Theodore Wind Farm

Bird and Bat Management Plan

PREPARED FOR

Theodore Energy Development Pty Ltd

DATE

22 August 2024

REFERENCE

0661076

DOCUMENT DETAILS

DOCUMENT TITLE	Theodore Wind Farm
DOCUMENT SUBTITLE	Bird and Bat Management Plan
PROJECT NUMBER	0661076
Date	22 August 2024
Version	4.0
Author	Shenna van Melick, Joey Shanahan, Sophie Allan, Jessica Kwok
Client name	Theodore Energy Development Pty Ltd

DOCUMENT HISTORY

				ERM APPROVAL TO ISSUE		
VERSION	REVISION	AUTHOR	REVIEWED BY	NAME	DATE	COMMENTS
Draft	1.0	Shenna van Melick	Tim Callaghan	David Dique	10.07.2024	Draft
Draft	2.0	Joey Shanahan	Tim Callaghan	David Dique	19.07.2024	Draft
Draft	3.0	Sophie Allan		David Dique	13.08.2024	Draft
Final	4.0	Jessica Kwok		David Dique	22.08.2024	For issue

SIGNATURE PAGE

Theodore Wind Farm

Bird and Bat Management Plan

0661076

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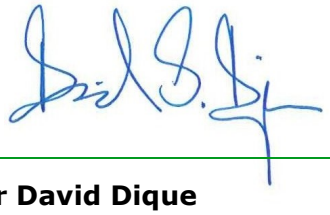

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LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

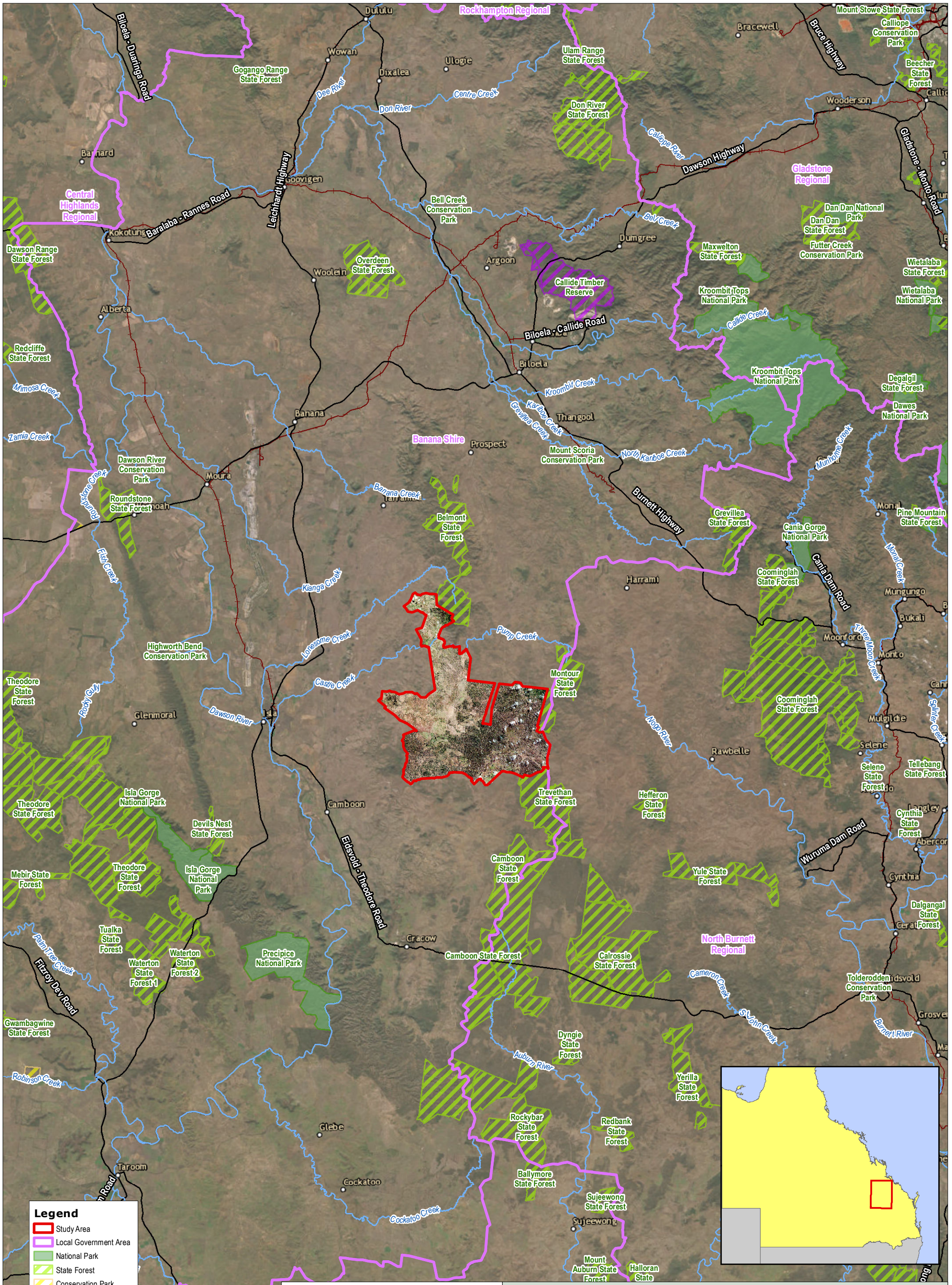
Acronyms	Description
ALA	Atlas of Living Australia
BACI	Before-After-Control-Impact
BBMP	Bird and Bat Management Plan
BUS	Bird Utilisation Surveys
CEMP	Construction Environmental Management Plan
CRM	Collision Risk Modelling
DAWE (now DCCEEW)	Department of Agriculture, Water and the Environment
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DES	Department of the Environment and Science
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EoA	Evidence of Absence
ERM	Environmental Resources Management Australia Pty Ltd
GenEst	Generalised Estimator
ha	Hectare
HSEQ	Health, Safety, Environment Quality
MW	Megawatts
NC Act	*Nature Conservation Act 1992*
PMST	Protected Matters Search Tool
PVA	Population Viability Analysis
RE	Regional Ecosystem
RSA	Rotor Swept Area
SARA	State Assessment and Referral Agency
SPRAT	Species Profile and Threats Database
TED	Theodore Energy Development Pty Ltd
VM Act	*Vegetation Management Act 1999*
WO	Wildlife Online
WTG	Wind Turbine Generator

1. INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) has been engaged by Theodore Energy Development Pty Ltd (TED) / (the Proponent) to prepare a Bird and Bat Management Plan (BBMP) for the proposed proposed Theodore Wind Farm located approximately 22 km east of the township of Theodore, Queensland (herein referred to as the Proposed Action).

The BBMP has been prepared for the area considered for the Proposed Action (herein referred to as the 'Study Area') (Figure 1-1).

The Proposed Action consists of up to 170 WTG and ancillary infrastructure including, but not limited to, access tracks, substations, overhead and underground electrical cabling, hardstands, and an operation and maintenance compound. In order to facilitate connection to the electricity grid, TED is working with Powerlink to determine the optimal connection point to the existing network. The Proposed Action is being developed across 9 land parcels, 8 freehold lots and 1 lands lease lot (currently being converted to freehold) (Figure 1-1), on alluvial plains with non-remnant grasslands predominantly used for agricultural grazing.



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1.1 REGULATORY REQUIREMENTS

The Queensland *Planning guidance State code 23: Wind farm development* (August 2023) requires a detailed BBMP to be prepared prior to the commencement of operation of the Proposed Action.As part of the Development Application, this BBMP has been prepared to address the requirements of State Code 23 in demonstrating the impacts associated with bird and bat collisions. This BBMP has been prepared in accordance with the Planning Guidance document and contains:

- Results of a desktop assessment to identify potential at-risk bird and bat species;
- The results of field surveys to identify potential habitat for birds, as well as bird utilisation surveys (BUS) completed in October 2022, February 2023, March 2023, June 2023, September 2023, October 2023, December 2023, February 2024 and June 2024;
- The results of bat surveys completed in October 2022 and during the February and March 2023 survey periods;
- A collision risk assessment and collision risk modelling (CRM) for listed threatened or least concern raptors that have been assessed as having a risk of collision with operating turbines; and
- Management, mitigation and monitoring measures to be considered to reduce the potential impact of collision with turbines.

At the time of drafting, the Department of Agriculture, Water and the Environment *Onshore Wind Farms – interim guidance on bird and bat management* (DAWE, 2021) was used to inform the BBMP. The guidance states:

> *"The BBMP must be prepared by a suitably qualified ecologist and in accordance with the department's Environmental Management Plan Guidelines. The BBMP must be informed by desktop and field-derived information, and best available practices, and include the following key requirements at a minimum:*
>
> - *Standards for pre and post-commissioning surveys that are appropriate to the scale and environmental risks of the Proposed Action;*
> - *Evidence of effectiveness of the methods used for other similar actions;*
> - *Demonstration that the proposed measures and outcomes of the BBMP are supported by published scientific evidence; and*
> - *Where innovative measures are proposed, details about how desired outcomes will be met".*

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) released *Draft Onshore Wind Farm Guidance – Best practice approaches when seeking approval under Australia' national environment law* (DCCEEW, 2024) in May 2024. The BBMP has been aligned with the guidance released in 2024.

In addition to the minimum requirements detailed above, this BBMP has been prepared to manage impacts to MNES protected under the EPBC Act 1999.

1.2 BIRD AND BAT MANAGEMENT PLAN OBJECTIVES

The objectives of this BBMP is to minimise and manage the overall impact on birds and bats within the vicinity of the proposed operational WTG associated with the Proposed Action. This BBMP aims to:

- Detail potential mitigation measures and implementation strategies to minimise impacts to birds and bats;
- Establish an adaptive management framework for managing and mitigating impacts on birds and bats;
- Outline a monitoring program to understand the impact of the Proposed Action to at-risk birds and bats;
- Document an agreed decision-making framework that identifies operational-phase impact triggers leading to a management response;
- Identify any additional measures that can be used to manage impacts based on the outcomes of ongoing monitoring; and
- Offset mortality impacts to listed threatened species where applicable.

This BBMP is a live document and will be continuously adapted in response to the outcomes of monitoring, detection of potential species triggers, as a result of, identified impacts to bird and bats from WTG collisions. This BBMP will involve consultation with DCCEEW for management responses following the identification of species mortality considered to meet trigger levels for at-risk species.

This BBMP will be further developed and submitted to DCCEEW prior to the pre-construction phase of the Proposed Action and will proceed through a review process prior to the commissioning phase.

1.3 STUDY AREA AND CONTEXT

The Study Area is approximately 46,830 ha in size and is located 22 km to the east of the township of Theodore, and approximately 50 km south of Biloela in the Banana Shire Council Local Government Area (LGA), Central Queensland. The Study Area lies adjacent to and within the locality (10 km) of several state forests including Belmont State Forest to the east, Montour State Forest to the north and Trevethan State Forest to the south of the Study Area (Figure 1-1).

The Study Area is comprised of 9 lots on 3 properties. The lot on plans are outlined below in Table 1-1 and displayed on Figure 1-1.

TABLE 1-1 RELEVANT STUDY AREA LAND PARCELS

Property	Lot on Plan
Landowner 1	Lot 4 on SP131475 Lot 2 on RP617749 Lot 1 on RP617748 Lot 8 on DW2
Landowner 2	Lot 17 on DW49 Lot 18 on DW550
Landowner 3	Lot 11 on DW446 Lot 19 on DW551 Lot 20 on SP100500
Road Reserves	Part of Defence Road Part of Crowsdale Camboon Road Unnamed Road Reserves
Total Study Area	46,830 ha

The Study Area occurs within the Banana Shire Council LGA and is zoned as Rural under the Banana Shire Council Planning Scheme 2017. Cattle grazing is the dominant land use in the Study Area, with largely cleared areas associated with lower slopes dominating the landscape.

The Study Area is located within the Southern Brigalow Belt bioregion as defined by the Interim Biogeographic Regionalisation for Australia (IBRA) framework. Ecological and topographical features observed within the Study Area are typical of the region and include eucalypt dominated open forest and woodlands on alluvial plains and igneous rock. Open forests and woodlands consistent with this bioregion are generally observed in the south of the Study Area. In the north, the landscape is characterised by non-remnant grasslands with historic land clearing and severe dieback.

Access to the Study Area is primarily from Defence Road, with crossings and smaller access from Crowsdale-Camboon Road in the centre of Study Area. Throughout the duration of the construction and operational phases of the Proposed Action, host properties are able to continue to use land for agricultural activities throughout the life of the Proposed Action and it is anticipated that tracks established during construction of the Proposed Action will aid in continued agricultural activities.

2. PRE-OPERATIONAL BIRD AND BAT INFORMATION

Eight field investigations have been undertaken within the Study Area between October 2022 and June 2024. The field effort undertaken during each survey event are described below:

- Four ecologists undertook a six-day ecological survey within the Study Area from 17th of October to the 22nd October 2022, with a total of 240 person hours on the ground. The surveys involved completing vegetation assessments, RE and TEC ground truthing and validation, habitat assessments, targeted threatened species surveys, spotlighting, call playback, deploying camera traps and Anabats, and BUS.
- Two ecologists undertook a five-day bird and bat survey within the Study Area from 13th of February to the 17th of February 2023, with a total of 100 person hours on the ground, completing assessment of threatened fauna, deploying Anabats, and BUS.
- Four ecologists undertook a five-day ecological survey within the Study Area from 27th of March to the 31st of March 2023, for a total of 200 person hours, completing vegetation assessments, RE and TEC ground truthing and validation, habitat assessments, targeted threatened species surveys, deploying Anabats, and BUS.
- Four ecologists undertook a five-day ecological survey within the Study Area from 5th of June to the 9th of June 2023, for a total of 200 person hours, completing vegetation and habitat assessments, targeted threatened species surveys, and BUS.
- Two ecologists undertook a five-day ecological survey within the Study Area from 25th of September to the 29th of September 2023, then another five-day ecology survey from the 9th of October to the 13th of October 2023, for a total of 200 person hours, completing habitat assessments, vegetation assessments, and BUS (survey period spread across two weeks due to site access issues).
- Two ecologists undertook a five-day ecology survey within the Study Area from the 4th of December to the 8th of December 2023, for a total of 100 person hours, completing BUS.
- Two ecologists undertook a five-day ecology survey within the Study Area from the 19th of February to the 23rd of February 2024, for a total of 100 person hours, completing BUS.
- Four ecologists undertook a four-day ecology survey within the Study Area from the 10th of June to the 14th June 2024, for a total of 160 person hours, completing BUS, RE and TEC ground truthing and validation, vegetation and habitat assessments.

Field investigations focussed on bird and bat surveys, in order to identify at-risk species required for consideration during the operation of the Proposed Action. Desktop information was utilised to inform an understanding of the at-risk species ecology and biology to support the development of management measures, as defined in this BBMP.

2.1 PRE-OPERATIONAL SURVEY METHODS

Prior to conducting field investigations, a review of desktop sources was undertaken to identify the ecological values of the Study Area, including Commonwealth, State and public information sources, as per Table 2-1.

The desktop analysis further guided the development of the field survey techniques and effort best suited to the ecological matters identified within the Study Area. Desktop information was utilised to assess and document the likelihood of occurrence (LoO) for threatened bird and bat species within the Study Area.

TABLE 2-1 DATABASES REVIEWED FOR DESKTOP ANALYSIS

Information Source	Name	Data Description
Department of Climate Change, Energy, the Environment and Water (DCCEEW)	Protected Matters Search Tool (PMST) *The PMST report for assessment was generated 19th March 2024*	The search tool provides predictive results of matters of national environmental significance based on mapping of known and potential species distribution, habitat, ecological communities and wetlands. The outputs are based on modelling results and do not necessarily reflect known records of species or communities. The features highlighted by the search are considered further through a likelihood of occurrence assessment (Appendix A). The PMST is available as Appendix B. Search area: Study Area Boundary .shp file (with a 10 km buffer, referred to as the Locality, around this area drawn in the PMST interactive search map).
Department of Resources (DoR)	Regional Ecosystem Version 13 mapping	This product maps remnant and regrowth vegetation communities across Queensland and identifies communities listed as Endangered, Of Concern or Least Concern status as defined by the VM Act.
DoR	Property Maps of Assessable Vegetation mapping (published 4 May 2017)	This product provides certified property scale maps indicating where landholders can clear regrowth in 'Category X' areas without further approval.
Queensland Government	MSES version 4.1 mapping	This product maps areas of MSES as defined under the Qld State Planning Policy.
DoR	Queensland Globe	A Queensland Government based product that allows viewing of spatial data and imagery covering Queensland.
Department of Environment, Science and Innovation (DESI)	WildNet records (WN) – Through Environmental Reports	A database that contains records of wildlife sightings including threatened flora and fauna species (protected under the NC Act) that have been provided to the agency by Government departments and external organisations. Search area: all Lots of the Study Area
ala.org.au	Atlas of Living Australia (ALA)	Australia national biodiversity database (supported by the National Collaborative Research Infrastructure Strategy, CSIRO). Database contains records accessed through an interactive spatial portal. Threatened species are searched to identify known records in proximity to the Study Area.
DCCEEW	Species Profile and Threats Database (SPRAT)	The SPRAT profiles and associated conservation advice documents were consulted as they provide detailed information for the likelihood of occurrence assessment on: • Species distribution; and • Species habitat (preferred and general). The conservation advice documents are particularly important for assessing TECs found in field surveys, against the listed TEC guidelines.

2.1.1 LIKELIHOOD OF OCCURRENCE

Consistent with the accepted approach for ecological assessment, a preliminary likelihood of occurrence assessment was undertaken informed by desktop sources and database searches, results of which are available in Appendix B. The LoO criteria is presented in Table 2-2. The preliminary output was refined using site-specific and specific-species habitat information obtained from field surveys to produce a final likelihood of occurrence (refer to Appendix B).

TABLE 2-2 LIKELIHOOD OF OCCURANCE CRITERIA

	Preferred habitat exists	**General habitat exists[1]**	**Habitat does not exist[2]**
Records within Study Area (based on site surveys and recent (last 20 years) records)	Known	Known	Known
Records in the locality[3]	Likely	Potential	Unlikely
No records in the locality, but Study Area is within known distribution	Potential	Potential	Unlikely
No records in the locality, and Study Area is outside of distribution	Unlikely	Unlikely	Unlikely

1. *Habitat may be considered general, but not preferred because: some desired habitat features may be present, but not all; habitat may have poor connectivity; or habitat may be known to be disturbed.*
2. *Based on sources reviewed and/or field survey results.*
3. '*Locality*' refers to a 10 km radius centred on the Study Area.

2.1.2 SURVEY TECHNIQUES AND EFFORT

A summary of the survey effort conducted throughout all eight field investigation events is provided in Table 2-3.

The field investigations focussed primarily on targeting listed threatened and migratory species which were assessed as known, likely or having the potential to occur within the Study Area (as per the LoO assessment; Appendix B) and were conducted in accordance with the following survey guidelines:

- Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010a);
- Draft referral guideline for 14 birds listed as migratory species under the EPBC Act (DoE, 2015);
- Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (DES, 2018);
- National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus* (DAWE, 2021); and
- Survey Guidelines for Australia's Threatened Bats (DEWHA, 2010b).

A summary of the survey techniques and effort for each targeted assessment, for each survey period is presented in Table 2-3.

A survey adequacy assessment was completed following each survey event to identify whether the survey techniques and effort adhered to the above listed guidelines. This survey adequacy assessment is provided in Appendix C.

TABLE 2-3 BIRD AND BAT SURVEYS UNDERTAKEN WITHIN THE STUDY AREA

Dates	Target	Techniques	Survey Effort
17 – 22 October 2022	Vegetation and habitat assessment (including targeted threatened species surveys)	• Assessment of habitat features present relating to relative cover and abundance of nesting/shelter/basking sites, presence of aquatic habitats, presence of foraging resources, dominant canopy species, connectivity and disturbances. • Representative sampling for regional ecosystem verification using quaternary vegetation sampling (Neldner et al., 2022). • Targeted surveys for threatened species identified with potential to occur, as described in the likelihood of occurrence analysis (Appendix B).	• 36 individual survey locations.
	Targeted fauna surveys	• Deployment of baited camera traps to target terrestrial mammals.	• 4 camera traps deployed for 4 consecutive nights, totalling 16 trap nights. • 2 nights, 8 hours survey effort, spotlighting transects along Defence Road
	Bird surveys	• Bird utilisation surveys (BUS) using the Fixed-Point Survey.	• 23 bird surveys including BUS and roaming surveys.
	Bat surveys	• Bat detection via the use of ultrasonic devices (Anabats).	• 2 Anabats locations recording for 4 consecutive nights, totalling 8 trap nights.
13 – 17 February 2023	Bird surveys	• BUS using the Fixed-Point Survey. • Roaming bird surveys between survey areas.	• 32 bird surveys including BUS and roaming bird surveys.
	Bat surveys	• Bat detection via the use of ultrasonic devices (Anabats).	• 4 Anabat locations recording for 4 consecutive nights, totalling 16 trap nights.
27 – 31 March 2023	Vegetation and habitat assessment (including targeted threatened species surveys)	• Assessment of habitat features present relating to relative cover and abundance of nesting/shelter/basking sites, presence of aquatic habitats, presence of foraging resources,	• 60 individual survey locations.

Dates	Target	Techniques	Survey Effort
		dominant canopy species, connectivity and disturbances. • Representative sampling for RE verification using quaternary vegetation sampling (Neldner et al., 2022) • Targeted surveys for threatened species identified with potential to occur, as described in the likelihood of occurrence analysis (Appendix B), with techniques outlined in Section 2.2.	
	Bird surveys	• BUS using the Fixed-Point Survey. • Roaming bird surveys between survey areas.	• 27 bird surveys, including BUS and roaming bird surveys.
	Bat surveys	• Bat detection via the use of ultrasonic devices (Anabats).	• 4 Anabat locations recording for 4 consecutive nights, totalling 16 trap nights.
5 – 9 June 2023	Vegetation and habitat assessment (including targeted threatened species surveys)	• Assessment of habitat features present relating to relative cover and abundance of nesting/shelter/basking sites, presence of aquatic habitats, presence of foraging resources, dominant canopy species, connectivity and disturbances. • Representative sampling for RE verification using quaternary vegetation sampling (Neldner et al., 2022) • Targeted surveys for threatened species identified with potential to occur, as described in the likelihood of occurrence analysis (Appendix B), with techniques outlined in Section 2.2.	• 48 individual survey locations
	Targeted fauna surveys	• Targeted spotlighting transects as well as koala SATs	• 4 spotlighting nights totalling 12 hours survey effort. • 7 koala SATs
	Bird surveys	• BUS using the Fixed-Point Survey. • Roaming bird surveys between survey areas.	• 24 bird surveys, including BUS and roaming bird surveys.
25 – 13 October 2023 (Survey	Habitat quality assessments	• Modified Habitat Quality Assessment (MHQA) and BioCondition Assessments	• 17 transects

Dates	Target	Techniques	Survey Effort
period split over two weeks)	Bird surveys	• BUS using the Fixed-Point Survey. • Roaming bird surveys between survey areas.	• 26 BUS
4 – 8 December 2023	Bird surveys	• BUS using the Fixed-Point Survey. • Roaming bird surveys between survey areas.	• 40 BUS
19 – 23 February 2024	Bird surveys	• BUS using the Fixed-Point Survey. • Roaming bird surveys between survey areas.	• 27 BUS
10 – 14 June 2024	Vegetation assessments	• Representative sampling for RE verification using quaternary vegetation sampling (Neldner et al., 2022) •	• 31 individual survey locations
	Habitat quality assessments	• Modified Habitat Quality Assessment (MHQA) and BioCondition Assessments	• 8 transects
	Bird surveys	• BUS	• 18 BUS

2.1.3 SURVEY CONDITIONS

During all field investigation periods, the weather typically remained dry (with the exception of a maximum 24.2 mm during the October 2022 survey period). Moderate wind conditions and temperatures were typical for the periods that each survey took place. A summary of the daily weather observations for each survey period is presented in Table 2-4 to Table 2-12.

It should be noted that creek flooding occurs within the Study Area during the October 2022 survey period, and thus, impacting levels of access across survey sites.

Weather observations were sourced from the Thangool weather station (station number 039089), located approximately 50 km north-east of the Study Area.

TABLE 2-4 DAILY WEATHER OBSERVATIONS OCTOBER 2022 - THANGOOL QUEENSLAND

	Daily Temp		Rain	9:00AM				3:00 PM			
	Min °C	Max °C	mm	Temp °C	RH %	Dir	Spd km/hr	Temp °C	RH %	Dir	Spd km/hr
17/10/22	16.6	29.3	7	22.5	79	NW	7	24.5	71	SE	13
18/10/22	14.8	28.9	0	25.5	65	NNE	20	26.8	53	N	20
19/10/22	19	23.9	1.4	21.5	89	NE	7	23.1	78	NNE	9
20/10/22	19.3	25.5	24.2	21.2	93	WNW	6	24.2	73	NE	15
21/10/22	17.1	29.5	14.6	25.4	72	NNE	11	28.3	52	NNE	22
22/10/22	17.6	27.2	23.2	18.2	99	ESE	13	25.2	59	ESE	13

Dir = wind direction; Spd = wind speed; RH = relative humidity
Blue denotes the lowest daily temperature; Red denotes the highest daily temperature.
Source: Australian Government Bureau of Meteorology, www.bom.gov.au

TABLE 2-5 DAILY WEATHER OBSERVATIONS FEBRUARY 2023 - THANGOOL QUEENSLAND

	Daily Temp		Rain	9:00 AM				3:00 PM			
	Min °C	Max °C	mm	Temp °C	RH %	Dir	Spd km/hr	Temp °C	RH %	Dir	Spd km/hr
13/02/23	19.4	37.9	0	29.4	58	NW	11	37.5	31	NNW	9
14/02/23	19	38.1	0	30.8	57	N	19	37.3	28	NNW	22
15/02/23	20.4	32.4	9.6	28.1	66	E	13	31	49	NNE	11
16/02/23	19	33.3	0.2	25.9	58	E	17	32	36	SE	11
17/02/23	15	32.2	0	25.9	53	E	6	31.2	38	SSE	13

Dir = wind direction; Spd = wind speed; RH = relative humidity
Blue denotes the lowest daily temperature; Red denotes the highest daily temperature.
Source: Australian Government Bureau of Meteorology, www.bom.gov.au

TABLE 2-6 DAILY WEATHER OBSERVATIONS MARCH 2023 - THANGOOL QUEENSLAND

	Daily Temp		Rain	9:00 AM				3:00 PM			
	Min	Max	mm	Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C		°C	%		km/hr	°C	%		km/hr
27/03/23	17	33.7	0	26	63	NE	4	33.4	38	WNW	13
28/03/23	16.6	34.6	0	26.6	70	ENE	2	33	37	NE	7
29/03/23	18.6	32	0	25.7	71	N	11	30.8	48	W	6
30/03/23	21.1	33.3	0	25.8	73	NW	13	31.7	44	SW	13
31/03/23	15.4	32.4	2.2	25	46	ESE	9	31.4	23	W	9

Dir = wind direction; Spd = wind speed; RH = relative humidity
Blue denotes the lowest daily temperature; Red denotes the highest daily temperature.
Source: Australian Government Bureau of Meteorology, www.bom.gov.au

TABLE 2-7 DAILY WEATHER OBSERVATIONS JUNE 2023 - THANGOOL QUEENSLAND

	Daily Temp		Rain	9:00 AM				3:00 PM			
	Min	Max	mm	Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C		°C	%		km/hr	°C	%		km/hr
05/06/23	14	26.8	0	21.1	66	ESE	22	25.5	41	ENE	22
06/06/23	12.1	24.9	0	18.8	74	ESE	17	22.5	54	ESE	17
07/06/23	9.4	26.4	0	19.2	68	ESE	15	25.6	38	ESE	9
08/06/23	4.7	26.4	0	16	82	SE	6	25.3	34	NNW	9
09/06/23	7.9	27.7	0	17.6	69	E	7	24.9	40	SSW	13

Dir = wind direction; Spd = wind speed; RH = relative humidity
Blue denotes the lowest daily temperature; Red denotes the highest daily temperature.
Source: Australian Government Bureau of Meteorology, www.bom.gov.au

TABLE 2-8 DAILY WEATHER OBSERVATIONS SEPTEMBER 2023 - THANGOOL QUEENSLAND

	Temp		Rain	9:00 AM				3:00 PM			
	Min	Max	mm	Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C		°C	%		km/hr	°C	%		km/hr
25/09/2023	8.1	27.9	0	20.9	51	ESE	17	26.0	30	ESE	7
26/09/2023	6.9	29.8	0	21.0	53	SSE	7	29.2	19	SW	6
27/09/2023	8.2	31.4	0	21.6	58	NNW	9	29.3	22	NNE	15
28/09/2023	9.3	32.9	0	21.7	58	NNW	7	31.9	18	ESE	9
29/09/2023	13.5	31.9	0	23.3	54	NNE	9	29.5	28	ESE	11

Dir = wind direction; Spd = wind speed; RH = relative humidity
Blue denotes the lowest daily temperature; Red denotes the highest daily temperature.
Source: Australian Government Bureau of Meteorology, www.bom.gov.au

TABLE 2-9 DAILY WEATHER OBSERVATIONS OCTOBER 2023 - THANGOOL QUEENSLAND

	Temp		Rain	9:00 AM				3:00 PM			
	Min	Max	mm	Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C		°C	%		km/hr	°C	%		km/hr
09/10/2023	8.3	28.9	0	23.1	35	E	13	26.6	26	SE	11
10/10/2023	8.1	30.0	0	22.0	54	S	7	27.0	31	ENE	7
11/10/2023	9.5	31.9	0	23.2	48	ENE	9	31.3	21	E	11
12/10/2023	11.0	32.2	0	23.7	52	WSW	9	30.6	25	NNW	9
13/10/2023	10.5	33.2	0	23.8	53	NNW	15	32.5	21	SSW	9

Dir = wind direction; Spd = wind speed; RH = relative humidity
Blue denotes the lowest daily temperature; Red denotes the highest daily temperature.
Source: Australian Government Bureau of Meteorology, www.bom.gov.au

TABLE 2-10 DAILY WEATHER OBSERVATIONS DECEMBER 2023 - THANGOOL QUEENSLAND

	Temp		Rain	9:00 AM				3:00 PM			
	Min	Max	mm	Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C		°C	%		km/hr	°C	%		km/hr
04/12/2023	20.7	38.7	0	31.1	53	NE	7	36.6	27	SW	6
05/12/2023	19.4	35.8	0	28.9	55	N	13	34.1	33	WNW	17
06/12/2023	17.5	38.4	0	29.3	47	WSW	6	36.5	18	ESE	17
07/12/2023	14.9	38.6	0	26.8	49	SE	7	37.1	16	NE	31
08/12/2023	15.1	37.7	0	28.5	45	SE	15	36.3	22	E	20

Dir = wind direction; Spd = wind speed; RH = relative humidity
Blue denotes the lowest daily temperature; Red denotes the highest daily temperature.
Source: Australian Government Bureau of Meteorology, www.bom.gov.au

TABLE 2-11 DAILY WEATHER OBSERVATIONS FEBRUARY 2024 - THANGOOL QUEENSLAND

	Temp		Rain	9:00 AM				3:00 PM			
	Min	Max	mm	Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C		°C	%		km/hr	°C	%		km/hr
19/02/2024	17.6	34.5	0	27.0	63	ESE	20	34.4	34	SE	11
20/02/2024	19.8	34.4	0	27.4	58	SE	9	32.4	37	S	7
21/02/2024	20.2	34.2	0	27.5	62	W	4	31.4	46	NE	20
22/02/2024	19.1	34.3	0	27.7	63	W	4	32.1	43	NNW	11
23/02/2024	19.4	35.6	0	28.1	66	N	4	34.5	35	SE	9

Dir = wind direction; Spd = wind speed; RH = relative humidity

Blue denotes the lowest daily temperature; Red denotes the highest daily temperature.
Source: Australian Government Bureau of Meteorology, www.bom.gov.au

TABLE 2-12 DAILY WEATHER OBSERVATIONS JUNE 2024 – THANGOOL QUEENSLAND

	Temp		Rain	9:00 AM				3:00 PM			
	Min	Max	mm	Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C		°C	%		km/hr	°C	%		km/hr
11/06/2024	2.6	26.1	0	14.8	57	SE	11	25.9	19	NW	6
12/06/2024	2.3	26.2	0	13.6	60	SSE	2	25.5	19	SSW	17
13/06/2024	0.9	24.0	0	14.7	51	SE	13	22.7	19	SSE	9
14/06/2024	1.6	24.0	0	12.6	47	E	7	23.3	17	N	11

Dir = wind direction; Spd = wind speed; RH = relative humidity
Blue denotes the lowest daily temperature; Red denotes the highest daily temperature.
Source: Australian Government Bureau of Meteorology, www.bom.gov.au

2.2 SITE SPECIFIC ASSESSMENTS

2.2.1 BIRD SURVEY METHODS

Bird utilisation surveys (BUS) involve 20-minute fix point surveys to provide data based on the species present and their height, speed and direction of flight as stipulated by the Band Model (SNH 2012, Band 2007).

Each fixed-point survey site was located to provide a search radius of at least 100 m for small birds and up to 800 m for large birds with range finders used to determine distances. Searches primarily focused on birds most likely to be affected by the development, such as raptors (birds of prey) and large flocks of birds. This technical requirement for BUS is outlined in AusWind's Report, *Wind Farms and Birds: Interim Standards for Risk Assessment* (AusWEA, 2006), draft *Onshore Wind Farm Guidance* (DCCEEW, May 2024) and Appendix 1 – Ecological assessment methodology and bird and bat studies of the draft *Planning guidance State code 23: Wind farm development* (DSDILGP, August 2023).

The survey guidelines for diurnal bird surveys and their requirements are as follows:

- *Survey Guidelines for Australia's threatened birds* (DEWHA, 2011)
  - Point surveys involve recording the presence, and usually number of individuals, of each taxon detected at a series of specified locations. The sampling points are usually pre-determined and selected either randomly or systematically within the Study Area; and
  - Point surveys typically involve an allocated survey time of 20-minutes .

As surveys commenced in October 2022, the BUS design was implemented with reference to the *Onshore Wind Farms – interim guidance on bird and bat management* by DAWE dated 2021 which required bird utilisation surveys to be completed over each relevant season over a minimum of 24 months prior to commissioning of a wind farm.

This survey effort is also consistent with the requirements of the updated draft *Onshore Wind Farm Guidance* (DCCEEW, 2024), which requires site utilisation surveys to be undertaken for each relevant season over at least two years (up to 8 survey events).

There are two distinct seasons in Queensland, wet season and dry season. The Study Area experiences a higher mean rainfall and higher mean temperatures between November and February (often extending into March). This also coincides with the season for migratory birds, including wetland birds.

To inform species use across the Study Area as part of the risk assessment for threatened birds with the potential to be impacted by WTG strike, eight BUS survey trips have been conducted to date across these two seasons (four surveys in the wet season and four surveys in the dry season), over a 20-month period. It is noted that the Proponent has committed to further survey events prior to commissioning of the Proposed Action, meeting the 24 month requirement.

BUS points were dispersed across the Study Area during the first two sampling events in October 2022 and February 2023, with the same sites subject to repeat visits in both the morning and afternoon period during all subsequent sampling events. A summary of the BUS survey effort is described in Table 2-13.

TABLE 2-13 SUMMARY OF BUS EFFORT

BUS Survey Event	BUS survey effort
October 2022 Dry season	23 surveys, 12 morning and 11 afternoon
February 2023 Wet season	32 surveys, repeat visits to BUS points including 16 morning and 16 afternoon surveys
March 2023 Wet season	28 surveys, repeat visits to BUS points including 14 morning and 14 afternoon surveys
June 2023 Dry season	24 surveys repeat visits to BUS points including 12 morning and 12 afternoon surveys
September/October 2023 Dry season	26 surveys, repeat visits to BUS points including 12 morning and 14 afternoon surveys
December 2023 Wet season	40 surveys, repeat visits to BUS points including 20 morning and 20 afternoon surveys
February 2024 Wet season	27 surveys, repeat visits to BUS points including 13 morning and 14 afternoon surveys
June 2024 Dry season	18 surveys, repeat visits to BUS points including 9 morning and 9 afternoon surveys

Survey Guidelines for Australia's threatened birds (DEWHA, 2011) outlines steps that aid in determining survey effort and timing, noting a particular focus on optimal timing for surveys of 'target' taxa. With the timing of surveys critical to species detection, it is important that surveys be timed to maximise potential detection across the year. As such, eight BUS events have been completed over the two distinct seasons observed within Central Queensland (wet and dry).

State Code 23 details the requirement for BUS for wind farm developments. Such surveys identify avian species, numbers present, height flown and site utilisation.

The eight field investigations undertook BUS at waterbodies and in open areas for birds of prey. Thus, the survey effort was performed in accordance with State Code 23 requirements.

The updated DCCEEW draft guidelines on the management of bird and bat species in onshore wind farms details the need to undertake a risk assessment for birds and bats following bird utilisation surveys for the Study Area (DCCEEW, 2024). This risk assessment has taken into account the likelihood and consequences of events including collision with wind turbines and the impact of construction and operation on the Proposed Action causing changes in site utilisation by bird and bat species.

State Code 23 also recommends Before-After-Control-Impact (BACI) design principle for surveys where the Study Area is determined to support significant bird species. The aim of the BACI design is to compare environmental variables before and after a human activity and between the areas affected by the development (impact site) and areas unaffected by the development (control sites) (Stewart-Oaten, 1986). In this instance, this would compare control and impact BUS sites, before and after the construction of the Proposed Action, to determine if there are any avian impacts as a result of the development. For the Proposed Action, impact sites are generally located within 1 km of the proposed turbine locations. Control sites are defined as sites that are placed at a sufficient distance from the proposed turbine locations to obtain data outside the zone of influence of the turbines (as defined in *State code 23: Wing farm development* (DSDILGP, 2022)).

Twenty potential impact sites and 18 potential control sites were visited over the eight survey events between October 2022 and June 2024 (Figure 2-1). These areas will be revisited and resurveyed during construction and after construction (operation phase) of the Proposed Action development, following the Proposed Actions Bird and Bat Management Plan (BBMP).

State Code 23 also requires Collision Risk Modelling (CRM) and Population Viability Analysis be conducted when a collision risk assessment identifies a risk to significant species, such as threatened birds, raptors and wetland birds. Collision Risk Modelling will be undertaken in future in accordance with the Band CRM Method (Band, 2007) for any listed threatened and/or migratory species, or non-threatened raptor species, recorded in the Study Area and assessed as having a potential collision risk. This will only be possible if the BACI designed surveys collect sufficient data to undertake this analysis. New draft guidance from DCCEEW on the management of birds and bats for onshore wind farms has detailed how CRM needs to be undertaken for listed threatened species (MNES) where risks from the Proposed Action, particularly collision risks, have been identified (DCCEEW, 2024). This CRM should consider a Study Area-wide assessment and identify high risk turbines as well as results from pre-commissioning surveys from a minimum period of 24 months.

In addition to the BUS, targeted threatened species surveys were also completed following the methods described below. All bird survey locations can be found on Figure 2-1.

2.2.1.1 POINT SURVEYS

Point surveys were conducted to target diurnal woodland and riparian bird species. Four ecologists during the October 2022 surveys, two ecologists during the February 2023 surveys, four ecologists during the March and June 2023 surveys, two ecologists during the September, October, December 2023 surveys and February 2024 and four ecologists during June 2024 survey traversed suitable woodland and riparian habitats and conducted 20-minute timed surveys for all birds in the area. This survey effort was targeted for listed threatened birds, and is additional to the BUS effort.

2.2.1.2 TRANSECT SURVEYS

Transect surveys were conducted in order to diurnal woodland and riparian bird species. Two ecologists during the February 2023 surveys, four ecologists during the March 2023 surveys and four ecologists during the June 2023 surveys traversed suitable riparian habitats and conducted transect walks for all birds in the area. This survey effort was targeted for listed threatened birds and is additional to the BUS effort.

2.2.1.3 WATERBODY SURVEYS

Waterbody surveys were conducted in order to target aquatic species and woodland species utilising the waterbody. Observations were made from a stationary position, and birds were identified by call detection and visual observations. The Study Area contained several artificial waterbodies, likely to act as important water sources in the landscape, particularly during dry conditions. This survey effort was targeted for listed threatened birds, and is additional to the BUS effort.

2.2.1.4 BIRDS OF PREY SURVEYS

Birds of prey surveys were undertaken to target the listed threatened species as well birds of prey with potential to be impacted by the Proposed Action. Bird of prey surveys were undertaken at vantage points (i.e. large plateaus and extensively cleared areas) at mid-morning when birds of prey become increasingly active.

2.2.2 BAT SURVEY METHODS

Microbat surveys were conducted to determine the presence/absence of bats within and surrounding the Study Area, with four ultrasonic bat detectors (Anabats) placed throughout the relevant properties in the Study Area. The four Anabat devices were placed in 10 total locations throughout the Study Area over the October 2022, February and March 2023 field surveys. Anabats were not deployed during the June 2023 winter surveys. These devices were used to detect ultrasonic signals from bat species in the Study Area, for either two or four consecutive survey nights.

The bat detectors were placed across representative remnant vegetation/habitat types. This included riparian woodlands and eucalypt or acacia open forest or woodlands. The detectors were specifically placed in areas that were in close proximity to potential flight paths/water sources (farm dams) and in relative proximity to proposed turbine locations. The survey locations were selected on the basis that they provided the greatest likelihood of detecting an abundance and diversity of bat species.

The detectors were secured onto trees at approximately 1.8 m above the ground. They were collected and the information recorded on the Anabats was then analysed by a specialist to determine the species recorded.

The BACI design has also been implemented for bat surveys (explained in Section 2.2.1), in order to identify any impacts on bats as a result of the Proposed Action, with control sites determined based on the current preliminary design and locations of WTGs.

The survey requirements and recommended survey effort and methods for bats is as follows:

- *Survey guidelines for Australia's threatened bats* (DEWHA, 2010)

- Trapping methods such as harp traps are recommended. Such effort is not precisely stated, but studies have found that the use of 20 or more traps a night a good for detection (Schulz, 1999). Harp trapping was not utilised as the target species, ghost bat (*Macroderma gigas*), can be detected via various other methods including however not limited to acoustic monitoring and spotlighting.
- Echolocation call detection to be carried out for a recommended 30-60 minutes per night for four to five survey nights Detectors were deployed to exceed these minimum requirements and set to record from dusk through to dawn during each sampling event.
- Recommended that a variety of trapping and call detection methods are used together, where possible.

State Code 23 identifies that methods must be carried out to determine which bat species occur on the Study Area. It recommends the use of survey techniques including mist nets and/or bat detection systems that record and analyse echolocation calls of bats. The survey efforts involved the use of Anabats and spotlighting, thus meeting the State Code 23 requirement.

The full echolocation analyses for the Anabats deployed during the October 2022, February and March 2023 field investigations can be found in Appendix E, with a summary of species recorded in Appendix D. The bat survey locations are shown in Figure 2-1.

Barfield Road
Sewells Walloon Road
Scotts Road
Coates Road
Shawlands Road
Dingly Dell Road
Rawbelle Road
Lyndale Road
Crowsdale Camboon Road
Hamiltons Road
Defence Road
Hutchinsons Road
Moocoorooba Road
Camboon State Forest

Legend
- BioCondition Transects
- Fauna Transect Point
- Other
- Control BUS
- Impact BUS
- Anabat
- Habitat Quality Assessment
- Observation Point
- Quaternary
- Species Observation
- Spotlighting
- Study Area
- Development Footprint
- Road
- Track and Path

Coordinate System:
GDA2020 MGA Zone 56

Date: 13/08/2024
Created By: SP
Drawing Size: A3

0 1 2 3km

1:125,000

2.1 -Survey Effort and Locations in the Study Area

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2.2.3 BIRD SITE UTILISATION

A combined total of 127 species, including one listed threatened species, squatter pigeon (southern) (*Geophaps scripta scripta*) (EPBC Act listed, and NC Act listed), and one listed migratory species, the satin flycatcher (*Myiagra cyanoleuca*) were identified across the eight field surveys. Birds were recorded in a variety of habitats including non-native grasslands, eucalypt woodlands, riparian corridors and waterbodies. However, bird abundance was regarded as generally low across the Study Area. Additionally, field investigations confirmed the presence of numerous active and abandoned small and medium-sized nests within the Study Area.

The following sections provide habitat mapping for the squatter pigeon (southern) and satin flycatcher.

A detailed discussion of bird utilisation across the Study Area, and how this relates to the Proposed Action with regards to CRM, is provided in Section 3.2.

It is noted that the results of future bat surveys and any evidence of threatened, migratory or raptor species in the Study Area, will be incorporated into future risk assessments and CRM within the BBMP. Therefore, the principle of adaptive management will be applied to ensure that any future risks identified are adequately reported, analysed, and subsequently managed as per the framework in the BBMP.

2.2.3.1 LISTED THREATENED OR MIGRATORY BIRD SPECIES

Squatter Pigeon (southern)

The squatter pigeon (southern) (squatter pigeon) is listed as Vulnerable, under the EPBC Act, as of 16th July 2000. This species has been concluded as known to occur within the Study Area, as per the likelihood of occurrence (Appendix B). This species was successfully identified on three occasions during field surveys in October 2022, September 2023 and December 2023. All observations were made in the north to north-west section of the Study Area outside the Development Footprint.

Squatter pigeon is a ground-dwelling pigeon and can be differentiated from the northern subspecies by its larger body, and the skin around the eyes being predominantly blue-grey compared with yellowy-orange to orange-red in the northern subspecies (Crome, 1976; Ford, 1986; Higgins & Davies, 1996; Squatter Pigeon Workshop, 2011). The squatter pigeon inhabits open forests to sparse, open woodlands and scrub mostly dominated in the overstorey by *Eucalyptus, Corymbia, Acacia* or *Callitris* species, on sandy or gravelly soils, within approximately 3 km of a suitable, permanent or seasonal waterbody. Retention of these woodland canopy species which provide shelter from predatory birds is an important habitat factor for the squatter pigeon and is a notable distinction between the habitat value of open woodland compared to cleared land, which does not constitute important or critical habitat for the species.

Additional to presence of woodland canopy species, squatter pigeon conservation guidelines identify proximity to water as the most important determinant of habitat suitability, with open ground cover that permits ease of movement also crucial:

It is nearly always found near permanent water such as rivers, creeks and waterholes. Sandy areas dissected by gravel ridges, which have open and short grass cover allowing easier movement, are preferred (DCCEEW, 2015).

Specifically in Queensland, foraging and breeding habitat is known to occur on well-draining, sandy or loamy soils on low, gently sloping, flat to undulating plains and foothills, and lateritic (duplex) soils on low 'jump-ups' and escarpments within 1 km of watercourses. The squatter pigeon nests on the ground where it forages for seeds among ground layers where these is sparse and low density grass cover. Suitable low grass cover for foraging will vary across the year in the Study Area, with cover reducing during dry the dry season. It roosts in low trees at night.

Habitat for the squatter pigeon has been delineated from the broad habitat types, based on the habitat requirements for the species. This is as follows:

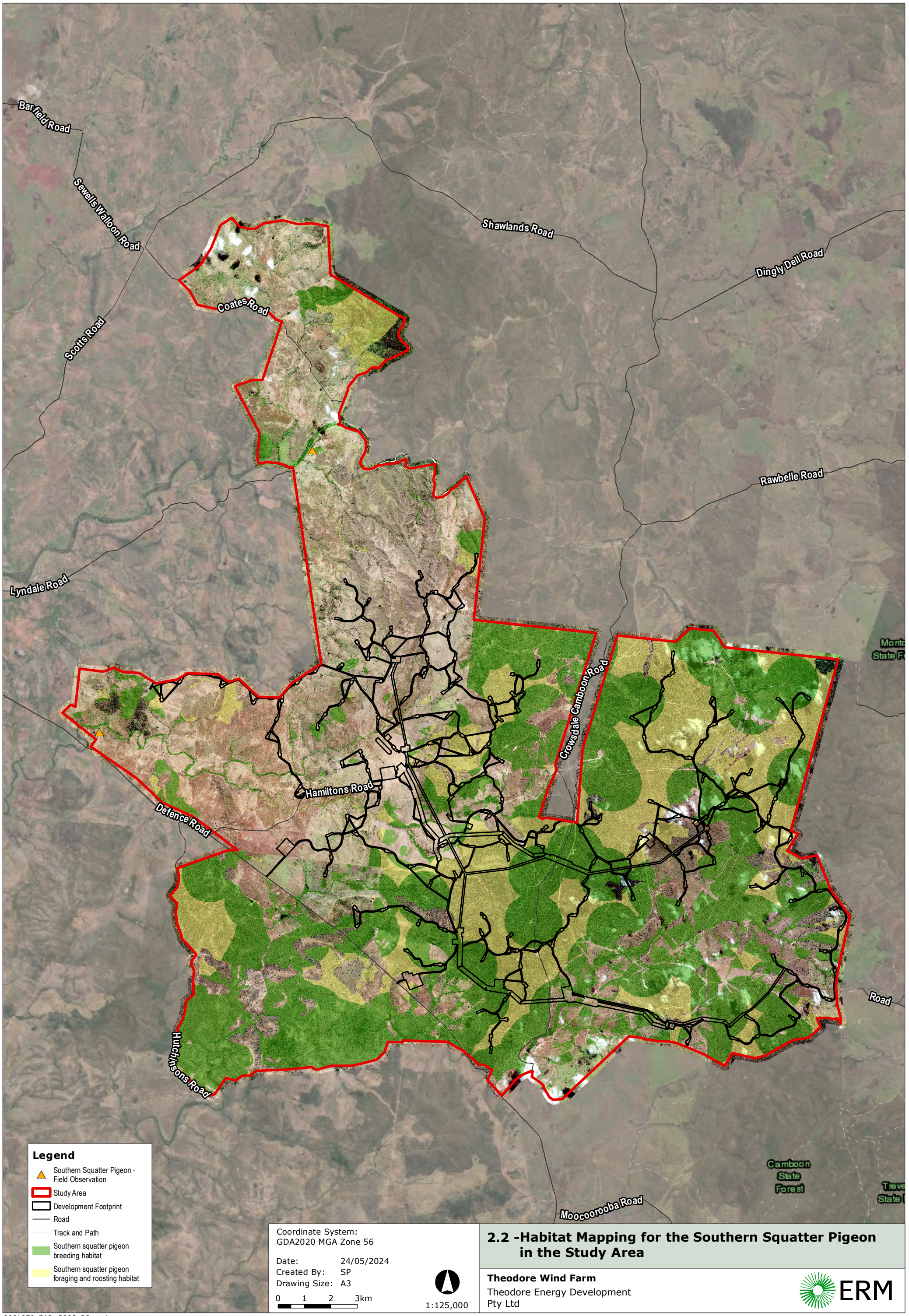
- Foraging habitat:
  - Eucalypt woodland and open forest dominated by E. crebra with a grassy understorey; and
  - Brigalow woodlands, within 3 km of permanent or seasonal waterbodies.
  - Riparian woodland and open forests dominated by E. tereticornis often associated with stream channels, within 3 km of permanent or seasonal waterbodies.
- Breeding habitat:
  - Eucalypt woodland and open forest dominated by *E. crebra* with a grassy understorey; and
  - Brigalow woodlands, within 1 km of permanent waterbodies.
  - Riparian woodland and open forests dominated by *E. tereticornis* often associated with stream channels, within 1 km of permanent waterbodies.
- Generally unsuitable habitat:
  - Vine forest/thickets and dry rainforest;
  - Waterbodies and drainage features; and
  - Grasslands and cultivated agricultural land.

There is a total of 8,023.0 ha foraging and dispersal habitat, 16,267.8 ha of breeding habitat, and 22,539.2 ha generally unsuitable habitat within the Study Area. A habitat summary for the squatter pigeon (southern) is provided in Table 2-14, and habitat mapping is provided on Figure 2-2.

TABLE 2-14 SQUATTER PIGEON (SOUTHERN) HABITAT TYPES IN THE STUDY AREA

	Breeding Habitat	Dispersal and Foraging Habitat	Generally Unsuitable Habitat
Description	Low, open eucalypt woodland on well-draining, gravelly, sandy or loamy soils and escarpments within 1 km of permanent dams, watercourses and waterbodies.	Low, open eucalypt woodland on well-draining, gravelly, sandy or loamy soils and escarpments within 3 km of dam, watercourses and waterbodies.	Not suitable habitat includes areas either bereft of suitable roosting and shelter sites or areas that are too dense for movement.

	Breeding Habitat	Dispersal and Foraging Habitat	Generally Unsuitable Habitat
Presence within the Study Area	Within 1 km of permanent waterbodies; • Eucalypt woodland and open forest dominated by *E. crebra* with a grassy understorey; and, • Brigalow woodlands; • Riparian woodland and open forests dominated by *E. tereticornis* often associated with stream channels	Within 3 km of permanent and seasonal waterbodies; • Eucalypt woodland and open forest dominated by *E. crebra* with a grassy understorey; and, • Brigalow woodlands; • Riparian woodland and open forests dominated by *E. tereticornis* often associated with stream channels	• Vine forest/thickets and dry rainforest; • Waterbodies and drainage features; and • Grasslands and cultivated agricultural land.
Total in the Study Area	• 16,267.8 ha of breeding habitat	• 8,023.0 ha foraging and dispersal habitat	• 22,539.2 ha generally unsuitable habitat



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Satin Flycatcher

The satin flycatcher is listed as 'Migratory' under the EPBC Act. This species was considered known to occur as per the likelihood of occurrence (Appendix B), due to positive identification of the species via direct observation and bird call identification during the October 2022 and October 2023 field surveys. The Study Area occurs within the range for the species, and the habitat requirements for the species occur within the Study Area as explained below.

Satin flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. There is no information available on roosting habitat and the species is known to forage in the canopy and subcanopy of its preferred habitat type. Breeding occurs within south-east Australia. The species is often found near wetlands and watercourses, often in moister, taller forests.

There are heavily vegetated gullies in eucalypt-dominated forests and taller woodlands in the form of vine thickets/rainforest with dense vegetation in the Study Area which are suitable foraging and dispersal habitat for the species. All other habitat in the Study Area is generally unsuitable for the species.

- Foraging habitat:
  - Riparian woodland and open forest dominated by *E. tereticornis* often associated with stream channels; and
  - Vine forest/ thickets and dry rainforest.
- Generally unsuitable habitat:
  - Eucalypt woodland and open forest dominated by *E. crebra* with a grassy understorey;
  - Waterbodies and drainage features;
  - Grasslands and cultivated agricultural land; and
  - Brigalow woodlands dominated by *Acacia harpophylla*.

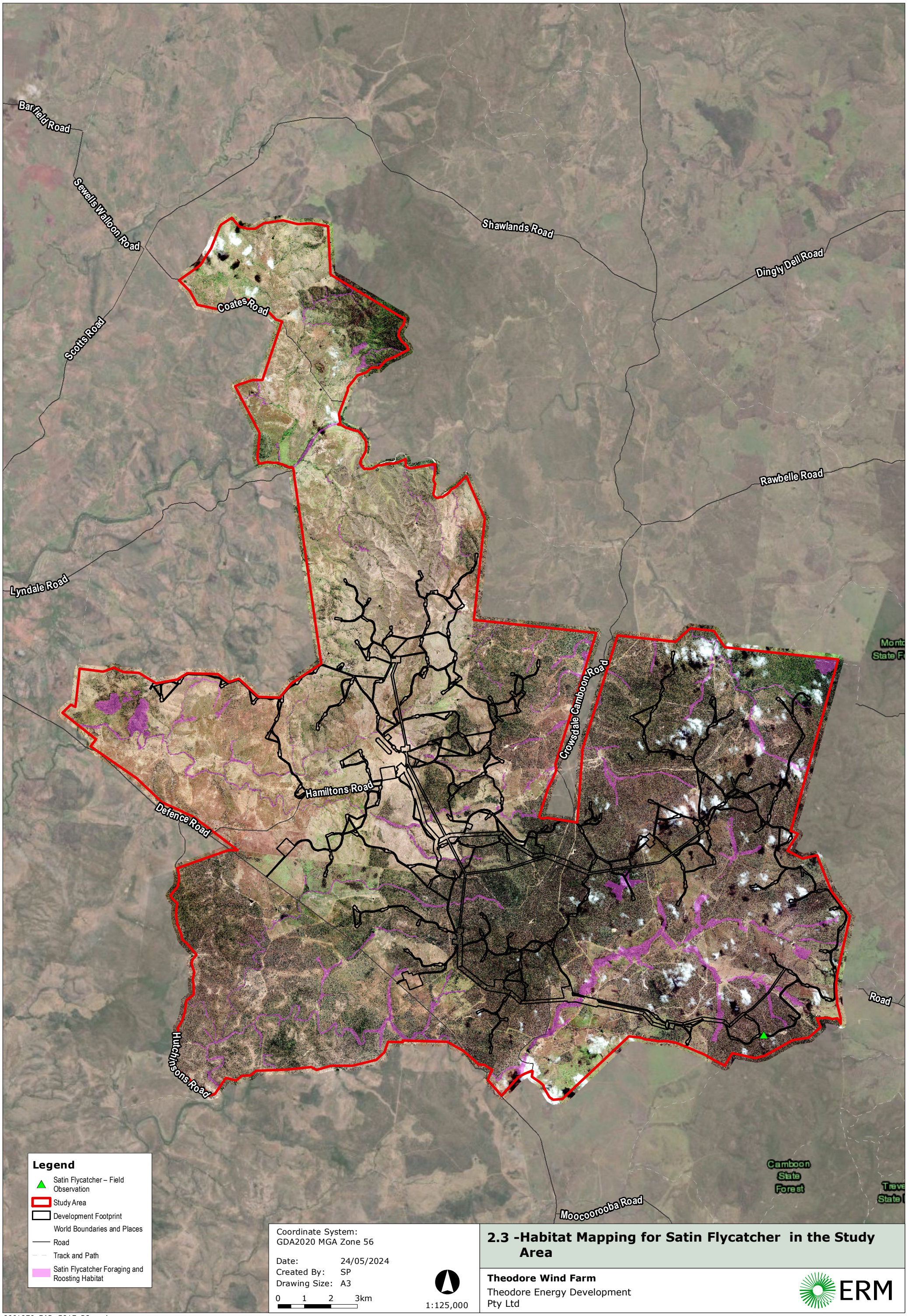
Ground-truthed surveys have identified 1,964.6 ha of satin flycatcher foraging and dispersal habitat within the Study Area. This habitat is mapped in Figure 2-3, with habitat types summarised in Table 2-15.

Due to a high level of disturbance (e.g., weeds and introduced predators) to these existing habitats, the species is only likely to occupy these habitats for movement, rather than breeding purposes.

TABLE 2-15 SATIN FLYCATCHER HABITAT SUMMARY IN THE STUDY AREA

	Foraging and Dispersal Habitat	**Generally Unsuitable Habitat**
Description	Heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and during migration, coastal forests, woodlands, mangroves and drier woodlands and open forests.	Not suitable habitat includes unvegetated areas or areas with open and spare vegetation. Brigalow woodlands are also considered unsuitable due to absence of Eucalypt species and dense vegetation.
Presence within the Study Area	Riparian woodland and open forest dominated by *E. tereticornis* often associated with stream channels; and Vine forest/ thickets and dry rainforest.	Eucalypt woodland and open forest dominated by *E. crebra* with a grassy understorey; • Waterbodies and drainage features;

	Foraging and Dispersal Habitat	Generally Unsuitable Habitat
		• Grasslands and cultivated agricultural land; and • Brigalow woodlands dominated by *Acacia harpophylla.*
Total in the Study Area	1,964.6 ha of foraging and dispersal habitat.	44,865.4 ha of generally unsuitable habitat.



2.3 -Habitat Mapping for Satin Flycatcher in the Study Area

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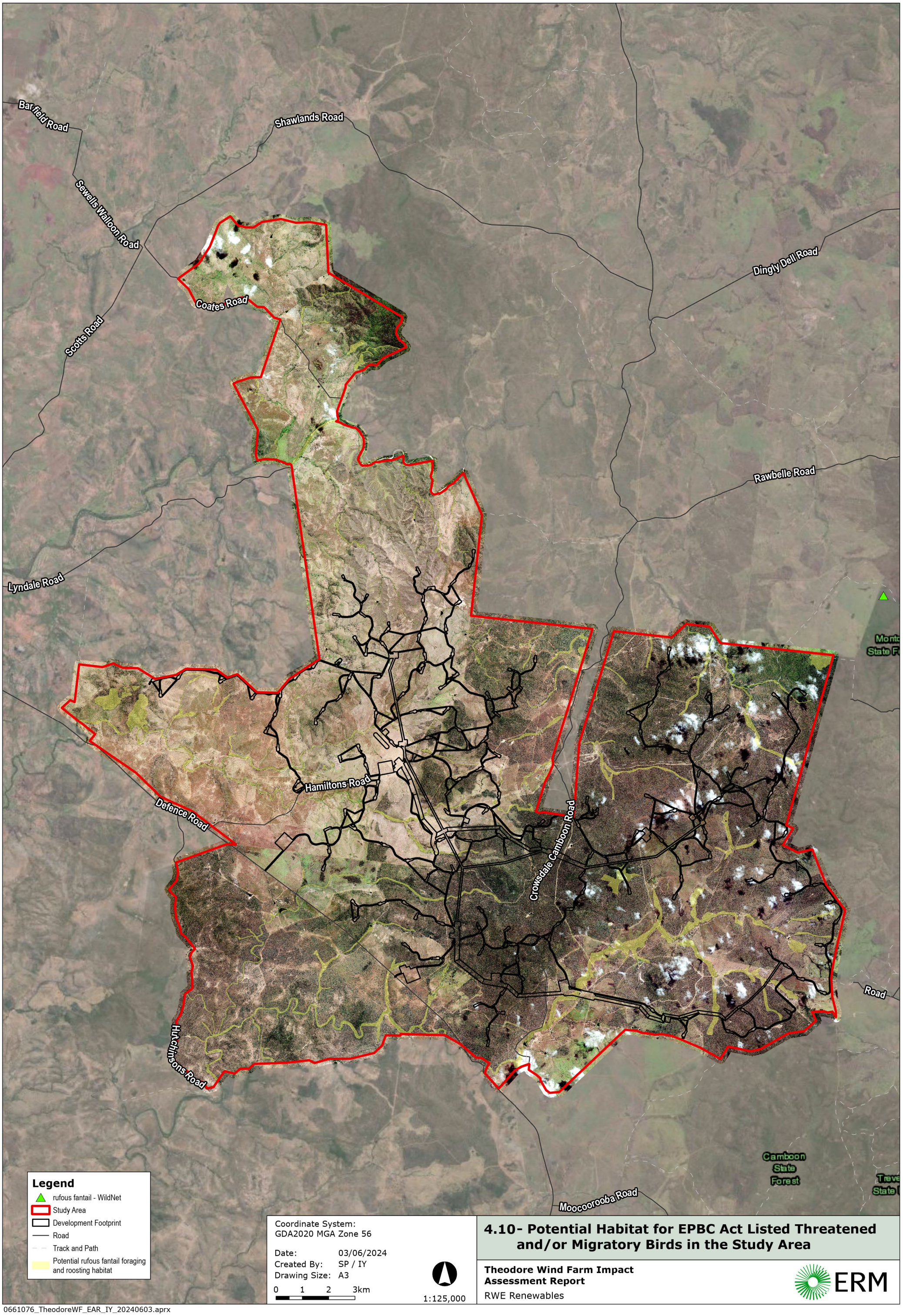
2.2.3.2 LISTED MIGRATORY BIRD SPECIES WITH POTENTIAL TO OCCUR

Two EPBC Act listed migratory species have been assessed as having the potential to occur within the Study Area as a result of the likelihood of occurrence (Appendix A). No signs or observations of these species within the Study Area during field surveys. However, species' presence within the Study Area cannot be ruled out due to overlapping distribution and suitable habitat occurring within the Study Area. Migratory species with potential to occur in the Study Area and their appropriate habitat are listed in Table 2-16. The mapped habitat for each potential threated fauna species is shown in Figure 2-4.

TABLE 2-16 EPBC ACT LISTED MIGRATORY SPECIES WITH POTENTIAL TO OCCUR WITHIN THE STUDY AREA

Species Name	Common Name	EPBC Act Status	Potential Habitat Mapped within the Study Area
Rhipidura rufifrons	Rufous fantail	Mi	Low density of foraging and roosting habitat is present in the Study Area in the form of vine thickets/forests and dry rainforest. However, no habitat critical to the survival of the species was identified from field surveys. This potential foraging and roosting habitat totals 232.3 ha and is presented on Figure 2-4.
Apus pacificus	Fork-tailed swift	Mi	Potential aerial habitat only. Lack of preferred coastal and riparian heathland for foraging and roosting. Potential aerial foraging habitat over dry open habitats present. There is a lack of preferred coastal and riparian heathland or swamp habitat. No habitat has been mapped due to the species likely being a flyover visitor only.

Status listing per EPBC Act: CE = Critically Endangered; V= Vulnerable; M = Migratory.
For the full reasoning for the potential outcomes for such species, refer to Appendix B.



4.10- Potential Habitat for EPBC Act Listed Threatened and/or Migratory Birds in the Study Area

Theodore Wind Farm Impact Assessment Report

RWE Renewables

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2.2.3.3 RAPTORS

A total of seven (7) raptor species were observed during the field surveys, of which, none are listed under the EPBC Act or NC Act, including:

- Brown falcon (*Falco berigora*);
- Black-shouldered kite (*Elanus axillaris*);
- Nankeen kestrel (*Falco cenchroides*);
- Spotted harrier (*Circus assimilis*);
- Whistling kite (*Haliastur sphenurus*);
- Peregrine falcon (*Falco peregrinus*); and
- Wedge-tailed eagle (*Aquila audax*).

A total of 76 wedge-tailed eagles were sighted during BUS' with sightings restricted mainly to cleared agricultural areas. This species was recorded between 10-250m above the ground, with 58 observations recorded within the RSA. As a result, wedge-tailed eagles have been considered within the risk assessment.

The nankeen kestrel (seen flying between 10-250m high), black kite (up to 50 m high), brown falcon (up to 250 m high) and peregrine falcon (up to 60 m high) have also been considered within the risk assessment. Black-shouldered kite was observed below the RSA (at 20m high), however the species is known to fly at heights up to and beyond the RSA and so, has been considered within the risk assessment. These raptor species predominantly prefer woodland and open area habitat (Olsen, 1995) and typically fly at heights to hunt for ground-dwelling prey in open/cleared areas or within woodlands and sparse open forests.

2.2.3.4 MIGRATORY FLYWAYS

The East Asia/Australasia Flyway is the most common and frequented flyway travelled by migratory shorebirds *en route* to, and within, Australia (BirdLife International, 2020). This flyway occurs over a total of 84,765,020 km^2 and occurs through 37 countries, including Australia (BirdLife International, 2020). This flyway extends from Arctic Russia and North America to the southern extents of Australia and New Zealand (BirdLife International, 2020). This flyway predominantly traverses the coastal extents of Australia, occasionally travelling inward through parts of South Australia and Western Australia (BirdLife International, 2020). When examining the records of the listed migratory shorebirds species from desktop searches, the vast majority of incidental records are consistent with the coastal routes of the East Asia/Australasia Flyway. Additionally, when examining the records of non-shorebird migratory birds, these species also generally traverse coastal areas.

Migratory flyways are known to correspond with the vast majority of Important Bird and Biodiversity Areas (IBAs). Such IBAs are globally known for their importance in bird conservation, particularly due to the number of migratory and/or threatened species that are found there. The East Asia/Australasia Flyway triggers a total of 1,184 migratory IBAs (BirdLife International, 2020), none of which occur within, or in close proximity to, the Study Area.

Therefore, it is concluded that the Study Area does not fall within an important flyway or IBA for migratory birds.

2.2.4 BAT SITE UTILISATION

2.2.4.1 THREATENED BAT SPECIES SITE UTILISATION

The full echolocation analyses for the anabats deployed during the October 2022, February and March 2023 field investigations can be found in Appendix E, with a summary of species recorded in Table 2-17. A total of 17 microbat species, and two microbat families (could not be identified to species level) were recorded in the Study Area. Call identification for this dataset was based on call keys and descriptions published for Queensland (Reinhold et al., 2001) and New South Wales (Pennay et al., 2004).

Species' identification was further refined using the probability of occurrence of each species based on their geographic distribution, with reliability of identification defined as:

- Definite - one or more calls where there is no doubt about the identification of the species;
- Probable - most likely to be the species named, low probability of confusion with species that use similar calls; and
- Possible - call is comparable with the named species, with a moderate to high probability of confusion with species of similar calls.

As outlined in the analysis of echolocations calls in Appendix B, where ambiguity occurs between species/families calls, further justification of species identification is provided. For example, probable *Nyctophilus* species were identified, and subsequent assessment indicated that they were likely to be the calls of *N. geoffroyi* and *N. gouldii*, neither of which are listed threatened species under the EPBC Act or NC Act. Further, the report also indicated that such calls are often confused with *Myotis macropus* microbats, which have been recorded in the Study Area.

There are three listed threatened bat species identified in the PMST in the Study Area as Known and potentially occurring, which are:

- Large-eared pied bat (*Chalinolobus dwyeri*) (likely to occur);
- Corben's long-eared bat (*Nyctophilus corbeni*) (potential to occur); and
- Ghost bat (*Macroderma gigas*) (potential to occur).

As a result of the likelihood of occurrence assessment (Appendix B), ghost bat and Corben's long-eared bat are unlikely to occur and the large-eared pied-bat is likely to occur. Audio detection is the preferred method of detection for each of the three species. Audio detection was noted as "probable" for the large-eared pied-bat, with no other listed species calls occurring in the field from the Anabat surveys.

TABLE 2-17 SUMMARY OF ECHOLOCATION ANALYSIS RESULTS

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Survey Period Identified	Reliability of identification
Austronomus australis	white-striped free-tailed bat	-	LC	October 2022, February and March 2023	Definite

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Survey Period Identified	Reliability of identification
Chaerephon jobensis	northern free-tailed bat	-	LC	October 2022, February and March 2023	Definite (March) Probable (October and February)
Chalinolobus dwyeri	large-eared pied-bat	V	VU	February and March 2023	Probable
Chalinolobus gouldii	Gould's wattled bat	-	LC	October 2022, February and March 2023	Definite (one Anabat with Probable)
Chalinolobus morio	chocolate wattled bat	-	LC	February and March 2023	Probable (one Anabat with definite)
Chalinolobus nigrogriseus	hoary wattled bat	-	LC	October 2022, February and March 2023	Definite
Miniopterus australis	little bent-wing bat	-	LC	March 2023	Probable
Miniopterus orianae[1]	large bent-wing bat	-	LC	October 2022, February and March 2023	Probable
Myotis macropus	southern myotis	-	LC	October 2022, February and March 2023	Possible
Nyctophilus sp	long-eared bat species	-	LC	October 2022, February and March 2023	Possible
Ozimops lumsdenae	molossid bat	-	LC	October 2022, February and March 2023	Possible
Ozimops ridei	molossid bat	-	LC	October 2022, February and March 2023	Definite (October 2022, February 2023) Probable (March 2023)
Rhinolophus megaphyllus	smaller horseshoe bat	-	LC	October 2022, February and March 2023	Definite
Saccolaimus flaviventris	yellow-bellied sheathtail bat	-	LC	March 2023	Definite
Scotorepens balstoni	inland broad-nosed bat	-	LC	October 2022, February and March 2023	Definite
Scotorepens greyii	little broad-nosed bat	-	LC	October 2022, February and March 2023	Probable
Scotorepens sp.	broad-nosed bat species	-	LC	October 2022, February and March 2023	Probable

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Survey Period Identified	Reliability of identification
Setirostris eleryi	bristle-faced free-tailed bat	-	LC	October 2022, February and March 2023	Probable
Taphozous troughtoni	Troughton's sheathtail bat	-	LC	October 2022, February and March 2023	Definite
Vespadelus troughtoni	eastern cave bat	-	LC	October 2022	Probable
Vespadelus vultumus	little forest bat	-	LC	October 2022, March 2023	Possible

The free-tailed bats recorded (family *Molossidae*) include white-striped free-tailed bat (*Austronomus australis*), northern free-tailed bat (*Chaerephon jobensis),* mossolid bats (*Ozimops ridei* and *Ozimops lumsdenae*), bristle-face free-tailed bat (*Setirostris eleryi*). Australian *molossids* have been recorded in a variety of habitats, including form closed forest to deserts. To be suitable habitat for free-tailed bats, habitat must supply roosting sites which can including buildings, hollow trees or rock crevices in rocky outcrops, riverbanks or stones. Free-tailed bats feed on a range of insects from moths to hard-shelled beetles (Allison, 1989).

The wattled bats recorded, including Gould's wattled bat (*Chalinolobus gouldii*), chocolate wattled bat (*Chalinolobus morio*) and hoary wattled bat (*Chalinolobus nigrogriseus*), occupy a wide range of habitats, including forests and woodlands and typically roost in tree hollows. Wattled bats prefer a diet of moths and beetles, however, they will feed on other insects if available (Churchill, 2008).

The bent-winged bats recorded, including little bent-wing bat (*Miniopterus australis*) and large bent-wing bat (*Miniopterus orianae)*, occupy well-timbered habitats, often in wetter areas or in close proximity to water features. Bent-winged bats species typically roost in caves or other man-made structures and show a dietary preference for moths (Churchill, 2008).

Nyctophilus species are found over a variety of habitats. The lesser long-eared bat (*Nyctophilus geoffroyi*) occupies tropical to alpine woodlands, mangroves, urban areas, wet and dry sclerophyll forests and rain forests (Churchill, 2008). Corben's long-eared bats (*Nyctophilus corbeni*) are found within semi-evergreen vine thicket, dry sclerophyll forests, Callitris forest and open forests with poplar box (Churchill, 2008). The eastern long-eared bats (*Nyctophilus bifax*) reside under the loose bark of melaleuca, in tree hollows as well amongst dense foliage of vegetation. Gould's long-eared bat (*Nyctophilus gouldi*) is a generalist and resides across a range of wet and dry sclerophyll forests and woodlands, roosting under loose bark and in tree hollows (Menkhorst, 2011).

The large-eared pied-bat habitat requirements have been discussed in the following section and Appendix E.

The yellow-bellied sheathtail bat (*Saccolaimus flaviventris*), has a diet preference for beetles, and is found in nearly all habitats, utilising large tree hollows for roosting (Armstrong & Lumsden, 2017). Very little is known about Troughton's sheathtail bat (*Taphozous troughtoni*), this species is only found in Australia (Tate, 1952). The species roosts in caves and mines and

the species is highly vulnerable to disturbance from human visitors as well as habitat clearing and land degradation as a result of agricultural practices (Tate, 1952).

The little forest bat (*Vespadelus vultumus*) was recorded in the Study Area. Forest bats live predominantly in eucalypt forests which are present in the Study Area and can also be found in subalpine woodland to alpine moors, where they feed upon insects and spiders and may roost in hollows of old eucalypts (Hall, 2008).

Broad nosed bats have been detected by the anabats within the Study Area. The little broad-nosed bat (*Scotorepens greyii*) roosts in hollows in old, unused buildings, inside hollow fence posts. Broad-nosed bats are insectivores (Churchill, 2008).

The southern myotis (*Myotis macropus*) roost in tree hollows, caves, mines, culverts and under bridges, often close to water (Law & Anderson, 1999).

The eastern cave bat (*Vespadelus troughtoni*) lives in caves that occur along Australia's east coast as well as caves that are found next to inland ranges (Ellis, 2001).

Large-eared pied-bat

The large-eared pied-bat is listed as Endangered under the EPBC Act, as of 15th November 2023. This species has been concluded as likely to occur within the Study Area as per the likelihood of occurrence (Appendix B), due to 'probable' recordings of the species that were produced from Anabats deployed in four locations throughout the Study Area across multiple survey events.

A total of 10 Anabats were deployed over three of the eight surveys for a total of 40 trapping nights. A total of 175 habitat and vegetation assessments were completed over the eight surveys and identified suitable habitat of ironbark woodlands close to a waterbodies where 'probable' large-eared pied bat calls were recorded. Additionally, the Study Area is within the range for the species and contains habitat suitable for large-eared pied-bat survival (as evidenced by species presence), as further explained below.

The large-eared pied-bat is a medium-sized bat that is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland, down south to Bungonia in the NSW Southern Highlands (DERM, 2011). Large-eared pied-bat prefers a specific intersection of habitat traits which makes habitat for the species both uncommon and susceptible to clearing-related impacts. Per the conservation guidelines for the species:

> *Large-eared pied-bat has close association with the presence of sandstone escarpment (for roosts) and fertile valleys (for foraging), particularly where the valleys support box gum woodland. This is a relatively restricted combination of habitat factors, and the extent of woodlands on fertile soils within its range has been greatly diminished by clearing (Pennay, 2008*).

Escarpments provide roosting habitat for this species, with the availability of diurnal roost options an important indicator of habitat suitability. Large-eared pied-bat prefers rhyolite cliffs and caves for roosting purposes, although geology is secondary to presence of suitably deep and high caves and overhangs which provide shelter from natural disturbances (DCCEEW, 2021). There are no deep caves or overhangs within the Study Area, so there is an absence of roosting and breeding habitat, however the species may utilise habitats for foraging.

Fertile valleys and vegetated areas provide foraging habitat for large-eared pied-bat, with riverine and riparian corridors being identified as favourable for the insectivorous species. The species has been recorded foraging in canopied vegetation communities of various descriptions including dry and wet sclerophyll forest, grassy woodland, *Callitris* dominated forest, tall open eucalypt forest with a rainforest sub-canopy, subtropical rainforest and small clearings adjacent to rainforest (DCCEEW, 2021).

Though not confirmed, the majority of records in canopied woodland indicates a sensitivity to broadscale land clearing. However, narrow connecting riparian strips in otherwise cleared habitat are sometimes quite heavily used (DCCEEW 2024). Habitat within the Study Area for this species can likely be defined as woodland foraging habitat within a proximity of several kilometres to roosting habitat as it is stated that that "Almost all records are within several kilometres of cliff lines or rocky terrain and it is likely that critical foraging resources are also located in these areas" (DAWE 2021). There are areas of potential steep, rocky terrain located to the north of the Study Area around Belmont State Forest, to the west of the Study Area at Isla Gorge and to the east at Kroombit Tops National Park. Belmont State Forest is located adjacent to the Study Area, while Isla Gorge is located over 40km to the west and Kroombit Tops National Park over 60km to the north-east from the Study Area. Potential bat roost caves and cliffs at Isla Gorge National Park and Kroombit Tops National Park are located beyond the likely distance the species will move during nightly foraging activities. Due to the proximity of Belmont State Forest to the northern boundary of the Study Area, there is a potential that areas of steep terrain may support roosting bats in this location that utilise the Study Area for foraging.

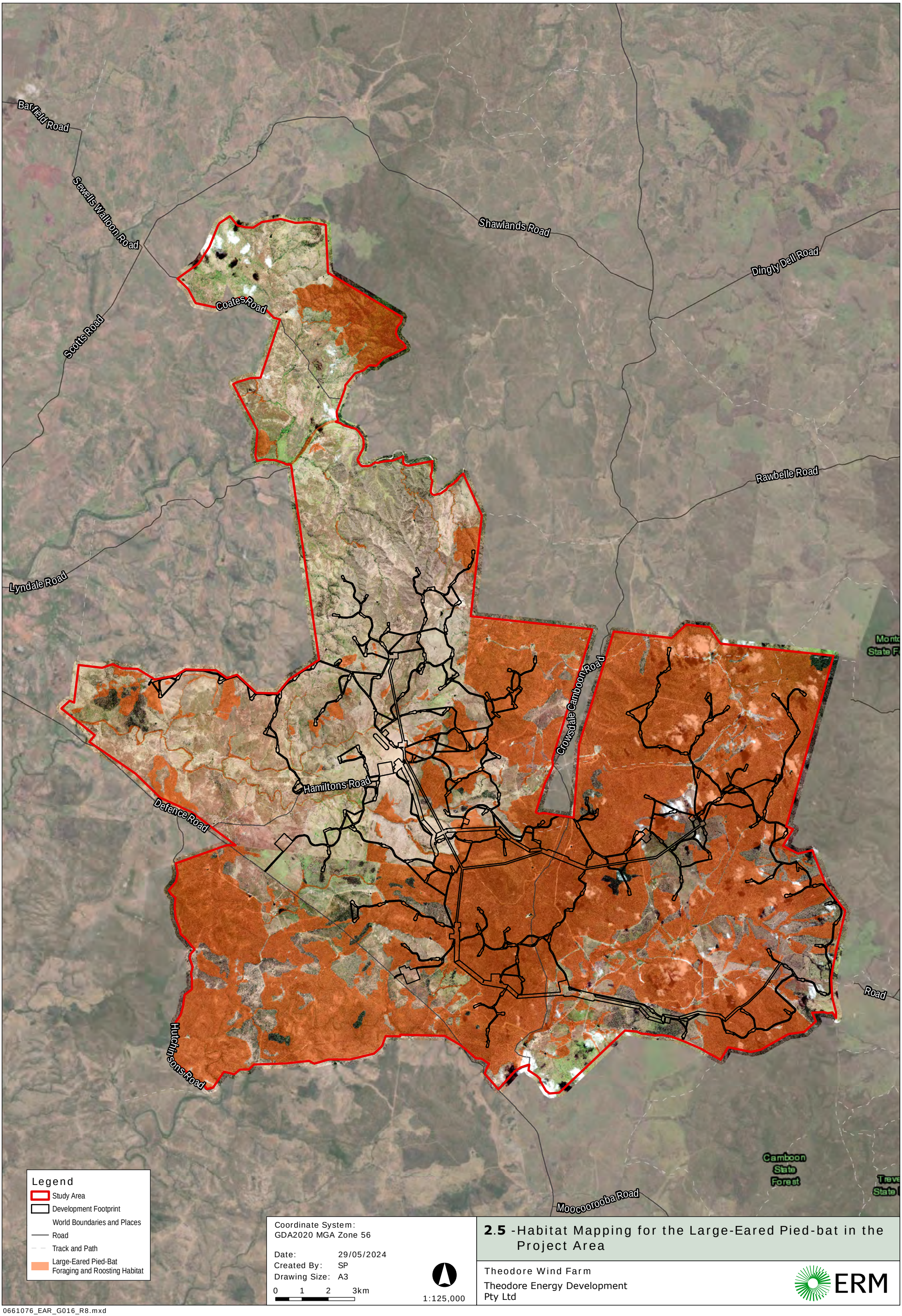
Habitat for the large-eared pied-bat has been delineated from the broad habitat types, based on the habitat requirements for the species. This is as follows:

- Foraging habitat:
  - Eucalypt woodland and open forest dominated by *E. crebra* with a grassy understorey; and
  - Riparian woodland and open forest dominated by *E. tereticornis* often associated with stream channels.
- Generally unsuitable habitat:
  - Vine forest/ thickets and dry rainforest;
  - Waterbodies and drainage features;
  - Grasslands and cultivated agricultural land; and
  - Brigalow woodlands dominated by *Acacia harpophylla*.

There is a total 21,719.7 ha foraging habitat, and 25,110.4 ha of generally unsuitable habitat, within the Study Area. No roosting habitat for this species was identified within the Study Area, however there is potential for such habitat to occur in the Locality. Mapped habitat for the large-eared pied-bat is shown on Figure 2-5, with habitat types summarised below in Table 2-18.

TABLE 2-18 LARGE-EARED PIED BAT HABITAT SUMMARY IN THE STUDY AREA

	Foraging Habitat	Generally Unsuitable Habitat
Description	Fertile valleys and vegetated areas, riverine and riparian corridors, dry and wet sclerophyll forest and grassy woodland	Cleared areas are likely to constitute unsuitable habitat, with Acacia woodland also not suitable within the Study Area. Though the species has been recorded foraging in subtropical and dry rainforest, vegetation communities within the Study Area are of generally low quality and do not form suitable habitat.
Presence within the Study Area	Eucalypt woodland and open forest dominated by *E. crebra* with a grassy understorey. Riparian woodland and open forest dominated by *E. tereticornis* often associated with stream channels.	• Vine forest/ thickets and dry rainforest; • Waterbodies and drainage features; • Grasslands and cultivated agricultural land; and • Brigalow woodlands dominated by *Acacia harpophylla*.
Total in the Study Area	21,719.7 ha of foraging habitat	25,110.4 ha of generally unsuitable habitat



2.5 -Habitat Mapping for the Large-Eared Pied-bat in the Project Area

Theodore Wind Farm

Theodore Energy Development Pty Ltd

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2.3 IMPACTS TO LISTED THREATENED AND MIGRATORY SPECIES

2.3.1 IMPACTS TO SQUATTER PIGEON (SOUTHERN)

The squatter pigeon (southern subspecies) (southern squatter pigeon) is listed as Vulnerable, under the EPBC Act, as of 16th July 2000, and is known to occur within the Study Area. This species was successfully identified on one occasion during field surveys in October 2022 survey at a farm dam located in the northern section of the Study Area, on one occasion during the September/October 2023 survey in the north-western section of the Study Area, and on one occasion during December 2023 survey.

The breeding, foraging and dispersal habitat requirements for the species, as well the habitat presence within the Study Area has been detailed as part of Section 1.3. Habitat mapping is presented on Figure 2-2.

The direct impacts to the southern squatter pigeon will be the clearing of breeding, foraging and disturbance to dispersal habitat during the construction phase of the Proposed Action. This initial clearing of habitat represents an initial short-term disturbance to the species, this is due to the species preference to occur (and sometimes preference) disturbed areas. The direct impact to southern squatter pigeon has been detailed in Table 2-19.

TABLE 2-19 DIRECT IMPACTS TO THE SOUTHERN SQUATTER PIGEON

	Breeding Habitat	**Foraging and Dispersal Habitat**
Total Amount of Habitat to be Impacted (ha)	524.0	437.2
% Amount of Total Habitat to be Impacted	2.1%	1.8%

Quality of Habitat to be Impacted	It is important to note that habitat for this species is differentiated between breeding and foraging and dispersal habitat only from the aspect of 'distance from water' (i.e., the habitat for all functions is the same, however breeding habitat is mapped closer to water).
	Quality of habitat for this species varies in condition across the Study Area. Mapped as the associated vegetation communities within 3 km to water:
	• *Eucalyptus crebra*. +/- *Corymbia* spp. dominated open woodland associated with plateaus
	  ◦ Condition of this habitat varies across the Study Area. Areas with more living trees, more juvenile trees and a thicker ground cover are of good condition. Other areas with a higher amount of stags and a degraded ground cover were of poor condition.
	• *Acacia cambagei* +/- *Acacia* spp. dominated open forest or woodland
	  ◦ Quality of this habitat is typically moderate due to its steep and rocky nature preventing it from being over grazed like other habitat types.
	• *Astrebla* spp. dominated grassland
	  ◦ Higher rates of degradation due to high pressures from cattle grazing, therefore quality is poor.
	Quality and quality of habitat is less relevant to this species, as it shows a preference for degraded and impacted areas and its requirement to be close to a water source.	

2.3.1.1 SIGNIFICANT IMPACT ASSESSMENT

The Proposed Action in the Study Area is Likely to result in a significant impact to the southern squatter pigeon.

This species was observed on three occasions within the Study Area. A total of 24,290.8 ha of southern squatter pigeon habitat has been mapped to occur within the Study Area, including 8,023.0 ha of foraging and roosting habitat and 16,267.8 ha of breeding habitat. 437.2 ha of foraging and roosting habitat and 524 ha of breeding habitat is expected to be impacted as a result of the Proposed Action.

Southern squatter pigeons do not fly at the RSA height and the Proposed Action will not cause a barrier to movement or dispersal of this species across the landscape. It has been concluded that the Proposed Action is likely to cause a significant impact to the species. A significant impact assessment for southern squatter pigeon based on the guidance provided in the SIG 1.1 is presented in Table 2-20.

TABLE 2-20 SIGNIFICANT IMPACT ASSESSMENT FOR THE SOUTHERN SQUATTER PIGEON

Criteria	Description	Criteria Triggered?
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
Lead to a long-term decrease in the size of an important population of a species;	437.2 ha of southern squatter pigeon foraging and dispersal habitat (1.8% of all foraging and dispersal) and 524 ha of breeding habitat (2.1% of all breeding habitat) is expected to be disturbed within the Study Area. Three individual observations of the species have been made across the Study Area. Additionally, based on a conservative approach, the Study Area falls within the conservation-significant southern extent of the species occurrence south of the Carnarvon Ranges, making the impacted population an 'important sub-population.' However, impacts to approximately 1.8% of total available foraging and dispersal habitat and 2.1% of total available breeding habitat are unlikely to cause a local population to experience decline. Furthermore, southern squatter pigeon has an observed tendency to inhabit disturbed and partially disturbed areas. Therefore, the Proposed Action is unlikely to lead to a long-term decrease in the size of an important population.	Unlikely
Reduce the area of occupancy of an important population;	This species' area of occupancy is roughly estimated at 10,000 km^2, with a presumed low reliability in this figure (Garnett & Cornell, 2000). The Proposed Action will lead to disturbance to 437.2 ha of southern squatter pigeon foraging and dispersal habitat (1.8% of all foraging and dispersal) and 524 ha of southern squatter pigeon breeding habitat (2.1% of all breeding habitat) within the Study Area. Three individual observations of the species have been made across the Study Area. Additionally, based on a conservative approach, the Study Area falls within the conservation-significant southern extent of the species occurrence south of the Carnarvon Ranges, making the impacted population an 'important sub-population.' The linear nature of the Proposed Action and the retention of the majority of the squatter pigeon habitat in the Study Area	Unlikely

Criteria	Description	Criteria Triggered?
	will allow the persistence of the species. Therefore, it is likely with implemented mitigation measures such as pre-clearance surveys and micro-siting, impacts associated with the Proposed Action are unlikely to reduce area of occupancy for an important population of this species.	
Fragment an existing important population into two or more populations;	Impacts to 437.2 ha of southern squatter pigeon foraging and dispersal habitat (1.8% of all foraging and dispersal habitat) and 524 ha of southern squatter pigeon breeding habitat (2.1% of all breeding habitat) are unlikely to fragment populations of this species due to southern squatter pigeon's comfort dispersing through disturbed areas. Three individual observations of the species have been made across the Study Area. Additionally, based on a conservative approach, the Study Area falls within the conservation-significant southern extent of the species occurrence south of the Carnarvon Ranges, making the impacted population an 'important sub-population.' Disturbance will largely occur within small, isolated turbine locations, or narrow linear areas within the Study Area. This will ensure that southern squatter pigeon remains connected, both within and outside of the Study Area.	Unlikely
Adversely affect habitat critical to the survival of a species;	24,290.8 ha of southern squatter pigeon habitat has been mapped to occur within the Study Area. Based on a conservative approach, the Study Area falls within the conservation-significant southern extent of the species occurrence south of the Carnarvon Ranges, making the impacted population an 'important sub-population.' Additionally, this habitat provides foraging and breeding function to the species. Due to the identified foraging and breeding habitat, and that the population of squatter pigeon within the Study Area potentially constitutes an 'important sub-population,' it has been considered likely the Study Area supports habitat critical to the survival of the species. Therefore, projected impacts of 437.2 ha to southern squatter pigeon foraging and dispersal habitat (1.8% of all foraging and dispersal habitat) and 524 ha to southern squatter pigeon breeding habitat (2.1% of all breeding habitat) are likely to adversely affect habitat critical to the survival of the species.	Likely
Disrupt the breeding cycle of an important population;	524 ha of southern squatter pigeon breeding habitat (2.1% of total breeding habitat) is expected to be disturbed within the Study Area. Three individual observations of the species have been made across the Study Area. Additionally, based on a conservative approach, the Study Area falls within the conservation-significant southern extent of the species occurrence south of the Carnarvon Ranges, making the impacted population an 'important sub-population.' Considering the retention of connectivity values, the species' ability to breed throughout the year (North, 1913-14), and the implementation of micro-siting at planned infrastructure sites, it is unlikely that the breeding cycle of southern squatter pigeon will be disrupted by the Proposed Action.	Unlikely
Modify, destroy, remove, isolate or decrease the availability or quality	The Proposed Action will result in the disturbance 437.2 ha of southern squatter pigeon foraging and dispersal habitat (1.8% of total foraging and dispersal habitat) and 524 ha of southern squatter pigeon breeding habitat (2.1% of all breeding	Unlikely

Criteria	Description	Criteria Triggered?
of habitat to the extent that the species is likely to decline;	habitat). This accounts for only a small area of habitat to be removed in relation to the larger context of the Study Area, which supports 24,290.8 ha of southern squatter pigeon habitat total. It is expected that the small amounts of disturbance in the larger context of the landscape will not remove/isolate or decrease the quality of habitat that would result in species decline.	
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	Invasive species such as feral cats (*Felis catus*) and European red foxes (*Vulpes vulpes*) are common pests encountered Queensland and are particularly harmful to native threatened birds. These invasive species are known to occur in the Study Area. The Proposed Action activities during construction and operation will adopt and follow Biosecurity measures to prevent introduction of new invasive species or the spread of those known to the Study Area.	Unlikely
Introduce disease that may cause the species to decline; and	There is currently limited evidence of diseases causing detrimental effects on southern squatter pigeon populations in Queensland. There is also no evidence to suggest the proposed disturbance would introduce a disease that would cause the species to decline. Additionally, precautions will be taken to ensure that the spread of disease does not occur. This includes following biosecurity measures as part of a biosecurity management plan.	Unlikely
Interfere substantially with the recovery of the species.	There are no formally adopted recovery plans for this species. However, it is considered that the disturbance of habitat in linear areas within the Study Area will not affect the recovery of this species. Additionally, impacted areas in the Study Area (437.2 ha impact to southern squatter pigeon foraging and dispersal habitat (1.8% of total foraging and dispersal habitat) and 524 ha impact to southern squatter pigeon breeding habitat (2.1% of total breeding habitat)) will remain connected to adjacent areas of suitable habitat, and mitigation measures such as micro-siting and pre-clearance surveys will be utilised. This will enable the species to continually traverse the landscape, ensuring genetic viability of the population. The Proposed Action is also unlikely to restrict access or limit the availability of current breeding habitat adjacent to known waterbodies such as farm dams and watercourses. While there is potential the population within the Study Area constitutes an 'important sub-population' of squatter pigeon, with the above avoidance and mitigation measures enacted, it is unlikely the Proposed Action will interfere substantially with the recovery of the species.	Unlikely
Significant Impact: Likely		

2.3.2 IMPACTS TO SATIN FLYCATCHER

The satin flycatcher is listed as Migratory under the EPBC Act. This species was considered known to occur as per the likelihood of occurrence (Appendix B), following a positive identification of the species via direct observation and bird call identification during the October 2022 and October 2023 field surveys. The Study Area occurs within the range for the species, and the habitat requirements for the species occur within the Study Area as explained below.

The foraging and roosting habitat requirements for the species, as well the habitat presence within the Study Area has been detailed as part of Section 2.2.3.1. Habitat mapping is presented on Figure 2-3.

Table 2-21 shows that direct impacts will result in a reduction in the total amount of habitat available for the species in the development footprint. Therefore, such direct impacts will be considered as part of the significant impact assessment for this species.

TABLE 2-21 DIRECT IMPACTS TO THE SATIN FLYCATCHER

	Foraging and Roosting Habitat
Total Amount of Habitat to be Impacted	19.6
% Amount of Total Habitat to be Impacted	1.0%

Quality of Habitat to be Impacted	Quality of habitat for this species varies in condition across the Study Area.
	• Riparian woodland and open forest dominated by *Eucalyptus populnea*, E. *tereticornis* often associated with stream channels.
	  ○ This habitat was generally of moderate to poor condition due to presence of weedy species of grasses and shrubs such as Lantana camara and erosion caused by cattle, high grazing pressures.
	• Vine Forest/Thickets and Dry Rainforest
	  ○ Trees present may provide habitat for birds and mammals. However, these areas are quite isolated and degraded.
	  ○ Woody debris generally absent.
	  ○ The ground layer largely consists of natives such as *Aristida spp.* (wire grass)*, Heteropogon sp* grass), and *Bothriochloa decipiens.*

2.3.2.1 SIGNIFICANT IMPACT ASSESSMENT

The Proposed Action is unlikely to result in a significant impact to the satin flycatcher.

A total of 1,964.6 ha of foraging and roosting habitat has been mapped for this species within the Study Area. The proposed disturbance during the construction phase is 19.6 ha (1.0% of available satin flycatcher habitat). Satin flycatchers are unlikely fly at the RSA height and the Proposed Action will not cause a barrier to movement or dispersal of this species across the landscape. It has been concluded that the Proposed Action will not have a significant impact on the satin flycatcher. A significant impact assessment for the satin flycatcher based on the guidance provided in the SIG 1.1 is presented in Table 2-20.

TABLE 2-22 SIGNIFICANCE IMPACT ASSESSMENT FOR THE SATIN FLYCATCHER

Criteria	Description	Criteria Triggered?
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:		
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of	A total of 1,964.6 ha of satin flycatcher habitat has been identified within the Study Area. Considering the definition above and that the species is known to utilise the Study Area, the entirety of this habitat has been considered important habitat for the species. The area of impact to important habitat for the satin flycatcher that is likely to result in a significant impact	Unlikely

Criteria	Description	Criteria Triggered?
important habitat for a migratory species.	is 4,400 ha (internationally significant) or 440 ha (nationally significant) (DoE, 2015). A total of 19.6 ha, or 1% of the total satin flycatcher habitat within the Study Area is estimated to be impacted as a result of the Proposed Action. Therefore, the Proposed Action is unlikely to substantially modify, destroy or isolate an area of important habitat for the satin flycatcher.	
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.	Invasive species that have been identified as a threat to the satin flycatcher include: • Black rat (*Rattus rattus*); and • Invasive vines of riparian habitat (e.g. rubber vine (*Cryptostegia grandiflora*)). A total of 1,964.6 ha of satin flycatcher habitat has been identified within the Study Area. Considering the definition above and that the species is known to utilise the Study Area, the entirety of this habitat has been considered important habitat for the species. The Proposed Action activities during construction and operation will adopt and follow Biosecurity measures, including development and adherence to a Biosecurity Management Plan that will ensure that new invasive species are not introduced into the Study Area and that populations of invasive species within the Study Area do not further proliferate as a result of the Proposed Action.	Unlikely
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Satin flycatchers breed at elevations of more than 600m above sea level in south-eastern Australia. They breed from November to early January, however eggs have been recorded in December in Queensland. An ecological significant proportion of a satin flycatcher population has been specified as 17,000 individuals (internationally significant) and 1,700 individuals (nationally significant). Satin flycatcher have been directly observed and detected through bird calls within the Study Area, however, it is considered unlikely that the Study Area supports an ecologically significant proportion of a satin flycatcher population and therefore it is unlikely that the Proposed Action will disrupt the lifecycle of an of an ecologically significant proportion of the population.	Unlikely
Significant Impact: Unlikely		

2.3.3 IMPACTS TO LARGE-EARED PIED-BAT

The large-eared pied-bat is listed as Endangered, under the EPBC Act. This species has been concluded as known to occur within the Study Area as per the likelihood of occurrence (Appendix B) due to several 'probable' recordings of the species that were produced from Anabats deployed throughout the Study Area.

The habitat requirements for the species, as well the habitat presence within the Study Area has been detailed as part of Section 2.2.4.1. Habitat mapping is presented on Figure 2-5.

Table 2-23 shows that direct impacts will result in a reduction in the total amount of habitat available for the species in the development footprint. Therefore, such direct impacts will be considered as part of the significant impact assessment for this species.

TABLE 2-23 DIRECT IMPACTS TO THE LARGE-EARED PIED-BAT

	Foraging Habitat
Total Amount of Habitat to be Impacted	886.3 ha
% Amount of Total Habitat to be Impacted	4.1%

Quality of Habitat to be Impacted	• Riparian woodland and open forest dominated by *Eucalyptus populnea*, E. *tereticornis* often associated with stream channels.
	  ○ This habitat was generally of moderate to poor condition due to presence of weedy species of grasses and shrubs such as L*antana camara* and erosion caused by cattle, high grazing pressures.
	• Eucalypt woodland and open forest dominated by E. crebra with a grassy understorey
	  ○ The trees present may provide habitat for birds and mammals. However, habitat for arboreal mammals is likely to be sparse due to the limited amount of hollow bearing and mature trees observed within the Study Area.
	  ○ The ground layer largely consists of natives such as *Aristida spp.* (wire grass)*, Heteropogon sp* grass), and *Bothriochloa decipiens.*

2.3.3.1 SIGNIFICANT IMPACT ASSESSMENT

The Proposed Action is considered to have the potential to result in a significant impact to the large-eared pied-bat.

There is a total 21,719.7 ha foraging habitat, and 25,110.4 ha of generally unsuitable habitat, within the Study Area. A total of 886.3 ha of large-eared pied bat habitat is expected to be impacted as a result of the Proposed Action.

A significant impact assessment based on the guidance provided in the SIG 1.1 is presented in Table 2-24. It has been concluded that the Proposed Action has the potential to cause a significant impact to the large-eared pied bat.

TABLE 2-24 SIGNIFICANCE IMPACT ASSESSMENT FOR THE LARGE-EARED PIED-BAT

Criteria	Description	Criteria Triggered?
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
Lead to a long-term decrease in the size of a population;	The Study Area likely supports a population of large-eared pied bat. The species is considered likely to occur within the Study area due to 'probable' recordings of the species that were produced from four Anabat recording devices deployed across the Study Area during multiple field surveys. 21,719.7 ha of foraging habitat for large-eared pied-bat has been identified and mapped within the Study Area, with a total of 886.3 ha of foraging habitat (4.1% of all	Potential

Criteria	Description	Criteria Triggered?
	foraging habitat within the Study Area) projected to be impacted as a result of the Proposed Action. Despite implementation of management and mitigation measures (e.g., pre-clearance surveys, micro-siting and biosecurity measures), a disturbance of 886.3 ha of habitat has the potential to lead to a long-term decrease in the size of a population, reduce the area of occupancy and adversely affect habitat critical to the survival of a species.	
Reduce the area of occupancy of the species;	The estimated area of occupancy of large-eared pied bat is 1,500 km^2 (150,000 ha), of which the Study Area occurs at the northern-most extent (DCCEEW, 2023). Area of occupancy for the species is determined by total area of know maternity roost sites, which provide an essential roosting, sheltering and breeding function for the species (DCCEEW, 2023). No roosting habitat is mapped to occur within the Study Area, however likely recordings of the species across multiple locations and multiple survey events indicate the possibility for large-eared pied-bat roosting habitat within the Locality. Vegetation clearance in the proximity of roosts is identified as a key threat to large-eared pied-bat in the species' conservation advice (DCCEEW, 2023). The Proposed Action is projected to impact a total of 886.3 ha of foraging habitat (4.1% of all foraging habitat within the Study Area). It is therefore considered potential that the Proposed Action will reduce the area of occupancy of the species.	Potential
Fragment an existing population into two or more populations;	The Proposed Action is expected to impact a total of 886.3 ha of foraging habitat (4.1% of all foraging habitat within the Study Area). This impact will only remove small, linear patches of habitat. Furthermore, large-eared pied-bat is a highly mobile species. It is therefore considered unlikely that the Proposed Action will fragment an existing important population into two or more populations.	Unlikely
Adversely affect habitat critical to the survival of a species;	Large-eared pied-bat conservation advice identifies that, due to loss, degradation and fragmentation of habitat, especially foraging habitat, all suitable habitat for the species likely constitutes habitat critical to the survival (DCCEEW, 2023). A total of 886.3 ha of foraging habitat (4.1% of all foraging habitat within the Study Area) for large-eared pied bat is projected to be impacted as a result of the Proposed Action. No roosting habitat, which is essential for the species, has been mapped to occur within the Study Area. However, large-eared pied-bats were recorded at four locations within the Study Area across multiple survey events, indicating the potential for suitable roosting sites within the Locality. Given this, there is potential the Proposed Action will adversely affect habitat critical to the survival of large-eared pied-bat, via removal of suitable foraging habitat in proximity of suitable roosting habitat.	Potential

Criteria	Description	Criteria Triggered?
Disrupt the breeding cycle of a population;	Large-eared pied bats utilise roosting habitat for breeding function. This includes cliffs, escarpments, overhangs, cracks or rocky ledges (DCCEEW, 2023). The Proposed Action is estimated to impact 886.3 ha of foraging habitat (4.1% of all foraging habitat within the Study Area), however no roosting habitat has been identified within the Study Area. Therefore, it is unlikely the Proposed Action will disrupt the breeding cycle of an important population of large-eared pied-bat.	Unlikely
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	A total of 21,719.7 ha of large-eared pied bat foraging habitat has been identified and mapped within the Study Area, with projected impacts to this habitat of 886.3 ha (4.1% of all foraging habitat within the Study Area). The species displays fidelity to established foraging habitat (DCCEEW, 2023). Foraging resources in proximity of established diurnal roosts are of high ecological value for large-eared pied-bat, however no essential roosting habitat in the Study Area has been identified, and while there is potential for roosting habitat in the Locality, that cannot be confirmed. Given this, it is considered unlikely that impacts associated with the Proposed Action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Predation by introduced predators (such as feral cats (*Felis catus*), European red foxes (*Vulpes vulpes*) and rats (*Rattus sp.*)) has been suggested as a potential threat to cave roosting microbats in Australia. Additionally, roosting habitat disturbance by feral goats (*Capra hircus)* is considered a major risk to the species (DCCEEW, 2023). No feral goats were observed within the Study Area. Additionally, the Proposed Action activities during construction and operation will adopt and follow Biosecurity measures, including development and adherence to a Biosecurity Management Plan that will ensure that new invasive species are not introduced into the Study Area and that populations of invasive species within the Study Area do not further proliferate as a result of the Proposed Action.	Unlikely
Introduce disease that may cause the species to decline; and	The impact of diseases, including but not limited to, whitenose syndrome (WNS) is a potential threat to the species. White-nose syndrome is caused by the fungus *Pseudogymnoascus destructans* and leads to death through an infection of the muzzle and other parts of the body. The disease has not yet been detected in Australia but is a threat to cave-dwelling bats in other parts of the world and could have a significant impact on this species if it is introduced (DCCEEW, 2023). Precautions will be taken to ensure that the spread of disease does not occur, as detailed in a Biosecurity Management Plan. This includes following biosecurity measures and ensuring proper personal protection equipment is worn by construction workers and vehicle washdowns before entering identified habitats.	Unlikely

Criteria	Description	Criteria Triggered?
Interfere substantially with the recovery of the species.	There is currently no adopted Recovery Plan for the species. The priority conservation objective stated within the species Conservation Advice is: *The distribution and the abundance of the species' subpopulations are maintained, and no known maternity roosts are lost. Foraging habitat within the vicinity of known roosts is maintained and is not cleared.* The Proposed Action will impact 886.3 ha (4.1% of all foraging habitat within the Study Area) of long-eared pied bat habitat within the Study Area. No maternity roost sites or roosting habitat has been identified in the Study Area or Locality, albeit the population structure of this species within QLD is poorly known and there are likely maternity roosts that have not been discovered (DCCEEW, 2023). However, with no known roosting sites to be impacted by the Proposed Action, it is unlikely the recovery of large-eared pied-bat will be interfered with.	Unlikely
Significant Impact: Potential		

2.3.4 IMPACTS TO MNES POTENTIAL SPECIES

Avian species with the potential to occur within the Study Area as identified through LoO are identified in Table 2-25.

TABLE 2-25 MNES (POTENTIAL SPECIES) SIGNIFICANT IMPACT ASSESSMENT SUMMARY

Species	Habitat within Study Area	Indicative Development footprint	Comments	Impact Significance
Fauna species				
White-throated needle tail	46,574.9 ha	1,933.2 ha	This species underwent a Significant Impact Assessment as both a vulnerable and migratory species. The species mapped habitat is potential foraging habitat, and if the species were to occur, it is thought to occur as an aerial flyover visitor only. Additionally, an important population or ecologically significant proportion of the species is not considered likely to occur in the Study Area. The proposed action impact to 1,933.2 ha of potential impacts is therefore considered unlikely to result in a significant impact. However, considering the species nature as an aerial species in Australia, and proclivity to fly at RSA heights and above, there is a risk of turbine collision risk should the species occur. Therefore, should the species be observed in the Study Area, adaptive management measures as	Unlikely

Species	Habitat within Study Area	Indicative Development footprint	Comments	Impact Significance
			outlined in a Bird and Bat Management will be undertaken to further avoid any impact to this species. These measures will be informed by operational phase bird monitoring to detect any listed threatened species impacted.	
Black-breasted button quail	232.3 ha	3.1 ha	A total of 232.3 ha potential habitat is mapped to occur within the Study Area, which is considered habitat critical to the survival of the species. 3.1 ha of this potential habitat (1.3% of this habitat type within the Study Area) is expected to be cleared as a result of the Proposed Action. Considering the negligible area of impact compared to the extent of available habitat in the Study Area, the impact is unlikely to result in a significant impact to the species, especially considering that there is no important population within the Study Area. Additionally, the management and mitigation measures outlined in Section 6 will mitigate impacts to the species. A full significant impact assessment in accordance with SIG 1.1 (DoE, 2013) is presented in Appendix E.	Unlikely
Australian painted snipe	56 ha	1.3 ha	A total of 56 ha potential foraging habitat is mapped to occur within the Study Area, which is not considered habitat critical to the survival of the species. 1.3 ha of this potential foraging habitat (2.3% of this habitat type within the Study Area) is expected to be cleared as a result of the Proposed Action. There is no breeding habitat mapped in the Study Area as it doesn't contain the required habitat features to constitute Australian painted snipe breeding habitat (such as canopy cover in proximity to wetlands, low vegetation, isolated islands in shallow wetlands). The potential foraging habitat subject to impact is a small impact in the greater context of the Study Area. This, the lack of breeding habitat in the Study Area, and the absence of any records of the species in the Study Area means that the Proposed Action is unlikely to result in a significant impact to the species. Additionally, the management and mitigation measures outlined in Section 6 will further mitigate impacts to the species. A full significant impact assessment in accordance with SIG 1.1 (DoE, 2013) is presented in Appendix E.	Unlikely

Species	Habitat within Study Area	Indicative Development footprint	Comments	Impact Significance
Rufous fantail	232.3 ha	3.1 ha	The rufous fantail is listed as Migratory under the EPBC Act and id considered potential to occur within the Study Area. A total of 232.3 ha of potential non-breeding foraging habitat for this species has been identified within the Study Area in the form of vine forest/thicket and dry rainforest' broad habitat type. The Study Area is not within the breeding distribution of the species. The area of impact to rufous fantail habitat that is likely to cause a nationally significant impact is 750 ha (DoE, 2014). As a result of the Proposed Action, only 3.1 ha or 1.3% of the total mapped habitat for this species within the Study Area will be impacted. Based on SIA (Appendix E), and in accordance with SIG 1.1 (DoE, 2013) it was determined that a significant impact to rufous fantail is unlikely.	Unlikely
Fork-tailed swift	46,574.9 ha	1,933.2 ha	The species mapped habitat is potential foraging habitat, and if the species were to occur, it is thought to occur as an aerial flyover visitor only. Additionally, an important population or ecologically significant proportion of the species is not considered likely to occur in the Study Area. The Proposed Action impact to 1,933.2 ha of potential impacts is therefore considered unlikely to result in a significant impact. However, considering the species nature as an aerial species in Australia, and proclivity to fly at RSA heights and above, there is a risk of turbine collision risk should the species occur. Therefore, should the species be observed in the Study Area, adaptive management measures as outlined in a Bird and Bat Management (BBMP) will be undertaken to further avoid any impact to this species. These measures will be informed by operational phase bird monitoring to detect any listed threatened species impacted.	Unlikely

2.4 OFFSET REQUIREMENTS

A SIA was undertaken for relevant MNES against the SIG 1.1 (DoE, 2013). The SIA concluded that there is likely to be a significant impact to:

- Breeding habitat for squatter pigeon (southern).

With the potential for a significant impact to:

- Foraging habitat for Large-eared pied-bat.

For more information on the SIA, refer to Appendix E.

Where significant impacts to MNES cannot be avoided, The Proponent is committed to offsetting these impacts. An Offset Management Strategy (OMS) will be prepared, that specifically outlines the requirements to deliver and manage appropriate land-based offsets, in accordance with the conditions of approvals for the Proposed Action. The Proposed Action will also offset the "actual" area of habitat impacted that will be further defined at the detailed design phase. This incentivises the minimisation of impacts to habitats so as to reduce the offset requirement and ecological burden on MNES. The disturbance area for species with likely or potential significant impacts, are outlined in Table 2-26 below. Offset requirements for these species will be calculated in accordance with the EPBC Act *Environmental Offsets Policy* (DSEWPC, 2012).

There is a preference for offsets to be located within the Study Area, avoiding areas of Proposed Action infrastructure. Once an offset area has been selected, and adequate surveys undertaken to confirm species habitat and habitat quality, an Offsets Area Management Plan (OAMP) will be prepared for the implementation and ongoing management of the selected offset areas.

TABLE 2-26 OFFSET REQUIREMENTS

Species	EPBC Act Status	Impact (ha)
Likely Significant Impact		
Southern squatter pigeon (*Geophaps scripta scripta*)	V	524.0 ha breeding habitat
Large-eared pied-bat (*Chalinolobus dwyeri*)	E	886.3 ha foraging habitat
Status listing per EPBC Act: CE = Critically Endangered; E= Endangered; V = Vulnerable; Mi = Migratory.		

3. COLLISION RISK ASSESSMENT AND MODELLING

3.1 COLLISION RISK MODEL LITERATURE REVIEW

Australia has been increasingly adopting renewable energy projects, with 94 operational wind farms present in the country as of October 2022, and that number predicted to grow exponentially in the coming years (Australian Renewable Energy Agency, 2023).

Collision risk is a factor that needs to be considered from an environmental impact perspective which looks to the collision risk to avian species if they were to fly within the Rotor Swept Area (RSA) of a wind farm. Increase in WTGs has resulted in adverse effects on many avian species, through both direct fatalities as a result of the collision with WTG rotor blades as well as secondary impacts such as the result of habitat alteration and loss and the changes in normal flight paths as a result of WTG presence/habitat loss (Drewitt and Langston, 2006, Madders and Whitfield, 2006).

Collision risk is particularly important to determine and account for in proposed wind farm areas where bird species present at a higher risk of decline, such as those of conservation significance. This is such that even a few fatalities can grossly alter the maturing and reproductive rates of a species, thus potentially result in regional and national declines (Drewitt and Langston, 2006; Loss et al., 2013). Other species that are vulnerable to collision with WTGs include high-flying, soaring birds of prey, such as raptors (Martin et al., 2022). Collision-related mortality is spread unevenly among species where few species often account for a large proportion of collisions (Madders and Whitfield, 2006, de Lucas et al., 2008, Watson, 2018). Collision risk will also vary dependent on each species, based on factors such as foraging behaviour, flight height, flock sizes, morphology and flight speed (Drewitt and Langston, 2006, de Lucas et al., 2008, Barrios and Rodríguez, 2004). WTG collision rates will vary based on variables such as time of day and time of year, based on the number of birds present in an RSA (Murgatroyd et al., 2018, May et al., 2010).

Raptors are known to utilise thermal soaring (slow circle-soaring flight on thermals) which is highly dependent on weather conditions. Under less favourable conditions for the species to gain altitude, WTG collision risk may be increased with the birds not tending to engage in active flight (Barrios and Rodríguez, 2004; Johnston et al., 2014b; Marques et al., 2014). This is such that the bird is soaring and not actively flapping through an airspace. This may prolong the amount of time it is present within the risk window of a WTG. It has been studied in a wind farm that most raptors will spend little time in a defined collision risk zone, but will often intersect in and out of the risk window (Linder et al., 2022a)

Important predictors of collision risk for raptors have been studied and some of the main findings include that active flight can lead to a higher risk of collision with the tendency for a bird to dissect the path of multiple WTGs in an area (Linder et al., 2022a). Furthermore, track tortuosity can also impact collision risk, such that less tortuosity increases collision risk. This is important as tortuous tracks can be a result of raptors utilising thermal soaring, and thus, thermal soaring may actually reduce collision risk, which is consistent with other studies having been conducted on the topic (Péron et al., 2017; Janss, 2000).

Collision risk models (CRM) have been developed to assess the risk of impact to species as a result of wind farms. It is noted that such models are only able to assess the risk as a result of direct mortality from WTG hits, and not as a result of other impacts like habitat loss and flight

redirection. A study by Masden and Cook (2016) reviewed 10 models that have been used broadly to assess the probability of bird species colliding with WTGs during passage through a Project dependent RSA. The methods that were assessed were divided into those based on observational flight data, where flight behaviour, habitat use and flux of birds are analysed, as well as those that focus primarily on collisions based on theoretical parameters in the absence of bird data. The study by Masden and Cook (2016) explained that all collision risk models involve the following:

- To calculate the probability of a collision occurring assuming no evasive action – which requires information on bird morphometrics, flight speed and WTG rotor speed and size; and
- To measure the of the number of birds within a risk window in a given year – which is formulated based on actual observational data, or theoretical behavioural flight data for species in a given wind farm Study Area.

Table 3-1 shows a summary review of four of the main models mentioned in Masden and Cook (2016), including the Band Model, which was used for the Proposed Action. For each model, this table presents the objective of the model, inputs required as well as the limitations or main assumptions of the model.

TABLE 3-1 COMPARISON OF COLLISION RISK MODELS

Collision Risk Model	Objective and Benefits of the Model	Limitations and Assumptions of the Model
Tucker Model (Tucker, 1996a, Tucker, 1996b).	• The model analyses the motions and dimensions of both birds and propeller-type rotor blades and predicts the probability of a collision when the bird flies through the RSA (Tucker, 1999a). • This model can account for upwind and downwind flights of birds.	• Does not measure a likely number of collisions as a measure of bird density; • Blades are 1 or 3 dimensional which consist of length, chord and twist; • Bird always considered to be gliding, and never flapping in flight behaviour; • Bird dimensions are always rectangular with a wingspan that always exceeds length; • Does not consider the collision with the WTG tower; and • Avoidance behaviour is mainly left out of this model.
Band and Band Model (Band 2007; and Band 2012).	• The model was developed to take into considered the probability of a WTG blade that occupies the same space as a bird, and the time taken for the bird to pass through the rotor swept volume (RSV) of the area occupied by this WTG. • It has two stages for estimating collisions per year: 1) number of birds flying through the rotor and 2) the probability of collision from a single transit of a rotor. • This model accounts for avoidance or evasive behaviour by implementing an avoidance rate often between 95-99%. • Bird specific parameters are included into this model such as	• In this model the bird is assumed to be a cruciform shape; • The thickness of the WTG blade still not included into this model; • This model only assumes the bird is flying parallel to the wind, such that it is flying perpendicular to the rotation of the WTG; • Assumes effects of approaching WTG at oblique angles will cancel out, although this may underestimate collision risk; and • Does not consider the collision with the WTG tower. • Can be observational data heavy, when normally in Projects the data can be quite limited.

Collision Risk Model	Objective and Benefits of the Model	Limitations and Assumptions of the Model
	bird length, wingspan, height and flight activity (diurnal/ nocturnal/ migratory). • WTG parameters considered such as diameter, length, operational time, rotor speed, hub height. • Considers bird both when flapping and gliding. • Updates as part of 2012 were made to consider offshore wind farms (not applicable to the Proposed Action).	
Monte Carlo Model (McAdam, 2005)	• This model is based upon the original Band Model however includes stochastic modifications to account for variation in flight height and the effects of wind. • This model calculate the probability of bird being struck given it has passed through the plane of the WTG at a given height and distance less than the rotor length from the centre. • This model considers the effect of wind variation on collision variation through the variance of bird speed as well as changes in the direction of the WTG.	• Includes same limitations of Band Model. • This model includes oblique angles but not bird orientation relative to WTG.
Biosis Propriety Limited (Smales et al., 2013).	• This model has been developed to provide a prediction of the number of collisions between WTGs and a local or migratory group of birds. • This model acknowledges that birds won't only approach WTG at a perpendicular angle, but flights can occur from any direction. • Considers the moving and stationary parts of the WTG – including the WTG tower that may be a factor to consider for bird collisions. • Considers bird parameters and WTG parameters considered as in the Band Model. • Considers avoidance rates of birds.	• This model does not consider when the collisions will occur. • Due to statistically minor numbers of collisions that are concluded from the model – it is unlikely that they will be evenly distributed in time. • Can be observational data heavy, when normally in Projects the data can be quite limited.

Section 3.3 is formulated based on the Collision Risk Model literature review undertaken by Masden and Cook (2016). It is noted that not all models reviewed in Masden and Cook (2016) are included in Section 3.1. However, the main ones that are most commonly adopted in current CRM have been considered.

In addition to the above limitations, the following are considered limitations for all of the models:

- Most models assume that avoidance behaviour is constant across all individuals within a species, and this is unlikely;
- Can overestimate bird collisions;

- Data incorporated is often count data of number of individuals in the species – the same individual may be counted more than once, however it can only be used in the model once, assuming collision equates to mortality – distinguishing individuals of a species is difficult (Eichhorn et al., 2012) circumvents above limitation by using an agent-based model to describe movements of individuals through a landscape and applying collision risk to each individual but this is specific to a single species, the red kite; and
- Species-specific behaviours, topography and wind parameters not considered for majority of the models.

Whilst there are other models available (refer to Table 3-1), the CRM that was chosen for this Proposed Action was the Band Model, also known as the Scottish Natural Heritage (SNH) Model. The Band Model was chosen based on its ability to calculate an estimate of collisions per year for a bird species which is a pre-construction assessment of collision impacts on local and national populations (SNH, 2016). It considers bird species sighted and WTG model parameters, that ensure that it is project specific and situation dependent.

Further to those discussed in Table 3-1, the limitations of the Band Model as discusses in Band et al. (2007) include the following:

- Birds may be more evident and prominent in some habitats;
- Birds may be easier to identify when flying at different elevations;
- Detection rate may differ for different species;
- Plotting routes of flying birds is difficult due to parallax and can be a skill that takes time to develop; and
- For gliding species such as eagles, it can be hard to tell their correspondence to landscape, however this can be circumvented by having knowledge of the species expected to be seen and knowledge of terrain.

It is noted that the disadvantage of the Band Model is that it does not necessarily consider the direction flying of the bird within the Study Area. Such information is important in order to identify higher risk areas. Nonetheless, this information is accounted for within the risk assessment and identifies areas of high bird activity that will require further surveying in future. Such limitations are all relevant to the Proposed Action and the CRM undertaken for the species relevant to the Study Area. All species identification parameters and detection rates are going to be the same across all CRM types as this comes down to survey effort rather than the model itself. It is noted that the 95% avoidance rate is dealt with within the Proposed Action Model through accounting for 98 and 99% avoidance rates as a result of research done by SNH (2016).

There is constant research going into collision risk, especially with the expansion of renewable energy into new countries and areas, including offshore windfarms. Due to the limited records of listed threatened species (none of which occur within the RSA) that occur within the RSA, as well as the limited raptors within the RSA, the use of the Band Model is considered an adequate model to assess the collision risk associated impacts of the Proposed Action on bird and bat species. Furthermore, the parameters entered into this model are based on field observations as well as information from literature, and therefore considers a conservation estimate of the collision risk to species which does not limit the data or the outcomes.

3.2 BIRD AND BAT RISK ASSESSMENT

The DCCEEW interim guidance on bird and bat management has detailed how CRM needs to be undertaken for listed threatened species (MNES) where risks from the Proposed Action, particularly collision risks, have been identified (DCCEEW, then DAWE, 2021). State Code 23 has listed that CRM be undertaken for listed threatened and migratory species, or species of interest such as raptors, that occur within the RSA and that are identified as at risk from the Proposed Action. Therefore, the risk assessment has identified species at risk of collision with turbines, and those which occur within the RSA have been included in the CRM.

The potential impacts to listed threatened and/or migratory species as a result of the Proposed Action are:

- Direct mortality through WTG collision, and barotrauma (bats only); and
- Changes in how relevant bird species utilise the Study Area.

The introduction of WTGs and associated infrastructure has the potential to lead to changes in how relevant bird species utilise the Study Area. Habitat mapping has been conducted for each listed threatened species that has been assessed as known, likely, or with the potential to occur in the Study Area, and shown on Figure 2-1, Figure 2-2, Figure 2-3, and Figure 2-4.

This Section of the BBMP will demonstrate how the potential impacts to each relevant species, including their risk of impact and site utilisation, have been analysed as part of the bird and bat risk assessment. The species covered in this risk assessment have been informed by the likelihood of occurrence results from desktop and field results conducted in 2022 – 2024.

3.2.1 COLLISION RISK ASSESSMENT APPROACH AND ASSUMPTIONS

Wind farms are known to impact birds and bats through collision with operating turbines. This section provides a detailed risk assessment for listed threatened and migratory birds and bats, using field data from surveys, desktop sources of historical records and literature on the ecology and characteristics of the species, to assess collision risk during the operational phase of the Proposed Action. This risk assessment has considered the likelihood of impact, and potential consequences of events including collision with wind turbines, as well as the impact of construction and operation on the Proposed Action causing changes in site utilisation by bird and bat species.

The risk assessment was based on the Risk Evaluation Matrix Model which complies within the *AS/NZS ISO 31000 Risk Assessment Standard: 2018*. This risk assessment considers the likelihood of an event (collision with WTGs and impact to site utilisation) (Table 3-2), and the consequences should the event occur (Table 3-3). Through calculating the likelihood and the consequence, an overall risk rating is assigned to each species and the risk of potential impact to a species because of the operation of the Proposed Action (Table 3-4). Such impacts include the direct collisions with WTGs as well as indirect impacts such as the deterrence of migratory flightpaths.

TABLE 3-2 LIKELIHOOD OF EVENT CRITERIA

Likelihood	Description
Certain	It is expected to occur in most circumstances. The risk event could occur in any year (>95%).
Almost Certain	It will probably occur in most circumstances. The risk event could occur in any year (>50%).
Likely	It may occur at some time. It is equally probable that the risk event could or could not occur in any year (50%).
Unlikely	It could occur at some time. It is probable than not that the risk event could occur in any year (<50%).
Rare	It may occur in exceptional circumstances. It is improbable that the risk event could occur in any year (<5%).

TABLE 3-3 CONSEQUENCE OF EVENT CRITERIA

Negligible	Low	Moderate	High	Severe
Occasional individuals lost but no reduction in local or regional population viability.	Repeated loss of small numbers of individuals but no reduction in local or regional population viability.	Moderate loss in numbers of individuals, leading to minor reduction in localised or regional population viability for between one and five years.	Major loss in numbers of individuals, leading to reduction in regional or state population viability for between five and 10 years.	Extreme loss in numbers of individuals, leading to reduction in regional or state population viability for a period of at least 10 years.

TABLE 3-4 RISK MATRIX OF RISK LEVEL BASED ON LIKELIHOOD AND CONSEQUENCE

Likelihood	Consequence				
	Negligible	**Low**	**Moderate**	**High**	**Severe**
Certain	Negligible	Low	High	Severe	Severe
Almost Certain	Negligible	Low	Moderate	High	Severe
Likely	Negligible	Low	Moderate	High	High
Unlikely	Negligible	Negligible	Low	Moderate	High
Rare	Negligible	Negligible	Negligible	Low	Low

Only two listed bird or bat species, the satin flycatcher and squatter pigeon (southern), were recorded within the Study Area The large-eared pied bat is considered likely due to a 'probable' occurrence in the Study Area via Anabat detection equipment. None of these species were recorded within the assessed RSA (60 – 270 m) for the Proposed Action.

Nonetheless, this risk assessment took a conservative approach to determine the risk level for each listed threatened and/or migratory species that is considered 'known', 'likely' or has the 'potential' to occur within the Study Area by considering hypothetical risks to the species if they were to occur. Raptors observed in the Study Area that are known to fly at typical RSAs have also had their potential risk assessed.

This approach considered profiling species based on information obtained from the published literature and the following factors when considering the risk level:

- Whether species were, based on the LoO criteria, known, likely, potential or unlikely to occur within the Study Area;
- Existence of records in the Study Area and Locality;
- Existence of records in a broader Locality (with this broader Locality being a 150 km radius search area of the Study Area);
- Flight heights inside or outside of RSA, based on literature and realistic observations for the Locality; and
- Amount of known or potential habitat in the Study Area.

The results of this approach are considered to provide a risk result as a 'worst-case' scenario, based on the use of literature and on-ground field observations during the field surveys.

3.2.2 COLLISION RISK ASSESSMENT RESULTS

As a result of the risk assessment, six listed threatened species and 21 non-listed species were assessed as having a low or moderate risk of collision (Table 3-5). All other listed bird and bat species were considered to have 'negligible' risk of impact from collision with WTGs and any indirect impacts associated with the Proposed Action (e.g. barrier effects from WTGs). It is emphasised that this risk assessment assumes a worst-case scenario for most of the species, based upon literature and realistic observational expectations. Therefore, the final risk ratings assigned to species that have the potential to occur within the Study Area are conservative and enable this worst-case scenario to be considered.

A full detailed risk assessment with conclusions can be found in Appendix F.

TABLE 3-5 BIRD AND BAT RISK ASSESSMENT

Species	Threatened Species Status (EPBC Act, NC Act)	Likelihood of Event	Consequence of Event	Risk Rating
Threatened or Migratory Bird Species				
Grey falcon (*Falco hypoleucos*)	V, VU	Rare	High	**Low**
Red Goshawk (*Erythrotriorchis radiatus*)	V, VU	Rare	High	**Low**
White-throated needletail (*Hirundapus caudacutus*)	V and Mi, VU	Likely	Moderate	**Moderate**

Species	Threatened Species Status (EPBC Act, NC Act)	Likelihood of Event	Consequence of Event	Risk Rating
Fork-tailed swift (*Apus pacificus*)	Mi, -	Unlikely	Moderate	**Low**
Curlew sandpiper (*Calidris ferruginea*)	CE and Mi,	Rare	High	**Low**
Non-threatened Bird Species				
Australian Magpie (*Gymnorhina tibicen*)	-, LC	Likely	Low	**Low**
Black Kite (*Milvus migrans*)	-, LC	Likely	Low	**Low**
Black-faced woodswallow (*Artamus cinereus*)	-, LC	Likely	Low	**Low**
Black-shouldered kite (*Elanus axillaris*)	-, LC	Likely	Low	**Low**
Brown falcon (*Falco berigora*)	-, LC	Almost certain	Low	**Low**
Brown Goshawk (*Accipiter fasciatus*)	-, LC	Likely	Low	**Low**
Galah (*Eolophus roseicapilla*)	-, LC	Almost Certain	Low	**Low**
Nankeen kestrel (*Falco cenchroides*)	-, LC	Almost certain	Low	**Low**
Pacific baza (*Aviceda subcristata*)	-, LC	Almost certain	Low	**Low**
Peregrine falcon (*Falco peregrinus*)	-, LC	Almost Certain	Low	**Low**
Pink-eared Duck (*Malacorhynchus membranaceus*)	-, LC	Likely	Low	**Low**
Rainbow Bee-eater (*Merops ornatus*)	-, LC	Likely	Low	**Low**
Rainbow Lorikeet (*Trichoglossus moluccanus*)	-, LC	Likely	Low	**Low**

Species	Threatened Species Status (EPBC Act, NC Act)	Likelihood of Event	Consequence of Event	Risk Rating
Spotted harrier (*Circus assimilis*)	-, LC	Likely	Low	**Low**
Sulphur-crested Cockatoo (*Cacatua galerita*)	-, LC	Likely	Low	**Low**
Torresian Crow (*Corvus orru*)	-, LC	Likely	Low	**Low**
Tree Martin (*Petrochelidon nigricans*)	-, LC	Likely	Low	**Low**
Wedge-tailed eagle (*Aquila audax*)	-, LC	Almost certain	Low	**Low**
Whistling kite (*Haliastur sphenurus*)	-, LC	Almost certain	Low	**Low**
White-Breasted Woodswallow (*Artamus leucorynchus*)	-, LC	Likely	Low	**Low**
Yellow-tailed black-cockatoo (*Zanda funereal*)	-, LC	Likely	Low	**Low**
Threatened Bat Species				
Large-eared Pied-bat (*Chalinolobus dwyeri*)	E, EN	Unlikely	Moderate	**Low**

Status listing per EPBC Act, NC Act: CE, CR = Critically Endangered; E, EN= Endangered; V, VU = Vulnerable; Mi = Migratory, LC=Least Concern, - = no listing

3.3 MATHEMATICAL COLLISION RISK MODELLING

3.3.1 COLLISION RISK MODELLING, DATA AND MORTALITY ESTIMATES

The Band Collision Risk Model (Band, 2007) has been used to predict the total number of bird and bat collisions that may result from the development of the wind farm. The Band Model is routinely used in wind farm assessment studies across the world. This method of collision risk modelling (CRM) requires the input of parameters that describe species-specific biometrics, flight speeds and characteristics and the expected amount of flight activity in the Study Area. Furthermore, the model requires the input of wind turbine specific information such as the turbine blade size and pitch, turbine height and rotor rotation period as well as the proportion of time the turbines will be operational (Band, 2007).

The CRM should use BUS data to determine the flight heights, frequency and flock size of a species (however, literature has been used to inform a worst-case scenario given lack of data from field surveys), for those known to occur within the RSA. This follows the process of determining:

- Stage 1: the number of birds or bats colliding per annum equals the number of birds or bats flying through the RSA (Band, Madders & Whitfield 2007); and
- Stage 2: the probability of the bird or bats flying through the RSA being hit (Band, Madders & Whitfield 2007).

Stage 1 depends on bird surveys at vantage points used to gather information on frequency of bird and bat flights in the RSA (Band, Madders & Whitfield 2007) and has been informed from data across eight survey periods and a dry and wet season, as well as literature where field data is not present.

Stage 2 depends on the characteristics of the bird and bat such as length and wingspan, as well as the breadth and pitch of the turbine blades, rotation speed of the turbine and average flight speed of birds and bats identified as flying in the rotor swept height (Band, Madders & Whitfield 2007).

The CRM model utilised has been developed to consider only the known species. As species considered as likely or potentially occurring in the Study Area have not been observed in the RSA, the species cannot have their collision risk modelled.

Draft Onshore Wind Farm Guidance (DCCEEW, 2024) and State Code 23 (SDAP version 3.0, February 2022) have listed that CRM only be undertaken for listed threatened and/or migratory species, or raptors, that occur within the RSA and that are identified as at risk from the Proposed Action. Therefore, the risk assessment has identified species at risk of collision with turbines, and those which occur within the RSA (Rotor Swept Area) have been included in the CRM. The following Sections detail the turbine and bird and bat species parameters relevant to the Study Area and the CRM.

3.3.1.1 COLLISION RISK MODEL INCLUSION CRITERIA

The species that were assessed as having a low and moderate risk of impact from the Proposed Action, as determined by the risk assessment (Section 3.2.2 and Appendix G) and were recorded in the RSA during BUS's on at least three occasions, were considered for the CRM.

Only species with at least three observation within the RSA have been included within the model to reduce the impact of low sample size on the accuracy of the model. With this inclusion criteria, eight species were included within the model including:

- Wedge-tailed eagle (Aquila audax);
- nankeen kestrel (Falco cenchroides);
- brown falcon (Falco berigora);
- whistling kite (Haliastur sphenurus);
- galah (Eolophus roseicapilla);
- rainbow lorikeet (Trichoglossus moluccanus);
- sulphur-crested cockatoo (Cacatua galerita); and
- torresian crow (Corvus orru).

Species not included within the model may still be at risk of collision throughout the life of the Proposed Action and will be monitored during further bird surveys. Additionally, such species will be considered for any potential impacts in the future if they are to occur within the RSA for the Proposed Action.

3.3.1.2 WINDFARM AND WTG PARAMETERS

The Proposed Action is a utility-scale wind farm of up to 170 WTGs with specifications outlined in Table 3-6. In order to facilitate connection to the electricity grid, TED is working with Powerlink to determine the optimal connection point to the existing network.. The Proposed Action will include ancillary infrastructure including, but not limited to, access tracks, collector stations, overhead and underground electrical cabling, hardstands, and an operation and maintenance compound.

TABLE 3-6 TURBINE PARAMETERS FOR THE PROPOSED ACTION

Turbine Parameter	General Turbine Specifications
Number of turbines	Up to 170 wind turbines
Hub height	Up to 185 metres
Turbine tip height	Up to 270 metres
Turbine rotor diameter	Up to 175 metres
Turbine blade length	84.5 metres
Depth of rotor blade from front to back	3.4 metres
Max chord	4.4 metres
Chord at 90% radius	~1.7 metres
Rotor tilt	6º
Hub coning	6º
Maximum RPM	9.5 rpm
Tip speed ratio	9.01
Rotor swept area range (noting that these heights will be determined by the hub height of the turbine, they may become lower)	60 – 270 metres

Turbine Parameter	General Turbine Specifications
Number of blades	3 blades
Average pitch angle of rotor	Approximately 14.5 º – dependent on conditions
Rotation period of turbine	Approximately 6.3 seconds – dependent on conditions

3.3.1.3 SPECIES PARAMETERS

Seasonal monitoring of 38-point locations were undertaken and have been used in the calculations for the CRM. In total there were 3,580 minutes (or 60 hours) of bird survey time undertaken throughout the eight field investigation periods. A total of 13 species were recorded within the RSA during BUSs, however only eight had three or more observations within the RSA over the eight field surveys. The parameters required for the CRM for each of these eight species is presented in Table 3-7.

TABLE 3-7 BIOMETRIC PARAMETERS OF SPECIES INCLUDED WITHIN THE CRM

Species	Wingspan (cm)	Length (cm)	Flight Speed (m/s)
Wedge-tailed eagle (*Aquila audax*)	230	110	16.7
Nankeen Kestrel (*Falco cenchroides*)	80	35	17.4
Brown falcon (*Falco berigora*)	115	45	13.6
Whistling kite (*Haliastur sphenurus*)	146	55	30
Galah (*Eolophus roseicapilla*)	75	37	19.4
Rainbow Lorikeet (*Trichoglossus moluccanus*)	46	31	14
Sulphur-crested cockatoo (*Cacatua galerita*)	103	48	19.4*
Torresian Crow (*Corvus orru*)	100	50	20.1

Sources for measurements are: Smales et al. (2015); DCCEEW (2023); Cochran et al. (1986); Menkhorst et al. (2017); DES (2022); Marchant, S. et al (eds) (1990-2006); Cameron (2007).
**Galah speed used as sulphur-crested cockatoo speed could not be sourced.*

3.3.1.4 COLLISION RISK MODELLING RESULTS

For the eight species included in the model, collision risk has been calculated as the number of collisions per species per annum in Table 3-8. It is expected that birds in practice show a high level of avoidance of wind turbines (Band, 2007). However, avoidance rates have not been calculated for all species and research is necessary to determine each species-specific avoidance rates.

For this CRM, 95% 98% and 99% avoidance rates have been used to calculate collision numbers per annum for the given species. These avoidance rates are typically used in CRM exercises (Smales, 2005; SNH, 2000).

TABLE 3-8 CRM RESULTS FOR RAPTORS OBSERVED IN RSA IN THE STUDY AREA

Species	Avoidance Rate		
	95%	98%	99%
Wedge-tailed eagle (*Aquila audax*)	0.01590	0.00636	0.00318
Nankeen Kestrel (*Falco cenchroides*)	0.00232	0.00093	0.00046
Brown falcon (*Falco berigora*)	0.00088	0.00035	0.00018
Whistling kite (*Haliastur sphenurus*)	0.00085	0.00034	0.00017
Galah (*Eolophus roseicapilla*)	0.00163	0.00065	0.00033
Rainbow Lorikeet (*Trichoglossus moluccanus*)	0.00047	0.00019	0.00009
Sulphur-crested cockatoo (*Cacatua galerita*)	0.00230	0.00092	0.00046
Torresian Crow (*Corvus orru*)	0.00531	0.00212	0.00106
Total	**0.02967**	**0.01187**	**0.00593**

In total, this CRM Model indicates <1 bird colliding with the turbines per year, or one collision approximately every 30 years as the worst-case scenario. This is based on the maximum specifications available and modelling approach as described. In the instance that final design delivers smaller WTG specifications, potential collision risk impacts will be lower than the above worst-case scenario.

3.4 POLICIES AND GUIDELINES

WTGs are preferentially located in areas for best wind resources, however based on the field surveys that have been conducted, and further pre-clearance micro-siting surveys that will be conducted prior to commissioning, final layout will consider at risk species habitat presence and addressed so far as reasonably practicable. With respect to individual species, the following documents were considered:

- Consultation of SPRAT profiles to identify species distribution, behavioural characteristics and habitat information, which was then mapped for all potential, likely and known to occur species within the Study Area;
- Scientific literature to understand further parameters of bird and bat species of interest, including size, flight speed, average flock sizes; and

- Survey guidelines which determined relevant methodology for BUS and BACI monitoring principles.

The consultation of these policies and guidelines where then able to inform the bird and bat studies, which were:

- A risk assessment based on species characteristics and behaviours; and
- A CRM which considers such species characteristics and factors these into how they would be impacted by the WTG parameters relevant to the Proposed Action.

This Proposed Action has gone further to consider species which have not been located in the Study Area or broader locality, to determine the 'potential impact' that would result from construction and operational activities.

The Proposed Action emphasises the importance of ongoing monitoring and as such, the BBMP has considered all relevant principles of BACI survey monitoring, and Adaptive Management to ensure that if any threatened species are to be found in future surveys, they are adequately considered, and impacts mitigated.

4. MITIGATION MEASURES AND ENVIRONMENTAL OUTCOMES

This section details the mitigation measures that will be implemented for potential significant impacts to listed threatened species arising out of the operation of the Proposed Action. Impact triggers which are described in Section 2.3, act as a measure to determine when additional mitigation measures should be implemented. Mitigation measures will be reviewed throughout the monitoring period, and at the end of every two-year monitoring period a suitably qualified ecologist will oversee and determine whether any adjustments should be made.

The adaptive management approach proposed to monitor impacts, detect impact triggers and apply corrective actions is outlined in Section 7.1. The mitigation measures in Table 4-1 have been designed so that potential significant impacts to bird and bat species (locally abundant, least concern and listed species) are appropriately mitigated. If changes to the mitigation measures are likely to result in a new or increased impact to any EPBC Act listed species (i.e. beyond minor variations or updates to the BBMP), impacts may need to be referred to the Minister in accordance with Section 143A of the EPBC Act, following a self-assessment.

The main causes of impact to listed species for the Proposed Action are considered as:

- Collision of birds and bats with blades of operating WTGs is likely to occur, with non-listed species most at risk. The only avifauna species within the combined group of assessed listed birds and raptors with a risk level higher than 'negligible' is the wedge-tailed eagle, with a risk rating of 'low'.
- Promotion of water and foraging resources that result in attracting birds and bats into the vicinity of the WTGs. This could result in higher rates of collision and injury/death. Nesting may occur close to WTGs.
- Lighting on WTGs and buildings causing an increase in bird and bat prey. This may result in increased bird and bat abundance in the vicinity of the WTGs and increase collision risk.

The management objectives for this BBMP, to address potential impacts are:

- Baseline monitoring surveys – prior to operation of the Proposed Action (eight have occurred from 2022-2024).
- Operational monitoring surveys – to be undertaken at selected WTGs throughout the operation of the Proposed Action, to estimate mortality of bird and bat species as well as record species within the Study Area.
- Reporting – to be undertaken in the first and second year of operation and agreed upon timeframes thereafter with DCCEEW and DESI. Such reports will include mortality estimates, incident findings, mitigation measure effectiveness or inefficiencies.
- Mitigation measures to reduce risks such as minimising mortality, keeping grain and waterbody sources a distance from WTGs as well as lighting spillage controls in and around WTGs.

Table 4-1 details the management objectives, mitigation measures and controls and subsequent timing of such controls for this BBMP. It also details the measures of success for these controls, as well as corrective actions that will be implemented if the controls are not meeting such criteria. Specifically, the management objectives aim to minimise the impact of mortality associated with collisions with WTGs. Despite these measures, a residual risk remains.

Implementation of the mitigation measures reduces the risk of collisions, and impact triggers are observed, consultations with DCCEEW will occur to determine appropriate management in line with the procedure outlined in Section 5.

TABLE 4-1 PROPOSED MITIGATION MEASURES, TIMINGS, PERFORMANCE CRITERIA AND CORRECTIVE ACTIONS

Management Objective	Management Activities and Controls	Timing	Performance Criteria for Measurement of Success	Corrective Action
Baseline surveys	• Baseline bird and bat data to be obtained from BUS, Anabat and harp trapping surveys.	• Eight surveys between October 2022 and June 2024.	• BUS to be undertaken in areas already chosen, in accordance with the method described in this BBMP. • Bat surveys to be undertaken in areas already chosen, in accordance with the method described in this BBMP.	• Bird and bat surveys have been undertaken in accordance with the method and timing described in this BBMP.
Operational phase mortality monitoring	• Chosen WTGs to be searched in the inner and outer search areas each month. • Mortality estimates to be made for each searched WTG for birds and bats. Such mortality estimates to be made upon considering factors like detector efficiency trials and scavenger trials. • Operational phase monitoring in response to any impact triggers and consultation with the DCCEEW.	• Operational phase – searches on approximate monthly basis for the first two years (see Section 5.3 for more information)	• Mortality surveys to be undertaken at 30% (approximately 29) of the WTGs within areas identified as habitat for listed species, within the Study Area. Reviews on locations will be undertaken after the first year of operation and updated if appropriate. • Scavenger and carcass detectability trials to be undertaken in accordance with the methods described in this BBMP. • Mortality estimates to be undertaken and analysed per the methods described in this BBMP. Such estimates will be included in monitoring reports.	• If operational phase surveys are not commenced during this phase, they will be commenced as soon the error is realised and as reasonably possible. • If mortality estimates are not undertaken, they will be added to an amended/updated report. • Where responses to impact triggers are not implemented, they will be undertaken as soon as this is realised and as reasonably possible.

Management Objective	Management Activities and Controls	Timing	Performance Criteria for Measurement of Success	Corrective Action
			• Responses to impact triggers will be reported and analysed by a suitably qualified ecologist as described in this BBMP.	
Monitoring reporting	• Preparation and submission of monitoring reports to DESI and DCCEEW.	• After the first year of operation, after year 3 (reporting on years 2-3), and subsequent reporting as agree upon by consultations with DCCEEW/DESI.	• Monitoring reports to be completed at allocated times, within three months of the years monitoring program completion. • Such monitoring reports will include mortality estimates and carcasses findings/locations, mitigation measure effectiveness or inefficiencies, incident reporting, any impact triggers, recommendations for ongoing monitoring activities etc. • Ongoing monitoring reporting to occur based on a outcomes of the two-year monitoring program included in this BBMP and by agreement between the landowner, Proponent and DESI/DCCEEW.	• Where monitoring reports are not prepared, or lack information necessary, this report/information is to be prepared and presented to DCCEEW/DESI as soon as reasonably practicable.
Mitigation measures to reduce risk - Movement of water	• Subject to agreement with landowners, determine a system which will allow for grain feeders to	• During operational phase.	• Carcasses/carrion to be removed when found and this is to be reported in	• Where mortality of birds due to presence of carcasses or grain

Management Objective	Management Activities and Controls	Timing	Performance Criteria for Measurement of Success	Corrective Action
and foraging resources that result in attracting birds and bats into the vicinity of the WTGs.	be placed outside of a 200 m radius of the WTGs where possible. These grain feeders should be placed as practicable to avoid creating a collision risk for parrots and cockatoos. • Carcass removal should be undertaken by suitably qualified personnel. This includes operation and construction staff, carcass searches and landowners if suitable training has been provided. Such carcasses should be appropriately recorded for GPS locations, photos taken and then disposed of in a safe manner. • Feral animal carcass removal and appropriate disposal within 200 m of a WTG. If large amount of pests are recognised as a problem near WTGs, integrated pest management may be required after consultation and cooperation of landowners. • Monthly searches for any stock or introduced species and bird carcasses that may attract larger raptor species. • Reporting on carcass removal based on Proposed Action's carcass removal register/data sheets. • Subject to Landowner agreement, provide alternative stock watering arrangements (e.g. establish replacement water sources further from WTGs).		an incident report. All measures taken to reduce risk are to be recorded on the date they are implemented – in the same incident report. • No increase or continuation of bird/bat mortality due to grain or carcass presence under WTGs.	occurs, options will be undertaken to immediately rectify the problem, including increasing methods to reduce grain and/or carcass occurrences around WTGs. • Increased consultation with landholders on grain-feeding locations.

Management Objective	Management Activities and Controls	Timing	Performance Criteria for Measurement of Success	Corrective Action
Mitigation measures to reduce risk – Removal/adjustment of lighting on WTGs and buildings causing an increase in bird and bat prey.	• Yellow or white light is proposed: • At entrance door to each WTGs, office building, substation • As portable and temporary lighting required to ensure the safety of workers. • Aligned with State DA requirements for monitoring masts. • Switch off unnecessary lights when not needed (building lights turned off when not in use). • Synchronise any flashing of lights.	• During operational phases.	• Bird and bat mortality to be low at unlit WTGs/infrastructure.	• Type and placement of lights will be reviewed in response to bird/bat mortality rates.

5. BIRD AND BAT MONITORING

The design for the bird and bat monitoring program has been based on the desktop and field investigations conducted for the Proposed Action. The design of the monitoring program includes habitat that has been mapped for known and potential listed threatened and migratory species. The following Sections detail the methods and locations for the bird and bat monitoring program.

5.1 BIRD AND BAT SURVEYS DURING CONSTRUCTION

During the construction phase, two wet season and two dry season surveys will be undertaken (in addition to the eight baseline surveys that have already been undertaken and informed the development of this BBMP). Bird and bat survey techniques undertaken during the construction phase of the Proposed Action will be consistent with the techniques and locations already undertaken in baseline surveys detailed in Section 2.1. The detailed surveys that will be undertaken for each species and the timing of such surveys can be found in Appendix G.

5.2 BIRD AND BAT MONITORING AT COMMENCEMENT OF OPERATION

Bird and bat surveys during the commencement of operation will target the species listed as 'known' or 'likely' to occur within the Study Area in Section 2.3 as well as those listed species with potential to occur in the Study Area. Bird surveys will occur during the first two years of commencement of operation with two wet season and two dry season surveys being undertaken in those years. The monitoring methods used in the initial two years of operation of the Proposed Action will be consistent with techniques used during previous field surveys.

It should be noted that one listed threatened and/or migratory bird and bat species (large-eared pied bat), and seven non-listed raptor species (i.e., spotted harrier, black kite, brown falcon, nankeen kestrel, wedge-tailed eagle, whistling kite and black-shouldered kite) were considered to be at 'low' risk' where all others were considered to be 'negligible' as per the risk assessment undertaken in Section 3.2, and as such, any bird found during carcass searches, or by Operations staff will be reported and stored in a freezer on-site for confirmation of species (refer to Section 5.3) and for use in scavenger trials.

The location of the operational phase bird and bat surveys has been informed by the habitat mapping prepared for the species determined as known, likely or having the potential to occur within the Study Area.

The monitoring during operation will be based on two main approaches:

- Approach 1 – monitor bird and bat activity and ongoing mortality searches that aim to determine impacts (collisions) occurring during the first two years of operation; and
- Approach 2 – inform specific response to impact triggers that may result to bird and bat species, which will include increased monitoring surveys and carcass searches, investigation of risk behaviours and subsequent risk mitigation.

This adaptive management approach is further detailed in Section 7.3.

5.3 CARCASS SEARCH METHODOLOGY

As part of the monitoring program, carcass searches will be performed to determine the actual impact of the Proposed Action on birds and bats. The results of the monitoring will be used to review the risk assessment if necessary and to identify and determine if any further monitoring of bird and bat species is required and to update mitigation measures or adaptive management approaches.

At the commencement of operation it is proposed that 30% (approximately 51) randomly selected WTGs will be searched over a two-year period, at 6 weekly intervals from late Autumn to early Spring, and 3 weekly intervals from early Spring to late Autumn with increased monitoring in warmer months aligned with increased potential for migratory species to occur within the Study Area.

The selected turbines (approximately 51) will be revisited over the course of the first two years of operation. These visits will ensure that carcass searches are able to gain high accuracy on data regarding the mortality associated with WTG strike. The order of selected WTGs searched will be random during each monitoring event. The final number and location of individual WTGs that will be constructed is not yet known, and so this will be reflected in an updated map of selected WTGs for monitoring.

All carcass searches will be undertaken by suitably qualified personnel with appropriate skills in both bird and bat identification, as well as the handling of deceased species. Searches within areas and near selected WTGs will target birds and bats of medium to large size as per the Hull and Muir Model (2010), which uses the Monte Carlo simulation. The model suggests that 95% of bat carcasses should be present within 74 m of a WTG, and the carcasses for birds of medium to large sizes would be distributed to distances up to 122 m. Some species (larger birds) may be found further out from this model, however 95% are expected to occur within an approximate 122 m search area from each selected turbine (Hull & Muir, 2010). This model was based upon parameters of a 72 m rotor radius and 120 m hub height. Based on the principles adopted in Hull and Muir (2010), the following search areas have been designed for birds and bats for the Proposed Action, with its approximate rotor tip height of up to 185 m and turbine rotor diameter of 172 m:

- Bats and small to medium sized birds, including some large sized birds: 100 m radius around the turbine. Transects will be spaced every 6 m from the WTG; and
- Medium to large sized birds (and some larger bats): 100 – 150 m radius around the WTG. Transects in this search area will be 12 m apart, undertaken from the inner (100 m) to outer (150 m) sections of the search area.

It should be noted that in search areas of WTGs that are difficult to access for safety reasons, due to dense vegetation or slope considerations, exceptions may be made as to where transects will be conducted. This will include searching within access tracks and hard-stand areas only. Such exceptions will be noted for reporting purposes.

5.3.1 RECORDING INFORMATION AND CARCASS HANDLING PROCEDURES

The following information is to be recorded if a carcass is detected during the carcass searches:

- Position of the carcass in relation to the WTG.
- Comments on the vegetation type and area where the carcass was located, including if the species was found on an access path or on the WTG hard-stand area.
- Details on the individual found such as species, age, sex, number of individuals, the injury description as well as the estimate time of death if found deceased. If the carcass is unable to identified, this will be taken to appropriate facilities for DNA testing to be undertaken.
- Photos must be taken of the area and of the individual found. Such photos will need to be sent to an appropriately qualified ecologist within two business days so they can adequately undertake identification.
- Weather details on the find date, as well as details taken of the weather conditions in the time preceding the find date of the carcass, including wind speeds, temperate and rainfall amounts.

The carcass found will need to be handled in accordance with the following procedure:

1. Carcass is to be safely removed from the site with appropriate personal safety equipment to be worn by personnel. This personal safety equipment includes thick rubber gloves and a long-sleeved shirt, a face mask if possible and appropriate eye wear. The carcass should be placed in a plastic bag, then wrapped in newspaper and placed into a second plastic bag. The removal of the carcass from the area ensures that recounting of the same carcass does not occur at a later date.
2. Labelling of the carcass plastic bag to ensure the species is easily identifiable later and all information is correct. This includes placing a completed datasheet with the above listed information into the outer plastic bag.
3. The carcass bag will then be placed into an appropriate freezer compartment, likely within the Proposed Action's site office. This will keep the carcass for future examination if required by a suitably qualified ecologist if the original retrieval was made by an unqualified operation staff member. Frozen specimens will also be able to be used for detectability trials at a later date.

It is noted that an NC Act authority, a Scientific Purposes Permit must be obtained in order to remove the carcasses from the Study Area. This will need to be obtained for the monitoring program and can be referred to in order to get more detail on the disposal methods of the carcasses. Should any carcasses be found at the Proposed Action during construction, commissioning and maintenance activities, the carcass should be handled as above.

5.3.2 SCAVENGER RATES AND TRIALS

The scavenger trial is adopted to ascertain at what rate naturally occurring scavengers remove carcasses from the Study Area. These trials will be developed such that they are adopted twice within the first year following operation commencement, with each trial undertaken across 30 days. This will ensure that the difference in vegetation conditions is accounted for within the trials; wet season with long grass and dry season with short grass. Such periods are also going to be associated with different stocking levels across seasons.

Scavenger trials will be undertaken in the inner search area of the turbines selected for carcass search trials (100 m radius from the turbine).

Two different categories of carcasses will be used for the scavenger trials. Such carcasses will be those that are found during mortality trials. Additionally, small mice can be used in place of micro-bats if these carcasses are not able to be found. The two different categories will help to ascertain the different scavenger rates in the search area.

The two categories and the number of replicates that will be used for each trial are:

- Micro-bats and small birds – seven replicates/trial; and
- Medium sized birds – six 6 replicates/trial.

At each of the randomly selected turbines used for the carcass searches, a total of 28 carcasses will be randomly placed under the turbines and will be checked as follows:

- Each day for the first five days;
- Every two days from day six to day 10;
- Every three days from day 11 to day 19; then
- Every four days from day 20 until they disappear or until the end of the 30-day trial period.

The Proposed Action operation staff will be trained over a five day period to undertake the scavenger trials following trial establishment by a suitably qualified ecologist.

Additional procedures to follow for scavenger trials is detailed below:

- Timing of searches has been based on the detailed experience and regulatory approval of other wind farms where scavenger trials have been undertaken that show almost all carcasses have been scavenged within a period of 5 – 10 days. Additionally, GPS coordinates will be taken for all carcasses placed during the scavenger trials, so as not to confuse these with any naturally occurring carcasses in the search areas;
- A mix of carcass sizes of bird and bats (small, medium to very large) will be obtained to use in scavenger trials from prior searches of the Study Area. If a carcass of species at risk or of concern cannot be located for the trial, a substitute of the same colour and size will be used in its place;
- Thick latex gloves must be worn at all times when handling the bird and bat carcasses. This will ensure that both the safety of the personnel but also that human scent will not replace the scent of the carcass which will alter scavenger behaviour and find rates;
- One carcass at minimum will be placed randomly within the 100 m search area at each trial site. This carcass will be thrown in the air in order to recreate the natural landing of a carcass from impact with a wind turbine, such that feathers, or fur may become dislodged or ruffled from the impact of the simulated fall;
- Detailed observations will be taken at the search areas where carcasses have been scavenged, including the composition of the carcass and weather any types of scavenging behaviour has been present (feathers, bones dispersed, pecking, tearing, partial removal of carcasses, as well as scats and tracks of potential predators); and
- The final state of the carcass will be recorded at the end of the survey period.

Scavenger trials will be conducted across seasons to account for different rates of scavenging that has been observed across seasons (Catling 1988; Molsher et al., 2000).

An alternative to the method used above is to use motion sensor cameras that could monitor scavenger activity. In this case a star picket (approximately 1 m high) will be placed in the ground approximately 4 m away from the carcass, with a camera attached. This camera will record any scavenging activity over the course of 30 days from placement. This method gathers the exact time and method of scavenging and thus eliminates any uncertainties in the results analysis. The scavenger trials will be conducted at the same locations as those chosen in Figure 2-1.

5.3.3 DETECTABILITY TRIAL

Detectability trials will be conducted at the same time as scavenger trials, conducted during the first day of placing carcasses. These detectability trials will be conducted to test the efficiency of searchers in finding the carcasses for the Study Area. The detectability trials will be conducted twice in the first year of operation, sampling across the wet (September – April) and dry (April – September) seasons. This sampling will represent the greatest change in vegetation cover. Such detectability trials will also be conducted for handlers and dogs, if they are to be used for the Proposed Action. The detectability trials will be conducted by personnel who have been involved in the monthly carcass searches.

The detection efficiency that is determined from the detectability trials will be incorporated into mortality rates and analyses to account for the error associated with human detection of carcasses. This detectability analysis will be documented in the report at the end of the first two-year monitoring period in accordance with this BBMP.

Carcasses will be randomly placed in the inner search area of a turbine (100 m zone) and their location noted by the suitably qualified ecologist. The efficiency will be recorded as the number of successful finds by a searcher against the actual carcasses placed by the suitably qualified ecologist.

The categories, number of carcasses and replicates to be used in the detectability trials across the wet and dry season is presented in Table 5-1.

TABLE 5-1 NUMBER OF REPLICATES OF BIRD AND BAT CARACASSES FOR DETECTABILITY

Time	Micro-bat - Small birds	Medium sized birds	Large raptor size birds
Wet season: (long grass)	7	7	3
Dry season: (short grass)	7	7	2

If there are shortages for bird and bat carcasses for the detectability trials, appropriate substitute species will be used to represent specific target carcass categories.

5.3.4 RESULTS ANALYSIS AND PRESENTATION

It is proposed that a 12-month monitoring report and a final monitoring report (end of two-year monitoring period) will be prepared. Data that will be analysed and documented in the reports will include information on carcass identification and timing, the results of the trials (scavenger and detectability) so that factors influencing mortality can be determined. Mortality rates should be expressed as the number of carcasses discovered per turbine per year and any spatiotemporal variation across the Study Area and seasons should be presented and discussed.

Data analysis will estimate mortality rates of birds and bats within the Study Area, considering standard error and variation. Appropriate software packages will be used to inform variables needed to be determined during the carcass, detectability and scavenger trials which will subsequently inform the survey design. At this stage, prior to construction and knowledge of precise turbines to be constructed, the following software packages and statistical principles are proposed for the Proposed Action, with specific variables to be measured and data input requirements (and associated assumptions) considered in the final monitoring design:

- Logistical regression (general liner modelling) to be used to determine searcher efficiency. This will account for significance;
- The proportion of the area searched to be estimated using the Monte-Carlo Simulation method as described in Hull and Muir (2010);
- Mortality will be estimated using the Hortvitz-Thompson style estimator from Huso (2011);
- Survival analysis (survival regression to account for interval censoring) to be calculated using Generalised Estimator (GenEst) (or similar). GenEst is used to estimate the total number of individuals that are present within an area in a given time period, when their detection probability may not be known. This program is used as counts of carcasses alone is not an accurate way to measure the true number of fatalities in an area due to those that may be missed in the process. This method also allows for comparisons across locations and years taking into account the rate of detection:
    - GenEst includes tools for estimating searcher efficiency, carcass persistence, and other detection probability parameters from experimental field trials. GenEst is not an evidence of absence-type estimator and is not going to be used in circumstances where few carcasses are found. This is where the Evidence of Absence (EoA) program will be adopted; and
    - EoA – This program can be used in order to help determine potential fatalities which may have occurred, with respect to the survey effort, even in the absence of a carcass being located.

Statistical analyses will assist in determining potential significant differences across size categories of species, vegetation composition or across seasons.

Documented results will inform adaptive management on whether additional mitigation measures are necessary and whether specific turbines in the Study Area pose higher risks to birds and bats than others. Such adaptive management will occur in consultation with DCCEEW.

5.4 BBMP PERSONNEL AND ASSOCIATED TRAINING REQUIREMENTS

All personnel involved in the implementation of the BBMP will be familiar with this BBMP, as well as with the relevant Proposed Action policies and procedures, and other important administrative matters (e.g., health and safety documents). The Proponent will be responsible for ensuring that suitably qualified and trained people are engaged to supervise and implement the formal monitoring program as defined in this BBMP. Beyond the formal period of monitoring, the Proponent will be additionally responsible for ensuring ongoing reporting of incidental finds and the engagement of relevant specialists where triggered by this BBMP.

Training will be provided to all personnel that will be undertaking carcass searches, species identification and handling. Such training will be delivered by suitably qualified ecologists who are specialists in the field of bird and bat carcass retrievals. The training will include trial establishment, transect search techniques, selection of specific turbines for monitoring, species identification, carcass handling practices and PPE management. The qualified ecologist will be involved in the initial search program of the turbines to oversee and assist with the carcass search, handling and identification. So that the BBMP is being implemented and monitoring routinely performed to standard, the suitably qualified ecologist will undertake an audit after the first 6 months of the commencement of the implementation of this BBMP.

The suitably qualified ecologist will be available to identify any carcasses that Proposed Action personnel are unable to identify, either from frozen specimens or from photographs taken at the search area.

Training will be provided to assigned operational personnel which on how to properly prepare and handle carcasses and how to randomise the placement of carcasses in trial areas.

Scavenger trials will be developed by the suitably qualified ecologist, who will supervise the searches undertaken by trained operational personnel.

The suitably qualified ecologist will undertake data analysis and prepare the 12 month interim and two year final monitoring reports.

Training will be provided by the suitably qualified ecologist to operational personnel involved in the monitoring program and trials, with refresher training available if requested or deemed necessary during the two-year implementation period of the BBMP.

5.5 HANDLING PROTOCOL AND TRAINING: INJURED AND DECEASED SPECIES

Operational personnel involved in the search for wildlife will be appropriately trained in handling and assisting with injured or deceased wildlife. All injured or deceased wildlife found during the first two years of operation will be reported to the Theodore Wind Farm’s Responsible Officer.

Once reported, it will be the responsibility of the Responsible Officer to organise for the retrieval and/or treatment of the individual. Such a protocol will involve defining the correct handling procedures, personal protective equipment, transportation, and wildlife hospital treatment arrangements.

Bats can carry many forms of diseases including Hendra virus and Australian Bat Lyssavirus. Extra precaution and care will need to be taken when handling bat species (Queensland Government, 2020). In this circumstance, professionals should be called to handle injured bat species. Information sources to contact in case of an injured bat include the RSPCA (1300 264 625) and the Department of Environment, Science and Innovation (1300 130 372). Appropriate and contemporary advice on the best practice for movement of individuals will be provided by these organisations.

6. REPORTING OF BIRD AND BAT DATA

Monitoring reports will be produced in the first and second year of operation. Monthly summaries of data from carcass searches and detectability trials will also be provided as attachments to the monitoring reports.

If impact triggers are met during monitoring and trials, then additional monitoring may be proposed by the suitably qualified ecologist after the initial two-year monitoring period has concluded.

The data to be analysed and results documented in the two monitoring reports include:

- Results of the carcass searches and observations, including the methods adopted during survey searches (dates and times of searches also reported);
- Discussion of the results of the report and how this should impact upon management and mitigation measures, such as high mortality;
- Analysis of bird and bat mortality rates via statistical tests, confirming the number of deaths per annum. This should also consider variability of bird and bat carcasses found during different seasons. Annual WTG strike reports comprising raw strike data and strike notifications, survey methodologies, results of detection/persistence trials, environmental/meteorological conditions and associated statistical analysis;
- Records of any species occurrences, in accordance with the DCCEEW Guidelines for biological survey and mapped data (2018) using the species observation data template on the DCCEEW website;
- Descriptions of the search areas including the presence of any introduced flora and fauna (specifically feral cats and foxes) that may impact the carcasses or species;
- Any construction or operational personnel carcass finds, including the WTG where the carcass was found, date and time; and
- Impact trigger identification, or identification of any species or risk levels that may need to be adaptively adjusted within the bird and bat risk assessment (Section 3.2).

Analysis of the effectiveness of the mitigation measures in place and whether changes or adjustments need to be made. This will include an analysis of the effectiveness of the impact trigger framework also to ensure that all impacts are being appropriately considered and accounted for in a reasonable manner.

7. SPECIES IMPACT TRIGGERS AND ADAPTIVE MANAGEMENT

This section outlines the species-specific impact triggers associated with interactions with turbines and the decision-making framework and adaptive management where a response is required.

Impact triggers and response requirements will be different for both listed and non-listed species. The impact triggers have been prepared following the approach implemented by multiple BBMPs across Queensland, New South Wales and Victoria.

The Proponent will be responsible for ensuring implementation of this BBMP and the adaptive management approach. A suitably qualified ecologist will support decision-making elements and provide advice where Regulator consultation (State and Commonwealth) is required.

7.1 LISTED THREATENED AND MIGRATORY SPECIES

7.1.1 IMPACT TRIGGER REQUIREMENTS

Where a listed threatened and/or migratory bird or bat species is found dead within the search area of a turbine (proximity that can be attributed to turbine collision) during implementation of this BBMP, or via an incidental find, then the impact trigger methodology as described below applies. Additionally, if a breeding area for these species is located within 200 m of a turbine, then an impact trigger will occur. There are no known breeding behaviours for the likely or known species within the Study Area or locality. Listed threatened and/or migratory species are those that are listed under the EPBC Act and NC Act.

Where a single carcass of a listed threatened and/or migratory species is detected within the Study Area, a decision-making framework will be implemented. This includes additional surveys being undertaken within two weeks of the carcass find by a suitably qualified ecologist, and where data is available, a population viability analysis (PVA) will be undertaken. A report will be prepared by a suitably qualified ecologist and presented to the Department for next steps of mitigation and management. It is noted that documents that will be assessed in determine impact triggers will include:

- Significant Impact Guidelines 1.1 - Matters of National Environmental Significance per the EPBC Act (DEWHA, 2013);
- Draft referral guideline for 14 birds listed as migratory species under the EPBC Act (Department of the Environment, 2015);
- Species-specific management plans and Conservation Advice from SPRAT profiles.

7.1.2 DECISION-MAKING FRAMEWORK

If the impact trigger requirements are met for the Proposed Action the following decision-making framework will be followed:

1. The bird or bat carcass must be immediately reported to the Proposed Action's Responsible Officer, including information such as the species type, the area where the species was found and any other contributing factors that appear appropriate. Photos must be taken of the carcass or injured species so that correct identification can be carried out. The Proposed Action's Responsible Officer will assess whether the death/ injury can be directly attributed to a WTG strike. Where there is adequate evidence that the death/injury is not related to WTG strike, no further action is required.
2. A suitably qualified ecologist will undertake an analysis to determine the presence of the impact trigger either in person or through analysis of the carcass and/or photographic evidence. The ecologist will assess whether the death/injury can be directly attributed to a WTG strike. Where there is conclusive evidence the death/ injury is not related to WTG strike, no further action is required.
3. If the impact trigger has been confirmed by the ecologist, the Proposed Action's Responsible Officer will report the trigger to DESI and/or DCCEEW within five business days.
4. The suitably qualified ecologist will undertake a detailed investigation in order to determine the events that caused the death or injury of the listed species. This investigation will include a PVA where data is available for the species. Once this investigation is concluded and if it is deemed that WTG collision or interference with the WTG has caused the death/injury, other factors like species behaviour will also be considered.
    a. If the evaluation undertaken by the suitably qualified ecologist reveals the impact trigger to be a one-off event and unlikely to occur again, a significant impact on the population's viability is unlikely and no further action will be required. This significant impact will be determined through following the relevant guidelines including but not limited to the *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance* per the EPBC Act (DEWHA, 2013). Species-specific guidelines may apply.
    b. If the evaluation undertaken by the suitably qualified ecologist (including a PVA) reveals the impact trigger may lead to a significant impact to the species, species-specific monitoring will likely be recommended and implemented. This monitoring will be informed by the ecologist, with a minimum six-week period of fortnightly monitoring. These monitoring exercises will need to be supervised and reported by the suitably qualified ecologist, who will include in the report any recommendations for additional mitigation measures to manage or reduce the impact to the species, in accordance with the adaptive management measures. DESI and/or DCCEEW will be consulted on the next steps in the course of action to best close-out the response.
    c. If the evaluation undertaken by the suitably qualified ecologist cannot determine the cause of the impact trigger beyond reasonable doubt, further monitoring (fortnightly for six-weeks) may be proposed to determine re-

occurrences/extent of the impact. As with the previous steps, if the additional monitoring confirms a one-off occurrence to the species, then no further action except advising the relevant authority is required. If more than a one-off occurrence is observed, then step 3.b) above applies.

5. Adaptive management will be implemented in order to ensure a timely reduction or mitigation of the impact to the species. Further monitoring of the effect of these additional mitigation measures and their impact would be undertaken by suitably qualified ecologist to determine and report on their effectiveness. The BBMP will be updated to include any additional or adjusted mitigation measures. As part of the adaptive management strategy, a number of mitigation measures may be considered, such as:
    a. Acoustics to discourage foraging birds at particular locations;
    b. Encourage species into alternative low-risk areas using social attraction techniques (decoys and audio playback systems);
    c. Removal of foraging habitat where appropriate; and
    d. Investigate alternative stocking arrangements.
6. All evaluations and decisions regarding mitigation measures for the impacted species will be reported to DESI and/or DCCEEW, with consultations to ensure the best course of action is applied for the Proposed Action and species affected. Outcomes will also be reported in the monitoring reports that are prepared by the ecologist to the Proponent.
7. Offsets may be required where the significant impact to the species cannot be effectively mitigated by other measures. Offsets may be in form of financial offsets or research-based offsets where an appropriate institution can undertake species specific research. Offsets will need to be considered and developed in accordance with *EPBC Act Environmental Offsets Policy* (DSEWPC, 2012). Any offset consultations will need to be undertaken with the relevant authority. Additionally, if a trigger is assessed to have occurred, surveys will be undertaken to review the area, and discussions with DCCEEW will occur, which may include turbine curtailing if assessed as appropriate for species management.

7.2 NON-THREATENED (PROTECTED AND LOCALITY ABUNDANT) SPECIES

7.2.1 IMPACT TRIGGER REQUIRMENTS

The impact trigger for the non-listed threatened species in this BBMP will be a total of five or more bat or bird carcasses of the same species that are recorded at the same WTG during two or more consecutive searches.

The definition of a significant impact to a non-listed threatened species is an impact that is likely to reduce the viability of the population of the species within that bioregion. Sometimes the population numbers for a species are not known or reported. In the case where such information is not publicly available, a suitably qualified ecologist will undertake an assessment of the potential impact to a species in the bioregion to determine whether the impact will reduce population viability.

7.2.2 DECISION-MAKING FRAMEWORK

If the impact trigger requirements are met for the Proposed Action, the following decision-making framework will be followed:

1. DCCEEW will be notified of the trigger (including species, time and area) within five business days of the trigger event.
2. A suitably qualified ecologist will undertake an analysis to determine if the impact trigger will cause a significant impact on the viability of the population of a species within the bioregion. This assessment will consider factors including the distribution of the species, known population size and habitat requirements, as well as any literature on specific threats to the species within the bioregion.
3. A report on the findings of the analysis will be prepared by the suitably qualified ecologist and presented to the Proposed Action's Responsible Officer and subsequently then presented to DCCEEW within three weeks of the impact triggering event (this date may be subject to change upon consultation with DCCEEW).
    a. If the evaluation undertaken by the suitably qualified ecologist reveals the impact trigger to be a one-off event and unlikely to occur again, no further action will be required.
    b. If the evaluation undertaken by the suitably qualified ecologist reveals the impact trigger may lead to a significant impact to the population viability of a species in the bioregion, species-specific monitoring will likely be recommended and implemented. These monitoring exercises (fortnightly for six-weeks) will need to be observed and reported on by the suitably qualified ecologist, who will then determine if any additional mitigation measures are necessary to manage or reduce the significant impact upon the species. Such measures will be decided upon through adaptive management approach.
4. The investigations and mitigation measures recommended in the case of a significant impact will need to be included in the monitoring reports, in accordance with this BBMP.

7.3 ADAPTIVE MANAGEMENT

In the event of a significant impact being triggered to a bird or bat species, adaptive management principles will be applied. Application of adaptive management will be upon written recommendation (from the reporting requirement of the impact trigger response) by a suitably qualified ecologist, in accordance with this BBMP.

Adaptive management will take into consideration the species impacted, the area of impact and other factors such as population dynamics, in order to determine the most appropriate solution.

Additional mitigation and monitoring measures, should they be required, and potential effects will be monitored and documented within the monitoring reports, in accordance with this BBMP, and presented to the appropriate Department for their advice on next steps for management.

7.4 ASSESSMENT OF SIGNIFICANT RESIDUAL IMPACTS

As part of the ecological investigation completed when an impact trigger is detected, the significance of impact will be assessed by a suitably qualified ecologist with reference to the EPBC Act *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance.*

It is proposed that the method for assessment for identifying if an impact will exceed an indicative significant impact threshold will quantify the number of mortalities of each species based on the carcass search results (refer to Section 5.3) that reaches or exceeds an ecologically significant proportion of a population over a defined time period (referred to as a "significant impact threshold").

As described in the referral guideline for 14 birds listed as migratory species under the EPBC Act (2015), an ecologically significant proportion of a population is defined as being 0.1% of the estimated national population size for a species. Where this is exceeded, offsets may be required for the significant residual impact.

A high-level review of species population ecology has been used to establish species specific indicative significant impact thresholds based on estimates of ecologically significant proportions of populations. This has been applied to all listed threatened and migratory species identified as possessing 'low' or 'negligible' risk of collision in this BBMP. For these species, mortality events as a result of the Proposed Action have the potential for significant residual impacts to the species population. These thresholds define these significant residual impacts as the number of mortality events and the time frame in which mortalities occur.

Generational time, defined as the average interval between the birth of an individual and the birth of its offspring, is approximately five to ten years for most species identified as having a potential future risk in this BBMP. These generational times can be used as an indication of the time required for a population to replace individuals lost to turbine collisions and have been used to identify the time frames for residual impact. As estimates of generational time for some species can have low reliability a conservative approach has been taken and a 5 year period has been applied to all species. The species ranges and population sizes have also been considered for these estimates presented in this BBMP. For those species possessing extensive or global distributions, population estimates more specific to the Study Area (Australian population estimates) have been used to more effectively define local.

Table 7-1 provides an indicative significant impact threshold associated with seven low risk listed threatened bird species in the Study Area.

Significant impact thresholds for ten species with the potential to occur have been identified in table 7-1.

TABLE 7-1 INDICATIVE SIGNIFICANT IMPACT THRESHOLD FOR LISTED THREATENED SPECIES

Species	Australian Population Estimate	Indicative Significant Impact Threshold (0.1% of population)
Fork-tailed swift	100,000	100 mortalities within a five-year period
Red Goshawk	<1,000	1 Mortality over a five-year period
Grey falcon	<1,000	1 mortality over a five-year period
White-throated needletail	10,000	10 Mortalities over a five-year period
Curlew sandpiper	40,100	40 Mortalities over a five-year period
Large-eared pied-bat	20,000	20 mortalities over a five-year period

These significant impact thresholds are indicative only, and the actual significant impact assessment and associated advice will be provided by a qualified ecologist aligned with the investigation process outlined in Section 6.1. These indicative thresholds may exhibit fluctuations through time as updated species population estimates become available and it is expected that contemporary information be used during an investigation, as required throughout the life of this BBMP.

7.5 SPECIFIC MANAGEMENT OBJECTIVES, ACTIVITIES, TIMING AND PERFORMANCE CRITERIA

Table 7-2 summarises management objectives, activities, timing and responsible parties for the implementation of this BBMP. This table should be referred to for reporting and monitoring purposes throughout the two-year monitoring period. It is noted that adaptive management may require an adjustment to the requirements in Table 7-2 under the direction of a suitably qualified ecologist.

TABLE 7-2 SUMMARY OF MANAGEMENT OBJECTIVES, ACTIVITIES, RESPONSIBLE PARTIES AND TIMING

Stage	Management Actions	Responsibility	Timing
Pre-Development	The two-stage impact and disturbance mitigation process will be implemented. Areas of remnant and regrowth vegetation will be avoided at the design and micro-siting phases.	Proponent	Design
	Design of a turbine with a blade sweep area to provide a collision-free foraging zone within the canopy and within a reasonable zone above the canopy.	Proponent	Design
	Locating turbines away from key bird and bat habitats (waterways and drainage lines).	Proponent	Design
	Initial field surveys for bird and bats will be undertaken. Impacts areas to be selected as part of the BACI designed bird surveys. CRM to be undertaken.	Proponent	Design
Pre-Construction	Pre-clearing surveys shall be undertaken prior to clearing efforts within the marked boundaries. These pre-clearance surveys will form part of the micro-siting process, which will closely analyse potential infrastructure locations. If potential habitat for bats, such as riparian areas and dense woodlands, occur in such locations, development layout will be adjusted. Control areas to be selected as part of BACI designed bird surveys. Surveys will then be undertaken in the control and impact areas prior to construction beginning. These surveys will include BUS such as point, waterbody and bird of prey surveys, in order to determine species presence in the RSA and bat surveys will be conducted via the use of echolocation call detectors and harp trapping.	Principal Contractor	Prior to Construction
	Targeted surveys to identify important habitat features of value to birds and bats in the Study Area, in particular, identify raptor nesting sites so that turbine location can be adjusted as part of micro-siting requirements to minimise collision risk.	Principal Contractor	Prior to Construction
Construction	All clearing shall be within clearly marked boundaries and in accordance with the Development Permit.	Principal Contractor	At all times
	Where trenching and excavations are created which may entrap fauna, suitable escape measures are put in place, and excavation are checked for fauna before backfilling.	Principal Contractor	At all times
	Include toolbox talks for site specific bird and bat information during the Proposed Action.	Principal Contractor	Monthly
	Ensure appropriate waste management (lidded bins), including food scraps, to reduce potential for feral species to become established on-site.	Principal Contractor	At all times

Stage	Management Actions	Responsibility	Timing
	BACI surveys conducted at impact and control areas during construction to determine bird and bat composition, abundance and density at control and development areas. This includes BUS and use of bat survey techniques.	Principal Contractor	Bi-annually to Quarterly
Monitoring	Daily inspections by spotter / catcher during clearing, specifically hollow trees, roosting sites, and rocky outcrops and caves for birds and bats	Principal Contractor	Daily
	Weekly site inspections to review flora and fauna control measures during clearing and construction	Principal Contractor	Weekly
	BACI surveys to be conducted in the operation phase at control and impacts areas, to determine the 'after' development effect on bird and bat composition, abundance and density.	Principal Contractor	Bi-annually to Quarterly
	Mortality monitoring: at approximately 30% of turbines (approximately 51 WTGs) monthly for two years. Any extension to monitoring is considered under Section 5 of this document.	Ecologist and trained personnel	Monthly
	Scavenger and detectability trials: two of each, undertaken within the first year of monitoring, approximately 6 months apart.	Ecologist and trained personnel	Detectability = biannually Scavenger = biannually
	Adaptive management and inclusion of additional mitigation measures as a result of impact triggers as a result of recommendations from a suitably qualified ecologist.	Proponent	As required
	Low wind speed curtailment required when wind speeds are below the manufacturer's cut in speed of 3 m/s (i.e. feathered to prevent turning or other mechanism).	Proponent	At all times
Reporting	Sightings and incidents reported in daily Pre-starts	Principal Contractor	Daily
	Fauna spotter-catcher will keep an inventory of any bird and bat species encountered with details of species, capture and release condition and capture and release GPS co-ordinates during construction. This also includes carcass reporting and notification.	Spotter Catcher	Daily
	Injured native fauna to be reported to Health, Safety, Environment Quality (HSEQ) Manager.	Site Manager	Within 24 hours
	Preparation of monitoring BBMP reports: one within three months of the first year of monitoring, and one within three months of the second year of monitoring.	Ecologist	Year 1 and Year 2 then as required.

Stage	Management Actions	Responsibility	Timing
	Monitoring report after two years: estimates of mortality for bird and bat species across the monitoring period, considering detectability and scavenger trial results.	Ecologist	As required
Corrective Action	All near misses and incidents will be investigated to establish root cause. Where necessary corrective actions will be developed to improve existing processes.	All Personnel	As required

7.6 BBMP MONITORING AND IMPLEMENTATION RISKS

There are certain factors that may impact the carcass searches and monitoring for the BBMP. Such factors include weather events that restrict access to search areas, including significant flooding and storms (electrical activity) as well as heatwaves and bushfires. Other incidents include risks to health and safety like the unlikely event of a WTG suffering a malfunction in weather events or due to mechanical failures. Access issues may also play a contributing factor to the hindering of search efforts, especially if vegetation becomes unmanageable to traverse.

There will also be stop work cues in which operational and construction personnel may cease their operations due to safety concerns. In this unlikely event, all BBMP monitoring will also cease.

If these factors arise and monitoring per the usual BBMP cannot proceed, limitations or changes to the original BBMP will be recorded during reporting periods.

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APPENDIX A PMST AND WILDNET RESULTS

Department of Climate Change, Energy, the Environment and Water

Protected Matters Search Tool

Report Generated - 4:24PM - 19 March 2024

Matters of National Environment Significance	Count
World Heritage Properties	0
National Heritage Places	0
Wetlands of International Importance (Ramsar Wetlands)	0
Great Barrier Reef Marine Park	0
Commonwealth Marine Area	0
Listed Threatened Ecological Communities	4
Listed Threatened Species	35
Listed Migratory Species	13

Other Matters Protected by the EPBC Act	Count
Commonwealth Lands	0
Commonwealth Heritage Places	0
Listed Marine Species	19
Whales and Other Cetaceans	0
Critical Habitats	0
Commonwealth Reserves Terrestrial	0
Australian Marine Parks	0
Habitat Critical to the Survival of Marine Turtles	0

Extra Information	Count
State and Territory Reserves	0
Regional Forest Agreements	0
Nationally Important Wetlands	0
EPBC Act Referrals	4
Key Ecological Features	0
Biologically Important Areas	0
Bioregional Assessments	0
Geological and Bioregional Assessments	0

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected and is accurate at the time of generation. Please see the caveat for interpretation of information provided here. Consider carefully the age of information for decision making.

Report Metadata	Caveat

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Listed Threatened Ecological Communities

[Resource Information]

				Presence	
Community ID	**Community Name**	**Threatened Category**	**Website**	**Rank**	**Text**
28	Brigalow (Acacia	Endangered	Species Profile and	Known	Community known to
66	Coolibah - Black Box	Endangered	Species Profile and	May	Community may occur
141	Poplar Box Grassy	Endangered	Species Profile and	Likely	Community likely to
98	Weeping Myall	Endangered	Species Profile and	Likely	Community likely to

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Listed Threatened Species [Resource Information]

Species ID	Scientific Name	Common Name	Class	Simple Presence	Presence Text	Threatened Category	Migratory Status	Migratory Category	Marine Status	Cetacean Status	Website
856	*Calidris ferruginea*	Curlew Sandpiper	Bird	May	Species or species	Critically Endangered	Migratory	Migratory Wetlands	Listed - overfly marine		Species Profile and
81648	*Elseya albagula*	Southern Snapping	Reptile	May	Species or species	Critically Endangered					Species Profile and
5481	*Dichanthium*	King Blue-grass	Plant	Likely	Species or species	Endangered					Species Profile and
942	*Erythrotriorchis*	Red Goshawk	Bird	May	Species or species	Endangered					Species Profile and
3066	*Cossinia australiana*	Cossinia	Plant	Known	Species or species	Endangered					Species Profile and
331	*Dasyurus hallucatus*	Northern Quoll, Digul	Mammal	Likely	Species or species	Endangered					Species Profile and
1179	*Hemiaspis damelii*	Grey Snake	Reptile	May	Species or species	Endangered					Species Profile and
77037	*Rostratula australis*	Australian Painted	Bird	Likely	Species or species	Endangered			Listed - overfly marine		Species Profile and
254	*Petauroides volans*	Greater Glider	Mammal	Known	Species or species	Endangered					Species Profile and
183	*Chalinolobus dwyeri*	Large-eared Pied Bat,	Mammal	May	Species or species	Endangered					Species Profile and
4146	*Xerothamnella*	null	Plant	May	Species or species	Endangered					Species Profile and
26027	*Neochmia ruficauda*	Star Finch (eastern),	Bird	Likely	Species or species	Endangered					Species Profile and
85104	*Phascolarctos cinereus*	Koala (combined	Mammal	Likely	Species or species	Endangered					Species Profile and
82772	*Polianthion*	null	Plant	May	Species or species	Vulnerable					Species Profile and
59398	*Stagonopleura guttata*	Diamond Firetail	Bird	May	Species or species	Vulnerable					Species Profile and
9828	*Cadellia pentastylis*	Ooline	Plant	Likely	Species or species	Vulnerable					Species Profile and
863	*Gallinago hardwickii*	Latham's Snipe,	Bird	May	Species or species	Vulnerable	Migratory	Migratory Wetlands	Listed - overfly marine		Species Profile and
470	*Grantiella picta*	Painted Honeyeater	Bird	May	Species or species	Vulnerable					Species Profile and
929	*Falco hypoleucos*	Grey Falcon	Bird	May	Species or species	Vulnerable					Species Profile and
59254	*Furina dunmalli*	Dunmall's Snake	Reptile	May	Species or species	Vulnerable					Species Profile and
83395	*Nyctophilus corbeni*	Corben's Long-eared	Mammal	May	Species or species	Vulnerable					Species Profile and
186	*Pteropus poliocephalus*	Grey-headed Flying-fox	Mammal	May	Foraging, feeding or	Vulnerable					Species Profile and
1656	*Delma torquata*	Adorned Delma,	Reptile	May	Species or species	Vulnerable					Species Profile and
1420	*Egernia rugosa*	Yakka Skink	Reptile	May	Species or species	Vulnerable					Species Profile and
9338	*Arthraxon hispidus*	Hairy-joint Grass	Plant	Likely	Species or species	Vulnerable					Species Profile and
923	*Turnix melanogaster*	Black-breasted Button-	Bird	May	Species or species	Vulnerable					Species Profile and
22647	*Rhaponticum australe*	Austral Cornflower,	Plant	May	Species or species	Vulnerable					Species Profile and
174	*Macroderma gigas*	Ghost Bat	Mammal	May	Species or species	Vulnerable					Species Profile and
14159	*Dichanthium setosum*	bluegrass	Plant	Likely	Species or species	Vulnerable					Species Profile and
874	*Calidris acuminata*	Sharp-tailed Sandpiper	Bird	May	Species or species	Vulnerable	Migratory	Migratory Wetlands	Listed		Species Profile and
87600	*Petaurus australis*	Yellow-bellied Glider	Mammal	May	Species or species	Vulnerable					Species Profile and
64440	*Geophaps scripta*	Squatter Pigeon	Bird	May	Species or species	Vulnerable					Species Profile and
682	*Hirundapus*	White-throated	Bird	May	Species or species	Vulnerable	Migratory	Migratory Terrestrial	Listed - overfly marine		Species Profile and
1193	*Denisonia maculata*	Ornamental Snake	Reptile	Known	Species or species	Vulnerable					Species Profile and
1761	*Rheodytes leukops*	Fitzroy River Turtle,	Reptile	May	Species or species	Vulnerable					Species Profile and

Back to Summary

Listed Migratory Species [Resource Information]

				Presence							
Species ID	Scientific Name	Common Name	Class	Rank	Text	Threatened Category	Migratory Status	Migratory Category	Marine Status	Cetacean Status	Website
863	*Gallinago hardwickii*	Latham's Snipe,	Bird	May	Species or species	Vulnerable	Migratory	Migratory Wetlands	Listed - overfly marine		Species Profile and
86651	*Cuculus optatus*	Oriental Cuckoo,	Bird	May	Species or species		Migratory	Migratory Terrestrial			Species Profile and
678	*Apus pacificus*	Fork-tailed Swift	Bird	Likely	Species or species		Migratory	Migratory Marine Birds	Listed - overfly marine		Species Profile and
612	*Myiagra cyanoleuca*	Satin Flycatcher	Bird	Likely	Species or species		Migratory	Migratory Terrestrial	Listed - overfly marine		Species Profile and
609	*Monarcha melanopsis*	Black-faced Monarch	Bird	May	Species or species		Migratory	Migratory Terrestrial	Listed - overfly marine		Species Profile and
592	*Rhipidura rufifrons*	Rufous Fantail	Bird	May	Species or species		Migratory	Migratory Terrestrial	Listed - overfly marine		Species Profile and
858	*Calidris melanotos*	Pectoral Sandpiper	Bird	May	Species or species		Migratory	Migratory Wetlands	Listed - overfly marine		Species Profile and
874	*Calidris acuminata*	Sharp-tailed Sandpiper	Bird	May	Species or species	Vulnerable	Migratory	Migratory Wetlands	Listed		Species Profile and
856	*Calidris ferruginea*	Curlew Sandpiper	Bird	May	Species or species	Critically Endangered	Migratory	Migratory Wetlands	Listed - overfly marine		Species Profile and
59309	*Actitis hypoleucos*	Common Sandpiper	Bird	May	Species or species		Migratory	Migratory Wetlands	Listed		Species Profile and
682	*Hirundapus*	White-throated	Bird	May	Species or species	Vulnerable	Migratory	Migratory Terrestrial	Listed - overfly marine		Species Profile and
644	*Motacilla flava*	Yellow Wagtail	Bird	May	Species or species		Migratory	Migratory Terrestrial	Listed - overfly marine		Species Profile and
1774	*Crocodylus porosus*	Salt-water Crocodile,	Reptile	Likely	Species or species		Migratory	Migratory Marine	Listed		Species Profile and

Queensland Government

WildNet species list

Search Criteria: Species List for a Specified Point
Species: All
Type: Native
Queensland status: Rare and threatened species
Records: All
Date: Since 1980
Latitude: -24.9007
Longitude: 150.4475
Distance: 25.5
Email: timothy.callaghan@erm.com
Date submitted: Tuesday 19 Mar 2024 17:36:12
Date extracted: Tuesday 19 Mar 2024 17:40:05

The number of records retrieved = 8

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Apodidae	*Hirundapus caudacutus*	white-throated needletail		V	V	1
animals	mammals	Petauridae	*Petaurus australis australis*	yellow-bellied glider (southern subspecies)		V	V	3
animals	mammals	Phascolarctidae	*Phascolarctos cinereus*	koala		E	E	1
animals	mammals	Pseudocheiridae	*Petauroides volans volans*	southern greater glider		E	E	3
animals	reptiles	Diplodactylidae	*Strophurus taenicauda*	golden-tailed gecko		NT		5
plants	land plants	Asteraceae	*Leuzea australis*			V	V	1/1
plants	land plants	Euphorbiaceae	*Bertya pedicellata*			NT		2/2
plants	land plants	Sapindaceae	*Cossinia australiana*			E	E	1/1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.*
The codes are Extinct (EX), Extinct in the Wild (PE), Critically Endangered (CR), Endangered (E), Vulnerable (V), Near Threatened (NT), Special Least Concern (SL) and Least Concern (C).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.*
The values of EPBC are Extinct (EX), Extinct in the Wild (XW), Critically Endangered (CE), Endangered (E), Vulnerable (V) and Conservation Dependent (CD).

Records - The first number indicates the total number of records of the taxon (wildlife records and species listings for selected areas).
This number is output as 99999 if it equals or exceeds this value. A second number located after a / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

APPENDIX B LIKELIHOOD OF OCCURENCE

A total of 52 MNES and MSES were considered in the LoO Assessment, including 47 threatened or migratory species and five threatened ecological communities (TECs). Of these, four threatened species and one migratory species are considered known or likely to occur in the Study Area, with TECs considered known or likely to occur. 21 threatened or migratory species are considered as having the potential to occur (six flora, eight fauna and seven migratory species). The remaining species are considered unlikely to occur in the Study Area. Species that are MNES considered as known, likely or as having the potential to occur in the Study Area are presented in Table 1 below.

Of the five ecological communities considered under the LoO Assessment, two are known or likely to occur in the Study Area:

- Brigalow (Acacia harpophylla dominant and co-dominant) (likely); and
- Poplar Box Grassy Woodland on Alluvial Plains (known).

The remaining **three** TECs are considered unlikely to occur based on ground-truthing completed within the Study Area:

- Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions; and
- Weeping Myall Woodlands.

TABLE 1 THREATENED OR MIGRATORY SPECIES AND TECS THAT ARE KNOWN OR LIKELY OCCUR WITH THE STUDY AREA

Scientific Name	Common name	NC Act	Comm. EPBC Act
Known			
Poplar Box Grassy Woodlands on Alluvial Plains TEC		-	E
Geophaps scripta scripta	Squatter Pigeon (southern)	V	V
Petauroides volans	Greater Glider (southern and central)	E	E
Phascolarctos cinereus	Koala	E	E
Tachyglossus aculeatus	Short-beaked Echidna	SLC	-
Myiagra cyanoleuca	Satin Flycatcher	SLC	Mi
Likely			
Brigalow *(Acacia harpophylla* dominant and co-dominant*) TEC*		-	E
Chalinolobus dwyeri	Large-eared pied-bat	E	E

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Birds (including listed and migratory species)					
Curlew sandpiper (*Calidris ferruginea*)	CE and Mi, CR	This species is recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters. **Breeding habitat:** This species does not breed in Australia. **Foraging habitat:** potential marginal foraging habitat exists in the Study Area in the form of dams. **Roosting habitat:** this species roost in open situations with damp substrate, especially on bare shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh. Low quality foraging and roosting habitat associated with farm dams. Non coastal environment.	Yes	No	Unlikely to occur • Study Area is within the distribution for the species (may occur). • Marginal foraging habitat in the form of farm dams present. • Area is non-coastal. • No records within the Study Area/locality (closest record is approximately 116 km to the west of the Study Area). • No habitat critical to the survival of the species was identified from field surveys within the Study Area.
Red goshawk (*Erythrotriorchis radiatus*)	V, VU	This species prefers wooded and forested lands of tropical and warm-temperate Australia. Forests of intermediate density, with tall stands or individual trees so that nests are supported, are favoured, or ecotones between habitats of differing densities, e.g. between rainforest and eucalypt forest, between gallery forest and woodland, or on edges of woodland and	Yes	No	Unlikely to occur • Study Area is within the distribution for the species (may occur). • No preferred ecotones are present within the Study Area as the plateaus and plains are dominated by stunted ironbark. • No records within the Study Area/locality.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		forest where they meet grassland, cleared land, roads or watercourses. This species avoids very dense and very open habitats. This species has a large home range. **Breeding and roosting habitat:** This species rarely breeds in areas with fragmented vegetation. Breeding habitat is restricted to trees that are taller than 20m and within 1km of a watercourse or wetland. **Foraging habitat**: Habitat must be open enough for fast hunting and manoeuvring in flight, but with enough cover for ambushing of prey. No preferred ecotones are present within the Study Area as the plateaus and plains are dominated by stunted ironbark.			• No habitat critical to the survival of the species identified from field surveys within the Study Area
Grey falcon (*Falco hypoleucos*)	V, VU	This species prefers arid and semi-arid Australia and frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined watercourses. This species has also been observed in treeless areas, frequenting tussock grassland and open woodland for foraging. **Breeding habitat**: Nests chosen are usually in the tallest trees along watercourses, particularly River Red Gum (*Eucalyptus camaldulensis*) and Coolibah (*E. coolabah*) **Foraging habitat:** timbered lowland plains, acacia shrubland crossed by tree-line watercourses, as well as	Yes	No	Unlikely to occur • Study Area is within the distribution for the species (likely to occur). • Study Area lacks preferred breeding, roosting and foraging habitat in the form of riverine Eucalypt communities, open woodlands, grasslands, and acacia shrublands near tree-lined watercourses. • No records within the Study Area/locality.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		treeless areas, tussock grasslands and open woodlands. **Roosting habitat**: this species is likely to roost in both its breeding and foraging habitat. This species has also been observed roosting on the ground. Study Area lacks preferred breeding, roosting and foraging habitat in the form of riverine Eucalypt communities, open woodlands, grasslands, and acacia shrublands near tree-lined watercourses.			
Southern squatter pigeon (*Geophaps scripta scripta*)	V, VU	Squatter pigeon (southern) habitat is generally defined as open-forests to sparse, open-woodlands and scrub that are mostly dominated by *Eucalyptus, Corymbia* or *Callitris* species. Additionally, they also favour remnant regrowth or partly modified vegetation communities that are within 3 km of water bodies. **Breeding habitat**: Breeding habitat occurs on stony rises on sandy, gravelly soils, within 1 km of a suitable, permanent waterbody (including farm dams and watercourses). **Foraging habitat**: Natural foraging habitat for the species is any remnant or regrowth open-forest to sparse, open-woodland or scrub dominated by *Eucalyptus, Corymbia, Acacia* or *Callitris* species, on sandy or gravelly soils, within 3 km of a suitable, permanent or seasonal waterbody **Dispersal habitat**: Dispersal habitat is any forest or woodland occurring	Yes	Yes	Known to occur • Study Area is within the species distribution (likely to occur). • General habitat exists as areas close to bodies of water, remnant grasslands and remnant *Eucalypt* vegetation within the Study Area. • One observation of the species was made during field surveys in October 2022. The species was observed at a farm dam located by the homestead in the northern section of the Study Area.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		between patches of foraging or breeding habitat, and suitable waterbodies Habitat within the Study Area is defined as areas close to bodies of water, remnant grasslands and remnant *Eucalypt* vegetation.			
Painted honeyeater (*Grantiella picta*)	V, VU	The painted honeyeater is a 4pecialized mistletoe honeyeater. This species inhabits dry, open forests and woodlands with a preference of high numbers of mature trees, as these host larger quantities of mistletoe. The species usually occurs in areas with flowering and fruiting mistletoe and flowering Eucalypts. **Breeding habitat**: breeding habitat is typically mature trees in remnant vegetation with high quantities of mistletoe. **Foraging and roosting habitat:** Associated with woodlands and forests with mistletoe. There is a lack of preferred mistletoe present throughout the riverine eucalypt communities, however potential breeding and foraging habitat does exist in these communities.	Yes	No	Unlikely to occur: • Study Area is within the distribution for the species (may occur). • A distinct lack of mistletoe in woodlands, or associated with tall eucalypts in riverine communities, and so the habitat is generally unsuitable for the species. • There are no records in the Study Area or locality. • No habitat critical to the survival of the species identified from field surveys within the Study Area

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
White-throated needletail (*Hirundapus caudacutus*)	V and Mi, VU	According to Higgins (1999), this species occurs over most types of habitat, but are recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland (as cited in DSEWPC, 2019b). Whilst rare, they have been recorded on wooded ends of ridges, roosting after dark high in the eucalypt tree canopies (Tarburton, 1993). **Breeding habitat;** this species does not breed in Australia. **Roosting habitat**: the species is noted to roost in tall mature forests and woodlands amongst dense foliage and in hollows often associated with ridgelines. **Foraging habitat**: the species almost always will fly aerially at 'cloud level' and forage over farmland, heathland and mudflats. Species likely to fly aerially over the Study Area. The Study Area does contain potential roosting and foraging habitat in the form of eucalypt forests, specifically on elevated areas with ridges.	Yes	Yes	Potential to occur • Study Area is within the distribution of the species (likely to occur). • Species likely to fly aerially over the Study Area, which also contains potential foraging and roosting habitat in the form of tall eucalypt forests likely in elevated areas. • There are records within the locality in 2009 (ALA, 2022).

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Star finch (eastern) (*Neochmia ruficauda ruficauda*)	E, EN	This species occurs mainly in grasslands and grassy woodlands that are located close to bodies of freshwater. Habitats can be habitats dominated by trees typically associated with permeant water or areas regularly inundated; with the most common species being *Eucalyptus Coolabah, E. tereticornis, E. tessellaris, Melaleuca leucadendra, E. camaldulensis and Casuarina cunninghamii.* Records that are more recent indicate that preferred habitat is areas dominated by grasses or have been in areas where the native vegetation has been partially cleared. Breeding, foraging and roosting habitat is not clearly delineated for this species; however, all habitat types are expected to be close to water and comprising of grasslands and grassy woodlands. Potential foraging and breeding habitat occurs in the Study Area present as Eucalypt dominated habitat associated with riparian areas.	Yes	No	Unlikely to occur • Study Area is within the distribution for the species (may occur). • Potential foraging and breeding habitat of Eucalypt dominated habitat adjacent to the riparian areas (*E crebra and E. melanophloia*), and partially cleared grasslands/grassy woodlands are located throughout the Study Area. • There are no records within the Study Area/locality. • No habitat critical to the survival of the species identified from field surveys within the Study Area.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
• Australian painted snipe (*Rostratula australis*)	E, EN	This species prefers shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. That also utilise inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia* or canegrass or sometimes tea-tree (*Melaleuca*) **Breeding habitat:** may be specific for this species, shallow wetlands with bare mud and both upper and canopy cover nearby. Nest records are all, or nearly all, from or near small islands in freshwater wetlands. **Foraging habitat**: Terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. Farm dams occur in the Study Area and regarded as potential foraging habitat for the species.	Yes	No	Potential to occur • Study Area is within the distribution for the species (likely to occur). • Potential foraging and roosting habitat in the form of farm dams present. • No records exist within the Study Area or locality. • No habitat critical to the survival of the species identified from field surveys within the Study Area

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Black-breasted button-quail (*Turnix melanogaster*)	V, VU	The black-breasted button-quail is restricted to rainforests and forests, mostly in areas with 770-1200 mm rainfall per annum. In south-eastern Queensland, they are recorded on rare occasions in open eucalypt forest. It also occurs within semi-evergreen vine thicket habitats. Habitat considered critical to the survival of the black-breasted button-quail includes: • Vine thickets and rainforest vegetation types that are periodically water-stressed. These include: semi-evergreen vine thicket, low microphyll vine forest, Araucarian microphyll vine forest, Araucarian notophyll vine forest and *Brachychiton* scrubs that may incorporate bottle trees (*Brachychiton sp.*), brigalow (*Acacia harpophylla*) and belah (*Casuarina cristata*); • Low thickets or woodlands with a dense understorey but little ground cover, typically dominated by *Acacia* spp.; and • In littoral situations, dry vine scrubs, acacia thickets and areas densely covered in shrubs, particularly midgen berry *Austromyrtus dulcis*. Small areas of potential foraging and roosting habitat with rainforest vegetation types do occur within the Study Area. There is a lack of good quality habitat and connectivity in the Study Area.	Yes	No	Potential to occur • Study Area is within the distribution for the species (likely to occur). • Low density of suitable quality habitat in the Study Area. • No records within the Study Area/locality. Nearest exists from Coominglah State Forest 20km to the east in 2021 (ALA, 2022). • No habitat critical to the survival of the species identified from field surveys within the Study Area.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Birds (Migratory)					
Oriental cuckoo (*Cuculus optatus*)	Mi, SLC	The species is found in forest canopy, open wooded areas and orchards, often in hill country, also in coniferous forest and in birch (*Betula*) above the treeline. The species may occur in association with remnant and regrowth RE types 11.3.2, 11.3.25, 11.9.4, 11.9.5, 11.9.10, 11.3.19, 11.5.1. The species winters in many different countries, including the coastal parts of northern and eastern Australia (BirdLife International, 2015). **Breeding habitat**: Does not breed in Australia. **Foraging and roosting habitat**: Monsoonal rainforest, vine thickets, wet sclerophyll forest or open *Casuarina, Acacia,* or *Eucalyptus* woodlands. Frequently at the edges or ecotones between habitat types. There is limited potential roosting and foraging habitat of monsoonal rainforest or vine thickets present within the Study Area.	Yes	No	Unlikely to occur • Study Area is within the species distribution (may occur). • There is limited potential roosting and foraging habitat of monsoonal rainforest or vine thickets present within the Study Area. • No records for the species exist within the Study Area/locality. • No important habitat for this migratory species was detected in the Study Area during field surveys.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
• Fork-tailed swift (*Apus pacificus*)	Mi, SLC	In Australia, they occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. **Breeding habitat**: Does not breed in Australia. **Foraging and roosting habitat**: exclusively aerial and found across a range of habitats. Potential aerial foraging habitat over dry open habitats present. There is a lack of preferred coastal and riparian heathland or swamp habitat.	Yes	Yes	Potential to occur • Study Area is within the distribution for this species (likely to occur). • Potential aerial foraging habitat over dry open habitats present. There is a lack of preferred coastal and riparian heathland or swamp habitat. • One record for the species exist within the locality from 2002 (ALA, 2022). • No important habitat for this migratory species was detected in the Study Area during field surveys.
Common sandpiper (*Actitis hypoleucos*)	Mi, SLC	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The common sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. **Breeding habitat**: Does not breed in Australia.	Yes	No	Unlikely to occur • Study Area is within the distribution for this species (may occur). • Potential marginal to low quality foraging and roosting habitat present within the Study Area associated with farm dams non-coastal area. Coastal environments preferred. • No records for the species exist within the Study Area/locality. The closest record from 1997 is approx. 23km west of the Study Area (ALA, 2022). • No important habitat for this migratory species was detected in the Study Area during field surveys.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		Foraging habitat: this species forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots. Birds sometimes venture into grassy areas adjoining wetlands. **Roosting habitat:** Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks Potential foraging and roosting habitat present within the Study Area associated with farm dams.			
Sharp-tailed sandpiper (*Calidris acuminata*)	V and Mi, SLC	Prefers habitat on muddy edges of freshwater wetlands or brackish wetlands. Can be found at dams inland. Will often occupy coastal mudflats when ephemeral terrestrial wetlands have dried out. **Breeding habitat**: Does not breed in Australia. **Foraging habitat**: foraging habitat is at the edge of the water of wetlands or intertidal mudflats, either on bare wet mud or sand, or in shallow water. Also among inundated vegetation of saltmarsh, grass or sedges. They forage in sewage ponds, and often in	Yes	No	Unlikely to occur • Study Area is within the distribution for this species (may occur). • Marginal foraging and roosting habitat present within the Study Area associated with farm dams, Study Area is non-coastal. Species prefers coastal environments. • No records for the species exist within the Study Area/locality. The closest historic record (2000) is 11pprox.. 30km south-west (ALA, 2022). • No important habitat for this migratory species was detected in the Study Area during field surveys.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		hypersaline environments. After rain, they may forage in paddocks of short grass, well away from water. They may forage on coastal mudflats at low tide, and move to freshwater wetlands near the coast to feed at high tide. **Roosting habitat:** Roosting occurs at the edges of wetlands, on wet open mud or sand, in shallow water, or in short sparse vegetation, such as grass or saltmarsh. Occasionally, they roost on sandy beaches, stony shores or on rocks in water Potential foraging and roosting habitat present within the Study Area associated with farm dams.			
Pectoral sandpiper (*Calidris melanotos*)	Mi, SLC	In Australasia, the pectoral sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. **Breeding habitat**: Does not breed in Australia. **Foraging habitat**: forages in shallow water or soft mud at the edge of wetlands **Roosting habitat:** prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools,	Yes	No	Unlikely to occur • Study Area is within the distribution for this species (may occur). • No wetland habitats, however, potential foraging and roosting habitat present within the Study Area associated with farm dams. • No records for the species exist within the Study Area/locality. The closest records are over 120km east (ALA, 2022). • No important habitat for this migratory species was detected in the Study Area during field surveys.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		creeks, floodplains and artificial wetlands No wetland habitats, however, potential foraging and roosting habitat present within the Study Area associated with farm dams.			
Latham's snipe (*Gallinago hardwickii*)	Vulnerable and Mi, SLC	They usually occur in open, freshwater wetlands that have some form of shelter (usually low and dense vegetation) nearby. They generally occupy flooded meadows, seasonal or semi-permanent swamps, or open waters, but various other freshwater habitats can be used including bogs, waterholes, billabongs, lagoons, lakes, creek or river margins, river pools and floodplains. This species has been said to occur very rarely in small patches of habitat such as roadside ditches and alpine bogs (Higgins & Davies, 1996). **Breeding habitat**: Does not breed in Australia. **Foraging habitat**: characterized by areas of mud (either exposed or beneath a very shallow covering of water) and some form of cover (e.g. low, dense vegetation) **Roosting habitat:** on the ground near (or sometimes in) their foraging areas, usually in sites that provide some degree of shelter, e.g. beside or under clumps of vegetation, among dense tea-tree, in forests, in drainage ditches or	Yes	No	Unlikely to occur • Study Area is within the distribution for this species. • Marginal foraging and roosting habitat present within the Study Area associated with farm dams. • No records for the species exist within the Study Area or locality. • No important habitat for this migratory species was detected in the Study Area during field surveys.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		plough marks, among boulders, or in shallow water if cover is unavailable. Potential foraging and roosting habitat present within the Study Area associated with farm dams.			
Osprey (*Pandion haliaetus*)	Mi, SLC	This species occurs in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are found in lakes, large waterholes, beaches, coastal cliffs as well as inshore waters, bays and reefs. **Breeding habitat**: Nests are constructed in a variety of natural and artificial sites, including in dead or partly dead trees or bushes on cliffs, rocks, rock stacks or islets; on the ground on rocky headlands, coral cays, deserted beaches, sandhills or saltmarshes; and on artificial nest platforms, pylons, jetties, lighthouses, navigation towers, cranes, exposed shipwrecks and offshore drilling rigs **Foraging habitat**: They require extensive areas of open fresh, brackish or saline water for foraging **Roosting habitat:** Various, typically similar to breeding habitat. No habitat associated with coastal or wetland areas is present within the Study Area where this species is commonly found.	Yes	No	Unlikely to occur • Study Area is within the distribution for this species (likely to occur). • No habitat associated with coastal or wetland areas is present within the Study Area where this species is commonly found. • No records for the species exist within the Study Area/locality. • No important habitat for this migratory species was detected in the Study Area during field surveys.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Satin flycatcher (*Myiagra cyanoleuca*)	Mi, SLC	Satin flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in drier woodlands and open forests. **Roosting habitat:** there is no information on the roosting behaviour for the species. **Foraging habitat:** the species is known to forage in the canopy and subcanopy of trees **Breeding habitat:** breeding occurs in south-east Australia, but no other information is provided on the specifics of such locations. Suitable foraging habitat of densely vegetated wet eucalypt gullies occur within the Study Area.	Yes	No	Known to occur • Study Area is within the species distribution (likely to occur). • There is low abundance of suitable foraging habitat of densely vegetated wet eucalypt gullies within the Study Area. • Species was detected during field surveys through both sight and call. • The closest record is 15pprox.. 19km east of the Study Area in Biloela, QLD (ALA, 2022).
Rufous fantail (*Rhipidura rufifrons)*	Mi, SLC	In east and south-east Australia, the rufous fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as tallow-wood (*Eucalyptus microcorys*) and mountain grey gum (*E. cypellocarpa*). When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands, including spotted gum (*E. maculata*), yellow box (*E. melliodora*), ironbarks or stringybarks, often with a shrubby or heath understorey. **Breeding habitat:** breeding occurs in south-east Australia but no other information is provided on the specifics of such locations.	Yes	No	Potential to occur • Study Area is within the species distribution (likely to occur). • There is a lack of preferred species in the tree canopy of eucalypt forests present, and an absence of wet sclerophyll forests for roosting and foraging habitat. General movement habitat exists along densely vegetated gully lines within the Study Area. • One out-of-date record for the species occur within the locality and no observations were made during field surveys. The closest recent record is approx. 40 km north-east of the Study Area (ALA, 2022).

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		Foraging and roosting habitat: There is no information concerning feeding or roosting sites during species migration. • • There is a lack of preferred species in the tree canopy of eucalypt forests present, and an absence of wet sclerophyll forests for roosting and foraging habitat. General movement habitat exists along densely vegetated gully lines within the Study Area.			
Black-faced monarch (*Monarcha melanopsis*)	Mi, SLC	The black-faced monarch mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest. It is also sometimes found in nearby open eucalypt forests (mainly wet sclerophyll forests), especially in gullies with a dense, shrubby understorey as well as in dry sclerophyll forests and woodlands, often with a patchy understorey. The species especially occurs in 'marginal' habitats during winter or during passage (migration). **Breeding habitat:** this species breeds in specific locations including the Atherton Region in Queensland, Julatten south to the Paluma Range and inland to the Atherton Tableland.	Yes	No	Unlikely to occur • Study Area is within the species distribution (may occur). • There is a lack of suitable foraging and roosting habitat in the Study Area. • The closest historic record (2002) is approximately 40km east of the Study Area in Coominglah State Forest (ALA, 2022). No records for the species occur within the Study Area/ locality and no observations were made during field surveys. • Habitat present is marginal with limited patches of vine thickets. The fragmentation and small size of these habitat patches in the landscape mean they are unlikely to be utilised by black-faced monarch.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		Roosting and foraging habitat: this species feeds in mostly rainforest ecosystems, at all vertical levels of the forest. There is limited suitable foraging and roosting habitat in the Study Area.			
Yellow wagtail (*Motacilla flava*)	Mi, SLC	Habitat requirements for the yellow wagtail are highly variable, but typically include open grassy flats near water. Habitats include open areas with low vegetation such as grasslands, airstrips, pastures, sports fields; damp open areas such as muddy or grassy edges of wetlands, rivers, irrigated farmland, dams, waterholes; sewage farms, sometimes utilise tidal mudflats and edges of mangroves (Garnett et al., 2010). This species may occur in association with non-remnant vegetation. **Breeding habitat**: Does not breed in Australia. **Foraging and roosting habitat**: Not clearly defined however will be in line with habitat requirements stated above. Potential breeding and foraging habitat of open grasslands associated with farm dams present within the Study Area.	Yes	No	Unlikely to occur • Study Area is within the distribution for this species (may occur). • No records for the species exist within the Study Area/locality. Closest historic record exists approximately 40 km away at Torrens Creek from 2009. • Records do not meet recency criteria nor locality criteria. • Open grasslands associated with farm dams are present within the Study Area however these dams are small in size and lack dense vegetation for roosting. • However, no important habitat for this migratory species was detected in the Study Area during field surveys, with a lack of well-watered open grasslands or fringes of wetlands surrounded by dense vegetation (DoE, 2014).

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Gastropods					
Boggomoss snail, Dawson River snail *(Adclarkia dawsonensis)*	CE, E	The snail appears to be restricted to alluvial flats and riparian environments between Mt Rose and south of Theodore. They are considered to occur as a single population connected by the Dawson River. The preferred habitat is the floodplain of the Dawson River in places where there is good canopy cover, a moist environment, fallen logs and deep leaf litter. This habitat once formed as an extensive archipelago of suitable patches connected by riparian vegetation, but most of the snail's habitat has been cleared for farming and little original vegetation remains (Clarke and Spier-Ashcroft 2003, cited in Queensland Department of Environment and Heritage Protection 2017). **Foraging habitat:** Foraging habitat is the floodplain of the Dawson River in places where there is good canopy cover, a moist environment, fallen logs and deep leaf litter. **Breeding habitat:** Breeding habitat is the floodplain of the Dawson River in places where there is good canopy cover, a moist environment, fallen logs and deep leaf litter. The species is unlikely as the Study Area is outside the preferred habitat of the floodplain of the Dawson River.	No	No	Unlikely to occur • The Study Area does not occur within the distribution for this species (unlikely to occur). • The species may forage in the Study Area in ironbark woodlands however there is a lack of suitable cypress pine and bulloak vegetation for suitable roosting habitat. • No records occur within the Study Area/locality.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Mammals					
Large-eared pied-bat (*Chalinolobus dwyeri*)	E, EN	This microbat species is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland, down south to Bungonia in the NSW Southern Highlands. The species has close association with the presence of sandstone escarpment (for roosts) and fertile valleys (for foraging). **Foraging habitat:** Foraging tends to occur in riverine and riparian corridors however eucalypt dominated patches of vegetation are also suitable. **Roosting and bredong habitat:** The large-eared pied bat requires the presence of diurnal roosts in order to shelter. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. Foraging habitat for the species is likely to occur within the Study Area in eucalypt open and riparian woodland however there is a lack of suitable roosting habitat.	Yes	No	Likely to occur • The Study Area occurs within the distribution for this species (may occur). • The species may forage in the Study Area in ironbark woodlands however there is a lack of suitable roosting habitat. • 'Probable' recordings of the species via Anabat Detection Equipment were recorded in four locations within the Study Area/locality.
Ghost bat (*Macroderma gigas*)	V, EN	This species occupies habitats ranging from the arid Pilbara to tropical savannah woodlands and rainforests. Ghost bats roost in caves or crevices that are generally deep with relatively stable temperatures and moderate to high relative humidity roosting cave dependency.	Yes	No	Unlikely to occur • Study Area is within the distribution for this species (may occur). • Suitable breeding, roosting and foraging habitat of deep crevices with stable temperatures and relatively high humidity were not observed within the Study Area.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		Breeding habitat: breeding habitat is within their roosting sites and is confined to caves with multiple entrances. **Foraging habitat**: Foraging habitat is comprised of tropical savanna woodlands and rainforests approximately 2km away from roosting sites. **Roosting habitat:** Roost sites used permanently are generally deep natural caves or disused mines with a relatively stable temperature of 23-28 degrees C and a moderate to high relative humidity of 50-100 percent. Suitable breeding, roosting and foraging habitat of deep crevices with stable temperatures and relatively high humidity were not observed within the Study Area.			• No records for the species exist within the Study Area/locality. • No habitat critical to the survival of the species was observed during fieldwork within the Study Area.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Corben's long-eared bat (*Nyctophilus corbeni*)	V, VU	This microbat species has a scattered distribution mostly within the Murray-Darling Basin, but with some records outside of this area. It is more common in box, ironbark and cypress pine woodland on the western slopes and plains. Its stronghold seems to be the Pilliga scrub. It roosts in tree hollows, crevices and under loose bark. **Foraging habitat:** Foraging tends to be located around patches of trees in the landscape. **Breeding habitat:** Little information is available on the breeding behaviour for the species. **Roosting habitat:** Roosting behaviour is located within dead trees including ironbark's, cypress and bulloak. Potential foraging and roosting habitat of ironbark woodland is present in areas within the Study Area.	Marginally	No	Unlikely to occur: • Potential foraging and roosting habitat of ironbark woodland is present in areas within the Study Area. • No records for the species exist within the Study Area/locality. The closest record is approx. 40km south-west of the Study Area from 2000 (ALA, 2022). • Anabat analysis indicates that distribution in the Study Area is more consistent with two unlisted species of *Nyctophilus*.
Greater glider (*Petauroides volans*)	V, VU	The greater glider is an arboreal, nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers. It is more common in taller, montane older forests which have an abundance of hollows. There is no information available that differentiates foraging, breeding and roosting habitat for the species however, for roosting it prefers tall	Yes	Yes	Known to occur • The Study Area occurs within the distribution for the species (likely to occur). • Potential foraging and roosting habitat of tall, mature eucalypt forests present within some areas of the Study Area, with large hollow bearing trees present at low densities. • There is one ALA record (2020) within the locality, and one Wildnet record from the Study Area (n.d.).

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		mature forests with hollow bearing trees. Potential foraging and roosting habitat of tall, mature eucalypt forests present within the Study Area, although large trees with large hollows are present at low densities.			
Northern quoll (*Dasyurus hallucatus*)	E, -	The northern quoll occurs in a range of habitats, including open dry sclerophyll forest and woodland, riparian woodland, low dry vine thicket, the margins of notophyll vineforest, sugarcane farms and in urban areas. They are most abundant in hilly or rocky areas close to permanent water. **Breeding habitat**: generally requires habitat encompassing some form of rocky area for denning purposes with surrounding vegetated habitats used for foraging and dispersal, as well as connection to permanent water. Dens are made in rock crevices, tree holes or occasionally termite mounds. **Foraging and dispersal habitat:** this species more likely to be present in Queensland where there are high relief areas that have shallower soils, greater cover of boulders, less fire impact and closer to permanent water.	Yes	Yes	Unlikely to occur • Study Area is within the distribution of the species. • Habitat within the Study Area was observed as generally unsuitable for northern quoll. • There is one historic ALA record within the locality from 1966 (ALA, 2022). Does not meet recency criteria (within 20 years) • No habitat critical to the survival of the species was observed during fieldwork within the Study Area.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
• Koala (*Phascolarctos cinereus*)	E, EN	Koalas naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by Eucalyptus species as explained by Martin & Handasyde 1999 (as cited in, DoE, 2019h). **Breeding and foraging habitat**: Koala habitat can be broadly defined as any forest or woodland containing species that are known koala food trees, or shrubland with emergent food trees. **Dispersal habitat**: Dispersal habitat is recognised as habitat that the koala can disperse into and is typically open woodland, paddock trees, riparian habitat and habitat where there are koala food trees. Foraging and breeding habitat associated with eucalypt dominated communities occurs within the Study Area, and potential dispersal habitat associated with *E. crebra* and *E. tereticornis* woodlands and forests.	Yes	Yes	Known to occur • Study Area is within the distribution of the species (likely to occur). • Foraging and breeding habitat associated with eucalypt dominated communities occurs within the Study Area, and potential dispersal habitat associated with *E. crebra* woodlands. Potential dispersal habitat present in the form of open grassy areas and cleared agricultural with occasional standalone koala food trees. • There is one historic ALA record (1996) within the locality, and one Wildnet record from the Study Area (n.d.).
Grey-headed flying fox (*Pteropus poliocephalus*)	V, -	It is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands. It also feeds on commercial fruit crops and on introduced tree species in urban areas. Ebv (1998) explained that the primary food source is blossom from Eucalyptus and related genera but in some areas it also utilises	Yes	No	Unlikely to occur • The Study Area is within the distribution of the species (likely to occur). • The Study Area is approximately 190 km north-west from the closest active colony with recent grey-headed flying fox activity (per the interactive flying-fox viewer of the Department of Environment). This colony is located near Woocoo National Park.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		a wide range of rainforest fruits (as cited in, DoE, 2019i). **Breeding habitat:** no specific information is available for breeding habitat requirements however it is said that roosting camps contain breeding habitat. **Foraging and roosting habitat**: The listing advice for this species says that individuals can travel up to 50 km from their known roosting camps, in order to forage. They generally roost within 20 km of food sources which include the nectar and pollen of Eucalyptus, Melaleuca and Banksia native trees.			• No records in the locality, closest record approx. 25km west of the Study Area (ALA, n.d.).
Yellow-bellied glider (south-eastern) (*Petaurus australis australis*)	V, VU	This species is found in eucalypt-dominated woodlands and forests, including both wet and dry sclerophyll forests (Kavanagh et al. 1995; Rees et al. 2007). **Breeding habitat:** no specific information is available on breeding habitat for the species **Foraging and roosting habitat:** The species shows a preference for larger patches of mature growth forests that contain suitable trees that they require for foraging and roosting. The Study Area does contain some old growth eucalypt forests that could be used as suitable habitat for the species. Larger remnant forests, which have records for the species, occur in the	Yes	Yes	Potential to occur: • The Study Area is within the distribution for the species. • There is potential foraging habitat for the species in the form of old growth eucalypt forests present within the Study Area. The locality contains remnant vegetation such as state forests that would make the Study Area a movement corridor, should suitable foraging resources be present. • There are historic records within the Locality from 1997 (Wildnet, 2022) and seven in locality from 1998 (ALA, 2022).

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		locality and are likely more favourable for the species in terms of foraging and denning. It is noted that Smooth-barked eucalypts are important due to the range of foraging substrates (and therefore food resources) they provide, as loose bark hanging in strips from these trees provides shelter for insect prey (DCCEEW 2022). Study Area may be a corridor for movement.			
Short-beaked echidna (*Tachyglossus aculeatus)*	-, SLC	This species is widespread in Australia, including Tasmania and offshore islands. Found in most habitat types, from deserts to rainforests, open woodland, eucalypt forests, alpine mountains, grasslands, and coastal shorelines. Echidnas burrow into the soil, hide under vegetation and shelter in hollow logs, rock crevices and in burrows created by wombats or rabbits (Nicol 2015b; Alpin et al. 2016). **Breeding habitat:** Courtship groups observed in a variety of habitats (Morrow et al. 2009) including; under rocks or rocky overhangs, grass tussocks, hollows at the base of trees, rotten tree stumps, hollow logs, in burrows and depressions in the soil. **Foraging habitat:** Echidnas spend a lot of time in areas with vegetation that provides cover (Nicol 2015a). The Study Area does contain suitable habitat for the species.	Yes	Yes	Known to occur • The Study Area is within the distribution for the species (likely to occur). • There is potential foraging and breeding habitat for the species within the Study Area. • There is one record within the Study Area (Wildnet, 2022) and five in locality from 2002 (ALA, 2022).

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Reptiles					
Yakka skink (*Egernia rugosa*)	V, VU	The yakka skink is known to occur in open dry sclerophyll forest, woodland and scrub. The core habitat of this species is within the Mulga lands and Brigalow belt south bioregions. It is known from rocky outcrops and sand plain areas with dense ground vegetation. This species will often take refuge among dense ground vegetation, large hollow logs, cavities in soil-bound root systems of fallen trees and beneath rocks. There is no delineation between breeding, dispersal and foraging habitat for this species. There is potential habitat occurs throughout the Study Area, as there are open woodlands associated with ironbark (*Eucalyptus* spp.)	Yes	No	Unlikely to occur • The Study Area occurs within the distribution for this species (may occur). • There is potential habitat occurs throughout the Study Area, as there are open woodlands associated with ironbark (Eucalyptus spp.) • No records exist for this species within the Study Area/locality. • No habitat critical to the survival of the species was observed during fieldwork within the Study Area.
Adorned delma (*Delma torquata*)	V, VU	This species normally inhabits eucalypt-dominated woodlands and open-forests in Queensland Regional Ecosystem Land Zones (LZ). The regional ecosystems it prefers are ones dominated by poplar box (*Eucalyptus populnea*) on alluvial plains, lemon-scented gum (*Corymbia citriodora*) open forest on coarse-grained sedimentary rocks and poplar box/brigalow (*Acacia harpophylla*) open forests on fine-grained sedimentary rocks. There is no delineation between breeding, dispersal and foraging habitat	Yes	No	Unlikely to occur • The Study Area occurs within the distribution for this species (may occur). • Potential habitat of Poplar Box, Brigalow woodlands and open forests are present within the Study Area. However, there is a lack of the required microhabitat features such as thick matts of leaf litter. • There is a lack of preferred canopy species occur, such as poplar box and brigalow trees, there is generally a lack of microhabitat features due to

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		for this species. However, microhabitat requirements include presence of rocks, logs and specific mats of leaf litter typically 30-100 mm thick. There is some preferred canopy species, such as poplar box and brigalow trees, but there is generally a lack of microhabitat features due to heavy grazing throughout the Study Area.			heavy grazing throughout the Study Area. • No records for this species occur within the Study Area/locality and no observations were made during field surveys. The closest record from 2010 is in Kroombit Tops National Park, approx. 60km from the Study Area (ALA, 2022).
Dunmall's snake (*Furina dunmalli*)	V, VU	This species is found in forests and woodlands on black alluvial cracking clay and clay loams dominated by Brigalow (*Acacia harpophylla*), other Wattles (*A. burowii, A. deanii, A. leioclyx*), native Cypress (Callitris spp.) or Bull-oak (*Allocasuarina luehmannii)*. There is no delineation between breeding, dispersal and foraging habitat for this species. Microhabitat features preferred includes fallen timber and ground litter. There is potential habitat on the Study Area associated with cracking clay soils, however due to the presence of cane toads and quality of soils being degraded due to grazing, suitable habitat would be considered low.	Yes	No	Unlikely to occur • The Study Area occurs within the distribution for this species (may occur). • There is some black cracking clay necessary for this species, but there is generally a lack of good quality habitat features due to heavy grazing throughout the Study Area. • No records for this species occur within the Study Area/locality and no observations were made during field surveys.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Golden-tailed gecko (*Strophurus taenicauda)*	-, NT	The Golden-tailed gecko is endemic to inland southern and central Queensland, where it inhabits a variety of dry woodland and open forest habitats within the Brigalow Belt. It is predominantly arboreal, often sheltering during the day beneath loose bark in standing dead or alive trees, such as Brigalow, Casuarina sp., ironbark and Callitris sp.. There is no delineation between breeding, dispersal, and foraging habitat for this species. There is likely habitat in the study area associated with dry woodland and open forest which supports tree hollows, splits, and loose bark.	Yes	Yes	Likely to occur • The Study Area does occur within the distribution for this species (may occur). • There is likely habitat in the Study Area associated with tree hollows and splits, and loosely barked trees. • There is one recorded species in the locality, recorded in 2012, +/- 1.5km from the Study Area (ALA, 2024). • No habitat critical to the survival of the species was observed during fieldwork within the Study Area.
Ornamental snake (*Denisonia maculata*)	V, VU	The Ornamental Snake's preferred habitat is within, or close to, habitat that is favoured by its prey - frogs. The species is known to prefer woodlands and open forests associated with moist areas, particularly gilgai (melon-hole) mounds and depressions in Queensland Regional Ecosystem Land Zone 4, but also lake margins and wetlands There is no delineation between breeding, dispersal and foraging habitat for this species. There is potential habitat in the Study Area associated with cracking clay soils, however due to the presence of cane toads and quality of soils being	Yes	Yes	Unlikely to occur • The Study Area does occur within the distribution for this species. • There is potential habitat within the Study Area associated brigalow communities. Deep cracking clay soils were not observed and due to the notable presence of cane toads and soil degradation resultant of historic land clearing and pastoral use suitable habitat is generally absent. • There is one record with unknown date in the locality, +/- 500m from the Study Area (ALA, 2022). • No habitat critical to the survival of the species was observed during fieldwork within the Study Area.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		degraded due to grazing, suitable habitat would be considered low.			
Grey snake (*Hemiaspis damelii)*	E, EN	The distribution and ecology of *H. damelii* is poorly known. It tends to favour dry sclerophyll forests and woodlands on clay soils where water bodies or gullies are present. It shelters under rocks, logs and other debris, as well as in cracks in soil. There is no delineation between breeding, dispersal and foraging habitat for this species. There is potential habitat in the Study Area associated with clay soils, however due to the presence of cane toads and quality of soils being degraded due to grazing, suitable habitat would be considered low.	Yes	No	Unlikely to occur • The Study Area occurs within the distribution for this species (may occur). • There is some clay soils necessary for this species, but there is generally a lack of good quality habitat features due to heavy grazing throughout the Study Area. • No records for this species occur within the Study Area/locality and no observations were made during field surveys.
Southern snapping turtle (*Elseya albagula*)	CE, CE	Habitat preferences of the white-throated snapping turtle are somewhat unclear. The species is considered by some to be a habitat specialist (Todd et al., 2013) **Breeding habitat and foraging habitat:** Prefer clear, flowing, well-oxygenated waters (Hamann et al., 2007). This preference is associated with its physiological adaptation to extract oxygen from water via cloacal (aquatic) respiration (Mathie & Franklin, 2006; Clark et al., 2008).	Yes	No	Unlikely to occur • The Study Area occurs within the distribution for this species (may occur). • There is potential habitat in the Study Area when ephemeral waterways are holding water. Likelihood is low with quality of water, when flowing, reduced due to livestock grazing. • No records for this species occur within the Study Area/locality and no observations were made during field surveys.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		There is potential habitat in the Study Area when ephemeral waterways are holding water. Likelihood is low with quality of water, when flowing, reduced due to livestock grazing.			
Fitzroy River turtle (*Rheodytes leukops)*	V, VU	The Fitzroy River Turtle is found in rivers with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles. **Breeding habitat and foraging habitat:** Preferred areas have high water clarity, and are often associated with Ribbonweed (*Vallisneria sp*.) beds (Cogger et al. 1993). Common riparian vegetation associated with the Fitzroy River Turtle includes Blue Gums (*Eucalyptus tereticornis*), River Oaks (*Casuarina cunninghamiana*), Weeping Bottlebrushes (*Callistemon viminalis*) and Paperbarks (*Melaleuca linariifolia*) (Tucker et al. 2001). There is potential habitat in the Study Area when ephemeral waterways are holding water. Likelihood is low with quality of water, when flowing, reduced due to livestock grazing	Yes	No	Unlikely to occur • The Study Area occurs within the distribution for this species (may occur). • There is potential habitat in the Study Area when ephemeral waterways are holding water. Likelihood is low with quality of water, when flowing, reduced due to livestock grazing. • No records for this species occur within the Study Area/locality and no observations were made during field surveys.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Salt-water crocodile, estuarine crocodile (*Crocodylus porosus)*	Mi, VU	Studies from Arnhem Land (Northern Territory) indicated that the Salt-water Crocodile mostly occurs in tidal rivers, coastal floodplains and channels, billabongs and swamps (Webb et al. 1987) up to 150 km inland from the coast (Webb et al. 1983f). In Queensland, the species is usually restricted to coastal waterways and floodplain wetlands. Populations may also be found hundreds of kilometres upstream, such as in the Fitzroy River and the waterways of the southern Gulf of Carpentaria (Read et al. 2004). **Breeding habitat and foraging habitat:** The salt-water crocodile usually inhabits the lower (estuarine) reaches of rivers, while the upper reaches are inhabited by *Crocodylus johnstoni* (Fresh-water Crocodile); although, areas of overlap occur in some rivers (Webb et al. 1983a).	Yes	No	Unlikely to occur • The Study Area occurs within the distribution for this species (may occur). • There is potential habitat in the Study Area when ephemeral waterways are holding water. Likelihood is low with quality of water, when flowing, reduced due to livestock grazing. • No records for this species occur within the Study Area/locality and no observations were made during field surveys.
Flora					
Xerothamnella herbacea	E, EN	*Xerothamnella herbacea* occurs in brigalow (*Acacia harpophylla*) dominated communities in shaded situations, often in leaf litter and is associated with gilgais (shallow ground depressions). Soils are heavy, grey to dark brown clays. This species is not known to occur in any conservation reserves. Three of the four known populations occur in cleared areas or non-remnant vegetation that are not	Yes	No	Potential to occur • The Study Area is within the distribution for the species (may occur). • There is potential habitat of brigalow woodlands within the Study Area. • There are no records within the Study Area/locality. The nearest record exist from Moura and Biloela, beyond the 10 km locality radius. However, it should

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		protected under the Vegetation Management Act 1999 (Queensland Herbarium 2012).			be noted that this is a very cryptic and under-collected species.
Solanum johnsonianum	E, EN	*Solanum johnsonianum* is endemic to Queensland, and found within a region bounded by the towns of Rolleston to Theodore to Biloela to Dululu, which is centred about 160 km due west of Gladstone (Bean 2004; ALA 2016). However, it is restricted to very small localised areas where stands of the species exist (ALA 2016). The speciesd is almost always found in open forest and woodland habitats where brigalow (*Acacia harpophylla*) dominates or co-dominates on heavy cracking clay soils (Bean 2004). Other associated species include lapunyah (*Eucalyptus thozetiana)* with an understory of wilga *(Geijera parviflora*) (Queensland Herbarium 2012, cited in DEHP 2015).	Yes	No	Potential to occur • The Study Area is within the distribution for the species (may occur). • There is potential habitat of eucalypt woodlands and brigalow woodlands present within the Study Area. • There are no records within the Study Area/locality. The nearest record exist from Moura and Biloela, beyond the 10 km locality radius.
Solanum dissectum	E, EN	*Solanum dissectum* is a Queensland-endemic species and found within a region bounded by the towns of Blackwater to Bauhinia to Thangool to Dululu, which is centred about 150 km due west of Gladstone (Bean 2004; ALA 2016). However, it is restricted to very small localised areas where populations exist (ALA 2016). In these areas, it may be found in open forest and woodland habitats where brigalow (*Acacia harpophylla*) and potentially lapunyah (*Eucalyptus thozetiana*) characterise the dominant vegetation types on solodic	Yes	No	Potential to occur • The Study Area is within the distribution for the species (may occur). • There is potential habitat of eucalypt woodlands present within the Study Area. • There are no records within the Study Area/locality. The nearest record exist from Moura and Biloela, beyond the 10 km locality radius.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		clay soils (Bean 2004; Queensland Herbarium 2012, cited in DEHP 2015).			
Austral cornflower *(Rhaponticum australe)*	V, VU	The Austral cornflower usually grows on heavy black or red-brown clay, or clay loams derived from basalt. Populations are often confined to roadsides and cultivation headlands and is often found in woodland and grassland and in association with *Eucalyptus crebra* (Narrow-leaved Ironbark*), E. orgadophila* (Mountain Coolibah), E. populnea (Poplar Box), *E. tereticornis* (Forest Red Gum), *E. melanophloia* (Silver-leaved Ironbark), *Angophora subvelutina* (Broad-leaved Apple), *A. floribunda* (Rough-barked Apple), *Cirsium vulgare* (Spear Thistle - introduced species), *Dichanthium sericeum* (Queensland Bluegrass) and Themeda triandra (Kangaroo Grass). The Austral cornflower is considered to be a poor competitor and prefers habitat where grass competition has been reduced by fire or other forms of disturbance. However, the species is unlikely to benefit from disturbance that allows the development of a dense cover of exotic grasses such as Chloris gayana (Rhodes Grass)	Yes	No	Potential to occur • The Study Area is within the distribution for the species (may occur). • There is potential habitat of eucalypt woodlands and open forests present within the Study Area. • There are no records within the Study Area/locality. The nearest records (3) exist 20 km east of the Study Area, from 1996.
Cossinia *(Cossinia australiana)*	E, EN	Cossinia is found only in restricted habitat areas of central-eastern to south-eastern Queensland. It grows naturally in habitats of seasonal–drought adapted rainforests and associated vegetation types not adapted to fire, typically on nutrient–	Yes	Yes (Locality, 2002)	Potential to occur • The Study Area is within the distribution for the species (may occur). • There is potential habitat of drought adapted rainforests and associated

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		rich soils derived from basalt parent materials. Study Area is connected to the Montour State Forest to the South-East where the sighting occurred. With some potentially suitable drought adapted rainforests and associated vegetation types present.			vegetation types within the Study Area. • There is one record within the locality from 2002 bordering the Study Area in the Montour State Forest (ALA, 2022).
Ooline *(Cadellia pentastylis)*	V, VU	Ooline grows in semi-evergreen vine thickets and sclerophyll vegetation on undulating terrain of various geology, including sandstone, conglomerate and claystone. Soils generally have low to medium nutrient content and are normally associated with upper and mid-slopes in the landscape. The altitude is generally 300-460 m above sea level, with some stands known to occur at 600 m above sea level. The species forms a closed or open canopy, as a dominant or commonly with White box (*Eucalyptus albens*) and White cypress pine (*Callitris glaucophylla*), with an open understorey and leaf litter dominating the forest floor. There is some uniformity in the understorey, with Native olive (*Notelaea microcarpa*), Pinkwood (*Beyeria viscosa*), Bitterbark (Alstonia constricta), Wilga (*Geijera parviflora*), Berry saltbush (*Einadia hastata*), Stipa spp. and Aristida spp., abundant at many locations. Small areas of potential habitat with semi-evergreen vine thickets and	Yes	No	Potential to occur • The Study Area is within the distribution for the species (may occur). • There is potential habitat within semi-evergreen vine thickets and sclerophyll vegetation types present within the Study Area. • There are no records within the Study Area/locality. The nearest record exist from Taroom.

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		sclerophyll vegetation types do occur within the Study Area. There is a lack of good quality habitat and connectivity in the Study Area.			
Polianthion minutiflorum	V, V	*Polianthion minutiflorum* grows in forests and woodlands on sandstone slopes and gullies with skeletal soil, or deeper soils adjacent to deeply weathered laterite. The distribution of this species overlaps with semi-evergreen vine thicket TEC. It is a one-meter-high shrub, with densely covered hairy leaves, and hairy minute white flowers. Flowering throughout the year, fruits observed in August and November. No associated species or vegetation was observed during field surveys.	Yes	No	Unlikely to occur • The study area is within the distribution for the species (may occur.) • No records within the Study Area locality. Closest record is approximately 40km east of the Study Area, from 1995. • No associated species or vegetation was observed during field surveys.
Hairy-joint grass *(Arthraxon hispidus)*	V, VU	Hairy-joint grass is found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps as well as woodland.	Yes	No	Unlikely to occur • The Study Area is within the distribution for the species (may occur). • No potential habitat in the Study Area in the form of rainforest, wet eucalypt forest or sedgelands. • There are no records within the Study Area/locality. The closest record is 50 km south of the Study Area, from 1995.
King blue-grass *(Dichanthium queenslandicum)*	E, VU	*Dichanthium queenslandicum* occurs on black cracking clay in tussock grasslands mainly in association with other species of blue grasses, but also with other grasses restricted to this soil	Yes	No	Unlikely to occur • The Study Area is within the distribution for the species (may occur).

Species name	Status (EPBC and NC Act)	Habitat requirements	Study Area within species distribution	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		type. *Dichanthium queenslandicum* is mostly confined to natural grassland on the heavy black clay soils (basalt downs, basalt cracking clay, open downs) on undulating plains. There is potential habitat in the Study Area associated with clay soils, however due to poor quality of soils being degraded due to grazing, suitable habitat would be considered low.			• There is potential habitat in the Study Area associated with clay soils, however due to poor quality of soils being degraded due to grazing, suitable habitat would be considered low. • There are no records within the Study Area/locality. The nearest record is approximately 17 km east of the Study Area, from 2012 (ALA, 2022).
Bluegrass *(Dichanthium setosum)*	V, LC	Associated with heavy basaltic black soils and red-brown loams with clay subsoils. Often found in moderately disturbed areas. Threats relate to heavy grazing, clearing for pasture improvement and cropping, fire, introduced grasses and road widening. Associated species include White Box (*Eucalyptus albens*), Silver-leaved Ironbark (*E. melanophloia*), Yellow Box (*E. melliodora*), Manna Gum (*E. viminalis*), Amulla (*Myoporum debile*), Purple Wire-grass (*Aristida ramosa*), Kangaroo Grass (*Themeda triandra*). Due to poor quality of soils being degraded due to grazing, clearing for pasture improvement and cropping and introduced grasses suitable habitat would be considered low. No individuals were observed during field surveys	Yes	No	Unlikely to occur • The Study Area is within the distribution for the species (may occur). • Habitat is generally unsuitable, and no individuals were observed during field surveys. • There are no records within the Study Area/locality. The nearest record is approximately 250 km east of the Study Area (ALA, 2022)

Status listing per EPBC Act, NC Act: CE, CR = Critically Endangered; E, EN= Endangered; V, VU = Vulnerable; LC = Least Concern; Mi = Migratory, - = no listing

APPENDIX C SURVEY ADEQUACY ASSESSMENT

SURVEY ADEQUACY OF TARGETED BIRDS AND BATS

Target Species	Listing Status		Survey Guidelines and Requirements	Sampling Technique / Effort	Comment on Survey Adequacy
	NC Act	EPBC Act			
Birds					
Squatter pigeon (southern) (*Geophaps scripta scripta*)	VU	V	*Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act* (DEWHA, 2017) Area searches or transect surveys in suitable habitat. Flushing surveys also likely to be useful. Area searches or transect surveys for 15 hours over 3 days. Flushing surveys for 10 hours over 3 days.	171 dawn and dusk timed surveys (20 minutes), bird utilisation surveys across 25 locations in the Study Area. 3 area/transect searches were also conducted during bird utilisation surveys in appropriate habitat. These area/transect searches were completed by 2 ecologists for 1.5 hours each (9 total hours)	*Survey effort considered adequate due to positive identification of squatter pigeon (southern).* The southern squatter has been observed on one occasion during the October 2022 survey at a farm dam located in the northern section of the Study Area, on one occasion during the September/October 2023 survey in the north-western section of the Study Area, and on one occasion during December 2023 survey • 171 surveys across 25 locations. • Surveys were conducted throughout the Study Area, in suitable patches of open eucalypt woodlands and areas close to permanent

Target Species	Listing Status		Survey Guidelines and Requirements	Sampling Technique / Effort	Comment on Survey Adequacy
	NC Act	EPBC Act			
					bodies like farm dams and waterways.
Listed Threatened Mammals					
Large-eared pied-bat (*Chalinolobus dwyeri*)	V	VU	Survey guidelines for Australia's threatened bats (DEWHA) A combination of survey efforts is recommended for this species. This includes unattended bat detectors for 16 detector nights for a minimum of four nights and attended bat detectors for six detector hours for a minimum of three nights. It is also including harp traps and/or mist nets for 16 trap or net nights for a minimum of four nights. Surveys are best undertaken from October through to March.	10 Anabats have been deployed in 10 locations within the Study Area (all for 4 nights), for a total of 30 Anabat trapping nights. 38 habitat assessments determining the presence of any suitable habitat features for the species, including any camps or roosting sites.	*Survey effort considered adequate to detect large-eared pied bat.* • This species' call was recorded as 'probable' on numerous Anabat devices deployed in the October 2022 and March 2023 surveys. • Surveys were conducted in suitable habitat of well-vegetated areas such as eucalypt forest and in the appropriate seasons of October to March.

APPENDIX D BIRD SPECIES RECORDED DURING FIELD SURVEYS

Birds recorded foraging and roosting predominately within the canopy (< 20 m high):

- Apostlebird (*Struthidea cinerea*);
- Australasian darter (*Anhinga novaehollandiae*);
- Australasian grebe (*Tachybaptus novaehollandiae*);
- Australasian pipit (*Anthus novaeseelandiae*);
- Australian bustard (*Ardeotis australis*);
- Australian king parrot (*Alisterus scapularis*);
- Australian magpie (*Cracticus tibicen*);
- Australian pied cormorant (*Phalacrocorax varius*);
- Australian wood duck (*Chenonetta jubata*);
- Australian zebra finch (*Taeniopygia guttata castanotis*);
- Black-fronted dotterel (*Elseyornis melanops*);
- Black-faced cuckoo-shrike (*Coracina novaehollandiae*);
- Black-winged stilt (*Himantopus himantopus*);
- Blue-faced honeyeater (*Entomyzon cyanotis*);
- Brush cuckoo (*Cacomantis variolosus*);
- Brown honeyeater (*Entomyzon cyanotis*);
- Brown treecreeper (*Climacteris picumnus*);
- Brown quail (*Coturnix ypsilophora*);
- Cockatiel (*Nymphicus hollandicus*);
- Common bronzewing (*Phaps chalcoptera*);
- Common myna (*Acridotheres tristis*);
- Crested pigeon (*Ocyphaps lophotes*);
- Dollarbird (*Eurystomus orientalis*);
- Double-barred finch (*Taeniopygia bichenovii*);
- Dusky moorhen (*Gallinula tenebrosa*):
- Eastern barn owl (*Tyto javanica*);
- Eastern koel (*Eudynamys orientalis*);
- Emu (*Dromaius novaehollandiae*);
- Fairy martin (*Petrochelidon ariel*);
- Fan-tailed cuckoo (*Cacomantis flabelliformis*);
- Forest kingfisher (*Todiramphus macleayii*);
- Galah (*Eolophus roseicapilla*);
- Golden-headed cisticola (*Cisticola exilis*);
- Grey butcherbird (*Cracticus torquatus*);
- Grey-crowned babbler (*Pomatostomus superciliosus*);

- Grey fantail (*Rhipidura albiscapa*);
- Grey shrikethrush
- Grey teal (*Anas gracilis*);
- Hoary-headed grebe (*Poliocephalus poliocephalus*);
- Horsfield bronze cuckoo (*Chrysococcyx basalis*);
- Horsfield's bushlark (*Mirafra javanica*);
- Large-billed scrubwren (*Sericornis magnirostra*);
- Laughing kookaburra (*Dacelo novaeguineae*);
- Leaden flycatcher (*Myiagra rubecula*);
- Lewin's honeyeater (*Meliphaga lewinii*);
- Little black cormorant (*Phalacrocorax sulcirostris*);
- Little friarbird (*Philemon citreogularis*);
- Magpie-lark (*Grallina cyanoleuca*);
- Masked lapwing (*Vanellus miles*);
- Mistletoebird (*Dicaeum hirundinaceum*);
- Noisy friarbird (*Philemon corniculatus*);
- Noisy miner (*Manorina melanocephala*);
- Olive-backed Oriole (*Oriolus sagittatus*);
- Painted buttonquail (*Turnix varius*);
- Pacific black duck (*Anas superciliosa*);
- Pacific koel (*Eudynamys orientalis*);
- Pale-headed rosella (*Platycercus adscitus*);
- Peaceful dove (*Geopelia placida*);
- Pheasant coucal (*Centropus phasianinus*);
- Pied butcherbird (*Cracticus nigrogularis*);
- Pied currawong (*Strepera graculina*);
- Pink-eared duck (*Malacorhynchus membranaceus*);
- Rainbow bee-eater (*Merops ornatus*);
- Rainbow lorikeet (*Trichoglossus moluccanus*);
- Red-backed fairywren (*Malurus melanocephalus*);
- Restless flycatcher (*Myiagra inquieta*);
- Red-winged parrot (*Aprosmictus erythropterus*);
- Rufous whistler (*Pachycephala rufiventris*);
- Sacred kingfisher (*Todiramphus sanctus*);
- Satin flycatcher (*Myiagra cyanoleuca*);
- Scaly-breasted lorikeet (*Trichoglossus chlorolepidotus*);

- Singing honeyeater (*Lichenostomus virescens*);
- Shining bronze cuckoo (*Chrysococcyx lucidus*);
- Spangled drongo (*Dicrurus bracteatus*);
- Spotted bowerbird (*Chlamydera maculata*);
- Sulphur-crested cockatoo (*Cacatua galerita*);
- Superb fairywren (*Malurus cyaneus*);
- Squatter pigeon (*Geophaps scripta scripta*);
- Straw-necked ibis (*Threskiornis spinicollis*);
- Striated pardalote (*Pardalotus striatus*);
- Tree martin (*Petrochelidon nigricans*);
- Weebill (*Smicrornis brevirostris*);
- White-bellied cuckoo-shrike (*Coracina papuensis*);
- White-browed babbler (*Pomatostomus superciliosus*);
- White-faced heron (*Egretta novaehollandiae*);
- White-naped honeyeater (*Melithreptus lunatus*);
- White-throated gerygone (*Gerygone olivacea*);
- White-throated honeyeater (*Melithreptus albogularis*);
- White-throated treecreeper (*Cormobates leucophaea*);
- White-winged chough (*Corcorax melanorhamphos*); and
- Willie wagtail (*Rhipidura leucophrys*).

Species recorded either above the canopy or with known tendencies or potential to fly >50 m high:

- Black kite (*Milvus migrans*);
- Black-shouldered kite (*Elanus axillaris*);
- Brown falcon (*Falco berigora*);
- Nankeen kestrel (*Falco cenchroides*);
- Peregrine falcon (*Falco peregrinus*);
- Torresian crow (*Corvus orru);* and
- Wedge-tailed eagle (*Aquila audax*).

APPENDIX E ECHOLOCATION ANALYSIS FOR BAT SURVEYS

Bat Call Analysis Report

Theodore Project

Prepared for ERM

Prepared by:

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Document Records - Quality

TITLE	Bat Analysis for the site at Theodore
FILED AS	ME23006_Theodore Wind Farm

Revision	Date	Prepared by (name/title)	Reviewed by (name/ title)	Approved by (name/title)
Version A	15/12/2022	Kelly Matthews, Principal Ecologist	ERM	Client
Version B	28/04/2022	Kelly Matthews, Principal Ecologist	ERM	Client

Table of Content

TABLES

FIGURES

1.0 Introduction

1.1 Background

Green Tape Solutions were commissioned to undertake bat call analysis for a Project Area in Theodore, Queensland.

1.2 Scope of Work

The specific scope of works for this report includes the following:

- Outline the methodology used to analyse the microbat call within the subject site; and,
- Present the findings of all of the bat call surveys conducted at the project site.

2.0 Methodology

2.1 Capture Technique

Microbat calls were sampled using Anabat Swift devices and Anabat Chorus devices (Titley Electronics). Passive monitoring was undertaken from several periods within the last 12 months totalling 77 trap nights (One trap night being one detector recording for one night) including 17-22 October 2022, 13-17 February 2023 and 27-31 March 2023. The original call files display Australian Eastern Standard Time. The data was analysed using Anabat Insight.

Monitoring commenced at dusk (approximately 1800 hours) and continued until dawn (approximately 0530 hours). Ultrasonic call monitoring surveys on anabat detectors were conducted using full-spectrum fitted with omnidirectional ultrasonic microphone.

2.2 Call Identification

Anabat recordings were analysed using Anabat software (Anabat Insight). Identifications were made by categorising call shape and frequency, with a species match given in consideration to region, known bat distributions, and habitats present. The focus of the bat surveys was to assess the presence of bat species found within the Project Area, and to assess the potential for rare and threatened species to occur.

Call identification for this dataset was based on call keys and descriptions published for Queensland (Reinhold *et al.*, 2001) and New South Wales (Pennay *et al.*, 2004).

Species' identification was further refined using the probability of occurrence of each species based on their geographic distribution (Churchill, 2008, Van Dyck and Strahan, 2008). Species nomenclature used in this report follows Churchill (2008).

The reliability of identification is as follows:

- **Definite** - one or more calls where there is no doubt about the identification of the species;
- **Probable** - most likely to be the species named, low probability of confusion with species that use similar calls; and,
- **Possible -** call is comparable with the named species, with a moderate to high probability of confusion with species of similar calls.

2.3 National Standard

The format and content of this report complies with the nationally accepted standards for the interpretation and reporting of Anabat and Songmeter data (Reardon, 2003), which is currently available from the Australasian Bat Society at www.ausbats.org.au.

3.0 Results

3.1 Total Species Recorded

The majority of calls were considered to be of medium to good quality calls.

A total of 8,840 sequence files were analysed. Two devices did not have any identifiable calls. A small proportion of the files in this dataset contained background noise or resulted in poor quality calls that did not provide bat calls for analysis. While some call sequences were recognised as bat calls, the quality was not sufficient to assign species identification.

A summary of the species identified through bat call analysis is provided in **Table 1**.

Table 1: Summary of bat call analysis (QLD)

Species	NC Act	EPBC Act	October 2022		February 2023			March 2023		
			A9	A12	A14	A19	A26	C2	C11	C15
Austronomus australis	LC	NOC	Definite	Definite		Definite			Definite	Definite
Chaerephon jobensis	LC	NOC		Probable	Probable	Probable			Definite	Probable
Chalinolobus dwyeri	V	V		Probable	Probable	Probable	Probable			Probable
Chalinolobus gouldii	LC	NOC	Definite	Definite	Definite	Definite	Probable	Definite	Definite	Definite
Chalinolobus morio	LC	NOC			Probable			Definite	Probable	Probable
Chalinolobus nigrogriseus	LC	NOC		Definite	Definite	Definite	Definite		Definite	Definite
Chalinolobus picatus	LC	NOC			Probable	Probable	Probable		Probable	Probable
Miniopterus australis	LC	NOC								Probable
Miniopterus orianae oceanensis	LC	NOC		Probable	Probable	Probable	Probable		Probable	Probable
Myotis macropus	LC	NOC	Possible		Possible	Possible	Possible	Possible	Possible	Possible
Nyctophilus sp	LC	NOC	Possible		Possible	Possible	Possible	Possible	Possible	Possible
Ozimops lumsdenae	LC	NOC	Possible		Possible	Possible	Possible	Possible	Possible	Possible
Ozimops ridei	LC	NOC	Definite	Definite	Definite	Definite	Probable			Probable
Rhinolophus megaphyllus	LC	NOC	Definite	Definite	Definite	Definite			Definite	Definite
Saccolaimus flaviventris	LC	NOC								Definite
Scotorepens balstoni	LC	NOC	Definite	Definite	Definite	Definite			Definite	Definite
Scotorepens greyii	LC	NOC	Probable	Probable	Probable	Probable	Probable		Probable	Probable
Scotorepens sp.	LC	NOC		Probable	Probable	Probable	Probable		Probable	Probable
Setirostris eleryi	LC	NOC		Possible	Possible	Possible	Possible		Possible	Possible

Taphozous troughton	LC	NOC	Definite	Definite	Definite	Definite		Definite	Definite
Vespadelus troughtoni	LC	NOC		Probable					Probable
Vespadelus vulturnus	LC	NOC		Probable			Probable		Probable

LC: Least Concern, NOC: Not of Concern, V: Vulnerable

3.2 Samples of Calls / Sequences Files

Samples of call extracted from the dataset for each species identified is provided in the following figures

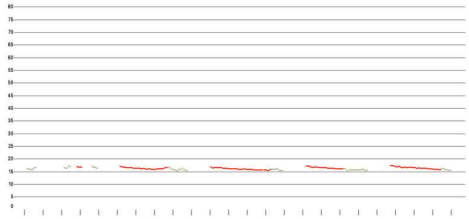
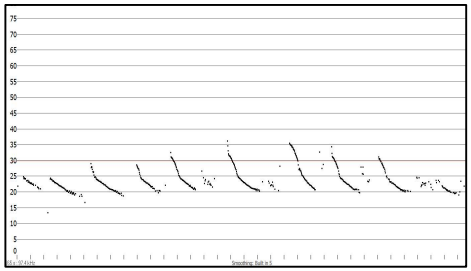
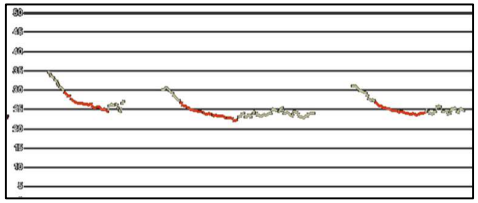
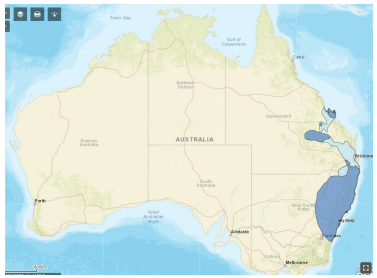
Species	Calls	Known distribution (Extract from Ausbats maps from Australian Bat Society)
Figure 1: *Austronomus australis*		
Definite call. This bat is easily recognised by its constant frequency calls range in bandwidth from 10.5 to 15 kHz (Pennay *et al.*, 2004).		
Figure 2: *Chaerephon jobensis*		
Definite call. Their characteristic frequency average 19.8 kHz (range 16.12-23.6kHz). Pulse shape variable and inconsistent with abrupt changes in frequency. *C. jobensis* often flies in pairs and therefore produce paired call pulses at alternating frequencies with intermittent, “excited”, linear pulses.		

Figure 3: *Chalinolobus dwyeri*

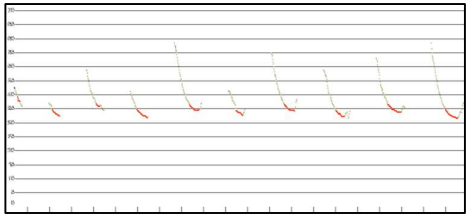




Probable call.

The call is composed of alternate curved pulses, which have up-sweeping, down-sweeping or no tail. The average call characteristic frequency varies between 23 to 24 kHz. Every second pulse stepped-up by about 2 kHz, so that the lower pulses are about 22.5 kHz and the higher pulses are about 25 kHz.

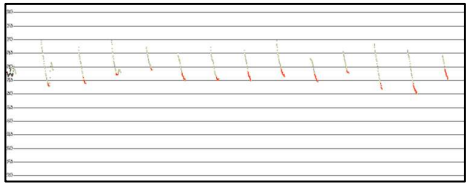
Figure 4: *Chalinolobus gouldii*



Definite call.

This species has a curved shape call with characteristic frequency 28 to 34kHz. Pulse alternates in frequency and mostly down-sweeping tail or no tail.

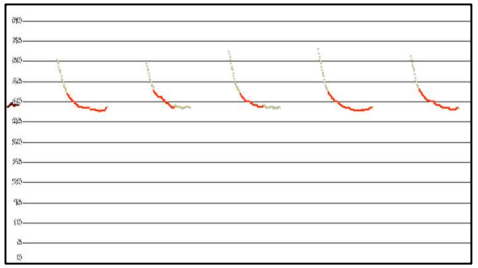
Figure 5: *Chalinolobus morio*



Definite call.

C. morio has a down-sweeping tail curved pulse with characteristic frequency 47.5 to 53 kHz. It often has a very brief characteristic section. Species that overlap in frequency (*Vespadelus troughtoni, V. pumilus* and *V. vulturnus*) but all have up-sweeping tails.

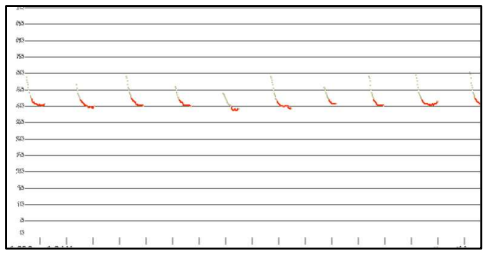
Figure 6: *Chalinolobus nigrogriseus*



Definite call.

This species has a curved shape pulse with characteristic frequency between 37 to 40 kHz. Usually with no tail or occasionally up sweeping tail. *C. nigrogriseus* have relatively longer characteristic and tail sections, usually 2/3 or more of the total pulse (Pennay *et al* 2004).

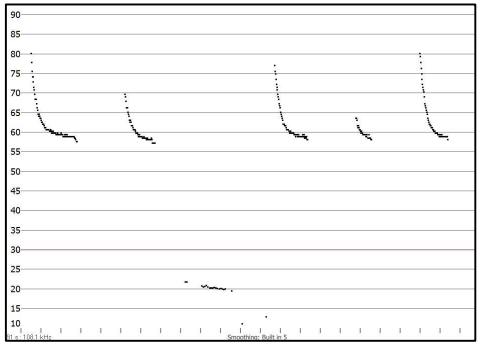
Figure 7: *Chalinolobus picatus*



Probable call.

The call is composed of alternate curved pulses without a tail or short up-sweeping tail when in search phase. Average characteristic frequency 38 to 42 kHz. Every second pulse is stepped-up by about 2 kHz.

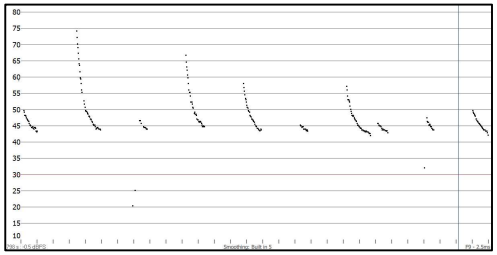
Figure 8: *Miniopterus australis*

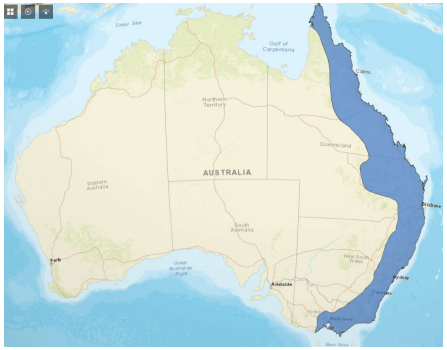


Definite call.

This species displays a characteristic frequency between 54.5 – 64.5 kHz with a curved, usually down-sweeping tail (Pennay *et al* 2004). It overlaps in frequency with *Vespadelus pumilus* between 57 – 58 kHz but the latter exhibits curved up-sweeping tail.

Figure 9: *Miniopterus orianae oceanensis*





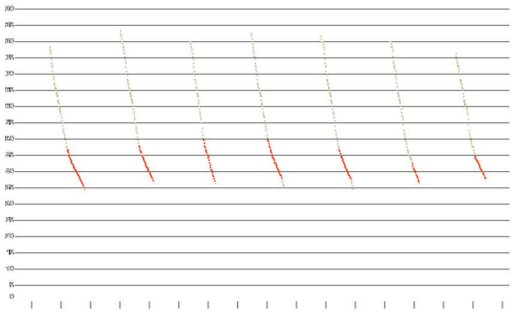
Probable call.

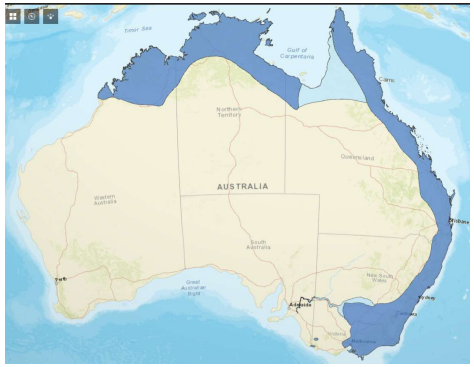
The species call is characterised by its long curved pulse with a small down-sweeping tail and its frequency between 43-47kHz (Reinhold, 2001).

Pulse shape and time between calls usually variable within a sequence.

Shorter duration, can be distinguished from *V. vulturnus* by having a longer pre-characteristic section (drop in frequency usually greater than 2 kHz) and most pulses do not have an up-sweeping tail (Reinhold, 2001). Pulse shape and time between calls can be quite variable within a sequence (Reinhold, 2001).

Figure 10: *Myotis macropus*





Possible call.

Near-vertical pulse dropping to about 30 to 35-50kHz. *M. macropus* mostly have a pulse interval of less than 75ms and usually have one kink close to the middle so that the second part has a lesser slope than the first (Reinhold, 2001).

This call can be confused with *Nyctophilus spp* calls. The latest have usually a pulse interval greater than 95ms and are slightly more complicated structure

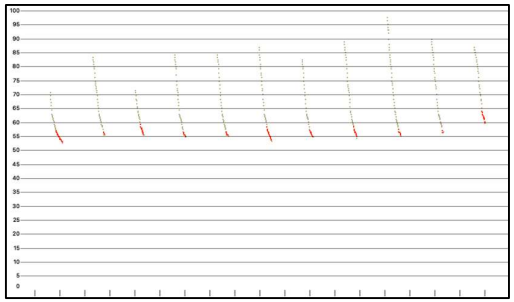
with two kinks instead of one.

Figure 11: Nyctophilus spp

Possible call.

This species displays a near-vertical pulse, characteristic frequency between 80 and 35KHz (Pennay *et al*, 2004).

The species from this genus cannot be distinguished from each other.



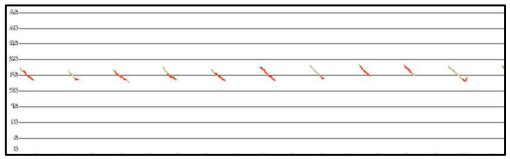
N. geoffroyi

N. gouldi

Figure 12: *Ozimops lumsdenae*

Definite call.

Characteristic frequency higher than 22 and lower than 24kHz. *O. lumsdenae* pulse can be confused with *S. flaviventris* However, the latter rarely has calls above 22kHz. *O. lumsdenae* reference calls have pulses] rising in frequency and can get up to 27kHz.



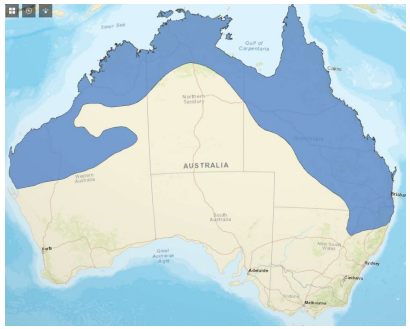
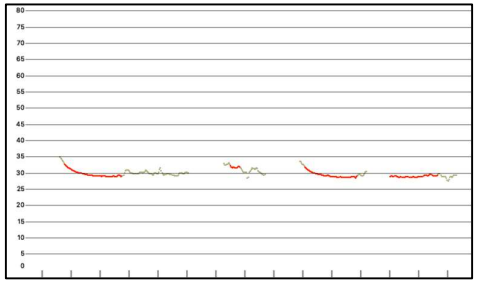
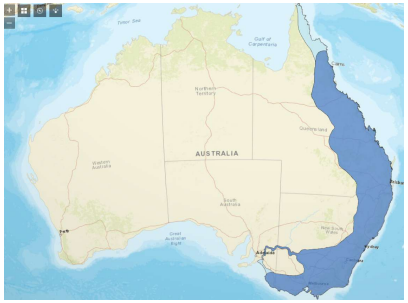


Figure 13: *Ozimops ridei*

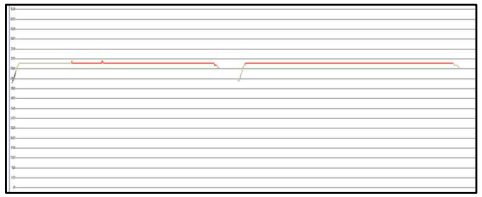


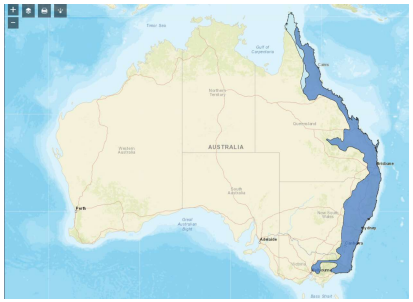


Definite call.

O. ridei calls are flat and sometimes a bit curved with frequency a bit lower than 30kHz. Characteristic frequency of this species is between 28 to 36 kHz. Calls in the same frequency range as *Micronomus norfolkensis*, but *O. ridei* calls may jump up to a higher frequency than the surrounding pulses, this does not occur in a regular pattern like in *M. norfolkensis*.

Figure 14: *Rhinolophus megaphyllus*

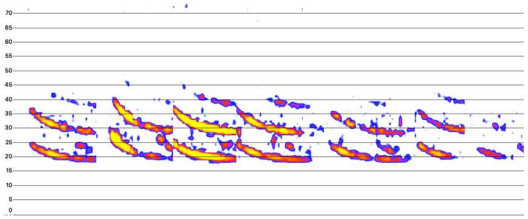




Definite call.

The species call cannot be misidentified with any other species. Pulses have an up-sweeping initial section a perfectly flat, relatively long characteristic section and a down sweeping tail (Reinhold, 2001). Characteristic frequency ranges from 66 to 72 kHz.

Figure 15: *Saccolaimus flaviventris*

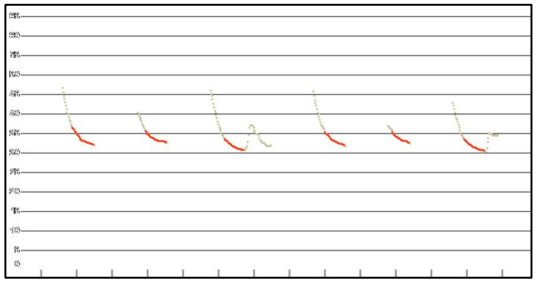


Definite call.

Curved, characteristic frequency 18 to 21.5 kHz. The characteristic frequency does not go above 22 kHz. Other species that could overlap do not occur in this area.

T. troughtoni also produces a flat type call pulse at the same frequency as *S. saccolaimus*. It is typically long and straight or slightly curved and almost horizontal, similar to *S. saccolaimus*.

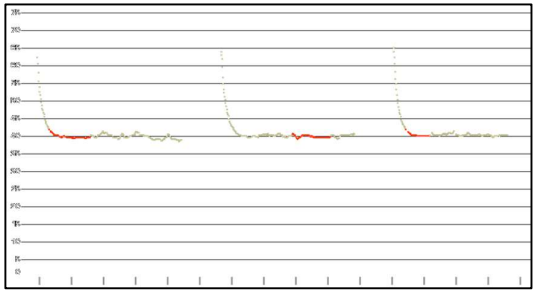
Figure 16: *Scotorepens balstoni*



Probable call.

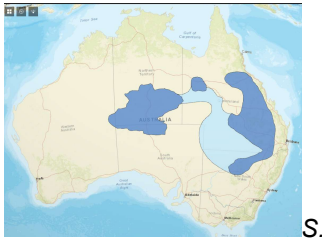
Pulse of this species is curved with tail variable, but an up-sweeping tail is often more prominent with greater duration. Characteristic frequency 31 to 35 kHz (n = 28) and the frequency of the knee 33 to 37 kHz.

Figure 17: *Scotorepens greyii*

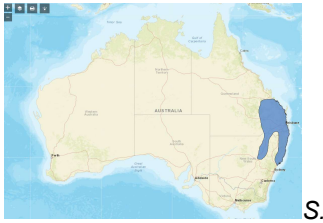


Probable call.

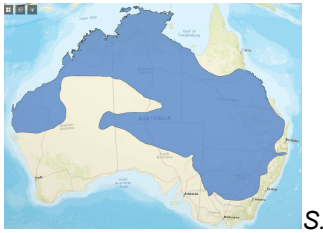
S. greyii has a curved and up-sweeping tail pulse. Its characteristic frequency is between 36 to 41.5 kHz. *S. eleryi* and S. sp (Parnaby) cannot be distinguished from S. greyii.



S. eleryi

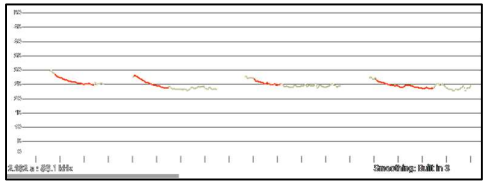


S. sp. (Parnaby



S. greyii

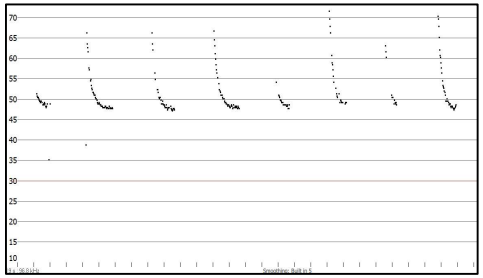
Figure 18: *Taphozous troughtoni*



Definite call.

T. troughtoni produces a flat type call pulse at the same frequency as *S. saccolaimus*. It is typically long and straight or slightly curved and almost horizontal, similar to *S. saccolaimus*.

Figure 19: *Vespadelus troughtoni*



Possible call.

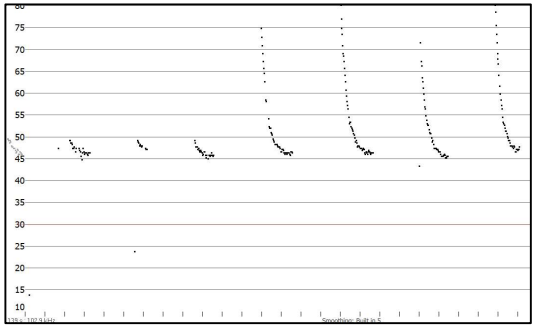
This species displays a curved pulse with not prominent up-sweeping tail. Its characteristic frequency is between 48.5 to 55 kHz (Pennay *et al*, 2004). If the end frequency is lower than 51 kHz, then the call can be identified to *V. Troughtoni* and be differentiated from *V. pumilus*.

Figure 20: Vespadelus vulturnus

Curved and up-sweeping tail calls with characteristic frequency between 45 to 53 kHz.

It cannot be distinguished from *V. regulus*, or some *V. darlingtoni* when up-sweeping tail.

It is distinguished from *Miniopterus schreibersii oceanensis* by having consecutive pulses even, with mostly up-sweeping tails and drop in frequency of pre-characteristic section mostly less than 2 kHz.



4.0 Conclusion

A total of 23 microbat species were either confirmed ‘definite’, ‘probable’ or ‘possible’ within the Project area. All bats identified on the site were expected to be present within the region.

Calls from *Nyctophilus sp* have been identified as possible in the project areas, as they are very similar to *Myotis macropus*. Two species of *Nyctophilus* possibly occur within the Project Area.

Chalinolobus dwyeri calls have been detected as probable at several sites. This species is listed as vulnerable under state and federal legislation.

Two of the reliably identified call types were only attributable to genus level due to similarities in call characteristics of the following groups:

- Nyctophilus/Myotis species
    - ✓ Steep, almost-linear linear (FM) call pulses are distinctive from those of other bat calls but cannot be reliably identified to species
    - ✓ Three species of Nyctophilus potentially occur in the project area (*N. geoffroyi* or *N. gouldii*)
    - ✓ These calls are also often confused with *Myotis Macropus* therefore all four species are listed as possible
- *Scotorepens greyii, Scotorepens sp. (Parnaby) and Setirostris eleryi*
    - Steep, curvilinear (FM-qCF) pulses with Fc of 37-41 kHz and a long tail
    - This species can be distinguished from *Chalinolobus nigrogriseus* in same Fc range by shorter pulse duration and hooked pulse body (cf. longer and flatter body in C. nigrogriseus)
    - Both Scotorepens spp. and *S. eleryi* are likely to occur in the project area, *S. eleryi* and *S. sp. (Parnaby)* calls are indistinguishable from *S. greyii* therefore both these species have been marked as ‘possible’ alongside *S. greyii identified* calls.

5.0 References

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APPENDIX F BIRD AND BAT RISK ASSESSMENT

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
Listed Migratory and Threatened Birds					
Grey falcon (*Falco hypoleucos*)	V, VU	Rare	High	**Low**	This species has been concluded as unlikely to occur within the Study Area. The following information was also considered for the risk rating: • No records exist for the species within the Study Area or locality; • Little to low number of records in the broader locality in the last 20 years (100 km radius of Study Area). Nearest records are west of the Study Area within 30km of the Study Area however the records are undated and have a spatial uncertainty of 2,000 m; • Flight height does occur within the RSA; and • Study Area lacks preferred breeding, roosting and foraging habitat in the form of riverine Eucalypt communities, open woodlands, grasslands, and acacia shrublands near tree-lined watercourses, • Small and low-density population. Although no detections have been made during seasonal BUS to date, the species is known to have extensive home ranges and the Study Area is within the known distribution so the likelihood of the event is Rare. Due to the species low population size, a collision event will constitute an ecologically significant proportion of the population and constitute a major loss in numbers of individual and so the consequence has been assessed to be High.

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					Thus, the risk rating for this species is Low as a precautionary measure to appropriately reflect the species listed status. The species has not been detected in BUS to date and so estimates of collision risk cannot be calculated for this species. Additional surveys and monitoring will be completed as detailed in this BBMP and should suitable data become available the collision risk model will be updated.
Red Goshawk (*Erythrotriorchis radiatus*)	V, VU	Rare	High	**Low**	This species has been concluded as being unlikely to occur within the Study Area. The following information was also considered for the risk rating: • No records exist for the species within the Study Area or locality; • Little to low number of records in the broader locality in the last 20 years (100 km radius of Study Area). Nearest records are west of the Study Area within 30km of the Study Area however the records are undated and have a spatial uncertainty of 2,000 m; • Flight height does occur within the RSA; and • Study Area lacks preferred breeding, roosting and foraging habitat in the form of riverine Eucalypt communities, open woodlands, grasslands, and acacia shrublands near tree-lined watercourses, • Small and low-density population Although unlikely to occur, the species is known to have extensive home ranges and the Study Area is within the known distribution so the likelihood of the event is Rare. Due to the species low population size, a collision event will constitute an ecologically significant

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					proportion of the population and constitute a major loss in numbers of individual. Thus, the risk rating for this species has been assessed as Low.
Painted Honeyeater (*Grantiella picta*)	V, VU	Rare	Low	**Negligible**	• This species has been considered as having the potential to occur within the Study Area. This is because the Study Area occurs partly within the distribution for the species. The following information was also considered for the risk rating: • No records exist for the species within the Study Area or locality; • Low (only two) records exist within the broader locality in the last 20 years (100 km radius of the Study Area); • Flight height does not occur within the RSA as the species is known to fly in the tree canopy; and • There is a distinct lack of mistletoe in woodlands, or associated with tall eucalypts in riverine communities, and so the habitat is generally unsuitable for the species and so site utilisation is unlikely to be impacted by the Proposed Action. Therefore, it is considered rare that the Proposed Action will provide a collision risk for this species and there is a low consequence of this happening due to the species listed status. Thus, the risk rating for this species is negligible.
Black-breasted button-quail (*Turnix melanogaster*)	V, VU	Rare	Low	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. This is because the Study Area is within the distribution for the species and suitable habitat is present. The

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					following information was considered for the risk rating: • No records exist for the species within the Study Area or locality; • Low number of records exist within the broader locality in the last 20 years (100 km radius of the Study Area), cloest occurring 50 km east of the Study Area within Coominglah State Forest; • Does not fly within RSA heights; and • Low density of suitable quality habitat in the Study Area. Therefore, it is considered rare that the Proposed Action will have an impact upon this species through collision with the WTGs, and it is considered that this impact would be low if it were to occur due to the Vulnerable listing of the species. Thus, the risk rating for this species is negligible.
Southern squatter pigeon (*Geophaps scripta scripta*)	V, VU	Unlikely	Low	**Negligible**	This species has been confirmed to occur within the Study Area. Squatter pigeon (southern) habitat is generally defined as open-forests to sparse, open-woodlands and scrub that are mostly dominated by Eucalyptus, Corymbia or Callitris species, within 3 km of waterbodies. The following information was also considered for the risk rating: • Records exist for the species within the Study Area and locality; • Moderate amounts of records exist within the broader locality in the last 20 years (100 km radius of the Study Area);

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					• Flight height generally does not occur within the RSA; and • Breeding, foraging and dispersal habitat occurs within the Study Area, particularly in association with permanent water bodies. The squatter pigeon is unlikely to be at risk of collision with the WTG as the species is not known to fly within the RSA and the consequence of this collision is low due to the species status. Thus, the risk rating for this species is negligible.
White-throated needletail (*Hirundapus caudacutus*)	V and Mi, VU	Likely	Moderate	**Moderate**	This species is considered potential to occur within the Study Area with no observation of the species during field surveys. The following information was also considered for the risk rating: • No records exist for the species within the Study Area and locality; • Low-moderate amounts of records exist within the broader locality in the last 20 years (100 km radius of the Study Area); • Flight height generally occur within the RSA (known to fly 1-300m above ground); • The species is known to form large flocks of up to 1000s of individuals; and • The species is considered to be exclusively aerial, with no roost habitat mapped within the Study Area. It is assumed that the species will utilised the entire Study Area aerially. The white-throated needletail is considered unlikely to be impacted by the windfarm in terms of collision risk and changes in site utilisation due to records in the

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					wider Locality. Due to the species being listed as vulnerable and migratory under the EPBC Act, the consequences of this impact have been considered Moderate as a precautionary approach to reflect the potential for large flocking events within the Study Area. Thus, the risk rating for this species is Low.
Star finch (eastern) (*Neochmia ruficauda ruficauda*)	E, EN	Rare	Moderate	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. This is because the Study Area is within the distribution for the species and suitable habitat is present. The following information was considered for the risk rating: • No records exist for the species within the Study Area or locality; • No records exist within the broader locality in the last 20 years (100 km radius of the Study Area); • Unlikely to fly within RSA heights; and • Potential foraging and breeding habitat of Eucalypt dominated habitat adjacent to the riparian areas (*Eucalyptus crebra nand E. melanophloia*), and partially cleared grasslands/grassy woodlands. Therefore, it is considered rare that the Proposed Action will have an impact upon this species and it is considered that this impact would be moderate if it were to occur due to the endangered listing of the species. Thus, the risk rating for this species is negligible.
Australian painted snipe	E, EN	Rare	Moderate	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. This is because the Study Area is within the distribution for

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
(*Rostratula australis*)					the species and suitable habitat is present. The following information was considered for the risk rating: • No records exist for the species within the Study Area or locality; • No records exist within the broader locality in the last 20 years (100 km radius of the Study Area) (several either undated or outdated records exist within 100 km of the Study Area); • Flight height is normally greater than the RSA; and • Potential foraging and roosting habitat in the form of farm dams present. Therefore, it is considered rare that the Proposed Action will have an impact upon this species through collision with the WTG, and it is considered that this impact would be moderate if it were to occur due to the endangered listing of the species. Thus, the risk rating for this species is negligible.
Fork-tailed swift (*Apus pacificus*)	Mi, -	Unlikely	Moderate	**Low**	This species is considered to have the potential to occur within the Study Area. The following information was considered for the risk rating: • No records exist for the species within the Study Area or locality; • Low amounts of records exist within the broader locality in the last 20 years; • Flight height does occur within the RSA; • The species is known to form large flocks of 1000s of individuals; • The species is known to be highly manoeuvrable; and

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					• Potential aerial foraging habitat over dry open habitats present. There is a lack of preferred coastal and riparian heathland or swamp habitat. The Fork-tailed Swift is considered unlikely to be impacted by the Proposed Action due to an absence of records within the Study Area. The likelihood of the collision event has therefore been assessed as Unlikely. As the species is known to form very large flocks during favourable conditions, there is potential that flocking events will occur within the Study Area resulting in collision events leading to a moderate loss of individuals and minor reductions in localised or regional populations. The consequence of this collision event has been assessed to be Moderate as a conservative approach. Thus, the overall risk rating for the species is Low.
Rufous fantail (*Rhipidura rufifrons)*	Mi, -	Rare	Negligible	**Negligible**	This species has been concluded as likely to occur within the Study Area. The following information was considered for the risk rating: • No records exist for the species within the Study Area or locality; • No records exist within the broader locality in the last 20 years (100 km radius of the Study Area) (several either undated or outdated records exist within 100 km of the Study Area); • The species is rarely observed flying >15 m above the ground (Cameron 1985). • There is a lack of preferred species in the tree canopy of eucalypt forests present, and an absence of wet sclerophyll forests for roosting and foraging

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					habitat. General movement habitat exists along densely vegetated gully lines within the Study Area. Therefore, it is considered rare that the Proposed Action will have an impact upon this species through collision with the WTGs, and negligible consequence of event due to the species being listed as migratory. Thus, the risk rating for this species is negligible.
Common sandpiper (*Actitis hypoleucos*)	Mi, -	Rare	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. The following information was also considered for the risk rating: • No records exist for the species within the Study Area or locality; • One record exist within the broader locality in the last 20 years (100 km radius of the Study Area), approximately 40 km north-west at Moura; • Flight height does not normally occur within the RSA; and • Potential foraging and roosting habitat present within the Study Area associated with farm dams. It is therefore considered rare that the species will be impacted by the windfarm through collision with the WTGs, with a negligible consequence due to the species migratory listing. Thus, the overall risk rating for the species is negligible.
Sharp-tailed sandpiper (*Calidris acuminata*)	Mi, -	Rare	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. Potential habitat is present in the form of farm dams, creeks and Proserpine Lake which fringes the Study Area. The following information was also considered for the risk rating:

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					• No records exist for the species within the Study Area or locality; • One record exist within the broader locality in the last 20 years (approximately 80 km east of the Study Area); • Flight height does occur within the RSA; and • Potential foraging and roosting habitat present within the Study Area associated with farm dams It is therefore considered rare that the species will be impacted by the windfarm through collision with the WTGs, with a negligible consequence due to the species migratory listing. Thus, the overall risk rating for the species is negligible.
Curlew sandpiper (*Calidris ferruginea*)	CE and Mi,	Rare	High	**Low**	This species has been concluded as having the potential to occur within the Study Area. The following information was also considered for the risk rating: • No records exist for the species within the Study Area or locality; • One record exists within the broader locality in the last 20 years (100 km radius of the Study Area), north-west from the Study Area along the Dawson River; • Flight height does occur within the RSA; • The species is listed as Critically Endangered under the EPBC Act; and • Potential foraging habitat in the form of farm dams is present. Due to a lack of suitable critical habitat and an absence of records within the Study Area the likelihood of a collision is Rare. Despite this a collision event is likely to constitute an ecologically significant

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					proportion of the population and constitute a major loss in numbers of individuals relative to regional or state popualtions, and so the consequence of the collision is rated as High. Thus, the collision risk rating is Low.
Pectoral sandpiper (*Calidris melanotos*)	Mi, -	Rare	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. The following information was also considered for the risk rating: • No records exist for the species within the Study Area or locality; • No records exist within the broader locality in the last 20 years (100 km radius of the Study Area) – closest record is over 200km south of the Study Area; • Flight height does occur within the RSA; and • No wetland habitats, however, potential foraging and roosting habitat present within the Study Area associated with farm dams. It is therefore considered rare that the species will be impacted by the windfarm through collision with the WTGs, with a negligible consequence. Thus, the overall risk rating for the species is negligible.
Oriental cuckoo (*Cuculus optatus*)	Mi, -	Unlikely	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. The following information was considered for the risk rating: • No recent records exist for the species within the Study Area or locality; • One record exist within the broader locality, only one sighting in the last 20 years (100 km radius of the Study Area);

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					• Unlikely to fly within RSA; and • There is limited potential roosting and foraging habitat of monsoonal rainforest or vine thickets present within the Study Area. Therefore, it is considered unlikely that the Proposed Action will have an impact upon this species and that there is a negligible consequence of this happening. Thus, the risk rating for this species is negligible.
Latham's snipe (*Gallinago hardwickii*)	Mi, -	Rare	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. The following information was also considered for the risk rating: • No records exist for the species within the Study Area or locality; • One record exist within the broader locality in the last 20 years (within a 100 km radius of the Study Area), 70 km east of the Study Area); • Flight height does occur within the RSA; and • Potential foraging and roosting habitat present within the Study Area associated with farm dams It is therefore considered rare that the species will be impacted by the windfarm through collision with the WTGs, with a negligible consequence. Thus, the overall risk rating for the species is negligible.
Black-faced monarch (*Monarcha melanopsis*)	Mi, -	Rare	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. The following information was also considered for the risk rating: • No recent records exist for the species within the locality; • Moderate amount of records exist within the broader locality in the last 20 years (100 km radius

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					of the Study Area), mainly within Kroombit Tops National Park; • Flight height does occur within the RSA; and • Low density of foraging and roosting habitat is present in the Study Area in the form of vine thickets/forests and dry rainforest It is therefore considered rare that the species will be impacted by the windfarm through collision with the WTGs, with a negligible consequence. Thus, the overall risk rating for the species is negligible.
Yellow wagtail (*Motacilla flava*)	Mi, -	Unlikely	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. The following information was considered for the risk rating: • No records exist for the species within the Study Area or locality; • No records exist within the broader locality in the last 20 years (100 km radius of the Study Area); • Flight height potentially entering the RSA during migration to Australia, however it is unlikely that the species will utilise this space after finishing passage. Suspected flight behaviour to be similar to other wagtails. • Potential breeding and foraging habitat of open grasslands associated with farm dams present within the Study Area. Therefore, it is considered unlikely that the Proposed Action will have an impact upon this species and there is a negligible consequence of this happening. Thus, the risk rating for this species is negligible.

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
Satin flycatcher (*Myiagra cyanoleuca*)	Mi, -	Unlikely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area. The following information was considered for the risk rating: • The species has been recorded within the Study Area during field surveys; • Low-moderate amount of records exist within the broader locality in the last 20 years (closest record 30 km from the Study Area within Shankeen Nature Refuge); • Flight height potentially entering the RSA during migration to Australia, however it is unlikely that the species will utilise this space after finishing passage; • There is low abundance of suitable foraging habitat of densely vegetated wet eucalypt gullies within the Study Area. Therefore, it is considered unlikely that the Proposed Action will have an impact upon this species and there is a negligible consequence of this happening. Thus, the risk rating for this species is negligible.
Non-listed Bird Species					
Australasian Darter (*Anhinga novaehollandiae*)	-	Unlikely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Low number of records exist within the locality (20km buffer) and moderate records exist within

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					the broader locality in the last 20 years (100km buffer); and • The species was not recorded flying above 50m during surveys but is known to flyer at higher heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is negligible.
Australasian little pied cormorant (*Microcarbo melanoleucos melanoleucos*)	-	Likely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Low number of records exist within the locality (20km buffer) and moderate records exist within the broader locality in the last 20 years (100km buffer); and • The species was recorded flying within the RSA but only on one occasion. Therefore, there is an unlikely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is negligible.
Australian Bustard		Rare	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
(*Ardeotis australis*)					field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Moderate number of records exist within the locality (20km buffer) and high records exist within the broader locality in the last 20 years (100km buffer); and • The species was not recorded flying within the RSA during field surveys. Therefore, there is a rare likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is negligible.
Australian Great Pied Cormorant (*Phalacrocorax varius hypoleucos*)	-	Unlikely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Low number of records exist within the locality (20km buffer) and moderate records exist within the broader locality in the last 20 years (100km buffer); and • The species was not recorded flying within the RSA during field surveys, with the highest record observed at 50m. Therefore, there is a rare likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the species non-threatened

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					listing and population size in the locality. Thus, the risk rating for this species is negligible.
Australian Magpie (*Gymnorhina tibicen*)	-	Likely	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was not recorded flying above 50m during surveys but is known to flyer at higher heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a low consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is low.
Australian Wood Duck (*Chenonetta jubata*)	-	Likely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Moderate number of records exist within the locality (20km buffer) and high records exist within the broader locality in the last 20 years (100km buffer); and

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					• The species was not recorded flying within the RSA during field surveys, with the highest record observed at 50m. Therefore, there is a likely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is negligible.
Black Kite (*Milvus migrans*)	-	Likely	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was not recorded flying above 50m during surveys but is known to flyer at higher heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a low consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is low.
Black-faced Cuckoo-shrike (*Coracina novaehollandiae*)	-	Likely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating:

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					• Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was not recorded flying above 50m during field surveys, however is known to fly at higher heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the high number of historically relevant records within the broader locality. Thus, the risk rating for this species is negligible.
Black-faced woodswallow (*Artamus cinereus*)	-	Likely	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • Although this species was not recorded flying within the RSA during field surveys, the species is known to fly at these heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a low consequence of such an event. Thus, the risk rating for this species is low.

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
Black-shouldered kite (*Elanus axillaris*)	-	Likely	Low	**Low**	This species is known to occur within the Study Area. The following information was considered for the risk rating: • Multiple records of the species exist within the Study Area and locality (1 individuals were sighted during bird surveys); • Moderate number of records exist within the broader locality in the last 20 years (100 km radius of the Study Area); • The species was not recorded flying through the RSA within the Study Area during field surveys, however the species is known to fly at these heights; and • This species is known to occur within and flying over wooded, forests and open land. Although this species was not recorded within the RSA during field surveys, the species is known to fly at these heights and therefore, to be conservative, it has been concluded that the likelihood of the species colliding with the turbines is 'likely'. Due to the species non-threatened status, it is concluded that the consequence of this event will be low and is unlikely to result in any significant change in local abundance. Therefore, this species is considered to be at a low risk of being impacted by the windfarm.
Brown falcon (*Falco berigora*)	-	Almost certain	Low	**Low**	This species is known to occur within the Study Area. The following information was considered for the risk rating: • Multiple records of the species exist within the Study Area and locality (10 individuals were sighted

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					during bird surveys, 6 of which were within the RSA); • High number of records exist within the broader locality in the last 20 years (100 km radius of the Study Area); and • This species is known to occur within and flying over wooded, forests and open land. This species has been seen in the RSA and to be conservative it has been concluded that the likelihood of it colliding with the turbines is 'almost certain', however due to its non-threatened status it is concluded that the consequence of this event will be low, and is unlikely to result in any significant change in local abundance. Therefore, this species is considered to be at a low risk of being impacted by the windfarm.
Brown Goshawk (*Accipiter fasciatus*)	-	Likely	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the RSA; • Moderate-high number of records exist within the broader locality (100 km); and • The species wasn't recorded within the RSA during field surveys. The species is known to occur within and flying over wooded, forests and open land, as its hunting tactic aligns with wait and pounce methods. However, the species has been observed reaching heights of over 100m during prospecting runs.

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					Therefore, there is a likely likelihood of collision due to species behaviour. Due to moderate-high historically relevant records within the broader locality the consequence of such an event is low. Thus, the risk rating for this species is low
Fairy martin (*Petrochelidon ariel*)	-	Likely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Low number of records exist within the locality (20km buffer) and moderate records exist within the broader locality in the last 20 years (100km buffer); and • The species was not recorded flying within the RSA during field surveys, with the highest record observed at 50m. Therefore, there is a rare likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is negligible.
Galah (*Eolophus roseicapilla*)	-	Almost Certain	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area;

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					• High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was recorded flying within the RSA during field surveys on 10 occasions. Therefore, there is a almost certain likelihood of collision due to the species records within the RSA and a low consequence of such an event. Thus, the risk rating for this species is low.
Grey Teal (*Anas gracilis*)	-	Likely	negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was not recorded within the RSA during field surveys, however the species is known to fly at these heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the high number of historically relevant records within the broader locality. Thus, the risk rating for this species is negligible.
Hardhead (*Aythya australis*)	-	Likely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating:

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					• Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was not recorded within the RSA during field surveys, however the species is known to fly at these heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the high number of historically relevant records within the broader locality. Thus, the risk rating for this species is negligible.
Intermediate Egret (*Ardea intermedia*)	-	Unlikely	Negligible	**Negligible**	This species is known to occur within the Project Area. The following information was considered for the risk rating: • The presence of this species was confirmed during field surveys. • There are moderate-high records within the broader locality. • The species was not recorded at heights above 30m during field surveys. • Suitable habitat has been identified within the Project Area. Therefore, it is considered unlikely that the species will collide with the WTGs due to the species behaviour, distribution and records, and there is a negligible consequence of this happening due to the species threatened listing and population size. Thus, the risk rating for this species is negligible.

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
Little black cormorant (*Phalacrocorax sulcirostris*)	-	Likely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Low number of records exist within the locality (20km buffer) and moderate records exist within the broader locality in the last 20 years (100km buffer); and • The species was recorded flying within the RSA, but only on 2 occasions. Therefore, there is a likely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is negligible.
Nankeen kestrel (*Falco cenchroides*)	-	Almost certain	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was not recorded flying above 50m during surveys but is known to flyer at higher heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a low consequence of such

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is low.
Noisy Miner (*Manorina melanocephala*)	-	Unlikely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was not recorded flying within the RSA, with the max height of the species recorded at 50 m. Therefore, there is an unlikely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the high number of historically relevant records within the broader locality. Thus, the risk rating for this species is negligible.
Pacific baza (*Aviceda subcristata*)	-	Almost certain	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the RSA; • High amounts of records exist within the broader locality in the last 20 years (100 km radius of the

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					Study Area) and few records within the Locality (20km from the Study Area); and • This species often moves in family groups concealed within the canopy and hunts within the canopy layer. Although the species was not observed within the RSA during field surveys, during breeding season, males are known to do aerial displays where they fly up high and do aerial manoeuvres and dives. Therefore, with an assumption of breeding behaviours occurring every season, it is almost certain likelihood of collision. Due to high historically relevant records within the broader locality the consequence of such an event is low. Thus, the risk rating for this species is low.
Pacific Black Duck (*Anas superciliosa*)	-	Likely	negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was no recorded within the RSA during field surveys, however the species is known to fly at these heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the high number of historically

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					relevant records within the broader locality. Thus, the risk rating for this species is low.
Peregrine falcon (*Falco peregrinus*)	-	Almost Certain	Low	**Low**	This species is known to occur within the Study Area. The following information was considered for the risk rating: • Multiple records of the species exist within the Study Area and locality (1 individuals were sighted during bird surveys); • Low- moderate number of records exist within the broader locality in the last 20 years (100 km radius of the Study Area); • The species was recorded flying through the RSA on one occasion within the Study Area during field surveys; and • This species is known to occur within and flying over wooded, forests and open land. This species has been seen in the RSA and to be conservative it has been concluded that the likelihood of it colliding with the turbines is 'almost certain', however due to its non-threatened status it is concluded that the consequence of this event will be low, and is unlikely to result in any significant change in local abundance. Therefore, this species is considered to be at a low risk of being impacted by the windfarm.
Pied Currawong (*Strepera graculina*)	-	Likely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating:

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					• Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was not recorded within the RSA during field surveys, however the species is known to fly at these heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the high number of historically relevant records within the broader locality. Thus, the risk rating for this species is negligible.
Pink-eared Duck (*Malacorhynchus membranaceus*)	-	Likely	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Low number of records exist within the locality (20km buffer) and low-moderate records exist within the broader locality in the last 20 years (100km buffer); and • The species was not recorded flying within the RSA during field surveys, with the highest record observed at 50m. Therefore, there is a likely likelihood of collision due to the species behaviour and a low consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is low.

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
Plumed whistling-duck (*Dendrocygna eytoni*)	-	Likely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Low number of records exist within the locality (20km buffer) and moderate-high records exist within the broader locality in the last 20 years (100km buffer); and • The species was not recorded flying within the RSA during field surveys, however the species is known to reach these heights Therefore, there is a likely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is negligible.
Rainbow Bee-eater (*Merops ornatus*)	-	Likely	Low	**Low**	This species is known to occur within the Project Area. The following information was considered for the risk rating: • The presence of this species was confirmed during field surveys. • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was not recorded within the RSA during field surveys, however the species is known to fly at these heights. • Suitable habitat has been identified within the Project Area.

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					Therefore, there is a likely likelihood of collision due to the species behaviour and a low consequence of such an event. Thus, the risk rating for this species is low.
Rainbow Lorikeet (*Trichoglossus moluccanus*)	-	Likely	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was recorded flying within the RSA on four occasions during BUS. Therefore, there is an almost certain likelihood of collision due to the species behaviour and a low consequence of such an event due to the high value of observations within the RSA during surveys. Thus, the risk rating for this species is negligible.
Red-winged Parrot (*Aprosmictus erythropterus*)		Unlikely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					• The species was recorded flying within the RSA, however this was only observed on one occasion (60m). Therefore, there is an unlikely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the high number of historically relevant records within the broader locality. Thus, the risk rating for this species is negligible.
Spotted harrier (*Circus assimilis*)	-	Likely	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Low number of records exist within the locality (20km buffer) and low-moderate records exist within the broader locality in the last 20 years (100km buffer); and • The species was recorded flying within the RSA during field surveys, however only on two occasions. Therefore, there is a likely likelihood of collision due to the species behaviour and a low consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is low.
Straw-necked Ibis	-	Likely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
(*Threskiornis spinicollis*)					field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Low number of records exist within the locality (20km buffer) and moderate-high records exist within the broader locality in the last 20 years (100km buffer); and • The species was not recorded flying within the RSA during field surveys (max 18 m). Therefore, there is a likely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is low.
Sulphur-crested Cockatoo (*Cacatua galerita*)	-	Likely	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Moderate-high number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was recorded flying within the RSA on 13 occasions during BUS. Therefore, there is a likely likelihood of collision due to the species behaviour and a low consequence of such an event. Thus, the risk rating for this species is low.

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
Torresian Crow (*Corvus orru*)	-	Likely	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was recorded flying within the RSA on 29 occasions during BUS. Therefore, there is a likely likelihood of collision due to the species behaviour and a low consequence of such an event. Thus, the risk rating for this species is low.
Tree Martin (*Petrochelidon nigricans*)	-	Likely	Low	**Low**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Low-moderate number of records exist within the locality (10 records) (20km buffer) and broader locality (70 records) (100km buffer); and • The species was not recorded within the RSA during field surveys, however the species is known to fly at these heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a low consequence of such an event due to the number of observations within the RSA during field surveys. Thus, the risk rating for this species is low.

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
Wedge-tailed eagle (*Aquila audax*)	-	Almost certain	Low	**Low**	This species is known to occur within the Study Area. The following information was considered for the risk rating: • Multiple records of the species exist within the Study Area and locality (99 individuals were sighted in the Study Area during bird surveys, 70 of which were within the RSA); • High number of records exist within the broader locality in the last 20 years (100 km radius of the Study Area); • The species was recorded on multiple occasions flying throughout the RSA within the Study Area; and • This species is known to occur within and flying over wooded, forests and open land. This species has been seen in the RSA and to be conservative it has been concluded that the likelihood of it colliding with the turbines is 'almost certain', however due to its non-threatened status it is concluded that the consequence of this event will be low, and is unlikely to result in any significant change in local abundance. Therefore, this species is considered to be at a low risk of being impacted by the windfarm.
Welcome Swallow (*Hirundo neoxena*)	-	Unlikely	Low	**Negligible**	This species has been concluded as known to occur within the Project Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Project Area;

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					• High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was not recorded flying within the RSA (max 5 m). Therefore, there is an unlikely likelihood of collision due to the species behaviour and a low consequence of such an event. Thus, the risk rating for this species is negligible.
Whistling kite (*Haliastur sphenurus*)	-	Almost certain	Low	**Low**	This species is known to occur within the Study Area. The following information was considered for the risk rating: • Multiple records of the species exist within the Study Area and locality (3 individuals were sighted during bird surveys, all of which were observed within the RSA); • High number of records exist within the broader locality in the last 20 years (100 km radius of the Study Area); • The species was recorded on multiple occasions flying throughout the RSA within the Study Area; and • This species is known to occur within and flying over wooded, forests and open land. This species has been seen in the RSA and to be conservative it has been concluded that the likelihood of it colliding with the turbines is 'almost certain', however due to its non-threatened status it is concluded that the consequence of this event will be low, and is unlikely to result in any significant change in local abundance. Therefore, this species is

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					considered to be at a low risk of being impacted by the windfarm.
White-Breasted Woodswallow (*Artamus leucorynchus*)	-	Likely	Low	**Low**	This species has been concluded as known to occur within the Project Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Project Area; • High number of records exist within the locality (20km buffer) and broader locality in the last 20 years (100km buffer); and • The species was not recorded flying within the RSA (max 50m), however the species is known to fly at these heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a low consequence of such an event. Thus, the risk rating for this species is low.
White-faced Heron (*Egretta novaehollandiae*)	-	Likely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Moderate number of records exist within the locality (20km buffer) and high records exist within the broader locality in the last 20 years (100km buffer); and • The species was recorded flying within the RSA during field surveys, however only on one occasions.

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					Therefore, there is a likely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is negligible.
White-necked heron (*Ardea pacifica*)	-	Likely	Negligible	**Negligible**	This species has been concluded as known to occur within the Study Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Study Area; • Moderate number of records exist within the locality (20km buffer) and high records exist within the broader locality in the last 20 years (100km buffer); and • The species was recorded flying within the RSA during field surveys, however it is known to reach these heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a negligible consequence of such an event due to the species non-threatened listing and population size in the locality. Thus, the risk rating for this species is negligible.
Yellow-tailed black-cockatoo (*Zanda funereal*)	-	Likely	Low	**Low**	This species has been concluded as known to occur within the Project Area as observations occurred during field surveys. The following information was considered for the risk rating: • Species was directly observed during field survey efforts within the Project Area;

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					• Moderate-High number of records exist within the locality (20km buffer) and broader locality (100km buffer); and • The species was not recorded flying within the RSA on during BUS (max 20m), however, the species is known to fly at these heights. Therefore, there is a likely likelihood of collision due to the species behaviour and a low consequence of such an event due to population size and density of the species within the area. Thus, the risk rating for this species is low.
Listed Threated Bats					
Grey-headed flying fox (*Pteropus poliocephalus*)	V, -	Unlikely	Low	**Negligible**	This species has been concluded as likely to occur within the Study Area. The following information was considered for the risk rating: • No records exist for the species within the Study Area or locality; • The Study Area is approximately 180 km north-west from the closest active colony with recent GHFF activity (per the interactive flying-fox viewer of the Department of Environment). This colony is located near Mundubbera. • Flight height unlikely to reach the RSA; and • Favoured habitat is mapped to exist in the Study Area in the form of box, ironbark, brigalow and forest red gum woodland communities. This species has an unlikely likelihood WTG collision, and as a vulnerable EPBC Act listed species, the consequence risk is concluded to be low. Therefore,

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					the species has been considered to be at a negligible risk of being impacted by the windfarm.
Corben's long-eared bat (*Nyctophilus corbeni*)	V, VU	Unlikely	Low	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. The following information was considered for the risk rating: • No records exist for the species within the Study Area or locality; • No records exist within the broader locality in the last 20 years (100 km radius of the Study Area); • Flight height unlikely to reach the RSA; and • Potential foraging and roosting habitat of ironbark woodland is present in areas within the Study Area. This species has an unlikely likelihood WTG collision, and as a vulnerable EPBC Act listed species, the consequence risk is concluded to be low. Therefore, the species has been considered to be at a negligible risk of being impacted by the windfarm.
Large-eared pied-bat (*Chalinolobus dwyeri*)	E, EN	Unlikely	Moderate	**Low**	This species has been concluded as known to occur within the Study Area. The following information was considered for the risk rating: • Several 'probable' recordings of the species were detected within the Study Area through Anabat recordings; • No records exist within the broader locality in the last 20 years (100 km radius of the Study Area); • Flight height unlikely to reach the RSA; and • Potential foraging habitat is present in areas within the Study Area. This species has an unlikely likelihood WTG collision, and as a endangered EPBC Act listed species, the

Species	Threatened Species Status EPBC Act	Likelihood of Event	Consequence of Event	Risk Rating	Comments
					consequence risk is concluded to be moderate. Therefore, the species has been considered to be at a low risk of being impacted by the windfarm.

Status listing per EPBC Act, NC Act: CE, CR = Critically Endangered; E, EN= Endangered; V, VU = Vulnerable; Mi = Migratory, - = no listing

APPENDIX G BIRD AND BAT SURVEY METHODOLOGY

The below methodology is suitable for detection of a wide range of bird species including those identified as target species that could be potentially impacted by turbine strike. The survey program has taken into consideration the seasonal variation of migratory and threatened species and is structured to ensure two visits occur each year within the suitable season and habitat of each targeted species. The bird and bat seasonal consideration table below details the seasonal considerations for each targeted species.

Appendix C details the full list of EPBC Act and NC Act listed bird and bat species targeted during the baseline surveys, their survey guideline requirements and survey adequacy.

The survey guidelines for diurnal bird surveys and their requirements are as follows:

- *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland:*
    - Diurnal bird surveys involve six 5-10 min area searches within 100 x 100 m survey site; and
    - Two surveys conducted in the morning (<two hours after sunrise), two in mid-morning (two to four hours after sunrise) and two in less optimal times (four hours after sunrise and two hours before sunset).

Bird and Bat Surveys during Construction

During the construction phase, two wet season and two dry season surveys will need to be undertaken (in addition to the four baseline surveys that have already been undertaken and informed the development of this BBMP). Bird and bat survey techniques undertaken during the construction phase of the Proposed Action will be consistent with the techniques and locations already undertaken in baseline surveys detailed in Section 2.1 and in accordance with the two phase and design avoidance process, will target known, likely and potentially occurring listed threatened and/or migratory species or micro-habitat features at proposed infrastructure locations in the Study Area.

Bird and Bat Monitoring at Commencement of Operation

Bird and bat surveys during the commencement of operation will target the species listed as 'known' or 'likely' to occur within the Study Area in Section 3, as well as those listed species with potential to occur in the Study Area. Bird surveys will occur during the first two years of commencement of operation with two wet season and two dry season surveys being undertaken in those years. Monitoring during the commencement of operation of the Proposed Action will be consistent with techniques used during previous field surveys.

The location of the operational phase bird and bat surveys has been informed by the habitat mapping prepared for the species determined as known, likely or having the potential to occur within the Study Area.

The monitoring during operation will be based on two main approaches. The first is to monitor bird and bat activity and ongoing mortality searches that aim to determine impacts (collisions) occurring during the first two years of operation. The second is to inform specific response to impact triggers that may result to bird and bat species, which will include increase monitoring surveys and carcass searches, investigation of risk behaviours and subsequent risk mitigation.

Bird Utilisation Surveys (BUS)

BUS involve 20-minute fixed point surveys to provide data based on the species present, height, speed and direction of flight as stipulated by the Band Model (SNH, 2012; Band, 2000). Each fixed-point survey site was located to provide a search radius of at least 100 m for small birds and up to 800 m for large birds with range finders used to determine distances. Searches primarily focused on birds most likely to be affected by the Proposed Action, such as raptors (birds of prey) and large flocks of birds.

The *Onshore Wind Farm Guidance* (DCCEEW, 2023) (DCCEEW,2024) details the need to undertake a risk assessment for birds and bats following BUS for the Study Area. This risk assessment has taken into account the likelihood and consequences of events including collision with WTGs and the impact of construction and operation on the Proposed Action causing changes in site utilisation by bird and bat species.

The State Code 23 details the requirement for BUS for proposed wind farm developments. Such surveys identify avian species, numbers present, height flown and site utilisation. The 2022-2023 field surveys undertook BUS in accordance with the Band Model, at waterbodies and in open areas for birds of prey (Band, 2000).

The State Code also recommends a Before-After-Control-Impact (BACI) design principle for surveys where the Study Area is determined to support significant bird species. The aim of the BACI design is to compare environmental variables before and after a human activity and between the area affected by the development footprint (impact) and an unaffected area (control) (Stewart-Oaten, 1986). Areas visited during the 2022-2024 field surveys, prior to construction/operation, were identified as impact areas. These areas will be revisited and resurveyed during the second design phase (pre-construction), during construction and after construction (operation phase) of the Proposed Action. Additional neighbouring control sites will be selected and surveyed as part of the second design phase (within 1 km of the Proposed Action).

The BACI designed bird surveys include BUS such as point, waterbody and birds of prey surveys, as was conducted during the phase one design field investigations. It is noted that the second design phase will include ongoing surveys at impact sites (at the sites already surveyed) as well as control sites that are yet to be determined. The final location of BACI survey sites will be dependent on changes in proposed infrastructure placement that may result from findings of the second phase design field program.

Point Surveys

Point surveys are conducted to target diurnal woodland and riparian bird species. Suitable woodland and riparian habitats will be traversed by suitably trained ecologists, with 20-minute timed surveys to be conducted for all birds in the Study Area.

Waterbody Surveys

Waterbody surveys are conducted in order to target waterbirds (particularly some migratory species), and woodland species utilising the waterbodies. Observations are made from a stationery position, and birds identified by call detection and visual observations. The Study Area contains approximately 17 artificial waterbodies (farm dams), with potential to act as important water sources in the landscape, particularly during dry conditions.

Birds of Prey Surveys

Birds of prey surveys will be undertaken to target the listed threatened species such as the red goshawk (*Erythrotriorchis radiatus*) and generally occurring, NC Act Least Concern birds of prey that may be at risk of collision with WTGs during operation, such as raptors. Surveys are undertaken at vantage points (e.g. large hills and extensively cleared areas) at mid-morning when birds of prey become increasingly active.

Call Playback

Call playback surveys are conducted to target cryptic, nocturnal bird species. Within suitable habitat 2-minute calls are broadcast interspersed with 2 minutes of silence to listen for response calls. Suitable habitat includes vegetated gully lines and areas with suitably sized tree hollows. A handheld Bluetooth speaker is used to broadcast calls. Following two rounds of call broadcasts, a spotlighting search is performed to search for owls that had responded by flying quietly to the broadcast area.

Bird and Bat Seasonal Consideration

Species Name	Threatened Species Status		Likelihood of Occurrence	Seasonal Consideration
	EPBC Act	NC Act		
Listed Threatened and Migratory Bird Species				
Squatter pigeon (southern) (*Geophaps scripta scripta*)	CE, M	CR	Unlikely	September to March
White-throated needletail (*Hirundapus caudacutus*)	-	V	Unlikely	March to August
Black-breasted button quail (*Turnix melanogaster*)	VU	V, Mi	Unlikely	July to November
Squatter pigeon (southern) (*Geophaps scripta scripta*)	V	VU	Unlikely	May to December
White-throated needletail (*Hirundapus caudacutus*)	V	VU	Unlikely	Wet and Dry season
Black-breasted button quail (*Turnix melanogaster*)	V	VU	Unlikely	Wet and Dry season
Squatter pigeon (southern) (*Geophaps scripta scripta*)	VU, Mi	VU	Potential	October to February
White-throated needletail (*Hirundapus caudacutus*)	E	EN	Potential	September to October
Black-breasted button quail (*Turnix melanogaster*)	V	VU	Unlikely	Wet and Dry season
Fork-tailed Swift (*Apus pacificus*)	Mi	SLC	Unlikely	Dry season
Sharp-tailed sandpiper (*Calidris acuminata*)	Mi	SLC	Unlikely	July to September
Latham's snipe (*Gallinago hardwickii*)	Mi	SLC	Unlikely	Wet season
Black-faced monarch (*Monarcha melanopsis*)	Mi	SLC	Potential	Wet season

Species Name	Threatened Species Status		Likelihood of Occurrence	Seasonal Consideration
	EPBC Act	NC Act		
Satin flycatcher (*Myiagra cyanoleuca*)	Mi	SLC	Known	Wet and Dry season
Rufous fantail (*Rhipidura rufifrons*)	Mi	SLC	Known	Wet and Dry season
Non-listed Bird Species (Raptors within the RSA)				
wedge-tailed eagle	-	LC	Known	Wet and Dry season
whistling kite	-	LC	Known	Wet and Dry season
brown falcon	-	LC	Known	Wet and Dry season
Listed Threatened Bat Species				
ghost bat	V	EN	Unlikely	September to April
grey-headed flying fox	V	LC	Unlikely	Wet and Dry season
Corben's long-eared bat	V	VU	Unlikely	October to March
large-eared pied bat	V	VU	Unlikely	October to March

Bats

The BACI design has also been implemented for bat surveys in order to identify any impacts on bats as a result of the Proposed Action, with future control sites also to be determined at the conclusion of the design process.

The survey requirements and recommended survey effort and methods for bats are as follows:

- *Survey guidelines for Australia's threatened bats:*
  - Trapping methods such as harp traps are recommended. Such effort is not precisely stated, but studies have found that the use of 20 or more traps a night a good for detection (Schulz, 1999);
  - Echolocation call detection to be carried out for a recommended 30-60 minutes per night for four to five survey nights; and

- Recommended that a variety of trapping and call detection methods are used together, where possible and if required to detect target species.

The 2022 and 2023 surveys were carried out in accordance with echolocation call detection requirements. Trapping methods such as harp traps are recommended in certain situations to target those bats that are difficult to identify to species level by echolocation surveys alone. Harp trapping was not used based on the lack of potential for listed threatened species detected by the deployed Anabats.

State Code 23 identifies methods must be carried out to determine which bat species occur on the Study Area. It recommends the use of survey techniques including mist nets and/or bat detection systems that record and analyse echolocation calls of bats. The 2022 and 2023 survey efforts involved the use of Anabats, thus meeting the State Code 23 requirement.

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