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**FORTESCUE LIMITED
BONNEY DOWNS WIND FARM
BIRD AND BAT SITE UTILISATION SURVEY**

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EXECUTIVE SUMMARY

Fortescue Ltd (Fortescue) is investigating potential options for renewable energy generation sites as part of Fortescue's commitment to decarbonise its mining operations in the Pilbara region of Western Australia.

Ecologia Environment (*ecologia*) was engaged by Fortescue to undertake bird and bat site utilisation surveys (BBSUS) over 24 months within the Bonney Downs survey area. Timing of BBSUS was designed to coincide with seasonal variation in the Pilbara region, with surveys undertaken in summer (December-February), autumn (March-May), winter (June-August) and spring (September-November) each year. A total of eight BBSUS have been completed to date: October 2023 (spring), February 2024 (summer), March 2024 (autumn), June (2024), September 2024 (spring), February 2025 (summer), April/May 2025 (autumn) and August 2025 (winter). This report consolidates the results of the first 24 months of BBSUS and provides a collision risk assessment for at-risk species occurring within the survey area.

Avifauna Assemblage

A total of 121 avifauna taxa were systematically recorded during first two years of BBSUS sampling, with two additional species recorded incidentally and five additional species previously recorded in the survey area during detailed and targeted surveys. Forty-five families were recorded during BBSUS, with the highest species diversity recorded from the Accipitridae (10 species) and Meliphagidae (eight species) families. Species most recorded commonly during BBSUS included the yellow-throated miner (345 records), Australian zebra finch (266 records), nankeen kestrel (249 records) and white-plumed honeyeater (220 records). At-risk species recorded during BBSUS were predominantly raptors (15 species) and waterbirds (26 species). Seven nocturnal bird taxa have been recorded on site; however, sufficient flight height information is not currently available for these species, therefore they were assigned a moderate collision risk.

The majority of flights (95.6%) recorded during BBSUS were undertaken at heights below the Rotor Swept Area (RSA) (84.5% below 41 m, 11.1% between 41-96 m), 3.3% of flights recorded within the RSA and 1.1% of flights were above RSA. Fifteen species of raptor were recorded during set-time surveys, with 11.9% of observed raptor flights occurring within the RSA. Twenty-four waterbird species were recorded during BBSUS, with 3.3% of observed waterbird flights occurring within the RSA.

Bat Assemblage

Echolocation calls belonging to at least nine bat species were recorded at BBSUS sites during the 24 months sampling period, comprising four families including Emballonuridae (two species), Vespertilionidae (three species), Molossidae (three species) and Rhinonycteridae (one species). Two additional species (ghost bat [Vulnerable] and black flying-fox) were recorded during the detailed and targeted surveys. The desktop assessment identified an additional five bat taxa as having the potential to occur within the survey area, despite not having been recorded at the site to date.

Significant Fauna

Three EPBC Act listed avifauna species, the grey falcon (*Falco hypoleucos* [Vulnerable]), fork-tailed swift (*Apus pacificus* [Migratory]) and the oriental plover (*Charadrius veredus* [Migratory]) were recorded in the survey area. Two EPBC Act listed bat taxa, the ghost bat (*Macroderma gigas* [Vulnerable]) and Pilbara leaf-nosed bat (*Rhinonictis aurantia* (Pilbara form) [Vulnerable]).

The grey falcon has been recorded on 23 occasions, comprising seven BBSUS records and 16 opportunistic records. Observed flight heights range from ground level to 235 m (within RSA), with seven observations recording birds flying within the proposed RSA height (97 m – 279 m). Based

on the repeated sightings of grey falcons pairs confirmation of breeding behaviours and ongoing utilisation of Drainage Line/River/Creek (major) habitat associated with the Bonnie Creek system, the survey area is known to support at least one breeding pair of grey falcons. The species is considered to represent a high collision risk given the spatial distribution and flight heights recorded.

Two Migratory taxa, comprising the fork-tailed swift (*Apus pacificus* [MI]) and oriental plover (*Anarhynchus veredus* [MI]) were recorded during the BBSUS surveys. The fork-tailed swift was recorded on four occasions during a single survey undertaken during the wet season (February 2025). Fork-tailed swifts were recorded flying below RSA on all occasions. The fork-tailed swift was assigned a high collision risk. The oriental plover was recorded on a single occasion (September 2024) during the southward migration and was recorded flying well below the RSA. The oriental plover was assigned a moderate collision risk.

Echolocation calls belonging to the Pilbara leaf-nosed bat have been recorded at 18 sites within the survey area. Although the Pilbara leaf-nosed bat has been recorded at Bonney Downs over multiple seasons, no call times indicative of a nearby roost site have been recorded and presence within the survey area appears to be restricted to intermittent foraging and transit only. The Pilbara leaf-nosed bat was assigned a low collision risk rating based on the low frequency of occurrence throughout the survey area and low likelihood of flight activity above 50 m.

A single 'fly-by' record, identified as ghost bat, was documented at acoustic lure site BDGB03 in March 2024. This species has the potential to use all habitat types while foraging, and rocky habitats within the broader Bonney Downs survey area may provide roosting habitat and nocturnal shelter. This species was assigned a low collision risk rating by Specialised Zoological based on the low frequency of occurrence throughout the survey area and moderate likelihood of flight activity above 50 m.

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

Fortescue Ltd (Fortescue) is investigating potential options for renewable energy generation sites as part of Fortescue's commitment to decarbonise its mining operations in the Pilbara region of Western Australia.

The Bonney Downs Wind Farm Project (hereafter referred to as the 'survey area') is proposed to include up to 200 wind turbine generators (WTG) with an indicative turbine and infrastructure layout yet to be finalised. The survey area comprises 102,802.55 ha and is located approximately 30 km south of Nullagine and 150 km north of Newman, in the Pilbara region of Western Australia (Map 1).

Fortescue engaged Ecologia Environment (*ecologia*) to undertake 24 months of bird and bat site utilisation surveys (BBSUS) (eight surveys total) at Bonney Downs to inform future environmental impact assessments. Surveys were undertaken four times per year, with timing coinciding with seasonal changes in the Pilbara. Eight surveys have been undertaken to date, with this report consolidating data collected during the first two years of BBSUS (October 2023-August 2025).

BBSUS surveys were utilised to document flight parameters for species recorded flying within, or above the anticipated Rotor Swept Area (RSA). The RSA is defined as the zone encompassing the area of an operating wind turbine, within which the blades rotate. The RSA utilised for the purposes of this report has been defined based on indicative turbine specifications as of December 2025, with a minimum RSA height of 97.45 metres (m), a maximum RSA height of 278.55 m and a total RSA spanning 97-278 m.

1.2 PROJECT SCOPE

The objective of the BBSUS is to evaluate site characteristics, identify seasonal and temporal patterns in bird and bat utilisation of the area, and assess potential strike-risk to significant fauna taxa occurring within the survey area. The specific scope of works included:

1. Desktop assessment, comprised of the following:
 - Assessment of site characteristics, including: topography, habitat features, proximity to wetlands and water bodies, and weather patterns;
 - Species database searches and consolidation of species records within proximity to the survey area; and
 - Assessment of species characteristics available in literature.
2. Bird and bat site utilisation surveys including:
 - At least 24 months of site utilisation surveys (up to eight survey events) must be undertaken to provide sufficient baseline data about a relevant species' potential to utilise the project site and its surrounds, to take account of climatic variations and to capture migratory and cryptic bird and bat species.
 - Each site utilisation survey must record the relevant information regarding species characteristics that was collated as part of the desktop assessment and used to form the target species list.

The BBSUS surveys consisted of:

- Fixed-point bird utilisation surveys;
- Fixed-point ultrasonic bat recorders;
- Targeted bird and bat searches; and
- Incidental bird, bat and predator/scavenger observations.

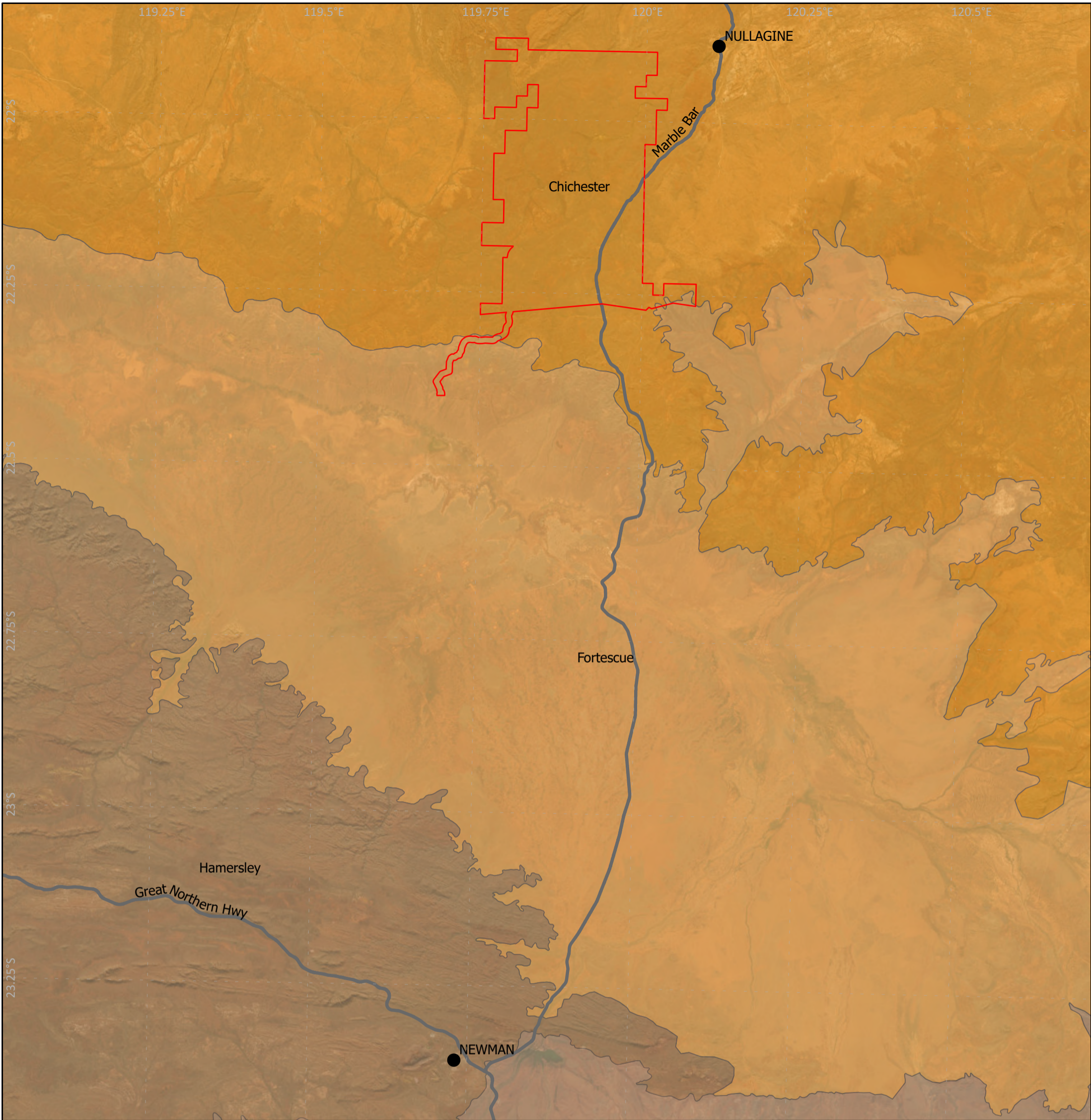
1.3 LEGISLATION AND GUIDELINES

The survey was designed and undertaken to comply with the following statutory legislation and policies (definitions can be seen in Appendix A):

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Biodiversity Conservation Act 2016* (BC Act); and
- *Environmental Protection Act 1986* (EP Act).

The assessments complied with all necessary Environmental Protection Authority (EPA) and Commonwealth guidelines, including but not limited to:

- Draft Onshore Wind Farm Guidance (DCCEE, 2024);
- EPBC Act Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (DEWHA, 2013);
- Conservation Advice for the Grey Falcon (Threatened Species Scientific Committee, 2020);
- Survey Guidelines for Australia’s Threatened Bats (Department of Sustainability Environment Water Population and Communities, 2010);
- Survey Guidelines for Australia’s Threatened Birds (DEWHA, 2010);
- Interim Guideline for Preliminary Surveys of Night Parrot (*Pezoporus occidentalis*) in Western Australia (DBCA, 2017);
- Guidelines for Determining the Likely Presence and Habitat Usage of Night Parrot (*Pezoporus occidentalis*) in Western Australia (DBCA, 2024).

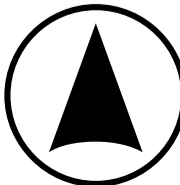
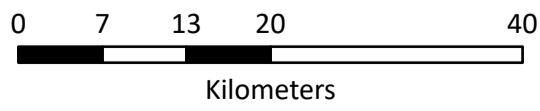


Survey area
 Towns
 State roads
IBRA7 Subregion
 Augustus
 Chichester
 Fortescue
 Hamersley



Project No.: 1981
 Author: CE
 Created Date: 12 January 2026
 Coordinate System: GDA 1994
 MGA Zone 50
 Projection: Transverse Mercator Earthstar Geographics

Map 1: Location of the survey area.



2 SURVEY METHODOLOGY

2.1 DESKTOP STUDY

2.1.1 Biological Database Searches

Searches of the databases listed in Table 1 along with a review of relevant survey data was undertaken to identify avifauna and bats previously recorded within 40 km of the survey area (hereafter referred to as the “study area”). As DBCA search buffers are determined based on the availability of significant fauna records in the local area, the buffers utilised for this database (100 km) differs to those applied for other databases. Habitat preferences were sourced, where available, from relevant taxonomic literature or Threatened Species Profiles (SPRATs). The presence of potentially suitable habitat within the survey area was determined using broad landforms, waterbodies, and vegetation associations in comparison to cited preferred habitat (if available) for each species. Database search results are provided in Appendix B.

Table 1: Databases queried for the desktop study.

Database	Search details
DCCEEW Protected Matters Database	Records of matters of national significance under the EPBC Act within 40 km of the survey area.
DBCAs Threatened and Priority Fauna Database	Fauna records within 100 km of the survey area
BirdLife Australia’s Birddata Database	All bird records within 40 km of the survey area.
Atlas of Living Australia (ALA) Database	All fauna records within 40 km of the survey area.
Fortescue Internal Fauna Databases	All fauna records within 40 km of the survey area.

2.1.2 Literature Review

Ecological surveys conducted within 100 km from the survey area were reviewed for the occurrence of significant fauna, specifically birds and bats. Results from the literature review were compiled in conjunction with the biological database searches outlined above and are provided in Appendix C.

2.1.3 Significant Fauna Likelihood of Occurrence

Results of database searches and the literature review were compiled, and significant species were identified. The criteria listed in Table 2 were then applied to determine the likelihood of occurrence of these species within the survey area. Consideration was also given to the age and locality of the record, recent taxonomic species revisions and modelled species distributions when determining the likelihood of species occurrence.

Table 2: Criteria used to assess the likelihood of occurrence of significant species and communities.

Rating	Criterion
Recorded	The species has been recorded within the survey area previously or during the current survey.
High (likely to occur)	The species is likely to occur within the survey area as suitable habitat is known to be present and there are existing records very close to the survey area (within ca. 5-15 km, depending on species mobility).
Moderate (possibly occurs)	The species may occur within the survey area as there are existing records in the vicinity of the survey area, and suitable habitat is likely to be present; OR The species may occur within the survey area as there is insufficient information available to exclude the possibility of occurrence.
Low (unlikely to occur)	The species is unlikely to occur within the survey area as suitable habitat is not present or is not likely to be present; OR Suitable habitat is present within the survey area, but the taxon has not been recorded despite reasonable survey effort.
Does not occur	The species is recognised as being locally extinct or extinct in the wild and does not occur within the survey area; OR Records identified through database searches are associated with a listed subspecies which does not occur within the region.

2.1.4 Species Characteristics

An additional literature review was conducted to assess the characteristics of significant species assessed with a 'High' or 'Moderate' likelihood of occurrence. In accordance with the Draft *Onshore Wind Farm Guidance* (DCCEEW, 2024), the literature was reviewed for the following species characteristics:

- behaviour;
- flight or demographic factors (e.g., species presence [ongoing, transitory/migratory]);
- site use (e.g., transit, roosting, breeding and/or foraging);
- habitat type use;
- movement and flight paths (including nightly foraging and migratory flight paths/patterns);
- flight heights;
- soaring;
- flocking;
- population numbers.

Flight height data is not currently available for a number of species identified as part of the desktop assessment.

2.1.5 At-risk Species Categorisation

Identification of at-risk species was undertaken based on the following characteristics:

- Species/species group known or likely to regularly fly at heights within the RSA.
- Species/species group is transient or migratory and therefore likely to lack local familiarity with turbine locations.
- Species/species group routinely exhibits nocturnal flight, reducing visual detection of turbine blades.

Based on the above criteria, the below species groups were identified as being at increased risk of turbine strike within the context of the Bonney Downs Wind Farm Project:

- Raptors
- Migratory birds
- Nocturnal birds

- Waterbirds
- Aerial birds (swifts, swallows and woodswallows)
- Bats

2.2 FIELD SURVEY

2.2.1 Survey Timing

Eight bird and bat site utilisation surveys have been conducted approximately every three months for a 24-month period between October 2023 and August 2025 (Table 3). The surveys were scheduled to target different seasons and predicted movements of species of interest such as migratory species and breeding/nesting times for threatened raptors. Each survey was conducted over an eight-day period by three *ecologia* zoologists. Survey timings were scheduled to accord with the *Draft Onshore Wind Farm Guidance* (DCCEEW, 2024).

Table 3: Field survey timing

Year	Season	Target groups/species	Optimal timing
1	Southward migration	Bats, migratory birds	August – October
	Wet season	Bats, migratory birds and water birds	November – February
	Northward migration	Bats, migratory birds	March – May
	Dry season	All species	June – July
2	Southward migration	Bats, migratory birds	August – October
	Wet season	Bats, migratory birds and water birds	November – February
	Northward migration	Bats, migratory birds	March – May
	Dry season	All species	June – July

2.2.2 Personnel and Licences

The fauna assessment was planned, coordinated, executed, and reported by those summarised below in Table 4.

Table 4: Study team and licences.

Project staff				
Name	Qualification	Experience	Role	Project role
Shaun Grein	B. Sc. Biol.; Grad. Dip. Nat. Resources; MBA	>30 yrs	Managing Director/Senior Principal Scientist	Project management, reporting, QA
Tim McCabe	B.Sc. Env. Biol, Dip Proj Mngment, Cert III Vert Pest Mngment	>15 yrs	Principal Zoologist	Project management, field assessment, reporting, GIS
Claudia Elliott	B.Sc. Cons. Biol. & Zool.; MWildlifeHth	>5 yrs	Senior Zoologist	Field assessment, GIS, reporting
Sam Plant	B. Sc WildlifeBiol. EnvSc.; MWildlifeHth; Cert II ConsLandMngment.	>5 yrs	Senior Zoologist	Field assessment, GIS, reporting
Dr Simon Cherriman	B.Sc. (PhD/Hons) Env. Biol, MSciComm. Nat. Hist. Film.	>15 yrs.	Ornithologist, wedge-tailed eagle expert	Field assessment, wedge-tailed eagle and grey falcon nest occupancy assessments
Thomas Burley	B. Sc Cons. Biol.	>5 yrs	Ornithologist	Field assessment
Daniel Terrington	B. Sc (Hons) Cons. Biol.	>5 yrs	Ornithologist	Field assessment
Dakota Scrimshaw	B. Sc (Hons) Biol.	<2 yrs	Zoologist	Reporting, GIS
Stephanie Mason	PhD (Zool); B. Sc Zool. (Hons). & Psych.	<2 yrs	Zoologist	Data analysis

2.2.3 Site Selection and Survey Design

Habitat types were previously identified and mapped by *ecologia* (2024b). Habitat representation within the survey area and broader landscape was taken into consideration in selecting BBSUS sites.

The survey was designed to record data in a way that permits the outputs to be put into a collision risk model for estimating the potential collision risk of a species.

2.2.4 Survey Adequacy

The methods and field data collection parameters used in this assessment were reviewed against the Draft *Onshore Wind Farm Guidance* (DCCEE, 2024) survey requirements. The following criteria were used in the assessment:

- providing ecological data;
- field and desktop data collection and collation, including:
 - site characteristics
 - species characteristics
 - habitat

- habitat and site utilisation assessment.

Additionally, survey adequacy criteria as per the *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA, 2020)* were addressed including:

- site selection;
- seasonality;
- survey timing; and
- survey duration.

A survey adequacy assessment of the methods and data collection parameters utilised in this assessment is provided in Section 5.1.2.

2.2.5 BACI Framework

The survey design included reference (or control) points and impact points to allow for a Before and After, Control Impact (BACI) design. The BACI design includes reference sites placed at a sufficient distance (>5 km) from the proposed turbine locations to obtain data outside the zone of influence of the turbines. Data are quantitative and are collected at pre-determined fixed points.

2.2.6 Survey Weather and Climate

The most reliable and accurate available climate data were sourced from the nearest long-term Bureau of Meteorology (BOM) weather stations; Bonney Downs (Station No. 4006) within the survey area for rainfall and Marble Bar (Station No. 4106), located approximately 78.4 km north of the survey area for temperature data.

Daily weather patterns recorded by the Fortescue Meteorological Mast during the surveys will be outlined and seasonal patterns will be discussed in Section 4.1.2 to provide contextual information for the site over the duration of the surveys.

2.2.7 Bird and Bat Site Utilisation Survey Sites

BBSUS sites were established to align with the Before-After, Control-Impact (BACI) design approach to allow future monitoring of potential impacts. A total of 40 BBSUS sites (30 impact and 10 reference) were established across the broader Bonney Downs survey area (Map 2). BBSUS sites were selected within representative habitat types, with an additional aim of providing the observer with a broad range of view of the surrounding site. BBSUS site locations were designed to provide adequate coverage of the extensive survey area with the inclusion of both impact and reference locations across the entirety of the survey area.

Reference sites (of similar landscape, and habitat types as the impact sites, but with a distinct population that will remain unaffected by the wind farms) were selected outside (>5 km) of the proposed impact areas (turbine layout) to record comparable baseline data with the impact sites.

2.2.8 Habitat Assessments

Habitat assessments were undertaken at sites considered representative of each habitat type identified within the survey area and at each systematic trapping site surveyed during the detailed and targeted vertebrate fauna surveys (ecologia, 2024a). The following parameters were recorded:

- Broad habitat type;
- Habitat condition
- Digital photographs;
- Landform type;
- Soil colour, type and characteristics;

- Type and extent of non-vegetative surface cover;
- Type of vegetation in lower, middle and upper strata;
- Observable fire history and evidence of any disturbance;
- Presence and extent of leaf litter and coarse woody debris;
- Presence of, or distance to, water sources;
- Presence of significant microhabitats such as tree hollows and rocky outcrops; and
- Notes on suitability for hosting significant fauna.

Habitat assessments informed broad fauna habitat mapping results provided in Section 0.

2.2.9 Set-time Avifauna Surveys

Thirty-minute set-time surveys were conducted at each BBSUS site to record avifauna species present and understand how each species is utilising the site. Each site was surveyed three times during daylight hours; once within three hours of sunrise, once at mid-day and once within three hours of sunset (three surveys total) during each survey phase. A unique survey identification (ID) was allocated to each individual survey and climatic conditions (cloud cover, weather conditions and prevailing wind) were recorded at the start of each survey period. With the exception of surveys undertaken in February 2025, where significant rainfall events prevented access to five BBSUS sites (BB001-BB005, total 15 surveys), 120 surveys were completed per survey period (three per BBSUS site) for a combined total of 945 surveys over eight survey periods.

The following parameters were recorded during each survey during the October 2023 (spring) and February 2024 (summer) surveys:

- Site ID;
- Date;
- Survey start and end time;
- Species ID;
- Abundance;
- Behaviour;
- Species presence (ongoing, transitory/migratory);
- Site use (transit, roosting, breeding and/or foraging);
- Flight paths in relation to the site (including migratory flight paths);
- Flight, behavioural and demographic factors (flight height zones (e.g. 'below RSA', 'at RSA', 'above RSA'), soaring, flocking and population numbers).

Following the first two surveys and the publication of the *Draft Onshore Wind Farm Guidance* (DCCEEW, 2024), further refinement of parameters recorded was undertaken in March 2024 to align with the draft guidelines and improve capacity to undertake Collision Risk Modelling (CRM) analysis on data collected.

Based on the parameters outlined in the *Draft Onshore Wind Farm Guidance* (DCCEEW, 2024) and discussions with Symbolix (pers. comm. 2024) regarding refinement of data collection for CRM, the following information was recorded for each species observed during the March 2024 (autumn) surveys:

- Site ID;
- Date;
- Survey start and end time;
- Species ID;
- Age (adult, juvenile, sub-adult) and sex (male, female, indeterminate);
- Observation period (start time and end time);
- Abundance;
- Height of first observation (specific heights);

- Minimum and maximum flight height (as accurately as possible);
- Distance to first observation;
- Flight behaviour: perched, directed flight (disturbed, transiting or moving to a perch), foraging, soaring/gliding;
- Prevailing wind;
- Other comments (e.g. other behaviours exhibited).

Additionally, an assessment of species presence (ongoing, transitory/migratory), site usage (transit, roosting, breeding or foraging), flight paths (including migratory flight paths) and relative population numbers was undertaken identifying seasonal and spatial variation in site usage.

Following the completion of the third BBSUS, recommendations made by Symbolix (pers. comm. 2024) and subsequent consultation with Fortescue, a decision was made to focus on observations of species observed flying within RSA, or known to fly within the RSA (specifically waterbirds, Migratory species and raptors) during subsequent BBSUS to increase accuracy associated with height and distance observations of at-risk species. From June 2024 onwards, a list of all species incidentally recorded at systematic sites but deemed to be at lower risk of turbine strike was recorded for each BBSUS; however, detailed height information was not recorded for these species unless they were observed flying within the RSA.

2.2.10 Species Accumulation Curve

Survey adequacy was assessed by estimating species richness using asymptotic richness estimators and by extrapolating a rarefaction curve. Rarefaction curves are produced by repeatedly re-sampling the pool of individuals at random and plotting the average number of species represented by various levels of sampling effort. As sampling effort increases, the rate at which new species are recorded gradually reduces until the number of species observed reaches the estimate of true species richness. Six species richness estimators (Chao 1, Chao 2, ICE, Bootstrap, Jackknife 1 and Jackknife 2) were calculated in EstimateS v9.1 with the default settings (R. K. Colwell, 2013) to estimate species richness for the survey area. The rarefaction curve was extrapolated in EstimateS to estimate the number of species (S_{est}) that would be found in an augmented sample of three times the number of sampled sites, where S_{est} is the expected number of species given the reference sample, following R.K. Colwell et al. (2012). Analyses were conducted using pooled species recorded from each survey.

2.2.11 Targeted Bird Surveys

Known water sources and significant habitat features were visited on multiple occasions during surveys to conduct targeted bird searches to record Migratory species which may utilise these waterbodies intermittently.

Grey falcon search transects were undertaken on foot within the Drainage Line/River/Creek (major) habitat type to identify suitably sized nests or primary sightings of the species. Particular focus was given to identifying intact nests located in large eucalypts or telecommunication towers, of a suitable size and condition to be utilised by grey falcons (Schoenjahn *et al.* 2020). Targeted searches were generally undertaken during the grey falcon breeding season (June–November) when detectability of the species and confirmation of nest utilisation is likely to be higher (Schoenjahn *et al.* 2020). Suitable nests were recorded, and secondary evidence of recent use (if present) was documented during searches of feeding debris and mutes within the drop zone below the nest. Targeted survey effort for the grey falcon was primarily focused within Drainage Line/River/Creek (major) habitat, as this habitat type represents suitable breeding and foraging habitat for the species.

2.2.12 Nest Searches and Monitoring

Raptor and corvid nests known or suspected to be utilised by the grey falcon were identified within the survey area during targeted searches and were re-visited seasonally to assess potential utilisation by the species.

Indicative wedge-tailed eagle territories were identified by wedge-tailed eagle expert Dr Simon Cherriman during the March 2024 BBSUS period, with subsequent monitoring of these nests undertaken on an annual basis to determine occupancy and breeding success. A helicopter was utilised to identify nest locations across the survey area and detection of adult pairs of birds in the vicinity of active nests was used to confirm occupancy of territories. Annual monitoring utilised a helicopter to access known nests, with visual assessment of nesting success undertaken either via air or on foot by Dr Cherriman.

2.2.13 Incidental Bird Records

In addition to the BBSUS, incidental observations of species of concern and raptors were recorded while traversing the site. Detailed vertebrate fauna assessments were conducted concurrently with the October 2023 and March 2024 BBSUS, and all avifauna taxa recorded during these surveys have been included in the incidental records to ensure that the site species list and subsequent risk assessment is as comprehensive as possible.

Additional records associated with concurrent detailed and targeted fauna surveys undertaken at Bonney Downs have been included in this report where relevant, with further details regarding methodologies, sampling sites and associated survey effort provided in the Bonney Downs North Vertebrate Fauna Assessment (ecologia, 2024a) and Bonney Downs South Vertebrate Fauna Assessment (Spectrum Ecology, 2024a).

For incidental records, the following parameters were recorded (where possible);

- Date;
- Species ID;
- Age;
- Observation start time and end time;
- Abundance;
- Height of first observation;
- Minimum and maximum flight height (as accurately as possible);
- Distance to first observation;
- Flight behaviour: perched, directed flight (disturbed, transiting or moving to a perch), foraging, soaring/gliding;
- Prevailing wind conditions.

2.2.14 Bat Surveys

Song Meter 4 (SM4) ultrasonic Autonomous Recording Units (ARUs) and Titley Chorus ARUs have a high sampling frequency and enable the full spectrum of bat echolocation calls to be recorded without transformation, allowing greater accuracy and sensitivity. ARUs were deployed with microphones facing towards the sky at a height of at least a metre above the ground, to record bat echolocation calls in the vicinity of the device. ARUs were deployed at each BBSUS site for a minimum of two nights during each survey period, resulting in a total of 610 recording nights across eight survey phases.

To provide an indication of site proximity to any potential roost locations, the period between sunset and the first detection, and the period between the last detection and sunrise was calculated. The presence or absence of low time calls (calls recorded within 20 minutes of sunset or sunrise) are used to indicate proximity of the detector to a potential roost location.

Echolocation calls recorded were analysed by bat specialist Dr Kyle Armstrong of Specialised Zoological (Appendix D).

2.2.15 Incidental Predator/Scavenger Records

Incidental observations of predators and scavengers were also recorded while traversing the site to provide contextual information for any carcass monitoring plans which may be required as part of the approvals process. For incidental predator/scavenger observations, the following parameters were collected (where possible):

- Date;
- Species ID;
- Abundance;
- Observation type (primary [sighting], secondary [scats/tracks]).

2.3 RISK ASSESSMENT

The avifauna and bat risk assessments in this report were conducted by Shephard et al. (2021) and Fleming & Dempster (in prep.), respectively. The methods for the avifauna risk assessment described below were obtained from the *Project 2.2.2 Collision Risk Modelling Data Requirements* (Shephard, Riley, & Fleming, in prep.). Flight height data used to inform the risk assessment was obtained from Bonney Downs BBSUS and East Pilbara Generation Hub Bird & Bat Assessment (Spectrum Ecology, 2024b).

Avifauna Risk Assessment Methodology

The following methods were developed by Shephard et al. (in prep.):

An overall risk score was calculated for all bird species observed at Bonney Downs, using the protocol established for onshore wind farms (Reid, Baker, & Ehmke, 2025b). Parameters used to inform risk scores are outlined in Table 5-Table 7. The scores were calculated as:

$$\text{Overall Risk Score} = ((\text{Productivity} - x_0)^2 + (\text{Susceptibility} - y_0)^2)^{1/2} \quad (\text{eq.1})$$

where x_0 and y_0 are the x, y origin coordinates (in this case these are equal to zero) and where:

$$\text{Susceptibility} = (\text{Flight Height} * 2 + \text{Flight Time} + \text{Flight Manoeuvrability} + \text{Habitat Specialisation} * 0.5) / 4 \quad (\text{eq.2})$$

$$\text{Productivity} = (\text{Conservation Status} * 1.5 + \text{Generation Time}) / 2 \quad (\text{eq.3})$$

Where:

Flight Height was scored using the values in Table 5. Notably, Reid et al. (2025) assumed a RSA between 30–275 m, whereas the RSA of the project is 97-289 m, therefore some species/values may not be relevant for the purposes of this assessment.

Flight Time was scored using the values in Table 6.

Flight Manoeuvrability was calculated as a wing loading index:

$$\text{FM} = \text{body mass} / (\text{wing length} * \text{wing width})$$

and subsequently scored on a scale between 1–5 as in Table 7.

Habitat Specialisation represented the non-trivial utilisation of 31 feeding habitat types defined by Commonwealth of Australia (2006) and identified by Stephen T Garnett et al. (2015). The Habitat Specialisation score reflects the bird species' ability to switch to an alternative feeding habitat as a result of disturbance or displacement from an

offshore windfarm. Categorised as scores 1: ≥ 9 habitats occupied (i.e. the most generalist species), 2: 6–8, 3: 4 or 5, 4: 2 or 3, 5: 1 (i.e., the most specialist species).

Table 5: Flight height groupings for Australian birds reproduced from Reid et al. 2025.

Group	under	within	above	Trait/taxon group example	Flight Height score
A	■			Flightless, obligate understory foragers	1
B	■	■		Megapodes, stiff-tailed ducks, grebes, Procellariiform seabirds, facultative ground foragers (scrubwrens, thornbills, logrunners, quail-thrush, whipbirds, mud-nesters)	2
C	■	■		Galliformes, frogmouths, quail & button-quail, rails, kingfishers, ground parrot, lyrebirds, non-migrant passerines (finches, treecreepers, chats, thrushes, finches, Australian robins and flycatchers)	2
D	■	■	■	Shorebirds, migratory passerines (honeyeaters, pardalotes, gerygones, fantails, flycatchers, larks, wagtails), terrestrial pigeons	2
E	■	■	■	Nightjars, waterbirds, whistlers, shrike-thrushes, currawongs	3
F	■	■	■	Generalist foragers - Cuckoos, parrots, Corvids	3
G	■	■	■	Waterbirds (most ducks, herons & allies, cormorants), Sulids, frigatebirds, tropicbirds, gulls & terns, Birds of Paradise,	4
H	■	■	■	Arboreal pigeons, owls, Accipiters, orioles, bee-eaters, rollers, wood swallows, cuckoo-shrikes, starlings	4
I	■	■	■	Nectivorous parrots (canopy feeders)	4
J	■	■	■	Aerial foragers, falcons	5

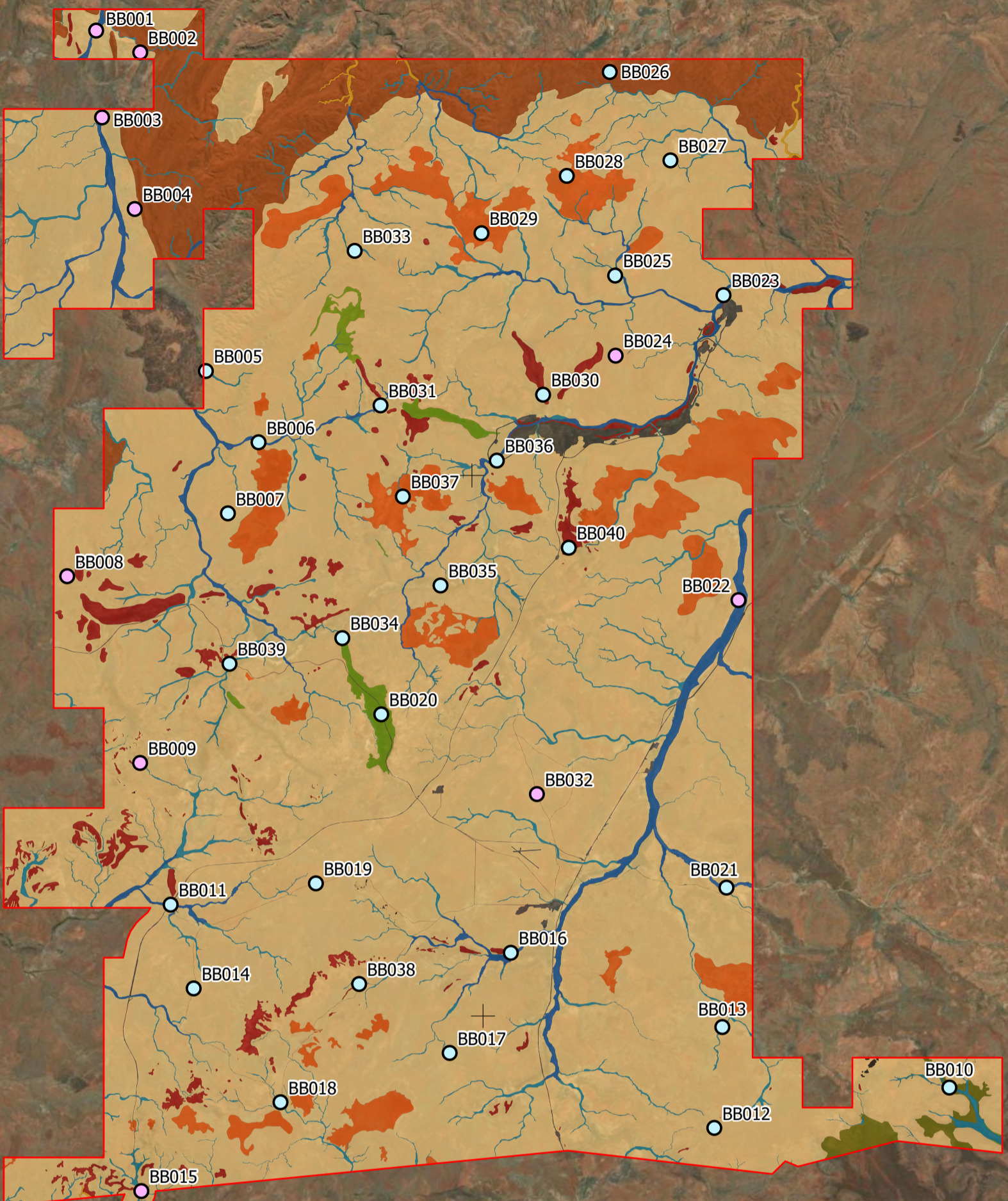
Note: The relative height bars are illustrative of the relative amount of time that birds in this trait group are expected to fly below, within and above collision risk height assuming a typical rotor swept zone between 30–275m.

Table 6: Trait-based grouping for relative amount of time spent flying by birds (from Reid et al. 2025).

Group	Trait group	Example	Flight Time score
A	Flightless and resident obligate ground foraging	Rails and crakes (resident), Grassbirds, Chats	1
B	Arboreal foraging, resident, foliage gleaner, nectarivore, frugivore	Bowerbirds and Catbirds, Whistlers, Shrike-thrushes, Kingfishers (resident), Parrots, Lorikeets and Rosellas (resident)	2
C	Foraging traits as in A or B but are internal migrants/nomadic	Kingfishers (migratory), Parrots, Lorikeets and Rosellas (nomadic/migratory), Gerygones (internal migrants), Cuckoos, Monarchs	3
D	Aerial predator, long distance/external migrant	Birds of prey, Gulls, Terns and Noddies, shorebirds	4
E	Aerial insectivores, marine surface feeders	Swifts, Swiftlets, Swallows and martins Albatrosses, Petrels and Shearwaters	5

Table 7: Allocation of flight manoeuvrability scores for birds (from Reid et al. 2025).

Flight Manoeuvrability value	Flight Manoeuvrability score
<.01	1
≥ 0.01 and < 0.02	2
≥ 0.02 and < 0.03	3
≥ 0.03 and ≤ 0.04	4
>0.04	5



Survey area

1981_Bonney_Downs_Ecologia_BBUS_Survey_Sites_final

BBSUS site

- Impact (indicative only)
- Reference (indicative only)

Habitat type

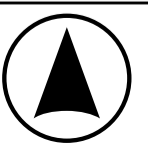
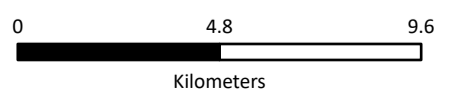
- Cleared
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Gorges/Gullies
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Plain (Cracking clays)
- Plain (stony/gibber)
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
- Woodland (closed)
- Woodland (open)



Project No.: 1981
 Author: CE
 Created Date: 12 January 2026
 Coordinate System: GCS GDA 1994
 Scale: 1:180,000 @A3

Map 2: BBSUS sites.

Earthstar Geographics



2.4 SURVEY EFFORT

Survey effort was calculated across the eight seasonal surveys, including the number of BBSUS sampling periods and ARU recording effort at each BBSUS site. The total survey effort undertaken at Bonney Downs between October 2023, and August 2025 is detailed in Section 4.1.3.

2.5 LIMITATIONS AND CONSTRAINTS

The methods and field survey parameters used in this survey were reviewed against potential limitation and constraint aspects as per the *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020)*. The following criteria were used in the assessment:

- competency/experience of the consultant carrying out the survey;
- scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions);
- proportion of fauna identified, recorded and/or collected;
- sources of information e.g. previously available information (whether historic or recent) as distinct from new data;
- the proportion of the task achieved and further work which might be needed;
- timing/weather/season/cycle;
- disturbances (e.g. fire, flood, accidental human intervention etc.) which affected results of survey;
- intensity (in retrospect, was the intensity adequate);
- completeness (e.g. was relevant area fully surveyed);
- resources (e.g. degree of expertise available in animal identification to taxon level);
- remoteness and/or access problems;
- availability of contextual (e.g. biogeographic) information on the region.

An assessment of survey-specific limitations and constraints is detailed in Section 4.1.4.

3 REGIONAL AND BIOLOGICAL CONTEXT

3.1 REGIONAL CONTEXT

Background environmental information for the survey area was reviewed to identify key environmental features of the site which may influence occupancy and/or utilisation of the survey area by at-risk species. A review of climate (Bureau of Meteorology, BOM), biogeography (IBRA 7) (DSEWPC, 2012), pre-European native vegetation of Western Australia (Shepherd, Beeston, & Hopkins, 2002), Nationally Important Wetlands (DCCEEW, 2023) and fauna habitat mapping was undertaken to assist with site characterisation and identification of areas which provide important habitat for significant fauna.

3.1.1 Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the Australian continent into regions or bioregions on the basis of similar geology, landform, vegetation, fauna and climate characteristics (DSEWPC, 2012). The survey area is situated entirely within the Pilbara bioregion according to IBRA 7 (DSEWPC, 2012). The Pilbara region is further divided into four subregions: Hamersley (PIL03), Fortescue (PIL02), Chichester (PIL01) and Roebourne (PIL04). The majority of the survey area (97.83%) intersects the Chichester subregion, with a small portion (2.17%) intersecting the Fortescue subregion (Map 1, Table 8).

The Chichester subregion (PIL01) comprises the northern section of the Pilbara Craton. Undulating Archaean granite and basalt plains include significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* (formerly *Triodia pungens*) hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges. The climate is semi-desert-tropical and receives 300 mm of rainfall annually. Drainage occurs to the north via numerous rivers (e.g. De Grey, Oakover, Nullagine, Shaw, Yule, Sherlock). Subregional area is 9,044,560 ha (Kendrick & McKenzie, 2001).

The Fortescue subregion is characterised by alluvial plains and river frontage. Extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains in the east. Deeply incised gorge systems in the western (lower) part of the drainage. River gum woodlands fringe the drainage lines. Northern limit of mulga (*Acacia aneura*). An extensive calcrete aquifer (originating within a palaeo-drainage valley) feeds numerous permanent springs in the central Fortescue, supporting large permanent wetlands with extensive stands of river gum and cadjeput *Melaleuca* woodlands. Climatic conditions are semi desert tropical, with average rainfall of 300 mm, falling mainly in summer cyclonic events. Drainage occurs to the north-west. Subregional area is 2,041,914 ha (Kendrick, 2001).

Table 8: IBRA subregions within the survey area.

IBRA subregion	Extent within the survey area (ha)	Extent within survey area (%)
Chichester	100,571.08	97.83
Fortescue	2,231.47	2.17

3.1.2 Climate

The survey area is located in the Pilbara region of Western Australia (WA) and experiences an arid-tropical climate with two distinct seasons: a hot, humid Wet season (summer) from November to April, marked by heavy rains and cyclones and a mild, Dry season (winter) from May to October, characterised by cooler temperatures and lower humidity. Temperatures are generally high, with summer temperatures frequently exceeding 40°C and light frosts occasionally occur inland during the winter months of July and August. Maximum daytime temperatures frequently exceed 40°C between November and January, and minimum temperatures can drop below 14°C between June and August.

The best available climate data from the nearest long-term Bureau of Meteorology (BOM) weather stations were obtained from Bonney Downs (Station No. 4006, within the survey area) for rainfall, and temperature data were obtained from Marble Bar (Station No.4106, 78.4 km north of the survey area).

A total of 279.5 mm of rainfall was recorded during the 12 months prior to the first survey in October 2023, which was 85.5% of the mean annual rainfall (326.9 mm) (Figure 1) (BOM, 2025). Significant rainfall events also occurred in the Eastern Pilbara in January and March 2024 after very little rain between May and December 2023 and a significant rain event occurred in February 2025. These events led to the inundation of waterbodies onsite in addition to the Fortescue Marsh. The inundation of the Fortescue Marsh is a notable occurrence for waterbirds as it provides suitable habitat for Migratory species.

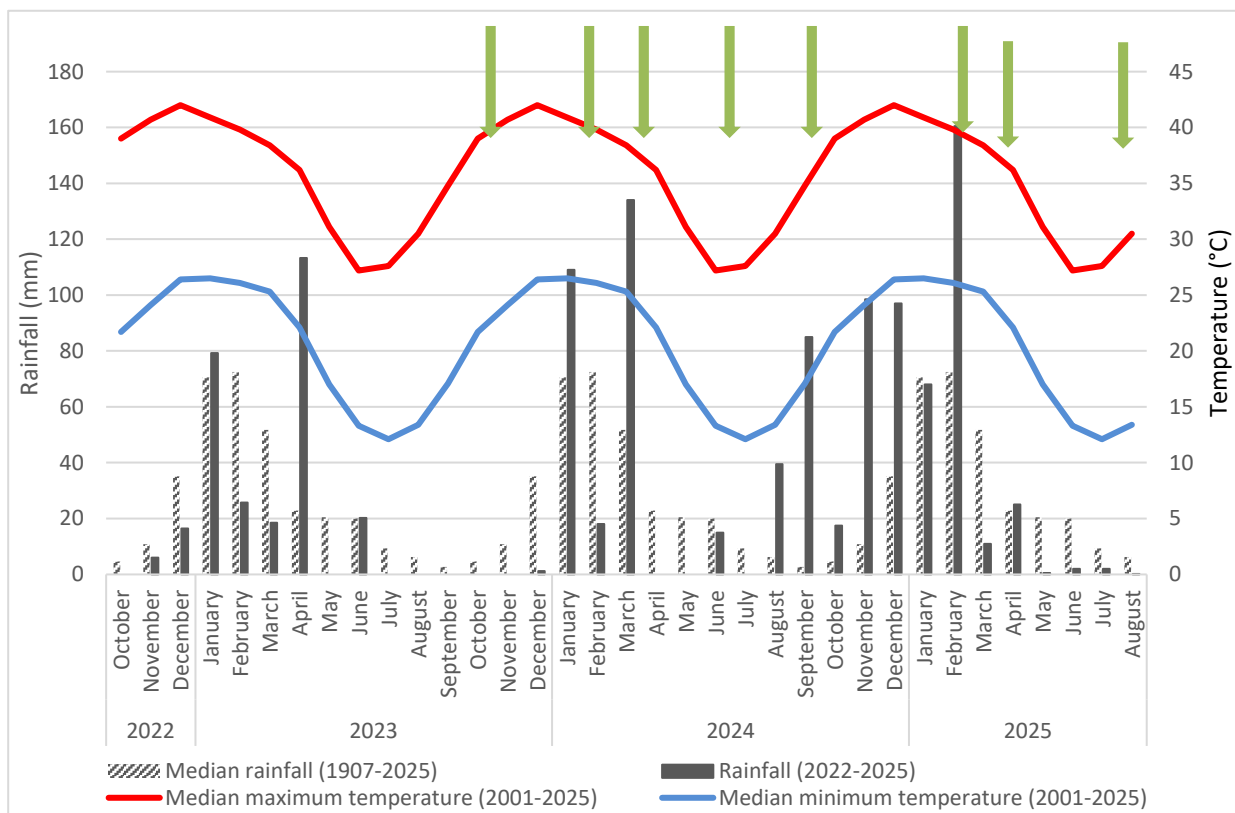


Figure 1: Climate data from Bonney Downs (rainfall) and Marble Bar (temperature). Green arrows indicate approximate timing of BBSUS.

3.1.3 Geology

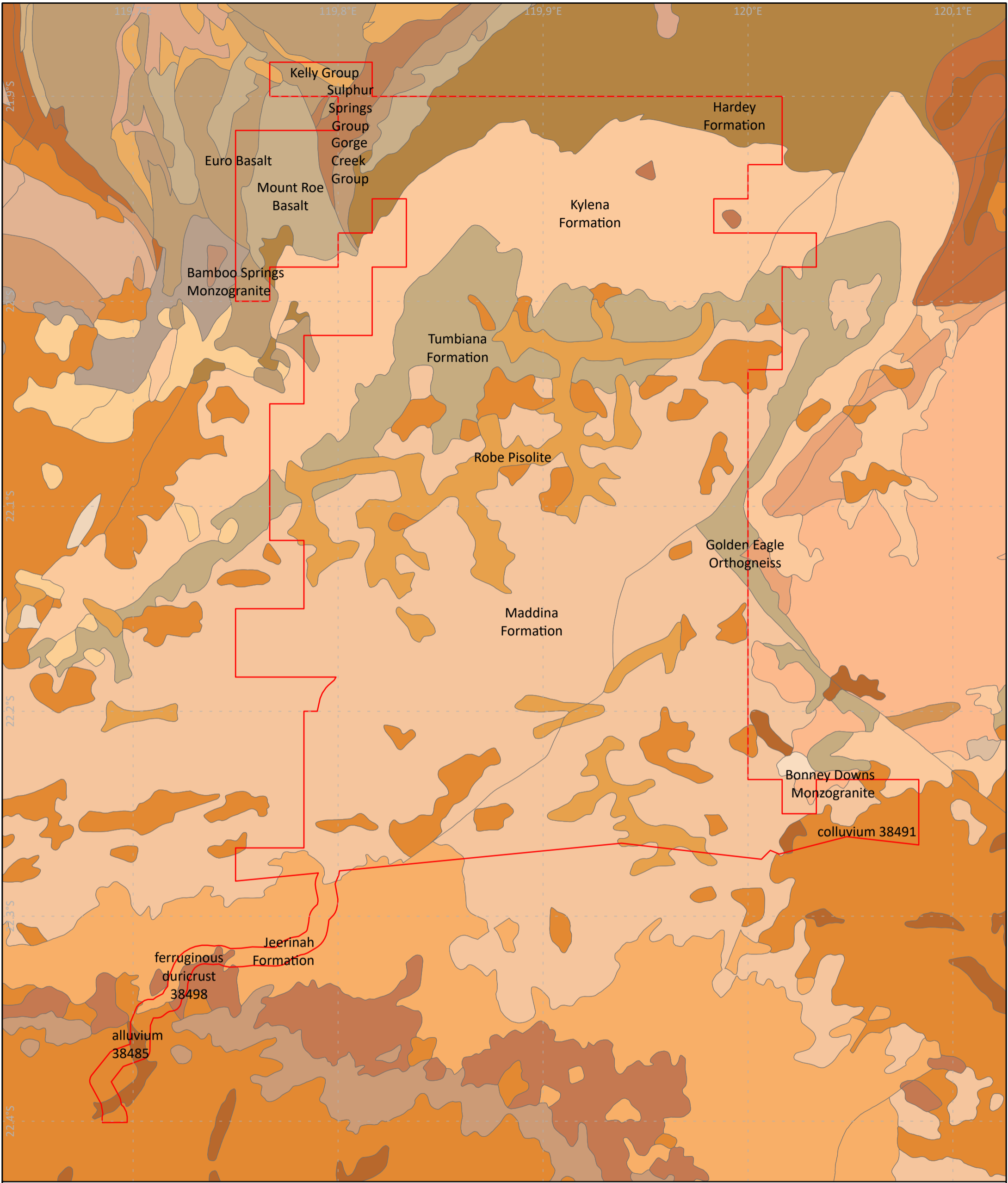
The Surface Geology of Australia 1:1,000,000 scale spatial dataset is a seamless national coverage of outcrop and surficial geology (Geoscience Australia, 2012). Seventeen surface geological units are associated with the survey area (Table 9, Map 3).

The Maddina Formation, a geological unit consisting of sediments derived from basalt, andesite, dacite, rhyolite and dolerite accounts for 43.21% of the survey area. Although two geological units (Brockman Iron Formation and Marra Mamba Iron Formation) typically associated with ghost bat and Pilbara leaf-nosed bat roosting habitat are absent from the survey area, a small portion (9.39%) of potential roosting habitat occurs within the Robe Pisolite geological unit (Bat Call WA, 2021a).

Table 9: Surface geology associated with the survey area (Geoscience Australia 2012).

Map symbol	Surface geological unit	Description	Extent within survey area (ha)	Extent within survey area (%)
Abfk	Kylena Formation	Basalt, andesite, dacite, high-Mg basalt, rhyolite; basaltic agglomerate; dolerite; grey carbonate rock with microbial laminations and stromatolites; sandstone; pillow breccia; tuff, limestone, conglomerate	17,111.22	16.64
Abfm	Maddina Formation	Massive, vesicular and amygdaloidal basalt, basaltic andesite, and andesite, minor dacite, dolerite sills; bedded lapilli, vitric, crystal and lithic tuff, volcanoclastic siltstone, shale, chert, sandstone, dolomite.	44,418.97	43.21
Abfr	Mount Roe Basalt	Massive, porphyritic, vesicular, amygdaloidal and doleritic basalt; some high-Mg basalt, agglomerate, volcanic breccia, tuff, mafic wacke, shale, polymictic conglomerate and sandstone, siliceous limestone and dolomite.	3,231.11	3.14
Abke	Euro Basalt	Basalt, chert, dolerite, komatiitic basalt, komatiite, amphibolite, basaltic fragmental rock, gabbro, ultramafic to mafic schist, carbonate rock, felsic tuff, shale, sandstone, quartzite, metapyroxenite, serpentinite	1,356.79	1.32
Acg	Gorge Creek Group	Chert, ferruginous chert, banded iron formation, jaspilite; minor siltstone, shale, sandstone, pebbly sandstone, quartzite, polymictic conglomerate, felsic volcanoclastic rock, basalt, ultramafic schist, mafic schist	663.88	0.65
Agnb	Bamboo Springs Monzogranite	Coarsely K-feldspar porphyritic monzogranite with a strong synmagmatic foliation defined by aligned K-feldspar phenocrysts.	73.53	0.07
Agro	Bonney Downs Monzogranite	Monzogranite and leucomonzogranite, sparsely porphyritic and muscovite-bearing, locally abundant xenoliths of granitic gneiss and greenstone.	83.09	0.08
Anbig	Golden Eagle Orthogneiss	Layered orthogneiss derived from tonalite, granodiorite, monzogranite and pegmatite; layers and lenses of amphibolite and ultramafic schist; foliated granite, granitic gneiss, mingled metasedimentary and metavolcanic xenoliths and granite.	10.38	0.01
Awfh	Hardey Formation	Sandstone, siltstone, shale, lithic wacke, mudstone, arkose, calcareous beds, conglomerate; porphyry, porphyry breccia; quartzite; dacitic to rhyolitic lavas; quartz-feldspar-mica schist; boulder breccia; basalt; felsic pyroclastics, ultramafic lava.	5,116.60	4.98

Map symbol	Surface geological unit	Description	Extent within survey area (ha)	Extent within survey area (%)
Awfj	Jeerinah Formation	Shale, sandstone, siltstone, mudstone, dolomite, local microbanded chert, jaspilite, conglomerate; fine-grained massive rhyolite; mafic tuff with local accretionary lapilli and agglomerate; thin basalt/dolerite and andesitic basalt flows.	1,646.27	1.60
Awft	Tumbiana Formation	Pisolitic tuff, siliceous limestone and dolomite, mudstone, tuffaceous shale, siltstone, sandstone, volcaniclastic sandstone and siltstone, calcareous sandstone, local basalt and basaltic breccia, chert, local conglomerate, shale, jasper.	10,089.79	9.81
Awk	Kelly Group	Felsic tuffaceous sandstone, quartz sandstone, siltstone, shale, chert, banded iron formation, schist, tuff, conglomerate, rhyolite, basalt, serpentinised peridotite; local dolerite sills; intrusive porphyry and microgranite; metamorphosed.	214.80	0.21
Awu	Sulphur Springs Group	Felsic to mafic volcanics and volcaniclastic rocks, chert, volcaniclastic sandstone, greywacke, shale, basalt, komatiitic basalt, amphibolite, mafic and ultramafic schist, banded iron formation, quartz-carbonate rock, siltstone.	823.14	0.80
Czl	ferruginous duricrust 38498	Ferruginous duricrust, laterite; pisolitic, nodular, vuggy; may include massive to pisolitic ferruginous subsoil, mottled clays, magnesite, reworked products of ferruginous and siliceous duricrusts, calcrete, gossan; residual ferruginous saprolite.	279.47	0.27
Czlr	Robe Pisolite	Pisolitic, oolitic and massive limonite, minor terrigenous siliciclastic material, goethite and hematite deposits; developed along palaeodrainage lines; dissected by present day drainage.	9,649.05	9.39
Qa	alluvium 38485	Channel and flood plain alluvium; gravel, sand, silt, clay; may be locally calcreted.	306.31	0.30
Qrc	colluvium 38491	Colluvium and/or residual deposits, sheetwash, talus, scree; boulder, gravel, sand; may include minor alluvial or sand plain deposits, local calcrete and reworked laterite.	7,728.17	7.52

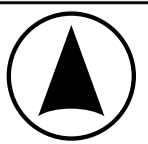
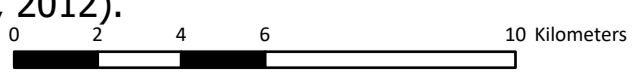


Survey area	Golden Eagle Orthogneiss	Kylenea Formation	Tumbiana Formation
Unit	Gorge Creek Group	Maddina Formation	alluvium 38485
Bambo Springs Monzogranite	Hardey Formation	Mount Roe Basalt	colluvium 38491
Bonney Downs Monzogranite	Jeerinah Formation	Robe Pisolite	ferruginous duricrust 38498
Euro Basalt	Kelly Group	Sulphur Springs Group	

Map 3: Surface geology (Geoscience Australia, 2012).



Project No.: 1981
 Author: SP
 Created Date: 10 December 2025
 Coordinate System: GCS GDA 1994
 Scale: 1:190,000 @A3



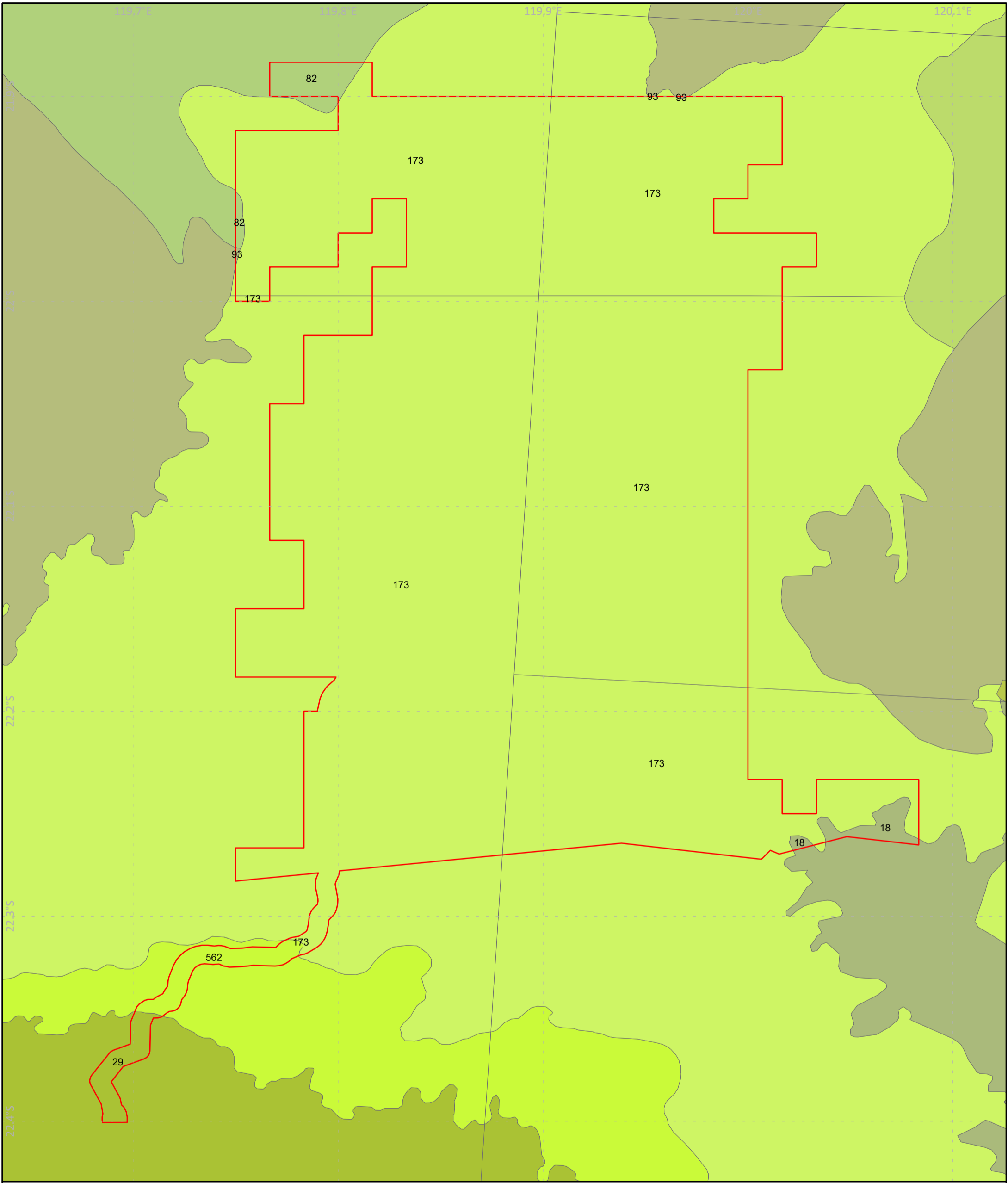
3.1.4 Beard Vegetation Associations


The Western Australian Land Use and Vegetation Data Project (Shepherd et al., 2002) produced a 1:250,000 scale digital spatial dataset of the pre-European native vegetation of Western Australia, compiled from previous vegetation mapping exercises, primarily by J.S. Beard from 1964 to 1981, with updates reflecting the National Vegetation Information System (NVIS) standards. Six vegetation associations (18, 29, 82, 93, 173 and 562) are mapped within the survey area (Table 10, Map 4). Most of the survey area (96.86%) is comprised of vegetation association 173, characterised by *Triodia wiseana* hummock grassland and low *Eucalyptus* steppe. None of the vegetation associations identified are restricted to the survey area, with all vegetation associations well represented at a regional level.

The pre-European and current extent of each vegetation association is available from the Statewide Vegetation Statistics dataset (Government of Western Australia, 2018). The National Objectives and Targets for Biodiversity Conservation 2001-2005 (DEH, 2001) recognise that the retention of 30% or more of the pre-clearing extent of an ecological community is necessary if Australia's biological diversity is to be protected, as this is the threshold below which species loss appears to accelerate exponentially (EPA, 2000). Vegetation associations at less than 30% of their pre-European extent are classified as either 'Vulnerable' (10-30%) or 'Endangered' (<10%) (DER, 2014). The current extent of vegetation associations within the survey area are all well above this 30% threshold (Table 10) and are classified as 'Least concern' (DER, 2014).







Table 10: Vegetation associations of the survey area.

Shepherd et al. (2002) vegetation association	Description	Pre-European extent within Pilbara IBRA region (ha)	Extent remaining within Pilbara IBRA region	Current percentage protected for conservation within Pilbara IBRA region	Extent within survey area ha (%)
18	Low woodland; mulga (<i>Acacia aneura</i>)	676,556.72	671,843.35	99.30	616.50 (0.60)
29	Sparse low woodland; mulga, discontinuous in scattered groups	1,133,219.76	1,131,712.01	99.87	736.86 (0.72)
82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>	360,666.90	360,322.69	99.9%	884.52 (0.86)
93	Hummock grasslands, shrub steppe; kanji over soft spinifex	2,940,348.04	2,936,731.54	99.88%	17.46 (0.02)
173	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>Triodia wiseana</i> on basalt	1,744,029.51	1,739,189.58	99.72%	99,576.62 (96.86)
562	Mosaic: Low woodland; mulga in valleys / Hummock grasslands, open low tree-steppe; snappy gum over <i>Triodia wiseana</i>	103,606.82	103,606.82	100.00%	970.59 (0.94)



 Survey area

Vegetation association

-  18: Low woodland; mulga (*Acacia aneura*)
-  29: Sparse low woodland; mulga, discontinuous in scattered groups
-  82: Hummock grasslands, low tree steppe; snappy gum over *Tridodia wiseana*
-  93: Hummock grasslands, shrub steppe; kanji over soft spinifex
-  173: Hummock grasslands, shrub steppe; kanji over soft spinifex & *Tridodia wiseana* on basalt
-  562: Mosaic: Low woodland; mulga in valleys / Hummock grasslands, open low tree-steppe; snappy gum over *Tridodia wiseana*

3.1.5 Land Systems

In 2016 the Department of Primary Industries and Regional Development (DPIRD) consolidated soil-landscape mapping of Western Australia from two technical reports created by the Department of Agriculture and Food (Department of Agriculture Resource Management Technical Reports RMTR No. 280 (Purdie, Tille, & Schoknecht, 2016) and RMTR No. 313 (Tille, 2006). The resulting spatial dataset, *Soil-landscape mapping covering Western Australia at the best available scale (Version 05.01)* (DPIRD, 2016), is a compilation of various surveys at different scales varying between 1:20,000 and 1:3,000,000. Mapping conforms to a nested hierarchy established to deal with the varying levels of information resulting from the variety of scales in mapping to provide soil-landscape data for all Western Australia.

Sixteen land systems are associated with the survey area, with the majority (55.67%) comprised of the Rocklea Land System (Table 11, Map 5). The Rocklea Land System is characterised by basalt hills, plateaux, lower slopes and stony plains, supporting hard spinifex and scattered shrubs.

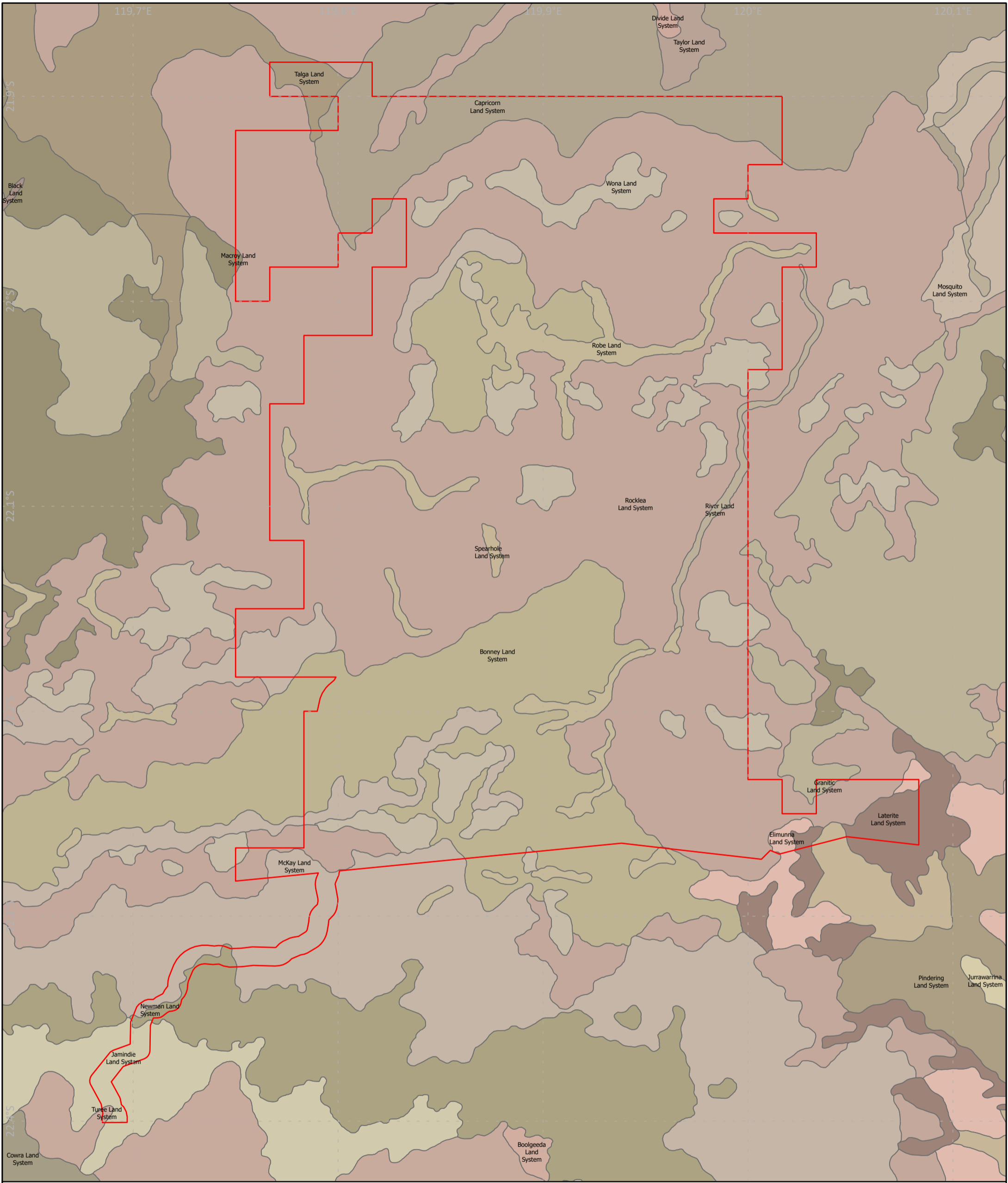
3.1.6 Significant Lands, Wetlands and Drainage

The DCCEEW (DCCEEW, 2023) and the Department of Biodiversity and Conservation (DBCA) legislated lands and waters database were queried for Ramsar Wetlands, and Nationally Important Wetlands, and DBCA managed lands and waters occurring within the survey area. The Fortescue Marsh Nationally Important Wetland occurs within a 40 km radius of the survey area (Map 6). The Ramsar listed Eighty Mile Beach is located approximately 275 km north of the survey area.

Pastoral activities associated with Bonney Downs station along with mining tenements (numerous mines and exploration tenements) are the dominant land uses in the vicinity of the survey area. Three major water courses intersect the survey area including the Nullagine River, the Coongan River and Bonnie Creek, encompassing numerous permanent water bodies including Bonnie Pools. Permanent and semi-permanent water sources within the survey area provide important seasonal habitat for a wide range of vertebrate fauna taxa, including Migratory birds.

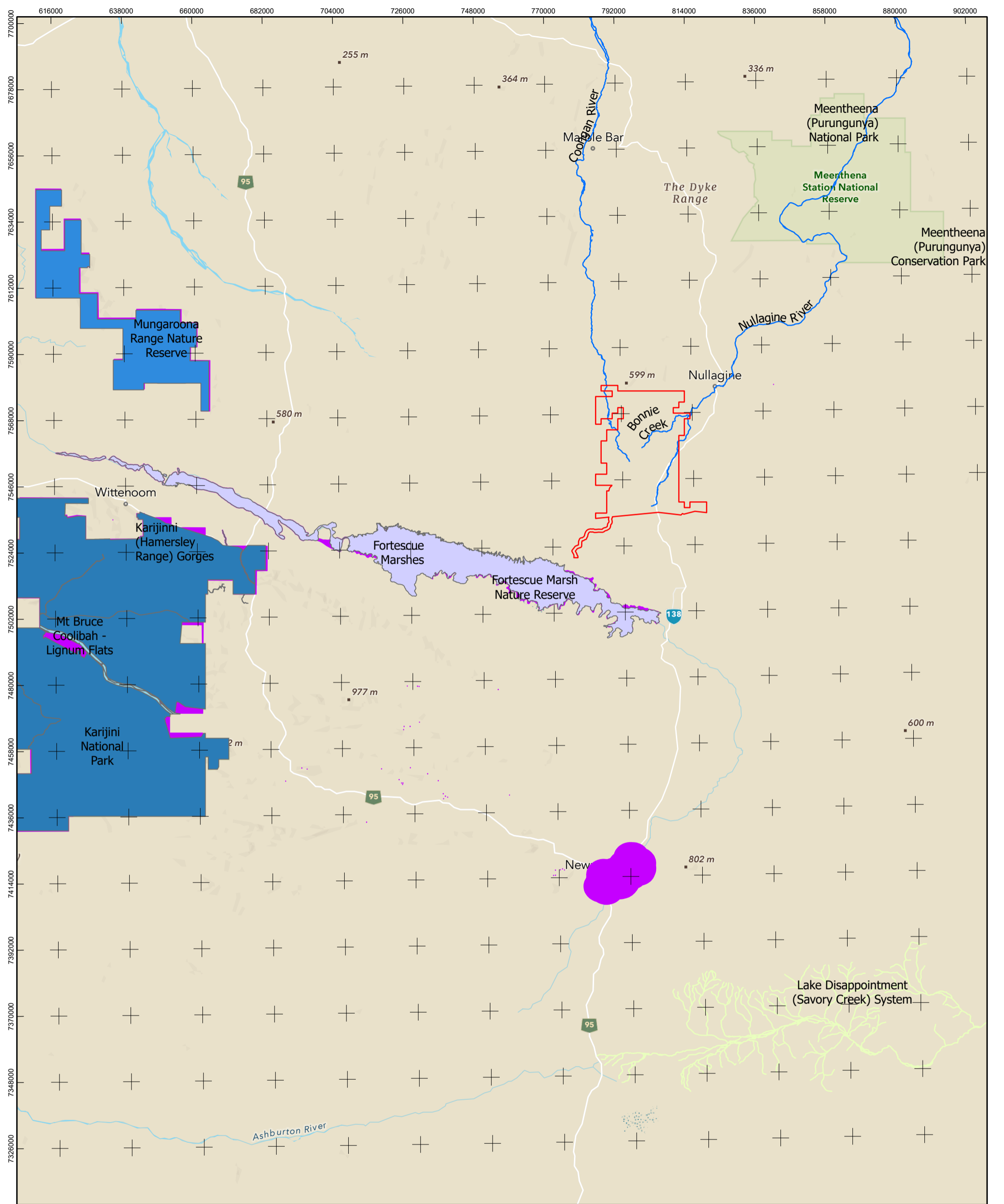
Table 11: Land systems within the survey area.

Land system	Description	Extent within the survey area (ha)	Extent within survey area (%)
Bonney Land System	Low rounded hills and undulating stony plains supporting soft spinifex grasslands.	17,775.6	17.29
Capricorn Land System	Rugged sandstone hills, ridges, stony footslopes and interfluves supporting low acacia shrublands or hard spinifex grasslands with scattered shrubs.	6,299.16	6.13
Elimunna Land System	Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands.	292.56	0.28
Granitic Land System	Rugged granitic hills supporting shrubby hard and soft spinifex grasslands.	77.65	0.08
Jamindie Land System	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey.	629.53	0.61
Laterite Land System	Low lateritic plateaux, mesas, buttes and gravelly rises and plains supporting sparse mulga shrublands.	878.33	0.85
Macroy Land System	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex shrubby grasslands.	28.02	0.03
McKay Land System	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.	5,726.3	5.57
Newman Land System	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	305.14	0.3
River Land 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.	498.98	0.49
Robe Land System	Low plateaux, mesas and buttes of limonite supporting soft spinifex and occasionally hard spinifex grasslands.	4,313.96	4.2
Rocklea Land System	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.	57,234.89	55.67
Spearhole Land System	Gently undulating gravelly hardpan plains and dissected slopes supporting groved mulga shrublands and hard spinifex.	273.99	0.27
Talga Land System	Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.	557.07	0.54
Turee Land System	Stony alluvial plains with gilgaied and non-gilgaied surfaces supporting tussock grasslands and grassy shrublands of mulga and snakewood.	35.39	0.03
Wona Land System	Basalt upland gilgai plains supporting Roebourne Plains grass and Mitchell grass tussock grasslands, minor hard spinifex grasslands or annual grasslands/herbfields.	7,876.02	7.66



Survey area	Cowra Land System	Laterite Land System	Pindering Land System	Taylor Land System
Land system	Divide Land System	Macroy Land System	River Land System	Turee Land System
Black Land System	Elimunna Land System	Marsh Land System	Robe Land System	Wona Land System
Bonney Land System	Granitic Land System	McKay Land System	Rocklea Land System	
Boolgeeda Land System	Jamindie Land System	Mosquito Land System	Spearhole Land System	
Capricorn Land System	Jurrawarrina Land System	Newman Land System	Talga Land System	

Map 5: Land systems (DPIRD 2016).

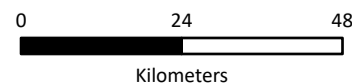


- | | | |
|-------------|---|---------------------------------------|
| Survey area | Nationally Important Wetlands | DBCA managed lands and waters |
| Rivers | Fortescue Marshes | Un-named |
| | Karijini (Hamersley Range) Gorges | Karijini National Park |
| | Lake Disappointment (Savory Creek) System | Mungaroon Range Nature Reserve |
| | Mt Bruce Coolibah - Lignum Flats | Environmentally sensitive area |
| | | Un-named ESA |

Map 6: DBCA Legislated Lands and Waters, Nationally Important Wetlands and Environmentally Sensitive Areas near the survey area.



Project No.: 1981
 Author: CE
 Created Date: 12 January 2026
 Coordinate System: GCS GDA 1994
 Scale: 1:1,130,000 @A3



3.2 FAUNA

3.2.1 Database Searches

According to database searches and the literature review, 204 bird and bat species have the potential to occur within 100 km of the survey area, comprising 17 bats and 187 birds (Appendix B). A summary outlining the results of database searches within the survey area can be seen in Table 12.

Table 12: Summary of fauna database search results within the survey area.

Database	Bats	Birds
Atlas of Living Australia	5	161
DBCAs Threatened and Priority Fauna Search	2	20
Fortescue Significant Fauna Databases	1	13
Birdlife Australia Birddata	-	149
DCCEEW Protected Matters Search	2	18

3.2.2 Literature Review

The literature review identified eight multi-phase detailed vertebrate fauna assessments, nine single-phase detailed fauna surveys, 10 targeted fauna surveys, two significant fauna monitoring programs and three basic fauna surveys undertaken within 100 km of the survey area. Of the literature reviewed, two basic fauna and fauna habitat assessments, three single-phase detailed and targeted surveys and one consolidation report encompassing two multi-phase detailed and targeted surveys were found to intersect the current survey area.

Key findings associated with reports which were available at the time of the review are outlined in Table 13, with a list of regional fauna records, including updated species names to align with the current Western Australian Museum (WAM) checklist of terrestrial vertebrates, provided in Appendix C. Asterixis indicate surveys for which the survey report and/or a comprehensive species list were unavailable at the time of the assessment.

Multi-phase detailed fauna assessments:

- Bonney Downs: Terrestrial Vertebrate Fauna Survey Consolidation (Ecologia Environment, 2025)¹;
- Corunna Downs Project: Terrestrial Vertebrate Fauna Survey (Stantec, 2016);
- East Hamersley Rail Terrestrial Vertebrate Fauna Assessment (ecologia, 2024c);
- McPhee Creek: Consolidated Terrestrial Fauna Report (Biologic, 2021);
- Mindy South: Detailed and Targeted Terrestrial Vertebrate Fauna Baseline Survey (Stantec, 2024);
- Nyidinghu Iron Ore Project Detailed Terrestrial Fauna Survey (360 Environmental, 2023);
- Nyidinghu Mine Terrestrial Vertebrate Fauna Assessment (ecologia, 2024d); and
- Roy Hill Iron Ore Project, Level 2 Terrestrial Vertebrate Fauna Survey (ecologia, 2009).

Single-phase detailed fauna assessments:

- Adele Flora, Fauna and SRE Survey (360 Environmental, 2021);
- Bonney Downs Rail Alignment Vertebrate Fauna Survey (Phoenix, 2011)*;
- Christmas Creek Terrestrial Vertebrate Fauna and Fauna Habitat Assessment (ENV Australia, 2012);
- Cloudbreak Level 2 Terrestrial Vertebrate Fauna Assessment (ecologia, 2011a);
- Fauna Assessment - Nyidinghu Iron Ore Project (Bamford Consulting Ecologists, 2012);

1-Consolidation of Bonney Downs North (ecologia, 2024a) and Bonney Downs South (Spectrum Ecology, 2024a) Terrestrial Vertebrate Fauna Assessments.

- Fauna Survey of the Proposed Iron Ore Mine, Cloud Break (Bamford Consulting Ecologists, 2005)*;
- FMG Stage A Rail Corridor Fauna Assemblage (Biota Environmental Sciences, 2004)*;
- FMG Stage B Rail (Biota Environmental Sciences, 2005)*; and
- Kutayi Project Vertebrate Fauna Survey (Spectrum Ecology, 2020)*.

Targeted significant fauna surveys:

- Adele West Targeted Flora and Fauna Survey (360 Environmental, 2022);
- Fortescue Marsh Migratory Shorebird and Waterbird Survey (Spectrum Ecology, 2022);
- Fortescue Marsh Tenement E46/684 Level 1 Targeted Vertebrate Fauna Survey (Biologic Environmental, 2014);
- Fortescue Metals Group Cloudbreak Expansion Project - Pre Clearance Night Parrot Survey (Outback Ecology, 2013a);
- Migratory Bird Habitat Survey of the Fortescue Marsh (Bennelongia Environmental Consultants, 2018);
- Roy Hill Level 1 Targeted Vertebrate Fauna Assessment Updated (Biologic, 2018);
- Targeted Fauna Assessment of the Rail Duplication (Bamford Consulting Ecologists, 2010);
- Vegetation and Fauna Habitat Mapping of the Northern Tenement Area, Cloudbreak (Ecoscape Australia, 2016);
- Warrawoona Gold Project: VHF Bat Foraging Studies (Biologic, 2019b); and
- Warrawoona Gold Project: 2019 Significant Species Survey (Biologic, 2019a).

Significant fauna monitoring:

- Nyidinghu Project: Baseline Significant Fauna Monitoring (Spectrum Ecology, 2023); and
- Fortescue Night Parrot Monitoring Procedure and Program (Adaptive NRM, 2021).

Basic fauna and fauna habitat assessment:

- BC Iron Nullagine Project Extension Areas – Bonnie East, Warrigal North and Coongan: Assessment of Fauna Values (Bamford, 2013);
- Bonney Downs Alignment Level 1 Fauna Survey (Phoenix Environmental Sciences, 2011)*; and
- Ministers North to Yandi Corridor: Single Phase Level 2 Fauna and Detailed Flora/Vegetation Survey (Biologic, 2017b).

Table 13: Summary of literature reviewed.

Survey details	Proximity to survey area	Bats	Birds	Significant birds/bats recorded
Single-phase detailed fauna survey				
Adele Flora, Fauna and SRE Survey (360 Environmental, 2021)	20 km	6	31	No significant birds or bats recorded.
Bonney Downs Rail Alignment Vertebrate Fauna Survey (Phoenix, 2010)	Intersects	6	62	Significant fauna assemblages not available.
Cloudbreak Level 2 Terrestrial Vertebrate Fauna Assessment (ecologia, 2011b)	<5 km	4	55	No significant birds or bats recorded.
Christmas Creek Terrestrial Vertebrate Fauna and Fauna Habitat Assessment (ENV Australia, 2012)	Intersects	7	61	No significant birds or bats recorded.
Fauna Assessment - Nyidinghu Iron Ore Project (Bamford Consulting Ecologists, 2012)	40 km	7	83	Fork-tailed swift, peregrine falcon.
Fauna Survey of the Proposed Iron Ore Mine, Cloud Break (Bamford, 2005)	<5 km	9	90	Significant fauna assemblages not available.
FMG Stage A Rail Corridor Fauna Assemblage (Biota Environmental Sciences, 2004)	<40 km	3	84	Significant fauna assemblages not available.
FMG Stage B Rail (Biota Environmental Sciences, 2005)	Intersects	0	103	Significant fauna assemblages not available.
Kutayi Project - Vertebrate Fauna Survey (Spectrum Ecology, 2020)	20 km	10	88	Significant fauna assemblages not available.
Multi-phase detailed fauna survey				
Bonney Downs: Terrestrial Vertebrate Fauna Survey Consolidation (Ecologia Environment, 2025)	Intersects	11	118	Pilbara leaf-nosed bat, grey falcon, ghost bat.
Corunna Downs Project: Terrestrial Vertebrate Fauna Survey (Stantec, 2016)	Adjacent	10	72	Pilbara leaf-nosed bat, ghost bat, peregrine falcon.
East Hamersley Rail Terrestrial Vertebrate Fauna Assessment (ecologia, 2024c)	40 km	8	36	Ghost bat, fork-tailed swift, grey wagtail, gull-billed tern, eastern osprey.
McPhee Creek: Consolidated Terrestrial Fauna Report (Biologic, 2021)	<50 km	4	70	Pilbara leaf-nosed bat, ghost bat, fork-tailed swift.
Mindy South: Detailed and Targeted Terrestrial Vertebrate Fauna Baseline Survey (Stantec, 2024)	50 km	9	89 (1)	Pilbara leaf-nosed bat, ghost bat, Caspian tern.
Nyidinghu Iron Ore Project Detailed Terrestrial Fauna Survey (360 Environmental, 2023)	20 km	12	75	Ghost bat, Pilbara leaf-nosed bat.
Nyidinghu Mine Terrestrial Vertebrate Fauna Assessment (ecologia, 2024d)	<15 km	9	66	Grey falcon, Pilbara leaf-nosed bat, night parrot, fork-tailed swift, peregrine falcon, Caspian tern, Australian painted snipe and eastern osprey.

Survey details	Proximity to survey area	Bats	Birds	Significant birds/bats recorded
Roy Hill Iron Ore Project, Level 2 Terrestrial Vertebrate Fauna Survey (ecologia, 2009)	<20 km	5	75	Ghost bat, peregrine falcon, grey falcon, wood sandpiper and western pebble-mound mouse.
Targeted fauna survey				
Adele West Targeted Flora and Fauna Survey (360 Environmental, 2022)	20 km	6	31	Northern quoll, western pebble-mound mouse.
Fortescue Marsh Migratory Shorebird and Waterbird Survey (Spectrum Ecology, 2022)	<10 km	0	38	Gull-billed tern, Caspian tern, sharp-tailed sandpiper, common greenshank, glossy ibis.
Fortescue Marsh Tenement E46/684 Level 1 Targeted Vertebrate Fauna Survey (Biologic Environmental, 2014)	<10 km	4	18	No significant fauna recorded.
Fortescue Metals Group Cloudbreak Expansion Project – Pre-Clearance Night Parrot Survey (Outback Ecology, 2013b)	10 km	0	72	No significant fauna recorded.
Migratory Bird Habitat Survey of the Fortescue Marsh (Bennelongia Environmental Consultants, 2018)	<10 km	0	35	Gull-billed tern, Caspian tern, sharp-tailed sandpiper, common greenshank, marsh sandpiper, glossy ibis.
Roy Hill Level 1 Targeted Vertebrate Fauna Assessment Updated (Biologic, 2018)	<20 km	1	2	Ghost bat, peregrine falcon, grey falcon.
Targeted Fauna Assessment of the Rail Duplication (Bamford Consulting Ecologists, 2010)	<30 km	0	25	No significant birds or bats recorded.
Warrawoona Gold Project: 2019 Significant Species Survey (Biologic, 2019a)	> 50 km	0	20	No significant birds or bats recorded.
Warrawoona Gold Project: VHF Bat Foraging Studies (Biologic, 2019b)	>50 km	2	0	Pilbara leaf-nosed bat, ghost bat.
Vegetation and Fauna Habitat Mapping of the Northern Tenement Area, Cloudbreak (Ecoscape Australia, 2016)	<40 km	2	12	Ghost bat, Pilbara leaf-nosed bat.
Basic fauna and fauna habitat assessment				
BC Iron Nullagine Project Extension Areas – Bonnie East, Warrigal North and Coongan: Assessment of Fauna Values (Bamford, 2013)	Intersects	9	96	Australian painted snipe, Pilbara leaf-nosed bat, grey falcon.
Bonney Downs Alignment: Level 1 Fauna Survey (Phoenix Environmental Sciences, 2011)	Intersects	0	38	Significant fauna assemblages not available.
Ministers North to Yandi Corridor: Single Phase Level 2 Fauna and Detailed Flora/Vegetation Survey (Biologic, 2017a)	>50 km	6	35	No significant birds or bats recorded.
Fauna monitoring				
Fortescue Night Parrot Monitoring Procedure and Program (Adaptive NRM, 2021)	<10 km	0	1	Night parrot.
Nyidinghu Project: Baseline Significant Fauna Monitoring (Spectrum Ecology, 2023)	20 km	0	35	Night parrot.

3.2.3 Species Characteristics

An additional literature review was conducted to assess the characteristics of the 23 significant species assessed with a ‘High’ or ‘Moderate’ likelihood of occurrence.

Preferred habitat types, seasonal movements and flight/ flocking behaviours were incorporated into an assessment of the potential site usage for each significant species. Four broad potential site-use categories were utilised, including: transitory, breeding, roosting and, foraging.

Seventeen species were assessed as potentially transitory, four species (one bat and three birds) were assessed as potentially breeding, roosting and foraging within the survey area, one bat was assessed as potentially foraging within the survey area only, and one bird was deemed unlikely to occur.

Detailed results from the species characteristics literature review which was used to inform the site-use assessment are provided in Appendix F.

3.2.4 Predator/Scavenger Assemblages

According to database searches and the literature review, 30 scavenger/predator species have been recorded within the study area, comprising seven reptiles, three mammals and 20 birds (Table 14). Likelihood of scavenging was assessed for all scavenger/predator taxa identified as occurring or potentially occurring within the survey area, based on whether the species was known to regularly consume carcasses (‘Likely’), may consume carcasses occasionally or only consume carcasses belonging to a particular size range (‘Possible’) or insufficient information was available to completely exclude the species from the assessment (‘Unlikely’). Six birds, three reptiles and three mammals are considered likely to scavenge carcasses stuck by wind turbines.

Table 14: Predator/scavenger species with the potential to scavenge carcasses.

Species	Common name	ALA	Birdata	Literature review	Recorded within the survey area	Likelihood of scavenging
Birds						
<i>Corvus bennetti</i>	Little crow	x	x	x	0	Possible
<i>Corvus orru</i>	Torresian crow	x	x	x	x	Likely
<i>Aquila audax</i>	Wedge-tailed eagle	x	x	x	x	Likely
<i>Tachypiza cirrocephala</i>	Collared sparrowhawk	x	x	x	x	Possible
<i>Tachypiza fasciata</i>	Brown goshawk	x	x	x	x	Possible
<i>Circus approximans</i>	Swamp harrier	x	x	0	0	Possible
<i>Circus assimilis</i>	Spotted harrier	x	x	x	x	Possible
<i>Elanus axillaris</i>	Black-shouldered kite	x	x	x	x	Possible
<i>Haliastur sphenurus</i>	Whistling kite	x	x	x	x	Likely
<i>Hamirostra melanosternon</i>	Black-breasted buzzard	x	x	x	0	Possible
<i>Hieraaetus morphnoides</i>	Little eagle	x	x	x	x	Likely
<i>Milvus migrans</i>	Black kite	x	x	x	x	Likely
<i>Lophoictinia isura</i>	Square-tailed kite	x	0	x	x	Likely
<i>Falco berigora</i>	Brown falcon	x	x	x	x	Possible
<i>Falco cenchroides</i>	Nankeen kestrel	x	x	x	x	Possible
<i>Falco hypoleucos</i>	Grey falcon	x	0	x	x	Possible
<i>Falco longipennis</i>	Australian hobby	x	x	x	x	Possible

Species	Common name	ALA	Birdata	Literature review	Recorded within the survey area	Likelihood of scavenging
<i>Falco peregrinus</i>	Peregrine falcon	x	x	x	0	Possible
<i>Falco subniger</i>	Black falcon	x	0	0	x	Possible
Reptiles						
<i>Varanus giganteus</i>	Perentie	x	N/A	x	x	Likely
<i>Varanus gouldii</i>	Bungarra	x	N/A	x	x	Likely
<i>Varanus panoptes</i>	Yellow-spotted monitor	x	N/A	x	x	Likely
<i>Pseudechis australis</i>	Mulga snake	x	N/A	x	x	Possible
<i>Antaresia childreni</i>	Children's python	x	N/A	x	0	Unlikely
<i>Aspidites melanocephalus</i>	Black-headed python	x	N/A	x	x	Unlikely
<i>Liasis olivaceus barroni</i>	Pilbara olive python	0	N/A	x	x	Unlikely
Mammals						
<i>Canis familiaris</i>	Dingo	x	N/A	x	x	Likely
<i>Felis catus</i> *	Cat	0	N/A	x	x	Likely
<i>Dasyurus hallucatus</i>	Northern quoll	x	N/A	x	x	Likely

*denotes invasive species. "0" - Denotes species which were not recorded by a particular database search.

4 FIELD SURVEY RESULTS

4.1 FIELD SURVEY OVERVIEW

4.1.1 Survey Timing

Eight bird and bat site utilisation surveys have been conducted at Bonney Downs approximately every three months over a 24-month period between October 2023 and August 2025. Each survey was conducted over an eight-day period by three *ecologia* zoologists (Table 15). The survey methods accord with the *Draft Onshore Wind Farm Guidance* (DCCEE, 2024). Three phases of detailed fauna and two phases of targeted fauna surveys were also undertaken by *ecologia* within the Bonney Downs survey area, with these results and survey effort associated with these surveys incorporated into this report where applicable.

Table 15: Survey timings.

Survey	Date	Season	Staff
Survey 1	12 - 19 October 2023	Spring, Southward Migration	Tim McCabe, Claudia Elliott, Thomas Burley
Survey 2	5 - 12 February 2024	Summer, Wet Season	Tim McCabe, Simon Cherriman, Thomas Burley
Survey 3	21 - 28 March 2024	Autumn, Northward migration	Tim McCabe, Simon Cherriman, Thomas Burley
Survey 4	17 – 24 June 2024	Winter, Dry Season	Tim McCabe, Simon Cherriman, Thomas Burley
Survey 5	10 – 17 September 2024	Spring, Southward Migration	Tim McCabe, Sam Plant, Daniel Terrington
Survey 6	10 -13, 24 - 28 February 2025	Summer, Wet Season	Tim McCabe, Claudia Elliott, Sam Plant, Thomas Burley
Survey 7	28 April – 5 May 2025	Autumn, Northward migration	Claudia Elliott, Simon Cherriman, Thomas Burley
Survey 8	13 – 20 August 2025	Winter, Dry Season	Tim McCabe, Sam Plant, Thomas Burley

4.1.2 Survey Weather and Climate

4.1.2.1 Temperature and Rainfall

Avifauna (birds of a specific region) activity is highly sensitive to weather conditions, particularly temperature, rainfall, and wind speed (Dokter et al., 2018). These factors influence daily behaviour, distribution, migration patterns, and long-term survival.

Daily temperature data for October 2023 was taken from the Marble Bar BOM station and the remaining surveys were taken from the Fortescue Bonney Downs Meteorological Mast (BDMM) at 144 m above ground level and daily rainfall data was taken from Bonney Downs (Station No. 4006) (Table 16). A summary of the weather data in the months preceding each survey can be seen in Table 16.

Table 16: Daily weather conditions experienced during the BBSUS.

Survey phase and timing	Date	Maximum temperature (°C)	Minimum temperature (°C)	Rainfall (mm)	Weather preceding survey (3 months)
Survey 1 (Southward migration)	12/10/2023	41.30	19.30	0	No rainfall was recorded in the three months (July - September) preceding survey 1, which is substantially less than the long-term rainfall for this period (July-
	13/10/2023	41.50	23.30	0	
	14/10/2023	42.00	24.20	0	
	15/10/2023	41.80	24.70	0	

Survey phase and timing	Date	Maximum temperature (°C)	Minimum temperature (°C)	Rainfall (mm)	Weather preceding survey (3 months)
	16/10/2023	40.00	23.80	0	September) of 18.3 mm. Although conditions were drier than usual, temperature was as expected for this time of year. No significant weather events occurred during this period.
	17/10/2023	40.00	20.90	0	
	18/10/2023	41.40	19.00	0	
	19/10/2023	42.40	22.60	0	
Survey 2 (wet season)	5/02/2024	40.65	25.77	0	Approximately 110.2 mm of rain was recorded in the three months (November - January) preceding survey 2, which is 6.2 mm below medium of long-standing records for this period. Although rainfall was lower than expected, rainfall just prior to the survey (January) was 38.5 mm above medium and accounted for approximately 18% of all rainfall collected in 2024. Temperature was as expected for this time of year. No significant weather events occurred during this period.
	6/02/2024	36.99	26.81	0	
	7/02/2024	37.05	26.66	0	
	8/02/2024	39.02	28.56	0	
	9/02/2024	39.84	30.12	0	
	10/02/2024	39.75	31.51	0	
	11/02/2024	40.27	31.78	0	
12/02/2024	43.94	35.06	0		
Survey 3 (Northward migration)	21/03/2024	34.40	23.47	0	Rainfall in the three months (December - February) preceding survey 3 was 49.9 mm below the medium of long-standing records. As identified above, January 2024 was wetter than expected at 38.5 mm above expected; however, February 2024 was drier than expected at 54.4 mm below medium long-standing records. Maximum and minimum temperature was consistently below the medium of long-standing records. No significant weather events occurred during this period.
	22/03/2024	34.58	25.16	0	
	23/03/2024	30.84	22.90	0	
	24/03/2024	27.95	19.58	0	
	25/03/2024	28.28	19.84	0	
	26/03/2024	29.74	19.28	0	
	27/03/2024	31.17	22.24	0	
	28/03/2024	33.96	23.80	0	
Survey 4 (Dry season)	17/06/2024	30.95	23.80	0	Rainfall was 38.9 mm above medium rainfall for the three months preceding survey 4 (March - May); however, no rainfall occurred in April or May. Although this three-month period was wetter than the medium for this time of year, conditions were drier immediately prior to the survey. Temperature was as expected for this time of year. No significant weather events occurred during this period.
	18/06/2024	30.28	20.63	0	
	19/06/2024	20.43	15.22	0	
	20/06/2024	18.78	11.87	0	
	21/06/2024	22.92	11.90	0	
	22/06/2024	28.64	16.82	0	
	23/06/2024	27.18	18.80	0	
	24/06/2024	22.66	14.48	0	
Survey 5 (Southward migration)	10/09/2024	34.98	20.63	0	The three months (June - August) preceding survey 5 were wetter than expected as rainfall was 8.9 mm above medium rainfall for the same period. Additionally, rainfall immediately prior to the survey (August) was 33.2 mm above the medium of long-standing records. Maximum and minimum temperature was consistently below the medium of long-standing records. No significant weather events occurred during this period.
	11/09/2024	28.83	20.80	0	
	12/09/2024	31.45	18.16	0	
	13/09/2024	31.88	18.67	0	
	14/09/2024	33.22	23.03	0	
	15/09/2024	29.33	20.13	0	
	16/09/2024	26.88	18.72	0	
	17/09/2025	30.12	17.90	0	
	10/02/2025	43.15	27.41	0	

Survey phase and timing	Date	Maximum temperature (°C)	Minimum temperature (°C)	Rainfall (mm)	Weather preceding survey (3 months)
Survey 6 (wet season)	11/02/2025	39.15	25.79	0	The three months (November - January) preceding survey 6 were substantially wetter than the medium of long-standing records as rainfall was 147.1 mm above expected. Tropical cyclone Zelia (Category 4) occurred mid-survey and the survey team had to be demobilised on 14/02/2025 and then remobilised on the 24/2/2025 to complete survey 6. Despite cyclone Zelia, temperature was as expected for this time of year.
	12/02/2025	28.80	21.41	1.5	
	13/02/2025	23.25	20.87	5.5	
	24/02/2025	39.81	28.43	0	
	25/02/2025	39.83	29.05	0	
	26/02/2025	42.38	29.83	0	
	27/02/2025	43.16	30.84	0	
	28/02/2025	43.00	31.48	0	
Survey 7 (Northward migration)	28/04/2025	27.88	19.10	0	The three months (January - March) preceding survey 7 were substantially wetter than the medium of long-standing records as rainfall was 98.8 mm above expected. The additional rainfall experienced during this time can be partially attributed to cyclone Zelia. Temperature was as expected for this time of year.
	29/04/2025	29.19	18.15	0	
	30/04/2025	27.40	19.08	0	
	1/05/2025	28.66	18.49	0	
	2/05/2025	28.80	20.62	0	
	3/05/2025	31.28	21.61	0	
	4/05/2025	33.18	24.62	0	
	5/05/2025	33.94	26.59	0	
Survey 8 (Dry season)	13/08/2025	31.00	22.44	0	The three months (May-July) preceding survey 8 was substantially drier than the medium of long-standing records as rainfall was 45.3 mm below expected. Temperature was as expected for this time of year. No significant weather events occurred during this period.
	14/08/2025	30.73	22.83	0	
	15/08/2025	27.78	17.42	0	
	16/08/2025	27.43	16.16	0	
	17/08/2025	27.81	16.46	0	
	18/08/2025	28.16	18.49	0	
	19/08/2025	28.47	19.88	0	
	20/08/2025	26.90	20.75	0	

4.1.2.2 Wind

An on-site meteorological mast was installed at Bonney Downs in 2023, with data provision starting on 19 October 2023. Instruments installed on this mast record wind speed at 60, 90, and 120 m heights, wind direction at 117 mAGL, and temperature, relative humidity, and air pressure at 144 m AGL. BDMM observational data is stored in Excel format and initial analysis has been conducted using Microsoft Excel (Kerryn Hawke & Margaret Andrew, in prep).

Wind data for 2024 was analysed by the Harry Butler Institute (Kerryn Hawke & Margaret Andrew, in prep) and a series of wind roses were produced to outline windspeed and frequency (direction) at different heights (Figure 2), monthly mean wind frequency (Figure 3), three hourly mean wind speed at various heights (Figure 4) and a comparison between three hourly wind direction of Marble Bar, Bonney Downs and Newman Aero (Figure 5).

The wind at Bonney Downs is generally from an east-south-easterly direction with winds tending to strengthen overnight and slacken during the middle of the day (Figure 4). There does not appear to be any strong fluctuations in wind direction across the months with the prevailing winds generally coming from the east-southeast year-round (Figure 3).

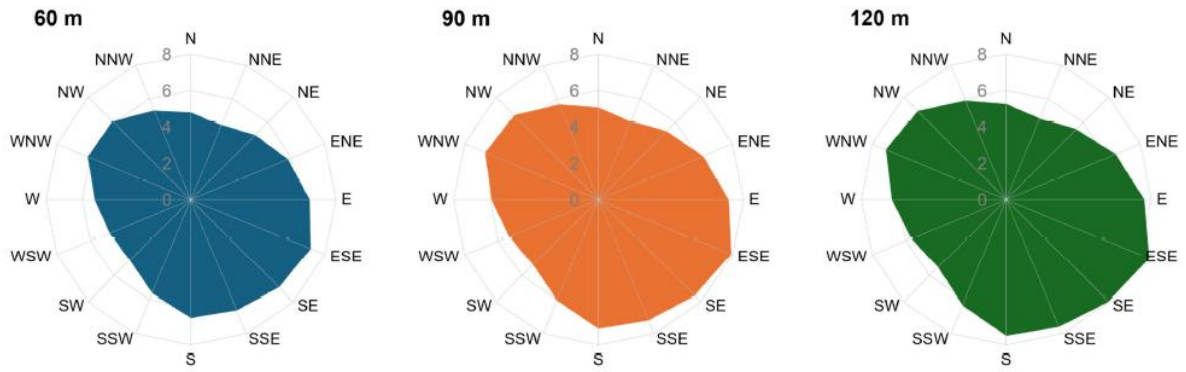


Figure 2: Average wind speed (m s^{-1}) at 60 m, 90 m and 120 m for Bonney Downs, 2024. Data: (Fortescue, 2025).

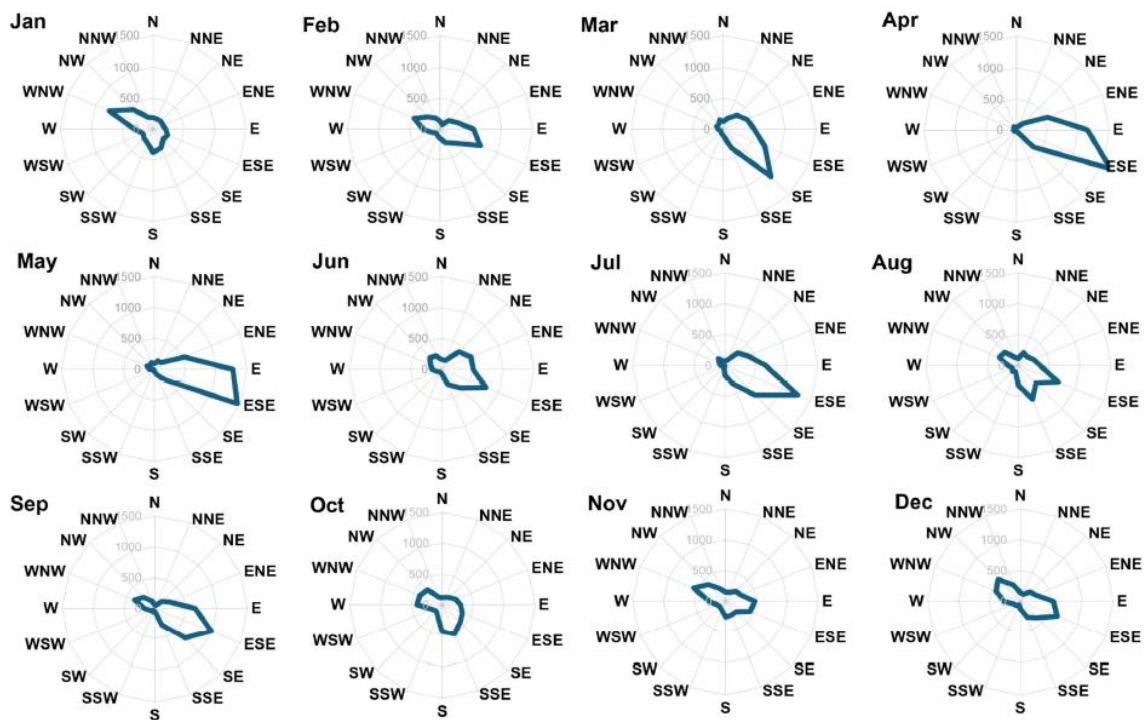


Figure 3: Monthly mean wind frequency at 117 m for Bonney Downs, 2024. Data: BDMM (Fortescue, 2025).

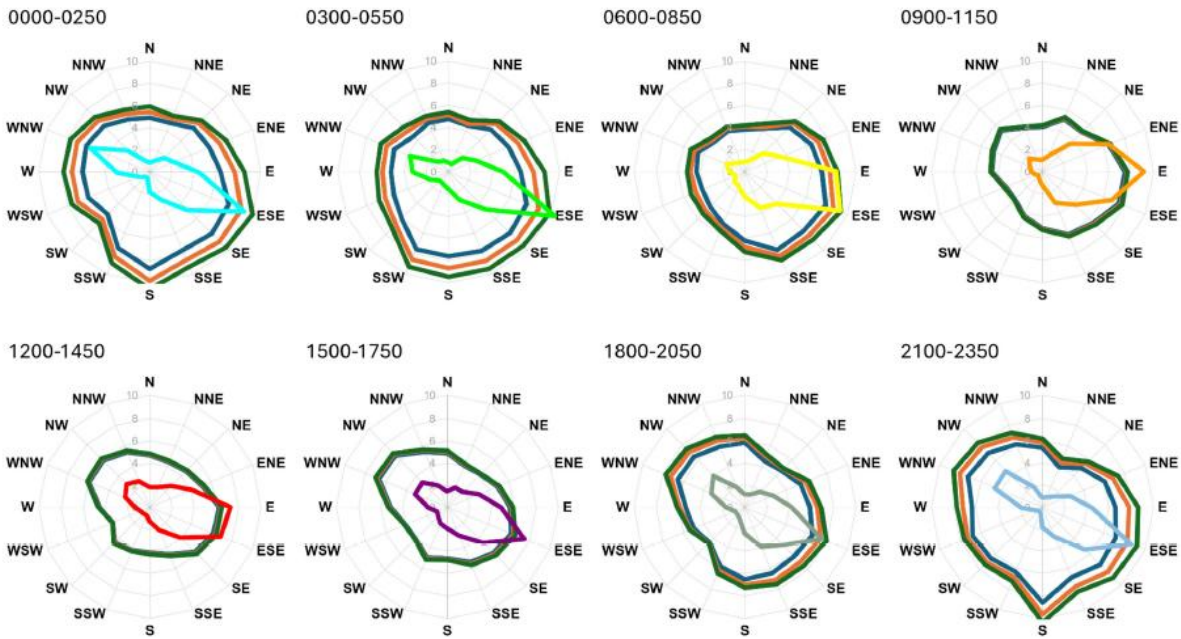


Figure 4: Three hourly mean wind speed at 60 m (blue), 90 m (orange) and 120 m (green) for Bonney Downs, 2024, with wind direction frequency in multicolour. Time is local (AWST). Data: BDMM (Fortescue, 2025).

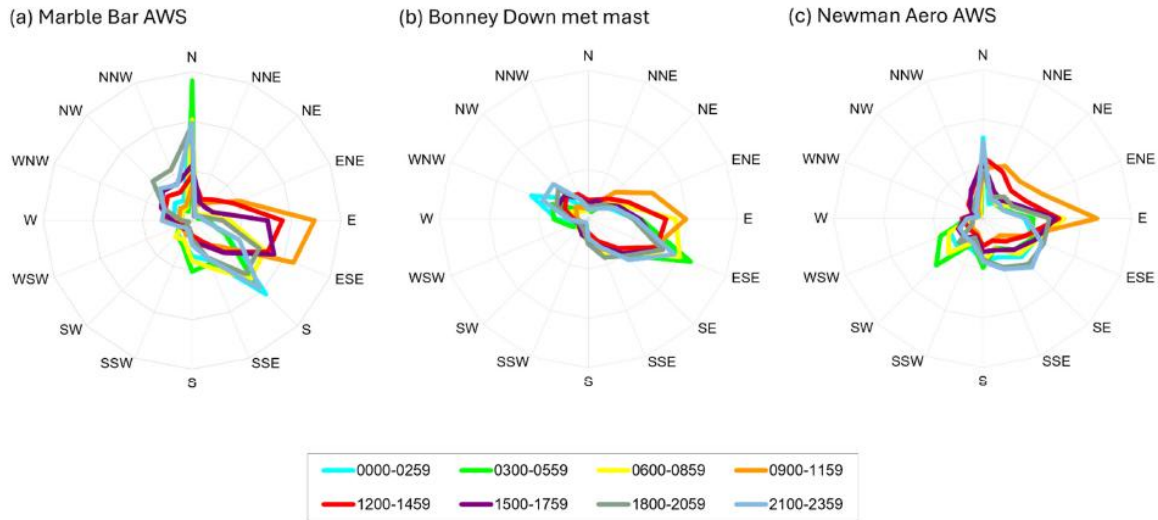


Figure 5: Three hourly mean wind directions at (a) Marble Bar (10 m height, 103 km north of Bonney Downs); (b) Bonney Downs (117 m height); and (c) Newman Aero (10 m height, 149 km south of Bonney Downs), calculated for 2024. Time is local (AWST). Data: BDMM (Fortescue, 2025); Marble Bar and Newman Aero AWS data, (Australian Bureau of Meteorology, 2025).

4.1.3 Survey Effort

The total survey effort undertaken over the 24 months is outlined in Table 17. Detailed survey effort for each BBSUS is provided in Appendix J.

Table 17: Survey site locations, habitat types and survey effort (BBSUS and ARU).

Site	Site type	Habitat	Number of BBSUS	Number of recording nights (ARU)
BB001	Reference	Drainage Line/River/Creek (major)	21	13
BB002	Reference	Plain (stony/gibber)	21	13
BB003	Reference	Drainage Line/River/Creek (major)	21	13
BB004	Reference	Plain (stony/gibber)	21	13
BB005	Impact	Plain (stony/gibber)	21	13
BB006	Impact	Drainage Line/River/Creek (major)	24	13
BB007	Impact	Plain (stony/gibber)	24	15
BB008	Reference	Plain (stony/gibber)	24	11
BB009	Reference	Plain (stony/gibber)	24	14
BB010	Impact	Woodland (open)	24	14
BB011	Impact	Drainage Line/River/Creek (major)	24	20
BB012	Impact	Plain (stony/gibber)	24	14
BB013	Impact	Drainage Line/River/Creek (major)	24	14
BB014	Impact	Plain (stony/gibber)	24	14
BB015	Reference	Hills/Ranges/plateaux	24	22
BB016	Impact	Station Dam, permanent water	24	17
BB017	Impact	Plain (stony/gibber)	24	18
BB018	Impact	Drainage Line/River/Creek (major)	24	16
BB019	Impact	Plain (stony/gibber)	24	17
BB020	Impact	Woodland (open)	24	15
BB021	Impact	Drainage Line/River/Creek (major)	24	16
BB022	Reference	Drainage Line/River/Creek (major)	24	16
BB023	Impact	Drainage Line/River/Creek (major)	24	16
BB024	Reference	Plain (stony/gibber)	24	16
BB025	Impact	Plain (stony/gibber)	24	15
BB026	Impact	Hills/Ranges/Plateaux	24	16
BB027	Impact	Plain (stony/gibber)	24	16
BB028	Impact	Plain (Cracking clays)	24	16
BB029	Impact	Plain (Cracking clays)	24	15
BB030	Impact	Rocky Escarpments	24	16
BB031	Impact	Drainage Line/River/Creek (major)	24	16
BB032	Reference	Plain (stony/gibber)	24	16
BB033	Impact	Plain (stony/gibber)	24	15
BB034	Impact	Woodland (open)	24	14
BB035	Impact	Plain (stony/gibber)	24	14

Site	Site type	Habitat	Number of BBSUS	Number of recording nights (ARU)
BB036	Impact	Drainage Line/River/Creek (major)	24	16
BB037	Impact	Plain (Cracking clays)	24	14
BB038	Impact	Plain (stony/gibber)	24	16
BB039	Impact	Drainage Line/River/Creek (major)	24	16
BB040	Impact	Rocky Escarpments	24	16
Total			945	610

4.1.4 Limitations and Constraints

An assessment of survey-specific issues and limitations is detailed in Table 18.

Table 18: Fauna survey limitations.

Aspect	Limitation?	Comment
Competency/experience of the consultant carrying out the survey.	Nil	The principal zoologist leading the surveys has 15+ years of experience conducting terrestrial vertebrate fauna and avifauna surveys in the Pilbara bioregion of Western Australia. Experienced zoologists with 5+ years of avifauna survey experience were used to undertake bird and bat site utilisation surveys.
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	Nil	The fauna survey focussed on collecting baseline avifauna and bat data, focussing on significant fauna species occurring in the survey area which may be impacted by wind farm infrastructure in order to quantify turbine strike risk. The scope was well defined. Standardised and well-established techniques were used to conduct surveys, with further refinement of methods undertaken in conjunction with advice from statistical analysts. Relevant databases and previous surveys of the survey area were reviewed.
Proportion of fauna identified, recorded and/or collected.	Nil	BBSUS focussed on identification of significant species occurring in the survey area and summary of flight heights and behaviours exhibited by these species in situ to inform CRM analysis. All taxa observed were identified and incidental records of raptors and significant species were collected to supplement systematic survey methods.
Sources of information (previously available information as distinct from new data).	Minor	Database records, including significant fauna species, were available for the area and are considered adequate in providing appropriate contextual information for the study. Published literature relating to maximum flight heights and flight behaviours of significant fauna in the context of wind farm risk assessments was limited for most species. Where insufficient information was available, a conservative approach was taken to account for data deficiencies.




Aspect	Limitation?	Comment
The proportion of the task achieved and further work which might be needed.	Nil	Planned survey works were conducted and completed. This report represents an interim summary of findings from the second year of BBSUS, with an additional three years of monitoring still to be conducted.
Timing/weather/season/cycle	Nil	The surveys were conducted during an appropriate time/season. Seasonal conditions during the February 2024, June 2024 and February 2025 surveys were conducive to high levels of migratory bird and waterfowl activity, following above-average rainfall.
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	Nil	The February 2025 survey was interrupted due to a large rainfall event, where staff were required to evacuate. The survey phase was completed later in the month once conditions were safe to proceed. All other survey phases were conducted without disturbance and survey effort was not adversely affected by weather events, natural disasters or accidental human intervention.
Intensity (in retrospect was the intensity adequate).	Minor	Although the size of the survey area and availability of access tracks prevents visual coverage of the entire survey area, the distribution of BBSUS sites provided adequate site and habitat coverage to ensure a representative sample was obtained.
Completeness (e.g. was relevant area fully surveyed).	Nil	Although heritage and pastoral land-access restrictions prevented small portions of the survey area from being directly accessed during the surveys, representative areas of habitat were able to be sampled elsewhere within the survey area. Access restrictions do not constitute a limitation for the observational surveys undertaken as part of the current assessment.
Resources (e.g. degree of expertise available in animal identification to taxon level).	Nil	Resources were adequate to carry out the survey and survey participants were competent in the identification of species. There were no resource or expertise issues encountered.
Remoteness and/or access problems.	Nil	There were no access issues.
Availability of contextual (e.g. biogeographic) information on the region.	Nil	Sufficient contextual information was available on the Pilbara region and the survey area.
Efficacy of sampling methods (i.e. any groups not sampled by survey methods).	Nil	Data analysis indicates that the current survey methodology displays good site coverage and sampling of different seasons.




4.1.5 Fauna Habitat



Fauna habitat assessments were undertaken to describe and map fauna habitat types with the potential to support significant fauna species within the survey area. After assessing the fauna habitat types identified, based on vegetation types, soil units, and landforms present, 10 broad fauna habitat types were identified within the survey area: Woodland (open), Woodland (closed), Plain (stony/gibber), Plain (cracking clays), Granite Outcrops (flat dome), Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways), Hills/Ranges/Plateaux, Gorges/Gullies, Drainage Line/River/Creek (major) and Drainage Line/River/Creek (minor) (Table 19, Map 7). An additional 0.99% of the survey area was mapped as Cleared, lacking suitable habitat for terrestrial vertebrate fauna.



From a local perspective, habitat features that are disjunct and provide sources of shelter, food and mesic qualities required for restricted species may be considered important. The Plain (stony/gibber) (79.22%) habitat type was the dominant feature of the survey area, with widespread grazing and trampling disturbances from European cattle documented throughout these areas. This habitat is widespread at a local and regional level and is not restricted to the survey area.

Table 19: Fauna habitats in the survey area.

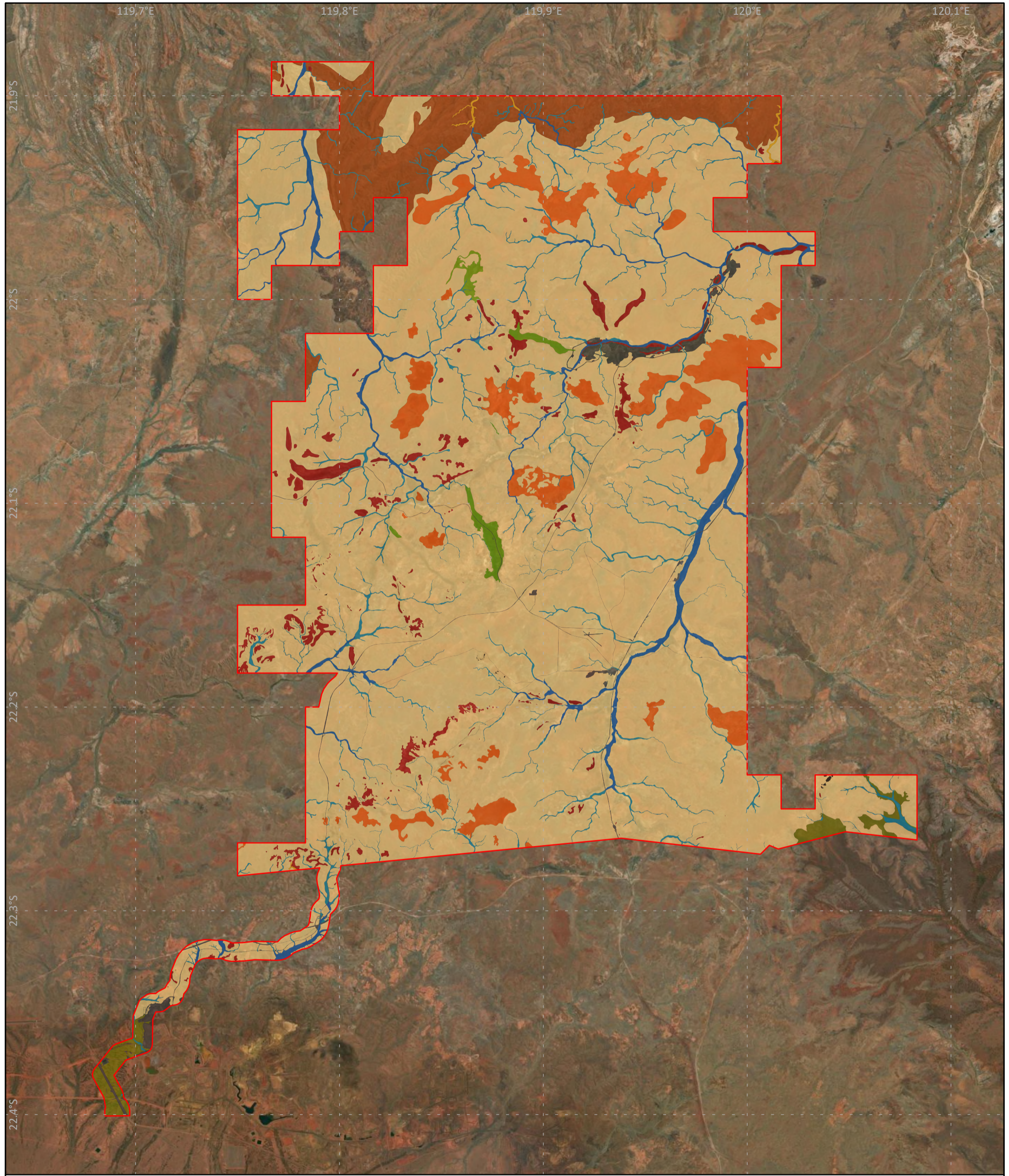
Broad habitat type	Area (ha)	%	Number of BBSUS sites	Vegetation description	Fauna suitability	Representative photos
Woodland (open)	573.49	0.56	2 sites	Open <i>Acacia aptaneura</i> (mulga) woodland over scattered mixed shrubs over scattered tussock grassland and herblands on red soil, sandy loam plains and stony substrates.	<p>Mulga woodlands are only found in small, isolated patches within the survey area usually associated with alluvial deposits. Some areas of the mulga woodland habitat were burnt at the time of survey. Refuges for fauna include woody debris and substrates conducive for burrowing by monitor species and trap door spiders.</p> <p>Widespread habitat degradation associated with grazing and trampling by European cattle was recorded within this habitat type, particularly in areas of mulga woodland adjacent to water sources.</p> <p>The grey falcon (VU) was recorded within this habitat type and may utilise Woodland (open) habitat while foraging.</p>	
Woodland (closed)	884.00	0.86	Incidental observations only	Dense <i>Acacia aptaneura</i> (mulga) woodland over scattered mixed shrubs over scattered tussock grassland and herblands on red soil, sandy loam plains and stony substrates.	<p>Mulga woodlands are only found in small, isolated patches within the survey area usually associated with alluvial deposits. Some areas of the mulga woodland habitat were burnt at the time of survey. Refuges for fauna include woody debris and substrates conducive for burrowing by monitor species and trap door spiders.</p> <p>Widespread habitat degradation associated with grazing and trampling by European cattle was recorded within this habitat type, particularly in areas of mulga woodland adjacent to water sources.</p> <p>No significant fauna taxa were recorded within this habitat type.</p>	
Granite Outcrops (flat dome)	12.46	0.01	Incidental observations only	Exposed boulder piles and domes, the vegetation is sparse and limited to scattered <i>Triodia</i> sp. hummocks and other soft grasses. Sandy substrate with no leaf or wood litter.	<p>Cracks and crevices, overhangs and the underside of rocks may provide shelter and foraging opportunities for terrestrial fauna.</p> <p>The open nature and small extent of this habitat type makes it unlikely to provide critical habitat for significant fauna; however, significant bats and both falcons may intermittently utilise this habitat while foraging or dispersing.</p> <p>No significant fauna taxa were recorded within this habitat type.</p>	

Broad habitat type	Area (ha)	%	Number of BBSUS sites	Vegetation description	Fauna suitability	Representative photos
Plain (stony/gibber)	81388.91	79.17	15 sites	Low open <i>Eucalyptus leucophloia</i> woodland over <i>Acacia bivenosa</i> and <i>Acacia inaequilatera</i> scattered shrubs over <i>Triodia longiceps</i> , <i>Triodia epactia</i> , <i>Triodia brizoides</i> , <i>Triodia wiseana</i> mid-dense hummock grassland. Some areas supporting <i>Acacia xip hophylla</i> (snakewood) tall shrubland.	<p>Stony or stony sand on undulating plains and low rises with spinifex hummock grasslands on loam-clay with a stony mantle. Mixed <i>Acacia</i> open shrubland may be present in isolated areas. The Pilbara leaf-nosed bat and ghost bat are known to forage in these areas.</p> <p>This habitat type is well represented at a local and regional scale and is not restricted to the survey area.</p> <p>The grey falcon (VU) and Pilbara leaf-nosed bat (VU) were recorded within this habitat type.</p> <p>Areas of Plain (stony/gibber) habitat containing long-unburnt <i>Triodia longiceps</i> may provide suitable roosting habitat for the night parrot (if present).</p>	
Plain (cracking clays)	5755.22	5.60	3 sites	Mid-sparse <i>Acacia synchronicia</i> and <i>Vachellia farnesiana</i> shrubland over low <i>Aristida latifolia</i> , <i>Cynodon convergens</i> , <i>Rhynchosia minima</i> tussock grassland/ herbland.	<p>Basalt upland gilgai plains associated with the Wona Land System supporting scattered shrubs over grasses and herbs. Provides quality foraging for granivores including cockatoos and budgerigars with large flocks recorded foraging in this habitat type. Habitat degradation associated with grazing and trampling by European cattle.</p> <p>The Pilbara leaf-nosed bat (VU) was recorded within this habitat type.</p> <p>Although this habitat type may provide foraging habitat for the night parrot, widespread cattle grazing and trampling throughout the survey area is likely to prevent year-round presence of potential foraging resources. Usage of herbland within this habitat type by the night parrot (if present) is limited to areas with low/no cattle impacts, during periods of high seasonal productivity only.</p>	
Hills/Ranges/Plateaux	6446.92	6.27	1 site	Low open <i>Eucalyptus</i> woodland over mixed <i>Acacia</i> and <i>Senna</i> shrubland over mixed <i>Triodia</i> low hummock grassland.	<p>Hills/Ranges/Plateaux consists of large ranges and hills associated with the Capricorn Land System with ridgelines and cliffs containing caves may provide shelter and foraging habitat for species such as the Pilbara leaf-nosed bat and ghost bat.</p> <p>No significant fauna taxa were recorded within this habitat type.</p>	

Broad habitat type	Area (ha)	%	Number of BBSUS sites	Vegetation description	Fauna suitability	Representative photos
Gorges/Gullies	82.56	0.08	Incidental observations only	Low open <i>Acacia cyperophylla</i> var. <i>omearana</i> , <i>Corymbia candida</i> woodland over tall sparse <i>Acacia tumida</i> , <i>Grevillea wickhamii</i> , <i>Santalum lanceolatum</i> shrubland over mixed <i>Triodia</i> and <i>Eriachne</i> low sparse tussock/hummock grassland.	<p>Gorges and Gullies are characterised by steep sided rocky habitats with breakaways, caves, crevices, and cracks with a number of semi-permanent and permanent water sources present at the time of survey. Moist areas, woody debris along with dense shrubbery and leaf litter provide shelter and habitat for ground dwelling species.</p> <p>Permanent and semi-permanent waterholes within this habitat type provide important habitat for numerous species (including the ghost bat, Pilbara leaf-nosed bat and grey falcon).</p> <p>No significant fauna taxa were recorded within this habitat type.</p>	
Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)	2142.95	2.08	2 sites	Mixed shrubland of <i>Acacia</i> sp., <i>Senna</i> sp., <i>Hakea</i> sp., <i>Eremophila</i> , <i>Ptilotus obovatus</i> , <i>Paspalidium clementii</i> and <i>Solanum lasiophyllum</i> over hummock grassland of <i>Triodia</i> sp.	<p>Rocky features from small-scale rock face to large protruding rocks/boulders and mesas, usually associated with the tops or bases of ridgelines, stony hills and rises. Ridgelines, cliff, breakaways, boulders, crevices and caves within this habitat type may provide shelter, foraging and potential roosting habitat for species such as the ghost bat and Pilbara leaf-nosed bat.</p> <p>The Pilbara leaf-nosed bat (VU) was recorded within this habitat type.</p>	

Broad habitat type	Area (ha)	%	Number of BBSUS sites	Vegetation description	Fauna suitability	Representative photos
Drainage Line/River/Creek (major)	2027.21	1.97	8 sites	Open woodland of <i>Eucalyptus camaldulensis</i> and <i>Eucalyptus victrix</i> over and <i>Acacia coriacea</i> subsp. <i>pendens</i> over mixed <i>Cenchrus</i> and <i>Triodia</i> low tussock and hummock grassland.	<p>Generally encompassing major drainage lines and associated tributaries, this habitat type feature deeply incised drainage channels, ephemeral and permanent pools and a higher density of vegetation than surrounding areas. Substrates of gravelly sand or rocks on clay/loam soils provide quality burrowing substrates. Scattered trees and shrub species provide dispersal and foraging habitat for significant species including the grey falcon, Pilbara leaf-nosed bat and ghost bat.</p> <p>The ghost bat (VU), grey falcon (VU) and Pilbara leaf-nosed bat (VU) were recorded in this habitat type.</p>	
Drainage Line/River/Creek (minor)	2420.29	2.35	4 sites	Scattered <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over <i>Acacia pruinocarpa</i> over <i>Triodia epactia</i> , <i>Eriachne lanata</i> low hummock/tussock grassland.	<p>This habitat type features shallow incised drainage channels and a higher density of vegetation than surrounding areas. Substrates of gravelly, sand or rocks on clay/loam soils supports scattered trees and shrubs.</p> <p>The grey falcon (VU) and Pilbara leaf-nosed bat (VU) were recorded in this habitat type.</p>	
Cleared	1068.55	1.04	5 sites	N/A	<p>Anthropogenic clearing with little to no vegetation.</p> <p>The grey falcon and Pilbara leaf-nosed bat were both recorded in this habitat type; however, these records are associated with dispersal or utilisation of man-made waterbodies rather than permanent occupancy.</p>	N/A
Total	102,803*	100*				

* Value rounded to the nearest whole number.



- Survey area**
- Survey area
- Habitat type**
- Cleared
 - Drainage Line/River/Creek (major)
 - Drainage Line/River/Creek (minor)
 - Gorges/Gullies
 - Granite Outcrops (flat dome)
 - Hills/Ranges/Plateaux
 - Plain (Cracking clays)
 - Plain (stony/gibber)
 - Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
 - Woodland (closed)
 - Woodland (open)

4.1.6 Avifauna Surveys

A total of 6,160 observations of 121 avifauna taxa were recorded during BBSUS at Bonney Down (Table 20). Species observations made during BBSUS comprise 94.53% of the total number of avifauna taxa recorded over the 24 months. Three thousand, six hundred and eight BBSUS records lack flight height data as they were associated with ground-dwelling taxa or species known to fly below the RSA.

Although the first two survey periods (October 2023 and March 2024) appear to have had significantly more species recorded during BBSUS, this disparity is attributed to methodological refinements which were implemented following the March 2024 survey rather than a true difference between surveys. These survey methodologies and associated changes are outlined in Section 2.2.9.

A summary of the avifauna observations recorded during BBSUS is provided in Table 20 and discussion on avifauna species assemblages is detailed in Section 4.2.

Table 20: Summary of avifauna observations made during BBSUS.

Year	Month	Season	Number observations with flight height data	Number observations without flight height data	Total number of species observed during BBSUS (including species without flight height data)
2023	October	Spring	508	70	67
2024	February	Summer	658	0	78
2024	March	Autumn	729	106	76
2024	June	Winter	147	599	75
2024	September	Spring	98	777	76
2025	February	Summer	118	822	83
2025	April	Autumn	183	528	76
2025	August	Winter	111	706	82
Total			2,552	3,608	121

4.1.7 Incidental Observations

A total of 505 incidental observations of 29 avifauna species were recorded at Bonney Downs across the 24 months (eight surveys). The majority of species recorded incidentally were also recorded during BBSUS; however, two species, western quail-thrush (*Cincoloma marginatum*) and pied stilt (*Himantopus leucocephalus*) were only recorded incidentally during the two-year survey period.

A summary of the incidental avifauna observations recorded over the 24 months (eight surveys) is provided in Table 21 and discussion on avifauna species assemblages in detailed in Section 4.2.

Table 21: Incidental avifauna observations recorded during each BBSUS phase.

Year	Month	Season	Total number of incidental observations	Total number of species observed incidentally
2023	October	Spring	8	4
2024	February	Summer	42	16
2024	March	Autumn	65	7
2024	June	Winter	105	12
2024	September	Spring	47	6
2025	February	Summer	47	8
2025	April	Autumn	154	19
2025	August	Winter	32	11
Total			505	29

4.1.7.1 Species Accumulation Curve

The avifauna species richness of the survey area was estimated using the Chao2, ICE, Jackknife 1, Jackknife 2, and Bootstrap, with estimators ranging from 131.1 to 161.7 species (Table 22). Observed species richness (S) recorded during BBSUS was 121, representing between 74.90% and 92.30% of the estimated species richness values. The species accumulation curve shows that the addition of new species approaches zero (asymptote) after 40 sites (Figure 6), suggesting that further site-based surveys are unlikely to increase the number of observed avifauna species at the sampling locations. An additional seven species were recorded opportunistically within the survey area during the two-year BBSUS period (2 species) and previous detailed surveys (five species), for a total of 128 species, which is comparable to estimated species richness values. Therefore, for the purposes of this survey, consolidated avifauna sampling effort is considered adequate.

Table 22: Species richness estimates for avifauna.

Data	
N (number of reference samples)	40
S (observed number of taxa within sites)	121
No. of singletons	7
No. of doubletons	7
No. species recorded opportunistically	7
Total species observed	128
<i>Species richness estimator</i>	
ICE	<i>Estimated species richness</i> ±SD ¹
Chao2	159.44±21.83
Jackknife 1	144.4±9.03
Jackknife 2	161.65
Bootstrap	131.1

¹Standard deviation is not calculated for some estimators.

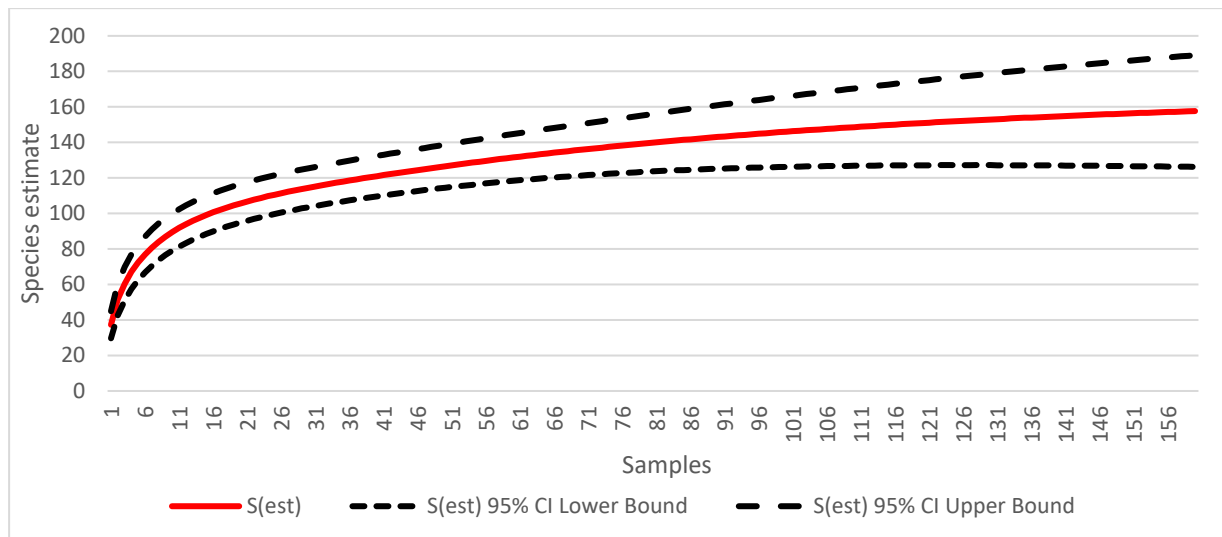


Figure 6: Extrapolated rarefaction curve of estimated avifauna species richness (S_{est}) after 40 sampling sites.

4.1.7.2 Targeted Bird Surveys

One hundred and thirty-four hours of targeted grey falcon searches were completed during the detailed and targeted fauna surveys undertaken by ecologia (2024a). The results of these searches and locations of raptor/corvid nests identified during these surveys were utilised to inform subsequent grey falcon searches undertaken during the BBSUS.

Targeted searches for the grey falcon were undertaken during each BBSUS sampling period, with search effort focused on major creeklines in the vicinity of areas where the species had been recorded. During targeted searches, known nests were monitored for evidence of occupancy by grey falcons, and any additional nest locations identified were recorded.

As part of the targeted BBSUS searches, a grey falcon individual was recorded defending a nest against other raptors in August 2025, with subsequent observations recorded outside of the two-year BBSUS sampling period confirming the presence of a female grey falcon incubating an active nest and subsequent fledging of a single chick.

4.2 AVIFAUNA SPECIES ASSEMBLAGE

Database searches and the literature review identified 187 avifauna species with the potential to occur within the survey area. A regional species summary is provided in Appendix C.

A total of 123 avifauna taxa were recorded at Bonney Downs over the 24 months (eight surveys) of BBSUS, with five additional avifauna species (black swan, emu, white-browed babbler, grey honeyeater and barn owl) recorded during previous detailed and targeted surveys undertaken at Bonney Downs (ecologia, 2024b). The consolidated avifauna assemblage recorded (128 species) represents 68.4% of the total avifauna taxa potentially occurring within the survey area based on database searches and the literature review.

Forty-five families were recorded during BBSUS, with the highest species diversity recorded from the Accipitridae (10 species) and Meliphagidae (eight species) families. Species most recorded commonly during BBSUS included the yellow-throated miner (345 records), Australian zebra finch (266 records), nankeen kestrel (249 records) and white-plumed honeyeater (220 records). A site-by-species matrix is provided in Appendix G.

At-risk species groups recorded within the survey area over the 24 months included raptors, waterbirds, swifts, woodswallows and nocturnal birds as detailed in Section 4.6.2. Fifteen

species of raptor were recorded during BBSUS, with no additional species recorded incidentally, 23 species of waterbird were recorded during BBSUS, with three additional species recorded incidentally. Three species of woodswallow were recorded during BBSUS. Seven nocturnal avifauna species were recorded incidentally within the survey area.

Three significant avifauna species were recorded during BBSUS comprising the grey falcon (*Falco hypoleucos* [VU]), fork-tailed swift (*Apus pacificus* [MI]) and oriental plover (*Anarhynchus veredus* [MI]). Further discussion regarding significant species results is detailed in Section 4.4.

4.2.1 Raptors

According to database search results and the literature review, 20 raptor species, comprising three families, have the potential to occur within the survey area. Fifteen raptor species from two families (Falconidae and Accipitridae), have been recorded within the survey area, with all 15 species recorded during BBSUS (Table 23). This represents 75.0% of the raptor assemblage potentially occurring within the survey area.

Table 23: Raptor observations recorded during BBSUS.

Common name	Scientific name	Number of observations	Maximum number of birds observed
Accipitridae			
Wedge-tailed eagle	<i>Aquila audax</i>	119	3
Spotted harrier	<i>Circus assimilis</i>	58	3
Black-shouldered kite	<i>Elanus axillaris</i>	7	1
White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>	2	1
Whistling kite	<i>Haliastur sphenurus</i>	93	3
Little eagle	<i>Hieraaetus morphnoides</i>	2	1
Square-tailed kite	<i>Lophoictinia isura</i>	2	1
Black kite	<i>Milvus migrans</i>	3	2
Collared sparrowhawk	<i>Tachypiza cirrocephalus</i>	19	1
Brown goshawk	<i>Tachypiza fasciatus</i>	11	1
Falconidae			
Brown falcon	<i>Falco berigora</i>	85	3
Nankeen kestrel	<i>Falco cenchroides</i>	249	4
Grey falcon	<i>Falco hypoleucos</i>	7	2
Australian hobby	<i>Falco longipennis</i>	15	2
Black falcon	<i>Falco subniger</i>	1	1

Figure 7 outlines the variation in raptor observation counts across different times of day. The majority of at-risk raptor species recorded within these groups have insufficient records available to differentiate activity trends. Peaks in nankeen kestrel observations were recorded during the early morning and late afternoon periods; however, these activity peaks generally coincide with sampling effort peaks.

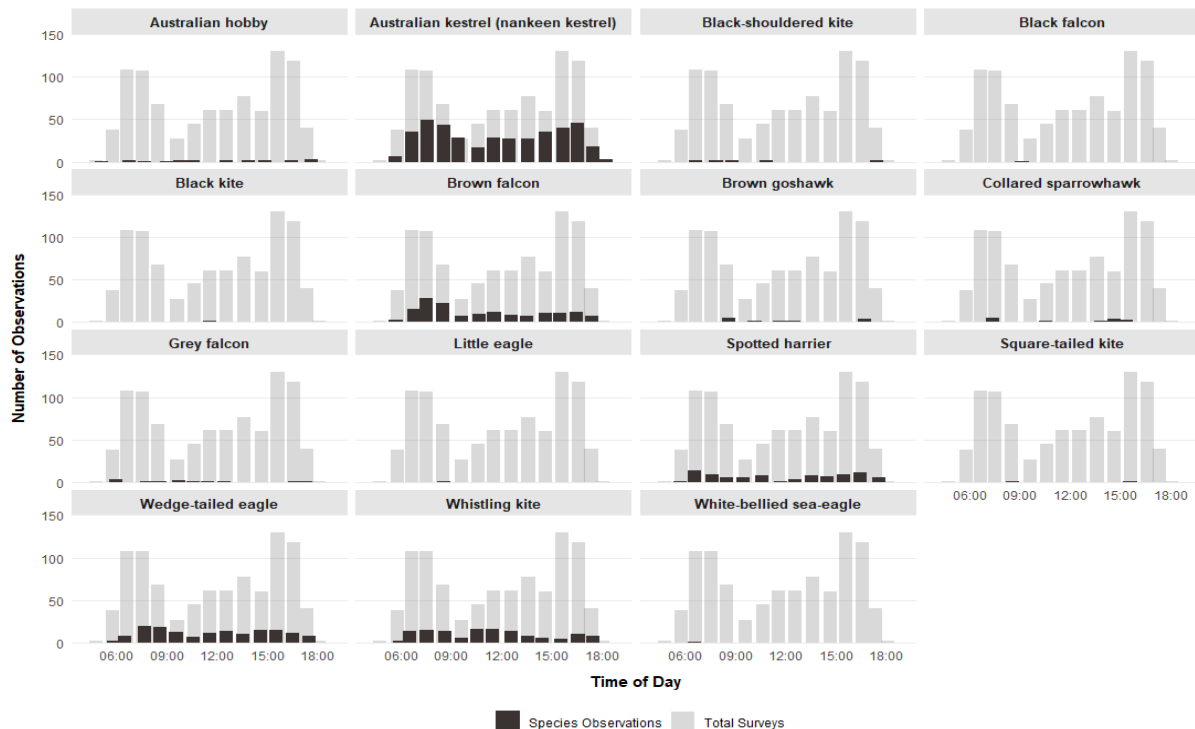


Figure 7: Variation in raptor observation counts across time of day.

Raptor behaviours

Seven raptor species have been consistently recorded over the 24 months of BBSUS, including the wedge-tailed eagle, brown falcon, nankeen kestrel, grey falcon, whistling kite, collared sparrowhawk and brown goshawk. These species have been recorded displaying a range of behaviours including nesting, roosting and foraging and are considered permanent residents within the survey area.

One additional species, the spotted harrier, has not been recorded nesting; however, the species has been consistently recorded foraging over the 24 months and is considered a permanent resident within the survey area.

Wedge-tailed eagle

The wedge-tailed eagle was recorded in the survey area on 191 occasions, comprising 119 records during BBSUS and 72 incidental records. The maximum number of wedge-tailed eagles recorded during a single observation was four individuals.

At least 22 wedge-tailed eagle breeding territories have been identified within the survey area over the 24 months (Map 8), with a territory defined as an area where at least two adults were recorded and at least one nest was identified. A further five unconfirmed breeding territories were identified, where adult wedge-tailed eagles were recorded on multiple occasions, but no nests were identified.

Nest monitoring in 2024 confirmed the occupation of 21 wedge-tailed eagle territories, with evidence of breeding recorded at seven nests. Two nests appeared to have failed (one during incubation and one during the nestling period) and five pairs appeared to successfully produce fledglings, with each nest producing at least one chick.

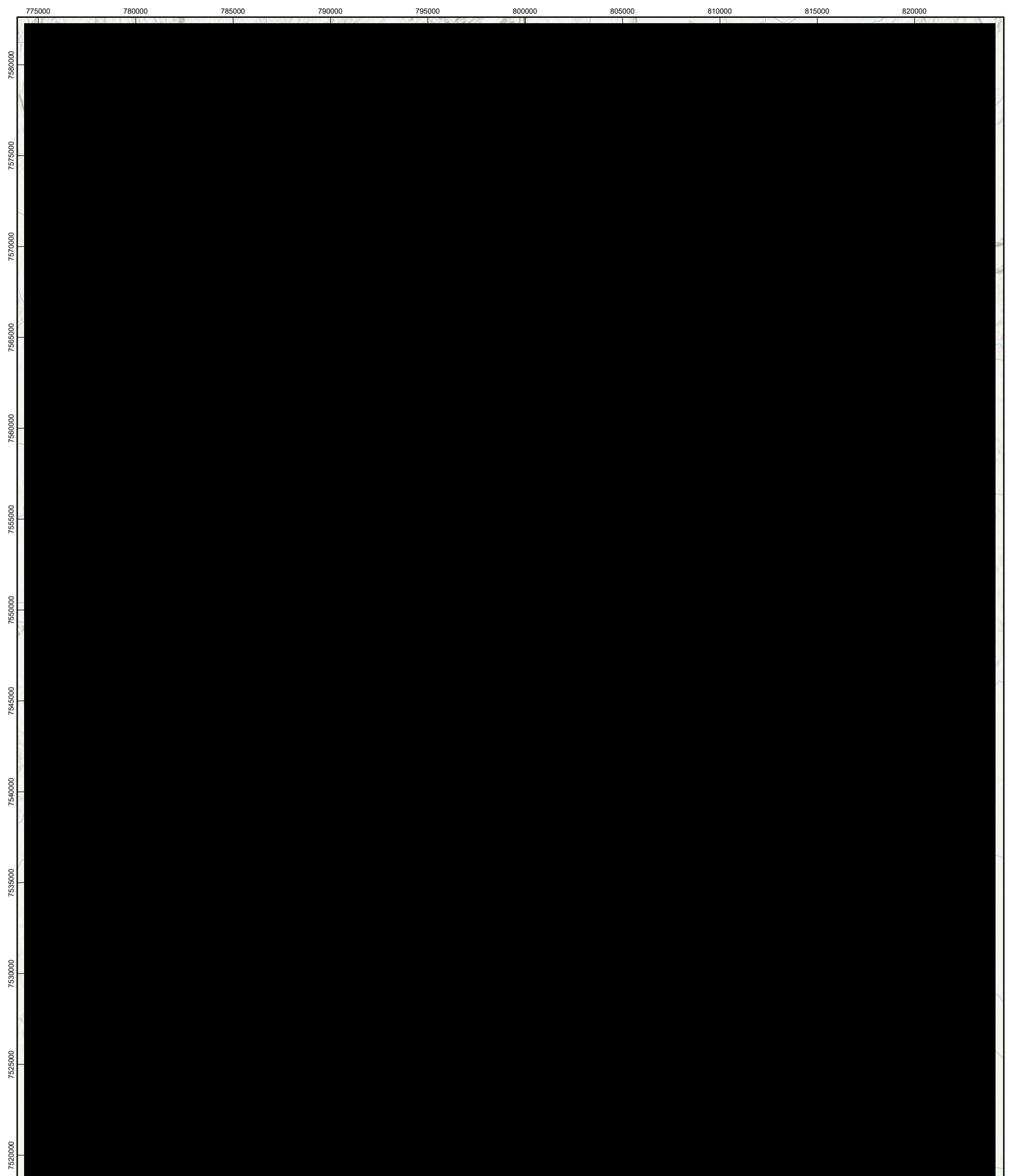
Nest monitoring in 2025 confirmed the occupation of 19 territories, with 10 nests recorded as being lined in preparation for breeding during the May 2025 survey. At least four of these nests had chicks present in the August 2025 survey, and at least three of these nests had eaglets

present in September 2025. The minimum number of productive nests for the 2025 breeding season was three, with four territories unable to be visited due to access issues.

An additional two wedge-tailed eagle territories were identified immediately adjacent to the survey area, with both territories occupied in 2025.

Habitat

Raptors have been recorded in eight habitat types across the survey area, including Drainage Line/River/Creek (major), Plain (Cracking clays), Gorges/Gullies, Drainage Line/River/Creek (minor), Plain (stony/gibber), Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways) Hills/Ranges/Plateaux, and Woodland (open).



- Habitat type**
- Cleared
 - Drainage Line/River/Creek (major)
 - Drainage Line/River/Creek (minor)
 - Gorges/Gullies
 - Granite Outcrops (flat dome)
 - Hills/Ranges/Plateaux
 - Plain (Cracking clays)
 - Plain (stony/gibber)
 - Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
 - Woodland (closed)
 - Woodland (open)

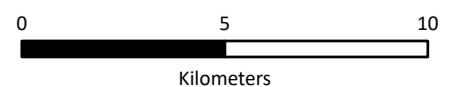
- Nest location and status (May 2025)**
- Nest lined
 - Unused
 - Egg layed
 - Old

- Breeding Territory (May 2025)**
- Occupied
 - No adult birds observed
 - Vacant
 - Survey area



Project No.: 1981
 Author: TM
 Created Date: 18 December 2025
 Coordinate System: GCS GDA 1994
 Scale: 1:190,000 @A3

Map 8: Wedge-tailed eagle territories and nest locations.



4.2.2 Waterbirds

According to database search results and the literature review, 56 waterbirds, belonging to 15 families, have the potential to occur within the survey area. A total of 23 waterbird species, representing nine families, were recorded during the BBSUS (Table 24), with three additional species (pied stilt, black-tailed nativehen and black swan) recorded in the survey area outside of BBSUS sampling periods.

Waterbirds recorded during BBSUS represent 46.4% of species potentially occurring within the survey area.

Behaviours

Seven waterbird species including, pink-eared duck, plumed whistling duck, black swan, little pied cormorant, grey teal, white-faced heron and Australasian darter were recorded breeding within the survey area, with records generally associated with the Bonney Downs station dam (BB016) and Bonney Creek (BB023).

Although waterbird species diversity and abundance of records appears to fluctuate slightly between seasons, the total number of waterbird taxa recorded each season remains generally consistent across seasons (13-15 species) (Figure 8). Abundances of most waterbird taxa appear to decrease in the dry season, potentially due to reduced availability of surface water; however, overall species diversity remains high during this period.

Table 24: Waterbird observations recorded during BBSUS.

Common name	Scientific name	Number of observations	Maximum number of birds observed
Anatidae			
Grey teal	<i>Anas gracilis</i>	31	30
Pacific black duck	<i>Anas superciliosa</i>	39	15
Hardhead	<i>Aythya australis</i>	3	2
Australian wood duck	<i>Chenonetta jubata</i>	11	5
Plumed whistling duck	<i>Dendrocygna eytoni</i>	3	9
Pink-eared duck	<i>Malacorhynchus membranaceus</i>	4	6
Anhingidae			
Australasian darter	<i>Anhinga novaehollandiae</i>	28	10
Ardeidae			
Great egret	<i>Ardea alba</i>	11	1
White-necked heron	<i>Ardea pacifica</i>	26	4
White-faced heron	<i>Egretta novaehollandiae</i>	40	5
Nankeen night heron	<i>Nycticorax caledonicus</i>	11	5
Charadriidae			
Oriental plover (MI)	<i>Anarhynchus veredus</i>	1	1
Black-fronted dotterel	<i>Charadrius melanops</i>	56	9
Red-kneed dotterel	<i>Erythrogonys cinctus</i>	2	2
Ciconiidae			
Black-necked stork	<i>Ephippiorhynchus asiaticus</i>	2	1
Pelecanidae			
Australian pelican	<i>Pelecanus conspicillatus</i>	4	2
Phalacrocoracidae			
Little pied cormorant	<i>Microcarbo melanoleucos</i>	25	5
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	25	24
Pied cormorant	<i>Phalacrocorax varius</i>	2	1
Podicipedidae			

Common name	Scientific name	Number of observations	Maximum number of birds observed
Hoary-headed grebe	<i>Poliiocephalus poliocephalus</i>	6	2
Australasian grebe	<i>Tachybaptus novaehollandiae</i>	5	5
Threskiornithidae			
Royal spoonbill	<i>Platalea regia</i>	2	1
Straw-necked ibis	<i>Threskiornis spinicollis</i>	14	14



Figure 8: Variation of waterbird and Migratory species observation counts across season.

Habitat

Waterbirds were recorded in five habitat types across the survey area including: Drainage Line/River/Creek (major), Hills/Ranges/Plateaux, Plain (cracking clay), Plain (stony/gibber) and Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways).

4.2.3 Migratory Birds

Two Migratory bird taxa (fork-tailed swift and oriental plover) were recorded during the BBSUS surveys. The fork-tailed swift was recorded on four occasions during a single survey undertaken during the wet season (February 2025) (Figure 8). Fork-tailed swifts were recorded flying below RSA on all occasions. The oriental plover was recorded on a single occasion (September 2024) during the southward migration (Figure 8) and was recorded flying well below the RSA.

4.2.4 Culturally Significant Species

Two culturally significant species (Australian bustard and black-necked stork) were recorded during BBSUS. Neither species has been recorded flying within the RSA during BBSUS or incidental observations.

4.2.5 Nocturnal Birds

Seven nocturnal bird species were recorded at Bonney Downs through a combination of BBSUS, incidental sightings, nocturnal spotlighting and motion camera trap images. Nocturnal species recorded on site include the southern boobook, barking owl, tawny frogmouth, bush stone-curlew, barn owl, Australian owl nightjar and spotted nightjar. Although these species are active at night and therefore represent a key group for consideration during wind farm projects due to increased turbine strike risk resulting from reduced visibility, limited site-specific flight height data is available for these species. These species have been assessed as having a moderate strike risk based on the precautionary principle. No nocturnal species of conservation significance have been recorded within the survey area.

Behaviours

Nocturnal birds recorded during the BBSUS were generally recorded roosting during daytime surveys in the vicinity of drainage lines, with additional records obtained from motion cameras and spotlighting activities.

Two pairs of barking owls have been recorded within the survey area, one at Bonnie Pools and another at the Bonney Downs Homestead. Since both pairs have been regularly recorded at these locations, they are considered permanent residents within the survey area.

Habitat

Tree-lined water courses (creeklines and waterbodies) within the survey area provide suitable roosting and breeding habitat for owls, frogmouths and nightjars.

4.2.6 Woodswallows and Swallows

Three woodswallow species (masked woodswallow, black-faced woodswallow and little woodswallow) and the welcome swallow were recorded during the BBSUS. Although the masked woodswallow was infrequently recorded, both species were recorded flying within RSA height. The black-faced woodswallow was recorded more frequently; however, the species was not recorded flying within the RSA during the BBSUS. Flight height data was not available for the welcome swallow, as this species was incidentally recorded and a single record of the little woodswallow was recorded below RSA.

4.2.7 Flight Heights

Flight height analysis was undertaken for all species recorded during the two-year BBSUS sampling period (Table 25, Figure 9). The majority of flights (95.6%) recorded during BBSUS were undertaken at heights below the RSA (84.5% below 41 m, 11.1% between 41-96 m), 3.3% of flights recorded within the RSA and 1.1% of flights were above RSA (Table 25). Eight raptors were recorded flying at RSA height during BBSUS and incidental observations, including the grey falcon

(VU), wedge-tailed eagle, whistling kite, spotted harrier, black-kite, nankeen kestrel, black falcon and brown falcon (Figure 9). Six waterbirds were recorded flying at RSA height comprising the straw-necked ibis, Australasian darter, white-necked heron, Australian pelican, little black cormorant and little pied cormorant (Figure 9). Two other species (masked woodswallow and Torresian crow) were also recorded flying within RSA height (Figure 9).

Seven species were recorded flying above RSA height during the 24-month monitoring period, with five raptors (wedge-tailed eagle, spotted harrier, whistling kite, nankeen kestrel and brown falcon), and two waterbirds (Australian pelican and straw-necked ibis) recorded above RSA height through a combination of BBSUS and incidental sightings.

Five-hundred and ninety-seven raptor observations were recorded during BBSUS, with 11.9% occurring within the RSA and 3.9% occurring above RSA. Of the 258 waterbird sightings that were recorded during BBSUS, only 6.9% occurred within RSA. A single waterbird species was recorded flying above RSA during the BBSUS sampling periods.

Table 25: Summary of flight height observations for all species recorded at Bonney Downs.

Observed height range	BBSUS		Incidental observations	
	Observation count (%) [*]	Species observed	Observation count	Species observed
0 - 40 m	1,990 (84.5)	101	378	28
41 - 96 m	261 (11.1)	37	87	14
< 100 m [*]	197 (N/A)	50	0	0
97 - 279 m (RSA)	78 (3.3)	16	36	8
> 280 m	26 (2.2)	6	4	3
Total	2,355 [*]	107	505	29

^{*}Observations from Survey 1 – October 2023 were categorised into flight ranges rather than specific values, these values have been separated from the RSA height to avoid artificial inflation of observation and species counts. These records are not included in percentage calculations.

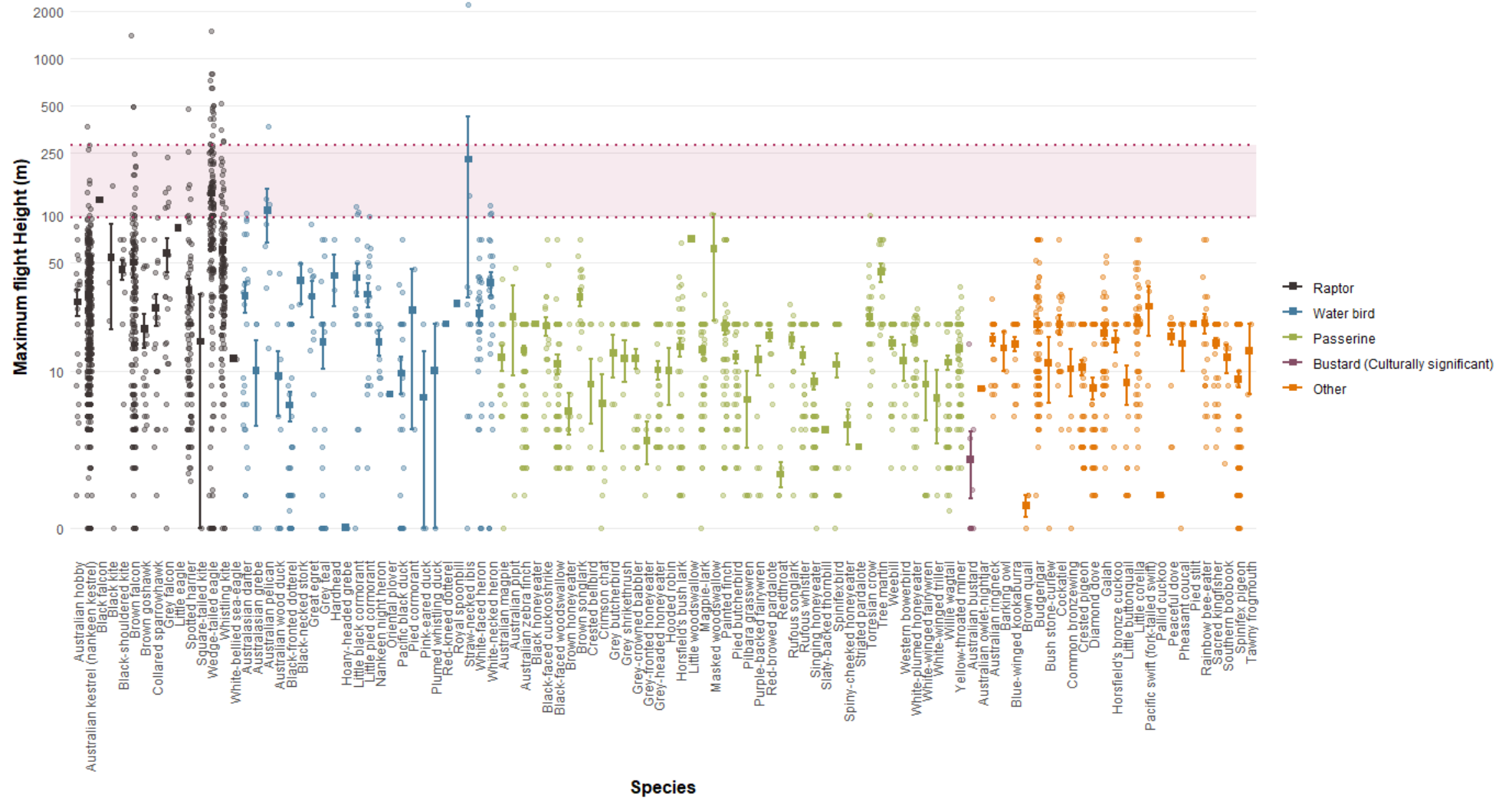


Figure 9: Maximum flight heights recorded at Bonney Downs. NB: squares denote mean and bars denote standard error.

4.2.7.1 Seasonal variations

Insufficient records are available to identify seasonal variations in flight behaviours above 97 m; however, species abundances recorded below RSA (<97 m) appear to exhibit a noticeable reduction during the dry season (Figure 10)

Figure 10). Abundances of individual birds recorded below RSA appear to be highest during the northward migration window, followed by the wet season and southward migration.

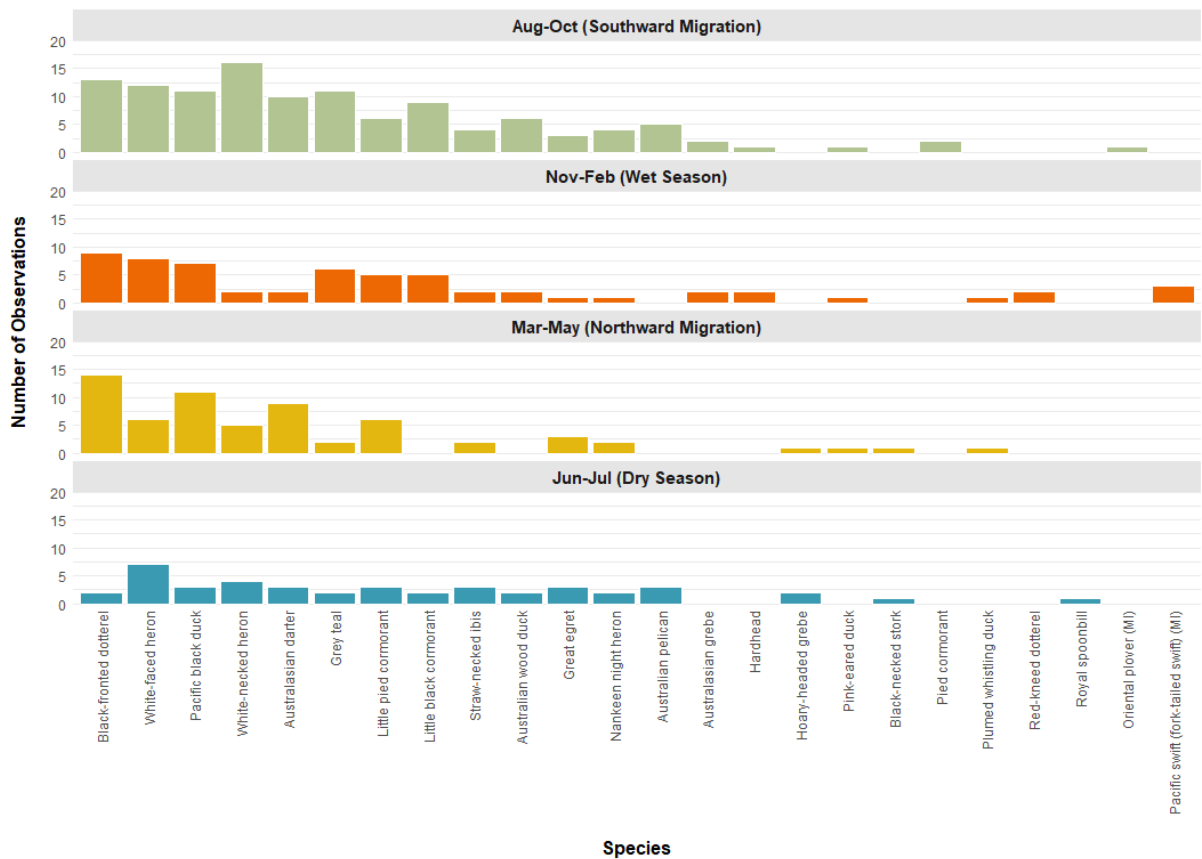


Figure 10: Seasonal variation in abundance and maximum flight heights observed (all species). NB: n=Total number of observations.

4.2.7.2 Raptor flight height trends (daily)

Limited trends in flight height data by time of day were recorded, primarily owing to the low numbers of flight height records available for a number of raptor taxa. Five raptor species (wedge-tailed eagle, nankeen kestrel, brown falcon, spotted harrier and whistling kite) are active throughout the day, with records spanning between 06:00-18:00 (Figure 11). No clear variations in flight height across time of day appear to be exhibited by these species.

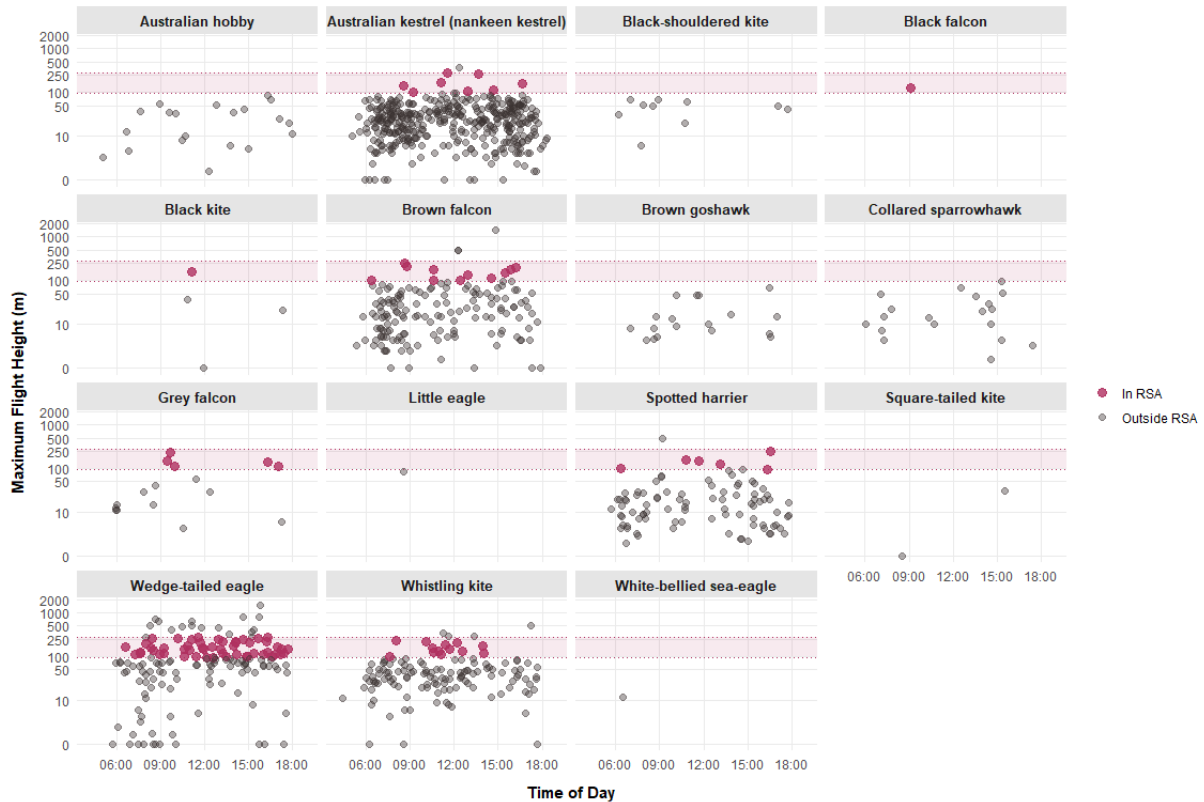


Figure 11: Maximum flight heights of raptors observed across time of day.

4.3 BAT SPECIES ASSEMBLAGE

According to database search results and the literature review, 16 bat species, representing six families, have the potential to occur within 100 km of the survey area (Appendix C). At least 12 bat taxa have been recorded at Bonney Downs to date, representing 75% of bat taxa potentially occurring within the survey area. A site-by-species matrix for bat species recorded at Bonney Downs during each survey is provided in Appendix D.

Echolocation calls belonging to at least 10 bat species were recorded at BBSUS sites, with two additional species (ghost bat [VU] and black flying-fox) incidentally recorded during the detailed and targeted surveys (Table 26). Decreased detections of the Finlayson's cave bat, greater northern free-tailed bat and northern free-tailed bat and increased detections of the yellow-bellied sheath-tailed bat were recorded during the wet season (Figure 12). Pilbara leaf-nosed bat echolocation call detections appear marginally lower during the wet season (Figure 12). No ghost bat or black flying fox calls were detected over the two-year BBSUS period.

Bat species recorded include the ghost bat [VU] (Megadermatidae), two species of sheath-tailed bat (Emballonuridae), three species of freetail bat (Molossidae), the Pilbara leaf-nosed bat [VU] (Rhinonycteridae) and at least four species of evening bats (Vespertilionidae). Additionally, the black flying fox was opportunistically recorded roosting in a large date palm near site BB006.

Two significant species of bat have been recorded at Bonney Downs, including the ghost bat (VU) and Pilbara-leaf nosed bat (VU).

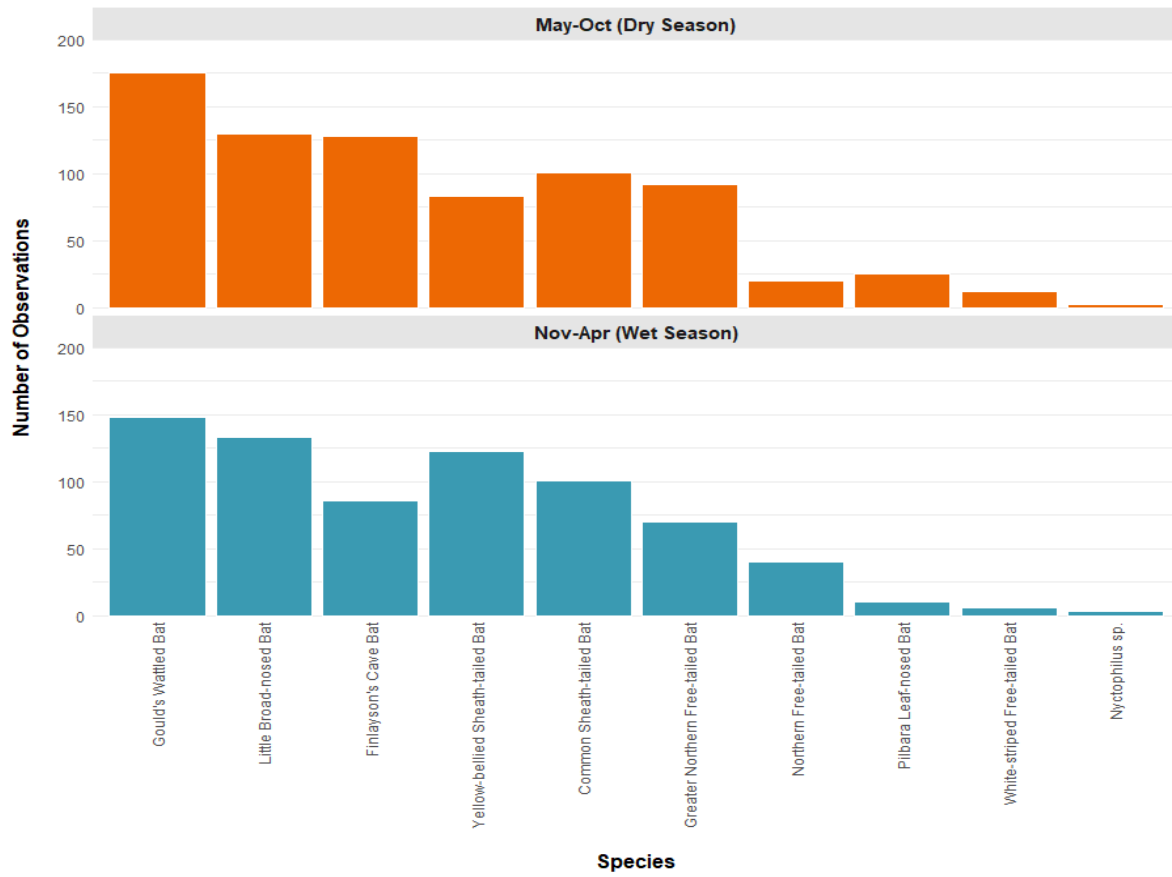


Figure 12: Bat echolocation detections across season.

Table 26: Bat species recorded and potentially occurring within the survey area, habitat preferences and flight demographics.

Common name	Taxon	Recorded	Habitat	Presence	Site use	Movement and flight paths	Soaring	Flocking
Pteropodidae								
Black flying-fox	<i>Pteropus alecto</i>	Yes	This species will utilise a range of habitats for roosting and foraging including Melaleuca open forests, tall eucalypt forest, monsoon rainforest, mangroves and floodplains	Ongoing and/or transit	Foraging/transit/breeding	Nocturnal	No	No
Little red flying-fox	<i>Pteropus scapulatus</i>	No. Species does not echolocate.	This species is highly nomadic. Roosts are found among trees in wet and dry eucalypt forests, mangroves, Melaleuca and Casuarina swamps, rainforest, dense vine thickets and bamboo communities.	Ongoing and/or transit	Foraging/transit/breeding	Nocturnal	No	No
Rhinonycteridae								
Pilbara leaf-nosed bat (BC & EPBC Act: Vulnerable)	<i>Rhinonycteris aurantia</i> (Pilbara form)	Yes	Restricted to Pilbara region. Roosts in deep caves and mines with high temperatures and humidity and will forage in all habitat types.	Ongoing	Foraging/transit	Nocturnal	No	No
Emballonuridae								
Yellow-bellied sheath-tailed bat	<i>Saccolaimus flaviventris</i>	Yes	Widespread across Australia. In forested areas it feeds above the canopy, but in mallee and open country it comes lower to the ground. Regular visitor to dams and waterholes. Roosts in tree hollows.	Ongoing	Foraging/transit/roosting	Nocturnal	No	No
Common sheath-tailed bat	<i>Taphozous georgianus</i>	Yes	Roosts in the twilight zone near cave entrances in the rocky country of northern Australia.	Ongoing	Foraging/transit/roosting	Nocturnal	No	No
Hill's sheath-tailed bat	<i>Taphozous hilli</i>	No. Calls may not be distinguished from <i>T. georgianus</i> .	Widely distributed in the semi-arid Pilbara. Typically roosts only a short distance inside the entrances of caves and mines, often in semi-daylight.	Ongoing	Foraging/transit/roosting	Nocturnal	No	No
Vespertilionidae								
Gould's wattled bat	<i>Chalinolobus gouldii</i>	Yes	One of Australia's most cosmopolitan and adaptable bats, occurring in a wide range of habitats, including open forest, woodland, mallee, tall shrubland and dense forest. Typically roosts in tree hollows, often inside dead spouts with entrance diameter of approximately 10cm.	Ongoing	Foraging/transit/roosting	Nocturnal	No	No
Little broad-nosed bat	<i>Scotorepens greyii</i>	Yes	Habitat includes dry grassland and woodland, sandy deserts, inland rivers, monsoon forest and paperbark swamps, Roosts in tree hollows.	Ongoing	Foraging/transit/roosting	Nocturnal	No	No
Finlayson's cave bat	<i>Vespadelus finlaysoni</i>	Yes	Associated with rocky outcrops and hilly terrain, where caves and overhangs provide natural roost sites. Also roosts in abandoned mine shafts and adits as well as abandoned nests of fairy martins.	Ongoing	Foraging/transit/roosting	Nocturnal	No	No

Common name	Taxon	Recorded	Habitat	Presence	Site use	Movement and flight paths	Soaring	Flocking
Pallid long-eared bat	<i>Nyctophilus daedalus</i>	Possible, unidentifiable <i>Nyctophilus</i> sp. calls recorded. Calls usually of low altitude and may be masked by clutter calls belonging to the little broad-nosed bat.	Species exhibits a disjunct distribution in the Pilbara. Locally common within restricted habitat types including monsoon forest, vine thickets, riparian areas (particularly with permanent pools) and adjoining open forests and woodlands.	Ongoing	Foraging/ transit/roosting	Nocturnal	No	No
Lesser long-eared	<i>Nyctophilus geoffroyi</i>	Possible, unidentifiable <i>Nyctophilus</i> sp. calls recorded. Calls usually of low altitude and may be masked by clutter calls belonging to the little broad-nosed bat.	Species is distributed throughout Australia and occupies a range of environments.	Ongoing	Foraging/ transit/roosting	Nocturnal	No	No
Megadermatidae								
Ghost bat	<i>Macroderma gigas</i>	Yes	Prey captured on the ground or while in flight and taken to an established feeding site in a rock overhang or cave entrance. Diurnal roosting occurs in deep caves and mines and occasionally in rock fissures and boulder piles.	Ongoing	Foraging/ transit	Nocturnal	No	No
Molossidae								
White-striped free-tailed bat	<i>Austronomus australis</i>	Yes	In Western Australia, this species is known to migrate 1,200km north during winter, then return south with the onset of hot and humid summer. Roosts in large eucalypts, typically within hollow trunks.	Ongoing	Foraging/ transit / roosting	Nocturnal	No	No
Greater northern free-tailed bat	<i>Chaerephon jobensis</i>	Yes	Species occurs widely across the tropical savannas. Typically roosts in hollow tree spouts.	Ongoing	Foraging/ transit / roosting	Nocturnal	No	No
Northern free-tailed bat	<i>Ozimops lumsdenae</i>	Yes	Occupies tropical Australia, foraging over riverine habitat, floodplains and eucalypt woodland and savannah. Usually roosts in tree hollows.	Ongoing	Foraging/ transit / roosting	Nocturnal	No	No
Northern coastal free-tailed bat	<i>Ozimops cobourgiensis</i>	No. Found only along Pilbara coast.	Population on Australia's west coast only recorded from mangrove stands.	Unlikely	Foraging/ transit	Nocturnal	No	No

Note: Rows highlighted in grey contain BC and EPBC Act listed species

4.4 SIGNIFICANT SPECIES

4.4.1 Likelihood of Occurrence Assessment

A post-survey likelihood of occurrence assessment was undertaken for significant fauna species with the potential to occur within the survey area, taking into consideration the field survey results, habitat types identified, and desktop survey (Appendix E).

Five significant species have been recorded at Bonney Downs, including:

- Grey falcon (*Falco hypoleucos*) – Vulnerable EPBC Act and BC Act;
- Ghost bat (*Macroderma gigas*) – Vulnerable EPBC Act and BC Act;
- Pilbara leaf-nosed bat (*Rhinonictes aurantia* (Pilbara form)) - Vulnerable EPBC Act and BC Act;
- Fork-tailed swift (*Apus pacificus*) – Migratory EPBC Act and BC Act; and
- Oriental plover (*Anarhynchus veredus*) - Migratory EPBC Act and BC Act.

The peregrine falcon (*Falco peregrinus* [Other Specially Protected Fauna]) was allocated a high likelihood of occurrence rating due to proximity of recent records and presence of suitable habitat within the survey area.

Eight migratory birds (common sandpiper, sharp-tailed sandpiper, red-necked stint, gull-billed tern, Caspian tern, glossy ibis, wood sandpiper and marsh sandpiper) and two Threatened avifauna taxa (common greenshank and Australian painted snipe) were allocated a moderate likelihood of occurrence based on distance of records from the survey area and ability of these species to overfly or intermittently utilise habitat within the survey area. One additional Threatened avifauna species (night parrot [CR/EN]) was assessed as moderately likely to occur, based on the modelled distribution of the species and presence of suitable roosting and foraging habitat within the survey area.

The likelihood of occurrence assessment identified seven avifauna species as having a low likelihood of occurrence within the survey area due to absence of suitable habitat, age of records, distance of records from the survey area or a combination of these factors. One additional species (barking owl (southwest subpopln., *Ninox connivens connivens* [P3]) was classified as 'Does Not Occur' as these records were assessed to represent inaccurate taxonomic identifications and/or the species does not occur within the region. Records of the barking owl obtained from the survey area instead represent the unlisted subspecies (*Ninox connivens peninsularis*).

4.4.2 Grey falcon (*Falco hypoleucos*) – Vulnerable EPBC Act and BC Act

The grey falcon has been recorded on 23 occasions (Table 27, Map 9), including seven records obtained during BBSUS, and 16 incidental records. Of the 16 incidental records, five observations were recorded during the Bonney Downs detailed and targeted surveys, and one observation was recorded by Spectrum in April 2024 (Spectrum Ecology, 2024a).

Grey falcons have been recorded throughout the day, with the earliest observations recorded at approximately 05:00 and the latest observation recorded at approximately 17:00.

Flight heights ranged from ground level to 235 m (within RSA), with seven observations documenting birds flying within the proposed RSA height (97 m – 279 m). Grey falcon records have been obtained from numerous locations within the survey area, with the species recorded in a range of habitat types.

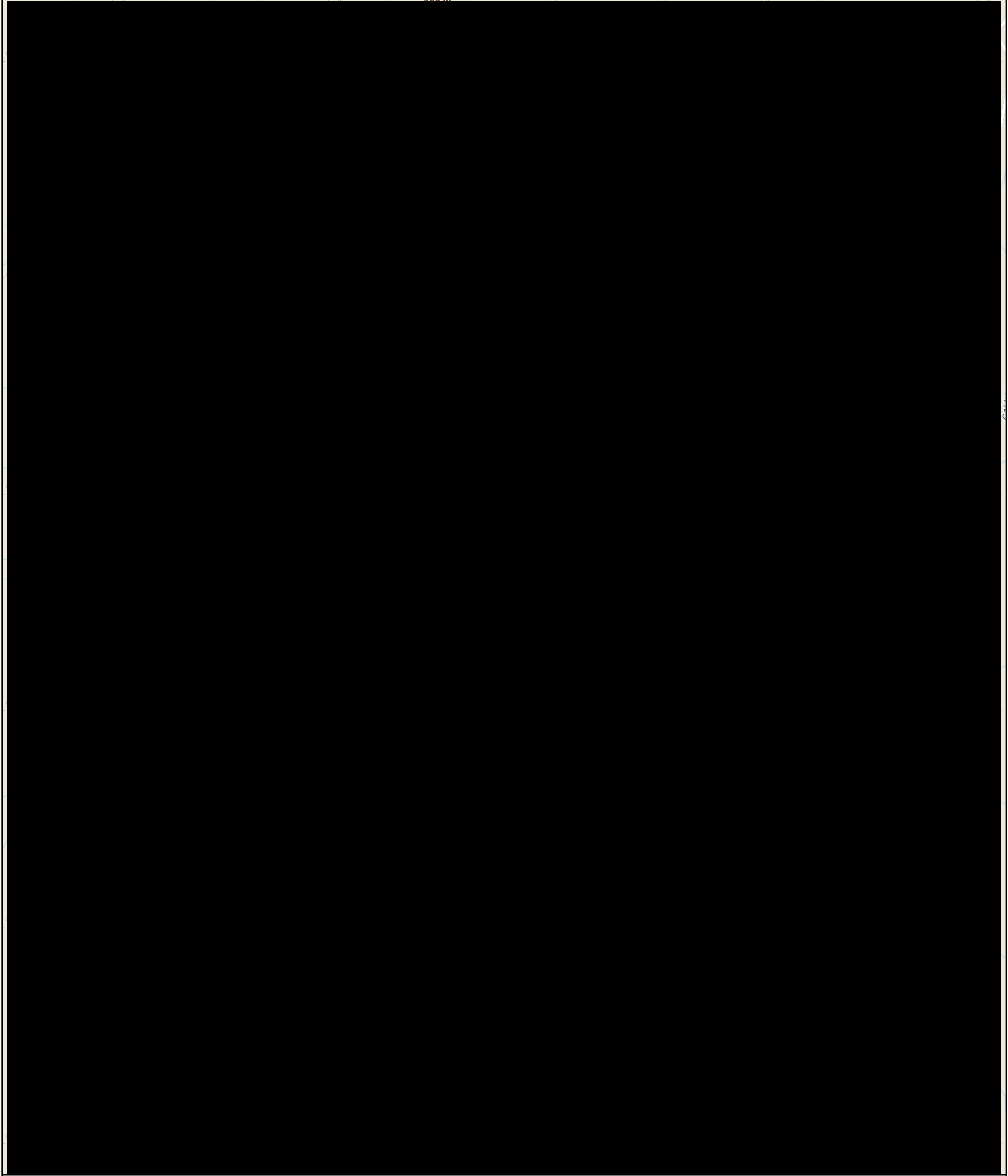
Set time and incidental grey falcon observations have documented a variety of behaviours, including breeding, roosting, nest defence, standing in water and consumption of prey. Flight

observations have included a variety of behaviours, including soaring, gliding and directional flight. Further discussion regarding the grey falcon is provided in Section 5.4.1.1.

Table 27: Summary of grey falcon observations.

Year	Month	Season	Incidental			BBSUS		
			Number of occasions grey falcons were observed	Minimum number of birds observed	Maximum number of birds recorded per observation	Number of occasions grey falcons were observed	Minimum number of birds observed	Maximum number of birds recorded per observation
2023	May	Outside survey period (detailed fauna survey)	2	2	2	-	-	-
2023	July	Outside survey period (targeted fauna survey)	3	1	2	-	-	-
2023	October	Spring	0	0	0	1	2	2
2024	February	Summer	2	1	1	1	1	1
2024	March	Autumn	1	1	1	0	0	0
2024	April	Autumn	1	2	2	-	-	-
2024	June	Winter	1	2	2	0	0	0
2024	September	Spring	0	0	0	0	0	0
2025	February	Summer	2	1	1	5	1	2
2025	April	Autumn	1	2	2	0	0	0
2025	August	Winter	3	1	2	0	0	0
Total number of observations			16			7		

Note: '-' denotes timeframe outside Ecologia BBSUS phase

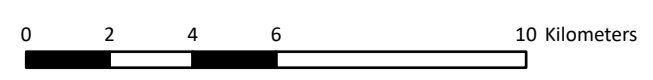


- Survey area
 - Grey falcon**
 - + BBSUS
 - + Incidental observation
 - ★ Grey falcon nest
-
- Habitat type**
- Cleared
 - Drainage Line/River/Creek (major)
 - Drainage Line/River/Creek (minor)
 - Gorges/Gullies
 - Granite Outcrops (flat dome)
 - Hills/Ranges/Plateaux
 - Plain (Cracking clays)
 - Plain (stony/gibber)
 - Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
 - Woodland (closed)
 - Woodland (open)



Project No.: 1981
 Author: SP
 Created Date: 10 December 2025
 Coordinate System: GDA2020
 Scale: 1:180,000 @A3

Map 9: Grey falcon records.



4.4.3 Ghost bat (*Macroderma gigas*) – Vulnerable EPBC Act and BC Act

The ghost bat was recorded in the survey area on one occasion during the Bonney Downs detailed and targeted surveys, with the species detected in a video recording using an acoustic ghost bat lure (BDGB03). Ghost bat calls were not detected at any BBSUS sites across the 24 months of monitoring; however, as the species does not routinely call while foraging and transiting this is not a reliable indication that the species was not present across the survey area during this period.

Ghost bat records are displayed in Map 10 and further discussion is provided in Section 5.4.1.1.

4.4.4 Pilbara leaf-nosed bat (*Rhinonictis aurantia* (Pilbara form)) - Vulnerable EPBC Act and BC Act

Echolocation calls belonging to the Pilbara-leaf nosed bat were recorded on 25 nights across 10 sites over the 24 months of surveys. The species was detected at an additional eight sites, over 11 nights during the Bonney Downs detailed and targeted surveys.

A summary of Pilbara leaf-nosed bat detections recorded between May 2023 and August 2025 is provided in Table 28, and records are displayed in Map 10. No low-time calls (within one hour of sunset) were recorded during the BBSUS, detailed or targeted surveys. Records of the Pilbara leaf-nosed bat within the survey area are consistent with modelled species distributions for the region as published by Shaw et al. (2025).

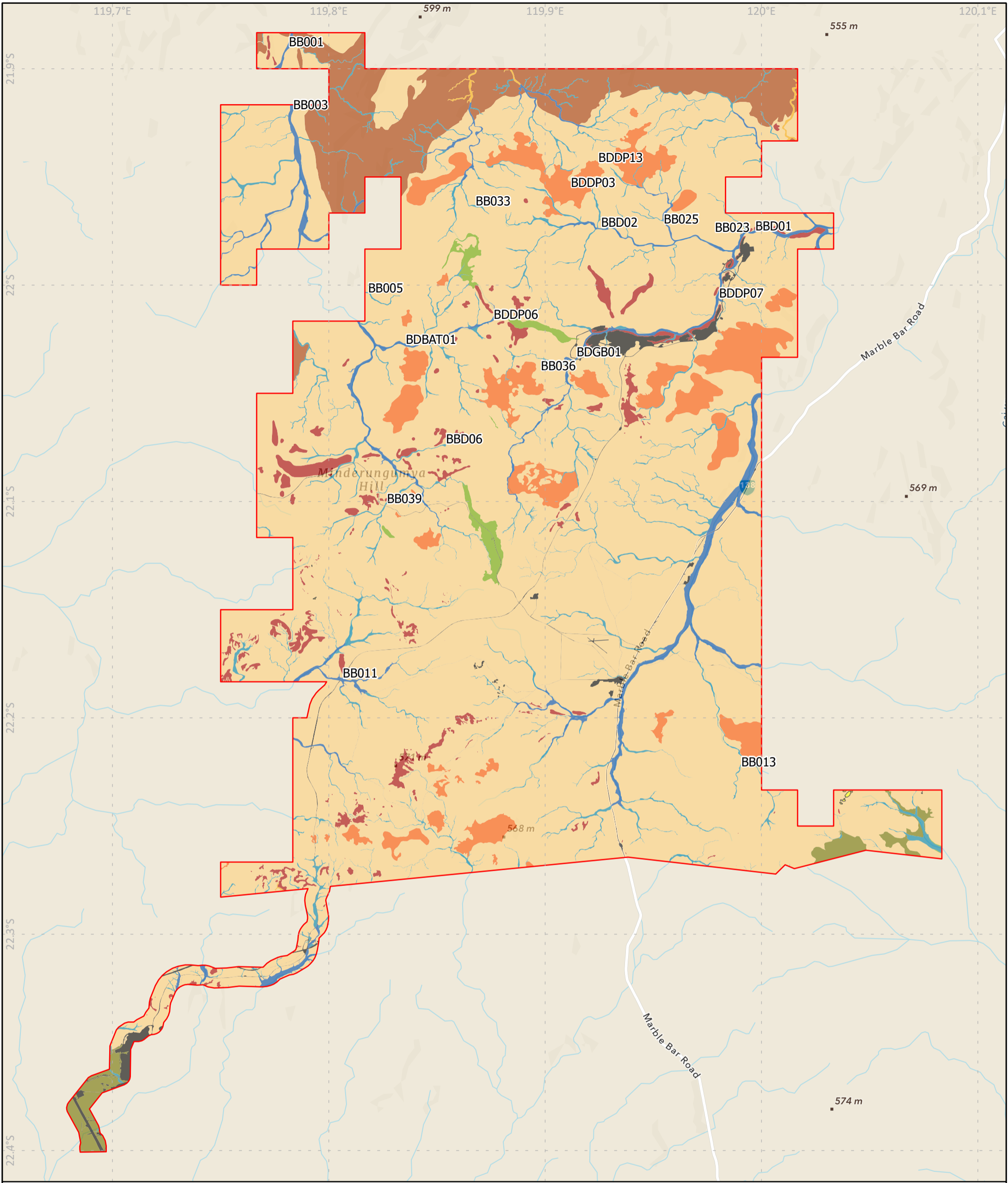
Further discussion on the Pilbara leaf-nosed bat is provided in Section 5.4.1.3.

Table 28: Summary of detections of the Pilbara leaf-nosed bat from systematic sites (Specialised Zoological, 2024b, 2025b).

Site	Night of recording	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
May 2023										
BBD01	27/05/2023	8	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	20:38:32	1:39:06	3H 13M 4S	4H 52M 50S
BBD02	28/05/2023	1	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	20:11:13	20:11:13	2H 45M 58S	10H 21M 9S
BBD06	30/05/2023	1	30/05/2023 17:24	30/05/2023 17:49	31/05/2023 6:09	31/05/2023 6:33	23:29:49	23:29:49	6H 4M 55S	7H 3M 25S
BDBAT01	28/05/2023	1	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	23:29:31	23:29:31	6H 4M 16S	7H 2M 51S
BDDP03	23/05/2023	1	23/05/2023 17:26	23/05/2023 17:50	24/05/2023 6:06	24/05/2023 6:30	23:25:59	23:25:59	5H 59M 32S	7H 4M 11S
BDDP06	26/05/2023	1	26/05/2023 17:25	26/05/2023 17:49	27/05/2023 6:07	27/05/2023 6:31	20:34:04	20:34:04	3H 8M 23S	9H 57M 26S
BDDP06	27/05/2023	9	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	19:53:28	2:01:34	2H 28M 0S	4H 30M 22S
BDDP06	28/05/2023	10	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	21:00:22	2:01:46	3H 35M 7S	4H 30M 36S
BDDP06	29/05/2023	21	29/05/2023 17:25	29/05/2023 17:49	30/05/2023 6:08	30/05/2023 6:32	21:13:34	1:23:40	3H 48M 30S	5H 9M 8S
BDDP07	27/05/2023	1	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	21:02:40	21:02:40	3H 37M 12S	9H 29M 16S
October 2023										
BDDP13	14/10/2023	1	14/10/2023 18:04	14/10/2023 18:26	15/10/2023 5:06	15/10/2023 5:29	0:21:28	0:21:28	6H 17M 24S	5H 8M 10S
BB011	16/10/2023	17	16/10/2023 18:04	16/10/2023 18:27	17/10/2023 5:05	17/10/2023 5:27	22:34:05	2:31:13	4H 29M 12S	2H 56M 42S
BB011	17/10/2023	6	17/10/2023 18:05	17/10/2023 18:28	18/10/2023 5:04	18/10/2023 5:27	21:36:50	1:45:44	3H 31M 32S	3H 41M 21S
BB036	13/10/2023	3	13/10/2023 18:03	13/10/2023 18:26	14/10/2023 5:07	14/10/2023 5:30	20:02:06	23:09:58	1H 58M 25S	6H 20M 32S
BB003	15/10/2023	11	15/10/2023 18:04	15/10/2023 18:27	16/10/2023 5:05	16/10/2023 5:28	19:32:11	3:50:51	1H 27M 43S	1H 37M 55S
BB003	16/10/2023	6	16/10/2023 18:04	16/10/2023 18:27	17/10/2023 5:05	17/10/2023 5:27	19:30:17	3:08:43	1H 25M 24S	2H 19M 12S

Site	Night of recording	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
February 2024										
BB003	9/02/2024	1	9/02/2024 18:44	9/02/2024 19:08	10/02/2024 5:24	10/02/2024 5:47	20:30:37	20:30:37	1H 46M 0S	9H 17M 21S
BB013	11/02/2024	1	11/02/2024 18:43	11/02/2024 19:06	12/02/2024 5:25	12/02/2024 5:49	2:16:32	2:16:32	7H 32M 58S	3H 32M 38S
BB039	11/02/2024	2	11/02/2024 18:43	11/02/2024 19:06	12/02/2024 5:25	12/02/2024 5:49	3:04:05	3:04:27	8H 20M 30S	2H 44M 43S
June 2024										
BB001	19/06/2024	4	19/06/2024 17:26	19/06/2024 17:51	20/06/2024 6:15	20/06/2024 6:39	1:42:24	2:54:44	8H 15M 46S	3H 45M 1S
BB001	20/06/2024	7	20/06/2024 17:26	20/06/2024 17:51	21/06/2024 6:15	21/06/2024 6:39	18:37:36	21:18:23	1H 10M 47S	9H 21M 35S
September 2024										
BB001	12/09/2024	5	12/09/2024 17:55	12/09/2024 18:17	13/09/2024 5:38	13/09/2024 6:00	18:50:38	3:28:21	55M 34S	2H 32M 3S
BB001	13/09/2024	5	13/09/2024 17:55	13/09/2024 18:17	14/09/2024 5:37	14/09/2024 5:59	21:56:55	3:43:09	4H 1M 35S	2H 16M 16S
May 2025										
BB001	30/04/2025	11	30/04/2025 17:38	30/04/2025 18:01	1/05/2025 5:56	1/05/2025 6:19	18:33:50	3:40:06	55M 50S	2H 39M 41S
BB001	1/05/2025	17	1/05/2025 17:37	1/05/2025 18:00	2/05/2025 5:57	2/05/2025 6:20	18:54:02	3:59:34	1H 16M 40S	2H 20M 38S
BB005	30/04/2025	1	30/04/2025 17:38	30/04/2025 18:01	1/05/2025 5:56	1/05/2025 6:19	22:28:44	22:28:44	4H 50M 44S	7H 51M 3S
BB023	28/04/2025	9	28/04/2025 17:39	28/04/2025 18:02	29/04/2025 5:55	29/04/2025 6:18	21:58:59	2:05:10	4H 19M 38S	4H 13M 48S
BB023	29/04/2025	2	29/04/2025 17:38	29/04/2025 18:01	30/04/2025 5:56	30/04/2025 6:19	0:34:11	2:24:44	6H 55M 32S	3H 54M 38S
BB025	29/04/2025	1	29/04/2025 17:38	29/04/2025 18:01	30/04/2025 5:56	30/04/2025 6:19	23:03:12	23:03:12	5H 24M 33S	7H 16M 10S
BB033	29/04/2025	1	29/04/2025 17:38	29/04/2025 18:01	30/04/2025 5:56	30/04/2025 6:19	23:23:01	23:23:01	5H 44M 22S	6H 56M 21S
BB036	29/04/2025	1	29/04/2025 17:38	29/04/2025 18:01	30/04/2025 5:56	30/04/2025 6:19	1:23:23	1:23:23	7H 44M 44S	4H 55M 59S
August 2025										

Site	Night of recording	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
BB001	15/08/2025	9	15/08/2025 17:46	15/08/2025 18:09	16/08/2025 6:02	16/08/2025 6:25	21:26:14	1:52:04	3H 39M 43S	4H 33M 6S
BB001	16/08/2025	3	16/08/2025 17:46	16/08/2025 18:09	17/08/2025 6:01	17/08/2025 6:24	18:50:35	0:35:42	1H 3M 42S	5H 48M 44S
BB003	15/08/2025	4	15/08/2025 17:46	15/08/2025 18:09	16/08/2025 6:02	16/08/2025 6:25	21:04:27	3:03:06	3H 17M 56S	3H 22M 4S
BB003	16/08/2025	4	16/08/2025 17:46	16/08/2025 18:09	17/08/2025 6:01	17/08/2025 6:24	19:01:40	2:40:18	1H 14M 48S	3H 44M 8S



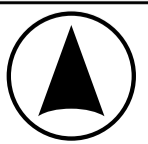
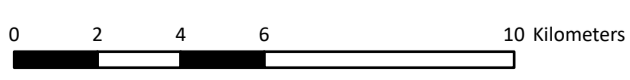
- ▭ Survey area
- Habitat type**
- Cleared
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Gorges/Gullies
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Plain (Cracking clays)
- Plain (stony/gibber)
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
- Woodland (closed)
- Woodland (open)

- Ghost bat**
- + Detailed survey
- Pilbara leaf-nosed bat**
- + Detailed Survey
- + BBSUS



Project No.: 1981
 Author: SP
 Created Date: 10 December 2025
 Coordinate System: GCS GDA 1994
 Scale: 1:180,000 @A3

Map 10: Pilbara leaf-nosed bat and ghost bat records.



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

4.4.5 Fork-tailed swift (*Apus pacificus*) – Migratory EPBC Act and BC Act

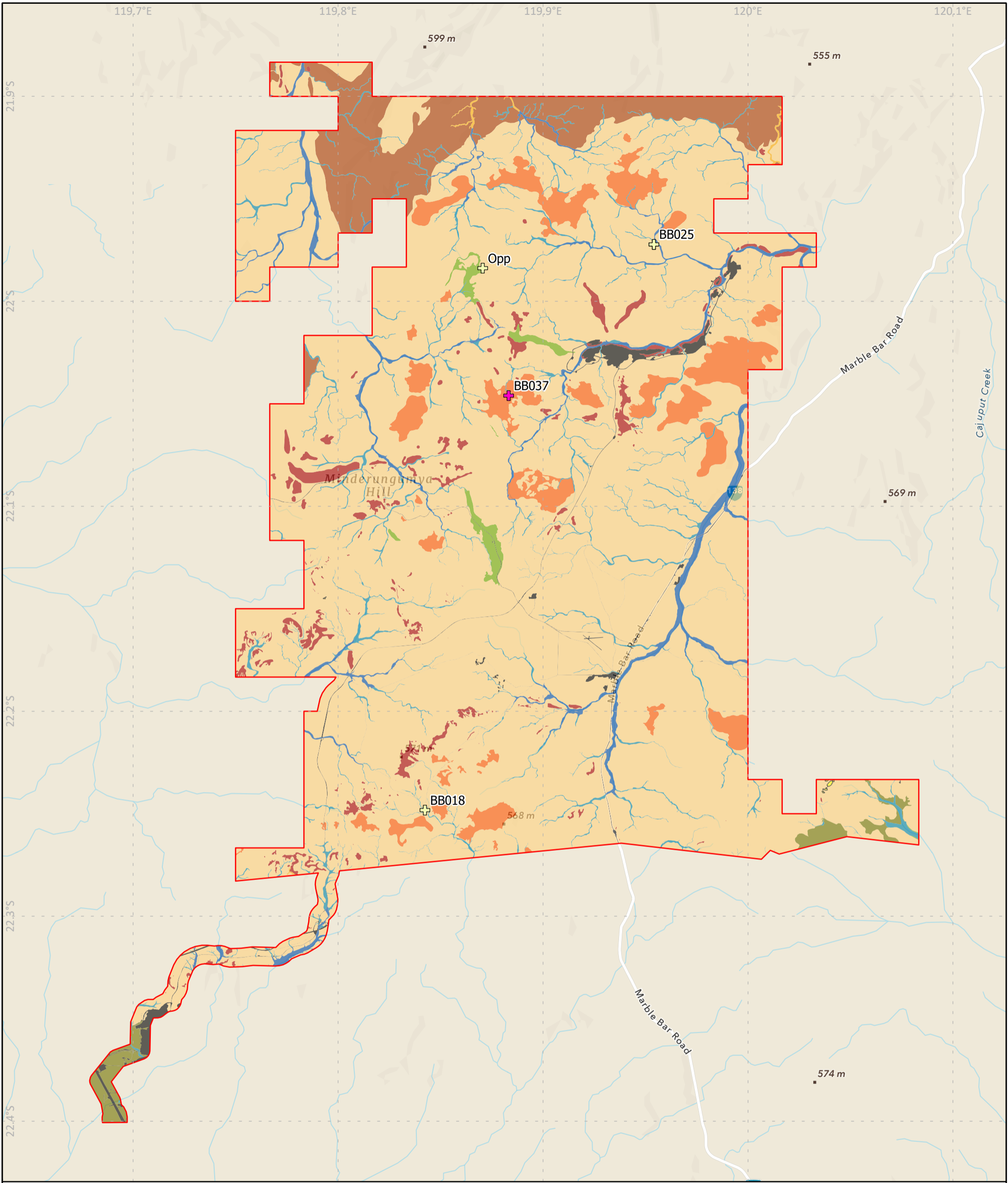
The fork-tailed swift was recorded within the survey area on four occasions across three sites during the February 2025 survey, including three records during BBSUS, and one incidental record. The species was observed overflying the site on each occasion, at a maximum flight height of 37 m.

Fork-tailed swift records are displayed in Map 11.

4.4.6 Oriental plover (*Anarhynchus veredus*) - Migratory EPBC Act and BC Act

The oriental plover was recorded within the survey area on one occasion over the 24 months of BBSUS. One individual was recorded at BB037 during the September 2024 survey, overflying the site at a maximum flight height of 7 m.

Oriental plover records are displayed in Map 11.

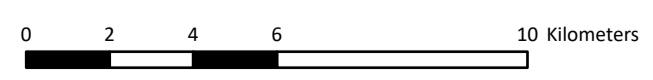


- Species**
- + Oriental plover
 - + Pacific swift (fork-tailed swift)
- Habitat type**
- Cleared
 - Drainage Line/River/Creek (major)
 - Drainage Line/River/Creek (minor)
 - Gorges/Gullies
 - Granite Outcrops (flat dome)
 - Hills/Ranges/Plateaux
 - Plain (Cracking clays)
 - Plain (stony/gibber)
 - Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
 - Woodland (closed)
 - Woodland (open)



Project No.: 1981
 Author: SP
 Created Date: 10 December 2025
 Coordinate System: GCS GDA 1994
 Scale: 1:190,000 @A3

Map 11: Migratory bird records.



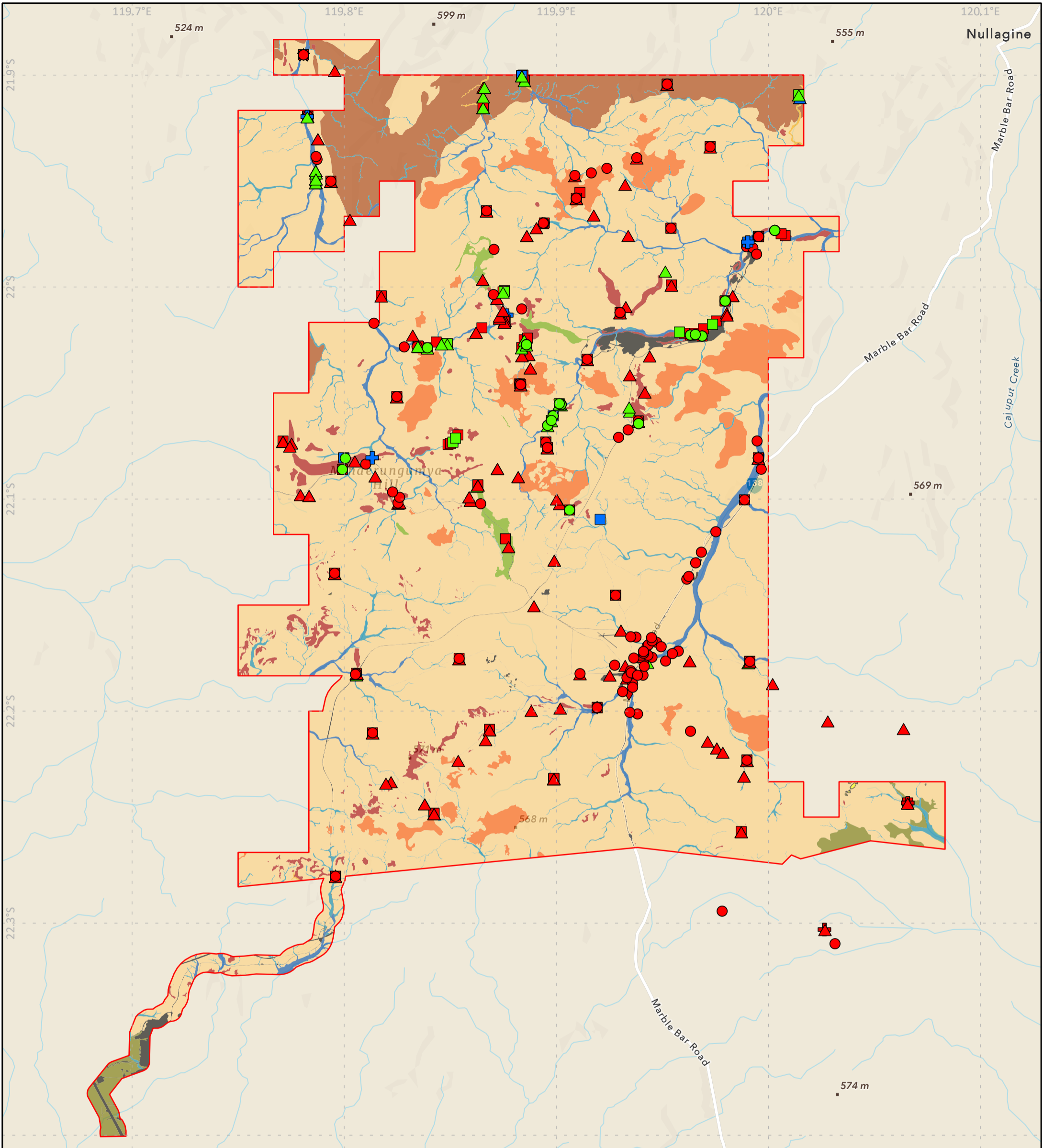
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

4.5 INCIDENTAL PREDATOR/SCAVENGER RECORDS

According to database searches and the literature review, 30 predator/scavenger species have the potential to occur within the survey area (Table 14). Fifteen avifauna species (14 raptors and one corvid) with the potential to scavenge carcasses were recorded within the survey area during current or previous surveys. Six reptile species (two pythons, one elapid and three monitor lizards) with the potential to scavenge carcasses have previously been recorded in the survey area and three mammals (cat, dingo and northern quoll) considered likely to scavenge carcasses have previously been recorded throughout the survey area, with the dingo incidentally recorded on numerous occasions during BBSUS.

Although beyond the scope of the current assessment, invertebrates (e.g. ants) and humans also have the potential to remove carcasses from the landscape.

Records of predator/scavengers considered likely to remove carcasses from the landscape are displayed on Map 12.



- Survey area
 - Birds**
 - ◆ Black kite
 - ★ Little eagle
 - Torresian crow
 - + Square-tailed kite
 - ▲ Wedge-tailed eagle
 - Whistling kite
 - Reptiles**
 - Perentie
 - ▲ Bungarra or sand goanna
 - + Yellow-spotted monitor
 - Mammals**
 - Cat
 - ▲ Dingo
 - Northern quoll
- Habitat type**
 - Cleared
 - Drainage Line/River/Creek (major)
 - Drainage Line/River/Creek (minor)
 - Gorges/Gullies
 - Granite Outcrops (flat dome)
 - Hills/Ranges/Plateaux
 - Plain (Cracking clays)
 - Plain (stony/gibber)
 - Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
 - Woodland (closed)
 - Woodland (open)

4.6 SITE UTILISATION RISK ASSESSMENT

4.6.1 Bats

The consolidated bat collision risk assessment conducted by Fleming & Dempster (in prep.) identified up to seven bat species with a high risk of collision (Table 29). The Pilbara-leaf nosed bat (VU) was rated as having a low or unknown risk across three different classification systems with an overall collision risk of 'low' assigned by Fleming & Dempster (in prep.). The ghost bat (VU) was rated as having a medium, low or unknown collision across the three classification systems, with an overall collision risk of 'low' assigned by Fleming & Dempster (in prep.).

4.6.2 Avifauna

The avifauna collision risk assessment conducted by Shephard et al. (in prep.) identified 37 species with 'high' overall risk rating, 63 species with 'medium' risk rating and 25 species with a 'low' risk rating (Table 30). Two EPBC significant species (grey falcon [VU] and fork-tailed swift [MI]) were assessed as having a high risk of collision, and one EPBC significant species (oriental plover [MI]) was assessed as having a medium risk of collision. Two culturally significant species were identified within the survey area, with the black-necked stork assessed as having a 'high' collision risk and the Australian bustard assessed as having a 'medium' risk of collision.

The high-risk category identified by Shephard et al. (in prep.) consists of 17 waterbirds, 11 raptors, three woodswallows, one swallow and one owl. An additional seven waterbirds, three raptors and four nocturnal birds are considered to have a medium risk of collision.

Table 29: Collision risk of bat species recorded at Bonney Downs (Reid, Baker, & Ehmke, 2025a; Specialised Zoological, 2024b, 2025b; Voigt et al., 2024).

Common name	Scientific name	Average body mass (g)	Number of records in the Pilbara (ALA)	Recorded mortalities elsewhere in Australia [†]	Specialised Zoological			Reid & Baker 2025 ⁶			Voigt et al. 2024		
					2024: Likelihood flying >50m altitude ⁵	2025: Collision risk scores	2025: Collision risk category	Flight height ⁶	Flight morphology ⁶	Habitat ⁶	Threat: Fatalities	Threat: Habitat loss	Threat: Displacement
Finlayson's cave bat	<i>Vespadelus finlaysoni</i>	4.3	576	0	Low	4	Med	3	1	2	High	Med	High
Little broad-nosed bat	<i>Scotorepens greyii</i>	6.4	98	1	Low	4	Med	4	1	1	High	Med	High
Unidentified long-eared bat	<i>Nyctophilus sp.</i>	8.0*	53*	26*	Low	1	Low	3	1	1	Low	High	High
Pilbara leaf-nosed bat	<i>Rhinonicteris aurantia</i>	8.3	15	0	Low	1	Low	3	1	5	Unknown	Unknown	Unknown
Gould's wattled bat	<i>Chalinolobus gouldii</i>	9.8	138	493	Low	4	Med	4	2	1	Low to Med	Low	Unknown
Northern free-tailed bat	<i>Ozimops lumsdenae</i>	12.2	83	0	Med	4	Med	4	2	2	High	Med	High
Greater northern free-tailed bat	<i>Chaerephon jobensis</i>	20.4	65	0	Med	4	Med	5	2	1	High	Med	High
Common sheath-tailed bat	<i>Taphozous georgianus</i>	26.2	273	0	High	9	High	5	2	2	High	Med	High
White-striped free-tailed bat	<i>Austronomus australis</i>	37.6	5	1420	High#	3	Med	5	3	1	High	Med	High
Yellow-bellied sheath-tailed bat	<i>Saccolaimus flaviventris</i>	44	12	5	Med	6	Med	5	3	1	High	Med	High
Ghost bat	<i>Macroderma gigas</i>	103.4	104	0	Med	-	-	3	3	4	Low	Unknown	Unknown
Black flying-fox †	<i>Pteropus alecto</i>	-	78	0	-	-	-	5	5	3	High	Low to Med	Unknown

Note: Bat species are arranged in order of increasing body mass. Coloured columns represent collision risk categories (Reid & Baker, 2025; Specialised Zoological, 2024a, 2025a; Voigt et al., 2024).

† present, but only recorded at one palm tree on the site.

[†] mortalities reported by P. Moloney, L. Lumsden, and I. Smales (2019) (recorded from Victorian windfarms between 2003-2018), review of 12 BBAMP annual reports (open access) from within Australia (from 2019-2025) reporting mortalities (see Interim Report for Project 4.2 Mortality Monitoring), Nature Advisory (IBRC presentation 2025) and (Gration, 2025).

⁵ Estimated risk scores for each bat species recorded in the 2023-2024 surveys at Bonney Downs, based on an authoritative estimate of which species are likely to be flying at >50 m in altitude (Specialised Zoological, 2024a, 2025a).

⁶ Flight height scores provided by (Reid & Baker, 2025): 1= trawlers that capture prey on the surface of water bodies; 2=foliage gleaners that capture non-flying prey; 3=close clutter aerial foragers that typically forage below canopy height; 4=outer canopy foragers; 5=open space aerial foragers and commuters

Austronomus australis is ranked high risk based on mortalities elsewhere in Australia – representing ~50% of mortalities as operational wind farms (mostly in Victoria and NSW) (Bennett, 2025) – but has not been commonly recorded in the Pilbara (ALA records and data collected for BBSUS carried out at Bonney Downs).

*Characteristics based on *N. geoffroyi* as this species has a marginally higher collision risk than the other *Nyctophilus* species potentially occurring at Bonney Downs (*N. daedalus*).

Table 30: Collision risk for avifauna species recorded at Bonney Downs (Shephard et al., in prep.).

Common name	Body mass average (g) [†]	Mortalities recorded across Australian wind farms [1]	Flight height records [2]	Below RSA <100m [3]	Within RSA 100–300 m [3]	Above RSA >300m [3]	Reid Habitat spec. SCORE	Reid flight height SCORE	Reid flight time SCORE	Reid flight manoeuv. SCORE	Reid generation time SCORE	Reid susceptibility INDEX	Reid productivity SCORE	Reid overall risk SCORE	Reid overall risk CATEGORY
Grey falcon ^{VU,^}	471		25	68%	32%	0%	3	5	4	3	2	4.6	3.3	5.7	High
Australian pelican	5426		10	50%	40%	10%	2	4	4	4	5	4.3	3.3	5.4	High
Black-necked stork	4197		0	100%	0%	0%	2	4	4	4	4	4.3	2.8	5.1	High
Wedge-tailed eagle	3558	58	172	58%	34%	9%	1	4	4	3	5	3.9	3.3	5.1	High
Pied cormorant	1763		2	100%	0%	0%	3	4	3	5	3	4.4	2.3	4.9	High
Brown falcon	587	48	180	88%	11%	2%	1	5	4	3	3	4.4	2.3	4.9	High
Straw-necked ibis	1353	1*	12	83%	8%	8%	2	4	3	4	4	4	2.8	4.9	High
Royal spoonbill	1731		1	100%	0%	0%	2	4	3	4	4	4	2.8	4.9	High
White-bellied sea-eagle	2900		1	100%	0%	0%	2	4	4	3	4	4	2.8	4.9	High
Hardhead	851		3	100%	0%	0%	3	4	3	5	2	4.4	1.8	4.7	High
Black falcon	744	1	1	0%	100%	0%	1	5	4	3	2	4.4	1.8	4.7	High
Australian hobby	247	1	21	100%	0%	0%	1	5	4	3	2	4.4	1.8	4.7	High
Australian pratincole	63		0				3	5	4	2	2	4.4	1.8	4.7	High
Fork-tailed swift ^{IA}	42		4	100%	0%	0%	1	5	5	2	2	4.4	1.8	4.7	High
Australasian darter	1630		25	96%	4%	0%	3	4	3	4	3	4.1	2.3	4.7	High
Little black cormorant	967		17	76%	24%	0%	2	4	3	4	3	4	2.3	4.6	High
Pacific black duck	1002		35	100%	0%	0%	2	4	3	4	3	4	2.3	4.6	High
Little pied cormorant	679		20	100%	0%	0%	2	4	3	4	3	4	2.3	4.6	High
Little eagle	812	1	5	40%	60%	0%	1	4	4	3	3	3.9	2.3	4.5	High
White-necked heron	893		26	92%	8%	0%	3	4	3	3	3	3.9	2.3	4.5	High
Australian wood duck	813		12	100%	0%	0%	3	4	3	4	2	4.1	1.8	4.5	High
Pink-eared duck	375		3	100%	0%	0%	3	4	3	4	2	4.1	1.8	4.5	High
Grey teal	492		23	100%	0%	0%	1	4	3	4	3	3.9	2.3	4.5	High
Australian kestrel	180	54	438	97%	2%	0%	1	5	4	2	2	4.1	1.8	4.5	High
Whistling kite	745	5	151	85%	13%	1%	1	4	4	3	3	3.9	2.3	4.5	High
Spotted harrier	570	1	99	94%	5%	1%	2	4	4	2	3	3.8	2.3	4.4	High
Nankeen night heron	759		10	100%	0%	0%	2	4	3	3	3	3.8	2.3	4.4	High
Masked woodswallow	35	1*	8	50%	50%	0%	2	4	5	2	2	4	1.8	4.4	High
Little woodswallow	17		5	60%	40%	0%	4	4	5	1	2	4	1.8	4.4	High

Common name	Body mass average (g) [†]	Mortalities recorded across Australian wind farms [1]	Flight height records [2]	Below RSA <100m [3]	Within RSA 100–300 m [3]	Above RSA >300m [3]	Reid Habitat spec. SCORE	Reid flight height SCORE	Reid flight time SCORE	Reid flight manoeuv. SCORE	Reid generation time SCORE	Reid susceptibility INDEX	Reid productivity SCORE	Reid overall risk SCORE	Reid overall risk CATEGORY
Plumed whistling duck	839		2	100%	0%	0%	2	4	3	4	2	4	1.8	4.4	High
Black-faced woodswallow	35		78	100%	0%	0%	2	4	5	2	2	4	1.8	4.4	High
Southern boobook	275		6	100%	0%	0%	1	4	2	2	3	3.1	3	4.3	High
Black kite	825		6	67%	33%	0%	1	4	4	2	3	3.6	2.3	4.3	High
White-faced heron	597		34	100%	0%	0%	1	4	3	3	3	3.6	2.3	4.3	High
Great egret	1027		11	100%	0%	0%	1	4	3	3	3	3.6	2.3	4.3	High
Square-tailed kite	647		2	100%	0%	0%	1	4	4	2	3	3.6	2.3	4.3	High
Welcome swallow	15		0				1	5	4	1	2	3.9	1.8	4.3	High
Australian bustard	5238		16	100%	0%	0%	3	2	3	4	4	3.1	2.8	4.2	Medium
Little corella	499		81	100%	0%	0%	1	3	3	3	4	3.1	2.8	4.2	Medium
Barking owl	537		2	100%	0%	0%	2	4	2	3	3	3.5	2.3	4.2	Medium
Black-shouldered kite	272		11	100%	0%	0%	2	4	4	2	2	3.8	1.8	4.1	Medium
Tree martin	16		17	100%	0%	0%	1	5	4	1	1	3.9	1.3	4.1	Medium
Fairy martin	11		0				1	5	4	1	1	3.9	1.3	4.1	Medium
Brown goshawk	430		21	100%	0%	0%	1	4	3	2	3	3.4	2.3	4.1	Medium
Rainbow bee-eater	29		39	95%	5%	0%	1	4	4	2	2	3.6	1.8	4	Medium
Galah	318		91	100%	0%	0%	1	3	3	3	3	3.1	2.3	3.9	Medium
Spotted nightjar	98		0				1	3	4	2	3	3.1	2.3	3.9	Medium
Black-faced cuckooshrike	115		39	97%	3%	0%	1	4	3	2	2	3.4	1.8	3.8	Medium
Collared sparrowhawk	184		20	100%	0%	0%	1	4	3	2	2	3.4	1.8	3.8	Medium
Cockatiel	88		33	100%	0%	0%	2	3	3	2	3	3	2.3	3.8	Medium
Ground cuckooshrike	126		0				2	4	2	2	2	3.3	1.8	3.7	Medium
Hoary-headed grebe	244		3	100%	0%	0%	3	2	2	4	3	2.9	2.3	3.7	Medium
Torresian crow	555	41*	55	96%	4%	0%	1	3	3	2	3	2.9	2.3	3.7	Medium
Bush stone-curlew	728		4	100%	0%	0%	1	2	2	3	4	2.4	2.8	3.6	Medium
Oriental plover ^{IA}	95		1	100%	0%	0%	3	2	4	3	2	3.1	1.8	3.6	Medium
Australian magpie	275	115	18	100%	0%	0%	2	3	2	2	3	2.8	2.3	3.6	Medium
Grey butcherbird	85		4	100%	0%	0%	2	3	2	2	3	2.8	2.3	3.6	Medium
White-winged triller	26		6	100%	0%	0%	2	4	3	1	1	3.3	1.3	3.5	Medium
Budgerigar	28		126	99%	1%	0%	2	3	3	2	2	3	1.8	3.5	Medium
Australian ringneck	150		22	100%	0%	0%	2	3	3	2	2	3	1.8	3.5	Medium

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Pied butcherbird	124		41	100%	0%	0%	1	3	2	2	3	2.6	2.3	3.5	Medium
Rufous whistler	29		19	100%	0%	0%	1	3	3	1	3	2.6	2.3	3.5	Medium
Grey shrikethrush	66		5	100%	0%	0%	1	3	2	2	3	2.6	2.3	3.5	Medium
Pied stilt	177		1	100%	0%	0%	3	2	3	2	3	2.6	2.3	3.5	Medium
Western bowerbird	136		9	100%	0%	0%	5	2	2	3	2	2.9	1.8	3.4	Medium
Horsfield's bronze-cuckoo	24		2	100%	0%	0%	1	3	3	2	2	2.9	1.8	3.4	Medium
Pallid cuckoo	89		2	100%	0%	0%	1	3	3	2	2	2.9	1.8	3.4	Medium
Crested pigeon	200		70	100%	0%	0%	1	2	2	3	3	2.4	2.3	3.3	Medium
Common bronzewing	335		9	100%	0%	0%	1	2	2	3	3	2.4	2.3	3.3	Medium
Tawny frogmouth	316		2	100%	0%	0%	1	2	2	3	3	2.4	2.3	3.3	Medium
Spinifex pigeon	97		75	100%	0%	0%	4	2	2	3	2	2.8	1.8	3.3	Medium
Australasian grebe	185		3	100%	0%	0%	2	2	2	4	2	2.8	1.8	3.3	Medium
Red-backed kingfisher	54		1	100%	0%	0%	2	2	3	3	2	2.8	1.8	3.3	Medium
Black-tailed native-hen	388		0				2	2	3	3	2	2.8	1.8	3.3	Medium
Pied honeyeater	27		0				4	2	3	2	2	2.8	1.8	3.3	Medium
Horsfield's bush lark	23		59	97%	3%	0%	3	2	3	2	2	2.6	1.8	3.2	Medium
Blue-winged kookaburra	314		16	100%	0%	0%	3	2	2	3	2	2.6	1.8	3.2	Medium
White-plumed honeyeater	19		60	100%	0%	0%	3	2	3	2	2	2.6	1.8	3.2	Medium
Black-fronted dotterel	34		40	100%	0%	0%	3	2	3	2	2	2.6	1.8	3.2	Medium
Rufous songlark	30		14	100%	0%	0%	3	2	3	2	2	2.6	1.8	3.2	Medium
Red-kneed dotterel	52		2	100%	0%	0%	3	2	3	2	2	2.6	1.8	3.2	Medium
Sacred kingfisher	52		28	100%	0%	0%	1	2	3	3	2	2.6	1.8	3.2	Medium
Black-eared cuckoo	31		0				1	3	3	1	2	2.6	1.8	3.2	Medium
Little buttonquail	45		14	100%	0%	0%	3	2	3	3	1	2.9	1.3	3.1	Medium
Grey-headed honeyeater	15		43	100%	0%	0%	4	2	3	1	2	2.5	1.8	3.1	Medium
Grey-fronted honeyeater	18		3	100%	0%	0%	4	2	3	1	2	2.5	1.8	3.1	Medium
Brown songlark	53		20	100%	0%	0%	2	2	3	2	2	2.5	1.8	3.1	Medium
Crested bellbird	64		5	100%	0%	0%	2	2	2	3	2	2.5	1.8	3.1	Medium
White-fronted honeyeater	17		0				4	2	3	1	2	2.5	1.8	3.1	Medium
Brown quail	105		3	100%	0%	0%	2	2	3	3	1	2.8	1.3	3	Medium
Slaty-backed thornbill	6		2	100%	0%	0%	5	2	2	1	2	2.4	1.8	3	Medium

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Yellow-throated miner	57		86	100%	0%	0%	1	2	3	2	2	2.4	1.8	3	Medium
Spiny-cheeked honeyeater	48		3	100%	0%	0%	1	2	3	2	2	2.4	1.8	3	Medium
Black-chinned honeyeater	19		0				3	2	3	1	2	2.4	1.8	3	Medium
Diamond dove	32		68	100%	0%	0%	2	2	2	2	2	2.3	1.8	2.9	Medium
Singing honeyeater	26		57	100%	0%	0%	2	2	3	1	2	2.3	1.8	2.9	Medium
Grey-crowned babbler	71		19	100%	0%	0%	2	2	2	2	2	2.3	1.8	2.9	Medium
Redthroat	12		4	100%	0%	0%	2	2	2	2	2	2.3	1.8	2.9	Medium
Western gerygone	6		0				2	2	3	1	2	2.3	1.8	2.9	Medium
Painted finch	11		118	99%	1%	0%	4	2	2	2	1	2.5	1.3	2.8	Low
Black honeyeater	10		1	100%	0%	0%	4	2	3	1	1	2.5	1.3	2.8	Low
Magpie-lark	79	13	64	98%	2%	0%	1	2	3	1	2	2.1	1.8	2.8	Low
Hooded robin	21		5	100%	0%	0%	3	2	2	1	2	2.1	1.8	2.8	Low
Willie wagtail	22		49	100%	0%	0%	1	2	3	1	2	2.1	1.8	2.8	Low
Peaceful dove	47		12	100%	0%	0%	1	2	2	2	2	2.1	1.8	2.8	Low
Brown honeyeater	11		11	100%	0%	0%	1	2	3	1	2	2.1	1.8	2.8	Low
Pheasant coucal	392		3	100%	0%	0%	1	2	2	2	2	2.1	1.8	2.8	Low
Chestnut-rumped thornbill	6		0				3	2	2	1	2	2.1	1.8	2.8	Low
Spinifexbird	11		25	100%	0%	0%	5	2	1	2	1	2.4	1.3	2.7	Low
Crimson chat	11		7	100%	0%	0%	3	2	3	1	1	2.4	1.3	2.7	Low
Australian zebra finch	14		164	100%	0%	0%	3	2	2	2	1	2.4	1.3	2.7	Low
Grey fantail	8		0				3	2	3	1	1	2.4	1.3	2.7	Low
Western quail-thrush	60		0				3	2	1	3	1	2.4	1.3	2.7	Low
Red-capped robin	9		0				2	2	2	1	2	2	1.8	2.7	Low
Australian pipit	28		6	100%	0%	0%	2	2	2	2	1	2.3	1.3	2.6	Low
Australian owl-nightjar	43		1	100%	0%	0%	1	2	2	1	2	1.9	1.8	2.6	Low
Red-browed pardalote	11		9	100%	0%	0%	3	2	2	1	1	2.1	1.3	2.5	Low
Striated pardalote	12		1	100%	0%	0%	1	2	3	1	1	2.1	1.3	2.5	Low
Mistletoebird	9		0				1	2	3	1	1	2.1	1.3	2.5	Low
Emu	35599		0				1	1	1	0	3	0.9	2.3	2.4	Low
Pilbara grasswren	20		2	100%	0%	0%	3	1	1	2	2	1.6	1.8	2.4	Low
Weebill	6		20	100%	0%	0%	2	2	2	1	1	2	1.3	2.4	Low

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White-winged fairywren	8		9	100%	0%	0%	2	1	1	2	2	1.5	1.8	2.3	Low
Purple-backed fairywren	8		10	100%	0%	0%	1	1	1	2	2	1.4	1.8	2.2	Low

Note: Species are sorted in decreasing order of their Overall Risk Score (Reid et al., 2025b). Also indicated are the records of mortalities for these species from other wind farms across Australia. The percentage of records in the rotor swept area (RSA) is based on visual observations (BBSUS records) and the indicative height of the turbines to be installed at Bonney Downs (100-300m). The Reid score for onshore wind farm assessment assumes an RSA between 30-275m. Adopting a precautionary approach the overall risk categories are appropriate to the site.

[^] EPBC Act listed.

[†] relevant in terms of potential rcs (radar cross-sectional area) values.

[1] Data are published records of mortalities at wind turbines in Victoria (P. D. Moloney, L. F. Lumsden, & I. Smales, 2019).

[2] Flight height observations recorded at either Bonney Downs or EPGH proposed wind farm sites, showing the proportion of records of flight height observations that would place them below the rotor swept area (RSA), within RSA, or above RSA.

[3] Percentages relative to the proposed turbine specifications to be used at Bonney Downs.

* numbers represent similar taxa where available. Turbine specifications (hub height, rotor swept zone) not stated in the report.

VU: Vulnerable (IUCN), IA: Migratory birds protected under international agreement

5 DISCUSSION

5.1 SURVEY METHODOLOGY

5.1.1 Justification for Survey Methods

The survey methods utilised for this assessment are in accordance with most current federal guidelines and guidance documents which outline the industry best-practise methods for surveying terrestrial vertebrate fauna for impact assessment. The following guidance documents were used in the survey design for this assessment:

- Draft Onshore Wind Farm Guidance (DCCEEW, 2024);
- Technical Guidance for terrestrial vertebrate fauna surveys for environmental impact assessment (EPA, 2020);
- Survey Guidelines for Australia’s Threatened Bats (Department of Sustainability Environment Water Population and Communities, 2010);
- Survey Guidelines for Australia’s Threatened Birds (DEWHA, 2010);
- Interim Guideline for Preliminary Surveys of Night Parrot (*Pezoporus occidentalis*) in Western Australia (DBCA, 2017);
- Guidelines for Determining the Likely Presence and Habitat Usage of Night Parrot (*Pezoporus occidentalis*) in Western Australia (DBCA, 2024).

5.1.2 Survey Adequacy Assessment

The survey adequacy assessment includes the criteria outlined in the *Onshore Wind Farm Guidance* (DCCEEW, 2024) and *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA, 2020), and addresses components of the desktop study, literature review, data collection and survey design (Table 31).

Table 31: Survey adequacy assessment for 24 months of BBSUS at Bonney Downs.

	Criteria	Addressed	Comment
	Providing ecological data	Yes	A spatial data package in ESRI shapefile (.shp) format is provided with this report.
Desktop, literature review and data collection	Site characteristics, including: habitat features, topography, prevailing wind, wetlands, distance to nesting, foraging and roosting areas, surface and aerial wildlife movement patterns.	Yes	Habitat features - Section 0 Prevailing wind and weather - Section 4.1.2 Distance to activity areas and movement patterns - provided in report maps, likelihood of occurrence (Appendix E) and movement corridors (Section 5.6)
	Species characteristics, including: behaviour, flight and demographic factors, flight paths, flight heights, soaring, flocking, population numbers.	Yes	The species characteristics literature review for significant species is provided in Appendix F.
	Type of habitat, including: vegetation composition and structure, suitable land zones to support foraging dispersal, permanent and temporary bodies of water.	Yes	Broad fauna habitats - Section 0 Vegetation composition and structure - Section 3.1.4 Land zones for movement and foraging (corridors) - Section 5.6 Water bodies - Section 3.1.6
	Survey design		
	Site selection	Yes	Site selection was determined based on fauna habitats within the survey area and achieving adequate spatial coverage. Site selection is addressed in Section 2.2.3
	Seasonality	Yes	

Criteria		Addressed	Comment
	Survey timing	Yes	Surveys were planned and conducted within the seasons outlined in Section 2.2.1. Each BBSUS site was surveyed in three different periods of day including morning, midday and afternoon.
	Survey duration	Yes	Nine BBSUS have been conducted to date at Bonney Downs, this report addresses the first eight surveys conducted over 24 months.

5.2 AVIFAUNA SPECIES ASSEMBLAGE

5.2.1 Flight Heights

Flight height data collected during BBSUS indicates that 95.6% of avifauna observations were recorded with a maximum flight height below the RSA, with only 16 species (eight raptors, six waterbirds, one aerial bird and one songbird) recorded flying at or above the RSA. Flight height analysis indicates that raptor taxa are active throughout the day, with records spanning between 06:00-18:00. Grey falcon observations within RSA appear to be recorded most frequently around 9am and 6pm, which would be consistent with birds utilising thermal updraughts to travel to and from foraging areas from overnight roost sites. No clear trends or consistent variations in daily flight height activity appear to be exhibited by the remaining seven raptor species recorded flying within the RSA.

5.2.2 At Risk Bird Species

5.2.2.1 Raptors

Fifteen raptor taxa were recorded within the survey area, representing 75.0% of the raptor assemblage potentially occurring within the survey area based on the database searches. Eight raptor taxa are considered permanent residents of the survey area and have been recorded across all seasons and surveys. The remaining seven species are considered transient

A collision risk assessment was undertaken for all raptor species recorded within the survey area, based on behavioural traits, distribution and flight observations. Twelve species were assessed as having a high risk of collision and three species were assessed as having a medium risk of collision (Table 30).

During flight, soaring birds exploit ascending currents to travel large distances, and thermal soaring enables birds to perform cost-efficient flights (Keskin, Duriez, Lacerda, Flack, & Nagy, 2025). The raptors assessed as high risk were recorded utilising thermals to ascend to heights within the RSA range.

Generally, raptors occupy fixed territories and are sedentary for much of the year, with juveniles dispersing to occupy new areas. The survey area encompasses a diversity of habitat types which provide nesting and foraging opportunities for raptors, which is likely to have contributed to the relatively high diversity of raptor species recorded. Although turbine construction and operation will result in the disruption of established raptor territories through displacement (turbine avoidance and displacement from usable habitat) or bird strike (, new individuals are likely to recolonise these territories over time. For some raptor species, portions of the survey area may become a local population sink, if recolonising animals are unable to avoid turbine arrays (DPIW, 2006).

5.2.2.2 Waterbirds

Twenty-six waterbirds were recorded within the survey area, representing nearly half (46.4%) of species potentially occurring within the survey area based on the desktop assessment and literature review.

The waterbird diversity recorded is consistent with expectations based on the presence of several seasonal and permanent waterbodies within the survey area. Seventeen species identified during the database searches which were not recorded during the BBSUS are Migratory taxa which are likely to only temporarily utilise habitat within (or the airspace above) the survey area while transiting to the Fortescue Marsh and therefore have a lower detectability. As these species generally travel at night, the majority of these flights would not be detected during daytime survey periods.

Seasonal movements and species-specific flight heights for waterbird and migratory species are poorly known and flight height parameters were not available for every species. As these species typically spend extended periods of time foraging on-ground at waterbodies, flight height data collected during surveys may not accurately reflect species-specific flight height capabilities for sites where these species were recorded at water sources.

The risk assessment conducted by (Shephard et al., in prep.) assessed 25 of the 26 waterbirds recorded within the survey area during the two-year BBSUS period (Table 30). Of these, 18 were assessed as having a high risk of turbine collision based on the species' behavioural traits, distribution and flight observations. Seven additional waterbird species were assessed as having a medium risk of collision, and one species (black swan) was not assessed in the risk assessment. One significant waterbird (oriental plover [MI]) was assessed as having a medium risk of collision (Table 30).

5.3 BAT SPECIES ASSEMBLAGE

5.3.1 At Risk Bat Species

At least twelve bat taxa have been recorded within the survey area to date. The site utilisation risk assessment identified at least eight bat species with a high risk of collision, including the Finlayson's cave bat, little broad-nosed bat, northern free-tail bat, greater northern free-tail bat, common sheath-tailed bat, white-striped free-tailed bat, yellow-bellied sheath-tailed bat and at least one species from the *Nyctophilus* genera which was unable to be identified to species level based on call sequences. One species (common sheath-tailed bat) was assessed as having a high risk of collision across all classification systems. Both the Pilbara leaf-nosed bat (VU) and ghost bat (VU) were assessed as having a low risk of turbine collision based on risk assessments undertaken by Fleming and Dempster (in prep.) and Specialised Zoological (2024b) (Table 29).

No Pilbara leaf-nosed bat roosts or ghost bat roosts were identified within the survey area and targeted searches did not identify any caves with suitable structure to provide potential diurnal roosting habitat for these species. No call timings indicative of a nearby roost have been recorded within the survey area. Due to the general absence of roosting habitat, the presence of these species within the survey area is likely to be restricted to foraging and dispersal activities.

5.4 SIGNIFICANT SPECIES

5.4.1 Significant Fauna Recorded

5.4.1.1 Grey falcon (*Falco hypoleucos*) – Vulnerable EPBC Act and BC Act

Ecology

The grey falcon (*Falco hypoleucos*) is a stocky, elusive species endemic to mainland Australia and is the rarest of the Australian members of the *Falco* genus (Marchant & Higgins, 1993); (Schoenjahn, 2011b). The total population in Australia is accepted to be <1,000 mature individuals (Schoenjahn, 2011a) and as a result, this species was listed as Vulnerable under the EPBC Act in September 2019. The grey falcon is also listed as Vulnerable under the BC Act.

The grey falcon is a medium-sized raptor, with average body mass for males around 390 grams and for females around 560 grams (Schoenjahn, 2011b). A sleek, grey plumaged falcon with a swift, direct flight pattern, foraging low over groundcover below treetop level with shallow wing beats and brief glides (Morcombe, 2022). Soars with wings held close to level with dark-tipped primaries slightly spread to give a blunt wingtip (Morcombe, 2022).

Grey falcons of all ages feed almost exclusively on birds including doves, pigeons, parrots, cockatoos and finches (Schoenjahn, Pavey, & Walter, 2020). Grey falcons hunt predominantly in open country, often over treeless grassland, which is also a key feeding habitat of prey species (Schoenjahn, 2013) and they are well known for hunting over natural and artificial water sources (Schoenjahn, 2018).

The grey falcon is distributed sparsely over parts of Australia's arid and semi-arid zone with the breeding distribution of the species confined to climate zones which are unlikely to experience winter rainfall and which exhibit the highest average annual temperatures (Schoenjahn et al., 2020). This species occurs in low densities across inland Australia and is considered to comprise a single, monotypic population (Marchant & Higgins, 1993). Although the species frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses (Ehmann & Watson, 2008; S.T. Garnett, Szabo, & Dutson, 2011; Schoenjahn, 2013), it has also been observed hunting in treeless areas, tussock grassland and open woodland, especially in winter (Schoenjahn, 2018); (Olsen & Olsen, 1986).

Grey falcons do not build their own nests, instead using old stick-nests of other birds, mainly corvid and other raptor nests located in trees or on artificial structures such as telecommunication towers and powerline poles (Johnstone & Storr, 1998; Schoenjahn et al., 2020). Nesting usually occurs high in the tallest trees in the area usually along watercourses or river pools (Morcombe, 2022) particularly in *Eucalyptus camaldulensis* and *Eucalyptus coolabah* (Threatened Species Scientific Committee, 2020). Breeding takes place between June and November with a clutch size of 2-4, a nestling number of 1-4 and a nestling period of >38 days (Schoenjahn, 2013).

Occurrence within the survey area

DBCA and Fortescue database searches indicate that a total of 20 grey falcon records have previously been documented within 100 km of the survey area. Grey falcons were recorded on two occasions in May 2023, with two birds recorded soaring in the vicinity of a cattle yard and two birds recorded feeding on a dead spinifex pigeon before flying to a large eucalypt. Three observations comprising between 1-2 individual birds were recorded in the July 2023 terrestrial vertebrate surveys, one systematic observation of two birds was recorded during a BBSUS in October 2023, three observations were recorded in February 2024 (one systematic and two

incidental), one incidental sighting was documented in March 2024, one incidental record in April 2024 and one incidental sighting of two birds gliding in June 2024.

In the second year of BBSUS, grey falcons were observed on 11 occasions, comprising five records during BBSUS and six incidental records. Of the 11 observations recorded in the second year of BBSUS, seven were recorded during February 2025, one was recorded during April 2025 survey, and three were recorded during the August 2025 survey. Records obtained in February and April 2025 comprised 1-2 individuals, observed during directed flight, antagonising nearby birds or perched in trees. In August 2025, two individuals were opportunistically observed in Bonnie Creek, approximately 2.7 km west of BB025.

One grey falcon individual was initially observed defending a nest against other raptors, with subsequent observations identifying a female grey falcon incubating an active nest (Map 9). The nest was identified as an old whistling kite nest (Simon Cherriman, pers comms 2025) and was situated on a eucalypt within a tributary of Bonnie Creek, with a permanent water pool located 80 m east of the nest. This nest was subsequently observed during September 2025, outside of the current 24-month survey period covered by the current assessment. A single, well-developed chick was observed within the nest, with two adult grey falcons exhibiting defence and foraging behaviours nearby.

Based on the repeated sightings of grey falcons, confirmation of breeding behaviours and ongoing utilisation of Drainage Line/River/Creek (major) habitat associated with the Bonnie Creek system, the survey area is known to support at least one breeding pair of grey falcons. The grey falcon is sparsely distributed, and species movements, including their home range size, are poorly understood (Schoenjahn et al., 2020). It is therefore possible that more than one pair of birds are utilising habitat within the survey area; however, simultaneous observations of more than one pair of birds have not been recorded to date.

Grey falcon flight heights recorded during BBSUS and incidental sightings ranged from ground level to 235 m with nearly one third of observations (30%) recording one or more grey falcons flying within the proposed RSA height (97 m – 279 m). Grey falcon observations within the RSA appear to be recorded most frequently around 9am and 6pm, which would be consistent with birds utilising thermal updraughts to travel to and from foraging areas from overnight roost sites. The grey falcon has been consistently recorded at Bonney Downs across multiple seasons and years, and the species has been assigned a high collision risk given its spatial distribution and height of records.

5.4.1.2 Ghost bat (*Macroderma gigas*) – Vulnerable EPBC Act and BC Act

Ecology

The ghost bat was historically distributed across much of Australia but now has a fragmented although widespread distribution restricted to northern Australia (Threatened Species Scientific Committee, 2016a). Following European settlement, the distribution of this species contracted northward with arid zone populations undergoing the greatest contractions (Threatened Species Scientific Committee, 2016a). Ghost bat populations are highly structured and are considered to be genetically distinct at both local and regional scales (Threatened Species Scientific Committee, 2016a).

The ghost bat is the largest microchiropteran bat in Australia, is strictly carnivorous and captures its prey mainly on the ground before returning to an established feeding site to devour its catch (Van Dyck & Strahan, 2008). The diet of this species includes amphibians, reptiles, birds, small terrestrial mammals, insects and other bats (Van Dyck & Strahan, 2008). Unlike other microchiropterans, the ghost bat does not continuously call when in flight and instead uses its

eyes and ears to scan for prey (Van Dyck & Strahan, 2008). Females reach reproductive maturity between two and three years of age (Hoyle, Pople, & Toop, 2001).

Preferred roosting habitat in the Pilbara includes caves beneath bluffs of low, rounded hills composed of Marra Mamba geology, and granite rock piles (K. Armstrong & Anstee, 2000). Ghost bats have also been known to roost in large colonies within sandstone caves, under boulder piles and in abandoned mines (Churchill, 1998). Permanent roost sites are typically deep caves, rock crevices or old mine adits with a relatively stable temperature (23-28°C) and high humidity (50-100%) (Threatened Species Scientific Committee, 2016a). During daylight hours, ghost bats roost in large caves, mines or deep rock fissures (Van Dyck & Strahan, 2008). In some parts of its range, the ghost bat shares roosts with the Pilbara leaf-nosed bat, Finlayson's cave bat, common sheath-tailed bat, and possibly Hill's sheath-tailed bat.

Ghost bats are known to seasonally move between a number of caves or as dictated by weather conditions (Hutson, Mickleburgh, & Racey, 2001) and disperse widely when not breeding, but concentrate in relatively few roost sites when breeding (Threatened Species Scientific Committee, 2016a). Maternity caves are relatively uncommon, with only eleven recorded in the Pilbara region (three natural caves and eight mines) (K. Armstrong & Anstee, 2000). Diurnal roost caves usually contain one or more large chambers with additional geological features including fissures and chambers which are fully dark and have a minimum roof height of 2-3 m (Bat Call, 2016). Maternal roost sites exhibit the features outlined for diurnal roosts with the addition of an interior chamber that rises towards the rear of the cave and creates a warm and humid environment for breeding females and pups (Bat Call, 2016). Nocturnal roosts or feeding caves (middens), which are only used at night, are usually present in rock overhangs and small caves which are well lit during the day and can be easily recognised based on the presence of discarded prey pieces and faeces on the floor (Richards, Hand, & Armstrong, 2008). K. Armstrong and Anstee (2000) suggested that ghost bats occur in small groups within the Hamersley Ranges and may move about in a local area, possibly in response to disturbance, microclimate or social factors.

Occurrence within the survey area

The ghost bat was recorded from a single acoustic lure site (BDGB03) (Map 10) during the Bonney Downs detailed and targeted fauna surveys in 2024 (ecologia, 2024b); however, it was not recorded at any BBSUS sites over the two year period. As this species exhibits cryptic call patterns when hunting, it may not reliably be detected using passive survey methods alone (e.g. ARUs) and absence of call records does not necessarily mean that the species was absent from the survey area during periods where it was not detected. This species was assigned a low collision risk rating by Specialised Zoological based on the low frequency of occurrence throughout the survey area and moderate likelihood of flight activity above 50 m (Specialised Zoological, 2024b).

Although Rocky Escarpment habitat within the survey area may provide nocturnal refugia and feeding perches for the ghost bat, no caves with attributes consistent with ghost bat roosting habitat were identified within the survey area. This species has the potential to forage in all habitat types and was recorded on an acoustic lure located within Drainage Line/River/Creek (major) habitat in March 2024.

5.4.1.3 Pilbara leaf-nosed bat (*Rhinonictoris aurantia* (Pilbara form)) – Vulnerable EPBC Act and BC Act

Ecology

This small insectivorous bat occurs throughout the Pilbara and adjacent upper Gascoyne regions of Western Australia (Threatened Species Scientific Committee, 2016b). The species was listed under the EPBC Act as Vulnerable in April 2001 as it had undergone a substantial reduction in numbers, its geographic distribution is precarious for its survival (being limited to the Pilbara), the

estimated total number of mature individuals is limited, and the number is likely to continue to decline. The Pilbara leaf-nosed bat has very restrictive habitat requirements, including caves and disused mines with hot to very hot and humid roost sites with temperatures in the 28° to 32°C range and 96% to 100% relative humidity (K. N. Armstrong, 2001; Churchill, 2008). Pilbara leaf-nosed bat colonies are thought to contract to the deepest mines and caves that maintain microclimates suitable for roosting during the Pilbara dry season, preceding the heavy summer rains (K. N. Armstrong, 2001; Bullen & McKenzie, 2011; Van Dyck & Strahan, 2008). During the hotter, wetter and more humid summer months, the species has a greater ability to disperse through the landscape. The Pilbara leaf-nosed bat has been observed foraging in a variety of habitats including *Triodia* hummock grasslands covering low rolling hills and shallow gullies, with scattered *Eucalyptus camaldulensis* along the creeks (DoE, 2023). This species is most commonly encountered over small pools of water in rocky gullies and gorges (DoE, 2023).

Occurrence within the survey area

Echolocation calls of the Pilbara leaf-nosed bat have been recorded at 10 BBSUS sites (Map 10), with detections recorded on 25 nights over the 24 months of BBSUS. Pilbara-leaf nosed bat calls have been recorded at nine additional sites (eight ARU and one ghost bat lure site) within the survey area, during detailed and targeted surveys undertaken in 2023. The Pilbara-leaf nosed bat has been recorded a total of 36 nights between May 2023 and August 2025. No low time calls indicative of a nearby Pilbara-leaf nosed roost site have been recorded to date, with low activity rates consistently recorded across the site, suggesting that habitat within the broader survey area is utilised for foraging and dispersal only.

This conclusion is supported by the fact that the majority of echolocation records obtained to date have been associated with sites located in or adjacent to major drainage lines (Map 10).

The Pilbara leaf-nosed bat was assigned a low collision risk rating by Specialised Zoological based on the low frequency of occurrence throughout the survey area and low likelihood of flight activity above 50 m (Specialised Zoological, 2024b).

5.4.1.4 Fork-tailed swift (*Apus pacificus*) – Migratory EPBC Act and BC Act

Ecology

The fork-tailed swift is a small, insectivorous species with a white throat and rump, and a deeply forked tail (Morcombe, 2010). Its distribution spans from central Siberia and throughout Asia, breeding in north-east and mid-east Asia, and wintering in Australia and south New Guinea. It is a relatively common trans-equatorial migrant from October to April throughout mainland Australia (Simpson & Day, 2004). In Western Australia the species begins to arrive in the Kimberley in late September, the Pilbara in November and the South-west by mid-December (Johnstone & Storr, 1998). In Western Australia the fork-tailed swift is considered uncommon to moderately common near the north-west, west and south-east coasts, common in the Kimberley and rare or scarce elsewhere (Johnstone & Storr, 1998). Fork-tailed swifts are nomadic in response to broad-scale weather pattern changes. They are attracted to thunderstorms where they can be seen in flocks, occasionally of up to 2,000 birds. They rarely land, living almost exclusively in the air and feeding entirely on aerial insects, especially nuptial swarms of beetles, ants, termites and native bees (Simpson & Day, 2004).

There is limited evidence of known threats to the fork-tailed swift by humans and wild predators (IUCN, 2019; Ktitorov, 2021), however; due to the species flight patterns and behaviours, they are generally considered at-risk of wind turbine collision (T.J. Regan, M.J. Bruce, E.M. van Harten, & Lumsden, 2025).

Occurrence within the survey area

The fork-tailed swift was recorded within the survey area on four occasions, comprising one incidental record and three records during BBSUS. All records were obtained during the first phase of the February 2025 survey, prior to the significant rain event that was associated with ex-tropical cyclone Zelia. The fork-tailed swift has been recorded at lower flight altitudes prior to low pressure systems when high winds increase food abundance and it is likely that atmospheric pressure changes associated with ex-tropical cyclone Zelia were responsible for the increased detections of this species during this period. The fork-tailed swift was assigned a high collision risk by Shephard et al. (in prep.) based on species characteristics which may make it more susceptible to turbine collision.

5.4.1.5 Oriental plover (*Anarhynchus veredus*) – Migratory EPBC Act and BC Act

Ecology

The oriental plover is a lightly built shorebird with long, yellowish legs and a distinctly upright stance (Johnstone & Storr, 1998; Simpson & Day, 2004). In Western Australia, this species occurs in the Kimberley, north-eastern interior (Lake Gregory) and north-west coastal plains.

The preferred habitat of the oriental plover consists of sparsely vegetated plains, including samphire and short-grass flats, where it feeds largely on insects (Johnstone & Storr, 1998). They often forage at night and roost during the day with other waders on beaches or mudflats (Morcombe, 2010). Oriental plovers breed in Mongolia, south Siberia and north China, returning to northern Australia during summer. They are uncommon to common, being most common in the drier parts of their range, occurring usually in flocks of up to 200 birds.

Occurrence within the survey area

The oriental plover was recorded on a single occasion within the survey area, overflying BB037 during a BBSUS sampling period. DBCA and Fortescue database records identified an additional five records within 100 km of the survey area, with the majority of records associated with the Fortescue Marsh. Occurrence of this species is likely to be restricted to a transient presence rather than permanent occupancy as permanent habitat does not occur within the survey area. The oriental plover was assigned a moderate collision risk by Shephard et al. (in prep.) based on species characteristics which may make it more susceptible to turbine collision.

5.4.2 Significant fauna which may utilise habitat within the survey area for foraging, roosting and breeding

5.4.2.1 Peregrine falcon (*Falco peregrinus*) – Other Specially Protected Fauna BC Act

Ecology

This species is widespread in Australia but requires specific nesting sites. It does not build a nest but requires cliffs, rocky outcrops, or large tree hollows (Johnstone & Storr, 1998). Suitable breeding habitat has the potential to occur in the survey area in the form of tree hollows and breakaways; however, due to its widespread movements, the species may also overfly all habitat types intermittently. Peregrine falcons feed almost entirely on birds, especially ducks, parrots, and pigeons.

Potential occurrence within the survey area

According to DBCA and Fortescue database searches, the peregrine falcon has been recorded on 44 occasions within the study area, with the closest record located 3 km south of the survey area. Records of the species appear to be concentrated around the Fortescue Marsh, with only a single record located north of the survey area; however, this may reflect sampling bias rather than a true species distribution pattern. Although no evidence of this species was recorded during the

current surveys, the peregrine falcon has the potential to utilise all habitat types while foraging. Rocky Escarpment habitat within the survey area supports cliffs and overhangs for breeding activities and Drainage Line/River/Creek (major) habitat provide foraging habitat and encompass large trees which potentially provide nesting opportunities for this species.

The peregrine falcon was not assigned a collision risk by Shephard et al. (in prep.), as the species has not been recorded at Bonney Downs. Although not recorded within the survey area to date, this species exhibits flight and behavioural characteristics similar to other falcons and would therefore represent a high collision risk if present within the survey area.

5.4.2.2 Night parrot (*Pezoporus occidentalis*) – Endangered EPBC Act and Critically Endangered BC Act

Ecology

The night parrot is a cryptic, nocturnal parrot that is endemic to Australia primarily feeding on the ground inhabiting remote arid and semi-arid areas of Australia (DBCA, 2017). Historical evidence indicates that night parrots were distributed over much of semi-arid and arid Australia (S.T. Garnett et al., 2011). This elusive parrot was thought to be extinct for a long period of time prior to purported sightings in 2005 in the vicinity of Fortescue Marsh and the discovery of night parrots in western Queensland by John Young in 2013. Since 2013, detailed studies at Pullen Pullen Reserve in western Queensland have provided critical information relating to breeding behaviour, physiology, roosting and foraging habitat, nocturnal movements, and calling behaviour (Murphy S. A. et al., 2017). This species has subsequently been recorded and sighted in the East Murchison by Jackett et al. (2017).

The structure of the *Triodia* recorded by Jackett et al. (2017) was similar to that described by Murphy et al. (2017) at Pullen Pullen, being dense, and ring-shaped. Murphy et al. (2017) recorded a nest located in *Triodia longiceps* while Jackett et al. (2017) recorded the nest in *Triodia* aff. *plurinervata*. Night parrot nest site selection may be more reliant on the structure of the spinifex and not necessarily the size of the spinifex expanse, or the substrate type (Jackett et al., 2017). It is also suggested that the proximity of dense ground layer vegetation (e.g., *Triodia*) to suitable foraging grounds is likely to play a role in nest (and roost) site selection, suggesting the samphire and herbfields adjacent to the *Triodia* expanse could be a food source (Jackett et al., 2017; Murphy et al., 2017).

Potential occurrence within the survey area

Night parrot calls were not recorded during the current surveys, and it is unlikely that a long-term stable night parrot roosts exists in the area immediately surrounding the points sampled or that night parrots were foraging in proximity to these surveyed points at the time of sampling (Adaptive NRM 2024). As patches of long-unburnt spinifex occur across portions of the survey area it is possible that the species may utilise these areas of habitat despite not being detected during the detailed or targeted surveys. DBCA database searches identified night parrot records associated with the Fortescue Marsh within 100 km of the survey area.

The night parrot was not assigned a collision risk by Shephard et al. (in prep.), as the species has not been recorded at Bonney Downs. Although the species has not been recorded within the survey area, the species is unlikely to fly at heights within the RSA and would therefore represent a low collision risk if present within the survey area.

5.4.2.3 Migratory birds

DBCA and Fortescue database searches identified eight Migratory bird species (common sandpiper, sharp-tailed sandpiper, red-necked stint, gull-billed tern, Caspian tern, glossy ibis, wood sandpiper and marsh sandpiper) and two Threatened species (Australian painted snipe and

common greenshank) which are considered moderately likely to occur within the survey area based on the proximity of records to the survey area and ability of these species to fly significant distances during migration. Although Migratory avifauna species may intermittently occur within the survey area (overflying or temporary utilisation of aquatic habitat), presence within the survey area is likely to be associated with migration to the Fortescue Marsh rather than permanent occupancy of the survey area.

These Migratory species were not assigned a collision risk by Shephard et al. (in prep.), as they have not been recorded at Bonney Downs. Although not recorded within the survey area to date, these Migratory taxa exhibit flight and behavioural characteristics similar to the oriental plover and would therefore represent a moderate collision risk if present within the survey area.

5.5 HABITAT FEATURES AND FAUNA USAGE

5.5.1 Waterbodies

Waterbodies in or immediately adjacent to the Bonney Downs survey area that have significance for avifauna and bats include the Bonnie Creek (BB023), the Nullagine River (BB021), the Coongan River (BB001, BB003, BB006), the Bonney Downs station dam (BB016) and Kookindinna Gorge. These waterbodies range from semi-permanent to permanent and experience prolonged inundation during the wet season, with many of these features continuing to hold water at varying levels during the dry season.

Waterbodies within the survey area provide aquatic habitat for Migratory species and may be utilised during transit to the Fortescue Marsh; however, no suitable foraging habitat for sustained use by Migratory species is found within the survey area.

Waterbirds such as ducks, cormorants and herons were recorded during all survey seasons utilising waterholes to forage. Additionally, Drainage Line/River/Creek (major) and Drainage Line/River/Creek (minor) habitat types are significant features in the landscape and provide roosting habitat for raptors and owls, and dispersal and foraging habitat for numerous birds and bats.

5.6 MOVEMENT CORRIDORS

5.6.1 Avifauna

5.6.1.1 Grey falcon

Although this species may overfly all habitat types during dispersing and foraging activities, hunting and breeding activities primarily occur within the Drainage Line/River/Creek habitat types. Many of the grey falcon sightings have been recorded within creeklines and rivers or adjacent habitat, with the Bonnie Creek, Nullagine River, Coongan River and associated tributaries providing movement corridors for the species within the survey area.

5.6.1.2 Migratory species

The Bonney Downs Windfarm Project is situated along the East Asian-Australasian Flyway, meaning that the airspace above the survey area may be intermittently occupied by Migratory species transiting between Eighty Mile Beach/Mandora Salt Marsh and the Fortescue Marsh. During the northward (March-May) and southward migration (August – October) periods, water sources (e.g. Bonnie Pools and the Bonney Downs Station dam) within the survey area may be temporarily utilised as overnight stepping stones by Migratory bird taxa travelling to and from the Fortescue Marsh.

5.6.2 Bats

5.6.2.1 Ghost bat (*Macroderma gigas*) – Vulnerable EPBC Act and BC Act

Ghost bats exhibit seasonal movement patterns between a number of caves or as dictated by weather conditions (Hutson et al., 2001) and disperse widely outside of the breeding season, but concentrate in a relatively few roost sites when breeding (Threatened Species Scientific Committee, 2016a). The species has been documented foraging in all habitat types and is commonly recorded along watercourses (Threatened Species Scientific Committee, 2016a).

Species distribution modelling of ghost bats within the Pilbara region indicates that several roosts are located to the north and east of the survey area (< 30 km), in proximity to the Coongan River and Bonnie Creek (Shaw et al., 2025). As only a single record of the ghost bat has been recorded within the survey area to date, there is insufficient data to discuss specific flights paths and movement corridors within the survey area for this species.

Ghost bats are known to forage in open habitats and often travel significant distances to forage. Bullen, Reiffer, and Trainer (2023) found that ghost bats will travel an average of 8 km from a roost site while foraging, with maximum distances of nearly 18 km from a roost site recorded during the study. Average maximum return flight distances recorded by Bullen et al. (2023) ranged from 12.2 km for females and 36 km for males. As a number of ghost bat roosts have been recorded within 30 km of the survey area, it is feasible that ghost bats may utilise the Coongan River and Boonie Creek as foraging and dispersal habitat, potentially creating a movement corridor along the creeks in the northern portion of the survey area.

5.6.2.2 Pilbara-leaf nosed bat (*Rhinonicteris aurantia* (Pilbara form)) - Vulnerable EPBC Act and BC Act

Pilbara leaf-nosed bats are known to forage in a range of habitat types but typically favour highly productive habitats including watercourses (Bat Call WA, 2021b), and the species is known to travel 20 km from a roost for foraging, with an increasing number of detections over 30 km from a diurnal roost. Species distribution modelling conducted by Shaw et al. (2025), have identified multiple known Pilbara-leaf nosed bat roosts within 30 km north of the survey area, including a combination of disused mine and natural roosts. Habitat modelling indicates that suitable habitat for this species is concentrated to the northern half, and the south-western corner, with the centre of the survey area representing less suitable habitat Shaw et al. (2025).

Habitat modelling and the spatial patterning of records within the survey area suggest that the Coongan River and the Bonnie Creek could be utilised as the main movement corridors in the northern portion of the survey area, with further dispersal into the surrounding foraging habitat including Gorges/Gullies, Woodland (open) and Plain (stony/gibber) habitats.

5.7 MIGRATION AND SEASONAL CONSIDERATIONS

5.7.1 Waterbirds

Analysis of waterbird observation counts indicates that higher numbers of at-risk avifauna taxa were present during southward migration (August – October), wet season (November – February) and northward migration (March – May) than during the dry season (June – July) (Figure 8). This may be attributable to the presence of the Fortescue Marsh staying inundated for a longer period into the dry season than the smaller watercourses present within the survey area. Additionally, local movements of waterbirds are likely reduced during this period to conserve energy.

5.7.2 Migratory Species

The fork-tailed swift (MI) was recorded on four occasions across three sites over the 24 months, with all records occurring prior to ex-tropical cyclone Zelia in February 2025. Fork-tailed swifts are known to be nomadic and are attracted to storms due to increased food availability from low-pressure systems (Ktitorov, 2021). This species may occur within the survey area during the wet season when localised storms and atmospheric pressure variations are more frequent.

The oriental plover (MI) was recorded overflying the survey area on a single occasion across the first two years of BBSUS. As the sighting was recorded during the southward migration period (September 2024), this record is likely to represent vagrant presence of the species within the airspace above the survey area while transiting to the Fortescue Marsh.

As the survey area is situated on the East Asian-Australasian Flyway between Eighty Mile Beach/Mandora Salt Marsh and the Fortescue Marsh, utilisation of the airspace above the survey area and waterbodies within the survey area by Migratory avifauna taxa not recorded during the BBSUS is possible during the northward and southward migration periods.

5.7.3 Bats

Pilbara leaf-nosed bats are known to travel longer distances to forage when the temperature decreases, and the lower detection rate between November and April may be attributable to the species travelling from roosts outside of the survey area to forage (Bat Call WA, 2021b). This has been attributed to lower temperatures after the wet season and younger individuals dispersing after the reproductive period (Bat Call WA, 2021b).

Ghost bats are also known to move between roosting caves dependent on weather conditions (Hutson et al., 2001) and forage more frequently in areas that have experienced significant localised rainfall events and therefore exhibit higher numbers of prey species in response to improved seasonal conditions.

Analysis of bat detections across seasons indicate that noticeable increases in the Finlayson's cave bat, greater northern free-tailed bat and northern free-tailed bat were recorded during the dry season (Figure 12). This difference may be attributed to reduced surface water availability during this period, resulting in increased utilisation of permanent waterbodies within the survey area between May and October. A noticeable increase in detections was recorded for the yellow-bellied sheath-tailed bat during the wet season, which may be associated with southward movements of the species during the summer (Churchill, 2008). A small decrease in detection rates between the dry season and wet season was identified for the Pilbara leaf-nosed bat detections; however, it is not possible to determine whether this difference is significant due to the low detection rate for this species across all seasons (Figure 12).

6 CONCLUSIONS

- Ten fauna habitat types occur within the survey area: Woodland (open), Woodland (closed), Plain (stony/gibber), Plain (cracking clays), Hills/Ranges/Plateaux, Granite Outcrops (flat dome), Gorges/Gullies, Drainage Line/River/Creek (major), Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways) and Drainage Line/River/Creek (minor). The remainder of the survey area encompasses previously cleared areas.
- One-hundred and twenty-eight avifauna taxa have been recorded within the survey area, representing 68.4% of species potentially occurring based on database searches and the literature review. One-hundred and twenty-one avifauna taxa were systematically recorded during BBSUS, with two additional species incidentally recorded within the two-year BBSUS sampling period. A further five species have been recorded within the survey area during previous surveys but were not recorded during the two-year BBSUS sampling period.
- Twenty-six waterbird taxa from 11 families have been recorded in the survey area. Fifteen raptor species, representing two families (Falconidae and Accipitridae), were recorded within the survey area. These species belong to groups considered to be at greater risk of turbine collision due to flight demographics and behavioural attributes. Seven nocturnal birds have also been recorded within the survey area, with the majority of these species considered to have a moderate risk of collision with wind turbines.
- Eighteen species were recorded flying at or above RSA height, comprising eight raptors (grey falcon [VU], wedge-tailed eagle, whistling kite, spotted harrier, black-kite, nankeen kestrel, black falcon and brown falcon), six waterbirds (straw-necked ibis, Australasian darter, white-necked heron, Australian pelican, little black cormorant and little pied cormorant), and two additional species (masked woodswallow and Torresian crow).
- Three EPBC Act listed avifauna species have been recorded in the survey area, including the grey falcon (*Falco hypoleucos* [VU]) (23 occasions), fork-tailed swift (*Apus pacificus* [MI]) (four occasions) and the oriental plover (*Charadrius veredus* [MI]) (one occasion). The site utilisation risk assessment assessed the grey falcon and fork-tailed swift as having a 'high' risk of collision, the oriental plover was rated with a 'medium' risk of collision.
- Echolocation calls belonging to at least 10 bat species were recorded at Bonney Downs during the BBSUS. One additional species, the black flying fox was opportunistically recorded during the detailed fauna surveys, and the ghost bat (VU) was recorded at an acoustic lure site during previous surveys. Based on analysis by Specialised Zoological, an additional five species have the potential to occur within the survey area and may fly at RSA height while foraging and transiting (if present within the area).
- The EPBC Act listed Pilbara leaf-nosed bat (*Rhinionictis aurantia* (Pilbara form) [VU]), and ghost bat (*Macroderma gigas* [VU]) have both been recorded within the survey area. The Pilbara leaf-nosed bat has been recorded from 18 sites within the survey area, with an additional record consisting of a single echolocation sequence recorded at a ghost bat lure site BDGB01 in March 2024. The ghost bat was recorded at a single location within the survey area during previous surveys; however, was not recorded during BBSUS. Both significant bat taxa were assessed as having a low collision risk, based on flight altitudes and frequency of species observations across the survey area.
- The night parrot (*Pezoporus occidentalis* [EN/CR]), peregrine falcon (*Falco peregrinus* [OS]) and eight Migratory bird taxa were identified as potentially occurring within the survey area; however, these species have not been recorded during the BBSUS or preceding detailed and targeted surveys.

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8 APPENDICES

Appendix A Definitions.

SIGNIFICANT FAUNA

According to the *EPA Factor Guideline: Terrestrial Fauna* (EPA, 2016) animal taxa (or records) may be considered significant for a number of reasons including, but not restricted to, the following:

A taxon listed as 'Threatened' under the Biodiversity Conservation Act 2016 (WA) or the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth);

- A taxon on the Department of Biodiversity, Conservation and Attractions (DBCA) Priority Fauna List;
- Species with restricted distributions;
- Degree of historical impact from threatening processes;
- Providing an important function required to maintain the ecological integrity of a significant ecosystem.

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Cwlth)

At a Commonwealth level, Threatened species are protected under the EPBC Act, which lists species in accordance with the criteria of the International Union for Conservation of Nature (International Union for Conservation of Nature, 2014), that is, 'Critically Endangered', 'Endangered', 'Vulnerable', 'Conservation Dependant', 'Extinct', or 'Extinct in the Wild' (see <http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora> and <http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=fauna>).

Biodiversity Conservation Act 2016 (Western Australia)

At a State level, Threatened species are protected under the BC Act. These are taxa which have been adequately surveyed and are deemed to be either rare, in danger of extinction, or otherwise in need of special protection in the wild and are gazetted as Threatened (Declared Rare) Flora. Threatened species are further categorised by the Department of Biodiversity, Conservation and Attractions (DBCA) according to their level of threat using the International Union for Conservation of Nature (IUCN) red list criteria ((International Union for Conservation of Nature, 2014) (see <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities> for definitions).

Priority Fauna (DBCA)

The DBCA maintains a list of Priority species, which are considered poorly known, uncommon or under threat but for which there is insufficient justification to be listed as Threatened, based on known distribution and population sizes. Priority species are assigned to one of four categories, described below. DBCA listed Priority species do not have any statutory protection (see <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants> for definitions.)

Appendix B Fauna database search results.

Appendix C Regional fauna records from detailed surveys within the study area.

Letter	Survey
Previous surveys	
A	Adele Flora, Fauna and SRE Survey (360 Environmental, 2021)
B	Cloudbreak Level 2 Terrestrial Vertebrate Fauna Assessment (ecologia Environment, 2011)
C	Fauna Assessment - Nyidinghu Iron Ore Project (Bamford Consulting, 2012)
D	Targeted Fauna Assessment of the Rail Duplication (Bamford Consulting, 2010)
E	Nyidinghu Iron Ore Project Detailed Terrestrial Fauna Survey (360 Environmental, 2023)
F	Corunna Downs Project: Terrestrial Vertebrate Fauna Survey (Stantec, 2016)
G	Nyidinghu Mine Terrestrial Vertebrate Fauna Assessment (Ecologia Environment, 2023)
H	East Hamersley Rail Terrestrial Vertebrate Fauna Assessment (Ecologia Environment, 2023)
I	Mindy South: Detailed and Targeted Terrestrial Vertebrate Fauna Baseline Survey
J	McPhee Creek: Consolidated Terrestrial Fauna Report (Biologic, 2021)
K	Roy Hill Iron Ore Project, Level 2 Terrestrial Vertebrate Fauna Survey (ecologia, 2009)
L	Christmas Creek Terrestrial Vertebrate Fauna and Fauna Habitat Assessment (ENV Australia, 2012)
Bonney Downs Detailed surveys	
M	Bonney Downs North: Terrestrial Vertebrate Fauna Assessment (ecologia, 2024a)
N	Bonney Downs South: Terrestrial Vertebrate Fauna Assessment (Spectrum Ecology, 2024a)
Current report	
O	Bonney Downs Wind Farm: Bird and Bat Site Utilisation Report

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Bonney Downs Detailed surveys		Current report		
			WA	EPBC	ALA	Birddata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O		
Birds																										
Acanthizidae	<i>Acanthiza apicalis</i>	Inland thornbill			x	x												x								
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped thornbill								x								x								
	<i>Acanthiza robustirostris</i>	Slaty-backed thornbill			x	x					x								x			X		X		
	<i>Acanthiza uropygialis</i>	Chestnut-rumped thornbill			x	x					x	x		x		x			x			X		X		
	<i>Gerygone fusca</i>	Western gerygone			x	x						x		x		x			x	x					X	
	<i>Pyrrholaemus brunneus</i>	Redthroat			x	x						x							x						X	
	<i>Smicronis brevirostris</i>	Weebill			x	x						x	x		x	x	x	x	x	x	x	X	X		X	
	<i>Calamanthus campestris</i>	Rufous fieldwren				x																				
Accipitridae	<i>Tachypiza cirrocephala</i>	Collared sparrowhawk			x	x						x			x			x		x		X	X		X	
	<i>Tachypiza fasciata</i>	Brown goshawk			x	x						x		x	x		x	x		x		X	X		X	
	<i>Aquila audax</i>	Wedge-tailed eagle			x	x					x		x	x	x	x	x	x			x	X	X		X	
	<i>Circus approximans</i>	Swamp harrier			x	x																				
	<i>Circus assimilis</i>	Spotted harrier			x	x						x			x	x	x			x		X	X		X	
	<i>Elanus axillaris</i>	Black-shouldered kite			x	x							x		x					x			X		X	
	<i>Erythroriorchis radiatus</i>	Red goshawk	VU	EN																						
	<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle			x	x	x																			X
	<i>Haliastur sphenurus</i>	Whistling kite			x	x						x	x	x	x	x	x	x		x	x	X	X		X	
	<i>Hamirostra melanosternon</i>	Black-breasted buzzard			x	x							x			x	x	x								
	<i>Hieraaetus morphnoides</i>	Little eagle			x	x											x	x		x			X		X	
	<i>Milvus migrans</i>	Black kite			x	x						x		x	x				x				X		X	
	<i>Lophoictinia isura</i>	Square-tailed kite																x								X
Acrocephalidae	<i>Acrocephalus australis</i>	Australian reed warbler			x	x					x			x												
Aegothelidae	<i>Aegotheles cristatus</i>	Australian owl-nightjar			x	x					x		x		x	x	x	x	x	x		X	X		X	
Alaudidae	<i>Mirafra javanica</i>	Horsfield's bush lark			x	x						x	x						x	x	X	X		X		
Alcedinidae	<i>Dacelo leachii</i>	Blue-winged kookaburra			x	x						x		x				x	x	x	x	X	X		X	
	<i>Todiramphus pyrrhopygius</i>	Red-backed kingfisher			x	x					x	x	x		x				x	x	X	X		X		
	<i>Todiramphus sanctus</i>	Sacred kingfisher			x	x						x			x					x	X	X		X		
Anatidae	<i>Anas gracilis</i>	Grey teal			x	x						x	x									X	X		X	
	<i>Anas superciliosa</i>	Pacific black duck			x	x						x		x				x				X	X		X	
	<i>Aythya australis</i>	Hardhead			x	x							x						x						X	
	<i>Chenonetta jubata</i>	Australian wood duck			x	x								x											X	
	<i>Cygnus atratus</i>	Black swan			x	x							x									X			X	
	<i>Dendrocygna eytoni</i>	Plumed whistling duck			x	x							x								x		X		X	
	<i>Malacorhynchus membranaceus</i>	Pink-eared duck			x	x								x									X		X	
	<i>Stictonetta naevosa</i>	Freckled duck			x	x																				

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Bonney Downs Detailed surveys		Current report			
			WA	EPBC	ALA	Birddata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O			
	<i>Tadorna tadornoides</i>	Australian shelduck			x	x						x															
Anhingidae	<i>Anhinga novaehollandiae</i>	Australasian darter			x	x																X	X			X	
Apodidae	<i>Apus pacificus</i>	Fork-tailed swift	MI	MI				x	x	x																	X
Ardeidae	<i>Ardea alba</i>	Great egret			x	x						x										x			X	X	X
	<i>Ardea pacifica</i>	White-necked heron			x	x								x								x			X	X	X
	<i>Bubulcus ibis</i>	Cattle egret			x	x	x																				
	<i>Egretta garzetta</i>	Little egret			x	x																					
	<i>Egretta novaehollandiae</i>	White-faced heron			x	x							x		x										X	X	X
	<i>Nycticorax caledonicus</i>	Nankeen night-heron			x	x																x			X		X
Artamidae	<i>Artamus cinereus</i>	Black-faced woodswallow			x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x	X	X	X
	<i>Artamus minor</i>	Little woodswallow			x	x					x				x	x						x					X
	<i>Artamus personatus</i>	Masked woodswallow			x	x							x				x	x	x	x				X	X	X	
	<i>Artamus leucorhynchus</i>	White-breasted woodswallow																				x					
	<i>Cracticus nigrogularis</i>	Pied butcherbird			x	x							x	x	x	x	x	x	x	x	x	x	x	x	X	X	X
	<i>Cracticus torquatus</i>	Grey butcherbird			x	x							x	x		x	x	x	x			x	x	X	X	X	
	<i>Gymnorhina tibicen</i>	Australian magpie			x	x								x		x						x	x		X	X	X
Burhinidae	<i>Burhinus grallarius</i>	Bush stone-curlew			x	x							x									x	x		X	X	X
Cacatuidae	<i>Cacatua sanguinea</i>	Little corella			x	x							x	x	x	x						x		x	X	X	X
	<i>Eolophus roseicapilla</i>	Galah			x	x					x			x	x	x	x	x	x	x	x	x	x	x	X	X	X
	<i>Nymphicus hollandicus</i>	Cockatiel			x	x								x	x	x	x	x	x	x	x	x	x	x	X	X	X
	<i>Lophochroa leadbeateri</i>	Major Mitchell's cockatoo			x																						
Campephagidae	<i>Coracina maxima</i>	Ground cuckoo-shrike			x																	x				X	X
	<i>Coracina novaehollandiae</i>	Black-faced cuckoo-shrike			x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x	X	X	X
	<i>Lalage tricolor</i>	White-winged triller			x	x									x	x						x		x	X	X	X
Caprimulgidae	<i>Eurostopodus argus</i>	Spotted nightjar			x	x								x	x	x						x	x		X	X	X
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu			x	x										x	x					x			X		X
Charadriidae	<i>Charadrius ruficapillus</i>	Red-capped plover				x																					
	<i>Anarhynchus veredus</i>	Oriental plover	MI	MI	x	x	x	x	x																		X
	<i>Charadrius melanops</i>	Black-fronted dotterel			x	x									x	x								x	X	X	X
	<i>Erythrogonys cinctus</i>	Red-kneed dotterel			x	x																	x				X
	<i>Vanellus miles</i>	Masked plover			x																				x		
Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	Black-necked stork			x	x																					X
Cinclosomatidae	<i>Cinclosoma marginatum</i>	Western quail-thrush			x																						X
	<i>Cinclosoma castaneothorax</i>	Chestnut-breasted quail-thrush			x	x																					
Climacteridae	<i>Climacteris melanurus</i>	Black-tailed treecreeper			x	x										x											
Columbidae	<i>Columba livia*</i>	Rock pigeon																									

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Bonney Downs Detailed surveys		Current report
			WA	EPBC	ALA	Birddata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	<i>Geopelia cuneata</i>	Diamond dove			x	x				x	x	x	x	x	x	x	x		x	x	x	x	x	
	<i>Geopelia placida</i>	Peaceful dove			x	x				x	x			x	x			x		x	x	x	x	
	<i>Geophaps plumifera</i>	Spinifex pigeon			x	x				x	x	x	x	x	x	x	x		x	x	x	x	x	
	<i>Ocyphaps lophotes</i>	Crested pigeon			x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	
	<i>Phaps chalcoptera</i>	Common bronzewing			x	x					x			x	x	x	x		x	x	x	x	x	
Corvidae	<i>Corvus bennetti</i>	Little crow			x	x					x	x			x				x	x				
	<i>Corvus orru</i>	Torresian crow			x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	
	<i>Centropus phasianinus</i>	Pheasant coucal				x								x							x	x	x	
Cuculidae	<i>Chalcites basalis</i>	Horsfield's bronze cuckoo			x	x							x	x	x	x	x		x		x	x	x	
	<i>Chalcites osculans</i>	Black-eared cuckoo			x		x										x		x	x			x	
	<i>Heteroscenes pallidus</i>	Pallid cuckoo			x	x					x	x			x	x			x	x	x	x	x	
Dicaeidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird			x	x								x	x				x				x	
	<i>Emblema pictum</i>	Painted finch			x	x					x	x		x	x	x	x	x	x	x	x	x	x	
Estrildidae	<i>Neochmia ruficauda</i>	Star finch			x	x								x					x	x				
	<i>Taeniopygia guttata castanotis</i>	Zebra finch			x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	
	<i>Falco berigora</i>	Brown falcon			x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	
	<i>Falco cenchroides</i>	Nankeen kestrel			x	x				x	x	x	x	x	x	x	x		x	x	x	x	x	
Falconidae	<i>Falco hypoleucos</i>	Grey falcon	VU	VU	x		x	x	x						x	x			x		x	x	x	
	<i>Falco longipennis</i>	Australian hobby			x	x											x		x			x	x	
	<i>Falco peregrinus</i>	Peregrine falcon	OS	-	x	x		x	x					x					x					
	<i>Falco subniger</i>	Black falcon			x																		x	
Glareolidae	<i>Stiltia isabella</i>	Australian pratincole			x																		x	
	<i>Glareola maldivarum</i>	Oriental pratincole	MI	MI	x																			
	<i>Cheramoeca leucosterna</i>	White-backed swallow			x										x									
	<i>Hirundo neoxena</i>	Welcome swallow			x	x																	x	
Hirundinidae	<i>Hirundo rustica</i>	Barn swallow	MI	MI			x																	
	<i>Petrochelidon ariel</i>	Fairy martin			x	x								x	x	x					x	x	x	
	<i>Petrochelidon nigricans</i>	Tree martin			x	x				x					x	x				x	x	x	x	
	<i>Chlidonias hybrida</i>	Whiskered tern			x	x																		
Laridae	<i>Gelochelidon nilotica</i>	Gull-billed tern	MI	MI	x	x		x	x															
	<i>Hydroprogne caspia</i>	Caspian tern	MI	MI	x	x		x	x									x						
	<i>Chroicocephalus novaehollandiae</i>	Silver gull			x	x																		
	<i>Cincloramphus cruralis</i>	Brown songlark			x	x								x									x	
Locustellidae	<i>Cincloramphus mathewsi</i>	Rufous songlark			x	x									x		x			x	x	x	x	
	<i>Poodytes carteri</i>	Spinifexbird			x	x				x		x	x	x	x	x	x	x	x	x	x	x	x	
Maluridae	<i>Amytornis whitei</i>	Pilbara grasswren (striated grasswren)			x	x								x	x	x		x		x	x	x	x	

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Bonney Downs Detailed surveys		Current report	
			WA	EPBC	ALA	Birddata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
	<i>Malurus assimilis</i>	Purple-backed fairywren			x	x				x	x	x		x	x	x	x	x		x	x	x	x	x	
	<i>Malurus leucopterus</i>	White-winged fairywren			x	x				x	x	x	x			x	x	x		x	x	x	x	x	
	<i>Stipiturus ruficeps</i>	Rufous-crowned emu-wren			x																				
Meliphagidae	<i>Acanthagenys rufogularis</i>	Spiny-cheeked honeyeater			x	x					x	x		x		x		x		x	x	x	x	x	
	<i>Certhionyx variegatus</i>	Pied honeyeater			x	x									x		x		x	x		x		x	
	<i>Epthianura aurifrons</i>	Orange chat			x	x																			
	<i>Epthianura tricolor</i>	Crimson chat			x	x						x			x					x	x	x	x	x	
	<i>Gavicalis virescens</i>	Singing honeyeater			x	x				x		x	x	x	x	x	x	x	x	x	x	x	x	x	
	<i>Conopophila whitei</i>	Grey honeyeater			x									x				x					x		
	<i>Lichmera indistincta</i>	Brown honeyeater			x	x				x	x	x		x	x	x	x	x		x	x	x	x	x	
	<i>Manorina flavigula</i>	Yellow-throated miner			x	x						x	x	x	x	x	x	x	x	x	x	x	x	x	x
	<i>Melithreptus gularis</i>	Black-chinned honeyeater			x	x						x				x		x	x	x					x
	<i>Ptilotula keartlandi</i>	Grey-headed honeyeater			x	x				x		x		x	x	x	x	x	x	x		x	x	x	x
	<i>Ptilotula penicillata</i>	White-plumed honeyeater			x	x				x		x		x	x	x	x	x		x	x	x	x	x	x
	<i>Ptilotula plumula</i>	Grey-fronted honeyeater			x	x									x										x
	<i>Purnella albifrons</i>	White-fronted honeyeater			x	x																		x	x
	<i>Sugomel nigrum</i>	Black honeyeater			x	x							x						x		x				x
	<i>Stomiopera unicolor</i>	White-gaped honeyeater				x																			
Meropidae	<i>Merops ornatus</i>	Rainbow bee-eater			x	x	x			x	x	x	x	x	x	x		x	x	x	x	x	x	x	
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark			x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Motacillidae	<i>Anthus australis</i>	Australian pipit			x	x					x	x	x		x			x		x	x	x	x	x	
	<i>Motacilla cinerea</i>	Grey wagtail	MI	MI				x	x																
	<i>Motacilla flava</i>	Yellow wagtail	MI	MI				x																	
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied sittella			x						x														
Oreoicidae	<i>Oreoica gutturalis</i>	Crested bellbird			x	x					x	x		x	x	x	x	x	x	x	x	x	x	x	
Otididae	<i>Ardeotis australis</i>	Australian bustard			x	x				x	x	x	x	x	x	x	x		x	x	x	x	x	x	
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey shrikethrush			x	x				x	x	x		x	x	x	x	x	x	x	x	x	x	x	
	<i>Pachycephala rufiventris</i>	Rufous whistler			x	x				x	x	x		x	x	x	x		x	x	x	x	x	x	
Pandionidae	<i>Pandion haliaetus</i>	Osprey	MI	MI				x																	
Pardalotidae	<i>Pardalotus rubricatus</i>	Red-browed pardalote			x	x					x	x		x	x	x			x	x	x	x	x	x	
	<i>Pardalotus striatus</i>	Striated pardalote			x	x									x	x	x					x	x	x	
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian pelican			x	x						x			x							x	x	x	
Petroicidae	<i>Melanodryas cucullata</i>	Hooded robin			x	x					x	x		x	x				x			x	x	x	
	<i>Petroica goodenovii</i>	Red-capped robin			x	x					x	x			x	x				x			x	x	
Phalacrocoracidae	<i>Microcarbo melanoleucos</i>	Little pied cormorant			x	x																x	x	x	
	<i>Phalacrocorax sulcirostris</i>	Little black cormorant			x	x													x			x	x	x	

Appendix D Bat call analysis and preliminary risk assessment 2024-2025 (Specialised Zoological, 2024b, 2025b).



**Identification of bat species
from Bonney Downs,
Western Australia**

Prepared for **Ecologia Environment Pty Ltd**

Version **22 August 2024**

SZ project reference **SZ720**

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Version history

Date	Version	Note
2024-06-20	2024-06-20	Interim results from partial analysis of the datasets
2024-08-19	2024-08-19	Final report with outcomes from full analysis
2024-08-22	2024-08-22	Final report with addition of 2023 data

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1.0 Summary

1.1 Scope and data

Bat identifications from acoustic recordings are provided from the Bonney Downs project area, in the Pilbara region of Western Australia. The datasets reported on here comprise a total of 144 sites, 320 recording nights and 475,151 WAV files:

- May 2023 'BBD' and 'BDDP' series—18 sites, 53 recording nights (119,133 sound files)
- July 2023 'BDTBD' series—4 sites, 18 recording nights (9,912 sound files)
- October 2023 'BB' and 'BDDP' series—42 sites, 80 recording nights (121,987 sound files)
- February 2024 'BB' series—39 sites, 78 recording nights (104,101 WAV sound files)
- March 2024 'BB' series—31 sites, 63 recording nights (65,952 WAV sound files)
- March 2024 'BDDP'—10 sites, 28 recording nights (54,066 WAV sound files)

Particular attention was given to the detection of two bat species of conservation significance: Ghost Bat *Macroderma gigas* (Megadermatidae) and Pilbara Diamond-faced Bat *Rhinonycteris aurantia* (Rhinonycteridae).

Two methods were used on the field survey:

1. Ultrasonic recordings with bat detectors to provide species identifications from echolocation calls;
2. Acoustic lure (portable speaker broadcasting Ghost Bat social calls; **Figure 1**) with detections and identification of the Ghost Bat from both infrared video and ultrasonic recordings; this is a targeted survey method to detect the species away from roost sites.

1.2 Species richness

Ten species of bat were detected (**Table 1**; **Figure 2**); which includes both the Ghost Bat and Pilbara Diamond-faced Bat. Each bat species was assigned to one of three categories representing the likelihood that they would be encountered above an altitude of 50 metres. This is an authoritative estimate based on my own accumulated casual field observations.

To give a further indication of the relative risk of collision of each species, the frequency of detection was calculated across sites for each species on each survey, and across all sites (**Table 2**). A risk matrix was devised based on the likelihood of detection at height categories and the frequency of detection values, which might be useful as a 'starting point' (conjecture) for considering the relative risk of collision with a turbine for each species (**Appendix 1**).

Details of detections at each site (collated across recording nights per site) are summarised in **Tables 3 – 8**.

One interesting observation was made for a high-flying species: the White-striped Free-tailed Bat *Austronomus australis* (Molossidae) is only seasonally present in the region from April to September according to an analysis presented by Bullen and McKenzie (2005). Observations

from the surveys were consistent with this analysis, with *A. australis* being detected only on the May and July 2023 surveys.

1.3 Ghost Bat

The Ghost Bat was detected at one acoustic lure site: BDGB03. One ‘fly-by’ was observed in video recordings on both infrared camera traps at 18:52:22 and 18:52:54 (**Table 9**). The identification was based on the observation of an anteriorly-directed structure resembling long ears, the broad wings, and lack of a distinct tail (**Figure 3**; see comparison with images of birds and insects in **Figure 4**). It was not detected in echolocation recordings at the acoustic lure sites. However, the bat detector recording failed at site BDGB03. No other detections of the Ghost Bat were made on the surveys.

1.4 Pilbara Diamond-faced Bat

The Pilbara Diamond-faced Bat was detected from one echolocation sequence from acoustic lure site BDGB01 (unit 641036) on the night of 2024-03-22 at 23:21:09 (**Figure 5**). I have observed this species approaching a Ghost Bat social call broadcast on previous occasions. The Pilbara Diamond-faced Bat was also detected well after sunset and well before sunrise at 14 other sites in 2023 and 2024 (**Table 10**):

- 7 sites in May 2023
- 4 sites October 2023
- 3 sites in February 2024

1.5 Bat species not detectable with the methods used

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 six species that were not detected in the analysis. Three of these are known to forage or commute above the tree canopy height and might range within the blade swept area of a wind turbine in this study area. These species cannot be detected using the methods described in the present report. Three other species not detected are either not found in this part of the Pilbara, or else have low detectability with bat detectors.

- **Black Flying-fox *Pteropus alecto* and Little Red Flying-fox *Pteropus scapulatus*** (Pteropodidae)—do not echolocate and are therefore not detected by acoustic recorders (bat detectors).
- **Hill’s Sheath-tailed Bat *Taphozous hilli*** (Emballonuridae)—could be present in addition to *T. georgianus*, given its distribution in the region (Milne et al. 2023), but its calls cannot be distinguished reliably from those of *T. georgianus*.
- **Pallid Long-eared Bat *Nyctophilus daedalus* and Lesser Long-eared Bat *Nyctophilus geoffroyi*** (Vespertilionidae)—might be present but their echolocation calls are usually low in amplitude, and can be difficult to distinguish from clutter calls of the Little Broad-nosed Bat *Scotorepens greyii*.
- **Northern Coastal Free-tailed Bat *Ozimops cobourgianus*** (Molossidae)—found only along the Pilbara coast, usually in mangal habitat.

2.0 Methods

2.1 Ultrasonic recordings

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), and Wildlife Acoustics SM4BAT-FS bat detectors (sampling rate 384 kHz).

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 23.1.

Species were identified based on information in the author's unpublished material and Churchill (2008). Nomenclature follows Jackson and Groves (2015). Identifications were supported by distribution information in a curated source of distribution records maintained by the Australasian Bat Society, Inc. (<https://www.ausbats.org.au/batmap.html>) (Milne et al. 2023). Custom [R] language scripts were used to summarise the analysis outcomes.

2.2 Acoustic lure sites with infrared video recordings

An acoustic lure system was set at seven sites for one night each. This method is based on recent demonstrations of its utility by Hanrahan et al. (2023) and Ruykys et al. (2023), and is broadly consistent with guidelines on the approach released in the Northern Territory (Ruykys et al. 2024). The system comprised a portable speaker (generic brand from Amazon), an Anabat Chorus bat detector, two infrared-capable camera traps (Jaycar model QC8051), and two 'long range infrared spotlights' (Jaycar model QC3654).

The portable speakers were loaded with a micro-SD card containing a sequence of sound files comprising 'squabble' calls; *sensu* Hanrahan et al. 2023; see **Appendix 2**) of the Ghost Bat. Sound files consisted of a 2-minute period with various examples of squabble calls, followed by a 2-minute period of silence. The speakers played sound files on a memory card

sequentially upon startup, for the entire night. The speaker volume was maximised. The distance at which Ghost Bats can hear the signals at night is unknown but assumed to be at least 100 m.

The camera trap was set to record back-to-back 3-minute black and white video files at high resolution (4K 3840 x 2160) continuously upon start up. Recordings were started after covering the camera lens so that the unit switched from colour to night (black and white) mode. The settings were adjusted so that built-in infrared LEDs were non-functional, and infrared light was instead provided by the long-range infrared spotlight, which was powered by 10 AA batteries that lasted c. 5 hours. Each camera trap contained a blank 256 GB Sandisk SD card, which had the capacity to save the recording from a full night.

The Chorus bat detector was placed on the central star picket underneath the portable speaker to maximise the chance of detection via echolocation calls if a Ghost Bat approached the speaker. Detection of echolocation calls provides a way to independently validate any detection made from the video recordings (**Appendix 2**).



Figure 1. Representation of the acoustic lure system deployment. There are two camera traps for redundancy and corroboration of images of bats, and a bat detector for validation of an identification made from videos based on echolocation calls only.

All videos were processed with an expeditious and robust analysis method. A custom Python (<https://www.python.org/>) script (Dr R. C. Morgans, Supersensory Technologies Pty Ltd unpublished) applied a background subtraction algorithm from the *opencv* framework (<https://opencv.org/>) to the recordings and constructed a concatenated short video containing only portions of the recording with moving objects above a certain size. These concatenated videos are watched at <50% speed in the MPV MEDIA PLAYER (<https://mpv.io/>), which allows fine control of frame advancement. Objects of interest were located and re-examined in the original 4K recording using the embedded timestamp information.

Smaller species of bat can be seen often in the infrared videos. Without careful consideration, these species can sometimes be confused for the Ghost Bat when they fly near the speaker—a behaviour that might intuitively be expected only from the Ghost Bat. Ghost Bats can be distinguished in infrared and thermal video recordings from other bat species and insects based on the observation of any combination of the following morphological and behavioural features that provide an empirical basis for the identification:

- flight pattern (four distinct behaviours classified as: ‘circling’ of the post containing the speaker; ‘hover’ in front of the speaker; ‘long glide’ towards the speaker; and ‘drop in’ whereby they would sometimes approach at c. 2 m above the speaker and then drop vertically towards it);
- body size relative to other objects in the frame;
- large ear size;
- lack of a tail;
- bright eyeshine of the reflected infrared light from their large eyes (infrared recordings only, though not always visible); and
- corroboration with concurrently-recorded diagnostic echolocation calls (**Appendix 2**).

All bats observed in videos are examined by single manual frame advancement to check for diagnostic features. The relatively high resolution and video frame rate provides a reasonable level of image quality.

3.0 Limitations

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

1. The identifications made herein were based on the ultrasonic sound recordings made and provided by a 'third party' (the client named on the front of this report).
2. In the case of the present report, the recording equipment was set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
3. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
4. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
5. This version of the document supersedes any previous version, including the interim report (Specialised Zoological 2024). Previous drafts are not authorised by us for submission to the regulator or the public domain.
6. Please see **Appendix 2** for more information about the application of the acoustic lure.

4.0 References

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Table 1. Species identified in the present survey from all sites combined. The predicted presence above 50 metres in altitude is an authoritative estimate based on my own accumulated casual field observations ('predicted to be encountered commonly above 50 m').

Predicted presence above 50 m altitude		
MEGADERMATIDAE		
Medium	Ghost Bat	<i>Macroderma gigas</i>
RHINONYCTERIDAE		
Low	Pilbara Diamond-faced Bat (Pilbara Leaf-nosed Bat)	<i>Rhinonictoris aurantia</i>
EMBALLONURIDAE		
Medium	Yellow-bellied Sheath-tailed Bat	<i>Saccolaimus flaviventris</i>
High	Common Sheath-tailed Bat	<i>Taphozous georgianus</i>
VESPERTILIONIDAE		
Low	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>
Low	Little Broad-nosed Bat	<i>Scotorepens greyii</i>
Low	Finlayson's Cave Bat	<i>Vespadelus finlaysoni</i>
MOLOSSIDAE		
High	White-striped Free-tailed Bat	<i>Austronomus australis</i>
Medium	Greater Northern Free-tailed Bat	<i>Chaerephon jobensis</i>
Medium	Northern Free-tailed Bat	<i>Ozimops lumsdenae</i>

Table 2. Frequency of detection across sites for each species on each survey (higher intensity of colour for higher values).

Species	May 2024	July 2024	October 2024	February 2024 (BB series)	March 2024 (BB series)	March 2024 (BDDP series)	Over all surveys
<i>A. australis</i>	0.00	0.00	0.00	0.44	0.50	0.00	0.07
<i>C. gouldii</i>	0.87	0.77	0.80	0.94	1.00	0.74	0.85
<i>C. jobensis</i>	0.54	0.39	0.50	0.83	1.00	0.45	0.55
<i>O. lumsdenae</i>	0.18	0.26	0.00	0.11	0.50	0.14	0.18
<i>R. aurantia</i>	0.08	0.00	0.00	0.39	0.00	0.10	0.10
<i>S. flaviventris</i>	0.87	0.84	0.90	0.50	0.25	0.48	0.71
<i>S. greyii</i>	0.87	0.74	0.80	0.89	1.00	0.79	0.85
<i>T. georgianus</i>	0.77	0.61	0.80	0.83	1.00	0.50	0.70
<i>V. finlaysoni</i>	0.49	0.42	0.60	0.50	1.00	0.55	0.53

Table 3. Species detected at each site in May 2023 ('BBD' and 'BDDP' sites).

						<i>A. australis</i>	<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
Site	Detector serial	Coordinates	First night	Last night	Nights									
BBD01	S4U06484-MDSM4-02	-22.579550, 117.011240	2023-05-27	2023-05-30	4	X	X	X	.	X	.	X	X	X
BBD02	S4U11723-MDSM4-03	-22.579550, 117.011240	2023-05-28	2023-05-29	2	X	X	X	.	X	.	X	X	X
BBD03	S4U11658-MDSM4-05	-22.579330, 117.011580	2023-05-30	2023-05-31	2	.	X	X	.	.	.	X	.	.
BBD04	S4U11723-MDSM4-03	-22.579550, 117.011240	2023-05-30	2023-05-31	2	.	X	X	.	.	X	.	.	.
BBD05	S4U06478-MDSM4-01	-22.579550, 117.011240	2023-05-30	2023-05-31	2	.	X	X	.	.	X	X	X	.
BBD06	S4U11657-MDSM4-07	-22.140550, 118.563240	2023-05-30	2023-05-31	2	X	X	X	.	X	X	X	X	X
BBD07	S4U11659-MDSM4-04	-22.579330, 117.011240	2023-05-30	2023-05-31	2	.	X	X	.	.	X	X	X	X
BBDP02	S4U11723-MDSM4-03	-22.579550, 117.011240	2023-05-25	2023-05-27	3	.	X	X	.	.	X	X	X	X
BDBAT01	S4U11651-MDSM4-06	-22.579330, 117.011580	2023-05-28	2023-05-30	3	X	X	X	X	X	.	.	X	X
BDDP01	S4U11651-MDSM4-06	-22.579330, 117.011580	2023-05-24	2023-05-26	3	X	X	.	.	.	X	X	X	.
BDDP03	S4U06478-MDSM4-01	-22.579550, 117.011240	2023-05-23	2023-05-26	4	X	X	X	.	X	.	X	X	.
BDDP04	S4U11657-MDSM4-07	-22.140550, 118.563240	2023-05-24	2023-05-26	3	X	X	X	.	.	X	X	X	X
BDDP05	S4U11658-MDSM4-05	-22.579330, 117.011580	2023-05-23	2023-05-25	3	.	X	X	X	.	X	X	X	X
BDDP06	S4U11658-MDSM4-05	-22.579330, 117.011580	2023-05-26	2023-05-29	4	.	X	X	.	X	.	X	X	X
BDDP07	S4U11659-MDSM4-04	-22.579330, 117.011240	2023-05-26	2023-05-29	4	.	X	X	.	X	.	X	X	.
BDDP08	S4U06484-MDSM4-02	-22.579550, 117.011240	2023-05-23	2023-05-26	4	.	X	.	.	.	.	X	X	.
BDDP09	S4U06478-MDSM4-01	-22.579550, 117.011240	2023-05-27	2023-05-29	3	.	X	.	.	.	.	X	.	.
BDDP10	S4U11657-MDSM4-07	-22.140550, 118.563240	2023-05-27	2023-05-29	3	X	.	X	.	.	X	X	X	.

Table 4. Species detected at each site in July 2023 ('BDTBD' sites).

						<i>A. australis</i>	<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
Site	Detector serial	Coordinates	First night	Last night	Nights									
BDTBD01	636494	-22.018644, 119.971222	2023-07-25	2023-07-28	4	.	X	X	X	.	.	X	X	X
BDTBD02	644439	-22.021631, 119.964485	2023-07-25	2023-07-28	4	.	X	X	X	.	.	X	X	X
BDTBD03	644439	-21.973442, 119.999969	2023-07-26	2023-07-31	6	X	X	X	.	.	.	X	X	X
BDTBD04	636494	-21.978964, 119.990219	2023-07-29	2023-08-01	4	X	X	X	.	.	X	X	X	X

Table 5. Species detected at each site in October 2023 ('BB' and 'BDDP' sites; continued next page).

						<i>A. australis</i>	<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aaurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
Site	Detector serial	Coordinates	First night	Last night	Nights									
BDDP13	S4U06484-MDSM4-02	.	2023-10-12	2023-10-14	3	.	.	.	.	X	.	X	X	X
BB017	S4U06484-MDSM4-02	.	2023-10-15	2023-10-16	2	.	X	X	.	.	X	X	.	X
BB012	S4U06484-MDSM4-02	.	2023-10-17	2023-10-18	2	.	X	.	.	.	X	X	.	X
BB040	S4U11723-MDSM4-03	.	2023-10-09	2023-10-10	2	.	X	.	.	.	.	X	.	.
BDDP11	S4U11723-MDSM4-03	.	2023-10-11	2023-10-13	3	.	X	X	.	.	X	X	X	X
BB039	S4U11723-MDSM4-03	.	2023-10-14	2023-10-15	2	.	X	X	.	.	X	X	X	.
BB011	S4U11723-MDSM4-03	.	2023-10-16	2023-10-18	3	.	X	X	.	X	X	X	X	X
BB028	S4U11659-MDSM4-04	.	2023-10-11	2023-10-12	2	.	.	.	.	.	.	X	X	.
BB026	S4U11659-MDSM4-04	.	2023-10-13	2023-10-14	2	.	X	X	.	.	.	.	X	X
BB018	S4U11659-MDSM4-04	.	2023-10-15	2023-10-16	2	.	X	.	.	.	.	X	.	X
BB015	S4U11659-MDSM4-04	.	2023-10-17	2023-10-18	2	.	X	X	X	.	X	X	X	X
BB033	S4U11658-MDSM4-05	.	2023-10-11	2023-10-12	2	.	X	X	X	.	.	X	.	.
BB030	S4U11658-MDSM4-05	.	2023-10-13	2023-10-14	2	.	X	X	.	.	.	X	X	.
BB002	S4U11658-MDSM4-05	.	2023-10-15	2023-10-16	2	.	.	.	.	.	.	.	.	.
BB029	MDSM4-06	no data	2023-10-11	2023-10-12	2	.	.	.	.	.	.	.	.	.
BB023	MDSM4-06	no data	2023-10-13	2023-10-14	2	.	.	.	.	.	.	.	.	.
BB001	MDSM4-06	no data	2023-10-15	2023-10-16	2	.	.	.	.	.	.	.	.	.
BB007	MDSM4-06	no data	2023-10-17	2023-10-18	2	.	.	.	.	.	.	.	.	.
BB032	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-09	2023-10-10	2	.	X	X	.	.	.	X	X	.
BB025	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-11	2023-10-12	2	.	X	X	.	.	X	X	X	X
BB036	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-13	2023-10-14	2	.	X	X	X	X	X	X	X	X
BB005	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-15	2023-10-16	2	.	X	X	.	.	.	X	X	X
BB010	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-17	2023-10-18	2	.	X	.	.	.	X	X	.	X
BB020	TC36-644436	-22.107889, 119.867348	2023-10-11	2023-10-13	2	.	X	.	.	.	X	X	.	X

						<i>A. australis</i>	<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
Site	Detector serial	Coordinates	First night	Last night	Nights									
BB016	TC36-644436	-22.198734, 119.918373	2023-10-13	2023-10-15	2	.	X	X	X	.	X	X	.	X
BB004	TC36-644436	-21.951029, 119.794090	2023-10-15	2023-10-17	2	.	X	.	.	.	X	X	.	X
BB021	TC36-644436	-22.196741, 120.013084	2023-10-17	2023-10-19	2	.	X	.	.	.	X	X	.	.
BB037	TC39-644439	-22.045776, 119.883430	2023-10-11	2023-10-13	2	.	.	.	.	.	.	X	X	.
BB022	TC39-644439	-22.114225, 119.975815	2023-10-13	2023-10-15	2	.	X	X	.	.	X	X	X	X
BB003	TC39-644439	-21.919384, 119.782402	2023-10-15	2023-10-17	2	.	X	X	.	X	X	X	X	X
BB008	TC39-644439	no data	.	.	.	.	.	.	.	.	.	.	.	.
BB035	TC40-644440	-22.076000, 119.895966	2023-10-11	2023-10-13	2	.	X	.	.	.	X	X	X	.
BB024	TC40-644440	-21.999393, 119.954002	2023-10-13	2023-10-15	2	.	X	X	X	.	.	.	X	X
BB038	TC40-644440	-22.225801, 119.852524	2023-10-15	2023-10-17	2	.	X	X	.	.	X	X	X	X
BB013	TC40-644440	-22.256664, 119.987633	2023-10-17	2023-10-19	2	.	X	.	.	.	X	X	.	X
BB031	TC88-636488	-22.015324, 119.875801	2023-10-11	2023-10-13	2	.	X	X	X	.	X	X	X	X
BB027	TC88-636488	-21.933846, 119.972397	2023-10-13	2023-10-15	2	.	X	.	.	.	.	.	X	.
BB014	TC88-636488	-22.209757, 119.814163	2023-10-15	2023-10-17	2	.	.	.	.	.	.	X	.	.
BB019	TC88-636488	-22.174740, 119.855011	2023-10-17	2023-10-19	2	.	X	X	.	.	.	X	.	.
BDDP12	TC94-636494	-22.070423, 119.854462	2023-10-11	2023-10-14	3	.	.	.	.	.	X	X	.	X
BB034	TC94-636494	-22.092993, 119.863396	2023-10-14	2023-10-16	2	.	X	.	.	.	.	X	X	X
BB009	TC94-636494	.	2023-10-17	2023-10-17	1	.	X	.	.	.	.	X	.	.

Table 6. Species detected at each site in February 2024 ('BB' sites; continued next page).

						<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
Site	Detector serial	Coordinates	First night	Last night	Nights								
BB001	S4U11723	-32.911090,116.475810	2024-02-09	2024-02-10	2	X	X	.	.	X	X	X	X
BB002	S4U11657	-32.816600,116.379770	2024-02-09	2024-02-10	2	X	X	.	.	X	X	.	.
BB003	S4U11659	-32.781330,116.495450	2024-02-09	2024-02-10	2	X	X	X	X	X	X	X	X
BB004	644439	-21.949577,119.793472	2024-02-09	2024-02-10	2	X	X	.	.	X	.	X	X
BB005	636494	-22.003422,119.817451	2024-02-09	2024-02-10	2	X	.	.	.	X	X	X	X
BB006	644436	-22.025839,119.844109	2024-02-09	2024-02-10	2	X	.	.	.	X	X	.	.
BB007	636494	-22.053459,119.824661	2024-02-11	2024-02-12	2	X	X	.	.	.	X	.	.
BB008	S4U11657	-32.816600,116.379770	2024-02-11	2024-02-12	2	X	X	.	.	X	X	X	X
BB009	S4U11723	-32.911090,116.475810	2024-02-11	2024-02-12	2	.	X	.	.	X	X	X	.
BB010	S4U06478	-32.816600,116.379770	2024-02-11	2024-02-12	2	X	X	.	.	X	X	X	.
BB011	S4U06478	-32.816600,116.379770	2024-02-09	2024-02-10	2	X	X	.	.	X	X	X	X
BB012	S4U06484	-32.830550,116.357890	2024-02-11	2024-02-12	2	.	.	.	.	X	X	X	.
BB013	S4U11651	-22.114890,119.916880	2024-02-11	2024-02-12	2	X	.	X	X	X	X	X	.
BB014	644439	-22.209053,119.813850	2024-02-07	2024-02-08	2	.	.	.	.	X	.	X	.
BB015	S4U11658	-32.791420,116.382810	2024-02-09	2024-02-10	2	X	X	.	.	X	X	X	X
BB016	S4U11651	-22.114890,119.916880	2024-02-05	2024-02-06	2	X	X	X	.	X	X	.	X
BB017	644440	-22.231794,119.898666	2024-02-07	2024-02-08	2	X	X	.	.	X	X	X	.
BB019	636488	-22.175192,119.854073	2024-02-07	2024-02-08	2	X	X	.	.	X	X	.	X
BB020	S4U11651	-22.114890,119.916880	2024-02-07	2024-02-08	2	X	.	.	.	X	X	.	X
BB021	S4U11658	-32.791420,116.382810	2024-02-11	2024-02-12	2	X	.	X	.	X	X	X	.
BB022	S4U06478	-32.816600,116.379770	2024-02-07	2024-02-08	2	X	X	X	.	X	X	X	X
BB023	S4U06484	-32.830550,116.357890	2024-02-07	2024-02-08	2	X	X	.	.	X	X	X	X
BB024	S4U06484	-32.830550,116.357890	2024-02-05	2024-02-06	2	.	.	.	.	.	X	X	.

						<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
Site	Detector serial	Coordinates	First night	Last night	Nights								
BB025	S4U11723	-32.911090,116.475810	2024-02-05	2024-02-06	2	X	X	X	.	X	X	X	X
BB026	S4U11657	-32.816600,116.379770	2024-02-05	2024-02-06	2	X	X	.	.	X	X	X	X
BB027	S4U06478	-32.816600,116.379770	2024-02-05	2024-02-06	2	X	.	.	.	.	X	X	.
BB028	S4U11658	-32.791420,116.382810	2024-02-05	2024-02-06	2	.	.	.	.	.	X	.	.
BB029	S4U11659	-32.781330,116.495450	2024-02-05	2024-02-06	2	X	X	X	.	X	X	X	.
BB030	636494	-22.011641,119.931221	2024-02-05	2024-02-06	2	X	.	.	.	X	.	X	.
BB031	636488	-22.015392,119.875801	2024-02-09	2024-02-10	2	X	.	.	.	X	.	X	.
BB032	644436	-22.145529,119.928078	2024-02-05	2024-02-06	2	X	.	.	.	.	X	.	.
BB033	644440	-21.964575,119.868095	2024-02-11	2024-02-12	2	X	.	.	.	X	X	.	X
BB034	S4U11651	-22.114890,119.916880	2024-02-09	2024-02-10	2	X	.	.	.	X	X	X	X
BB035	S4U06484	-32.830550,116.357890	2024-02-09	2024-02-10	2	X	X	.	.	X	X	X	.
BB036	644440	-22.033985,119.914337	2024-02-05	2024-02-06	2	X	X	.	.	X	X	X	X
BB037	644440	-22.045576,119.883087	2024-02-09	2024-02-10	2	X	.	.	.	X	.	X	.
BB038	636494	-22.209028,119.868584	2024-02-07	2024-02-08	2	X	X	.	.	X	X	X	X
BB039	S4U11659	-32.781330,116.495450	2024-02-11	2024-02-12	2	X	.	.	X	X	X	X	X
BB040	644439	-22.058601,119.935104	2024-02-05	2024-02-06	2	X	.	.	.	X	X	X	.

Table 7. Species detected at each site in March 2024 ('BB' sites; continued next page).

						<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
Site	Detector serial	Coordinates	First night	Last night	Nights								
BB002	S4U11651	-22.112400,119.871900	2024-03-22	2024-03-23	2	.	.	.	.	X	.	X	.
BB004	644439	-21.949398,119.793747	2024-03-18	2024-03-19	2	X	.	.	.	X	X	X	X
BB006	S4U11657	-21.951290,119.792600	2024-03-21	2024-03-22	2	X	X	.	.	X	X	X	X
BB007	636488	-22.051115,119.825081	2024-03-18	2024-03-19	2	X	.	.	.	X	X	.	.
BB008	S4U11657	-21.951290,119.792600	2024-03-25	2024-03-26	2	X	.	.	.	X	.	X	X
BB009	S4U06478	-22.079100,119.814400	2024-03-25	2024-03-26	2	X	X	.	.	X	X	X	.
BB014	655145	-22.210754,119.813789	2024-03-23	.	1	.	.	.	.	X	.	.	.
BB015	S4U11659	-22.079630,119.814300	2024-03-21	2024-03-22	2	X	X	.	.	X	X	.	X
BB016	S4U11723	-22.199810,119.920150	2024-03-17	2024-03-19	3	X	X	X	.	X	X	X	.
BB017	S4U11723	-22.199810,119.920150	2024-03-20	2024-03-22	3	X	X	.	.	X	X	.	X
BB018	636473	-22.247828,119.842186	2024-03-23	2024-03-24	2	X	.	.	.	X	X	.	X
BB019	S4U11723	-22.199810,119.920150	2024-03-23	2024-03-24	2	X	X	.	.	X	X	X	.
BB021	S4U11651	-22.112400,119.871900	2024-03-24	2024-03-25	2	X	.	X	.	X	X	X	X
BB022	S4U06484	-22.102180,119.825030	2024-03-23	2024-03-24	2	X	X	.	.	X	X	.	X
BB023	644439	-21.975859,119.996063	2024-03-26	2024-03-27	2	X	X	X	.	X	X	.	.
BB024	S4U11651	-22.112400,119.871900	2024-03-26	2024-03-27	2	X	.	X	.	X	X	X	.
BB025	S4U11659	-22.079630,119.814300	2024-03-26	2024-03-27	2	X	.	X	.	X	X	.	.
BB026	636488	-21.906364,119.951920	2024-03-26	2024-03-27	2	X	X	X	.	X	X	X	.
BB027	S4U06484	-22.102180,119.825030	2024-03-26	2024-03-27	2	.	.	.	.	.	.	X	.
BB028	S4U11658	-21.919290,119.783830	2024-03-26	2024-03-27	2	X	X	.	.	.	X	X	.
BB029	S4U11657	-21.951290,119.792600	2024-03-23	2024-03-24	2	.	.	.	.	X	X	X	.
BB030	S4U11723	-22.199810,119.920150	2024-03-26	2024-03-27	2	X	.	X	.	X	X	X	X
BB031	S4U11658	-21.919290,119.783830	2024-03-21	2024-03-22	2	X	.	.	.	X	X	X	.
BB032	644439	-22.145163,119.928123	2024-03-21	2024-03-22	2	X	X	.	.	X	X	.	.

						<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
Site	Detector serial	Coordinates	First night	Last night	Nights								
BB033	S4U11658	-21.919290,119.783830	2024-03-23	2024-03-24	2	.	.	.	.	.	.	.	.
BB034	S4U11659	-22.079630,119.814300	2024-03-23	2024-03-24	2	X	.	.	.	X	.	X	X
BB036	644439	-22.034061,119.914505	2024-03-23	2024-03-24	2	X	.	X	.	X	X	X	X
BB037	636488	-22.045712,119.883575	2024-03-23	2024-03-24	2	.	.	.	.	.	.	X	.
BB038	636472	-22.208471,119.869171	2024-03-23	2024-03-24	2	.	X	.	.	X	X	.	.
BB039	S4U06484	-22.102180,119.825030	2024-03-18	2024-03-19	2	X	.	.	.	X	X	.	X
BB040	S4U06478	-22.079100,119.814400	2024-03-23	2024-03-24	2	X	.	.	.	.	.	X	X

Table 8. Species detected at each site in March 2024 ('BDDP' sites).

						<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
Site	Detector serial	Coordinates	First night	Last night	Nights								
BB003/BDDP16	S4U11658	-21.919290,119.783830	2024-03-18	2024-03-20	3	X	X	.	.	X	X	X	X
BDDP14	S4U11657	-21.951290,119.792600	2024-03-19	.	1	X	X	.	.	X	X	X	.
BDDP15	636494	-22.029480,119.826431	2024-03-18	2024-03-20	3	.	.	.	.	.	.	.	.
BDDP17	S4U11651	-22.112400,119.871900	2024-03-19	2024-03-21	3	.	X	.	.	X	.	X	.
BDDP18	636488	-21.893881,119.785057	2024-03-20	2024-03-22	3	X	.	.	.	X	X	X	X
BDDP19	S4U11659	-22.079630,119.814300	2024-03-17	2024-03-19	3	X	.	.	.	X	X	.	X
BDDP20	S4U06478	-22.079100,119.814400	2024-03-17	2024-03-19	3	X	X	.	.	X	X	X	X
BDDP22	S4U06478	-22.079100,119.814400	2024-03-20	2024-03-22	3	X	.	.	.	X	X	X	.
BDDP23	S4U11651	-22.112400,119.871900	2024-03-16	2024-03-18	3	X	.	.	.	X	X	X	X
DBOPP1	636472	-21.900614,119.884453	2024-03-26	2024-03-27	3	X	X	.	.	X	X	X	X

Table 9. Summary of analyses of the acoustic lure recordings (Chorus bat detector and two infrared camera traps per site).

Site	Chorus	Coordinates	Video timestamp
BDGB01	641036	-22.034065 119.914177	.
BDGB02	636474	-21.888155 119.781609	.
BDGB03	rec fail	.	18:52:22 and 18:52:54
BDGB04	641036	-22.100115 119.988914	.
BDGB05	636473	-21.905867 119.865448	.
BDGB06	641036	-21.975908 119.999283	.
BDGB07	636474	-21.915771 120.013268	.

Table 10. Summary of detections of the Pilbara Diamond-faced Bat from all sites (blue highlight aid inspection by separating sites; continued next page).

Site-unit	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
May 2023										
BBD01 MDSM4-02	27/05/2023	8	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	20:38:32	1:39:06	3H 13M 4S	4H 52M 50S
BBD02 MDSM4-03	28/05/2023	1	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	20:11:13	20:11:13	2H 45M 58S	10H 21M 9S
BBD06 MDSM4-07	30/05/2023	1	30/05/2023 17:24	30/05/2023 17:49	31/05/2023 6:09	31/05/2023 6:33	23:29:49	23:29:49	6H 4M 55S	7H 3M 25S
BDBAT01 MDSM4-06	28/05/2023	1	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	23:29:31	23:29:31	6H 4M 16S	7H 2M 51S
BDDP03 MDSM4-01	23/05/2023	1	23/05/2023 17:26	23/05/2023 17:50	24/05/2023 6:06	24/05/2023 6:30	23:25:59	23:25:59	5H 59M 32S	7H 4M 11S
BDDP06 MDSM4-05	26/05/2023	1	26/05/2023 17:25	26/05/2023 17:49	27/05/2023 6:07	27/05/2023 6:31	20:34:04	20:34:04	3H 8M 23S	9H 57M 26S
BDDP06 MDSM4-05	27/05/2023	9	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	19:53:28	2:01:34	2H 28M 0S	4H 30M 22S
BDDP06 MDSM4-05	28/05/2023	10	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	21:00:22	2:01:46	3H 35M 7S	4H 30M 36S
BDDP06 MDSM4-05	29/05/2023	21	29/05/2023 17:25	29/05/2023 17:49	30/05/2023 6:08	30/05/2023 6:32	21:13:34	1:23:40	3H 48M 30S	5H 9M 8S
BDDP07 MDSM4-04	27/05/2023	1	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	21:02:40	21:02:40	3H 37M 12S	9H 29M 16S
October 2023										
BDDP13 MDSM4-02	14/10/2023	1	14/10/2023 18:04	14/10/2023 18:26	15/10/2023 5:06	15/10/2023 5:29	0:21:28	0:21:28	6H 17M 24S	5H 8M 10S
BB011 MDSM4-03	16/10/2023	17	16/10/2023 18:04	16/10/2023 18:27	17/10/2023 5:05	17/10/2023 5:27	22:34:05	2:31:13	4H 29M 12S	2H 56M 42S
BB011 MDSM4-03	17/10/2023	6	17/10/2023 18:05	17/10/2023 18:28	18/10/2023 5:04	18/10/2023 5:27	21:36:50	1:45:44	3H 31M 32S	3H 41M 21S
BB036 MDSM4-07	13/10/2023	3	13/10/2023 18:03	13/10/2023 18:26	14/10/2023 5:07	14/10/2023 5:30	20:02:06	23:09:58	1H 58M 25S	6H 20M 32S

Site-unit	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
BB03 TC39-644439	15/10/2023	11	15/10/2023 18:04	15/10/2023 18:27	16/10/2023 5:05	16/10/2023 5:28	19:32:11	3:50:51	1H 27M 43S	1H 37M 55S
BB03 TC39-644439	16/10/2023	6	16/10/2023 18:04	16/10/2023 18:27	17/10/2023 5:05	17/10/2023 5:27	19:30:17	3:08:43	1H 25M 24S	2H 19M 12S
February 2024										
BB03	9/02/2024	1	9/02/2024 18:44	9/02/2024 19:08	10/02/2024 5:24	10/02/2024 5:47	20:30:37	20:30:37	1H 46M 0S	9H 17M 21S
BB13	11/02/2024	1	11/02/2024 18:43	11/02/2024 19:06	12/02/2024 5:25	12/02/2024 5:49	2:16:32	2:16:32	7H 32M 58S	3H 32M 38S
BB39	11/02/2024	2	11/02/2024 18:43	11/02/2024 19:06	12/02/2024 5:25	12/02/2024 5:49	3:04:05	3:04:27	8H 20M 31S	2H 44M 43S

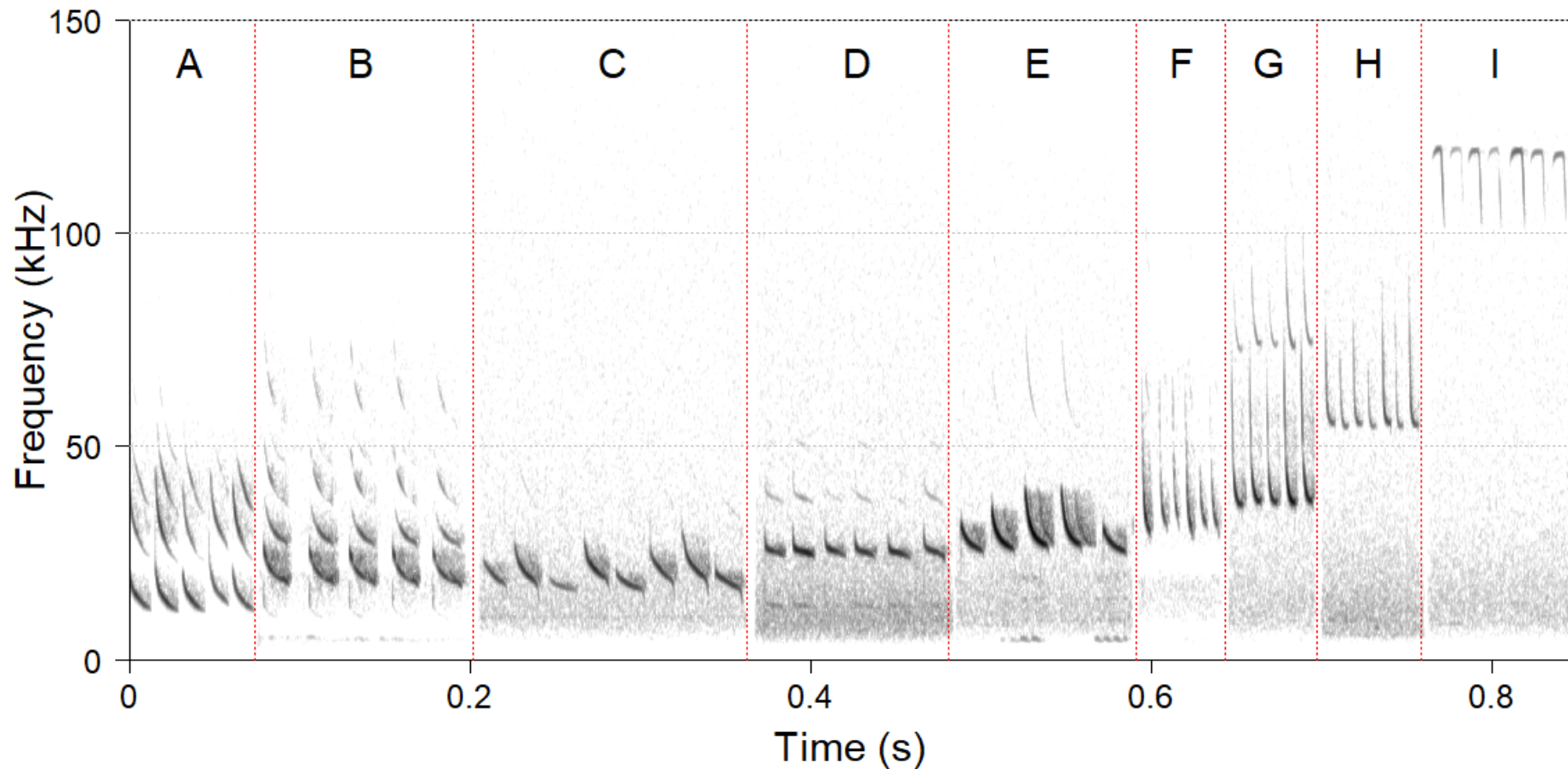


Figure 2. Representative echolocation call sequence portions of the species identified (**A:** *Austronomus australis*; **B:** *Saccolaimus flaviventris*; **C:** *Chaerephon jobensis*; **D:** *Taphozous georgianus*; **E:** *Ozimops lumsdenae*; **F:** *Chalinolobus gouldii*; **G:** *Scotorepens greyii*; **H:** *Vespadelus finlaysoni*; **I:** *Rhinonicteris aurantia*; time between pulses has been compressed).



Figure 3. Composite image of a 'fly-by' by one Ghost Bat at site BDGB03. No bat detector recordings were available from this site to confirm the observation, but the likelihood that this was a Ghost Bat is high (based on recognition of: anterior parts resembling long ears; the broadness of the wings, and lack of a distinct tail).



Figure 4. Examples of organisms that had features inconsistent with those of the Ghost Bat (**Top and middle:** Spotted Nightjar; **Bottom:** moth).

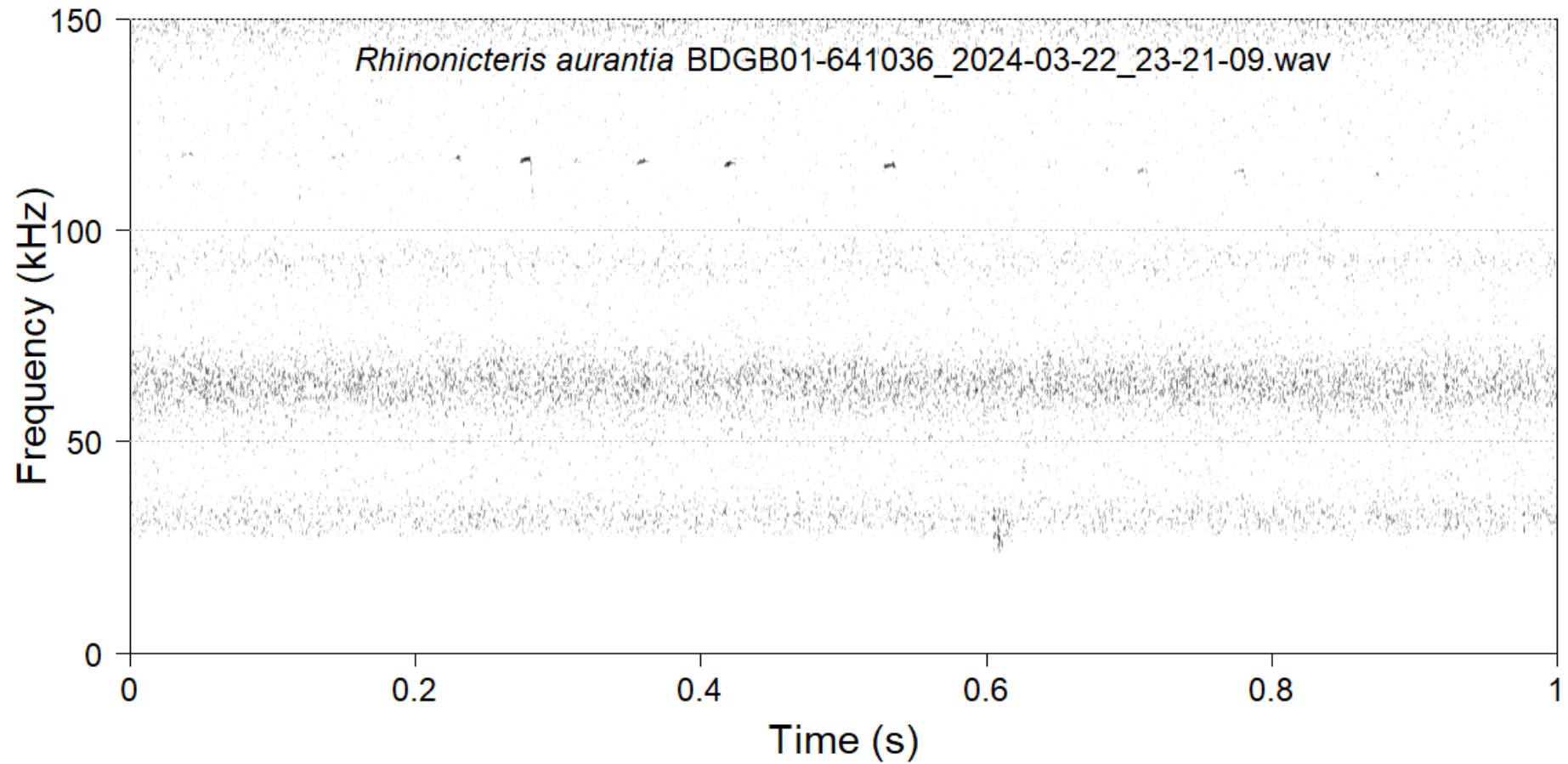


Figure 5. Representative echolocation call sequence portion of the Pilbara Diamond-faced Bat from acoustic lure site BDGB01.

Appendix 1. Summarising collision risk—a possible starting point

To understand the ‘collision risk’ of different bat Pilbara bat species, it might be useful to apply a modified generic risk matrix. I have provided a possible starting point for the development of a scheme in this appendix. In place of ‘Probability’ (rows), I have used the frequency of detection values calculated across all sites surveyed in 2023 – 2024, as sorted into four frequency ranges between 0 and 1; and in place of ‘Consequence’ (columns), I have used three likelihood categories of the species being present above 50 metres in altitude (turbine absent). The latter is an authoritative estimate based on my own accumulated casual field observations. The final score in the matrix is then divided into three risk categories. The final Risk Score and Collision Risk for each species is given in **Table A1**; and predictions for species not detected on the survey are given in **Table A2**. The Risk Scores and their Collision Risk categorisation seem to be sensible outcomes, though greater sampling effort for the Ghost Bat will give a more robust understanding of Collision Risk for this species.

		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	Collision Risk
0 – 2	Low risk
3 – 6	Medium risk
7 – 12	High risk

Table A1. Calculated Risk Scores for each species based on the surveys in 2023 – 2024.

		High altitude likelihood	Altitude category	Frequency across all surveys	Frequency category	Risk Score	Collision Risk
MEGADERMATIDAE							
Ghost Bat	<i>Macroderma gigas</i>	Medium	2	0.14	1	2	Low
RHINONYCTERIDAE							
Pilbara Diamond-faced Bat	<i>Rhinonicteris aurantia</i>	Low	1	0.10	1	1	Low
EMBALLONURIDAE							
Yellow-bellied Sheath-tailed Bat	<i>Saccolaimus flaviventris</i>	Medium	2	0.71	3	6	Medium
Common Sheath-tailed Bat	<i>Taphozous georgianus</i>	High	3	0.70	3	9	High
VESPERTILIONIDAE							
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	Low	1	0.85	4	4	Medium
Little Broad-nosed Bat	<i>Scotorepens greyii</i>	Low	1	0.85	4	4	Medium
Finlayson's Cave Bat	<i>Vespadelus finlaysoni</i>	Low	1	0.53	3	3	Medium
MOLOSSIDAE							
White-striped Free-tailed Bat	<i>Austronomus australis</i>	High	3	0.07	1	3	Medium
Greater Northern Free-tailed Bat	<i>Chaerephon jobensis</i>	Medium	2	0.55	3	6	Medium
Northern Free-tailed Bat	<i>Ozimops lumsdenae</i>	Medium	2	0.18	1	2	Low

Table A2. Predicted Risk Score and Collision Risk categories for Pilbara species of bat not observed on the survey (based on distributions given by Milne et al. 2023; 'estimated frequency' was 'imagined' based on records of occurrence in the Atlas of Living Australia).

		High altitude likelihood	'Estimated frequency'	Risk Score	Collision Risk
Black Flying-fox	<i>Pteropus alecto</i>	High	0.30	6	Medium
Little Red Flying-fox	<i>Pteropus scapulatus</i>	High	0.10	3	Medium
Hill's Sheath-tailed Bat	<i>Taphozous hilli</i>	High	0.20	3	Medium
Pallid Long-eared Bat	<i>Nyctophilus daedalus</i>	Low	0.10	1	Low
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>	Low	0.90	4	Medium
Northern Coastal Free-tailed Bat	<i>Ozimops cobourgianus</i>	Medium	0.00	0	Low

Appendix 2. Use of acoustic lures

Specialised Zoological provided the equipment for the acoustic lure surveys, and provided advice on how set and use it. The equipment and procedure are broadly consistent with recently released guidelines in the Northern Territory for the use of acoustic lures for Ghost Bat detection (Ruykys et al. 2024). In the Introduction to these guidelines, the authors state that “...it is expected that further application across the species’ distribution will improve its generality and functionality.”; (see also section 2.8). Given my own experience with the use of this method on several projects, and some practical considerations, I have provided advice in the present survey that I consider to be important improvements. These include:

1. The use of a bat detector directly under the portable speaker to detect the echolocation calls of a Ghost Bat that approaches and might briefly circle the post with this equipment. I address the five cautions articulated in the third ‘author’s tip’ in section 2.6 of the guidelines:
 - i. **“ghost bats do not consistently use echolocation when in flight”** Indeed Ghost Bats are thought not to echolocate continuously while in flight, but they are more likely to echolocate when approaching an object of their attention. In my own experience (not yet in the public domain; n = >20; exact number not given to preserve project anonymity), 74% of approaches could be validated unambiguously by the concurrent detection of an echolocation sequence on a bat detector placed under the speaker. For the remaining 26% of sites, it is possible that echolocation calls were not detected because of a combination of the low amplitude of the calls and the direction of flight relative to the zone of sound reception of the microphone.
 - ii. **“the acoustic lure may mask any echolocation pulses from ghost bats”** This is not the case. No echolocation calls are part of the broadcast sequence used. Further, echolocation pulses are of a different frequency range than the various social calls, and overlapping of broadcast social calls and the echolocation calls of an approaching bat does not prevent them from being distinguished, either by casual observation in a spectrogram, or the semi-automated analysis method used by Specialised Zoological.
 - iii. **“no ghost bats were detected acoustically during the study by Ruykys et al. (2023), despite ghost bats routinely flying with 1 m of bat detectors”** In that study, bat detectors were not placed in an ideal position (see underlined segments) for recording echolocation calls, and consequently the usefulness of bat detectors is under-emphasised in the guidelines:

“To determine whether the echolocation calls of lured ghost bats could be passively detected, a bat detector (Anabat Swift, Titley Scientific, Queensland, Australia) was deployed on the reference tree at each survey site for both the control and active treatment. Detectors were deployed at chest height, with the ultrasonic omnidirectional microphone placed on the far side of the tree, away from the speaker. The microphone was angled at 45° down from vertical.” (Ruykys et al. 2023; my underline)

- iv. **“expertise is required to identify bats – particularly ghost bats – via their echolocation call”** Specialised Zoological has a long track record of being able to identify these calls reliably, using an efficient semi-automated method, and being able to distinguish them from signals of similar shape produced by other cave-roosting bat species.
- v. **“the analysis of acoustic recordings will add significant analysis time to a project”** The analysis of bat detector recordings from acoustic lure sites using Specialised Zoological’s semi-automated method is efficient, requiring relatively little time for analysis, and certainly far less than a full manual inspection of the dataset. Most importantly, a validation of observations from videos from an independent, unambiguous identification based on diagnostic echolocation calls is extremely valuable. While some visitations of Ghost Bats might be very clearly of this species in the videos, there can be uncertainty with others. Echolocation call detection provides adequate validation.

In addition, there is comment in the guidelines about the difficulty of recognising juvenile Ghost Bats in videos, and consequently a recommendation to avoid using the technique when juveniles are likely to be present (section 2.3.1; p. 15). This is unnecessary because juveniles can also be recognised by echolocation calls in the same way as adults.

2. Much detail is given in the guidelines about the density of sampling and the probability of detection—especially for a ‘first stage’ survey (see section 2). But it should be noted that probability of detection is likely to be different in other landscapes, given the number of nearby roosts, and the colony size in those roosts. In addition, the effective broadcast range of the acoustic lure is relatively limited, and has not yet been properly estimated (or standardised), though a diameter of 200 metres seems reasonable. The size of this stimulus zone might be too small for some situations, especially where different habitats and landscape features might need to be investigated to address specific requirements. Thus, increased sampling density consistent with the notion of the ‘second stage’ survey might be required for questions such as *‘Which habitats do Ghost Bats use in this study area?’* or *‘Do Ghost Bats visit this feature?’* The notion of the appropriate sampling density for different regions and study objectives is deserving of more discussion. This is acknowledged in section 2.8 of the guidelines.
3. Further empirical observations will provide a better understanding of the potential impact of the technique on the Ghost Bat, which will either support or diminish concern for the various ethical considerations mentioned throughout the guidelines. In my own experience in one comprehensive study, visitations typically involved either a single pass of the speaker, or else presence of a few seconds only, and typically less than one minute. Key to understanding impacts is knowing how many individuals might be detected (this information cannot be determined), the total visitation time, number of visitations per night, associated behaviours, and whether a roost site is likely to be nearby (relevant for the time when broadcasts are started). At present, I have recommended that broadcasts continue for longer than is recommended in the guidelines because the aim is to maximise the chance of detection in relatively large,

complex geological terrains. In my experience, the time of first detection of a Ghost Bat can be anytime throughout the night, though certainly most detections are within the first 2 – 3 hours after sunset.

4. The equipment described and illustrated in the guidelines comprises a single video camera. I recommend two 4K video cameras placed at right angles so that a second view of any approaching bat is available for situations where an identification is ambiguous. It also provides redundancy in case of equipment set-up issues, given the high cost of remote field surveys. I also recommend speakers that play from a micro-SD card rather than Bluetooth. The equipment set-up used on the present survey has been used successfully elsewhere, though it has several constraints, and the system will likely keep evolving with experience, feedback and the availability of newer technology.
5. In the guidelines there is an emphasis on the manual review of video streams and how this should be undertaken. The semi-automated analysis conducted by Specialised Zoological represents a significant improvement over manual reviews, and is undertaken with a different set of considerations designed to maximise robustness. Most of the information in section 2.6 on page 20 is not relevant to the present study.
6. I consider that effort for the discovery of diurnal roost sites is still the primary consideration for environmental impact assessments, but that the acoustic lure method is useful for confirming presence both near roosts and away from them, and for characterising the use of a study area for foraging.
7. Specialised Zoological has had minimal input into the sampling design and level of sampling intensity in this study.

This study used squabble calls provided by Dr Nicola Hanrahan with permission. I have confirmed with her that no registration number is required for this project because it began before the guidelines were released.



**Identification of bat species
from Bonney Downs,
Western Australia**

Prepared for **Ecologia Environment Pty Ltd**

Version **22 February 2025**

SZ project reference **SZ756**

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

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Version history

Version	Note
2025-02-22	Final version

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1.0 Summary

Bat identifications from bat detector recordings are provided from the Bonney Downs project area, in the Pilbara region of Western Australia. It builds on a previous report by Specialised Zoological (2024).

The datasets reported on here comprise a total of 77 sites, 160 recording nights and 275,029 WAV files:

- June 2024 'BB' series—40 sites, 86 recording nights (82,632 sound files)
- September 2024 'BB' series—37 sites, 74 recording nights (192,397 sound files)

The scope of the analysis extended to the identification of all bat species but with particular attention given to the detection of two bat species of conservation significance: Ghost Bat *Macroderma gigas* (Megadermatidae) and Pilbara Leaf-nosed Bat *Rhinonictoris aurantia* (Rhinonycteridae).

Eight species of bat were detected (**Table 1; Figure 2**), 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 **Tables 2 – 3**.

The Pilbara Leaf-nosed Bat was detected at two sites (**Table 4**) from a total of 21 passes. Times of first detection after sunset, and times of last detection prior to sunrise, were mostly greater than one hour (one detection was 55 minutes from sunset), indicating that a diurnal roost was unlikely to be in the immediate vicinity.

Each bat species was assigned to one of three categories representing the likelihood that they would be encountered above an altitude of 50 metres. This is an authoritative estimate based on my own accumulated casual field observations.

To give a further indication of the relative risk of collision of each species, the frequency of detection was calculated across sites for each species on each survey, and across all sites (**Table 5**). A risk matrix was devised based on the likelihood of detection at height categories and the frequency of detection values, which might be useful as a 'starting point' (conjecture) for considering the relative risk of collision with a turbine for each species (**Appendix 1**).

The following should be noted for one high-flying species: the White-striped Free-tailed Bat *Austronomus australis* (Molossidae) is only seasonally present in the region from April to September according to an analysis presented by Bullen and McKenzie (2005). This species was not detected in the 2024 datasets, but the species might still have been present at low density.

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 six species that were not detected in the analysis. Three of these are known to forage or commute above the tree canopy height and might range within the blade swept area of a wind turbine in this study area. These species cannot be detected using the methods described in the present report. Three other

species not detected are either not found in this part of the Pilbara, or else have low detectability with bat detectors.

- **Black Flying-fox *Pteropus alecto* and Little Red Flying-fox *Pteropus scapulatus*** (Pteropodidae)—do not echolocate and are therefore not detected by acoustic recorders (bat detectors).
- **Hill's Sheath-tailed Bat *Taphozous hilli*** (Emballonuridae)—could be present in addition to *T. georgianus*, given its distribution in the region (Milne et al. 2023), but its calls cannot be distinguished reliably from those of *T. georgianus*.
- **Pallid Long-eared Bat *Nyctophilus daedalus* and Lesser Long-eared Bat *Nyctophilus geoffroyi*** (Vespertilionidae)—might be present but their echolocation calls are usually low in amplitude, and can be difficult to distinguish from clutter calls of the Little Broad-nosed Bat *Scotorepens greyii*.
- **Northern Coastal Free-tailed Bat *Ozimops cobourgianus*** (Molossidae)—found only along the Pilbara coast, usually in mangal habitat.

2.0 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), and Wildlife Acoustics SM4BAT-FS bat detectors (sampling rate 384 kHz).

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 23.1.

Species were identified based on information in the author's unpublished material and Churchill (2008). Nomenclature follows Jackson and Groves (2015). Identifications were supported by distribution information in a curated source of distribution records maintained by the Australasian Bat Society, Inc. (<https://www.ausbats.org.au/batmap.html>) (Milne et al. 2023). Custom [R] language scripts were used to summarise the analysis outcomes.

3.0 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 Specialised Zoological. The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
5. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
6. While 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. Specialised Zoological bears no liability for any follow-up work that may be required to support an identification based initially on the analysis of acoustic recordings undertaken and reported on here.
7. There are a variety of factors that affect the 'detectability' of each bat species, given the frequency, power and shape characteristics of their calls. Further information on the analysis and the various factors that can impinge on the reliability of identifications can be provided upon request.
8. The analysis of ultrasonic recordings is one of several methods that can be used to survey for bats, and comprehensive surveys typically employ more than one method. If an identification in the present report is ambiguous or in question, a trapping programme would help to resolve the presence of the possibilities in the project area.
9. The most reliable way of detecting the ghost bat *Macroderma gigas* 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 (Ruykys et al. 2023, 2024; Hanrahan et al. 2023).
10. Predictions about whether the Pilbara Leaf-nosed Bat roosts within a particular surveyed cave (where a bat detector was placed at the entrance), or somewhere nearby, based on the time of first detection should be considered indicative only. If unambiguous information of diurnal roosting of this species is required, diurnal roosting should be confirmed using the entrance sheeting method that is described in DEWHA (2010).
11. 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.

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- Ruykys L., Hanrahan N. and Stokeld D. (2024) Northern Territory guidelines for surveying for the ghost bat at the landscape scale. Technical Report 05/2024, Department of Environment, Parks and Water Security, Palmerston, Northern Territory and Charles Darwin University, Brinkin, Northern Territory.
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Table 1. Species identified in the present survey from all sites combined. The predicted presence above 50 metres in altitude is an authoritative estimate based on my own accumulated casual field observations ('predicted to be encountered commonly above 50 m').

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

Table 2. Species identifications from across all recording nights at each site sampled in June 2024 [see *Table 1* for full species names; coordinates are from embedded metadata and may not be accurate for Wildlife Acoustics detectors].

Site	Serial	First night	Last night	No. nights	Coordinates	<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
BB01	644440	19/06/2024	20/06/2024	2	-21.890276, 119.781105	X	.	.	X	.	X	X	X
BB02	644436	19/06/2024	20/06/2024	2	-21.897375, 119.795815	.	.	.	.	.	.	.	.
BB03	S4U06478	19/06/2024	20/06/2024	2	-22.180950, 119.932470	X	X	.	.	.	.	X	X
BB04	644439	19/06/2024	20/06/2024	2	-21.949718, 119.793442	X	.	.	.	.	.	.	X
BB05	636488	19/06/2024	20/06/2024	2	-22.003580, 119.817299	X	X	.	.	.	.	X	.
BB06	644440	17/06/2024	18/06/2024	2	-22.026152, 119.843964	X	X	.	.	.	X	.	X
BB07	644436	17/06/2024	18/06/2024	2	-22.026152, 119.843964	X	.	.	.	.	.	.	.
BB08	S4U06478	23/06/2024	23/06/2024	1	-22.180950, 119.932470	X	.	.	.	.	.	.	.
BB09	S4U11651	23/06/2024	23/06/2024	1	-22.180550, 119.932870	X	.	.	.	.	.	X	.
BB10	S4U11651	19/06/2024	20/06/2024	2	-22.180550, 119.932870	X	.	.	.	.	.	.	.
BB11	S4U11651	17/06/2024	22/06/2024	6	-22.180550, 119.932870	X	X	.	.	.	.	X	.
BB12	S4U09499	19/06/2024	20/06/2024	2	-22.180840, 119.932820	.	X	.	.	.	.	.	.
BB13	S4U11659	19/06/2024	20/06/2024	2	-22.180950, 119.932470	X	X	.	.	.	.	X	.
BB14	S4U06478	22/06/2024	22/06/2024	1	-22.180950, 119.932470	X	.	.	.	.	.	.	.
BB15	S4U11658	17/06/2024	23/06/2024	7	-22.180950, 119.932470	X	X	.	.	X	X	X	X
BB16	S4U11723	18/06/2024	19/06/2024	2	-22.180950, 119.932470	X	X	X	.	.	X	X	X
BB17	644439	21/06/2024	23/06/2024	3	-22.184155, 119.933365	X	X	.	.	.	.	.	.
BB18	644440	21/06/2024	23/06/2024	3	-22.247458, 119.842934	X	.	.	.	.	X	.	.
BB19	644436	21/06/2024	23/06/2024	3	-22.175093, 119.854576	X	.	.	.	.	.	X	.
BB20	S4U11651	17/06/2024	18/06/2024	2	-22.180550, 119.932870	X	.	.	.	X	.	X	.
BB21	S4U11657	19/06/2024	20/06/2024	2	-22.180550, 119.933470	X	X	.	.	.	.	.	.
BB22	S4U11723	20/06/2024	21/06/2024	2	-22.180950, 119.932470	.	X	.	.	.	X	.	X

Site	Serial	First night	Last night	No. nights	Coordinates	<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
BB23	S4U11658	19/06/2024	20/06/2024	2	-22.180950, 119.932470	X	X	.	.	X	.	X	.
BB24	S4U11651	21/06/2024	22/06/2024	2	-22.180550, 119.932870	X	X	.	.	.	.	X	.
BB25	2LU00756	21/06/2024	21/06/2024	1	-22.183230, -119.934640	.	.	.	.	.	.	.	.
BB26	2LU00656	21/06/2024	22/06/2024	2	-22.183240, -119.934620	X	X	.	.	.	.	X	X
BB27	S4U11657	21/06/2024	22/06/2024	2	-22.180550, 119.933470	X	.	.	.	.	.	X	.
BB28	S4U09499	21/06/2024	22/06/2024	2	-22.180840, 119.932820	X	X	.	.	.	.	.	.
BB29	S4U09499	23/06/2024	23/06/2024	1	-22.180840, 119.932820	X	.	.	.	.	.	.	.
BB30	S4U11723	22/06/2024	23/06/2024	2	-22.180950, 119.932470	X	X	.	.	.	.	X	.
BB31	644439	17/06/2024	18/06/2024	2	-22.016544, 119.875618	X	.	.	.	X	X	.	X
BB32	S4U11658	17/06/2024	18/06/2024	2	-22.180950, 119.932470	X	X	.	.	.	X	X	.
BB33	S4U11657	23/06/2024	23/06/2024	1	-22.180550, 119.933470	.	.	.	.	.	.	.	.
BB34	S4U09499	17/06/2024	18/06/2024	2	-22.180840, 119.932820	X	X	.	.	.	X	X	.
BB35	S4U06484	19/06/2024	20/06/2024	2	-22.180950, 119.932470	X	X	.	.	X	.	.	.
BB36	S4U11659	21/06/2024	22/06/2024	2	-22.180950, 119.932470	X	X	.	.	X	X	X	X
BB37	636488	17/06/2024	18/06/2024	2	-22.046221, 119.883186	.	X	.	.	.	X	X	.
BB38	636488	22/06/2024	23/06/2024	2	-22.208508, 119.869370	.	X	.	.	.	.	.	.
BB39	S4U06478	17/06/2024	18/06/2024	2	-22.180950, 119.932470	X	X	.	.	.	X	X	.
BB40	S4U06484	19/06/2024	20/06/2024	2	-22.180950, 119.932470	X	X	.	.	.	.	.	.

Table 3. Species identifications from across all recording nights at each site sampled in September 2024 [see *Table 1* for full species names; coordinates are from embedded metadata and may not be accurate for Wildlife Acoustics detectors].

Site	Serial	First night	Last night	No. nights	Coordinates	<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
BB01	636474	12/09/2024	13/09/2024	2	-21.890572, 119.781036	X	X	.	X	X	X	X	X
BB02	S4U9499	12/09/2024	13/09/2024	2	-21.874470, 120.045420	X	.	.	.	X	.	X	.
BB03	636472	12/09/2024	13/09/2024	2	-21.919254, 119.783073	X	X	.	.	.	X	X	X
BB04	S4U11658	14/09/2024	15/09/2024	2	-21.927460, 119.938290	X	.	.	.	.	X	X	X
BB05	S4U06484	12/09/2024	13/09/2024	2	-21.874470, 120.045420	X	.	.	.	X	X	X	X
BB06	644439	12/09/2024	13/09/2024	2	-22.025846, 119.844124	X	X	.	.	X	X	X	X
BB07	644436	12/09/2024	13/09/2024	2	-22.051115, 119.825081	X	.	.	.	.	X	.	.
BB09	S4U11659	12/09/2024	13/09/2024	2	-21.874470, 120.045420	.	.	.	.	.	X	.	.
BB10	644436	14/09/2024	15/09/2024	2	-22.243425, 120.065529	X	.	.	.	.	X	.	X
BB11	655144	12/09/2024	13/09/2024	2	-22.181982, 119.805649	X	X	.	.	X	X	.	X
BB12	644440	14/09/2024	15/09/2024	2	-22.254961, 119.987465	.	.	.	.	X	.	.	.
BB13	644439	14/09/2024	15/09/2024	2	-22.224499, 119.988815	X	.	.	.	X	X	.	X
BB14	636472	14/09/2024	15/09/2024	2	-22.210238, 119.813316	X	.	.	.	.	X	.	.
BB15	644440	12/09/2024	13/09/2024	2	-22.275028, 119.794693	X	.	.	.	X	X	.	X
BB16	S4U11723	12/09/2024	13/09/2024	2	-21.874470, 120.045430	X	X	X	.	X	X	.	X
BB17	S4U11657	14/09/2024	15/09/2024	2	21.874470, 120.045430	.	.	.	.	.	X	.	.
BB18	S4U11659	14/09/2024	15/09/2024	2	-21.874470, 120.045420	X	X	.	.	X	X	.	X
BB19	636488	14/09/2024	15/09/2024	2	-22.175526, 119.853386	X	.	.	.	.	X	.	X
BB20	S4U06478	12/09/2024	13/09/2024	2	-21.874470, 120.045430	.	.	.	.	X	.	.	.
BB21	655144	14/09/2024	15/09/2024	2	-22.177034, 119.989716	X	X	X	.	X	X	.	X
BB22	S4U09499	14/09/2024	15/09/2024	2	-21.874470, 120.045420	X	.	.	.	X	X	X	X
BB23	644436	10/09/2024	11/09/2024	2	-21.975826, 119.996193	X	X	.	.	X	X	.	X

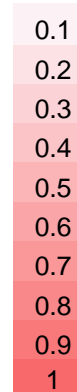
Site	Serial	First night	Last night	No. nights	Coordinates	<i>C. gouldii</i>	<i>C. jobensis</i>	<i>O. lumsdenae</i>	<i>R. aurantia</i>	<i>S. flaviventris</i>	<i>S. greyii</i>	<i>T. georgianus</i>	<i>V. finlaysoni</i>
BB24	644439	10/09/2024	11/09/2024	2	-21.998837, 119.953972	.	.	.	.	.	.	X	.
BB25	655144	10/09/2024	11/09/2024	2	-21.974049, 119.957207	X	X	X	.	X	X	.	X
BB26	S4U11658	10/09/2024	11/09/2024	2	-21.927460, 119.938290	X	.	.	.	X	.	X	X
BB27	636472	10/09/2024	11/09/2024	2	-21.933687, 119.972572	.	.	.	.	X	X	.	.
BB28	636474	10/09/2024	11/09/2024	2	-21.939026, 119.937958	.	.	.	.	.	X	.	X
BB29	S4U06478	10/09/2024	11/09/2024	2	-21.874470, 120.045430	.	.	.	.	X	.	X	.
BB30	644440	10/09/2024	11/09/2024	2	-22.011637, 119.931267	X	.	X	.	X	.	X	.
BB31	S4U11651	10/09/2024	11/09/2024	2	-21.874470, 120.045420	X	.	.	.	X	X	X	X
BB32	S4U06484	10/09/2024	11/09/2024	2	-21.874470, 120.045420	X	X	.	.	X	X	X	.
BB33	S4U11723	10/09/2024	11/09/2024	2	-21.874470, 120.045430	X	.	.	.	.	X	.	.
BB35	S4U11659	10/09/2024	11/09/2024	2	-21.874470, 120.045420	X	.	.	.	X	.	.	.
BB36	636488	10/09/2024	11/09/2024	2	-22.034086, 119.914520	X	.	.	.	X	X	.	X
BB38	636474	14/09/2024	15/09/2024	2	-22.208174, 119.869385	.	.	.	.	X	.	.	.
BB39	S4U11651	12/09/2024	13/09/2024	2	-21.874470, 120.045420	X	.	.	.	X	X	.	.
BB40	S4U06484	14/09/2024	15/09/2024	2	-21.874470, 120.045420	.	.	.	.	.	X	.	.

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
June 2024											
BB01	644440	19/06/2024	4	19/06/2024 17:26	19/06/2024 17:51	20/06/2024 6:15	20/06/2024 6:39	1:42:24	2:54:44	8H 15M 46S	3H 45M 1S
BB01	644440	20/06/2024	7	20/06/2024 17:26	20/06/2024 17:51	21/06/2024 6:15	21/06/2024 6:39	18:37:36	21:18:23	1H 10M 47S	9H 21M 35S
September 2024											
BB01	636474	12/09/2024	5	12/09/2024 17:55	12/09/2024 18:17	13/09/2024 5:38	13/09/2024 6:00	18:50:38	3:28:21	55M 34S	2H 32M 3S
BB01	636474	13/09/2024	5	13/09/2024 17:55	13/09/2024 18:17	14/09/2024 5:37	14/09/2024 5:59	21:56:55	3:43:09	4H 1M 35S	2H 16M 16S

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).

Species	June 2024	September 2024	Combined
<i>C. gouldii</i>	0.83	0.73	0.78
<i>C. jobensis</i>	0.60	0.27	0.44
<i>O. lumsdenae</i>	0.03	0.11	0.06
<i>R. aurantia</i>	0.03	0.03	0.03
<i>S. flaviventris</i>	0.15	0.68	0.40
<i>S. greyii</i>	0.30	0.76	0.52
<i>T. georgianus</i>	0.50	0.35	0.43
<i>V. finlaysoni</i>	0.25	0.54	0.39



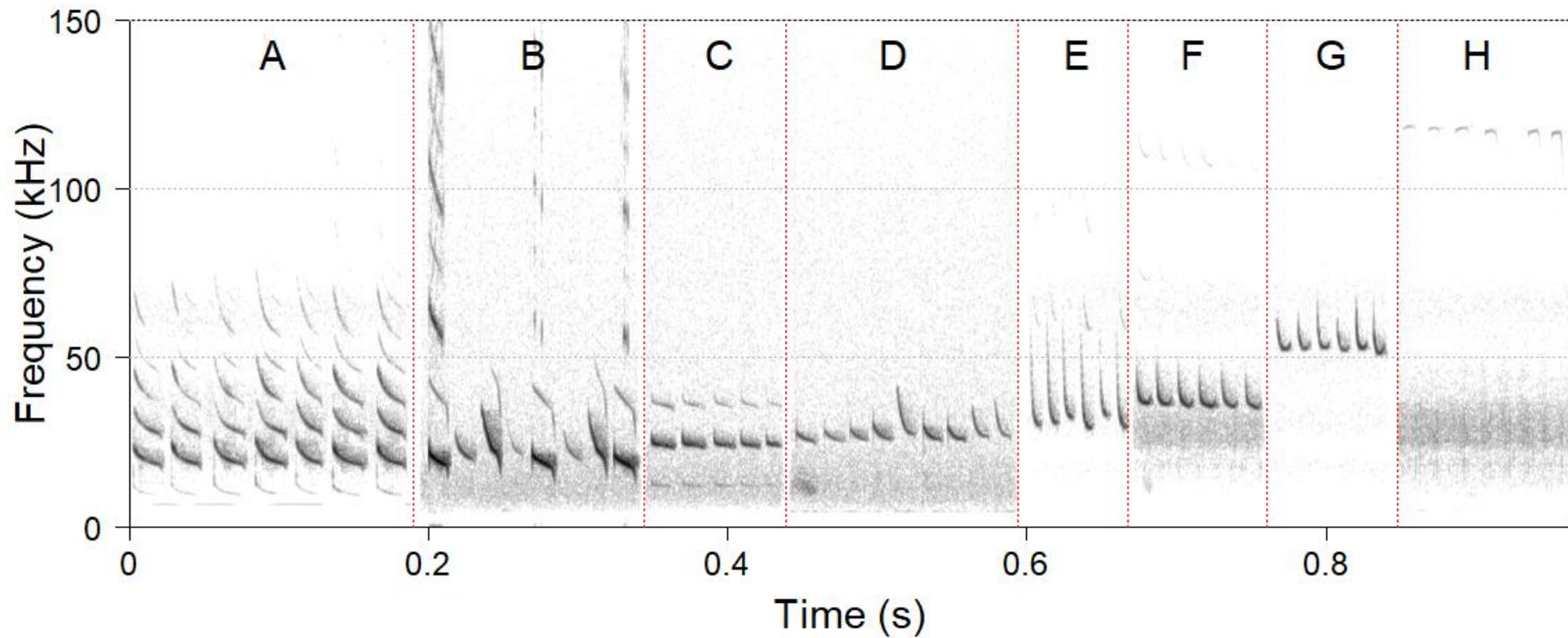


Figure 1. Representative echolocation call sequence portions of the species identified (**A:** *Saccolaimus flaviventris*; **B:** *Chaerephon jobensis*; **C:** *Taphozous georgianus*; **D:** *Ozimops lumsdenae*; **E:** *Chalinolobus gouldii*; **F:** *Scotorepens greyii*; **G:** *Vespadelus finlaysoni*;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

Appendix 1. Summarising collision risk—a possible starting point

To understand the ‘collision risk’ of different bat Pilbara bat species, it might be useful to apply a modified generic risk matrix. I have provided a possible starting point for the development of a scheme in this appendix. In place of ‘Probability’ (rows), I have used the frequency of detection values calculated across all sites surveyed in 2023 – 2024, as sorted into four frequency ranges between 0 and 1; and in place of ‘Consequence’ (columns), I have used three likelihood categories of the species being present above 50 metres in altitude (turbine absent). The latter is an authoritative estimate based on my own accumulated casual field observations. The final score in the matrix is then divided into three risk categories. The final Risk Score and Collision Risk for each species is given in **Table A1**; and predictions for species not detected on the survey are given in **Table A2**. The Risk Scores and their Collision Risk categorisation seem to be sensible outcomes, though greater sampling effort for the Ghost Bat will give a more robust understanding of Collision Risk for this species.

		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	Collision Risk
0 – 2	Low risk
3 – 6	Medium risk
7 – 12	High risk

Table A1. Calculated Risk Scores for each species based on the surveys in June and September 2024.

		High altitude likelihood	Altitude category	Frequency across all surveys	Frequency category	Risk Score	Collision Risk
RHINONYCTERIDAE							
Pilbara Leaf-nosed Bat	<i>Rhinonicteris aurantia</i>	Low	1	0.03	1	1	Low
EMBALLONURIDAE							
Yellow-bellied Sheath-tailed Bat	<i>Saccolaimus flaviventris</i>	Medium	2	0.40	2	4	Medium
Common Sheath-tailed Bat	<i>Taphozous georgianus</i>	High	3	0.43	2	6	Medium
VESPERTILIONIDAE							
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	Low	1	0.78	4	4	Medium
Little Broad-nosed Bat	<i>Scotorepens greyii</i>	Low	1	0.52	3	3	Medium
Finlayson's Cave Bat	<i>Vespadelus finlaysoni</i>	Low	1	0.39	2	2	Low
MOLOSSIDAE							
Greater Northern Free-tailed Bat	<i>Chaerephon jobensis</i>	Medium	2	0.44	2	4	Medium
Northern Free-tailed Bat	<i>Ozimops lumsdenae</i>	Medium	2	0.06	1	2	Low

Table A2. Predicted Risk Score and Collision Risk categories for Pilbara species of bat not observed on the survey (based on distributions given by Milne et al. 2023; 'estimated frequency' was 'imagined' based on records of occurrence in the Atlas of Living Australia).

		High altitude likelihood	'Estimated frequency'	Risk Score	Collision Risk
Black Flying-fox	<i>Pteropus alecto</i>	High	0.30	6	Medium
Little Red Flying-fox	<i>Pteropus scapulatus</i>	High	0.10	3	Medium
Ghost Bat	<i>Macroderma gigas</i>	Medium	0.05*	2	Low
Hill's Sheath-tailed Bat	<i>Taphozous hilli</i>	High	0.20	3	Medium
Pallid Long-eared Bat	<i>Nyctophilus daedalus</i>	Low	0.10	1	Low
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>	Low	0.90	4	Medium
White-striped Free-tailed Bat	<i>Austronomus australis</i>	High	0.10*	3	Medium
Northern Coastal Free-tailed Bat	<i>Ozimops cobourgianus</i>	Medium	0.00	0	Low

* Present in Specialised Zoological (2024), and value for 'frequency of detection' given for *A. australis*.



**Identification of bat species
from Bonney Downs, Western Australia:
October 2023 – August 2025**

Prepared for **Ecologia Environment Pty Ltd**

Version **1 December 2025**

SZ project reference **SZ761**

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Version history

Date	Note
2025-12-01	Final version

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Summary

Bat identifications from bat detector sound files are provided from recordings made between October 2023 and August 2025 in the Bonney Downs project area in the Pilbara region of Western Australia (see also Specialised Zoological 2024, 2025).

The scope of the analysis extended to the identification of all bat species present, but with particular attention given to the detection of species of conservation significance: Ghost Bat *Macroderma gigas* (Megadermatidae) and Pilbara Leaf-nosed Bat *Rhinonycteris aurantia* (Rhinonycteridae). Note that the Ghost Bat was targeted with acoustic lures (method follows Hanrahan et al. 2023; Ruykys et al. 2023, 2024), and the present report does not include those outcomes.

The dataset submitted for analysis comprised a total of 966,446 full spectrum WAV-format sound files recorded from eight surveys at up to 40 standardised recording positions over a total of 586 survey nights (mostly two nights per site) for the period October 2023 to August 2025 (**Table 1**). In addition, results from other sites in the project area were reported in Specialised Zoological (2024).

Ten species of bat were identified as being present (**Tables 2 and 3; Figure 1**).

The Ghost Bat was not detected in these recordings.

The Pilbara Leaf-nosed Bat was detected at 17 sites across a total of 25 sampling nights (**Table 1**). The times of detection were well after sunset and well before dawn, which is indicative of individuals foraging away from a diurnal roost.

A brief summary of Collision Risk was derived using a novel risk matrix developed for Pilbara bats by Specialised Zoological, the overall Frequency of Detection values calculated across the eight surveys, and an authoritative estimate of the relative probability that a bat species could be detected above 50 metres in altitude (**Appendix A**).

Only a summary of the identifications is presented in this report (Frequency of Detection—the proportion of sampling sites where each species was detected), with the detail presented in an accompanying spreadsheet [SZ761_master20251130.xlsx](#)

Methods

The ultrasonic recordings provided were recorded in WAV format with Wildlife Acoustics SM4BAT-FS bat detectors (sampling rate 384 kHz) and Titley Scientific Anabat Chorus bat detectors (sampling rate 500 kHz), both set for automated triggered recordings between sunset and 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 Pilbara bat species;
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 and Churchill (2008). Nomenclature follows Jackson and Groves (2015). Identifications were supported by distribution information in a curated source of distribution records maintained by the Australasian Bat Society, Inc. (<https://www.ausbats.org.au/batmap.html>) (Milne et al. 2023). Custom [R] language scripts were used to summarise the analysis outcomes.

Limitations and constraints

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 for this survey by Specialised Zoological. The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
5. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
6. While identifications have been made to the best of our ability given the available materials, Specialised Zoological reserves the right to re-examine the data and revise any identification following a query, and it is the client's and / or proponent's responsibility to provide supporting evidence for any identification, which might require follow-up trapping effort or non-invasive methods such as video recordings. Specialised Zoological bears no liability for any follow-up work that may be required to support an identification based initially on the analysis of acoustic recordings undertaken and reported on here.
7. There are a variety of factors that affect the 'detectability' of each bat species, given the frequency, power and shape characteristics of their calls. Further information on the analysis and the various factors that can impinge on the reliability of identifications can be provided upon request.
8. The analysis of ultrasonic recordings is one of several methods that can be used to survey for bats, and comprehensive surveys typically employ more than one method. If an identification in the present report is ambiguous or in question, a trapping programme would help to resolve the presence of the possibilities in the project area.
9. The most reliable way of detecting the Ghost Bat *Macroderma gigas* 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. 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 (Ruykys et al. 2023, 2024; Hanrahan et al. 2023). These results are reported elsewhere (including in Specialised Zoological 2024).
10. This version of the document supersedes any previous version. Previous drafts and interim reports are not authorised by us for submission to the regulator or the public domain.

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Table 1. Summary of recordings made over all surveys (Ra—Pilbara Leaf-nosed Bat; asterisk indicates that the numbers presented include only those that had data available for analysis).

Survey	Period	WAVs	Sites*	Nights	Sites with Ra	Nights with Ra
1	October 2023	121,987	42	80	4	6
2	February 2024	104,101	39	78	3	3
3	March 2024	65,952	31	63	0	0
4	June 2024	82,632	40	86	1	2
5	September 2024	192,397	37	74	1	2
6	February 2025	182,468	33	68	0	0
7	May 2025	139,817	31	62	6	8
8	August 2025	77,092	37	76	2	4
Totals	8	966,446	290	587	17	25

Table 2. Species identified in the present survey from all sites combined (* possibilities include the Lesser Long-eared Bat *N. geoffroyi* and Pallid Long-eared Bat *N. daedalus*).

RHINONYCTERIDAE	
Pilbara Leaf-nosed Bat (Pilbara Diamond-faced Bat)	<i>Rhinonictoris aurantia</i>
EMBALLONURIDAE	
Yellow-bellied Sheath-tailed Bat	<i>Saccolaimus flaviventris</i>
Common Sheath-tailed Bat	<i>Taphozous georgianus</i>
VESPERTILIONIDAE	
Gould’s Wattled Bat	<i>Chalinolobus gouldii</i>
Unidentified long-eared bat*	<i>Nyctophilus</i> sp.
Little Broad-nosed Bat	<i>Scotorepens greyii</i>
Finlayson’s Cave Bat	<i>Vespadelus finlaysoni</i>
MOLOSSIDAE	
White-striped Free-tailed Bat	<i>Austronomus australis</i>
Greater Northern Free-tailed Bat	<i>Chaerephon jobensis</i>
Northern Free-tailed Bat	<i>Ozimops lumsdenae</i>

Table 3. Frequency of Detection (summed over sites) across all surveys (see *Table A1* for the overall values of Frequency Detection across the entire survey programme).

Species	Oct2023	Feb2024	Mar2024	Jun2024	Sep2024	Feb2025	May2025	Aug2025	Key
<i>A. australis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.05	0.1
<i>C. gouldii</i>	0.74	0.87	0.77	0.83	0.73	0.91	0.97	0.86	0.2
<i>C. jobensis</i>	0.45	0.54	0.39	0.60	0.27	0.36	0.65	0.41	0.3
<i>Nyctophilus sp.</i>	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.03	0.4
<i>O. lumsdenae</i>	0.14	0.18	0.26	0.03	0.11	0.39	0.32	0.14	0.5
<i>R. aurantia</i>	0.10	0.08	0.00	0.03	0.03	0.00	0.19	0.05	0.6
<i>S. flaviventris</i>	0.48	0.87	0.84	0.15	0.68	0.82	0.55	0.43	0.7
<i>S. greyii</i>	0.79	0.87	0.74	0.30	0.76	0.94	0.65	0.76	0.8
<i>T. georgianus</i>	0.50	0.77	0.61	0.50	0.35	0.67	0.77	0.65	0.9
<i>V. finlaysoni</i>	0.55	0.49	0.42	0.25	0.54	0.52	0.87	0.86	1

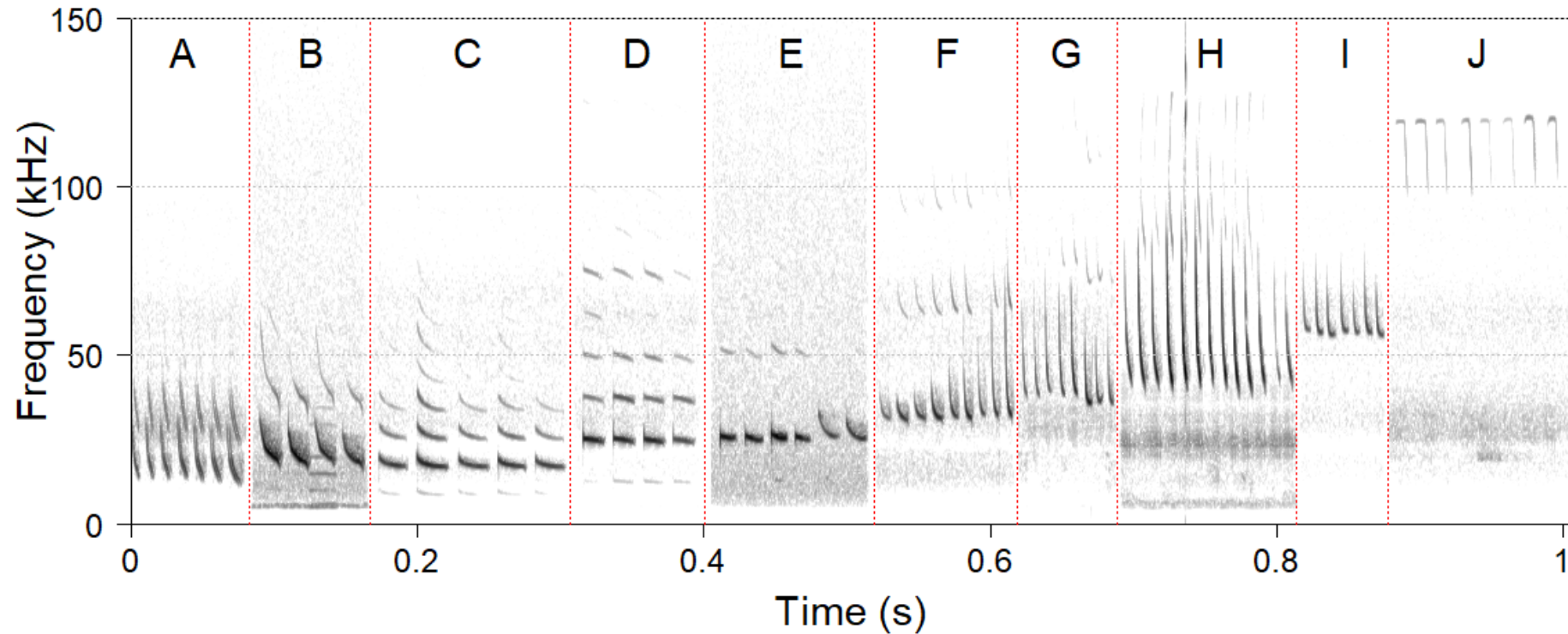


Figure 1. Representative echolocation call sequence portions of the species identified (**A:** *Austronomus australis*; **B:** *Chaerephon jobensis*; **C:** *Saccolaimus flaviventris*; **D:** *Taphozous georgianus*; **E:** *Ozimops lumsdenae*; **F:** *Chalinolobus gouldii*; **G:** *Scotorepens greyii*;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

Appendix 1. Summarising Collision Risk based on Frequency of Detection in the project area

To understand the ‘Collision Risk’ of different bat Pilbara bat species, it is useful to apply a modified generic risk matrix. I have provided a starting point for the development of a scheme in this appendix. In place of ‘Probability’ (rows), I have used the Frequency of Detection values calculated across all sites surveyed in 2023 – 2025, as sorted into four frequency ranges between 0 and 1; and in place of ‘Consequence’ (columns), I have used three likelihood categories of the species being present above 50 metres in altitude (turbine absent). The latter is an authoritative estimate based on my own accumulated casual field observations. The final score in the matrix is then divided into three risk categories. The final Risk Score and Collision Risk for each species is given in **Table A1**.

		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	Collision Risk
7 – 12	High risk
3 – 6	Medium risk
0 – 2	Low risk

Table A1. Calculated Risk Scores for each species based on the surveys in June and September 2024.

		High altitude likelihood	Altitude category	Frequency across all surveys	Frequency category	Risk Score	Collision Risk
RHINONYCTERIDAE							
Pilbara Leaf-nosed Bat	<i>Rhinonictoris aurantia</i>	Low	1	0.08	1	1	Low
EMBALLONURIDAE							
Yellow-bellied Sheath-tailed Bat	<i>Saccolaimus flaviventris</i>	Medium	2	0.59	3	6	Medium
Common Sheath-tailed Bat	<i>Taphozous georgianus</i>	High	3	0.69	3	9	High
VESPERTILIONIDAE							
Gould’s Wattled Bat	<i>Chalinolobus gouldii</i>	Low	1	0.91	4	4	Medium
Unidentified long-eared bat	<i>Nyctophilus</i> sp.	Low	1	0.04	1	1	Low
Little Broad-nosed Bat	<i>Scotorepens greyii</i>	Low	1	0.78	4	4	Medium
Finlayson’s Cave Bat	<i>Vespadelus finlaysoni</i>	Low	1	0.75	4	4	Medium
MOLOSSIDAE							
White-striped Free-tailed Bat	<i>Austronomus australis</i>	High	3	0.13	1	3	Medium
Greater Northern Free-tailed Bat	<i>Chaerephon jobensis</i>	Medium	2	0.47	2	4	Medium
Northern Free-tailed Bat	<i>Ozimops lumsdenae</i>	Medium	2	0.28	2	4	Medium

Appendix E Likelihood of Occurrence

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Comments	Likelihood of occurrence
				DBCA	Fortescue				
BIRD									
<i>Actitis hypoleucos</i>	Common sandpiper	MI	MI	4	6	2020	Inland wetlands and sheltered coastal areas, utilises permanent and ephemeral wetlands.	Closest record (Fortescue) within 3 km of survey area, with most records associated with Fortescue Marsh. Permanent habitat does not occur within survey area and presence of species is unlikely. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Moderate
<i>Apus pacificus</i>	Fork-tailed swift	MI	MI	4	25	2014	Occupies low to very high airspace over varied habitat. Aerial specialist.	Closest records (DBCA and Fortescue) 27 km from survey area. Species does not utilise terrestrial habitats; however, may utilise the airspace above the survey area while transiting.	Recorded (current survey)
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	MI	MI	7	1	2020	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	Closest Fortescue records 11 km from survey area, with most records associated with Fortescue Marsh. Permanent habitat does not occur within survey area and presence of species is unlikely. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Moderate
<i>Calidris ruficollis</i>	Red-necked stint	MI	MI	2	1	2017	Edge of sheltered estuaries, beaches and salt lakes both on the mainland and on offshore islands. Occasionally occur on inland salt lakes and freshwater swamps.	Closest records (DBCA) located 24 km from survey area, in association with the Fortescue Marsh. Permanent habitat does not occur within survey area and presence of species is unlikely. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Moderate
<i>Charadrius veredus</i>	Oriental plover	MI	MI	4	1	2017	Inland wetlands and sheltered coastal areas, utilises permanent and ephemeral wetlands.	Recorded within survey area. Permanent habitat does not occur within survey area. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Recorded (current survey)
<i>Falco hypoleucos</i>	Grey falcon	VU	VU	18	20	2024	Resident or nomadic to most of semi-arid interior.	One historical (1977) DBCA database record located within 70m of the survey area. Species recorded on 11 occasions in and around the survey area during the current surveys, with nine records in/around Bonney Downs North and two records in Bonney Downs South.	Recorded (current survey)
<i>Falco peregrinus</i>	Peregrine falcon	OS	-	32	13	2018	Cliffs and gorges, inland drainage systems, lowland plains, <i>Acacia</i> shrublands intersected by water courses.	Numerous database records within 10 km of survey area, with the closest record located 3 km south of Bonney Downs South survey area. All bar one record are located south of survey area and survey area appears to be located within a region of species distribution with fewer records/less frequent sightings (ALA database). Suitable breeding and foraging habitat present within survey area within Drainage Line/River/Creek (major) habitat type. Species not recorded during current surveys.	High
<i>Gelochelidon nilotica</i>	Gull-billed tern	MI	MI	10	15	2020	The species utilises sheltered coastal seas, watered flatlands, estuaries, salt lakes, freshwater wetlands, and dams.	Thirteen records within 10 km of survey area, with most records associated with Fortescue Marsh. Permanent habitat does not occur within survey area and presence of species is unlikely. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Moderate
<i>Hydroprogne caspia</i>	Caspian tern	MI	MI	2	21	2020	Occurs in sheltered seas, inland watercourses such as estuaries, tidal creeks, near-coastal salt lakes, and brackish pools in the lower courses of rivers.	Closest Fortescue records located approximately 6 km from survey area, with all records associated with Fortescue Marsh. Permanent habitat does not occur within survey area and presence of species is likely to be restricted to transitory utilisation only. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Moderate

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Comments	Likelihood of occurrence
				DBCA	Fortescue				
<i>Macronectes giganteus</i>	Southern giant petrel	MI	EN	3	0	2011	Widespread throughout the Southern Ocean, utilises offshore islands for breeding.	Three records located approximately 70 km south of survey area, south of the Fortescue Marsh. Permanent habitat does not occur within survey area and species is considered unlikely to occur. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Low
<i>Motacilla cinerea</i>	Grey wagtail	MI	MI	1	0	2012	Typically occurs along freshwater habitats such as creeks and streams, however species could occur in any habitats during migration.	A single DBCA record located approximately 62 km from survey area. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Low
<i>Ninox connivens connivens</i>	Barking owl (southwest subpop.)	P3	-	2	0	1981	Occurs primarily in sclerophyll woodland. Nests in large hollows in live eucalypts.	Two historical records located between 75-80 km from the survey area. This subspecies is restricted to the south-west of Western Australia and does not occur within the survey area based on the current modelled distribution. Historical records instead represent <i>Ninox connivens peninsularis</i> , which is not listed under state or national legislation and is considered locally common and widespread.	Does not occur
<i>Pandion haliaetus</i>	Osprey	MI	MI	2	0	2012	Usually associated with coastal habitats and occasional visitor to inland water bodies.	Closest record located within 49 km of survey area. Permanent habitat does not occur within survey area and species is considered unlikely to occur. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Low
<i>Pezoporus occidentalis</i>	Night parrot	CR	EN	2	1	2005	Old, long unburnt, ring-forming <i>Triodia</i> grasslands and/or chenopod shrublands in arid and semi-arid zones.	Species recorded on two occasions (DBCA) within 100 kilometres of survey area. Recorded south-west (2005) and northeast of survey area (1980). Potential roosting and foraging habitat occur within the survey area, which is located within the high priority region for night parrot surveys.	Moderate
<i>Plegadis falcinellus</i>	Glossy ibis	MI	MI	3	5	2017	The preferred habitat is shallows and adjacent flats of freshwater lakes and swamps, but it is also found in river pools, flooded samphire, and sewage ponds.	Three Fortescue records within 7 km of survey area, with all records associated with Fortescue Marsh. Potential usage of habitat within the survey area likely to be restricted to transient presence rather than permanent occupancy.	Moderate
<i>Polytelis alexandrae</i>	Princess parrot	P4	VU	2	0	2012	Preferred habitat is lightly wooded country, including desert oak (<i>Casuarina decaisneana</i>), open mallee-spinifex and open marble gum (<i>Eucalyptus gongylocarpa</i>) woodland.	Two records of species identified approximately 63 km from survey area. Suitable habitat highly restricted within survey area which generally lacks open woodland, desert oak and mallee.	Low
<i>Rostratula australis</i>	Australian painted snipe	EN	EN	2	0	2012	Usually found in shallow inland wetlands that are either permanently or temporarily filled.	Two DBCA records of species identified approximately 36 km from survey area, in the vicinity of the Fortescue Marsh. Permanent habitat does not occur within survey area and species is considered unlikely to occur. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Moderate
<i>Tringa glareola</i>	Wood sandpiper	MI	MI	16	4	2017	Occurs most commonly in coastal, better-watered regions of the state but will visit areas of suitable habitat in the interior. Occurs around the muddy or grassy margins of freshwater wetlands, including swamps, lagoons, river pools, dams, bore overflows and sewage ponds.	Two DBCA records located approximately 11 km from survey area. Permanent habitat does not occur within survey area and presence of species is unlikely. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Moderate
<i>Tringa nebularia</i>	Common greenshank	EN	MI	5	18	2020	Found in shallow, fresh waters (e.g. claypans, swamps, river pools) and salt waters (e.g. estuaries, samphire flats, reef flats).	Closest records (DBCA) located within 3 km of survey area, with most records in the vicinity of the Fortescue Marsh. Permanent habitat does not occur within survey area and species is considered unlikely to occur. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Moderate

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Comments	Likelihood of occurrence
				DBCA	Fortescue				
<i>Tringa stagnatilis</i>	Marsh sandpiper	MI	MI	2	0	2016	Inhabit permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, salt pans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats as well as sewage farms and saltworks.	Closest record located 14 km from survey area in the vicinity of the Fortescue Marsh. Permanent habitat does not occur within survey area and species is considered unlikely to occur. Potential usage of habitat within the survey area restricted to transient presence rather than permanent occupancy.	Moderate
<i>Calidris ferruginea</i>	Curlew sandpiper	CR	CR	0	0	?	The species utilises coastal and near-coastal waterbodies including saltmarshes, wetlands, sewage ponds and shallow estuaries.	No known records of species within 40 km of survey area. EPBC Act Protected Matters Search identified species/species habitat may occur within survey area.	Low
<i>Erythrotriorchis radiatus</i>	Red goshawk	VU	EN	0	0	?	The preferred habitat is tall open eucalypt forest and riparian areas, including paperbark forest and gallery forests.	No known records of species within 40 km of survey area. EPBC Act Protected Matters Search identified species/species habitat may occur within survey area.	Low
<i>Motacilla flava</i>	Yellow wagtail	MI	MI	0	0	?	Non-breeding habitat only. Well-watered open grasslands and fringes of wetlands. Roosts in mangroves and dense vegetation.	No known records of species within 40 km of survey area. EPBC Act Protected Matters Search identified species/species habitat may occur within survey area.	Low
BATS									
<i>Macroderma gigas</i>	Ghost bat	VU	VU	133	37	2024	Rocky habitat for roosting, will forage in all habitat types.	Numerous DBCA database records within 10 km of survey area. Potential nocturnal refugia present within the Hills/Ranges/Plateaux and Rocky Escarpments habitat types; however, no suitable roosting habitat identified within the survey area. Species recorded by a ghost bat lure deployed at acoustic lure site BDGB03 within Drainage Line/River/Creek (major) habitat type during detailed survey.	Recorded (current survey)
<i>Rhinonictis aurantia</i> (Pilbara form)	Pilbara leaf-nosed bat	VU	VU	1,397	441	2024	Restricted to Pilbara region. Roosts in deep caves and mines with high temperatures and humidity and will forage in all habitat types.	Numerous records in vicinity of survey area. Closest database record located approximately 20 kilometres from survey area. Echolocation calls recorded at 18 sites (35 nights) at Bonney Downs North and BBSUS survey areas. No low time calls indicative of a potential roost site recorded during current or previous surveys. May forage in all habitat types. Species appears to utilise waterbodies within the site during the dry season, with very low activity recorded in the post-wet season. Known roost locations occur north of the survey area in vicinity of Corunna Downs. No suitable roost caves were recorded during targeted searches in rocky habitats.	Recorded (current survey)

Appendix F Potential site use assessment for significant fauna identified through database searches (DBCA, Fortescue and Protected Matters).

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Movements, flight and flocking behaviours	Comments	Potential site use
				DBCA	Fortescue					
BIRD										
<i>Actitis hypoleucos</i>	Common sandpiper	MI	MI	4	11	2020	Inland wetlands and sheltered coastal areas, utilises permanent and ephemeral wetlands.	Does not soar, seen in small flocks in Australia, non-breeding visitor, movements poorly known in Australia.	Few records within 100 km of the survey area, with closest record located 9.7 km south of the survey area and 3.2 km east of the transmission line. Most records associated with Fortescue Marsh. Critical habitat does not occur within the survey area; however, species may occasionally utilise airspace above the survey area during migratory flights to/from the Fortescue Marsh.	Transitory
<i>Apus pacificus</i>	Fork-tailed swift	MI	MI	3	1	2014	Occupies low to very high airspace over varied habitat. Aerial specialist.	Flocks in low numbers to thousands, does not soar, non-breeding visitor, movements nomadic	Very few records within 100 km of the survey area. Closest record located 26.9 km south of the survey area. Species does not utilise terrestrial habitats; however, may utilise the airspace above the survey area while transiting.	Transitory
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	MI	MI	7	1	2020	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	Non-breeding visitor, does not soar, flocks in small or large groups	Closest record located 11.3 km from the survey area, with most records associated with Fortescue Marsh. Critical habitat does not occur within the survey area; however, species may occasionally utilise airspace above the survey area during migratory flights to/from the Fortescue Marsh.	Transitory
<i>Calidris ruficollis</i>	Red-necked stint	MI	MI	2	1	2017	Edge of sheltered estuaries, beaches and salt lakes both on the mainland and on offshore islands. Occasionally occur on inland salt lakes and freshwater swamps.	Non-breeding visitor, does not soar, flocks in small or large groups	Very few records within 100 km of the survey area. Closest record 31.2 km from survey area and 24 km from the transmission line, with most records associated with Fortescue Marsh. Critical habitat does not occur within the survey area; however, species may occasionally utilise airspace above the survey area during migratory flights to/from the Fortescue Marsh.	Transitory
<i>Charadrius veredus</i>	Oriental plover	MI	MI	3	1	2017	Inland wetlands and sheltered coastal areas, utilises permanent and ephemeral wetlands.	Non-breeding visitor, dispersive in Australia with climate events, does not soar, flocks in small or large flocks	Very few records within 100 km of the survey area. Closest record 26.23 km from survey area and 14.2 km from the transmission line, with most records associated with Fortescue Marsh. Critical habitat does not occur within the survey area; however, species may occasionally utilise airspace above the survey area during migratory flights to/from the Fortescue Marsh.	Transitory
<i>Falco hypoleucos</i>	Grey falcon	VU	VU	18	2	2021	Resident or nomadic to most of semi-arid interior.	Semi-permanent with nomadic movements, triggered by environmental conditions, does not flock, soar	Closest database record within 100 m of the survey area. Individuals of this species recorded on numerous occasions during current survey. Species may utilise Drainage Line/River/Creek (major) habitat within the survey area while foraging or breeding and may overfly all habitat types.	Permanent occupancy. Foraging, roosting, breeding (confirmed)
<i>Falco peregrinus</i>	Peregrine falcon	OS	-	29	6	2018	Cliffs and gorges, inland drainage systems, lowland plains, <i>Acacia</i> shrublands intersected by water courses.	Sedentary and dispersive, soars at heights (<1200m), does not flock	Numerous records within 10 km of the survey area with the closest 2.4 km south of the survey area. Suitable breeding and foraging habitat present within the Drainage Line/River/Creek (major) habitat type. Species not recorded during current surveys.	Breeding, roosting and foraging
<i>Gelochelidon nilotica</i>	Gull-billed tern	MI	MI	10	20	2020	The species utilises sheltered coastal seas, watered flatlands, estuaries, salt lakes, freshwater wetlands, and dams.	Australian movements not well understood, flocks in small or large groups, does not soar	Closest database record within 8 km of the survey area, with most records associated with Fortescue Marsh. Critical habitat does not occur within the survey area; however, species may occasionally utilise airspace above the survey area during migratory flights to/from the Fortescue Marsh.	Transitory
<i>Hydroprogne caspia</i>	Caspian tern	MI	MI	2	21	2020	Occurs in sheltered seas, inlands watercourses such as estuaries, tidal creeks, near-coastal salt lakes, and brackish pools in the lower courses of rivers.	Mostly sedentary, also dispersive, flocks in small or large groups, does not soar	Closest record 30.8 km from the survey area, with all records associated with Fortescue Marsh. Critical habitat does not occur within the survey area; however, species may occasionally utilise airspace above the survey area during migratory flights to/from the Fortescue Marsh.	Transitory
<i>Macronectes giganteus</i>	Southern giant petrel	MI	EN	3	0	2011	Widespread throughout the Southern Ocean, utilises offshore islands for breeding.	Partially migratory, highly dispersive, forms small groups	Recorded 84 km from the survey area, south of the Fortescue Marsh. Critical habitat does not occur within the survey area; however, species may occasionally utilise airspace above the survey area during migratory flights to/from the Fortescue Marsh.	Transitory

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Movements, flight and flocking behaviours	Comments	Potential site use
				DBCA	Fortescue					
<i>Motacilla cinerea</i>	Grey wagtail	MI	MI	1	0	2012	Typically occurs along freshwater habitats such as creeks and streams, however species could occur in any habitats during migration.	Non-breeding visitor, spring to autumn, does not soar, does not flock	A single record of species identified 68.8 km from the survey area, in the vicinity of the Fortescue Marsh. Permanent occupancy of the survey area unlikely; however, species may occasionally utilise airspace above the survey area during migratory flights.	Transitory
<i>Pandion haliaetus</i>	Eastern osprey	MI	MI	2	0	2012	Usually associated with coastal habitats and occasional visitor to inland water bodies.	Mainly coastal, may sporadically occur inland after weather events, does not flock, soars at height	Closest record 62.9 km from survey area, in the vicinity of the Fortescue Marsh. Permanent occupancy of the survey area unlikely; however, species may occasionally utilise airspace above the survey area.	Transitory
<i>Pezoporus occidentalis</i>	Night parrot	CR	EN	2	0	2005	Old, long unburnt, ring-forming <i>Triodia</i> grasslands and/or chenopod shrublands in arid and semi-arid zones.	Poorly known species	Species recorded on two occasions within 100 km of the survey area. Recorded 50.2 km south-west of survey area in vicinity of Fortescue Marsh and 83.3 km northeast of the survey area. Potentially suitable roosting habitat occurs within the survey area, which is located within the High Priority region for night parrot surveys. No night parrot calls recorded during the current survey.	Foraging, roosting, breeding (if present)
<i>Plegadis falcinellus</i>	Glossy Ibis	MI	MI	3	5	2020	The preferred habitat is shallows and adjacent flats of freshwater lakes and swamps, but it is also found in river pools, flooded samphire, and sewage ponds.	Sporadic movements, typically north in winter, fly at height in large flocks	Closest record 20.6 km from the survey area, with all records associated with Fortescue Marsh. Permanent occupancy of the survey area unlikely; however, species may occasionally utilise airspace above the survey area or may temporarily utilise aquatic habitat associated with Bonney Creek and Bonney Pools.	Transitory
<i>Polytelis alexandrae</i>	Princess parrot	P4	VU	2	0	2012	Preferred habitat is lightly wooded country, including desert oak (<i>Casuarina decaisneana</i>), open mallee-spinifex and open marble gum (<i>Eucalyptus gongylocarpa</i>) woodland.	Flocks in small or large groups (<100), may fly at height, does not soar, movements poorly known, thought to be nomadic	Two records of species identified 75.5 km from survey area. Suitable habitat highly restricted within survey area which generally lacks open woodland, desert oak and mallee.	Transitory
<i>Rostratula australis</i>	Australian painted snipe	EN	EN	2	0	2012	Usually found in shallow inland wetlands that are either permanently or temporarily filled.	Rare in Western Australia, movements poorly known	Two records of species identified 70 km from survey area, in the vicinity of the Fortescue Marsh. Critical habitat does not occur within the survey area; however, species may occasionally utilise airspace above the survey area during migratory flights to/from the Fortescue Marsh.	Transitory
<i>Tringa glareola</i>	Wood sandpiper	MI	MI	16	4	2017	Occurs most commonly in coastal, better-watered regions of the state but will visit areas of suitable habitat in the interior. Occurs around the muddy or grassy margins of freshwater wetlands, including swamps, lagoons, river pools, dams, bore overflows and sewage ponds.	Non-breeding visitor, flocks in medium sized groups, does not soar	Closest record 10 km from survey area. Critical habitat does not occur within the survey area; however, species may occasionally utilise airspace above the survey area during migratory flights to/from the Fortescue Marsh.	Transitory
<i>Tringa nebularia</i>	Common greenshank	MI	MI	5	18	2020	Found in shallow, fresh waters (e.g. claypans, swamps, river pools) and salt waters (e.g. estuaries, samphire flats, reef flats).	May be resident or dispersive in Australia, moves at night, flocks in small or large numbers, does not soar	Closest record located 27 km from survey area, with most records in the vicinity of the Fortescue Marsh. Critical habitat does not occur within the survey area; however, species may occasionally utilise airspace above the survey area during migratory flights to/from the Fortescue Marsh.	Transitory
<i>Tringa stagnatilis</i>	Marsh sandpiper	MI	MI	2	1	2016	Inhabit permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, salt pans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats as well as sewage farms and saltworks.	Mostly summer migrant, non-breeders may be present year-round, flocks in small or large numbers	Very few records within 100km, with the closest record located 45km from survey area, with most records in the vicinity of the Fortescue Marsh. Critical habitat does not occur within the survey area; however, species may occasionally utilise airspace above the survey area during migratory flights to/from the Fortescue Marsh.	Transitory
<i>Calidris ferruginea</i>	Curlew sandpiper	CR	CR	0	0	?	The species utilises coastal and near-coastal waterbodies including saltmarshes,	Mostly non-breeding visitor, occasionally	No known records of species within 40 km of the survey area. EPBC Act Protected Matters Search identified species/species habitat may occur within survey area. Critical habitat does not occur within the survey	Transitory

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Movements, flight and flocking behaviours	Comments	Potential site use
				DBCA	Fortescue					
							wetlands, sewage ponds and shallow estuaries.	inland, small or large flocks	area; however, species may occasionally utilise airspace above the survey area during migratory flights to/from the Fortescue Marsh.	
<i>Erythrotriorchis radiatus</i>	Red goshawk	VU	EN	0	0	?	The preferred habitat is tall open eucalypt forest and riparian areas, including paperbark forest and gallery forests.	Movements poorly known, possibly sedentary and occasionally dispersive, does not flock, likely to soar at heights	No known records of species within 40 km of the survey area; however, EPBC Act Protected Matters Search identified species/species habitat may occur within survey area.	Unlikely to occur
BATS										
<i>Macroderma gigas</i>	Ghost bat	VU	VU	136	3	2018	Rocky habitat for roosting, will forage in all habitat types.	Nocturnal, resident, does not flock or soar	Numerous records in vicinity of survey area. Closest record located 10.5 km from survey area. Potential roosting habitat and nocturnal refugia present within the Hills/Ranges/Plateaux and Rocky Escarpments habitat types. No echolocation or social calls recorded during BBSUS or targeted surveys; however, species recorded at ghost bat lure site BDGB03 within Drainage Line/River/Creek (major) habitat type. May forage in all habitat types.	Foraging (confirmed), roosting/nocturnal shelter (potential)
<i>Rhinonictis aurantia (Pilbara form)</i>	Pilbara leaf-nosed bat	VU	VU	1397	0	2020	Restricted to Pilbara region. Roosts in deep caves and mines with high temperatures and humidity and will forage in all habitat types.	Nocturnal, resident, does not flock or soar	Numerous records in vicinity of survey area. Closest database record located 21 km from survey area. Echolocation calls recorded during BBSUS, detailed and targeted surveys. No low time calls indicative of a potential roost site recorded to date and no suitable roosting caves identified within the survey area. May forage in all habitat types. Known roost locations occur north of the survey area in vicinity of Corunna Downs	Foraging (confirmed)

Appendix G Site-by-species matrix.

Common name	Species name	Site																																Incidental																
		BB001	BB002	BB003	BB004	BB005	BB006	BB007	BB008	BB009	BB010	BB011	BB012	BB013	BB014	BB015	BB016	BB017	BB018	BB019	BB020	BB021	BB022	BB023	BB024	BB025	BB026	BB027	BB028	BB029	BB030	BB031	BB032		BB033	BB034	BB035	BB036	BB037	BB038	BB039	BB040								
Birds																																																		
Acanthizidae																																																		
Chestnut-rumped thornbill	<i>Acanthiza uropygialis</i>										41																																							
Redthroat	<i>Pyrrholaemus brunneus</i>													1											1	1														1										
Slaty-backed thornbill	<i>Acanthiza robustirostris</i>										16																																							
Weebill	<i>Smicromis brevirostris</i>	8		8		1	5			x	13	x	3	15		10	4	3	11			11	6	4			27	5					12			x	2	x	x	x	13	6								
Western gerygone	<i>Gerygone fusca</i>										x					1																																		
Accipitridae																																																		
Black kite	<i>Milvus migrans</i>														1	2							1																					x						
Black-shouldered kite	<i>Elanus axillaris</i>											1		2				1		1																								2		x				
Brown goshawk	<i>Tachypiza fasciata</i>			1							1					1		1						2		1															1			x						
Collared sparrowhawk	<i>Tachypiza cirrocephala</i>	1		1			5						1			1		1						5		1															1			1	x					
Little eagle	<i>Hieraaetus morphnoides</i>	1																																																
Spotted harrier	<i>Circus assimilis</i>		1	1		1		4	1	2	1	1		1	4	2	1	3		4		2		3			12	3	2	2	1		1	1	1				3	5		1			x					
Square-tailed kite	<i>Lophoictinia isura</i>										1																																			x				
Wedge-tailed eagle	<i>Aquila audax</i>		1	2	9	3	2	5	9	13	2	2	2	6	3	1		7	2	3		1	1		4		5	1	1	5	4	3		3	5	5	7	2	5	1	8			x						
Whistling kite	<i>Haliastur sphenurus</i>	6		4	2			2		1		2		3	1	1	27			1		1	5	16			1	3	1	1	2	2		1	2			4	1	2				1	x					
White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>																1																																	
Aegothelidae																																																		
Australian owllet-nightjar	<i>Aegotheles cristatus</i>										1																																							
Alaudidae																																																		
Horsfield's bush lark	<i>Mirafrja javanica</i>				1	1		19	2				10		17	x			2	20					6			5	22	16														12		1				
Alcedinidae																																																		
Blue-winged kookaburra	<i>Dacelo leachii</i>	2		2		1	9					2		7			7		3	1		5	6	24	1	5																	4			2			3	
Red-backed kingfisher	<i>Todiramphus pyrrhopygius</i>						x									1	1	1						1	x	1																								
Sacred kingfisher	<i>Todiramphus sanctus</i>	10		14		1	2						7				1						8	9	31		2																			9			2	
Anatidae																																																		
Australian wood duck	<i>Chenonetta jubata</i>						4										3								9	4																								
Grey teal	<i>Anas gracilis</i>	12					2										130							19	25																									
Hardhead	<i>Aythya australis</i>																3																																	x
Pacific black duck	<i>Anas superciliosa</i>	25		3			9										31							41	16		2																						x	
Pink-eared duck	<i>Malacorhynchus membranaceus</i>	2															10																																x	
Plumed whistling duck	<i>Dendrocygna eytoni</i>																19																																	
Anhingidae																																																		
Australasian darter	<i>Anhinga novaehollandiae</i>			1			1										26																																	x
Apodidae																																																		
Pacific swift (fork-tailed swift)	<i>Apus pacificus</i>																																																	x
Ardeidae																																																		
Great egret	<i>Ardea alba</i>	1															6								1	1																							x	
Nankeen night heron	<i>Nycticorax caledonicus</i>						27										1																																	
White-faced heron	<i>Egretta novaehollandiae</i>	11		1			1										5							17	10		6																							x
White-necked heron	<i>Ardea pacifica</i>	3		2			1										13	1																																x
Artamidae																																																		
Australian magpie	<i>Gymnorhina tibicen</i>	2	3			2		x					x	5			1	3	5			x	1	2	2	2	x	1				x	9	2	6										3	4				
Black-faced woodswallow	<i>Artamus cinereus</i>	3	19	5	9	8		17	x	2	1	3	67		7	10	2	16		30	6		x	2	17			14	5	18	11	15	4	25	1	20	27				17	2				5				
Grey butcherbird	<i>Cracticus torquatus</i>													1																																				
Little woodswallow	<i>Artamus minor</i>				4																																												5	
Masked woodswallow	<i>Artamus personatus</i>						x	7	3	2				14		8	7																																x	
Pied butcherbird	<i>Cracticus nigrogularis</i>	12	3	3	6	8	2	1	7	x	6	5	2	14	5	3	4	9	21	2	1	23	3	1	4	7	6	2	1			3	5	6	7	x	5	4								12	13	3		

Common name	Species name	Site																																Incidental													
		BB001	BB002	BB003	BB004	BB005	BB006	BB007	BB008	BB009	BB010	BB011	BB012	BB013	BB014	BB015	BB016	BB017	BB018	BB019	BB020	BB021	BB022	BB023	BB024	BB025	BB026	BB027	BB028	BB029	BB030	BB031	BB032		BB033	BB034	BB035	BB036	BB037	BB038	BB039	BB040					
Burhinidae																																															
Bush stone-curlew	<i>Burhinus grallarius</i>				2																	2		1																				x			
Cacatuidae																																															
Cockatiel	<i>Nymphicus hollandicus</i>	71	25	2	x	2	51	2	48	7	x	31	3	31	5	14	63	34	34	1	30	25	2	9	x	35		x	6	x	6	x	19	17	25		7	4	40	19	x						
Galah	<i>Eolophus roseicapilla</i>	51	15	5	41	4	45	x	48	14	20	10	36	76	x	12	66	39	49	x	2	63	1	3	2	119	20		84		x	73		125	2	13	17	171	25	66	7						
Little corella	<i>Cacatua sanguinea</i>	103	80	40	14		93		1	0	5	57	37	270	1	4	574	51	30	10	2	282	31	69	x	166	1		0	1	5	118	144		x		61	29	7	142	2						
Campephagidae																																															
Black-faced cuckooshrike	<i>Coracina novaehollandiae</i>	11	1	8	2	2	1			2	1	8	1	1		3	12	x					x	6	18	x	6	4	2					4	3		1		2		5	3	2				
Ground cuckooshrike	<i>Coracina maxima</i>																																										x	x			
White-winged triller	<i>Lalage tricolor</i>			1										1	1	1				4		3		x																							
Caprimulgidae																																															
Spotted nightjar	<i>Eurostopodus argus</i>										1											1		1																							
Charadriidae																																															
Black-fronted dotterel	<i>Charadrius melanops</i>	11					1										50		1			3	42	16		1												1						x			
Oriental plover	<i>Anarhynchus veredus</i>																																							1							
Red-kneed dotterel	<i>Erythronyx cinctus</i>																4																												x		
Ciconiidae																																															
Black-necked stork	<i>Ephippiorhynchus asiaticus</i>																																														
Cinclosomatidae																																															
Western quail-thrush	<i>Cinclosoma marginatum</i>																																														x
Columbidae																																															
Common bronzewing	<i>Phaps chalcoptera</i>		2								5		1	3			1										x															1		2	3		
Crested pigeon	<i>Ocyphaps lophotes</i>	3	x		x	14	x		7	1	1	7	74	91	11	x	9	4	67	42	5	4	11		1	20	3	x	2	x			43	3	43	5	1	8	42	1	7	6					
Diamond dove	<i>Geopelia cuneata</i>	20	7	6	1			1		2	2	11	25	35	3	15	19	2	5	6	17	2	12	16	3	1				2	x	18	6	1	1	2			51	2							
Peaceful dove	<i>Geopelia placida</i>	4		6					x								13			1			7	26	x	1																					
Spinifex pigeon	<i>Geophaps plumifera</i>	40	16	14	x	9	7	1	16	1		3	2	78		1	13	x	86	x	3	4	17	24	17	38	2	1	6		6	113	3	159	1	1	10	7	4	4	9						
Corvidae																																															
Torresian crow	<i>Corvus orru</i>	12		8	1	1	15	1	3	1	7	4	1	6	1	6	16	9	5	2	3	6	8	6	3	1	1	5		2	4	11	16	2	2	7	5	8	5		4	x					
Cuculidae																																															
Black-eared cuckoo	<i>Chalcites osculans</i>																																														
Horsfield's bronze cuckoo	<i>Chalcites basalis</i>						x					2	2	1		1		1	1	1		2					x					x														1	
Pallid cuckoo	<i>Heteroscenes pallidus</i>						1				2			2		2						1		x																							
Pheasant coucal	<i>Centropus phasianinus</i>											1					5				1		1	2			2																			52	
Dicaeidae																																															
Mistletoebird	<i>Dicaeum hirundinaceum</i>																																														
Estrildidae																																															
Australian zebra finch	<i>Taeniopygia castanotis</i>	39	28	17	13	111	40	79	8	7	42	20	27	34	32	63	137	72	33	32	25	5	60	8	29	64	14	43	16	84	21	94	11	5	3	6	38	81	90	5	14						
Painted finch	<i>Emblema pictum</i>	18	10	13	6	7	2	11	15	4	4	16	11	2	2	76	4	21	6	32	25	2	30	109	72	12	9	6	10		28	88		32	12	8	30	14	28	9	70						
Falconidae																																															
Australian hobby	<i>Falco longipennis</i>				1									4																																	x
Australian kestrel (nankeen kestrel)	<i>Falco cenchroides</i>	7	1	1	4	5	8	8	14	14	2	1	14	6	16	7		8	2	6		4	4	5	7	1	3	4	9	14	8	9	8	9	8	9	3	1	10	14	5	2	6	x			
Black falcon	<i>Falco subniger</i>																																														1
Brown falcon	<i>Falco berigora</i>	2	1			1	4	4		1	3		3		3	6	2	2	3	4	1	2	3	1	3	2	2	3	6	1	5	10			2	2	3			1	1	1	3	x			
Grey falcon	<i>Falco hypoleucos</i>																																														x
Glareolidae																																															
Australian pratincole	<i>Stiltia isabella</i>													3																																	
Hirundinidae																																															
Fairy martin	<i>Petrochelidon ariel</i>													3			41																													1	
Tree martin	<i>Petrochelidon nigricans</i>	5	x									1				6	66																													2	
Welcome swallow	<i>Hirundo neoxena</i>																																														
Locustellidae																																															

Appendix H Night parrot call analysis (Adaptive NRM, 2024).

Results of acoustic surveys conducted for
Night Parrot (*Pezoporus occidentalis*)
Bonney Downs
July-October 2023

Report to:
Ecologia

Prepared by:
Nick Leseberg
Adaptive NRM
19th May 2024



1. Summary

Between July and October 2023, autonomous recording units (ARUs) were deployed at nine sites in the Bonney Downs project area to survey for Night Parrots (*Pezoporus occidentalis*). The project area is approximately 70 km northeast of Fortescue Marsh, within the Chichester bioregion of Western Australia. Resulting acoustic data was analysed using signal parameters optimised for detecting Night Parrot calls. No Night Parrot calls were detected during the analysis.

2. Survey effort

Analysis of historical Night Parrot records suggest it was formerly found throughout arid central Australia, before undergoing a significant decline and range contraction during the late-19th and early-20th centuries (Leseberg *et al.* 2021). The species is now known from a small area in western Queensland, and the central and northern inland of Western Australia. There are several historical reports from the Chichester bioregion, although none that are considered of high veracity (Leseberg *et al.* 2021). There are several contemporary records from the Fortescue Marsh which is only 70 km southwest of the project area (Leseberg 2022), so it is feasible that if suitable habitat exists, Night Parrots could be resident in the survey area.

Research in western Queensland has demonstrated Night Parrots occupy long-term stable roost sites for periods of up to several years. These long-term stable roost sites support both roosting and breeding. The birds also have predictable year-round calling periods at dusk and dawn (Murphy *et al.* 2017a, Leseberg *et al.* 2019). This ensures that if Night Parrots are roosting at a particular site, the likelihood of detecting them using ARUs is very high, provided the ARU is placed for a minimum of four nights in calm weather, and the recorder is set to record during the peak calling periods. During breeding, and following large rain events, calling is more frequent, extends throughout the night, and the likelihood of detection is increased (Murphy *et al.* 2017a). Preliminary results from research in central Western Australia suggest patterns of behaviour in that region are similar (Jackett *et al.* 2017).

Night Parrots are also known to call during the night at feeding and drinking sites (S. Murphy, N. Leseberg, N. Jackett unpubl. data). Anecdotal evidence suggests they may call when moving between these sites (N. Leseberg, N. Jackett, S. Murphy unpubl. data). However, the detection of birds away from roosting sites is likely to be a chance event given the large area over which

birds range at night (Murphy *et al.* 2017b). Night Parrots are known to drink, and modelling suggests they may be reliant on free-standing water (or succulent food containing >55% water) during hot weather (Kearney *et al.* 2016). Birds have been detected in the Great Sandy Desert by focusing survey effort at water sources (J. Brown pers. comm.). It is likely this technique will be most effective during periods of water scarcity, when survey effort can focus on just a few possible locations.

The likelihood of detection is also influenced by the type of ARU being used. In calm conditions, a Song Meter 4 (Wildlife Acoustics, MA, USA), is known to be capable of reliably detecting 95% of Night Parrot calls out to a range of around 205 m (Leseberg *et al.* 2022). SM4s were used at seven of the nine sites surveyed. Titley Chorus machines were used at two sites. How these machines compare to SM4s is unclear, although a qualitative assessment of the recordings from these machines suggest their recording radius was less than that of the SM4s.

Ecologia conducted sampling for the Night Parrot across two blocks, during July/August, and also October 2023. A total of nine sites were surveyed in the project area, and a combined total of 60 nights of data was recorded (Table 1). Several different recording programs were used. During the July/August phase, all four machines recorded two periods each night, one at sunset the other at sunrise. Two machines recorded an hour either side of sunset and sunrise, and two recorded ninety minutes either side of sunset and sunrise. While it is recommended that recordings are made from sunset to sunrise, in each case the peak Night Parrot calling period would have been captured, allowing conclusions around the presence or absence of a long-term stable roost site in the immediate vicinity of the ARU. During the October surveys, all five machines recorded from before sunset until after sunrise, capturing the recommended period for Night Parrot surveys. All ARUs recorded a minimum of four non-windy nights. It is likely that any long-term stable roost sites in the vicinity of these ARUs would have been detected.

3. Data analysis

ANRM received the raw acoustic data as '.wav' files. These were scanned using the software Kaleidoscope Pro v5.2.1, targeting the frequency range of 1500 – 3500 Hz, within which all known Night Parrot calls are distributed (Leseberg *et al.* 2019). Search parameters were optimised using a random selection of 250 Night Parrot call examples manually detected from

both Great Sandy Desert and East Murchison datasets, of which 205 (82.0%) were automatically detected. Calls not detected were typically extremely faint. The probability of non-detection of a true-positive call was 18.0%; two true-positive calls was 3.2%; three true-positive calls was 0.6%; etc. Of the data tested, the median number of consecutive (spaced at < 5 minutes apart) calls in a sequence when Night Parrots were recorded was 5 (1–34, $n = 29$). The probability of at least one call being detected within a sequence of median length, assuming there was variation in the location of the source of the call, was > 99.9%.

Table 1. Bioacoustic recordings analysed from the July/August and October 2023 survey.

Site name	ARU Type	Recording start date (PM)	Recording end date (AM)	Total recording nights
BDNP01	SM4	24-Jul-23	2-Aug-23	9
BDNP02	SM4	24-Jul-23	2-Aug-23	9
BDNP03	Chorus*	27-Jul-23	2-Aug-23	6
BDNP04	Chorus *	27-Jul-23	2-Aug-23	6
BDNP05	SM4	13-Oct-23	19-Oct-23	6
BDNP06	SM4	13-Oct-23	19-Oct-23	6
BDNP07	SM4	13-Oct-23	19-Oct-23	6
BDNP08	SM4	13-Oct-23	19-Oct-23	6
BDNP09	SM4	13-Oct-23	19-Oct-23	6
			Total	60

Potential Night Parrot calls detected during the analysis were compared to a reference library comprising several thousand Night Parrot calls from Western Australia. This library consists of calls recorded at sites where Night Parrots have been confirmed using visual means and is therefore considered of high reliability. The library also comprises multiple examples of all known call types from Western Australia (Leseberg *et al.* 2019).

4. Survey results

No calls attributable to Night Parrots were detected during the analysis.

5. Conclusion

It is unlikely long-term stable Night Parrot roosts exist in the area immediately surrounding the points sampled during this survey at the time of sampling. Additionally, it is unlikely that Night

Parrots were foraging in proximity to these surveyed points at the time of sampling. It is important to reinforce that these results pertain specifically to that area immediately surrounding the survey points, and only for the period during which the survey was conducted. The results of these surveys do not enable robust conclusions about the presence or absence of Night Parrots in the wider landscape.

6. References

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Appendix I Bonney Downs Year 1 Collision Risk Modelling Suitability Analysis (Symbolix, 2024).



symbolix

making your data work harder

To: Tim McCabe
Ecologia Environment
Via email

Ref #: ELGBONN20240613

Date: 13 June 2024

CC: Claudia Buters

Re: Bonney Downs Year 1 Collision Risk Modelling Suitability

To Tim,

We understand that Ecologia Environment (Ecologia) have undertaken the first year of Bird Utilisation Surveys (BUS) at the proposed site for Bonney Downs Wind Farm (BDWF), north-west Western Australia. From these surveys, Ecologia have identified one Environment Protection and Biodiversity Conservation Act (EPBC 1999) listed species present on site and potentially at risk - the Grey Falcon (*Falco hypoleucos*).

Ecologia wish to assesses the feasibility of collision risk modelling (CRM) as a tool for quantifying the expected annual collisions between Grey Falcon and turbines with the current dataset. To understand the suitability of CRM for this species and for the data collected during the BUS conducted at BDWF, we have reviewed the BUS data collected to date.

1 Data requirements for Collision Risk Modelling

CRMs are used globally to quantify risk of turbine collision to Avian species. While most CRMs derive from Band (2012) and its predecessors, the CRMs commonly employed today include varying degrees of differences in their implementations (Masden and Cook 2016). Despite the differences we can make some generalisations about the structure and the data needed. Most CRMs use a step-wise risk model (Reason 1997), where the total risk is the probabilistic combination of the risk of each step in the process.



The process can be summarised by the equation:

$$N_{\text{collision}} = F \times P(I|F) \times P(C|I) \times (1 - \text{AR})$$

where:

- $N_{\text{collision}}$ is the estimated number of flights ending in collision
- F is the estimated activity rate of flights in the region (flights / area / time)
- $P(I|F)$ is the probability of a flight interacting with a turbine or power line (given a flight in the region)
- $P(C|I)$ is the probability of collision, given an interaction occurs
- AR is the avoidance rate. This is an estimate of the proportion of post-construction flights that will exhibit turbine avoidance (fly above, below, change path because of blade position), i.e. micro- and meso-avoidance. It is notoriously difficult to measure Cook et al. (2012) and usually the most uncertain of any input.

Some inputs can be sourced through desktop review, i.e.:

- Species specific biological and morphological data; e.g. body length, wingspan and average flight speed. This can usually be obtained from grey and peer-reviewed literature or through expert consultation.
- Proportion of the year the species is active on site
- Proportion of the day the species is active on site
- Turbine specifications including blade length, hub height, location, revolutions per minute (average), and anticipated percentage downtime. This data is readily available or reliably estimated.

This data must be combined with field surveys to inform the following inputs:

- Average activity rate (flights / area / time)
- Proportion of flights at rotor swept height

The whole-site model can be expanded to provide per-turbine spatial collision prediction but this requires either:

- sufficient flight path data to resolve a spatial flight distribution map (we advise 50-100 flight paths); or
- sufficient data to inform a spatial distribution model where location is predicted from landscape features.

In the following sections we will break down the specific data requirements and evaluate the data collected during the previous BUS to establish whether:

- sufficient data exists to drive a quantitative collision risk model, or
- additional data collection is likely to lead to sufficient data.

1.1 Species suitability

Models based on the above equation have been widely used for Avian species worldwide. There are, however, currently no established methods for other volant species. For example, there are no CRMs currently available that predict bat collision rates. Some preliminary approaches have been discussed at relevant conferences (e.g. Rodrigues et al. (2023)) but no robust framework exists.

2 Bonney Downs BUS Summary

2.1 Survey effort

We have reviewed data collected between 2023-10-13 and 2024-04-18 across 3 seasons (Spring 2023, Summer 2024 and Autumn 2024). The survey effort for this period is summarised in Table 1.

Table 1: Survey effort completed to date

Year	Season	Start date	End date	Number of surveys	Total survey hours (hours)	Number of sites
2023	Spring	2023-10-13	2023-10-19	120	61.83	40
2024	Summer	2024-02-06	2024-02-12	120	59.58	40
2024	Autumn	2024-03-18	2024-04-18	120	59.75	40

2.2 Summary of observations

During BUS, Ecologia have recorded all observations of all avian species. This includes observations of 95 species and 10,194 individual birds.

Of these observations, the only EPBC listed species and species considered a collision risk recorded was the Grey Falcon. During these surveys, only 2 observations of Grey Falcons were recorded (3 individuals in total). Additionally, 9 observations (13 individuals in total) were made outside of the BUS. Incidentals can be used to inform spatial patterns, but cannot be used to calculate an activity rate.

These observations are summarised in Table 2 and Table 3, BUS and incidental observations respectively.

For the first two surveys periods, Ecologia collected the following data per observation:

- Survey date
- Survey start and end time
- Survey location
- Observation start and end time
- Number of individuals observed
- Minimum and maximum height of birds

Additionally, in the most recent survey (2024 Autumn), the distance of the bird from the observer was also recorded (346 records) - however, no Grey Falcon observations were made during this season.

Table 2: Summary of observations made during the BUS

Year	Month	Season	Number of GF obs.	Number of GF individuals	Total number of obs.	Number of species
2023	10	Spring	1	2	578	67
2024	2	Summer	1	1	663	78
2024	3	Autumn	0	NA	836	76

Table 3: Summary of incidental observations made outside the formal BUS

Year	Month	Survey period	Number of individuals observed
2024	4	Autumn	2
2023	7	Outside of survey period	4
2024	2	Summer	2
2023	5	Outside of survey period	4
2024	3	Autumn	1

2.2.1 Other Raptor observations

Additionally to Grey Falcon, several other raptor species have been observed. This includes Whistling Kite, Brown Falcon, Wedge-Tailed Eagle, Nankeen Kestrel, Spotted Harrier, Collared Sparrowhawk, Australian Hobby, Brown Goshawk and Black-Shouldered Kite, which were observed during the BUS. Table 4 summarises the number of each potential proxy species recorded over the three seasons of BUS.

If similar in behaviour and detectability, these species may provide useful information (such as typical distances and heights of observations), which may be used in lieu of sufficient data on the Grey Falcon. Note proxy data would only be used to quantify observer detection distances

and height profiles. Actual flight density calculations and subsequent collision rates would only use Grey Falcon data.

Table 4: Summary of potential proxy species seen during BUS

Common Name	Observations	Individuals
Whistling Kite	22	24
Brown Falcon	18	22
Grey Falcon	2	3
Wedge-Tailed Eagle	11	16
Nankeen Kestrel	41	44
Spotted Harrier	16	19
Collared Sparrowhawk	6	6
Australian Hobby	3	3
Brown Goshawk	1	1
Black-Shouldered Kite	5	5

2.3 Site coverage

To capture spatial variability of utilisation, survey coverage (visibility) of the whole turbine envelope is important. If this is not feasible, or no significant spatial pattern is recorded, CRM can proceed under the assumption that the average flight density is constant for all turbines.

To investigate the spatial coverage of the current field placement we calculated the radius of the 90th percentile of observation distance to capture the area in which the majority of raptors were observed, highlighting areas where the current survey sites cannot detect raptors. This is a indicator of observability only, and we acknowledge that the visibility is unlikely to be consistent in every direction from the site.

As we have no instances where distances were recorded for Grey Falcon (and few observations in total being made), we use the observations of all raptors. This assumes observers have a similar ability to detect Grey Falcon and other raptors during their surveys.

Figure 1 displays the location of each observation site with the site number and radius of the 90th percentile of observations distances around each site to indicate coverage for each site. Despite some observations being recorded at large distances away from the site (up to 2000m away from the observer), their is limited observed area across the site.

The site placement is ideal, i.e. there are a large number of sites placed relatively evenly across the study area. However, due to the very large extent of the study area, complete coverage will be either extremely difficult or logistically impossible. As such, we simply need to ensure that the sites are representative of the site as a whole.

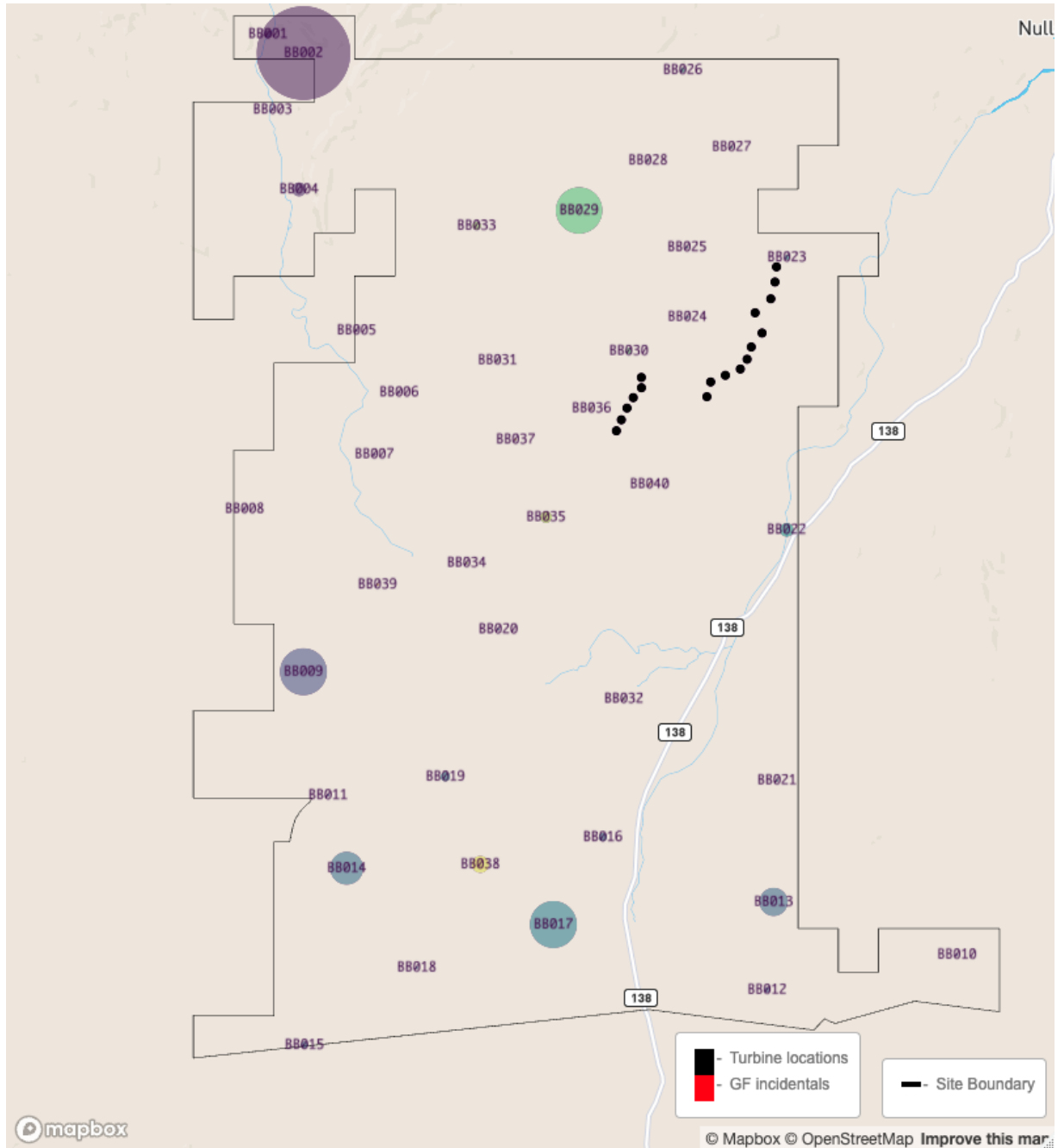


Figure 1: Observation coverage of each site across the survey area.



2.4 Spatial and temporal patterns

Currently too few observations of Grey Falcon exist across the site to understand spatial and temporal patterns of activity. Ideally, additional surveys will collect sufficient data to understand spatial patterns (i.e. which sites have higher activity), seasonal patterns, and daily patterns in activity.

3 Data assessment

We reviewed the data against the requirements for CRM. In particular, we considered:

- Is there sufficient data to estimate the flight density for Grey Falcon within and outside of the distance observable from the BUS sites?
- Is there sufficient data to model the height distribution to reliably estimate the proportion of Grey Falcon flights at rotor swept height?
- Is there sufficient spatial coverage to information patterns of utilisation across the site? Flat utilisation across the site can be used where this is not available
- Does any information exist to inform an evidence-based value for the avoidance rate (i.e. the propensity for a given species to modify their behaviour onsite to avoid turbines)?

3.1 Ability to estimate the flight density

To determine the flight rate (flights per square kilometre per year) you need:

- Positive identification of target species during formal surveys - We have this for Grey Falcon.
- Known survey duration - We have this for BUS
- A 'distance from observer' for at least 50-70 positive observations of the target species (as recommended by [Buckland et al. 1993](#)). This data is used to generate a detectability curve which allows us to correct for the fact that an observer is more likely to detect close individuals than those further away. This distribution changes depending on the species (for example, a Wedge-tailed Eagle can be identified from further away than a Sparrow).

For rare species, proxies can be used to derive a detectability curve. This relies on having an analogous species that has a similar likelihood of being detected to the rare species (determined by its size, shape, colour and behaviour) and has sufficient detections for modelling.

Currently, no observations of Grey Falcon with an associated distance measure have been recorded. There are several raptors on site that could likely be used as proxies. However, we would have low confidence currently in selecting proxies as we have no Grey Falcon distances



to compare to other raptors. There is a high likelihood that we will need to use proxies regardless of the number of additional surveys, given that after a three seasons only 2 have been observed (and therefore, we are unlikely to get to 50-70 positive observations in the two year duration typical for surveys). However, even a small number of observations with associated distance data would give us increase confidence and justification for proxy selection. We note that there appears to be some rounding in the distance data. This is not ideal when performing distance analysis, as it makes model fitting more difficult and less robust. We would recommend recording distances as precisely as possible (even if there is low confidence that the observer is recording the exact distance at which the bird is away).

3.2 Ability to determine flight height

To determine the proportion of flights at rotor swept height we need to have sufficient height observations. As with the distance distribution we ideally want 50+ observations to resolve the height distribution, but this can involve the use of proxies. Only 1 observation of Grey Falcon was of a bird in flight and therefore has an associated flight height. This again is not enough to have confidence as to which species might have similar flight heights that could be used as a proxy.

Additionally, we would recommend recording the flight height at first observation. The flight height at first observation gives the best representative sample of all flight and does not bias the proportion of flights at rotor swept height low or high.

3.3 Spatial patterns of utilisation

As there are few Grey Falcon records, we cannot determine patterns of utilisation across the site. Flight path data is ideal for resolving spatial patterns of use. However, given the extent of the site and the improbability of being able to get full coverage, it is likely that even with flight paths for Grey Falcon that we would not be able to resolve spatial patterns. Given the rarity of its occurrence it would be best to assume that a (rare) flight could cross the site in any manner. This also fits with observations of other raptors who have been observed relatively evenly across the site. The relatively flat utilisation of raptors is observable in Figure 2. Therefore, there is no data to meaningfully assign a relative risk rating of turbines across the site currently, and it is likely that a flat utilisation rate will be suitable for Grey Falcon. However, this may be resolved with further surveys and auxiliary studies (such as nest searches).

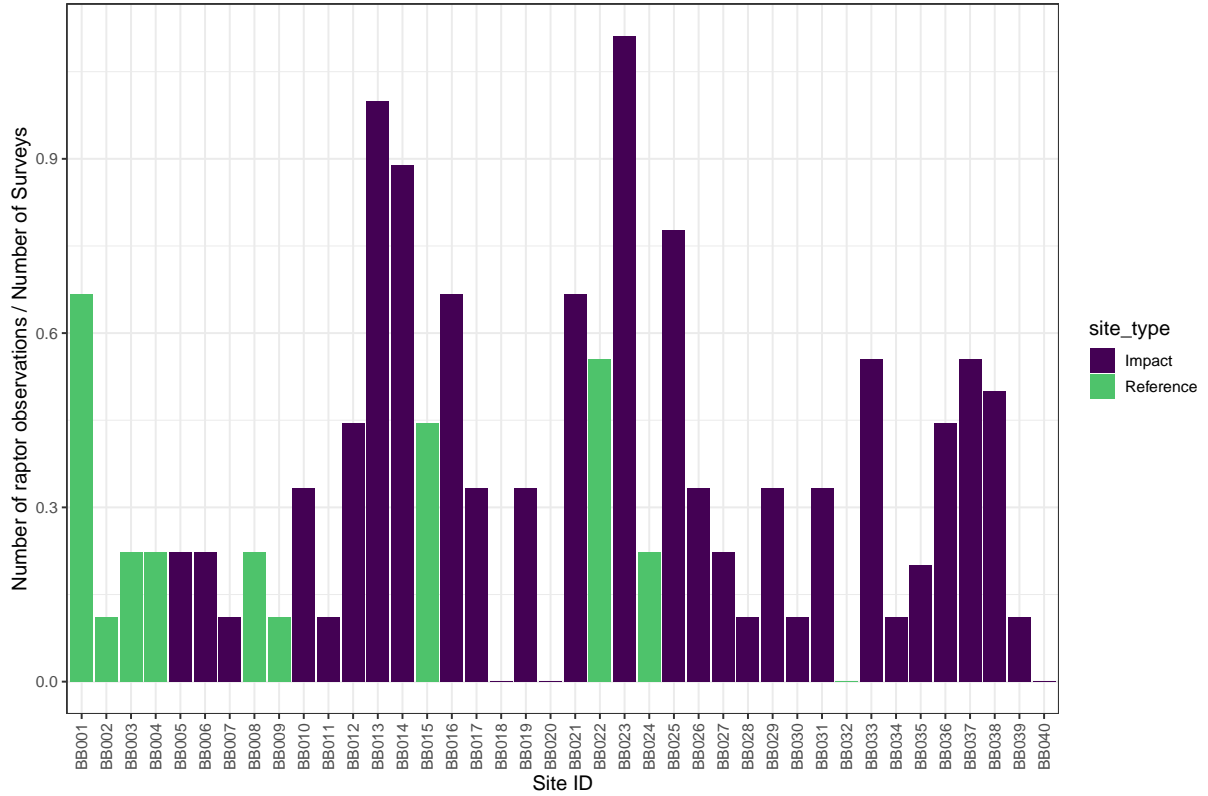


Figure 2: Number of raptors per survey observed across sites

3.4 Avoidance rates

This review does not include the review of literature to determine the availability of avoidance rate data for the Grey Falcon. To our knowledge, avoidance rate data is not available for this species. However, available avoidance rates for Wedge-tailed Eagles are available and could be used in the absence of a Grey Falcon specific avoidance rate.



4 Conclusions and recommendations

The current survey methodology displays good site coverage and sampling of different seasons onsite. The current approach to recording height and distance limits our ability to use the data as a CRM input, and the low activity rate of Grey Falcon also requires caution. We list the current strengths and weaknesses, and our recommendations below. With these recommendations in place the data is more likely to support collision risk modelling, or (at least) a robust collision assessment.

Considering the survey methods, survey effort and data collected we conclude:

Survey design and data collection

The survey methods overall are suitable for Collision Risk Modelling, and should continue to collect distance and height data going forward. There is currently insufficient distance data to undertake distance correction to estimate the flight density for Grey Falcon, nor compare it to proxy species. There is currently insufficient data to model the height distribution to reliably estimate the proportion of all flights at rotor swept height for Grey Falcon, nor compare it to proxy species. We recommend:

- Heights should be recorded at the first sighting of the species (for all BUS species).
- Horizontal distance should be recorded at the first sighting of the species (for all BUS species).
- Height and distance data should be recorded as precisely as is feasible in the field.
- Ecological assessment of potential proxy species is needed to increase the likelihood we will be able to undertake height and distance analysis for CRM.

Assessing relative spatial risk

The number and placement of sites is suitable to gain a representative sample across the site, but given the large extent of the site, we are unlikely to have visual coverage to get a detailed model of spatial variability in utilisation across the site. We recommend:

- CRM could proceed under an assumption of constant flight activity for each turbine.
- Given the size of the study area additional survey sites are not recommended.

Final remarks

Taking this into account we recommend waiting for further data collection before attempting quantitative collision risk modelling at BDWF. The resulting collision estimate would be too imprecise to provide sufficient insight understand the collision risk.

Although Grey Falcon are rare, with additional surveys conducted that collect flight height and distance data (without rounding) a CRM should be possible, but may need to rely on data from proxy species (i.e. other raptors).



symbolix

Regards,

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Appendix J BBSUS and ARU survey effort

BBSUS survey effort

Site	Habitat	Latitude	Longitude	Number of BBSUS							
				Oct-23	Feb-24	Mar-24	Jun-24	Sep-24	Feb-25	Apr-25	Aug-25
BB001	Drainage Line/River/Creek (major)	-21.8905	119.7808	3	3	3	3	3	No access	3	3
BB002	Plain (stony/gibber)	-21.8978	119.7955	3	3	3	3	3	No access	3	3
BB003	Drainage Line/River/Creek (major)	-21.9195	119.7828	3	3	3	3	3	No access	3	3
BB004	Plain (stony/gibber)	-21.95	119.7937	3	3	3	3	3	No access	3	3
BB005	Plain (stony/gibber)	-22.0041	119.8175	3	3	3	3	3	No access	3	3
BB006	Drainage Line/River/Creek (major)	-22.0279	119.8351	3	3	3	3	3	3	3	3
BB007	Plain (stony/gibber)	-22.0517	119.8248	3	3	3	3	3	3	3	3
BB008	Plain (stony/gibber)	-22.0726	119.7711	3	3	3	3	3	3	3	3
BB009	Plain (stony/gibber)	-22.135	119.7955	3	3	3	3	3	3	3	3
BB010	Woodland (open)	-22.2433	120.0657	3	3	3	3	3	3	3	3
BB011	Drainage Line/River/Creek (major)	-22.1823	119.8057	3	3	3	3	3	3	3	3
BB012	Plain (stony/gibber)	-22.2568	119.9872	3	3	3	3	3	3	3	3
BB013	Drainage Line/River/Creek (major)	-22.2231	119.9899	3	3	3	3	3	3	3	3
BB014	Plain (stony/gibber)	-22.2102	119.8134	3	3	3	3	3	3	3	3
BB015	Hills/Ranges/plateaux	-22.2779	119.7959	3	3	3	3	3	3	3	3
BB016	Station Dam, permanent water	-22.1983	119.9193	3	3	3	3	3	3	3	3
BB017	Plain (stony/gibber)	-22.2318	119.8989	3	3	3	3	3	3	3	3
BB018	Drainage Line/River/Creek (major)	-22.2482	119.8424	3	3	3	3	3	3	3	3
BB019	Plain (stony/gibber)	-22.1752	119.8542	3	3	3	3	3	3	3	3
BB020	Woodland (open)	-22.1188	119.876	3	3	3	3	3	3	3	3
BB021	Drainage Line/River/Creek (major)	-22.1766	119.9913	3	3	3	3	3	3	3	3
BB022	Drainage Line/River/Creek (major)	-22.0806	119.9953	3	3	3	3	3	3	3	3
BB023	Drainage Line/River/Creek (major)	-21.9762	119.9954	3	3	3	3	3	3	3	3
BB024	Plain (stony/gibber)	-21.999	119.9543	3	3	3	3	3	3	3	3
BB025	Plain (stony/gibber)	-21.9723	119.9541	3	3	3	3	3	3	3	3
BB026	Hills/Ranges/Plateaux	-21.9043	119.9523	3	3	3	3	3	3	3	3
BB027	Plain (stony/gibber)	-21.9338	119.9726	3	3	3	3	3	3	3	3
BB028	Plain (Cracking clays)	-21.939	119.938	3	3	3	3	3	3	3	3
BB029	Plain (Cracking clays)	-21.9581	119.9095	3	3	3	3	3	3	3	3
BB030	Rocky Escarpments	-22.012	119.9301	3	3	3	3	3	3	3	3
BB031	Drainage Line/River/Creek (major)	-22.0156	119.8758	3	3	3	3	3	3	3	3
BB032	Plain (stony/gibber)	-22.1454	119.928	3	3	3	3	3	3	3	3
BB033	Plain (stony/gibber)	-21.964	119.8671	3	3	3	3	3	3	3	3
BB034	Woodland (open)	-22.0933	119.863	3	3	3	3	3	3	3	3
BB035	Plain (stony/gibber)	-22.0757	119.8958	3	3	3	3	3	3	3	3
BB036	Drainage Line/River/Creek (major)	-22.034	119.9146	3	3	3	3	3	3	3	3
BB037	Plain (Cracking clays)	-22.046	119.8832	3	3	3	3	3	3	3	3
BB038	Plain (stony/gibber)	-22.2088	119.8686	3	3	3	3	3	3	3	3

Site	Habitat	Latitude	Longitude	Number of BBSUS							
				Oct-23	Feb-24	Mar-24	Jun-24	Sep-24	Feb-25	Apr-25	Aug-25
BB039	Drainage Line/River/Creek (major)	-22.1016	119.8261	3	3	3	3	3	3	3	3
BB040	Rocky Escarpments	-22.0631	119.9386	3	3	3	3	3	3	3	3
Total				120	120	120	120	120	105	120	120

Ultrasonic recording effort (ARU)

Site	Habitat	Latitude	Longitude	Number of ARU Nights							
				Oct-23	Feb-24	Mar-24	Jun-24	Sep-24	Feb-25	Apr-25	Aug-25
BB001	Drainage Line/River/Creek (major)	-21.8905	119.7808	2	2	0	2	3	No access	2	2
BB002	Plain (stony/gibber)	-21.8978	119.7955	2	2	2	2	1	No access	2	2
BB003	Drainage Line/River/Creek (major)	-21.9195	119.7828	2	2	3	2	0	No access	2	2
BB004	Plain (stony/gibber)	-21.95	119.7937	2	2	2	2	1	No access	2	2
BB005	Plain (stony/gibber)	-22.0041	119.8175	2	2	0	2	3	No access	2	2
BB006	Drainage Line/River/Creek (major)	-22.0279	119.8351	0	2	2	2	1	2	2	2
BB007	Plain (stony/gibber)	-22.0517	119.8248	2	2	2	2	1	2	2	2
BB008	Plain (stony/gibber)	-22.0726	119.7711	0	2	2	1	0	2	2	2
BB009	Plain (stony/gibber)	-22.135	119.7955	1	2	2	1	2	2	2	2
BB010	Woodland (open)	-22.2433	120.0657	2	2	0	2	2	2	2	2
BB011	Drainage Line/River/Creek (major)	-22.1823	119.8057	3	2	0	6	2	2	2	3
BB012	Plain (stony/gibber)	-22.2568	119.9872	2	2	0	2	2	2	2	2
BB013	Drainage Line/River/Creek (major)	-22.2231	119.9899	2	2	0	2	2	2	2	2
BB014	Plain (stony/gibber)	-22.2102	119.8134	2	2	1	1	2	2	2	2
BB015	Hills/Ranges/plateaux	-22.2779	119.7959	2	2	2	7	2	2	2	3
BB016	Station Dam, permanent water	-22.1983	119.9193	2	2	3	2	2	2	2	2
BB017	Plain (stony/gibber)	-22.2318	119.8989	2	2	3	3	2	2	2	2
BB018	Drainage Line/River/Creek (major)	-22.2482	119.8424	2	0	2	3	2	2	2	3
BB019	Plain (stony/gibber)	-22.1752	119.8542	2	2	2	3	2	2	2	2
BB020	Woodland (open)	-22.1188	119.876	2	2	0	2	2	3	2	2
BB021	Drainage Line/River/Creek (major)	-22.1766	119.9913	2	2	2	2	2	2	2	2
BB022	Drainage Line/River/Creek (major)	-22.0806	119.9953	2	2	2	2	2	2	2	2
BB023	Drainage Line/River/Creek (major)	-21.9762	119.9954	2	2	2	2	2	2	2	2
BB024	Plain (stony/gibber)	-21.999	119.9543	2	2	2	2	2	2	2	2
BB025	Plain (stony/gibber)	-21.9723	119.9541	2	2	2	1	2	2	2	2
BB026	Hills/Ranges/Plateaux	-21.9043	119.9523	2	2	2	2	2	2	2	2
BB027	Plain (stony/gibber)	-21.9338	119.9726	2	2	2	2	2	2	2	2
BB028	Plain (Cracking clays)	-21.939	119.938	2	2	2	2	2	2	2	2
BB029	Plain (Cracking clays)	-21.9581	119.9095	2	2	2	1	2	2	2	2
BB030	Rocky Escarpments	-22.012	119.9301	2	2	2	2	2	2	2	2
BB031	Drainage Line/River/Creek (major)	-22.0156	119.8758	2	2	2	2	2	2	2	2
BB032	Plain (stony/gibber)	-22.1454	119.928	2	2	2	2	2	2	2	2
BB033	Plain (stony/gibber)	-21.964	119.8671	2	2	2	1	2	2	2	2
BB034	Woodland (open)	-22.0933	119.863	2	2	2	2	0	2	2	2

Bonney Downs Wind Farm: Bird and Bat Site Utilisation Survey

Site	Habitat	Latitude	Longitude	Number of ARU Nights							
				Oct-23	Feb-24	Mar-24	Jun-24	Sep-24	Feb-25	Apr-25	Aug-25
BB035	Plain (stony/gibber)	-22.0757	119.8958	2	2	0	2	2	2	2	2
BB036	Drainage Line/River/Creek (major)	-22.034	119.9146	2	2	2	2	2	2	2	2
BB037	Plain (Cracking clays)	-22.046	119.8832	2	2	2	2	0	2	2	2
BB038	Plain (stony/gibber)	-22.2088	119.8686	2	2	2	2	2	2	2	2
BB039	Drainage Line/River/Creek (major)	-22.1016	119.8261	2	2	2	2	2	2	2	2
BB040	Rocky Escarpments	-22.0631	119.9386	2	2	2	2	2	2	2	2
Total				76	78	66	86	70	71	80	83