	P1	-	No	No
<i>Drosera orbiculata</i>	P1	-	No	No
<i>Stylidium vinosum</i>	P1	-	unknown	unknown
<i>Synaphea panhesya</i>	P1	-	No	No
<i>Tetralthea plumosa</i>	P1	-	unknown	unknown
<i>Acacia browniana</i> var <i>glaucescens</i>	P2	-	No	No
<i>Calectasia elegans</i>	P2	-	unknown	unknown
<i>Dampiera spicigera</i>	P2	-	Yes	Yes
<i>Desmocladius myriocladus</i>	P2	-	Yes	Yes
<i>Goodenia xanthotricha</i>	P2	-	Yes	Yes
<i>Hibbertia glomerata</i> subsp. <i>ginginensis</i>	P2	-	Yes	No
<i>Lepyrodia curvescens</i>	P2	-	No	Yes
<i>Stylidium glabrifolium</i>	P2	-	No	Yes
<i>Synaphea sparsiflora</i>	P2	-	No	No
<i>Tetralthea</i> sp. Chandala	P2	-	unknown	unknown
<i>Tetralthea hirsuta</i> subsp. <i>boonanarring</i>	P2	-	unknown	unknown
<i>Banksia dallanneyi</i> subsp. <i>pollostia</i>	P3	-	Yes	No
<i>Lasiopetalum venustum</i>	P3	-	unknown	unknown
<i>Acacia anarthros</i>	P3	-	No	No
<i>Acacia cummingiana</i>	P3	-	Yes	No
<i>Acacia drummondii</i> subsp. <i>affinis</i>	P3	-	No	No
<i>Acacia latipes</i> subsp. <i>latipes</i>	P3	-	Yes	No
<i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>	P3	-	No	No
<i>Acacia pulchella</i> var <i>reflexa</i> <i>acuminate</i> <i>bracteole</i> <i>variant</i>	P3	-	Yes	No
<i>Acacia ridleyana</i>	P3	-	Yes	No
<i>Allocasuarina grevilleoides</i>	P3	-	No	unknown
<i>Allocasuarina ramosissima</i>	P3	-	No	unknown
<i>Banksia kippistiana</i> var. <i>paenepeccata</i>	P3	-	No	Yes
<i>Banksia pteridifolia</i> subsp. <i>vernalis</i>	P3	-	Yes	No
<i>Beaufortia eriocephala</i>	P3	-	No	Yes
<i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>	P3	-	Yes	Yes

<i>Chamelaucium</i> sp. Wongan Hills	P3	-	unknown	unknown
<i>Comesperma rhadinocarpum</i>	P3	-	Yes	Yes
<i>Conospermum scaposum</i>	P3	-	Yes	Yes
<i>Desmocladius biformis</i>	P3	-	Yes	No
<i>Dielsiodoxa leucantha</i> subsp. <i>leucantha</i>	P3	-	unknown	unknown
<i>Dillwynia dillwynioides</i>	P3	-	No	Yes
<i>Eucalyptus macrocarpa</i> x <i>pyriformis</i>	P3	-	Yes	No
<i>Grevillea florida</i>	P3	-	Yes	No
<i>Guichenotia impudica</i>	P3	-	No	No
<i>Guichenotia tuberculata</i>	P3	-	No	No
<i>Haemodorum loratum</i>	P3	-	Yes	Yes
<i>Isopogon drummondii</i>	P3	-	unknown	No
<i>Lasiopetalum caroliae</i>	P3	-	unknown	No
<i>Leucopogon allittii</i>	P3	-	No	No
<i>Melaleuca sclerophylla</i>	P3	-	No	No
<i>Persoonia rudis</i>	P3	-	Yes	Yes
<i>Petrophile biternata</i>	P3	-	Yes	No
<i>Petrophile plumosa</i>	P3	-	No	Yes
<i>Schoenus benthamii</i>	P3	-	No	Yes
<i>Schoenus capillifolius</i>	P3	-	No	Yes
<i>Stylidium nonscandens</i>	P3	-	Yes	Yes
<i>Stylidium sacculatum</i>	P3	-	Yes	Yes
<i>Styphelia filifolia</i>	P3	-	unknown	unknown
<i>Verticordia huegelii</i> var. <i>tridens</i>	P3	-	No	Yes
<i>Verticordia muelleriana</i> subsp. <i>muelleriana</i>	P3	-	Yes	Yes
<i>Acacia alata</i> var. <i>platyptera</i>	P4	-	No	No
<i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i>	P4	-	Yes	No
<i>Asterolasia grandiflora</i>	P4	-	No	No
<i>Banksia chamaephyton</i>	P4	-	Yes	Yes
<i>Boronia tenuis</i>	P4	-	No	Yes
<i>Caladenia speciosa</i>	P4	-	Yes	No
<i>Calothamnus pachystachyus</i>	P4	-	No	No
<i>Conostylis pauciflora</i> subsp. <i>euryrhipis</i>	P4	-	Yes	No
<i>Eucalyptus macrocarpa</i> subsp. <i>elachantha</i>	P4	-	No	Yes
<i>Grevillea drummondii</i>	P4	-	No	No
<i>Grevillea saccata</i>	P4	-	No	Yes
<i>Hibbertia miniata</i>	P4	-	No	Yes
<i>Hydrocotyle lemnoides</i>	P4	-	No	No
<i>Hypolaena robusta</i>	P4	-	Yes	No
<i>Lepidobolus densus</i>	P4	-	No	unknown
<i>Ornduffia submersa</i>	P4	-	No	unknown
<i>Persoonia sulcata</i>	P4	-	No	Yes
<i>Regelia megacephala</i>	P4	-	No	Yes
<i>Schoenus griffinianus</i>	P4	-	Yes	No
<i>Schoenus natans</i>	P4	-	No	No
<i>Stylidium longitubum</i>	P4	-	No	Yes
<i>Synaphea grandis</i>	P4	-	No	Yes
<i>Thelymitra apiculata</i>	P4	-	Yes	No
<i>Thysanotus glaucus</i>	P4	-	unknown	unknown
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	P4	-	No	Yes
<i>Verticordia paludosa</i>	P4	-	No	No

3.3.1 *Environment Protection and Biodiversity Conservation Act (1999) – Species level significance*

The *Environment Protection and Biodiversity Conservation (EPBC) Act*, 1999, promotes the conservation of biodiversity by providing strong protection for plants at a species level. Section 178 and 179 provides the lists and categories of threatened species under the Act and is presented in **Table 3** below.

Table 3: Categories of Threatened Species (EPBC Act, Section 179, 1999)

1	Extinct (E) A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
2	Extinct in the Wild (EW) A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
3	Critically Endangered (CE) A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
4	Endangered (En) A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
5	Vulnerable (V) A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria..
6	Conservation Dependant A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

A search using the Department Environment and Energy (DEE) Protected Matters Tool was undertaken within a 5km radius of the site. The search result noted eighteen flora species of significance likely to occur in the area. Sixteen flora species have been listed as Endangered; two species are listed as Vulnerable. These species are listed in **Table 4** below.

Table 4: Protected Matters listed flora species

Species Name	Conservation Code	Likely to occur onsite	Survey undertaken in flowering time
<i>Andersonia gracilis</i>	Endangered	No	Yes
<i>Banksia mimica</i>	Endangered	Yes	No
<i>Banksia serratuloides</i> subsp. <i>serratuloides</i>	Vulnerable	No	No
<i>Conospermum densiflorum</i> subsp. <i>unicephalum</i>	Endangered	No	Yes
<i>Darwinia carnea</i>	Endangered	No	Yes
<i>Diplolaena andrewsii</i>	Endangered	No	No
<i>Eleocharis keigheryi</i>	Vulnerable	No	Yes
<i>Eremophila glabra</i> subsp. <i>chlorella</i>	Endangered	No	Yes
<i>Eremophila scaberula</i>	Endangered	No	No
<i>Eucalyptus absita</i>	Endangered	No	No
<i>Eucalyptus leprophloia</i>	Endangered	No	No
<i>Eucalyptus x balanites</i>	Endangered	No	No
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	Endangered	No	No
<i>Hemiandra gardneri</i>	Endangered	Yes	No
<i>Melaleuca sciotostyla</i>	Endangered	No	No
<i>Spirogardnera rubescens</i>	Endangered	No	Yes
<i>Thelymitra dedmaniarum</i>	Endangered	No	Yes
<i>Thelymitra stellata</i>	Endangered	Yes	Yes

3.4 THREATENED ECOLOGICAL COMMUNITIES

In Western Australia Threatened Ecological Communities (TEC's) are assessed through a procedure coordinated by the DBCA and are assigned to one of the categories outlined below in **Table 5**. While they are not afforded direct statutory protection at a State level (unlike Threatened Flora under the *Biodiversity Conservation Act 2016*) their significance is acknowledged through other State environmental approval processes (i.e. Environmental Impact Assessment pursuant to Part IV of the *Environmental Protection Act 1986*). Scheduled TEC's are afforded statutory protection at a Federal level pursuant to the EPBC Act. The department has been identifying and listing threatened ecological communities since 1994 through the non-statutory process.

The Minister for Environment previously listed ecological communities as threatened through a non-statutory process if the community was presumed to be totally destroyed or at risk of becoming totally destroyed. The *Biodiversity Conservation (BC) Act, 2016* provides for the statutory listing of threatened ecological communities (TECs) by the Minister. The new legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat, and penalties for unauthorised modification of TECs.

The department has been identifying and listing TECs since 1994 through the non-statutory process. The WA Minister for Environment has endorsed 69 ecological communities as threatened in the following categories:

- 20 critically endangered

- 17 endangered
- 28 vulnerable
- 4 presumed totally destroyed.

25 of these are listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. As at January 2019, an additional 393 ecological communities (community types and sub-types) with insufficient information available to be considered a TEC, or which are rare but not currently threatened, have been placed on the Priority list and referred to as priority ecological communities (PECs).

Table 5: Categories of DBCA's Threatened Ecological Communities

PD	Presumably Totally Destroyed An ecological community that has been adequately searched for but for which no representative occurrences have been located.
CE	Critically Endangered An ecological community that has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.
E	Endangered An ecological community that has been adequately surveyed and is not critically endangered but is facing a very high risk of total destruction in the near future.
V	Vulnerable An ecological community that has been adequately surveyed and is not critically endangered or endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future.

The EPBC Act provides for the strong protection of TEC's, which are listed under section 181 of the Act and are described as 'Critically Endangered', 'Endangered' or 'Vulnerable' under section 182. Schedules of protected TECs maintained pursuant to the EPBC Act are based on the same Floristic Community Type's (FCT's) as adopted by DBCA, however not all TEC's listed by the DBCA are scheduled under the EPBC Act.

A Department Environment and Energy (DEE) Protected Matters Report indicated there are two known Threatened Ecological Communities (TEC's) likely to occur within a 5km radius of the area, these are listed in **Table 6** below. During the site assessment one TEC, the Endangered *Banksia woodlands of the Swan Coastal Plain ecological community* has been identified as occurring onsite. The dominant species, the condition of the vegetation and the size of the area currently fit the criteria of this area being classified as Banksia woodlands of the Swan Coastal Plain ecological community. This is discussed further in **Section 3.5**. The location of this TEC is shown in the vegetation community mapping displayed as **Figure 3**.

Table 6: Protected Matters listed Threatened Ecological Communities

Species Name	Conservation Code		Likely to occur on site
	BC Act	EPBC Act	
Banksia woodlands of the Swan Coastal Plain ecological community	Endangered	Endangered	Yes
Clay pans of the Swan Coastal Plain	Critically Endangered	Critically Endangered	No

3.5 BANKSIA WOODLAND CRITERIA

The determination of the presence of the Endangered Banksia woodlands of the Swan Coastal Plain ecological community occurring within the site meets the following criteria:

3.5.1 *Location and physical environment*

The Banksia woodlands ecological community primarily occurs in the Swan Coastal Plain IBRA bioregion, which this site is situated within.

3.5.2 *Soils and landform*

The Banksia woodlands ecological community typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands. The site is characterised by well drained sandy soils.

3.5.3 *Structure and Composition*

The structure of the ecological community is low woodland to forest with these features:

- 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 these diagnostic *Banksia* species;
 - *Banksia attenuata* (Candlestick Banksia)
 - *Banksia menziesii* (Firewood Banksia)
 - *Banksia prionotes* (Acorn Banksia); and/or
 - *Banksia ilicifolia* (Holly-leaved Banksia)

The areas of the survey area mapped as Banksia woodland are dominated by *Banksia attenuata* (Candlestick Banksia), and commonly includes *Banksia menziesii* (Firewood Banksia), *Banksia prionotes* (Acorn Banksia) and occasionally includes *Banksia ilicifolia* (Holly-leaved Banksia).

- Emergent trees of medium or tall (>10 m) height *Eucalyptus* or *Allocasuarina* species may sometimes be present above the *Banksia* canopy. During the survey emergent *Eucalyptus tottiana* (Pricklybark) was recorded.
- A often highly species-rich understorey that consists of:

- a layer of sclerophyllous shrubs of various heights; and,
- a herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history.

Key species of this community type recorded in the sclerophyllous shrub layer include; *Adenanthos cygnorum* (Woolly Bush), *Allocasuarina humilis* (Dwarf Sheoak), *Bossiaea eriocarpa* (Common Brown Pea), *Conostephium pendulum* (Pearl Flower), *Daviesia* spp., *Eremaea pauciflora*, *Gompholobium tomentosum* (Hairy Yellow Pea), *Jacksonia* spp., *Petrophile linearis* (Pixie Mops) and *Stirlingia latifolia* (Blueboy).

Key species of this community type recorded in the herbaceous ground layer include; *Amphipogon turbinatus* (Tufted Beard Grass), *Lyginia barbata* (Southern Rush), *Lyginia imberbis*, *Mesomelaena pseudostygia* (Semaphore Sedge), *Patersonia occidentalis* (Purple Flag) and *Xanthosia huegelii* (Heath Xanthosia).

3.5.4 Condition

To be considered as part of the ecological community for EPBC Act referral, assessment and compliance purposes, a patch should meet at least the Good Condition category and a minimum patch size. The Banksia woodland recorded on this site meets the size and condition criteria as it is greater than 2ha and is in Very Good to Excellent vegetation condition.

3.5.5 Summary of threats

The main ongoing threats to the Banksia dominated woodlands ecological community are:

The greatest threat is clearing and fragmentation. This includes:

- clearing for urban developments, especially in the Perth metropolitan region but also in the urban centres of Bunbury and Busselton;
 - associated urban degradation/disturbance such as rubbish dumping, uncontrolled vehicle access, wildflower and seed harvesting;
 - clearing for agriculture and horticulture (mainly in the past); and
 - mining for basic raw materials (e.g. road/building materials), mineral sands and silica sands, that involve vegetation clearing and hydrological impacts.
- Dieback diseases (especially those caused by *Phytophthora* species).
 - Invasive species.
 - Fire regime change (particularly increased fire frequency; prescribed burning during late autumn to late spring when plants are in active growth, flowering and seed development and animals are active).

- Hydrological degradation (groundwater abstraction, eutrophication, soil acidification).
- Climate change (increasing temperatures, declining rainfall, changing rainfall timing).
- Grazing (including overabundance of kangaroos particularly in peri-urban reserves).
- Decline in pollinating and seed dispersing fauna.

3.6 FLORISTIC COMMUNITY TYPES

A key aim of this survey was to gather data which could be compared to that of the previously mentioned Mandogalup site. The floristic community type of the Mandogalup site is FCT 28 (Strategen, 2017). This community is described as *Banksia attenuata* woodlands, *Corymbia calophylla* - *B. attenuata* woodlands or *Eucalyptus marginata* - *B. attenuata* woodlands. It has been recorded from between Thompson's Lake and as far north as Seabird. Species richness averages 55.2 species per plot and average weed frequency is high at 8 species per plot (Strategen, 2017).

FCT 28 is not listed as a TEC under the *Biodiversity Conservation Act 2016* (BC Act) or as a PEC by DBCA, but forms part of the *Banksia* woodlands of the Swan Coastal Plain ecological community, listed as Endangered under the EPBC Act (Strategen, 2017).

3.6.1 Comparison methodology

The data from the Mandogalup site was compared to the data collected during this survey statistically. Data analysis was carried out for flora quadrat data utilising PATN™ software (Belbin 1995). It involved multivariate cluster analysis of species presence/absence. The data was used to statistically determine the similarity of the species composition and diversity of the two sites.

3.7 BLACK COCKATOO HABITAT ASSESSMENT METHODOLOGY

An informal assessment of the value of the Survey Area as Black Cockatoo Habitat was undertaken. No potential breeding trees were specifically recorded during this assessment. Observations and running notes were made during the survey. The site was opportunistically surveyed for signs of foraging and roosting.

4. VEGETATION ASSESSMENT RESULTS

A total of 56 taxa, comprising of 21 families and 44 genera were recorded on site. A list of these species has been provided in **Appendix A**. Species representation was greatest among the Proteaceae (13 species) and Myrtaceae (8 species) families.

4.1 INTRODUCED SPECIES

Five introduced flora species were recorded on the site. Four of these species were from the Asteraceae family. Introduced species represent 8.9% of the total number of flora species recorded on site.

4.2 THREATENED AND PRIORITY FLORA

No species of Threatened (T) or Priority Flora were recorded during the survey; No other flora, pursuant to subsection 2 of section 23F of the *Wildlife Conservation Act* 1950 and listed by the Department of Biodiversity, Conservation and Attractions (DBCA) were located during the time of the survey. The botanical survey was undertaken in spring to coincide with the majority of the flowering times of the threatened species.

4.3 EPBC LISTED SPECIES AND THREATENED ECOLOGICAL COMMUNITIES

One TEC *Banksia woodlands of the Swan Coastal Plain ecological community* has been identified as occurring onsite. The dominant species, the condition of the vegetation and the size of the area currently fit the criteria of this area being classified as Banksia woodlands of the Swan Coastal Plain ecological community. The location of this community is mapped as Banksia woodland in **Figure 3**.

4.4 LOCAL VEGETATION COMMUNITIES

Only the Banksia woodland areas were sampled in detail as part of this survey. Other vegetation types were observed and broadly mapped according to dominant species observed. All vegetation communities are shown in **Figure 3**.

Vegetation structure classes were used to determine the Banksia woodland vegetation community recorded. Definitions of the vegetation structure classes are shown in **Table 7** below. They are the ones defined and used in Bush Forever (2000, Volume 2, Table 11 and p. 493) to describe vegetation in Bush Forever sites.

Table 7: Vegetation Structure Classes

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

Five vegetation communities were recorded at a local level during the survey; these have been described below in **Table 8**. Vegetation communities, condition and quadrat locations are shown on **Figure 3 and 4**.

Table 8: Local Vegetation Communities Recorded at Neames Rd Mogumber, November 2019

Community Descriptions
Vegetation Community 1 – Banksia woodland
Low woodland of <i>Banksia attenuata</i> and <i>Banksia menziesii</i> over shrubland of <i>Adenanthos cygnorum</i> , <i>Eremaea pauciflora</i> , <i>Beaufortia elegans</i> and <i>Verticordia densiflora</i> over sedgeland of <i>Desmocladius asper</i> and <i>Lyginea imberbis</i>
Vegetation Community 2 - Wetland
Wetland vegetation including <i>Melaleuca</i> spp. and <i>Regelia</i> sp.
Vegetation Community 3 – <i>Eucalyptus tottiana</i> woodland
Very open woodland of <i>Eucalyptus tottiana</i> over mixed shrubland
Vegetation Community 4 – <i>Banksia prionotes</i> woodland
Dense stands of <i>Banksia prionotes</i> with very little understorey

Vegetation Community 5 – Open Heath
Open heath dominated by <i>Regelia</i> spp

4.5 VEGETATION CONDITION

Many bushland remnants have been historically and/or subject to ongoing degradation and are especially susceptible to disturbances arising as a result of indirect impacts from surrounding developments and human activity. Degradation is caused by a wide range of factors, including isolation and edge effects, weed invasion, plant diseases, changes in fire frequency and behaviour, landscape fragmentation, increased predation on native fauna by feral animals, resulting in a decrease in species richness and general modification of ecological function. These issues can affect the biodiversity rating and ecological viability of areas of remnant vegetation and should be assessed in line with conservation values.

The vegetation condition was rated according to the Vegetation Condition Scale commonly used in the Perth Metropolitan Region (Government of WA 2000). The definitions are described in **Table 9** below.

Table 9: Vegetation Condition Scale (Technical Guidance Statement, 2016)

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

The vegetation condition of the Survey Area ranged varied from “Completely Degraded” to “Excellent” with the majority of the site recorded as being in Excellent condition. Vegetation condition mapping is provided on **Figure 4**.

4.6 FLORISTIC COMMUNITY TYPES

Data analysis was carried out for flora quadrat data utilising PATN™ software (Belbin 1995). It involved multivariate cluster analysis of species presence/absence data. Data was first prepared for analysis including the grouping of some taxa to minimise or exclude ambiguity. For example, removing infra-specific epithets and using only the specific epithet, and removing all species identified to genus only. Replicates of data were also produced that excluded weeds, annuals and singletons (Focused Vision, 2019). Dendrograms are provided in **Appendix C**.

An association matrix of Bray-Curtis dissimilarity coefficients was generated from the presence and absence site by species matrix using the software. The resultant Bray-Curtis matrices were analysed for similarity (from dissimilarity) and the dendrograms were analysed to identify clusters, where statistically significant similarities in species composition exist. Comparisons were made in the analysis in accordance with the scenarios listed below:

- Between the sites including weeds and annuals;
- Between the sites excluding weeds and annuals;
- Between both sites and the consolidated Gibson *et. al* (1994) and Keighery (2012) floristic datasets, including weeds, annuals and singletons (species recorded only once at each site); and
- Between both sites and the consolidated Gibson *et. al* (1994) and Keighery (2012) floristic datasets, excluding weeds, annuals and singletons.

The results show that the species composition/floristics between the Mandogalup and Mogumber sites are statistically distinct and very little similarity is evident. The greatest similarity is between Quadrat 1 at Mogumber and site RR04 at Mandogalup, with 28% similarity. The similarity of Quadrat 4 with other sites in the same location at Mogumber is also low (Focused Vision, 2019). The species richness comparison between the two sites is shown below in **Table 10**

Table 10: Species Richness comparison between Mogumber and Mandogalup

Area/FCT	Number of Quadrats	Species richness/quadrat		
		All recorded species (annuals, perennials and species excluded from PATN analysis)	Native sp. (including annuals and perennials but removed species excluded from PATN analysis)	Native sp. (including perennials only and removed species excluded from PATN analysis)
Mogumber	5	24.8	21.4	21.4
Mandogalup	4	41.75	32.5	30.5

FCT 28	38	55.21	45.47	38.74
FCT S09	34	39.53	38.79	38.68

Quadrat data from the Mandogalup ('RR') and Mogumber ('Quadrat #') sites were analysed against data for Banksia woodland sites from regional datasets from Gibson *et. al* (1994) and Keighery (2012) studies, which have aimed to define floristic community types (FCTs) across the Swan Coastal Plain. Following an initial analysis, which resulted in clusters close to sites for FCTs S09, 28 and 23c, further analyses were then carried out with site data from only those FCTs (Focused Vision, 2019).

The analysis has determined the following key results:

- The species composition/floristics between the Mandogalup and Mogumber sites are statistically distinct with very little similarity.
- The Mandogalup sites show closest affinity to regional data from sites characterised as FCT 28
- The Mogumber sites show closest affinity to regional data from sites characterised as SCP S09.
- Species richness across all sites was relatively low and this may be the reason for relatively poor cohesion in the dendrograms.

The Mandogalup site is confirmed as FCT 28, which is not listed as a TEC under the *Biodiversity Conservation Act 2016* or as a PEC by DBCA, but forms part of the Banksia woodlands of the Swan Coastal Plain, listed as Endangered under the EPBC Act (Strategen, 2017). FCT 28 is described as Spearwood *Banksia attenuata* or *Banksia attenuata* - Eucalyptus woodlands.

The Mogumber site is confirmed as SCP S09 which is not listed as a TEC under the *Biodiversity Conservation Act 2016* or as a PEC by DBCA, but forms part of the Banksia woodlands of the Swan Coastal Plain, ecological community listed as Endangered under the EPBC Act. SCP S09 is described as *Banksia attenuata* woodlands over dense low shrublands.

4.7 BLACK COCKATOO HABITAT ASSESSMENT

During the informal assessment of the value of the Survey Area as Black Cockatoo Habitat, no signs of roosting were recorded. Although 360 ha of the site was mapped as Banksia woodland in very good to excellent condition, which is known to be key forage habitat for Black Cockatoo species, particularly Carnaby's Cockatoo, no signs of foraging were recorded during the survey. No sightings of Black Cockatoos were made during the survey.

5. CONCLUSIONS AND RECOMMENDATIONS

The recent Flora and Vegetation Assessment of the Banksia woodland components of Lot 310 and Lot 300 Neames Road, Mogumber, identified a number of flora species. The vegetation condition varies across the site ranging from “Completely Degraded” to “Excellent”.

Five vegetation types were recorded at a local level during the survey. No species of Threatened (T), or Priority Flora pursuant to The *Biodiversity and Conservation Act* 2016 were located during the time of the survey. One Threatened Ecological Community (TEC) was located during the survey, approximately 360 ha of the Endangered *Banksia woodlands of the Swan Coastal Plain ecological community* was recorded within the Survey Area.

This vegetation type was statistically compared to the quadrat data for FCT 28 which was recorded in the Mandogalup Survey Area. SCP S09 was inferred for the Mogumber site. The data from each site was also compared to determine species similarity of the two sites; the sites have a low similarity index, with the highest similarity index being 28%.

The Survey Area includes 360 ha of Black Cockatoo forage habitat. No evidence of foraging was recorded during the survey.

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FIGURES

FIGURE 2: PROJECT AREA



FIGURE 3: VEGETATION COMMUNITIES

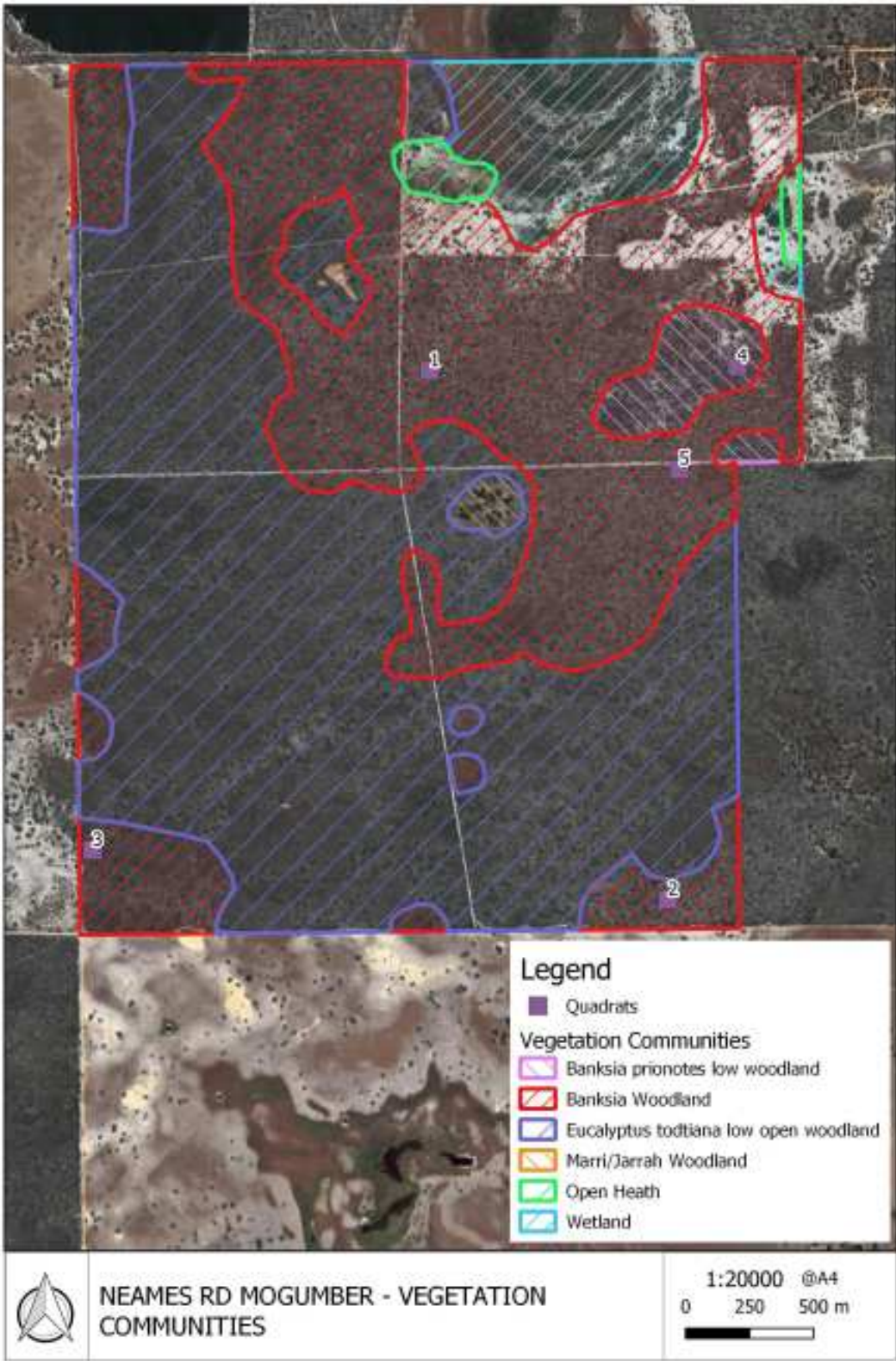
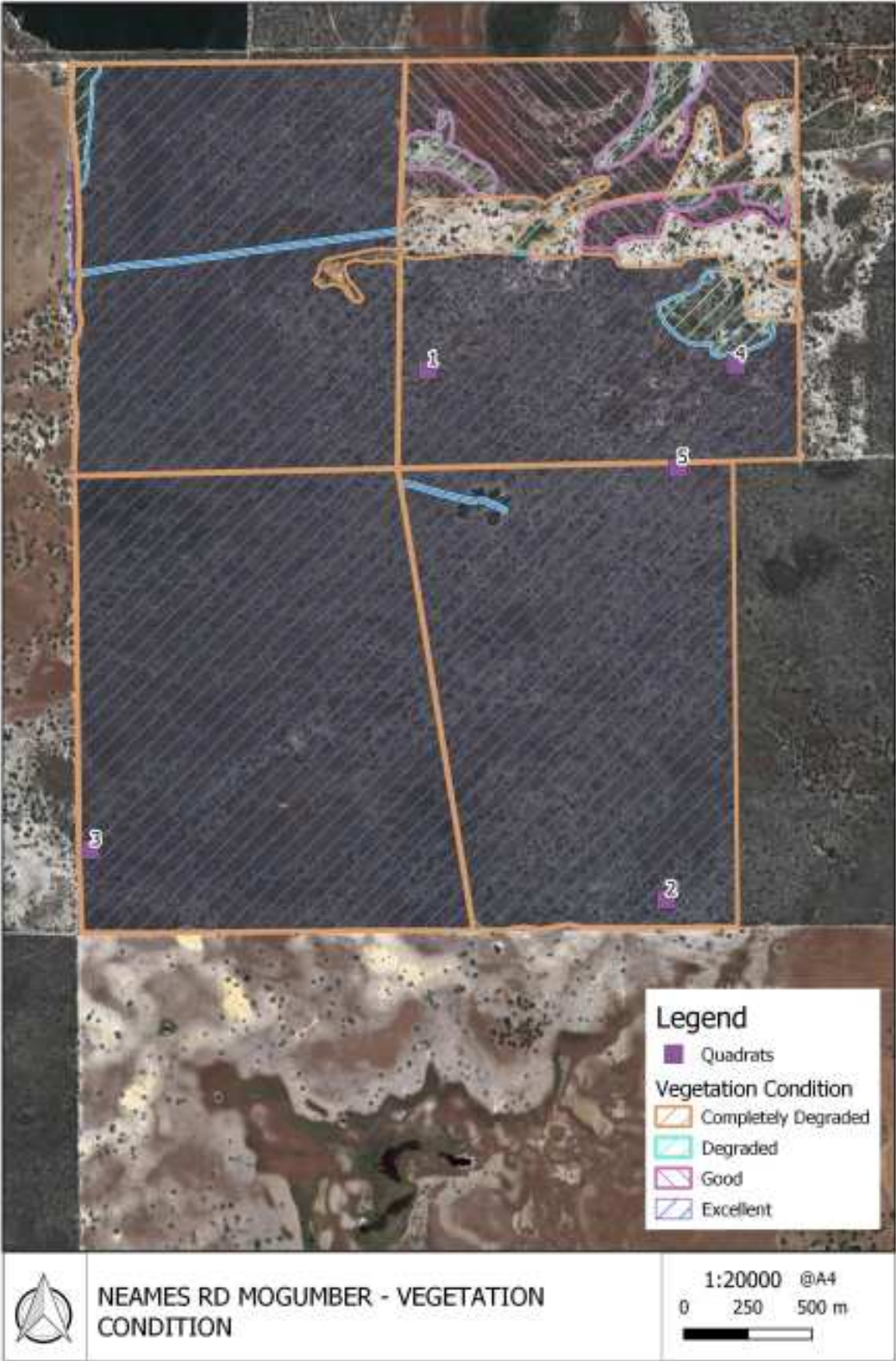


FIGURE 4: VEGETATION CONDITION



PHOTOGRAPHIC PLATES



Plate 1: Banksia woodland



Plate 2: *Eucalyptus tottiana* woodland

APPENDIX A
VASCULAR PLANT SPECIES RECORDED

**APPENDIX A: VASCULAR PLANT SPECIES RECORDED AT NEAMES RD,
MOGUMBER, NOVEMBER 2019**

(* denotes weed species)

FAMILY	SPECIES
Anarthriaceae	<i>Lyginia barbata</i>
	<i>Lyginia imberbis</i>
Apiaceae	<i>Xanthosia heugelii</i>
Asparagaceae	<i>Lomandra</i> sp.
Asteraceae	* <i>Hypochaeris glabra</i>
	<i>Siloxerus</i> sp.
	* <i>Ursinia anthemoides</i>
Cyperaceae	<i>Caustis dioica</i>
	<i>Mesmolaena pseudostygia</i>
	<i>Schoenus pedicellatus</i>
Dilleniaceae	<i>Hibbertia acerosa</i>
	<i>Hibbertia subvaginata</i>
Ericaceae	<i>Conostephium pendulum</i>
	<i>Andersonia</i> sp.
Fabaceae	<i>Bossiaea eriocarpa</i>
	<i>Daviesia decurrens</i>
	<i>Daviesia nudiflora</i>
	<i>Jacksonia floribunda</i>
Haemodoraceae	<i>Conostylis aculeata</i>
	<i>Phlebocarya filifolia</i>
Iridaceae	* <i>Gladiolus caryophyllaceus</i>
	<i>Patersonia occidentalis</i>
Lamiaceae	<i>Hemiandra incana</i>
Lauraceae	<i>Cassytha pomiformis</i>
Loranthaceae	<i>Nuytsia floribunda</i>
Myrtaceae	<i>Beaufortia elegans</i>
	<i>Calytrix flavescens</i>
	<i>Calytrix variabilis</i>
	<i>Eremaea pauciflora</i>
	<i>Eucalyptus tottiana</i>
	<i>Leptospermum erubescens</i>
	Myrtaceae sp
	<i>Verticordia densiflora</i>
	<i>Verticordia nitens</i>
Poaceae	* <i>Aira caryophyllea</i>
	<i>Amphipogon turbinatus</i>
	<i>Austrostipa</i> sp.
	* <i>Erharta longiflora</i>
Proteaceae	<i>Adenanthos cygnorum</i>
	<i>Banksia attenuata</i>

	<i>Banksia dallaneyi</i> subsp. <i>dallaneyi</i> var <i>dallaneyi</i>
	<i>Banksia echinata</i>
	<i>Banksia ilicifolia</i>
	<i>Banksia menziessii</i>
	<i>Banksia prionotes</i>
	<i>Conospermum stoechadis</i>
	<i>Hakea preissii</i>
	<i>Lambertia</i> sp.
	<i>Petrophile linearis</i>
	<i>Petrophile macrostachya</i>
	<i>Stirlingia latifolia</i>
	<i>Synaphea</i> sp.
Restionaceae	<i>Desmocladius asper</i>
	<i>Lepidobolus chaetocephalus</i>
Rutaceae	<i>Boronia</i> sp.
Stylidiaceae	<i>Stylidium repens</i>
	<i>Stylidium</i> sp.
Thymelaeaceae	<i>Pimelea</i> sp.
Xanthorrhoeaceae	<i>Xanthorrhoea acanthostachya</i>

APPENDIX B

QUADRAT DATA

Del Botanics

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Neames Rd, Mogumber	Date: 24/11/2019	Site: Q1
GPS Datum: 50 404217 6562003	Topography: upper slope	Litter cover: 10 % twigs, 10 % leaves 20% logs
Age since fire: >10 yrs	Disturbance: Hi Med Lo	Soils: White/grey sand
Vegetation Description: Low open forest of <i>Banksia attenuata</i> over <i>Leptospermum erubescens</i> shrubland over <i>Eremaea pauciflora</i> low shrubland over a very open sedgeland of <i>Desmocladius asper</i> .		
Vegetation Condition: Excellent		
Observations: no weeds, limited disturbance, no deaths		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	<i>Banksia attenuata</i>	650	99	1	35
	<i>Banksia menziesii</i>	450	100	0	5
	<i>Leptospermum erubescens</i>	120	100	0	14
DBM1	<i>Verticordia densiflora</i>	40	100	0	1
	<i>Calytrix flavescens</i>	50	100	0	1
	<i>Eremaea pauciflora</i>	60	100	0	13
	<i>Jacksonia floribunda</i>	250	100	0	2
	<i>Stirlingia latifolia</i>	80	100	0	1
	<i>Cassitya pomiformis</i>	T	100	0	5
DBM2	<i>Petrophile macrostachya</i>	100	99	1	5
DBM3	<i>Beaufortia elegans</i>	60	100	0	5
	<i>Desmocladius asper</i>	10	100	0	3
	<i>Lyginea imberbis</i>	60	100	0	0.1
	<i>Bossiaea eriocarpa</i>	30	100	0	0.1
	<i>Daviesia nudiflora</i>	30	100	0	0.1
	<i>Synaphea</i> sp.	30	100	0	0.5

	<i>Lomandra</i> sp.	30	100	0	0.2
	<i>Petrophile linearis</i>	15	100	0	0.1
	<i>Boronia</i> sp.	10	100	0	0.1
DBM4	<i>Schoenus pedicellatus</i>	50	100	0	2
	<i>Hibbertia subvaginata</i>	30	100	0	0.5
	<i>Patersonia occidentalis</i>	40	100	0	1
	<i>Conostephium pendulum</i>	35	100	0	0.5
	<i>Mesmolaena pseudostygia</i>	50	100	0	0.5
	<i>Stylidium</i> sp.	5	100	0	0.01
	<i>Stylidium repens</i>	10	100	0	0.2
	<i>Adenanthos cygnorum</i>	10	100	0	0.1
OPP	<i>Eucalyptus todtiana</i>				
	<i>Calytrix variabilis</i>				

Del Botanic

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Neames Rd, Mogumber	Date: 24/11/2019	Site: Q2
GPS Datum: 50 405148 6559934	Topography: lower slope	Litter cover: 5% twigs, 5% leaves 5% logs
Age since fire: >10 yrs	Disturbance: Hi Med Lo	Soils: White/grey sand
Vegetation Description: Low woodland of <i>Banksia attenuata</i> over <i>Eremaea pauciflora</i> shrubland over a very open sedgeland of <i>Lyginea imberbis</i> .		
Vegetation Condition: Excellent		
Observations: no weeds, sparse Banksia		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	<i>Banksia attenuata</i>	600	100	0	10
	<i>Banksia menziesii</i>	500	100	0	3
DBM3	<i>Beaufortia elegans</i>	40	100	0	6
	<i>Mesomelaena pseudostygia</i>	50	100	0	4
	<i>Eremaea pauciflora</i>	140	100	0	12
	<i>Cassityha pomiformis</i>	T	100	0	1
	<i>Lyginea imberbis</i>	60	100	0	6
	<i>Patersonia occidentalis</i>	60	100	0	1
	<i>Verticordia nitens</i>	120	100	0	0.5
	<i>Daviesia nudiflora</i>	160	100	0	2
DBM1	<i>Verticordia densiflora</i>	50	99.5	0.5	1
	<i>Xanthorrhoea acanthostachya</i>	100	100	0	3
DBM5	Myrtaceae sp	130	100	0	0.5
	<i>Amphipogon turbinatus</i>	30	100	0	0.01
	<i>Bossiaea eriocarpa</i>	120	100	0	4
DBM6	<i>Conospermum stoechadis</i>	110	100	0	0.5

DBM7	<i>Banksia echinata</i>	12	100	0	0.1
	<i>Stirlingia latifolia</i>	40	100	0	1
DBM8	<i>Banksia dallaneyi</i> subsp. <i>dallaneyi</i> var <i>dallaneyi</i>	15	100	0	0.3
	<i>Caustis dioica</i>	60	100	0	3.5
	<i>Xanthosia heugelii</i>	10	100	0	1.5
	<i>Conostephium pendulum</i>	40	100	0	0.5
	<i>Petrophile linearis</i>	30	100	0	0.5
	<i>Lyginea imberbis</i>	20	100	0	0.4
	<i>Adenanthos cygnorum</i>	10	100	0	0.1
	<i>Stylidium repens</i>	5	100	0	0.01
	<i>Jacksonia floribunda</i>	10	100	0	0.2
OPP	<i>Eucalyptus todtiana</i>				
OPP	<i>Leptospermum erubescens</i>				
OPP	<i>Nuytsia floribunda</i>				

Del Botanic

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Neames Rd, Mogumber	Date: 24/11/2019	Site: Q3
GPS Datum: 50 402899 6560128	Topography: upper slope	Litter cover: 20% twigs, 30% leaves 10% logs
Age since fire: >10 yrs	Disturbance: Hi Med Lo	Soils: White/grey sand
Vegetation Description: Low woodland of <i>Banksia attenuata</i> over open heath of <i>Adenanthos cygnorum</i> over low open shrubland of <i>Beaufortia elegans</i> over low open shrubland of <i>Petrophile macrostachya</i> .		
Vegetation Condition: Excellent		
Observations: no weeds, dense vegetation		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	<i>Banksia attenuata</i>	600	100	0	20
	<i>Banksia menziesii</i>	400	100	0	7
	<i>Adenanthos cygnorum</i>	160	100	0	40
DBM1	<i>Verticordia densiflora</i>	40	100	0	0.5
DBM9	<i>Lambertia sp.</i>	150	100	0	5
DBM3	<i>Beaufortia elegans</i>	100	100	0	7
DBM4	<i>Schoenus pedicellatus</i>	50	100	0	3
	<i>Hibbertia acerosa</i>	20	100	0	1.5
	<i>Stirlingia latifolia</i>	40	100	0	1
	<i>Desmocladius asper</i>	15	100	0	1
	<i>Synaphea sp.</i>	60	100	0	0.5
	<i>Cassytha pomiformis</i>	T	100	0	0.5
	<i>Xanthorrhoea acanthostachya</i>	130	100	0	3
	<i>Bossiaea eriocarpa</i>	70	100	0	1.5
	<i>Amphipogon turbinatus</i>	60	100	0	0.01
DBM7	<i>Banksia echinata</i>	40	100	0	0.1
	<i>Caustis dioica</i>	25	100	0	0.2
	<i>Lyginea barbata</i>	60	100	0	1

	<i>Patersonia occidentalis</i>	60	100	0	1
	<i>Austrostipa</i> sp.	60	100	0	0.01
	<i>Conostephium pendulum</i>	40	100	0	0.5
	<i>Pimelea</i> sp.	20	100	0	0.1
DBM10	<i>Lepidobolus chaetocephalus</i>	80	100	0	0.1
DBM11	<i>Phlebocarya filifolia</i>	25	100	0	0.5
	<i>Jacksonia floribunda</i>	12	100	0	0.2
	<i>Petrophile linearis</i>	15	100	0	0.2
DBM2	<i>Petrophile macrostachya</i>	60	100	0	4
	<i>Stylidium</i> sp.	15	100	0	2
	<i>Daviesia decurrens</i>	20	100	0	0.5
	<i>Daviesia nudiflora</i>	110	100	0	1.5
DBM12	<i>Andersonia</i> sp	60	100	0	1
DBM13	<i>Siloxerus</i> sp	6	100	0	0.3
	<i>Stylidium repens</i>	5	100	0	0.01
	<i>Eremaea pauciflora</i>	130	100	0	2.5
	<i>Hemiandra incana</i>	20	100	0	0.1
OPP	<i>Banksia ilicifolia</i>				
OPP	<i>Hakea preissii</i>				

Del Botanic

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Neames Rd, Mogumber	Date: 24/11/2019	Site: Q4
GPS Datum: 50 405418 6562021	Topography: lower slope	Litter cover: 40% twigs, 60% leaves 10% logs
Age since fire: >10 yrs	Disturbance: Hi Med Lo	Soils: White/grey sand
Vegetation Description: Low open forest of <i>Banksia attenuata</i> over shrubland of <i>Calytrix variabilis</i> over low open shrubland of <i>Conostephium pendulum</i> over very open grassland of * <i>Aira caryophyllea</i> .		
Vegetation Condition: Good - Degraded		
Observations: Contains weed species & bare areas, less diversity		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	<i>Banksia attenuata</i>	400	100	0	50
	<i>Banksia menziesii</i>	500	100	0	10
	<i>Banksia prionotes</i>	600	100	0	20
	<i>Calytrix variabilis</i>	150	100	0	25
	* <i>Ursinia anthemoides</i>	15	20	80	5
	<i>Conostephium pendulum</i>	50	100	0	7
	<i>Jacksonia floribunda</i>	200	100	0	5
	* <i>Aira caryophyllea</i>	15	0	100	3
OPP	<i>Eremaea pauciflora</i>				
	* <i>Hypochaeris glabra</i>	8	100	0	0.5
DBM3	<i>Beaufortia elegans</i>	100	100	0	0.7
	* <i>Erharta longiflora</i>	50	100	0	0.01
	* <i>Gladiolus caryophyllaceus</i>	10	100	0	0.01
OPP	<i>Stirlingia latifolia</i>				

Del Botanics

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Neames Rd, Mogumber	Date: 24/11/2019	Site: Q5
GPS Datum: 50 405192 6561619	Topography: mid slope	Litter cover: 10% twigs, 20% leaves 10% logs
Age since fire: >10 yrs	Disturbance: Hi Med Lo	Soils: White/grey sand
Vegetation Description: Low woodland of <i>Banksia menziessii</i> over shrubland of <i>Beaufortia elegans</i> over low open shrubland of <i>Verticordia densiflora</i> .		
Vegetation Condition: Very Good		
Observations: no weeds		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	<i>Banksia menziessii</i>	650	100	0	20
	<i>Banksia attenuata</i>	500	100	0	7
	<i>Eremaea pauciflora</i>	100	100	0	6
	<i>Stirlingia latifolia</i>	100	100	0	8
DBM3	<i>Beaufortia elegans</i>	120	100	0	10
DBM1	<i>Verticordia densiflora</i>	50	100	0	3
	<i>Bossiaea eriocarpa</i>	60	100	0	1
	<i>Adenanthos cygnorum</i>	150	100	0	6
	<i>Cassitya pomiformis</i>	T	100	0	0.1
	<i>Desmocladius asper</i>	7	100	0	1
	<i>Amphipogon turbinatus</i>	40	100	0	0.05
	<i>Patersonia occidentalis</i>	60	100	0	1
	<i>Lyginea imberbis</i>	50	100	0	0.2
	<i>Petrophile linearis</i>	20	100	0	0.2
	<i>Conospermum stoechadis</i>	120	100	0	0.5
	<i>Conostephium pendulum</i>	35	100	0	0.5

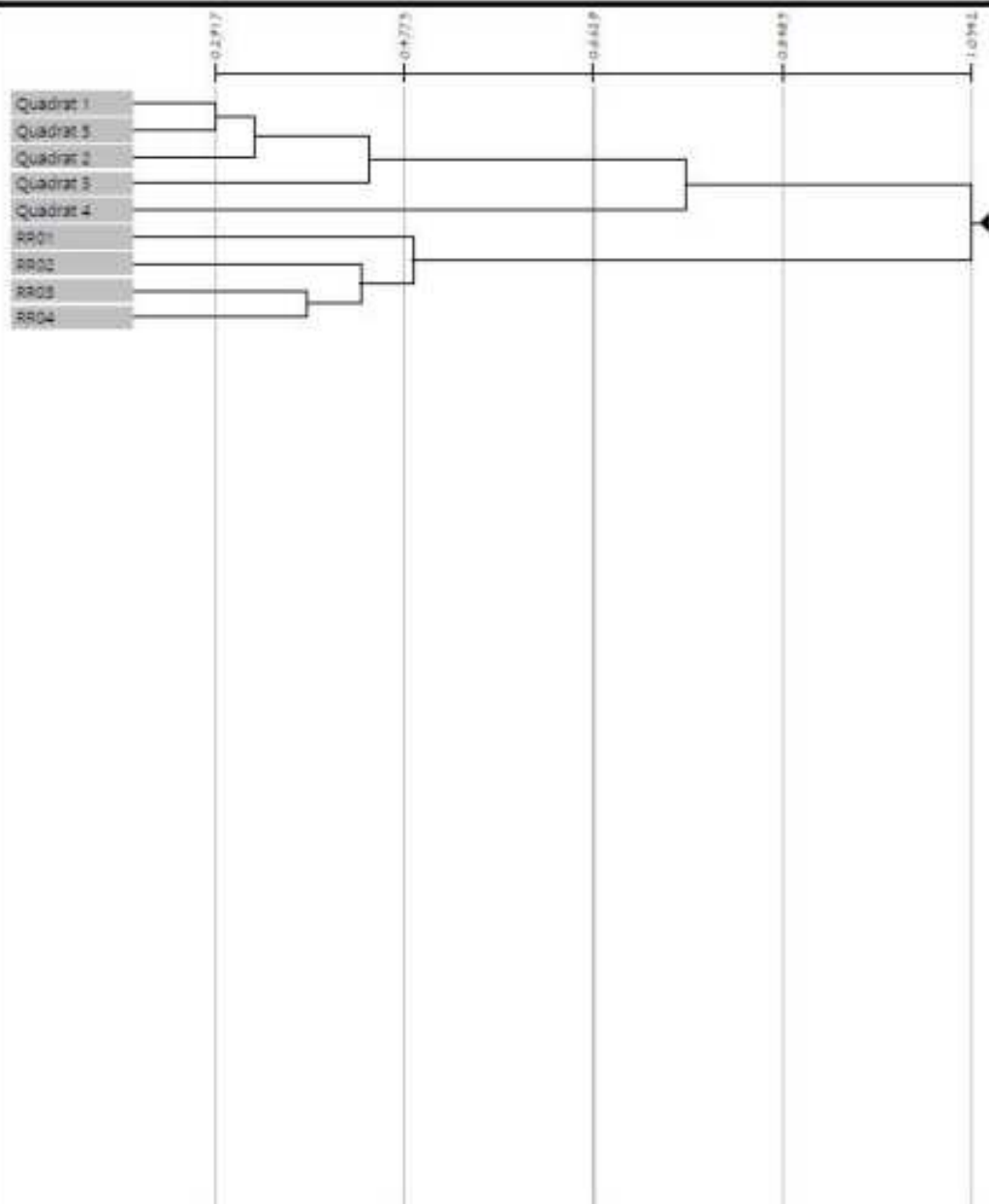
DBM12	<i>Andersonia sp.</i>	40	100	0	0.5
	<i>Calytrix flavescens</i>	20	100	0	0.2
DBM9	<i>Lambertia sp</i>	50	100	0	0.25
DBM4	<i>Schoenus pedicellatus</i>	50	100	0	0.1
	<i>Conostylis aculeata</i>	60	100	0	0.5
	<i>Stylidium repens</i>	3	100	0	0.2

APPENDIX C
DENDROGRAMS FOR MOGUMBER AND MANDOGALUP

Fusion Type: Flexible UPGMA Beta = -0.10

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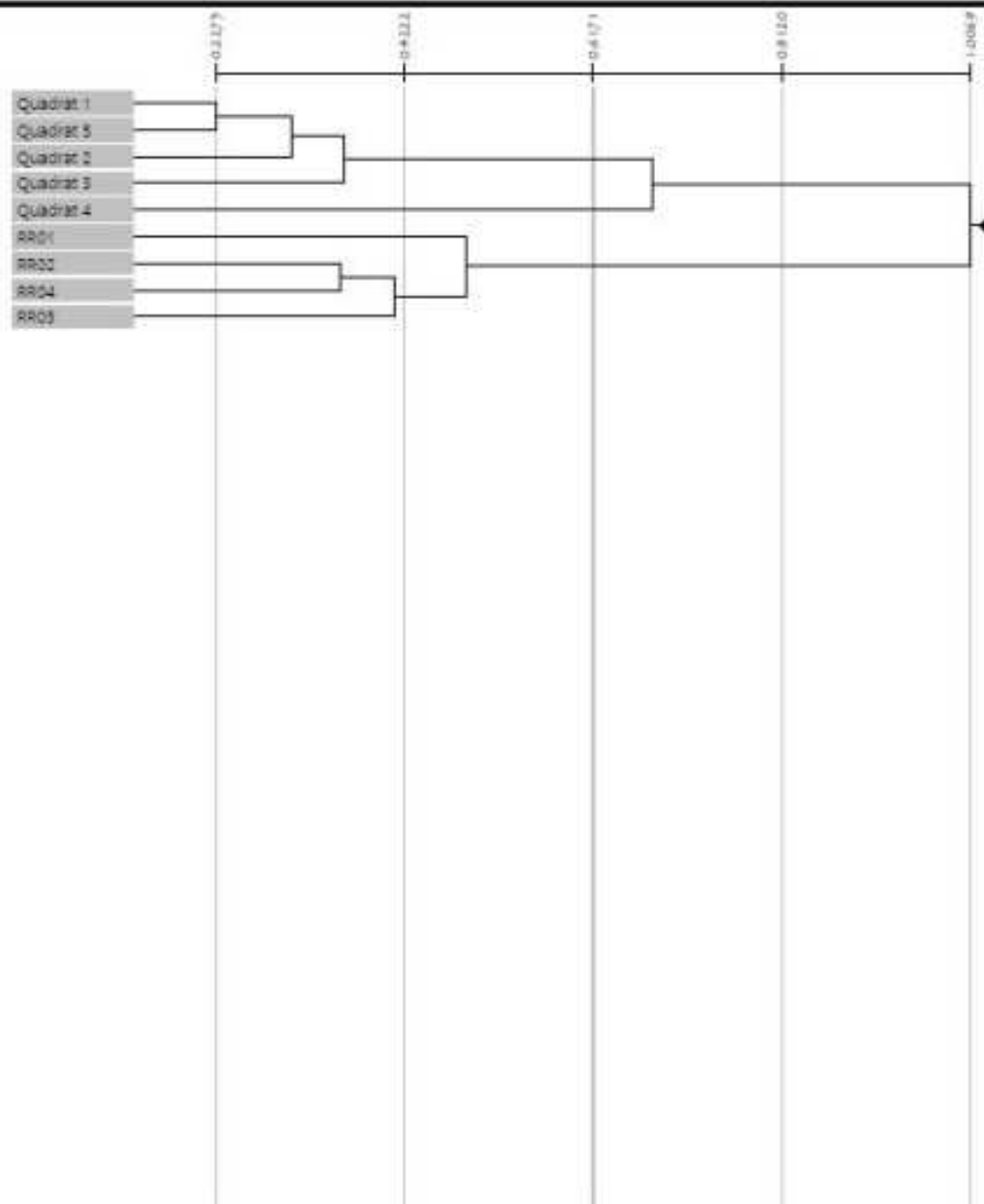
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA Beta = -0.10

On Association: Bray & Curtis (Columns) Created on: 15/05/11, December 05, 2019

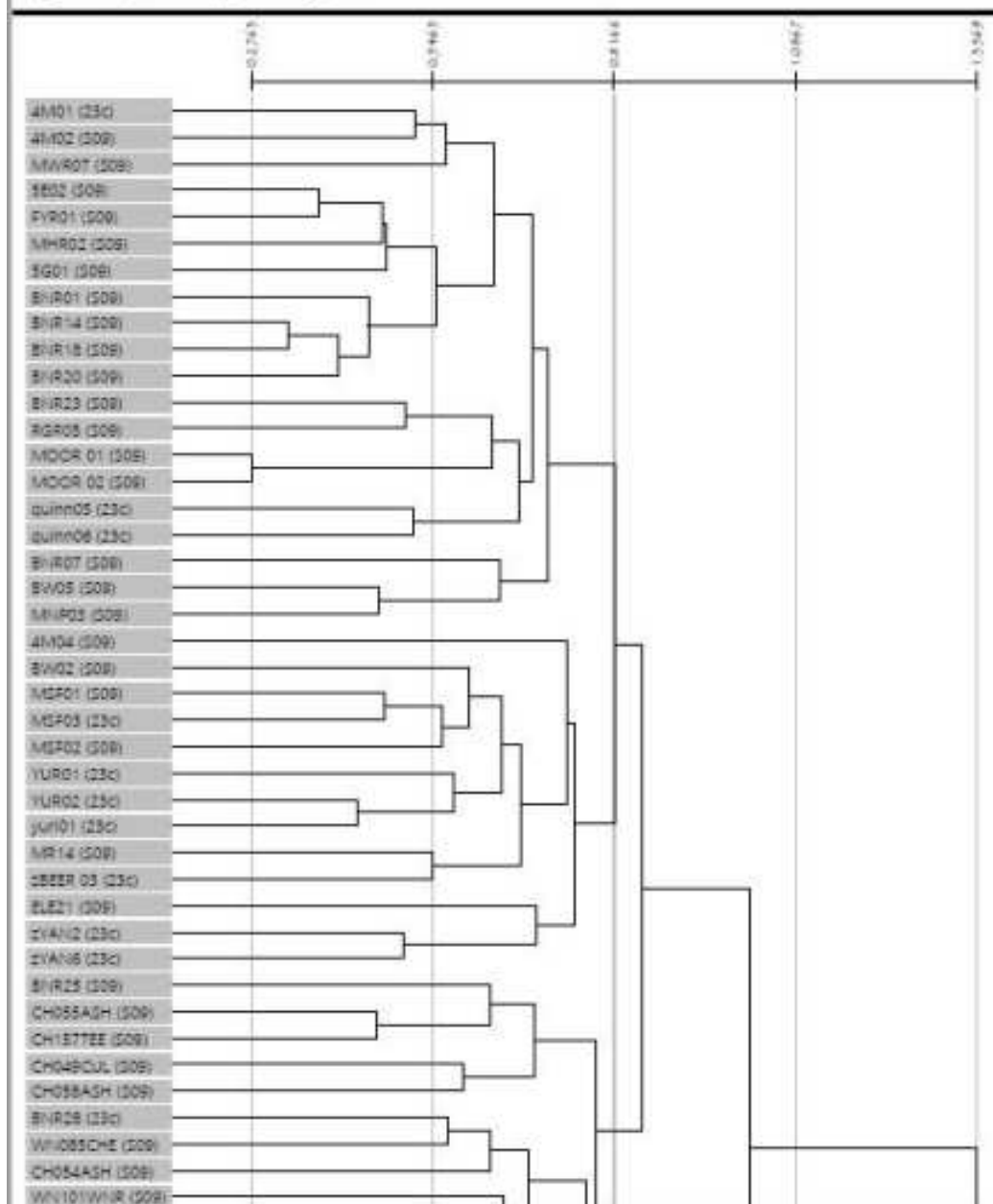
Column Fusion Dendrogram



Fusion Type: Flexible UPGMA, Beta = 0.10

On Association Bray & Curtis (Column) Created on: 13:17:03, December 05, 2019

Column Fusion Dendrogram



Column Fusion Dendrogram

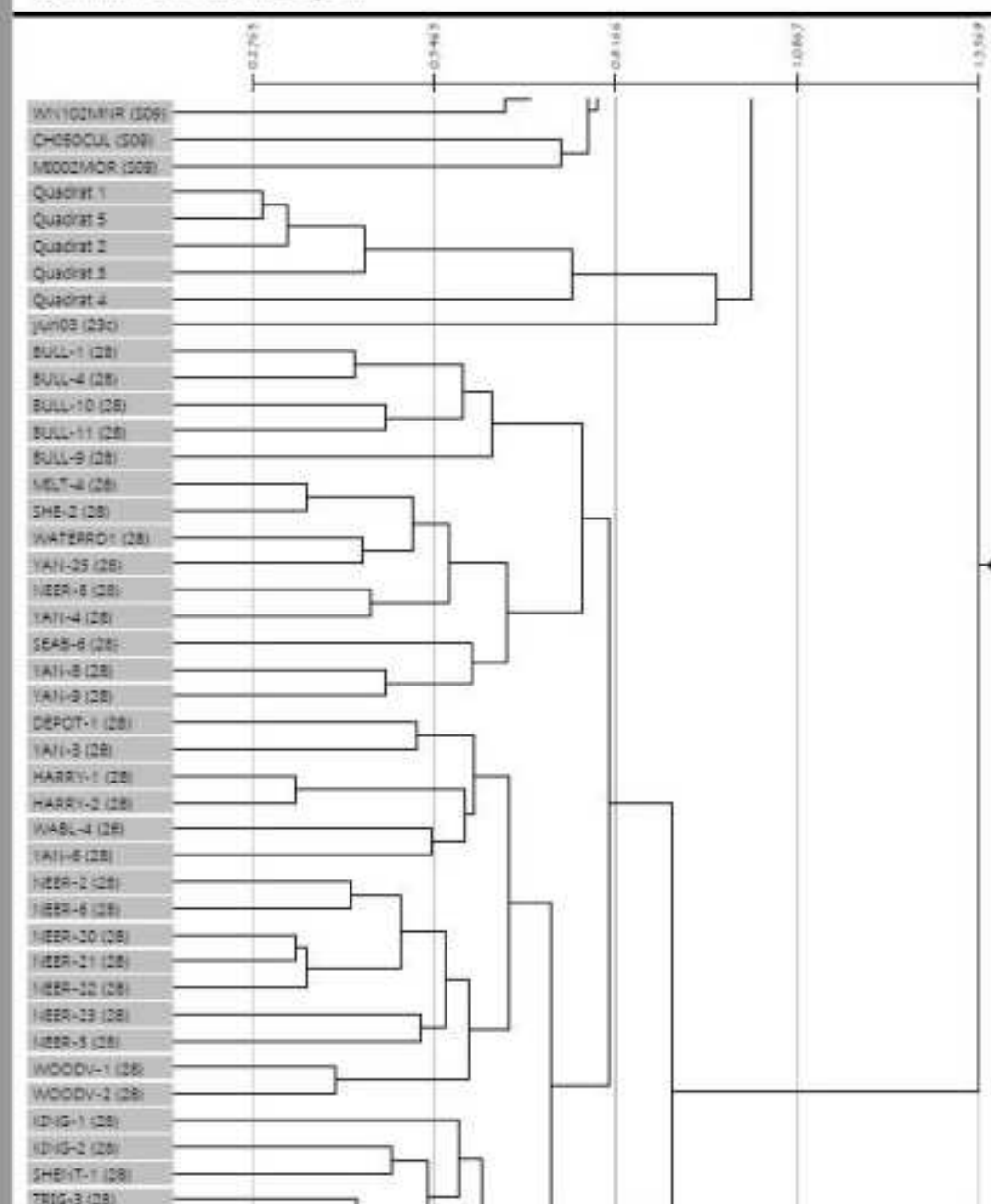


Table 6

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Column Fusion Dendrogram

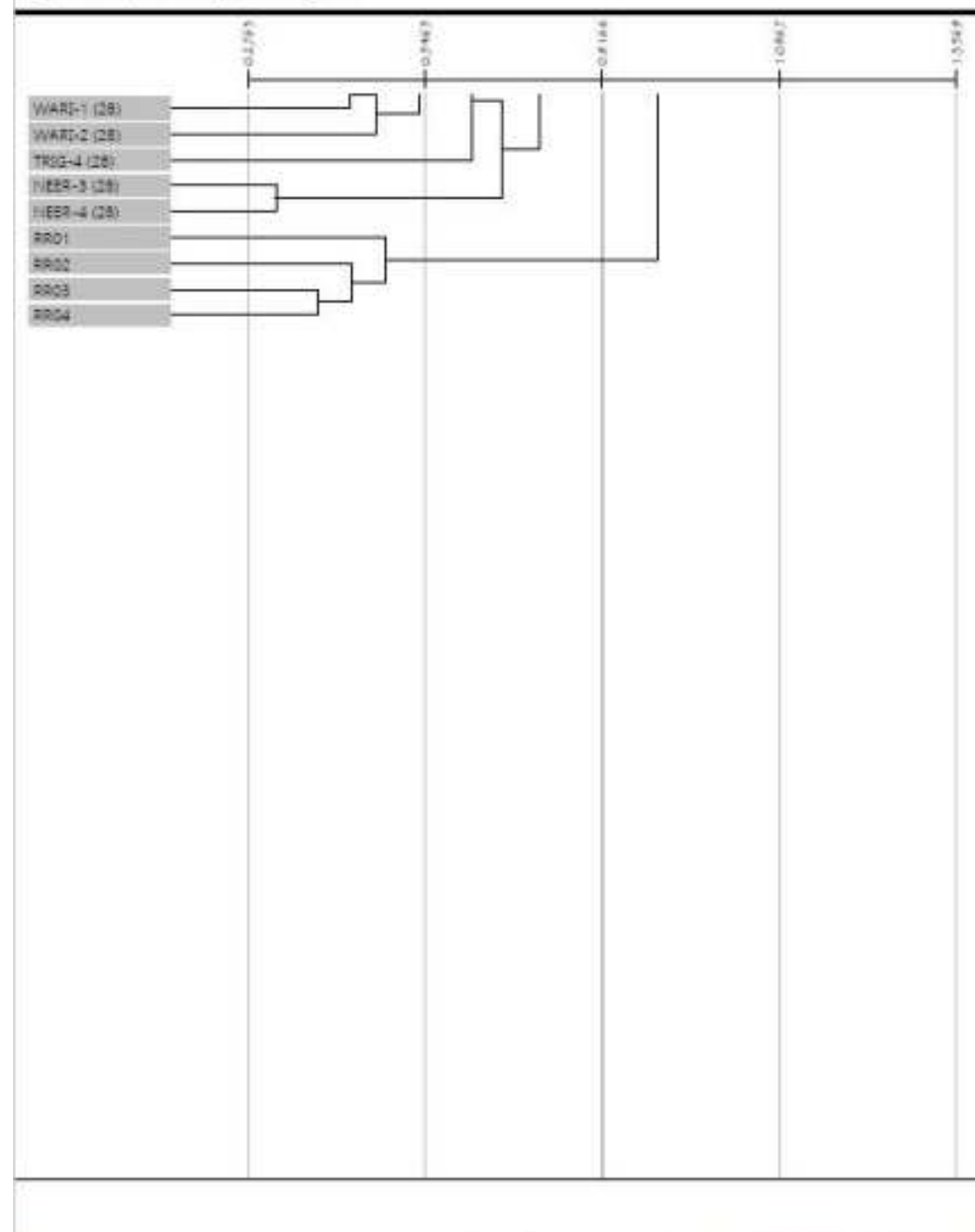


Table 5

Fusion Type: Flexible (UPGMA) Beta = 0.10

On Association: Bray & Curtis (Column) Created on: 13/11/07, December 05, 2019

Column Fusion Dendrogram

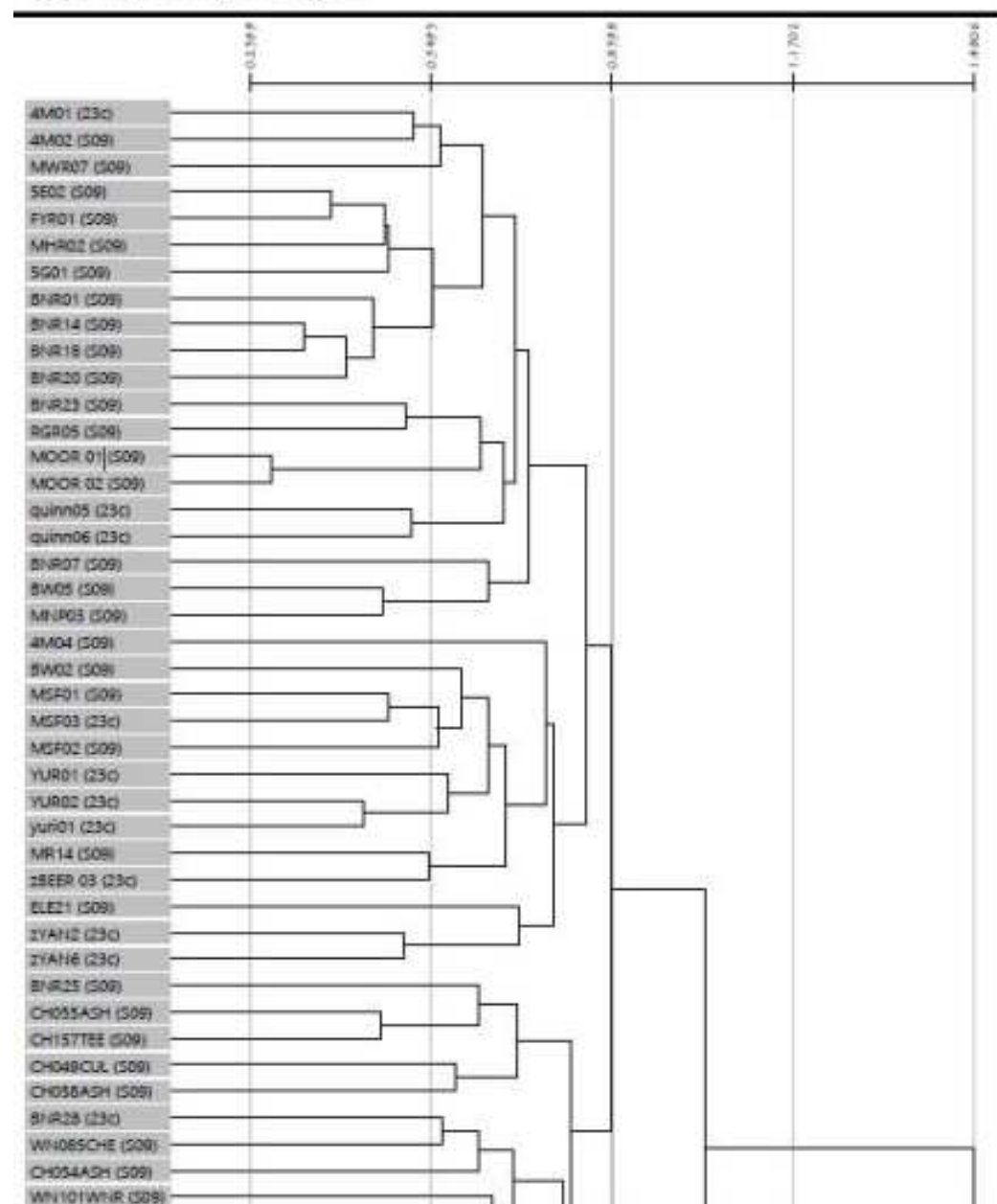


Table 1

Union Type: Flexible UPGMA Beta = -0.10

In Association: Bray & Curtis (Column) Created on: 15:11:07, December-05, 2019

Column Fusion Dendrogram

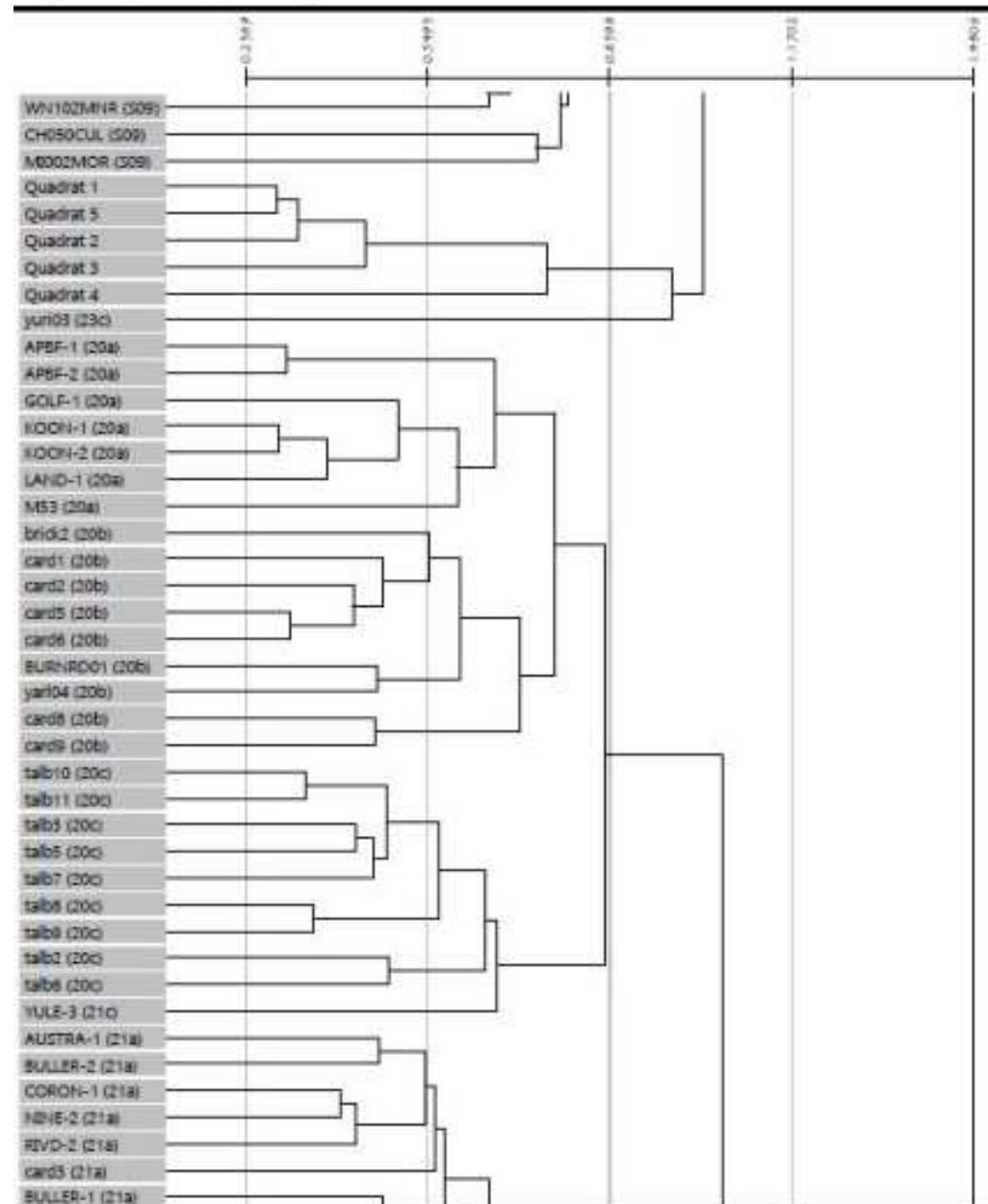


Table 7

Fusion Type: Flexible UPGMA Beta = -0.10

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Column Fusion Dendrogram

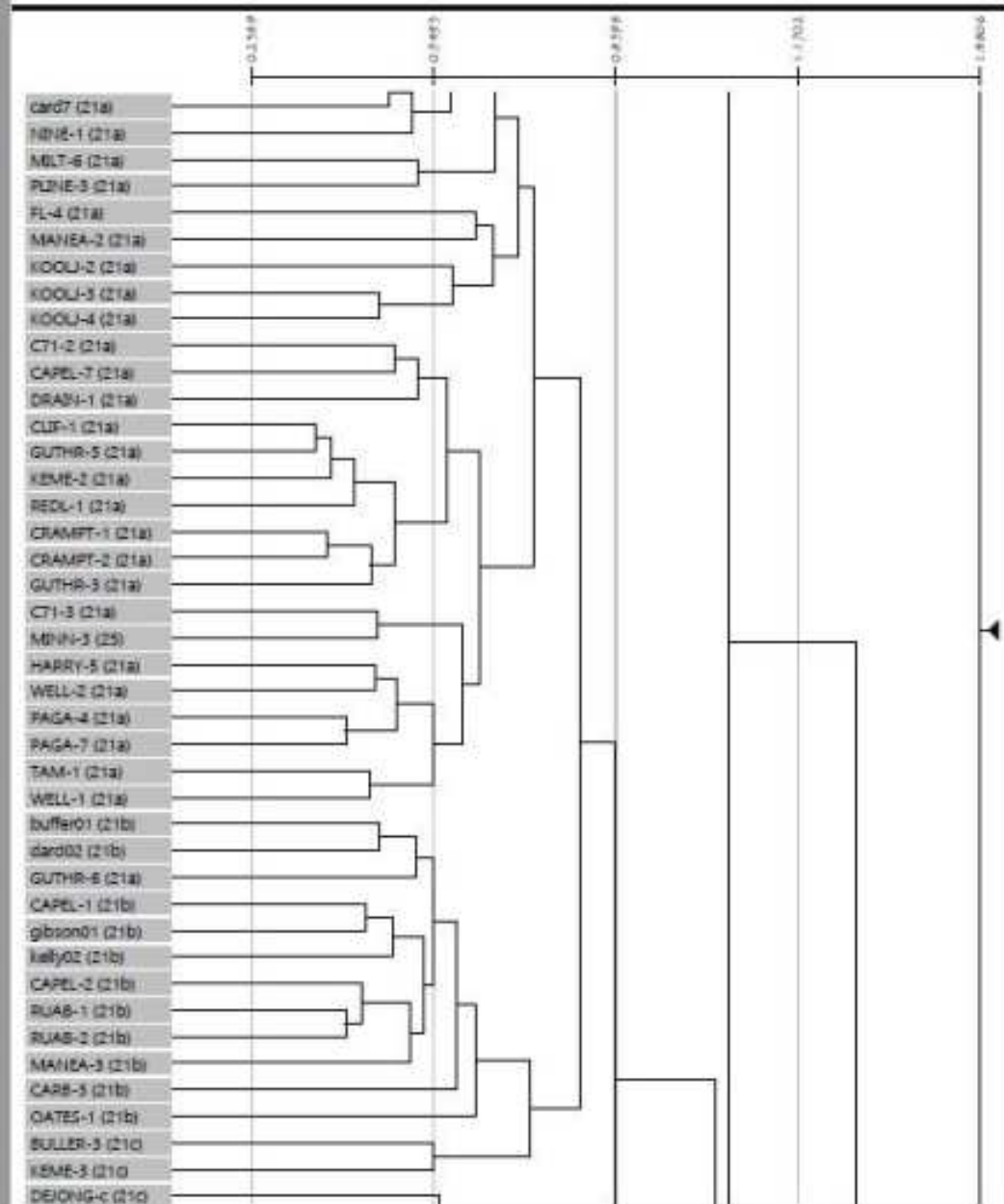


Table 9

Fusion Type: Flexible UPGMA Beta = -0.10

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Column Fusion Dendrogram

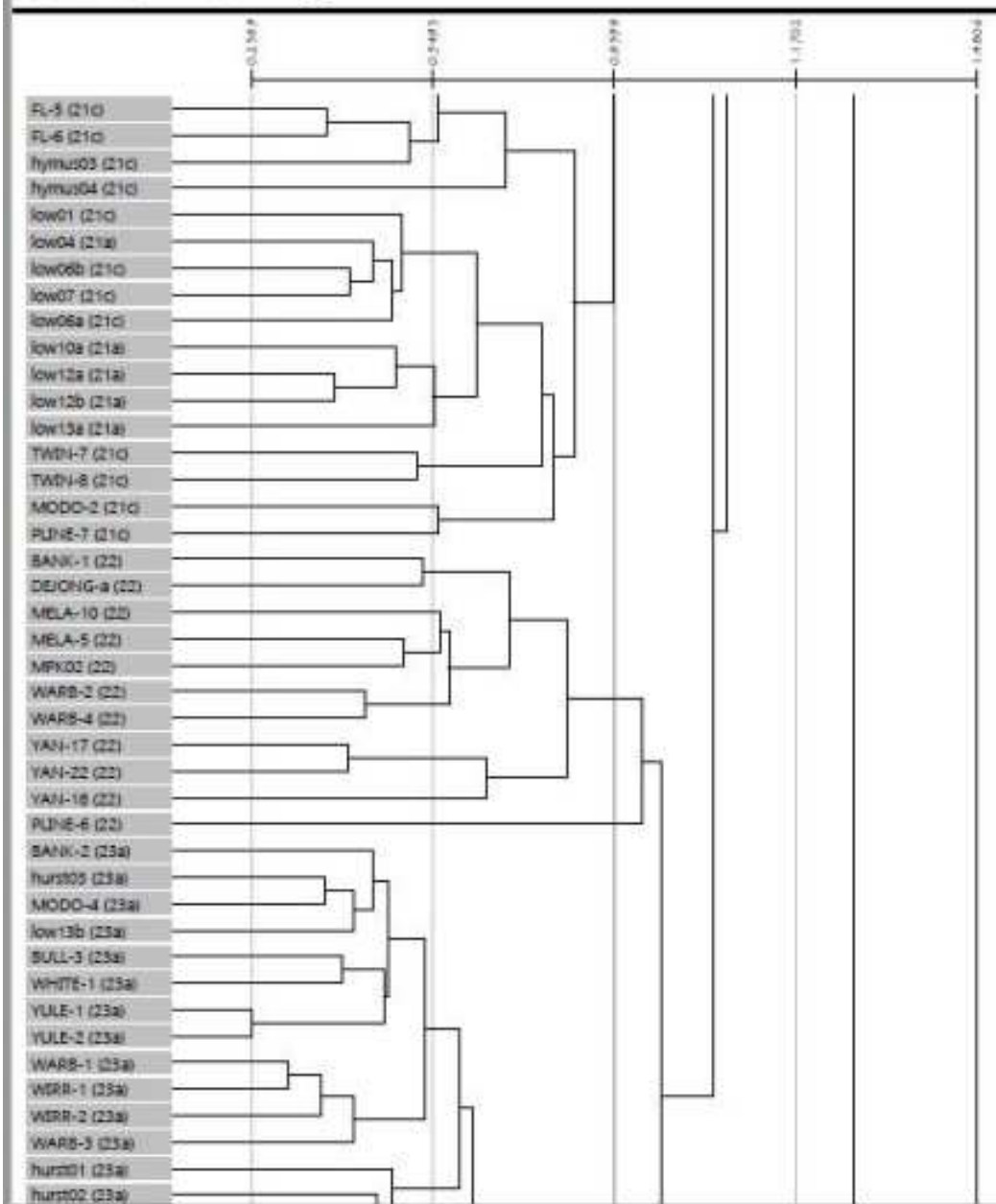
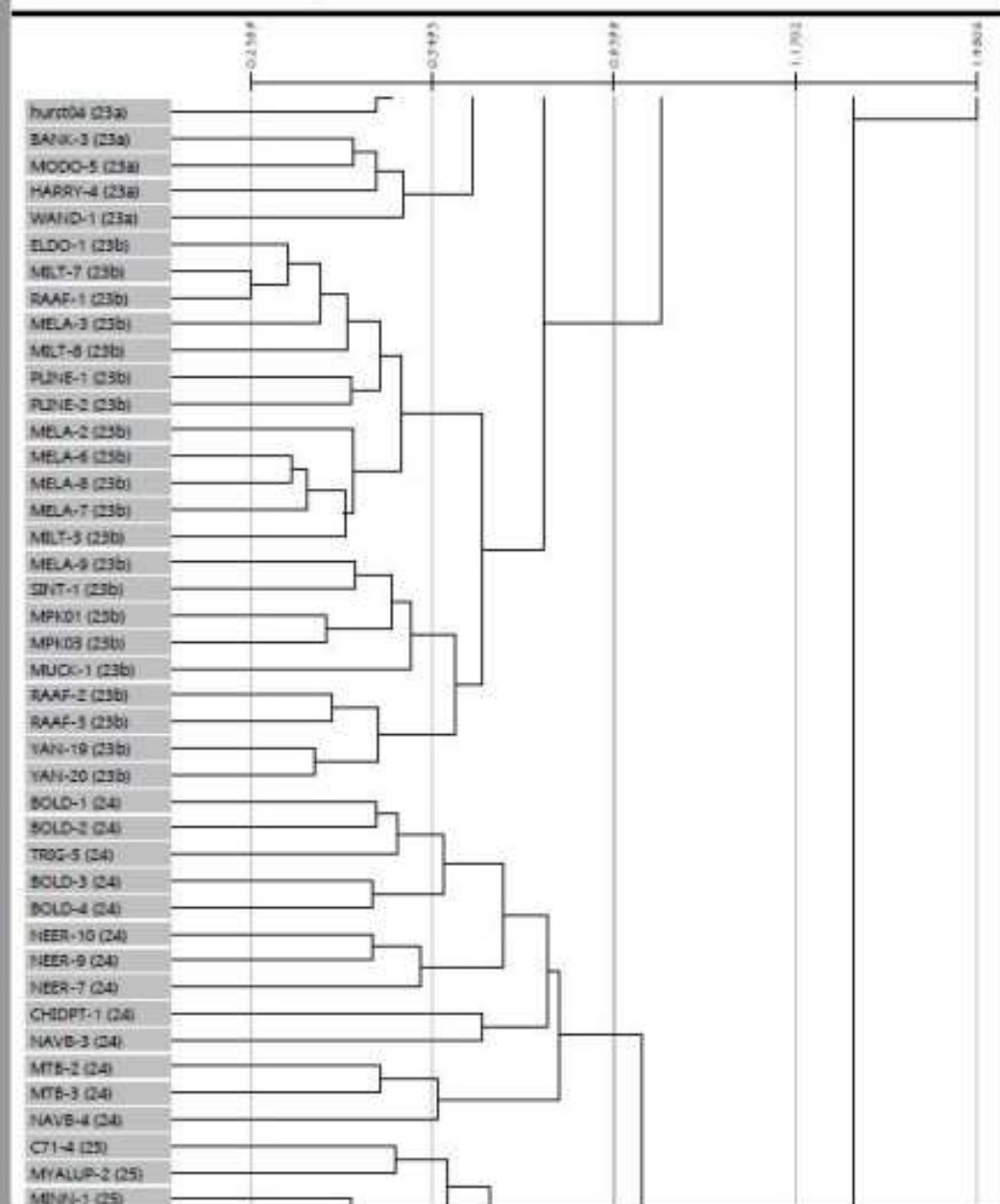


Table 5

Fusion Type: FlexibleUPGMA Beta = -0.10

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Column Fusion Dendrogram



Column Fusion Dendrogram

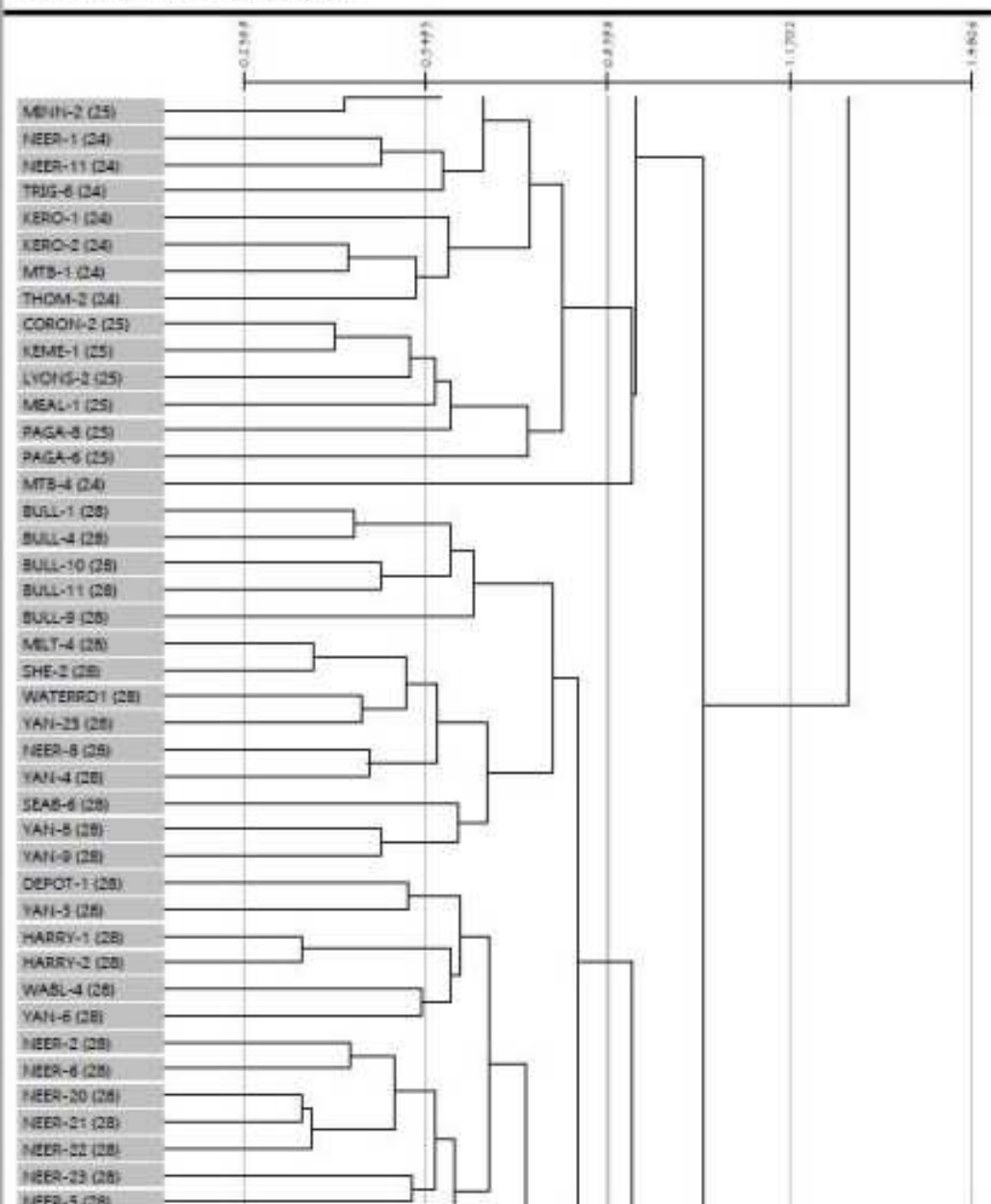
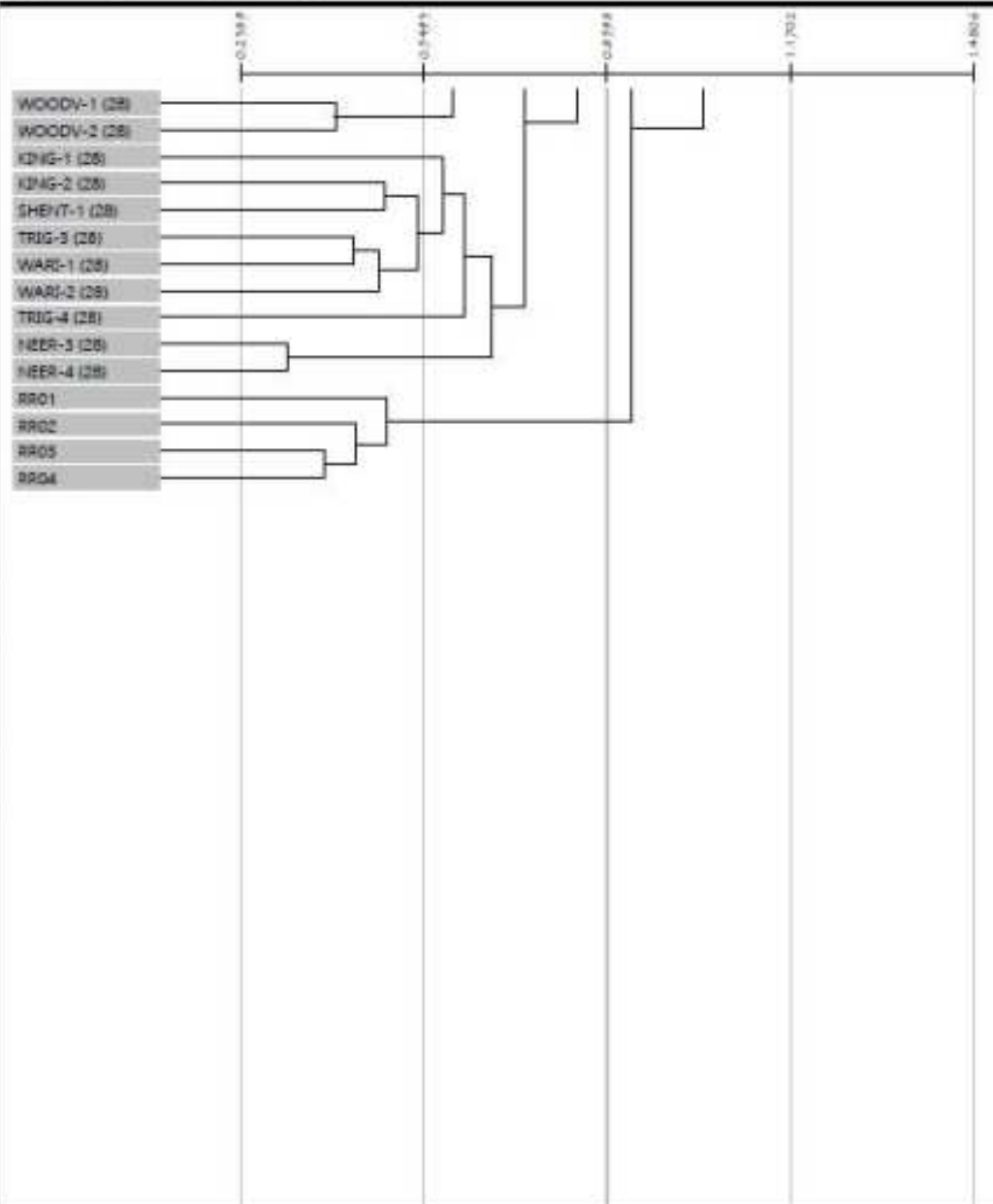


Table 9

Fusion Type: Flexible (UPGMA) Beta = 0.10

On Association: Bray-Curtis (Columns) Created on: 55:11:07, Dezember 05, 2018

Column Fusion Dendrogram



Appendix C Mogumber Offset Site – Black Cockatoo Habitat Value

Name:	Tina Ronci	Date:	9 November 2020
Company:	Questdale Holdings Pty Ltd	Job/Doc. No.:	56799
Email:	ronic@westnet.com.au	Inquiries:	Darren Walsh / Kathy Choo

Lot 310 and Lot 300 Neames Road, Mogumber - Targeted Black cockatoo habitat assessment

1. Background

This technical memorandum has been produced to support the development of Lots 2 and 10 Rowley Road, Mandogalup (the Survey Area).

2. Scope

The scope of work to be undertaken is as follows:

- Undertake a targeted Black Cockatoo habitat assessment
- prepare a report detailing the findings of the above.

3. Methods

The survey and analysis reported here have been conducted with strong reference to both the existing guidelines (DSEWPaC 2012) as well as the recently revised draft guidelines (DEE 2017). In addition, survey methodology followed the recommendations listed on the DAWE's Species Profile and Threats Database (DAWE 2020b).

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.

It should be noted that the only threatened species of black-cockatoo likely to occur within the project area is Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*).

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, and this numerical value is designed to provide the sort of 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 Bamford (2018) 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.

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.

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 (Peck et al. 2016; DBCA 2020).

4. Results and Discussion

Foraging Habitat

There was approximately 317 ha of habitat with a foraging value of moderate to high recorded within the Survey area (Figure 1). Foraging species dominant within the Survey area were, *Eucalyptus marginata*, *Banksia attenuata*, *Banksia menziesii*, and *Xanthorrhoea preissii*. For the purposes of this assessment, habitat with foraging value less than moderate has not been considered.

Based on the composition, structure and condition of the vegetation assessed, the foraging habitat identified within the Survey area was classified as moderate to high foraging value. Using the scoring system developed by Bamford (2018), adding in site context and species presence, this habitat rates as a quality of 7 out of a maximum score of 10.

Potential breeding habitat

Twenty-six trees suitable for black cockatoos were identified in the survey area, including 25 *Eucalyptus marginata* (Jarrah), and one *Corymbia calophylla* (Marri). Observations indicated two trees contained hollows of a size and orientation suitable for nesting by black cockatoo species. The locations of the potential breeding trees are displayed in Figure 1 and Table 1.

Table 1: Potential breeding trees

Tree No.	Latitude	Longitude	Taxa	DBH (cm)	Suitable hollows
1	-31.07719793	115.9984558	<i>Eucalyptus marginata</i>	60	no
2	-31.0771854	115.997448	<i>Eucalyptus marginata</i>	50	no
3	-31.07711121	115.9987204	<i>Eucalyptus marginata</i>	75	no
4	-31.07701559	115.9984196	<i>Eucalyptus marginata</i>	80	no
5	-31.0769846	115.9971192	<i>Eucalyptus marginata</i>	75	no
6	-31.07694782	115.9984951	<i>Eucalyptus marginata</i>	50	no
7	-31.0769462	115.9987628	<i>Eucalyptus marginata</i>	60	no
8	-31.076841	115.9985806	<i>Eucalyptus marginata</i>	110	yes
9	-31.0768178	115.9980073	<i>Eucalyptus marginata</i>	75	no
10	-31.07674623	115.9992015	<i>Eucalyptus marginata</i>	90	no
11	-31.0767413	115.9977458	<i>Eucalyptus marginata</i>	50	no
12	-31.0767297	115.9971914	<i>Eucalyptus marginata</i>	65	no
13	-31.0766568	115.9979059	<i>Eucalyptus marginata</i>	75	no
14	-31.0766354	115.9973477	<i>Eucalyptus marginata</i>	70	no
15	-31.0766266	115.998044	<i>Eucalyptus marginata</i>	65	no
16	-31.07661041	115.9972784	<i>Eucalyptus marginata</i>	90	no
17	-31.0764047	115.9992402	<i>Eucalyptus marginata</i>	60	no
18	-31.07627702	115.9992313	<i>Eucalyptus marginata</i>	50	no
19	-31.07619001	115.9985065	<i>Eucalyptus marginata</i>	80	no

Tree No.	Latitude	Longitude	Taxa	DBH (cm)	Suitable hollows
20	-31.0761768	115.9977964	<i>Eucalyptus marginata</i>	85	no
21	-31.07617565	115.9983925	<i>Eucalyptus marginata</i>	90	no
22	-31.0761597	115.9979079	<i>Eucalyptus marginata</i>	50	no
23	-31.07614148	115.9986768	<i>Eucalyptus marginata</i>	200	yes
24	-31.07613631	115.9981092	<i>Eucalyptus marginata</i>	90	no
25	-31.07609841	115.9981997	<i>Eucalyptus marginata</i>	90	no
26	-31.06102342	116.011083	<i>Corymbia calophylla</i>	100	no

Black Cockatoos breed in large hollow-bearing trees, generally within woodlands or forests (Johnstone et al. 2011). The size of the tree can be a useful indication of the hollow-bearing potential of the tree. Trees of suitable DBH are potentially important for maintaining breeding in the long-term, through maintaining the integrity of the habitat and allowing trees to provide future nest hollows. Maintaining the long-term supply of trees of a size to provide suitable nest hollows is particularly important in woodland stands that are known to support Black Cockatoo breeding (DSEWPac 2012).

The Black Cockatoo habitat assessment revealed that the survey area contains *Eucalyptus marginata* (Jarrah), and *Corymbia calophylla* (Marri) which have reached a size that are potential future hollow bearing trees, therefore potential breeding trees (i.e. >500 mm) according to both the current EPBC Act Black Cockatoo referral guidelines. In total, 26 trees were recorded which met the criteria to be classed as a potential breeding tree. This suggests that these trees may develop hollows and have the potential to be use for breeding in the future. To be suitable for Black Cockatoos, the hollow entrances need to be greater than 120 mm diameter. Observations indicated two trees contained hollows of a size and orientation suitable for nesting by black cockatoo species (Plate 1 and Plate 2). The depth of both hollows was not able to be confirmed by on-ground observations.

Roosting Habitat

Twenty-six trees suitable for black cockatoo roosting were identified in the survey area, including 25 *Eucalyptus marginata*, and one *Corymbia calophylla*. The nearest water source is 3 km east of the identified roosting habitat. Given preferred roosts are generally located within 2km of a water resource, and the presence of roosting habitat adjacent to permanent water sources nearby, the potential roosting trees within the Survey area are unlikely to be used preferentially.

Summary

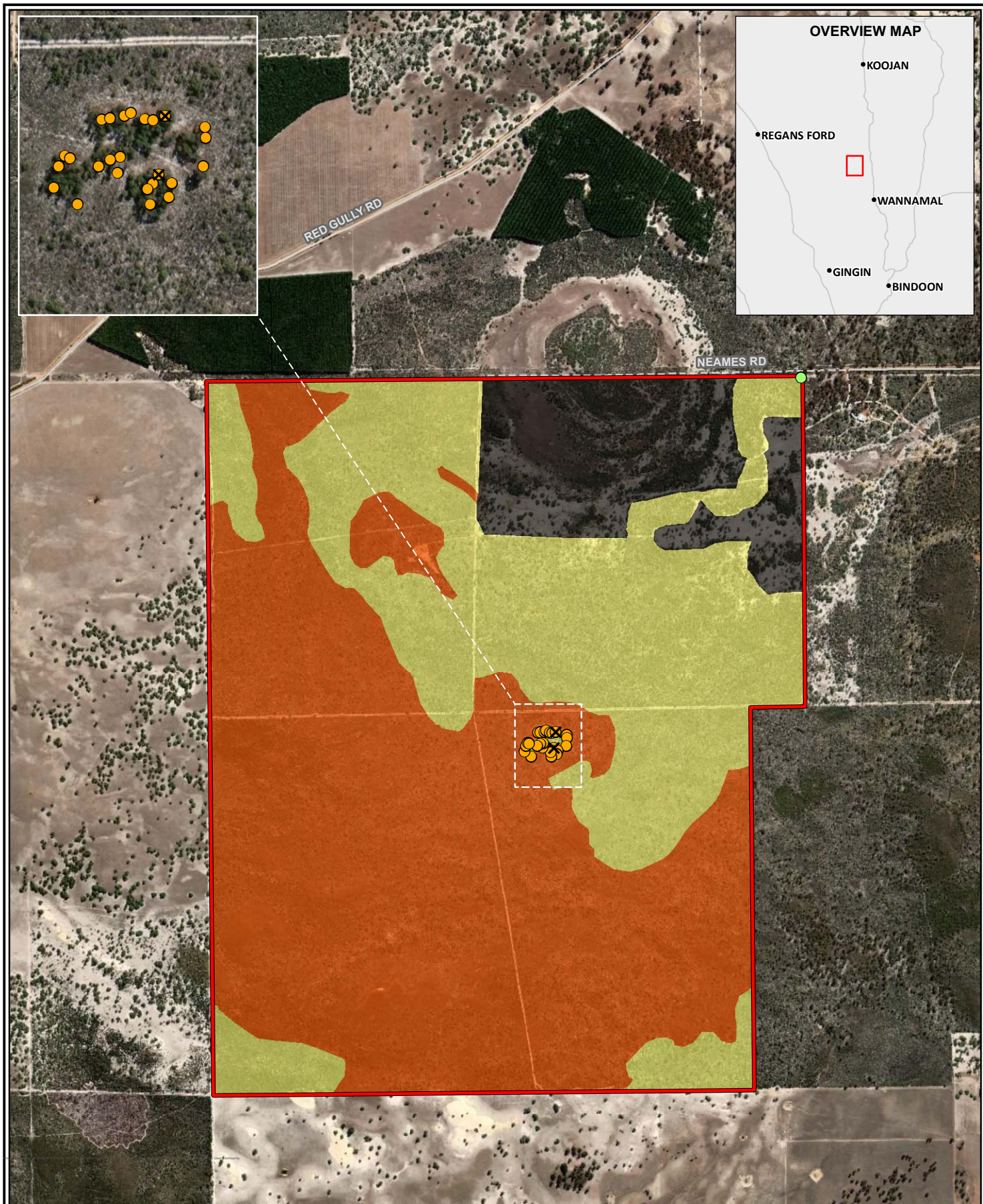
The key results from the Black cockatoo habitat survey were:

- 317
- - two potentially suitable hollows.

References

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- DBCA. (2020). Black Cockatoo Roosting Sites - Buffered (DBCA-064). Department of Biodiversity, Conservation and Attractions. <https://catalogue.data.wa.gov.au/dataset/black-cockatoo-roosting-sites-buffered>

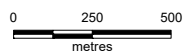
- DSEWPaC. (2012). *EPBC Act referral* guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*. Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australian Capital Territory.
- Johnstone, R.E., Johnstone, C. and Kirkby, T. (2011). Black Cockatoos on the Swan Coastal Plain. Report for the Department of Planning, Western Australia.
- Keighery B., (1994). Bushland Plant Survey: A Guide to Plant Community Survey for the Community, Wildflower Society, Floreat.
- Peck, A., Barrett, G. and Williams, M. (2016). The 2016 Great Cocky Count: A community-based survey for Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*). BirdLife Australia and Department of Parks and Wildlife, Perth, Western Australia.



Legend:

 Survey area	Habitat trees
Fauna habitat	● <i>Corymbia calophylla</i>
 Nil	● <i>Eucalyptus marginata</i>
 Low	X Suitable hollows
 Moderate	— Minor road
	--- Track

Scale 1:24,000 at A4



Coord. Sys. GDA 1994 MGA Zone 50



Job No: 56799

Client: Qube

Version: A

Date: 10-Nov-2020

Drawn By: cthatcher

Checked By: TS

Lot 310 and Lot 300 Neames Road
Mogumber, WA

BLACK COCKATOO HABITAT

FIGURE 1





Plate 1: Potential suitable hollow



Plate 2: Potential suitable hollow

Attachment A: Habitat scoring system (Bamford 2018)

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 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.

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

- Determining a score out of six for the vegetation composition, condition and structure; plus
- Determining a score out of three for the context of the site; plus
- Determining a score out of one for species density.
- Determining the total score out of 10, which may require moderation for context and species density with respect to the vegetation composition.

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

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).	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 partly vegetated with melons or other known food-source weeds (e.g. <i>Erodium</i> 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.
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. <i>Erodium</i> 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, <i>Eucalyptus caesia</i> and <i>E. erythrocorys</i> .

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).
4	Moderate foraging value. Examples: Woodland/forest with tree banksias 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 Forest with 40-60% projected foliage cover; Banksia Forest 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.	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.
6	High foraging value. Example: Banksia 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).	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).

Site context.

The maximum score is given in situations where foraging habitat is supporting breeding birds. It can also be given in fragmented landscapes where there is little foraging habitat remaining and thus what is left has a high contextual value. The site context score is species-specific as it depends upon factors such as the vegetation type and extent, and the presence of breeding birds, and the following table, developed by Bamford consulting in conjunction with DEE, provides a *guide* to the

assignment of site context scores (note that 'local area' is defined as within a 15 km radius of the centre point of the study site).

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%	< 0.1%

Species density.

Assignment of the species density score (0 or 1) is based upon the black-cockatoo species being either abundant or not abundant, and is species specific. 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.

Note that context and species density scores are affected by the vegetation score and this is discussed below.

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

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 the Environment and Energy (DoEE) 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 DoEE offsets guide but the scoring approach was developed by Bamford Consulting Ecologists.

- 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.

Foraging value can thus be assigned a score out of six, based upon site vegetation characteristics, or a score out of 10 if context and species density are considered. Assigning a score out of 10 represents step D and may require moderation rather than simple addition.

The score out of six for vegetation characteristics and value can be compared across a site, while a score out of 10 is the overall foraging value and is used for the purposes of aiding offset calculations. 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 assigning a context and species density score of zero to with a characteristic 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 (≥ 3). The approach to calculating a score out of 10 can be summarised as follows.

vegetation composition, condition and structure score	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

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