Baru-Marnda Renewable Energy Project
Fauna Assessment Report

View in Marnda Project area showing softly undulating landscape in background interspersed with small hills in foreground. (Photo: Barry Shepherd)

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Executive Summary

Introduction

Bamford Consulting Ecologists (BCE) has been commissioned by the Yindjibarndi Energy Corporation (YEC), to conduct a Level 1 (Basic) fauna assessment, Level 2 targeted fauna survey, and a Bird and Bat Utilisation Survey, for a proposed renewable energy project development comprised of two overall areas (Baru and Marnda) in the Pilbara region. This report presents results of the fauna assessment, bird and bat surveys.

The project will comprise a combination of solar panels, wind turbines and battery energy storage systems (BESS). Associated infrastructure will include internal connection lines, export transmission lines and service roads. YEC propose to install up to 1GW of wind turbines across Baru and Marnda.

Fauna values

Landscape and Vegetation Types. The project area encompasses rocky hills to undulating stony plains dissected by creek lines and with occasional boulder fields to the north. A distinctive feature of the landscape is that it has three broad geological components:

- Rocky basaltic hills of the Rocklea Land System across much of Baru and in part (mostly south) of Marnda. The hills are more abrupt in Baru than in Marnda. Hills are dissected by valleys with minor watercourses.
- Undulating granitic plains and granite boulderfields of the Boolaloo and Macroy Land Systems in the north of Baru.
- Undulating sandstone hills of the Capricorn Land System that form a belt aligned east-west across Marnda.

The sites are divided into the upper catchments of river systems that flow to the north and those to the south. The northern creeklines on Baru and Marnda form tributaries of the Maitland River and Harding River systems. The southern creeklines of Baru and Marnda flow south into the Fortescue Basin. The close proximity between the northern and southern creeklines offer relatively short corridors across harsh landscape linking fauna from the two separate systems.

The dominant five community types (by proportion of the survey area) are summarised briefly here:

- VSA 1 - Open hummock grassland on rocky hilltops and plains over mixed geology including basalt and sandstone (33,493 ha [82.6%]), with low isolated trees. This grassland is broadly distributed mostly across the higher slopes of Baru and Marnda.
- VSA 2 - Low and sparse shrubland over sparse hummock grasslands on stony plains and granite tor fields (2,782 ha [6.9%]), comprised of low isolated trees. This shruband type lies on the lower areas in the north of Baru and Marnda and is interspersed with fields of large boulders.
- VSA 3 - Open woodland along ephemeral drainage channels incised into rocky sandstone creeklines (2,266 ha [5.6%]), over mid sparse shrubland. This vegetation type dominates the creeklines in both the northern and southern catchment areas and is interspersed with permanent and ephemeral pools.
- VSA 4 - Grassland with low isolated shrubs over friable cracking clay on hilltops and flats (1,145 ha [2.8%]), comprised of low sparse tussock grassland and low isolated shrubs and diverse annual herbs and grasses. This grassland type is limited to the full width of Marnda's southern slopes.

- Low open woodland and isolated shrubs on sandstone hilltops (849.15 ha [2.1%]), comprised of low open woodland over low isolated shrubs and low sparse hummock grassland on rocky sandstone alluvium. This woodland type is confined to a band across the southern half of Marnda and Baru.

Fauna assemblage. The desktop assessment identified 261 vertebrate fauna species as potentially occurring in the project area: three fish, six frogs, 65 reptiles, 149 birds, 35 native mammals (including the Mujira (Dingo), considered 'naturalised') and 3 introduced mammals. This does not include domesticated species that may be present in the project area. Six native mammal species that would have once been present in the project area are now locally extinct. The presence of at least 111 expected fauna species (two fish, two frogs, ten reptiles, 81 birds and 14 native mammals and two introduced mammals) was confirmed during the various visits by either direct observation, being caught on camera or acoustic recorder or due to the presence of evidence such as tracks, shed skin and scats. One reptile (Steindachner's Tortoise) was not represented in the desktop but was recorded on site. Of the three introduced mammals expected to be present, only the Feral Cat was confirmed. The fauna assemblage is typical of that expected in this region of Western Australia and is likely to be represented elsewhere in the region. The assemblage is likely to be relatively complete for reptiles and birds, and incomplete for mammals, though for bats it appears to be near-complete. The expected assemblage is likely to be somewhat poor in a regional context, due to the harsh nature of the environment, the lack of sandy soils and the limited amount of complex structures such as caves, overhangs, etc., that would otherwise provide shelter for a variety of fauna.

Species of conservation significance. Three broad levels of conservation significance are used in this report:

- Conservation Significance 1 (CS1) – species listed under State or Commonwealth Acts.
- Conservation Significance 2 (CS2) – species listed as Priority by DBCA but not listed under State or Commonwealth Acts.
- Conservation Significance 3 (CS3) – species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

Thirty-nine vertebrate species of conservation significance are expected to occur in the project area: 24 CS1, ten CS2 and five CS3 species. Following rains in March 2025, a large and diverse influx of birds was recorded. This was likely in response to the new growth in vegetation, maturing seed heads of grasses and resultant irruption of insects (crickets in particular). A number of bird groups increased noticeably, including raptors, parrots, pigeons/doves, finches, woodswallows and martins. This captures the sporadic nature of "boom and bust" arid-zone ecology.

Key bird species of conservation significance recorded in the survey area include the Grey Falcon (Boorga) and Fork-tailed Swift, both being CS1 (Cwlth) with the former being a regular visitor or possible resident, and the latter a regular migratory visitor. The Grey Falcon was observed flying in the project areas on 14 separate occasions in August, September, October and March; nine of which were collected on formal VP survey, and four times opportunistically. Most observations were of adult pairs, but a single juvenile was also recorded near the Ngurrawaana Community. Little over half of the time Grey Falcons were recorded flying was estimated to be within rotor swept pathway. The area in which all Grey Falcons were spotted was in the undulating plains of the south-eastern half of

Marnda where the landscape is considered more typical of its preferred habitat. Fork-tailed Swifts were recorded in three separate sightings of a total of seven individuals in March 2025. These were observed in the southern and central area of Marnda. All were below 40 m height.

Pilbara Leaf-nosed (Diamond-faced) Bat and Ghost Bat, both of which are CS1 (state and Cwlth), are expected to occur in the region. No evidence of Ghost Bats has been obtained but four passes of Pilbara Leaf-nosed Bat were recorded on ARUs along two creeklines in Marnda. The four acoustic passes detected of this species were obtained along two creeklines in August and was considered to represent very low activity levels. The four detections were below RSA and there were no records from detectors set at RSA height. The roosting opportunities constrain these species to very short stays, likely during transit only; both are considered regular visitors. Eight other bat species were detected of which the Common Sheath-tailed Bat was potentially detected near or in RSA and would be at risk of colliding with turbines. Other key vertebrate species of conservation significance are the Yirriwardu (Northern Quoll) and Bargunyji (Pilbara Olive Python); both CS1 and confirmed as residents in the project area. Four invertebrates of conservation significance may be present in the project area.

Patterns of biodiversity. The wooded creeklines, springs, water bodies and rocky areas are considered locally significant with regard to fauna, as they provide freshwater, shelter and denning for a variety of fauna species, including fish, frogs, birds and reptiles. However, the temporary nature of many of the pools will also be a factor in defining the fauna interests of the area, with the result of many species being sporadic and irruptive. The limited extent of sandy substrates will limit the number of reptiles expected to be present in the project area. The fire in 2023 may have adversely affected the assemblage temporarily, but the relationship between fire and fauna assemblage composition is complex.

Conclusions

It is early to make recommendations for the proposed development and the survey will be ongoing until at least August 2025. The south-eastern quarter of Marnda is increasingly looking like a strong-hold for Grey Falcon, but it is still too early to tell whether that is the case or birds were passing through. It is important to identify the optimal strategy for ongoing survey and monitoring of irruptive, seasonal and regionally nomadic birds in a way that will allow mitigations to be identified and employed that will control or limit the risk of collision with turbine blades. The Grey Falcon has been recorded on site and is the primary bird target for recording during sampling. Like many bird species in the Pilbara it is highly erratic in its movements, not staying for long at any location unless breeding. Only one of the two conservation significant bats has been recorded on site and in very low activity levels. Call playback (acoustic lures) can be used to help Ghost Bats reveal themselves and establish whether they too use the Project Areas.

Management of the risks for the ground-dwelling fauna is understood and commonplace across a range of other development types. These may include providing a buffer around the creeklines, springs and gorge systems as they provide denning habitat and movement corridors for the Yirriwardu (Northern Quoll) and Bargunyji (Pilbara Olive Python), and are likely to be areas of high species richness. Buffers would be beneficial to much of the fauna assemblage due to the importance to fauna of the spring, gorge and drainage lines. Understanding the hydrology that maintains the water courses is essential to protect this feature. Fire management and management of introduced species are also recommended. Some future studies are suggested; these are all focussed on gathering information relevant to the assessment of risk posed by the proposed development.

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1 Introduction

Bamford Consulting Ecologists (BCE) has been commissioned by the Yindjibarndi Energy Corporation (YEC), to conduct a Level 1 (Basic) fauna assessment and Level 2 Bird and Bat Utilisation Survey (BBUS) of a proposed renewable energy project comprised of two areas (Baru and Marnda) in the Pilbara region. This involves a desktop review, site inspection and specific bird and bat surveys derived for wind farm developments. This report presents results of the fauna assessment and the bird surveys. Preliminary results of the bat surveys are also presented. This involves a summary of the expected fauna assemblage, information on species of conservation significance and their expected occurrence in the project area, field observations and a detailed summary of the bird and bat records acquired to date. Fauna values (as described in Appendix 1) are discussed.

1.1 Description of the Baru and Marnda Renewable Energy Project

The Yindjibarndi Energy Corporation (YEC) is a partnership between the Yindjibarndi Aboriginal Corporation and the ACEN Corporation to develop the Baru and Marnda Renewable Energy Hubs. The project will comprise a combination of solar panels, wind turbines and battery energy storage systems (BESS). Associated infrastructure will include internal connection lines, export transmission lines and service roads. YEC propose to install up to 1GW of wind turbines across Baru and Marnda. The reference wind turbine assumes a hub height of 150 m, a rotor diameter of 172 m and a blade tip clearance above ground level of 64 m.

1.2 Description of project area and background environmental information

1.2.1 Overview

The Baru and Marnda project areas are located approximately 53 to 74 km south of Karratha in the north-western portion of the Pilbara management region (DBCA, 2024a), on traditional lands of the Yindjibarndi people and within the Shire of Ashburton. The project areas are 19,840 ha (Baru) and 16,970 ha (Marnda) and broadly 20.5 km east to west and 21 km north to south. The two project areas are separated by the Pannawonica Rail Service Road and associated Railway. The Manuwarra Red Dog (Tom Price – Karratha) Highway and Railway lie just to the east. The location of the project area is indicated in Figure 1-1. The project areas remain largely undisturbed except for two transmission lines, several tracks and small clearings some of which have been created to install meteorological equipment for the wind farm. There are signs of cattle grazing throughout.

Prior to being commissioned for the Baru and Marnda project areas, BCE had undertaken a Level 1 (Basic) Fauna Assessment for the Jinbi Solar Farm that lies immediately north of the Marnda Project area (BCE, 2024). This included a site investigation in December 2023 and provided an insight to the broader landscape of the area. In 2024 and early 2025, field campaigns to the Baru and Marnda project areas were conducted on:

- 16 July
- 6 - 8 August
- 27 September to 1 October
- 11 - 14 November
- 22 December
- 10 – 13 March (2025).

The trip on 22 December was arranged to maintain recording equipment. Large parts of the Baru Project area were subject to a bushfire in spring 2023 and appeared to have been burnt on a regular basis. This is of relevance to several fauna species for which unburnt environments are important.

1.2.2 Recognised sensitive sites

There are several recognised sensitive sites within c. 40 km of the project areas; these are shown on Figure 1-2 and Figure 1-3. The Marnda project is directly adjacent to Millstream Chichester National Park, a protected terrestrial area (DCCEEW, 2022) and Environmentally Sensitive Area (DWER, 2023b, 2023a), and this National Park is within 2 km of the boundaries of the Jinbi and Baru project areas.

Other sensitive sites of note include the following:

- Millstream Pools, c. 20 km south, which is an Important Wetland (DBCA, 2023a) and Proposed Ramsar Site (DBCA, 2023c).
- Priority Ecological Communities (PECs) c. 20 km north-east and north-west. These correspond to areas of the Horseflat land system (DPIRD, 2024c) and are therefore likely to be clay pans of the Horseflat land system of the Roebourne plains, which is a priority 3 PEC (DBCA, 2023b).
- Priority Ecological Communities to the south, overlapping with the southern portion of the Marnda project area. These correspond to areas of the Wona land system (DPIRD, 2024c) which is associated with four plant assemblages which are Priority Ecological Communities (two are Priority 1 and two are Priority 3) (DBCA, 2023b).

Although not officially recognised as a sensitive site, the Harding Dam and Lake Poongkaliyarra are c. 30 km north-east of the project areas (shown on Figure 1-2). These locations will be used by waterbirds and shorebirds and proximity to these locations may influence the likelihood of these species using the project areas and thus being impacted by the proposed developments.

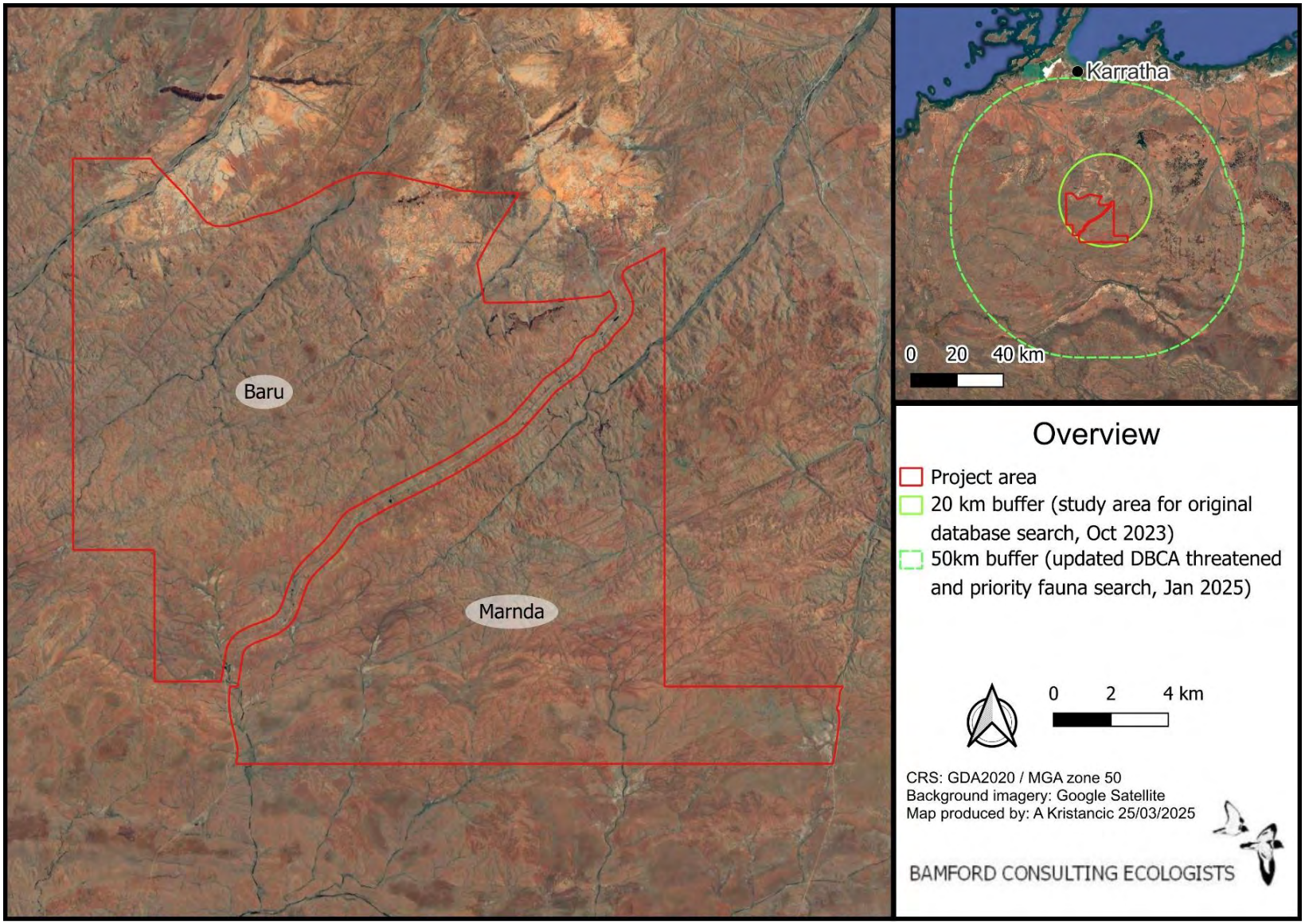


Figure 1-1. Location of the project area.

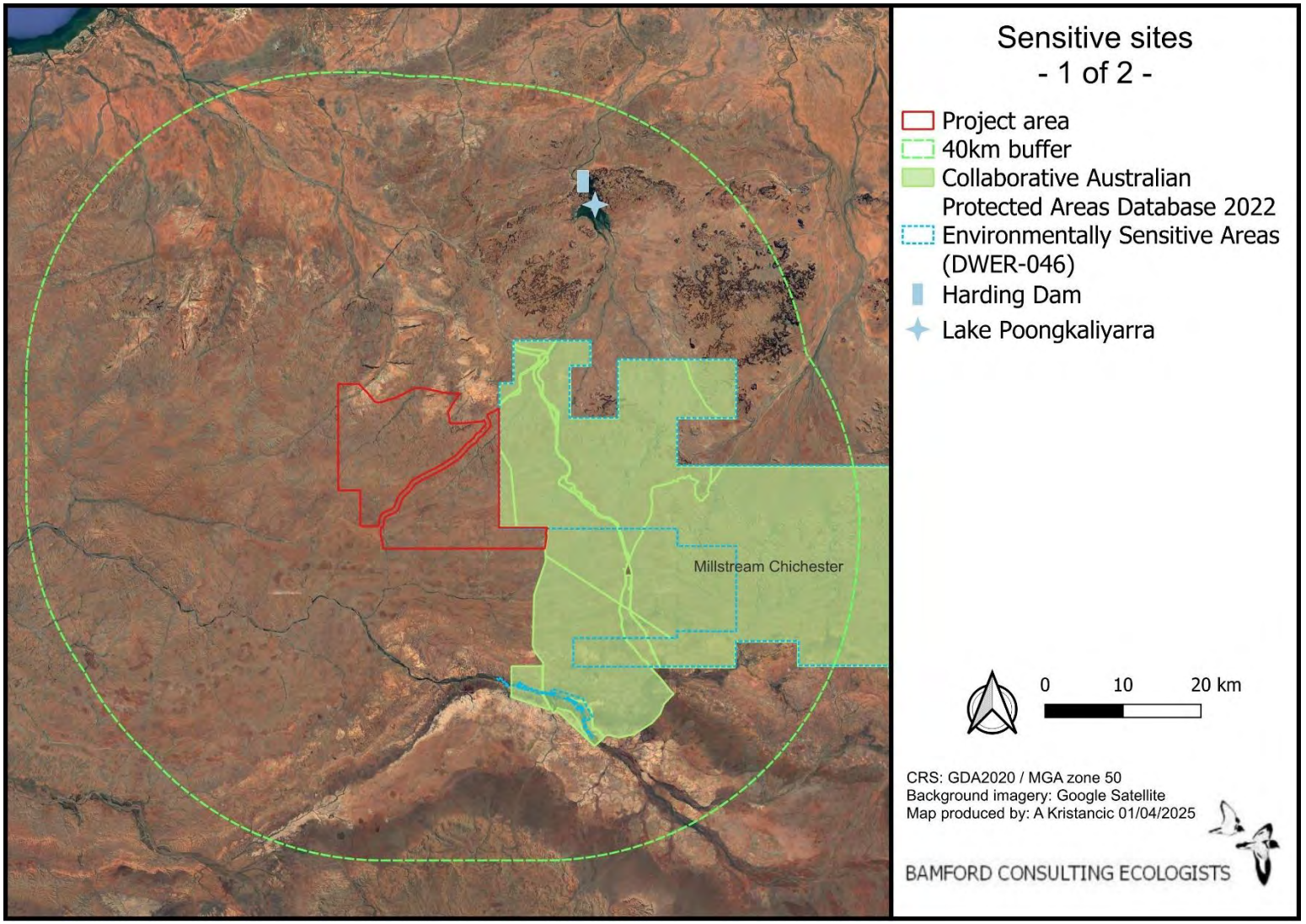


Figure 1-2. Protected areas, as per the Collaborative Australian Protected Areas Database (CAPAD; DCCEEW, 2022) and Environmentally Sensitive Areas (DWER, 2023a) within 40 km of the project area. Figure also shows the locations of Harding Dam and Lake Poongkaliyarra.

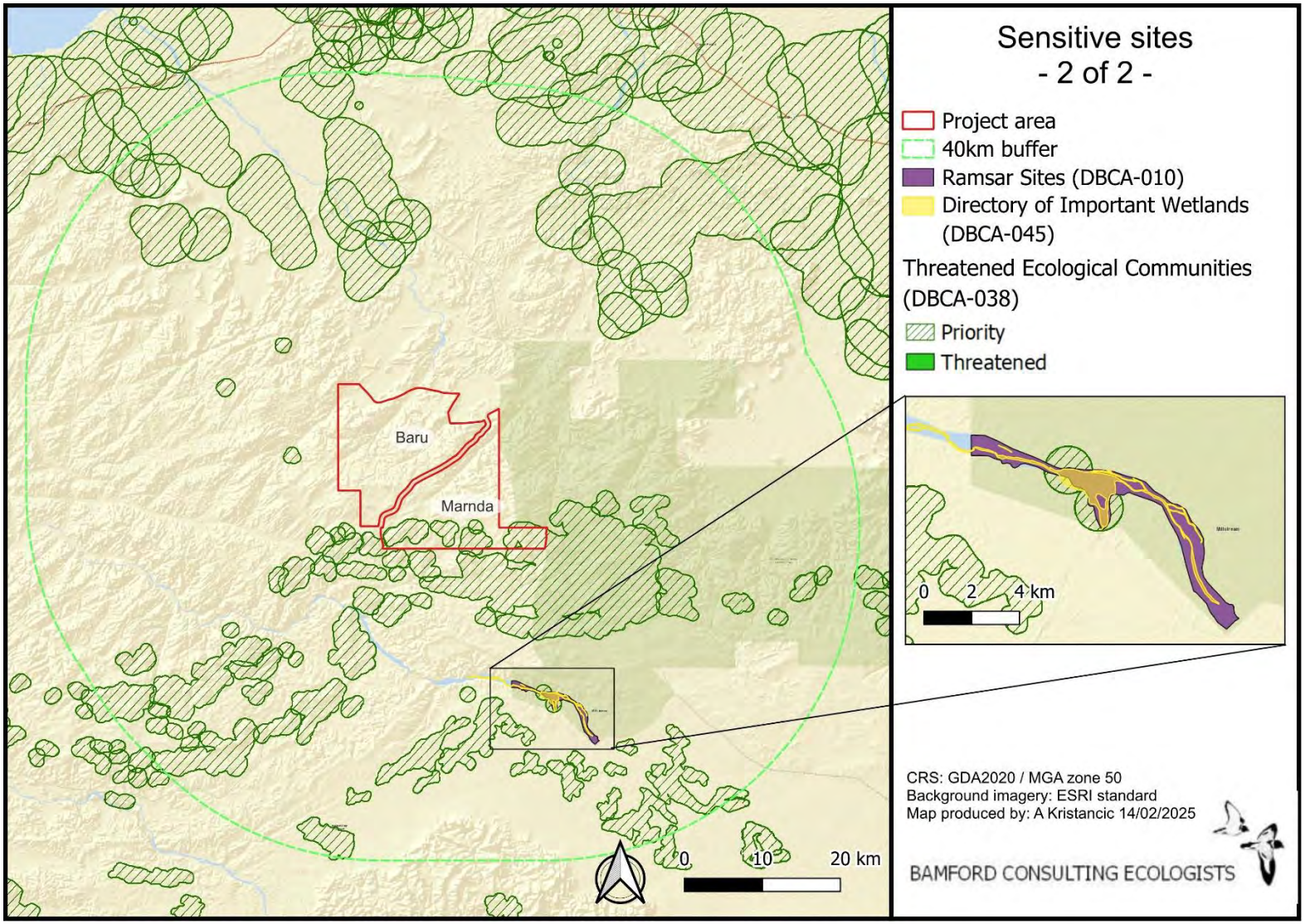


Figure 1-3. Important Wetlands (DBCA, 2023a), Ramsar Sites (DBCA, 2023c) and Priority Ecological Communities (DBCA, 2023d) within 40 km of the project area. No Threatened Ecological Communities were present within the database searches.

1.2.3 Interim Biogeographic Regionalisation of Australia (IBRA)

The latest version of the Interim Biogeographic Regionalisation of Australia (IBRA v7) has identified 27 bioregions in Western Australia which are further divided into subregions (DCCEEW, 2023b). Bioregions are classified on the basis of climate, geology, landforms, vegetation and fauna (Thackway & Cresswell, 1995). The project areas are in the Chichester subregion (PIL01) of the Pilbara bioregion, as shown on Figure 1-4. The Chichester subregion was described by Kendrick and McKenzie (2001) and a summary of their work follows here. This subregion comprises Archaean granite and basalt plains and significant areas of basaltic ranges. A shrub steppe of Acacia over Triodia hummock grassland is supported by the plains, with Eucalyptus occurring on the ranges. The climate of the subregion is semi-desert tropical, with highly variable rainfall that falls mostly in summer, and significant cyclonic activity (Kendrick & McKenzie, 2001).

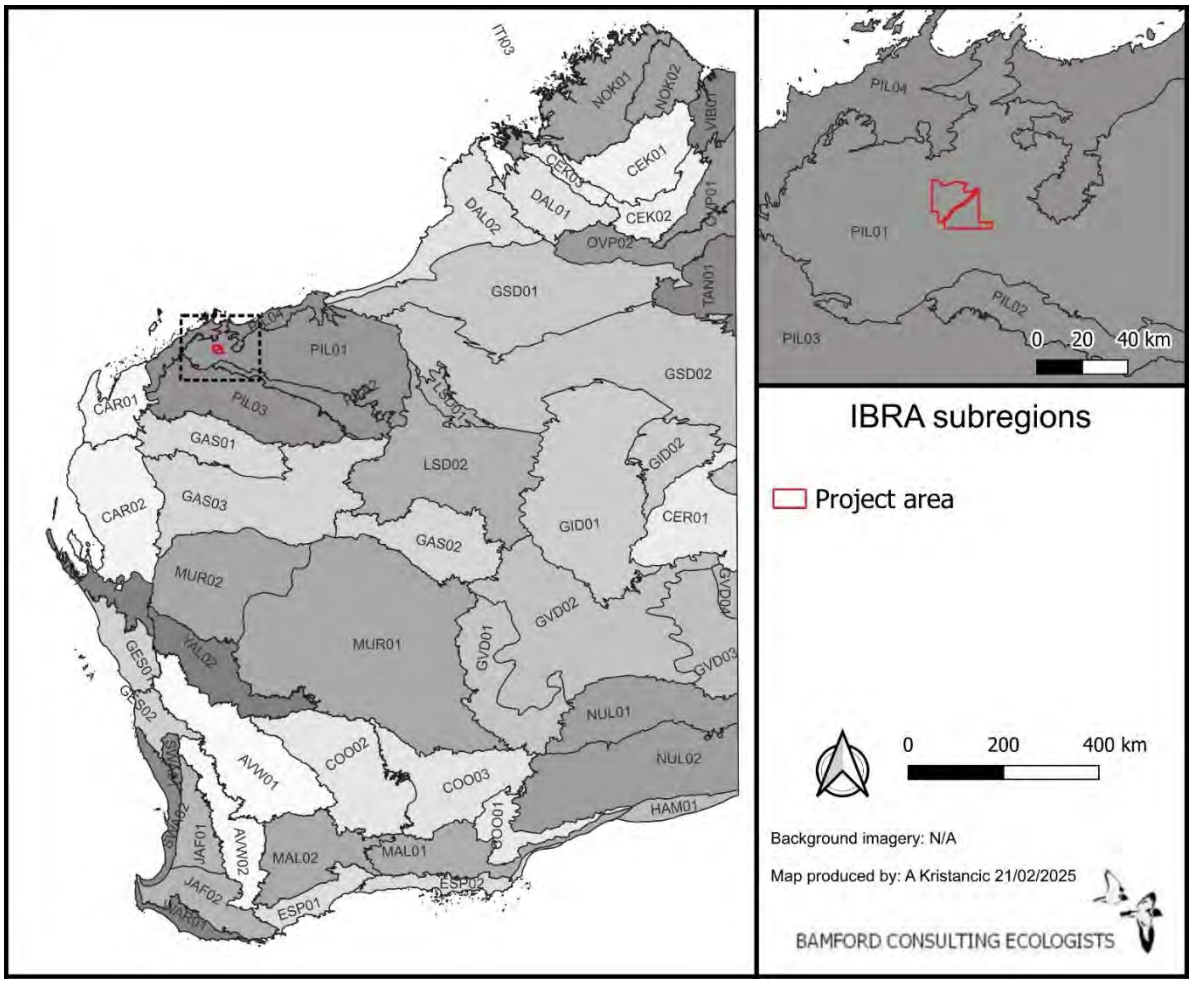


Figure 1-4. Location of the project area within the Interim Biogeographic Regionalisation for Australia **(IBRA; DCCEEW, 2023f)**

1.2.4 Soil-Landscape and Pre-European Vegetation Mapping

Mapping of a survey area in relation to broad scale datasets can provide useful context regarding the current and historical landscape of the survey area and surrounds. A dataset of soil-landscape mapping across Western Australia is provided by DPIRD (2024c). Beard *et al.* (2013) have described and mapped the original vegetation presumed to have existed across Western Australia prior to European settlement and this dataset is provided by DPIRD (2024b). The survey area in relation to these datasets is described below and shown in Figure 1-5 (Soil-landscape mapping) and Figure 1-6 (Pre-European vegetation).

The landscape within 15 km of the project areas consists of 16 soil-landscape subsystems (DPIRD, 2024c), which are shown in Figure 1-5. Details are provided here for the seven soil-landscape subsystems which overlap with the project areas. The project areas consists of the following (descriptions from DPIRD, 2024c):

- **Boolaloo system:** Granite hills, domes, tor fields and sandy plains supporting spinifex grasslands with scattered shrubs. Occurs within Baru.
- **Boolgeeda system:** Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands. Occurs only in north-western part of Baru.
- **Capricorn system:** Rugged sandstone hills, ridges, stony footslopes and interfluves supporting low acacia shrublands or hard spinifex grasslands with scattered shrubs. Occurs in both project areas; makes up a considerable proportion (c. 40-50%) of the Marnda project area.
- **Macroy system:** Stony plains and occasional tor fields based on granite supporting hard and soft spinifex shrubby grasslands. Occurs in Baru.
- **River system:** Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex. Occurs in both project areas.
- **Rocklea system:** Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs. Makes up majority of Baru, and considerable proportion of Marnda (40-50%).
- **Wona system:** Basalt upland gilgai plains supporting Roebourne Plains grass and Mitchell grass tussock grasslands, minor hard spinifex grasslands or annual grasslands/herbfields. Occurs only in southern half of Marnda.

Pre-European vegetation types within 15 km of the project area include six vegetation types (Beard et al., 2013; DPIRD, 2024b) as shown on Figure 1-6. Three of these are present within the project area and are described as follows (from Beard *et al.*, 2013):

- **Vegetation type 29.** Short bunch-grass savanna: annual grasses (*Enneapogon* spp., *Aristida* spp. etc) on dry plains.
- **Vegetation type 38.** Shrub-steppe: hummock grassland (*Triodia* spp.) with scattered shrubs (*Acacia* spp., *Grevillea* spp.) or mallee (*Eucalyptus* spp.).
- **Vegetation type 117**. Mosaic of low tree-steppe and sparse shrub-steppe. In the Pilbara Bioregion, this mosaic consists of "*Triodia wiseana* (limestone spinifex) and scattered *Eucalyptus leucophloia* (Pilbara snappy gum) open low tree-steppe that occurs along the drainage lines and a shrub-steppe of *T. pungens* (soft spinifex) and *Acacia pyrifolia* (ranji bush) on the mesas" (Beard *et al*., 2013, p. 124).

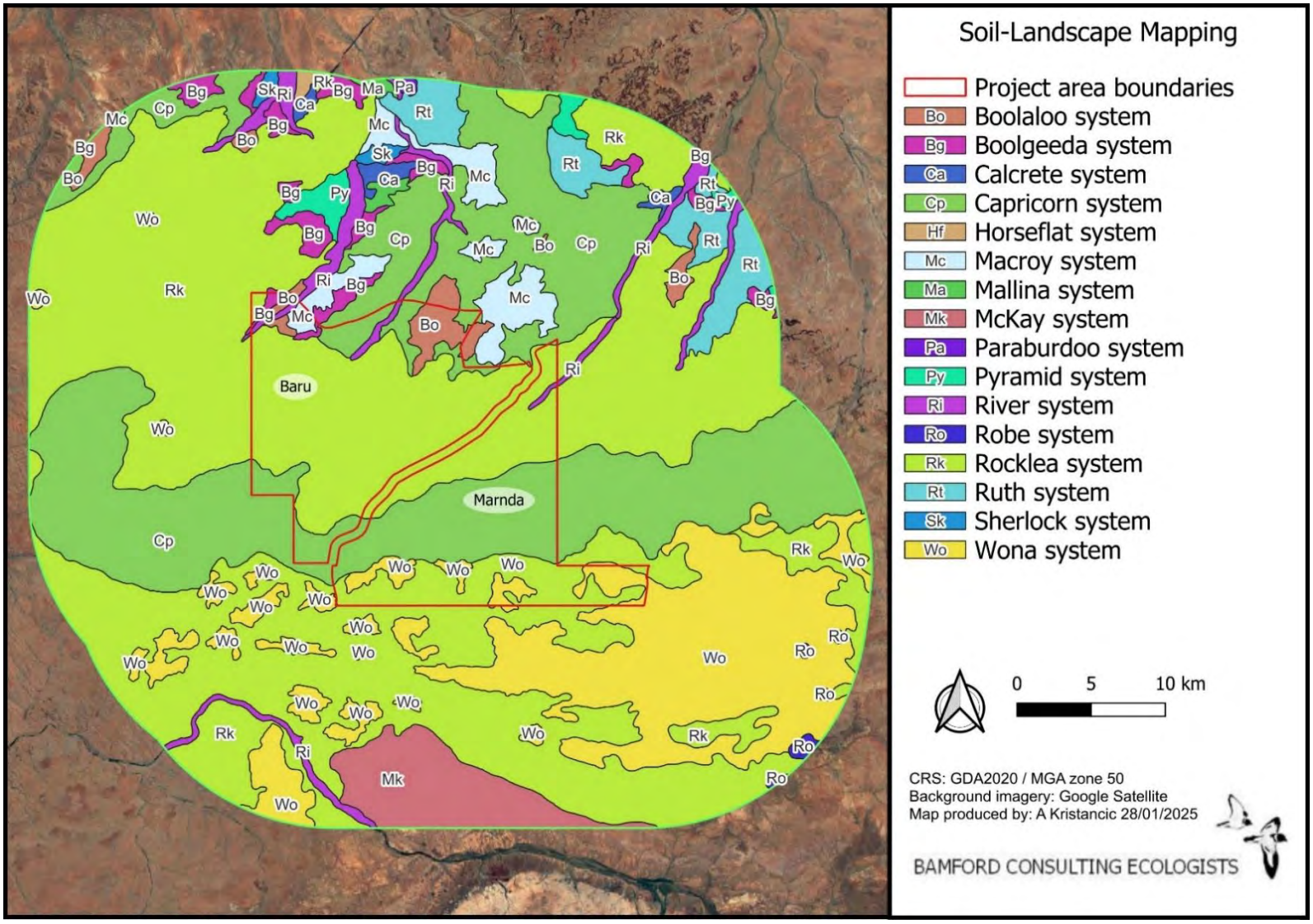


Figure 1-5. Soil-landscape mapping (DPIRD, 2024c) within 15 km of the survey area.

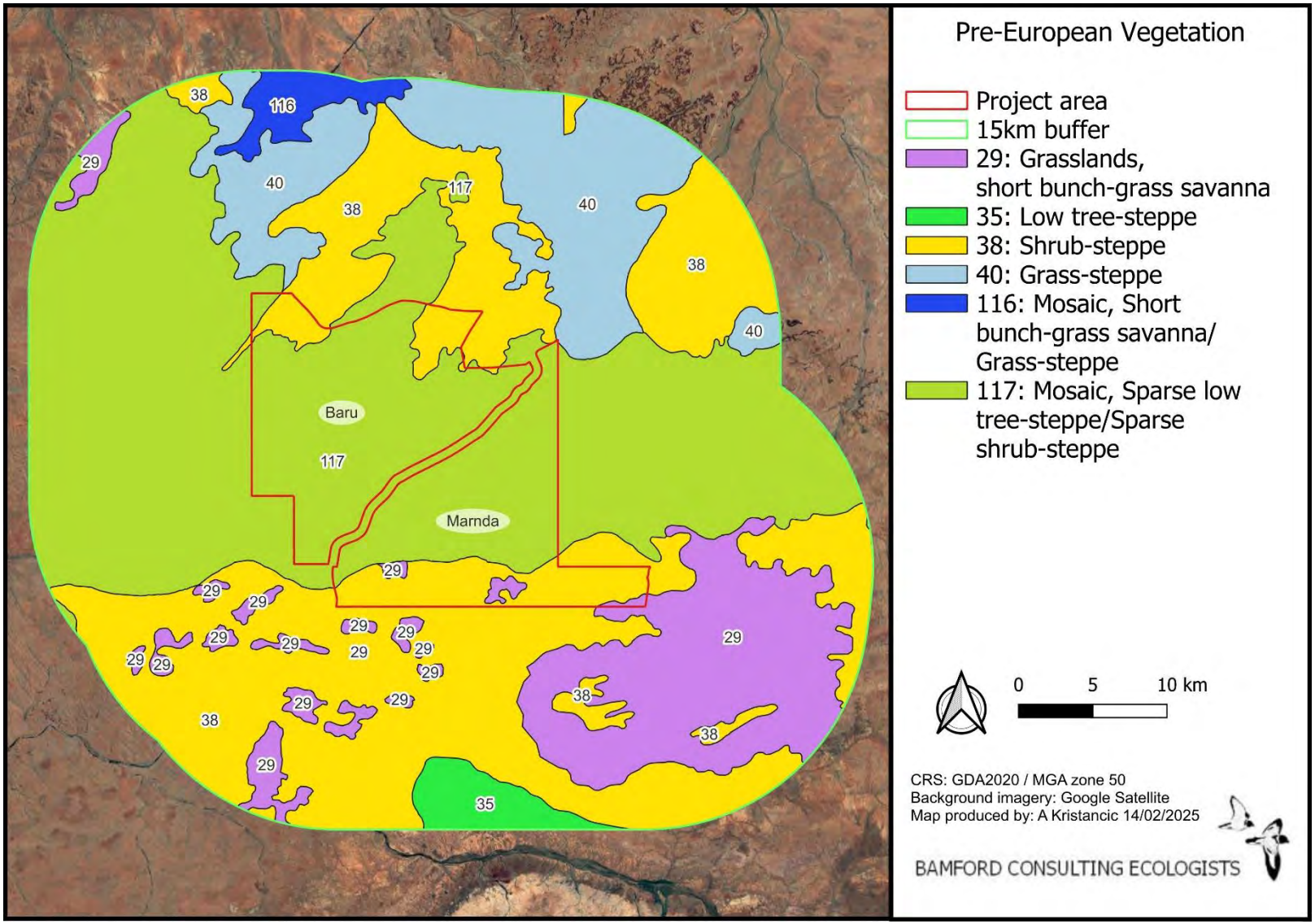


Figure 1-6. Pre-European vegetation types (DPIRD, 2024b) within 15km of the survey area.

1.2.5 Land use and tenure

The dominant land uses within the Chichester subregion (PIL01) are grazing (native pastures), Aboriginal lands and Reserves, UCL and Crown Reserves, conservation and mining (Kendrick & McKenzie, 2001). Authorisation to enter upon and use the project area for feasibility and investigative works was granted to Yiyangu Pty Ltd (a wholly owned subsidiary of Yindjibarndi Aboriginal Corporation) through a license under section 91 of the Land Administration Act 1997. Development and environmental approvals are identified as one of the licensee's works (Milestones) in Annexure B of this license.

1.2.6 Regional development

The project areas are surrounded predominantly by remnant vegetation, intersected by a network of roads, mostly unsealed. Figure 1-7 illustrates the existing extent of land clearing and development within a 15 km buffer. The area within a 15 km buffer around the survey area is c. 169,600 ha in 40 size. Within this buffer, c. 169,566 ha of native vegetation remains (DPIRD, 2024a); therefore existing land clearing or development (c. 34 ha) impacts <0.1 % of the land within the 15 km buffer.

According to the native vegetation extent dataset from DPIRD (2024a), the entire survey area is comprised entirely of native vegetation. To provide more detail concerning areas that provide habitats for fauna, BCE describes and provides maps of vegetation and substrate associations (VSAs) observed during site inspections. This is described in more detail in Sections 2.2 and 3.1.

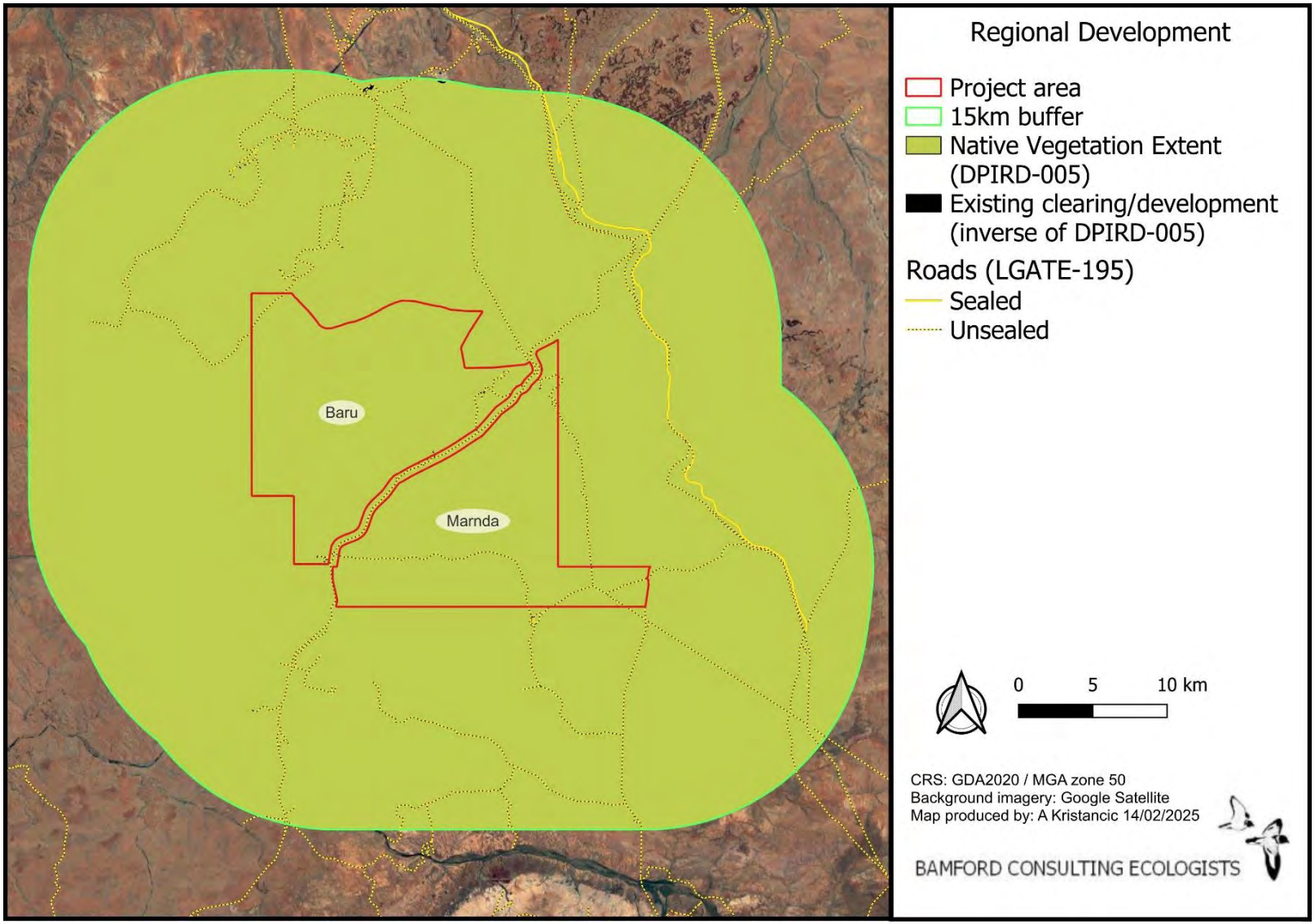


Figure 1-7. Regional development and extent of native vegetation within 15 km of the project area.

2 Methods

2.1 Overview

BCE has been commissioned to conduct a level 1 (Basic) fauna assessment, targeted survey for conservation significant fauna, and a comprehensive BBUS. The approach taken was guided by recommendations from regulators. The level of assessment recommended by the EPA (2020) for environmental impact assessment studies is determined by geographic position, with a generic statement that detailed surveys are expected across all of the state except the south-west, but also recommending that site and project characteristics be considered, such as the survey objectives, existing available data, information required, the scale and nature of the potential impacts of the proposal and the sensitivity of the surrounding environment in which the disturbance is planned. These aspects should be considered in the context of the information acquired by the desktop study. When determining the type of survey required, the EPA (2020) suggested that the following be considered:

- level of existing regional knowledge;
- type and comprehensiveness of recent local surveys;
- degree of existing disturbance or fragmentation at the regional scale;
- extent, distribution and significance of habitats;
- significance of species likely to be present;
- sensitivity of the environment to the proposed activities; and
- scale and nature of impact.

The EPA (2020) recommends three levels of investigation that differ in their approach for field investigations:

- Basic – a low-intensity survey, conducted at the local scale to gather broad fauna and habitat information (formerly referred to as 'Level 1'). The primary objectives are to verify the overall adequacy of the desktop study, and to map and describe habitats. A basic survey can also be used to identify future survey site locations and determine site logistics and access. The results from the basic survey are used to determine whether a detailed and/or targeted survey is required. During a basic survey, opportunistic fauna observations should be made and low-intensity sampling can be used to gather data on the general faunal assemblages present. While referred to as 'basic', this level of survey is involved and powerful, and should be considered the primary level of assessment. Other levels of assessment (where deemed necessary) add information to inform this primary level.
- Detailed – a detailed survey to gather quantitative data on species, assemblages and habitats in an area (formerly referred to as 'Level 2'). A detailed survey requires comprehensive survey design and should include at least two survey phases appropriate to the biogeographic region (bioregion). Surveys should be undertaken during the seasons of maximum activity of the relevant fauna and techniques should be selected to maximise the likelihood that the survey will detect most of the species that occur, and to provide data to enable some community analyses to be carried out.
- Targeted – to gather information on significant fauna and/or habitats, or to collect data where a desktop study or field survey has identified knowledge gaps. Because impacts must be placed into context, targeted surveys are not necessarily confined to potential impact areas. A

targeted survey usually requires one or more site visits to detect and record significant fauna and habitats. For areas with multiple significant species there may not be a single time of year suitable to detect all species. In these cases, multiple visits, each targeting different species or groups, should be conducted.

The DCCEEW (2024a) draft guidance for wind farm bird and bat survey does not specify survey methods but instead provides a framework on which the impacts from wind farms are to be assessed. It does however, specify that best-practise must be employed for Bird and Bat Utilisation Survey and that the survey programme is to extend for at least 24-months and to sample in each relevant season (e.g. four separate campaigns) per year. The basis for 24 months is to sample across climatic and annual variations while sampling migratory bird and bat species, some of which may be difficult to sample.

In consideration of guidance, the overall approach was therefore to conduct a desktop review and the following survey types:

- Walkover surveys – used to verify the Vegetation and Substrate Associations and record sightings or signs of fauna and their habitats whenever surveyors are in the field
- Baited camera traps – deployed to record and confirm the presence of targeted fauna
- Bird Census – a timed series of walked transects along which birds are sampled visually and aurally within 20 m of the transect.
- Vantage Points – a series of point locations from which birds flying through the proposed turbine array are sampled visually and aurally
- Acoustic Recording Units – a number of recorders deployed across the set to record the audible and ultrasonic calls of birds and bats

2.2 Identification of vegetation and substrate associations (VSAs)

Vegetation and substrate associations (VSAs) combine vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna.

BCE deliberately makes the distinction between 'habitat' (a species-specific term that may encompass the whole or part of one or more VSAs and is the physical subset of an ecosystem that a given species, or species group, utilises) and 'VSA' (a general, discrete and mutually exclusive spatial division of a target area, based on soil, vegetation and topography). It is recognised, however, that, within the broader EIA literature/guidance, the former term is used more or less synonymously to indicate the latter (e.g.' habitat assessment' used by EPA, 2020). Further discussion is provided in Appendix 1.

For the current assessment, VSAs were identified based on observations made during the field investigations, combined with the identification of vegetation types and vegetation mapping provided by Mattiske (2025) and interpretation of land systems.

2.3 Desktop assessment of expected species

2.3.1 Sources of information

As per the recommendations of EPA (2020), information on the fauna assemblage of the project area was drawn from a range of sources including databases (as listed in Table 2-1). The search areas used for the database review are shown on Figure 1-1. Information from these sources was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns are listed in Table 2-3.

2.3.2 Previous fauna surveys

In addition to the Level 1 Fauna Assessment conducted by BCE for the Jinbi Solar Farm (BCE, 2024), six previous fauna studies were identified within c. 40 km of the project area boundaries. These are listed in Table 2-2, and include three Basic fauna surveys, two SRE invertebrate surveys, a fauna habitat assessment, and a regional review of Ghost Bats in the Pilbara. Any fauna observations available from these previous studies were included in the compilation of the expected fauna assemblage (presented in Appendix 3).

Table 2-1. Databases searched for the desktop review. Most were accessed October 2023 using the following central coordinates: 50 K 496422E 7651345N (Jinbi project area). The DBCA Threatened and priority fauna database search was subsequently updated in November 2024 for a 50 km buffer around the boundaries of the current project areas.

Database	Type of records held in database	Area searched
Previous studies	Fauna recorded by the literature and previous studies in the vicinity of the project area.	20 km buffer around the centre point of the project area.
Atlas of Living Australia (ALA, 2024)	Fauna records from Australian museums and conservation/research bodies, including records from BirdLife Australia's Atlas (Birdata) Database.	20 km buffer around central coordinates.
NatureMap (DBCA, 2024c) (via request to DBCA)	Records from the Western Australian Museum (WAM) and Department of Biodiversity, Conservation and Attractions (DBCA) databases, including historical data and Threatened and Priority species in WA.	20 km buffer around central coordinates.
EPBC Protected Matters Search Tool (DCCEEW, 2024b)	Records on Matters of National Environmental Significance (MNES) protected under the EPBC Act.	20 km buffer around central coordinates.
Birdata (BirdLife Australia, 2024)	Bird records held by Birdlife Australia.	20 km buffer around central coordinates.
DBCA Threatened and Priority Fauna search (DBCA, 2024d)	DBCA records of threatened fauna.	50 km buffer around boundary of Baru and Marnda project areas.
DBCA Threatened Fauna List (DBCA, 2024d)	DBCA list of threatened fauna species	All invertebrate species of Pilbara region

Table 2-2. Previous terrestrial fauna surveys within a c. 40 km buffer around the Baru and Marnda boundaries.

Author	Title	Distance to site
Bamford Consulting Ecologists; BCE (2024)	Level 1 Fauna Assessment, Jinbi Solar Farm. Unpublished report for Yindjibarndi Energy Corporation.	adjacent
Astron (2013)	Millstream Transmission Corridor Level 1 Vegetation, Flora and Fauna Survey. Unpublished report for Rio Tinto.	c. 10 km
Rio Tinto (2021)	CPS 4442/6 – Supporting Report. Flora, Vegetation and Fauna Habitat Assessment at 7 Mile and 123-124 km Study Areas	c. 20 km
Biologic (2014)	Pilbara Ghost Bat Review. Targeted survey conducted for BHP Billiton Iron Ore, for the South Flank project. Unpublished report for BHP Billiton Iron Ore	regional
Ecoscape (2018a)	47 Patch, Silica Hills, Carlow Castle, Radio Hill and Weerianna Biological Surveys. Detailed Flora and Vegetation Survey. Level 1 fauna field survey and SRE field survey. Unpublished report prepared for Artemis Resources.	c. 27-35 km
Ecoscape (2018b)	Radio Hill Additional Area Biological Survey. Detailed Flora and Vegetation Survey. Level 1 fauna field survey and SRE field survey. Unpublished report prepared for Artemis Resources.	c. 25 km
Biologic (2012)	Targeted Ghost Bat Survey at Karijini National Park. Unpublished survey for BHP Billiton Iron Ore Pty Ltd.	c. 180-200 km (outside buffer but included for information on species biology)

Table 2-3. Sources of information used for general patterns of fauna distribution.

Taxa	Sources
Fish	Morgan *et al.* (1998), Allen *et al.* (2003), Morgan *et al.* (2014), DoF (2023).
Frogs	Tyler and Doughty (2009), Anstis (2017).
Reptiles	Storr *et al*. (1983, 1990, 1999, 2002) , Bush *et al.* (2010), Wilson and Swan (2021).
Birds	Johnstone and Storr (1998, 2005), Menkhorst *et al*. (2017).
Mammals	Van Dyck and Strahan (2008), Churchill (2009), Menkhorst and Knight (2011).

2.3.3 Nomenclature and taxonomy

As per the recommendations of the EPA (2020), the nomenclature and taxonomic order presented in this report are generally based on the Western Australian Museum's (WAM) Checklist of the Fauna of Western Australia 2020. The authorities used for each vertebrate group were: fish (Morgan et al., 2014), frogs (Doughty, 2022a), reptiles (Doughty, 2022b), birds (Gill et al., 2023), and mammals (Travouillon, 2022). In some cases, more widely-recognised names and naming conventions have been followed, particularly for birds where there are national and international naming conventions in place (e.g. the BirdLife Australia working list of names for Australian Birds (BirdLife Australia, 2022), and the International Ornithological Congress' 'World Bird List'). English common names (as proper nouns consistent with most guidance) of species, where available, are used throughout the text; Latin names are presented with corresponding English names in tables in the appendices. Where available, Yindjibarndi names are given. The use of subspecies is limited to situations where there is an important (and relevant) geographically distinct population, or where the taxonomic distinction has direct relevance to the conservation status or listing of a taxon.

2.3.4 Interpretation of species lists

2.3.4.1 Expected occurrence

Species lists generated from the review of sources of information are generous as they include records drawn from a large region (the study area; a 20 km buffer around the centre point of the project area) and possibly from environments not represented in the project area. Therefore, some species that were returned by one or more of the database and literature searches have been excluded because their ecology, or the environment within the project area, determined that it is highly unlikely that these species will be present. Such species can include, for example, seabirds that might occur as extremely rare vagrants at a terrestrial, inland site, but for which the site is of no importance. Species returned from the databases and not excluded on the basis of ecology or environment are therefore considered potentially present or expected to be present in the project area at least occasionally,

whether or not they were recorded during field surveys, and whether or not the project area is likely to be important for them. This list of expected species is therefore subject to interpretation by assigning each a predicted status, the expected occurrence, in the project area. The status categories used are:

- **Resident:** species with a population permanently present in the project area.
- **Regular visitor:** species that occur within the project area regularly in at least moderate numbers, such as part of an annual cycle (thus includes migrants).
- **Irregular Visitor:** species that occur within the project area irregularly such as nomadic and irruptive species. The length of time between visitations could be decades but when the species is present, it uses the project area in at least moderate numbers and for some time.
- **Vagrant:** species that occur within the project area unpredictably, in small numbers and/or for very brief periods. Therefore, the project area is unlikely to be of importance for the species.
- **Locally extinct:** a species that would have been present historically but has not been recently recorded in the local area and therefore is almost certainly no longer present in the project area.

These status categories make it possible to distinguish between vagrant species, which may be recorded at any time but for which the project area is not important in a conservation sense, and species which use the project area in other ways but for which the site is important at least occasionally. This is particularly useful for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive, and further recognises that even the most detailed field survey can fail to record species which will be present at times. The status categories are assigned conservatively based on the precautionary principle. For example, a lizard known from the general area is assumed to be a resident unless there is very good evidence the project area will not support it, and even then, it may be classed as a vagrant rather than assumed to be absent if the site might support dispersing individuals. It must be stressed that these status categories are predictions only and that often very intensive sampling would be required to confirm a species' status. It should be noted that the aim of the desktop assessment and field investigations is not to confirm the presence or absence of species in the project area. By using a precautionary approach, the expected species assemblage represents a conservative estimate of the species assemblage that may use the project area, with errors of inclusion rather than exclusion.

The results of the database searches were reviewed and interpreted, and obvious errors and out of date taxonomic names were deleted.

2.3.4.2 Conservation significance

All expected species were assessed for conservation significance as detailed in Appendix 1. Three broad levels of conservation significance are used in this report:

- Conservation Significance 1 (CS1) – species listed under State or Commonwealth Acts such as the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian *Biodiversity Conservation Act 2016* (BC Act);
- Conservation Significance 2 (CS2) – species listed as Priority by DBCA but not listed under State or Commonwealth Acts; and

- Conservation Significance 3 (CS3) – species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

See Appendix 1 for an expanded discussion of these categories and Appendix 2 for a description of the categories used in the legislation (EPBC and BC Acts) and by the DBCA.

2.4 Field investigations

2.4.1 Targeted Surveys

Targeted sampling of conservation significant ground fauna was undertaken using camera traps and observations made during the site walkovers. Three camera traps were deployed on 16th July and retrieved in August. A further two were deployed during the August visit and retrieved in November. These were placed and baited at locations in which conservation significant fauna could be expected. Through existing knowledge, the desktop study and the reconnaissance visit, the conservation significant species that require targeted sampling includes the Yirriwardu or Northern Quoll (*Dasyurus hallucatus*), Jardanmurra or Rock Wallabies (*Petrogale* spp.)) and Bargunyji or Pilbara Olive Python (*Liasis olivaceous pilbarensis*). A single camera trap was also deployed on 13th November at the entrance of the largest cave found in the development boundary. This cave is approximately 5 m wide, 8 m long and 2 m high at its highest point, and well-ventilated through fissures and boulders at one end. The cave also contained a number of roosting bats, scats of several bat species and scats of the Northern Quoll. Camera locations are shown on Figure 2-3. Camera traps were set to take three images each time they were triggered, and bait consisted of sardines, oats and peanut butter placed c. 2 m in front of each camera.

2.4.2 Bird and Bat Utilisation Survey

For wind farm projects in Australia, it is expected that the Proponent will need to undertake a Bird and Bat Utilisation Survey (BBUS) for wind farm developments. This can involve a range of sampling methods depending on site conditions and the assemblage expected. A reconnaissance visit to better understand how to conduct the BBUS was conducted between 6th and 8th August 2024 by Mrs Mandy Bamford and Drs Mike Bamford and Barry Shepherd. This survey team was transported around the project areas by helicopter.

Three specific sampling methods for birds, bird census, Vantage Points (VPs) and acoustic (aural) recording units, were selected that can reasonably be expected to investigate presence, behaviour and risk from a wind farm development. Ten VPs and seven Bird Census transects were laid out across the Project areas, as shown in Figure 2-2 and Figure 2-3. These were located to ensure all representative landscapes, and environments across the development area were sampled. Bats are sampled primarily using static acoustic recording units (ARUs), evening bat transects (where access allows) and by inspecting caves and boulder piles. A series of 24-26 ARUs was deployed and maintained during each campaign; locations are shown on Figure 2-3 and details of settings are provided in Table 2-4 and Table 2-5.

Resident birds that are potentially at risk of displacement due to construction or operations of the proposed development, are systematically recorded along a series of 1-2 km long bird census transects. A surveyor traverses a transect at a steady pace recording the number of birds and species either sighted or heard from within a 20 m corridor either side. Each transect takes approximately

one hour to complete. Bird Census data can be used during monitoring to identify whether bird numbers have changed through construction or operations of the wind farm. Bird Census sampling was undertaken during the September 2024 and November 2024 surveys, and their positions are shown on Figure 2-3.

The vantage point (VP) sampling method was included in the BBUS to sample the birds that fly through the airshed of the wind farm at the height of the turbine blades (rotor swept path or RSP) and thus at risk of being struck by the spinning blades. The VP method is described by Scottish Natural Heritage (2017) and has been applied in many theatres around the world in various derivations. SNH (2017) is referred to in the *Guidance for Bird Surveys on Wind Farms* (DCCEEW, 2024a). The primary intention of VP sampling is to target CS1 bird species listed under the EPBC Act as Threatened or Migratory and these are deemed "primary targets". Primary targets include Grey Falcon, Peregrine Falcon and migrants. If spotted wherever they are, birds considered primary are to be tracked for as long as they are in view, and records of their height, number and behaviour made. Primary targets must be recorded whenever they are observed and not just within the RSP/VP buffer. Secondary targets include the Black-breasted Buzzard and all other raptors but should not distract the observer from detecting and tracking primary species. Other species flying within RSP are listed only. A list of primary and secondary bird species together with the lower and upper heights of the RSP, is communicated to the survey team prior to commencement. VPs were established at locations that gave good platform to view the landscape and were generally on higher ground to minimise the amount of dead ground obscuring the observer's ability to spot birds. Each VP and their 2 km buffer zones are shown in Figure 2-2.

Where resultant data for a species are sufficient, they are used to estimate the density (or flux) of birds passing through the wind farm each year, and to drive collision risk modelling (CRM). The principal output from CRM is an estimate of the number of birds of each species that can be expected to be killed annually by the wind turbines. To this end, each VP is sampled throughout the day, for a set period of time up to three hours. It is normal to divide the day into three periods (AM, noon and PM) and adjusted to capture the main periods of flight activity. The distance of detection is normally limited to a 2 km "buffer zone" from the VP, but may be adjusted depending on how far a target species can reasonably be detected and tracked. Each observer scans primarily using binoculars (7-10 X magnification) but also with the naked eye. A spotting scope (20-60 X magnification), is used to confirm species where necessary. When target birds are detected, their position in the landscape and flight heights are estimate and recorded as often as possible to track their flight until they are no longer visible. Secondary species are recorded in a similar way but only when they are in the RSP and buffer zone. Records can be taken either on oral recordings, paper maps or through digital devices and directly into a Geographic Information System (GIS). Most recording was carried out digitally using a customised version of Q-Field.

The first campaign for VP and bird census was undertaken between 27 September and 1 October 2024 and conducted by Drs Mike Bamford and Barry Shepherd, with Will Oversby (Coterra) and Angus Mack (Yindjibarndi Corporation) in attendance. A second campaign occurred between 11th and 14th November 2024 and was conducted by Dr Mike Bamford, Dr Barry Shepherd and Peter Smith with Angus Mack (Yindjibarndi Corporation) and Tamara Booker (YEC) accompanying part of the survey. The ARUs were attended on both trips. All survey campaigns were based out of the Ngurrawaana Community and facilitated via helicopter for the majority of sampling sites. 4X4 vehicles were used to

access the four most southern sampling sites. VP sampling times and effort are provided in Appendix 8.

In addition, to the visual sampling, Acoustic Recording Devices (ARUs), have been set to periodically record audible sounds for birds and other fauna, and ultrasonic sounds for bat species. In August and September 2024, 24 Titley Chorus ARUs and two Titley Ranger ARUs were deployed. Batteries are expected to last between three to four weeks for the Chorus and four to six weeks for the Ranger. Battery life depends largely on how often ultrasonic recording is triggered. The batteries and SD cards are planned to be replaced at least once in each quarter. Two ultrasonic microphones attached to the Ranger ARUs were elevated to approximately 25 and 50 m above ground level using one of the Meteorological masts. This would potentially provide some information on flight height of the bats recorded. All ARU positions are shown on Figure 2-3. The ARUs were set to record with the settings provided in Table 2-4 and sampling schedules (duty cycles) in Table 2-5. Twenty-three Titley Chorus ARUs and one Titley Ranger ARU were deployed across the project area between 6 and 8 August 2024. Between 27 September and 1 October 2024, data from deployed ARUs were retrieved and batteries replaced. A second Ranger and another Chorus (making a total of 26 ARUs) were deployed. The ultrasonic microphones for both Rangers being elevated to approximately 25 and 50 m up the meteorological mast (metmast). The three ARUs located at the metmast were set purely for detecting bats at elevation. Durations of sampling on ARUs for birds from the period 6 August to 27 September 2024, ranged from five to 21 days/nights. Acquisition of bat calls ranged from three to 27 nights with the Ranger ARUs having substantially more endurance due to larger battery capacity. Duration of sampling on all units was negatively related to the quantity of ultrasonic recording being triggered.

Data were collected again between 11 and 14 November 2024. Unfortunately, a technical issue had beset the majority of ARUs and some of the Chorus's had collected only one day of bird data. The two Rangers deployed at the metmast acquired bat data over 24 nights while the Chorus at the metmast acquired data over 10 nights.

Data were again collected on 22nd December 2024 whereby the technical issue was resolved and data from all detectors acquired (where available). Only the three ARUs at the metmast had operated and acquired bat data from between 14 and 23 nights. One Ranger had also failed 17 days into recording and needed to be retrieved for repair.

Ultrasonic records were sent to and analysed by Dr Kyle Armstrong (Supersensory Technologies, 2025) who has provided a memo report for data up to and including 21st December 2024.

Despite the technical difficulties, a substantial amount of acoustic data were acquired.

Table 2-4. Settings for the Chorus and Ranger ARUs.

Ultrasonic				
Sample Rate	Min. trigger Freq.	Max. Trigger Freq.	Min. event	Min/Max file duration
320 ksps	5 kHz	160 kHz	2 ms	2/10s
Audible				
Sample Rate		Acoustic Gain		File Duration
44.1 ksps		+12 dB		30 mins

The ultrasonic settings (and locations of the ARUs) were selected to maximise the chances of being able to sample Ghost Bats and Pilbara Leaf-nosed Bats. However, both species are acoustically cryptic and can only be recorded under very specific circumstances. Sampling in the audible range (for birds) was used to acquire a more robust suite of data that satisfies the following:

- over a longer period than ecologists could attend the site
- when hot weather would be a risk to surveyors
- nocturnal species
- rarer events that have very low likelihood of being detected by surveyor alone
- bioacoustics as a representation of biodiversity to support long term monitoring.

Table 2-5. Sampling schedules for the Chorus and Ranger ARUs. ARUs at the met-mast were scheduled for bats and nocturnal birds only. All others were set to record all four schedules sequentially through the week.

Target Taxa	From	To	Mode	Days/week
Dawn Chorus	2 hrs before sunrise	1 hr after sunrise	Continuous	2
Diurnal Birds	75 min after sunrise	1 hr before sunset	30 min on, 60 min off	3
Nocturnal Birds	1 hr after sunset	1 hr before sunrise	30 min on, 60 min off	2
Bats	30 min before sunset	30 min after sunrise	Triggered	3

2.4.3 Survey Limitations

The EPA Guidance Statement 56 (EPA, 2004) and the EPA (2020) outline a number of limitations that may arise during field investigations for Environmental Impact Assessment. These survey limitations are discussed in the context of the BCE investigation of the Project Area in

Table 2-6. No limitations were identified.

Table 2-6. Survey limitations as outlined by EPA (2020).

EPA Survey Limitations	BCE Comment
Availability of data and information	Sufficient information from databases and previous studies. Not a limitation.
Competency/experience of the survey team, including experience in the bioregion surveyed	The ecologists have had extensive experience in conducting field surveys for environmental impact assessment fauna studies, particularly for bird survey and habitat assessments and have undertaken a number of similar studies within Western Australia. Not a limitation.
Scope of the survey (e.g. where faunal groups were excluded from the survey)	No fauna groups were excluded from the survey. Not a limitation.

EPA Survey Limitations	BCE Comment
Timing, weather and season	Seasonality is of great importance for this type of assessment, and, together with previous studies was undertaken during appropriate times of the year. Not a limitation.
Disturbance that may have affected results	Surveyors were mindful not to disturb fauna and in particular birds and bats being studied. Surveyors took appropriate actions for their dress, and timing following deployment by helicopter to ensure bird activities were unaffected during survey campaigns. Not a limitation.
The proportion of fauna identified, recorded or collected	The sampling regime provided a very high chance for detecting and recording the target species. Not a limitation.
Adequacy of the survey intensity and proportion of survey achieved (e.g. the extent to which the area was surveyed)	The project area was adequately sampled to the level appropriate for distribution and flight survey of the targeted species. Not a limitation.
Access problems	The site had difficult terrain and weather conditions. However, Proponent provided helicopters to access the more remote locations and vehicles were used elsewhere. One sampling session in March 2025 was foreshortened due to electric storm but time was made up. Not a limitation.
Problems with data and analysis, including sampling biases	Due to the technically challenging data collection and remoteness, a digital recording system was devised to efficiently record flight data directly into GIS. Not a limitation.

2.4.5 Personnel and permits

Personnel involved in the field investigations and report preparation (including desktop review) are listed in Table 2-7. Although almost all work was by observation and did not involve capture or even interference with animals in any way, work was carried out under DBCA Fauna Taking (Biological Assessment) Regulation 27 Licence Number BA27001096, and under Wildlife Animal Ethics Committee approval WAEC 22-02-22.

Table 2-7. Personnel involved in the field investigations and report preparation.

Personnel	EIA/Wildlife Survey Experience	Field Investigations	Report Preparation
Angus Mack (Yindjibarndi Corporation)		+	
Dr Mike Bamford *BSc (Biology), Hons (Biology), PhD (Biology)*	40 years	+	+
Mandy Bamford *BSc (Zool.)*	35 years	+	
Will Oversby (Coterra) *BSc (Environmental Biology), Hons (Zoology)*	7 years	+	
Dr Amanda Kristancic *BSc (Zoology/Biochemistry), Hons (Zoology), PhD (Parasitology)*	8 years		+
Dr Barry Shepherd *BSc Hons. (Env. Biol.), PhD (Ecology)*	30 years	+	+
Peter Smith *Assoc. Dip. Agric. (Farm Management)*	30 years	+	

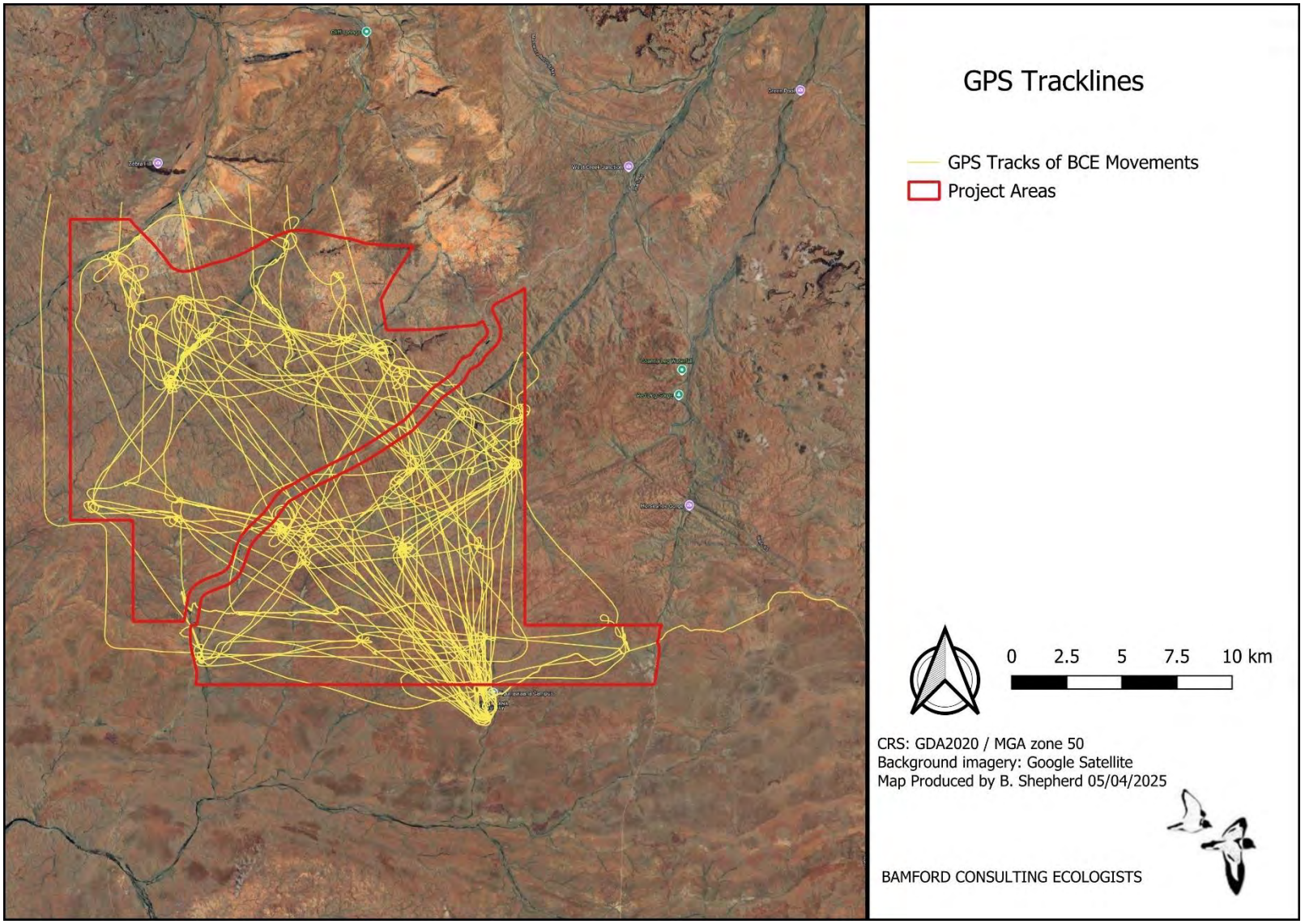


Figure 2-1. GPS tracks for the BCE surveyors recorded throughout campaigns from August 2024 to March 2025.

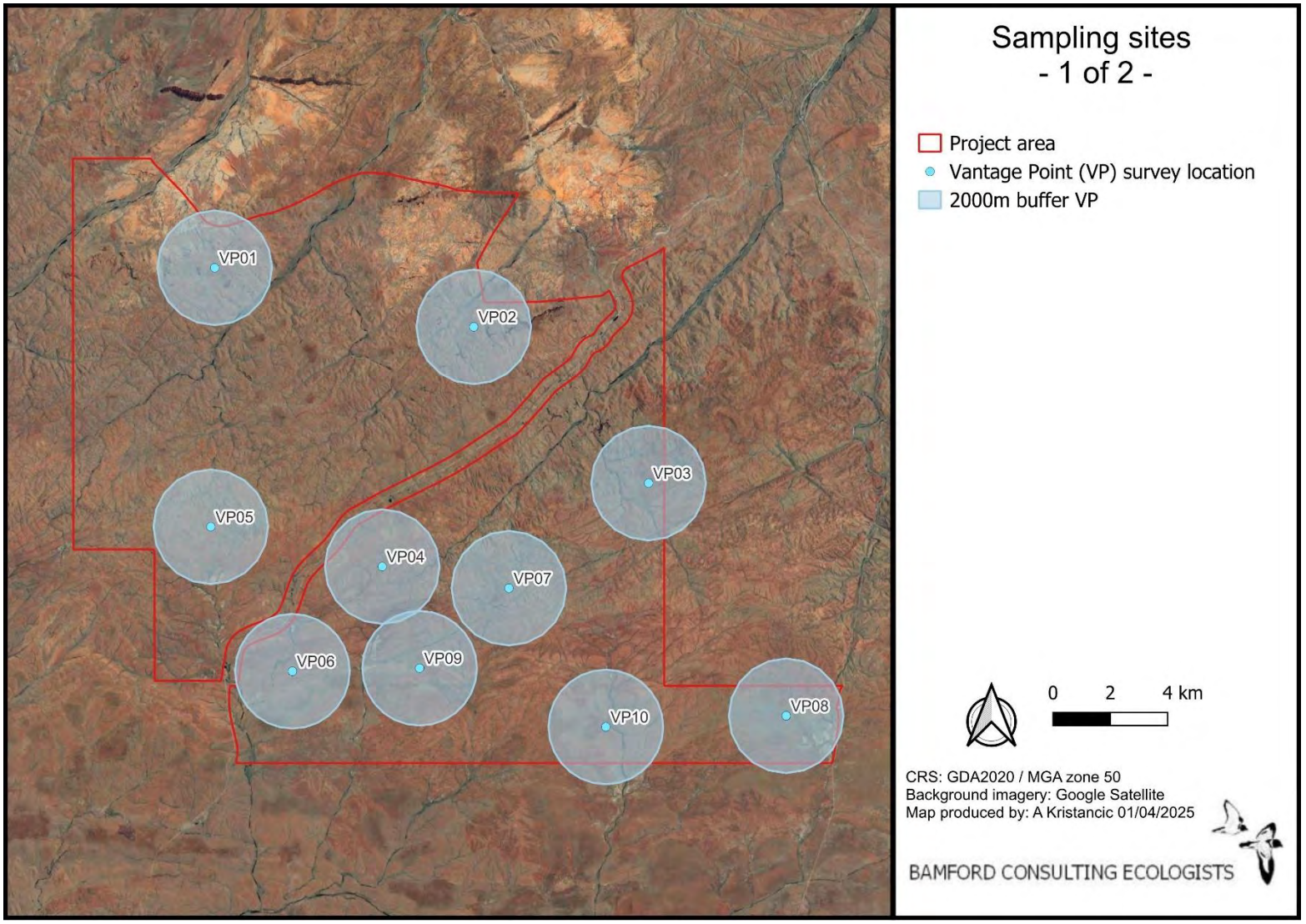


Figure 2-2. Locations of VP surveys (including 2000m buffer indicating area covered during VP survey).

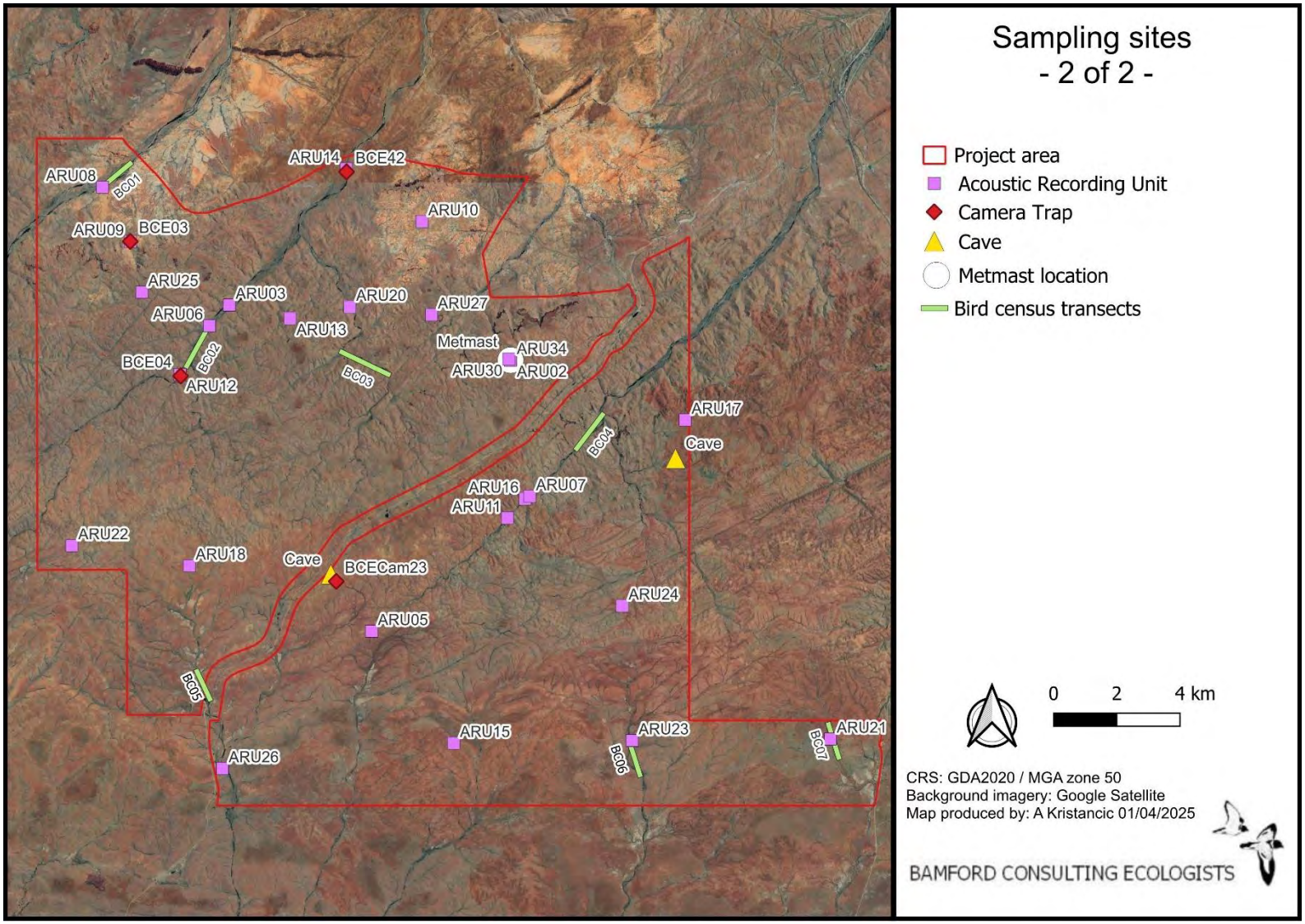


Figure 2-3. Locations of deployed devices and bird census transects. Figure also indicates locations of caves, one of which was targeted with a motion sensitive camera.

3 Fauna values

This section presents the results of the desktop and field investigations in terms of key fauna values (described in detail in Appendix 1) and includes:

- Preliminary information regarding environments and VSAs in the areas visited
- Fauna assemblage characteristics (uniqueness, completeness and richness)
- Species of conservation significance
- Patterns of biodiversity across the landscape
- Ecological processes affecting fauna.

3.1 Landscape, and Vegetation and Substrate Associations (VSAs)

Rainfall had fallen prior to the visits in July and August 2024 which left substantial amounts of standing water throughout the creeklines in the north and centre of Baru and Marnda. No pools were observed in the southern third of either Baru or Marnda during these campaigns, but there was water in creeklines south of Marnda (near Ngurrawaana). A significant rainfall event occurred a month or so prior to the March 2025 campaign leaving a substantial amount of water across the entire area. Because of this rain, new vegetation growth and seed heads were prominent. New growth was prominent on VSA 4 in particular and seed heads of Triodea was abundant across the entire project area. In response to the new growth and seed abundance was a very high abundance and diversity of insect and bird life, especially across the southern quarter of Marnda.

The project area encompasses rocky hills to undulating stony plains. Highest elevation on Baru is around 320 m above sea level in the north-west while valleys drop to around 120 m in the alluvial plains to the north-east. On Marnda, the higher ground is approximately 370 m in the south-east, with another high-point of 340 m towards the centre. Valley floor of the Harding tributary drops to around 165 m above sea level on Marnda in the north while lowest elevation in the south is around 260 m in the western-most creekline.

A distinctive feature of the landscape is that it has several broad geological components:

- Rocky basaltic hills of the Rocklea Land System across much of Baru and in part (mostly south) of Marnda. The hills are more abrupt in Baru than in Marnda. Hills are dissected by valleys with minor watercourses. Soil very shallow or even non-existent on hills, but some valleys have flats with loam/cobbles and the largest drainage lines with coarse sand beds. Several of the larger watercourses have formed deeper valleys and occasional gorges containing near-permanent pools. In places the deeper drainage systems have intersected strata of conglomerate rocks. Vegetation very sparse on rockiest hills but gorges often well-vegetated.
- Undulating granitic plains and granite boulderfields of the Boolaloo and Macroy Land Systems in the north of Baru. Boulderfields are very distinctive and massive, rising tens of metres about the surrounding landscape, but also extensive areas of a grey conglomerate and layers of alluvial loam/cobbles over decomposed granite across undulating plains. A linear feature in the south-west appears to be two lines of basalt crumbling into boulders; possibly an intrusion through the granite. Vegetation across the plains mid-dense tall shrubland over spinifex. Scattered eucalypts in slightly low-lying areas of best loam soil. Major watercourses on the granitic plain are not deeply incised but have a broad sandy bed with exposed granite. Much evidence of seasonal pools but all dry at the time of the site visits. Some dense shrub-thickets along watercourses and occasional eucalypts.

- Undulating sandstone hills of the Capricorn Land System that form a belt aligned east-west across Marnda.
- Small areas of the Wona Land System of gilgai plains in the south of Marnda supporting Roebourne Plains grass and Mitchell grass tussock grasslands, minor hard spinifex grasslands or annual grasslands/herbfields.

The entire area is incised by several major and minor creeklines each with their own smaller tributaries towards their sources in the higher ground. There are three major and one minor watercourses flowing to the north and four lesser watercourses flowing to the south, with the Maitland and Harding systems to the north and the Fortescue catchment to the south. Therefore, the combined project area straddles the upper reaches of two watersheds. Importantly, the close proximity of the upper reaches of the northern and southern creek lines potentially offer relatively short passage over harsh landscapes for the fauna from the two separate systems to move.

Vegetation across a substantial northern section of Baru and Marnda was almost entirely burnt in spring 2023 (see Plate 1 and Plate 2). Away from the burnt area, the hills and slopes are mostly dominated by spinifex of varying densities, with occasional stunted *Corymbia* trees dotting the landscape. Trees are substantially more numerous across the southern hills when compared to the north. Small hillocks occur along a southern band of Marnda and in particular these support small patches of open *Corymbia* woodland. Valley flats are comprised of loamy, cobbled soils supporting mid-dense to dense tall shrubland with scattered eucalypts (*Corymbia* spp). Shrubs form thickets along drainage lines with occasional Corymbia and probably *Eucalyptus victrix*. A few Cadjeput and beds of Typha were present in just one drainage line in the south-west. The presence of Cadjeput is an indicator of permanent groundwater close to the surface.

Botanists from Mattiske Consulting have visited the project area and described 14 vegetation types (Mattiske, 2025). These were used as the basis for the VSAs (fauna 'habitats') as plotted in Figure 3-1 and summarised briefly here:

- VSA 1 - Open hummock grassland on rocky basalt hills, plateaux and plains (25,575.3 ha [63.2%]), comprised of low isolated trees (comprised of *Acacia inaequilatera* and *Corymbia hemersleyana*) over low sparse shrubland (comprised of *Indigofera monophyla*, *Acacia pyrifolia* and *Acacia bivenosa*) over low open hummock grassland (comprised of *Triodia wiseana* and *Triodia epactia*). This grassland is broadly distributed mostly across the higher slopes of Baru and Marnda. See Plate 1 and Plate 2.
- VSA 2 - Low and sparse shrubland over sparse hummock grasslands on stony plains and granite tor fields (2,784.7 ha [6.9%]), comprised of low isolated trees (*C. hamersleyana*) over sparse shrubland (*Acacia ancistrocarpa*, *A. pyrifolia* and *Grevillea wickhamii*) *over sparse* hummock grassland (*T. epactia* and *T. wiseana*). This shrubland type lies on the lower areas in the north of Baru and Marnda and is interspersed with fields of large boulders. See Plate 3 and Plate 4.
- VSA 3 - Open woodland along ephemeral drainage channels incised into rocky creeklines (2,268.1 ha [5.6%]), comprised of *E. victrix* woodland over mid sparse shrubland (*Melaleuca linophylla*, *A. bivenosa*, *Acacia coriacea*) and low sparse shrubland (comprised of *Cyperus vaginatus*, *Stemodia grossa* and *Tephrosia rosea*). This vegetation type dominates the creeklines in both the northern and southern catchment areas and is interspersed with permanent and ephemeral pools. See Plate 5 and Plate 6.

- VSA 4 - Grassland with low isolated shrubs over friable cracking clay on basalt upland gilgai plains and flats (1,146 ha [2.8%]), comprised of low sparse tussock grassland (*A. latifolia* and *T. wiseana*) with low isolated shrubs and diverse annual herbs and grasses (of *Rhynchosia minima* and *Streptoglossa bubakii*). This grassland type is limited to the flats in the south of Marnda. See Plate 7.
- VSA 5 - Low open woodland and isolated shrubs on sandstone hilltops (8665.7 ha [21.4%]), comprised of low open woodland (*Eucalyptus leucophloia*) over low isolated shrubs (*A. bivenosa*, other *Acacia* spp, and *Senna glutinosa*) over low sparse hummock *Triodia wiseana* grassland on rocky sandstone alluvium. This woodland type is confined to a band of higher ground and small patches that lies across the southern half of Marnda with some small areas in Baru. Corresponds roughly to the Capricorn Land System. See Plate 8 and Plate 9.

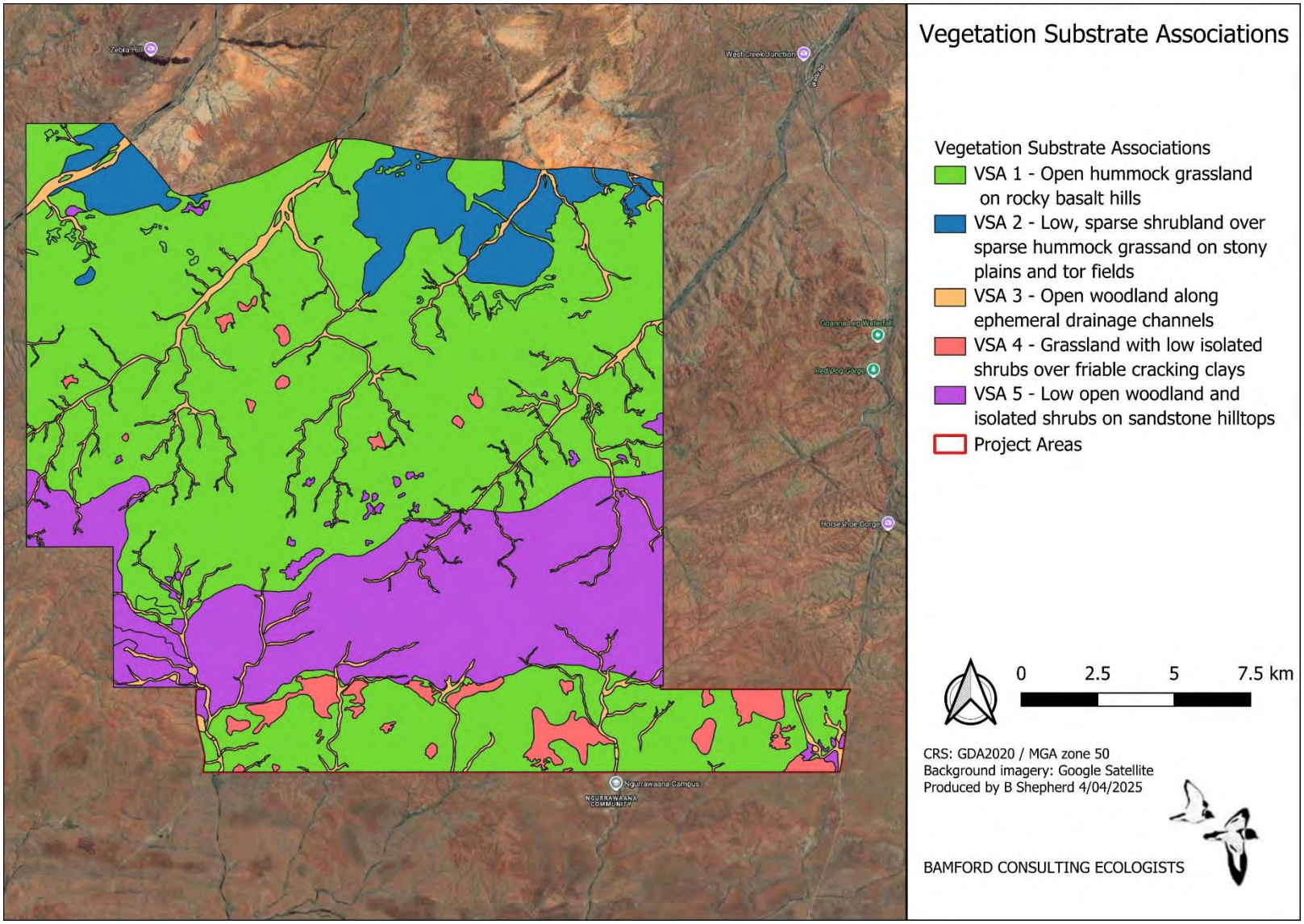


Figure 3-1. Vegetation Substrate Associations based partly on vegetation mapping from Mattiske (2025).

Plate 1. Typical landscape view of basalt hills (VSA 1 – Rocklea Land System) and creeklines (VSA 3) in the centre of Baru from the air looking north along one of the tributaries of the Maitland River. Image was taken in November 2024 and show patchwork of unburnt spinifex grasslands and extensive areas of more or less open ground where it was burnt in November 2023.

Plate 2. VSA 1 - Top of basalt plateau in centre of Baru showing sparse Triodia recovering from fire in spring 2023 and cobbled basalt. Note small creeklines on far ground and hidden creekline (containing VSA 3) falling away in centre of view. Rocklea Land System.

Plate 3. VSA 2 – Boulder tor on lower ground in north-west corner of Baru. Boulders form plentiful cavities which are used as shelter for many fauna species including Rock Wallabies (as seen against skyline), Northern Quoll, and many species of bats and birds. Example of Boolaloo Land System.

Plate 4. VSA 2 – Boulder field in northern Baru.

Plate 5. VSA 3 – dried creekline forming a tributary of the Maitland River towards higher ground in the centre of Baru. Woodland and scrub vegetation varies widely along creeklines likely due to depth of the water table below surface.

Plate 6. VSA 3 of sparse herbs and shrubs along creekline with an ephemeral pool following spring rains. Cattle were seen throughout the creeklines and signs of poaching (trampling) were present at drinking locations. Aquatic plants and fish (Grunters and Rainbowfish) were plentiful in the larger pools. Slopes to left and right of picture contain VSA 1 with vegetation recovering from fire.

Plate 7. VSA 4 – grassland and herb community on cracking clay plains along southern edge of Marnda. This image was taken during the September visit when most vegetation lay dormant.

Plate 8. VSA 5 - Dense Triodia and scattered shrubs on undulating low, rocky hills on high ground on southern parts of Marnda; Capricorn Land System.

Plate 9. VSA 5 – Scattered Corymbia over spinifex on higher ground along a band across Marnda.

3.2 Fauna assemblage

The abundance of recorded fauna changed considerably between campaigns. Substantial rainfall had fallen before the August and March campaigns and a storm went through the west of Baru during the March campaign. Rainfall provided abundant water bodies across the northern parts of Baru and Marnda in the winter, and across the entire area in the summer whereby far greater amounts of standing water were present. In response, new plant grow was evident especially in VSA 4, and seed heads of Triodea were universally abundant. These factors played a leading role in the presence, abundance and diversity of transitory or irruptive fauna.

3.2.2 Overview of vertebrate fauna assemblage

The desktop assessment identified 261 vertebrate fauna species as potentially occurring in the project area: three fish, six frogs, 65 reptiles, 149 birds, 35 native mammals (including the Mujira (Dingo) considered 'naturalised') and three introduced mammals. These species are listed in Appendix 3. The presence of at least 111 expected fauna species (two fish, two frogs, ten reptiles, 81 birds, 14 native mammals and two introduced mammals) has been confirmed during field investigations, either by direct observation, cameras, recordings or due to the presence of evidence such as tracks, shed skin, and scats. Steindachner's Turtle was recorded on site but was not represented in the databases for the area. An annotated list of these species is presented in Appendix 4 and observed species are indicated in Appendix 3. Note that European Cattle are present in the project area (and evidence of this species was observed along major drainage lines) but as this is a domesticated species, it is excluded from the expected species assemblage and instead listed in Appendix 6. The composition of the expected vertebrate fauna assemblage is summarised in Table 3-1.

At least six mammal species that would historically have been present in the project area are considered locally extinct and have been omitted from the expected species list. These species are listed in Appendix 5 and summarised in Table 3-1.

Thirty-four species returned from databases were omitted due to habitat or range limitations, or because they are domesticated species. These are listed in Appendix 6.

Table 3-1. Composition of expected vertebrate fauna assemblage of the project area.

Taxon	Total*	Number of species in each status category				
		Resident	Regular visitor	Irregular visitor	Vagrant	*Extinct or locally extinct*
Fish	**3**	0	3	0	0	*0*
Frogs	**6**	6	0	0	0	*0*
Reptiles	**65**	65	0	0	0	*0*
Birds	**149**	50	42	39	18	*0*
Native mammals[+]	**35**	25[+]	6	2	2	*6*
Introduced mammals	**3**	2	0	1	0	*0*
Total	**261**	**148**	**51**	**42**	**20**	*6*

[+] Includes the Dingo, considered 'naturalised'

* Extinct or locally extinct species are not included in the number of expected vertebrate fauna species.

3.2.3 Expected vertebrate fauna

Records of vertebrate fauna (excluding birds and bats) detected during survey campaigns are plotted in Figure 3-2, while bat records are shown in Figure 3-3.

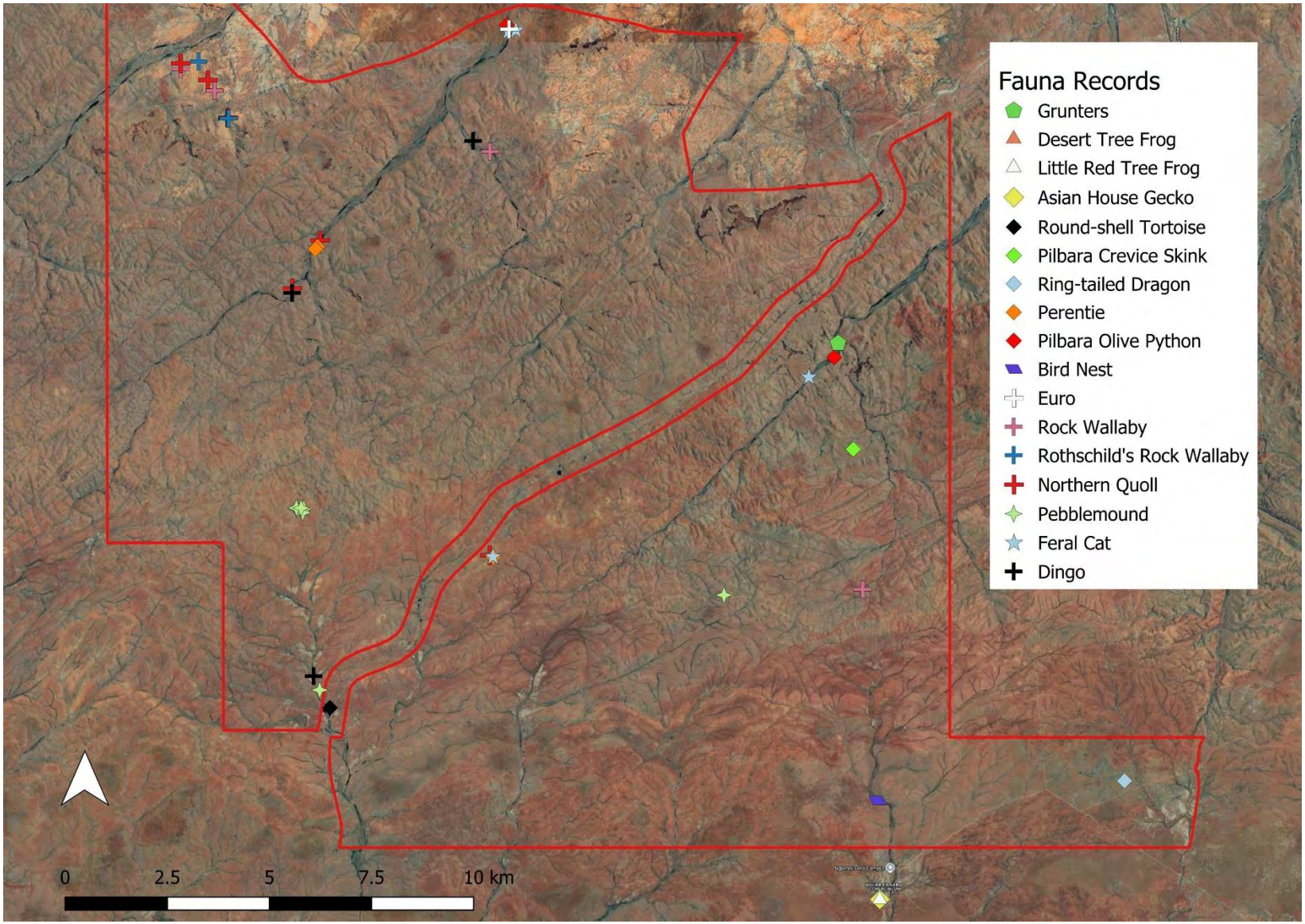


Figure 3-2. Records of fish, frogs, reptiles and mammals (excluding bats) recorded throughout campaigns.

Fish

The Western Rainbowfish (*Melanotaenia australis*) and Spangled Grunter (*Leiopotherapon unicolor*) were observed in water bodies along the creeklines on Baru during August, September and March campaigns. Both are freshwater fish species that are common in waterways in the region. Both are likely to be seasonal visitors following rain and flooding, though the Grunter may be able to aestivate in moist substrate during dry periods (Froese & Pauly, 2019). The Fortescue Grunter may occasionally occur in the upper reaches of watercourses that are part of the Fortescue River catchment. It is a priority species and is discussed further below. Note that other freshwater fish species known from rivers in the western Pilbara may occasionally be present as distributions are uncertain.

Frogs

The six frog species are all expected to be resident to the project area. The Little Red Tree-Frog (Jarrarna – *Litoria rubella*) and Douglas's Toadlet (*Pseudophryne douglasi*) were heard calling in August, September and March from dense emergent vegetation around pools along creeklines, and the Little Red Tree-Frog was resident at Ngurrawaana. Most of the frog species are likely to disperse widely away from the springs and drainage systems for part of the year, but rely on seasonal pools for breeding. Permanent or near-permanent pools that may contain fish are likely to be less important for breeding due to predation risk posed by the fish. For example, tadpoles of at least two frogs species were present in pools towards the higher creeklines (Plate 6), but tadpoles were not present in the larger and probably permanent pools in the deeper gorges. None of the frog species is of conservation significance.

Reptiles

The 64 reptile species include 50 lizards and 14 snakes, and all are expected to be residents. Note that this is effectively a precautionary assessment and means that if a reptile species is considered potentially present in the area, it is likely to be a resident. This is only a moderately rich assemblage as the lack of sandy soils means that a number of additional species known from the broader region are not likely to be present. During the site inspection in August, the Ring-tailed Dragon (Marndangatha, see Plate 10) was common even in areas that had been burnt intensely, and Long-nosed Water Dragons (Garlirrinygaa) were common around pools and springs. A sloughed skin of a medium sized Pilbara Olive Python (Bargunyji) was found on the banks of a water body in the north of Baru during the September visit, and a large scat, almost certainly of this species, was recorded during the November visit. A Pilbara Crevice Skink was also photographed in a shallow cave towards the north of Marnda during the March 2025 visit. Perentie (*Varanus giganteus*) were encountered several times during the March visit and were recorded on a camera trap placed outside a shallow cave in the north of Marnda on two separate occasions. The House Gecko, the only introduced reptile species expected, was recorded at Ngurrawaana. Four of the expected reptile species are of conservation significance: Pilbara Olive Python (CS1), Gane's Blind Snake (CS2), Lined Soil-crevice Skink (CS2) and Four-lined Slider (CS2). A carcass of a Steindachner's (or Plane-shelled) Tortoise (*Chelodina steindachneri*) was found in the southwestern corner of Marnda adjacent a dried muddy pond.

Plate 10. (Left) - photo of the Ring-tailed Dragon (*Ctenophorus caudicinctus*) taken at VP08 and Pilbara Crevice Skink (*Egernia pilbarensis*) taken in shallow cave in north of Marnda.

Birds

The expected bird assemblage of 148 species is rich, with about one third (50 species) expected as residents. The remainder are expected as regular visitors (43 species), irregular visitors (38 species) and vagrants (17 species). The recent fire across the spinifex country on higher ground is likely to have resulted in a reduction in the diversity and numbers normally present. The Spinifexbird was recorded from September 2024 despite the condition of the vegetation (all records were from unburnt patches), and birds associated with this VSA are likely to return when the vegetation recovers.

Changes in abundance and diversity were noticed between winter, spring and summer. This was likely in response to availability of standing freshwater and plant growth. Waterbirds were more prevalent in winter following rain and pools were abundant but virtually absent in summer when standing freshwater was at its highest levels following rainfall before and during the March 2025 campaign.

Throughout the March campaign, seed and flower-dependent birds such as Budgerigar, Cockatiels, finches and chats were particularly abundant. Insectivores such as Woodswallows, Swifts, Martins and Kestrels were also present in large numbers ,while Black-shouldered Kites and Spotted Harriers were recorded for the first time. Other raptors such as Kestrels, Brown Falcon and Grey Falcon were also recorded in higher numbers at this time.

The creeklines and associated vegetation provide habitat for a variety of birds that would otherwise not be expected to use the area, including some waterbirds. Several Jinbirdiny (Black-fronted Dotterel) were present along pools during visits in September and November 2024. During the five visits to the area in 2024, 58 bird species were recorded. Fresh tracks of a Wilumarra (Bush Stone-curlew) were found (Plate 11) during August 2024 indicating that this ground-dwelling species had remained despite the recent fire. A single Grey Falcon was spotted below the helicopter in August 2024 over the south-eastern corner of Marnda. Four more sightings were recorded in the November

2024 visit including a pair circling over the southern slopes of Marnda. Twenty-four bird species are of conservation significance: 20 CS1, one CS2 and three CS3. Only two of these (both CS3) are expected as residents, with the majority expected as vagrants (10 species) and visitors (nine irregular visitors and two regular visitors). Little Corella was the only non-raptor species observed within RSP and that was for a very brief period of several seconds only. Raptors are discussed below with respect to wind turbines, while conservation significant birds are discussed in Section 3.2.7.

Seven raptor species were recorded during formal VP survey, five of which were observed within RSP. The Grey Falcon is discussed in Section 3.2.6. Most raptor sightings and species were recorded in the southern quarter of Marnda (See Figure 3-3). Spotted Harriers and Black-shouldered Kites were only recorded during March 2025, and always below 30 m. Both were likely present at this time in response to an abundance of crickets browsing on new growth of vegetation following rains. Brown Falcons, Nankeen Kestrels, Wedge-tailed Eagles and Whistling Kites were recorded during formal VP survey and frequently within RSP.

Kestrels were recorded more often than all other raptors on 38 separate flights in pairs and singles, with an influx in March 2025 likely to prey on the irruption of crickets. Kestrels were observed only across the southern undulating plains. They were observed on several occasions hawking at low elevations before soaring to height and hunting over a wide area, before returning to perch and repeating the flight pattern. Total individual flight time for Kestrels was 180.75 minutes of which 15.9 minutes (c. 9%) were in RSP.

Brown Falcons were recorded across a wider area than other raptors throughout Baru and Marnda, including regularly on the high ground (VSA 1). Brown Falcons were recorded in pairs and single animals. A female was also observed sitting on a nest on an electrical transmission tower to the east of Ngurrawaana Community. Brown Falcons were recorded during VP on 34 separate flights for a total bird time of 130.5 minutes. Of that time, 35.77 minutes were in RSP amounting to c. 27% of the observed bird time.

Wedge-tailed Eagles were observed mostly across the southern undulating plains but also opportunistically flying along a creekline in the north of Marnda. Individual Wedge-tailed Eagles were observed during VP on 9 flights. A family of three were recorded opportunistically in the November visit just north of the Ngurrawaana Community. One individual was observed leaving a roost in a tree and flushing a group of 55 Little Corellas that 'vortexed' to 60 metres or so in response. Wedge-tailed Eagles were recorded in the air for a total of 27.98 minutes of which 18.17 minutes were within RSP (c. 65%). Flight lines of the commonest raptors are shown in Figure 3-4 (Brown Falcon), Figure 3-5 (Nankeen Kestrel) and Figure 3-6 (Wedge-tailed Eagle) (see also Figure 3-15 and Figure 3-16 for Grey Falcon).

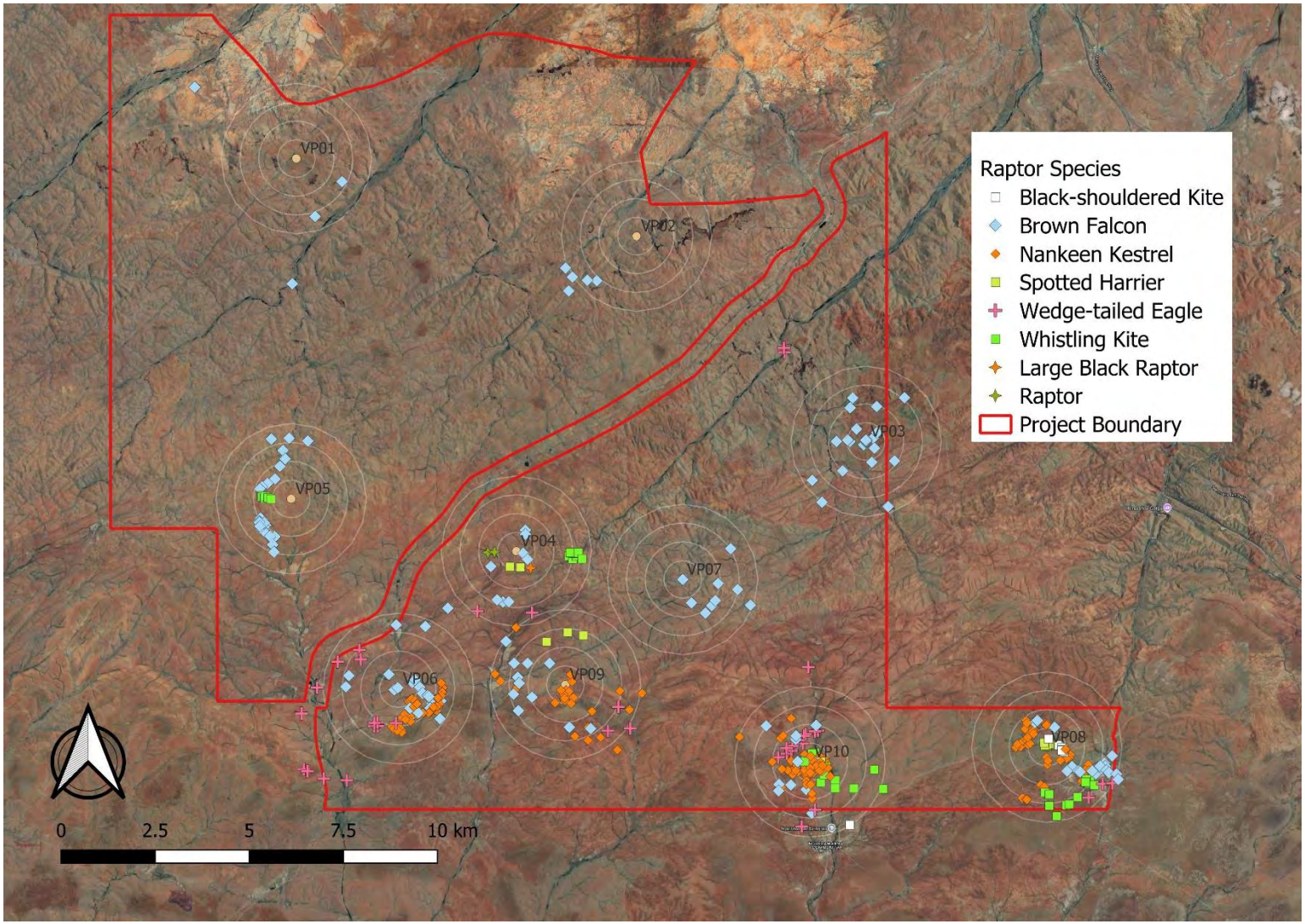


Figure 3-3. Records of all raptors (except Grey Falcon) observed from VPs, BCs and through opportunistic encounters. Kestrels were the commonest raptor encountered, while Brown Falcons were observed more consistently across a broader area than all other raptors. Kestrels, Brown Falcons and Wedge-tailed Eagles were recorded during all campaigns.

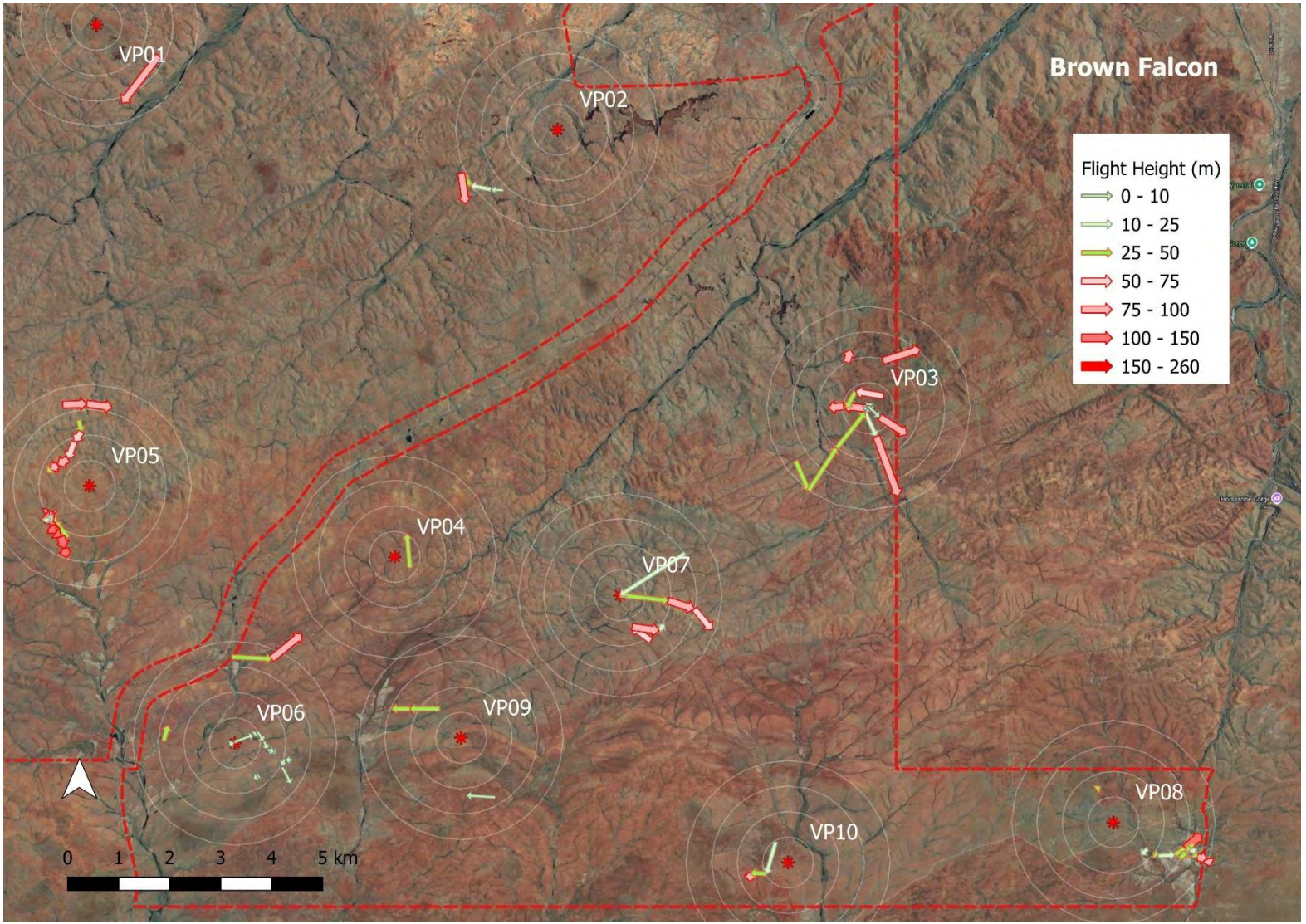


Figure 3-4. Flights of Brown Falcons showing the elevation above ground and direction. There was a large increase in sightings during the March 2025 campaign. The data do not show flight behaviours such as soaring and circling.

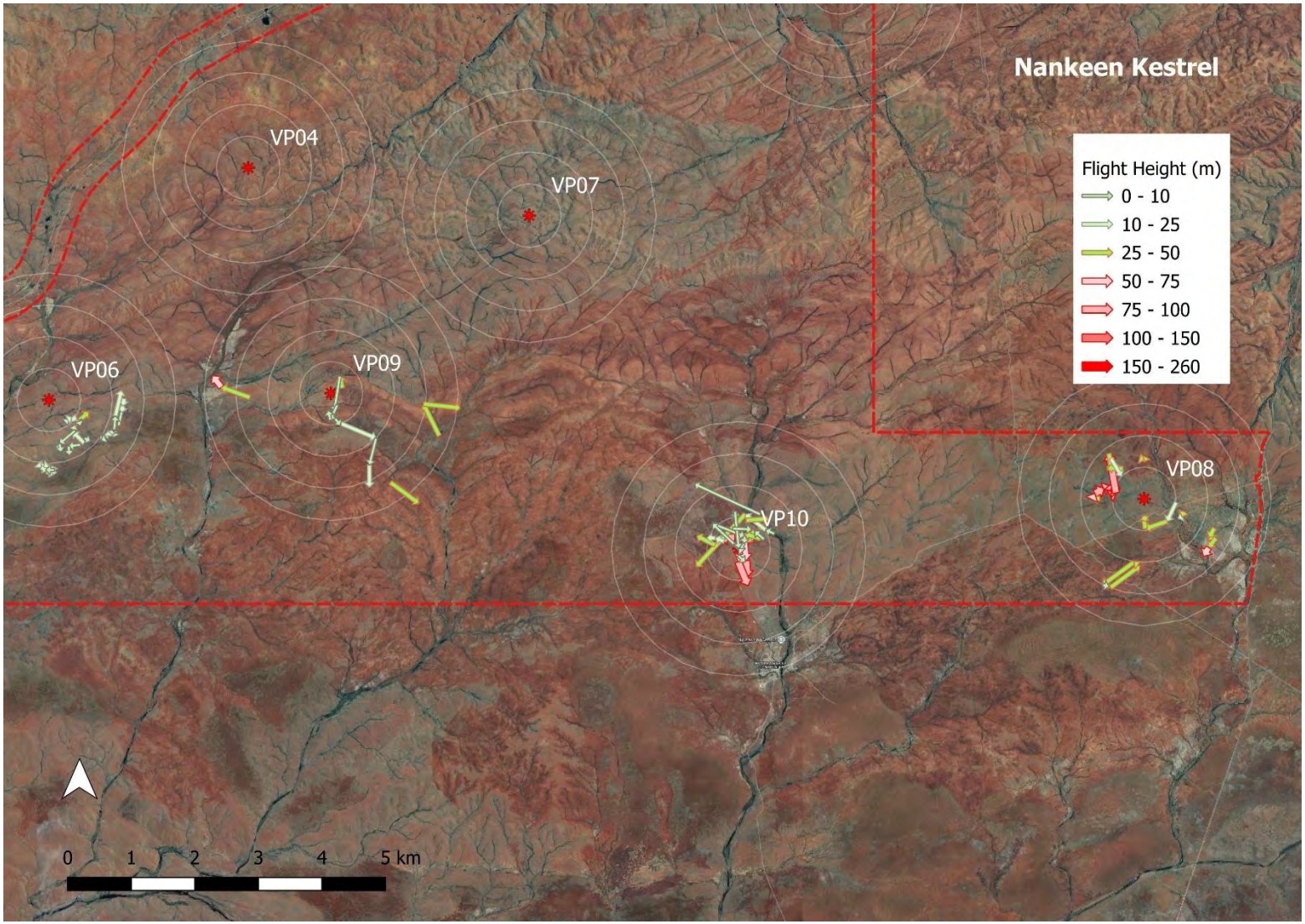


Figure 3-5. Flight lines of Nankeen Kestrels. These flight lines do not show recorded behavioural aspects of flight such as soaring and hovering.

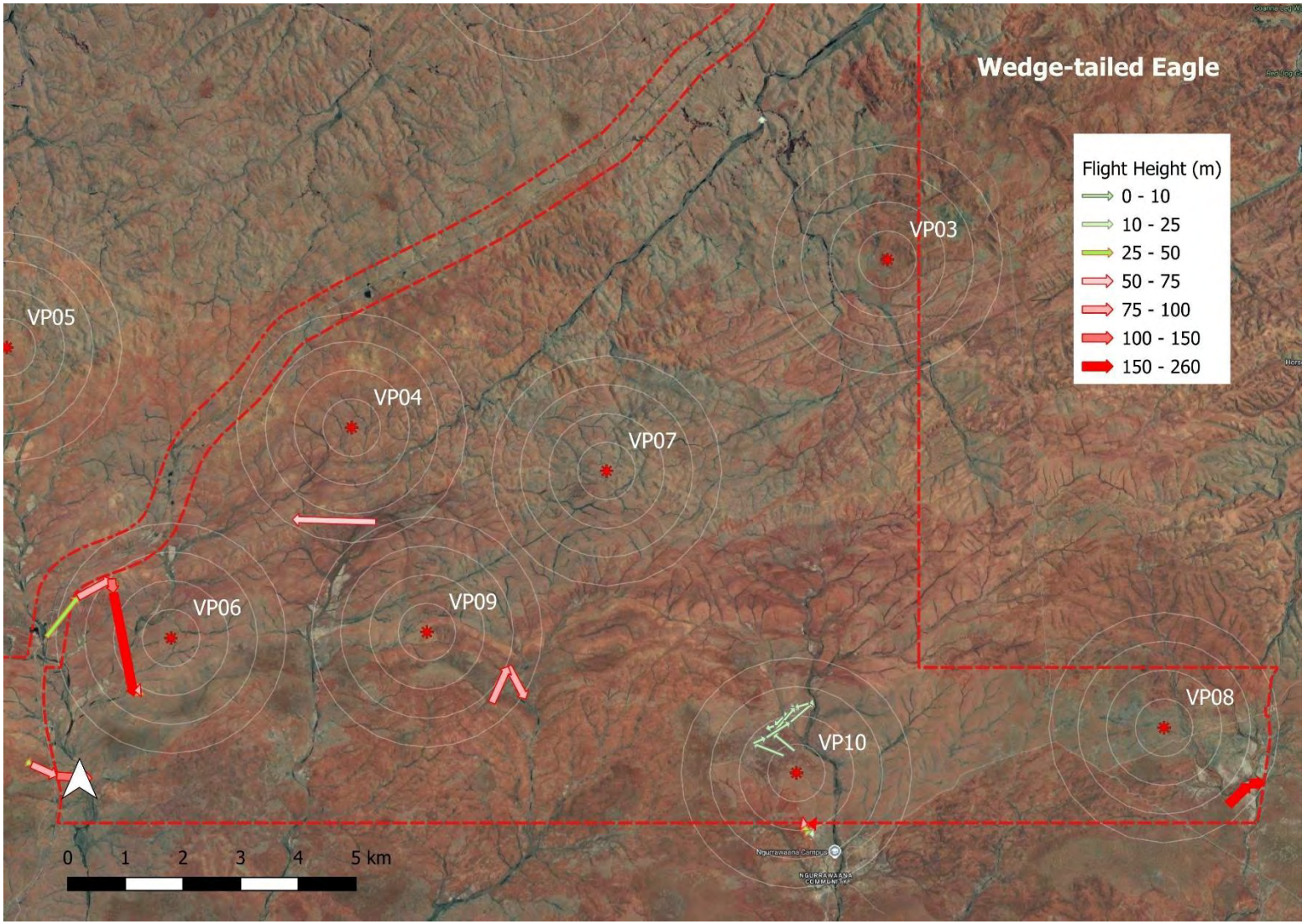


Figure 3-6. Flight lines and height data for Wedge-tailed Eagles. The flight recorded near the Ngurrawaana Community in November 2024 was of a family group of three birds.

Plate 11. Bush Stone-curlew (Willumarra) track observed during initial site inspection in August 2024.

Mammals

The mammal assemblage is incomplete, with six species considered locally extinct, but still relatively rich with a total of 35 native mammals expected and 25 of these expected as residents. The remaining native species are expected as visitors (six regular and two irregular). The recent fire affecting the spinifex on higher ground is likely to have resulted in a reduction in the diversity and numbers of small mammals. As the spinifex recovers, it is likely the abundance of small mammals will revert. The Dingo (Mujira), expected as a resident, has been included in the native mammals, as it is considered naturalised rather than introduced. Photos of Dingo (Plate 12), Rock-Wallaby (Wayuwarra, and most likely to be Rothschild's) (Plate 13), Northern Quoll (Yirriwardu) (Plate 14) and Euro (Marndanyungu) were taken on cameras set along the northern creeklines of Baru. A single Rock Wallaby (likely to be Rothschild's) was photographed on a boulder pile in the north-western corner of Baru (see Plate 3). A Feral Cat was photographed on a camera set in the south-east of Marnda and an individual was spotted crossing a dry creekline in August 2024. Several Euros were spooked during survey in the north-western corner of Baru in August. Scats of a Rock Wallaby, Northern Quoll, Euro and Dingo were observed in the project area during the initial site inspection. Around 50 Northern Freetail Bats (*Taphozous georgiana*) were found in a cave on the side of a hill close to the railway that bisects Baru and Marnda in September, and two smaller bats, likely to be Gould's Wattled Bat (*Chalinolobus gouldii*), were disturbed in a shallow cave towards the north of Marnda in March 2025. Scats of this species and other microbats were found here and in several other caves and overhangs around the

two project areas. The ranges of the Black Flying-fox and Little Red Flying-fox are considered to extend across the project area (Timmiss et al, 2021). These two bat species are considered to be vagrants and therefore disregarded from the assessment. Ten native mammals are of conservation significance (three CS1, five CS2 and two CS3) and are discussed in Section 3.2.7. Results from the camera trapping are presented in Table 3-2.

Table 3-2. Results from the camera traps deployed across Baru and Marnda between July 2024 and March 2025.

Camera	Deployed	Location	Species	N events
BCE01	Jul 2024	Baru	Brown Quail	1
		Lower Creekline	Magpie Lark	5
			Cat	2
			Euro	1
			Cow	1
BCE03	Jul 2024	Baru	Northern Quoll	2
		Upper Creekline	Willy Wagtail	1
			Rothschild's Rock-Wallaby	4
			Common Bronzewing	7
			Torresian Crow	1
			Dingo	1
			Spinifex Pigeon	1
BCE04	Jul 2024	Baru	Northern Quoll	6
		Upper Creekline	Cow	12
			Spinifex Pigeon	2
			Dingo	6
			Torresian Crow	1
BCE23a	Jul 2024	Marnda	Cat	1
		Mid-creekline	Common Bronzewing	1
			Grey Shrike-thrush	1
BCE23b	Sep 2024	Marnda	Cat	2
		Cave Entrance	Perentie	2
			Magpie	10
			Yellow-throated Miner	8
			Pied Butcherbird	3

Plate 12. Dingo (Mujira) taken on BCE03 Camera Trap in northern Baru.

Plate 13. Rothschild's Rock Wallaby (Wayuwarra) were taken on camera trap at several locations across the north of Baru and Marnda. This one was in the northwest of Baru.

Plate 14. Image of Northern Quoll (Yirriwardu). Quolls were captured on camera traps across the northern halves of Baru and Marnda.

Plate 15. Tracks of Northern Quoll along a small water course in the north-western corner of Baru. Scats of this species were also found across the project areas including in small caves and plains on the higher ground.

Supersensory Technologies ((2025); see in Appendix 9), undertook ultrasonic analyses to identify the species, distribution and relative abundance of all bat species recorded on the ARUs. The bat acoustic analysis from 2024 confirmed the presence of eight bat species from four Families across the project areas, with another potential long-eared bat species. These records are plotted in Figure 3-7. Of note

are four records of the Leaf-nosed (Diamond-faced) Bat (*Rhinonicteris aurantia* Pilbara form). This species is listed as Vulnerable (CS1) and is discussed in more detail below. In order of declining distribution, the following additional bats were detected during the acoustic survey: Finlayson's Cave Bat (*Vespadelus finlaysoni*); Gould's Wattled Bat (*Chalinolobus gouldii*); Little Broad-nosed Bat (*Scotorepens greyii*); Greater Northern Free-tailed Bat (*Chaerephon jobensis*); Common Sheathtail Bat (*Taphozous georgianus*); Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*), and Northern Free-tailed Bat (*Ozimops lumsdenae*), all of which are relatively common. The White-striped Free-tailedBat (*Austronomus australis*) is also likely to be present as a seasonal winter visitor. Sonograms for all bats are shown in Supersensory Technologies (2025) attached in Appendix 9.

While the majority of bat records were obtained from along water courses, relatively high levels of activity were also detected on the higher ground of both Baru and Marnda. Finlayson's Cave Bat was detected at all ARU locations (but not on ARUs placed at height), while the Common Sheath-tailed Bat was detected frequently by the ARU placed highest on the metmast, suggesting this species flies regularly within the RSP. The Yellow-bellied Sheath-tailed Bat was also recorded flying on the higher microphones and potentially within RSP. Gould's Wattled Bat, Little Broad-nosed Bat and the Northern Free-tailed Bat were recorded on the microphone placed at 25 m but not at 50 m, suggesting these may not fly as high as the RSP.

Three introduced mammals are expected in the project area; two as residents (House Mouse and Feral Cat) and one as an irregular visitor (Red Fox). A single Feral Cat was spotted in a creekline and this species was captured on camera at four locations (see Figure 3-2). Evidence of European Cattle was observed throughout the project area but as this species is domesticated it is not included in the expected vertebrate fauna assemblage which is limited to species present as free-living and wild populations. Despite this, domestic livestock can have an impact on the fauna assemblage. The introduced species may negatively impact native species via predation (particularly the Feral Cat and Red Fox), competition for food and nesting resources, and degradation of habitat via grazing and trampling of vegetation.

Summary

The key features of the fauna assemblage expected in the project area are:

- **Uniqueness:** The fauna assemblage is typical of that expected in this region of Western Australia. The assemblage is likely to be represented elsewhere in the region.
- **Completeness:** The assemblage is likely to be relatively complete for reptiles and birds but incomplete for mammals, with six mammal species locally extinct. Over a third (44%) of the expected vertebrate fauna assemblage are expected as regular visitors, irregular visitors or vagrants, so will not be present at all times. This is typical of the variability of the fauna assemblage in the region.
- **Richness:** The expected assemblage is likely to be somewhat poor in a regional context, due to the harsh nature of the environments present, the lack of sandy soils and the limited amount of complex structures such as caves, overhangs, etc., that provide shelter for a variety of fauna. The recent fire may have adversely affected the assemblage, but the relationship between fire and fauna assemblage composition is complex.

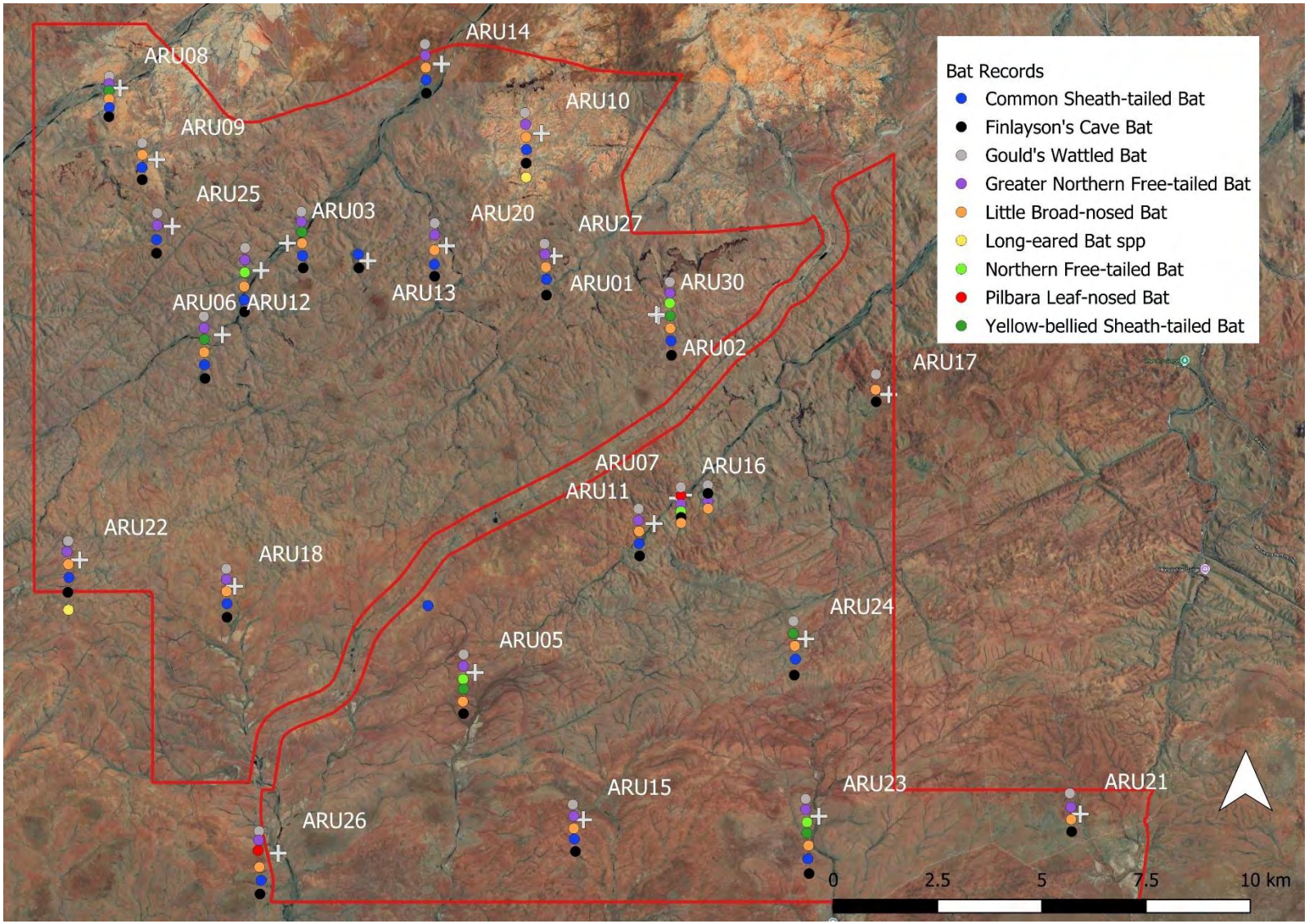


Figure 3-7. Bat records acquired from ARUs (as analysed by Supersensory Technologies 2025) and observations.

3.2.4 Locally extinct vertebrate fauna

There are at least six mammal species that would be expected to be present in the project area but are considered locally extinct (Appendix 5). For these species, the likely causes of local extinction are introduced species (e.g. cats, foxes and possibly domestic livestock) and altered fire regimes.

3.2.5 Invertebrate fauna of conservation significance

The project area sits within DBCA's Pilbara management region (DBCA, 2024a), within which DBCA (2023a) has listed 49 threatened or priority invertebrate fauna. Forty-three species were considered unlikely to be present in the project area based on distance from known populations and/or lack of suitable habitat in the project area and were therefore excluded. These species are shown in Appendix 7. Of the remaining six species, there are DBCA database records of four species within 50 km of the project area boundary. The Garlawirrura (Pilbara Dragonfly (*Antipodogomphus hodgkini*)) and Pilbara Threadtail (Damselfly) (*Nososticta pilbara*) occur around the Millstream area 20-40 km to the south of the current project area. Given the presence of a near-permanent stream and seasonal drainage lines in the project area, both may be present at least occasionally. There is one record of the freshwater amphipod *Nedsia hurlberti* c. 47 km from the project area. Based on a recent taxonomic revision (King et al., 2021) *Nedsia hurlberti* is restricted to Barrow Island. It is therefore presumed that this record has not been updated to reflect the results of the King et al. (2021) study, and likely represents a different lineage of *Nedsia* found in 'Bungaroo Creek and the lower Robe River catchment (both Onslow catchment basin)' (King et al., 2021, p. 120). It is likely still a short-range endemic species and of conservation significance. However, the Onslow catchment basin is distant and not connected to the catchment of the project area and it is therefore considered unlikely this *Nedsia* sp. will be present in the project area. The draculoides (*Draculoides mesozeirus*) recorded c. 49 km from the project area boundary is out of range as it is known only from the Middle Robe area.

The remaining two species are both millipedes: Antichiropus sp. 'DIP007' (Bond's Antichiropus Millipede) and Antichiropus sp. 'DIP008' (Flinder's Antichiropus Millipede). There is limited information on the distribution and habitat preferences of these species, so either one or both may be present, and are likely to favour mesic (moist) locations. Springs, permanent pools and surrounding moist soils may be suitable for them. Known records of CS invertebrates within 50 km of the project area (from the DBCA threatened fauna database) are shown on (Figure 3-8). All invertebrate records are from the major drainage system (Fortescue River) to the south, and while this may be a true reflection of distribution, it may also reflect where collecting has been carried out. If these species were present in the project area, it indicates that they have much wider distributions and they might not qualify as of conservation significance.

In addition to the listed species, there are records of three isopods that are possible short-range endemic (SRE) invertebrates within 20 km of the central coordinates used for the original database searches. These are Buddelundia '13', Buddelundia '18' and Buddelundia '20'. Any or all of these could be present, possibly favouring mesic locations such as near the permanent water bodies and springs.

It should be noted that the ecology and distribution of short-range endemic invertebrates is often poorly understood or documented. Thus there may be undetected SRE species present.

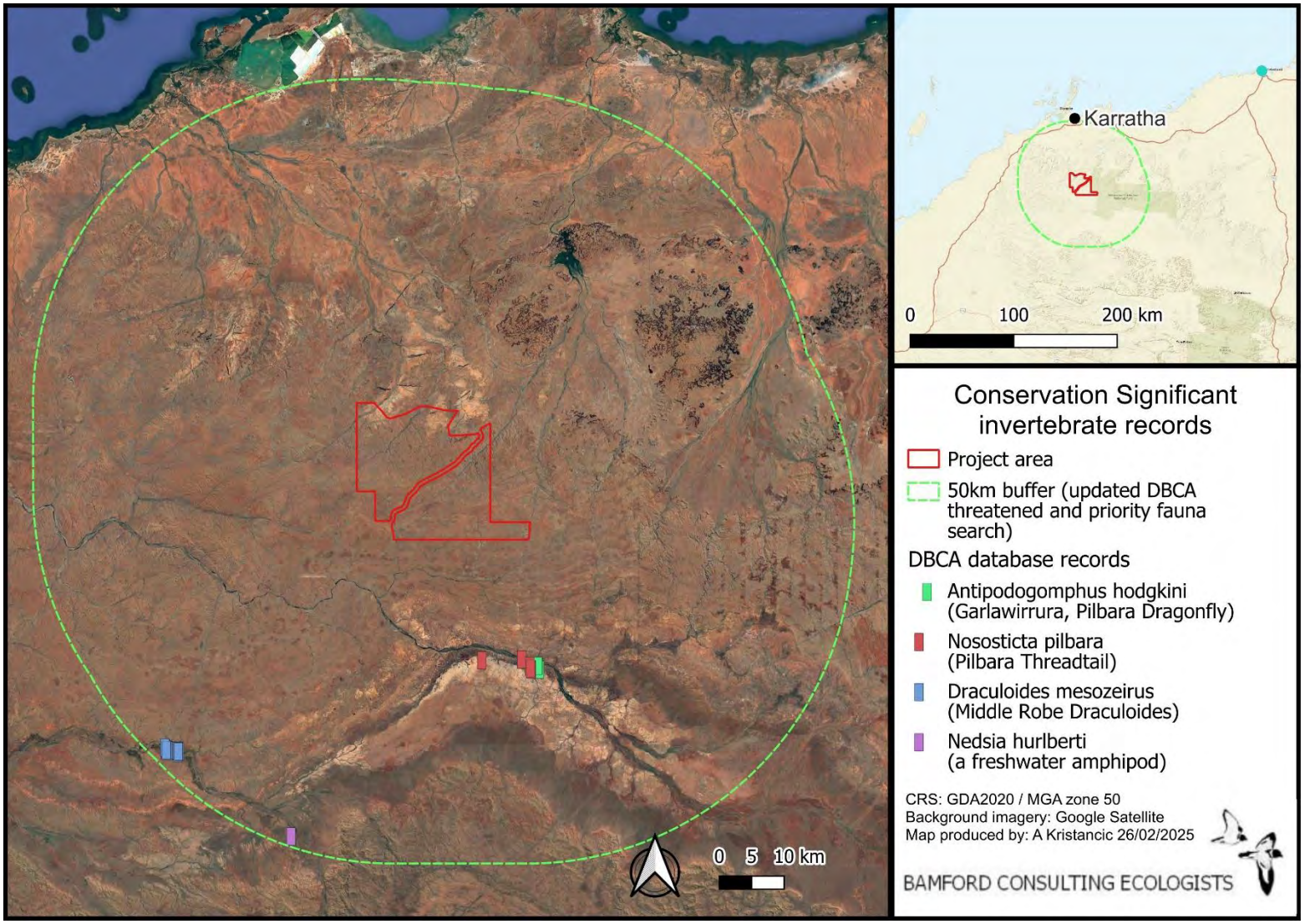


Figure 3-8. Records of conservation significant invertebrates, from the DBCA threatened and priority fauna database. Records are from DBCA (2024d).

3.2.6 Vertebrate fauna of conservation significance

Of the 261 species of vertebrate fauna expected to occur in the project area, 39 are considered to be of conservation significance: 24 CS1, ten CS2 and five CS3. A summary of the numbers in each vertebrate class is presented in Table 3-3. These species of conservation significance are indicated in the complete species list (Appendix 3) but are also listed with details of their conservation significance in Table 3-4. The CS1 and CS2 species include three reptiles, 13 birds and seven mammals. Six are expected as residents, four as regular visitors, seven as irregular visitors and six as vagrants. The CS3 species include three birds (two expected as residents and one as an irregular visitor) and two mammals (one expected as a regular visitor and one as an irregular visitor). More details regarding CS species are given under conservation significant species accounts in Section 3.2.5.

Locations of expected CS1 and CS2 species records within 40 km of the central coordinates used for the database search (from the DBCA threatened and priority fauna database) are illustrated in Figure 3-9 (mammals), Figure 3-10 (birds) and Figure 3-11 (fish and reptiles). In the search area used for the DBCA database, there are records of several CS1 and CS2 species that have been omitted from the expected fauna assemblage; these are shown in Figure 3-12, and reasons for omission are detailed in Appendix 6.

Table 3-3. The number of conservation significant species in each vertebrate class expected to occur within the project area.

See Appendix 1 for full explanation of Conservation Significance (CS) levels: CS1 = listed under WA State and/or Commonwealth legislation; CS2 = listed as Priority by DBCA; CS3 = considered locally significant. Locally extinct species not included.

CLASS	Total	CONSERVATION SIGNIFICANCE		
		CS1	CS2	CS3
Fish	**1**	0	1	0
Frogs	**0**	0	0	0
Reptiles	**4**	1	3	0
Birds	**24**	20	1	3
Mammals	**10**	3	5	2
Total	**39**	**24**	**10**	**5**

Table 3-4. Conservation significant fauna species expected to occur within the project area.

Species are listed in taxonomic order.
CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.
EPBC Act listings: CR = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory (see Appendix 2).
Biodiversity Conservation Act 2016 listings: S1 to S3 = Schedules 1 to 3, D1 to D3 = Divisions 1 to 3 (see Appendix 2).
DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).
Recorded species are indicated in **bold**.

Yindjibarndi Name	Latin Name	English Common Name	Status	Expected Occurrence
	FISH			
	Leiopotherapon aheneus	Fortescue Grunter	CS2 (P4)	Regular visitor
	REPTILES			
Bargunyji	*Liasis olivaceus barroni*	Pilbara Olive Python	CS1 (V, S2D3)	**Resident**
	Notoscincus butleri	Lined Soil-Crevice Skink	CS2 (P4)	Resident
	Lerista quadrivincula	Four-lined Slider	CS2 (P1)	Resident
	Anilios ganei	Gane's Blind Snake	CS2 (P1)	Resident
	BIRDS			
	Cuculus optatus	Oriental Cuckoo	CS1 (MI, S1D2)	Vagrant
	Elanus scriptus	Letter-winged Kite	CS2 (P4)	Vagrant
	Erythrotriorchis radiatus	Red Goshawk	CS1 (E, S2D3)	Vagrant
	Rostratula australis	Australian Painted-snipe	CS1 (E, S2D2)	Vagrant
	Actitis hypoleucos	Common Sandpiper	CS1 (MI, S1D2)	Irregular visitor
	Calidris acuminata	Sharp-tailed Sandpiper	CS1 (VU & MI, S1D2)	Irregular visitor
	Calidris ferruginea	Curlew Sandpiper	CS1 (CR & MI, S2D1)	Vagrant
	Calidris melanotos	Pectoral Sandpiper	CS1 (MI, S1D2)	Vagrant
	Calidris ruficollis	Red-necked Stint	CS1 (MI, S1D2)	Irregular visitor
	Tringa glareola	Wood Sandpiper	CS1 (MI, S1D2)	Irregular visitor
	Tringa nebularia	Common Greenshank	CS1 (EN & MI, S1D2)	Irregular visitor
	Tringa stagnatilis	Marsh Sandpiper	CS1 (MI, S1D2)	Irregular visitor
	Glareola maldivarum	Oriental Pratincole	CS1 (MI, S1D2)	Irregular visitor
	Gallinago stenura	Pin-tailed Snipe	CS1 (MI, S1D2)	Vagrant
	Apus pacificus	Fork-tailed Swift	CS1 (MI, S1D2)	**Regular visitor**
Boorga	*Falco hypoleucos*	Grey Falcon	CS1 (VU, S2D3)	**Regular visitor**
	Falco peregrinus	Peregrine Falcon	CS1 (S1D3)	Regular visitor
	Pezoporus occidentalis	Night Parrot	CS1 (E, S2D1)	Vagrant
	Amytornis whitei	Rufous Grasswren	CS3	**Resident**
	Stipiturus ruficeps	Rufous-crowned Emu-wren	CS3	Resident
	Hirundo rustica	Barn Swallow	CS1 (MI, S1D2)	Irregular visitor
	Neochmia ruficauda	Star Finch	CS3	**Irregular visitor**
	Motacilla cinerea	Grey Wagtail	CS1 (MI, S1D2)	Vagrant
	Motacilla flava	Yellow Wagtail	CS1 (MI, S1D2)	Vagrant
	MAMMALS			

Yindjibarndi Name	Latin Name	English Common Name	Status	Expected Occurrence
	Antechinomus (Sminthopsis) longicaudata	Long-tailed Dunnart	CS2 (P4)	Resident
	Dasycercus blythi	Brush-tailed Mulgara	CS2 (P4)	Irregular visitor
Yirriwardu	*Dasyurus hallucatus*	Northern Quoll	CS1 (E, S2D2)	**Resident**
Warrgi	*Trichosurus vulpecula*	Brushtail Possum	CS3	Resident
Wayuwarra	*Petrogale rothschildi*	Rothschild's Rock-Wallaby	CS3	**Resident**
	Hydromys chrysogaster	Water-rat, Rakali	CS2 (P4)	Irregular visitor
	Leggadina lakedownensis	Short-tailed Mouse	CS2 (P4)	Resident
Gurdi	*Pseudomys chapmani*	Ngadji or Western Pebble-mound Mouse	CS2 (P4)	Resident[1]
	Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed (Diamond-faced) Bat	CS1 (V, S2D3)	**Regular visitor**
	Macroderma gigas	Ghost Bat	CS1 (V, S2D3)	Regular visitor

[1] Inactive mounds found

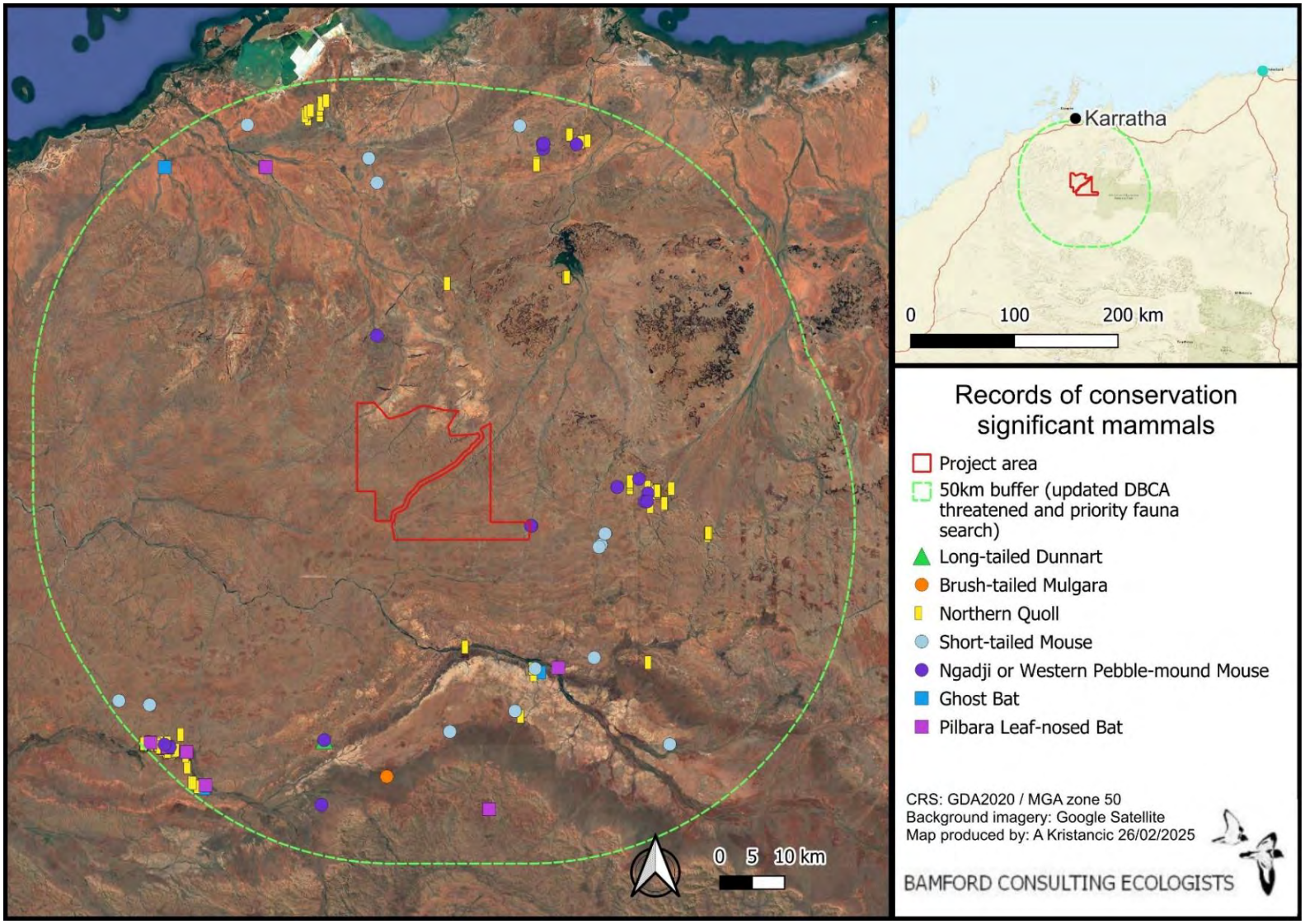


Figure 3-9. Location of records of expected conservation significant mammal species within the 50 km buffer used for the DBCA database search. Records are from DBCA (2024d).

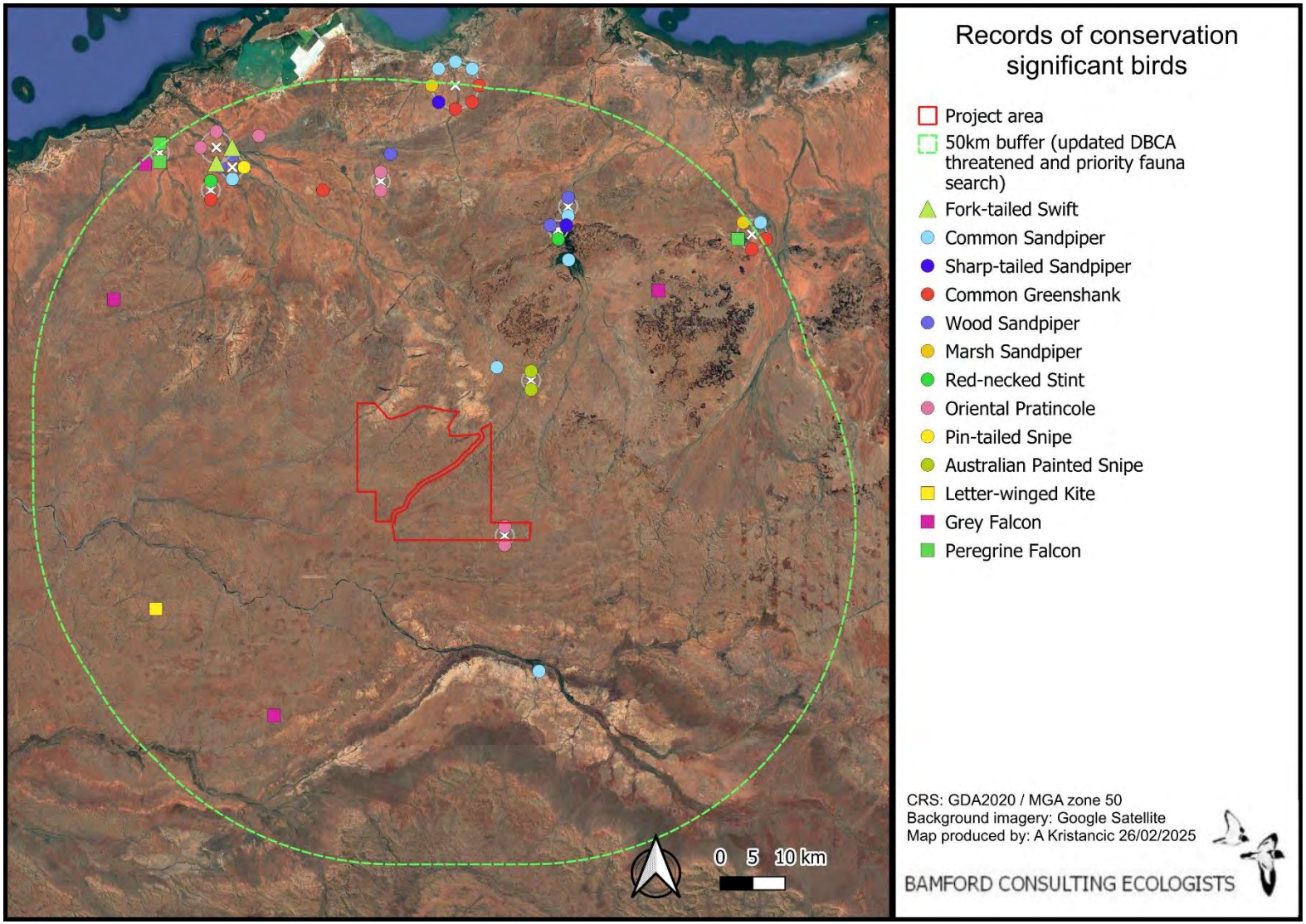


Figure 3-10. Location of records of expected conservation significant bird species within the 50 km buffer used for the DBCA database search. Point displacement (around a central white X) has been used to display overlapping records. Records are from DBCA (2024d).

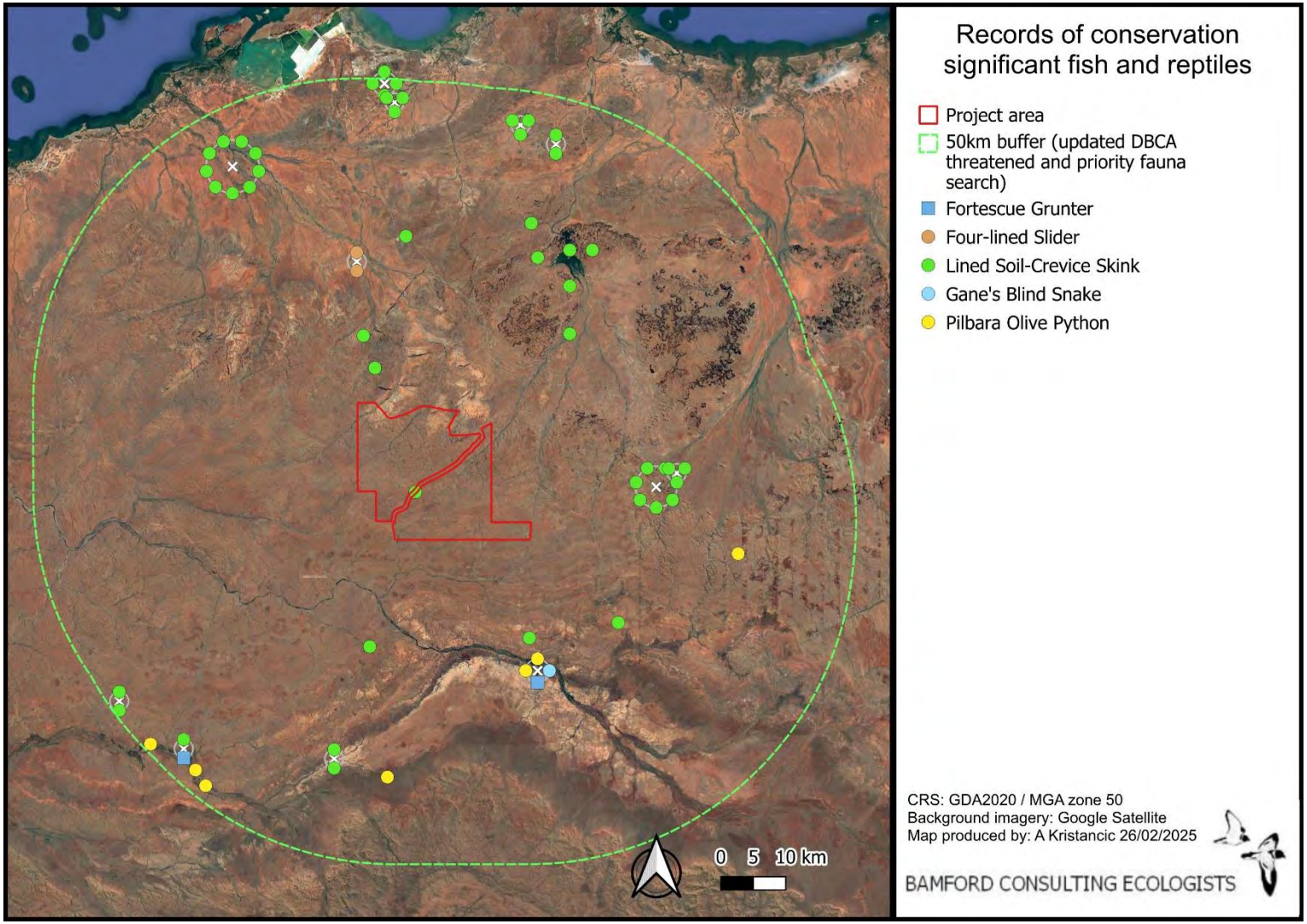


Figure 3-11. Location of records of expected conservation significant fish and reptile species within the 50 km buffer used for the DBCA database search. Point displacement (around a central white X) has been used to display overlapping records. Records are from DBCA (2024d).

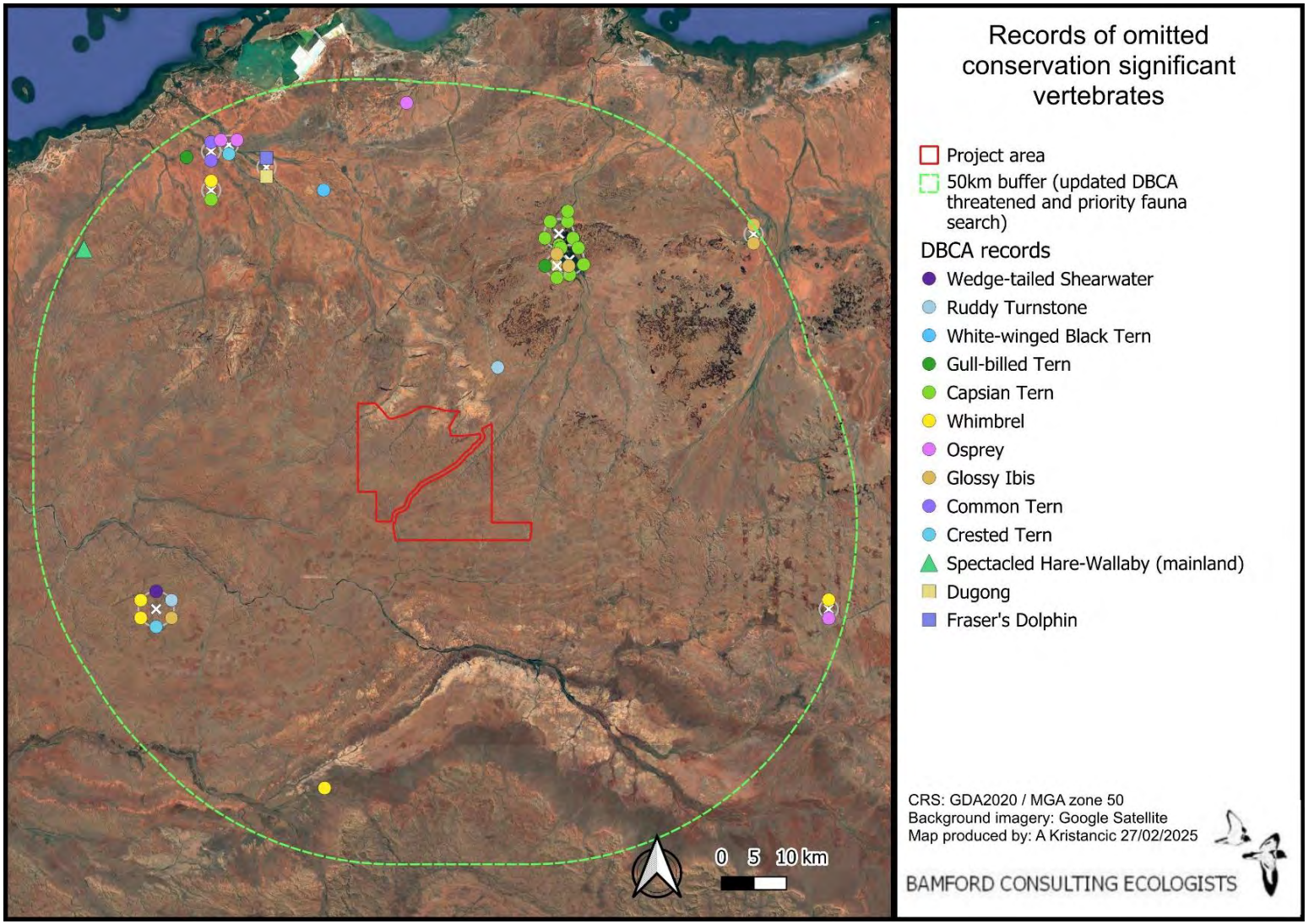


Figure 3-12. Location of records of omitted conservation significant species within the 50 km buffer used for the updated DBCA database search. Point displacement (around a central white dot) has been used to display overlapping records. Records are from DBCA (2024b).

3.2.7 Conservation significant species accounts

A list of all conservation significant species expected within the project area is provided in Table 3-4; these comprise one fish, four reptiles, 24 birds and 10 mammals (see Section 3.2.6). Information on the conservation status, distribution and habitat, salient ecology and expected occurrence within the project area is provided below for all species. Database records of the listed species are plotted in Figure 3-9 (mammals), Figure 3-10 (birds) and Figure 3-11 (fish and reptiles) and observations made during field investigations are shown on Figure 3-2. Records of fauna that were present in the database searches, but omitted are plotted in Figure 3-12.

3.2.7.1 Conservation Significance 1

Pilbara Olive Python (Bargunyji) (*Liasis olivaceus barroni*) CS1 (V, S2D3)

Conservation status:	Vulnerable under the EBPC Act and Schedule 2 Division 3 under the BC Act.
Distribution and habitat:	This subspecies is restricted to ranges within the Pilbara region and Mount Augustus in the Gascoyne and is often recorded near waterholes (Wilson & Swan, 2021). Usually associated with rocky landscapes (Burbidge, 2004; Wilson & Swan, 2021).
Ecology:	Usually found in proximity to water, although breeding males and juveniles may disperse widely (Burbidge, 2004). An ambush predator that feeds predominately on mammals and birds (Burbidge, 2004). Probably cathemeral.
Expected occurrence:	**Resident.** There are seven records within the 50 km buffer used for the updated DBCA database search and there are anecdotal accounts of the species in the Millstream area (c. 20 km to the south). A skin slough and a scat most likely to be from this species were found along creeklines in the northern half of Baru. All creeklines in which rocky areas lie adjacent to pools are likely to support this python species (within VSA 3). Such areas may be affected by construction of access tracks and laying of interconnecting cables.

Red Goshawk (*Erythrotriorchis radiatus*) CS1 (EN, S2D3)

Conservation status: Endangered under the EBPC Act and Schedule 2 Division 3 under the BC Act.

Distribution and habitat: A sparsely distributed species that occurs in well-wooded areas (generally not dense or very open habitats) in northern Australia (DCCEEW, 2023e; DERM, 2012; Menkhorst et al., 2017). Birds are usually located adjacent to areas of permanent water (DCCEEW, 2023e; DERM, 2012). In Western Australia the Red Goshawk is restricted to the Kimberley, south to Broome, Gieke Gorge and Carlton Gorge (Johnstone & Storr, 1998), although with a recent record from the Pilbara (Atlas of Living Australia). In the Kimberley, Red Goshawks are most often found in "extensive open forest, open woodlands and riparian vegetation dominated by mature *Eucalyptus tetrodonta*, woollybutt *E. miniata*, and Cadjeputs *Melaleuca leucadendron*" (DERM, 2012). Habitat needs to be open enough for fast attack and manoeuvring in flight, but provide cover for ambushing of prey (DCCEEW, 2023e).

Ecology: A diurnal predator (most active early morning and late afternoon) that predominantly feeds on birds, usually by ambushing prey from concealed perches (DCCEEW, 2023e; Johnstone & Storr, 1998). Mammals, reptiles and insects are occasionally taken (DCCEEW, 2023e; Johnstone & Storr, 1998). Typical of bird-eating raptors, Red Goshawks have large home ranges (up to 200 km^2). This species nests in tall stands of trees that are within one kilometre of permanent water, with the nest usually in the tallest and most massive trees (DERM, 2012).

Expected occurrence: **Vagrant.** There are no records of Red Goshawk within the 50 km buffer used for the updated DBCA database search. The project area is many hundreds of kilometres south of its documented breeding range, but there are some recent records of individual birds in the Pilbara. It is therefore possible that individual birds may be present very occasionally during juvenile dispersal or non-breeding migration (DCCEEW, 2023c).

Fork-tailed Swift (*Apus pacificus*) CS1 (M, S1D2)

Conservation status: Migratory under the EPBC Act and Schedule 1 Division 2 under the BC Act.

Distribution and habitat: This swift is a largely aerial species of unpredictable occurrence in Western Australia. There are scattered records from the south coast, widespread in coastal and subcoastal areas between Augusta and Carnarvon, scattered along the coast from south-west Pilbara to the north and east Kimberley region. Sparsely scattered inland records, especially in the Wheatbelt, but more common in the north and north-west Gascoyne Region, north through much of the Pilbara Region, and the south and east Kimberley (DCCEEW, 2023a; Higgins, 1999). Aerial, usually flying from as low as one metre to more than 300 m above the ground.

Ecology: A diurnal, aerial insectivore, this species often forages along the edge of low pressure systems in flocks of ten to 1000 birds (DCCEEW, 2023a; Higgins, 1999). Breeds in Siberia (April to July) and spends the non-breeding season (October to mid-April) in Australia. Being aerial, it is effectively independent of terrestrial ecosystems when in Australia.

Expected occurrence: **Regular visitor.** There are only two records within the 50 km buffer used for the updated DBCA database search (more than 40 km from project area), but as noted above the species does appear to occur more or less regularly in the Pilbara. Three sightings of this species involving seven individuals were recorded during the March 2025 campaign (See Figure 3-13). Two birds were hawking at around 20 m height and another four at around 40 m. Individuals may fly over the project area during their visitation to Australia between October and March. They are likely to hawk for insects within RSP occasionally. Given the low encounter rate, their presence is likely to be an uncommon event and the species may be better classed as an irregular visitor.

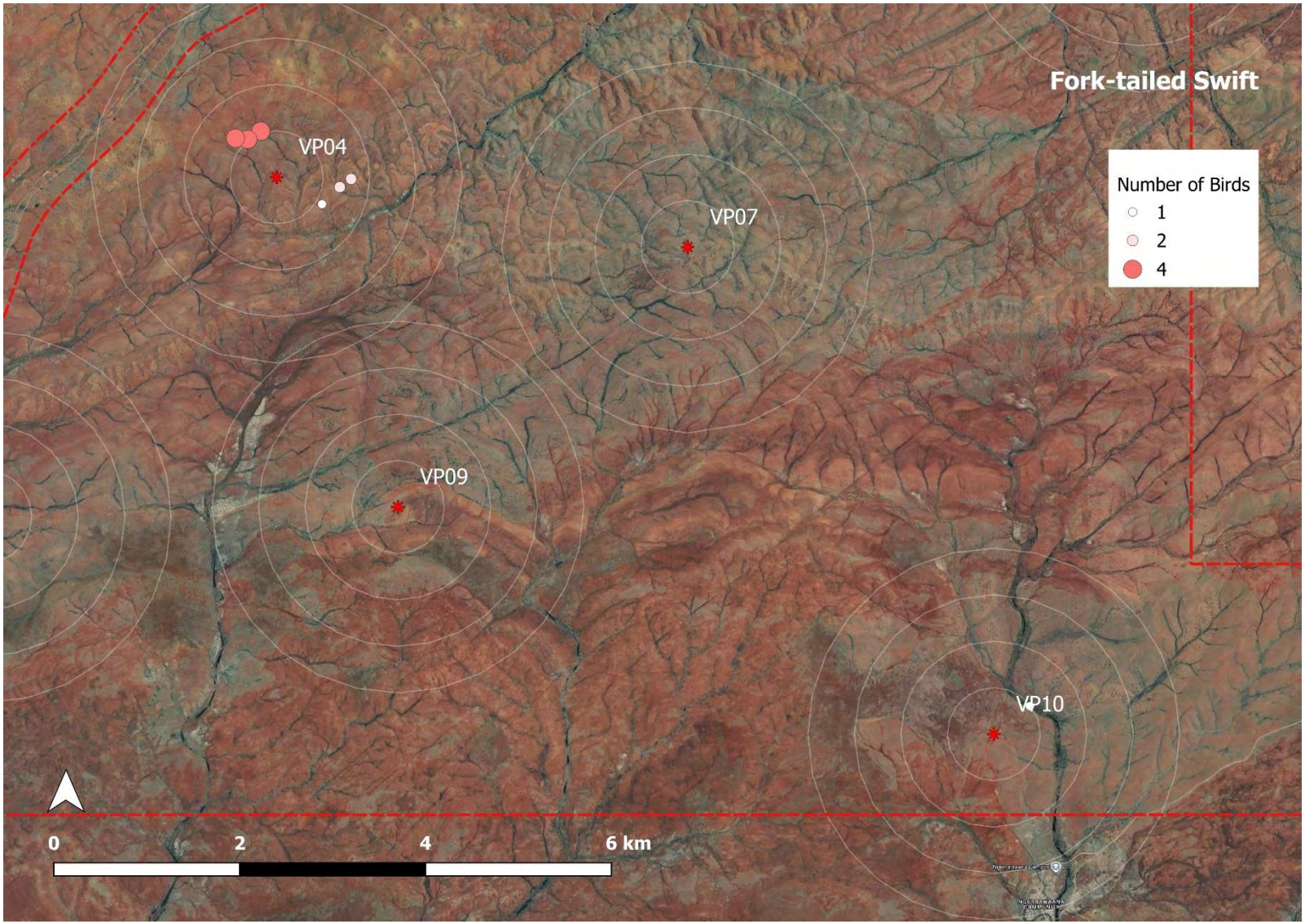


Figure 3-13. Fork-tailed Swifts recorded during the March 2025 campaign.

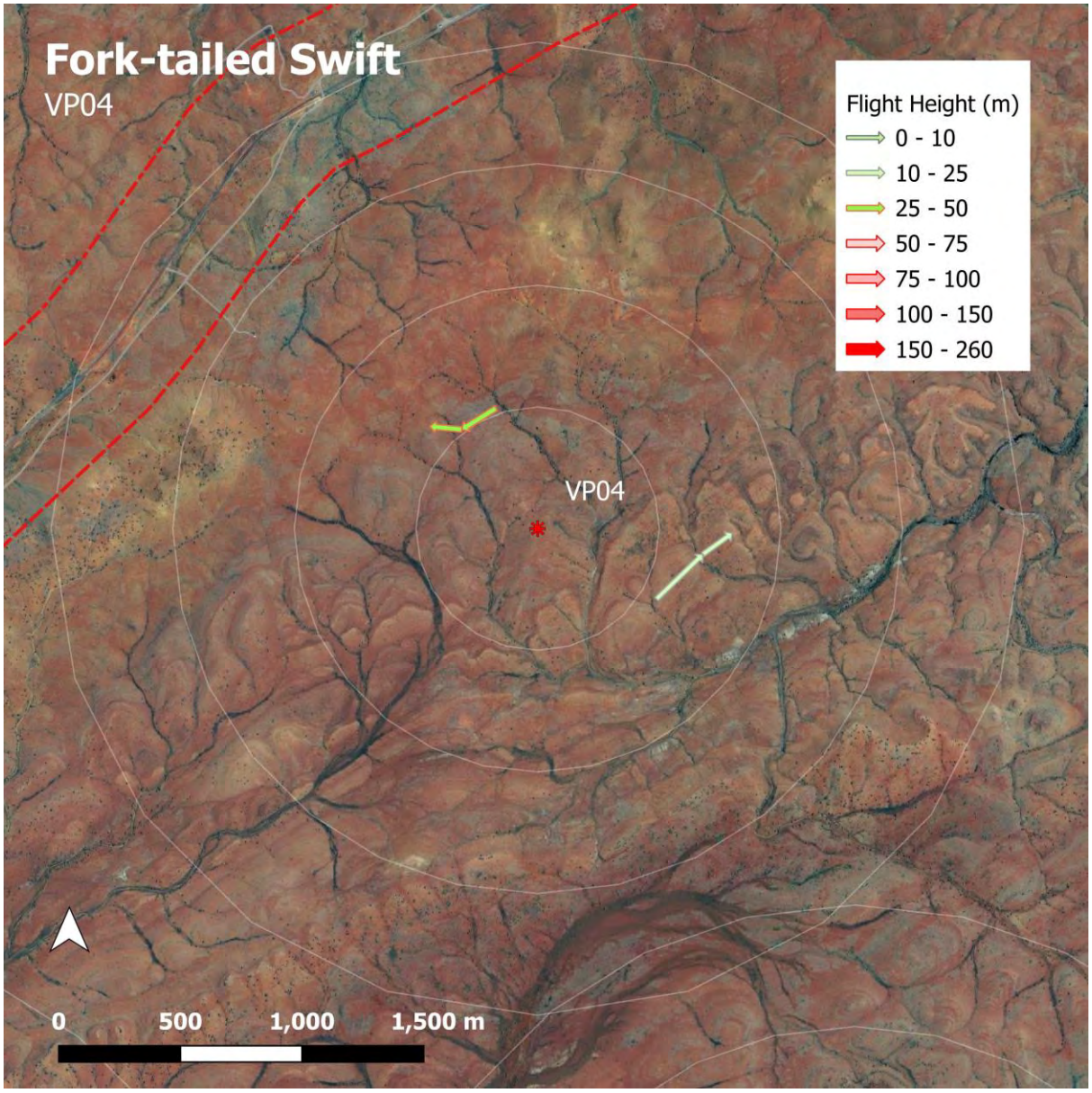


Figure 3-14. Flights of Fork-tailed Swifts recorded formally from VP04 showing flight height.

Oriental Cuckoo (*Cuculus optatus*) CS1 (M, S1D2)

Conservation status: Migratory under the EPBC Act and Schedule 1 Division 2 under the BC Act.

Distribution and habitat: A migrant to northern and east-coast Australia, the Oriental Cuckoo favours areas of dense vegetation including riverside forests, rainforests, vine thickets and mangroves (Johnstone & Storr, 1998) but will also inhabit open woodlands and gardens (Menkhorst et al., 2017). In Western Australia its occurrence is scarce and largely limited to the Kimberley region (Johnstone & Storr, 1998).

Ecology: A diurnal insectivore, this species has a preference for caterpillars (Menkhorst *et al.*, 2017). Oriental Cuckoos are non-breeding migrants (from northern Asia) to Australia between September and May, although most birds are observed from November to March (Menkhorst *et al*., 2017).

Expected occurrence: **Vagrant.** There are no records within the 50 km buffer used for the updated DBCA database search. The project area is south of the expected distribution, and does not provide the species' favoured habitats of riverside forests, rainforests, vine thickets and mangroves (Johnstone & Storr, 1998). It is broadly considered a vagrant in the Pilbara.

Grey Falcon (*Falco hypoleucos*) CS1 (V, S2D3)

Conservation status: Vulnerable under the EPBC Act and Schedule 2 Division 3 under the BC Act. Endemic to mainland Australia.

Distribution and habitat: Sparsely distributed through arid central, northern and north-western Australia, this species appears to have a distribution that is centred around wooded ephemeral or permanent drainage lines interspersed with acacia scrub (Shoenjahn, 2013). They are highly nomadic across their range.

Ecology: An aerial, diurnal predator that predominantly preys on pigeons and parrots, although may also take invertebrates, reptiles and small mammals (Debus, 2019). Resident and sedentary when seasonal conditions are favourable, and when breeding, nomadic in times of drought (Jonny Schoenjahn, Pers. Comm., Debus, 2019). Breeding period is from June to November when they become sedentary, occupying unused nests of other raptors and corvids in taller trees. They may also use nests in man-made structures such as telecommunication towers. Fledged young will remain with the parents for up to a year (Schoenjahn, 2018). They routinely soar at heights of up to 300 m to transit in their hunting forays (Jonny Schoenjahn, Pers. Comm.).

Expected occurrence:

Regular visitor; possible resident. There are four records within the 50 km buffer used for the updated DBCA database search; all more than 30 km from the project area boundary. The species is expected to visit the project area regularly, particularly in environments associated with drainage lines. Landscape in the southern halves of Baru and Marnda contain Grey Falcon habitat of tall trees along creeklines interspersed with Acacia scrub, especially towards the east. A single Grey Falcon was recorded opportunistically below the helicopter on the 8th August 2024; estimated flight height was around 120 m. Grey Falcons were recorded four times on VP watches on 29th and 30th September, and 1st October 2024. The flight over VP04 on 29 September was of an adult pair soaring at between 35 and 90 m. The other sightings were of individuals from VP10 and VP08. The adult pair was recorded at the end of the known breeding period and may have bred, but were without juveniles. In March 2025, a further four flights of an adult pair were recorded from VP08, one of those being around the same time that a single juvenile was recorded from VP10. Three opportunistic records of Grey Falcon were also made in March 2025 near the Ngurrawaana Community. Grey Falcon data are plotted in Figure 3-15.

Grey Falcons were most often observed soaring at heights estimated to be between 35 and 160 m and covering large expanses of ground in very short time. Formal observations of this species lasted for an approximate 33 minutes and 39 seconds. 27 minutes of observations were of pairs. Therefore, individual birds spent 33 minutes and 27 seconds within the RSP (64-322 m) which amounts to c. 55% of observed flight. This is consistent with information given by Jonny Schoenjahn (Pers. Comm.) who advised that Grey Falcons spend the majority of flight time at heights consistent with modern turbines. Several large nests in tall trees were recorded along creeklines in the southern parts of Marnda. A Brown Falcon was also observed occupying a nest in a transmission tower, which may potentially be used by Grey Falcons. The recorded flight-lines of Grey Falcons are presented in Figure 3-16.

Grey Falcons were not observed in the November campaign or during a brief visit in December. All sightings were confined to the southern half of Marnda following heavy rainfall and an influx of large numbers of birds known to be prey for this species. None were recorded over the basalt hills to the north, despite surveyors spending a similar amount of time at each VP.

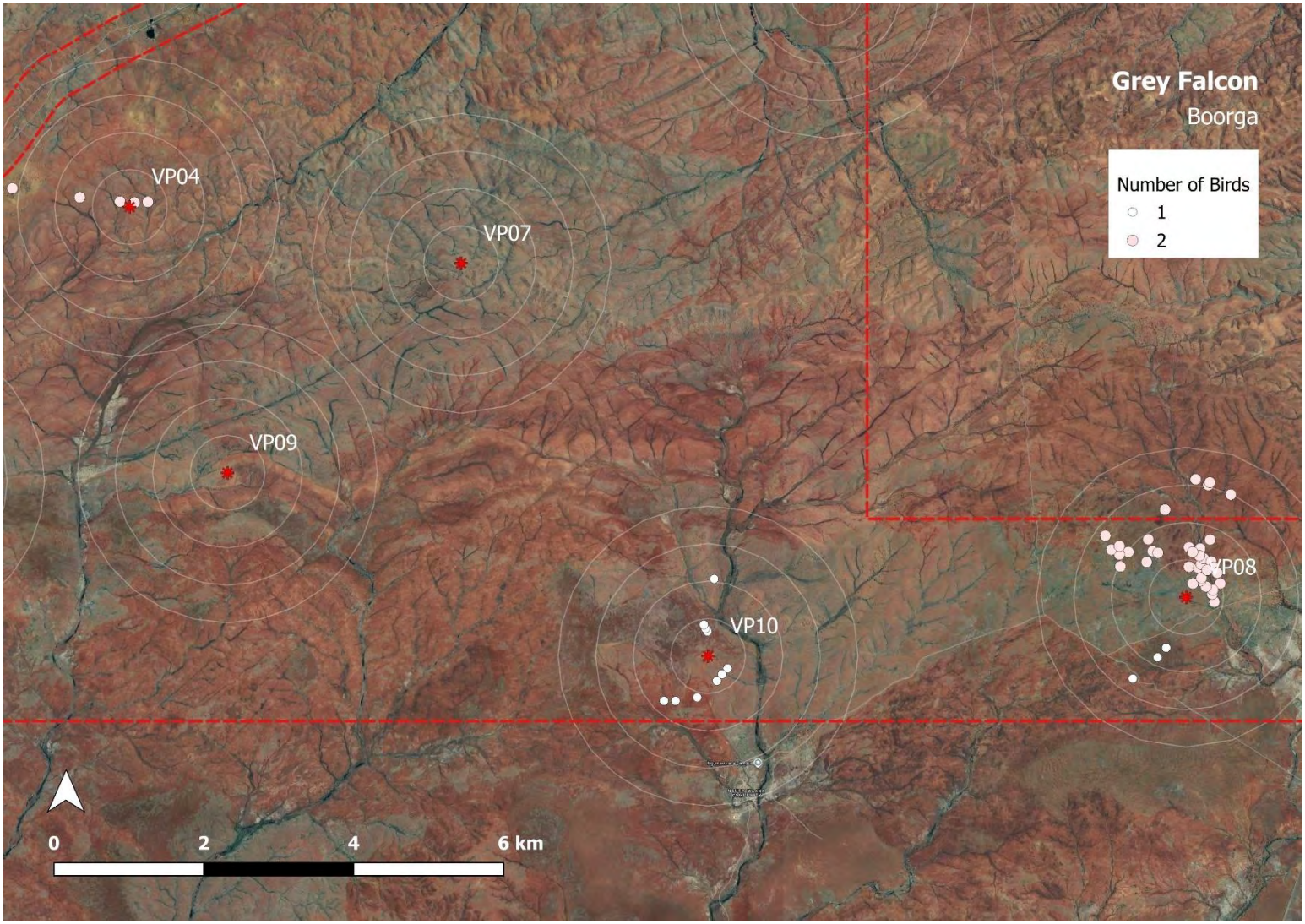
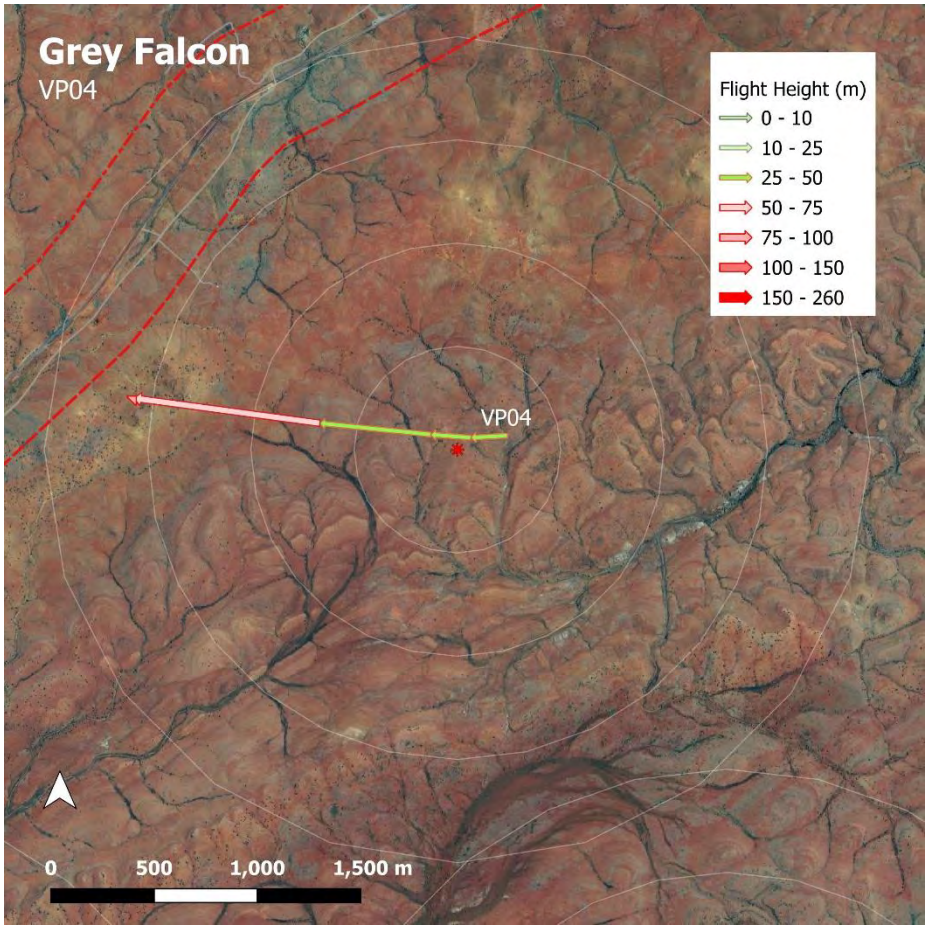
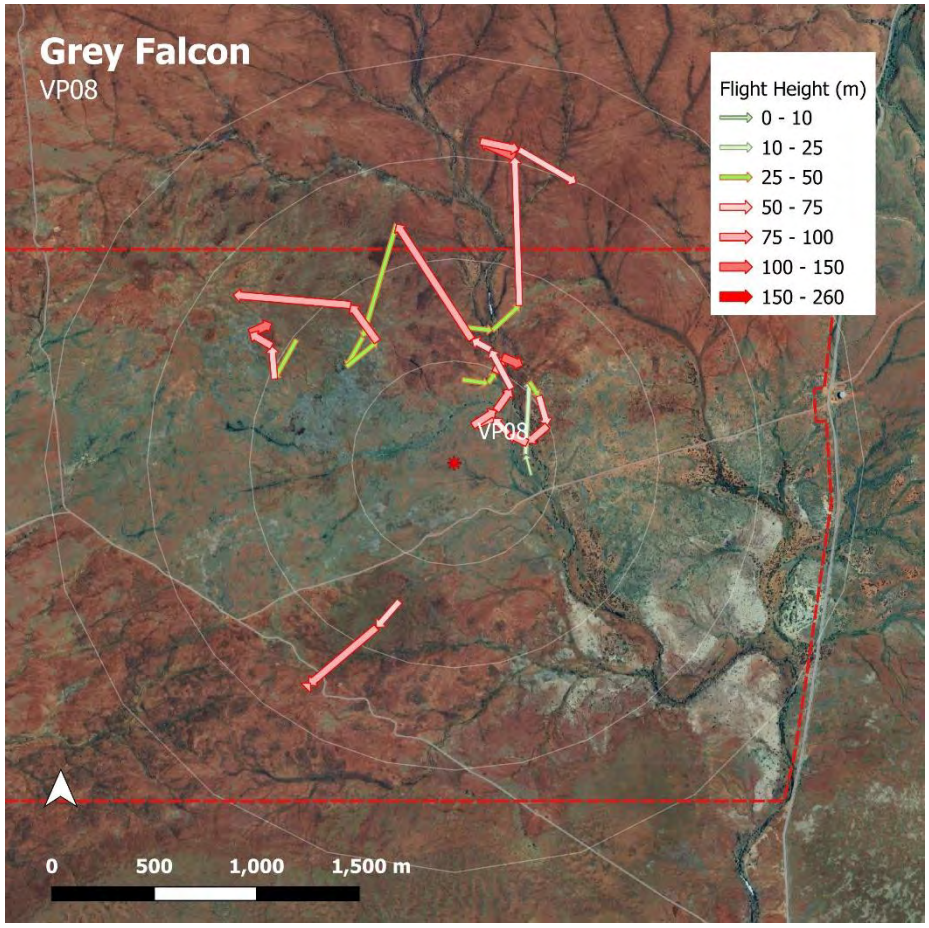


Figure 3-15. All data for Grey Falcon (Boorga) showing group size. Most sightings were of adult pairs with two sightings of single animals which looked to be sub-adults. The species was recorded opportunistically in August and March campaigns, while all data from VPs were from September/October and March campaigns.


Grey Falcon
VP04
Flight Height (m)
0 - 10
10 - 25
25 - 50
50 - 75
75 - 100
100 - 150
150 - 260
VP04
0
500
1,000
1,500 m


Grey Falcon
VP08
Flight Height (m)
0 - 10
10 - 25
25 - 50
50 - 75
75 - 100
100 - 150
150 - 260
VP08
0
500
1,000
1,500 m

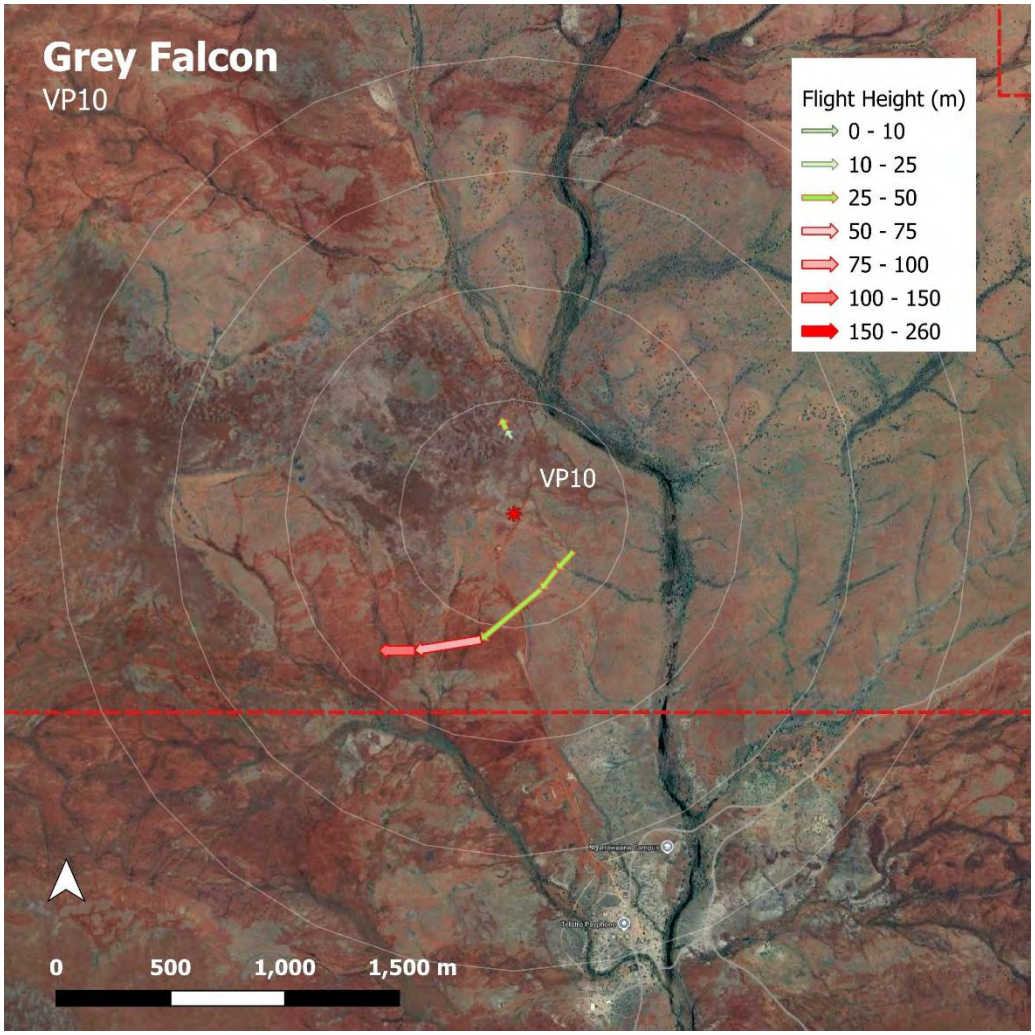


Figure 3-16. Refer to Figure 3-15 for overall locations of VPs. Flight-lines of Grey Falcon recorded from VPs 04, 08 and 10 on Marnda. During flight, the Grey Falcon spent just over half of its time in the RSP where it was soaring in spirals and using the wind to get lift.

Peregrine Falcon (*Falco peregrinus*) CS1 (S1D3)

Conservation status: Schedule 1 Division 3 under the BC Act.

Distribution and habitat: More or less cosmopolitan throughout Australia (Menkhorst *et al.* 2017). This species occurs in a variety of habitats but is usually reliant on cliff faces or tall trees for nesting (Debus, 2019).

Ecology: A highly adept aerial predator that predominantly forages on birds, although will also occasionally take invertebrates, fish, reptiles and mammals (Debus, 2019). Mostly diurnal or crepuscular.

Expected occurrence: **Regular visitor.** There are only three records within the 50 km buffer used for the DBCA database search, likely due to the fact that this species is not common (but is widespread) (Western Australian Museum, 2019). The project area is likely to be within the home range of a pair but breeding habitat is limited. It is likely that if a pair was breeding regularly in the project area, the birds would have been observed.

Conservation significant shorebirds (waders) CS1 (M,S1D2)

Conservation status: Eleven wader species expected to occur, at least as vagrants, are listed under legislation (CS1); these are shown in Table 3-4. Ten of these are migratory, with one also Vulnerable , one Endangered and one Critically Endangered. The eleventh species is Endangered only.

Distribution and habitat: Most of these wader species favour coastal tidal environments, but the 11 species are known to also use inland wetlands, although these are usually broad lakes and estuaries with extensive shallows, rather than the narrow drainage lines and pools of the project area. One of the species, the Oriental Pratincole, will also forage on dry grasslands and will hawk for winged insects when these are in abundance, and this behaviour has been observed occasionally in the Pilbara (I. Harris pers, comm.). Such aerial foraging can occur over any vegetation type (Marchant & Higgins, 1993).

Ecology: Most species forage on invertebrates in damp soil and shallows. The Oriental Pratincole feeds terrestrially on insects and seeds, usually across dry grasslands; will occasionally hawk for flying insects.

Expected occurrence: **Irregular visitor or vagrant.** There are several records of waders within the 50 km buffer used for the updated DBCA database search. These include seven records of the Oriental Pratincole, five records of Wood Sandpiper, seven records of Common Greenshank and two records each of Marsh Sandpiper, Sharp-tailed Sandpiper and Red-necked Stint. Records of the latter five species are all more than 30 km from the project area boundary. There are DBCA database records of the Oriental Pratincole within the project area boundary and it is the species most likely to occur at least occasionally and in moderate numbers. Several vagrants (eg Pin-tailed Snipe, Australian Painted-snipe) may also occur but on an extremely irregular and unpredictable basis. There is suitable habitat in the plains in the south and to the south of Marnda (VSA 4 and the Wona Land System).

Barn Swallow (*Hirundo rustica*) CS1 (M, S1D2)

Conservation status: Migratory under the EPBC Act and Schedule 1 Division 2 under the BC Act.

Distribution and habitat: A northern hemisphere species that reaches northern Australia in small numbers in summer each year, and often seems to congregate around coastal towns (M. Bamford pers. obs.).

Ecology: An aerial insectivore that forages over a range of environments but is often seen close to water and built structures.

Expected occurrence: **Irregular visitor.** There are no records within the 50 km buffer used for the updated DBCA database search. Most Pilbara observations appear to be in towns, particularly Onslow (M. Bamford pers. obs.).

Yellow Wagtail (*Motacilla flava*) and Grey Wagtail (*Motacilla cinerea*) CS1 (M, S1D2)

Conservation status: Migratory under the EPBC Act and Schedule 1 Division 2 under the BC Act.

Distribution and habitat: Both species breed in Asia/Siberia and small numbers may migrate as far south as northern Australia in the non-breeding season, generally confined to coastal areas (Johnstone & Storr, 2005; Menkhorst et al., 2017). The Yellow Wagtail is considered to be the more common of the two in Australia (Menkhorst et al., 2017). Both species are associated with wetland habitats: the Yellow Wagtail being more diverse in its choice of habitats (open, moist grassy areas; sewage ponds; bare ground; beaches), and the Grey Wagtail being restricted to fast-flowing rocky waterways (Johnstone & Storr, 2005; Menkhorst et al., 2017).

Ecology: Diurnal insectivores (Johnstone & Storr, 2005; Menkhorst et al., 2017). These migrants may be present in Australia between October and April (Johnstone & Storr, 2005; Menkhorst et al., 2017).

Expected occurrence: **Vagrants.** There are no records of either species within the 50 km buffer used for the updated DBCA database search and both are considered vagrants in the Pilbara. Both species are generally confined to near-coastal regions when in Australia and are closely associated with wetland habitats. The project area thus lacks habitat for species that are not expected to occur regularly within the greater region.

Night Parrot (*Pezoporus occidentalis*) CS1 (E, S2D1)

Conservation status: Endangered under the EBPC Act and Schedule 2 Division 1 under the BC Act.

Distribution and habitat: Highly elusive and known from only a very small number of records, it is difficult to ascertain the distribution and habitat of this species. DCCEEW (2023g) lists central Western Australia, north-eastern South Australia and south-western Queensland as 'core' areas, although the Night Parrot may occur throughout any part of inland Australia. Habitat associations are also tenuous but the species may occur in areas of spinifex grassland and/or chenopod shrublands, or in areas of shrubby samphire (TSSC, 2016b).

Ecology: The Night Parrot was recorded more or less regularly through the late 19th Century but appeared to decline early in the 20th Century, with a lack of reliable records from the 1930s to the end of the century leading to some speculation that it was extinct. In the early 20th Century, however, there have been multiple records including in the eastern Pilbara, northern Murchison and western deserts of Western Australia (Davis & Metcalf, 2008; Hamilton et al., 2017; Jackett et al., 2017), and a population has been studied in south-western Queensland since 2013 (DCCEEW, 2023g). The species has been mired in controversy due to the implications of records close to development proposals, and after researchers falsified recordings and subsequently retracted recent Night Parrot records from South Australia (Jones et al., 2019). It is likely to be predominantly nocturnal and granivorous.

Expected occurrence: **Vagrant.** There are no records within the 50 km buffer used for the updated DBCA database search. The project area is within the high priority area for Night Parrot survey (DBCA, 2024b). Following the recent fire (spring 2023) it lacks dense old spinifex that provides shelter, and it also lacks the species rich grasslands and herbfields favoured for foraging (DBCA, 2024b).

CS1 (EN,S2D2)

Yirriwardu (Northern Quoll) (*Dasyurus hallucatus*)

Conservation status: Endangered under the EBPC Act and Schedule 2 Division 2 under the BC Act.

Distribution and habitat: Oten associated with rocky areas in the Pilbara (but also occurs along watercourses and beaches), and occurs through forests, savannahs and dissected rocky environments in the Kimberley (DCCEEW, 2023d; Van Dyck & Strahan, 2008). It also occurs, patchily, across northern Australia to Queensland (DCCEEW, 2023d; Van Dyck & Strahan, 2008). This species formerly occurred across much of northern Australia, from the Pilbara to south-east Queensland, but now only occurs in a number of fragmented populations across its former range, largely due to poisoning by Cane Toads.

Ecology: A predominantly nocturnal predator of invertebrates, amphibians, reptiles, birds and small mammals (Van Dyck & Strahan, 2008). Northern Quoll are both terrestrial and arboreal (Van Dyck & Strahan, 2008). This species undergoes a partial post-breeding male-die off (semelparity), with most individuals (including females) only surviving for one or two breeding seasons (Van Dyck & Strahan, 2008).

Expected occurrence: **Resident.** The species is known from the region, with a large number of records (nearly 500) within the 50 km buffer used for the updated DBCA database search, and a large cluster (c. 200 records) about 20 km from the project area boundary. Most of the landscape within the project area provides limited rocky shelter, but the creeklines, boulder tors, overhangs and small caves (even on the higher ground) provide features suited to this species. Northern Quoll tracks were recorded along a small creek bed in the north-west of Baru (Plate 15), and scats were found along all creeklines in 2024. Several Northern Quoll scats were also found in small caves on higher ground and away from water courses, showing their wide-ranging use of the landscape and not just along water courses. Individuals were photographed on three camera traps, set mostly along creeklines in the north of Marnda and Baru (see Figure 2-3 and Table 3-2). The number of records show this area to be relatively densely populated, and the animals are probably most abundant along rocky drainage lines and amongst rocky hills. These areas will be potentially impacted when constructing access tracks and linear infrastructure.

Ghost Bat (*Macroderma gigas*) CS1 (VU, S2D3)

Conservation status: Vulnerable under the EBPC Act and Schedule 2 Division 3 under the BC Act.

Distribution and habitat: The species current range is discontinuous, with distinct colonies in the Pilbara and the Kimberley (including several islands) of Western Australia, as well as in other locations across the north of Australia (TSSC, 2016a). Colonies are geographically isolated and genetically distinct; with the Kimberley bats being considered distinct from all other Australian populations of Ghost Bats (TSSC, 2016a). Gene flow within regions is primarily due to movement of male Ghost Bats. Permanent roost sites are usually deep natural caves or disused mines with a stable temperature between 23-28°C and moderate to high humidity (50-100%) (TSSC, 2016a). Such conditions only normally occur in deep caves (often protected by restricted entrances from initial chambers), and mine adits that are close to the water table (Bat Call, 2021a).

Ecology: A nocturnal carnivore with a broad diet encompassing small mammals (including other bats), birds, reptiles, frogs and large insects (TSSC, 2016a). The main threat to Ghost Bats is habitat loss and degradation due to mining activities. The geographic and genetic isolation of each subpopulation suggests that an area will not be recolonised if a population becomes locally extinct (TSSC, 2016a). Genetic studies indicate that females remain in or return to their place of birth, and significant impacts to sites containing breeding females are of particular concern as loss of these sites may significantly reduce the population size (TSSC, 2016a). Outside of the breeding period and during dispersion or transiting between permanent roosts, individuals will use a wider variety of temporary roosts and don't require the micro-climate conditions needed for permanent and maternity roosts (Bat Call, 2021a). Ghost Bats are mostly ambush predators and launch an attack from a perch. They capture prey on the ground and on the wing and normally consume the prey from a routinely used perch, under which a scattering of remains can be found.

Expected occurrence: **Regular visitor.** There are nine records within the 50 km buffer used for the updated DBCA database search; the low number of records most likely reflects lack of survey effort in this area. Large cave formations suited to Ghost Bats are known in the Millstream National Park to the east of the project area. However, geology in the project area does not form large caves and suitable shelter is limited to the boulder tors, small overhangs and caves, that may be used only temporarily. Several caves were spotted around the breakaways of small hills and these are present along the western side of Marnda. These were inspected but found to be well-ventilates and did not contain any prey remains or scats consistent with presence of the Ghost Bat. It is concluded that the species could visit the project for foraging on a regular basis or when transiting, but probably only in small numbers. No records of Ghost Bat were obtained between August and December 2024, but the acoustic programme is ongoing.

Pilbara Leaf-nosed (Diamond-faced) Bat (*Rhinonicteris aurantia* (Pilbara)) CS1 (V, S2D3)

Conservation status: Vulnerable under the EBPC Act and Schedule 2 Division 3 under the BC Act.

Distribution and habitat: The Pilbara Leaf-nosed Bat is constrained in range mostly to banded iron formations of the Hammersley Ranges and eastern Pilbara where there is access to deep caves and/or abandoned mine voids that provide very stable conditions, that are very warm (28-32 °C) and very humid (96-100%) (Armstrong, 2001; Van Dyck & Strahan, 2008). Such caves are normally found in specific geological conditions such as banded ironstone formations or mine adits where water may penetrate. This is a critical range constraint because of this species' inability to retain body moisture (Churchill *et al*., 1998). Movement between regions is thought to occur mostly being in April and May (Bat Call, 2021b). The Pilbara form is distinct from the population in the Kimberley to Queensland.

Ecology: A nocturnal, aerial insectivore (DCCEEW, 2023h) that utilises a variety of landscapes and vegetation. They are known to be detected principally along creeklines, gullies and flooded gorges that contain vegetation with complex vertical structure. They have, however, also been recorded over hilly terrain and Triodia grassland such as that dominating Baru and Marnda (Bat Call 2021b). They are notorious for being difficult to detect due to soft and highly directional echolocation calls at high frequency.

Expected occurrence: **Regular visitor.** There are eight records within the 50 km buffer used for the updated DBCA database search; the low number of records most likely reflects lack of survey effort in this area. Large cave formations suited to Pilbara Leaf-nosed Bats are known in the Millstream National Park to the east of the project area and to the south in the ironstone of the Hammersley Ranges. However, geology in the project area does not lend itself to formation of large, deep caves. Several caves were spotted around the breakaways of small hills in Marnda. These were inspected but found to be either too small, or well-ventilated and with few to no opportunities for roosting Leaf-nosed Bats. Leaf-nosed Bats were recorded on ARUs deployed in creeklines in the north and south of Marnda. This was during a wet period when atmospheric humidity is high and they can venture further away from established roosting caves. The records were all from late at night, with the latest record over three hour before sunrise. This suggests the bats were probably a considerable distance from their roost site and effectively in transit. Locations of ARU 16 and 26 are shown in Figure 2-3 and Figure 3-7.

Table 3-5. Acoustic records of Pilbara Leaf-nose Bats detected along creeklines in Marnda.

ARU Ref	Date	No. Passes	Earliest Pass	Latest Pass	Sunset	Sunrise
ARU16	7-Aug-24	2	01:18:02	03:20:23	17:56	06:41
	14-Aug-24	1	02:16:26	02:16:26	17:59	06:36
ARU26	31-Aug-24	1	00:51:13	00:51:13	18:04	06:23

3.2.7.2 Conservation Significance 2

Fortescue Grunter (*Leiopotherapon aheneus*) CS2 (P4)

Conservation status: Listed as Priority 4 by DBCA.

Distribution and habitat: Restricted to the Fortescue River catchment.

Ecology: Confined to permanent water but will disperse widely during high water level periods. Feed primarily on aquatic invertebrates

Expected occurrence: **Regular visitor.** There are two records within the 50 km buffer used for the updated DBCA database search (see Figure 3-11). Drainage lines in the south of Marnda are part of the Fortescue catchment and therefore at least in principle, the species may disperse along these systems when they are in flood.

Lined Soil-crevice Skink *(Notoscincus butleri)* CS2 (P4)

Conservation status: Listed as Priority 4 by DBCA. It has a somewhat limited distribution and is believed to be threatened by altered fire regimes and invasive Buffel grass.

Distribution and habitat: Once thought to be restricted to coastal areas between Karratha and Port Hedland, it is more widespread than originally thought, encompassing most of the western Pilbara from Dampier Peninsula, Pannawonica and Karijini National Park. This species is associated with spinifex-dominated areas near creek and river margins in arid, rocky areas (Wilson & Swan, 2021).

Ecology: A species that forages in leaf litter and feeds on invertebrates.

Expected occurrence: **Resident.** This species is known from the region, with 49 records within the 50 km buffer used for the updated DBCA database search, including one record along the rail alignment between Baru and Marnda (see Figure 3-11). It is therefore assumed to be resident in the project area on a precautionary basis. Areas of sandy soils close to drainage lines on the plains may provide suitable habitat.

Gane's Blind-Snake (Pilbara) *(Anilios ganei)* CS2 (P1)

Conservation status: Listed as Priority 1 by DBCA.

Distribution and habitat: A fossorial snake with a patchy and poorly documented distribution from Newman to Pannawonica, and thought to be associated with moist soils of gorges and gullies (Wilson & Swan, 2021). One specimen found by BCE just south of Pannawonica was in deep litter at the base of a large eucalypt close to a major river system, and this appears to be typical habitat.

Ecology: Burrows in soil and leaf mould and probably feeds mainly on ant larvae and pupae (like most blind-snakes).

Expected occurrence: **Resident.** There is one DBCA database record about 20 km from the boundary of the project area. This species is presumed to be resident on a precautionary basis. If present, it is probably restricted to the major drainage lines where there is suitable habitat.

Four-lined Slider *(Lerista quadrivincula)* CS2 (P1)

Conservation status: Listed as Priority 1 by DBCA.

Distribution and habitat: Only known from one specimen, found 25 km south of Karratha Station in Western Australia (IUCN, 2023).

Ecology: Likely to be similar to other members of the genus *Lerista*: typically burrowing species found in loose soil or sand, beneath ground cover such as stones, logs, and termite mounds (IUCN, 2023).

Expected occurrence: **Resident.** There are two records within the 50 km buffer used for the updated DBCA database search (these are presumably duplicate records of the only known specimen). This species is assumed to be resident on a precautionary basis. Most likely to occur in sandy soils along drainage lines of the Maitland drainage system in Baru.

Letter-winged Kite (*Elanus scriptus*) CS2 (P4)

Conservation status: Listed as Priority 4 by DBCA.

Distribution and habitat: This species' core range is arid inland and northern Australia but it may be a casual occupier of other parts when suitable seasonal conditions prevail (Johnstone & Storr, 1998; Menkhorst et al., 2017). Prefers open country and grasslands (Menkhorst et al., 2017).

Ecology: A crepuscular or nocturnal predator, mostly targeting smaller mammals such as rodents(Johnstone & Storr, 1998; Menkhorst et al., 2017). It is a boom-bust species that will move and breed opportunistically in response to rainfall events, and coincident prey-population increases(Menkhorst et al., 2017). The Letter-winged Kite roosts communally, during the day, in leafy trees (Menkhorst et al., 2017).

Expected occurrence: **Vagrant.** There is one record within the 50 km radius used for the updated DBCA database search. The species is irruptive and in principle could very infrequently become abundant for short periods of time.

Brush-tailed Mulgara (*Dasycercus blythi*) CS2 (P4)

Conservation status: Listed as Priority 4 by DBCA.

Distribution and habitat: Pilbara and inland, central Western Australia, as well as central Australia (southern Northern Territory and northern South Australia). This species is often compared with its congener, the Crest-tailed Mulgara (*D. cristicauda*), as the two are sympatric over parts of their range (Van Dyck & Strahan, 2008). In general, the Brush-tailed Mulgara is less closely associated with the dune fields than the Crest-tailed Mulgara (Woolley et al., 2013). Where the two co-occur, the Crest-tailed Mulgara is restricted to sandridges with an understorey dominated by spinifex (*Triodia*), whereas the Brush-tailed Mulgara occupies sand plain and gibber plain (Pavey et al., 2011).

Ecology: A nocturnal predator, the Brush-tailed Mulgara is among the largest native predatory mammals remaining in Australia's deserts (Pavey et al., 2011). Its main prey include rodents, other dasyurid marsupials, reptiles, small birds and a wide range of invertebrate taxa (Pavey et al., 2011). Generally solitary (Van Dyck & Strahan, 2008). This species constructs characteristic burrows for shelter (Triggs, 1996; Van Dyck & Strahan, 2008).

Expected occurrence: **Irregular visitor.** There is one record within the 50 km buffer used for the updated DBCA database search; the low number of records is probably due to lack of survey effort in this region. However, suitable habitat (extensive sandy soils supporting spinifex) may be limiting. Assuming that the species does occur in the region, it can be expected to be an irregular visitor in the project area as this provides limited suitable habitat.

Long-tailed Dunnart (*Antechinomys (Sminthopsis) longicaudata*) CS2

Conservation status: Listed as Priority 4 by DBCA.

Distribution and habitat: Closely-associated with rocky landscapes (Menkhorst & Knight, 2011) across much of inland Australia, but the distribution is poorly-documented as the species is hard to detect.

Ecology: An insectivore that is probably largely nocturnal and forages within and close to rocky areas.

Expected occurrence: **Resident.** There is one DBCA database record within c. 35 km of the project area (see Figure 3-9). The project area does contain rocky environments that are presumable suitable habitat, therefore assumed to be a resident cross much of the area.

Water-rat, Rakali (*Hydromys chrysogaster*) CS2 (P4)

Conservation status: Listed as Priority 4 by DBCA.

Distribution and habitat: Generally occurs in the vicinity of permanent fresh or brackish water sources (including lakes, rivers, swamps, mangroves and beaches) throughout much of Australia, with the exception of inland/central Western Australia, Northern Territory, South Australia and New South Wales (Van Dyck & Strahan, 2008). In the south of Western Australia Water-rats preferentially use wetland habitats characterised by dense, low-lying vegetation, low-density canopy cover and shallow, narrow water bodies (Speldewinde et al., 2013). Within the greater Perth area, Water-rats occurred in association with high value habitat quality characteristics such as high bank stability, habitat diversity, stream cover and foreshore vegetation (Smart et al., 2011).

Ecology: While most active around sunset (crepuscular), Water-rats are also known to forage during the day (Van Dyck & Strahan, 2008). They are generally carnivorous, feeding on aquatic invertebrates, fish and also terrestrial mammals, including birds but may also browse on plant material (Van Dyck & Strahan, 2008).

Expected occurrence: **Irregular visitor.** There are no records within the 50 km buffer used for the updated DBCA database search. Despite this, the drainage systems do provide suitable habitat, although a status of 'Vagrant' may be more suited.

Short-tailed Mouse, Lakeland Downs Mouse (*Leggadina lakedownensis*) CS2 (P4)

Conservation status: Listed as Priority 4 by DBCA.

Distribution and habitat: Northern Pilbara through the Kimberley and into northern Australia (Van Dyck & Strahan, 2008), inhabiting a range of environments including spinifex and tussock grasslands, samphire and sedgelands, *Acacia* shrublands, tropical *Eucalyptus* and *Melaleuca* woodlands, and stony ranges(Van Dyck & Strahan, 2008). Usually associated with areas that are seasonally inundated on red or white sandy-clay soils (Van Dyck & Strahan, 2008).

Ecology: Nocturnal and solitary, the Short-tailed Mouse feeds predominately on invertebrates but may supplement its diet with plant material (Van Dyck & Strahan, 2008). Populations of the Short-tailed Mouse appear to fluctuate dramatically, probably in response to environmental conditions and food availability.

Expected occurrence: **Resident.** There are 63 records within the 50 km radius used for the DBCA database search. Nearly half of these records are from within c. 17 km of the boundary of the project area. There may be suitable habitat associated with heavy soils along drainage lines. Extreme population fluctuations mean that the species can be undetectable for long periods even when present, and can then appear where it had not been recorded previously. A status of regular visitor may be more appropriate to reflect the irruptive native of populations.

Gurdi; Ngadji or Western Pebble-mound Mouse (*Pseudomys chapmani*) CS2 (P4)

Conservation status: Listed as Priority 4 by DBCA.

Distribution and habitat: This species is found through much of the Pilbara and prefers rocky soils in grassland and *Acacia* woodland.

Ecology: The Western Pebble-mound Mouse lives in groups in burrows surrounded by mounds of pebbles. Mounds are typically found on low gravelly and stony rises.

Expected occurrence: **Resident.** There are nine records within c. 30 km of the central coordinates used for the DBCA database search. The undulating terrain part of Marnda (Capricorn Land System of undulating sandstone hills) appears suitable for this species, but the more rugged terrain of the Rocklea Land System does not (most of Baru). Inactive mounds were found at several locations, most in Marnda (see Figure 3-2). Most mounds were old and disused, but several were recent. None appeared occupied.

3.2.7.3 Conservation Significance 3

Star Finch (*Neochmia ruficauda*) CS3 (LS)

Conservation status: This species is patchily distributed and was formerly listed as priority by DBCA.

Distribution and habitat: Distributed patchily from the Pilbara to north-eastern Queensland. Its preferred habitat is grasslands associated with drainage systems. Usually seen in flocks close to dense vegetation and even rushes.

Ecology: A granivore that often feeds on the ground along the margins of riparian grasslands and shrublands.

Expected occurrence: **Irregular visitor**. Some suitable habitat appeared to be present along drainage lines, and the species was recorded during field investigations, with several records of small flocks near waterholes.

Rufous Grasswren (*Amytornis whitei*)* and Rufous-crowned Emu-wren (*Stipiturus ruficeps*) CS3 (LS)

* formerly a sub-species of Striated Grasswren (*Amytornis striatus whitei*)

Conservation status: These species are patchily distributed in the Pilbara and often associated with long-unburnt spinifex.

Distribution and habitat: Both species prefer tall, dense unburnt spinifex on plains and rocky hills.

Ecology: Insectivorous and granivorous, both species are secretive and stay close to cover.

Expected occurrence: **Residents**. The recent fire may have displaced birds that would normally be present in the project area, but they are expected to persist nearby with unburnt landscapes just to the south. One party of the Rufous (Pilbara) Grasswren observed at VP04 in March 2025.

Wayuwarru (Rothschild's Rock-Wallaby) (*Petrogale rothschildi*) CS3 (LS)

Conservation status: This species is considered locally significant due to its restricted distribution (it is confined to the Pilbara).

Distribution and habitat: Distributed patchily in the Pilbara region. Its preferred habitat is rocky hills.

Ecology: A nocturnal herbivore which prefers to shelter in caves and rocky outcrops during the day but may forage away from rocky hills at night.

Expected occurrence: **Resident.** The boulder tors, boulder fields and rocky outcrops along creeklines offer shelter for this species and one was photographed on a boulder tor during the August 2024 survey (See Plate 3). One was captured on a camera trap in the north-western corner of Baru only two kilometres from where the individual was spotted. Scats were found mostly around the rocky outcrops but one sample was also found in the south-eastern corner of Marnda along a small drainage line approximately 500 m from a hill with scattered boulders.

CS3 (LS)

Warrgi; Brush-tailed Possum (*Trichosurus vulpecula*)

Conservation status:	This species is considered locally significant as it is recorded infrequently in the Pilbara (Anderson et al., in prep). It has declined throughout its range in Western Australia. The taxonomic affinities of Brush-tailed Possums in the Pilbara are uncertain; the northern sub-species (*T. vulpecula arnhemensis*) of the Kimberley is considered Vulnerable (EPBC Act) and Schedule 3 (BC Act).
Distribution and habitat:	Formerly distributed across almost the whole of Australia, the Brush-tailed Possum's range has now been reduced in Western Australia to the south-west, the Kimberley and an isolated population within the north-western Pilbara, including offshore islands (Van Dyck & Strahan, 2008). There may be other outlying Pilbara records (M. Bamford, pers. obs). It occurs in a wide variety of environments that usually encompass trees, including forests, woodlands, riparian zones and urban areas, but it also persists in treeless landscapes such as Barrow Island (Van Dyck & Strahan, 2008) (Van Dyck and Strahan 2008). The Robe Valley area (south of Pannawonica) appears to be a possible stronghold for the Pilbara population (Anderson et al., in prep).
Ecology:	A nocturnal herbivore, its preferred diet is predominantly leaves, flowers and fruits (Van Dyck & Strahan, 2008).
Expected occurrence:	**Irregular visitor.** The project area has limited suitable habitat (such as drainage systems lined with trees and thickets) but the species is known from the broader region.

3.3 Patterns of biodiversity

While patterns of biodiversity have not been studied in detail, and indeed are beyond the reach even of detailed surveys, some patterns can be interpreted based on the landscape and VSAs. Drainage lines, the springs and rocky gorges at various locations along the creeklines are likely to support species that would not otherwise be present, and a permanent water source can affect the abundance and movement pattern of a range of fauna species. The majority of bird observations made during surveys were taken along the creeklines. Ducks, cormorants, herons, dotterel and other birds associated with water were present frequently along the creeklines but varied widely. Thickets and dense vegetation along drainage lines were also where most species such as the Purple-backed Fairy-wren and honeyeaters were observed. These observations emphasises the value of this area as a refugium during hot conditions, and following fire. The very shallow, rocky soils across much of the landscape may also affect patterns of biodiversity, with rocky slopes providing micro-habitat and shelter.

3.4 Ecological processes

The landscape in the project area is continuous with very little degradation or weed invasion. The two sites are separated by the railway line and service road, but no fencing divides the two areas. The arid landscape and particularly high in the landscape may impose restrictions on abundance and dispersal of many species, meaning that the drainage systems are effectively corridors for movement and dispersal. The current fauna assemblage is likely to be affected by:

- Fire regime. A very large area to the north of Baru and Marnda was burnt in the spring of 2023, and fires are likely to be too frequent and too extensive, resulting in the decline in abundance and possible disappearance of some sensitive species.
- Landscape patterns, with strong linear features in the form of drainage lines and some geological features affecting landscape permeability for some species. For example, areas of loose rock tend to be found along the upper slopes of valleys within VSA 1, and these may facilitate movement of fauna across the landscape. The close proximity of the headwaters of two distinct drainage systems (Harding and Maitland in the north, and Fortescue in the south) has the possibility of linking the fauna from the Hammersley Ranges in the south with those in the north in a harsh landscape otherwise not conducive to passage.
- The presence of feral species. Cattle may be causing some damage as they forage along drainage lines and some trampling was observed at various pools along creeklines. The Feral Cat is present and would prey upon reptiles, small mammals and birds. However, due to ephemeral availability of standing water, it is likely to occur only in relatively low numbers. Foxes may also be present but perhaps not resident.
- Hydrology of the different catchment systems flowing to the north and south is an important feature for the landscape ecology and fauna assemblage. It is therefore an important consideration in understanding impacts from the development, and in particular when crossing creeklines and any excavations for access tracks etc.

These ecological processes help identify some of the vulnerabilities of the fauna assemblage to impacts and change wrought be development.

3.5 Summary of fauna values

Landscape and VSAs. The project area encompasses arid rocky hills to undulating stony plains with several major water courses flowing to the north, and several more flowing to the south. The proximity of the headwaters of both north and south systems offer a corridor between the two areas through which fauna are more likely to transit than if there was large expanses of arid hills. Vegetation is broadly low, open to sparse woodland over sparse shrubland with occasional thickets, over spinifex hummock grassland, but was difficult to define due to a recent fire. The creeklines contain patchworks of dense vegetation with occasional patches of open woodland. Five dominant VSAs were identified:

- VSA 1 - Open hummock grassland on rocky basalt hills, plateaux and plains (33,156 ha [81.79%]), comprised of low isolated trees (comprised of *Acacia inaequilatera* and *Corymbia hemersleyana*) over low sparse shrubland (comprised of *Indigofera monophyla*, *Acacia pyrifolia* and *Acacia bivenosa*) over low open hummock grassland (comprised of *Triodia wiseana* and *Triodia epactia*). This grassland is broadly distributed mostly across the higher slopes of Baru and Marnda.
- VSA 2 - Low and sparse shrubland over sparse hummock grasslands on stony plains and granite tor fields (2,782 ha [6.86%]), comprised of low isolated trees (*C. hemersleyana*) over sparse shrubland (*Acacia ancistrocarpa*, *A. pyrifolia* and *Grevillea wickhamii*) *over sparse* hummock grassland (*T. epactia* and *T. wiseana*). This shrubland type lies on the lower areas in the north of Baru and Marnda and is interspersed with fields of large boulders

- VSA 3 - Open woodland along ephemeral drainage channels incised into rocky sandstone creeklines (1,564 ha [3.86%]), comprised of *E. victrix* woodland over mid sparse shrubland (*Melaleuca linophylla*, *A. bivenosa*, *Acacia coriacea*) and low sparse shrubland (comprised of *Cyperus vaginatus*, *Stemodia grossa* and *Tephrosia rosea*). This vegetation type dominates the creeklines in both the northern and southern catchment areas and is interspersed with permanent and ephemeral pools.
- VSA 4 - Grassland with low isolated shrubs over friable cracking clay on basalt upland gilgai plains and flats (1,145 ha [2.82%]), comprised of low sparse tussock grassland (*A. latifolia* and *T. wiseana*) with low isolated shrubs and diverse annual herbs and grasses (of *Rhynchosia minima* and *Streptoglossa bubakii*). This grassland type is limited to the slopes across Marnda's south.
- VSA 5 - Low open woodland and isolated shrubs on sandstone hilltops (849.15 ha [2.09%]), comprised of low open woodland (*Eucalyptus leucophloia*) over low isolated shrubs (*A. bivenosa*, other *Acacia* spp, and *Senna glutinosa*) over low sparse hummock *Triodia wiseana* grassland on rocky sandstone alluvium. This woodland type is confined to a band of higher ground and small patches that lies across the southern half of Marnda with some small areas in Baru.

Fauna assemblage. The desktop assessment identified 261 vertebrate fauna species as potentially occurring in the project area: three fish, six frogs, 65 reptiles, 149 birds, 35 native mammals (including the Dingo, considered 'naturalised') and 3 introduced mammals. At least six mammal species that would historically have been present in the project area are considered locally extinct and have been omitted from the expected species list.

The fauna assemblage is typical of that expected in this region of Western Australia and is likely to be represented elsewhere in similar landscapes nearby. It is only moderately rich in a regional context due to the virtual absence of sandplains and strongly rocky landscapes which provide habitat for a number of species not expected to be present. The assemblage is expected to be intact except for some extinct mammal species. Over a third (38%) of the expected vertebrate fauna assemblage are expected as regular visitors, irregular visitors or vagrants, so will not be present at all times.

The species of note when considering impacts through a wind farm and wind turbines are the raptors, including Minybirriirrii (Nankeen Kestrel), Wirndiwirndi (Brown Falcon) and Jarburrungu (Wedge-tailed Eagle) all of which were recorded in the project area and for substantial amounts of their flight time in the rotor swept pathway. Common bat species may also be at risk of colliding with the turbine blades and four such species have been confirmed present. The ongoing acoustic survey will allow a full assessment of their presence, and with the use of the met-mast, may also offer insights into their relative flight heights.

Species of conservation significance. Thirty-nine vertebrate species that are listed under state or federal *Acts* or publications are expected to occur in the project area: 24 CS1, ten CS2, and five CS3 species. More than half the conservation significant species are expected only as irregular visitors (12 species) or vagrants (10 species); five species are expected as regular visitors and twelve species are expected as residents. The Grey Falcon is a key species for consideration of turbine collision risk due to its flight patterns and confirmed presence during winter, early spring and summer. Being a likely breeding visitor, it may be present every year. Its sporadic occurrence will also render it difficult to

sample or to monitor. Other conservation significant species may also be expected, such as the Peregrine Falcon and migrant waders, but, similarly to the Grey Falcon, are nomadic and sampling is purely down to chance. Though not listed as conservation significant, the Black-breasted Buzzard is a large raptor that can be expected to occur in the project area. It is endemic to arid northern Australia and occurs in very low densities across very large areas including the Pilbara. For these reasons it is therefore at risk of even low-levels of mortality.

Pilbara Leaf-nosed Bats are confirmed in the area but with only four passes it is considered to be an infrequent visitor. This species was only detected along water courses and is not expected to fly at the height of the RSA. It is not known yet whether Ghost Bats occur in the project area, or whether they fly high enough to be at risk of collision with blades. However, the intensive acoustic survey is ongoing and results posted when they become available.

Of particular interest are the resident Yirriwardu (Northern Quoll) and the Bargunyji (Pilbara Olive Python) both of which were recorded along creeklines, with the former also being seen to have used a wider area. The Jardunmarra (Rothschild's Rock Wallaby) was also confirmed present through scats, sightings and photographs. Several conservation significant invertebrate species may also be present, with the spring potentially providing habitat for the Garlawirrura (Pilbara Dragonfly) and Pilbara Threadtail (Damselfly), and the spring area also possibly providing the sort of mesic environment favoured by several potential SRE invertebrates.

Patterns of biodiversity. Patterns of biodiversity have not been studied in detail, but can be interpreted from the landscape. The extensive creeklines are distinctive features that are likely to support many species that would not otherwise be present, and also affecting the abundance of a range of species not wholly reliant on these features. The creeklines, gorges and associated vegetation are therefore a locally significant feature for fauna. Across the broader landscape, small areas of rocks may provide shelter.

Ecological processes. Important ecological processes affecting the fauna assemblage include the fire regime, the presence of strong linear landscape features, the presence of feral species and the presence of a permanent or near-permanent spring, a feature of the local hydrology. These ecological processes help identify some of the vulnerabilities of the fauna assemblage to impacts and change wrought be development. The close proximity of the upper creeklines that separately flow to the north and south, may create a narrow corridor over arid and otherwise inhospitable landscapes. This may allow fauna to move between the northern and southern systems, that otherwise may not occur, and could include species such as the Pilbara Leaf-nosed Bats.

4 Conclusions

The fauna assessment and surveys have identified several fauna species of significance in the area, and several features of the landscape that are important for the fauna assemblage.

The southern half of the project area contains a broad area considered to be good Grey Falcon foraging and potentially breeding habitat. Grey Falcon was confirmed present on three separate visits in winter, early spring and summer. They were present as pairs and potentially a juvenile and were observed flying in RSP for 55% of the time observed. Due to its conservation status and tendency to fly regularly at RSP, it has been established as the primary species to be targeted during survey. Rains had fallen through the winter and there was an abundance of parrot and other bird species on which

the Grey Falcon is known to hunt. One adult pair was seen towards the end of the breeding season, suggesting they may have been breeding, but no juveniles were observed. Grey Falcon use abandoned nests previously made by other birds, and especially crows. However, they are highly nomadic and seldom use the same nest site in consecutive seasons (or longer) and may not be seen again in the project area for some time. It is not known how this species would respond to a wind farm, but the nearest analogue is the Peregrine Falcon, whereby much data is available from other areas around the world. Other raptors species recorded within RSP for substantial periods of time observed, were the Brown Falcon, Nankeen Kestrel and Wedge-tailed Eagles. None of these are conservation significant but commonly featured during carcass retrieval on wind farm monitoring programmes throughout Australia. The only other bird species recorded in RSP was a group of 55 Little Corellas for a very brief period in response to a flying Wedge-tailed Eagle. A single flight of circa 150 medium-sized birds was observed at 100 m height, flying a couple of kilometres south of the project area. The size of bird and flight pattern was similar to that of Cockatiels, but were too far away to determine.

The Northern Quoll is present and likely to be resident. It was recorded on several of the camera traps and scats and tracks were found across a large part of the north. Signs were found mostly along creeklines, but scats were also found in a cave on the side of a hill showing they will cross high, open ground when transiting and dispersal. They are likely to rely heavily on the rocky areas along water courses and the boulder tors and boulder fields to the north for denning and shelter. Protecting denning areas and providing protected buffers of adjacent landscapes would allow the Northern Quoll to persist and would also protecting other important features and functions, such as connectivity for a range of fauna species.

The Pilbara Olive Python was confirmed present through a skin slough and scats found on a creekline. This species is likely to be reliant on the rocky creeklines where water is present. Dispersal is likely to occur along other drainage lines and possibly more broadly across the landscape, especially where shelter is provided by boulder tors and boulder fields. Protection of the creeklines and boulder fields, with a buffer, would be important for retaining this species in the landscape.

The standing water and springs are important aspects of landscape ecology for fauna and its hydrology needs to be understood to ensure construction work does not change the hydrological regime. There may be significant SRE invertebrates, the various creeklines provide water sources for fauna and it is likely to be locally important for frogs and freshwater fish. The spring itself appears to be located above the actual gorge in a broad seepage area, but there may also be upwellings within the gorge.

Fires in the area are likely to have been too frequent and too extensive. Reduction in the frequency and extent of fires (but not fire exclusion except possibly around the spring) is likely to benefit the fauna assemblage.

There are likely to be some impacts from introduced species. Removal of Cattle and an assessment of the abundance of the Feral Cat (with subsequent control if necessary) may benefit the fauna assemblage.

The Grey Falcon has been recorded on site and is expected to be a frequent visitor and potentially breeding in the project area. Ongoing VP survey as proposed will help detect its presence and distribution, should it occur again during the overall fauna survey programme. Should it reoccur, targeted survey would be required to investigate where it roosts, nests and hunts. This would be most effective during the peak breeding period (June to November). Rainfall has a large effect on the

presence and diversity of fauna (including large raptors and Grey Falcons) and it is recommended that a short survey is arranged following rains to sample water courses and the broader landscape where Grey Falcon was detected.

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6 Appendices

Appendix 1. Explanation of fauna values.

Fauna values are the features of a site and its fauna that contribute to biodiversity, and it is these values that are potentially at threat from a development proposal. Fauna values can be examined under the five headings outlined below. It must be stressed that these values are interdependent and should not be considered equal, but contribute to an understanding of the biodiversity of a site. Understanding fauna values provides opportunities to predict and therefore mitigate impacts.

Assemblage characteristics

Uniqueness. This refers to the combination of species present at a site. For example, a site may support an unusual assemblage that has elements from adjacent biogeographic zones, it may have species present or absent that might be otherwise expected, or it may have an assemblage that is typical of a very large region. For the purposes of impact assessment, an unusual assemblage has greater value for biodiversity than a typical assemblage.

Completeness. An assemblage may be complete (i.e. has all the species that would have been present at the time of European settlement), or it may have lost species due to a variety of factors. Note that a complete assemblage, such as on an island, may have fewer species than an incomplete assemblage (such as in a species-rich but degraded site on the mainland).

Richness. This is a measure of the number of species at a site. At a simple level, a species rich site is more valuable than a species poor site, but value is also determined, for example, by the sorts of species present.

Vegetation and substrate associations (VSAs)

VSAs combine broad vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna. The term habitat is widely used in this context, but by definition an animal's habitat is the environment that it utilises (Calver et al., 2009), not the environment as a whole. Habitat is a function of the animal and its ecology, rather than being a function of the environment. For example, a species may occur in eucalypt canopy or in leaf-litter on sand, and that habitat may be found in only one or in several VSAs. VSAs are not the same as vegetation types since these may not incorporate soil and landform, and recognise floristics to a degree that VSAs do not. Vegetation types may also not recognise minor but often significant (for fauna) structural differences in the environment. VSAs also do not necessarily correspond with soil types, but may reflect some of these elements.

Because VSAs provide the habitat for fauna, they are important in determining assemblage characteristics. For the purposes of impact assessment, VSAs can also provide a surrogate for detailed information on the fauna assemblage. For example, rare, relictual or restricted VSAs should automatically be considered a significant fauna value. Impacts may be significant if the VSA is rare, a large proportion of the VSA is affected and/or the VSA supports significant fauna. The disturbance of

even small amounts of habitat in a localised area can have significant impacts to fauna if rare or unusual habitats are disturbed.

VSA assessment was made with reference to the key attributes provided by (EPA, 2020):

- soil type and characteristics
- extent and type of ground surfaces and landforms
- height, cover and dominant flora within each vegetation stratum
- presence of specific flora or vegetation of known importance to fauna
- evidence of fire history including, where possible, estimates of time since fire
- evidence and degree of other disturbance or threats, e.g. feral species
- presence of microhabitats and significant habitat features, such as coarse woody debris, rocky
- outcrops, tree hollows, water sources and caves
- evidence of potential to support significant fauna
- function of the habitat as a fauna refuge or part of an ecological linkage.

Patterns of biodiversity across the landscape

This fauna value relates to how the assemblage is organised across the landscape. Generally, the fauna assemblage is not distributed evenly across the landscape or even within one VSA. There may be zones of high biodiversity such as particular environments or ecotones (transitions between VSAs). There may also be zones of low biodiversity. Impacts may be significant if a wide range of species is affected even if most of those species are not significant per se.

Species of conservation significance

Species of conservation significance are of special importance in impact assessment. The conservation status of fauna species in Australia is assessed under Commonwealth and State Acts such as the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian *Biodiversity Conservation Act 2016* (BC Act). In addition, the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) recognises priority levels, while local populations of some species may be significant even if the species as a whole has no formal recognition. Therefore, three broad levels of conservation significance can be recognised and are used for the purposes of this report, and are outlined below. A full description of the conservation significance categories, schedules and priority levels mentioned below is provided in Appendix 2.

<u>Conservation Significance (CS) 1: Species listed under State or Commonwealth Acts</u>.

Species listed under the EPBC Act are assigned to categories recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN, 2012), or are listed as migratory. Migratory species are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA), the Japan Australia Migratory Bird Agreement (JAMBA), the Republic of South Korea Australia Migratory Bird Agreement (ROKAMBA), and/or the Convention on the Conservation of Migratory Species of Wild Animals (CMS; also referred to as the Bonn Convention). The *Biodiversity Conservation Act 2016* uses a series of divisions within three Schedules to classify conservation status that largely reflect the IUCN categories (IUCN, 2012).

Conservation Significance (CS) 2: Species listed as Priority by DBCA but not listed under State or Commonwealth Acts.

In Western Australia, DBCA has produced a supplementary list of Priority Fauna, being species that are not considered threatened under the *Biodiversity Conservation Act 2016* but for which DBCA feels there is cause for concern.

Conservation Significance (CS) 3: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

This level of significance has no legislative or published recognition and is based on interpretation of distribution information, but is used here as it may have links to preserving biodiversity at the genetic level (EPA, 2002). If a population is isolated but a subset of a widespread (common) species, then it may not be recognised as threatened, but may have unique genetic characteristics. Conservation significance is applied to allow for the preservation of genetic richness at a population level, and not just at a species level. Species on the edge of their range, or that are sensitive to impacts such as habitat fragmentation, may also be classed as CS3, as may colonies of waterbirds. The Western Australian Department of Environmental Protection, now DBCA, used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of the Perth Bushplan (Dell & Banyard, 2000).

Marine-listed species

Some conservation significant species may also be listed as 'Marine' under the EPBC Act. This listing protects these species in 'Commonwealth areas' which include "marine areas beyond the coastal waters of each State and the Northern Territory, and includes all of Australia's Exclusive Economic Zone (EEZ)" (DEH, 2006). The EEZ extends to 200 nautical miles (approximately 350 kilometres) from the coast (DEH, 2006). This may mean that the 'Marine' listing does not apply to the project/project area (depending on its location). Therefore, when a species is otherwise protected (under the EPBC Act or BC Act) or priority-listed (by the DBCA) then the Marine listing is also noted but it does not have site-specific relevance. In cases where a species is solely Marine-listed (for a list see DEH, 2000) and a project/project area is not within a Commonwealth area then it is treated like all other fauna.

Invertebrates

Invertebrate species considered to be short range endemics (SREs) also fall within the CS3 category, as they have no legislative or published recognition and their significance is based on interpretation of distribution information. Harvey (2002) notes that the majority of species that have been classified as short-range endemics have common life history characteristics such as poor powers of dispersal or confinement to discontinuous habitats. Several groups, therefore, have particularly high instances of short-range endemic species: Gastropoda (snails and slugs), Oligochaeta (earthworms), Onychophora (velvet worms), Araneae (mygalomorph spiders), Pseudoscorpionida (pseudoscorpions), Schizomida (schizomids), Diplopoda (millipedes), Phreatoicidea (phreatoicidean crustaceans), and Decapoda (freshwater crayfish). The poor understanding of the taxonomy of many of the short-range endemic species hinders their conservation (Harvey, 2002).

Introduced species

In addition to these conservation levels, species that have been introduced (INT) are indicated throughout the report. Introduced species may be important to the native fauna assemblage through effects by predation and/or competition.

Ecological processes upon which the fauna depend

These are the processes and conditions that apply to the existing environment and that affect and maintain fauna populations in an area. As such they are very complex; for example, populations are maintained through the dynamic of mortality, survival and recruitment being more or less in balance, and these are affected by a myriad of factors. The dynamics of fauna populations in a project area may be affected and effectively determined by processes such as:

- fire regime.
- landscape patterns (such as extent of existing habitat, fragmentation and/or linkage).
- the presence of feral species.
- hydrology.

Appendix 2. Categories used in the assessment of conservation status.

IUCN (International Union for the Conservation of Nature) categories, as outlined by IUCN (2012), and as used for the *Environment Protection and Biodiversity Conservation Act 1999* and the Western Australian *Biodiversity Conservation Act 2016*.

Extinct	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (Ex)	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 (E)	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable (V)	Taxa facing a high risk of extinction in the wild in the medium-term future.
Near Threatened	Taxa that risk becoming Vulnerable in the wild.
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern.	Taxa that are not Threatened.

Schedules used in the WA *Biodiversity Conservation Act 2016, updated 2023*

Schedule 1	Specially protected fauna Division 1 – Species of special conservation interest (S1D1) Division 2 – Migratory species (S1D2) Division 3 – Species otherwise in need of special protection (S1D3)
Schedule 2	Threatened species Division 1 – Critically endangered species (S2D1) Division 2 – Endangered species (S2D2) Division 3 – Vulnerable species (S2D3)
Schedule 3	Extinct species (S3)

WA DBCA Priority species (species not listed under the *WA Biodiversity Conservation Act 2016*, but for which there is some concern).

Priority 1 (P1)	Taxa with few, poorly known populations on threatened lands.
Priority 2 (P2)	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3 (P3)	Taxa with several, poorly known populations, some on conservation lands.
Priority 4. (P4)	Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.
Priority 5 (P5)	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years (IUCN Conservation Dependent).

Appendix 3. Expected fauna assemblage of the project area.

Status codes:

CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.

EPBC Act listings: CR = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory, Mar = Marine (see Appendix 2).

Biodiversity Conservation Act 2016 listings: S1 to S3 = Schedules 1 to 3, D1 to D3 = Divisions 1 to 3 (see Appendix 2).

DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).

CS3 = considered to be of local significance by Bamford Consulting Ecologists (see Appendix 1).

Int = introduced species.

See Section 2.3.4 for explanation of expected occurrence categories.

Sources: 1 = Previous studies, 2 = Atlas of Living Australia, 3 = Naturemap, 4 = Protected Matters Search Tool, 5 = Birdata, 6* = updated DBCA threatened and priority fauna search, Lit = general literature, R = Recorded on site

*Expected occurrence in **bold** indicates species observed during field investigations in Baru and Marnda

Species	Common Name	Status	Source	Expected Occurrence
Tetrapontidae				
Leiopotherapon aheneus	Fortescue Grunter	CS2 (P4)	6*	Regular visitor
Leiopotherapon unicolor	Spangled Grunter		Lit	**Regular visitor**
Melanotaenidae				
Melanotaenia australis	Western Rainbowfish		Lit	**Regular visitor**
Hylidae (Tree frogs)				
Cyclorana maini	Main's Frog		2 3	Resident
Litoria rubella	Little Red Tree Frog		2 3	**Resident**
Myobatrachidae (Ground frogs)				
Platyplectrum spenceri	Spencer's Frog		2 3	Resident
Pseudophryne douglasi	Douglas's Toadlet		2 3	**Resident**
Uperoleia russelli	Russells Toadlet		3	Resident
Uperoleia saxatilis	Pilbara Toadlet		2 3	Resident
Chelidae (side-necked tortoises)				
Chelodina steindachneri	Steindachner’s Tortoise		R	**Resident**
Carphodactylidae (Carphodactylid geckoes)				
Nephrurus cinctus	Northern Banded Knobtail Gecko		3	Resident
Diplodactylidae (Diplodactylid geckoes)				

Species	Common Name	Status	Source	Expected Occurrence
Diplodactylus bilybara	Western Fat-tailed Gecko		2	**Resident**
Diplodactylus galaxias	Northern Pilbara Beak-faced Gecko		2 3	Resident
Diplodactylus mitchelli	Pilbara Stone Gecko		3	Resident
Lucasium stenodactylum	Crowned Gecko		3	Resident
Lucasium wombeyi	Pilbara Ground Gecko		2 3	Resident
Lucasium woodwardi			3	Resident
Oedura fimbria	Western Marbled Velvet Gecko		2	Resident
Strophurus elderi	Jewelled Gecko		2 3	Resident
Gekkonidae (Gekkonid geckoes)				
Gehyra crypta	Western Cryptic Gehyra		2	Resident
Gehyra incognita	Northern Pilbara Cryptic Gehyra		Lit	Resident
Gehyra punctata	Spotted Dtella		2 3	Resident
Gehyra variegata	Variegated Dtella		3	Resident
Hemidactylus frenatus	House Gecko	Int	Lit	**Resident**
Heteronotia binoei	Bynoe's Gecko		2 3	Resident
Heteronotia spelea	Pilbara Cave Gecko		3	Resident
Pygopodidae (Legless lizards)				
Delma elegans	Pilbara Delma		2 3	Resident
Delma nasuta	Sharp-snouted Delma		3	Resident
Delma pax	Peace Delma		2 3	Resident
Lialis burtonis	Burton's Snake-lizard		3	Resident
Pygopus nigriceps	Western Hooded Scaly-foot		3	Resident
Agamidae (Dragons)				
Ctenophorus caudicinctus	Ring-tailed Dragon		1 2 3	**Resident**
Ctenophorus isolepis	Central Military Dragon		1 3	Resident
Diporiphora valens	Southern Pilbara Tree Dragon		2 3	Resident
Gowidon longirostris	Long-nosed Dragon		2 3	Resident
Pogona minor	Dwarf Bearded Dragon		2 3	Resident
Scincidae (Skinks)				
Carlia munda	Shaded-litter Rainbow-Skink		2 3	Resident

Species	Common Name	Status	Source	Expected Occurrence
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink		Lit	Resident
Ctenotus grandis			2 3	Resident
Ctenotus helenae	Clay-soil Ctenotus		2 3	Resident
Ctenotus inornatus	Bar-shouldered Ctenotus		2	Resident
Ctenotus pantherinus	Leopard Ctenotus		2 3	Resident
Ctenotus rubicundus	Ruddy Ctenotus		2 3	Resident
Ctenotus saxatilis	Rock Ctenotus		3	**Resident**
Cyclodomorphus melanops	Northern Slender Blue-Tongue		2 3	Resident
Egernia cygnitos	Western Pilbara Spiny-tailed Skink		Lit	Resident
Egernia pilbarensis	Pilbara Crevice Skink		R	**Resident**
Glaphyromorphus pallidus	Western Narrow-banded Skink		Lit	Resident
Lerista muelleri			2 3	Resident
Lerista quadrivincula	Four-lined Slider	CS2 (P1)	6*	Resident
Lerista verhmens	Powerful Lerista		2 3	Resident
Menetia greyii	Common Dwarf Skink		3	Resident
Morethia ruficauda			2 3	Resident
Notoscincus butleri	Lined Soil-Crevice Skink	CS2 (P4)	2 3 6*	Resident
Tiliqua multifasciata	Central Blue-tongue		3	Resident
Varanidae (Monitors and goannas)				
Varanus acanthurus	Spiny-tailed Monitor		2 3	Resident
Varanus brevicauda	Short-tailed Pygmy Monitor		2 3	Resident
Varanus giganteus	Perentie		Lit	**Resident**
Varanus panoptes			Lit	**Resident**
Varanus pilbarensis	Pilbara Rock Monitor		2 3	Resident
Varanus tristis	Racehorse Monitor		3	Resident
Typhlopidae (Blind snakes)				
Anilios ammodytes			2 3	Resident
Anilios ganei	Gane's Blind Snake	CS2 (P1)	6*	Resident
Pythonidae (Pythons)				
Antaresia children	Children's Python		Lit	Resident

Species	Common Name	Status	Source	Expected Occurrence
Antaresia perthensis	Pygmy Python		2 3	Resident
Aspidites melanocephalus			Lit	Resident
Liasis olivaceus barroni	Pilbara Olive Python	CS1 (VU, S2D3)	4 6*	**Resident**
Elapidae (Venomous land snakes)				
Acanthophis wellsei	Pilbara Death Adder		2 3	Resident
Brachyurophis approximans	North-western Shovel-nosed Snake		3	Resident
Demansia psammophis	Yellow-faced Whipsnake		3	Resident
Furina ornata	Orange-naped Snake		2 3	Resident
Pseudechis australis	Mulga Snake		3	Resident
Pseudonaja mengdeni	Western Brown Snake		3	**Resident**
Suta fasciata	Rosen's Snake		3	Resident
Vermicella snelli	Pilbara Bandy-bandy		3	Resident
Casuariidae (Emus and Cassowaries)				
Dromaius novaehollandiae	Emu		Lit	Regular visitor
Anatidae (Ducks, Swans and Geese)				
Anas gracilis	Grey Teal		2 3 5	**Irregular visitor**
Anas superciliosa	Pacific Black Duck		2 3 5	**Irregular visitor**
Aythya australis	Hardhead		2 3 5	Irregular visitor
Chenonetta jubata	Australian Wood Duck		3 5	Irregular visitor
Cygnus atratus	Black Swan		2 3 5	Irregular visitor
Dendrocygna arcuata	Wandering Whistling-Duck		5	Vagrant
Dendrocygna eytoni	Plumed Whistling-Duck		3 5	Irregular visitor
Malacorhynchus membranaceus	Pink-eared Duck		5	Irregular visitor
Podicipedidae (Grebes)				
Podiceps cristatus	Great Crested Grebe		5	Vagrant
Tachybaptus novaehollandiae	Australasian Grebe		2 3 5	**Irregular visitor**
Phasianidae (Pheasants and Quail)				
Coturnix ypsilophora	Brown Quail		2 3 5	**Regular visitor**
Turnicidae (Button-quails)				
Turnix velox	Little Button-quail		2 3 5	**Resident**

Species	Common Name	Status	Source	Expected Occurrence
Columbidae (Pigeons and Doves)				
Geopelia cuneata	Diamond Dove		1 2 3 5	**Resident**
Geopelia placida	Peaceful Dove		2 3 5	**Resident**
Geophaps plumifera	Spinifex Pigeon		2 3 5	**Resident**
Ocyphaps lophotes	Crested Pigeon		1 2 3 5	**Resident**
Phaps chalcoptera	Common Bronzewing		1 2 3 5	**Resident**
Phaps histrionica	Flock Bronzewing		2 3 5	**Irregular visitor**
Cuculidae (Cuckoos)				
Cacomantis pallidus	Pallid Cuckoo		2 3 5	**Regular visitor**
Centropus phasianinus	Pheasant Coucal		2 3 5	**Resident**
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo		2 3 5	**Regular visitor**
Chrysococcyx osculans	Black-eared Cuckoo		4	Regular visitor
Cuculus optatus	Oriental Cuckoo	CS1 (MI, S1D2)	Lit	Vagrant
Threskiornithidae (Ibis and Spoonbills)				
Platalea flavipes	Yellow-billed Spoonbill		5	Irregular visitor
Threskiornis moluccus	Australian White Ibis		5	Irregular visitor
Threskiornis spinicollis	Straw-necked Ibis		2 3 5	Irregular visitor
Ardeidae (Herons, Bitterns and Egrets)				
Ardea garzetta	Little Egret		2 3 5	**Irregular visitor**
Ardea modesta	Eastern Great Egret		2 3 5	Irregular visitor
Ardea novaehollandiae	White-faced Heron		2 3 5	**Irregular visitor**
Ardea pacifica	White-necked Heron		2 5	**Irregular visitor**
Nycticorax caledonicus	Nankeen Night Heron		2 3 5	Irregular visitor
Ciconiidae (Storks)				
Ephippiorhynchus asiaticus	Black-Necked Stork		2 5	Vagrant
Pelecanidae (Pelicans)				
Pelecanus conspicillatus	Australian Pelican		2 5	Vagrant
Phalacrocoracidae (Cormorants)				
Phalacrocorax melanoleucos	Little Pied Cormorant		2 3 5	**Regular visitor**
Phalacrocorax sulcirostris	Little Black Cormorant		2 3 5	Irregular visitor

Species	Common Name	Status	Source	Expected Occurrence
Phalacrocorax varius	Pied Cormorant		5	Vagrant
Anhingidae (Darters)				
Anhinga novaehollandiae	Australasian Darter		3 5	Vagrant
Accipitridae (Kites, Eagles, Goshawks)				
Accipiter cirrocephalus	Collared Sparrowhawk		2 3 5	Resident
Accipiter fasciatus	Brown Goshawk		5	**Resident**
Aquila audax	Wedge-tailed Eagle		2 3 5	**Resident**
Circus approximans	Swamp Harrier		5	Vagrant
Circus assimilis	Spotted Harrier		2 3 5	**Regular visitor**
Elanus caeruleus	Black-shouldered Kite		3 5	**Regular visitor**
Elanus scriptus	Letter-winged Kite	CS2 (P4)	6* Lit	Vagrant
Erythrotriorchis radiatus	Red Goshawk	CS1 (E, S2D3)	4	Vagrant
Haliastur sphenurus	Whistling Kite		1 2 3 5	**Regular visitor**
Hamirostra melanosternon	Black-breasted Buzzard		2 3 5	Regular visitor
Hieraaetus morphnoides	Little Eagle		2 3 5	Regular visitor
Lophoictinia isura	Square-tailed Kite		3 5	Irregular visitor
Milvus migrans	Black Kite		2 3 5	Regular visitor
Falconidae (Falcons)				
Falco berigora	Brown Falcon		2 3 5	**Resident**
Falco cenchroides	Nankeen Kestrel		1 2 3 5	**Resident**
Falco hypoleucos	Grey Falcon	CS1 (VU, S2D3)	4 6*	**Regular visitor**
Falco longipennis	Australian Hobby		3 5	**Regular visitor**
Falco peregrinus	Peregrine Falcon	CS1 (S1D3)	6* Lit	Regular visitor
Otididae (Bustards)				
Ardeotis australis	Australian Bustard		1 3 5	**Regular visitor**
Rallidae (Rails, Crakes, Coots)				
Fulica atra	Eurasian Coot		5	Irregular visitor
Hypotaenidia philippensis	Buff-banded Rail		3 5	Irregular visitor
Porphyrio porphyrio	Purple Swamphen		5	Vagrant
Tribonyx ventralis	Black-tailed Native-hen		5	Irregular visitor

Species	Common Name	Status	Source	Expected Occurrence
Burhinidae (Stone-curlews)				
Burhinus grallarius	Bush Stone-curlew		2 3 5	**Resident**
Recurvirostridae (Stilts)				
Himantopus himantopus	Pied Stilt		5	Irregular visitor
Charadriidae (Dotterals)				
Elseyornis melanops	Black-fronted Dotterel		2 3 5	**Regular visitor**
Erythrogonys cinctus	Red-kneed Dotterel		5	Irregular visitor
Vanellus tricolor	Banded Lapwing		5	Irregular visitor
Rostratulidae (Snipes)				
Rostratula australis	Australian Painted-snipe	CS1 (E, S2D2)	3 4 5 6*	Vagrant
Scolopacidae (Sandpipers and Stints				
Actitis hypoleucos	Common Sandpiper	CS1 (MI, S1D2)	3 4 5 6*	Irregular visitor
Calidris acuminata	Sharp-tailed Sandpiper	CS1 (VU & MI, S1D2)	4 5 6*	Irregular visitor
Calidris ferruginea	Curlew Sandpiper	CS1 (CR & MI, S2D1)	4	Vagrant
Calidris melanotos	Pectoral Sandpiper	CS1 (MI, S1D2)	4	Vagrant
Calidris ruficollis	Red-necked Stint	CS1 (MI, S1D2)	5 6*	Irregular visitor
Tringa glareola	Wood Sandpiper	CS1 (MI, S1D2)	5 6*	Irregular visitor
Tringa nebularia	Common Greenshank	CS1 (EN & MI, S1D2)	5 6*	Irregular visitor
Tringa stagnatilis	Marsh Sandpiper	CS1 (MI, S1D2)	6*	Irregular visitor
Glareolidae (Pratincoles)				
Glareola maldivarum	Oriental Pratincole	CS1 (MI, S1D2)	2 3 4 5 6*	Irregular visitor
Stiltia isabella	Australian Pratincole		5	Irregular visitor
Scolopacidae (Sandpipers and Stints				
Gallinago stenura	Pin-tailed Snipe	CS1 (MI, S1D2)	6*	Vagrant
Strigidae (Hawk Owls)				
Ninox boobook	Southern Boobook		2 3 5	**Resident**

Species	Common Name	Status	Source	Expected Occurrence
Caprimulgidae (Nightjars)				
Eurostopodus argus	Spotted Nightjar		3 5	**Regular visitor**
Podargidae (Frogmouths)				
Podargus strigoides	Tawny Frogmouth		5	Resident
Aegothelidae (Owlet-nightjars)				
Aegotheles cristatus	Australian Owlet-nightjar		3 5	**Resident**
Apodidae (Swifts)				
Apus pacificus	Fork-tailed Swift	CS1 (MI, S1D2)	4 6*	**Regular visitor**
Alcedinidae (Kingfishers)				
Dacelo leachii	Blue-winged Kookaburra		2 3 5	**Resident**
Todiramphus pyrrhopygius	Red-backed Kingfisher		2 3 5	**Resident**
Todiramphus sanctus	Sacred Kingfisher		2 3 5	**Regular visitor**
Meropidae (Bee-eaters)				
Merops ornatus	Rainbow Bee-eater		2 3 4 5	**Regular visitor**
Cacatuidae (Cockatoos)				
Cacatua roseicapilla	Galah		1 2 3 5	**Resident**
Cacatua sanguinea	Little Corella		2 3 5	**Resident**
Nymphicus hollandicus	Cockatiel		2 3 5	**Regular visitor**
Psittacidae (Parrots)				
Melopsittacus undulatus	Budgerigar		1 2 3 5	**Regular visitor**
Neopsephotus bourkii	Bourke's Parrot		Lit	Irregular visitor
Pezoporus occidentalis	Night Parrot	CS1 (E, S2D1)	4	Vagrant
Platycercus varius	Mulga Parrot		1	**Irregular visitor**
Platycercus zonarius	Australian Ringneck		2 3 5	**Resident**
Ptilonorhynchidae (Bowerbirds)				
Ptilonorhynchus maculatus	Western Bowerbird		2 3 5	**Resident**
Maluridae (Wrens)				
Amytornis whitei	Rufous Grasswren	CS3	2 3 5	**Resident**
Malurus lamberti	Purple-backed Fairy-wren		2 3 5	**Resident**
Malurus leucopterus	White-winged Fairy-wren		2 3 5	**Resident**

Species	Common Name	Status	Source	Expected Occurrence
Stipiturus ruficeps	Rufous-crowned Emu-wren	CS3	3	Resident
Meliphagidae (Honeyeaters)				
Acanthagenys rufogularis	Spiny-cheeked Honeyeater		1	Regular visitor
Certhionyx variegatus	Pied Honeyeater		3 5	Regular visitor
Epthianura tricolor	Crimson Chat		1 2 3 5	**Regular visitor**
Gavicalis virescens	Singing Honeyeater		1 2 3 5	**Resident**
Lichmera indistincta	Brown Honeyeater		1 2 3 5	**Resident**
Manorina flavigula	Yellow-throated Miner		2 3 5	**Resident**
Melithreptus gularis	Black-chinned Honeyeater		3 5	**Resident**
Ptilotula keartlandi	Grey-headed Honeyeater		2 3 5	**Resident**
Ptilotula penicillata	White-plumed Honeyeater		2 3 5	**Resident**
Ptilotula plumula	Grey-fronted Honeyeater		3	Regular visitor
Sugomel nigrum	Black Honeyeater		2 3 5	Regular visitor
Pardalotidae (Pardalotes)				
Pardalotus rubricatus	Red-browed Pardalote		2 3 5	**Resident**
Pardalotus striatus	Striated Pardalote		2 3 5	**Resident**
Acanthizidae (Gerygones)				
Smicrornis brevirostris	Weebill		1 2 3 5	**Resident**
Pomatostomidae (Babblers)				
Pomatostomus temporalis	Grey-crowned Babbler		2 3 5	Resident
Campephagidae (Cuckoo-shrikes and Trillers)				
Coracina novaehollandiae	Black-faced Cuckoo-shrike		1 2 3 5	**Regular visitor**
Lalage tricolor	White-winged Triller		2 3 5	**Regular visitor**
Oreoididae (Bellbirds)				
Oreoica gutturalis	Crested Bellbird		1 2 3 5	**Resident**
Pachycephalidae (Whistlers)				
Colluricincla harmonica	Grey Shrike-thrush		1 2 3 5	**Resident**
Pachycephala rufiventris	Rufous Whistler		1 3 5	**Resident**
Artamidae (Woodswallows)				
Artamus cinereus	Black-faced Woodswallow		2 3 5	**Resident**

Species	Common Name	Status	Source	Expected Occurrence
Artamus leucorynchus	White-breasted Woodswallow		5	Regular visitor
Artamus minor	Little Woodswallow		2 3 5	**Resident**
Artamus personatus	Masked Woodswallow		1 3 5	**Irregular visitor**
Cracticidae (Butcherbirds and Magpie)				
Cracticus nigrogularis	Pied Butcherbird		1 2 3 5	**Resident**
Cracticus tibicen	Australian Magpie		2 3 5	**Resident**
Cracticus torquatus	Grey Butcherbird		1 5	Resident
Rhipiduridae (Fantails)				
Rhipidura leucophrys	Willie Wagtail		1 2 3 5	**Resident**
Monarchidae (Monarchs)				
Grallina cyanoleuca	Magpie-Lark		2 3 5	**Resident**
Corvidae (Crows and Ravens)				
Corvus bennetti	Little Crow		5	Regular visitor
Corvus orru	Torresian Crow		1 2 3 5	**Resident**
Hirundinidae (Swallows and Martins)				
Cheramoeca leucosterna	White-backed Swallow		2 3 5	Regular visitor
Hirundo neoxena	Welcome Swallow		5	Regular visitor
Hirundo rustica	Barn Swallow	CS1 (MI, S1D2)	4	Irregular visitor
Petrochelidon ariel	Fairy Martin		2 3 5	**Regular visitor**
Petrochelidon nigricans	Tree Martin		2 3 5	**Regular visitor**
Acrocephalidae (Reed-warblers)				
Acrocephalus australis	Australian Reed-Warbler		2 3 5	**Regular visitor**
Alaudidae (Larks)				
Mirafra javanica	Horsfield's Bushlark		2 3 5	**Resident**
Locustellidae (Songlarks and Grassbirds)				
Cincloramphus cruralis	Brown Songlark		2 3 5	**Regular visitor**
Cincloramphus mathewsi	Rufous Songlark		2 3 5	**Regular visitor**
Poodytes carteri	Spinifexbird		2 3 5	**Resident**
Poodytes gramineus	Little Grassbird		3 5	Regular visitor
Dicaeidae (Mistletoebirds)				

Species	Common Name	Status	Source	Expected Occurrence
Dicaeum hirundinaceum	Mistletoebird		2 3 5	Regular visitor
Estrildidae (Finches and Mannikins)				
Emblema pictum	Painted Finch		2 3 5	**Regular visitor**
Neochmia ruficauda	Star Finch	CS3	2 3 5	**Irregular visitor**
Taeniopygia guttata	Zebra Finch		1 2 3 5	**Regular visitor**
Motacillidae (Pipits)				
Anthus australis	Australian Pipit		3 5	**Resident**
Motacilla cinerea	Grey Wagtail	CS1 (MI, S1D2)	4	Vagrant
Motacilla flava	Yellow Wagtail	CS1 (MI, S1D2)	4	Vagrant
Tachyglossidae (Echidna)				
Tachyglossus aculeatus	Short-beaked Echidna		Lit	**Resident**
Dasyuridae (Carnivorous Marsupials)				
Antechinomus (Sminthopsis) longicaudata	Long-tailed Dunnart	CS2 (P4)	6*	Resident
Dasycercus blythi	Brush-tailed Mulgara	CS2 (P4)	6* Lit	Irregular visitor
Dasykaluta rosamondae	Kaluta		2 3	Resident
Dasyurus hallucatus	Northern Quoll	CS1 (E, S2D2)	4 6*	**Resident**
Ningaui timealeyi	Pilbara Ningaui		2 3	Resident
Planigale sp. 't'			Lit	Resident
Planigale tealei	Cracking-clay Pilbara Planigale		Lit	Resident
Pseudantechinus macdonnelensis			Lit	**Resident**
Sminthopsis macroura	Stripe-faced Dunnart		2 3	Resident
Phalangeridae (Possums)				
Trichosurus vulpecula	Brushtail Possum	CS3	Lit	Resident
Macropodidae (Kangaroos and Wallabies)				
Osphranter robustus	Euro		1 3	**Resident**
Petrogale rothschildi	Rothschild's Rock-Wallaby	CS3	2	**Resident**
Muridae (Rats and Mice)				
Hydromys chrysogaster	Water-rat, Rakali	CS2 (P4)	Lit	Irregular visitor
Leggadina lakedownensis	Short-tailed Mouse	CS2 (P4)	2 3 6*	Resident
Mus musculus	House Mouse	Int	3	Resident

Species	Common Name	Status	Source	Expected Occurrence
Pseudomys chapmani	Ngadji or Western Pebble-mound Mouse	CS2 (P4)	2 3 6*	**Resident**
Pseudomys delicatulus	Delicate Mouse		2 3	Resident
Pseudomys desertor	Desert Mouse		3	Resident
Pseudomys hermannsburgensis	Sandy Inland Mouse		2 3	Resident
Zyzomys argurus	Common Rock-Rat		2 3	**Resident**
Pteropodidae (Fruit Bats)				
Pteropus alecto	Black Flying-fox		Lit	Vagrant
Pteropus scapulatus	Little Red Flying-fox		Lit	Vagrant
Rhinonycteridae (Leaf-nosed Bats)				
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed (Diamond-faced) Bat	CS1 (VU, S2D3)	4 6*	**Regular visitor**
Megadermatidae (Ghost Bat)				
Macroderma gigas	Ghost Bat	CS1 (VU, S2D3)	1 4 6*	Regular visitor
Emballonuridae (Shreath-tail Bats)				
Saccolaimus flaviventris	Yellow-bellied Sheath-tail Bat		Lit	**Regular visitor**
Taphozous georgianus	Common Sheath-tail Bat		Lit	**Resident**
Molossidae (Free-tail Bats)				
Austronomus australis	White-striped Free-tail Bat		Lit	Regular visitor
Chaerephon jobensis	Greater Northern Free-tail Bat		Lit	**Regular visitor**
Ozimops lumsdenae	Northern Free-tail Bat		Lit	**Resident**
Vespertilionidae (Vespertilionid Bats)				
Chalinolobus gouldii	Gould's Wattled Bat		Lit	**Resident**
Nyctophilus daedalus	Pallid Long-Eared Bat		Lit	Regular visitor
Nyctophilus geoffroyi	Lesser Long-eared Bat		Lit	Resident
Scotorepens greyii	Little Broad-nosed Bat		Lit	Resident
Vespadelus finlaysoni	Finlayson's Cave Bat		Lit	**Resident**
Canidae (Dogs and Foxes)				
Canis lupus dingo	Dingo		1	**Resident**
Vulpes vulpes	Red Fox	Int	Lit	**Irregular visitor**

Species	Common Name	Status	Source	Expected Occurrence
Felidae (Cats)				
Felis catus	Cat	Int	1 2	**Resident**

Appendix 4. Species recorded throughout survey between December 2023 and March 2025. Maximum flight heights of birds are shown in bold italics.

Yindjibarndi Name	Latin Name	Common Name	Status	Expected Occurrence	Comment
	FISH				
	Melanotaenia splendida	Western Rainbowfish		Regular visitor	Several seen in largest pools in spring and summer.
	Leiopotherapon unicolor	Spangled Grunter		Regular visitor	Seen in large pools in summer.
	FROGS				
Jarrarna	*Litoria rubella*	Little Red Tree Frog		Resident	Heard in spring on 7/12/23.
	Pseudophryne douglasi	Douglas's Toadlet		Resident	A typical Pseudophryne call heard in spring
	REPTILES				
	Chelodina steindachneri	Steindachner's Tortoise		Resident	One dead specimen found near water hole in south (March 2025)
Thawu	*Diplodactylus bilybara*	Western Fat-tailed Gecko		Resident	Skin found in south
	Egernia pilbarensis	Pilbara Crevice Skink		Resident	One spotted (camera) in cave northern Marnda
Marndangatha	*Ctenophorus caudicinctus*	Ring-tailed Dragon		Resident	Several seen even in completely burnt areas. Some were panting due to heat.
Garlirrinygaa	*Gowidon longirostris*	Long-nosed Dragon		Resident	Several seen on rocks and even in the water at the spring.
Yujurli	*Ctenotus saxatilis*	Rock Ctenotus		Resident	Dead specimen found on rocks near spring
Barnka	*Varanus panoptes*	Yellow-spotted Monitor		Resident	Burrow complex in south in area of loam soil close to large drainage line.
Ngintaka	*Varanus giganteus*	Perentie		Resident	Spotted in creekline and captured on camera trap
Bargunyji	*Liasis olivaceous*	Pilbara Olive Python		Resident	Scats and skin slough found in northern creekline
	BIRDS				

	Microcarbo melanoleucos	Little Black Cormorant	Regular visitor	Several on various pools in August and November 24. ***25 m***
Wilumarra	*Burhinus grallarius*	Bush Stone-curlew	Resident	Fresh tracks just south of transmission station, see Plate 11, and one observed next to track north of Ngurrawaana.
Jinbirdiny	*Elseyornis melanops*	Black-fronted Dotterel	Regular visitor	Several associated with waterbodies in all campaigns and one flew over Ngurrawaana in March 25.
	Anas gracilis	Grey Teal	Regular visitor	Few observed on pools in November 24. ***15 m***.
	Anas superciliosa	Pacific Black Duck	Regular visitor	Pair on pool in Baru in March 25. ***15 m***
	Tachybaptus novaehollandiae	Australasian Grebe	Irregular visitor	Pair on pool in March 25.
	Egretta novaehollandiae	White-faced Heron	Irregular visitor	Several seen in August and September and few in March. ***10 m***
	Ardea pacifica	White-necked Heron	Regular visitor	Pair disturbed on BC01 in March.
	Egretta garzetta	Little Egret	Regular visitor	Several seen adjacent pools along creeklines in August and September.
	Ardeotis australis	Australian Bustard	Regular visitor	Two seen west of Ngurrawaana 12/11, several seen across southern Marnda and one on VP06 in March 25. ***20 m***
	Coturnix ypsilophora	Brown Quail	Regular visitor	One on creek crossing 26/09, two outside house Ngurrawaana 29/09 and several observed during bird census and spotlighting. ***2 m***
	Turnix velox	Little Button-quail	Regular visitor	Group of five flushed on BC07. ***1 m***
	Aquila audax	Wedge-tailed Eagle	Regular visitor	Several seen each campaign mostly in south and often at great height. Regularly soaring between ***100*** and ***300 m***.

Garranyga	*Haliastur sphenurus*	Whistling Kite		Resident	One occasionally around Ngurrawaana throughout, single birds seen at VPs along south. ***150 m.***
	Circus assimilis	Spotted Harrier		Regular visitor	One at VP08 and VP10 in March 25. ***5 m***
	Accipiter fasciatus	Brown Goshawk		Irregular visitor	One at Ngurrawaana 09/03 and at VP04 on 12/03. ***10 m***
	Elanus caeruleus	Black-shouldered Kite		Irregular visitor	One seen in SE on track near Ngurrawaana and possibly same bird from VP08 in March 25. ***8 m***
Minybirrirrii	*Falco cenchroides*	Nankeen Kestrel		Resident	Three in the east, along the edge of the basalt hills dropping down to the granitic plains. Most numerous of raptors but restricted to south of Marnda. ***150 m***
Wirndiwirndi	*Falco berigora*	Brown Falcon		Resident	One in tall trees along spring and occasional throughout. Female on nest in trans tower September 24. Frequently recorded on VP and BC across entire area. ***150 m***
	Falco longipennis	Australian Hobby		Regular visitor	One seen at Ngurrawaana 9/03. ***60 m***
Boorga	*Falco hypoleucos*	Grey Falcon	CS1 (V)	Regular visitor	One opportunistic sighting beneath helicopter in August 24. Several pairs on VP in November 24 and March 25 mostly in SE corner and several opportunistic sightings by pilot near Ngurrawaana. ***150 m***
	Ninox boobook	Southern Boobook			One spotted in creekline 12/03.
	Eurostopodus argus	Spotted Nightjar			Two seen separately in November when flushed along creeklines and on rocky hills near VP01. ***8 m***

	Aegotheles cristatus	Australian Owlet Nightjar		One heard at night from Ngurrawaana 28/09, and one flushed from hollow in November in SE creekline. ***3 m***
	Cacatua roseicapilla	Galah	Resident	Few seen around Ngurrawaana and Project Areas especially along creeklines and tree-lines in groups <10. ***15 m***
	Cacatua sanguinea	Little Corella	Resident	c. 100 around Ngurrawaana late afternoon 27/09, Several hundred north of Ngurrawaana 29/09. Common along creeklines in south and few seen along creeklines to north. ***50 m***
	Nymphicus hollandicus	Cockatiel	Resident	Several heard and seen in project area throughout. Poss flock of c. 100 from VP08 in September 24. Many small flocks around Ngurrawaana in March 25. ***25 m***
	Melopsittacus undulatus	Budgerigar	Resident	Few small flocks seen in September and November 24. March 25 small and large flocks, up to 100 birds, seen and heard throughout. ***35 m***
	Platycercus varius	Mulga Parrot	Irregular visitor	Group of six seen in SE in November 24. ***12 m***
	Platycercus zonarius	Australian Ringneck	Resident	Few seen and heard throughout. A few pairs at VP08 on 10/03 and two near VP06 on 13/03. ***12 m***
	Geopelia cuneata	Diamond Dove	Resident	Many seen in scrub with influx in March 25. ***5 m***
	Geopelia placida	Peaceful Dove	Resident	Several seen and heard including young juvenile on BC06 13/03.

Jurlawurdu	*Geophaps plumifera*	Spinifex Pigeon		Resident	Seen frequently throughout in groups of 2-10 birds, including Ngurrawaana. ***5 m***.
	Ocyphaps lophotes	Crested Pigeon		Resident	Many seen across southern areas throughout with several around Ngurrawaana. ***5 m***
	Phaps chalcoptera	Common Bronzewing		Resident	Several seen and heard mainly along creekline, and on camera. ***8 m***
	Phaps histrionica	Flock Bronzewing		Irregular visitor	One observed adjacent to pool in creekline near VP10 in March 25.
	Cacomantis pallidus	Pallid Cuckoo		Regular visitor	One on ARU and heard at VP sites. In March 2025, abundant on flats in south with up to five birds at once near VP10 inc juveniles. ***8 m***
	Chrysococcyx basalis	Horsfield's Bronze-Cuckoo		Resident	Heard several times along creekline in September and in March. One on BC06 10/03. ***7 m***
	Centropus phasianinus	Pheasant Coucal		Resident	Heard in September from dense vegetation east of Ngurrawaana. Several males in breeding plumage seen and heard along southern creeklines. ***6 m***
	Dacelo leachii	Blue-winged Kookaburra		Resident	September 24. Heard along creek just north of Ngurrawaana. November 24. Along some creeklines in bird transects. March 2025. Heard along BC06 and several along BC02. ***7 m***
	Todiramphus pyrrhopygius	Red-backed Kingfisher		Resident	September 24. Heard occasionally on site. November 24. Several seen along creeklines. March 2025. Two at Ngurrawaana (10/03) and seen along several of the transects. ***5 m***

	Todiramphus sanctus	Sacred Kingfisher		Resident	One around Ngurrawaana calling regularly. Seen around Ngurrawaana and along BCs in March 25. ***8 m***
	Merops ornatus	Rainbow Bee-eater		Regular visitor	September 24. Few seen along creeklines. November 24. Few seen along creeklines. March 2025. Two along BC06 and several along BC02. ***25 m***
	Apus pacificus	Fork-tailed Swift	CS1 (M)	Irregular visitor	Three records totalling seven birds seen on VPs 04 and 10 in March 25. ***40 m***
	Petrochelidon ariel	Fairy Martin		Resident	About 50 nests under verandah of house in Ngurrawaana and >50 birds there; a few nests were active with chicks in September. Abundant around house at Ngurrawaana in November with at least one nest being entered. No activity at house in March but Martins seen regularly elsewhere in dispersed groups but unsure if Fairy, Tree or both. ***60 m***
	Petrochelidon nigricans	Tree Martin		Irregular visitor	Seen occasionally near the house and elsewhere in March; calls heard clearly and some birds seen well. ***20 m***
	Hirundo neoxena	Welcome Swallow		Regular visitor	Several seen across southern Marnda in March. ***15 m***
	Smicrornis brevirostris	Weebill		Resident	September 24. Few in eucalypts on site. March 25. Party at VP03 (12/03).
	Pardalotus rubricatus	Red-browed Pardalote		Resident	Few heard in eucalypts along creeklines and on all campaigns.
	Pardalotus striatus	Striated Pardalote		Resident	One heard at VP03 in September.

Buyiyirri	*Malurus lamberti*	Purple-backed Fairy-wren		Resident	Several parties with coloured males in remnant unburnt vegetation along drainage lines. ***2 m***
	Malurus leucopterus	White-winged Fairy-wren		Resident	White-winged Fairy-wren. September 24. Several parties in low spinifex with scattered shrubs along access track near big tank. March 2025. Party at Ngurrawaana. Male very black and white. Herd occasionally elsewhere. ***2 m***
	Amytornis whitei	Pilbara (Rufous) Grasswren		Resident	March 2025. Party at VP04 (12/03). Male perched at ***1.5 m*** in dead shrub and called!
Juudi	*Gavicalis virescens*	Singing Honeyeater		Resident	Few seen along higher creeklines in all campaigns. ***4 m***
Juudi	*Ptilotula keartlandi*	Grey-headed Honeyeater		Resident	Few seen and heard in eucalypts, generally in higher landscape. ***8 m***
	Ptilotula penicillata	White-plumed Honeyeater		Resident	Few around Ngurrawaana and occasionally elsewhere throughout. ***10 m***
	Melithreptus gularis	Black-chinned Honeyeater		Irregular visitor	One heard along BC02 (11/03) and one heard along BC03 (12/03).
	Lichmera indistincta	Brown Honeyeater		Resident	Several in creekline bird census. On all campaigns. Few along creek at BC02 (11/03). ***3 m***
Wirnmirdbula	*Manorina flavigula*	Yellow-throated Miner		Resident	Several seen throughout programme especially in lower broader creeklines. ***7 m***
	Epthianura tricolor	Crimson Chat		Regular visitor	Many seen throughout in March 25 in small flocks of up to 15. ***40 m***
	Oreoica gutturalis	Crested Bellbird		Resident	Heard regularly throughout. One heard in distance at VP01 (11/03).

	Lalage tricolor	White-winged Triller	Resident	Two seen at VP03 in September, and one in creekline bird census in November 24. Few seen and heard in March 25. ***7 m***
	Ptilonorhynchus maculatus	Western Bowerbird	Regular visitor	One seen on transect on 13/11 and one on BC02 on 11/03.
Julgira	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	Regular visitor	Few seen in September and November including one on 11/11 and two on 12/11. Pair along BC06 on 10/03 and few occasionally elsewhere. ***12 m***
Jarrbinyjarra	*Artamus cinereus*	Black-faced Woodswallow	Resident	Few seen across southern area throughout. Two at VP01 and few hawking around Ngurrawaana on 11/03. ***20 m***
	Artamus minor	Little Woodswallow		Few in NW corner in August and one at VP in September. ***15 m***
	Artamus personatus	Masked Woodswallow	Regular visitor	Abundant in March 25 in flocks of up to 50 birds near Ngurrawaana. ***60 m***
Guruwarru	*Cracticus nigrogularis*	Pied Butcherbird	Resident	Heard around Ngurrawaana and along creeklines throughout. VP03 on 11/11 and occasionally elsewhere in March 25. ***7 m***
Warndurla	*Cracticus tibicen*	Australian Magpie	Resident	Pair east of Ngurrawaana and on camera traps. Sheltering from heat in a shallow cave with two butcherbirds, two Magpie-larks and two miners. ***5 m***
Wangangga	*Corvus orru*	Torresian Crow	Resident	Present throughout but many around Ngurrawaana with up to six birds at once. Warble heard around Ngurrawaana. ***80 m***
Yilimbirraa	*Grallina cyanoleuca*	Magpie-Lark	Resident	Seen around Ngurrawaana throughout and occasional groups along creeklines and especially BC05 and 07. ***12 m***

	Rhipidura leucophrys	Willie Wagtail	Resident	Few in project area with singles and pairs seen regularly. About six birds around Ngurrawaana. ***4 m***
	Colluricincla harmonica	Grey Shrike-thrush	Resident	Few heard in vegetation along creeklines in September. Two along creek at BC02 (11/03) and one along creek at BC04 (12/03).
	Pachycephala rufiventris	Rufous Whistler	Resident	Occasionally along creeklines including bird census in September and November 24.
	Poodytes carteri	Spinifexbird	Resident	One seen crossing track just east of Ngurrawaana (1/10). Few seen and heard in November 24. March 2025. Heard at VP10 (10/03) and few seen on higher ground (abundance seems to be increasing). Recent burn on high ground would have reduced numbers. ***2 m***
	Cincloramphus mathewsi	Rufous Songlark	Irregular visitor	One at VP10 (10/03) and a pair on BC07. ***3 m***
	Mirafra javanica	Horsfield's Bush-lark	Irregular visitor	One seen along access track near big tank in September 24. Few calling on grassland and herbfields especially on gilgai flats in March 25.
	Acrocephalus australis	Clamorous (Australian) Reed Warbler	Irregular visitor	One calling from Typha at Petroglyph site in September 24.
	Taeniopygia guttata	Zebra Finch	Resident	Present throughout programme. Small flocks around Ngurrawaana and nesting in old Fairy Martin nests in school house. Pairs and small flocks of <5 birds along creeklines. Influx in March 25. ***20 m***

	Neochmia ruficauda	Star Finch		Regular visitor	Group of about 20 at Ngurrawaana (30/09). One adult male at BC02 (11/03). Group of six birds at BC05 (13/03). ***10 m***
	Emblema pictum	Painted Finch		Regular visitor	Pairs seen occasionally along creeklines throughout programme. Pair seen on BC03 on 14/11. ***30 m***
	MAMMALS				
Yirriwardu	*Dasyurus hallucatus*	Northern Quoll	CS1 (E, S2D2)	Resident	Scats at several location long major drainage lines, in caves on hillsides and caught on two camera traps.
	Pseudantechinus macdonnelensis			Resident	Skull of an adult male found near the helipad fuel dump.
	Petrogale rothschildi	Rothschild's Rock-Wallaby		Resident	One spotted on boulder pile, and several caught on camera trap, scats throughout.
Marndanyungu	*Osphranter robustus*	Euro		Resident	Scats along major drainage lines and around spring, mob of five seen in northwest in August.
Mujira	*Canis lupus dingo*	Dingo		Regular visitor	Scats found and several on cameras.
	Felis domestica	Feral Cat	Int	Resident	One spotted in creekline in August and several caught on camera trap.
	Bos taurus	European Cattle	Int	Domestic	Abundant evidence throughout and especially along major drainage lines. Much poaching in and around lower pools.
	Equus ferus caballus	Domestic Horse	Int	Domestic	Several roaming free around Ngurrawaana.
	Pseudomys chapmani	Western Pebblemound Mouse			Several pebblemounds found across southern half.

	Rhinonicteris aurantia	Pilbara Leaf-nosed (Diamond-faced) Bat	CS1 (E)		Four passes recorded on ARUs along two creeklines in north and south of Marnda.
	Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat			Recorded on ARUs throughout.
	Taphozous georgianus	Common Sheath-tailed Bat			Recorded on ARUs most throughout.
	Chalinolobus gouldii	Gould's Wattled Bat			Recorded on most ARUs throughout.
	Scotorepends greyii	Little Broad-nosed Bat			Recorded on most ARUs throughout.
	Vespadelus finlaysoni	Finlayson's Cave Bat			Recorded on all ARUs throughout.
	Chaerephon jobensis	Greater Northern Free-tailed Bat			Recorded on ARUs throughout.
	Ozimops lumsdenae	Northern Free-tailed Bat			Recorded on ARUs throughout.
	Nyctophilus spp	Long-eared Bat			Potentially recorded on two ARUs.

Appendix 5. Vertebrate species returned from the literature review and database search that have been omitted from the expected species list because they are considered locally extinct.

Status codes: CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.
EPBC Act listings: CR = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory, Mar = Marine (see Appendix 2).
Biodiversity Conservation Act 2016 listings: S1 to S3 = Schedules 1 to 3, D1 to D3 = Divisions 1 to 3 (see Appendix 2).
DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).
See Section 2.3.4 for explanation of expected occurrence categories.
Sources: 1 = Previous studies, 2 = Atlas of Living Australia, 3 = Naturemap, 4 = Protected Matters Search Tool, 5 = Birdata, 6 = DBCA threatened and priority fauna search, Lit = general literature

Latin Name	Common Name	Source	Status
Peramelidae (Bandicoots)			
Isoodon auratus	Golden Bandicoot	Lit	CS1 (V, S2D3)
Thylacomyidae (Bilbies)			
Macrotis lagotis	Greater Bilby	4	CS1 (V, S2D3)
Macropodidae (Kangaroos and Wallabies)			
Lagorchestes conspicillatus	Spectacled Hare-Wallaby	Lit	CS2 (P4)
Muridae (Rats and Mice)			
Leporillus conditor	Greater Stick-nest Rat	Lit	CS1 (V, S1D1)
Pseudomys nanus	Chestnut Mouse	Lit	
Rattus tunneyi	Pale Field Rat	Lit	

Appendix 6. Species returned from the literature review that have been omitted from the expected species list because of habitat or range limitations, or because they are domesticated species.

Note that some birds could still occur as extremely rare vagrants.

Sources: 1 = Previous studies, 2 = Atlas of Living Australia, 3 = Naturemap, 4 = Protected Matters Search Tool, 5 = Birdata, 6* = updated DBCA threatened and priority fauna search, Lit = general literature

Species	Common Name	Status	Source	Reason for omitting
Gekkonidae (Gekkonid geckos)				
Gehyra media	Medium Pilbara Spotted Rock Gehyra		2	out of range
Gehyra micra	Small Pilbara Spotted Rock Gehyra		2	out of range
Scincidae (Skinks)				
Ctenotus duricola	Pilbara Ctenotus		3	out of range
Ctenotus pallasotus	Western Pilbara Lined Ctenotus		2	out of range
Egernia formosa	Goldfields Crevice-skink		2 3	out of range
Glaphyromorphus isolepis	Northern Bar-lipped Skink		3	out of range
Lerista flammicauda	Pilbara Flame-tailed Slider		2 3	out of range
Threskiornithidae (Ibis and Spoonbills)				
Platalea regia	Royal Spoonbill		2 5	no habitat
Plegadis falcinellus	Glossy ibis	CS1 (MI, S1D2)	5 6*	no habitat
Ardeidae (Herons, Bitterns and Egrets)				
Ardea ibis	Cattle Egret		4	no habitat
Ardea intermedia	Intermediate Egret		2 3 5	no habitat
Accipitridae (Kites, Eagles, Goshawks)				
Haliaeetus leucogaster	White-Bellied Sea-Eagle		4 5	no habitat
Haliastur indus	Brahminy Kite		3	no habitat
Pandion haliaetus	Eastern Osprey	CS1 (MI, S1D2)	4 6*	no habitat
Charadriidae (Dotterals)				
Charadrius leschenaultii	Greater Sand Plover	CS1 (VU & MI, S2D3)	5	no habitat
Charadrius ruficapillus	Red-Capped Plover		5	no habitat
Charadrius veredus	Oriental Plover	CS1 (MI, S1D2)	4 5	no habitat
Vanellus miles	Masked Lapwing		5	no habitat

Species	Common Name	Status	Source	Reason for omitting
Scolopacidae (Sandpipers and Stints				
Arenaria interpres	Ruddy Turnstone	CS1 (VU & MI, S1D2)	3 6*	no habitat
Numenius madagascariensis	Eastern Curlew	CS1 (CR & MI, S2D1)	4	no habitat
Numenius phaeopus	Whimbrel	CS1 (MI, S1D2)	6*	no habitat
Laridae (Gulls and Terns)				
Chlidonias hybrida	Whiskered Tern		5	no habitat
Chlidonias leucopterus	White-winged Black Tern	CS1 (MI, S1D2)	6*	no habitat
Gelochelidon macrotarsa	Australian Gull-billed Tern		5 6*	no habitat
Gelochelidon nilotica	Gull-billed Tern	CS1 (MI, S1D2)	6*	no habitat
Hydroprogne caspia	Caspian Tern	CS1 (MI, S1D2)	5 6*	no habitat
Laridae (Gulls and Terns)				
Thalasseus bergii	Crested Tern	CS1 (MI, S1D2)	6*	no habitat
Procellariidae (Shearwaters)				
Ardenna pacifica	Wedge-tailed Shearwater	CS1 (MI, S1D2)	4 6*	no habitat
Laridae (Gulls and Terns)				
Sterna hirundo	Common Tern	CS1 (MI, S1D2)	6*	no habitat
Campephagidae (Cuckoo-shrikes and Trillers)				
Lalage leucomela	Varied Triller		3	out of range
Zosteropidae (Silvereyes)				
Zosterops luteus	Yellow White-eye		2 5	no habitat
Bovidae (Horned ruminants)				
Bos taurus	European Cattle	Int	1	domestic
Delphinidae				
Lagenodelphis hosei	Fraser's Dolphin		6*	no habitat
Dugongidae				
Dugong dugon	Dugong		6*	no habitat

Appendix 7. Excluded conservation significant invertebrate fauna species.

Status codes:
CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.
EPBC Act listings: CR = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory, Mar = Marine (see Appendix 2).
Biodiversity Conservation Act 2016 listings: S1 to S3 = Schedules 1 to 3, D1 to D3 = Divisions 1 to 3 (see Appendix 2). EX = extinct
DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).
Sources: 6 = DBCA threatened and priority database within 50 km, 7 = DBCA threatened species list for Pilbara region

	Latin Name	Common Name	Source	Status	Reason for excluding
Arachnida					
	Bamazomus subsolanus	eastern Cape Range bamazomus	7	CS1 (E S2D2)	Out of range
	Bamazomus vespertinus	western Cape Range bamazomus	7	CS1 (E S2D2)	Out of range
	Draculoides bramstokeri	Barrow Island draculoides	7	CS1 (V S2D3)	Out of range
	Draculoides brooksi	northern Cape Range draculoides	7	CS1 (E S2D2)	Out of range
	Draculoides julianneae	western Cape Range draculoides	7	CS1 (E S2D2)	Out of range
	Draculoides mesozeirus	Middle Robe draculoides	6, 7	CS1 (V S2D3)	Out of range – Robe Mesa
	Ideoblothrus linnaei	Linnaeus' pseudoscorpion (Mesa A)	7	CS2 (P1)	Out of range
	Ideoblothrus sp. 'Mesa A' (WAM T81374)	an Ideoblothrus pseudoscorpion (Mesa A)	7	CS2 (P1)	Out of range
	Indohya damocles	Cameron's Cave pseudoscorpion	7	CS1 (CR S2D1)	Out of range
	Lagynochthonius asema	Mesa A Lagynochthonius pseudoscorpion	7	CS2 (P1)	Out of range
	Paradraculoides anachoretus	Mesa A paradraculoides	7	CS1 (V S2D3)	Out of range
	Paradraculoides bythius	Mesa B/C paradraculoides	7	CS1 (V S2D3)	Out of range
	Paradraculoides gnophicola	Mesa G paradraculoides	7	CS1 (V S2D3)	Out of range
	Paradraculoides kryptus	Mesa K paradraculoides	7	CS1 (V S2D3)	Out of range
	Tyrannochthonius sp. 'Mesa A' (WAM T81480)	a Tyrannochtonius pseudoscorpion (Mesa A)	7	CS2 (P1)	Out of range
Diplopoda					
	Antichiropus sp. 'DIP004'	Roy Hill Antichiropus millipede	7	CS2 (P1)	Out of range
	Antichiropus sp. 'DIP005'	Abydos Antichiropus millipede	7	CS2 (P1)	Out of range

	Latin Name	Common Name	Source	Status	Reason for excluding
	Antichiropus sp. 'DIP006'	Area C Antichiropus millipede	7	CS2 (P1)	Out of range
	Antichiropus sp. 'DIP013'	Cloudbreak Antichiropus millipede	7	CS2 (P1)	Out of range
	Antichiropus sp. 'DIP029'	Mt Bruce Antichiropus millipede	7	CS2 (P1)	Out of range
	Speleostrophus nesiotes	Barrow Island millipede	7	CS1 (V S2D3)	Out of range
	Stygiochiropus isolatus	a stygiochiropus millipede (Cape Range)	7	CS1 (V S2D3)	Out of range
	Stygiochiropus peculiaris	Cameron's Cave millipede	7	CS1 (Cr S2D1)	Out of range
	Stygiochiropus sympatricus	a stygiochiropus millipede (Cape Range)	7	CS1 (V S2D3)	Out of range
Insecta					
	Nocticola flabella	Cape Range blind cockroach	7	CS2 (P4)	Out of range
Amphipoda					
	Bogidomma australis	Barrow Island bogidomma amphipod	7	CS1 (V S2D3)	Out of range
	Liagoceradocus branchialis	Cape Range liagoceradocus amphipod	7		
	Liagoceradocus subthalassicus	Barrow Island liagoceradocus amphipod	7	CS1 (V S2D3)	Out of range
	Nedsia chevronia	Chevron's freshwater amphipod (Barrow Island)	7	CS2 (P2)	Out of range (King *et al.* 2021)
	Nedsia fragilis	a freshwater amphipod	7	CS1 (V S2D3)	Now N. hurlberti (King *et al.* 2021)
	Nedsia humphreysi	a freshwater amphipod	7	CS1 (V S2D3)	Now N. hurlberti (King *et al.* 2021)
	Nedsia hurlberti	a freshwater amphipod	6, 7	CS1 (V S2D3)	Out of range (King *et al.* 2021) – Barrow Island
	Nedsia macrosculptilis	a freshwater amphipod	7	CS1 (V S2D3)	Out of range (King *et al.* 2021)
	Nedsia sculptilis	a freshwater amphipod	7	CS1 (V S2D3)	same as macrosculptilis (King et al. 2021)
	Nedsia straskraba	a freshwater amphipod	7	CS1 (V S2D3)	Out of range (King *et al.* 2021)

	Latin Name	Common Name	Source	Status	Reason for excluding
	Nedsia urifimbriata	a freshwater amphipod	7	CS1 (V S2D3)	Out of range (King *et al.* 2021)
Copepoda					
	Bunderia misophaga	a copepod (Bundera Sinkhole)	7	CS1 (CR S2D1)	Out of range
	Speleophria bunderae	a copepod (Bundera Sinkhole)	7	CS1 (CR S2D1)	Out of range
	Stygocyclopia australis	a copepod (Bundera Sinkhole)	7	CS1 (CR S2D1)	Out of range
Ostracoda					
	Welesina kornickeri	Kornicker's Bundera Sinkhole ostracod	7	CS1 (CR S2D1)	Out of range
Malacostraca					
	Stygiocaris lancifera	lance-beaked cave shrimp	7	CS1 (V S2D3)	Out of range
	Stygiocaris stylifera	spear-beaked cave shrimp	7	CS2 (P4)	Out of range
Remipedia					
	Kumonga exleyi	Cape Range remipede	7	CS1 (V S2D1)	Out of range
Annelida					
	Prionospio thalanji	Bundera Sinkhole worm	7	CS1 (Cr S2D1)	Out of range
Gastropoda					
	Dupucharopa millestriata	Depuch Island charopid land snail	7	CS2 (P2)	Out of range

Appendix 8. Sampling point locations and schedule for ARUs, Camera Traps, Vantage Points and Bird Census

Table A8-1. Point sampling (Camera, ARU, Vantage Point) locations and descriptions

ACOUSTIC RECORDING UNITS				
Site Ref	**ARU01**	**Model/Type**	Ranger	
Eastings	494385	**Northings**	7647291	
Elevation	328			
Description: Located in VSA 1 adjacent the met-mast at 50 m height on pully system. Hummocky Spinifex grassland on basalt plateau. Occasional scattered scrubs and trees.				
Site Ref	**ARU02**	**Model/Type**	Ranger	
Eastings	494385	**Northings**	7647291	
Elevation	328			
Description: Located in VSA 1 adjacent the met-mast at 25 m height on pully system. Hummocky Spinifex grassland on basalt plateau. Occasional scattered scrubs and trees.				
Site Ref	**ARU03**	**Model/Type**	Chorus	
Eastings	485488	**Northings**	7649035	
Elevation	182			
Description: Located in VSA 3 in a broad and steep-sided creekline with many boulders and rocky outcrops, frequent pools and patchwork of Acacia scrub and eucalypts.				
Site Ref	**ARU05**	**Model/Type**	Chorus	
Eastings	489990	**Northings**	7638717	
Elevation	307			

Description:
Undulating plains of spinifex with scattered trees and shrubs of VSA 5. Landscape contains shallow upper creeklines with denser stands of shrubs.

Site Ref	**ARU06**	**Model/Type**	Chorus
Eastings	484858	**Northings**	7648381
Elevation	185		

Description:
Located in VSA 3 in a broad and steep-sided creekline with many boulders and rocky outcrops, frequent pools and patchwork of Acacia scrub and eucalypts.

Site Ref	**ARU07**	**Model/Type**	Chorus
Eastings	494990	**Northings**	7642983
Elevation	220		

Description:
Located in VSA 3 in a steep-sided creekline with frequent pools and patchwork of dense Acacia scrub and eucalypts. ARU placed at the base of a Eucalypt adjacent a relatively large water body.

Site Ref	**ARU08**	**Model/Type**	Chorus
Eastings	481473	**Northings**	7652763
Elevation	134		

Description:
Located in VSA 3 in a broad floodplain creekline with frequent pools and patchwork of Acacia scrub and eucalypts. Much poaching by cattle. ARU placed in dead Eucalypt adjacent a ephemeral pool.

Site Ref	**ARU09**	**Model/Type**	Chorus
Eastings	482354	**Northings**	7651045
Elevation	176		

Description:
Located in VSA 3 in a steep-sided dry creekline towards the entrance of a broad valley. The top of the valley reaches to the high basalt plateau and likely to be part of a corridor linking adjacent creek systems.

Site Ref	**ARU10**	**Model/Type**	Chorus
Eastings	491582	**Northings**	7651677
Elevation	192		

Description:
Located in VSA 2 adjacent boulder piles and rocky outcrop in large boulder field on lower ground northern Baru. Occasional small pools, with trees and small shrubs. Many cavities amidst boulder piles.

Site Ref	**ARU11**	**Model/Type**	Chorus
Eastings	494285	**Northings**	7642298
Elevation	235		

Description:
Located in VSA 3 in a steep-sided creekline with dried pools and matted dead aquatic vegetation. Patchwork of dense Acacia scrub and several mature eucalypts. ARU placed at the base of a Eucalypt.

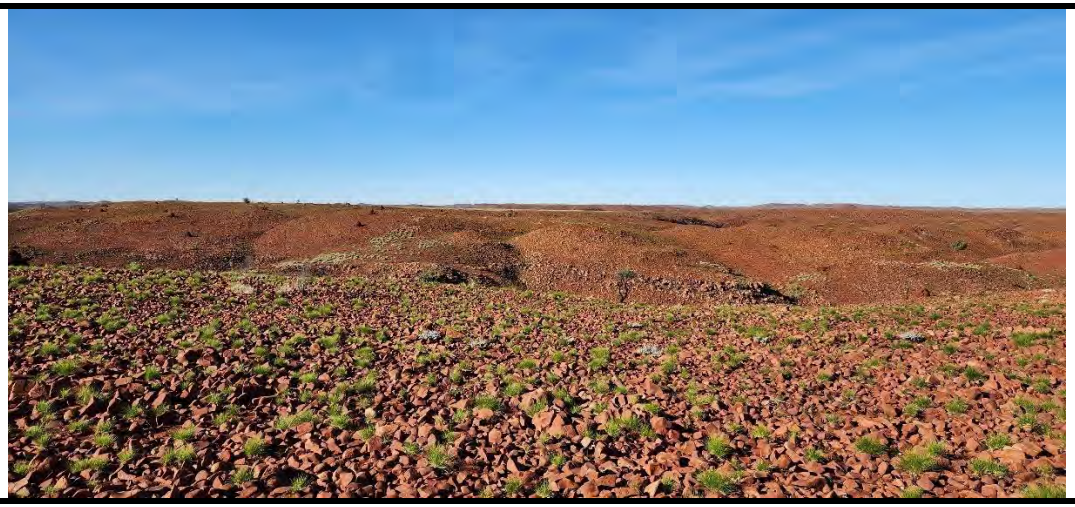
Site Ref	**ARU12**	**Model/Type**	Chorus
Eastings	483925	**Northings**	7646835
Elevation	204		

Description:
Located in VSA 3 in a steep-sided creekline with relatively large pools containing aquatic vegetation.

Patchwork of dense Acacia scrub and several mature eucalypts. ARU placed at the base of a Eucalypt.

Site Ref	**ARU13**	**Model/Type**	Chorus
Eastings	487412	**Northings**	7648612
Elevation	274		

Description:
Recently burnt Spinifex grassland on basalt plateau with few shrubs and trees (VSA 1). Landscape sandwiched between several incised creeklines (VSA 3) flowing to the north.



Site Ref	**ARU14**	**Model/Type**	Chorus
Eastings	489188	**Northings**	7653340
Elevation	155		

Description:
Wide alluvial valley in VSA 3 and adjacent VSA 2, with steeply-banked creekline and mature Eucalypts lining banks. Dense scrub adjacent pools.

Site Ref	**ARU15**	**Model/Type**	Chorus
Eastings	492585	**Northings**	7635177
Elevation	318		

Description:
Hilly and irregular landscape in VSA 5 with spinifex grassland and occasional trees. Landscape interspersed with varying creeklines lined with scrub.

Site Ref	**ARU16**	**Model/Type**	Chorus
Eastings	494845	**Northings**	7642907

Elevation	224		
Description: Located in VSA 3 in a steep-sided creekline with frequent pools and patchwork of dense Acacia scrub and eucalypts. ARU placed at the base of a Eucalypt adjacent a relatively large water body.			
Site Ref	**ARU17**	**Model/Type**	Chorus
Eastings	499910	**Northings**	7645399
Elevation	291		
Description: Bare basalt plateau in VSA 1 in an area burnt in spring 2023. Undulating hills and dark red cobbles.			
Site Ref	**ARU18**	**Model/Type**	Chorus
Eastings	484224	**Northings**	7640786
Elevation	301		
Description: In VSA 3 small creekline and tributary of catchment system flowing south. Surrounded by undulating hills and spinifex grassland of VSA 5.			
Site Ref	**ARU20**	**Model/Type**	Chorus
Eastings	489301	**Northings**	7648976
Elevation	192		
Description: Creekline of VSA 3 with broad slopes and large pools. Large trees along banks of pools. Open slopes leading to higher basalt plateau.			
Site Ref	**ARU21**	**Model/Type**	Chorus
Eastings	504502	**Northings**	7635310
Elevation	317		

Description:
Shallow creekline (VSA 3) in east of Marnda surrounded by undulating plains (VSA 4). Occasional large eucalypts along creekline and dense scub. Grassy weeds along creekline with spinifex on plains. Same location as CAM03

Site Ref	**ARU22**	**Model/Type**	Chorus
Eastings	480508	**Northings**	7641426
Elevation	326		

Description:
On small hill surrounded by basalt plains (VSA 1) and spinifex grasslands. Close by are creeklines serving systems to south and north. Hill has many small trees with many hollows.

Site Ref	**ARU23**	**Model/Type**	Chorus
Eastings	498230	**Northings**	7635261
Elevation	299		
Description: Creekline and VSA 3 with shallow slopes surrounded by undulating plains of VSA 4. Scattered trees throughout with dense patches of scrub. No standing water recorded here.			

Site Ref	**ARU24**	**Model/Type**	Chorus
Eastings	497919	**Northings**	7639521
Elevation	309		
Description: In shallow creekline (VSA 3) surrounded by undulating plains (VSA 5). Scattered trees along creek and plains.			

Site Ref	**ARU25**	**Model/Type**	Chorus
Eastings	482724	**Northings**	7649441
Elevation	325		
Description:			

Spinifex grassland on basalt plateau with few shrubs and trees (VSA 1). No burn. Landscape contains many small creekline lined with scrub and small trees.				
Site Ref	**ARU26**	**Model/Type**	Chorus	
Eastings	485270	**Northings**	7634376	
Elevation	264			
Description: In a creekline with steep banks to the water course (VSA 3). Creek lined with very large paperbarks (*Melaleuca* spp), and surrounded by dense acacia scrub. Main creekline surrounded by southern grassland type VSA 5.				
Site Ref	**ARU27**	**Model/Type**	Chorus	
Eastings	491886	**Northings**	7648727	
Elevation	256			
Description: On undulating basalt plateau with hummocky spinifex (VSA 1). Hills sandwiched between creeklines containing thicker vegetation and low scrub.				
Site Ref	**ARU30**	**Model/Type**	Chorus	
Eastings	494331	**Northings**	7647322	
Elevation	320			
Description: Located adjacent the met-mast at ground level. Hummocky Spinifex grassland on basalt plateau (VSA 1). Occasional scattered scrubs and trees.				
CAMERA TRAPS				
Site Ref	**BCE03**	**Model/Type**	Camera Trap	
Eastings	482355	**Northings**	7651047	
Elevation	176			

Description:
Located in a steep-sided dry creekline (VSA 3) towards the entrance of a broad valley. The top of the valley reaches to the high basalt plateau and likely to be part of a corridor linking adjacent creek systems.

Site Ref	**BCE04**	**Model/Type**	Camera Trap
Eastings	483948	**Northings**	7646790
Elevation	205		

Description:
Located in a broad and steep-sided creekline (VSA 3) with many boulders and rocky outcrops, frequent pools and patchwork of Acacia scrub and eucalypts.

Site Ref	**BCE23a**	**Model/Type**	Camera Trap
Eastings		**Northings**	
Elevation			

Site Ref	**BCE23b**	**Model/Type**	Camera Trap
Eastings	488871	**Northings**	7646790
Elevation	337		

Description:
Placed at the entrance of a cave near the top of a small hill. Hill contained many smaller caves and sits within undulating plains of Spinifex grasslands (VSA 1). Cave contained Common Sheath-tailed Bats in November 2024 and scats from many different fauna species.

Site Ref	**BCE42**	**Model/Type**	Camera Trap
Eastings	489197	**Northings**	7653249
Elevation	155		

Description:
Located in a large creekline (VSA 3) with frequent pools and patchworks of Acacia scrub and eucalypts. Camera placed at the base of a Eucalypt adjacent a relatively large, ephemeral water body.

Site Ref	**BCE02**	**Model/Type**	Camera Trap
Eastings	504504	**Northings**	7635308
Elevation	317		

Description:
Located in a creekline with shallow banks, surrounded on either side by flat Spinifex plains.

VANTAGE POINTS

Site Ref	**VP01**	**Model/Type**	Vantage Point
Eastings	484349	**Northings**	7650491
Elevation	292		

Description:
Recently burnt Spinifex grassland on basalt plateau with few shrubs and trees (VSA 1). Landscape sandwiched between several incised creeklines (VSA 3) flowing to the north.

Site Ref	**VP02**	**Model/Type**	Vantage Point
Eastings	493389	**Northings**	7648430
Elevation	273		

Description:
On small hill overlooking basalt plateau with hummocky grassland (VSA 1). Occasional stunted eucalypts and shrubs.


Site Ref	**VP03**	**Model/Type**	Vantage Point
Eastings	499489	**Northings**	7642975
Elevation	291		

Description:
VP located on a hill of hummocky Spinifex grassland, topped by Eucalypts (VSA 1), surrounded by undulating plains with frequent trees and shrubs. Major tributary of Maitland River lies 1 km south-west.



Site Ref	VP04	Model/Type	Vantage Point
Eastings	490195	Northings	7640060
Elevation	316		

Description:
Hummocky Spinifex grassland on undulating plains (VSA 1), surrounded by undulating plains with frequent trees and shrubs. Dense shrubland follow small creeklines.




Site Ref	**VP05**	**Model/Type**	Vantage Point
Eastings	484212	**Northings**	7641450
Elevation	310		
Description: VP on hill of hummocky Spinifex grassland and topped by Eucalypts (VSA 1), surrounded by undulating plains with frequent trees and shrubs.			

Site Ref	**VP06**	**Model/Type**	Vantage Point
Eastings	487060	**Northings**	7636407
Elevation	294		
Description: Hummocky Spinifex grassland (VSA 1) on plain, with occasional trees and shrubs. VP surrounded by undulating hills and major creekline lies 500 m west. Small creeklines dissect the landscape and are vegetated with low shrubs.			

Site Ref	**VP07**	**Model/Type**	Vantage Point
Eastings	494616	**Northings**	7639308
Elevation	348		
Description: Hummocky Spinifex grassland (VSA 5) on undulating plains and hills with frequent trees and shrubs.			

Site Ref	**VP08**	**Model/Type**	Vantage Point
Eastings	504290	**Northings**	7634853
Elevation	323		
Description: Hummocky Spinifex grassland (VSA 1) on sloping plains with occasional trees and shrubs. Major wooded creekline (flowing south) lies approximately 400 m east.			

Site Ref	**VP09**	**Model/Type**	Vantage Point

Eastings	491499	**Northings**	7636513	
Elevation	323			
Description: Hummocky Spinifex grassland (VSA 5) on low hill surrounded by plains, with occasional trees and shrubs. Small creeklines dissect the landscape and are vegetated with low shrubs.				
Site Ref	**VP10**	**Type**	Vantage Point	
Eastings	497998	**Northings**	7634463	
Elevation	299			
Description: Nilgai (VSA 4) on plain, with occasional shrubs and trees. Adjacent a large, wooded creekline (VSA 3) near Ngurrawaana Community.				

Table A8-2. Bird Census transects locations and description

Site Ref	Model/Type	Eastings Start	Northings Start	Eastings End	Northings End	Elevation	Description
BC01	Bird Census	482347	7653511	481555	7652844	130-133	Broad creekline on open alluvial plain with occasion boulder piles
BC02	Bird Census	484704	7648135	484144	7647097	189-195	Narrow and higher creekline
BC03	Bird Census	489041	7647549	490526	7646835	201-219	Narrow and higher creekline
BC04	Bird Census	497290	7645553	496483	7644493	190-207	Narrow and higher creekline
BC05	Bird Census	484465	7637432	484873	7636578	278-280	Broad creekline on open alluvial plain with woodland
BC06	Bird Census	498473	7634178	498182	7635093	296-299	Broad creekline on open alluvial plain with woodland
BC07	Bird Census	504445	7635764	504762	7634735	314-320	Broad creekline on open alluvial plain with woodland

Table A8-3. Vantage Point sampling conducted between September 2024 and March 2025.

Date	Sample Ref.	Sample Type	Obs.	Start Time	End Time	Duration	Cloud (Okta)	Min Temp	Max Temp	Wind Dir	Wind Vel
27-Sep-24	VP01	Vantage Point	MJB	08:24:15	11:25:22		5	25	26	W	Moderate
	VP05	Vantage Point	MJB	13:50:00	16:51:00	3 h 01 m	4	27	29	W	Moderate
28-Sep-24	VP03	Vantage Point	MJB				0	20	28	WNW	Moderate
29-Sep-24	VP02	Vantage Point	MJB				0	26	30	E	Moderate
	VP04	Vantage Point	BS	08:52:10	11:53:32	3 h 01 m	0	26	30	E	Moderate
	VP06	Vantage Point	BS	13:40:21	15:31:25	1 hr 51 m	0	30	34	NNE	Moderate
	VP03	Vantage Point	MJB	13:51:12	15:10:12	1 hr 19 m	0	30	34	NNE	Moderate
30-Sep-24	VP08	Vantage Point	BS	07:45:53	10:45:05	2 hr 59 m	5	22	28	N	Moderate
	VP09	Vantage Point	BS	14:11:54	16:58:35	2 hr 46 m	0	28	31	NW	Moderate
1-Oct-24	VP10	Vantage Point	BS	07:10:47	10:11:39	3 hr 01 m	4	25	28	E	Moderate
11-Nov-24	VP07	Vantage Point	MJB	07:48:53	11:14:41	3 hr 01 m	0	27	35	W	Light
	VP03	Vantage Point	PMS	08:22:22	11:20:22	2 hr 58 m	0	30	35	W	Light
	VP04	Vantage Point	MJB	14:03:43	16:21:02	2 hr 17 m	0	35	35	W	Moderate
	VP05	Vantage Point	PMS	14:20:34	16:11:24	1 hr 50 m	0	35	35	W	Moderate
12-Nov-24	VP08	Vantage Point	MJB	07:00:00	10:00:00	3 hr 00 m	0	31	36	SW	Light-Mod.
	VP09	Vantage Point	PMS	07:45:00	10:45:31	3 hr 00 m	0	33	38	SW	Light-Mod.
	VP06	Vantage Point	BS	08:04:09	11:05:31	3 hr 01 m	0	33	38	SW	Light-Mod.
	VP02	Vantage Point	MJB	14:26:02	16:08:01	1 hr 41 m	0	36	37	W	Moderate
13-Nov-24	VP10	Vantage Point	MJB	06:58:09	09:59:39	3 hr 01 m	0	30	32	W	Moderate
	VP07	Vantage Point	PMS	14:13:15	16:02:23	1 hr 49 m	1	36	36	W	Moderate
	VP03	Vantage Point	MJB	14:14:10	17:15:01	3 hr 01 m	2	36	36	W	Moderate
10-Mar-25	VP08		BS	08:56:40	10:45:43	1 hr 49 m	1	33	37	W	Slight
	VP10		MJB	08:30:30	10:44:00	2 hr 13 m	1	33	37	W	Slight
	VP01		BS	13:39:41	16:01:43	2 hr 22 m	2	37	37	NW	Light
	VP04		PMS	13:29:26	15:47:00	2 hr 17 m	2	37	37	NW	Light
	VP05		MJB	13:26:09	15:40:21	2 hr 14 m	2	37	37	NW	Light
11-Mar-25	VP01		MJB	08:45:27	11:28:02	2 hr 42 m	0	33	36	NW	Moderate
	VP08		MJB	15:33:04	16:20:02	0 hr 46 m	3	36	37	E	Strong
	VP02		PMS	09:28:02	11:21:52	1 hr 53 m	0	33	38	E	Moderate
	VP03		PMS	13:41:08	14:37:38	0 hr 56 m	3	36	37	NW	Moderate

	VP10		PMS	15:14:10	16:31:28	1 hr 17 m	5	36	37	NW	Strong
12-Mar-25	VP07		PMS	15:11:39	17:12:04	2 hr 00 m	6	35	37	W	Moderate
	VP04		BS	06:57:00	09:02:21	2 hr 05 m	1	30	34	E	Light
	VP03		MJB	08:11:03	10:22:59	2 hr 11 m	1	30	34	E	Light
	VP06		MJB	10:44:22	11:48:28	1 hr 04 m	3	34	37	NE	Moderate
	VP05		BS	15:19:35	17:23:17	2 hr 03 m	6	35	37	NE	Moderate
	VP05		PMS	07:08:15	09:11:16	2 hr 03 m	1	30	34	E	Light
	VP04		MJB	15:14:42	17:17:46	2 hr 03 m	6	35	37	NE	Moderate
	VP09		PMS	09:32:43	11:43:47	2 hr 11 m	3	34	37	E	Light
13-Mar-25	VP07		PMS	08:51:00	10:57:01	2 hr 06 m	8	28	30	W	Light
	VP10		PMS	11:16:45	13:26:46	2 hr 10 m	8	34	35	W	Light
	VP06		BS	08:50:47	11:11:07	2 hr 20 m	8	28	30	SW	Light
	VP08		BS	12:24:37	13:42:09	1 hr 17 m	8	34	35	W	Light
	VP09		MJB	09:02:31	10:02:33	1 hr 00 m	8	28	30	SW	Light

Appendix 9. Acoustic analysis and bat call identification from Baru project area: 2024 (Supersensory Technologies 2025)

SuperSensory Technologies Pty Ltd

Systems for continuous environmental monitoring ABN 54 665 618 351

Acoustic analysis and bat call identification from Baru Wind Farm: 2024

Prepared for **Bamford Consulting Ecologists Pty Ltd**
Prepared by **Supersensory Technologies Pty Ltd**
Project reference **ST020**
Version **2025-04-09**

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Version history

Version	Note
2025-04-09	Final version

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

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1.0 Summary

An analysis of bat echolocation calls from ultrasonic (bat detector) recordings are provided from the proposed Yindjibarndi Energy Corporation Baru Wind Farm, c. 60 km south of Karratha, in the Pilbara region of Western Australia.

The datasets reported on here comprise a total of 30 sampling positions (sites) over four survey periods, and a total of 338 recording nights and 176,624 WAV sound files (**Table 1**).

The scope and associated outcomes in brief were:

1. A summary of bat species detected across the project area, plus mention of those that might be present but were not detected;

Nine species of bat were detected across the area sampled. For the remaining species that were expected to be present in the study area: the survey methods did not target two species of flying-fox or the Ghost Bat *Macroderma gigas*; distinguishing the species of long-eared bat from each other is unreliable based on echolocation calls; and the project area is just outside the coastal distribution of two mangrove habitat specialists.

2. A special determination of the presence of Threatened species (Ghost Bat *Macroderma gigas* (Megadermatidae) and Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* (Rhinonycteridae), with details of their detection rates and times;

The Pilbara Leaf-nosed Bat was detected at two sites (from three sampling nights, and four sound files only). The Ghost Bat was not detected, but the sampling method is not suitable for detecting this species away from cave entrances.

3. Indication of the 'frequency of detection' of each bat species based on how often each was detected across sampling sites and nights;

The highest frequencies of detection were from species that forage in open space around vegetation (species in the genera *Chalinolobus*, *Scotorepens*, *Vespadelus*). The most commonly encountered species that forages in open spaces was the Common Sheath-tailed Bat *Taphozous georgianus*.

4. An assessment of the relative level of activity of different bat species at different altitudes based on recordings at different heights of a meteorological ('met') mast;

The Common Sheath-tailed Bat was recorded at a higher rate at the highest position on the met mast. It could have been detected up to 75 – 85 metres in altitude, and has the potential to be present even higher.

5. A preliminary analysis of the 'Collision Risk' of each bat species based on their rate of encounter and 'likely flight height'.

This scheme derived from a standard risk matrix was used to calculate the relative levels of Collision Risk amongst bat species. The echolocating bat species most at risk from collisions is the Common Sheath-tailed Bat *T. georgianus*, and it is likely to fly regularly at altitudes within the Rotor Swept Area.

2.0 Species detected

2.1 Methods

The ultrasonic recordings provided were recorded in WAV format with Titley Scientific Anabat Chorus 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 the Pilbara;
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 25.0.

Species were identified based on information in the author's unpublished material, Churchill (2008), and McKenzie and Bullen (2009). 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) (Milne et al. 2023). Custom [R] language scripts were used to summarise the analysis outcomes.

2.2 Results and interpretations

Nine species of bat were detected (**Table 2**; **Figure 1**), including the Pilbara Leaf-nosed Bat. The Ghost Bat was not detected. Details of detections at each site (collated across recording nights per site) are summarised in **Table 3**.

The Pilbara Leaf-nosed Bat was detected at two sampling sites across three nights from a total of four passes (=four sound files; **Table 4**). Times of first detection after sunset, and times of last detection prior to sunrise, were much greater than one hour, indicating that a diurnal roost was unlikely to be in the immediate vicinity.

Given that this survey was conducted to understand the possible effects of the construction and operation of wind turbines on bats, it is worth noting several species that were not detected in the analysis.

Some species have the potential to fly within the Rotor Swept Area of a wind turbine, but could not be detected by the survey methods used:

- **Black Flying-fox *Pteropus alecto* and Little Red Flying-fox *Pteropus scapulatus*** (Pteropodidae)—These two species do not echolocate and are therefore not detected by acoustic recorders (bat detectors).
- **Ghost Bat *Macroderma gigas*** (Megadermatidae)—The most reliable way of detecting the Ghost Bat with bat detectors is to place the equipment with the microphone facing into a potential cave roosting site. The echolocation calls of this species are of low amplitude, and therefore most detectable when a Ghost Bat flies close to the bat detector as it exits the underground structure. If there is uncertainty about whether Ghost Bats are present in a cave, then video recordings can be a useful addition to the survey. The detection of Ghost Bats with bat detectors away from cave entrances is less reliable, unless an approach based on an acoustic lure is used (Hanrahan et al. 2023; Ruykys et al. 2023, 2024). If caves within and adjacent to the project area are not used by this species, the likelihood of their presence will be low, but the application of a sampling design with an acoustic lure can demonstrate this empirically.

One species is expected to be present, but only at times of the year that the four surveys in 2024 did not cover:

- **White-striped Free-tailed Bat *Austronomus australis*** (Molossidae)—This species was not detected in the 2024 recording dataset. It is only present seasonally in the Pilbara region from April to September according to an analysis presented by Bullen and McKenzie (2005). This species is very likely be detected in future surveys that are timed to coincide with its presence in the region.

Some species have similar echolocation calls and cannot be distinguished from one another, but they generally fly at lower altitudes within and around vegetation:

- **Pallid Long-eared Bat *Nyctophilus daedalus* and Lesser Long-eared Bat *Nyctophilus geoffroyi*** (Vespertilionidae)—These species might be present but their echolocation calls are usually low in amplitude (reducing their detection distance), cannot be distinguished from each other, and can also sometimes be difficult to distinguish from clutter calls of the Little Broad-nosed Bat *Scotorepens greyii*.

The remaining species of bat present in the Pilbara region have distributions that do not extend to the Baru project area:

- **Hill's Sheath-tailed Bat *Taphozous hilli*** (Emballonuridae)—This species is found roosting in caves in more southerly areas of the Pilbara region.

- **Arnhem Long-eared Bat *Nyctophilus arnhemensis*** (Vespertilionidae)—This species is found only along the Pilbara coast or a short distance inland, is usually found in mangal habitat, and probably does not range as far inland as the Baru project area. Like other species of long-eared bats, it generally flies at lower altitudes within and around vegetation.
- **Northern Coastal Free-tailed Bat *Ozimops cobourgianus*** (Molossidae)—This species is found only along the Pilbara coast or a short distance inland, is usually found in mangal habitat, and probably does not range as far inland as the Baru project area.

3.0 Frequency of detection

3.1 Methods

Careful consideration was given to choosing a metric to estimate how common each species of bat was in the project area, and whether there were patterns according to the habitat where recordings were made. It is important to understand the limitations of bat detector recordings for questions that allow an understanding of 'commonness'. Several metrics were deemed to be inappropriate given these limitations, and the chosen metric was considered in the context of an appropriately-worded question and its assumptions.

Number of individuals. Bat detectors cannot be used to estimate true abundance (number of individuals) because it is not possible to determine how many individuals contribute to a particular ultrasonic recording. Thus, it is not possible to determine 'local population size' directly.

Relative abundance. Likewise, it is not possible to calculate relative abundance, because this metric is also derived from a count—it is the proportion or percentage of individuals of one species compared to the total number of individuals from all species within a given community or ecosystem. The output metric is a decimal value between 0 and 1 that sums to 1.0 across all species at a particular site.

Activity levels. In pre-construction environmental assessments for wind energy assessments in other parts of Australia, it is common for consultancy reports to contain compiled totals of the number of bat detector sound files that contain an echolocation sequence of each species. This measure is compared over time (seasonal and yearly survey periods) at the same sites to document trends in levels of presence; and it is sometimes compared across project areas and regions. This is a reasonable approach but there are numerous biases that contribute to the totals for each species, and reports do not always state them explicitly or make mention of how they were controlled:

- Some individual bats might linger near a particular bat detector for longer periods than other species or individuals, inflating how common they appear to be. This can be addressed somewhat by maximising the number of sampling site replicates and sampling nights.
- How well the echolocation calls of certain species, especially those of conservation significance, can be distinguished from the calls of other bat species.
- The consistency with which the same and different analysts will allocate particular echolocation sequence examples to candidate species within and across datasets.
- The consistency and accuracy of the performance of custom automated identification routines developed by different analysts in commercial software programmes (e.g., Titley Scientific ANABAT INSIGHT; Wildlife Acoustics KALEIDOSCOPE).
- The lack of standard identification models for regions or species of interest.

- Biases in sampling design, such as habitat representation, microphone orientation and microphone condition, and bat detector types (some models of certain brands have microphones with different capabilities), and the trigger settings on bat detectors.

Occupancy (frequency of detection). This is a measure based on Species Richness; it reports the proportion of sampling sites where each species was detected. Ideally the number of sampling nights per site would be standardised where bat detectors are left for more than one night, so sampling effort and therefore probability of detection would be equivalent amongst sites. The output metric is a decimal value between 0 and 1 that does not sum to 1.0 across all species. In this report the term 'frequency of detection' is used to avoid confusion with a more sophisticated approach called 'occupancy modelling' (*sensu* MacKenzie et al. 2002), which accounts for (estimates) detectability and reports the probability that a site is truly occupied.

Given the sampling design and the various constraints discussed above, the most appropriate metric was **frequency of detection**. This metric can directly address the following question:

How common is each species of bat across the project area?

The assumptions include:

- The sampling design (sampling sites and nights) was sufficient to provide a good estimate.
- No significant biases arose in the application of the method of Armstrong et al. 2021a,b).
- Microphone condition in the bat detectors was good and relatively consistent amongst units.
- The detectability of each species is approximately equal (this will be violated for some species).

It is straightforward to identify the echolocation calls of most species of bat in the Pilbara to species level (the exception being the calls of the three long-eared bats *Nyctophilus* spp.). However, for large recording datasets, it is not expeditious for an analyst to check each sound file and validate the output from an automated identification routine developed within a commercially available software such as those mentioned above. These systems produce too many false positive detections with non-target signals (false attributions) to be relied on without a manual inspection check. The method described by Armstrong et al. (2021a,b; see section *2.0 Species detected*) has been used in a significant number of consultancy reports in the past 10+ years, and is an expeditious approach to producing a species-by-site-by-night matrix of presence-absence values. A determination of species presence for each sampling night at each site was made using this approach. Frequency of detection of each species at each site was calculated by determining the proportion of sampling nights that they were detected. Overall values of frequency of detection across each survey, and across all surveys combined was calculated from a compilation of relevant sampling nights.

3.2 Results and interpretations

The highest frequencies of detection were for species that forage in flight spaces in the open adjacent to vegetation (McKenzie and Bullen 2009; Denzinger and Schnitzler 2013)—Gould's Wattled Bat *Chalinolobus gouldii*, Little Broad-nosed Bat *Scotorepens greyii* and Finlayson's Cave Bat *Vespadelus finlaysoni* (**Table 5**). These species are not expected to be present well above the tree canopy and within the Rotor Swept Area of a wind turbine, but sometimes bat species can be attracted to tall infrastructure (Cryan and Barclay 2009; Cryan et al. 2014; Guest et al. 2022), so it is important to not discount their presence at higher altitudes around turbines.

The Common Sheath-tailed Bat *Taphozous georgianus* had a moderate frequency of detection in August 2024, but overall it had one of the highest frequencies of detection, especially at the met mast (**Table 5**).

4.0 Levels of activity at height

4.1 Methods

The recordings from the December survey where three bat detectors were placed on a met mast were analysed separately.

All sound files with echolocation calls were marked and extracted (copied elsewhere) using an 'Allbats' filter in Titley Scientific ANABAT INSIGHT version 2.1.3 software. These copies were then inspected in higher quality spectrograms in ADOBE AUDITION version 25.0 software. The number of sound files with calls for each species was tallied for each of the sampling heights on the met mast (0, 25 and 50 metres). A frequency of detection value was calculated across sampling nights, given that there was a different number of recording nights at different heights on the met mast.

A separate analysis was focussed on the timing of detections of the Common Sheath-tailed Bat given that it had a sufficient number of detections to conduct further analysis. First the time offsets of each unit were determined by locating the same echolocation call sequences in recordings at different heights. The calculated times of detections were then standardised according to the time offsets. Lastly, the number of echolocation sequences that were recorded at the same time (within three seconds) at different heights was tallied.

The values were inspected to examine two questions:

1. *Which species might focus their foraging and/or commuting activities at higher altitudes?*
2. *What is the 'maximum detectable flight altitude' for relevant species that we can infer from the recordings?*

4.2 Results and interpretations

1. *Which species might focus their foraging and/or commuting activities at higher altitudes?*

The Common Sheath-tailed Bat *T. georgianus* had the highest rate of detection of any bat species on the met mast detectors; and it was recorded more frequently at higher positions on the met mast (**Table 6**). This species is more likely to be impacted by a wind energy project than other bat species detected on the survey.

2. *What is the 'maximum detectable flight altitude' for relevant species that we can infer from the recordings?*

Further analysis focussed on the Common Sheath-tailed Bat because it had a sufficient number of detections, and it was also clearly active at higher altitudes.

By summarising simultaneous detections of the same echolocation sequence across the three sampling heights, it was possible to make an estimation of how high this species could have been foraging at a minimum (**Table 7**).

The detection range of bat detectors depends on the frequency of the signal, the flight path of the bat relative to the microphone orientation, and its altitude. Thus, there are many scenarios that could be devised to explain the results in **Table 7**, but insufficient information to choose amongst them. However, one key observation allows a reasonable estimation of whether this species would be flying within the Rotor Swept Area.

A single echolocation sequence was detected simultaneously at all three heights, suggesting that the calls of this species can be detected from at least 25 metres away (**Figure 2**). In Scenario A, the bat was flying on-axis (or almost so) towards the detector microphones at a height of c. 25 metres and c. 1 metre from the met mast. A bat calling at this point in space is detectable at 0 m and 50 m at a distance of 25.1 (using the Pythagorean Theorem to derive the distance of the hypotenuse). This is the most conservative measure of on-axis detection distance.

In Scenario B, given that we have established a conservative detection distance of c. 25 metres, we can derive a less conservative estimate of maximum detection distance. When the bat is 25 metres from the met mast at a height of 25 metres, then the detection distance at height 0 m and height 50 m is 35 metres.

Given these two scenarios, the maximum detection distance that is supported by this single observation is 35 metres, meaning that the maximum height that the Common Sheath-tailed Bat could be flying when detected at height 50 m is 85 metres. Thus, the species is likely to be flying within the Rotor Swept Zone. There is no evidence from this dataset that other echolocating bat species would be flying within the Rotor Swept Zone, but further work is required.

5.0 Collision Risk

5.1 Concept development

To understand the Collision Risk of different bat Pilbara bat species, it can be useful to apply a modified generic risk matrix (**Box 1**).

In place of 'Probability' (rows), it uses the frequency of detection values calculated across all sites surveyed in 2024, as sorted into four frequency ranges between 0 and 1.

In place of 'Consequence' (columns), it uses three likelihood categories of the species being present above 50 metres in altitude (turbine absent). This is an authoritative estimate based on my (K. Armstrong) own accumulated casual field observations (see also **Table 2**).

The final score in the matrix is then divided and used to derive three collision risk categories.

Box 1. A Collision Risk score calculator (**above**), and derived categorisation of risk level (**below**).

	Likelihood of presence above 50 metres altitude	**Low**	**Medium**	**High**
Frequency of detection		1	2	3
0 – 0.25	1	1	2	3
0.25 – 0.50	2	2	4	6
0.50 – 0.75	3	3	6	9
0.75 – 1.0	4	4	8	12

Risk Score from matrix	**Collision Risk**
1 – 2	Low risk
3 – 6	Medium risk
7 – 12	High risk

5.2 Concept application to bats both present and predicted

The final Risk Score and Collision Risk for each species is given in **Table 7**. The Risk Scores and their Collision Risk categorisation seem to be sensible outcomes. The Common Sheath-tailed Bat appears to be most at risk from wind turbines given how common it is, and how high it forages.

Predictions for species expected but not detected on the survey are given in **Table 8**. The frequency of detection values need to be based on empirical estimates. Thermal camera recordings can easily detect flying-foxes and are recommended for future surveys. A more appropriate sampling approach for the Ghost Bat that uses an acoustic lure will give a more robust understanding of Collision Risk for this species. Surveys between April and September are required to investigate the Collision Risk for the White-striped Free-tailed Bat *Austronomus australis*.

6.0 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 not set up and supplied by Supersensory Technologies. The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Supersensory Technologies 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. Supersensory Technologies 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 identifications have been made 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. Supersensory Technologies 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.

7.0 References

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Table 1. Summary of recordings made.

Unit name	Detector serial	First night	Last night	Nights	Coordinates
August 2024					
ARU01 Ranger	799032	3/08/2024	23/09/2024	18	-21.276127, 116.945885
ARU03	787566	1/08/2024	2/09/2024	14	-21.260027, 116.859573
ARU05	797005	1/08/2024	2/09/2024	14	-21.353645, 116.90345
ARU06	796994	7/08/2024	28/08/2024	10	-21.266195, 116.854088
ARU07	797034	7/08/2024	17/08/2024	5	-21.315052, 116.951645
ARU08	797038	7/08/2024	26/08/2024	9	-21.22649, 116.821449
ARU09	787491	7/08/2024	31/08/2024	11	-21.242155, 116.829834
ARU10	796999	10/08/2024	2/09/2024	11	-21.236483, 116.918785
ARU11	797045	7/08/2024	26/08/2024	9	-21.321203, 116.944794
ARU12	787468	7/08/2024	26/08/2024	9	-21.280159, 116.844986
ARU13	787568	10/08/2024	26/08/2024	8	-21.264139, 116.878632
ARU14	787429	7/08/2024	24/08/2024	8	-21.22146, 116.895821
ARU15	787495	10/08/2024	28/08/2024	9	-21.385576, 116.928467
ARU16	797009	7/08/2024	17/08/2024	5	-21.315573, 116.950294
ARU17	797046	10/08/2024	31/08/2024	9	-21.293295, 116.999123
ARU18	787551	7/08/2024	28/08/2024	10	-21.33485, 116.847885
ARU20	797004	7/08/2024	24/08/2024	8	-21.261442, 116.899384
ARU21	797048	7/08/2024	21/08/2024	7	-21.384363, 117.043167
ARU22	787457	7/08/2024	26/08/2024	9	-21.329037, 116.811996
ARU23	762366	7/08/2024	28/08/2024	10	-21.384823, 116.983009
ARU24-19	787553	10/08/2024	31/08/2024	10	-21.346386, 116.979912
ARU25	787524	7/08/2024	28/08/2024	10	-21.25662, 116.833496
ARU26	787548	10/08/2024	31/08/2024	10	-21.392525, 116.858253
ARU27	787500	10/08/2024	28/08/2024	9	-21.263163, 116.921806
September 2024					
ARU30	799044	29/9/2024	14/10/2024	10	-21.275867, 116.945328
October–November2024					
ARU01A Ranger	799032	29/09/2024	10/11/2024	23	-21.275846, 116.945587
ARU02-1 Ranger	799044	10/08/2024	10/11/2024	25	-21.275646, 116.945473
December 2024					
ARU01A 50m	799032	13/11/2024	20/12/2024	20	-21.275789, 116.945511
ARU02A 25m	799044	11/11/2024	13/12/2024	15	-21.275871, 116.945541
ARU30 Mast 0m	751251	11/11/2024	2/12/2024	13	-21.27589, 116.945328

Table 2. Species identified in the dataset from all sites combined. The predicted presence above 50 metres in altitude is an authoritative estimate based on accumulated casual field observations (K. Armstrong), as well as the results in section 4.0 *Levels of activity at height.*

Predicted presence above 50 m altitude		
	RHINONYCTERIDAE	
Low	Pilbara Leaf-nosed Bat (Pilbara Diamond-faced Bat)	*Rhinonicteris aurantia*
	EMBALLONURIDAE	
Medium	Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*
High	Common Sheath-tailed Bat	*Taphozous georgianus*
	VESPERTILIONIDAE	
Low	Gould's Wattled Bat	*Chalinolobus gouldii*
Low	Little Broad-nosed Bat	*Scotorepens greyii*
Low	Finlayson's Cave Bat	*Vespadelus finlaysoni*
	MOLOSSIDAE	
Medium	Greater Northern Free-tailed Bat	*Chaerephon jobensis*
Medium	Northern Free-tailed Bat	*Ozimops lumsdenae*

Table 3. Species identifications from all recording nights at all sites [see *Table 2* for full species names].

Unit name	Detector serial	First night	Last night	Nights	*A. australis*	*C. gouldii*	*C. jobensis*	*Nyctophilus sp.*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
August 2024														
ARU01 Ranger	799032	3/08/2024	23/09/2024	18	.	X	X	.	.	.	.	X	X	X
ARU03	787566	1/08/2024	2/09/2024	14	.	X	X	.	.	.	X	X	X	X
ARU05	797005	1/08/2024	2/09/2024	14	.	X	X	.	X	.	X	X	.	X
ARU06	796994	7/08/2024	28/08/2024	10	.	X	X	.	X	.	.	X	X	X
ARU07	797034	7/08/2024	17/08/2024	5	.	.	X	.	.	.	.	X	.	X
ARU08	797038	7/08/2024	26/08/2024	9	.	X	X	.	.	.	X	X	X	X
ARU09	787491	7/08/2024	31/08/2024	11	.	X	.	.	.	.	.	X	X	X
ARU10	796999	10/08/2024	2/09/2024	11	.	X	X	NC	.	.	.	X	X	X
ARU11	797045	7/08/2024	26/08/2024	9	.	X	X	.	.	.	.	X	X	X
ARU12	787468	7/08/2024	26/08/2024	9	.	X	X	.	.	.	X	X	X	X
ARU13	787568	10/08/2024	26/08/2024	8	.	.	.	.	.	.	.	.	X	X
ARU14	787429	7/08/2024	24/08/2024	8	.	X	X	.	.	.	.	X	X	X
ARU15	787495	10/08/2024	28/08/2024	9	.	X	X	.	.	.	.	X	X	X
ARU16	797009	7/08/2024	17/08/2024	5	.	X	X	.	X	X	.	X	.	X
ARU17	797046	10/08/2024	31/08/2024	9	.	X	.	.	.	.	.	X	.	X
ARU18	787551	7/08/2024	28/08/2024	10	.	X	X	.	.	.	.	X	X	X
ARU20	797004	7/08/2024	24/08/2024	8	.	X	X	.	.	.	.	X	X	X
ARU21	797048	7/08/2024	21/08/2024	7	.	X	X	.	.	.	.	X	.	X
ARU22	787457	7/08/2024	26/08/2024	9	.	X	X	NC	.	.	.	X	X	X
ARU23	762366	7/08/2024	28/08/2024	10	.	X	X	.	X	.	X	X	X	X
ARU24-19	787553	10/08/2024	31/08/2024	10	.	X	.	.	.	.	X	X	X	X
ARU25	787524	7/08/2024	28/08/2024	10	.	X	X	.	.	.	.	.	X	X

Unit name	Detector serial	First night	Last night	Nights	*A. australis*	*C. gouldii*	*C. jobensis*	*Nyctophilus sp.*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
ARU26	787548	10/08/2024	31/08/2024	10	.	X	X	.	.	X	.	X	X	X
ARU27	787500	10/08/2024	28/08/2024	9	.	X	X	.	.	.	.	X	X	X
September 2024														
ARU30	799044	2024-09-29	2024-10-14	10	.	X	X	.	X	.	.	X	X	.
October–November2024														
ARU01A Ranger	799032	29/09/2024	10/11/2024	23	.	X	.	.	X	.	.	.	X	.
ARU02-1 Ranger	799044	10/08/2024	10/11/2024	25	.	X	X	.	X	.	.	X	X	X
December 2024														
ARU01A 50m	799032	13/11/2024	20/12/2024	20	.	.	.	.	.	.	X	.	X	.
ARU02A 25m	799044	11/11/2024	13/12/2024	15	.	X	.	.	X	.	X	X	X	.
ARU30 Mast 0m	751251	11/11/2024	2/12/2024	13	.	X	.	.	.	.	.	.	X	X

Definition of confidence level codes

. Not detected.

X Unambiguous identification of the species at the site based on measured call characteristics and comparison with available reference material. Greater confidence in this ID would come only after capture and supported by morphological measurements or a DNA sequence.

NC Needs Confirmation. Either call quality was poor, or the species cannot be distinguished reliably from another that makes similar calls. Alternative identifications are indicated in the *Comments on identifications* section of this report. If this is a species of conservation significance, further survey work might be required to confirm the record.

Table 4. Summary of detections of the Pilbara Leaf-nosed Bat from all sites.

Site	Serial	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
2024 August ARU16	797009	7/08/2024	2	7/08/2024 17:56	7/08/2024 18:19	8/08/2024 6:18	8/08/2024 6:41	1:18:02	3:20:23	7H 21M 24S	3H 20M 58S
2024 August ARU16	797009	14/08/2024	1	14/08/2024 17:59	14/08/2024 18:21	15/08/2024 6:13	15/08/2024 6:36	2:16:26	2:16:26	8H 17M 21S	4H 20M 23S
2024 August ARU26	787548	31/08/2024	1	31/08/2024 18:04	31/08/2024 18:26	1/09/2024 6:00	1/09/2024 6:23	0:51:13	0:51:13	6H 47M 6S	5H 31M 55S

Table 5. Frequency of detection across sites for each species on each survey, and combined over all 2024 sites (higher intensity of colour for higher values).

Unit name	Detector serial	First night	Last night	Nights	*A. australis*	*C. gouldii*	*C. jobensis*	*Nyctophilus sp.*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
August 2024														
ARU01 Ranger	799032	3/08/2024	23/09/2024	18	0.00	0.06	0.06	0.00	0.00	0.00	0.00	0.06	0.67	0.17
ARU03	787566	1/08/2024	2/09/2024	14	0.00	0.71	0.07	0.00	0.00	0.00	0.14	0.79	0.57	0.86
ARU05	797005	1/08/2024	2/09/2024	14	0.00	0.43	0.14	0.00	0.07	0.00	0.07	0.50	0.00	0.50
ARU06	796994	7/08/2024	28/08/2024	10	0.00	0.90	0.30	0.00	0.10	0.00	0.00	1.00	0.50	1.00
ARU07	797034	7/08/2024	17/08/2024	5	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.40	0.00	1.00
ARU08	797038	7/08/2024	26/08/2024	9	0.00	0.89	0.22	0.00	0.00	0.00	0.11	0.89	0.78	0.89
ARU09	787491	7/08/2024	31/08/2024	11	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.73	0.91	1.00
ARU10	796999	10/08/2024	2/09/2024	11	0.00	0.18	0.18	0.27	0.00	0.00	0.00	0.91	0.64	1.00
ARU11	797045	7/08/2024	26/08/2024	9	0.00	0.67	0.22	0.00	0.00	0.00	0.00	0.33	0.11	1.00
ARU12	787468	7/08/2024	26/08/2024	9	0.00	0.89	0.44	0.00	0.00	0.00	0.11	0.89	0.44	0.89
ARU13	787568	10/08/2024	26/08/2024	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.25
ARU14	787429	7/08/2024	24/08/2024	8	0.00	0.75	0.25	0.00	0.00	0.00	0.00	0.88	0.50	1.00
ARU15	787495	10/08/2024	28/08/2024	9	0.00	1.00	0.22	0.00	0.00	0.00	0.00	0.67	0.11	0.56
ARU16	797009	7/08/2024	17/08/2024	5	0.00	1.00	0.20	0.00	0.00	0.00	0.00	1.00	0.00	1.00
ARU17	797046	10/08/2024	31/08/2024	9	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.33
ARU18	787551	7/08/2024	28/08/2024	10	0.00	0.40	0.10	0.00	0.00	0.00	0.00	0.80	0.10	0.70
ARU20	797004	7/08/2024	24/08/2024	8	0.00	0.75	0.25	0.00	0.00	0.00	0.00	0.50	0.50	0.88
ARU21	797048	7/08/2024	21/08/2024	7	0.00	0.71	0.14	0.00	0.00	0.00	0.00	0.57	0.00	0.43
ARU22	787457	7/08/2024	26/08/2024	9	0.00	0.33	0.22	0.11	0.00	0.00	0.00	0.56	0.22	0.22
ARU23	762366	7/08/2024	28/08/2024	10	0.00	0.80	0.40	0.00	0.10	0.00	0.40	0.90	0.20	0.60
ARU24-19	787553	10/08/2024	31/08/2024	10	0.00	0.90	0.00	0.00	0.00	0.00	0.40	0.70	0.10	0.90
ARU25	787524	7/08/2024	28/08/2024	10	0.00	0.20	0.10	0.00	0.00	0.00	0.00	0.00	0.30	1.00

KEY
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Unit name	Detector serial	First night	Last night	Nights	*A. australis*	*C. gouldii*	*C. jobensis*	*Nyctophilus sp.*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
ARU26	787548	10/08/2024	31/08/2024	10	0.00	1.00	0.20	0.00	0.00	0.00	0.00	1.00	0.30	1.00
ARU27	787500	10/08/2024	28/08/2024	9	0.00	0.11	0.11	0.00	0.00	0.00	0.00	0.22	0.56	0.11
Overall Aug 2024					**0.00**	**0.53**	**0.16**	**0.02**	**0.02**	**0.00**	**0.06**	**0.60**	**0.36**	**0.70**
September 2024														
ARU30	799044	2024-09-29	2024-10-14	10	**0.00**	**0.20**	**0.20**	**0.00**	**0.10**	**0.00**	**0.00**	**0.20**	**0.80**	**0.00**
October–November2024														
ARU01A Ranger	799032	29/09/2024	10/11/2024	23	0.00	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.70	0.00
ARU02-1 Ranger	799044	10/08/2024	10/11/2024	25	0.00	0.16	0.04	0.00	0.04	0.00	0.00	0.08	0.68	0.08
Overall Oct–Nov 2024					**0.00**	**0.10**	**0.02**	**0.00**	**0.04**	**0.00**	**0.00**	**0.04**	**0.69**	**0.04**
December 2024														
ARU01A 50m	799032	13/11/2024	20/12/2024	20	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.80	0.00
ARU02A 25m	799044	11/11/2024	13/12/2024	15	0.00	0.20	0.00	0.00	0.07	0.00	0.07	0.07	0.87	0.00
ARU30 Mast 0m	751251	11/11/2024	2/12/2024	13	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.31
Overall Dec 2024					**0.00**	**0.13**	**0.00**	**0.00**	**0.02**	**0.00**	**0.04**	**0.02**	**0.73**	**0.08**
Over all four surveys														
				338	**0.00**	**0.40**	**0.12**	**0.01**	**0.02**	**0.00**	**0.04**	**0.43**	**0.47**	**0.50**

Table 6. Frequency of detection at the met mast in December 2024 (taken from *Table 5*), number of WAV files with calls of each species, and the number of WAV files averaged over the number of sampling nights.

	Frequency of detection				WAV files			WAV files per night		
	0 m	**25 m**	**50 m**	**Overall**	**0 m**	**25 m**	**50 m**	**0 m**	**25 m**	**50 m**
A. australis	0.00	0.00	0.00	**0.00**	.	.	.	.	.	.
C. gouldii	0.23	0.20	0.00	**0.13**	4	6	.	0.31	0.40	.
C. jobensis	0.00	0.00	0.00	**0.00**	.	.	.	.	.	.
***Nyctophilus* sp.**	0.00	0.00	0.00	**0.00**	.	.	.	.	.	.
O. lumsdenae	0.00	0.07	0.00	**0.02**	.	2	.	.	0.13	.
R. aurantia	0.00	0.00	0.00	**0.00**	.	.	.	.	.	.
S. flaviventris	0.00	0.07	0.05	**0.04**	.	3	1	.	0.20	0.05
S. greyii	0.00	0.07	0.00	**0.02**	.	5	.	.	0.33	.
T. georgianus	0.46	0.87	0.80	**0.73**	22	101	127	1.69	6.73	6.35
V. finlaysoni	0.31	0.00	0.00	**0.08**	1	.	.	0.08	.	.

Table 7. Summary of detections of the same bat simultaneously by detectors at different heights on the met mast.

Height class	**No. of detections**
One height class only	
0 m only	16
25 m only	78
50 m only	124
Simultaneous detections amongst height classes	
0 and 25 m	1
25 and 50 m	30
0 and 25 and 50 m	1

Table 8. Calculated Risk Scores for each species based on the surveys in 2024 (see *Table 5* for values of 'Frequency across all surveys').

		High altitude likelihood	Altitude category	Frequency across all surveys	Frequency category	Risk Score	Collision Risk
RHINONYCTERIDAE							
Pilbara Leaf-nosed Bat	*Rhinonicteris aurantia*	Low	1	0.00	1	1	Low
EMBALLONURIDAE							
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*	Medium	2	0.04	1	2	Low
Common Sheath-tailed Bat	*Taphozous georgianus*	High	3	0.47	2	6	Medium
VESPERTILIONIDAE							
Gould's Wattled Bat	*Chalinolobus gouldii*	Low	1	0.40	2	2	Low
Long-eared bat species	*Nyctophilus* sp.	Low	1	0.01	1	1	Low
Little Broad-nosed Bat	*Scotorepens greyii*	Low	1	0.43	2	2	Low
Finlayson's Cave Bat	*Vespadelus finlaysoni*	Low	1	0.50	3	3	Medium
MOLOSSIDAE							
Greater Northern Free-tailed Bat	*Chaerephon jobensis*	Medium	2	0.12	1	2	Low
Northern Free-tailed Bat	*Ozimops lumsdenae*	Medium	2	0.02	1	2	Low

Table 9. Predicted Risk Score and Collision Risk categories for Pilbara species of bat likely to be present but not observed on the survey (based on distributions given by Milne et al. 2023; 'estimated frequency' was informed partly by the density of records of occurrence in the Atlas of Living Australia, but standardised at a value of 0.05 until further data becomes available).

		High altitude likelihood	'Estimated frequency'	Risk Score	Collision Risk
Black Flying-fox	*Pteropus alecto*	High	0.05	3	Medium
Little Red Flying-fox	*Pteropus scapulatus*	High	0.05	3	Medium
Ghost Bat	*Macroderma gigas*	Medium	0.05	2	Low
Pallid Long-eared Bat	*Nyctophilus daedalus*	Low	0.05	1	Low
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	Low	0.05	1	Low
White-striped Free-tailed Bat	*Austronomus australis*	High	0.05	3	Medium

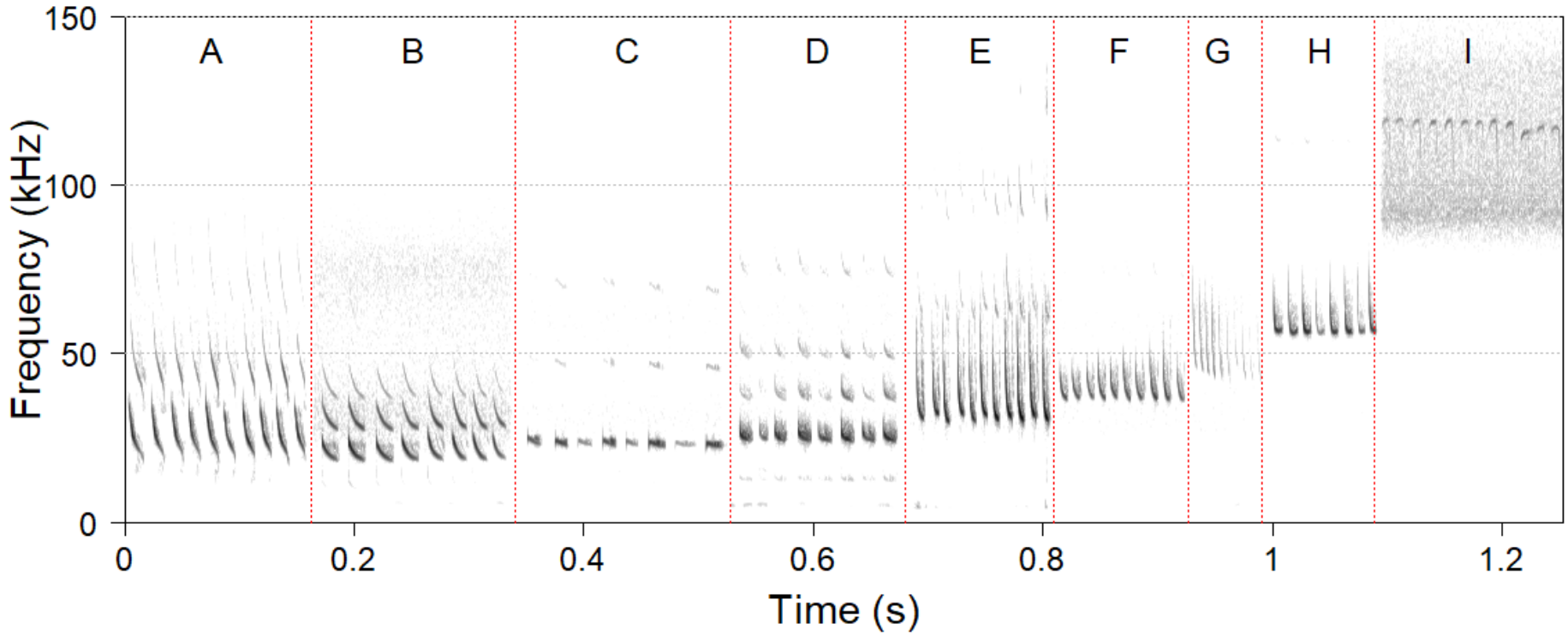

Figure 1. Representative echolocation call sequence portions of the species identified (**A**: *Chaerephon jobensis*; **B**: *Saccolaimus flaviventris*; **C**: *Ozimops lumsdenae*; **D**: *Taphozous georgianus*; **E**: *Chalinolobus gouldii*; **F**: *Scotorepens greyii*; **G**: *Nyctophilus* sp.; **H**: *Vespadelus finlaysoni*; **I**: *Rhinonicteris aurantia*; time between pulses has been compressed).

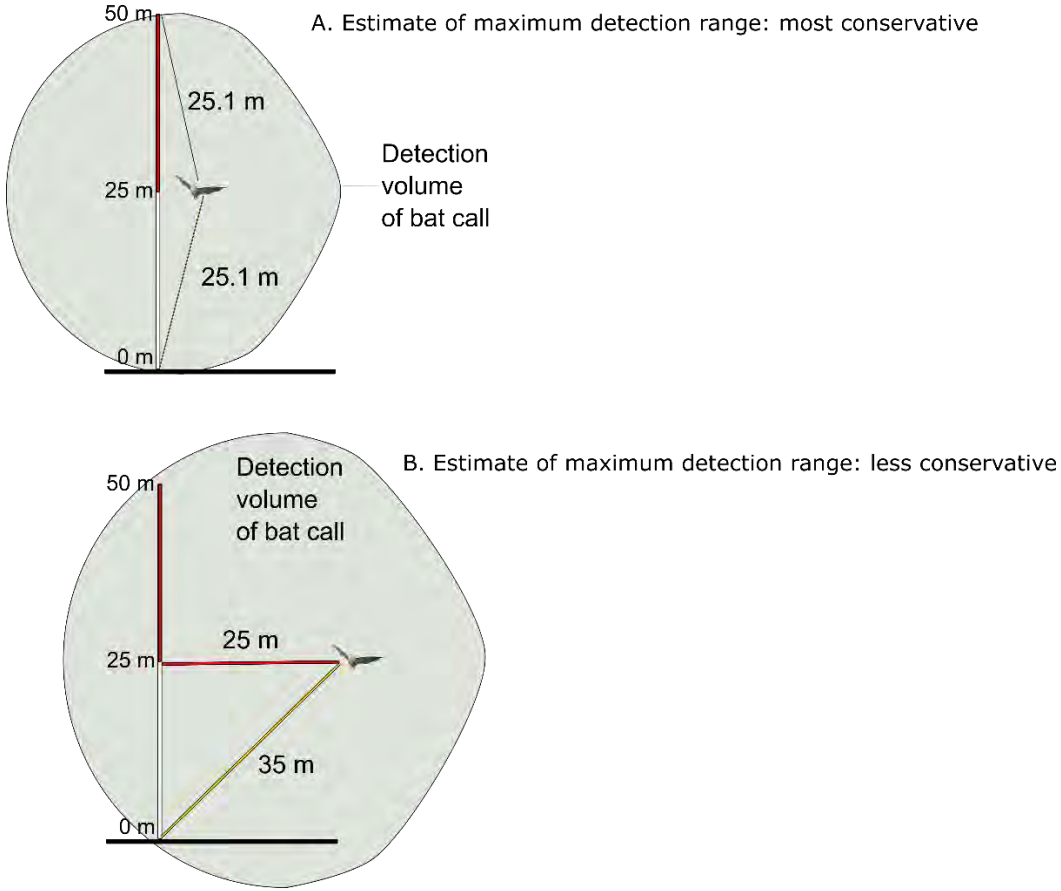

Figure 2. A scenario showing estimates of maximum detection distance of the Common Sheath-tailed Bat (**Scenario A**: most conservative when the bat is 1 metre from the met mast; **Scenario B**: less conservative where the bat is 25 metres from the met mast at a height of 25 metres). The detection volume is a semi-spherical volume that is maximal directly in front of the bat when the microphone is also pointing at the bat (on-axis), and diminishes (at rates not determined) around the remaining area of the bat where the microphone is off-axis. In scenario A, the bat can be detected from at least 25 metres away when it is c. 1 metre from the met mast. In scenario B, given the detection distance calculated in A, a less conservative estimate of maximum detection distance is 35 metres. This (the hypotenuse length) was calculated using the Pythagorean Theorem.

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