

# Carnaby's Black-Cockatoo habitat assessment

## Jurien



Banksia woodland in project area (photo taken from Umwelt 2023)

Prepared for: Tronox Limited  
Mason Road  
KWINANA BEACH WA 6167

Prepared by: Amanda Kristancic, Natalia Huang and Mike Bamford  
**M.J. & A.R. BAMFORD CONSULTING ECOLOGISTS**  
23 Plover Way  
KINGSLEY WA 6026



17<sup>th</sup> April 2024

## Executive Summary

Bamford Consulting Ecologists (BCE) was commissioned by Tronox Limited (Tronox) to conduct a black-cockatoo habitat assessment for two small patches of native vegetation (the project area, c. 0.1 ha combined) to support future clearing permit applications. The project area is located c. 15 km east of Jurien Bay and is comprised primarily of *Banksia* woodland. A detailed vegetation survey was recently conducted in the project area (Umwelt 2023) and BCE used this information to support its Carnaby's Black-Cockatoo foraging, breeding and roosting assessment of the project area.

The project area is out of range for the Forest Red-tailed Black-Cockatoo and Baudin's Black-Cockatoo and, as such, Carnaby's Black-Cockatoo is the only black-cockatoo expected to occur in the project area. Carnaby's Black-Cockatoo is listed as Endangered under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* (EPBC Act) and falls under Schedule 2 Division 2 (Endangered) of the Western Australian *Biodiversity Conservation Act 2016* (BC Act). The species is expected to occur as a regular visitor in the project area.

Based on the vegetation assessment by Umwelt (2023), suitable foraging habitat for Carnaby's Black-Cockatoo is present within vegetated parts of the project area, in the form of *Banksia* species, but no suitable species for nesting or roosting trees are present in the project area.

### Summary of black-cockatoo assessment

- Foraging value – overall the vegetation within the project area is of moderate foraging value for Carnaby's Black-Cockatoo. Foraging scores ranged from 6/10 for the *Banksia* woodland in good condition (VSA 1), to 2/10 for the *Banksia* woodland in degraded condition (VSA 2). Cleared areas (VSA 3) were of no foraging value for Carnaby's Black-Cockatoo.
- Breeding value – there are no suitable nesting tree species in the project area. According to the protected matters search tool, breeding is known to occur within 15 km. However, the closest known breeding sites are 23 km from the project area, according to the publicly available DBCA database.
- Roosting value – there are no suitable roosting tree species in the project area. There are six confirmed roosts within 15 km, two of which are within c. 4-9 km of the project area and were last confirmed used in 2022.

### **Review against the Native Vegetation Clearing Principles**

The amount of foraging habitat proposed to be cleared is under the 1 ha threshold (DAWE, 2022) and it is therefore unlikely that an EPBC referral will be required. A clearing permit will be required, therefore the proposed clearing was assessed against the fauna-related Native Vegetation Clearing Principles as per Schedule 5 of the EP Act. The project is not considered to be at variance with any of the Principles assessed.

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# 1 Background

Bamford Consulting Ecologists (BCE) was commissioned by Tronox Limited (Tronox) to conduct a black-cockatoo habitat assessment for two small patches of native vegetation (the project area) to support future clearing permit applications. This consists of a foraging, breeding and roosting assessment. The project area is located c. 15 km east of Jurien Bay and is comprised primarily of Banksia woodland.

A detailed vegetation survey was recently conducted in the project area (Umwelt 2023) and this was used by BCE personnel to support a desktop assessment of foraging values for Carnaby's Black-Cockatoo, with a site inspection being considered unnecessary. It is not expected that the project area will contain any breeding or roosting sites given the lack of tall trees, and the amount of potential foraging habitat (for Carnaby's Black-Cockatoo) proposed to be cleared is less than 0.32 ha (as per Umwelt 2023). As such, it is considered unlikely that an EPBC referral will be required. However, the action will be subject to approval under the Native Vegetation Clearing Permit and is therefore assessed against the Native Vegetation Clearing Principles that are of relevance to Carnaby's Black-Cockatoo.

This report presents the results of the black-cockatoo habitat assessment and a review of the Native Vegetation Clearing Principles that relate to the Carnaby's Black-Cockatoo in the project area.

## 1.1 Carnaby's Black-Cockatoo

The project area is out of range for the Forest Red-tailed Black-Cockatoo and Baudin's Black-Cockatoo and, as such, Carnaby's Black-Cockatoo is the only black-cockatoo expected to occur in the project area. The project area is within the species' range, and the species is known from within 15 km of the project area. Carnaby's Black-Cockatoo is listed as Endangered under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* (EPBC Act) and falls under Schedule 2 Division 2 (Endangered) of the *Western Australian Biodiversity Conservation Act 2016* (BC Act). The species is expected to occur as a regular visitor in the project area.

### 1.1.1 Guidelines

The Department of Climate Change, Energy, the Environment and Water (DCCEEW, formerly DAWE) provides guidelines for the referral of actions that may result in impacts to black-cockatoos (for assessment under the EPBC Act) (DAWE, 2022). The assessment reported here have been conducted with reference to both the referral guidelines provided by DSEWPaC (2012) and DAWE (2022) and recommendations listed on the DCCEEW's Species Profile and Threats Database (DCCEEW, 2023b, 2023d, 2023c). 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). Actual scoring of foraging value was based on systems developed by BCE that are outlined below in Section 2.1.1 and detailed in Appendix 1. The Department of Biodiversity, Conservation and Attractions (DBCA) has indicated that the methods developed and applied previously by BCE are an acceptable approach.

## 1.2 Project area

The project area is made up of two very small areas of remnant vegetation and cleared land that are c. 0.1 ha in size (combined, size calculated from shapefile provided by client) and located approximately 200 km north of Perth, near Jurien Bay (Figure 1-1). This is in the Midwest region (DBCA, 2023b), and within the Perth subregion (SWA02) of the Swan Coastal Plain bioregion (Interim Biogeographic Regionalisation of Australia (DCCEEW, 2023a)). The most recent version, IBRA v7 (DCCEEW, 2023a), recognises 27 bioregions within Western Australia, which are classified on the basis of climate, geology,

landforms, vegetation and fauna (Thackway & Cresswell, 1995). The Swan Coastal Plain bioregion is a low lying coastal plain, with woodlands the predominant vegetation type, and dominant species comprising Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas (Mitchell *et al.*, 2003). The Swan Coastal Plain bioregion falls into the Southern Climatic Region (EPA, 2020) and the climate of the Perth subregion is Mediterranean (Mitchell *et al.*, 2003). Average rainfall for the station closest to the project area is 547 mm (Station: Jurien Bay, Number 009131, BOM, 2023).

The dominant land uses within the Perth (SWA02) subregion are Cultivation (both dry land agriculture, and irrigated horticulture, agriculture and plantations), Conservation, UCL and Crown reserves, Urban, Rural residential, Forestry plantations, Roads and other easements and Grazing (improved pastures), with smaller areas of Mining and Defence lands (Mitchell *et al.*, 2003). The project area is within a road reserve comprised of remnant vegetation surrounded by areas cleared for agriculture and mining and large areas of native vegetation (most of which exists in protected terrestrial reserves). Existing development within 15 km consists of cleared land for agriculture, mining and residential use and a network of sealed and unsealed roads.

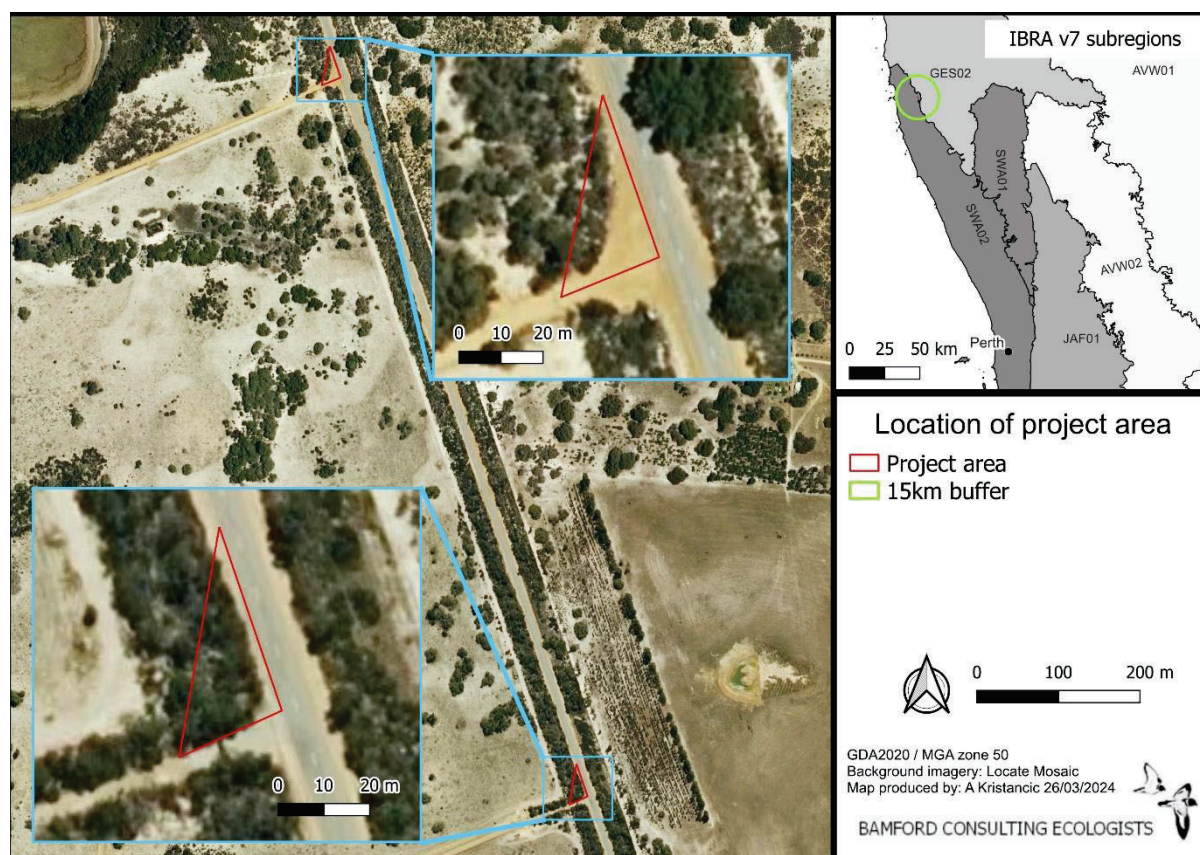


Figure 1-1. Location and overview of the project area.

### 1.3 Recognised sensitive sites

A number of recognised sensitive sites occur within 15 km of the project area, including Threatened Ecological Communities (TECs) (DBCA, 2023c, 2023d) and Environmentally Sensitive Areas (ESAs) (DWER, 2023b, 2023a), some of which are also protected terrestrial reserves (DCCEEW, 2020, 2023e).

The project area overlaps with a TEC, believed by Umwelt (2023) to be the Banksia Woodlands of the Swan Coastal Plain ecological community, which is Priority 3 under the WA BC Act and Endangered under the EPBC Act.

## 2 Methods

### 2.1 Black-cockatoo assessment

#### 2.1.1 Foraging

The foraging value of the project area was assessed by calculating a foraging score for areas of similar vegetation type/condition, based on the vegetation assessment conducted by Umwelt (2023). The report provided by Umwelt (2023) is very detailed with photographs and detailed descriptions of each area, so it was considered sufficient information on which to base a foraging assessment. BCE uses the concept of Vegetation and Substrate Associations (VSAs) to describe these areas of similar vegetation type/condition. VSAs combine vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna.

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 DCCEEW, the state Department of Water and Environmental Regulation (DWER) and the WA Environmental Protection Authority (EPA) 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 in Appendix 1. These three components are drawn from the DCCEEW offset calculator (**DCCEEW, undated**) but with the scoring approach developed by BCE:

- 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 (the Habitat Quality core; HQS) if context and species density are also considered. A higher score represents better foraging value. A score out of 10 is presented for the purposes of aiding offset calculations.

#### 2.1.2 Breeding and Roosting

The Protected Matters Search Tool was used to obtain information regarding the status of Carnaby's Black-Cockatoo within 15 km of the project area. The publicly available database of black-cockatoo breeding sites (DBCA, 2023a) and BirdLife Australia's black-cockatoo roosting dataset (BirdLife Australia, 2023) were queried for known black-cockatoo breeding and roosting sites within 15 km of the project area and these are presented in the relevant section below.

## 3 Results

### 3.1 Black-cockatoo habitat assessment

#### 3.1.1 Black-cockatoo presence

Carnaby's Black-Cockatoo is known from the area, with eleven records of individuals or flocks (of up to 120 birds) within 15 km of the project area (ALA, 2024) and 'breeding known to occur' within this 15 km buffer (DCCEEW, 2023e).

#### 3.1.2 Foraging value (Habitat Quality Score (HQS))

One broad vegetation type (Banksia Woodland) was identified by Umwelt (2023) and the project area also contained areas of already cleared land. The Banksia Woodland (Umwelt VT1) is mostly in good condition, with a small strip described as 'degraded'; Umwelt noted that this patch appears to have been historically cleared and has re-grown to some extent. For the purpose of foraging assessment for Carnaby's Black-Cockatoo, three VSAs were identified by BCE within the project area:

##### VSA 1: Banksia Woodland (Umwelt VT1) in good condition

Low woodland dominated by *Banksia attenuata*, *Banksia prionotes* and *Banksia menziesii* over mixed, non-proteaceous shrubland over low open sedgeland on white-grey sand.

##### VSA 2: Banksia Woodland (Umwelt VT1) in degraded condition.

Vegetation dominated by *Daviesia divaricata* and *Acacia rostellifera* with scattered natives (*Banksia prionotes*, *Adenanthos cygnorum*, *Hibbertia hypericoides* subsp. *hypericoides*, *Verticordia densiflora*) over understorey dominated by weeds, on white-grey sand. Likely previously cleared and regrown.

##### VSA 3: Cleared Areas.

Areas devoid of vegetation; previously cleared for access roads.

Foraging habitat for Carnaby's Black-Cockatoo was present throughout most of the vegetation within the project area, due to the presence of *Banksia* tree species including *Banksia attenuata*, *B. prionotes* and *B. menziesii*. The foraging value of the majority of vegetation (VSA 1: Banksia Woodland in good condition) was 6/10, thus the site is of moderate foraging value for this species. The remaining area of vegetation (VSA 2: Banksia Woodland in degraded condition) had very low foraging value for Carnaby's Black-Cockatoo, with a score of 2/10. Cleared areas (VSA 3) offer no foraging value for Carnaby's Black-Cockatoo and thus received a score of zero for all components.

The foraging scores for Carnaby's Black-Cockatoo for each vegetation type are presented in **Error! Reference source not found.** and Figure 3-1, and details regarding the different components (vegetation condition, context and stocking rate) are described in detail in Sections 3.1.2.1, 3.1.2.2 and 3.1.2.3.

The overall (rounded) weighted habitat quality score (HQS) for vegetation within the project area (excluding cleared areas) is 6/10.

Table 3-1. Foraging scores for each VSA for Carnaby's Black-Cockatoo

Vegetation and Substrate Association	Area (ha)	% of total vegetation	Veg'n (/6)	Context (/3)	Density (/1)	HQS (/10)
Banksia Woodland – good condition	0.037	80	4	1	1	6
Banksia Woodland – degraded	0.009	20	1	0	1	2
Cleared Areas	0.056	n/a	0	0	0	0
<b>Total</b>	0.102		Rounded weighted average HQS			<b>6/10</b>

### 3.1.2.1 Vegetation condition score

The project area consists primarily of VSA 1 (Banksia Woodland in good condition), which was estimated to contain a projected foliage coverage of suitable foraging species (*Banksia* spp.) of 20-40 %, resulting in a vegetation condition score of 4/6. The small area of VSA 2 (Banksia Woodland in degraded condition) was considered to be of negligible to low foraging value. Although there are scattered *Banksia prionotes*, this patch was dominated by *Acacia rostellifera* and *Daviesia divaricata* (Umwelt, 2023) which do not provide foraging value. It was therefore given a vegetation condition score of 1/10. Cleared areas can provide some limited foraging value, but were assigned no value as they are extremely extensive in the region.

### 3.1.2.2 Calculation of context score

For VSA 1, a context score of 1/3 was given. This is higher than suggested by the extensive foraging habitat within 15 km (see Appendix 1) but provides recognition that this patch of moderate foraging value vegetation is important on a local scale. This is because it is adjacent to cleared land on either side and is part of a corridor of native vegetation that links larger patches of remnant vegetation to the north and south. For VSA 2, the vegetation score was negligible to low, and so a context score of 0/3 was given. This recognises that this patch of vegetation, while providing some foraging value, is less important in the local landscape given the abundance of higher quality foraging habitat nearby.

### 3.1.2.3 Species density score

Carnaby's Black-Cockatoo is known to occur within the region and is expected to visit the project area regularly to forage. A species density score of 1 was therefore given for VSA 1 and VSA 2 as both provide foraging habitat.



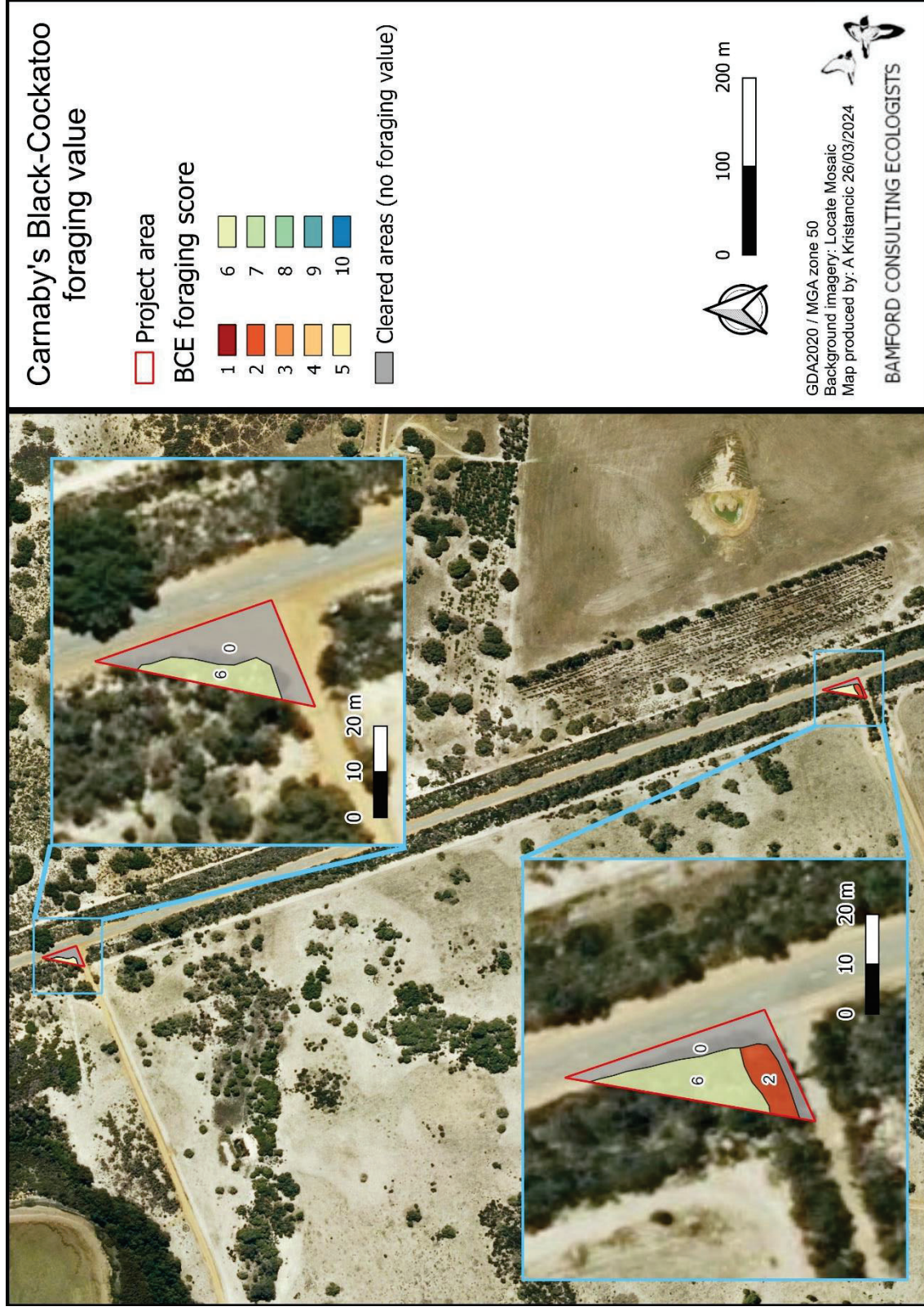


Figure 3-1-1. Distribution of foraging scores (HOS out of 10) for Carnaby's Black-Cockatoo.

### ***3.1.3 Black-cockatoo breeding***

Based on the vegetation assessment by Umwelt (2023), there are no hollow-bearing trees present in the project area. According to the Protected Matters Search Tool (DCCEEW, 2023e) breeding by Carnaby's Black-Cockatoo is known to occur within a 15 km buffer around the project area. However, there are no known breeding sites in this buffer based on publicly available records from DBCA (2023a); the closest known breeding sites in this publicly available dataset are c. 23 km north of the project area (DBCA, 2023a), as shown on Figure 3-2.

### ***3.1.4 Black-cockatoo night roosting***

Based on the vegetation assessment by Umwelt (2023) there are no large trees in the project area that would be suitable for night roosting by Carnaby's Black-Cockatoo.

There are six confirmed roosts within c. 15 km of the project area (BirdLife Australia, 2023). Two of these are within c. 4-9 km of the project area and both were last confirmed used in 2022. The other four are c. 13-15 km from the project area; three of these were surveyed in 2022 and no birds were counted, while the other has not been surveyed since 2015 (when 11 birds were counted). Note that the dataset available (BirdLife Australia, 2023) contains data up to 2022; therefore these roosting sites may have been surveyed and/or confirmed used in 2023. Known roost locations within the region are shown on Figure 3-3.



Figure 3-2. Known breeding sites in the region.

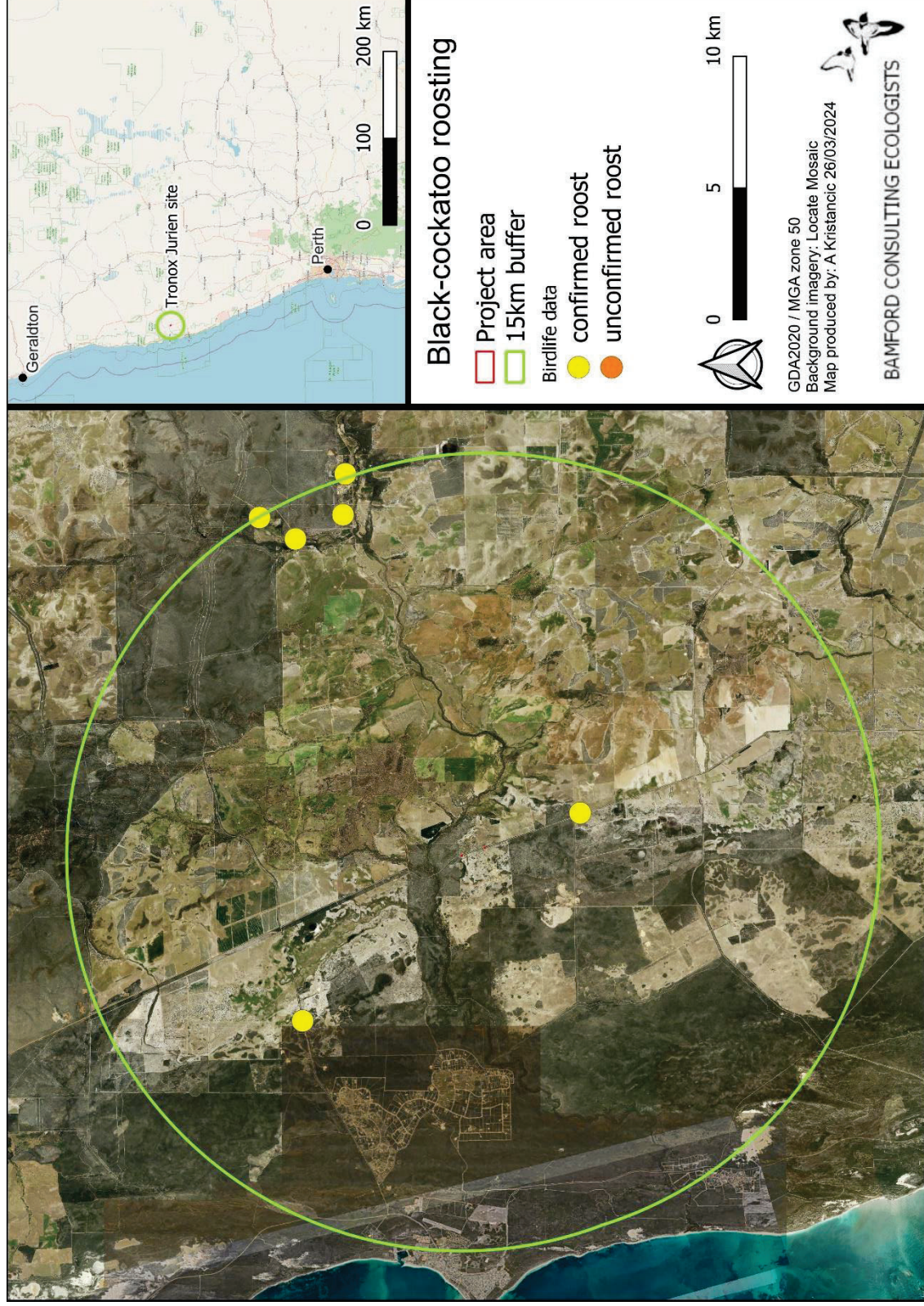


Figure 3-3. Known black-cockatoo roost locations within 15 km.

## 4 Review against Native Vegetation Clearing Principles

The project area is discussed here with regard to the fauna-related Clearing Principles as listed in Schedule 5 of the Environmental Protection Act (WA) 1986 (EP Act). For each of the Clearing Principles, a general statement is made on how the fauna values of the project area relate to that Clearing Principle, with further discussion providing the basis for this general statement.

Principles for clearing native vegetation under Schedule 5 of the EP Act:

**Native vegetation should not be cleared if –**

**a) it comprises a high level of biological diversity.**

The project is considered not to be at variance with this Principle.

It is not expected that these small patches of remnant *Banksia* woodland comprise a high level of faunal diversity, especially when compared with nearby remnants which are much larger and of better condition.

**b) it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.**

The project is considered not to be at variance with this Principle.

The project area provides foraging habitat for black-cockatoos, which does represent part of a significant habitat for fauna indigenous to Western Australia. However, the patches of foraging habitat are extremely small and extensive similar habitat is present in the surrounding landscape, therefore the impact of the removal of these small areas is considered negligible on a local and regional scale.

**c) it includes, or is necessary for the continued existence of, rare flora**

Not assessed by BCE.

**d) it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community**

Not assessed by BCE.

**e) it is significant as a remnant of native vegetation in an area that has been extensively cleared**

The project is considered not to be at variance with this Principle.

Although the project area is part of a remnant of vegetation in a region that is extensively cleared, it is very small, especially in comparison with other patches of remnant vegetation nearby.

**f) it is growing in, or in association with, an environment associated with a watercourse or wetland**

The project is considered not to be at variance with this Principle.

The vegetation of the project area is not closely associated with a watercourse or wetland.

**g) the clearing of the vegetation is likely to cause appreciable land degradation**

The project is considered not to be at variance with this Principle.

The project area is very small, and clearing of this vegetation is not likely to cause appreciable land degradation.

**h) the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area**

The project is considered not to be at variance with this Principle.

The project area is very small, and clearing of this vegetation is not likely to have an impact on adjacent or nearby conservation areas.

- i) **the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water**

Not assessed by BCE.

- j) **the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.**

Not assessed by BCE.

## **5 Summary**

The project area consists of two very small remnants of Banksia woodland, which represent moderate foraging value for Carnaby's Black-Cockatoo, with the majority of the vegetation having a Habitat Quality Score of 6/10, and one small section having a score of 2/10. There are no potential breeding or roosting sites within the vegetation proposed to be cleared, based on the plant species identified in the vegetation and flora assessment by Umwelt (Umwelt 2023). The amount of foraging habitat proposed to be cleared is under the 1 ha threshold (DAWE 2022) and it is therefore unlikely that a referral will be required. The project is not considered to be at variance with any of the Native Vegetation Clearing Principles assessed.

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## 7 Appendices

### Appendix 1. Scoring system for the assessment of foraging value of vegetation for Black-Cockatoos.

Bamford Consulting Ecologists. Revised 4<sup>th</sup> April 2021

#### Introduction

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

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

Note that the scoring system can only be applied within the range of the species or at least where the species could reasonably be expected to occur based upon existing information.

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

- A. Site condition. Determining a score out of six for the vegetation composition, condition and structure; plus
- B. Site context. Determining a score out of three for the context of the site; plus
- C. Species stocking rate. Determining a score out of one for species density.
- D. Determining the total score out of 10, which may require moderation for context and species density with respect to the site condition (vegetation) score. Moderation also includes consideration of pine plantations as a special case for foraging value.

The BCE scoring system places the greatest weight on site condition (scale of 0 to 6) because this has the highest influence on the foraging values of a site, which in turn is the fundamental driver in meeting ecological requirements for continued survival.

Site context has a lower weight (scale of 0 to 3) in recognition of the mobility of the species, which means they can access good foraging habitat even in fragmented landscapes, but allowing for recognition of the extent of available habitat in a region and context in relation to activity (such as breeding and roosting). The application of scoring site context is further discussed below.

Species stocking rate is given a low weight (0 to 1) as it is a means only of recognising that a species may or may not be abundant at a site, but that abundance is dependent upon site condition and context and is thus not an independent variable. The abundance of a species is also sensitive to sampling effort, and to seasonal and annual variation, and is therefore an unreliable indicator of actual importance of a site to a species.

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

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

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
0	<p>No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> <li>• Water bodies (e.g. salt lakes, dams, rivers);</li> <li>• Bare ground;</li> <li>• Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits) or with vegetation of no food value, such as some suburban landscapes.</li> <li>• Mown grass.</li> </ul> <p>Negligible to low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Scattered specimens of known food plants but projected foliage cover of these is &lt; 2%. This could include urban areas with scattered foraging trees;</li> <li>• Paddocks that are lightly 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;</li> <li>• Blue Gum plantations (foraging by Carnaby's Black-Cockatoos has been reported but appears to be unusual).</li> </ul>	<p>No foraging value. No eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> <li>• Water bodies (e.g. dams, rivers);</li> <li>• Bare ground;</li> <li>• Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).</li> </ul>	<p>No foraging value. No eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> <li>• Water bodies (e.g. dams, rivers);</li> <li>• Bare ground;</li> <li>• Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).</li> </ul>
1	<p>Negligible to low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Scattered specimens of known food plants but projected foliage cover of these is &lt; 2%. This could include urban areas with scattered foraging trees;</li> <li>• Paddocks that are lightly 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;</li> <li>• Blue Gum plantations (foraging by Carnaby's Black-Cockatoos has been reported but appears to be unusual).</li> </ul>	<p>Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these &lt; 1%. This could include urban areas with scattered foraging trees.</p>	<p>Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these &lt; 1%. Could include urban areas with scattered foraging trees.</p>

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
2	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Shrubland in which species of foraging value, such as shrubby banksias, have &lt; 10% projected foliage cover;</li> <li>• Woodland with tree banksias 2-5% projected foliage cover;</li> <li>• Woodland with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with &lt;10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Open eucalypt woodland/mallee of small-fruited species;</li> <li>• 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.</li> </ul>	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Woodland with scattered specimens of known food plants (e.g. Marri and Jarrah) 1-5% projected foliage cover;</li> <li>• Marri-Jarrah Woodland with &lt;10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Parkland-cleared Eucalypt Woodland/Forest with known food plants &lt;10% projected foliage cover (poor long-term viability without management);</li> <li>• Younger areas of (managed) revegetation with known food plants &lt;10% projected foliage cover (establishing food sources with good long-term viability);</li> <li>• Urban areas with scattered foraging trees.</li> </ul>	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Woodland with scattered specimens of known food plants (e.g. Marri, Jarrah) 1-5% projected foliage cover;</li> <li>• Marri-Jarrah Woodland with &lt;10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Sheoak Woodland with &lt;10% projected foliage cover;</li> <li>• Parkland-cleared Eucalypt Woodland/Forest with known food plants &lt;10% projected foliage cover (poor long-term viability without management);</li> <li>• Younger areas of (managed) revegetation with known food plants &lt;10% projected foliage cover (establishing food sources with good long-term viability);</li> <li>• Urban areas with scattered food plants such as Cape Lilac, <i>Eucalyptus caesia</i> and <i>E. erythrocarys</i>.</li> </ul>

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
3	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Shrubland in which species of foraging value, such as shrubby banksias, have 10-20% projected foliage cover;</li> <li>• Woodland with tree banksias 5-20% projected foliage cover;</li> <li>• Woodland with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Eucalypt Woodland/Mallee of small-fruited species;</li> <li>• Eucalypt Woodland with Marri &lt; 10% projected foliage cover.</li> </ul>	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Eucalypt Woodland with known food plants (especially Marri) 5-20% projected foliage cover;</li> <li>• Marri-Jarrah Woodland with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management);</li> <li>• Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).</li> </ul>	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Eucalypt Woodland with known food plants (especially Marri and Jarrah; also Pricklybark (Coastal Blackbutt) where it occurs in Banksia Woodlands) 5-20% projected foliage cover;</li> <li>• Marri-Jarrah Woodland with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Sheoak Forest with 10-40% projected foliage cover;</li> <li>• Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management);</li> <li>• Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).</li> </ul>

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
4	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Woodland/low forest with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) 20-40% projected foliage cover;</li> <li>• Woodland/low forest with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover;</li> <li>• Eucalypt Woodland/Forest with Marri 20-40% projected foliage cover.</li> </ul>	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover;</li> <li>• Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Parkland-cleared Eucalypt Woodland/Forest with known food plants 40-60% projected foliage cover (poor long-term viability without management);</li> <li>• Younger areas of (managed) revegetation with known food plants 40-60% projected foliage cover (establishing food sources with good long-term viability);</li> <li>• Orchards with highly desirable food sources (e.g. apples, pears, some stone fruits).</li> </ul>	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover;</li> <li>• Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Sheoak Forest with 40-60% projected foliage cover;</li> <li>• Parkland-cleared Eucalypt Woodland/Forest with known food plants 40-60% projected foliage cover (poor long-term viability without management);</li> <li>• Younger areas of (managed) revegetation with known food plants 40-60% projected foliage cover (establishing food sources with good long-term viability).</li> </ul>

Site Score	Description of Vegetation Values	
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo
5	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with 40-60% projected foliage cover;</li> <li>• Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with &gt; 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 40-60% projected foliage cover;</li> <li>• Marri-Jarrah Forest with 40-60% 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).</li> <li>• Pine plantations with trees more than 10 years old (but see pine note below in moderation section).</li> </ul>	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Marri-Jarrah Forest with 40-60% projected foliage cover;</li> <li>• Marri-Jarrah Forest with &gt; 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Sheoak Forest with &gt; 60% projected foliage cover;</li> <li>• Parkland-cleared Eucalypt Woodland/Forest with known food plants &gt;60% projected foliage cover (poor long-term viability without management);</li> <li>• Younger areas of (managed) revegetation with known food plants &gt;60% projected foliage cover (establishing food sources with good long-term viability).</li> </ul>



Site Score	Description of Vegetation Values	
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo
6	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> <li>Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with &gt; 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).</li> <li>Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have &gt;60% projected foliage cover;</li> <li>Marri-Jarra Forest with &gt; 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).</li> </ul>	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> <li>Marri-Jarra Forest with &gt; 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).</li> </ul>
		<p>High foraging value. Example:</p> <ul style="list-style-type: none"> <li>Marri-Jarra Forest with &gt; 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).</li> </ul>

Vegetation structural class terminology follows Keighery (1994).

### A. Site context.

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

The maximum score for site context is 3, and because it is effectively a function of presence/absence of nearby breeding and the distribution of foraging habitat across the landscape, the following table, developed by Bamford Consulting in conjunction with the Department of the Environment and Energy (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. This is greater than the maximum distance of 12 km known to be flown by Carnaby's Black-Cockatoo when feeding chicks in the nest.

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

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

### B. Species density (stocking rate).

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

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

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

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

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

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

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

### Pine plantations

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

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

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

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

proportion of foraging habitat (>5% if breeding occurs; >10% if no breeding), but where pines are a small part of the foraging landscape they will receive a context score of less than this.

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

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