BASIC FAUNA AND TARGETED BLACK COCKATOO SURVEY REPORT

CBH Nyabing Receival Bin

Lot 9231 Bin Rd, Nyabing WA 6341

Final v. 1

16/01/2024

BUSHFIRE | ENVIRONMENTAL | WATER | GIS

DOCUMENT CONTROL

Title: Basic Fauna and Targeted Black Cockatoo Survey Report – CBH Nyabing
Author (s): [redacted]
Reviewer (s): [redacted]
Job No.: CBH0026-005
Client: Cooperative Bulk Handling

REVISION RECORD

Revision	Summary	Prepared By	Reviewed By	Date
Draft v.1	Internal QA and fauna technical review	[redacted]		15/12/2023
Draft v.1	Internal QA review			12/01/2024
Final v.1	Approval review			16/01/2024

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Executive Summary

Cooperative Bulk Handling (CBH; the client), commissioned Bio Diverse Solutions as Environmental Consultants to undertake a spring basic fauna and targeted black cockatoo survey of the proposed development areas around the intersections of the CBH Nyabing receival site (4.15 ha). The site is situated in the township of Nyabing in the Shire of Kent. This survey was required to assess the potential impact of the proposed development on fauna in the area and on potential breeding, roosting and foraging habitat for black cockatoos, as part of the targeted component of this survey.

Four different fauna habitats were identified within the survey area; 1: Euclox OW; 2: Eucsal OW; 3: SamShr; and 4: MMMSL. During the survey 13 fauna taxa were recorded, including seven birds, two insects and four mammals; of the detected taxa, four are introduced. There were some habitat constraints that limited the occupancy of the survey area by native species; primarily the high presence of introduced species.

The desktop assessment identified 33 Threatened or Priority species within the study area. The pre-survey Likelihood of Occurrence (LOO) identified one species as 'Likely' to occur, and four species as 'Possible' to occur. The post-survey LOO identified three species; Carnaby's Cockatoo, southern whiteface and western rosella, as 'Possible' to occur. Of the fauna habitat units present Eucsal OW, Euclox OW and MMMSL provided some suitable habitat for the above species.

No evidence of black cockatoo breeding, foraging or roosting was observed. A total of 61 significant trees were identified during the survey, of which 12 were hollow-bearing. Based on Carnaby's Cockatoo tree hollow size preference (between 100 mm – 650 mm in diameter) and availability of hollow (not occupied by bees), ten hollow bearing trees were judged to be suitable for use by Carnaby's Cockatoo.

The habitat present was considered to be "Low quality" foraging habitat. The quality of the roosting habitat present is reduced by the lack of quality foraging habitat. Results from application of the 'Foraging Habitat Tool" (Bamford Consulting Ecologists, 2020) indicate that foraging habitat for Carnaby's Cockatoo, within the survey area fall within the category of 'Low quality'.

1. Introduction, Scope and Background Information

Cooperative Bulk Handling (CBH), herein referred to as "the client" commissioned Bio Diverse Solutions as Environmental Consultants to undertake a spring basic fauna and targeted black cockatoo survey of the proposed development areas around the intersections of their Nyabing receival site.

The purpose of the survey is to provide environmental assessment data. It is preceded by a *'Reconnaissance Flora and Vegetation Survey Report'* (BDS, 2023a), an additional '*Reconnaissance Flora and Vegetation Survey* Report' (BDS, 2023b) of intersections at the site, a *'Targeted Flora Survey Report'* (BDS, 2023c) and an updated '*Reconnaissance Flora and Vegetation Survey Report',* including targeted Threatened and Priority Ecological Communities (BDS, 2023d).

The scope of works include:

- Desktop assessment of the survey area, including all publicly available database searches for Threatened and Priority fauna. Undertake a Likelihood of Occurrence (LOO) analysis of species identified in the desktop assessment;
- Undertake a basic fauna survey across the survey area, field GPS fauna, including threatened and priority if present and mapping of fauna habitat types in accordance with EPA (2020) guidance;
- Threatened and priority fauna forms to be submitted to Department of Biodiversity, Conservation and Attractions (DBCA) if required;
- Identification and mapping of Carnaby's Cockatoo (*Zanda latirostris*), Baudin's Cockatoo (*Zanda baudinii*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) foraging habitat, roosting habitat and breeding habitat (trees with suitable Diameter at Breast Height (DBH)) as per Commonwealth guidelines (DAWE, 2022).
    - Trees mapped with a GPS (<3 m accuracy) and the number and size of hollows and any signs of use recorded.
- Prepare a report on survey outcomes, consistent with EPA (2020) guidance; and
- Provide the client with the IBSA Data package (as required to be submitted by the client).

1.1. Location and Development Proposal

The "survey area" consists of three areas surrounding the intersections around the CBH Nyabing Receival Site, totalling 4.15 ha. The survey area covered the road reserve of Bin Road and intersection with Kukerin Road; the intersections of Nyabing-Pingrup Road, Richmond Street, Kuringup Road and Bin Road; and the road reserve of Katanning-Nyabing Road and intersection with Bin Road, see Figure 1 and Table 1. The survey area is situated within the township of Nyabing within the Shire of Kent, approximately 320 km south-east of Perth.

The "study area" consists of the 20-40 km radius around the survey area, with a 20 km radius presented in Figure 1, used for indications of LOO of Threatened or Priority fauna. It provides a broader local context and assessment of the survey area. This basic fauna survey provides base-line data for determining what further surveys and environmental approvals are required for the clearing and development of these areas, such as further targeted or detailed surveys.

Table 1: Areas included in the survey area.

Area	Location	Area (ha)	Tenure Management
1	Road reserve of Bin Road and intersection with Kukerin Road	1.38	Shire of Kent
2	Intersections of Nyabing-Pingrup Road, Richmond Street, Kuringup Road and Bin Road	1.72	Shire of Kent
3	Road reserve of Katanning-Nyabing Road and intersection with Bin Road	1.05	Shire of Kent
Total		**4.15**	

1.2. Alignment to Legislation, Guidelines and Policies

This survey and subsequent report are aligned to the following legislation, guidelines and policies:

- *Environmental Protection and Biodiversity Conservation Act 1999* (Cth; EPBC Act). Administered by the Federal Department of Climate Change, Energy, the Environment and Water (DCCEEW);
- *Biodiversity Conservation Act 2016* (WA; BC Act). Administered by the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA);

- *Environmental Protection Act 1986* (WA; EP Act). Administered by the Western Australian Department of Water and Environmental Regulation (DWER);
- *Biosecurity and Agriculture Management Act 2007* (WA; BAM Act);
- EPA (2020) Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact;
- Department of the Environment, Water, Heritage and the Arts (DEWHA, 2010) Survey Guidelines for Australia's Threatened Birds;
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC, 2011) Survey Guidelines for Australia's Threatened Mammals; and
- Department of Agriculture, Water and the Environment (DAWE, 2022) Referral guideline for 3 WA Threatened black cockatoo species.

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Overview Map Scale 1:5,000,000

Legend

Survey Area

- Survey Area
- 20 km Search Area

Scale
1:150,000 @ A3
GDA2020 MGA Zone 50

Data Sources
Aerial Imagery: WA Now, Landgate Subscription Imagery
Cadastre, Relief Contours and Roads: Landgate 2017
IRIS Road Network: Main Roads Western Australia 2017
Overview Map: World Topographic map service, ESRI 2012

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CBH Nyabing Receival Bin,
Lot 9231 Bin Rd
Nyabing, WA 6341

Figure 1: Survey area locality

	QA Check	*Drawn by*
	CvdM	**MH**
STATUS	*FILE*	*DATE*
FINAL	**CBH0026-005**	**08/01/2024**

2. Methodology – Desktop Assessment

An investigation into background information for this site was completed in the updated '*Reconnaissance Flora and Vegetation Survey Report',* including targeted Threatened and Priority Ecological Communities (BDS, 2023d), which precedes this report. As such this information in not included in this report, this investigation included; geology and soils, climate, habitat connectivity, water and wetlands, environmentally sensitive areas, remnant vegetation, heritage and dieback (BDS, 2023d).

2.1. Fauna

A desktop assessment was conducted to analyse and determine a desktop inventory of potential Threatened or Priority fauna species 'Likely' or 'Possible' to occur within the survey area. This was undertaken by compiling a register of species recorded within the study area, using the following databases:

20 km Conservation Species Search (DCCEEW, 2023a)

- 20 km Nature Map Database Search (combined data from DBCA, WA Museum and WA Herbarium; DBCA, 2023);
- 20 km Protected Matters Search Tool (DCCEEW, 2023b); and
- 40 km Fauna DBCA database records (DBCA, 2023a).

The conservation significance of fauna species has been assessed using data from the following sources:

- EPBC Act, administered by DCCEEW; and
- BC Act, administered by DBCA;

Desktop assessment for the Black Cockatoo habitat consisted of reviewing DBCA locational records and a range of publicly available datasets relevant to Black Cockatoo breeding, roosting and foraging areas. These included:

- Distribution maps for Black Cockatoos within the Referral Guidelines for Three Threatened Black Cockatoo Species DAWE (2022).
- Carnaby's Cockatoo Confirmed (DBCA_050; DBCA, 2018a and Unconfirmed Roost Sites (DBCA_051; DBCA, 2018b).
- Carnaby's Cockatoo Confirmed (DBCA_52; DBCA, 2018c) and Unconfirmed Roost Sites Buffered 6 km (DBCA-053; DBCA, 2018d).
- Black Cockatoo Breeding Sites (DBCA_063; DBCA, 2019a).
- Black Cockatoo Roosting Sites (DBCA_064; DBCA, 2019b).

3. Methodology – Field Survey

3.1. Basic Fauna and Targeted Black Cockatoo Survey

Field survey work was carried out by [redacted] (Ecologist) and [redacted] (Ecologist) on the 24th November 2023. The aim of the basic fauna survey was to assess and map habitat for Threatened and Priority fauna species within the survey area, assess the likelihood of occupancy for Threatened and Priority fauna species, record the presence of Threatened and Priority taxa, and undertake an opportunistic inventory of fauna species within the survey area. In addition, opportunistic targeted searches for individuals, census of calls, and searches for indirect indicators of presence were undertaken within suitable habitat for threatened species.

A total of 11.22 km of traverses were walked in a manner that ensured the variety of vegetation units onsite were encountered and habitats and micro-niches likely to be important to Threatened and Priority species were targeted. The overall type, quantity, and quality of habitat suitable for threatened or priority species was assessed and mapped.

Basic fauna survey techniques applied included:

- Surveys for indicators of species presence such as scats, latrines, tracks, diggings, burrows, log hollows, earth burrows, active dens, incubation mounds, breeding hollows, characteristic nests, feeding debris.
- Census of calls for birds and frogs.
- Opportunistic diurnal detections of calls.
- Hand searches within micro-niches undertaken for reptiles and short-range endemic invertebrates, such as within rock piles, leaf litter, under rocks, bark, and logs.
- Searches for important elements of habitat and potentially suitable habitat resources such as rock refuges, areas of deep leaf litter, active and potential breeding hollows, feeding resources, den resources, incubation mounds, termite galleries, shelter sites, wetland resources.
- Particular emphasis was placed on habitat requirements and potential indicators of presence for threatened, priority and migratory species identified in the LOO (Table 9, Appendix B).

Targeted survey techniques applied for black cockatoos included:

- Census of calling individuals throughout the survey period to detect feeding individuals, pairs, or flocks.
- Diurnal searches for evidence of feeding (chewed nuts or cones).
- Searches for plant species likely to be used as food resources.
- Searches for hollow-bearing trees, potential breeding hollows, and any evidence of active breeding hollows for Carnaby's Cockatoo, as evidenced by chewing around the hollow entrance, nest remains (eggshells, feathers faecal material), or bird activity within or near the hollow.
- Systematic searches for active or potential nest trees (significant trees). Significant trees for cockatoos were defined as those with a diameter measured at breast height (1.3 m above the ground; DBH) of >300 mm. Where these trees were present, they were measured at DBH using a diameter tape, photographed, and the presence or absence of potential or active breeding hollows determined.
- Where present, hollows were photographed, the entrance type (chimney, side, or elbow) and dimensions of the hollow were recorded and hollows were assessed for signs of use, based on evidence such as chewing around the hollow entrance, and activity at the base of the tree, e.g., feathers, faecal material, feeding debris.
- Systematic searches for potential and active roosting sites, as evidenced by the presence of birds, feathers and faecal material.

Targeted survey techniques applied for each of the threatened species with a 'Possible' or 'Likely' likelihood of occurring in the survey area are summarised in Table 2. Full threatened species occurrence likelihoods can be found in Table 9, Appendix B.

Survey techniques applied were consistent with recommendations within species recovery plans, species profiles, listing advice, referral guidelines, guidance statements as well as survey guidelines developed by the EPA and Department of Agriculture, Water and the Environment (DAWE), formerly the Department of Sustainability, Water, Population, and Communities (DSEWPaC), and Department of the Environment, Water, Heritage and the Arts (DEWHA). In particular, the following formal guidelines were complied with:

- DEWHA (2010) Survey guidelines for Australia's Threatened birds;
- DSEWPaC (2011) Survey guidelines for Australia's Threatened mammals;
- EPA (2020) Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment; and
- DAWE (2022) Referral Guidelines for Three Threatened Black Cockatoo Species.

Table 2: Brief overview of survey techniques applied for each of the threatened species with a 'Possible' or 'Likely' likelihood of occurring in the survey area.

Scientific Name	Vernacular	Status WA/EPBC	Survey Technique
BIRDS			
Aphelocephala leucopsis	Southern whiteface	VU	Search for individuals foraging on the ground in areas of low tree density and herbaceous understorey.
Zanda latirostris	Carnaby's Cockatoo	EN/EN	Listen for calls, detect birds by sight. Diurnal searches for evidence of feeding (chewed nuts or cones). Targeted searches for active or potential nest trees, food resources, and roosting habitat. Potential nest trees include those with a DBH >300 mm. Hollows where present are inspected for evidence of activity and their dimensions estimated, see Section 3.2 for more information.
Platycercus icterotis xanthogenys	Western rosella (inland)	P4/-	Listen for calls, detect birds by sight. Targeted searches for active or potential nest trees, food resources, and roosting habitat. Search for tree-hollows.
MAMMALS			
Phascogale calura	Red tailed phascogale	CD/VU	Difficult to detect presence. Search for potential habitat, including nesting hollows.
Notamacropus irma	Western brush wallaby	P4 / -	Difficult to detect presence. Search for potential habitat.

3.2. Targeted Black Cockatoo Habitat Survey

3.2.1. Surveys for Breeding Hollows

The aim of the black cockatoo habitat assessment was to identify all potential breeding trees (refer to Table 3) with a diameter, measured at 1.3 metres from the base of the tree (DBH), of 300 millimetres or greater (referred to hereafter as a significant tree) and that contained one or more hollows of potential suitability for breeding by Carnaby's Cockatoo, Baudin's Cockatoo and Forest Red-Tailed Black Cockatoo (hereafter referred to as a suitable cockatoo tree).

If present, significant trees were GPS located (<3 m accuracy), measured at DBH using a diameter tape, photographed, and the presence or absence of potential breeding hollows determined. Where present, hollows were photographed, the entrance type (chimney, side or elbow) and dimensions of the hollow were recorded and hollows were assessed for signs of use by cockatoos, based on evidence such as chewing around the hollow entrance, and activity at the base of the tree, e.g., feathers, faecal material, and feeding debris.

Long term studies on Carnaby's Black Cockatoos have shown that they utilise tree hollows ranging from 100 mm – 650 mm (average 260 mm) in diameter (Saunders *et al.* 2014a, 2014b), whilst Forest Red-tailed Black Cockatoos utilise hollows with diameters ranging from 100 mm x 120 mm to 440 mm x 1500 mm (mean 280 mm x 300 mm; Johnstone & Storr, 1998; Johnstone *et al.* 2013). There is little published about dimensions of hollows utilised by Baudin's Black Cockatoo; however, it is expected they would be similar to those utilised by Carnaby's. In all instances, these species also require a hollow with significant depth. Based on the published information, hollows with an entrance diameter larger than 100 mm x 100 mm that occurred in branches or trunks with the capacity for deep hollows were recorded as potential cockatoo hollows. Smaller hollows with the potential to develop into suitable nesting hollows were also recorded.

3.2.2. Surveys for Foraging Habitat and Feeding Activity

The '*Scoring system for the assessment of foraging value of vegetation for Black-Cockatoos*' developed by Bamford Consulting Services (Bamford, 2020) outlines a simple scoring tool to assess foraging habitat quality. This has been used to assess foraging habitat quality. Fauna habitat units that do not contain known foraging species were not considered to contain foraging habitat.

Assessment of foraging habitat was based on published foraging preferences for the three target species. Carnaby's Cockatoo is known to prefer Kwongkan heathland, shrublands and woodlands dominated by Proteaceous species as foraging habitat but will feed on individual Eucalypts and small stands of Eucalypt woodland or forest (Table 3). Forest Red-tailed Black Cockatoos feed mostly on seeds of marri and jarrah and other Eucalypts within their range (Table 3). Baudin's Cockatoo prefer the seeds of marri and native proteaceous species as foraging habitat but will also feed on some other species (Table 3). The presence of foraging habitat was mapped in the field, and individual locations where feeding activity was encountered were GPS recorded.

3.2.3. Surveys for Roosting Habitat and Activity

The presence of cockatoo feathers and faecal material were used as indicators of roosting activity, with tall trees of any species within close proximity to water being assessed as a potential roosting tree. The presence of roosting habitat if present was mapped in the field, and individual locations where roosting activity was encountered were GPS recorded.

Table 3: Habitats used by Threatened Black Cockatoos (DAWE, 2022).

Habitat	Baudin's	Carnaby's	Forest Red-tailed
Breeding	Generally, in woodland or forest, but may also breed in partially cleared woodland or forest, including isolated trees. Nest in hollows in live or dead trees (many eucalypt species may provide suitable hollows), particularly karri *(Eucalyptus diversicolor)*, marri, jarrah, wandoo, bullich *(E. megacarpa)* and Tuart.	Generally, in woodland or forest, but also breeds in partially cleared woodland or forest, including isolated trees. Nest in hollows in live or dead trees (many eucalypt species may provide suitable hollows), particularly salmon gum, wandoo, tuart, jarrah, flooded gum *(E. rudis)*, York gum, powderbark *(E. accedens)*, karri and marri.	Generally, in woodland or forest, but may also breed in partially cleared woodland or forest, including isolated trees. Nest in hollows in live or dead trees (many eucalypt species may provide suitable hollows), particularly marri, karri, wandoo, bullich, blackbutt *(E. patens)*, tuart and jarrah.
Night Roosting	Generally, in or near riparian environments or other permanent water sources. Any tall trees may provide roosting habitat, but particularly jarrah, flooded gum, blackbutt, tuart and introduced eucalypts (blue gum *(E. globulus)*, lemon scented gum *(Corymbia citriodora)*.	Generally, in or near riparian environments or natural and artificial permanent water sources. Any tall trees may provide roosting habitat, but particularly flat-topped yate *(E. occidentalis)*, salmon gum, wandoo, marri, karri, blackbutt, tuart, introduced eucalypts and introduced pines.	Any tall trees may provide roosting habitat, but particularly tall jarrah, marri, blackbutt, tuart and introduced eucalypt trees or large trees on the edges of forests.

Table 3 continued.

Habitat	Baudin's	Carnaby's	Forest Red-tailed
Foraging and common food items	Primarily seeds of marri, rarely jarrah, in woodlands and forest, and seeds of native proteaceous plant species (for example, *Banksia* spp. (includes *Dryandra* spp.) and *Hakea* spp.). During the breeding season feed primarily on native vegetation, particularly marri (seeds, flowers, nectar and grubs). Also insects and insect larvae; pith of kangaroo paw (*Anigozanthos flavidus*); tips of *Pinus* spp.; *Macadamia* spp., almonds and pecans; seeds of apples and pears; and persimmons.	Native shrubland, kwongan heathland and woodland on seeds, flowers and nectar of native proteaceous plant species (*Banksia* spp., *Hakea* spp. and *Grevillea* spp.), as well as *Callistemon* spp. and marri. Also seeds of introduced species including *Pinus* spp., *Erodium* spp., wild radish, canola, almonds, macadamia and pecan nuts; insects and insect larvae; occasionally apples and persimmons; and liquidambar.	Primarily seeds of Jarrah and Marri in woodlands and forest, and edges of Karri forests, including wandoo and blackbutt. Forages on *Allocasuarina* cones, fruits of Snottygobble (*Persoonia longifolia*) and mountain marri (*C. haematoxylon*). Other less important foods include blackbutt, bullich, *Allocasuarina fraseriana*, *Hakea* spp., tuart, redheart moit (*E. decipiens*) and bushy yate (*E. lehmanni*). Also, some introduced eucalypts such as river red gum (*E. camaldulensis*) and rose gum (*E. grandis*). On the Swan Coastal Plain, often feeds on introduced cape lilac (*Melia azedarach*), *E. caesia*, *E. erythrocorys*, lemon-scented gum and kaffir plum (*Harpephyllum caffrum*).

3.3. Fauna Survey Limitations and Constraints

An assessment of potential survey limitations was undertaken as per the EPA (2020) document *Technical Guidance-Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* refer to Table 4 below. Limitations were primarily nil-minor in nature, and did not affect the validity of results presented in the survey.

Table 4: Fauna survey limitations and constraints.

Limitation	Constraint	Comment
Experience of personnel	Nil	[redacted] has been employed by Bio Diverse Solutions since 2019. She has over 4 years' experience with fauna and black cockatoo surveys in the South West, South Coast, Midwest, Esperance-Goldfields and Wheatbelt regions. She has a BSc in Environmental Science and Masters in Environmental Management, and is Environmental Team Leader at Bio Diverse Solutions. [redacted] started at Bio Diverse Solutions in March 2023 and has gained valuable experience and guidance working alongside a senior zoologist and experienced consultants conducting fauna and black cockatoo surveys. She has a BSc in Conservation Biology and Marine Science. [redacted] has over 6 years of fauna survey experience through her role at Bio Diverse Solutions. She has experience assisting other Zoologists (Bush Heritage, Australian Wildlife Conservancy and DBCA) in a voluntary capacity with fauna monitoring surveys.

Table 4 continued.

Limitation	Constraint	Comment
Species detection probability (e.g., Survey timing, cryptic species, etc.)	Minor	In the wheatbelt region the typical breeding season for *Zanda latirostris* (Carnaby's Cockatoo) is July to September (DAWE, 2022). This survey was conducted in November, after that period, however this factor was assessed to have a minor limitation on detecting breeding habitat. Cockatoos also use a range of areas for foraging and roosting, the use of activity indicators such as feeding debris (nuts) and faecal material negate this limitation and enable determination of presence/regularity with which an area is visited. Of the Threatened and Priority species assessed as likely or possible to occur pre-survey, likelihood of detection for the majority was rated from high to low. Carnaby's Cockatoo and southern whiteface were assessed as having a high likelihood of detection. Western rosella (inland) was assessed as having a moderate likelihood of detection. Suitable habitat for this species was present, however, no other evidence of their presence was detected. Red-tailed phascogale and Western brush wallaby were assessed as having a low likelihood of detection. This was evaluated as a minor limitation as habitat constraints identified in the field indicated it was unlikely for the above species to occur in the survey area. See Table 9, Appendix B for full LOO analysis and species detection probabilities.
Significant tree survey limitations	Minor	Identifying hollows from the ground has limitations, as the full characteristics of a hollow are not evident, for example the internal dimensions such as depth. As such the entrance dimensions and size of the branch/trunk into which the hollow was forming were used as indicators of the potential internal dimensions. The relative visibility of the canopy can also be limiting in identifying potential hollows, particularly where hollows are upward facing or obscured by foliage.
Access restrictions	Nil	No access restrictions were encountered during the survey.
Availability of contextual information	Nil	Publicly available desktop and background information was readily available to provide a broad contextual understanding of the site.
Survey effort and extent	Nil	The basic fauna survey and targeted components of the survey were deemed appropriate given the scope was to identify the general presence of fauna species and fauna habitat in the survey area. See Figure 12, Appendix A for survey effort.
Disturbances that may affect results	Nil	The primary form of disturbance within the survey area is the presence of roads and an active grain receival site. These areas regularly experience varying levels of traffic. As this type of disturbance is regular and continuous it is unlikely to have resulted in a significant limitation on detection probability or species occurrence during the survey period. No other signs of disturbances such as fire or a stochastic event were noted at the time of the survey.

Table 4 continued.

Limitation	Constraint	Comment
Scope	Nil	The scope was a basic terrestrial fauna survey to generally assess the presence/evidence of fauna species within the survey area, map the fauna habitat, undertake opportunistic inventory of species including priority conservation species. Additional targeted assessment of significant trees was undertaken to identify breeding, roosting or foraging habitat for black cockatoos.

4. Results – Desktop Assessment

4.1. Fauna

The desktop assessment identified 33 Threatened and Priority species within the study area (40 km buffer). Of these, 13 were Threatened taxa under the BC Act and/or EPBC Act (critically endangered, endangered or vulnerable), ten were Priority listed or specially protected taxa. nine were Migratory species and one species was threatened and migratory (Table 9, Appendix B). Conservation categories for Threatened and Priority fauna are presented in Tables 13 and 14 in Appendix C.

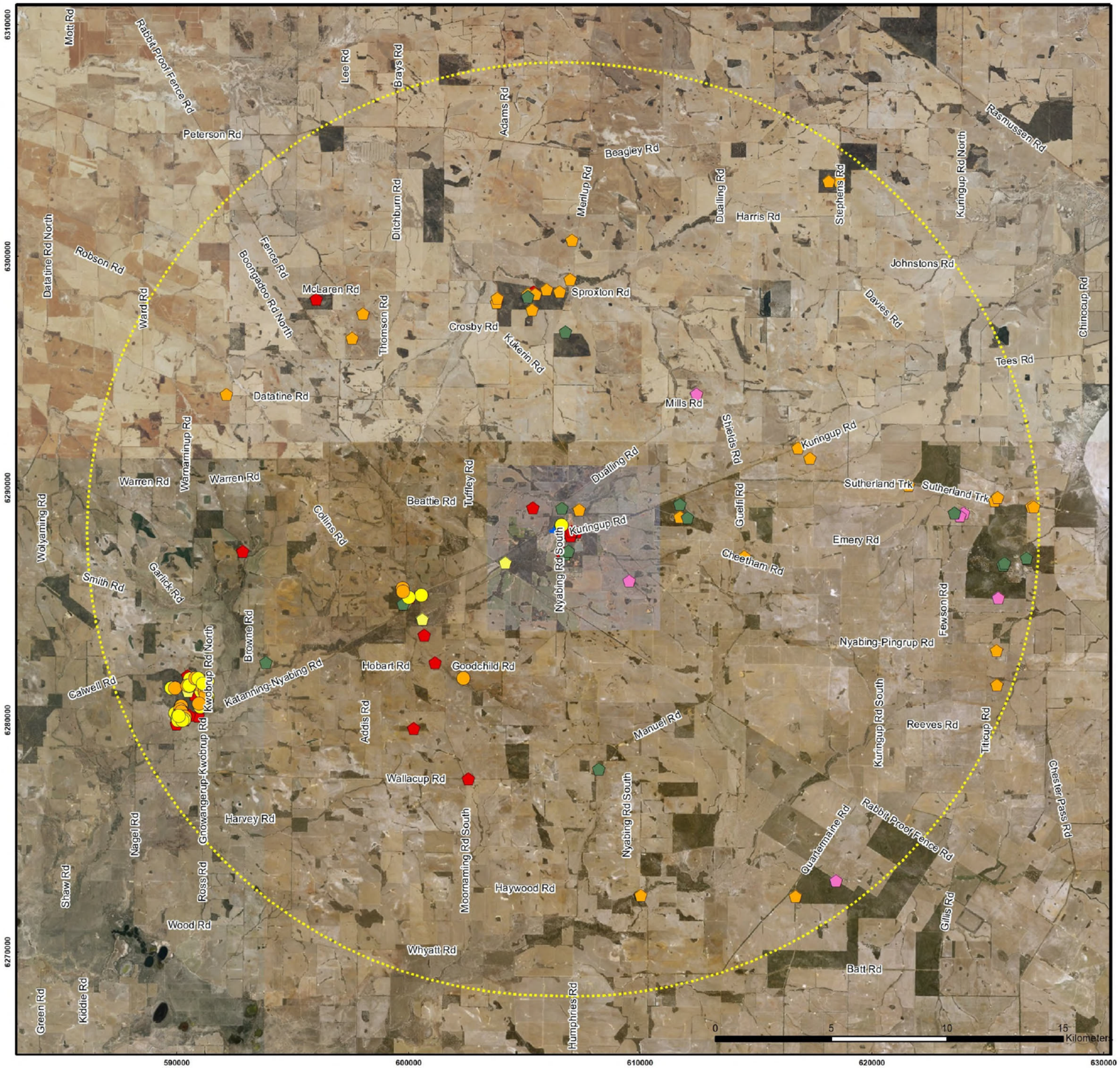
Of these 33 species, pre-survey LOO analysis assessed one species as 'Likely' to occur and four species as 'Possible' to occur. Refer to Table 9, Appendix B for more detail. Species assessed as 'Likely' to occur were:

- Carnaby's Cockatoo (*Zanda latirostris*; EN/EN).

Species assessed as 'Possible' to occur were:

- Red-tailed phascogale (*Phascogale calura*; CD/VU),
- Southern whiteface (*Aphelocephala leucopsis;* VU);
- Western brush wallaby (*Notamacropus irma*; P4); and
- Western rosella (inland; Platycercus icterotis xanthogenys; P4).

Post-survey LOO analysis, assessed Carnaby's Cockatoo, southern whiteface and western rosella (inland) as 'Possible' to occur, as potential habitat for these species was observed in the survey area, with varying levels of suitability. Post-survey LOO assessed western brush wallaby and red-tailed phascogale as 'Unlikely' to occur, based on various habitat limitations. The full LOO compiled from all available data (Table 9, Appendix B) is based on observations from a broader area than the survey area and is likely to include species that would not occur in the actual survey area due to a lack of suitable habitat. The data also includes very old records and in some cases the species in question may have become locally or regionally extinct.



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Overview Map Scale 1:5,000,000

Legend

- Survey Area
- 20 km Search Area

White Tail Black Cockatoo Breeding Sites (DBCA, 2023)

- Confirmed
- Potential

Threatened and Priority Fauna (DBCA, 2023)

WA Status, EPBC Status

- CD, VU
- EN, EN
- OS,
- P4,
- VU, VU

Scale
1:160,000 @ A3
GDA2020 MGA Zone 50

Data Sources
Aerial Imagery: WA Now, Landgate Subscription Imagery
Cadastre, Relief Contours and Roads: Landgate 2017
IRIS Road Network: Main Roads Western Australia 2017
Overview Map: World Topographic map service, ESRI 2012

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Figure 2: Desktop Fauna Data

	QA Check	*Drawn by*
	CvdM	**MH**
STATUS	*FILE*	*DATE*
FINAL	**CBH0026-005**	**09/01/2024**

5. Results – Field Survey

5.1. Fauna Diversity

A total of 13 species were detected during the survey, including seven birds, two insects and four mammals. Four of the species detected were invasive species. Refer to the full fauna species list in Table 16 in Appendix D.

5.2. Fauna Habitat Units

A total of four fauna habitat units were identified during the survey period. Approximately 60.24% (2.50 ha) of the survey area was cleared, this area was primarily composed of access roads or cleared bare ground. Of the remainder of the survey area, areas that are not cleared, 83.77% (1.39 ha) was in Degraded to Completely Degraded condition (see Table 15, Appendix C for condition rating scale). The fauna habitat units correlate with the vegetation units mapped and described in the updated '*Reconnaissance Flora and Vegetation Survey Report*', including targeted Threatened and Priority Ecological Communities (BDS, 2023d). Each habitat unit is presented below and mapped in Figure 9.

1. Fauna Habitat Unit: *Eucalyptus loxophleba* subsp. *loxophleba* Open Woodland [Euclox OW]

Associated vegetation unit: Vegetation Unit 1: *Eucalyptus loxophleba* subsp. *loxophleba* Open Woodland [Euclox OW]

Fauna Habitat Unit 1 comprises approximately 18.55% (0.77 ha) of the survey area. Euclox OW consisted of a eucalypt woodland community characterised by a York gum (*Eucalyptus loxophleba* subsp. *loxophleba)* overstorey and a mixed understorey of shrubs, herbs and grasses. Common understorey species included *Acacia acuminata*, *Maireana brevifolia*, *Gazania linearis*, and *Ehrharta calycina*. Several salmon gums (*Eucalyptus salmonophloia*) feature in the overstorey within the mapped extent of the habitat unit, although several areas contain no upper-storey structural layer due to previous disturbance of the site. See Figure 3 for photos of the fauna habitat unit.

Habitat value for Threatened or Priority fauna species:

Euclox OW provides potential breeding, roosting and foraging habitat for Carnaby's Cockatoo. A total of 19 significant trees were recorded in this fauna habitat unit, of which two were hollow-bearing and one was a suitable cockatoo tree (see Table 7). This fauna habitat unit was characterised by woodland associations that are suitable habitat for southern whiteface and western rosella (inland).

Figure 3: Fauna Habitat Unit: *Eucalyptus loxophleba* subsp. *loxophleba* Open Woodland [Euclox OW] present within the survey area.

2. Fauna Habitat Unit: *Eucalyptus salmonophloia* Open Woodland [Eucsal OW]

Associated vegetation unit: Vegetation Unit 2: *Eucalyptus salmonophloia* Open Woodland [Eucsal OW].

Fauna Habitat Unit 2 comprises approximately 12.77% (0.53 ha) of the survey area. Eucsal OW is characterised by a salmon gum eucalypt woodland over a sparse shrubland and herbland/grassland. Common species present within the shrubland understorey include *Acacia acuminata, Templetonia sulcata*, and *Acacia erinacea*. The grassland/herbland component was dominated by *Gazania linearis*, *Austrostipa elegantissima*, and *Austrostipa compressa*. See Figure 4 for photos of the fauna habitat unit.

Habitat value for Threatened or Priority fauna species:

Euclsal OW provides potential breeding, roosting and foraging habitat for Carnaby's Cockatoo. A total of 23 significant trees were recorded in this fauna habitat unit, of which nine were hollow-bearing and suitable cockatoo trees (see Table 7). This fauna habitat unit was characterised by woodland associations that are suitable habitat for southern whiteface and western rosella (inland).

Figure 4: Fauna Habitat Unit 2: *Eucalyptus salmonophloia* Open Woodland [Eucsal OW] present within the survey area.

3. Fauna Habitat Unit: Samphire Shrubland [SamShr]

Associated vegetation unit: Vegetation Unit 3: Samphire Shrubland [SamShr]

Fauna Habitat Unit 3 comprises approximately 6.02% (0.25 ha) of the survey area. SamShr was characterised by a low samphire shrubland dominated by *Tecticornia disarticulata*, with a sparse herb layer of *Cotula australis.* This habitat unit occurred in a saline drainage depression, where dead York gum trunks were indicative of potential occurrence of secondary salinisation. See Figure 5 for photos of the fauna habitat unit.

Habitat value for Threatened or Priority fauna species:

Due to the small area of this fauna habitat unit and its degraded condition, its habitat value to any of the threatened or priority species identified in the LOO was judged to be low. There were 15 significant trees in this survey area, likely planted, none of which contained hollows.

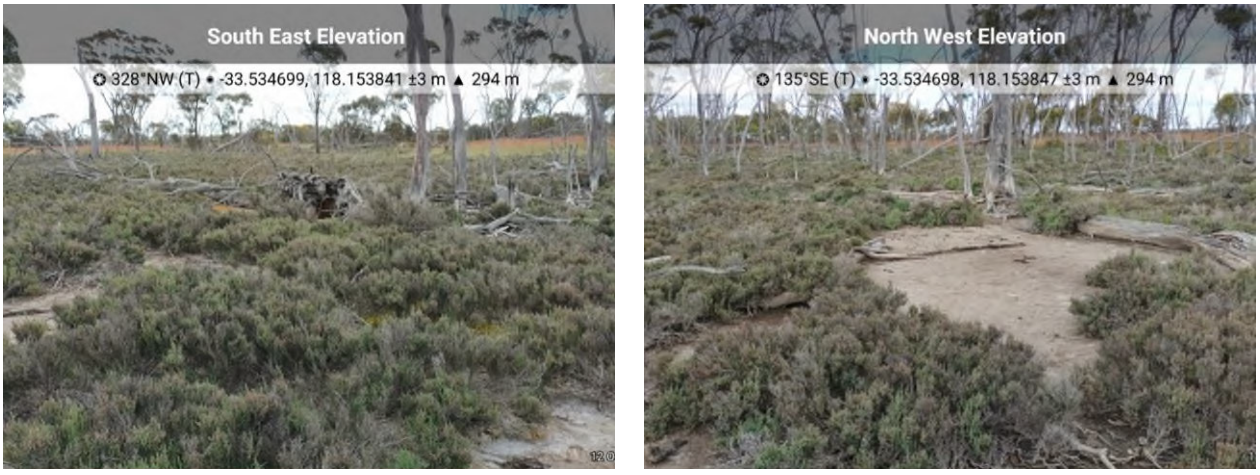

Figure 5: Fauna Habitat Unit 3: Samphire Shrubland (SamShr) present within the survey area.

4. Fauna Habitat Unit: Mixed Mallee and Melaleuca Shrubland [MMMSL]

Associated vegetation unit: Vegetation Unit 4: Mixed Mallee and Melaleuca Shrubland [MMMSL]

Fauna Habitat Unit 4 comprises approximately 2.89% (0.12 ha) of the survey area. MMMSL was characterised by a mallee overstorey dominated by *Eucalyptus orthostemon* and *Eucalyptus phaenophylla*, over a closed shrubland dominated by *Melaleuca acuminata*, *Melaleuca scalena*, and *Daviesia decurrens*, with a sparse herb, sedge and grass layer of *Gahnia ancistrophylla* and *Austrostipa elegantissima.* See Figure 6 for photos of the fauna habitat unit.

Habitat value for Threatened or Priority fauna species:

MMMSL provides some foraging habitat for Carnaby's Cockatoo, however that value is marginal due to the area this fauna habitat unit encompasses. There are four significant trees in this habitat unit, one of which is hollow bearing, however is not considered a suitable cockatoo tree.

Figure 6: Fauna Habitat Unit 4: Mixed Mallee and Melaleuca Shrubland (MMMSL) present within the survey area.

5.3. General Fauna Observations

Limited fauna activity was detected within the survey area during the survey. Fauna presence was determined via direct observations (sighted) or indirectly via calls, or signs of presence such as tracks, runnels, scats, diggings, bones, feeding remains or scratching. See Figure 7 for some of the presence indicators observed in the survey area and Table 16 in Appendix D for full species list.

Of the 13 taxa detected within the survey area (Figure 9), four are introduced;

- European honey bee (*Apis mellifera*);
- Rabbit (*Oryctolagus cuniculus*);
- Red fox (*Vulpes vulpes)*; and
- Domesticated cow *(Bos taurus;* it is assumed that remains were transported to survey area from adjacent farmland, likely via red fox scavenging).

There was a high level of fox and rabbit presence detected during the survey period, this is likely a limiting factor in the occupancy of habitat by native fauna, particularly small mammals, birds and reptiles. This limitation would primarily be attributed to predation and competition for resources. In addition, the European honey bee and yellow-throated miner bird, are known to be aggressive species, and as such will outcompete most native fauna species

The majority of the habitat available is in Degraded to Completely Degraded condition (83.77% of the remnant vegetation), which reduces the availability of suitable habitat for many native species. Generally invasive species will utilise areas of poorer quality habitat, as well as reduce the overall diversity of a site through other modes such as competition for food and nest sites, this is evident in the survey area.

a)

b)

c)

d)

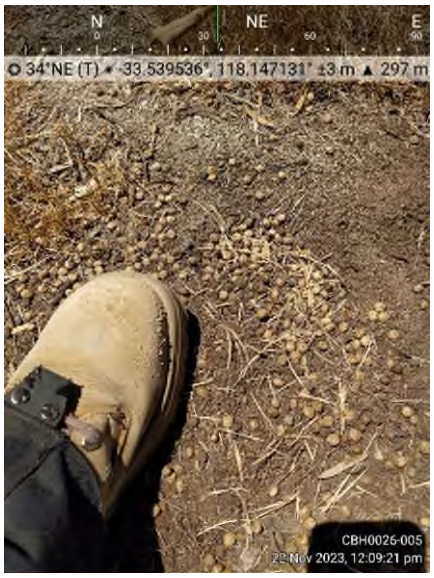

Figure 7: Presence indicators of detected taxa in the survey area.

a) Remains of a cow. b) Red fox scat. c) Wolf spider borrow. d) Rabbit scat.

5.4. Threatened and Priority Fauna

None of the 13 species detected were listed as Threatened or Priority, however potential habitat was identified in the survey area for three species identified in the post-survey LOO as possible to occur, see Table 5. It is also noted that no Short-Range Endemics (SREs) were identified in the LOO or in the field, however, areas of high leaf litter were present and would be ideal habitat for numerous SRE species, see Figure 8 and 9.

Table 5: Conservation listed species assessed as possible to occur pre-survey and potential habitat in the survey area.

Species	Details of potential habitat
Carnaby's Cockatoo (*Zanda latirostris*)	Potential breeding habitat was present, associated with eucalypt woodland pockets of salmon gums, wandoo, York gum and powder bark found in Euclox OW and Eucsal OW fauna habitat units. Multiple suitable cockatoo trees were present (see Section 5.5). Suitable night roosting habitat associated with Yate, salmon gums and wandoo was present (Euclox OW and Eucsal OW). An artificial dam is located outside of the survey area, thus providing an adjacent water source. There was suitable foraging habitat present associated with the open woodland pockets (Euclox OW, Eucsal OW). MMMSL also offers a marginal amount of foraging value, however it is considered negligible due to the small area it encompasses within the survey area. Overall lack of proteaceous species is likely a limiting factor for use by black cockatoos for foraging. No evidence of recent or historical use, including scratching/chewing around hollow entrances or feeding evidence was observed. For more information see Section 5.5.
Southern whiteface (*Aphelocephala leucopsis*)	Potential nesting habitat associated with the open woodland pockets and feeding habitat associated with areas with an understorey litter cover was present (Euclox OW, Eucsal OW). The high invasive species presence is likely a limiting factor for this species. No nests, calls or other evidence of presence were observed.
Western rosella (inland) (*Platycercus icterotis xanthogenys*)	Potential habitat for the Western rosella was present in the dry open eucalypt woodland (Euclox OW, Eucsal OW). Multiple hollows suitable for breeding were also present (see Section 5.5). No calling individuals or feeding evidence was found. The high invasive species presence is likely a limiting factor for this species.

a)

b)

c)

Figure 8: Examples of potential habitat and habitat elements for threatened fauna within the survey area.
a) Areas of high leaf litter suitable for SREs or southern whiteface. b) Eucalypt woodland associated with Carnaby's Cockatoo, southern whiteface and western rosella. c) Example of a hollow.

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Overview Map Scale 1:100,000

Legend

- Cadastre
- Survey area

Fauna Habitat

- Leaf litter

Fauna Habitat Unit

- 1: *Eucalyptus loxophleba* subsp. *loxophleba* Open Woodland [Euclox OW]
- 2: *Eucalyptus salmonophloia* Open Woodland [Eucsal OW]
- 3: Samphire Shrubland [SamShr]
- 4: Mixed Mallee and Melaleuca Shrubland [MMMSL]
- Cleared

Detected Fauna

- *Apis mellifera* (European honey bees)
- *Barnardius zonarius* (Australian ringneck)
- *Bos taures* (Domesticated cow)
- *Cacatua* sp. (Corella)
- *Eolophus roseicapilla* (Galah)
- *Gymnorhina tibicen* (Magpie)
- *Lycosidae* sp. (Wolf spider)
- *Macropus fuliginosus* (Western grey kangaroo)
- *Manorina flavigula* (Yellow-throated miner bird)
- *Oryctolagus cuniculus* (Rabbit)
- *Phaps chalcoptera* (Common bronze wing)
- *Strepera versicolor* (Grey Currawong)
- *Vulpes vulpes* (Red fox)

Scale
1:4,000 @ A3
GDA MGA 2020 Zone 50

Data Sources
Aerial Imagery: WA Now, Landgate Subscription Imagery
Cadastre, Relief Contours and Roads: Landgate 2017
IRIS Road Network: Main Roads Western Australia 2017
Overview Map: World Topographic map service, ESRI 2012

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Figure 9: Fauna and fauna habitat

	QA Check	*Drawn by*
	GP	**CvdM, MH**
STATUS	*FILE*	*DATE*
FINAL	**CBH0026-005**	**4/12/2023**

5.5. Targeted Black Cockatoo Survey

Of the three WA threatened black cockatoos; Carnaby's Cockatoo, Baudin's Cockatoo and Forest Red-Tailed Black Cockatoo, only Carnaby's modelled distribution falls within the survey area (DAWE, 2022). As such the following section will be discussed primarily in reference to Carnaby's Cockatoo.

There were a number of trees with hollows suitable for black cockatoos or phascogales, however no evidence that they were in use by these species was detected. Evidence of hollow use by European honey bees and other common bird species was observed. Hollow use in the area by conservation significant species is likely limited due to occupation of hollows by other species, non-continuous canopy, degraded condition of vegetation and high levels of disturbance present at the site.

5.5.1. Breeding Habitat

A total of 61 trees, with a DBH >300mm, were identified within the survey area, of which 12 were hollow-bearing trees. Significant trees occurred in all habitat units, however suitable hollow bearing trees were primarily present in the Euclox OW and Eucsal OW fauna habitat units. See Table 7 for details on hollow-bearing trees in the survey area and Figure 9 for photographs of trees and hollows. See Table 17 in Appendix D for complete list of all the significant trees recorded in the survey area and see Figure 10 for a map.

Based on Carnaby's Cockatoos tree hollow size preference (between 100 mm – 650 mm in diameter) and availability of hollow (not occupied by bees), ten hollow-bearing trees were judged to be suitable cockatoo trees for use by Carnaby's Cockatoo. See Table 7.

The survey area does not lie within the known breeding range for Baudin's Cockatoo or Forest Red-tailed Black Cockatoo, but is within the known breeding range for Carnaby's Cockatoo (DAWE, 2022). See Table 6 for more details on breeding habitat for Carnaby's Cockatoo.

5.5.2. Foraging and Roosting Habitat

No cockatoo feeding debris was detected within the survey area. The Euclox OW and Eucsal OW habitat units provide limited foraging habitat for Carnaby's Cockatoo. The lack of proteaceous species in the survey area as a food source is a limiting factor.

Using the 'Scoring system for the assessment of foraging value of vegetation for Black-Cockatoos' (Bamford Consulting Services, 2020) the survey area provides 'Low' foraging value for Carnaby's Cockatoo (Table 10 Appendix B). In addition to using this component of the scoring tool, site context and species presence, the habitat within the survey area rates as a maximum quality of 2 for Carnaby's Cockatoo (Tables 10 to 12 in Appendix D). The DAWE (2022) Foraging quality scoring tool template is only applicable to sites that are equal to or larger than 1 ha in size. Given the available foraging habitat for Carnaby's Cockatoo is less than 1 ha it has not been applied for this survey.

There was no evidence of black cockatoos roosting within the survey area, as assessed through the presence of accumulated feathers and faecal material. Fauna habitat units; Eucsal OW and Euclox OW, provide potentially suitable roosting habitat, particularly given the presence of Yate, salmon gums and wandoo and proximity of the site to an artificial dam and the subsequent availability of a nearby water source. No detailed assessment of vegetation outside of the survey area was undertaken, however the immediate surrounding areas contain some patches of remnant vegetation, however the broader landscape is highly fragmented. In addition, the lack of very high-quality foraging habitat decreases the roosting potential of the area. The potential breeding, roosting and foraging habitat for Carnaby's Cockatoo is broken down in Table 6.

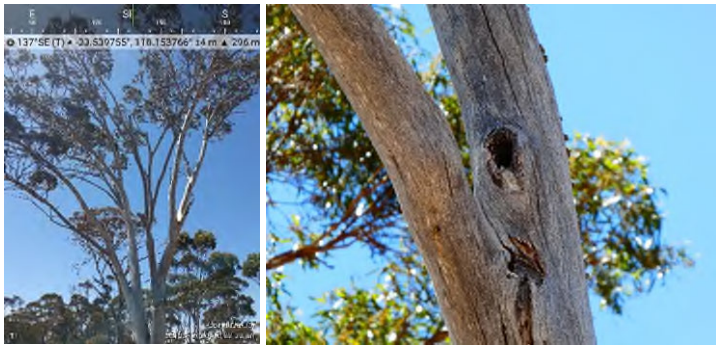
Table 6: Potential Carnaby's Cockatoo habitat present within the survey area.

Habitat Type	Description	Area (ha)	Percentage of all mapped Cockatoo Habitat (%)
Breeding, Foraging and Roosting Habitat	The Eucsal OW and Euclox OW fauna habitat units contain potential breeding, foraging and roosting habitat.	1.30	92.43
Foraging Habitat	MMMSL fauna habitat unit contains foraging habitat.	0.12	7.57
	Totals	**1.41**	**100**

Table 7: Summary of hollow bearing significant trees (>300 mm DBH) in the survey area. (* denotes trees with hollows suitable for Carnaby's Cockatoo.)

ID	Species	DBH (mm)	Crown Senescent	Hollows Present	Location	Size of entrance (mm)	Type of entrance	Height above ground (m)	Comments	GPS location
1	Eucalyptus salmonophloia	1035	No	Yes	Branch	50x70	Side	12	Possible multiple hollows.	[redacted]
10	Eucalyptus salmonophloia*	738	No	Yes	Branch	150x150	Side	10	Multiple hollows.	
11	Eucalyptus salmonophloia*	632	Yes	Yes	Stem	200x200	Elbow	9	Suitable hollows.	
12	Eucalyptus salmonophloia*	820	No	Yes	Trunk	150x100	Side	6	Multiple suitable hollows.	
13	Eucalyptus salmonophloia*	748	No	Yes	Branch	150x100	Elbow	10	Multiple hollows.	
14	Eucalyptus salmonophloia*	731	No	Yes	Trunk	150x100	Elbow	10		
15	Eucalyptus salmonophloia*	796	No	Yes	Branch	100x100	Chimney	12	Multiple hollows. Bees and birds observed around tree.	
16	Eucalyptus salmonophloia*	1023	Yes	Yes	Branch	300x300	Chimney	5	Multiple suitable hollows.	
19	Eucalyptus salmonophloia*	955	Yes	Yes	Branch	500x300	Elbow	12	Multiple hollows.	
20	Eucalyptus salmonophloia*	1055	Yes	Yes	Trunk	200x200	Chimney	5	Multiple suitable hollows.	
25	Eucalyptus salmonophloia*	994	Yes	Yes	Branch	200x200	Chimney	12	Galahs observed flying from tree.	
29	Eucalyptus loxophleba subsp. loxophleba	799	Yes	Yes	Branch	150x150	Chimney	10	Upwards facing hollow. Bees observed coming out.	

1)



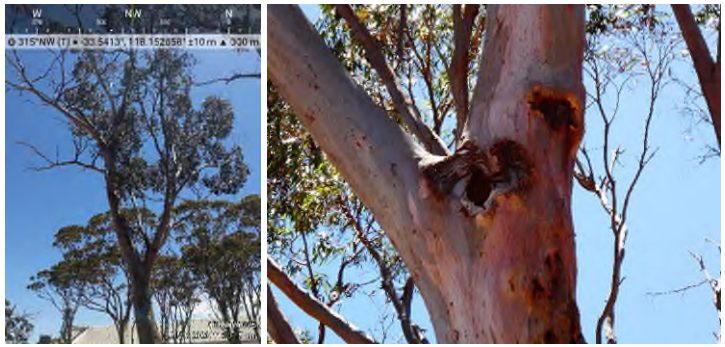
10)

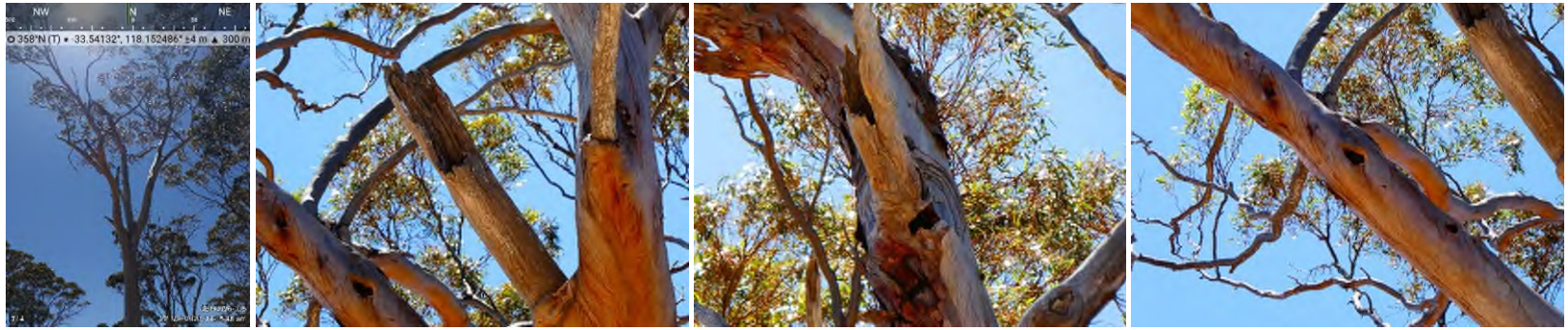
11)

12)

Figure 10: Photographs of hollow-bearing trees in the survey area. Denoted with respective tree ID.

13) 

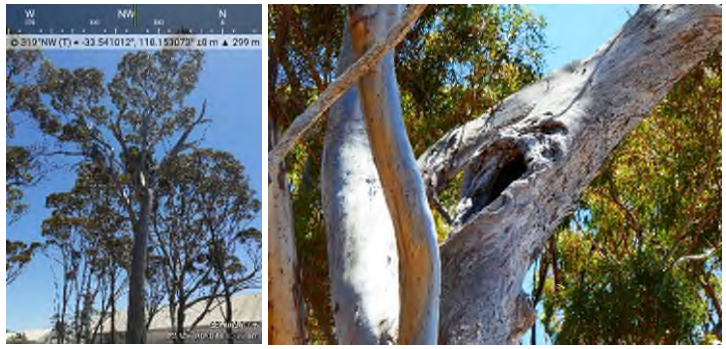
14) 

15) 

16) 

Figure 10 continued

19)



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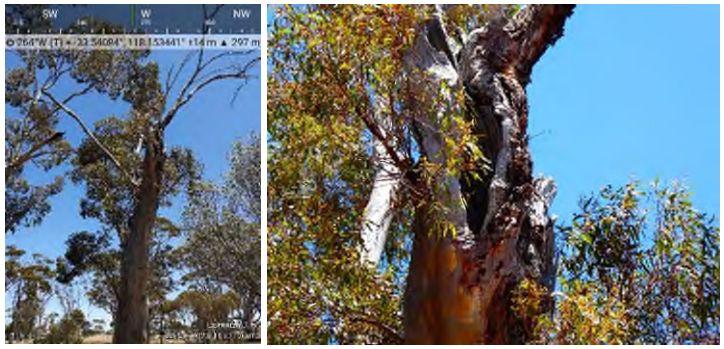

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Figure 10 Continued

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Overview Map Scale 1:100,000

Legend

Cadastre

Survey area

Fauna Habitat Unit

1: *Eucalyptus loxophleba* subsp. *loxophleba* Open Woodland [Euclox OW]

2: *Eucalyptus salmonophloia* Open Woodland [Eucsal OW]

3: Samphire Shrubland [SamShr]

4: Mixed Mallee and Melaleuca Shrubland [MMMSL]

Cleared

Significant Trees (>300 mm DBH)

Eucalyptus loxophleba subsp. *loxophleba*, Hollow bearing

Eucalyptus salmonophloia, Hollow bearing

Eucalyptus loxophleba subsp. *loxophleba*, No hollows

Eucalyptus salmonophloia, No hollows

Eucalyptus occidentalis, No hollows

Eucalyptus salubris, No hollows

Eucalyptus wandoo, No hollows

Carnaby's Cockatoo Habitat Potential

Breeding, Roosting and Foraging

Foraging

Data Sources
Aerial Imagery: WA Now, Landgate Subscription Imagery
Cadastre, Relief Contours and Roads: Landgate 2017
IRIS Road Network: Main Roads Western Australia 2017
Overview Map: World Topographic map service, ESRI 2012

Scale
1:4,000 @ A3
GDA MGA 2020 Zone 50

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Figure 11: Significant Trees (>300mm DBH)

	QA Check	Drawn by
	CvdM	MH
STATUS	FILE	DATE
FINAL	CBH0026-005	10/01/2024

6. Discussion

6.1. Basic Fauna Survey

The aim of the basic fauna survey and targeted black cockatoo survey was to assess and map the fauna habitat within the survey area, including the black cockatoo habitat, assess the likelihood of Threatened or Priority fauna being present within the survey area and/or particular habitat units, record actual presence of Threatened and Priority listed species, and undertake opportunistic inventory of fauna species encountered whilst traversing the survey area on foot. The targeted black cockatoo survey involved collecting information on the presence of breeding, foraging and roosting habitat for black cockatoos within the survey area.

Four different fauna habitats were identified within the survey area; 1: Euclox OW; 2: Eucsal OW; 3: SamShr; and 4: MMMSL. During the survey 13 fauna taxa were recorded, including seven birds, two insects and four mammals; of the detected taxa four are introduced. There were some habitat constraints that limited the occupancy of the survey area by native species; primarily the high presence of introduced species; pressure from predation and competition for resources by foxes and rabbits, particularly small mammals, birds and reptiles. Additionally, the European honey bee and yellow-throated miner bird are known to be aggressive species, and as such will outcompete most native fauna species, this would particularly affect birds and hollow occupying species.

In context to the adjacent remnant vegetation, outside of the survey area, the available habitat is a buffer to the larger patches of vegetation, particularly in the north west and south east, and in some cases a wildlife corridor. The broader landscape is fragmented and mainly composed of agricultural properties and so connectivity is fairly low between any patches of intact vegetation, thus limiting species arriving and departing the habitat in the survey area and the associated adjacent vegetation.

The desktop assessment identified 33 Threatened or Priority species within the study area. The pre-survey LOO identified one species as ‘Likely’ to occur, and four species as ‘Possible’ to occur. The post-survey LOO identified three species: Carnaby’s Cockatoo, southern whiteface and western rosella, as ‘Possible’ to occur. Of the fauna habitat units present Eucsal OW, Euclox OW and MMMSL provided some suitable habitat for the above species. However, the other occupancy constraints discussed above lower the quality of the available habitat. No Threatened or Priority species were detected during the survey.

6.2. Targeted Black Cockatoo Survey

No evidence of black cockatoo breeding, foraging or roosting was observed. A total of 61 significant trees were identified during the survey, of which 12 were hollow-bearing. Based on Carnaby’s Cockatoo tree hollow size preference (between 100 mm – 650 mm in diameter) and availability of hollow (not occupied by bees), ten hollow-bearing trees were judged to be suitable for use by Carnaby’s Cockatoo.

The habitat present was considered to be “Low quality” foraging habitat. The quality of the roosting habitat present is reduced by the lack of quality foraging habitat. Results from application of the ‘Foraging Habitat Tool” (Bamford Consulting Ecologists, 2020) indicate that foraging habitat for Carnaby’s Cockatoo, within the survey area fall within the category of ‘Low quality’.

Total foraging habitat available for Carnaby’s Cockatoo is 1.41 ha and encompasses the EucsalOW, Euclox OW and MMMSL fauna habitat units. Of this, 1.30 ha of Eucsal OW and Euclox OW, is also considered potential breeding and roosting habitat due to the woodland associations and hollow-bearing significant trees (>300mm DBH) present.

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8. Appendices

Appendix A – Maps

Appendix B –Likelihood of Occurrence (LOO) Analysis and Black Cockatoo Scoring Matrix

Appendix C – Conservation Status Definitions and Condition

Appendix D – Species and Significant Tree Lists

Appendix E - EPBC Act PMST reports

Appendix A

Maps

Figure 12: Survey effort

Albany Office:
29 Hercules Crescent
Albany, WA 6330
(08) 9842 1575

Denmark Office:
7/40 South Coast Highway
Denmark, WA 6333
(08) 9848 1309

Esperance Office:
2A/113 Dempster Street
Esperance, WA 6450
(08) 9072 1382

BIO DIVERSE SOLUTIONS

Overview Map Scale 1:100,000

Legend

- Cadastre
- Survey Area
- Survey Effort

Scale
1:4,000 @ A3
GDA MGA 2020 Zone 50

Data Sources
Aerial Imagery: WA Now, Landgate Subscription Imagery
Cadastre, Relief Contours and Roads: Landgate 2017
IRIS Road Network: Main Roads Western Australia 2017
Overview Map: World Topographic map service, ESRI 2012

CLIENT
CBH Nyabing Receival Bin
Lot 9231 Bin Rd
Nyabing, WA 6341

Figure 12: Survey effort

	QA Check	*Drawn by*
	CvdM	**MH**
STATUS **FINAL**	*FILE* **CBH0026-005**	*DATE* **29/11/2023**

Appendix B

Likelihood of Occurrence Analysis and Black Cockatoo Scoring Matrix

Table 8: Criteria for assessing the likelihood of occurrence of Threatened or Priority fauna within the study area.

Likelihood	Criteria
Present	Species is recorded within the survey area.
Likely	Species has been previously recorded in close proximity and suitable habitat occurs within the survey area.
Possible	Species previously recorded within 10 km and suitable habitat occurs in the survey area.
Unlikely	The species has been recorded locally through database searches. However, suitable habitat for the species does not occur at the survey area or suitable habitat may occur but the species has a highly restricted distribution, is very rare and only known from a limited number of populations. Species is unlikely to occur due to the site lacking critical habitat, only containing marginally suitable habitat, and/or the survey area is considerably degraded. The species has not been recorded in the survey area despite adequate survey effort.
Highly Unlikely	No suitable habitat within the survey area or the survey area is outside the species' natural distribution.

Table 9: Potential Threatened or Priority fauna located within the study area and likelihood of occurrence analysis (LOO) (post survey).
Note: Species are presented based on likelihood of occurrence. Habitat information taken from publicly available resources such as: DSEWPaC (2011) Survey guidelines for Australia's Threatened mammals; DEWHA (2010) Survey guidelines for Australia's Threatened birds; SPRAT profiles (DCCEEW, 2023a) and species-specific recovery plans.

Family	Scientific Name	Vernacular	Status (WA)/ EPBC Act	Habitat Description	Likelihood of Occurrence (Pre-Survey)	Likelihood of Occurrence (Post Survey)	Habitat Present (Y/N)	Likelihood of Detection if Present	Species Present (Y/N)	Comment
Cacatuidae	*Zanda latirostris*	Carnaby's Cockatoo, white-tailed short-billed black cockatoo	EN / EN	Eucalypt woodlands, especially those that contain salmon gum and wandoo, and in shrubland or kwongan heathland dominated by hakea, dryandra, banksia and grevillea species. It also occurs in remnant patches of native vegetation on land otherwise cleared for agriculture. It also forages in forests containing marri, jarrah or karri.	Likely	Possible	Yes	High	No	Presence of suitable foraging, roosting, breeding habitat associated with Eucalypt woodland pockets. Multiple significant trees with roosting potential. However, no evidence of recent or historical use, including scratching/chewing around hollow entrances or feeding evidence.
Acanthizidae	*Aphelocephala leucopsis*	Southern whiteface	- / VU	Favours wide range of open woodlands and shrublands with understorey of grasses, shrubs or both. Foraging on ground in areas of low tree density and herbaceous understorey litter cover.	Possible	Possible	Yes	High	No	Presence of suitable foraging habitat.
Dasyuridae	*Phascogale calura*	Red-tailed phascogale, red-tailed wambenger, kenngoor	CD / VU	Inhabits wandoo (*Eucalyptus wandoo*) and sheoak (*Allocasuarina huegeliana*) woodland associations, with populations being most dense in the latter vegetation type. They show a preference for long unburnt habitat with a continuous canopy, as well as tree hollows.	Possible	Unlikely	No	Low	No	Presence of preferred woodland associations and hollows for this species. No evidence of occupation (scratching) around hollows and low canopy connectivity undermines the suitability of habitat for species.
Macropodidae	*Notamacropus irma*	Western brush wallaby	P4 / -	Preferred habitat includes open forest or woodland, particularly open, seasonally-wet flats with low grasses and open scrubby thickets.	Possible	Unlikely	No	Low	No	Lack of suitable shelter and feeding habitat.
Psittacidae	*Platycercus icterotis xanthogenys*	Western rosella (inland)	P4 / -	Found in open eucalypt forest and timbered areas, including cultivated land and orchards. Subspecies, xanthogenys, found in drier woodland, with a heath understorey.	Possible	Possible	Yes	Moderate	No	Suitable habitat present, however no calling individuals or feeding evidence found.
Apodidae	*Apus pacificus*	Fork-tailed swift	MI / MI	Dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. Almost exclusively aerial, flying from less than 1 m to at least 300 m above ground over inland plains but sometimes above foothills or in coastal areas.	Unlikely	Unlikely	No	NA	No	Lack of suitable habitat.
Dasyuridae	*Dasyurus geoffroii*	Chuditch, western quoll	VU / VU	Woodland or forest. Logs must have a diameter > 30 cm and a hollow with 7–20 cm diameter and 1 m length (Dunlop and Morris 2012). Burrows are constructed beneath habitat features such as stumps, logs, trees or rock outcrops.	Unlikely	Unlikely	No	NA	No	Lack of suitable habitat.
Falconidae	*Falco hypoleucos*	Grey falcon	VU / VU	Usually in lightly timbered country, especially stony plains and lightly timbered acacia shrublands.	Unlikely	Unlikely	No	NA	No	Lack of suitable habitat.
Falconidae	*Falco peregrinus*	Peregrine falcon	OS / -	It requires abundant prey and secure nest sites, and prefers coastal and inland cliffs or open woodlands near water.	Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat, including a water source. No evidence of nests or calling individuals.
Macropodidae	*Notamacropus eugenii subsp. derbianus*	Tammar wallaby	P4 / -	Dense, low vegetation for daytime shelter and open grassy areas for feeding. This species inhabits coastal scrub, heath, dry sclerophyll forest and thickets in mallee and woodland.	Unlikely	Highly unlikely	No	NA	No	Lack of suitable shelter and feeding habitat.
Megapodiidae	*Leipoa ocellata*	Malleefowl	VU / VU	Arid and semi-arid areas dominated by mallee eucalypts on sandy soils. They are known to also occur in mulga (*Acacia aneura*), broombush (*Melaleuca uncinata*), scrub pine (*Callitris verrucosa*), Eucalyptus woodlands and coastal heathlands. Malleefowl require abundant leaf litter and a sandy substrate for the successful construction of nest mounds.	Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat including leaf litter, sandy substrate or mallee eucalypts.

Table 9 continued.

Family	Scientific Name	Vernacular	Status (WA)/ EPBC Act	Habitat Description	Likelihood of Occurrence (Pre-Survey)	Likelihood of Occurrence (Post Survey)	Habitat Present (Y/N)	Likelihood of Detection if Present	Species Present (Y/N)	Comment
Muridae	*Pseudomys occidentalis*	Western mouse	P4 / -	Historical distribution. Preference for long unburnt habitat (between 30 and 50 yrs) on sandy clay loam or sandy loam. Vegetation in suitable habitats is variable and includes sparse low shrubland, tall dense shrubland, sparse to dense shrub mallee and mid-dense woodland. All sites where the western mouse has been collected have had patches of extremely dense vegetation.	Unlikely	Highly Unlikely	No	NA	No	Lack of dense vegetation.
Myrmecobiidae	*Myrmecobius fasciatus*	Numbat, walpurti	EN / EN	Current known distribution is a small area of WA's Jarrah Forest and Wheatbelt, notably at Dryandra Woodland and the Upper Warren area. Habitat is generally woodland dominated by Eucalyptus species, with abundant hollow logs and branches for shelter and termites for food.	Unlikely	Highly unlikely	No	NA	No	Not within species currently known distribution and degraded site not suitable for species.
Peramelidae	*Isoodon fusciventer*	Quenda, southwestern brown bandicoot	P4 / -	Scrubby, often swampy, vegetation with dense cover up to 1 m high, often feeding in adjacent forest and woodland that is burnt on a regular basis. Forest, woodlands, heath and coastal scrub, usually on sandy combination soils.	Unlikely	Highly unlikely	No	NA	No	Lack of suitable shelter and feeding habitat.
Psophodidae	*Psophodes nigrogularis*	Western whip bird	EN / EN	Dense heath-like shrubby thickets on coastal dunes, and mallee woodland or shrubland with an open upperstorey above a dense shrubby understorey. Preferred habitat is usually 2–3 metres tall and dominated by shrubs such as *Agonis marginata*, hakeas (e.g. *Hakea elliptica* and *H. trifurcata*), showy dryandra (*Banksia formosa*), *Eutaxia obovata*, *Acacia myrtifolia* and heart-leaf poison-bush (*Gastrolobium bilobum*), usually with a dense shrubby understorey, and sometimes intermixed with stunted eucalypts such as marri (*Eucalyptus calophylla*) and jarrah (*E. marginata*).	Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.
Psophodidae	*Psophodes nigrogularis subsp. oberon*	Western Wheatbelt whipbird	P4 / -	Occurs in mallee, often open mallee vegetation with a dense, tall shrub layer up to 1.5 m tall and dominated by such species as Hakea, Lambertia, Dryandra or Banksia.	Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.
Accipitridae	*Elanus scriptus*	Letter-winged kite	P4 / -	Semi-desert and desert along tree-lined creeks; hunts over grasslands and other low vegetation.	Highly Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.
Anatidae	*Oxyura australis*	Blue-billed duck	P4 / -	Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation.	Highly Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.
Ardeidae	*Botaurus poiciloptilus*	Australasian bittern	EN / EN	Wetlands, permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or cutting grass (Gahnia) growing over a muddy or peaty substrate.	Highly Unlikely	Highly Unlikely	No	NA	No	Lack of suitable habitat.
Charadriidae	*Thinornis rubricollis*	Hooded plover, hooded dotterel	P4 / -	Ocean sandy beaches and coastal lakes, also occur around salt and freshwater lakes that range from close to the coast to inland areas.	Highly unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.
Dasyuridae	*Parantechinus apicalis*	Dibbler	EN / EN	Old-growth mallee heath. Prefer vegetation with a dense canopy greater than 1 m high which has been unburnt for at least 10 years or more.	Highly Unlikely	Highly Unlikely	No	NA	No	Lack of suitable habitat.
Motacillidae	*Motacilla cinerea*	Grey wagtail	MI / MI	Species has a strong association with water (wetlands, water courses banks of lakes and marshes, artificial wetlands).	Highly Unlikely	Highly Unlikely	No	NA	No	Lack of suitable habitat.
Pseudocheiridae	*Pseudocheirus occidentalis*	Western ringtail possum, ngwayir	CR / CR	Current populations inhabit coastal peppermint/tuart associations from Bunbury to Albany, and in eucalypt forest near Manjimup. The highest density of western ringtail possums is found on the southern Swan Coastal Plain near Busselton, in habitats with dense, relatively lush vegetation. The Upper Warren area east of Manjimup is the only place the western ringtail possum currently survives in the absence of peppermint trees.	Highly Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.

Table 9 continued.

Family	Scientific Name	Vernacular	Status (WA)/ EPBC Act	Habitat Description	Likelihood of Occurrence (Pre-Survey)	Likelihood of Occurrence (Post Survey)	Habitat Present (Y/N)	Likelihood of Detection if Present	Species Present (Y/N)	Comment
Rostratulidae	*Rostratula australis*	Australian painted snipe	EN / EN	Generally, inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia or canegrass or sometimes tea-tree (Melaleuca).	Highly Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.
Scolopacidae	*Actitis hypoleucos*	Common sandpiper	MI / MI	Wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. Has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags.	Highly Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.
Scolopacidae	*Calidris acuminata*	Sharp-tailed sandpiper	MI / MI	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season. They may be attracted to mats of algae and water weed either floating or washed up around terrestrial wetlands, and coastal areas with much beach cast seaweed. Sometimes they occur on rocky shores and rarely on exposed reefs.	Highly Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.
Scolopacidae	*Calidris ferruginea*	Curlew sandpiper	CR / CR & MI	Intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. Also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters.	Highly Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.
Scolopacidae	*Calidris melanotos*	Pectoral sandpiper	MI / MI	Shallow fresh to saline wetlands. Found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. Usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetland.	Highly Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.
Scolopacidae	*Calidris ruficollis*	Red-necked stint	MI / MI	Coastal areas, including sheltered inlets, bays, lagoons and estuaries with intertidal mudflats; ephemeral or permanent shallow wetlands near the coast or inland, and sometimes flooded paddocks or damp grasslands.	Highly Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.

Table 9 continued.

Family	Scientific Name	Vernacular	Status (WA)/ EPBC Act	Habitat Description	Likelihood of Occurrence (Pre-Survey)	Likelihood of Occurrence (Post Survey)	Habitat Present (Y/N)	Likelihood of Detection if Present	Species Present (Y/N)	Comment
Scolopacidae	*Calidris subminuta*	Long-toed stint	MI / MI	Occurs in a variety of terrestrial wetlands. They prefer shallow freshwater or brackish wetlands including lakes, swamps, river floodplains, streams, lagoons and sewage ponds. The species is also fond of areas of muddy shoreline, growths of short grass, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire. It has also been observed at open, less vegetated shores of larger lakes and ponds and is common on muddy fringes of drying ephemeral lakes and swamps. The Long-toed Stint also frequents permanent wetlands such as reservoirs and artificial lakes. They are uncommon, but not unknown, at tidal estuaries, saline lakes, saltponds and bore swamps.	Highly Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.
Scolopacidae	*Tringa glareola*	Wood sandpiper	MI / MI	Inland shallow freshwater wetlands, often with other waders. They prefer ponds and pools with emergent reeds and grass, surrounded by tall plants or dead trees and fallen timber.	Highly Unlikely	Highly Unlikely	No	NA	No	Lack of suitable habitat.
Scolopacidae	*Tringa nebularia*	Common greenshank, greenshank	MI / MI	Found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. Uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and salt flats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees.	Highly Unlikely	Highly Unlikely	No	NA	No	Lack of suitable habitat.
Thylacomydidae	*Macrotis lagotis*	Bilby, dalgyte, ninu	VU / VU	Known distribution in WA includes the Gibson Desert, Little Sandy Desert, Great Sandy Desert and parts of the Pilbara and Southern Kimberley. Habitat includes open tussock grassland on uplands and hills, Acacia aneura (mulga) woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas.	Highly Unlikely	Highly unlikely	No	NA	No	Lack of suitable habitat.

Black Cockatoo Scoring Matrix

Habitat scoring system (Bamford 2020)

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

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

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

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

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

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

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

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

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

Table 10: Site condition. Vegetation composition, condition and structure scoring.

Site Score	Description of Vegetation Values		
	Carnaby's Cockatoo	**Baudin's Cockatoo**	**Forest Red-tailed Black Cockatoo**
0	No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples: • Water bodies (e.g. salt lakes, dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits) or with vegetation of no food value, such as some suburban landscapes. • Mown grass	No foraging value. No eucalypts or other potential sources of food. Examples: • Water bodies (e.g. dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).	No foraging value. No eucalypts or other potential sources of food. Examples: • Water bodies (e.g. dams, rivers); • Bare ground; Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).

Table 10 continued.

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

Table 10 continued.

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

Vegetation structural class terminology follows Keighery (1994).

B) Site context

Site Context is a function of site size, availability of nearby habitat and the availability of nearby breeding areas. Site context includes consideration of connectivity, although Black-Cockatoos are very mobile and will fly across paddocks to access

foraging sites. Based on BCE observations, Carnaby's are unlikely to regularly go over open ground for a distance of more than a few kilometres and prefer to follow tree-lines.

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

Table 11: Site Context Score.

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

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

C) Species density (stocking rate).

Species stocking rate is described as "the usage and/or density of a species at a particular site" in the offsets guide. The description also implies that a site supports a discrete population, which is unlikely in the case of very mobile black-cockatoos. Assignation of the species density score (0 or 1) is based upon the black-cockatoo species being either abundant or not abundant. A score of 1 is used where the species is seen or reported regularly and/or there is abundant foraging evidence. Regularly is when the species is seen at intervals of every few days or weeks for at least several months of the year. A score of 0 is used when the species is recorded or reported very infrequently and there is little or no foraging evidence. Where information on actual presence of birds is lacking, a species density score can be assigned by interpreting the landscape and the site context. For example, a site with a moderate condition score that is part of a network of such habitat where a black-cockatoo species is known would get a species density score of 1 even without clear presence data, while a species density score of 0 can be assigned to a site where the level of usage can confidently be predicted to be low. 0

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

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

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

Table 12: Moderation of calculated scores.

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

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

Appendix C

Conservation Status Definitions and Condition Scale

Table 13: Conservation code definitions for fauna listed as Threatened or specially protected.
Threatened, Extinct and Specially Protected fauna or flora are species which have been adequately searched for and are deemed to be, in the wild, Threatened, extinct or in need of special protection, and have been gazetted as such.

Threat Category	Definition
Threatened - Critically endangered species (CR)	Facing an extremely high risk of extinction in the wild in the immediate future
Threatened - Endangered species (EN)	Facing a very high risk of extinction in the wild in the near future
Threatened - Vulnerable species (VU)	Facing a high risk of extinction in the wild in the medium-term future
Threatened - Extinct (EX)	There is no reasonable doubt that the last member of the species has died
Threatened – Extinct in the wild (EW)	Species 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
Specially protected species - Migratory species (MI)	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.
Specially protected species – Conservation Dependent (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as Threatened,
Specially protected species – Other specially protected species (OS)	Fauna otherwise in need of special protection to ensure their conservation

Table 14: Conservation code definitions for fauna listed as Priority.
Possibly Threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3.

Threat Category	Definition
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.
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.
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.
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.

Table 15: Condition rating scale (adapted from Keighery, 1994) outlined in EPA (2016).

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

Appendix D

Species and Significant Tree Lists

Table 16: Fauna species recorded within survey area. Listed by class, then alphabetically by family.

Family	Species	Vernacular	Invasive
Aves			
Artamidae	*Gymnorhina tibicen*	Magpie	
Artamidae	*Strepera versicolor*	Grey Currawong	
Cacatuidae	*Cacatua sp.*	Corella	
Cacatuidae	*Eolophus roseicapilla*	Galah	
Columbidae	*Phaps chalcoptera*	Common bronzewing	
Meliphagidae	*Manorina flavigula*	Yellow-throated miner	
Psittaculidae	*Barnardius zonarius*	Australian ringneck	
Insecta			
Apidae	*Apis mellifera*	European honey bee	X
Lycosidae	*Lycosidae* sp.	Wolf spider	
Mammalia			
Bovidae	Bos taures	Domesticated cow	X
Canidae	*Vulpes vulpes*	Red fox	X
Leporidae	*Oryctolagus cuniculus*	Rabbit	X
Macropodidae	*Macropus fuliginosus*	Western grey kangaroo	

Table 17: Significant trees in the survey area.

ID	Species	DBH (mm)	Crown Senescent	Hollows Present	Location	Size of entrance (mm)	Type of entrance	Height above ground (m)	Comments	GPS location
1	*Eucalyptus salmonophloia*	1035	No	Yes	Branch	50x70	Side	12	Possible multiple hollows.	[redacted]
2	*Eucalyptus occidentalis*	339	No	No	-	-	-	-		
3	*Eucalyptus wandoo*	421	No	No	-	-	-	-		
4	*Eucalyptus wandoo*	476	No	No	-	-	-	-		
5	*Eucalyptus wandoo*	345	No	No	-	-	-	-	Multi-stemmed.	
6	*Eucalyptus wandoo*	327	No	No	-	-	-	-		
7	*Eucalyptus salmonophloia*	469	No	No	-	-	-	-		
8	*Eucalyptus salmonophloia*	421	No	No	-	-	-	-		
9	*Eucalyptus salmonophloia*	364	No	No	-	-	-	-	2 stems. Hollow forming potential.	
10	*Eucalyptus salmonophloia*	738	No	Yes	Branch	150x150	Side	10	Multiple hollows.	
11	*Eucalyptus salmonophloia*	632	Yes	Yes	Stem	200x200	Elbow	9	Suitable hollows.	
12	*Eucalyptus salmonophloia*	820	No	Yes	Trunk	150x100	Side	6	Multiple suitable hollows.	
13	*Eucalyptus salmonophloia*	748	No	Yes	Branch	150x100	Elbow	10	Multiple hollows.	
14	*Eucalyptus salmonophloia*	731	No	Yes	Trunk	150x100	Elbow	10		

Table 17 continued.

ID	Species	DBH (mm)	Crown Senescent	Hollows Present	Location	Size of entrance (mm)	Type of entrance	Height above ground (m)	Comments	GPS location
15	*Eucalyptus salmonophloia*	796	No	Yes	Branch	100x100	Chimney	12	Multiple hollows. Bees and birds observed around tree.	[redacted]
16	*Eucalyptus salmonophloia*	1023	Yes	Yes	Branch	300x300	Chimney	5	Multiple suitable hollows.	
17	*Eucalyptus salubris*	500	No	No	-	-	-	-		
18	*Eucalyptus salubris*	495	No	No	-	-	-	-		
19	*Eucalyptus salmonophloia*	955	Yes	Yes	Branch	500x300	Elbow	12	Multiple hollows.	
20	*Eucalyptus salmonophloia*	1055	Yes	Yes	Trunk	200x200	Chimney	5	Multiple suitable hollows.	
21	*Eucalyptus salmonophloia*	517	No	No	-	-	-	-		
22	*Eucalyptus salmonophloia*	410	No	No	-	-	-	-		
23	*Eucalyptus salmonophloia*	740	No	No	-	-	-	-		
24	*Eucalyptus salmonophloia*	658	No	No	-	-	-	-	Multi-stemmed.	
25	*Eucalyptus loxophleba* subsp. *loxophleba*	448	No	No	-	-	-	-		
26	*Eucalyptus salmonophloia*	994	Yes	Yes	Branch	200x200	Chimney	12	Galahs observed flying from tree.	
27	*Eucalyptus loxophleba* subsp. *loxophleba*	402	No	No	-	-	-	-	Multi-stemmed.	
28	*Eucalyptus loxophleba* subsp. *loxophleba*	640	Yes	Forming	-	-	-	-		

Table 17 continued.

ID	Species	DBH (mm)	Crown Senescent	Hollows Present	Location	Size of entrance (mm)	Type of entrance	Height above ground (m)	Comments	GPS location
29	*Eucalyptus loxophleba* subsp. *loxophleba*	799	Yes	Yes	Branch	150x150	Chimney	10	Upwards facing hollow. Bees observed coming out.	[redacted]
30	*Eucalyptus loxophleba* subsp. *loxophleba*	336	No	No	-	-	-	-	Multi-stemmed.	
31	*Eucalyptus loxophleba* subsp. *loxophleba*	388	No	No	-	-	-	-		
32	*Eucalyptus loxophleba* subsp. *loxophleba*	362	No	No	-	-	-	-		
33	*Eucalyptus loxophleba* subsp. *loxophleba*	341	No	No	-	-	-	-		
34	*Eucalyptus loxophleba* subsp. *loxophleba*	305	No	No	-	-	-	-		
35	*Eucalyptus salmonophloia*	831	Yes	No	-	-	-	-		
36	*Eucalyptus salmonophloia*	429	No	No	-	-	-	-		
37	*Eucalyptus salmonophloia*	587	No	No	-	-	-	-		
38	*Eucalyptus salmonophloia*	380	No	No	-	-	-	-		
39	*Eucalyptus salmonophloia*	401	No	No	-	-	-	-		
40	*Eucalyptus salmonophloia*	391	No	No	-	-	-	-	Multi-stemmed.	
41	*Eucalyptus loxophleba* subsp. *loxophleba*	521	No	No	-	-	-	-		
42	*Eucalyptus loxophleba* subsp. *loxophleba*	511	No	No	-	-	-	-		

Table 17 continued.

ID	Species	DBH (mm)	Crown Senescent	Hollows Present	Location	Size of entrance (mm)	Type of entrance	Height above ground (m)	Comments	GPS location
43	*Eucalyptus loxophleba* subsp. *loxophleba*	371	No	No	-	-	-	-		[redacted]
44	*Eucalyptus salmonophloia*	505	No	No	-	-	-	-		
45	*Eucalyptus salmonophloia*	460	No	No	-	-	-	-		
46	*Eucalyptus salmonophloia*	355	Dead	Forming	-	-	-	-	Dead.	
47	*Eucalyptus loxophleba* subsp. *loxophleba*	338	No	No	-	-	-	-		
48	*Eucalyptus occidentalis*	440	No	No	-	-	-	-		
49	*Eucalyptus occidentalis*	424	No	No	-	-	-	-		
50	*Eucalyptus occidentalis*	603	No	No	-	-	-	-		
51	*Eucalyptus occidentalis*	550	No	No	-	-	-	-		
52	*Eucalyptus occidentalis*	554	No	No	-	-	-	-	Multi-stemmed.	
53	*Eucalyptus occidentalis*	610	No	No	-	-	-	-		
54	*Eucalyptus occidentalis*	401	No	No	-	-	-	-		
55	*Eucalyptus occidentalis*	615	No	No	-	-	-	-		
56	*Eucalyptus occidentalis*	380	No	No	-	-	-	-		

Table 17 continued.

ID	Species	DBH (mm)	Crown Senescent	Hollows Present	Location	Size of entrance (mm)	Type of entrance	Height above ground (m)	Comments	GPS location
57	*Eucalyptus occidentalis*	329	Dead	No	-	-	-	-	Dead.	[redacted]
58	*Eucalyptus occidentalis*	360	No	No	-	-	-	-		
59	*Eucalyptus occidentalis*	755	No	No	-	-	-	-		
60	*Eucalyptus occidentalis*	540	No	No	-	-	-	-		
61	*Eucalyptus occidentalis*	572	No	No	-	-	-	-		