Narrogin Wind Farm Project

Vertebrate Fauna Survey 2023

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Executive Summary

Introduction

Neoen Australia Pty Ltd (Neoen) is investigating the potential development of the Narrogin Wind Farm (the Project), located approximately 160km south-east of Perth in the Shires of Williams and Narrogin. On Behalf of Neoen, Umwelt (Australia) Pty Ltd (Umwelt) commissioned Western Wildlife to undertake a vertebrate fauna survey of the Narrogin Wind Farm.

The key objectives of the vertebrate fauna survey were to:

- Collate existing fauna data from in and around the study area.
- Identify and map the fauna habitats present in the study area.
- Identify the vertebrate fauna that have the potential to occur in the study area.
- Identify species of conservation significance, or habitats of particular importance for fauna, that have the potential to occur in the study area.
- Discuss, at a high level, the potential ecological impacts of the Project.

Methods

The fauna survey was undertaken in accordance with the Technical Guidance: terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020) and relevant State and Federal Guidelines on surveying conservation significant fauna. The fauna survey comprised one fieldtrip, 23 - 27 October 2023, with methods including:

- Habitat assessment.
- High-level assessment of black-cockatoo breeding and foraging habitat.
- Bat survey with ultrasonic detectors.
- Conservation significant owl survey with passive acoustic detectors.
- Conservation significant mammal survey with camera traps.
- Keeping opportunistic records of fauna.

Species of conservation significance were classified as: Threatened if listed as Extinct in the Wild, Critically Endangered, Endangered or Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or *Biodiversity Conservation Act 2016* (BC Act); Migratory if listed as Migratory under the EPBC Act and/or BC Act, excluding those species also listed as threatened; Specially Protected if listed as Other Specially Protected Species or Conservation Dependent Fauna under the BC Act and Priority if listed as Priority by DBCA.

Results and Discussion

Five broad fauna habitats were identified in the study area:

- Eucalypt woodlands on laterite rise
- Eucalypt – Sheoak woodlands with granites
- Creekline
- Planted
- Cleared (includes isolated paddock trees and farm dams)

The habitats of the study area are unlikely to support very diverse, restricted or rare faunal assemblages compared with more intact habitat areas in the region. Although the habitats of the study area are degraded, they are still likely to provide ecological linkage, particularly for more mobile species such as birds, and are also likely to support some conservation significant fauna. In a largely cleared agricultural landscape, all remaining native vegetation is likely to be of some importance for maintaining populations of native fauna.

The predicted faunal assemblage includes up to 12 frogs, 46 reptiles, 158 birds, 27 native mammals and five introduced mammals. As the habitats of the study area are fragmented and the understory is degraded, the actual faunal assemblage is likely to be species poor compared with more intact habitats, and thus not all the predicted species are likely to be present, despite being known to occur in the region. The observed faunal assemblage within the study area thus far includes one frog, three reptiles, 69 birds, eleven native mammals and four introduced mammals.

A total of 23 vertebrate fauna of conservation significance may occur in the study area: nine Threatened, two Migratory, two Specially Protected and ten Priority species.

The nine **Threatened** species are:

- Woylie (*Bettongia penicillata ogilbyi*) - EPBC Act (Endangered), BC Act (Critically Endangered)
- Numbat (*Myrmecobius fasciatus*) - EPBC Act (Endangered), BC Act (Endangered)
- Australia Painted Snipe (*Rostratula australis*) - EPBC Act (Endangered), BC Act (Endangered)
- Malleefowl (*Leipoa ocellata*) - EPBC Act (Vulnerable), BC Act (Vulnerable)
- Chuditch (*Dasyurus geoffroii*) - EPBC Act (Vulnerable), BC Act (Vulnerable)
- Red-tailed Phascogale (*Phascogale calura*) - EPBC Act (Vulnerable), BC Act (Conservation Dependent)
- Forest Red-tailed Black-cockatoo (*Calyptorhynchus banksii naso*) - EPBC Act (Vulnerable), BC Act (Vulnerable)
- Carnaby's Cockatoo (*Zanda latirostris*) - EPBC Act (Endangered), BC Act (Endangered)
- Baudin's Cockatoo (*Zanda baudinii*) - EPBC Act (Endangered), BC Act (Endangered)

Of these, the study area is unlikely to provide important habitat for the Woylie, Numbat, Malleefowl or Australian Painted Snipe, although these species may range into the area on occasion. The Chuditch was recorded at one site during the fauna survey and is likely to use any habitat in the study area for dispersal. The Red-tailed Phascogale was recorded at one site in the study area and two additional sites nearby. It is likely to be a breeding resident of Eucalypt – Sheoak woodlands with granites and Eucalypt woodland on laterite rises.

Baudin's Cockatoo was not recorded during the survey and is on the eastern edge of its distribution in the study area, but potentially occurs. The Forest Red-tailed Black-cockatoo is likely to occur and was recorded nearby during the survey. Secondary signs (foraging evidence) of Carnaby's Cockatoo were recorded. Foraging habitat for black-cockatoos is present in woodlands dominated by or containing Marri (*Corymbia calophylla*) and/or Jarrah (*Eucalyptus marginata*), isolated paddock trees of these species, and areas with an understory including shrubby *Banksia* spp. Potential breeding habitat is present in eucalypt woodlands and creeklines, but individual habitat trees were not assessed as part of this study.

The two **Migratory** species are:

- Fork-tailed Swift (*Apus pacificus*)
- Common Sandpiper (*Actitis hypoleucos*)

No Migratory species were recorded on the survey. The study area is not likely to provide important habitat to Migratory fauna or regularly support significant numbers of any Migratory species, although occasional individuals may occur from time to time.

The two **Specially Protected** species are:

- Peregrine Falcon (*Falco peregrinus*) – Other Specially Protected Fauna
- Brush-tailed Phascogale (*Phascogale tapoatafa*) - Conservation Dependent

The Peregrine Falcon was recorded in the study area during the fauna survey. The Brush-tailed Phascogale possibly occurs on occasion, but the habitats of the study area are likely to be too fragmented to regularly support this species and it is generally believed to be locally extinct in the wheatbelt.

The ten **Priority** species are:

- Southern Death Adder (*Acanthophis antarcticus*) – Priority 3
- Barking Owl (*Ninox connivens connivens*) – Priority 3
- Masked Owl (*Tyto novaehollandiae novaehollandiae*) – Priority 3
- Central Long-eared Bat (*Nyctophilus major tor*) – Priority 3
- Inland Western Rosella (*Platycercus icterotis xanthogenys*) - Priority 4
- Quenda (*Isoodon fusciventer*) – Priority 4
- Tammar Wallaby (*Notamacropus eugenii derbianus*) – Priority 4
- Western Brush Wallaby (*Notamacropus irma*) – Priority 4
- Western False Pipistrelle (*Falsistrellus mackenziei*) – Priority 4
- Water Rat (*Hydromys chrysogaster*) – Priority 4

Of these, only the Inland Western Rosella was recorded on this survey, and it is likely to be an uncommon breeding resident in eucalypt woodlands. The Western False Pipistrelle and Central Long-eared Bat were not detected in the bat survey, but potentially occur, roosting in tree hollows. The Barking Owl and Masked Owl possibly occur but were not recorded on this survey and are rarely recorded in the region. The Tammar Wallaby, Western Brush Wallaby and Quenda occur in woodlands to the north of the study area but are unlikely to regularly occur in the study area as the habitats are too fragmented and the understory too degraded. The Water-rat possibly occurs along creeklines and in farm dams. Although known from the region, most habitats in the study area are likely to be too degraded to support the Southern Death Adder.

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1. Introduction

Neoen Australia Pty Ltd (Neoen) is investigating the potential development of the Narrogin Wind Farm (the Project), located approximately 160km south-east of Perth in the Shires of Williams and Narrogin (Figure 1). The Project is expected to comprise up to 25 Wind Turbine Generators (WTG), Battery Energy Storage System (BESS) and associated ancillary infrastructure.

On Behalf of Neoen, Umwelt (Australia) Pty Ltd (Umwelt) commissioned Western Wildlife to undertake a vertebrate fauna survey of the Narrogin Wind Farm.

The key objectives of the vertebrate fauna survey were to:

- Collate existing fauna data from in and around the study area.
- Identify and map the fauna habitats present in the study area.
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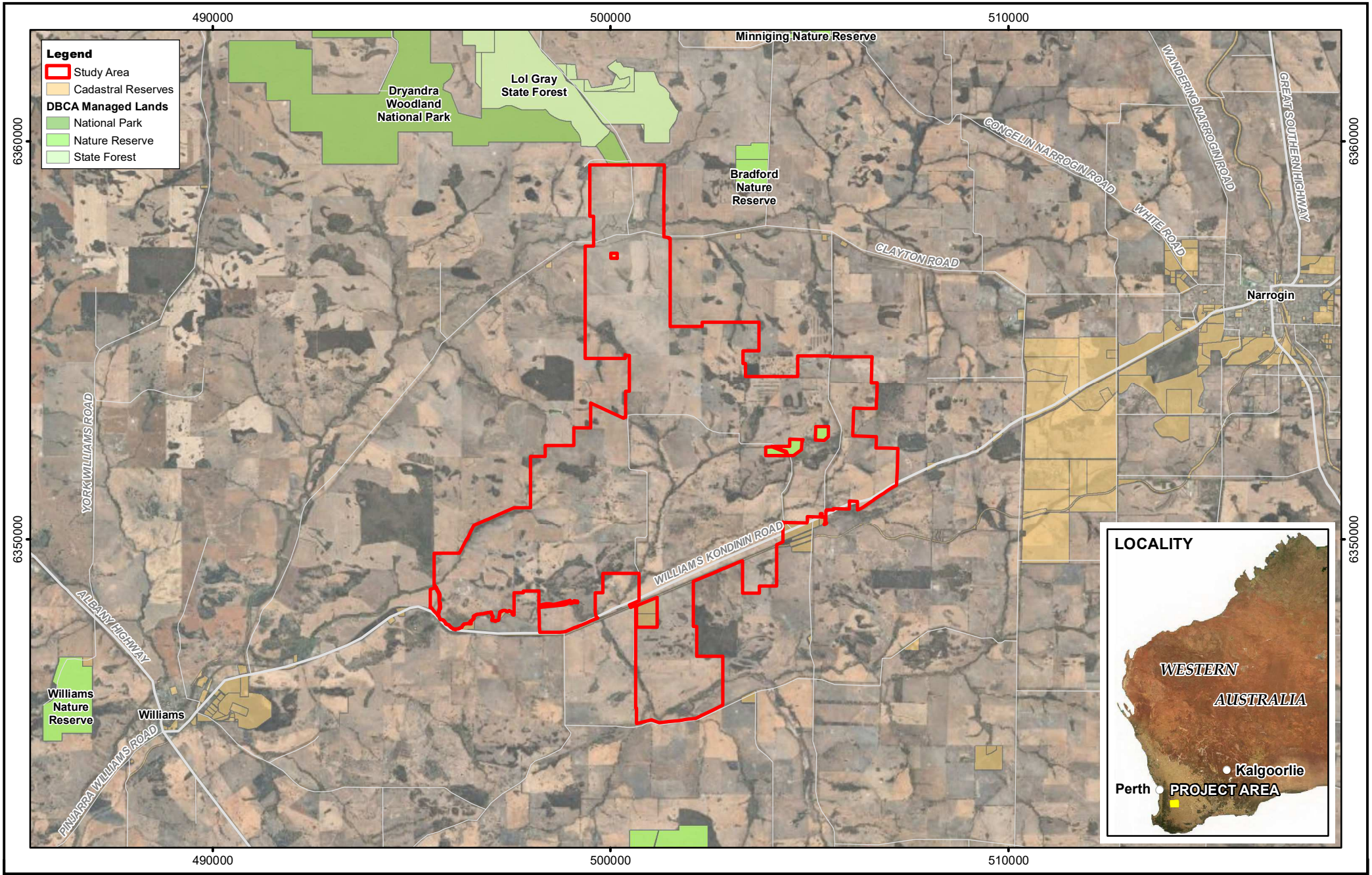
- Discuss, at a high level, the potential ecological impacts of the Project.

The vertebrate fauna survey specifically excluded a targeted bird and bat utilisation study, and any discussion of collision risks for aerial species, as this study is being undertaken separately.

1.1 Study Area

The study area consists of several freehold properties located between the towns of Narrogin and Williams, about 160km south-east of Perth (Figure 1). The study area totals 6,344ha. An earlier project concept and the field survey effort covered a larger area than the study area. All areas outside the study area are designated the 'additional survey area', and this area totals 3,023ha (Figure 2). All field results presented in this report are from the study area only, except where stated otherwise.

The current land use is primarily agricultural, with the majority of the study area cleared for cropping and grazing. Remnant vegetation in patches of various size and condition occur throughout the study area, and it is these areas that were the focus of the fauna survey.



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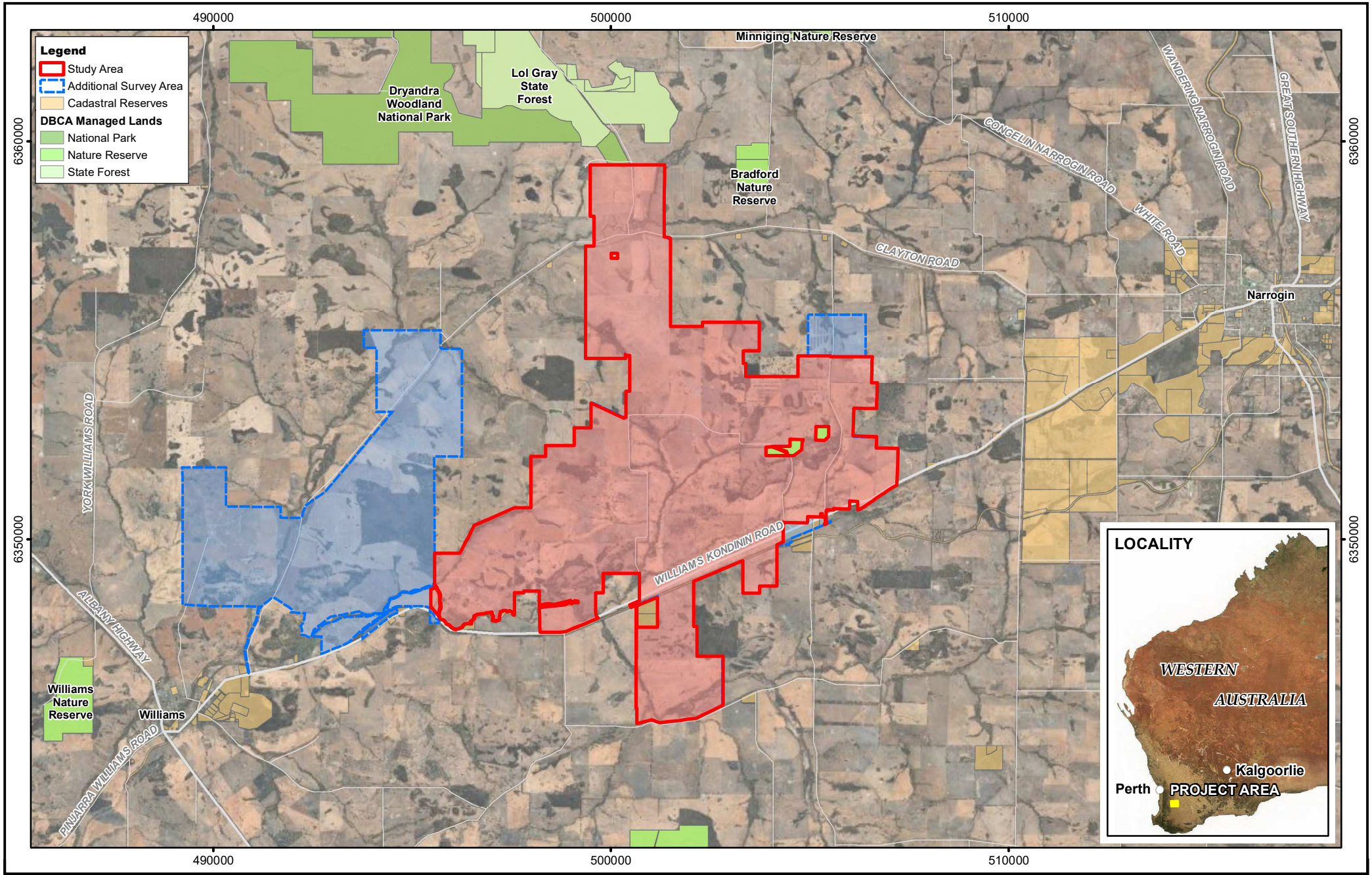

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1.2 Regional Context

1.2.1 IBRA Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the land surface of Australia into 89 Bioregions and 419 subregions, each defined by a set of environmental influences that impact the occurrence of flora and fauna and their interaction with the physical environment (DCCEEW 2020).

The study area falls across two IBRA subregions: the Northern Jarrah Forest subregion of the Jarrah Forest Bioregion and the Katanning subregion of the Avon Wheatbelt Bioregion (DoEE 2018).

The Katanning subregion has a semi-arid (dry) Warm Mediterranean climate, and the primary land-uses are dryland agriculture and grazing on improved pastures, with smaller areas of conservation, Crown reserves and rural residential (Beecham 2001). The vegetation in the subregion consists of woodlands of Wandoo (*Eucalyptus wandoo*), York Gum (*Eucalyptus loxophleba*) and Salmon Gum (*Eucalyptus salmonophloia*) with Jam (*Acacia acuminata*) and Rock Sheoak (*Allocasuarina huegeliana*), and proteaceous scrub-heaths on the residual lateritic uplands (Beecham 2001).

The Northern Jarrah Forest subregion of the Jarrah Forest Bioregion occurs east of the Darling Scarp, this subregion supports Jarrah – Marri forests on lateritic soils, Wandoo – Marri woodlands on clayey soils and Powderbark Wandoo on breakaways. There are Banksia woodlands on sands in localized patches, and granites support heaths (Williams and Mitchell 2001).

1.2.2 Botanical Province

The Botanical Provinces are determined by vegetation mapping (Beard 1980) and broadly correspond to climactic regions; the Southwest (Bassian) Province experiencing warm dry summers and cool wet winters, the Northern Province experiencing warm wet summers and cool dry winters and the Eremaean Province experiencing low, irregular rainfall. The study area falls within the Southern Province.

1.2.3 Parks and Reserves

There are no parks or reserves overlapping the study area, but several occur in the region. Most significantly, Dryandra Woodland National Park and Lol Gray State Forest occur to the north of the study area (Figure 1).

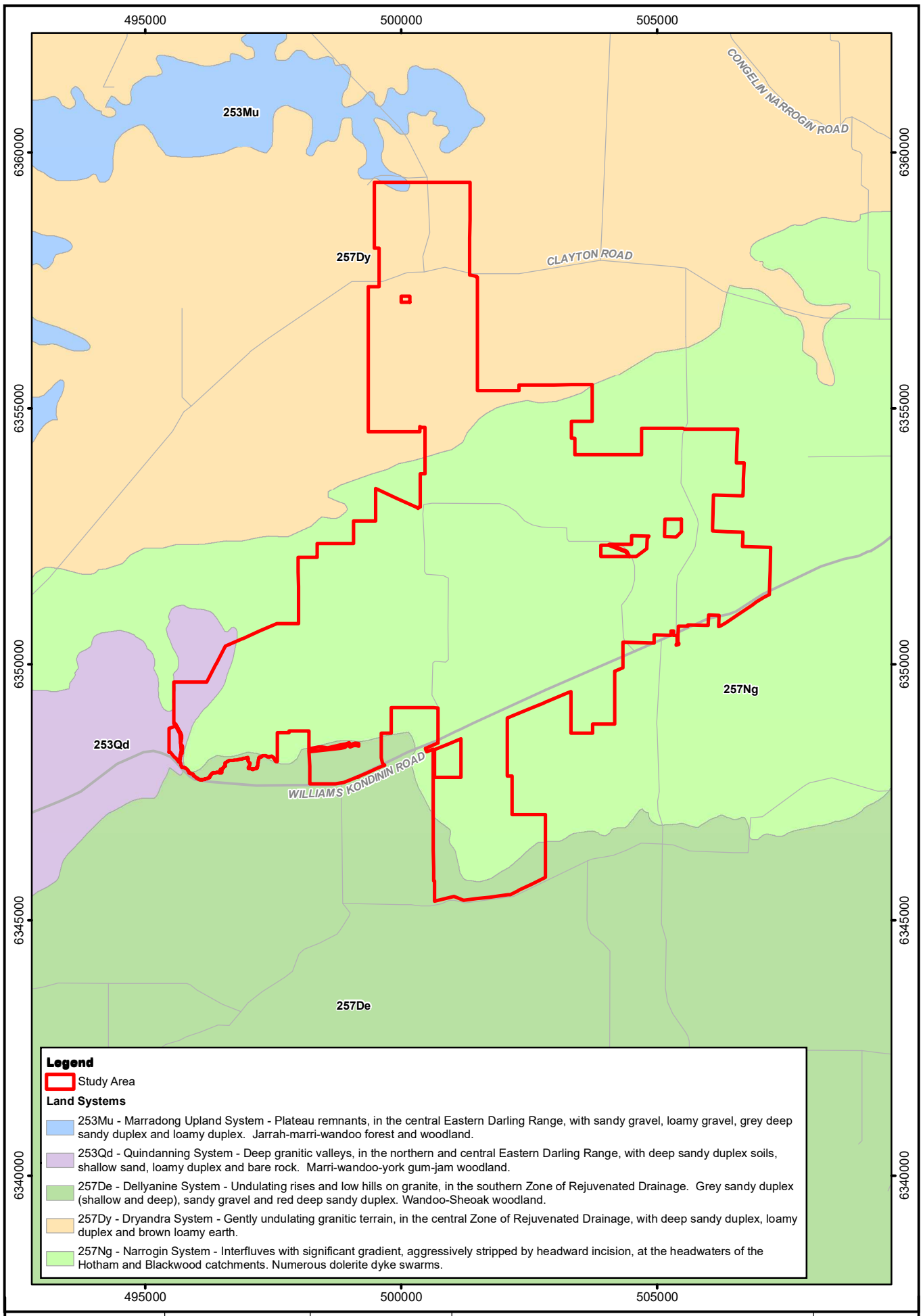
1.2.4 Threatened or Priority Ecological Communities

The study area includes 41.8ha of the Critically Endangered Threatened Ecological Community (TEC) *Eucalypt Woodlands of the Western Australian Wheatbelt* (Umwelt 2024b). This ecological community is defined primarily by its vegetation, so its significance is not further discussed in this report, except in terms of its value to fauna. The *Eucalypt Woodlands of the Western Australian Wheatbelt* are recognised as supporting many fauna species, in particular a diversity of woodland birds (DoE 2015a). Bird species supported by these woodlands include Carnaby's Cockatoo (*Zanda latirostris*) and the Malleefowl (*Leipoa ocellata*).

1.2.5 Land Systems

Land systems are broad descriptions of landform, geology and soils. The study area intersects five land systems (Figure 3), which are characterised as follows:

- **Marradong System:** Plateau remnants, in the central Eastern Darling Range, with sandy gravel, loamy gravel, grey deep sandy duplex and loamy duplex. Jarrah-marri-wandoo forest and woodland.
- **Dryandra System:** Ridges of banded iron formation supporting dense mixed shrublands with emergent native pines, mallees and casuarinas.
- **Narrogin System:** Interfluves with significant gradient, aggressively stripped by headward incision, at the headwaters of the Hotham and Blackwood catchments. Numerous dolerite dyke swarms.
- **Dellyanine System:** Undulating rises and low hills on granite, in the southern Zone of Rejuvenated Drainage. Grey sandy duplex (shallow and deep), sandy gravel and red deep sandy duplex. Wandoo-Sheoak woodland.
- **Quindanning System:** Deep granitic valleys, in the northern and central Eastern Darling Range, with deep sandy duplex soils, shallow sand, loamy duplex and bare rock. Marri-wandoo-york gum-jam woodland.



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1.3 Climate and Weather

The nearest weather station is Narrogin, site number 010614, and the mean monthly maximum and minimum temperatures and rainfall for this weather station are presented in Figure 4.

The long-term average annual rainfall for Narrogin is 488.8mm, based on data between 1891 and 2023 (BOM 2024). The annual rainfall was higher than average in 2021 (573.5mm), but lower than average in 2022 (398.8mm) and 2023 (361.2mm). Weather during the fauna survey 23rd – 27th October 2023 was characterised by cool nights (5.0 – 13.6°C), cool to warm days (20.0 – 29.9°C) and no rainfall (BOM 2024). No heavy rain fell during the period that camera traps and passive acoustic detectors were deployed.

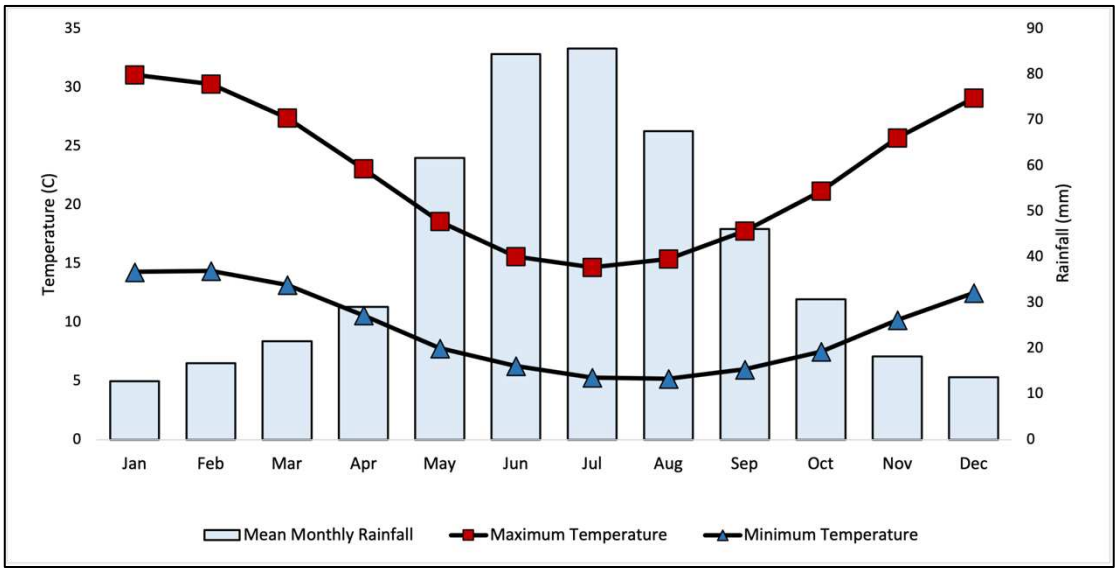


Figure 4. Monthly Climate Statistics for Narrogin.

2. Methods

2.1 Overview

A preliminary desktop vertebrate fauna assessment was undertaken for the study area in May - June 2023. In October 2023, a basic vertebrate fauna survey was completed, with targeted surveys for conservation significant mammals (camera trapping), conservation significant owls (passive acoustic recording), bats (bat call recording) and habitat for Threatened black-cockatoos. The methods are further described in the sections below.

2.2 Guidance Documents

The fauna survey was conducted with reference to the following documents:

- *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020).
- *Referral Guideline for Three WA Threatened Black-Cockatoo Species* (DAWE 2022).
- *Survey Guidelines for Australia's Threatened Mammals* (DSEWPaC 2011).

2.3 Personnel

The field survey was undertaken by Ms. Jenny Wilcox (*B.Sc., Hons*.) and Mr Brenden Metcalf (*B.Sc., Hons*.), both of whom have more than 20 years' experience as fauna consultants. This report was prepared by Ms. Jenny Wilcox.

2.4 Taxonomy and Nomenclature

Taxonomy and nomenclature for fauna species used in this report follow the Western Australian Museum checklists. In the text, common names are used where appropriate, and all scientific names are given in species lists. Where a species lacks a common name, they are referred to by their scientific name. Where there have been taxonomic changes, mainly where a single species has been split into several species, effort has been made to assign older records to their current names.

2.5 Literature Review

2.5.1 Previous Fauna Surveys in the Region

The review of previous fauna surveys in the region was restricted to surveys within 40km of the study area, in the Katanning subregion. Note that where the fauna records from these surveys have been submitted to DBCA, they will also occur on the DBCA Threatened and Priority Fauna database (DBCA 2023), except where the database is not up to date with recent survey submissions. No detailed fauna surveys were found. A targeted survey for Red-tailed Phascogale (*Phascogale calura*) on the Williams – Narrogin Highway found the presence of this species in a patch of native vegetation to the west of the study area (Bamford Consulting Ecologists 2017). Other than habitat tree assessments along roads, no other relevant reports could be found in the public domain.

2.5.2 Fauna Records on Databases and the General Literature

The databases listed in Table 1 were searched for fauna records in and around the study area. In all cases the extent of the database search was larger than the extent of the study area in order to pick up records of species in the wider area that may also occur in the study area.

Where possible, coastal species, vagrants, species that favour habitats absent from the study area and erroneous records have been excluded from the list, unless some further discussion is warranted. The lists of fauna expected to occur in the study area were reviewed against a number of sources, including publications that provide information on general patterns of distribution of frogs (Tyler *et al*. 2000), reptiles (Wilson and Swan 2017, Storr *et al*. 1983, 1990, 1999 and 2002), birds (Barrett *et al*. 2003; Johnstone and Storr 1998 and 2004) and mammals (Churchill 2008, Menkhorst and Knight 2011; Van Dyck and Strahan 2008).

Table 1. Databases used in the preparation of this report.

Database	Type of records held	Area searched
Atlas of Living Australia (ALA) Database (2023)	Datasets from numerous sources, including Birdata, WA museum and interstate museum databases, iNaturalist and records from the general public.	40km buffer around study area. Extract obtained May 2023.
Dandjoo (DBCA 2023)	Datasets from numerous sources, including industry.	40km buffer around a point central to the study area. Extract obtained May 2023.
DBCA's Threatened and Priority Fauna Database (DBCA 2023)	Information and records on Threatened and Priority species in Western Australia, including confirmed black-cockatoo roosting and breeding locations.	40km buffer around study area. Extract obtained March 2023.
EPBC Act Protected Matters Search Tool	Information and modelled distributions for matters protected under the EPBC Act, including threatened species and ecological communities, migratory species and marine species.	40km buffer around study area. Extract obtained October 2023.
Index of Biological Surveys for Assessment (IBSA) Database	Reports and spatial data from fauna surveys undertaken for environmental impact assessment in Western Australia.	Surveys in the same IBRA Bioregions, within 40km of the study area.

2.6 Field Survey

2.6.1 Licensing

The field survey was carried out under Fauna Taking (Biological Assessment) License BA27000961.

2.6.2 Timing

The basic fauna survey was undertaken between 23 – 27th October 2023, with some remote sensing equipment (camera traps and passive acoustic recorders) remaining in the field until retrieval on the 24th and 25th November 2023.

2.6.3 Habitat Assessment

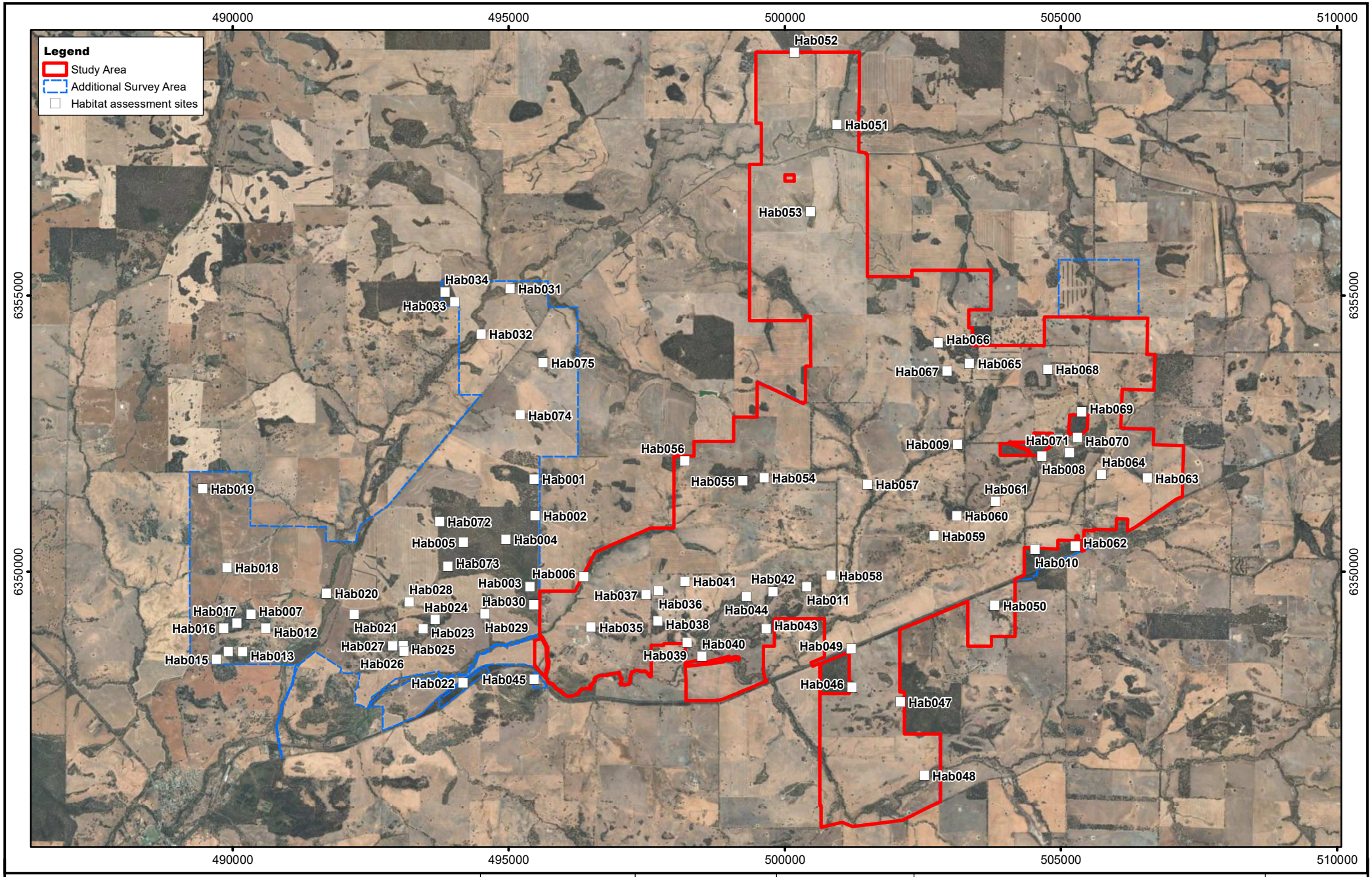
Habitat assessments were undertaken at 39 points in the study area (Figure 5), with the aim of sampling the heterogeneity present in each habitat in both large and small remnant patches. A further 36 sites were located in the additional survey area. At each habitat assessment point the following were recorded:

- Site designation and GPS co-ordinates
- Representative photographs
- Habitat name
- Landform
- Vegetation (brief description of structure and dominant species, if known)
- Evidence of fire
- Disturbance (e.g., weeds, grazing, firewood collection)
- Soil colour and type
- Rock type and presence of any outcropping
- Important habitat elements, including, but not limited to the presence of:
    - Leaf litter accumulations
    - Woody debris and logs
    - Tree hollows or crevices
    - Soils suitable for burrowing
    - Long-unburnt vegetation
    - Water
    - Caves or rock crevices
    - Dense shelter vegetation
    - Important plant species for conservation significant fauna
- Presence of wetlands
- Any fauna

2.6.4 Camera Trapping

A total of 21 camera traps were deployed in vegetated parts of the study area, with the purpose of detecting conservation significant mammals including the Chuditch (*Dasyurus geoffroii*; Vulnerable), Red-tailed Phascogale (*Phascogale calura*; Vulnerable), Western Brush Wallaby (*Notamacropus irma*; Priority 4) and Quenda (*Isoodon fusciventer*; Priority 4). A further 18 camera traps were deployed in the additional survey area. The location of each camera trap is shown in Figure 6 and Appendix 1.

Each trap was deployed with a non-reward bait lure of a fish oil-soaked sponge in a perforated plastic container. The bait lure was secured to the ground and the camera secured to a stake or sturdy tree. The cameras were deployed for a month, giving a total of 685 trap-nights in the study area and a further 591 trap-nights in the additional survey area. The camera images were reviewed and all vertebrate fauna were identified to species level where possible.



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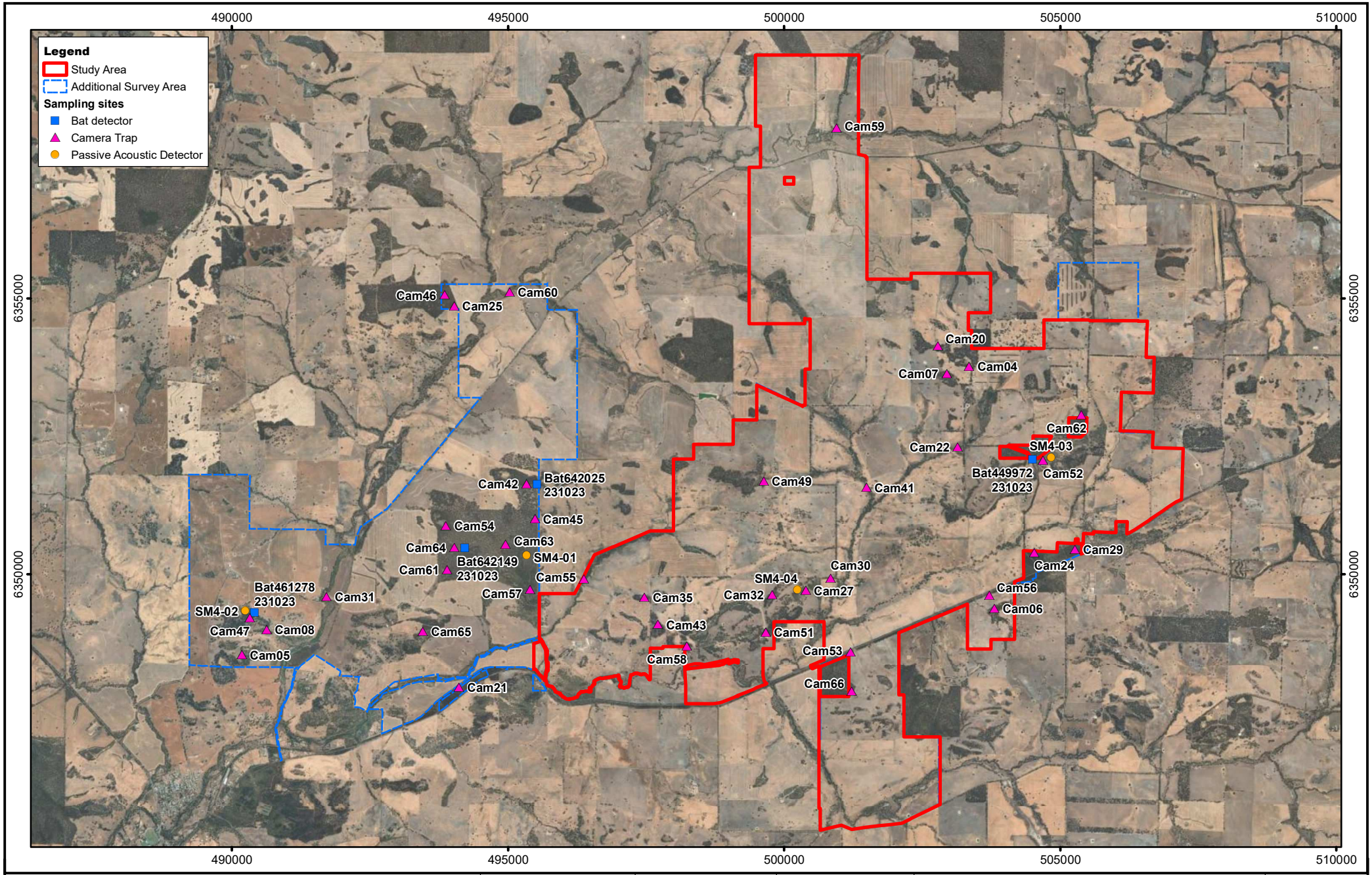

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2.6.5 Passive Acoustic Recording

Two Songmeter 4 (SM4) passive acoustic detectors were deployed in vegetated parts of the study area, with the purpose of detecting two conservation significant owls, the Barking Owl (*Ninox connivens connivens*; Priority 2) and the Masked Owl (*Tyto novaehollandiae novaehollandiae*; Priority 2). A further two detectors were deployed in the additional survey area. The location of each detector is shown in Figure 6 and Appendix 1.

All passive acoustic detectors were set to record between dusk and dawn. Each unit was secured to a tree, about 1.5m off the ground. The detectors recorded until the batteries ran out, giving about 18 nights per unit, or a total of 36 trap-nights in the study area and 36 trap-nights in the additional survey area. The SM4 data were reviewed by Louis Masarei of Malu Fauna (2024) and all bird species able to be identified were recorded.

2.6.6 Bat Survey

The purpose of the bat survey was to identify the bat assemblage present in the study area, supplementing the data available in the literature review. A separate bat utilisation study is being undertaken by Umwelt (2024a).

Bat calls were recorded at one sites in a vegetated area using one Anabat Swift call detector set to record between dusk and dawn. A further three detectors were deployed in the additional survey area. Detectors were deployed for four nights at each sampling site, to give a total of 16 nights of recordings (Appendix 1, Figure 6). The calls were then analysed by Kyle Armstrong of Specialised Zoological (2024), and the bat calls identified to species level where possible.

2.6.7 Opportunistic Records

At all times, observations of fauna were noted when they contributed to the accumulation of information on the fauna of the site. These included casual observations of reptiles, mammals and birds seen while travelling between sites or while undertaking other activities. Opportunistic observations were recorded to a general location for common species, and conservation significant species were recorded with a GPS location.

2.7 Habitat Mapping

2.7.1 Fauna Habitat

The fauna habitats of the study area were identified and mapped using the habitat assessments and observations made in the field during the fauna survey, interpretation of vegetation mapping (Umwelt Australia 2024), aerial photography and land system mapping.

2.7.2 Black-Cockatoo Habitat

Vegetation in the study area was mapped according to its potential to provide breeding or foraging habitat for black-cockatoos, using vegetation data and field observations. Potential breeding habitat was deemed to be any vegetation containing tree species known to be used for breeding, as listed in DAWE (2022), noting that any suitably-sized hollow may be used. Potential foraging habitat was deemed to be any vegetation containing food-plants known to be important for black-cockatoos, as listed in DAWE (2022).

2.8 Assessment of Conservation Significance

2.8.1 Legislative Protection for Fauna

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Commonwealth Government's primary piece of environmental legislation. Listed under Part 3 of the EPBC Act are 'Matters of National Environmental Significance' (MNES); these include threatened species, threatened ecological communities and migratory species. Threatened fauna species are assessed against categories based on International Union for Conservation of Nature (IUCN) criteria.

The migratory species listed under the EPBC Act are those recognised under international agreements. These agreements are the China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA), the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA), or species listed under the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) for which Australia is a range state.

Matters of National Environmental Significance (MNES) include the following categories:

- **Extinct in the wild (EW)**: Taxa known to survive only in captivity.
- **Critically Endangered (Cr)**: Taxa facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered (En)**: Taxa facing a very high risk of extinction in the wild in the near future.
- **Vulnerable (Vu)**: Taxa facing a very high risk of extinction in the wild in the medium-term future.
- **Migratory (Mi):** Taxa listed under international agreements to which Australia is a party.

Reports on the conservation status of most vertebrate fauna species have been produced by the federal Department of Climate Change, Energy, the Environment and Water (DCCEEW) in the form of Action Plans. An Action Plan is a review of the conservation status of a taxonomic group against IUCN categories. Action Plans have been prepared for amphibians (Tyler 1998), reptiles (Cogger et al. 1993), birds (Garnett and Barker 2020) and mammals (Woinarski et al. 2014). These publications also use categories similar to those used by the EPBC Act. The information presented in some of the earlier Action Plans may be out of date due to changes since publication.

The *Biodiversity Conservation Act 2016* (BC Act) is State legislation that aims to conserve and protect biodiversity and biodiversity components in Western Australia, including threatened fauna. It is administered by the Department of Biodiversity, Conservation and Attractions (DBCA). In addition to threatened fauna, the BC Act has scope to protect threatened ecological communities and important habitats. Fauna species are listed under the BC Act as threatened species using IUCN categories, or as specially protected species, as described below.

Threatened Species:

- **Extinct in the wild (EW)**: Taxa known to survive only in captivity.
- **Critically Endangered (Cr)**: Taxa facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered (En)**: Taxa facing a very high risk of extinction in the wild in the near future.
- **Vulnerable (Vu)**: Taxa facing a very high risk of extinction in the wild in the medium-term future.

Specially Protected Species:

- **Migratory (Mi)**: A subset of the migratory fauna that are known to visit Western Australia that are protected under the international agreements or treaties, excluding species that are listed as Threatened species.
- **Conservation dependent fauna (CD):** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened
- **Other specially protected species (OS):** fauna in need of special protection to ensure their conservation.

Priority species are not listed under State or Commonwealth Acts. In Western Australia, DBCA maintains a list of Priority Fauna made up of species that are possibly Threatened but do not meet adequacy of survey requirements or are otherwise data deficient. There are four levels of Priority as defined by DBCA, as listed below.

- **Priority 1:** Poorly known species (on threatened lands)
- **Priority 2:** Poorly known species in few locations (some on conservation lands)
- **Priority 3:** Poorly known species in several locations (some on conservation lands)
- **Priority 4:** Rare, near threatened and other species in need of monitoring

2.8.2 Species of Conservation Significance

In this report, fauna species of conservation significance are considered to be:

- Species listed as Critically Endangered, Endangered, Vulnerable or Migratory under the EPBC Act.
- Species listed as Critically Endangered, Endangered, Vulnerable, Migratory, Conservation Dependent or Other Specially Protected Species under the BC Act.
- Species listed as Priority 1, 2, 3 or 4 by DBCA.

2.9 Likelihood of Occurrence

Fauna of conservation significance were assessed and ranked for their likelihood of occurrence in the study area, according to the criteria in Table 2. Species deemed unlikely to occur are listed briefly with their reasons for exclusion but are not discussed further.

Table 2. Criteria for assessing likelihood of occurrence.

Likelihood	Criteria
Unlikely	• The study area is outside the current known distribution of the species as presented in the literature. • No suitable habitat was identified as being present during the field survey. • For some species, individuals may occur occasionally as vagrants, especially if suitable habitat is located nearby, but the study area itself would not support the species. • May include species generally accepted as being locally extinct.
Possible	• The study area is within or just outside the current known distribution of the species, as presented in the literature. • Any habitat present is either limited in extent or of marginal suitability at best. • No recent or nearby records of the species on databases. • The species is generally known to be less common in the vicinity of the study area (e.g., for inland sites, where the species usually occurs on the coast).
Potential	• The study area is within the current known distribution of the species, as presented in the literature. • Habitat of reasonable suitability was identified as being present during the field survey. • There are some recent and/or nearby records of the species of databases.
Likely	• The study area is well within the current known distribution of the species, as presented in the literature. • Habitat of good suitability was identified as being present during the field survey. • Many recent and nearby records of the species on databases.
Known to occur	• The species was positively identified in the study area during this field survey or recorded as occurring in the study area on previous recent field surveys. • Note that for a species 'known to occur', the habitat may still be marginal and therefore the population may be small, or the species may visit the site irregularly.

3. Survey Limitations

Various factors can limit the effectiveness of a fauna survey. Pursuant to EPA Technical Guidance (EPA 2020), these factors have been identified and their potential to impact on the effectiveness of the surveys has been assessed in Table 3. All fauna surveys have limitations, and not all fauna species present on the site are likely to be sampled during a survey. Fauna may not be recorded because they are rare, they are difficult to trap or observe, or because they are only present on the site for part of the year.

Table 3. Fauna survey limitations.

Potential Limitation	Extent of limitation for the fauna survey
Availability of data and information	**Not Limiting.** The south-west is a relatively well-studied region and there are numerous records in the vicinity of the study area on databases.
Competency/experience of the survey team, including experience in the bioregion surveyed	**Not Limiting.** Key personnel have over 20 years' experience with fauna surveys in Western Australia and are experienced with targeted surveys for black-cockatoos, Chuditch and other conservation significant fauna. All personnel have undertaken previous surveys in the Bioregions in which the study area lies.
Scope of survey (e.g., faunal groups excluded from the survey)	**Not Limiting.** The basic survey covered all vertebrate faunal groups at a desktop level, targeting key conservation significant species with a variety of methods including camera traps and searches for secondary signs.
Timing, weather and season	**Not Limiting.** The timing of the survey was consistent with that recommended in the Technical Guidelines (EPA 2020, DAWE 2022). The weather during the survey was warm to hot and suitable for observing and recording fauna.
Disturbance that may have affected the results	**Not Limiting.** Small parts of the study area were under crop and therefore some of the vegetation was temporarily inaccessible, however, a representative portion was able to be surveyed.
The proportion of fauna identified, recorded or collected	**Not Limiting.** A complete inventory was outside the scope of the survey, however, 88 of the 247 predicted species were recorded. The field component of the survey was supported with a literature review.
The adequacy of the survey intensity and proportion of survey achieved (e.g., extent to which the area was surveyed)	**Not Limiting.** The intensity and coverage of the fauna survey was adequate and appropriate for the level of survey. A representative portion of all habitats were visited during the survey.
Access problems	**Minor limitation.** All habitats were readily accessible by vehicle and/or on foot and a representative portion of each habitat was able to be surveyed.
Problems with data and analysis, including sampling biases	**Not Limiting.** No complex analyses were undertaken, and no problems were noted.

4. Fauna Habitats of the Study Area

4.1 Broad Fauna Habitats

Five broad fauna habitats were identified in the study area (Table 4, Figure 7) and the individual habitat assessments for both the study area and additional survey area are in Appendix 3. The habitats are further described in the sections below, with the vegetation descriptions drawn from Umwelt (2024b).

Table 4. Fauna habitats of the study area.

Fauna Habitat	Important Habitat Elements	Area (ha)
Eucalypt woodland on laterite rise	• Laterite outcropping and surface rocks provide shelter habitat for reptiles. • Fallen timber, logs, woody debris and leaf litter provides shelter for reptiles and small mammals. • Tree hollows provide habitat for hollow nesting birds, roosting bats and some arboreal reptiles and mammals. • Where present, Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*) and/or an understory of shrubby Banksia (e.g. *B. sessilis*) may provide foraging habitat for Threatened cockatoos. • Wandoo (*Eucalyptus wandoo*), Jarrah and Marri potentially provide breeding habitat for Threatened cockatoos.	407.4
Eucalypt - Sheoak woodland with granites	• Fallen timber, logs, woody debris and leaf litter provides shelter for reptiles and small mammals. • Tree hollows provide habitat for hollow nesting birds, roosting bats and some arboreal reptiles and mammals. • Dense vegetation provides nesting habitat for birds. • Exfoliating rock on granite outcrops and granite boulders provide shelter for reptiles. • Ephemeral rock pools and seasonally wet runoff areas provide breeding habitat for frogs. • York Gum (*Eucalyptus loxophleba*) or Wandoo potentially provide breeding habitat for Threatened cockatoos.	181.0
Creekline	• Tree hollows may support breeding and roosting by birds, bats and arboreal reptiles. • Fallen timber and hollow logs may provide shelter for reptiles and mammals. • Seasonally wet areas may provide frog breeding habitat. • Linear corridors of vegetation may provide 'wildlife corridors' promoting the movement of fauna through the landscape. • Where present, Marri (*Corymbia calophylla*) may provide foraging habitat for Threatened cockatoos. • Where present, Marri, Flooded Gum (*Eucalyptus rudis*) and York Gum (*Eucalyptus loxophleba*) potentially provide breeding habitat for Threatened cockatoos.	563.0

Table 4. (cont.)

Fauna Habitat	Important Habitat Elements	Area (ha)
Planted	• Linear corridors of vegetation may provide 'wildlife corridors' promoting the movement of fauna through the landscape.	93.8
Cleared	• Pasture may provide foraging habitat for macropods and birds that forage in open habitats. • Crops such as Canola may provide foraging habitat for birds, including Carnaby's Cockatoo. • Farm dams may provide frog breeding habitat and breeding and foraging habitat for a small number of waterbirds. • Isolated paddock trees may provide foraging and/or breeding habitat for birds and roosting habitat for bats.	5,098.9
		6,344.1

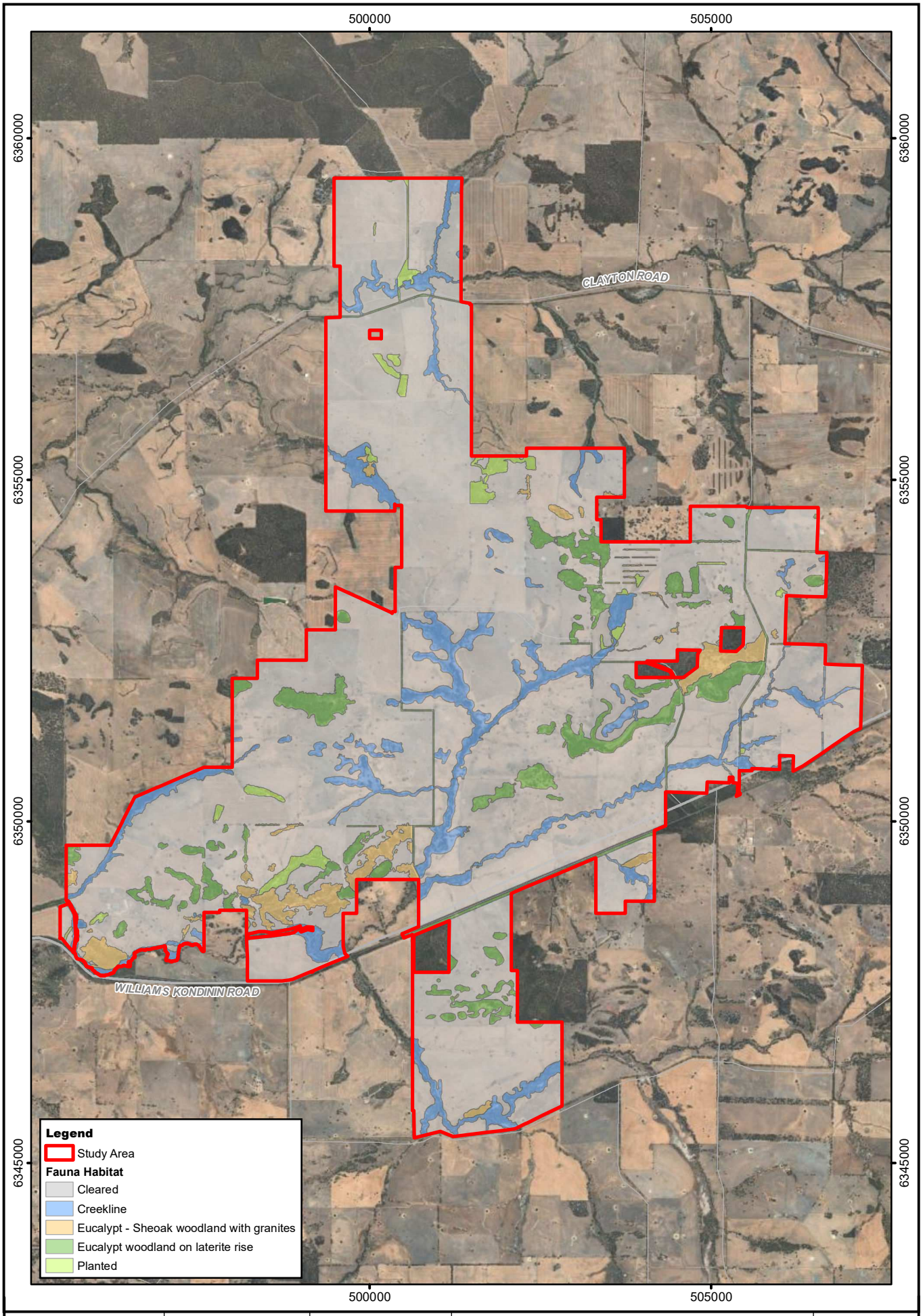
Almost all the vegetation in the study area is described as degraded or completely degraded by Umwelt (2024b), and the understory is either completely absent or significantly reduced. Despite this, the habitats of the study area, particularly the eucalypt woodlands on laterite rise, eucalypt - sheoak woodlands on granites and creeklines, have value for fauna as habitat for shelter, foraging and breeding. They also have value in providing a network of ecological connectivity through agricultural land. Even planted vegetation can provide connectivity.

As the study area is in the Western Australian wheatbelt, it is within a landscape that has been largely cleared for agriculture. Although not as extreme as local government areas in the central wheatbelt where clearing has resulted in less than 7% of the native vegetation remaining, the clearing is still substantial with the Shire of Williams being 65% cleared (35% native vegetation remaining) and the Shire of Narrogin 80% cleared (20% native vegetation remaining) (DoE 2015b).

The study area is about 80% cleared. The habitats in the study area occur in a multitude of patches, varying in size from individual paddock trees (in cleared areas, not separately mapped) to a larger patches of eucalypt woodland on laterite rise and/or eucalypt-sheoak woodland with granite of 20, 80 and over 100ha (Figure 7). The patches vary in their connectivity, and the majority of the patches lack any understory.

Patches that are smaller, isolated and relatively far from other patches, are less desirable as fauna travelling between patches must traverse longer stretches of cleared ground. In cleared areas fauna are likely to be more susceptible to predation, both from introduced predators such as foxes and cats and natural predators such as birds of prey. This is particularly true for terrestrial fauna and species that are naturally poor dispersers, such as birds that are not strong fliers.

Larger habitat patches and patches in close proximity are more desirable, as fauna have less distance to travel across cleared ground and larger patches are likely to support a more diverse faunal assemblage. The larger remaining patches in the study area are usually associated with rocky upland areas, as the more fertile valley floors have been cleared.



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Author: J. Wilcox

Western Wildlife

Narrogin Wind Farm
Fauna habitats

Figure: **7**

Small habitat patches are more vulnerable to edge effects, as they have proportionally more 'edge' compared to 'centre'. Edge effects can include invasion of weeds and feral predators. However, as the majority of habitat patches are unfenced, they are already heavily impacted by grazing livestock which is known to result in increased tree deaths, reduced understory cover and plant species richness, reduced leaf litter and increased soil nutrients and weeds (Scougall *et al*. 1993). Even small, isolated patches have value, however, as they may be used as 'stepping stones' for dispersal by fauna that are more mobile, such as birds.

In the study area, the habitat patches form a complex network for dispersal that is more permeable for some species and less permeable for others. The lack of understory in almost all woodland patches, for example, means that there is limited shelter for many ground-dwelling terrestrial species, and these species would both find the habitat undesirable and be more vulnerable to predation. These same patches are likely to provide dispersal habitat for birds that forage in the eucalypt canopy, and habitat for more robust species such as the Common Brushtail Possum (*Trichosurus vulpecula*). Where fauna can disperse, it means that they can take advantage of seasonal resources (such as flowering events), can recolonise patches after local extinctions and maintain gene-flow between populations through the wider region.

4.1.1 Eucalypt Woodland on Laterite Rise

Low gravelly rises support eucalypt woodlands, mainly of Wandoo (*Eucalyptus wandoo*) and Marri (*Corymbia calophylla*) with some Jarrah (*Eucalyptus marginata*) (Plates 1 – 4). Crests and breakaways with outcropping boulders of laterite support woodlands of Brown Mallet (*Eucalyptus astringens*), Drummond's Gum (*Eucalyptus drummondii*) and/or *Eucalyptus dorrienii*. The understory is usually very sparse or absent due to the impacts of grazing by livestock, consisting of mainly of exotic grasses with the occasional native shrub. A very sparse and patchy native understory of mixed species, including shrubby *Banksia* spp., occurs in the larger habitat patches and parts of some road verges.

Plate 1. Eucalypt woodland on laterite rise in small area with some native understory.

Plate 2. Eucalypt woodland on laterite rise.

Plate 3. Eucalypt woodland on laterite rise.

Plate 4. Eucalypt woodland on crest with laterite outcropping.

4.1.2 Eucalypt - Sheoak Woodland with Granites

Sloping brown sandy-clays, often with granite outcropping, support a woodland of York Gum (*Eucalyptus loxophleba*) and/or Wandoo (*Eucalyptus Wandoo*) with Rock Sheoak (*Allocasuarina huegeliana*), sometimes also with Jam (*Acacia acuminata*) or Manna Wattle (*Acacia microbotrya*) (Plates 5 – 8). The understory is usually sparse or absent due to the impacts of grazing by livestock, consisting of mainly of exotic grasses with the occasional native shrub. A sparse native understory of mixed species, including shrubby *Banksia* spp., occurs in the larger habitat patches.

Plate 5. Eucalypt – Sheoak woodland with granites.

Plate 6. Eucalypt – Sheoak woodland with granites.

Plate 7. Eucalypt – Sheoak woodland with granites on road verge.

Plate 8. Granite boulders.

4.1.3 Creekline

Small creeklines on clayey soils support narrow strips of vegetation, usually open woodlands, usually of Flooded Gum (*Eucalyptus rudis*), sometimes with York Gum (*Eucalyptus loxophleba*) or other tree species, including planted trees (Plates 9 – 11). The understory can be minimal (due to grazing), or a mix of weedy species including Spike-rush (*Juncus acutus*). This habitat is disturbed due to grazing, weeds and increasing salinity.

Plate 9. Creekline.

Plate 10. Creekline.

Plate 11. Creekline.

4.1.4 Planted

Planted vegetation consists of a mix of species, usually eucalypts, planted in patches or short corridors (Plate 12).

Plate 12. Planted trees.

4.1.5 Cleared

Cleared areas comprise mainly agricultural lands used cropping and pasture, but also include farm dams and isolated paddock trees (Plate 13). Isolated paddock trees consist mainly of York Gum (*Eucalyptus loxophleba*), Marri (*Corymbia calophylla*) and/or Wandoo (*Eucalyptus Wandoo*), as single trees or small patches.

Plate 13. Cleared land with isolated paddock trees.

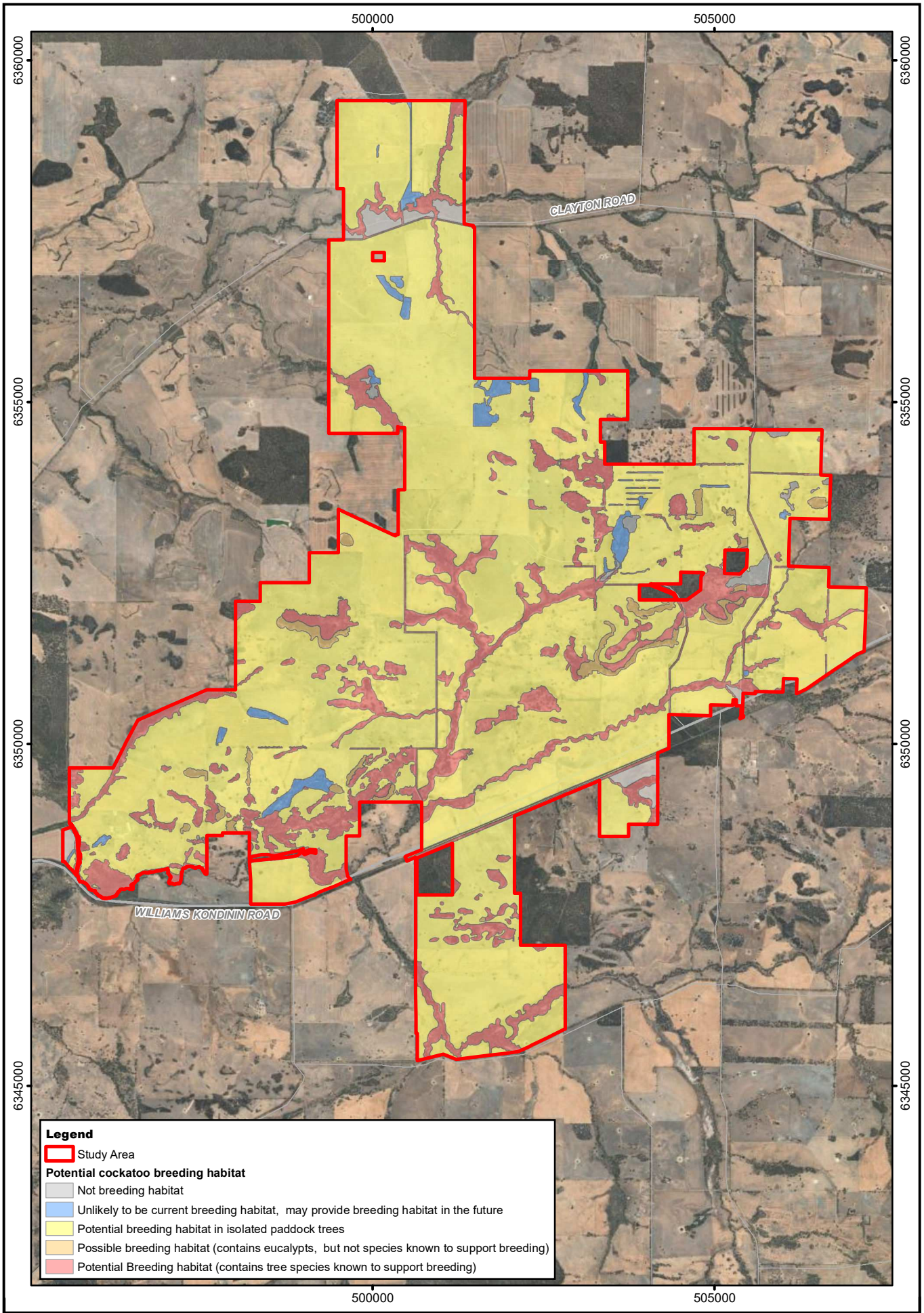
4.2 Black-Cockatoo Habitat

4.2.1 Breeding Habitat

The vegetation in the study area was divided into five categories, based on its potential to provide tree hollows suitable for black-cockatoo breeding (Table 5, Figure 8). Although individual habitat trees were not assessed as part of this study, high-level commentary based on field observations has been included in Table 5 where relevant. Although tree hollows were noted to be present (Appendix 3), no tree hollows of a size potentially suitable for cockatoos were observed opportunistically during the field survey.

Table 5. Black-cockatoo breeding habitat.

Category	Explanation	Area (ha)
Potential breeding habitat (contains tree species known to support breeding)	Many of the woodlands in the study area include tree species known to support breeding (DAWE 2022), including Wandoo (*Eucalyptus wandoo*), Marri (*Corymbia calophylla*), York Gum (*Eucalyptus loxophleba*) and Jarrah (*Eucalyptus marginata*) and Powderbark wandoo (*Eucalyptus accedens*). Note that even within this habitat, particularly in the smaller patches, many of the trees are small (below diameter at breast height thresholds), possibly due to past logging of mature trees.	1,013.9
Potential breeding habitat in Isolated Paddock Trees	Cleared areas contain remnant eucalypts as individual trees or small patches, many of which are likely to be tree species known to support breeding.	5,035.1
Possible breeding habitat (contains eucalypts, but not species known to support breeding)	Woodlands including Brown Mallet (*Eucalyptus astringens*), Drummond's Gum (*Eucalyptus drummondii*) and/or *Eucalyptus dorrienii* are not known to support breeding, but any suitably sized hollow may be used by cockatoos (DAWE 2022), so these areas cannot be entirely excluded.	90.8
Unlikely to be current breeding habitat, but may provide breeding habitat in the future	Planted areas often include eucalypts, including local and non-local species. Eucalypts usually take many years (200+) to form suitably-sized hollows, so planted areas are usually too young to contain breeding habitat.	107.9
Not breeding habitat	Treeless areas, or woodlands lacking eucalypts, are not breeding habitat.	96.4
		6,344.1



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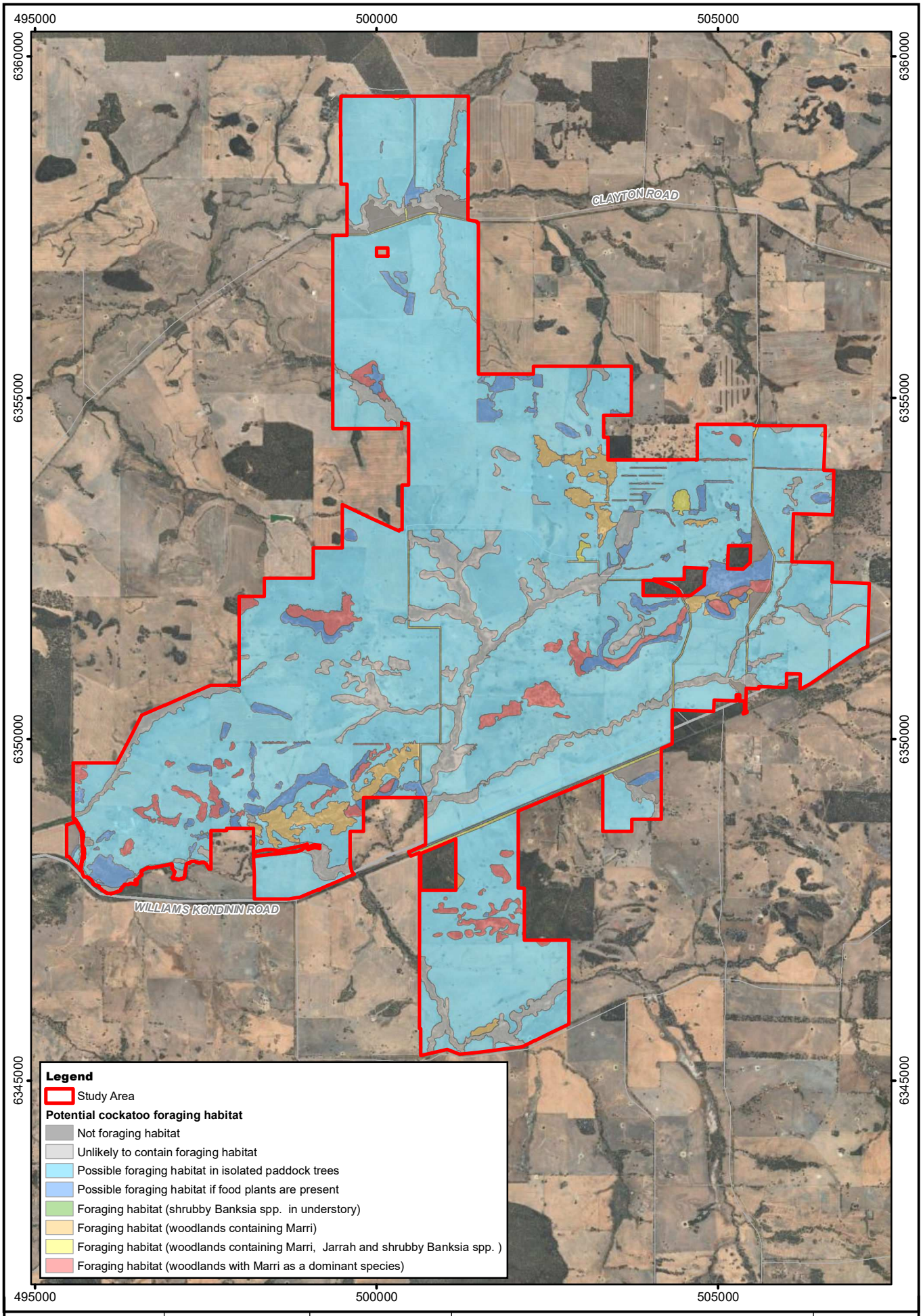
Date: July 2024 Rev: A	Author: J. Wilcox			

4.2.2 Foraging Habitat

Vegetation in the study area was divided into seven categories based on the cockatoo food-plants present (Table 6, Figure 9). It is difficult to determine the relative importance of foraging habitat, as in a largely cleared region, all foraging habitat, even small patches or individual trees/shrubs, potentially have importance. According to the *Foraging Quality Scoring Tool* presented in DAWE (2022), the study area scores 5/10 for Baudin's Cockatoo, 10/10 for Carnaby's Cockatoo and 8/10 for the Forest Red-tailed Black-Cockatoo and is thus considered high quality foraging habitat for all species (Appendix 2).

Table 6. Black-cockatoo foraging habitat.

Category	Explanation	Area (ha)
Foraging habitat (shrubby *Banksia* spp. in understory)	Shrubby *Banksia* spp., such as Parrotbush (*Banksia sessilis*), are important food-plants for Carnaby's Cockatoo and a lesser extent to Baudin's Cockatoo.	0.5
Foraging habitat (woodlands containing Marri, Jarrah and shrubby Banksia spp.)	Marri (*Corymbia calophylla*) is an important food-plant for all three black-cockatoo species, Jarrah (*Eucalyptus marginata*) is important to the Forest Red-tailed Black-Cockatoo and shrubby *Banksia* spp. are important food-plants for Carnaby's Cockatoo and a lesser extent to Baudin's Cockatoo. Rock Sheoak (*Allocasuarina huegeliana*) also occurs, providing a less important food-plant for the Forest Red-tailed Black-Cockatoo.	57.4
Foraging habitat (woodlands containing Marri)	Marri is an important food-plant for all three black-cockatoo species and is particularly important for the Forest Red-tailed Black-cockatoo and Baudin's Cockatoo. Woodlands dominated by Marri are likely to provide a greater density of this important food plant than woodlands with a lesser density of Marri. Rock Sheoak (*Allocasuarina huegeliana*) also occurs, providing a less important food-plant for the Forest Red-tailed Black-Cockatoo.	149.3
Foraging habitat (woodlands with Marri as a dominant species)		200.7
Possible foraging habitat if food plants are present	Some eucalypt woodlands may contain a small proportion of food-plants, including occasional Marri trees or shrubby *Banksia* spp., or stands of Rock Sheoak. Planted areas often include eucalypts, including local and non-local species, some of which may provide foraging habitat. Not all planted areas are likely to provide foraging habitat.	284.3
Possible foraging habitat in isolated paddock trees.	Cleared areas contain remnant eucalypts as individual trees or small patches, some of which may be Marri or Jarrah and therefore black-cockatoo food-plants. Areas planted to Canola may also provide foraging habitat.	5,015.9
Unlikely to contain foraging habitat	Vegetation or cleared areas lacking food-plants for cockatoos.	553.0
		6,344.1



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Author: J. Wilcox

Western Wildlife

Narrogin Wind Farm
Potential cockatoo foraging habitat

Figure: **9**

5. Vertebrate Fauna of the Study Area

5.1 Vertebrate Faunal Assemblage

The amphibians, reptiles, birds and mammals that have the potential to occur in the study area are listed in Appendix 4. The number of vertebrate species potentially occurring in the study area are summarised below in Table 7. As most of the habitat in the study area is degraded, particularly the understory vegetation, the faunal assemblage is likely to be less species rich than in undisturbed habitats and it is unlikely that all of the potential species occur. However, as these species all occur in the region, and there are large areas of remnant vegetation in close proximity to the study area, it is difficult to state with certainty which of these species do or do not occur.

Table 7. Summary of vertebrate fauna potentially occurring in the study area.

Taxon	Predicted species	Introduced species	Recorded species	Conservation significant species			
				Threatened	Migratory	Specially Protected	Priority
Amphibians	12	0	1	-	-	-	-
Reptiles	46	0	3	-	-	-	1
Birds	158	3	69	5	2	1	3
Mammals	32	5	15	4	-	1	6
Totals:	**248**	**8**	**88**	**9**	**2**	**2**	**10**

5.1.1 Amphibians

There are up to 12 species of frog that have the potential to occur in the study area (Appendix 4). One species, the Motorbike Frog (*Litoria moorei*), was recorded opportunistically on a camera trap during the fauna survey. Other species are likely to be present, but the survey did not target frogs as no conservation significant species occur in the region. In general, the frog species that occur in the study area are common and widely distributed in the southwest region. Parts of the creekline habitat and farm dams that hold water permanently or seasonally potentially provide breeding habitat for frogs. Some species, such as the Motorbike Frog (*Litoria moorei*) rely on permanently damp situations. Burrowing frogs, such as the Moaning Frog (*Heleioporus eyrei*) require winter-wet areas to breed, but during the non-breeding season range away from water and be found in terrestrial habitats where they forage and/or aestivate underground.

5.1.2 Reptiles

There are up to 46 species of reptile that have the potential to occur in the study area (Appendix 4). Three species were recorded opportunistically in the study area, and a fourth was recorded in the additional survey area. The reptile assemblage is likely to be relatively species poor, as much of the understory vegetation is absent. The species likely to be present have broad habitat preferences and therefore potentially occur throughout the study area. Fallen logs, woody debris and leaf litter are important shelter sites for reptiles. Laterite rises and granite outcrops provide shelter habitat where outcropping or exfoliating rocks are present. Some species can negotiate cleared areas, but many reptiles are likely to be restricted to areas of native vegetation.

5.1.3 Birds

There are up to 158 species of bird that have the potential to occur in the study area (Appendix 4). A total of 69 species were recorded in the study area during habitat assessments, in the passive acoustic recording (Appendix 7), or opportunistically. Several additional species were recorded nearby in the additional survey area and by the Bird and Bat Utilisation Study (Umwelt 2024a, Appendix 4), and these species are also likely to occur in the study area.

The bird assemblage is likely to be relatively diverse due to the mix of habitats present, the relatively large size of some of the remaining habitat patches and their proximity to larger areas of habitat outside the study area. About 49% of Western Australian wheatbelt bird species have declined in abundance and/or distribution (Saunders and Ingram 1995). Passerine birds appear particularly vulnerable, with up to 75% of wheatbelt species experiencing declines (Burbidge and Gole 2005). All remnant native vegetation in the wheatbelt is likely to be important for birds. The larger the area of remnant vegetation, the more bird species it is likely to support, and though areas of over 1,500ha are required to conserve a local avifauna, areas as small as 80ha can be important (Kitchener *et al*. 1982). The largest patches of habitat in the study area are approximately 80ha and 100ha and likely to support a relatively diverse bird assemblage, despite the almost entire lack of understory vegetation.

Eucalypt woodlands potentially provide tree hollows suitable for nesting. Species that nest in hollows include owls, parrots, cockatoos, pardalotes, kingfishers and tree0creepers. Densely vegetated areas provide breeding habitat for smaller species. Waterbirds, such as ducks, herons, egrets and ibis occur in the region and potentially occur in small numbers on farm dams or creeklines. Some waterbirds are likely to breed in the study area, but overall, the study area is unlikely to provide important waterbird habitat as the creekline habitat is limited in extent, affected by salinity and the riparian vegetation is limited.

5.1.4 Mammals

There are 32 species of mammal that have the potential to occur in the study area, of which 27 are native and five introduced (Appendix 4). Of these, eleven native and four introduced species were recorded in the study area opportunistically, with bat detectors or on camera traps during the field survey.

Six species of bat were recorded on the basis of their calls (Appendices 4 and 6). Bats are likely to forage over the study area at night, including over cleared areas, roosting in tree hollows or crevices by day. Feral predators were common, and of the 21 camera traps in the study area, cats (*Felis catus*) were recorded on 5 and foxes (*Vulpes vulpes*) were recorded on 13 (Plate 14). Native species recorded on camera traps were the Echidna (*Tachyglossus aculeatus*) on 5 cameras, Common Brushtail Possum (*Trichosurus vulpecula*) on 7 (Plate 15), Western Grey Kangaroo (*Macropus fuliginosus*) on 5, Red-tailed Phascogale (*Phascogale calura*) on 1 and Chuditch (*Dasyurus geoffroii*) on 1.

Plate 14. Fox recorded on a camera trap in the study area.

Plate 15. Common Brushtail Possums recorded on a camera trap in the study area.

Twenty of the 53 species of mammal known to occur in the Avon Wheatbelt Bioregion are now extinct in the Bioregion (DoE 2015b). Almost all the remaining species have undergone dramatic reductions in their area of occupancy, as much of the native vegetation in the subregion has been cleared. While some species, such as the Western Grey Kangaroo, may range on to farmland to forage, almost all native mammals rely on native vegetation for breeding, foraging and shelter. Connectivity is important for terrestrial species, with creeklines, road verges and even planted tree-lines providing opportunities for dispersal.

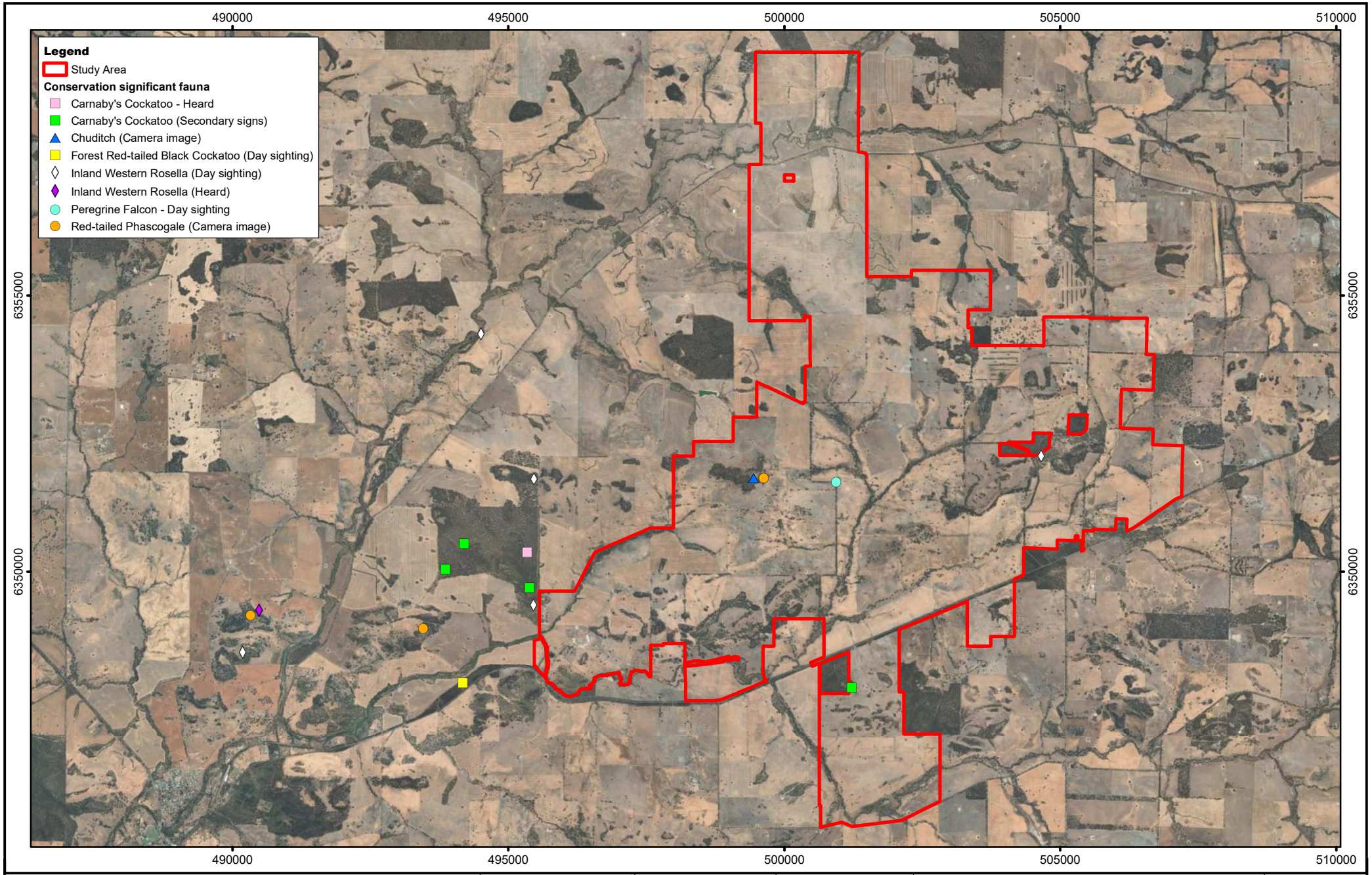
5.2 Vertebrate Fauna of Conservation Significance

A total of 23 vertebrate fauna of conservation significance may occur in the study area: nine Threatened, two Migratory, two Specially Protected and ten Priority species. The likelihood of occurrence of each species is summarised in Table 8 and their ecology and habitat use are discussed in the sections below.

Conservation significant fauna recorded on this survey are shown in Figure 10, noting that records from both the study area and additional survey area are shown. Conservation significant fauna recorded within 40km of the study area on DBCA's Threatened and Priority Fauna Database are shown in Figures 11 - 14. Note that some of the points shown have been generalized by DBCA to protect the exact location of protected species, and that the distribution of records reflects survey effort, rather than just distribution of species. Figure 12 shows confirmed breeding and roosting sites for cockatoos (mainly Carnaby's) in the region surrounding the study area. Note that these sites are shown as buffered by 2km (roosting) and 12km (breeding).

Five species recorded on DBCA's Threatened and Priority Fauna Database were omitted from the list in Appendix 4 and the discussion below, although the records are still shown on Figures 11 and 13. The Bilby (*Macrotis lagotis*; Vulnerable) and Shark Bay Boodie (*Bettongia lesueur lesueur*; Other Specially Protected Fauna) are locally extinct. Although re-introduced into Dryandra National Park in 2003, these two species are currently present only in fenced enclosures. The Western Ringtail Possum (*Pseudocheirus occidentalis*; Critically Endangered) is represented by a single historical record and is also locally extinct. The Inland Boodie (*Bettongia lesueur graii*) is extinct. The Red-necked Stint (*Calidris ruficollis*; Migratory) is a shorebird represented by a single record, and although these mobile birds may occur on occasion, the study area lacks habitat likely to regularly support shorebirds.

Nine species listed on the EPBC Act Protected Matters Search Tool (Appendix 4) were omitted from the list in Appendix 4 and the discussion below. The Curlew Sandpiper (*Calidris ferruginea*; Critically Endangered/Migratory), Eastern Curlew (*Numenius madagascariensis*; Critically Endangered/Migratory), Grey Wagtail (*Motacilla cinerea*; Migratory), Sharp-tailed Sandpiper (*Calidris acuminata*; Migratory) and Pectoral Sandpiper (*Calidris melanotos*; Migratory) are shorebirds, many of which prefer coastal habitats. These birds are highly mobile and may occur in the region on occasion, but there are no DBCA Threatened and Priority Fauna Database records of these species within 40km and the habitats of the study area are unlikely to regularly support shorebirds. The Southern Whiteface (*Aphelocephala leucopsis*; Vulnerable) and Grey Falcon (*Falco hypoleucos*; Vulnerable) are birds of the arid interior and the study area is outside their current known ranges as presented in the literature. The Bilby is omitted for the reasons given above. The Night Parrot (*Pezoporus occidentalis*; Critically Endangered) is an extremely rare species that is reliant on mature spinifex for breeding, a habitat absent from the study area.



Drawn: CAD Resources www.cadresources.com.au Tel: (08) 9246 3242	N 0 0.5 1 km Scale: 1:90,000 MGA94 (Zone 50)	Western Wildlife	Narrogin Wind Farm **Conservation significant fauna recorded on this survey**	Figure: **10**
CAD Ref: a3021Fa009 A4				
Date: August 2024 Rev: A	Author: J. Wilcox			

Table 8. Likelihood of conservation significant vertebrate fauna.

Key to status: Cr = Critically Endangered, En = Endangered, Vu = Vulnerable, Mi = Migratory, OS = Other Specially Protected, CD = Conservation Dependent, P1 – P4 = Priority 1 – 4, LS = Locally Significant.

Species	Conservation Status			Likelihood of Occurrence	Explanation
	EPBC Act	BC Act	DBCA Priority		
Threatened Species					
Bettongia penicillata ogilbyi **Woylie**	En	Cr	-	Possible	Resident in Dryandra Woodland National Park, this species may range into the study area, however, the habitats in the study area are unlikely to be suitable for this species, particularly in the absence of fox control, as the habitat patches are generally too small, the understory too degraded and the larger patches are not well-connected.
Myrmecobius fasciatus **Numbat**	En	En	-	Possible	Resident in Dryandra Woodland National Park, this species may range into the study area, however, the habitats in the study area are unlikely to be suitable for this species, particularly in the absence of fox control, as the habitat patches are generally too small, the understory too degraded and the larger patches are not well-connected.
Rostratula australis **Australian Painted Snipe**	En	En	-	Possible	Single birds may occur in creeklines on occasion, but the study area is unlikely to provide important habitat or regularly support significant numbers.
Zanda latirostris **Carnaby's Cockatoo**	En	En	-	Known to occur	**Foraging evidence recorded during field survey and recorded on passive acoustic detector in the additional survey area (Figure 10)**. A seasonal visitor, this species is likely to forage and/or roost in the study area and may breed in large tree hollows.
Zanda baudinii **Baudin's Cockatoo**	En	En	-	Potential	Potentially a seasonal visitor, this species may forage and/or roost in the study area and breed in large tree hollows.
Calyptorhynchus banksii naso **Forest Red-tailed Black Cockatoo**	Vu	Vu	-	Likely	**Recorded in additional survey area during field survey (Figure 10)**. A seasonal visitor, this species is likely to forage and/or roost in the study area and may breed in large tree hollows.
Dasyurus geoffroii **Chuditch**	Vu	Vu	-	Known to occur	**Recorded on camera trap (Figure 10).** Resident in Dryandra Woodland National Park, this species is very mobile and likely to occur in the study area, at least for dispersal. Hollow logs and burrows are important for this species.

Table 8. (cont.)

Species	Conservation Status			Likelihood of Occurrence	Explanation
	EPBC Act	BC Act	DBCA Priority		
Leipoa ocellata **Malleefowl**	Vu	Vu	-	Possible	This species may forage in the study area or use the vegetation as a corridor for movement, but disturbance to understory vegetation means it is unlikely that this species breeds in the study area.
Phascogale calura **Red-tailed Phascogale**	Vu	CD	-	Known to occur	**Recorded on camera trap (Figure 10).** The study area is within the range of this species, there are many records in the surrounding area and there is potentially suitable habitat available in woodlands.
Migratory Species					
Actitis hypoleucos **Common Sandpiper**	Mi	Mi	-	Possible	Single birds may occur on farm dams on occasion, but the study area is unlikely to provide important habitat or regularly support significant numbers.
Apus pacificus **Fork-tailed Swift**	Mi	Mi	-	Potential	May overfly study area but the study area is unlikely to provide important habitat or regularly support significant numbers.
Specially Protected Fauna					
Falco peregrinus **Peregrine Falcon**	-	OS	-	Known to occur	**Observed during field survey (Figure 10)**. A foraging visitor over pasture that may breed in tall trees.
Phascogale tapoatafa **Brush-tailed Phascogale**	-	CD	-	Possible	There are some records of this species in the region, however, it is likely that most of the woodland habitats present are too fragmented to support this species, as it prefers an intact canopy and its home-range is large.
DBCA Priority Fauna					
Acanthophis antarcticus **Southern Death Adder**	-	-	P3	Possible	This species occurs in the region but is not commonly recorded. Although it possibly occurs in the largest habitat patch in association with granite, most habitat patches lack suitably dense understory habitat to support this species.
Ninox connivens connivens **Barking Owl**	-	-	P3	Possible	There are few records of this species in the region, however, it possibly occurs as a foraging visitor and may breed in large hollows.
Tyto novaehollandiae novaehollandiae **Masked Owl**	-	-	P3	Possible	There are few records of this species in the region, however, it possibly occurs as a foraging visitor and may breed in large hollows.

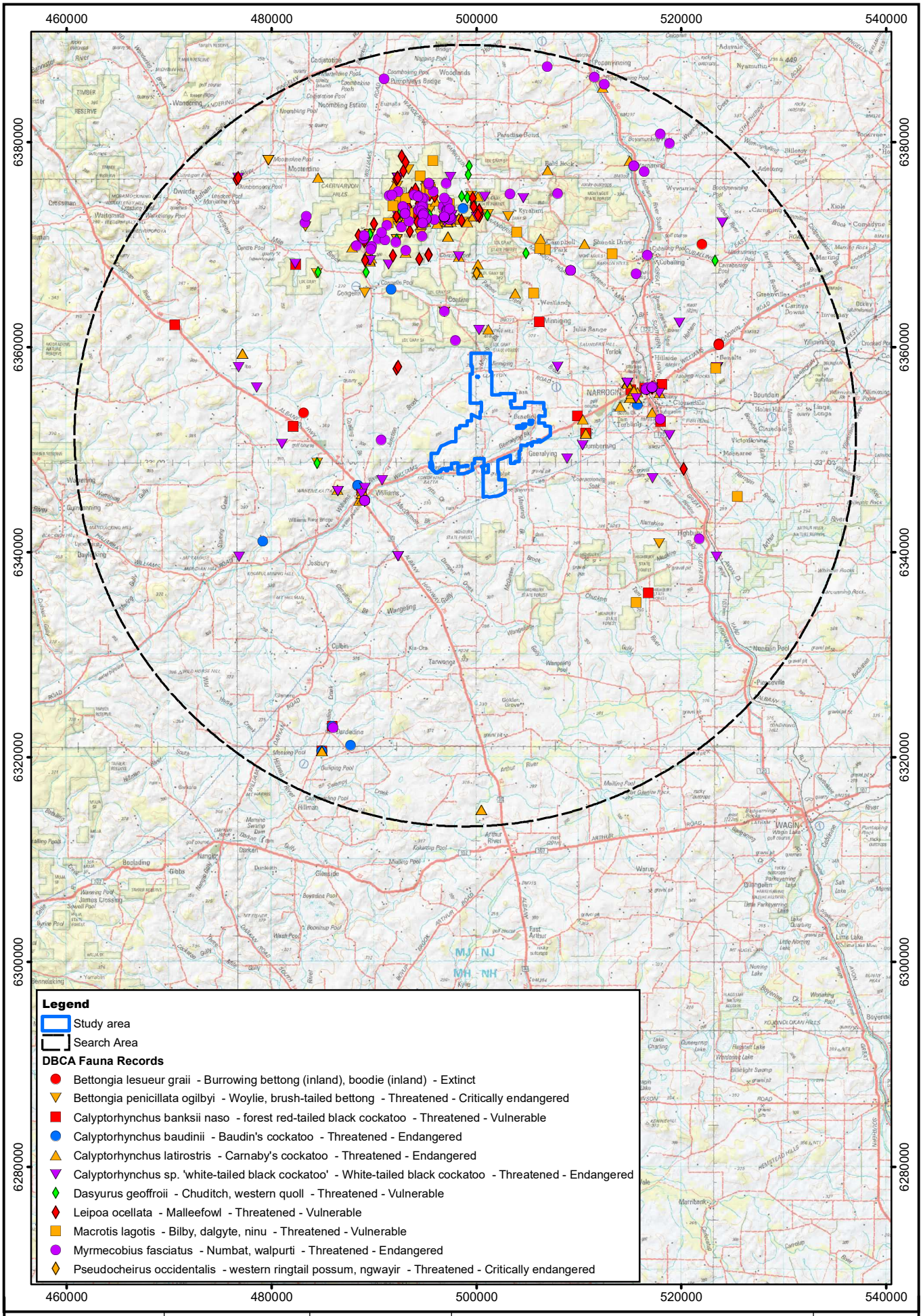
Table 8. (cont.)

Species	Conservation Status			Likelihood of Occurrence	Explanation
	EPBC Act	BC Act	DBCA Priority		
Nyctophilus major tor **Central Long-eared Bat**	-	-	P3	Potential	Although there are few records of this species in the region, it potentially occurs, roosting and/or breeding in tree hollows.
Platycercus icterotis xanthagenys **Inland Western Rosella**	-	-	P4	Known to occur	**Observed during field survey (Figure 10)**. This species is likely to be an uncommon breeding resident of woodlands in the study area.
Isoodon fusciventer **Quenda**	-	-	P4	Possible	Resident in Dryandra Woodland National Park, this species is relatively mobile and possibly occurs in the study area, where dense vegetation, including weedy vegetation in creeklines, may provide dispersal habitat.
Notamacropus eugenii derbianus **Tammar Wallaby**	-	-	P4	Possible	Resident in Dryandra Woodland National Park, this species may range into the study area, foraging in pasture, but is only likely to occur in close proximity to the National Park.
Notamacropus irma **Western Brush Wallaby**	-	-	P4	Possible	Resident in Dryandra Woodland National Park, this species may range into the study area, foraging in pasture, but is only likely to occur in close proximity to the National Park or other large remnants.
Falsistrellus mackenziei **Western False Pipistrelle**	-	-	P4	Potential	Although there a few records of this species in the region, it potentially occurs, roosting and/or breeding in tree hollows.
Hydromys chrysogaster **Water Rat**	-	-	P4	Possible	There are few records of this species in the region however, this species may occur on larger farm dams or use creeklines when wet, favouring permanent water.

5.2.1 Threatened Fauna

Threatened species are those that are considered in danger of extinction as their populations have declined and/or are still declining, and their total population size is small and/or fragmented or geographically restricted. Sites that support these species are likely to be important for their long-term conservation, particularly if the site supports a resident breeding population. An area of habitat that is essential to the conservation of a listed species can be considered 'habitat critical to the survival' of the species. Critical habitat is usually defined in recovery plans and is different for each species.

Nine Threatened species may occur in the study area (Table 8).



Drawn: CAD Resources www.cadresources.com.au Tel: (08) 9246 3242	N 0 3.5 7 km Scale: 1:500,000 MGA94 (Zone 50)	Western Wildlife	Narrogin Wind Farm **DBCA Threatened fauna records**	Figure: **11**
CAD Ref: a3021Fa010 A4				
Date: July 2024 Rev: A	Author: J. Wilcox			

Woylie - *Bettongia penicillata ogilbyi*

The Woylie is listed as Endangered under the EPBC Act and Critically Endangered under the BC Act.

The Woylie was formerly widespread across much of Australia south of the tropics, but by 1970 was restricted to four subpopulations in Western Australia (TSSC 2018). Initial translocation efforts resulted in a population increase, but it suffered a catastrophic population decline between 2000 and 2010, dropping by about 90% (Woinarski *et al*. 2014). The population in the Upper Warren region is the largest known and was estimated at between 7,000 – 11,000 individuals in 2010, a drop from an estimated 140,000 – 210,000 in 1999 (Woinarski *et al*. 2014). In recent years the population has once again started to recover (DCCEEW 2020).

Key threats impacting this species are predation by feral cats and foxes, habitat loss and inappropriate fire regimes (TSSC 2018, Woinarski *et al*. 2014). Cats and foxes predate on young Woylies and appropriate fire regimes are required to maintain the dense protective cover of understory vegetation.

The Woylie used to inhabit a wide variety of habitats, but the remnant subpopulations occur in woodlands and heaths. During the day, this species rests in a concealed nest built over a small depression on the ground (TSSC 2018). Habitat critical to the survival of the species is considered to include tall eucalypt forests or woodlands, dense myrtaceous shrubland and proteaceous or mallee heath that either currently support Woylies or have the potential to support Woylies (Yeatman and Groom 2012). Habitats that are less fragmented by roads and agriculture were found to support more Woylies when the population is under stress (Yeatman *et al*. 2016).

There are many records of this species within 40km on DBCA's Threatened and Priority Fauna Database, the majority from Dryandra Woodland National Park (Figure 11, DBCA 2023). As a population occurs adjacent to the study area, this species possibly ranges into the study area on occasion, where it may use the Eucalypt woodland on laterite rise and Eucalypt – Sheoak woodland on granites habitats, and the creekline habitat may provide for dispersal. The habitats in the study area are unlikely to regularly support this species, however, particularly in the absence of fox control. The habitat patches are too small and the understory too degraded to provide shelter and protection from foxes, therefore, it is considered unlikely that the study area currently provides critical habitat for this species.

Numbat – *Myrmecobius fasciatus*

The Numbat is listed as Endangered under the BC Act and EPBC Act.

The Numbat is a diurnal marsupial that once ranged over much of southern semi-arid Australia but is now restricted to populations in the south-west of Western Australia (Woinarski *et al*. 2014). The population size is estimated at under 1000 individuals, and in decline (Woinarski *et al*. 2014).

Numbats almost entirely on termites and shelter in hollow logs, burrows and tree hollows, using a variety of habitats. The young are born in summer. In about July they are left in the burrow and juveniles emerge in September, becoming independent by October (Woinarski *et al*. 2014). Threats to the Numbat are predation by the Fox, Cat and raptors, habitat loss and fragmentation and inappropriate fire regimes that result in the loss of hollow logs as well as direct mortalities and increased predation rates (Woinarski *et al*. 2014).

There are many records of the Numbat within 40km on DBCA's Threatened and Priority Database (Figure 11, DBCA 2023), with a population known to occur in Dryandra Woodland National Park. Although the Numbat possibly disperses into the study area on occasion, the study area is unlikely to provide critical habitat, for reasons similar to those described above for the Woylie. The habitats in the study area are unlikely to regularly support this species, particularly in the absence of fox control, as the habitat patches are too small and the understory too degraded. If dispersing into the study area, the Numbat may use the Eucalypt woodland on laterite rise and Eucalypt – Sheoak woodland on granites habitats, and the creekline habitat may provide for dispersal.

Carnaby's Cockatoo – *Zanda latirostris*

Carnaby's Cockatoo is listed as Endangered under the BC Act and EPBC Act.

Carnaby's Cockatoo is endemic to the southwest of Western Australia, occurring mostly in the wheatbelt but also on the Swan Coastal Plain and wetter southwest (Johnstone and Storr 1998). The population size is estimated to be 40,000 birds (or possibly between 10,000 – 60,000) (Garnett *et al*. 2011), and there have been no recent estimates of population size (Garnett and Baker 2021).

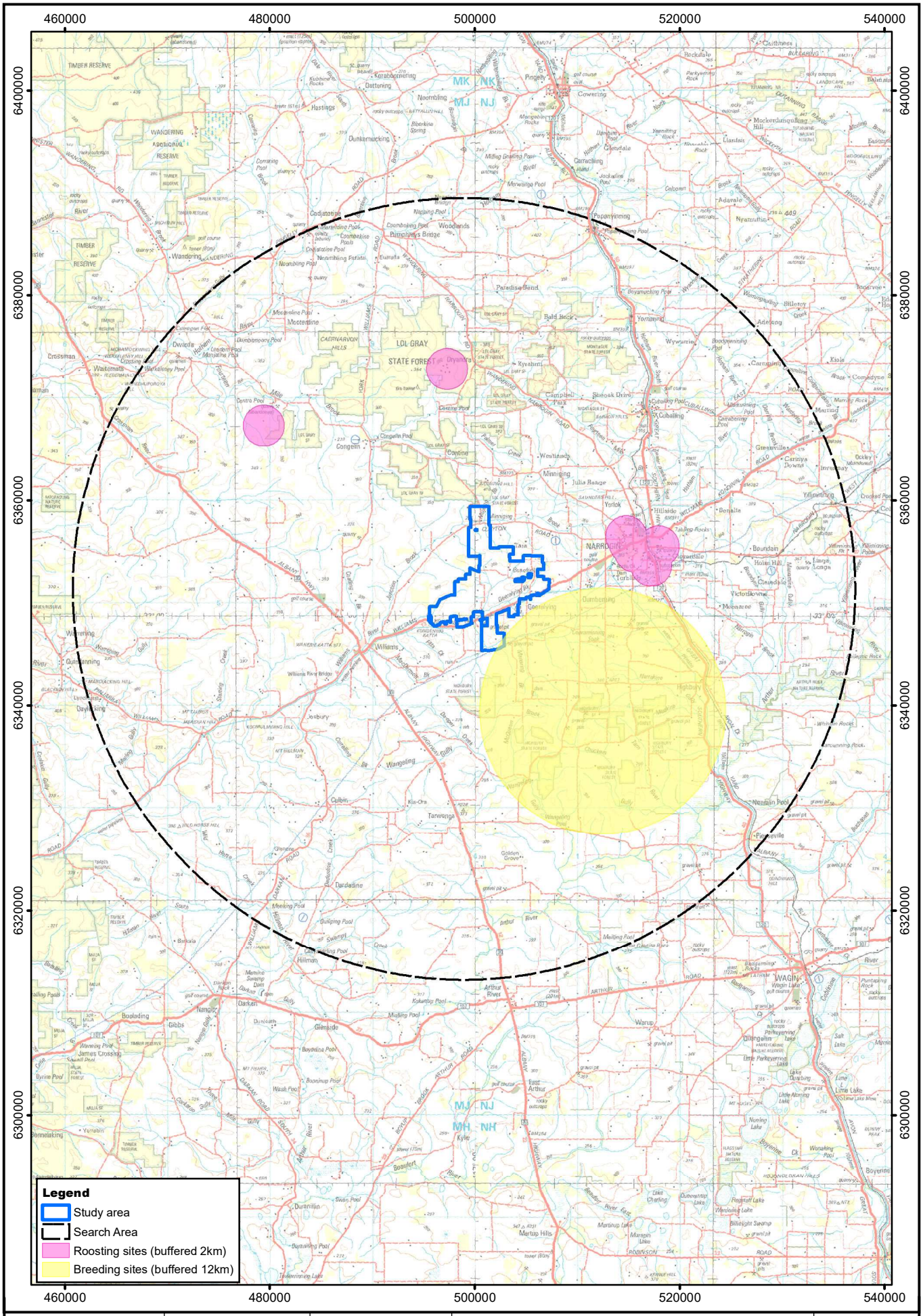
Typically, Carnaby's Cockatoo breeds in the wheatbelt region of Western Australia, nesting in large hollows in smooth-barked eucalypts such as the Salmon Gum (*Eucalyptus salmonophloia)* and Wandoo (*Eucalyptus wandoo*). However, it has started breeding in areas further west and south than its traditional breeding range, including areas in the Darling Range and on the Swan Coastal Plain (Johnstone *et. al*. 2005, Johnstone *et al*. 2011). Some of the Carnaby's Cockatoo population is resident (particularly in wetter areas) and some of the population moves west and south towards the coast after breeding (Johnstone and Storr 1998). Eggs are laid from early July to mid-October (Johnstone and Storr 1998).

A study of GPS-tagged Carnaby's Cockatoos at Coomallo Creek (200km north of Perth) and Borden (350km southeast of Perth) found that breeding birds foraged over two main periods of the day: 6 – 9AM and 3 – 6 PM, separated by a period of day roosting (Riley *et al*. 2023). Each day, birds travelled on average 5.98km from the breeding site, (up to a maximum of 13.55km) in order to forage at Borden, and 6.4km per day (up to a maximum of 11.11km) to forage at Coomallo Creek. Birds at Borden were noted to show clear movement paths along roads when transiting daily between patches of habitat (Shephard and Warren 2018). Similarly, birds tracked in the Pinjar Pine Plantation showed that birds avoided built-up urban areas and cleared land, preferring to move along vegetated areas, including road verges, parks and remnant patches (Shephard and Warren 2018). When travelling over cleared areas, birds flew faster and transited more quickly (Shephard and Warren 2018).

For non-breeding birds, average daily movement from a night roost site when foraging was 16km but ranged from 3 - 31.5km. Flocks appear to partition resources, foraging and roosting in non-overlapping areas. (Shephard and Warren 2018). Larger movements of just over 50km in a day were observed when flocks changed roost sites, and linear migration flights of birds towards breeding sites in the south and east were recorded in October (Shephard and Warren 2018).

Carnaby's Cockatoos forage on the seeds of a range of plant species, but are particularly attracted to proteaceous heaths, *Banksia* and *Eucalyptus* woodlands and pine plantations (Johnstone and Storr 1998). On the Swan Coastal Plain, important food plants include *Banksia attenuata*, *B. menziesii*, *B. grandis*, *B. ilicifolia*, *B. sessilis*, *B. prionotes*, Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) (Shah 2006). In breeding areas, it is important to have sufficient foraging resources in close proximity to nest hollows (DAWE 2022). Carnaby's Black-Cockatoo generally roosts in tall native or introduced eucalypts or pines in riparian habitats or near permanent water (Burnham *et al*. 2010, DAWE 2022).

There are many records of this species within 40km on DBCA's Threatened and Priority Database, including a flock of 95 birds in Narrogin in 2016 and 60 birds in Dryandra Woodland National Park in 2014 (Figure 11, DBCA 2023). There are known breeding sites for 'white-tailed black cockatoos', likely to be Carnaby's given that Baudin's Cockatoo is not known to breed in the area, about 12km southeast of the study area, and roosting is known to occur in Narrogin, about 10km east of the study area, as well as to the north in Dryandra Woodland National Park (Figure 12). Although no birds were observed, evidence of Carnaby's Cockatoo foraging on *Banksia* spp. was found in the study area (Figure 10) and a landholder reported seeing this species foraging on planted pine trees each year in about March, about 1.5km south of the border with the National Park. During the fauna survey a flock of 57 birds was observed foraging in canola and Marri about 13km northwest of the study area, so it is clear that the species is present in the region in spring. Areas of potential breeding habitat in the study area are shown in Figure 8. Potential foraging habitat is present in woodlands with Marri and/or woodlands with shrubby *Banksia* spp. in the understorey, and the foraging habitat is considered to be high quality (Figure 9, Appendix 2).



Drawn: CAD Resources www.cadresources.com.au Tel: (08) 9246 3242	N 0 3.5 7 km Scale: 1:500,000 MGA94 (Zone 50)	Western Wildlife	Narrogin Wind Farm **DBCA cockatoo breeding and roosting records**	Figure: **12**
CAD Ref: a3021Fa011 | A4				
Date: July 2024 | Rev: A	Author: J. Wilcox			

Baudin's Cockatoo – *Zanda baudinii*

Baudin's Cockatoo is listed as Endangered under the BC Act and EPBC Act.

Baudin's Cockatoo is endemic to the southwest of Western Australia and is more common in the deep south-west (Johnstone and Storr 1998). The population size was estimated to be 5,000 – 8,000 birds in 2017, down from 10,000 - 15,000 birds in 1995 – 2004, and the current population estimate is 3,250 (Garnett and Baker 2021). Baudin's Cockatoo has declined primarily due to persecution by orchardists and loss of habitat due to wildfires and vegetation clearance in their range (Johnstone and Storr 1998).

Baudin's Cockatoos breed in forests of Karri, Marri and Jarrah in the deep southwest, where the annual rainfall is on average more than 750mm. Breeding occurs in late winter to spring (August to November), using a large hollow in a eucalypt, generally in Karri, Marri or Wandoo (Johnstone and Storr 1998). The hollows used are usually 30 - 40cm in diameter and more than 30cm deep. Breeding occurs as far north as Lowden, with an isolated breeding record from Serpentine (Johnstone and Kirkby 2008).

Outside of the breeding season Baudin's Cockatoo can gather into large foraging flocks. Baudin's Cockatoos in urban or peri-urban areas have smaller flock sizes (<50 birds) than in forested areas (200+ birds) and undertake smaller daily movements (3.42 – 6.89km) compared with flocks in the forest (9.44km) (Rycken *et al.* 2021). In the non-breeding season this species ranges more widely, foraging primarily in habitats that contain Marri, and their distribution is probably defined by where Marri trees occur. They also feed on seeds from other plants (e.g., Jarrah, *Banksia*, *Hakea* or commercial orchard crops such as apples and pears) and take some invertebrate material by stripping bark from trees (Johnstone and Storr 1998, Johnstone *et al*., 2005). Roosting habitat is generally in the tallest trees in riparian habitats, near permanent water or in sheltered gullies (Johnstone and Kirkby 2008).

There are scattered records of this species within 40km on DBCA's Threatened and Priority Database, the most recent from Dryandra Woodland National Park in 2014 (Figure 11, DBCA 2023). Although not recorded on this survey, Baudin's Cockatoo potentially occurs as an occasional foraging visitor. The study area falls on the eastern boundary of the distribution of Baudin's Cockatoo as modelled by DAWE (2022), and a consequence of the steep population decline experienced by this species is likely to have been a contraction of their range over time. Areas of potential breeding habitat in the study area are shown in Figure 8, however, this species is not known to breed in the region. Potential foraging habitat is present in areas with Marri and/or areas with shrubby Banksia spp. in the understorey (Figure 9). No evidence of foraging was recorded, however, despite the abundance of Marri, a favoured food-plant.

Forest Red-tailed Black-Cockatoo – *Calyptorhynchus banksii naso*

The Forest Red-tailed Black-Cockatoo is listed as Vulnerable under the BC Act and EPBC Act.

The Forest Red-tailed Black-Cockatoo is endemic to the southwest of Western Australia. It is patchily distributed through its range (Johnstone and Storr 1998), with the population size estimated to be 15,000 birds (Johnstone and Kirkby 1999). It occurs in Jarrah, Marri and Karri forests, also ranging onto the Swan Coastal Plain.

On a study of Forest Red-tailed Black-Cockatoos on the Swan Coastal Plain, average daily movement was 11km, but ranged between 4 - 16.5km (Shephard and Warren 2019). The birds show a daily movement pattern consisting of morning foraging, day roosting, afternoon foraging and night roosting, with the longest residence times associated with night roosting and morning foraging sites (Shephard and Warren 2019, Riley *et al*. 2023).

Flight speed for the Forest Red-tailed Black-Cockatoos was low (at or below 1m/s), and the birds appeared to move slowly through the landscape while either foraging, day roosting or resting (Shephard and Warren 2018). This species also appears to partition both roosting and foraging resources across the Swan Coastal Plain. Resident flocks had home-range sizes between 8 and 45km^2, which when applied to a roost site, suggested the home-range of the flock has a maximum radius of 3.8km from the roost.

Home-range size varies between resident urban and peri-urban flocks, with a range of 6.02 – 52.57km^2 (Rycken *et al*. 2022). Larger home-ranges were associated with the flock moving between multiple smaller foraging sites, often travelling along and making use of vegetation in road verges (Rycken *et al*. 2022). Daily movements averaged 16.41km for the flock with the larger home-range, with several days showing a movement of more than 20km. A flock with a smaller home-range of 6.02km^2, based in larger areas of remnant vegetation, travelled only 4.96km per day on average.

The average distance that birds moved between key night roost and foraging sites was small at 0.47 – 5.12km (Shephard and Warren 2018). Roost sites on the Swan Coastal Plain were in mature stands of trees ranging from 10 – 20m, dominated by Marri and other tall tree species including Jarrah and Spotted Gum. Water was present at 67% of day roost sites and 40% of night roost sites, although most peri-urban sites that did not have water immediately present had water nearby, usually in troughs. Roost occupancy is seasonal on the Swan Coastal Plain.

Forest Red-tailed Black Cockatoos feed primarily on the seeds of Marri and Jarrah, but also feed on the seeds of Blackbutt (*Eucalyptus patens*), Forest Sheoak (*Allocasuarina fraseriana*), Snottygobble (*Persoonia longifolia*) and Cape Lilac (Johnstone and Storr 1998). It nests in hollows in Karri (*Eucalyptus diversicolor*), Marri, Jarrah, Bullich (*Eucalyptus megacarpa*) and Wandoo (*Eucalyptus wandoo*) (Johnstone and Storr 1998, DAWE 2022). However, they have generally been found to prefer nesting in large veteran or stag Marri trees with a mean DBH of 90cm (Johnstone *et al*. 2013). The Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) breeds through much of the year with peaks in autumn (April-June) and spring (August-October).

There are scattered records of this species within 40km on DBCA's Threatened and Priority Database, the most recent from Dryandra Woodland National Park in 2017 (Figure 11, DBCA 2023). All Jarrah, Marri and Karri forests, woodlands and remnants in regions receiving more than 600mm rain annually are considered to be 'habitats critical to the survival' of the Forest Red-tailed Black-cockatoo (DEC 2008). The Forest Red-tailed Black-cockatoo was recorded about 1km west of the study area during the fauna survey (Figure 10), with a small flock of probably two birds heard. No evidence of foraging was recorded, despite the abundance of Marri, a favoured food-plant. Areas of potential breeding habitat in the study area are shown in Figure 8. Potential foraging habitat is present in areas with Marri or Jarrah, with Rock Sheoak (*Allocasuarina huegeliana*) being a possible secondary food, and the foraging habitat is considered to be high quality (Figure 9, Appendix 2).

Chuditch – *Dasyurus geoffroii*

The Chuditch is listed as Vulnerable under the BC Act and EPBC Act.

The Chuditch used to occur across much of Australia but is now restricted to the southwest of Western Australia. It is vulnerable to predation by foxes and increases in areas where fox control is undertaken (Burbidge 2004). Although they used to occupy a variety of habitats, the majority of Chuditch now occur in the Jarrah forest with some wheatbelt populations in drier woodlands, heath and mallee shrublands (Van Dyck and Strahan 2008; Orrell and Morris 1994). Critical habitat for the Chuditch includes all habitats currently occupied by Chuditch for foraging, breeding and/or dispersal, habitat within their known range in which an undiscovered population may reside and habitats temporarily unoccupied (e.g. due to fire) but which will support Chuditch in the future (DEC 2012). Important habitat elements include sufficient sites for dens, sufficient prey resources and large areas of vegetation (DEC 2012).

Chuditch are wide-ranging and occupy large home-ranges of 300-400ha for females and more than 1,200ha for males. These home-ranges are overlapping, with a core non-overlapping area described by the den sites, of about 90ha for females and 400ha for males (Serena and Soderquist 1989). Chuditch use a variety of denning sites including hollow logs, burrows, and rocky outcrops, and an individual may use up to 180 den sites within their home-range.

Key threats to the Chuditch include predation by foxes and consumption of toxic feral cat baits, with minor threats including road mortalities, timber harvesting, predation by feral cats and prescribed burning (Woinarski *et al*. 2014).

There are several records of the Chuditch within 40km on DBCA's Threatened and Priority Database, with the majority of records are in Dryandra Woodland National Park (Figure 11, DBCA 2023). Chuditch was recorded on a single camera trap on a single night, which is indicative of dispersal rather than residency in the study area (Figure 10, Plate 16). The majority of habitat patches in the study area are too small and fragmented to regularly support a population of the species, and this species is susceptible to predation by foxes that are common in farmland. This species is resident in Dryandra Woodland National Park and it is likely that individuals from this population disperse through the study area, taking daytime shelter in hollow logs, rock crevices and possibly tree hollows.

The Chuditch may use any habitat in the study area to disperse, and this can be considered critical habitat as dispersal potentially allows gene-flow between the population in Dryandra Woodland and forests to the west. Unlike the Numbat and Woylie described in the sections above, the Chuditch is very mobile and capable of dispersing long distances in a short span of time. Although some individuals are likely to be lost to fox predation, the Chuditch is more likely to be able to successfully move between populations using the network of small habitat patches as an ecological linkage.

Plate 16. Chuditch recorded on a camera trap in the study area.

Malleefowl – *Leipoa ocellata*

The Malleefowl is listed as Vulnerable under the BC Act and EPBC Act.

The Malleefowl is a bird of dense shrublands, mulga woodlands and mallee woodlands. It used to be common in the southern arid and semi-arid areas of Western Australia (Johnstone and Storr 1998). In order to construct their nest mounds, the Malleefowl needs leaf litter on sandy substrates (Garnett and Crowley 2010). The mounds are usually constructed intermittently by a pair of birds between autumn and spring. Between early spring and mid to late summer, 15 - 25 eggs are laid in the mound by the female, while the male continues to tend the mound. The chicks emerge between November and January (sometimes as late as March), and as they receive no parental care, chick mortality can be high (Benshemesh 2007). Malleefowl will often breed in the same general area year after year, and new mounds may be constructed, or old mounds re-used. The adult birds have been found to range over one to many square kilometres, and these home ranges overlap (Benshemesh 2007).

As Malleefowl nest on the ground, the eggs and flightless chicks are vulnerable to predation by feral predators. However, the main threat to Malleefowl is habitat loss and the fragmentation and degradation of remaining habitat, as well as the death of adults on roads (Benshemesh 2007, Garnett *et al*. 2011). Fire can have a significant impact on populations, by killing adult birds, causing local extinctions in fragmented habitats and causing a cessation in breeding activity for many years after a fire (Benshemesh 2007).

There are many records of Malleefowl within 40km of the study area on DBCA's Threatened and Priority Fauna Database, many of them recent and most within the Dryandra Woodland National Park (Figure 11, DBCA 2023). Malleefowl possibly occur in the study area, however, breeding habitat is entirely absent due to the disturbed understory and associated lack of leaf litter. Malleefowl may disperse through the study area on occasion, using the Eucalypt woodland on laterite rise or Eucalypt – Sheoak woodland on granites habitats, but the lack of understory makes these habitats only marginally suitable for the species.

Australian Painted Snipe – *Rostratula australis*

The Australian Painted Snipe is listed as Endangered under the BC Act and EPBC Act.

The Australian Painted Snipe is more common in eastern Australia but occurs patchily in Western Australia. It favours inland temporary wetlands, usually occurring singly or in small groups (Geering *et al*. 2007). It prefers wetlands with dense fringing vegetation, shallow waters and exposed mud. In southern Australia it breeds in spring and summer (Geering *et al*. 2007). The population of this species is estimated at about 1,500 adult birds and the population trend is declining (Garnett *et al*. 2011). Key threats to this species include loss and degradation of wetland habitats through water diversion, drainage, grazing, trampling and invasive weeds. Feral mammals may also be a threat, but this has not yet been substantiated (Garnett *et al.* 2011).

There are no records of this species within 40km on DBCA's Threatened and Priority Fauna Database (Figure 11, DBCA 2023). The Australian Painted Snipe may occur in seasonally wet areas in the creekline habitat where sufficiently vegetated, or occasionally use farm dams in the cleared areas, but these are not likely to provide critical habitat. The study area is unlikely to regularly support the Australian Painted Snipe as it is uncommonly recorded in south-western Australia, the study area is outside the usual distribution of the species according to Birdlife International (2023) and it prefers wetland habitats with dense fringing vegetation and exposed muds.

Red-tailed Phascogale – *Phascogale calura*

The Red-tailed Phascogale is listed as Vulnerable EPBC Act and Conservation Dependent under the BC Act.

The Red-tailed Phascogale has declined in numbers and in range. It favours Wandoo or York Gum woodlands with Rock Sheoak but also uses other habitats including shrublands (Woinarski *et al*. 2014). The home-range is from 1.5 - 8ha, and this species uses a range of nesting sites including tree hollows, grasstree skirts and stumps (Woinarski *et al*. 2014). Long-unburnt habitats are important for this species, with frequent, intense fires being a key threat to the species. Other key threats include loss and fragmentation of habitat and predation by feral cats (Woinarski *et al*. 2014). The majority of the range of this species overlaps the southern wheatbelt, and as such the population is fragmented, often occurring in isolated reserves (Maxwell *et al*. 1996).

There are many records of this species within 40km on DBCA's Threatened and Priority Fauna Database, including several in native vegetation immediately adjacent to the study area (Figure 11, DBCA 2023). The Red-tailed Phascogale was recorded on one camera trap in the study area and two camera traps in the additional survey area (Figure 10, Plate 17), all in the Eucalypt woodland on laterite rise habitat. The study area is within the core range of this species and it is known to survive in relatively small habitat patches.

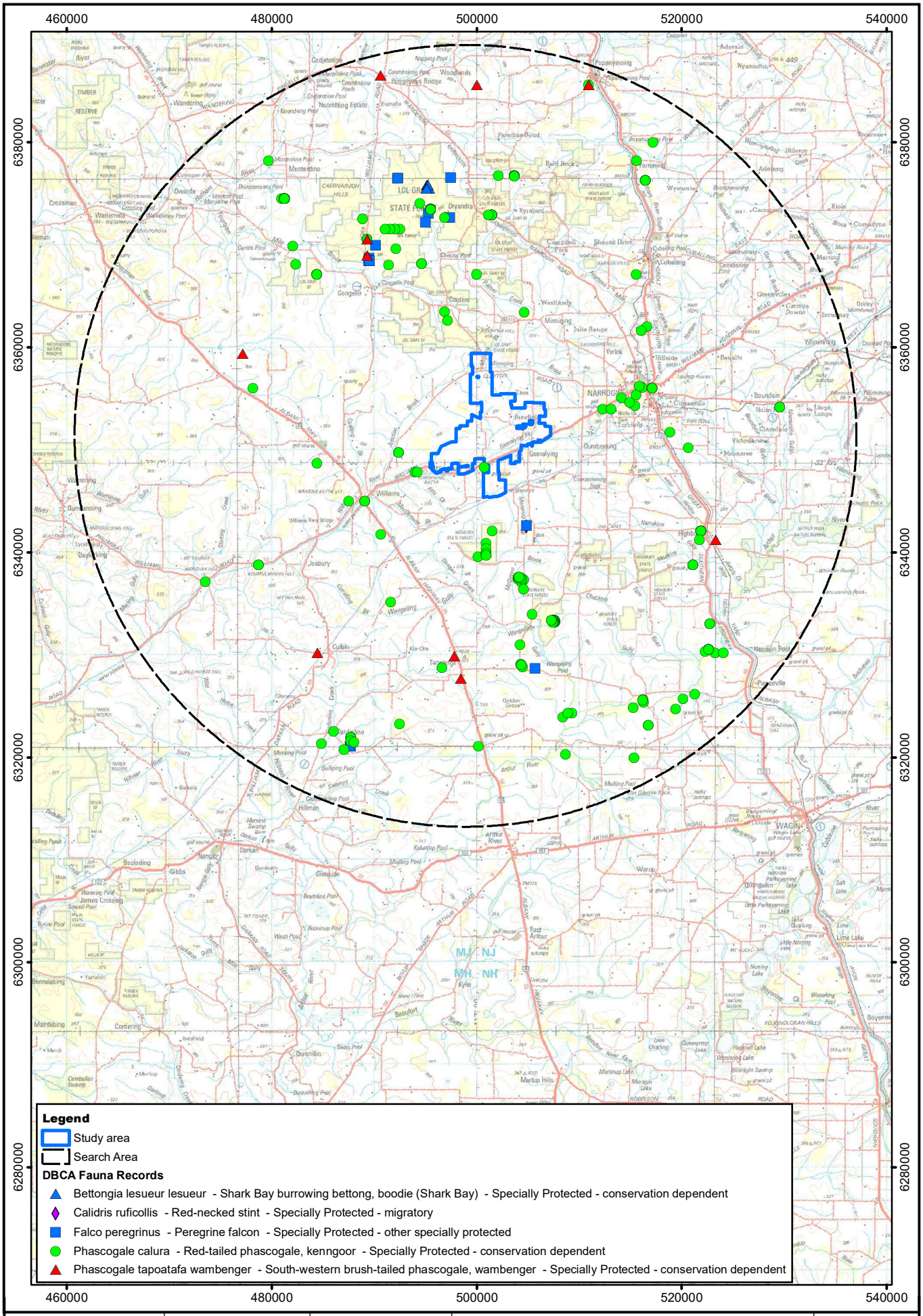
The Eucalypt – Sheoak woodland with granites and Eucalypt woodland on laterite rise habitats are likely to provide critical habitat for this species, and it may also disperse through creekline or planted habitats. Some woodland patches that are small and degraded may not support the species due to a lack of shelter and foraging opportunities, but it would require further survey to exclude these areas as potential critical habitat. Cleared areas and isolated paddock trees are not likely to be used by this species.

Plate 17. Red-tailed Phascogale recorded on a camera trap in the study area.

5.2.2 Migratory Fauna

Migratory species are not always present at a site, but a particular site may have significance as a seasonal or ephemeral foraging, breeding or shelter area. Impacts to these sites may then impact the population both within the site and further afield. For Migratory shorebirds, a site is deemed internationally important if it regularly supports more than 1% of the flyway population of a species, or a total abundance of at least 20,000 shorebirds, and nationally important if it regularly supports more than 0.1% of the flyway population of a species, at least 2,000 shorebirds or at least 15 shorebird species (Hansen *et al*. 2016, Commonwealth of Australia 2017). The study area is not likely to provide important habitat for Migratory shorebirds, although individuals may occur on occasion, as the creekline habitat and the farm dams in the cleared areas do not provide the exposed mudflats and shorelines that these species require.

There are two Migratory species that may occur in the study area (Table 8).



Drawn: CAD Resources www.cadresources.com.au Tel: (08) 9246 3242	N 0 3.5 7 km Scale: 1:500,000 MGA94 (Zone 50)	Western Wildlife	Narrogin Wind Farm **DBCA Migratory and Specially Protected fauna records**	Figure: **13**
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Common Sandpiper – *Actitis hypoleucos*

The Common Sandpiper is listed as Migratory under the BC Act and EPBC Act.

This species is a non-breeding migrant to Western Australia, with some individuals present all year but usually present between September and March in the south-west (Johnstone and Storr 1998). It occurs on a range of fresh and saltwater habitats, including rocky creeks, dams, river pools and estuaries (Geering *et al*. 2007, Johnstone and Storr 1998).

There are no records of this species within 40km on DBCA's Threatened and Priority Fauna Database (Figure 13), however, this species was recorded within 40km on the ALA database (Appendix 4). A site is deemed internationally important if it regularly supports 1% of the flyway population (1,900 birds) or nationally important if it regularly supports 0.1% of the flyway population (190 birds) (Hansen *et al*. 2016). Although the study area contains creeklines and farm dams, these habitats are only marginally suitable and are unlikely to regularly support this species. This species is not likely to occur in nationally or internationally important numbers, but small numbers (one or two birds) possibly occur on occasion.

Fork-tailed Swift – *Apus pacificus*

The Fork-tailed Swift is listed as Migratory under the BC Act and EPBC Act.

The Fork-tailed Swift is a non-breeding visitor to Australia between September and April (Boehm 1962). While it can be common further north, in southwest Australia this species is generally scarce (Johnstone and Storr 1998). The bird is primarily observed foraging for insects in proximity to cyclonic weather (Boehm 1962). Although a migratory species, the Fork-tailed Swift has a large range, a large population that appears to be stable Birdlife International 2023).

There are no records of this species within 40km on DBCA's Threatened and Priority Fauna Database (Figure 13, DBCA 2023), however, this species was recorded within 40km on the ALA database (Appendix 4) and potentially occurs. A site is deemed internationally important if it regularly supports 1% of the population (1,000 birds) or nationally important if it regularly supports 0.1% of the population (100 birds) (DoE 2015c). Although the Fork-tailed Swift potentially occurs, the study area is not likely to regularly support the species and nationally or internationally important numbers of birds are unlikely to ever occur. The Fork-tailed Swift is a largely aerial species when in Australia and is only likely to forage above the study area.

5.2.3 Specially Protected and Conservation Dependent Fauna

The populations of Specially Protected species are large enough that they are not considered to be Threatened. However, they require on-going conservation intervention (i.e., Conservation Dependent) or be specially protected in order to prevent them from becoming Threatened.

There are two specially protected fauna that potentially occur in the study area (Table 8).

Peregrine Falcon – *Falco peregrinus*

The Peregrine Falcon is listed as Other Specially Protected Fauna under the BC Act.

The Peregrine Falcon is a widespread bird of prey that globally has a very large range and a very large population that appears to be secure (BirdLife International 2023). In Western Australia the population is secure, though this species may experience reductions at a local level due to human disturbance at nesting sites (Debus 1998). The Peregrine Falcon nests mainly on ledges on cliffs or rocky outcrops, and it may also use tall trees (Johnstone and Storr 1998). This species often takes advantage of man-made structures such as abandoned open pits or quarries.

The Peregrine Falcon has been recorded within 40km on DBCA's Threatened and Priority Fauna Database, with the majority of records at the Dryandra Woodland National Park (Figure 13, DBCA 2023). The Peregrine Falcon was recorded during the fauna survey (Figure 10) and is likely to forage in open habitats, including pasture and open areas within woodlands. A pair of birds is likely to occupy a home-range of 20-30km^2 (BirdLife International 2023), so the study area potentially supports less than 10 birds. The habitats of the study area are unlikely to be important for this species unless a nesting site is present, as cleared agricultural land is common in the region and its population is large and increasing (Birdlife International 2023). Nesting may occur in tall trees of any habitat.

Brush-tailed Phascogale – *Phascogale tapoatafa*

The Brush-tailed Phascogale is listed as Conservation Dependent under the BC Act.

The Brush-tailed Phascogale is a nocturnal carnivore that occurs in open forests and woodlands with a sparse understory (Van Dyck and Strahan 2008). It is listed as Near Threatened in the Action Plan for Australian Mammals 2012 due to its continuing population decline due to the actions of habitat loss, degradation and fragmentation (Woinarski *et al*. 2014). Females have been found to have non-overlapping home ranges of about 20 – 40 ha, and males have or 100 ha home ranges that may overlap with other males or females (Van Dyck and Strahan 2008). Nest sites include tree hollows and stumps, and within a year an individual phascogale may use up to 40 different sites.

There are a few scattered records of this species within 40km of the study area on DBCA's Threatened and Priority Fauna Database, the most recent records at Dryandra Woodland National Park in 2015 and 2018 (Figure 13, DBCA 2023). Although not recorded on camera traps in this survey, the Brush-tailed Phascogale possibly occurs in Eucalypt woodland on laterite rise and Eucalypt-Sheoak woodland on granites on occasion. It is probable, however, that the woodland habitats in the study area are too fragmented to regularly support this species. It is considered likely to be locally extinct in the wheatbelt and confined to the wetter Jarrah forest regions (Woinarski *et al*, 2014).

5.2.4 Priority Fauna

Priority 1, 2 or 3 species are considered to be in need of further survey, as insufficient data exist to adequately determine their status. Many Priority 1, 2 and 3 species are known from only a few records in a limited number of locations, thus determining their status in the study area may be problematic. Priority 4 species are considered to require regular monitoring, as although they are adequately known, they are either rare, near threatened or recently removed from the threatened list.

There are ten Priority fauna species that may occur in the study area (Table 8).

Southern Death Adder – *Acanthophis antarcticus*

The Southern Death Adder is listed as Priority 3 by DBCA.

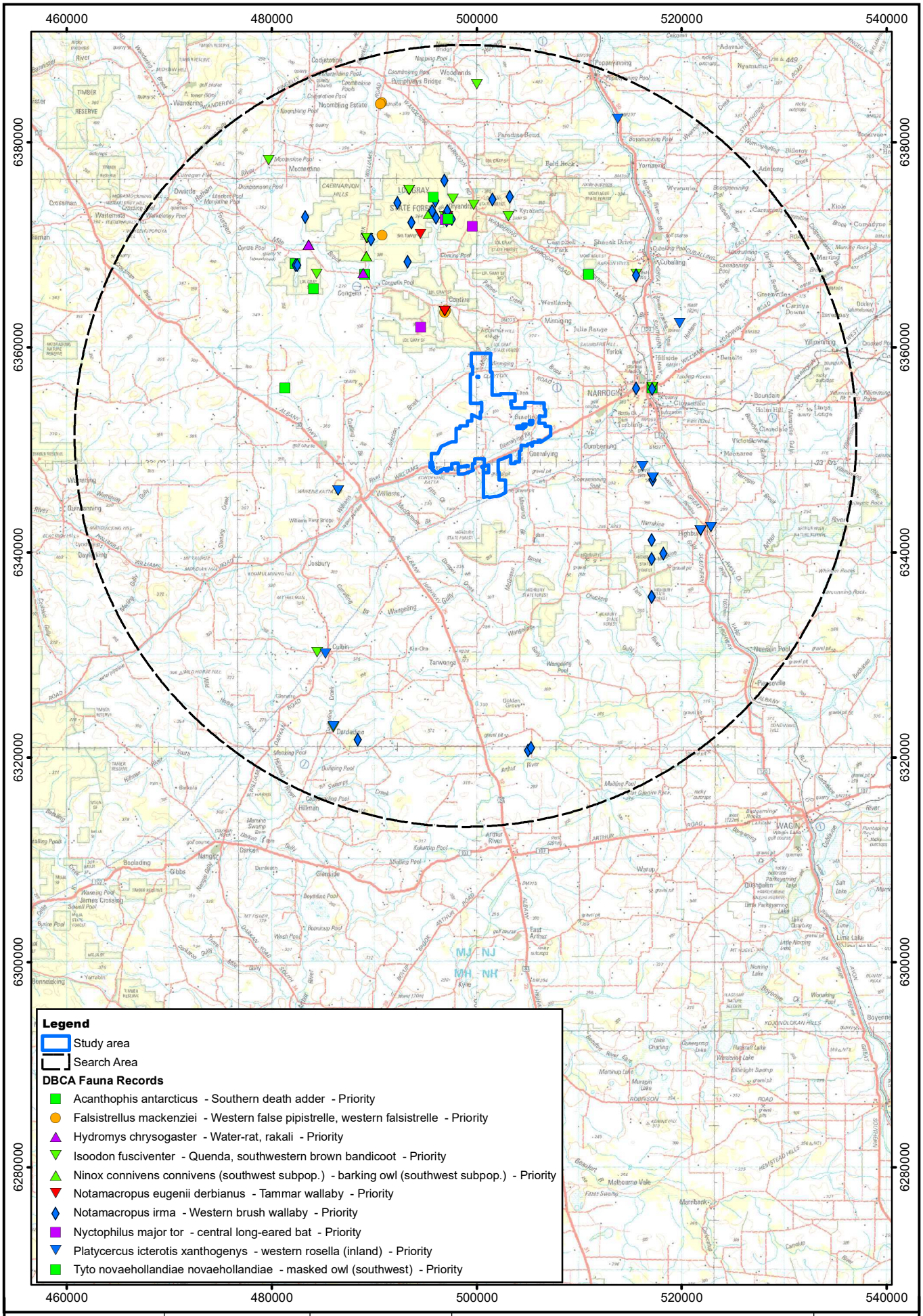
The Southern Death Adder occurs in the Darling Range and Southern Wheatbelt, as well as on the south coast, east from Esperance. An ambush predator, it requires deep leaf litter and is usually associated with deep gullies and rocky outcrops (Bush *et al*. 2007). There are a few records of this species on DBCA's Threatened and Priority Fauna Database, the most recent from 1998 (Figure 14, DBCA 2023). It is possible that the Southern Death Adder occurs in the study area, in larger areas of Eucalypt-Sheoak woodland on granites, but most of the habitat is likely to be too degraded to currently support the species.

Barking Owl – *Ninox connivens connivens*

The southwest subpopulation of the Barking Owl is listed as Priority 3 by DBCA.

The southwest subpopulation of the Barking Owl inhabits the southwest corner of Western Australia. The range of this subspecies also extends across the southeast of Australia. It occurs in dry sclerophyll woodlands, particularly in association with watercourses and forest edge (Garnett *et al*. 2010). It nests in large eucalypt hollows in mature trees. The southwest subpopulation is extremely rare, with only five reported sightings between 2011 and 2020, and no records from targeted searches undertaken in 1999/2000 and 2015/2016 (Garnett and Baker 2021, Liddelow *et al*. 2002, Fulton 2017).

There are three records of this species within 40km on DBCA's Threatened and Priority Fauna Database, all from Dryandra Woodland National Park in 2005 (Figure 14, DBCA 2023). The status of the species in the local area is uncertain due to the paucity of records, however, this species may occur in the study area, although it was not recorded at passive acoustic detector sites on this survey (Appendix 7). If present, this species may nest in large hollows in Eucalypt woodland on laterite rises and Eucalypt-Sheoak woodlands on granites, foraging in woodlands and on woodland edges.



Drawn: CAD Resources www.cadresources.com.au Tel: (08) 9246 3242	N 0 3.5 7 km Scale: 1:500,000 MGA94 (Zone 50)	Western Wildlife	Narrogin Wind Farm DBCA Priority fauna records	Figure: 14
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Masked Owl – *Tyto novaehollandiae novaehollandiae*

The southwest subspecies of the Masked Owl is listed as Priority 3 by DBCA.

The south-west subspecies of the Masked Owl inhabits forested areas, breeding in large tree hollows (Johnstone and Storr 1998). It is suggested that this species prefers open forests and forest edges for hunting (Liddelow *et al*. 2002). There are two records of this species within 40km of the study area on DBCA's Threatened and Priority Fauna Database, from Dryandra Woodland National Park 2001 and 2003 (Figure 14, DBCA 2023). The Masked Owl was not recorded at passive acoustic detector sites on this survey (Appendix 7), but may occur in the study area. If present, this species may nest in large hollows in Eucalypt woodland on laterite rises and Eucalypt-Sheoak woodlands on granites, foraging in woodlands and on woodland edges.

Inland Western Rosella – Platycercus icterotis xanthogenys

The Inland Western Rosella is listed as Priority 4 by DBCA.

The Inland Western Rosella is endemic to southern Western Australia. The population of this species is thought to be declining in the western wheatbelt due to clearing, but stable in the western woodlands (Garnett and Crowley 2000). Although still listed as a Priority species, the Inland Western Rosella was not listed in the 2010 Action Plan for Australian Birds as the population is considered too large and the decline too slow to be designated Near Threatened (Garnett *et al*. 2011). This species occurs in eucalypt and casuarina woodlands, nesting in tree hollows (Johnstone and Storr 1998).

The Inland Western Rosella is known from a scattered records within 40km on DBCA's Threatened and Priority Fauna Database (Figure 14, DBCA 2023). This species was recorded in the study area during the fauna survey (Figure 10) and is likely to be an uncommon resident of the area. The Inland Western Rosella is likely to occur in Eucalypt woodland on laterite rises and Eucalypt-Sheoak woodlands on granites, breeding in eucalypt hollows. This species may also feed in crops.

Quenda – *Isoodon fusciventer*

The Quenda (or Southern Brown Bandicoot) is listed as Priority 4 by DBCA.

The Quenda occurs in a range of habitats, preferring dense vegetation such as wetlands and heathlands (Woinarski *et al*. 2014). The Quenda is listed as Least Concern in the Action Plan for Australian Mammals 2012, as although it has declined in the past, fox control has allowed its numbers to recover and the population is no longer declining (Woinarski *et al.* 2014).

There are several records of Quenda within 40km of the study area on DBCA's Threatened and Priority Fauna Database, however, the only recent records are from Dryandra Woodland National Park 2005 – 2016, where animals have been translocated (Figure 14, DBCA 2023). Although this species is likely to be locally extinct in most remnant vegetation in the region, it may possibly occur if dispersing from the National Park. This species was not recorded on camera traps during the fauna survey, however, there is anecdotal evidence from a landholder that this species has occurred in the study area about 1.5km south of the National Park boundary, where an individual was killed by a dog. Most habitat patches lack understory and are therefore unsuitable for this species, but Quenda may disperse along dense creekline vegetation.

Tammar Wallaby – *Notamacropus eugenii derbianus*

The Tammar Wallaby is listed as Priority 4 by DBCA.

The Tammar Wallaby was once widespread in south-western Australia, but now occurs only on islands and in several reserves and National Parks, with reintroduced populations at a number of sites (Woinarski *et al*. 2014). This species is locally common in areas that are baited for foxes. The Tammar Wallaby inhabits dense vegetation during the day, foraging in open grassy areas at night (Woinarski *et al*. 2014).

There are four records of this species within 40km on DBCA's Threatened and Priority Fauna Database, all from Dryandra Woodland National Park (Figure 14, DBCA 2023). The Tammar Wallaby possibly occurs in the study area in Eucalypt woodland on laterite rises, Eucalypt-Sheoak woodlands on granites or creeklines, however, is likely to be restricted to foraging in pasture and remnant vegetation only in close proximity to Dryandra Woodland National Park.

Western Brush Wallaby – *Notamacropus irma*

The Western Brush Wallaby is listed as Priority 4 by DBCA.

The Western Brush Wallaby occurs in areas of forest or woodland where there is a dense, shrubby understory. Although there are no robust measures of abundance, it is considered to be relatively common, particularly in areas with fox baiting (Woinarski *et al*. 2014). The home-range size of one individual has been estimated at about 9.9ha for males and 5.3ha for females (Bamford and Bamford 1999).

The Western Brush Wallaby has been recorded within 40km on DBCA's Threatened and Priority Fauna Database (Figure 14, DBCA 2023). The majority of the records are from Dryandra Woodland National Park, but there are also several in the vicinity of Highbury State Forest. This species is likely to occur in larger areas of remnant native vegetation in the region, and possibly occurs in the study area on occasion. The habitats in the study area are unlikely to regularly support this species and it is most likely to occur in proximity to Dryandra Woodland National Park.

Western False Pipistrelle – *Falsistrellus mackenziei*

The Western False Pipistrelle is listed as Priority 4 by DBCA.

The Western False Pipistrelle is considered Near Threatened in the Action Plan for Australian Mammals 2012, as its population is declining, however, the population is not severely fragmented and does not exhibit extreme fluctuations (Woinarski *et al*. 2014). This species is endemic to south-west Australia and occurs in forests and woodlands. It is thought to be locally common in Karri forest but may be uncommon or declining in Jarrah and Tuart forests. The Western False Pipistrelle roosts in tree hollows, hollow branches or stumps during the day, in colonies of five to 30 (Churchill 2007).

There are five records of this species within 40km on DBCA's Threatened and Priority Fauna Database, the most recent from 1996 (Figure 14, DBCA 2022). The Western False Pipistrelle was not detected during the fauna survey (Appendix 6), but potentially occurs in the study area. If present, it is likely to occur in Eucalypt woodland on laterite rises or Eucalypt-Sheoak woodlands on granites, roosting in tree hollows.

Central Long-eared Bat – *Nyctophilus major tor*

The Central Long-eared Bat is listed as Priority 3 by DBCA.

The Central Long-eared Bat is widespread across the arid south of Australia, and though thought to have a population of substantially more than 10,000 individuals, the reliability of this estimate is low (Woinarski *et al*. 2014). It occurs in eucalypt woodlands with a tall shrub understorey and around granite outcrops, roosting beneath bark, in tree crevices or in the foliage of trees (Van Dyck and Strahan 2008, Churchill 2008). Current threats to this species are inferred and include habitat loss and fragmentation or inappropriate fire regimes leading to a loss of habitat and/or roost sites (Woinarski *et al*. 2014).

There are three records of this species within 40km of the study area on DBCA's Threatened and Priority Fauna Database, all from individuals trapped at Dryandra Woodland National Park in 2007 (Figure 14, DBCA 2023). The Central Long-eared Bat was not detected on this survey (Appendix 6), but potentially occurs in the study area. If present, it is likely to favour Eucalypt-Sheoak woodlands with granites and may also occur in Eucalypt woodland on laterite rises, roosting in tree hollows.

Water-rat – *Hydromys chrysogaster*

The Water-rat is listed as Priority 4 by DBCA.

The Water-rat lives near permanent freshwater or brackish wetlands, including rivers, lakes and farm dams (Van Dyck and Strahan 2008). Although it hunts on land, the majority of its prey are aquatic insects, fish, crustaceans and molluscs. It dens in a burrow tunnelled into the bank, or sometimes a hollow log. This species is listed as Least Concern in the Action Plan for Australian Mammals 2012 (Woinarski *et al*. 2014) and is considered likely to have benefited from artificial waterways (Van Dyck and Strahan).

There are three records of this species within 40km of the study area on DBCA's Threatened and Priority Fauna Database, the most recent from 2021 (Figure 14, DBCA 2023). The Water-rat possibly occurs along the creeklines and in dams in the study area, favouring areas of more permanent water.

6. Discussion

6.1 Vertebrate Faunal Assemblage

As the study area is within a relatively well-studied region, there was a large amount of contextual data available on databases and in fauna reports for the desktop review. The predicted faunal assemblage includes up to 12 frogs, 46 reptiles, 158 birds, 27 native mammals and five introduced mammals. As the habitats of the study area are fragmented and the understory is degraded, the actual faunal assemblage is likely to be species poor compared with more intact habitats, and thus not all the predicted species are likely to be present, despite being known to occur in the region. The larger habitat patches in the study area are likely to support the more diverse faunal assemblages, and the smaller patches are likely to support only a small number of species.

The observed faunal assemblage within the study area thus far includes one frog, three reptiles, 69 birds, eleven native mammals and four introduced mammals. This is unlikely to represent all the species present, as the methods used to observe fauna in this survey targeted certain taxa, and taxa such as reptiles are likely to be underrepresented in the results.

6.2 Conservation Significant Fauna

Twenty-three conservation significant fauna potentially occur in the study area: nine Threatened, two Migratory, two Specially Protected and ten Priority species. For the majority of conservation significant species, the study area is unlikely to provide important habitat, even if they may occur on occasion.

All habitats have some importance in that they support native fauna, however, habitats may be of particular importance if they:

- support very diverse or unique faunal assemblages
- are restricted or rare in the region (and thus the faunal assemblages are restricted or rare)
- are refugia (e.g. from drought or fire)
- provide ecological linkage
- support conservation significant fauna

The habitats of the study area are unlikely to support very diverse, restricted or rare faunal assemblages compared with more intact habitat areas in the region. Although the habitats of the study area are degraded, they are still likely to provide a network of ecological linkage, particularly for more mobile species such as birds, and are also likely to support some conservation significant fauna. In a largely cleared agricultural landscape, all remaining native vegetation is likely to be of some importance for maintaining populations of native fauna.

The study area is in close proximity to Dryandra Woodland National Park, a large area of remnant wheatbelt vegetation, as well as other smaller areas of remnant vegetation in reserves and on private land. The National Park is known to support populations of several Threatened, Specially Protected and Priority Fauna species. Most of these species are likely to only range into the study area on occasion, attempting to disperse from the National Park, but the habitats of the study area are unlikely to regularly support these species. For species such as the Woylie, Numbat and Malleefowl, the patches of habitat in the study area are likely to be too small and the understory too degraded to support them. These species are also susceptible to predation by foxes, and in the absence of effective fox control within farmland foxes are likely to be common, and indeed were commonly recorded on camera traps in this study. Small and fragmented habitat patches with limited understory and increased 'edge', increases the risk of predation by foxes. For some of these species, habitats in the study area may act as a population 'sink', where individuals disperse into the area only to be predated by foxes.

A few species may disperse through the study area more regularly, some using habitats in the study area for shelter, foraging and/or breeding. This includes birds such as cockatoos, that are able to fly between habitat patches, species known for their mobility, such as the Chuditch and species known to persist in small habitat patches, such as the Red-tailed Phascogale.

Threatened species recorded or considered likely to occur, and for which the habitats of the study area are likely to provide critical habitat are:

- Chuditch (*Dasyurus geoffroii*; Vulnerable)
- Red-tailed Phascogale (*Phascogale calura*; Vulnerable)
- Forest Red-tailed Black-cockatoo (*Calyptorhynchus banksii naso*; Vulnerable)
- Carnaby's Cockatoo (*Zanda latirostris*; Endangered)

The study area is likely to provide critical dispersal habitat for the Chuditch. Potentially any habitat patch may be used, but larger, better-connected patches with some understory and with denning sites such as granites, logs or hollows, are likely to be more important. Eucalypt woodland on laterite rises and Eucalypt – Sheoak woodland on granites are likely to be critical habitat for the Red-tailed Phascogale, and it is likely to be a breeding resident in some patches. Habitat connectivity is important for both the Chuditch and Red-tailed Phascogale, as well as other terrestrial species. All vegetation in the study area, including planted vegetation, potentially plays a role in providing linkage between habitat patches both inside and outside the study area.

There are little specific data on the use of the study area by black-cockatoos (i.e. tracked movements of flocks moving through the area), with none available in unpublished datasets from the Murdoch University Black Cockatoo Management Conservation Project. There are several published studies on black-cockatoo movements and habitat use on a landscape level in other areas (e.g. Shephard and Warren 2018, Shepard and Warren 2019, Riley *et al*. 2023, Rycken *et al*. 2021 and 2022), and the findings of these studies may be used to draw some general conclusions about the way that black-cockatoos are likely to use the study area.

It is important to have foraging habitat in close proximity to both night roosting and breeding sites (Shephard and Warren 2018, 2019, DAWE 2022). Foraging habitat, even in small patches and along road verges, are important to cockatoos, and road verges are also a corridor for movement (Rycken *et al*. 2021, 2022 and Shephard and Warren 2018). In the study area, foraging habitat consists of woodlands dominated by or containing Marri (*Corymbia calophylla*), or containing Jarrah (*Eucalyptus marginata*), isolated paddock trees of these species, and areas with an understory including shrubby *Banksia* spp. (Figure 9). It is uncertain how important this foraging habitat is, as foraging evidence was scarce and despite the abundance of Marri, no evidence of foraging on this species could be found. It is probable that Marri in more productive fertile areas have been historically cleared for agriculture, and what remains are trees on less productive soils, which are likely to produce less abundant seed for food. Despite this, the foraging habitat ranks as high quality for all three species according to the DAWE (2022) *Foraging Quality Scoring Tool* (Appendix 2).

The closest known black-cockatoo roost sites are in the vicinity of Narrogin (about 8.6km east of the study area), with maximum counts of 9, 36 and 80 birds. Other roosts are at the village at Dryandra Woodland National Park (13.4km north) and 19km northwest of the study area, but there are no counts for these sites (Figure 12, DBCA 2023). Note that it is unlikely that all roost locations are known, and roosts are used seasonally, so may not always be occupied.

The closest known black-cockatoo breeding site is about 12km southeast of the study area (Figure 12). Although foraging habitat in the study area is unlikely to be of importance for birds breeding at that particular site, it is likely that there are unidentified breeding sites in the region, and possible that there are unidentified breeding site in or in close proximity to the study area. Breeding habitat is potentially present in the study area, in eucalypt woodlands and creeklines, as well as isolated habitat trees (Figure 8).

Specially Protected or Priority species recorded or considered likely to occur, and for which the habitats of the study area are likely to provide important habitat are:

- Inland Western Rosella (*Platycercus icterotis xanthogenys*; Priority 4)

The Inland Western Rosella was recorded in or near the study area on several occasions (Figure 10) and is likely to be dependent on Eucalypt woodland on laterite rises and Eucalypt – Sheoak woodland on granites. The Peregrine Falcon Peregrine Falcon (*Falco peregrinus*; other specially protected fauna) was also recorded, however, as this species forages in cleared areas which are common in the region, and its population is large and increasing (Birdlife International 2023), it is unlikely that the habitats of the study area are of particular importance to the species.

6.3 Potential Impacts on Fauna

This section does not include any discussion of the potential impacts of the Wind Turbine Generators (WTG) on birds and bats and is instead focussed on the potential impacts of clearing and construction. A separate bird and bat utilisation study has been undertaken by Umwelt (2024a). The following points are general only, and do not speak to a particular WTG layout.

The key impacts on terrestrial vertebrate fauna area likely to be:

- habitat loss
- an increase in habitat fragmentation
- habitat degradation
- accidental mortalities during construction

The overall amount of clearing for wind and solar farms is generally modest, with WTGs sited in cleared areas, but there is likely to be some clearing for access and transmission infrastructure. The scale of the impact is related to the amount of habitat cleared, with the caveat that some habitats may be of greater importance where they are more intact, better connected in a network of ecological linkage, or provide breeding or foraging habitat for black-cockatoos.

A small amount of habitat loss is unlikely to significantly impact most species, however, loss of any potential cockatoo breeding habitat or more than 1ha of high-quality foraging habitat is likely to be considered a significant impact for black-cockatoos (DAWE 2022), and the woodlands of the study area are likely to provide both potential breeding habitat and high quality foraging habitat (Figures 8 and 9, Appendix 2). Losses to habitat patches containing the Red-tailed Phascogale are likely to impact this species, given how little habitat remains in the landscape, and at the minimum, all occupied habitat is likely to be considered critical habitat for this species.

Loss of entire habitat patches or increases in the distance between patches may negatively impact the ability of fauna to move through an already highly cleared landscape. Smaller species, such as the Red-tailed Phascogale, are more at risk, as they are less likely to negotiate cleared areas and would be vulnerable to the feral predators that are prevalent in the landscape. Black-cockatoo movements are unlikely to be impeded by minor habitat loss, but cockatoos do travel along vegetated areas, including road verges, and this should be taken into consideration.

Increased habitat fragmentation and an influx of construction vehicles has the potential to add to habitat degradation through an increase in edge effects and importing weeds or disease. It is noted, however, that the habitats are already degraded through grazing, salinity, weeds and the presence of feral predators, and further impacts would be difficult to define in this context.

It is likely that there would be some mortality of fauna during construction, mostly due to habitat clearing, but also through accidental road mortalities or entrapment of fauna in trenches or bins. Conservation significant species at risk are species that den in hollows during the day, such as the Chuditch or Red-tailed Phascogale, and therefore may be accidently crushed during clearing. The Chuditch and other mammals may be attracted to food-waste and trapped in bins, or at risk of road mortalities if there are vehicle movements at night.

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Appendices

Appendix 1. Sampling Locations.

Appendix 1						
Site Type (Reference sites in the additional survey area are designated – R)	**Site Name**	**Zone**	**Easting**	**Northing**	**Start Date**	**Stop Date**
Bat detector	Bat449972 231023	50	504644	6352115	23/10/2023	27/10/2023
Bat detector - R	Bat461278 231023	50	490411	6349307	23/10/2023	27/10/2023
Bat detector - R	Bat642025 231023	50	495524	6351635	23/10/2023	27/10/2023
Bat detector - R	Bat642149 231023	50	494213	6350476	23/10/2023	27/10/2023
Camera Trap	Cam04	50	503351	6353769	23/10/2023	24/11/2023
Camera Trap	Cam05	50	490178	6348548	23/10/2023	25/11/2023
Camera Trap	Cam06	50	503805	6349385	23/10/2023	24/11/2023
Camera Trap	Cam07	50	502943	6353639	23/10/2023	24/11/2023
Camera Trap - R	Cam08	50	490626	6348999	23/10/2023	25/11/2023
Camera Trap	Cam20	50	502783	6354141	23/10/2023	24/11/2023
Camera Trap - R	Cam21	50	494109	6347960	23/10/2023	24/11/2023
Camera Trap	Cam24	50	504525	6350399	23/10/2023	24/11/2023
Camera Trap - R	Cam22	50	503144	6352312	23/10/2023	25/11/2023
Camera Trap - R	Cam25	50	494022	6354868	23/10/2023	25/11/2023
Camera Trap	Cam27	50	500392	6349713	23/10/2023	25/11/2023
Camera Trap - R	Cam29	50	505264	6350458	23/10/2023	24/11/2023
Camera Trap	Cam30	50	500841	6349934	23/10/2023	25/11/2023
Camera Trap - R	Cam31	50	491711	6349598	23/10/2023	25/11/2023
Camera Trap	Cam32	50	499782	6349636	23/10/2023	25/11/2023
Camera Trap	Cam35	50	497468	6349586	23/10/2023	25/11/2023
Camera Trap	Cam41	50	501488	6351579	23/10/2023	25/11/2023
Camera Trap - R	Cam42	50	495463	6351680	23/10/2023	25/11/2023
Camera Trap	Cam43	50	497715	6349096	23/10/2023	25/11/2023
Camera Trap - R	Cam45	50	495487	6351007	23/10/2023	25/11/2023
Camera Trap - R	Cam46	50	493847	6355068	23/10/2023	25/11/2023
Camera Trap - R	Cam47	50	490327	6349214	23/10/2023	25/11/2023
Camera Trap	Cam49	50	499630	6351697	23/10/2023	25/11/2023
Camera Trap	Cam51	50	499668	6348958	23/10/2023	25/11/2023
Camera Trap	Cam52	50	504687	6352067	23/10/2023	25/11/2023
Camera Trap	Cam53	50	501202	6348599	23/10/2023	24/11/2023
Camera Trap - R	Cam54	50	493874	6350889	23/10/2023	25/11/2023
Camera Trap	Cam55	50	496374	6349925	23/10/2023	25/11/2023

Appendix 1						
Site Type (Reference sites in the additional survey area are designated – R)	**Site Name**	**Zone**	**Easting**	**Northing**	**Start Date**	**Stop Date**
Camera Trap	Cam56	50	503710	6349624	23/10/2023	24/11/2023
Camera Trap - R	Cam57	50	495397	6349729	23/10/2023	25/11/2023
Camera Trap	Cam58	50	498235	6348705	23/10/2023	25/11/2023
Camera Trap	Cam59	50	500947	6358097	23/10/2023	25/11/2023
Camera Trap - R	Cam60	50	495029	6355117	23/10/2023	25/11/2023
Camera Trap - R	Cam61	50	493899	6350092	23/10/2023	25/11/2023
Camera Trap	Cam62	50	505378	6352892	23/10/2023	24/11/2023
Camera Trap - R	Cam63	50	494954	6350544	23/10/2023	25/11/2023
Camera Trap - R	Cam64	50	494186	6350520	23/10/2023	25/11/2023
Camera Trap - R	Cam65	50	493455	6348970	23/10/2023	25/11/2023
Camera Trap	Cam66	50	501224	6347889	23/10/2023	24/11/2023
Habitat Assessment - R	Hab001	50	495464	6351678	23/10/2023	23/10/2023
Habitat Assessment - R	Hab002	50	495480	6351014	23/10/2023	23/10/2023
Habitat Assessment - R	Hab003	50	495388	6349728	23/10/2023	23/10/2023
Habitat Assessment - R	Hab004	50	494953	6350577	23/10/2023	23/10/2023
Habitat Assessment - R	Hab005	50	494182	6350529	23/10/2023	23/10/2023
Habitat Assessment	Hab006	50	496359	6349908	23/10/2023	23/10/2023
Habitat Assessment - R	Hab007	50	490333	6349224	23/10/2023	23/10/2023
Habitat Assessment	Hab008	50	504652	6352093	23/10/2023	23/10/2023
Habitat Assessment	Hab009	50	503134	6352310	23/10/2023	23/10/2023
Habitat Assessment - R	Hab010	50	504532	6350400	23/10/2023	23/10/2023
Habitat Assessment	Hab011	50	500394	6349722	23/10/2023	23/10/2023
Habitat Assessment - R	Hab012	50	490602	6348971	24/10/2023	24/10/2023
Habitat Assessment - R	Hab013	50	490183	6348542	24/10/2023	24/10/2023
Habitat Assessment - R	Hab014	50	489925	6348550	24/10/2023	24/10/2023
Habitat Assessment - R	Hab015	50	489713	6348406	24/10/2023	24/10/2023
Habitat Assessment - R	Hab016	50	489844	6348972	24/10/2023	24/10/2023
Habitat Assessment - R	Hab017	50	490080	6349060	24/10/2023	24/10/2023
Habitat Assessment - R	Hab018	50	489902	6350066	24/10/2023	24/10/2023
Habitat Assessment - R	Hab019	50	489457	6351503	24/10/2023	24/10/2023
Habitat Assessment - R	Hab020	50	491702	6349603	24/10/2023	24/10/2023
Habitat Assessment - R	Hab021	50	492199	6349220	24/10/2023	24/10/2023
Habitat Assessment - R	Hab022	50	494175	6347983	24/10/2023	24/10/2023
Habitat Assessment - R	Hab023	50	493451	6348964	24/10/2023	24/10/2023
Habitat Assessment - R	Hab024	50	493670	6349129	24/10/2023	24/10/2023
Habitat Assessment - R	Hab025	50	493094	6348657	24/10/2023	24/10/2023

Appendix 1						
Site Type (Reference sites in the additional survey area are designated – R)	**Site Name**	**Zone**	**Easting**	**Northing**	**Start Date**	**Stop Date**
Habitat Assessment - R	Hab026	50	493105	6348563	24/10/2023	24/10/2023
Habitat Assessment - R	Hab027	50	492906	6348649	24/10/2023	24/10/2023
Habitat Assessment - R	Hab028	50	493200	6349450	24/10/2023	24/10/2023
Habitat Assessment - R	Hab029	50	494574	6349228	24/10/2023	24/10/2023
Habitat Assessment - R	Hab030	50	495455	6349397	24/10/2023	24/10/2023
Habitat Assessment - R	Hab031	50	495029	6355124	24/10/2023	24/10/2023
Habitat Assessment - R	Hab032	50	494503	6354303	24/10/2023	24/10/2023
Habitat Assessment - R	Hab033	50	494021	6354880	24/10/2023	24/10/2023
Habitat Assessment - R	Hab034	50	493849	6355065	24/10/2023	24/10/2023
Habitat Assessment	Hab035	50	496493	6348992	25/10/2023	25/10/2023
Habitat Assessment	Hab036	50	497714	6349645	25/10/2023	25/10/2023
Habitat Assessment	Hab037	50	497490	6349577	25/10/2023	25/10/2023
Habitat Assessment	Hab038	50	497703	6349111	25/10/2023	25/10/2023
Habitat Assessment	Hab039	50	498236	6348715	25/10/2023	25/10/2023
Habitat Assessment	Hab040	50	498500	6348462	25/10/2023	25/10/2023
Habitat Assessment	Hab041	50	498198	6349817	25/10/2023	25/10/2023
Habitat Assessment	Hab042	50	499785	6349637	25/10/2023	25/10/2023
Habitat Assessment	Hab043	50	499668	6348963	25/10/2023	25/10/2023
Habitat Assessment	Hab044	50	499311	6349539	25/10/2023	25/10/2023
Habitat Assessment	Hab045	50	495464	6348049	25/10/2023	25/10/2023
Habitat Assessment	Hab046	50	501218	6347901	25/10/2023	25/10/2023
Habitat Assessment	Hab047	50	502096	6347639	25/10/2023	25/10/2023
Habitat Assessment	Hab048	50	502532	6346310	25/10/2023	25/10/2023
Habitat Assessment	Hab049	50	501202	6348599	25/10/2023	25/10/2023
Habitat Assessment	Hab050	50	503805	6349386	25/10/2023	25/10/2023
Habitat Assessment	Hab051	50	500947	6358097	25/10/2023	25/10/2023
Habitat Assessment	Hab052	50	500174	6359402	25/10/2023	25/10/2023
Habitat Assessment	Hab053	50	500465	6356520	25/10/2023	25/10/2023
Habitat Assessment	Hab054	50	499627	6351696	26/10/2023	26/10/2023
Habitat Assessment	Hab055	50	499243	6351641	26/10/2023	26/10/2023
Habitat Assessment	Hab056	50	498191	6352002	26/10/2023	26/10/2023
Habitat Assessment	Hab057	50	501504	6351575	26/10/2023	26/10/2023
Habitat Assessment	Hab058	50	500838	6349928	26/10/2023	26/10/2023
Habitat Assessment	Hab059	50	502706	6350645	26/10/2023	26/10/2023
Habitat Assessment	Hab060	50	503119	6351003	26/10/2023	26/10/2023
Habitat Assessment	Hab061	50	503815	6351269	26/10/2023	26/10/2023

Appendix 1						
Site Type (Reference sites in the additional survey area are designated – R)	**Site Name**	**Zone**	**Easting**	**Northing**	**Start Date**	**Stop Date**
Habitat Assessment - R	Hab062	50	505262	6350463	26/10/2023	26/10/2023
Habitat Assessment	Hab063	50	506565	6351690	26/10/2023	26/10/2023
Habitat Assessment	Hab064	50	505740	6351757	26/10/2023	26/10/2023
Habitat Assessment	Hab065	50	503348	6353773	26/10/2023	26/10/2023
Habitat Assessment	Hab066	50	502783	6354141	26/10/2023	26/10/2023
Habitat Assessment	Hab067	50	502942	6353634	26/10/2023	26/10/2023
Habitat Assessment	Hab068	50	504760	6353661	26/10/2023	26/10/2023
Habitat Assessment	Hab069	50	505378	6352891	26/10/2023	26/10/2023
Habitat Assessment	Hab070	50	505301	6352427	27/10/2023	27/10/2023
Habitat Assessment	Hab071	50	505158	6352154	27/10/2023	27/10/2023
Habitat Assessment - R	Hab072	50	493747	6350909	27/10/2023	27/10/2023
Habitat Assessment - R	Hab073	50	493901	6350087	27/10/2023	27/10/2023
Habitat Assessment - R	Hab074	50	495209	6352837	27/10/2023	27/10/2023
Habitat Assessment - R	Hab075	50	495618	6353785	27/10/2023	27/10/2023
Passive Acoustic Detector - R	SM4-01	50	495337	6350347	23/10/2023	10/11/2023
Passive Acoustic Detector - R	SM4-02	50	490390	6349304	23/10/2023	10/11/2023
Passive Acoustic Detector	SM4-03	50	504669	6352129	23/10/2023	10/11/2023
Passive Acoustic Detector	SM4-04	50	500402	6349744	23/10/2023	10/11/2023

Appendix 2. Foraging Quality Scoring Tool.

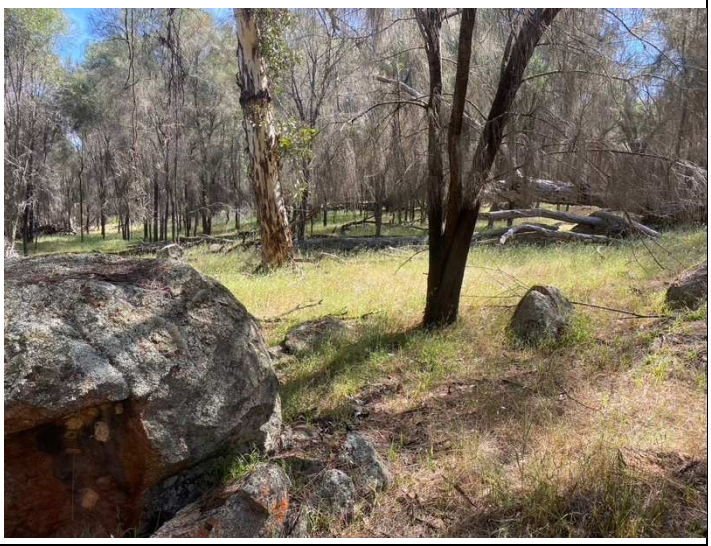
Appendix 2			
Attribute	**Baudin's Cockatoo**	**Carnaby's Cockatoo**	**Forest Red-tailed Black-cockatoo**
Starting Score	**10** Site contains at least 407.9ha of foraging habitat, consisting of woodlands containing or dominated by Marri and/or containing shrubby *Banksia* spp. in the understory. Site also contains other vegetation that may include foraging habitat, including planted vegetation and isolated paddock trees.	**10** Site contains at least 407.9ha of foraging habitat, consisting of woodlands containing or dominated by Marri, and/or containing shrubby *Banksia* spp. in the understory. Site also contains other vegetation that may include foraging habitat, including planted vegetation and isolated paddock trees.	**10** Site contains at least 407.9ha of foraging habitat, consisting of woodlands containing or dominated by Marri, containing Jarrah and/or containing shrubby *Banksia* spp. in the understory. Site also contains other vegetation that may include foraging habitat, including planted vegetation and isolated paddock trees.
Foraging potential *Subtract 2 from your score if there is no evidence of feeding debris on your site.*	-2 No foraging evidence noted.	-0 Evidence of foraging on *Banksia* spp.	-2 No foraging evidence noted.
Connectivity *Subtract 2 from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your site.*	-0 Site is within 12km of similar woodlands likely to provide foraging habitat.	-0 Site is within 12km of similar woodlands likely to provide foraging habitat.	-0 Site is within 12km of similar woodlands likely to provide foraging habitat.
Proximity to breeding *Subtract 2 if you have evidence to conclude that your site is more than 12 km from breeding habitat*	-2 This species is not known to breed in the vicinity of the study area and is outside the modelled breeding range of the species as presented in DAWE (2022).	-0 The closest confirmed breeding record for 'white-tailed black-cockatoos', likely to be Carnaby's Cockatoo, is about 12km southeast of the study area (Figure 12). It is likely that there is undocumented breeding within 12km as the study area is within the breeding range of the species.	-0 Although there are no breeding records, it is possible that there is undocumented breeding within 12km as the study area is within the breeding range of the species.

Appendix 2			
Attribute	**Baudin's Cockatoo**	**Carnaby's Cockatoo**	**Forest Red-tailed Black-cockatoo**
Proximity to roosting *Subtract 1 if you have evidence to conclude that your site is more than 20 km from a known night roosting habitat.*	-1 No known roosts are present in the region and this species is close to the edge of its range in the vicinity of the study area, so it is probable that there are no close roost sites.	-0 Several roost sites are known in the region, the nearest are 10km east at Narrogin with a max count of 80 birds (Figure 12).	-0 No known roosts are present in the region, but there is no evidence to suggest that this species does not roost within 20km, as it is known to occur in the study area.
Impact from significant plant disease *Subtract 1 if your site has disease present (e.g. Phytophthora spp. or Marri canker) and the disease is affecting more than 50% of the preferred food plants present.*	-0 No significant plant disease noted during field survey.	-0 No significant plant disease noted during field survey.	-0 No significant plant disease noted during field survey.
Total Score	**5**	**10**	**8**
Appraisal	Likely to be high quality foraging habitat, scoring at least 5/10. Site contains at least 407.9ha of foraging habitat, consisting of woodlands containing or dominated by Marri, containing Jarrah and/or containing shrubby *Banksia* spp. in the understory. Site also contains other vegetation that may include foraging habitat, including planted vegetation and isolated paddock trees. Although much of the vegetation is disturbed (e.g. lacking in understory, fragmented), the canopy containing important food-plants such as Marri and Jarrah, is relatively intact and therefore still provides an important resource. The shrubby *Banksia* spp. in the understory are most frequent in less disturbed areas, but occasional stands occur even in areas with almost no other understory. There are relatively large areas likely to comprise foraging habitat within 12km, including Dryandra Woodland National Park (adjacent to the northern boundary of the site) woodlands in the vicinity of Narrogin (about 10km east) and Williams Nature Reserve (about 3km southwest), as well as patches remaining on private lands (Figure 1). It must be assumed that potential breeding sites of Carnaby's and the Forest Red-tailed Black-cockatoo occur within 12km, as there are woodland habitats likely to contain potential nesting trees and the study area is within the breeding range of both species.		

Appendix 3. Habitat Assessments.

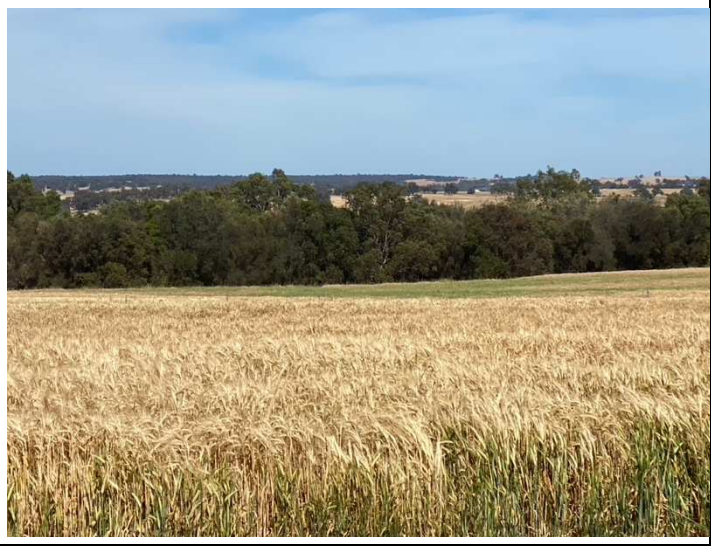
Appendix 3	
Habitat Assessment	**Photograph**
Hab001 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and Marri woodland over native grasses and sparse Banksia sessilis. **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab002 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo woodland with occasional Jam and Banksia sessilis over open low shrubs, native grasses and herbs **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly clay **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab003 - R **Habitat**: Eucalypt woodland **Landform**: gentle slope **Vegetation**: Wandoo and Marri woodland over native grasses and patches of Banksia spp. **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab004 - R **Habitat**: Eucalypt woodland **Landform**: gentle slope **Vegetation**: Wandoo and Jarrah woodland over open Banksia sessilis, low shrubs and native grasses **Fire age**: no recent fire **Disturbance**: timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab005 - R **Habitat**: Eucalypt woodland **Landform**: gentle slope **Vegetation**: Wandoo, Marri and Jarrah woodland over open Banksia sessilis, low shrubs and native grasses **Fire age**: no recent fire **Disturbance**: timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab006 **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum woodland over sparse shrubby Acacia sp., spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, salinity **Soil**: brown clay **Rock**: none **Important elements**: tree hollows, wildlife corridor **Wetlands**: seasonal creek	

Appendix 3	
Habitat Assessment	**Photograph**
Hab007 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and Marri woodland over sparse native grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, bees, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel, laterite outcrops **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab008 **Habitat**: Eucalypt woodland **Landform**: gentle slope **Vegetation**: Wandoo and Sheoak woodland over native and exotic grasses and herbs. **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sandy clay **Rock**: outcropping granite boulders **Important elements**: tree hollows, logs, leaf litter, rock crevices **Wetlands**: none	
Hab009 **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum and York Gum woodland over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, salinity **Soil**: brown clay **Rock**: none **Important elements**: tree hollows, wildlife corridor **Wetlands**: seasonal creek	

Appendix 3	
Habitat Assessment	**Photograph**
Hab010 - R **Habitat**: Eucalypt woodland **Landform**: gentle slope **Vegetation**: Wandoo and Sheoak woodland over native and exotic grasses and herbs. **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: grey gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab011 **Habitat**: Eucalypt woodland **Landform**: gentle slope **Vegetation**: York Gum and Sheoak woodland over native and exotic grasses and herbs **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sandy clay **Rock**: outcropping granite boulders **Important elements**: tree hollows, rock crevices **Wetlands**: none	
Hab012 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Marri and Sheoak woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: outcropping granite boulders **Important elements**: tree hollows, logs, rock crevices **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab013 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Marri and Sheoak woodland with occasional Wandoo and Banksia sp. over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs **Wetlands**: none	
Hab014 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo woodland over sparse Banksia sp. and native grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: pink gravelly clay **Rock**: laterite gravel, outcropping laterite **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab015 - R **Habitat**: Eucalypt woodland **Landform**: moderate slope **Vegetation**: Wandoo and Sheoak woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting, gravel pit **Soil**: brown gravelly sand **Rock**: some outcropping granite **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab016 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting, bees **Soil**: grey gravelly sand **Rock**: outcropping granite **Important elements**: tree hollows, logs, leaf litter, rock crevices **Wetlands**: none	
Hab017 - R **Habitat**: Eucalypt woodland **Landform**: moderate slope **Vegetation**: Wandoo and Marri woodland over sparse native grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel, occasional laterite outcrop **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab018 - R **Habitat**: Planted **Landform**: gentle slope **Vegetation**: Planted trees and shrubs, including non-local eucalypts **Fire age**: no recent fire **Disturbance**: planted **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: habitat patch **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab019 - R **Habitat**: Planted **Landform**: low rise **Vegetation**: Planted trees and shrubs, including non-local eucalypts, Melaleuca sp. and Acacia sp. **Fire age**: no recent fire **Disturbance**: planted vegetation, weeds, grazed **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: habitat patch **Wetlands**: seasonal creek	
Hab020 - R **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum woodland over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sand **Rock**: none **Important elements**: tree hollows, logs, wildlife corridor **Wetlands**: seasonal creek	
Hab021 - R **Habitat**: Eucalypt woodland **Landform**: moderate slope **Vegetation**: Wandoo and Sheoak woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel, outcropping laterite **Important elements**: tree hollows, logs **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab022 - R **Habitat**: Planted (?) **Landform**: flat **Vegetation**: Dense Sheoak and Mallee Eucalypts over sedges and grasses. **Fire age**: no recent fire **Disturbance**: weeds, ground disturbance **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: dense vegetation cover, leaf litter **Wetlands**: none	
Hab023 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and Marri woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel, outcropping laterite **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab024 - R **Habitat**: Eucalypt woodland **Landform**: moderate slope **Vegetation**: Wandoo woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: minor ephemeral drainage	

Appendix 3	
Habitat Assessment	**Photograph**
Hab025 - R **Habitat**: Eucalypt woodland **Landform**: gentle slope **Vegetation**: Wandoo and regrowth Wandoo woodland over native grasses **Fire age**: possible fire leading to regrowth (?) **Disturbance**: weeds, grazed **Soil**: brown gravelly sand **Rock**: laterite gravel, occasional granite boulder **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab026 - R **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum and Marri woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: orange gravelly clay **Rock**: laterite gravel, granite boulders **Important elements**: tree hollows, logs **Wetlands**: dam	
Hab027 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Regrowth Wandoo woodland over sparse native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel, some laterite outcrops **Important elements**: leaf litter **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab028 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and Marri woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel, some laterite outcrops **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab029 - R **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum woodland and Planted Eucalypts over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: orange gravelly clay **Rock**: none **Important elements**: tree hollows, logs **Wetlands**: seasonal creek	
Hab030 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and Sheoak woodland over sparse Banksia spp. and native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sand **Rock**: none **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab031 - R **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum woodland and sparse shrubby Acacia over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, salinity **Soil**: brown sandy clay **Rock**: none **Important elements**: tree hollows **Wetlands**: seasonal creek	
Hab032 - R **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum woodland over sparse spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, salinity **Soil**: brown sandy clay **Rock**: none **Important elements**: tree hollows, logs **Wetlands**: seasonal creek	
Hab033 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo, Sheoak and Jam woodland over scattered shrubs and native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown sand **Rock**: none **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab034 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo woodland over native grasses and herbs **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel, outcropping granite **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab035 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel and outcrops **Important elements**: tree hollows, logs, leaf litter, rock crevices **Wetlands**: none	
Hab036 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel and outcrops **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab037 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown gravelly sand **Rock**: laterite gravel and outcrops **Important elements**: tree hollows, logs, leaf litter, rock crevices **Wetlands**: none	
Hab038 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and Marri woodland over sparse Banksia sessilis, native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown gravelly sand **Rock**: laterite gravel and outcrops **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab039 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: York Gum, Wandoo and Sheoak woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown gravelly sand **Rock**: laterite gravel, granite outcropping **Important elements**: tree hollows, logs, leaf litter, rock crevices **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab040 **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum and York Gum woodland over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: orange clay **Rock**: granite outcropping **Important elements**: tree hollows **Wetlands**: dam	
Hab041 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and Marri woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel and outcrops **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab042 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo, Marri and Sheoak woodland over occasional banksia sessilis and native and exotic grasses and herbs. **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel and outcrops **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab043 **Habitat**: Eucalypt woodland **Landform**: moderate slope **Vegetation**: Wandoo, Marri and Sheoak woodland over occasional banksia sessilis and native and exotic grasses and herbs. **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel and outcrops **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab044 **Habitat**: Planted **Landform**: gentle slope **Vegetation**: Mixed planted eucalypts **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: leaf litter **Wetlands**: none	
Hab045 - R **Habitat**: Eucalypt woodland **Landform**: gentle slope **Vegetation**: York Gum, Sheoak and Jam woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sand **Rock**: granite outcropping **Important elements**: tree hollows, logs, leaf litter, rock crevices **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab046 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and York Gum woodland over low shrubs, mixed Banksia spp., and native grasses **Fire age**: no recent fire **Disturbance**: weeds, old gravel pit **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter, dense understory vegetation **Wetlands**: none	
Hab047 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo woodland over exotic and native grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel and outcrops **Important elements**: tree hollows, logs, leaf litter, rock crevices **Wetlands**: none	
Hab048 **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum woodland over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sandy clay **Rock**: none **Important elements**: tree hollows, logs **Wetlands**: seasonal creek	

Appendix 3	
Habitat Assessment	**Photograph**
Hab049 **Habitat**: Planted **Landform**: flat **Vegetation**: Wandoo, Sheoak and Jam woodland over tall shrubs including Hakea prostrata over grasses. **Fire age**: no recent fire **Disturbance**: weeds, railway **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: dense vegetation, leaf litter, wildlife corridor **Wetlands**: none	
Hab050 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: York Gum woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sand **Rock**: granite outcropping **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab051 **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum woodland over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, salinity **Soil**: brown sandy clay **Rock**: none **Important elements**: tree hollows, logs **Wetlands**: seasonal creek	

Appendix 3	
Habitat Assessment	**Photograph**
Hab052 **Habitat**: Eucalypt woodland **Landform**: flat **Vegetation**: Remnant Wandoo and Marri woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, cleared **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows **Wetlands**: none	
Hab053 **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Planted eucalypts over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, salinity **Soil**: yellow sandy clay **Rock**: none **Important elements**: logs, wildlife corridor **Wetlands**: seasonal creek	
Hab054 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and Marri woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel and outcropping **Important elements**: tree hollows, logs **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab055 **Habitat**: Eucalypt woodland **Landform**: lower slope **Vegetation**: Wandoo and Marri woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: orange gravelly clay **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab056 **Habitat**: Eucalypt woodland **Landform**: gentle slope **Vegetation**: Wandoo and Marri woodland over scattered Banksia sessilis over sparse low shrubs, native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel and outcropping **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab057 **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sandy clay **Rock**: none **Important elements**: logs, tree hollows, wildlife corridor **Wetlands**: seasonal creek	

Appendix 3	
Habitat Assessment	**Photograph**
Hab058 **Habitat**: Eucalypt woodland **Landform**: gentle slope **Vegetation**: York Gum and Jam woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds **Soil**: brown gravelly sand **Rock**: granite outcropping **Important elements**: tree hollows, leaf litter, rock crevices, wildlife corridor **Wetlands**: none	
Hab059 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and York Gum woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: granite outcropping **Important elements**: tree hollows, logs, leaf litter, rock crevices **Wetlands**: none	
Hab060 **Habitat**: Eucalypt woodland **Landform**: gentle slope **Vegetation**: Wandoo woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab061 **Habitat**: Eucalypt woodland **Landform**: moderate slope **Vegetation**: Wandoo and Marri woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel and outcropping **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab062 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Jam, Sheoak and Wandoo woodland over sparse shrubs, native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab063 **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum and York Gum over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sandy clay **Rock**: none **Important elements**: logs, tree hollows, wildlife corridor **Wetlands**: seasonal creek	

Appendix 3	
Habitat Assessment	**Photograph**
Hab064 **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Flooded Gum and York Gum over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sandy clay **Rock**: outcropping granite **Important elements**: logs, tree hollows, wildlife corridor **Wetlands**: seasonal creek	
Hab065 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo, Jarrah and Marri woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: orange sand **Rock**: outcropping granite **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab066 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and Marri woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab067 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo, Jarrah and Marri woodland over sparse low shrubs, Banksia sessilis and native grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter, rock crevices **Wetlands**: none	
Hab068 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo, Jarrah and Marri woodland over sparse Banksia sessilis and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab069 **Habitat**: Eucalypt woodland **Landform**: moderate slope **Vegetation**: Wandoo and Sheoak woodland over sparse shrubs, native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab070 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: York Gum and regrowth York Gum woodland over exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sandy clay **Rock**: outcropping granite **Important elements**: tree hollows, logs **Wetlands**: none	
Hab071 **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and Marri woodland over native and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed, timber cutting **Soil**: brown gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs **Wetlands**: none	
Hab072 - R **Habitat**: Granite outcrop **Landform**: low rise **Vegetation**: Mosses, grasses, herbs and Boyra. **Fire age**: no recent fire **Disturbance**: weeds, rock collection **Soil**: brown sand **Rock**: outcropping granite **Important elements**: rock crevices, seasonal rock pools **Wetlands**: none	

Appendix 3	
Habitat Assessment	**Photograph**
Hab073 - R **Habitat**: Eucalypt woodland **Landform**: low rise **Vegetation**: Wandoo and Marri woodland over open Banksia spp., low shrubs, sedges and native grasses **Fire age**: no recent fire **Disturbance**: tracks, gravel pit **Soil**: orange gravelly sand **Rock**: laterite gravel **Important elements**: tree hollows, logs, leaf litter **Wetlands**: none	
Hab074 - R **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Remnant York Gum, Marri and Wandoo on edge, over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sandy clay **Rock**: none **Important elements**: logs, tree hollows, wildlife corridor **Wetlands**: seasonal creek	
Hab075 - R **Habitat**: Creek **Landform**: shallow valley **Vegetation**: Planted eucalypts and Melaleuca shrubs over spikerush and exotic grasses **Fire age**: no recent fire **Disturbance**: weeds, grazed **Soil**: brown sandy clay **Rock**: none **Important elements**: wildlife corridor **Wetlands**: seasonal creek	

Appendix 4. Vertebrate Fauna Predicted to Occur in the Study Area.

- Study Area = species recorded on this survey, Oct-Nov 2023.
- Additional SA = species recorded within 7km in the additional survey area, Oct-Nov 2023.
- BBUS = species recorded in the study area on the Bird and Bat Utilisation Survey (Umwelt Australia 2024)
- ALA = species recorded within 40km on the Atlas of Living Australia Database.
- Dandjoo = species recorded within 40km on Dandjoo Database.
- DBCA = species records from the DBCA Threatened and Priority Species Database.
- EPBC = species & species habitat from the EPBC Protected Matters Search Tool.
- Int = introduced species.

Appendix 4									
Species		Status	Records						
			Study Area	Additional SA	BBUS	ALA	Dandjoo	DBCA	EBPC
FROGS									
Pelodryadidae									
Motorbike Frog	*Litoria moorei*		+			+			
Limnodynastidae									
Western Spotted Frog	*Heleioporus albopunctatus*					+			
Hooting Frog	*Heleioporus barycragus*					+			
Whooping Frog	*Heleioporus inornatus*					+			
Moaning Frog	*Heleioporus eyrei*					+			
Pobblebonk / Banjo Frog	*Limnodynastes dorsalis*					+			
Kunapalari Frog	*Neobatrachus kunapalari*					+			
Humming Frog	*Neobatrachus pelobatoides*					+			
Myobatrachidae									
Quacking Frog	*Crinia georgiana*					+			
Bleating Froglet	*Crinia pseudinsignifera*					+			
Turtle Frog	*Myobatrachus gouldii*					+			
Guenther's Toadlet	*Pseudophryne guentheri*					+			
REPTILES									
Chelidae									
Long-necked Turtle	*Chelodina oblonga*					+			
Carphodactylidae									
Southern Barking Gecko	*Underwoodisaurus milii*					+			
Diplodactylidae									
Clawless Gecko	*Crenadactylus ocellatus*					+			
South Coast Gecko	*Diplodactylus calcicolus*					+			
Wheatbelt Ground Gecko	*Diplodactylus granariensis*					+			
Speckled Stone Gecko	*Diplodactylus lateroides*					+			
Fine-faced Gecko	*Diplodactylus pulcher*								
Reticulated Velvet Gecko	*Hesperoedura reticulata*					+			

Appendix 4									
Species		Status	Records						
			Study Area	Additional SA	BBUS	ALA	Dandjoo	DBCA	EBPC
Gekkonidae									
Marbled Gecko	*Christinus marmoratus*					+			
Variegated Dtella	*Gehyra variegata*					+			
Pygopodidae									
Sandplain Worm-Lizard	*Aprasia repens*								
Fraser's Legless Lizard	*Delma fraseri*					+			
Burton's Legless Lizard	*Lialis burtonis*					+			
Common Scaly-foot	*Pygopus lepidopodus*					+			
Agamidae									
Ornate Crevice Dragon	*Ctenophorus ornatus*			+		+			
Bearded Dragon	*Pogona minor*					+			
Scincidae									
Southwestern Cool-skink	*Acritoscincus trilineatus*					+			
Fence Skink	*Cryptoblepharus buchananii*					+			
Barred Wedgesnout Ctenotus	*Ctenotus schomburgkii*					+			
King's Skink	*Egernia kingii*					+	+		
Southwestern Crevice-skink	*Egernia napoleonis*					+			
Broad-banded Sandswimmer	*Eremiascincus richardsonii*					+			
Southwestern Earless Skink	*Hemiergis initialis*					+			
Four-toed Earless Skink	*Hemiergis peronii*					+			
Dwarf Four-toed Slider	*Lerista distinguenda*					+			
Bull Skink	*Liopholis multiscutata*					+			
Dwarf Skink	*Menetia greyii*					+			
Dusky Morethia	*Morethia obscura*					+			
Western Blue-tongue	*Tiliqua occipitalis*								
Bobtail	*Tiliqua rugosa*		+	+		+			
Varanidae									
Gould's Monitor	*Varanus gouldii*		+	+		+			
Southern Heath Monitor	*Varanus rosenbergi*								
Black-tailed Monitor	*Varanus tristis*					+			
Pythonidae									
Carpet Python	*Morelia spilota imbricata*					+			
Typhlopidae									
Southern Blind Snake	*Anilios australis*					+			
Fat Blind Snake	*Anilios pinguis*					+			
Beaked Blind Snake	*Anilios waitii*					+			
Elapidae									
Southern Death Adder	*Acanthophis antarcticus*	P				+		+	
Bardick	*Echiopsis curta*								
Tiger Snake	*Notechis scutatus*					+			

Appendix 4									
Species		Status	Records						
			Study Area	Additional SA	BBUS	ALA	Dandjoo	DBCA	EBPC
Mulga Snake	*Pseudechis australis*					+			
Dugite	*Pseudonaja affinis*		+	+		+			
Gwardar / Western Brown Snake	*Pseudonaja mengdeni*					+	+		
Jan's Banded Snake	*Simoselaps bertholdi*					+			
Gould's Hooded Snake	*Suta gouldii*					+	+		
Black-backed Snake	*Suta nigriceps*					+			
BIRDS									
Casuariidae									
Emu	*Dromaius novaehollandiae*					+			
Anatidae									
Black Swan	*Cygnus atratus*					+			
Grey Teal	*Anas gracilis*		+		+	+	+		
Pacific Black Duck	*Anas superciliosa*		+		+	+			
Australian Wood Duck	*Chenonetta jubata*		+	+	+	+			
Pink-eared Duck	*Malacorhynchus membranaceus*					+			
Australian Shelduck	*Tadorna tadornoides*				+	+			
Megapodiidae									
Malleefowl	*Leipoa ocellata*	T				+		+	+
Phasianidae									
Stubble Quail	*Coturnix pectoralis*			+		+			
Brown Quail	*Synoicus ypsilophora*					+			
Podargidae									
Tawny Frogmouth	*Podargus strigoides*		+	+		+			
Caprimulgidae									
Spotted Nightjar	*Eurostopodus argus*					+			
Aegothelidae									
Australian Owlet-Nightjar	*Aegotheles cristatus*		+	+		+			
Apodidae									
Fork-tailed Swift	*Apus pacificus*	Mi				+			+
Cuculidae									
Pallid Cuckoo	*Heteroscenes pallidus*				+	+			
Fan-tailed Cuckoo	*Cacomantis flabelliformis*					+			
Black-eared Cuckoo	*Chalcites osculans*								
Horsfield's Bronze-Cuckoo	*Chalcites basalis*		+		+	+	+		
Shining Bronze-Cuckoo	*Chalcites lucidus*					+			
Columbidae									
Domestic (Feral) Pigeon	*Columba livia*	Int				+			
Common Bronzewing	*Phaps chalcoptera*		+	+	+	+	+		

Appendix 4									
Species		Status	Records						
			Study Area	Additional SA	BBUS	ALA	Dandjoo	DBCA	EBPC
Brush Bronzewing	*Phaps elegans*					+			
Crested Pigeon	*Ocyphaps lophotes*		+	+	+	+			
Spotted Turtle Dove	*Spilopelia chinensis*	Int			+	+			
Rallidae									
Eurasian Coot	*Fulica atra*				+	+			
Dusky Moorhen	*Gallinula tenebrosa*					+			
Purple Swamphen	*Porphyrio porphyrio*					+			
Australian Spotted Crake	*Porzana fluminea*					+			
Spotless Crake	*Zapomia tabuensis*					+			
Black-tailed Nativehen	*Tribonyx ventralis*					+			
Podicipedidae									
Great Crested Grebe	*Podiceps cristatus*					+			
Hoary-headed Grebe	*Poliocephalus poliocephalus*				+	+			
Australasian Grebe	*Tachybaptus novaehollandiae*		+			+			
Turnicidae									
Painted Button-quail	*Turnix varius*					+	+		
Little Button-quail	*Turnix velox*					+			
Burhinidae									
Bush Stone-Curlew	*Burhinus grallarius*					+			
Recurvirostridae									
Black-winged Stilt	*Himantopus himantopus*					+			
Charadriidae									
Red-capped Plover	*Charadrius ruficapillus*					+			
Black-fronted Dotterel	*Elseyornis melanops*				+	+			
Banded Lapwing	*Vanellus tricolor*					+			
Rostratulidae									
Australian Painted Snipe	*Rostratula australis*	T							+
Scolopacidae									
Common Sandpiper	*Actitis hypoleucos*	Mi				+			+
Anhingidae									
Darter	*Anhinga novaehollandiae*					+			
Phalacrocoracidae									
Little Pied Cormorant	*Microcarbo melanoleucos*		+			+			
Great Cormorant	*Phalacrocorax carbo*					+			
Little Black Cormorant	*Phalacrocorax sulcirostris*					+			
Threskiornithidae									
Yellow-billed Spoonbill	*Platalea flavipes*					+			
Australian White Ibis	*Threskiornis moluccus*					+			
Straw-necked Ibis	*Threskiornis spinicollis*					+			
Ardeidae									

Appendix 4									
Species		Status	Records						
			Study Area	Additional SA	BBUS	ALA	Dandjoo	DBCA	EBPC
Eastern Great Egret	*Ardea alba*					+			
White-necked Heron	*Ardea pacifica*					+			
White-faced Heron	*Egretta novaehollandiae*		+	+	+	+	+		
Nankeen Night Heron	*Nycticorax caledonicus*					+			
Accipitridae									
Black-shouldered Kite	*Elanus axillaris*		+	+	+	+			
Square-tailed Kite	*Hamiostra isura*					+	+		
Whistling Kite	*Haliastur sphenurus*					+			
Swamp Harrier	*Circus approximans*					+			
Spotted Harrier	*Circus assimilis*				+	+			
Brown Goshawk	*Accipiter fasciatus*		+			+			
Collared Sparrowhawk	*Accipiter cirrocephalus*			+		+			
Wedge-tailed Eagle	*Aquila audax*		+		+	+	+		
Little Eagle	*Hieraaetus morphnoides*					+	+		
Tytonidae									
Eastern Barn Owl	*Tyto javanica*			+		+			
Masked Owl	*Tyto novaehollandiae*	P				+		+	
Strigidae									
Barking Owl (southwest)	*Ninox connivens connivens*	P				+		+	
Southern Boobook Owl	*Ninox boobook*		+	+		+	+		
Alcedinidae									
Laughing Kookaburra	*Dacelo noveguineae*	Int	+	+	+	+	+		
Red-backed Kingfisher	*Todiramphus pyrrhopygius*					+			
Sacred Kingfisher	*Todiramphus sanctus*		+	+	+	+			
Meropidae									
Rainbow Bee-eater	*Merops ornatus*		+	+	+	+			
Falconidae									
Peregrine Falcon	*Falco peregrinus*	OS	+		+	+		+	
Australian Hobby	*Falco longipennis*				+	+			
Brown Falcon	*Falco berigora*		+		+	+			
Australian Kestrel	*Falco cenchroides*		+	+	+	+			
Cacatuidae									
Western Long-billed Corella	*Cacatua pastinator*					+			
Little Corella	*Cacatua sanguinea*					+			
Forest Red-tailed Black-cockatoo	*Calyptorhynchus banksii naso*	T		+		+		+	+
Baudin's Cockatoo	*Zanda baudinii*	T				+	+	+	+
Carnaby's Black-Cockatoo	*Zanda latirostris*	T	+	+		+		+	+
Galah	*Eolophus roseicapilla*			+	+	+	+		
Psittaculidae									

Appendix 4									
Species		Status	Records						
			Study Area	Additional SA	BBUS	ALA	Dandjoo	DBCA	EBPC
Purple-crowned Lorikeet	*Parvipsitta porphyrocephala*		+	+	+	+	+		
Regent Parrot	*Polytelis anthopeplus*			+	+	+			
Australian Ringneck	*Barnardius zonarius*		+	+	+	+	+		
Inland Western Rosella	*Platycercus icterotis xanthogenys*	P	+	+	+	+		+	
Red-capped Parrot	*Purpureicephalus spurius*		+	+	+	+	+		
Mulga Parrot	*Psephotus varius*					+			
Budgerigar	*Melopsittacus undulatus*					+			
Elegant Parrot	*Neophema elegans*		+	+	+	+	+		
Climacteridae									
Rufous Treecreeper	*Climacteris rufus*		+	+	+	+	+		
Maluridae									
Splendid Fairy-wren	*Malurus splendens*		+			+	+		
Blue-breasted Fairy-wren	*Malurus pulcherrimus*		+	+		+	+		
Meliphagidae									
Western Spinebill	*Acanthorhynchus superciliosus*					+	+		
Red Wattlebird	*Anthochaera carunculata*		+	+	+	+	+		
Western Wattlebird	*Anthochaera lunulata*					+			
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*					+			
Yellow-throated Miner	*Manorina flavigula*					+			
Singing Honeyeater	*Gavicalis virescens*		+	+	+	+	+		
White-eared Honeyeater	*Nesoptilotis leucotis*					+	+		
Yellow-plumed Honeyeater	*Ptilotula ornata*		+	+	+	+			
Brown-headed Honeyeater	*Melithreptus brevirostris*		+	+		+	+		
Gilbert's Honeyeater	*Melithreptus chloropsis*		+		+	+			
Brown Honeyeater	*Lichmera indistincta*		+	+	+	+	+		
New Holland Honeyeater	*Phylidonyris novaehollandiae*		+	+		+	+		
White-cheeked Honeyeater	*Phylidonyris niger*					+	+		
White-fronted Honeyeater	*Purnella albifrons*					+			
Tawny-crowned Honeyeater	*Glyciphila melanops*					+	+		
Black Honeyeater	*Sugomel nigrum*					+			
White-fronted Chat	*Epthianura albifrons*					+			
Crimson Chat	*Epthianura tricolor*					+			
Pardalotidae									
Spotted Pardalote	*Pardalotus punctatus*			+	+	+	+		
Striated Pardalote	*Pardalotus striatus*		+	+	+	+	+		
Acanthizidae									
White-browed Scrubwren	*Sericornis frontalis*					+	+		
Rufous Fieldwren	*Calamanthus campestris*					+			
Shy Heathwren	*Hylacola cauta*					+			

Appendix 4									
Species		Status	Records						
			Study Area	Additional SA	BBUS	ALA	Dandjoo	DBCA	EBPC
Weebill	*Smicrornis brevirostris*		+	+	+	+	+		
Western Gerygone	*Gerygone fusca*		+	+	+	+	+		
Inland Thornbill	*Acanthiza apicalis*			+		+	+		
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*		+	+	+	+	+		
Western Thornbill	*Acanthiza inornata*		+			+	+		
Chestnut-rumped Thornbill	*Acanthiza uropygialis*					+			
Pomatostomidae									
White-browed Babbler	*Pomatostomus superciliosus*		+	+	+	+	+		
Artamidae									
Masked Woodswallow	*Artamus personatus*				+	+			
Black-faced Woodswallow	*Artamus cinereus*			+	+	+			
Dusky Woodswallow	*Artamus cyanopterus*		+	+	+	+			
Grey Butcherbird	*Cracticus torquatus*		+			+			
Pied Butcherbird	*Cracticus nigrogularis*		+	+		+			
Australian Magpie	*Gymnorhina tibicen*		+	+	+	+	+		
Grey Currawong	*Strepera versicolor*					+	+		
Campephagidae									
Ground Cuckoo-shrike	*Coracina maxima*								
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		+	+	+	+			
White-winged Triller	*Lalage tricolor*		+		+	+			
Neosittidae									
Varied Sittella	*Daphoenositta chrysoptera*		+	+	+	+	+		
Oreoicidae									
Crested Bellbird	*Oreoica gutturalis*					+			
Falcunculidae									
Crested Shrike-tit	*Falcunculus frontatus*		+			+			
Pachycephalidae									
Western Golden Whistler	*Pachycephala fuliginosa*		+	+		+	+		
Rufous Whistler	*Pachycephala rufiventris*		+	+	+	+	+		
Grey Shrike-thrush	*Colluricincla harmonica*		+	+	+	+	+		
Rhipiduridae									
Grey Fantail	*Rhipidura albiscapa*		+	+	+	+	+		
Willie Wagtail	*Rhipidura leucophrys*		+	+	+	+	+		
Monarchidae									
Magpie-lark	*Grallina cyanoleuca*		+	+	+	+	+		
Restless Flycatcher	*Myiagra inquieta*		+	+	+	+			
Corvidae									
Australian Raven	*Corvus coronoides*		+	+	+	+	+		
Little Crow	*Corvus bennetti*				+				
Petroicidae									

Appendix 4									
Species		Status	Records						
			Study Area	Additional SA	BBUS	ALA	Dandjoo	DBCA	EBPC
Jacky Winter	*Microeca fascinans*		+	+		+	+		
Hooded Robin	*Melanodryas cucullata*					+			
Red-capped Robin	*Petroica goodenovii*		+	+	+	+	+		
Scarlet Robin	*Petroica boodang*		+	+	+	+	+		
Western Yellow Robin	*Eopsaltria griseogularis*		+	+	+	+	+		
Hirundinidae									
White-backed Swallow	*Cheramoeca leucosterna*					+			
Welcome Swallow	*Hirundo neoxena*		+		+	+	+		
Tree Martin	*Petrochelidon nigricans*		+	+	+	+	+		
Acrocephalidae									
Australian Reed Warbler	*Acrocephalus australis*					+			
Locustellidae									
Brown Songlark	*Cincloramphus cruralis*		+	+	+	+			
Rufous Songlark	*Cincloramphus mathewsi*			+	+	+			
Little Grassbird	*Poodytes gramineus*					+			
Zosteropidae									
Silvereye	*Zosterops lateralis*		+	+		+	+		
Dicaeidae									
Mistletoebird	*Dicaeum hirundinaceum*		+	+		+	+		
Motacillidae									
Australian Pipit	*Anthus australis*		+	+	+	+			
MAMMALS									
Tachyglossidae									
Echidna	*Tachyglossus aculeatus*		+	+		+			
Dasyuridae									
Mardo	*Antechinus flavipes*					+			
Chuditch	*Dasyurus geoffroii*	T	+			+		+	+
Red-tailed Phascogale	*Phascogale calura*	T	+	+		+		+	+
Brush-tailed Phascogale	*Phascogale tapoatafa*	P				+		+	
Fat-tailed Dunnart	*Sminthopsis crassicaudata*					+			
Gilbert's Dunnart	*Sminthopsis gilberti*					+			
Myrmecobiidae									
Numbat	*Myrmecobius fasciatus*	T				+			+
Peramelidae									
Quenda	*Isoodon fusciventer*	P				+		+	
Burramyidae									
Western Pygmy Possum	*Cercartetus concinnus*					+			
Tarsipedidae									
Honey Possum	*Tarsipes rostratus*					+			

Appendix 4									
Species		Status	Records						
			Study Area	Additional SA	BBUS	ALA	Dandjoo	DBCA	EBPC
Phalangeridae									
Common Brushtail Possum	*Trichosurus vulpecula*		+	+		+			
Potoroidae									
Woylie	*Bettongia penicillata ogilbyi*	T				+		+	+
Macropodidae									
Tammar Wallaby	*Notamacropus eugenii derbianus*	P				+		+	
Western Brush Wallaby	*Notamacropus irma*	P				+		+	
Western Grey Kangaroo	*Macropus fuliginosus*		+	+		+			
Muridae									
Water Rat	*Hydromys chrysogaster*	P				+		+	
House Mouse	*Mus musculus*	Int				+			
Black Rat	*Rattus rattus*	Int	+			+			
Molossidae									
White-striped Free-tailed Bat	*Austronomus australis*		+	+		+			
Western Free-tailed Bat	*Ozimops kitcheneri*		+	+		+			
Vespertilionidae									
Gould's Wattled Bat	*Chalinolobus gouldii*		+	+		+			
Chocolate Wattled Bat	*Chalinolobus morio*		+	+		+			
Western False Pipistrelle	*Falsistrellus mackenziei*	P				+		+	
Lesser Long-eared Bat	*Nyctophilus geoffroyi*		+	+		+			
Gould’s Long-eared Bat	*Nyctophilus gouldii*								
Central Long-eared Bat	*Nyctophilus major tor*	P				+		+	
Inland Broad-nosed Bat	*Scotorepens balstoni*					+			
Southern Forest Bat	*Vespadelus regulus*		+	+		+			
Canidae									
Fox	*Vulpes vulpes*	Int	+	+		+			
Felidae									
Feral Cat	*Felis catus*	Int	+	+		+			
Leporidae									
European Rabbit	*Oryctolagus cuniculus*	Int	+	+		+			

Appendix 5. EPBC Protected Matters Search Tool results.

Fauna species listed for the study area with a 5km buffer.

Species	EPBC Act Status	Type of Presence
Pezoporus occidentalis **Night Parrot**	Endangered	Species or species habitat **MAY** occur within area
Rostratula australis **Australian Painted Snipe**	Endangered	Species or species habitat **MAY** occur within area
Aphelocephala leucopsis **Southern Whiteface**	Vulnerable	Species or species habitat **MAY** occur within area
Calidris acuminata **Sharp-tailed Sandpiper**	Vulnerable, Migratory	Species or species habitat **MAY** occur within area
Calidris ferruginea **Curlew Sandpiper**	Critically Endangered, Migratory	Species or species habitat **MAY** occur within area
Calyptorhynchus banksii naso **Forest Red-tailed Black-cockatoo**	Vulnerable	Species or species habitat **KNOWN** to occur within area
Falco hypoleucos **Grey Falcon**	Vulnerable	Species or species habitat **MAY** occur within area
Leipoa ocellata **Malleefowl**	Vulnerable	Species or species habitat **KNOWN** to occur within area
Zanda baudinii **Baudin's Cockatoo**	Endangered	Species or species habitat **KNOWN** to occur within area
Zanda latirostris **Carnaby's Cockatoo**	Endangered	Species or species habitat **KNOWN** to occur within area
Dasyurus geoffroii **Chuditch**	Vulnerable	Species or species habitat **KNOWN** to occur within area
Macrotis lagotis **Bilby**	Vulnerable	Translocated population **KNOWN** to occur within area
Bettongia penicillata ogilbyi **Woylie**	Endangered	Species or species habitat **KNOWN** to occur within area
Myrmecobius fasciatus **Numbat**	Endangered	Species or species habitat **KNOWN** to occur within area
Phascogale calura **Red-tailed Phascogale**	Vulnerable	Species or species habitat **KNOWN** to occur within area
Actitis hypoleucos **Common Sandpiper**	Migratory	Species or species habitat **MAY** occur within area
Calidris melanotos **Pectoral Sandpiper**	Migratory	Species or species habitat **MAY** occur within area
Apus pacificus **Fork-tailed Swift**	Migratory	Species or species habitat **LIKELY** to occur within area
Motacilla cinerea **Grey Wagtail**	Migratory	Species or species habitat **MAY** occur within area

Appendix 6. Bat Call Analysis Report

Acoustic analysis and bat call identification from Narrogin, Western Australia

Prepared for **Western Wildlife Pty Ltd**

Version **25 January 2024**

SZ project reference **SZ719**

Prepared by **Dr Kyle Armstrong and Yuki Konishi**

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This report should be included as an appendix in any larger submission to Government, and cited as:

Specialised Zoological (2024). Acoustic analysis and bat call identification from Narrogin, Western Australia. Unpublished report by Specialised Zoological for Western Wildlife Pty Ltd, 25 January 2024, project reference SZ719.

Summary

Bat identifications from acoustic recordings are provided from near Narrogin, c. 165 km south-east of Perth, Western Australia. The identification of bat species from full spectrum WAV-format recordings of their echolocation calls was based on measurements of characteristic frequency, observation of pulse shape, and the pattern of harmonics. Six species of bat were identified as being present (**Tables 1** and **2**). Representative echolocation calls for each identification are illustrated (**Figure 1**), as recommended by the Australasian Bat Society (ABS 2006). Further details are available should verification be required.

Methods

The data provided were recorded in WAV format with Titley Scientific Anabat Swift bat detectors (sampling rate 500 kHz, set to turn on automatically at sunset and off at sunrise).

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong et al. 2021a,b) was applied to the recordings made on the survey. Firstly, the WAV files were scanned for bat echolocation calls using several parameter sets in the software SCAN'R version 1.8.3 (Binary Acoustic Technology), which also provides measurements (SCAN'R parameters) from each putative bat pulse. The outputs were then used to determine if putative bat pulses measured in SCAN'R could be identified to species. This was done using a custom [R] language application that performed three tasks:

1. undertook a Discriminant Function Analysis on training data from representative calls from south-western Australia;
2. from the measurements of each putative bat pulse from SCAN'R, calculated values for the first two Discriminant Functions that could separate the echolocation call types derived from the analysis of training data, and plotted these resulting coordinates over data ellipses representing one standard deviation of the variation for the defined call types; and
3. facilitated an inspection in a spectrogram of multiple examples of each call type for each recording night by opening the original WAV files containing pulses of interest in Adobe Audition version 23.1.

Species were identified based on information in Churchill (2008). Nomenclature follows Jackson and Groves (2015). Identifications were supported by distribution information in a curated source of distribution records maintained by the Australasian Bat Society, Inc. (https://www.ausbats.org.au/batmap.html).

Comments on identifications

Most species were identified unambiguously. The call type allocated to the Lesser long-eared bat *Nyctophilus geoffroyi* was recognised from two call sequences only. These were difficult to distinguish from clutter calls of the southern forest bat *Vespadelus regulus*. Other species of long-eared bat *Nyctophilus* spp. were not considered as sources for this call type because their known distributions do not extend to the study area.

Limitations

The identifications presented in this report have been made within the following context:

1. The identifications made herein were based on the ultrasonic acoustic data recorded and provided by a 'third party' (the client named on the front of this report).
2. The scope of this report extended to providing information on the identification of bat species in bulk ultrasonic recordings. Further comment on these species and the possible impacts of a planned project on bat species were not part of the scope.
3. In the case of the present report, the recording equipment was set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
5. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
6. While Specialised Zoological has made identifications to the best of our ability given the available materials, and reserves the right to re-examine the data and revise any identification following a query, it is the client's and / or proponent's responsibility to provide supporting evidence for any identification, which might require follow-up trapping effort or non-invasive methods such as video recordings. Specialised Zoological bears no liability for any follow-up work that may be required to support an identification based initially on the analysis of acoustic recordings undertaken and reported on here.
7. There are a variety of factors that affect the 'detectability' of each bat species, given the frequency, power and shape characteristics of their calls. Further information on the analysis and the various factors that can impinge on the reliability of identifications can be provided upon request.
8. The analysis of ultrasonic recordings is one of several methods that can be used to survey for bats, and comprehensive surveys typically employ more than one method. If an identification in the present report is ambiguous or in question, a trapping programme would help to resolve the presence of the possibilities in the project area.
9. This version of the document supersedes any previous version. Previous drafts are not authorised by us for submission to the regulator or the public domain.

References

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Table 1. Species identified in the present survey from all sites combined.

VESPERTILIONIDAE	
Gould's wattled bat	*Chalinolobus gouldii*
Chocolate wattled bat	*Chalinolobus morio*
Lesser long-eared bat	*Nyctophilus geoffroyi*
Southern forest bat	*Vespadelus regulus*
MOLOSSIDAE	
White-striped free-tailed bat	*Austronomus australis*
Western free-tailed bat	*Ozimops kitcheneri*

Table 2. Species identifications from all recording nights at all sites. Date and recording unit number correlates with site; see *Table 1* for full species names.

		A. australis	*C. gouldii*	*C. morio*	*N. geoffroyi*	*O. kitcheneri*	*V. regulus*
449972							
23/10/2023	-32.970873, 117.048440	.	X	X	X	.	X
24/10/2023	-32.968808, 117.049563	.	X	X	.	X	X
25/10/2023	-32.969348, 117.049643	X	X	.	.	X	X
26/10/2023	-32.969267, 117.049637	.	X	.	.	X	X
461278							
23/10/2023	-32.994720, 116.897492	.	X	.	.	X	X
24/10/2023	-32.994688, 116.897415	X	X	X	.	X	X
25/10/2023	-32.994688, 116.897415	X	X	.	.	X	X
26/10/2023	-32.994695, 116.897335	X	X	.	.	X	X
642025							
23/10/2023	-32.973670, 116.952083	X	X	X	.	X	X
24/10/2023	-32.973647, 116.952025	X	X	X	.	X	X
25/10/2023	-32.973720, 116.952073	X	X	X	.	X	X
26/10/2023	-32.973700, 116.952038	X	X	X	X	X	X
642149							
23/10/2023	-32.984228, 116.938082	X	X	X	.	X	X
24/10/2023	-32.983938, 116.938165	X	X	.	.	X	X
25/10/2023	-32.983932, 116.938210	X	X	.	.	X	X
26/10/2023	-32.984008, 116.938088	X	X	X	.	X	X

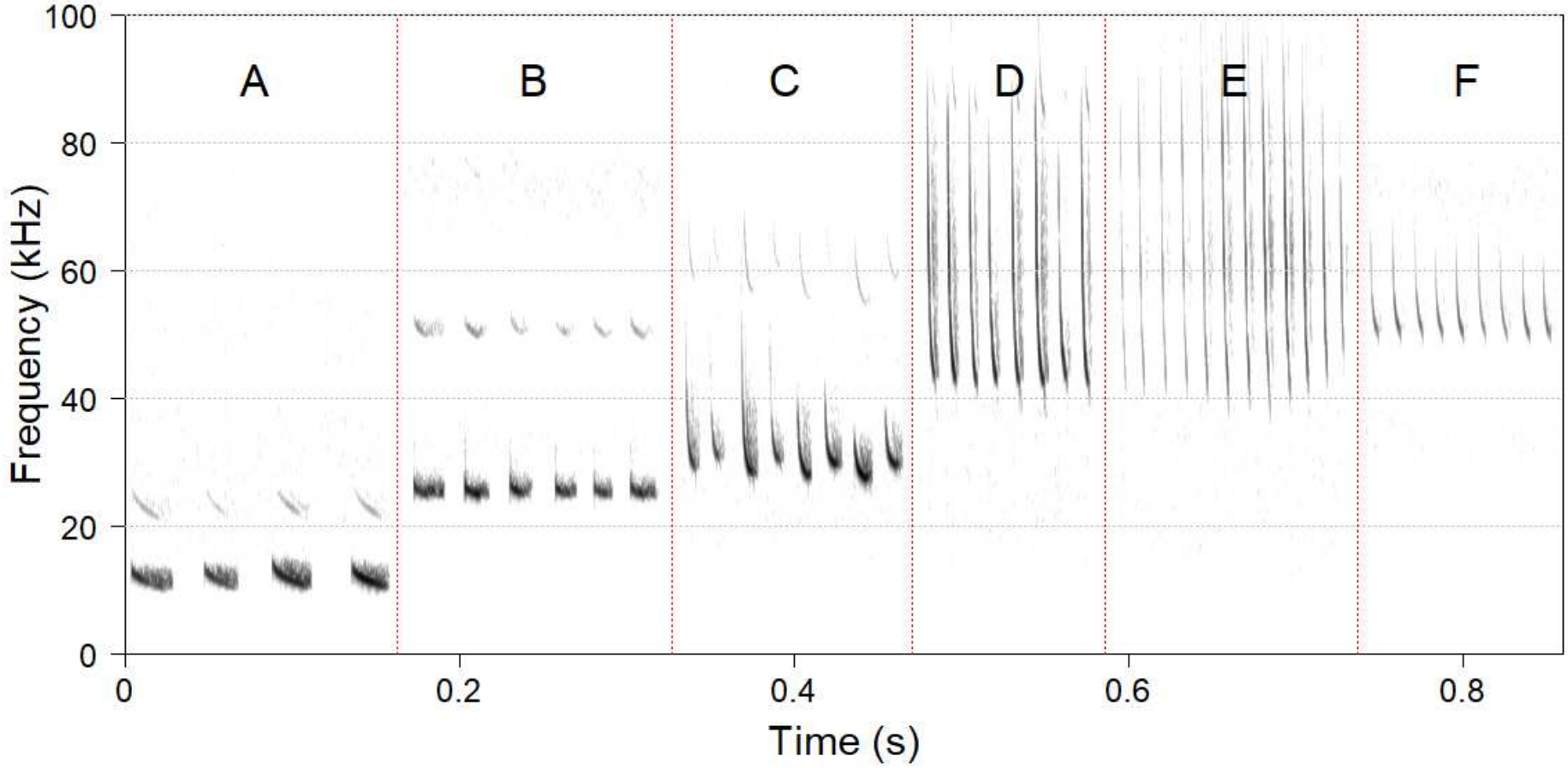

Figure 1. Representative echolocation call sequence portions of the species identified (**A**: *Austronomus australis*; **B**: *Ozimops kitcheneri*; **C**: *Chalinolobus gouldii*; **D**: *Vespadelus regulus*; **E**: *Nyctophilus geoffroyi*; **F**: *Chalinolobus morio*; time between pulses has been compressed).

Appendix 7. Passive Acoustic Detector Analysis Report

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15-02-2024

Dear Jen,

Analysis of 72 nights of acoustic recording across 4 sites in the southern wheatbelt of Western Australia during October and November 2023 presented no detection of Barking Owl (*Ninox connivens*) or Australian Masked Owl (*Tyto novaehollandiae*) calls.

Conditions were generally calm throughout the survey period although significant wind was detected across all sites on the 23rd & 25th of October and the 2nd,3rd & 4th of November for short periods during the night and may have masked some concurrent calls within those specific frequencies. Sheep and dogs were recorded regularly at SM-04 and may have also masked some concurrent calls within those specific frequencies. Those interferences are considered minimal and the recording quality was considered adequate for detection of Barking Owl and Australian Masked Owl vocal signals.

There is a very low likelihood that Barking Owl and/or Australian Masked Owl roost sites exist within two hundred metres of each recording point. It is also highly unlikely that Barking Owls and/or Australian Masked Owls foraged within the same areas during the survey. These statements pertain only to the areas within two hundred metres of each recording point and not the entire survey area.

A total of 51 non-target species were recorded. These are shown for each site in Appendix 1.

Regards,

Louis Masarei

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Appendix 1: Species detected during acoustic analyses

Common Name	Scientific Name	SM4-01	SM4-02	SM4-03	SM4-04
Dog	*Canis familiaris*		○	○	○
Stubble Quail	*Coturnix pectoralis*	○	○		
Tawny Frogmouth	*Podargus strigoides*	○			○
Australian Owlet-nightjar	*Aegotheles cristatus*	○	○		○
Horsfield's Bronze Cuckoo	*Chalcites basalis*			○	
Common Bronzewing	*Phaps chalcoptera*	○	○		
Southern Boobook	*Ninox boobook*	○	○	○	○
Laughing Kookaburra	*Dacelo novaeguineae*	○	○		○
Sacred Kingfisher	*Todiramphus sanctus*		○		○
Carnaby's Black Cockatoo	*Calyptorhynchus latirostris*	○			
Galah	*Eolophus roseicapilla*	○			
Regent Parrot	*Polytelis anthopeplus*	○			
Red-capped Parrot	*Purpureicephalus spurius*	○	○		○
Western Rosella	*Platycercus icterotis*		○		
Australian Ringneck	*Barnardius zonarius*	○	○	○	○
Purple-crowned Lorikeet	*Glossopitta porphyrocephala*	○	○	○	
Rufous Treecreeper	*Climacteris rufus*	○	○	○	
Blue-breasted Fairywren	*Malurus pulcherrimus*		○		○
Brown Honeyeater	*Lichmera indistincta*	○	○	○	○
Brown-headed Honeyeater	*Melithreptus brevirostris*				○
Gilbert's Honeyeater	*Melithreptus chloropsis*			○	
Singing Honeyeater	*Gavicalis virescens*	○			
Yellow-plumed Honeyeater	*Ptilotula ornata*	○	○	○	
Red Wattlebird	*Anthochaera carunculata*	○	○		○
Spotted Pardalote	*Pardalotus punctatus*	○			
Striated Pardalote	*Pardalotus striatus*	○	○	○	○
Weebill	*Smicrornis brevirostris*	○			○
Western Gerygone	*Gerygone fusca*	○		○	○
Inland Thornbill	*Acanthiza apicalis*	○			
Western Thornbill	*Acanthiza inornata*				○
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	○		○	
Dusky Woodswallow	*Artamus cyanopterus*		○		
Australian Magpie	*Cracticus tibicen*	○	○	○	○
Grey Butcherbird	*Cracticus torquatus*				○
Western Shrike-tit	*Falcunculus leucogaster*				○
Western Whistler	*Pachycephala fuliginosa*	○	○	○	
Rufous Whistler	*Pachycephala rufiventris*	○	○		○
Grey Shrike-thrush	*Colluricincla harmonica*	○	○	○	○
Willie Wagtail	*Rhipidura leucophrys*		○	○	○
Grey Fantail	*Rhipidura albiscapa*			○	

Magpie-lark	***Grallina cyanoleuca***		○		○
Restless Flycatcher	***Myiagra inquieta***			○	
Australian Raven	***Corvus coronoides***	○	○	○	○
Western Yellow Robin	***Eopsaltria griseogularis***			○	
Scarlet Robin	***Petroica boodang***	○		○	
Red-capped Robin	***Petroica goodenovii***			○	○
Tree Martin	***Petrochelidon nigricans***	○	○		
Rufous Songlark	***Cincloramphus mathewsi***	○			
Silvereye	***Zosterops lateralis***	○		○	
Mistletoebird	***Dicaeum hirundinaceum***	○			