BIRD AND BAT UTILISATION SURVEY

for the

Paling Yards Wind Farm

Prepared for Global Power Generation Australia Pty Ltd

12 September 2022

ERM

Hunter Ecology

CERTIFICATION

Fieldwork was undertaken by Bart Schiebaan, Lizzie Bowman and Lorena Boyle. Report writing was undertaken by Lucinda Casey and Lizzie Bowman. Qualifications are provided below.

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Bart Schiebaan Project Director bart@hunterecology.com	Bachelor of Applied Science (Coastal Management) Cert II Conservation & Land Management Adv. Dip in Business Mgt Certificate IV in Workplace Training and Assessment BAAS 18033 Accredited Assessor
Lorena Boyle Ecologist Lorena.Boyle@erm.com	Bachelor of Zoology
Lucinda Casey Ecologist Lucinda.rose.casey@gmail.com	Bachelor of Biodiversity & Conservation

Licensing and Insurance

When conducting fauna surveys, consultants are required to possess licences to ensure that works are completed appropriately. Hunter Ecology has the relevant Scientific License under the *Biodiversity Conservation Act 2016*, allowing Hunter Ecology to undertake scientific investigations and to collect specimens of protected flora and fauna across NSW. This licence requires that all survey results be reported to DPIE through our BioNet Sensitive Species Data License. Hunter Ecology also holds an Animal Research Authority under the *Animal Research Act 1995*, as administered by NSW Agriculture. Surveys are approved and supervised by an Animal Care and Ethics Committee, applying the standards as detailed in the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes (NHMRC, 1997). Hunter Ecology is First Aid and White Card certified and relevantly trained in off-road vehicle driving. Hunter Ecology is insured with EnviroSure having both Professional Indemnity Insurance (Policy LPS021671363 ($5 mil)) and Public Liability Insurance (Policy LCS021671556 ($20 mil)) as well as Workers Compensation Policy (Policy 208829001).

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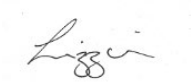

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ABBREVIATIONS

BC Act	Biodiversity Conservation Act 2016
BioNet	NSW Atlas of NSW Wildlife.
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GPGA	Global Power Generation Australia Pty Ltd
LGA	Local Government Area
OEH	Office of Environmental Heritage
SSD	State Significant Development
WTG	Wind Turbine Generator

TERMS

Barotrauma	Barotrauma results from a rapid reduction in air-pressure caused by the rotation of turbine blades. Resulting in tissue damage to air-containing structures caused by a rapid or extreme change in pressure
Study area	The area directly affected by the proposal. The subject site includes the footprint of the development and any ancillary works, facilities, accesses, or hazard reduction zones that support the construction or operation of the development or activity.
Subject site	The subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The study area should extend as far as is necessary to take all potential impacts into account.
Threatened species	Critically endangered, endangered, or vulnerable species as defined by Schedule 1 of the BC Act, or any such listed species under the EPBC Act.

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1. INTRODUCTION

1.1 Background and Purpose

Global Power Generation Australia Pty Ltd (GPGA) (formally known as Union Fenosa Wind Australia Pty Ltd) propose to develop and operate the Paling Yard Wind Farm ('the proposal', 'the project' or 'the proposed development'). The proposed development would be located at Paling Yards, south of Oberon, within the Oberon local government area (LGA). See **Figure 1-1** for the project layout. Hunter Ecology Pty Ltd was engaged by Environmental Resource Management Australia Pty Ltd (ERM) to undertake a bird and bat utilisation survey (BBUS), for the purpose of:

- Assessing the impact of the proposal on birds and bats, as part of the Biodiversity Development Assessment Report (BDAR); and
- Providing baseline data on the utilisation of birds and bats of the wind farm site for a Bird and Bat Adaptive Management Plan (BBAMP) (which would be implemented if the project receives consent). Baseline surveys aim to document the ongoing use of the site by bats and birds to monitor trends in usage by species over time and in response to the post-construction and operational phases of the project.

1.2 Objectives

The objective of this BBUS is to document the diversity and abundance of bird and bat species within and directly adjacent to the proposed development and identify 'at risk' species, susceptible to turbine blade collision impacts or barotraumas. Desktop assessment and targeted surveys aimed to:

- Undertake a review of the existing bird and bat data for the development area;
- Describe the diversity of bird and bat species within the development area;
- Monitor local population of bats and birds through targeted surveys;
- Identify any observed bat or bird species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or the NSW *Biodiversity Conservation Act 2016* (BC Act);
- Identify 'at risk' species based on occurrence, flight behaviour, biology, and turbine design;
- Identify potential impacts on 'at risk' species; and
- Provide harm minimization recommendations for the construction and operational phases of the project.

1.3 Wind Turbine Specifications

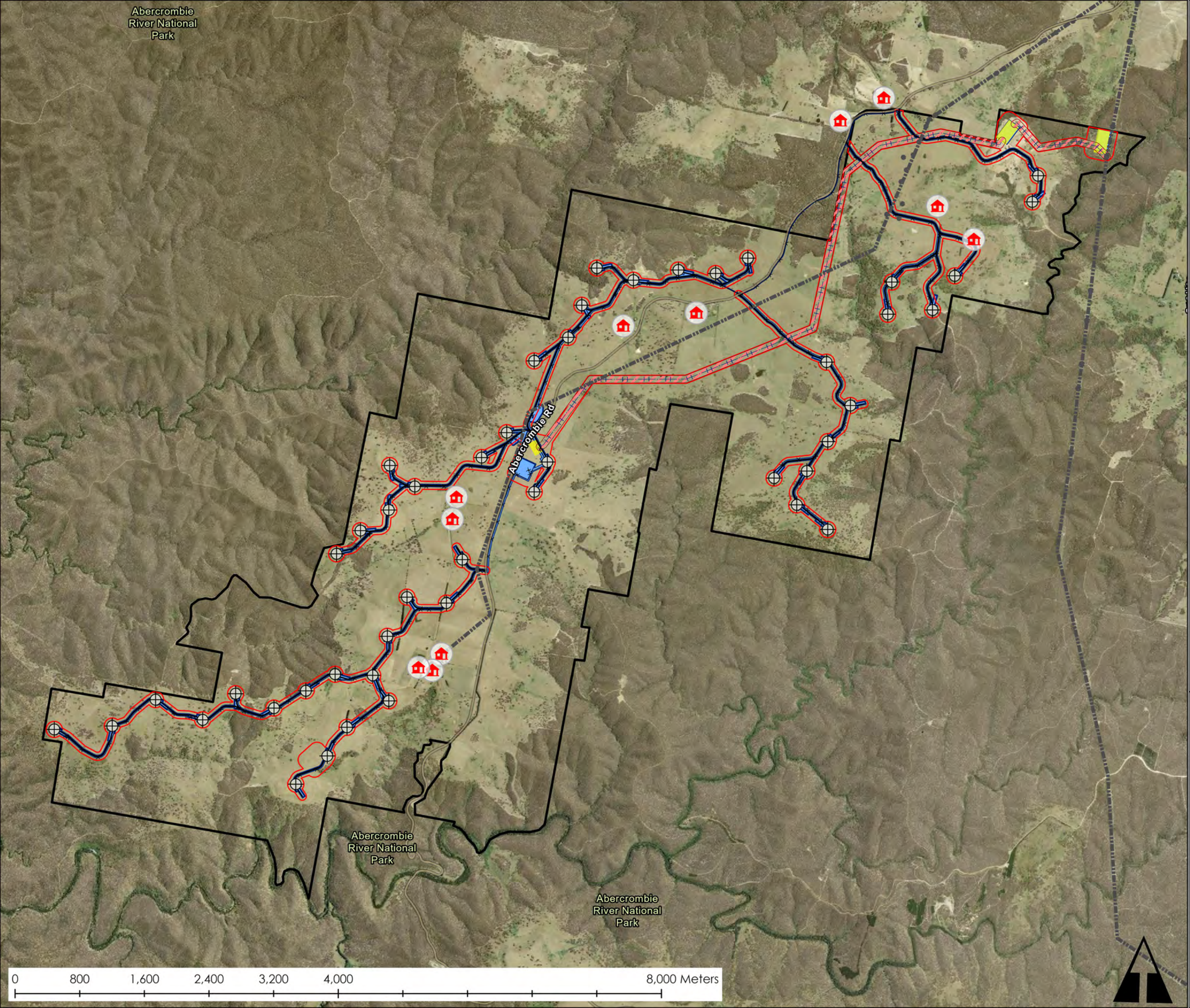
The project comprises up to 47 wind turbine generators (WTG) and ancillary infrastructure. Each of the turbines consists of a tall tower with 3 long blades mounted at the top designed to capture wind (see **Figure 1-1** for locations of turbines).

The turbine manufacturing industry is dynamic, with new and updated models regularly released. Existing models are often made redundant only a few years after their release. The industry is rapidly growing and benefits from constant innovation and advancement in the efficiency of the turbines. Due to the rapidly evolving industry, the proposed turbine models may be subject to change.

Table 1-1 provides the operational measures of the WTGs. Note that data for this BBUS was collected prior to development of the latest specifications in Table 1-1 when rotor sweep area (RSA) encompassed a larger area than what is currently proposed. For the purposes of this BBUS, the maximum RSA is 30-240 m. Therefore, as it stands, the impacts described and assessed in this report are likely to be less.

Table 1-1: Operational Measures of the Wind Turbine Generators

Rotor sweep area	72-240 m
Maximum chord width of rotor	4 m
Pitch angle of rotor	90°
Rotor diameter	158 m
Rotation period	6.18 m/s



Hunter Ecology

Figure 1.1 Project Layout

- PYWF_Site_Boundary_v2_01
- Survey Area
- Dwelling Location
- PYWF_WTG_Layout_v2_01
- PYWF_Existing_TL_v1_01
- PYWF_TL_v2_02
- PYWF_cable_v2_02
- PYWF_AccessRoad_v2_01
- PYWF_Substation_v2_03
- PYWF_Footprint_v2_02
- Transmission Clearing Footprint

DATE : 12/09/2022
Map Version: 1.2

Aerial Imagery: NSW LPI Six Imagery 2019

Projected Coordinate System:
GDA 2020 Zone 55

Scale: 1:42,000

Dwelling locations digitised from geo-referenced image.
For illustration purposes only

Although all care has been taken WiZarDTech accepts no responsibility from the use or inaccuracies of this map and spatial data.

2. BIRD UTILISATION SURVEY

2.1 Methodology

Bird utilisation surveys were undertaken in accordance with the following guidelines:

- AusWEA Wind Farms and Birds: Interim Standards for Risk Assessment (BL&A 2005).
- Best Practice Guidelines for the implementation of Wind Energy Projects in Australia (Clean Energy Council 2018).
- *National Wind Farm Development Guidelines – Draft* (Environment Protection and Heritage Council, 2010).

2.1.1 Fixed-Point Bird Count Method

Bart Schiebaan and Lizzie Bowman of Hunter Ecology and Lorena Boyle of ERM, undertook two separate bird utilisation survey events representing the 2021 Summer (02/2021) and Spring (10/2021) survey events. Each survey event consisted of monitoring 20-24 fixed observation points strategically placed throughout development footprint. Each observation point was monitored for a period of 20 minutes, during this time any bird observations were recorded, including species and abundance, as well as flight height and distance from the observation point.

For the purposes of this report, flight height relative to RSA height is presented and described below. These intervals are based on the height and RSA of the turbine design that is currently proposed for the development.

A = Below RSA (<30 meters above ground level)

B = Within RSA (30-240 meters above ground level)

C = Above RSA (>240 meters above ground level)

When a bird or large flock of birds were recorded flying at multiple height intervals including within the RSA (30-240 m), a conservative approach was taken, and the bird or birds were recorded as flying at RSA height.

2.1.2 Locations of Survey Points

All fixed-point monitoring locations were selected based on their proximity to proposed turbine and associated ancillary infrastructure locations (see **Figure 2-1**). Note that due to changes in development layout over time, some monitoring points have been removed and others added between surveys. Monitoring points 5, 18 and 20 were made redundant after the Summer (02/2021) survey event and additional monitoring points 21-24 were added during the Spring (10/2021) survey event.

2.1.3 Survey Timing and Weather Conditions

The two bird utilisation survey events represent the Summer (02/2021) and Spring (10/2021) monitoring events for 2021 and are expected to coincide with peak biodiversity and bio-abundance of avian species utilising the site. To account for diurnal differences in bird activity, each fixed-point

observation location was monitored at a different time of day between 6 am and 7 pm. Environmental variables including cloud cover, temperature, wind and rain were also recorded at all observation points prior to monitoring. **Table 2-1** details the time of day and weather conditions during the monitoring of each fixed-point observation location.

Table 2-1: Survey Timing and Weather Conditions

Monitoring Point	SUMMER 02-02-2021 – 10-02-2021			SPRING 01-10-2021 – 07-10-2021		
	Time	Temp	Weather Conditions	Time	Temp	Weather Conditions
1	6:20 pm	25°C	Light cloud, light breeze, no rain.	9:30am	12°C	Overcast, light rain.
2	1:05 pm	23°C	Light cloud, light breeze, no rain.	1:24 pm	13°C	Overcast, moderate wind.
3	1:12 pm	22°C	Light cloud, light breeze, no rain.	3:07 pm	12°C	Overcast, moderate wind.
4	5:33 pm	26°C	Moderate cloud, no wind, no rain.	4:10 pm	12°C	Overcast, moderate wind.
5	5:58 pm	24°C	Moderate cloud, light breeze, no rain.	Na	Na	Na
6	3:00 pm	27°C	Moderate cloud, light breeze, no rain.	1:09 pm	18°C	Overcast.
7	2:26 pm	26°C	Moderate wind, moderate cloud, no rain.	12:24 am	18°C	Mostly cloudy.
8	2:01 pm	26°C	Moderate cloud, moderate wind, no rain.	11:48 am	18°C	Mostly cloudy.
9	1:08 pm	26°C	moderate cloud, light breeze, no rain.	10:45 am	18°C	Mostly cloudy.
10	1:07 pm	28°C	Light cloud, heavy wind, no rain.	10:49 am	12°C	Cloudy and windy.
11	4:39 pm	23°C	Moderate cloud, light breeze, no rain.	9:23 am	11°C	Patchy cloud, no wind.
12	5:32 pm	23°C	Moderate cloud, light breeze, no rain.	10:04 am	12°C	Patchy cloud, light wind.
13	6:38 pm	20°C	Moderate cloud, moderate wind, no rain.	11:09 am	12°C	Patchy cloud, mod-high wind.
14	4:23 pm	26°C	Moderate cloud, light breeze, no rain.	11:52 pm	11°C	Patchy cloud, moderate wind.
15	4:47 pm	26°C	Moderate cloud, light wind, no rain.	12:55 pm	13°C	Patchy cloud, high wind.
16	7:14 am	22°C	Light cloud, light breeze, no rain.	3:49 pm	12°C	Patchy cloud, moderate to high wind.
17	6:10 am	23°C	Light cloud, light breeze, no rain.	11:50 am	12°C	Partly cloudy.

18	1:35 pm	27°C	Moderate cloud, no wind, rain.	Na	Na	Na
19	2:34 pm	27°C	Moderate cloud, moderate wind, no rain.	11:22 am	18°C	Mostly cloudy.
20	4:45 pm	26°C	Light cloud, no wind, rain.	Na	Na	Na
21	Na	Na	Na	2:10 pm	11°C	Overcast and windy.
22	Na	Na	Na	3:04 pm	13°C	Overcast and windy.
23	Na	Na	Na	3:51 pm	14°C	Overcast and windy.
24	Na	Na	Na	5:50 pm	13°C	Overcast.

2.1.4 Limitations

The bird utilisation surveys were undertaken in spring and summer and therefore cover the optimal survey times for most bird types, including resident, summer and transient migratory species. However, the timing of these survey events has the potential to preclude the detection of some wintering and migratory species typically absent during this time of year. Future bird utilisation surveys should aim to address temporal variability with a particular focus on these species.

Figure 2-1: Locations of Bird Utilisation Survey (BUS) Points

2.2 Bird Utilisation Results

2.2.1 Species Composition

A total of 19 species were recorded during the Summer (02/2021) survey across 20 monitoring locations. The Spring (10/2021) survey experienced an increase in observed diversity, with a total of 34 species recorded across 22 monitoring locations. The total number of species observed across both survey events amounted to 37, accounting for approximately 17% of the 215 avian species reported to occur within the Oberon LGA (species list as reported by Bionet Atlas of NSW). Do note though that Bionet data includes many specific habitat dependant species that are not likely to occur within the areas of the site where turbines have been proposed for development.

Figures 2-2 and **2-3** detail the cumulative number of species recorded across fixed-point monitoring locations, demonstrating the relationship between survey effort and the total number of species observed. Neither survey reached an asymptote.

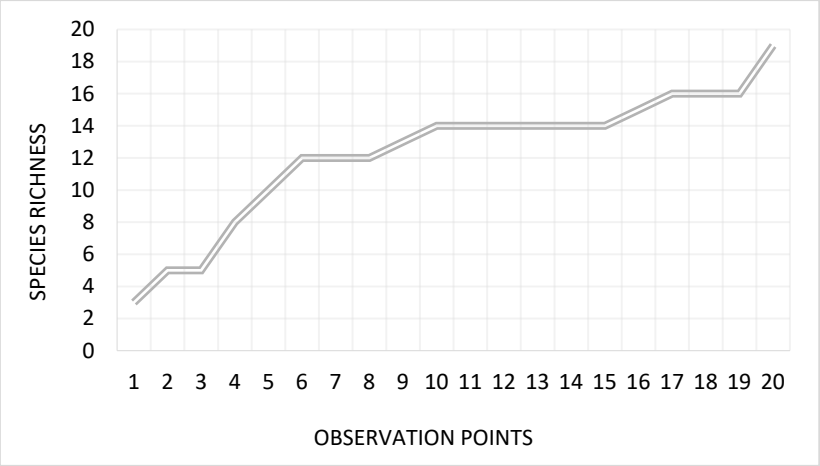


Figure 2-2: Cumulative Number of Bird Species Recorded Across 20 Fixed Point Monitoring Locations During the Summer (02/2021) BUS

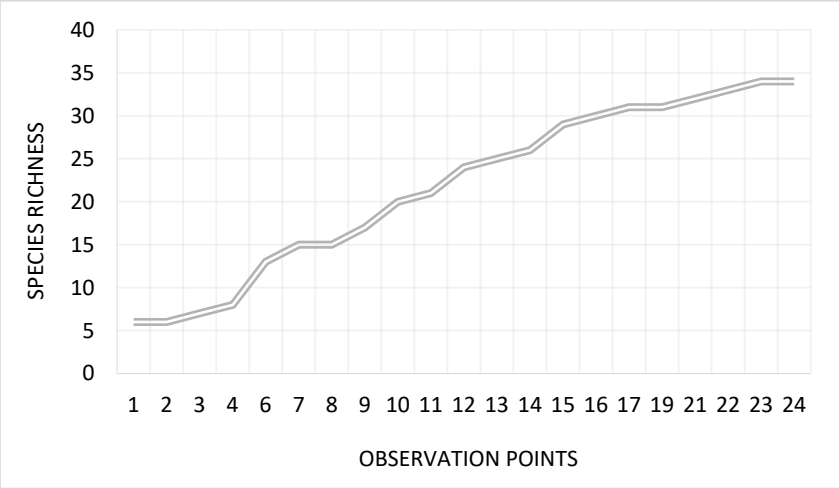


Figure 2-3: Cumulative Number of Bird Species Recorded Across 22 Fixed Point Monitoring Locations During the Spring (10/2021) BUS

2.2.2 Bird Species Abundance

The species observed utilising the site during the Summer (02/2021) and Spring (10/2021) surveys are detailed in **Table 2-3** and **Table 2-4**, respectively. Both tables include a list of the species observed during the BUS at each point, as well as the number of individuals per species recorded at each height zone (below RSA [<30 m], at [30-240m] and above [>240] RSA).

Total abundance varied between Summer and Spring, with 123 individual birds counted across the 20 Summer survey points, and 497 birds observed across the 22 Spring survey points. The increase in abundance in Spring is likely attributed to seasonal variability and changes in behaviour associated with nesting and rearing fledglings, coupled with the observance of several large flocks of Australian Magpie (*Cracticus tibicen*) and Sulphur-crested Cockatoo (*Cacatua galeritaand*), both known to form large family groups. It should not be discounted that many individual birds have the potential to be represented multiple times across monitoring locations, resulting in potential inflation of the total observed abundance.

The Australian Magpie, Sulphur-crested Cockatoo and Wedge-tailed Eagle (*Aquila audux*) were well represented in both the Summer and Spring survey events. Other dominant species included Eastern Rosella (*Platycercus eximius*) and Noisy Miner (*Manorina melanocephala*) in Summer and Australian Raven (*Corvus coronoides*) and Crimson Rosella (*Platycerus elegans*) in Spring. **Table 2-2** shows the five most dominant species represented in each survey event and their relative abundance (i.e., percentage of total observations). **Tables 2-3** and **2-4** provide a summary of all observations.

Table 2-5 shows the distribution of bird numbers among the survey points for both survey events. The total number of birds counted at each survey point varied from 0-17 in Summer, and 6-92 in Spring. The largest observations were flocks of Australian Magpie and Sulphur crested Cockatoo. The abundance of birds varied between survey points, however, no obvious trends in site utilisation were observed across the two surveys events.

Table 2-2: Five Most Dominant Species Recorded

SUMMER (02/2021)		SPRING (10/2021)	
Species / Common Name	**Relative Abundance**	**Species / Common Name**	**Relative Abundance**
Cracticus tibicen Australian Magpie	26.7%	***Cracticus tibicen*** Australian Magpies	25%
Aquila audux Wedge-tailed Eagle	12.2%	***Cacatua galerita*** Sulphur-crested Cockatoo	20.6%
Cacatua galerita Sulphur-crested Cockatoo	11.4%	***Corvus coronoides*** Australian Raven	12.7%
Platycercus eximius Eastern Rosella	9.8%	***Aquila audux*** Wedge-tailed Eagle	10%
Manorina melanocephala Noisy Miner	8%	***Platycerus elegans*** Crimson Rosella	7.5%

Table 2-3: Summer 02/2021 – Number and Height Distribution of Birds by Species Recorded at each Survey Point

Species Name Common Name	Point 1		Point 2		Point 3		Point 4		Point 5		Point 6		Point 7		Point 8		Point 9		Point 10		Point 11		Point 12		Point 13		Point 14		Point 15		Point 16		Point 17		Point 18		Point 19		Point 20		Σ	Σ	Σ	% Imp
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	Total	
Anthochaera carunculate Red Wattlebird	3		1												1														1										6	0	6	4.9
Anthus novaeseelandiae Australasian Pipit							1																							1										2	0	2	1.6
Aquila audux Wedge-tailed Eagle	1					1		2		2		2		1												4		2											1	14	15	12.2
Cacatua galerita Sulphur-crested Cockatoo								10																		4													0	14	14	11.4
Coracina novaehollandiae Black-faced Cuckoo-shrike																																							1		1	0	1	0.8
Cormobates leucophaea White-throated Treecreeper																																							1		1	0	1	0.8
Cracticus tibicen Australian Magpie				2			2		2								3				4		4		8				4			3					1				28	5	33	26.8
Egretta novaehollandiae White-faced Heron																			1																						1	0	1	0.8
Eolophus roseicapilla Galah												2																				2								0	4	4	3.3
Falco berigora Brown Falcon											1																													1	0	1	0.8
Falco cenchroides Australian Kestrel								1		2						2										1														0	6	6	4.9
Falco longipennis Australian Hobby																																2								0	2	2	1.6
Manorina melanocephala Noisy Miner																	4				2		2														2				10	0	10	8.1
petrochelidon ariel Fairy Martin									2																															2	0	2	1.6
Platycercus eximius Eastern Rosella	2																				4		4						2											12	0	12	9.8
Platycerus elegans Crimson Rosella			2								4																													6	0	6	4.9
Rhipidura albiscapa Grey Fantail																																							2		2	0	2	1.6
Vanellus tricolor Banded Lapwing							1																																	1	0	1	0.8
Zanda funereal Yellow-tailed Black Cockatoo										4																														0	4	4	3.3
Totals	6	0	3	2	0	1	4	13	4	8	5	4	0	1	1	2	7	0	1	0	10	0	10	0	8	0	0	9	7	2	1	5	0	2	0	0	3	0	4	0	74	49	123	100
	6		5		1		17		12		9		1		3		7		1		10		10		8		9		9		6		2		0		3		4					

Notes: A – Denotes below rotor sweep height (0-30m), B – Denotes at RSA height (30-240m) C – Denotes above RSA height (>240); Note that no birds were recorded flying over 240 m in this survey so there is no C column in the table. ∑ denotes the sum of bird numbers. % Imp denotes the percentage of total observations.

Table 2-4: Spring (10/2021) – Number and Height Distribution of Birds by Species Recorded at each Survey Point

Scientific Name Common Name	Point 1		Point 2		Point 3		Point 4		Point 6		Point 7		Point 8		Point 9		Point 10		Point 11		Point 12		Point 13		Point 14		Point 15		Point 16		Point 17		Point 19		Point 21		Point 22		Point 23		Point 24		Σ	Σ	Σ	% Imp.
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	Total	
Accipiter fasciatus Brown Goshawk																																				1				1	0	2	2	0.4
Anthochaera carunculate Red Wattlebird									1																														1	0	1	0.2
Anthus novaeseelandiae Australasian Pipit																						1																	1	0	1	0.2
Aquila audux Wedge-tailed Eagle		4		7		15						1						1				1		3		6		5		5		2							0	50	50	10
Artamus cyanopterus Dusky Woodswallow																									6														6	0	6	1.2
Cacatua galerita Sulphur-crested Cockatoo																		8		60		30		2		1				2									0	103	103	21
Caligavis chrysops Yellow-faced Honeyeater											4																												4	0	4	0.8
Callocephalon fimbriatum Gang-gang Cockatoo																					2																		0	2	2	0.4
Chenonetta jubata Australian Wood Duck																			20		4																		24	0	24	4.8
Coracina novaehollandiae Black-faced Cuckoo-shrike																													2										2	0	2	0.4
Corvus coronoides Australian Raven		5	2		3					1				2		19	3			3		5		5		1				2		3	2			1		3	3		13	50	63	13
Cracticus tibicen Australian Magpie		1		2		50		6		4		5	2		1			1		5		7					1			2	1			5		1		2		2		27	5	120	125	25
Dacelo novaeguineae																					2										2										4	0	4	0.8

Laughing Kookaburra																																														
Egretta novaehollandiae White-faced Heron																													1														1	0	1	0.2
Elanus axillaris Bar-shouldered Kite										1			1																														1	1	2	0.4
Eolophus roseicapilla Galah															1																				1								2	0	2	0.4
Falco berigora Brown Falcon																1																											0	1	1	0.2
Falco cenchroides Australian Kestrel	1								1					1		2																		3					2				4	6	10	2
Grallina cyanoleuca Magpie-lark											1														1																		2	0	2	0.4
Hirundo neoxena Welcome Swallow																																			2								2	0	2	0.4
Malurus cyaneus Superb Fairy-wren																																							2				2	0	2	0.4
Manorina melanocephala Noisy Miner									2		2				1		1																2				2				3		13	0	13	2.6
Menura novaehollandiae Superb Lyrebird																											1				1												2	0	2	0.4
Oriolus sagittatus Olive-backed Oriole																											1																1	0	1	0.2
Pardalotus striatus Striated pardalote																	1				1										1												3	0	3	0.6
petrochelidon ariel Fairy Martin																	2		2		2														2								8	0	8	1.6
Petrochelidon nigricans Tree Martin															4																												4	0	4	0.8
Platycercus eximius Eastern Rosella									4																										2				2		2		10	0	10	2

Platycerus elegans Crimson Rosella	2										28								2														4						2								38	0	38	7.6
Rhipidura albiscapa Grey Fantail	2																																														2	0	2	0.4
Rhipidura leucophrys Willie Wagtail									1																																						1	0	1	0.2
Strepera graculina Pied Currawong																		1								1		1																			0	3	3	0.6
Tachybaptus novaehollandiae Australasian Grebe																					1																										1	0	1	0.2
Vanellus tricolor Banded Lapwing							2																																								2	0	2	0.4
A & B Totals	**5**	**10**	**2**	**9**	**3**	**65**	**2**	**6**	**9**	**6**	**35**	**6**	**3**	**3**	**7**	**22**	**7**	**11**	**24**	**68**	**10**	**45**	**1**	**10**	**1**	**9**	**9**	**6**	**1**	**9**	**9**	**4**	**4**	**11**	**9**	**1**	**4**	**4**	**6**	**5**	**8**	**28**					**159**	**338**	**497**	**100**
Observation Point total	**15**		**11**		**68**		**8**		**15**		**41**		**6**		**29**		**18**		**92**		**55**		**11**		**10**		**15**		**10**		**13**		**15**		**10**		**8**		**11**		**36**									

Notes: Yellow highlighting denotes a vulnerable species under the BC Act 2016, A – Denotes below rotor sweep height (0-30m), B – Denotes at RSA height (30-240m) C – Denotes above RSA height (>240); Note that no birds were recorded flying over 240m in this survey so there is no C column in the table. ∑ denotes the sum of bird numbers. % Imp denotes the percentage of total observations.

Table 2-5: Number of Birds Recorded at Each Survey Point

Survey Point	SUMMER (02/2021)				SPRING (10/2021)			
	Below RSA Height	At RSA Height	Total	% Importance	Below RSA Height	At RSA Height	Total	% Importance
1	6	0	6	4.9	5	10	15	3.0
2	3	2	5	4.1	2	9	11	2.2
3	0	1	1	0.8	3	65	68	13.7
4	4	13	17	13.8	2	6	8	1.6
5	4	8	12	9.8	n/a	n/a	n/a	n/a
6	5	4	9	7.3	9	6	15	3.0
7	0	1	1	0.8	35	6	41	8.2
8	1	2	3	2.4	3	3	6	1.2
9	7	0	7	5.7	7	22	29	5.8
10	1	0	1	0.8	7	11	18	3.6
11	10	0	10	8.1	24	68	92	18.5
12	10	0	10	8.1	10	45	55	11.1
13	8	0	8	6.5	1	10	11	2.2
14	0	9	9	7.3	1	9	10	2.0
15	7	2	9	7.3	9	6	15	3.0
16	1	5	6	4.9	1	9	10	2.0
17	0	2	2	1.6	9	4	13	2.6
18	0	0	0	0.0	n/a	n/a	n/a	n/a
19	3	0	3	2.4	4	11	15	3.0
20	4	0	4	3.3	n/a	n/a	n/a	n/a
21	n/a	n/a	n/a	n/a	9	1	10	2.0
22	n/a	n/a	n/a	n/a	4	4	8	1.6
23	n/a	n/a	n/a	n/a	6	5	11	2.2
24	n/a	n/a	n/a	n/a	8	28	36	7.2
Total	**74**	**49**	**123**	**100**	**159**	**338**	**497**	**100**
	60.2%	**39.9%**			**32%**	**68%**		

Notes: N/a - Denotes that no BUS was undertaken at this location during the survey event.

2.2.3 Bird Flight Heights

Bird flight heights were classified as below (<30 m), at (30-240 m), and above (>240m) RSA height. The number of birds recorded at different flight heights is presented in **Table 2-6**. Note that no birds were recorded flying above RSA height (>240 m). The percentage of birds recorded flying below (<30m) and at RSA height (30-240m) varied significantly between the Summer and Spring surveys, with a total of 60.2% below RSA height and 39.9% within RSA height in Spring, compared to a total of 32% below RSA height and 68% within RSA height in Summer. Some of the variability in the data may be attributed to several flocks of Sulphur-crested Cockatoos (*Cacatua galeritaand*) and Australian Magpies (*Cracticus tibicen*) recorded flying below and within RSA height. Note that when birds were recorded flying at multiple height intervals including within the RSA (30-240 m), a conservative approach was taken and birds were recorded as flying at RSA height.

Of the species recorded utilising the wind farm site across the two surveys, a total of 13 species were recorded flying within RSA height (7 species in Spring and 10 species in Summer). **Table 2-7** details the four most highly represented species recorded flying at RSA height for both survey events. Of the most highly represented species, three were consistent across the two survey events, these include the Wedge-tailed Eagle (*Aquila audux*), Australian Magpie (*Cracticus tibicen)* and Sulphur-Crested Cockatoo (*Cacatua galeritaand*).

Table 2-6: Percentage of Species Recorded Flying within RSA

SUMMER (02/2021)						
Species	**Common Name**	**Total A**	**Total B**	**Grand Total**	**% At RSA**	**% of all RSA birds**
Aquila audux	Wedge-tailed Eagle	1	14	15	93.3	28.6
Cacatua galerita	Sulphur-crested Cockatoo	0	14	14	100	28.6
Cracticus tibicen	Australian Magpie	28	5	33	15.2	10.2
Eolophus roseicapilla	Galah	0	4	4	100	8.2
Falco cenchroides	Australian Kestrel	0	6	6	100	12.2
Falco longipennis	Australian Hobby	0	2	2	100	4.1
Zanda funerea	Yellow-tailed Black Cockatoo	0	4	4	100	8.2
Total		**29**	**49**	**78**	**62.8**	**100**
SPRING (10/2021)						
Species	**Common Name**	**Total A**	**Total B**	**Grand Total**	**% At RSA**	**% of all RSA birds**
Accipiter fasciatus	Brown Goshawk	0	2	2	100	0.6
Aquila audux	Wedge-tailed Eagle	0	50	50	100	14.8
Cacatua galerita	Sulphur-crested Cockatoo	0	103	103	100	30.5
Callocephalon fimbriatum	Gang-gang Cockatoo	0	2	2	100	0.6
Corvus coronoides	Australian Raven	13	50	63	79.4	14.8
Cracticus tibicen	Australian Magpie	5	120	125	96	35.5

Elanus axillaris	Bar-shouldered Kite	1	1	2	50	0.3
Falco berigora	Brown Falcon	0	1	1	100	0.3
Falco cenchroides	Australian Kestrel	4	6	10	60	1.8
Strepera graculina	Pied Currawong	0	3	3	100	0.9
Total		**23**	**338**	**361**	**93.6**	**100**

Notes: Yellow highlighting denotes a threatened species, A – Denotes below rotor sweep height (0-30 m), B – Denotes at RSA height (30-240 m). Note that no birds were recorded flying over 240 m in this survey.

Table 2-7: Four Most Dominant Species Recorded Flying within RSA

SUMMER (02/2021)		SPRING (10/2021)	
Species / Common Name	**% of all RSA Birds**	**Species / Common Name**	**% of all RSA Birds**
Aquila audux Wedge-tailed Eagle	28.6 %	***Cracticus tibicen*** Australian Magpie	35.5 %
Cacatua galerita Sulphur-crested Cockatoo	28.6 %	***Cacatua galerita*** Sulphur-crested Cockatoo	30.5 %
Falco cenchroides Australian Kestrel	12.2 %	***Aquila audux*** Wedge-tailed Eagle	14.8 %
Cracticus tibicen Australian Magpie	10.2 %	***Corvus coronoides*** Australian Raven	14.8 %

2.2.4 Raptors

Table 2-8 details the species of raptors observed during the Summer and Spring BUS. During the Summer survey event a total of four raptor species were observed, and five during the Spring event, amounting to a total of six total species of raptor across both surveys. Raptors were well represented in both surveys, accounting for 19.5% of all observations in Summer and 13% of all observations in Spring, with the majority of these observations falling within RSA height.

The most highly represented species of raptor in both BUS was the Wedge-tailed Eagle (*Aquila audux*). The observed high utilisation rate of the species suggests that the wind farm site likely forms part of the feeding territories for multiple families of eagles. The tendency of the species to fly within the proposed RSA height along with their flight behaviours places them at risk of rotor strike during the operational phase of the development, for this reason the population should be monitored closely.

Table 2-8: Recorded Raptor Species

Summer (02/2021)					Spring (10/2021)				
Species / Common Name	**A**	**B**	**Total**	**% Imp.**	**Species / Common Name**	**A**	**B**	**Total**	**% Imp.**
Aquila audux Wedge-tailed eagle	1	14	15	12.2	***Accipiter fasciatus*** Brown Goshawk	0	2	2	0.4
Falco berigora Brown Falcon	1	0	1	0.8	***Aquila audux*** Wedge-tailed eagle	0	50	50	10
Falco cenchroides Australian Kestrel	0	6	6	4.9	***Elanus axillaris*** Bar Shouldered Kite	1	1	2	0.4
Falco longipennis Australian Hobby	0	2	2	1.6	***Falco berigora*** Brown Falcon	0	1	1	0.2
					Falco cenchroides Australian Kestrel	4	6	10	2
Total	**2**	**22**	**24**	**19.5%**	**Total**	**5**	**60**	**65**	**13%**

Notes: A – Denotes below RSA (0-30m), B – Denotes at RSA (30-240m) C – Denotes above RSA (>240). Note that no birds were recorded flying over 240 m. % Imp – Denotes the percentage of all observations recorded during the BUS.

2.2.6 Threatened Bird Species

Most birds found to utilise the wind farm site were common species. Of the species recorded during the BUS surveys, only two of the observed species are currently listed as threatened under State or Commonwealth legislation. These species include Dusky Woodswallow (*Artamus cyanopterus cyanopterus)* and Gang-gang Cockatoo (*Callocephalon fimbriatum*). Both species are listed as vulnerable under the *Biodiversity Conservation Act 2016* (BC Act) and both were only observed within the Spring survey event and in low densities.

Dusky Woodswallow was observed at monitoring point 15 with a total of 6 individuals, all flying below (<30 m) RSA height. Two Gang-gang Cockatoos (*C. fimbriatum*) were observed at monitoring point 12, both recorded flying within (30-240 m) RSA height. Together these species account for 1.6 % of the total of birds observed during the Spring survey event.

2.2.7 Review of May 2013 BUS (ERM, 2014)

In May 2013 (20th & 21st), ERM undertook a BUS at the Paling Yards Wind Farm. The results of this are presented in ERM (2014). The survey consisted of utilising the fixed-point bird count methodology, monitoring 18 fixed-point observation locations for a period of 15 minutes. Across the 18 monitoring points, a total of 125 birds were observed, with the most abundant being Australian Raven (*Corvus coronoides*), Australian Magpie (*Cracticus tibicen*) and Wedge-tailed eagle (*Aquila audux*). One threatened species was recorded, being Scarlet Robin (*Petroica boodang*); this species was recorded below RSA height (which at the time of the survey was defined as 30-175 m) and was considered unlikely to fly at RSA height.

Wedge-tailed Eagle (*Aquila audux*) was observed flying within RSA height nine times during the BUS, which accounted for 7% of the total number of birds observed during the survey. Overall, the species was observed flying at heights from 10 m to over 250 m across the study area.

Few birds were recorded flying at RSA height outside of the BUS and were limited to Sulphur-Crested Cockatoo (*Cacatua galeritaand*), Australian Magpie (*Cracticus tibicen*) and Australian Raven (*Corvus coronoides*), all of which were recorded infrequently flying close to the lower limit of the RSA at a height between 25 and 35 m. The majority of birds recorded incidentally and during the BUS were seen to hug the contours, rarely flying directly above ridge tops where the turbines are proposed.

Using the data collected and a 99% avoidance rate, the collision risk for Wedge-tailed eagle (*Aquila audux*) was modelled using the Band Model (SNH 200 & 2010, Band 2000). The results indicated that the Wedge tailed Eagle had a collision risk which would result in 0.052 bird per month or 0.62 birds per annum colliding with rotors once the project is operational. However, it should be noted that the analysis was undertaken applying turbine specifications that are no longer part of the proposed development.

2.3 Discussion of Impacts

2.3.1 Bird Collision-related Mortality

It is widely accepted that operational wind farms present some level of risk to the avian species that inhabit and pass through the area. The risk is attributed to the potential for birds to directly collide with turbine rotors (rotor strike), and to a lesser extent, collide with associated infrastructure such as guy lines and powerlines. Such collisions can directly result in injury or fatality and are considered a major ecological concern posed by wind farms.

Wind farm related avian collisions are well documented and researched globally, this research has led to the understanding that avian collision risk is influenced by a broad array of variables including species-specific factors, site-specific factors, and wind farm-specific factors.

Factors related to species-specific flight behaviour are recognised to influence the risk of collision in avian species. High wing loading, low manoeuvrability and reduced capability for powered flight have been linked to a greater risk of collision (De Lucas *et al*, 2008). Species with such flight behaviours have increased reliance on thermal and orographic updrafts to gain altitude and soar, factors that are dependent on wind strength, terrain topography and seasonal variations in temperature. Low manoeuvrability in flight diminishes the capacity of a species to escape an encountered object fast enough to avoid collision (Marques *et al*, 2014).

As a result of these flight-behaviours, Accipitriformes (raptors and birds of prey) have the highest rates of turbine collision, yielding significantly higher rates of mortality in comparison to other groups (Thaxter *et al*, 2017). Three Accipitriformes have been identified as utilising the Paling Yards wind farm site, including Wedge-tailed Eagle (*Aquila audux*), Brown Goshawk (*Accipiter fasciatus*) and Bar Shouldered Kite (*Elanus axillaris*). These species tend to be *k*-selected with low fecundity and late ages of maturity, leaving them highly sensitive to impacts of additional mortality.

Of the three Accipitriformes species present, the Wedge-tailed Eagle was observed in the highest abundance, accounting for 12.2% of species observed in the (02/2021) survey and 10% in the Spring

(10/2021). The observed high abundance of the Wedge-tailed Eagle paired with its heightened vulnerability to turbine collision places it at a higher risk. Close on-going monitoring will be essential to ensure the longevity of the local population.

An assessment of bird global vulnerability to collision mortality at windfarms undertaken by Thaxter et al (2017) has estimated that the fatality rate for Accipitriformes species is equal to approximately 0.07 birds per turbine per year. Based on the current proposal of 47 wind turbines, the annual fatality rate of Accipitriformes species at the Paling Yards wind farm would be approximately 3.29 birds. The vast majority of species observed in both survey events belong to the Passeriformes order, with a significantly lower estimated collision fatality rate of approximately 0.022 birds per turbine per year. This equates to an estimated 1.03 fatalities per year based on the current development proposal. See **Table 2-9**.

These collision estimations are based on a collation of 9538 collision fatalities observed at wind farms globally over a 10-year period and have the potential to provide valuable insight; however, these wind farms occur in Europe and North America and their statistics should be applied with caution to Australian conditions. These generalised estimations also do not consider site-specific factors, species abundance and activity levels, or turbine specifications that have the potential to reduce or inflate actual observed fatality rates at the Paling Yards wind farm.

Table 2-9: Estimated Annual Collision-related Fatality Rates for Confirmed Bird Species, by Order

Bird Order	Associated Protected or Threatened Species*	Thaxter et al. (2017) Annual Fatality Rate	Estimated Annual Fatality Rate
Accipitriformes	*Aquila audax* (Wedge-tailed Eagle), *Elanus axillaris* (Black-shouldered Kite), *Haliaeetus leucogaster* (White-bellied Sea-Eagle), *H. morphnoides* (Little Eagle) and *Circus assimilis* (Spotted Harrier)	0.07 birds per WTG.	3.29 birds.
Apodiformes	*Apus pacificus* (Fork-tailed Swift), *Hirundapus caudacutus* (White-throated Needletail)	0.021 birds per WTG.	0.99 birds.
Falconiformes	*Accipiter fasciatus* (Brown Goshawk), *Falco cenchroides* (Australian Kestrel), *F. longipennis* (Australian Hobby) and *F. berigor* (Brown Falcon)	No annual fatality rate for this order was provided in Thaxter et al. (2017).	
Passeriformes	*Monarcha melanopsis* (Black-faced Monarch), *Cracticus tibicen* (Australian Magpie), *Strepera graculina* (Pied Currawong), *Corvus coronoides* (Australian Raven)	0.022 birds per WTG.	1.03 birds.
Pelecaniformes	*Egretta novaehollandiae* (White-faced Heron)	0.022 birds per WTG.	1.03 birds.
Psittaciformis	*Cacatua galerita* (Sulphur-crested Cockatoo), *Calyptorhynchus funereus* (Yellow-tailed Black Cockatoo), *Eolophus*	0.03 birds per WTG.	1.41 birds.

	roseicapilla (Galah), *Polytelis swainsonii* (Superb Parrot), *Calyptorhynchus lathami* (Glossy Black-Cockatoo), *Glossopsitta pusilla* (Little Lorikeet), *Callocephalon fimbriatum* (Gang-gang Cockatoo), *Lathamus discolor* (Swift Parrot)		
Strigiformes	*Ninox strenua* (Powerful Owl)	0.022 birds per WTG.	1.03 birds.

*** These species were confirmed in the BDAR as being potentially impacted. They include confirmed ecosystem credit or species credit species, migratory species and recorded protected native species that are likely to fly at RSA height.**

2.3.2 Habitat Reduction

The installation of WTG also has the potential to contribute to alienation of habitat resulting from species actively avoiding the WTG and connecting ancillary. In Australia, birds are generally considered to avoid flying through WTG at a rate of 95% to 99% (Smales, 2005). This avoidance effect essentially leads to a loss of habitat within the development footprint, however, also greatly reduces the number of birds interacting with the WTGs once the wind farm enters its operational phase.

3. BAT UTILISATION SURVEY

3.1 Methodology

Bat utilisation surveys were undertaken in accordance with the following guidelines:

- AusWEA Wind Farms and Birds: Interim Standards for Risk Assessment (BL&A 2005).
- Best Practice Guidelines for the implementation of Wind Energy Projects in Australia (Clean Energy Council 2018).
- *National Wind Farm Development Guidelines, Draft* (Environment Protection and Heritage Council, 2010).

3.1.1 Survey Timing and Weather Conditions

Bat echolocation detection surveys were undertaken over seven nights in summer (3-9 February 2021). This survey represents the Spring 2021 pre-construction phase monitoring event and is expected to have captured the peak biodiversity and abundance of microbat species within the development area. Targeted surveys for *Pteropus poliocephalus* (Grey-headed Flying Fox) were also undertaken in summer (3-10 February 2021) and spring (1-7 October 2022). These included nocturnal spotlighting and diurnal searches for colony camps. **Table 3-1** details the weather conditions during the surveys and **Table 3-2** details the Anabat deployment schedule.

3.1.2 Recording Protocol

Bat echolocation detection was undertaken at five locations, using two Anabat Express and three Anabat Swift detectors (see **Table 3-2** for the deployment schedule and **Figure 3-1** for survey locations). Detectors were pre-programmed to commence recording 30 minutes before dusk and ceased recording 30 minutes after sunrise.

Table 3-1: Weather Conditions During Bat Surveys

Date	Temp. Range	Wind	Cloud Cover	Rain
2/2/2021	12-24°C	Moderate-high	Cloudy	31 mm
3/2/2021	11-23°C	Moderate-high	Moderate	0.2 mm
4/2/2021	12-25.5°C	Calm	Clear	0 mm
5/2/2021	16-25.5°C	Calm	Cloudy	3 mm
6/2/2021	18-27°C	Moderate	Cloudy	0.2 mm
7/2/2021	10-25.5°C	Moderate	Cloudy	21 mm
8/2/2021	11.5-21.5°C	Moderate-high	Cloudy	0 mm
9/2/2021	13.5-28.2°C	Moderate-high	Cloudy	0 mm
10/2/2021	8.5-22°C	Calm-moderate	Cloudy	0 mm
1/10/2021	5-22.5°C	Moderate	Cloudy	19 mm

2/10/2021	7-17.2°C	Moderate	Moderate	0.5 mm
3/10/2021	7-17°C	Moderate	Moderate	3 mm
4/10/2021	5-16°C	Calm	Clear	None
5/10/2021	4-12.5°C	Moderate-high	Cloudy	2 mm
6/10/2021	1-17.5°C	Moderate	Clear	None
7/10/2021	2.5-21°C	Moderate	Clear	None

Table 3-2: Anabat Deployment Schedule

Detector Name	(Model Serial no.)	Deployment Dates	Latitude	Longitude	Site Code
Anabat1	(Swift SN583085)	3-4 Feb	-34.1259	149.7623	A1-1
		5-9 Feb	-34.1583	149.7276	A1-2
Anabat2	(Swift SN583108)	2-4 Feb	-34.1261	149.7678	A2-1
		5-9 Feb	-34.1261	149.7116	A2-2
Anabat3	(Express SN542982)	3-6 Feb	-34.1857	149.7299	A3-1
		7-9 Feb	-34.1757	149.7138	A3-2
Anabat4	(Express SN54294)	2-9 Feb	-34.1732	149.723	A4-1
Anabat6	(Express SN507220)	2-6 Feb	-34.1733	149.7183	A6-1

3.1.3 Call Analysis

All bat call data was analysed by Balance Environmental, the details of the analysis are as follows:

A total of 21 raw ZCA files were recorded using the three Anabat Express devices, these files were then processed using Anabat Insight (Version 1.9.7: Titley Scientific, Brisbane) to extract individual zero-crossing call sequence files for analysis. The data collected using the three Anabat Swift devices amounted to a total of 23,690 full-spectrum acoustic files in WAV format.

All WAV and Zero-crossing call sequence files were passed through a noise filter using Anabat Insight to remove any files where bat sounds were absent. This process excluded 23,891 files, leaving 18,580 for further analysis.

The Anabat Insight Decision Tree analysis function was used to process the remaining files and group them according to similarities in call pulse characteristics (e.g., characteristic frequency, slope, duration). Each group was then reviewed manually to verify species identities and separate, if necessary, the different species assigned to the group. Calls were thus assigned either a positive species label, where identification was unequivocal, or a multi-species group label, where identity

remained “unresolved” because the call had features potentially attributable to two or more species. Where the Decision Tree attributed many files to a single group, the manual species verification for that group proceeded only until at least a few calls of each constituent species were teased out for each detector-night.

Files that contained calls from multiple species in different frequency bands were assigned a “mixed” species label once all potential species were identified for a site. Species confirmation was achieved by comparing call spectrograms and derived metrics with those of regionally relevant reference calls and published call descriptions. Consideration was also given to the probability of species’ occurrence based on published distribution information and online database records

3.1.4 Limitations

The identification of echolocation calls for microbats in South-eastern Australia is facilitated by the fact that many calls are species specific. Calls that could not be definitively identified were narrowed down to two potential species matches or assigned to a genus.

The applied methodology is limited in that it is not possible to census bat numbers as to provide a reliable estimation of the abundance of bats occurring at the site. This limitation is due to the inability of Anabat Insight to differentiate calls of individuals of the same species. Anabat Insight can therefore only inform us of the presents or absents of a species and inform us of their activity levels, however, does not provide reliable information of population densities and utilisation rates at the site.

The echolocation recording devices utilised during the survey are limited to recording in the immediate location that the detector has been deployed and is not likely to reliably record calls further than 20-30m away. The height at which a recording device has been placed is also recognised to have an impact on the species detected due to the behavioural differences exhibited by different species (Collins & Jones 2009).

Furthermore, the levels of bat activity are subjective to environmental conditions including air temperature, wind speed, cloud cover, rain and moonlight. For example, high wind speeds and heavy rain fall have all been correlated with lower levels of activity (Perks & Goodenough 2020).

3.2 Bat Utilisation Survey Results

3.2.1 Microbat Species Composition, Distribution and Abundance

See **Table 3-2** for overall bat species recorded at each survey location. The positively identified calls amounted to a total of 13 species with the addition of one call signature that was narrowed down to genus level (see **Table 3-3**). The unresolved calls consisted primarily of the species positively identified and were generally narrowed down to two potential species options. The exception to this was the possible occurrence of the Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*). This unresolved call was identified based on a single call recorded at A6. A further 2094 calls could not be identified through Anabat Insight, accounting for approximately 10.7% of all recorded calls.

Based on the positively identified calls, the most recorded species was the Large Forest Bat (*Vespadelus darlingtonia*) with a total of 3324 positively identified calls across the entire survey event.

This was followed by Ride's Free-Tailed Bat (*Ozimops ridei*) with 1270 calls, and the White-striped Freetail Bat (*Austronomus australis*) with 737 calls.

The majority of species were a regular occurrence across Anabat locations and don't appear limited to any particular section of the wind farm (see **Table 3-3**). The two exceptions were the Eastern Horseshoe Bat (*Rhinolophus megaphyllus*), positively identified by a single call recorded at site A3-2, and the Yellow-bellied Sheathtail-bat that was 'possibly' identified based on a single call recorded at site A6-1.

Table 3-3: Bat Species Recorded at each Survey Location

Species / Common Name	A1-1	A1-2	A2-1	A2-2	A3-1	A3-2	A4-1	A6-1
Rhinolophus megaphyllus Eastern Horseshoe Bat						●		
Chalinolobus gouldii Gould's wattled bat	●	●	●	●	●	●	●	●
Chalinolobus morio Chocolate wattled bat	●	●	●	●	●	●	●	●
Falsistrellus tasmaniensis Eastern False Pipistrelle	●	●	●	●	●	●	●	●
***Nyctophilus* sp.**	●	●	●	●	●	●	●	●
Scoteanax rueppellii Greater Broad-nosed Bat	●	●	●	●	●	●	●	●
Scotorepens greyii Little broad-nosed bat	○	●	●	●	○	●	●	●
Scotorepens orion Eastern broad-nosed bat	●	●	●	●	●	●	●	●
Vespadelus darlingtoni Large forest bat	●	●	●	●	●	●	●	●
Vespadelus regulus Southern Forest Bat	●	●	●	●	●	●	●	●
Vespadelus vulturnus Little Forest Bat	●	●	●	●	●	●	●	●
Miniopterus orianae *Large Bent-winged Bat*	○		○	●	○	●	●	○
Austronomus australis White-striped Freetail Bat	●	●	●	●	●	●	●	●
Ozimops planiceps South-Eastern Free-Tailed Bat	●	●	●	●	●	●	●	●
Saccolaimus flaviventris								○

Yellow-bellied Sheath tail-bat								

Notes: ● – Denotes "definite" – at least one call recorded at the site was unequivocally identified to the species. ○ – Denotes "possible" – calls had some characteristics of the species but could not be reliably attributed. Yellow Highlighting denotes a vulnerable species listed under the BC Act.

Table 3-4: Abundance of Recordings for each Bat Species

Species / Common Name	A1-1	A1-2	A2-1	A2-2	A3-1	A3-2	A4-1	A6-1	Species total
Positively identified calls									
Rhinolophus megaphyllus Eastern Horseshoe Bat						1			1
Chalinolobus gouldii Gould's wattled bat	38	85	32	65	54	54	205	94	627
Chalinolobus morio Chocolate wattled bat	18	45	18	35	73	133	109	159	590
Falsistrellus tasmaniensis Eastern False Pipistrelle	5	21	44	20	13	2	66	13	184
***Nyctophilus* sp.**	6	66	80	165	131	7	19	19	493
Scoteanax rueppellii Greater Broad-nosed Bat	6	11	21	26	25	3	23	7	122
Scotorepens greyii Little broad-nosed bat		12	4	1		1	19	1	38
Scotorepens orion Eastern broad-nosed bat	3	12	9	4	33	2	17	8	88
Vespadelus darlingtoni Large forest bat	92	510	603	377	324	139	910	369	3324
Vespadelus regulus Southern Forest Bat	13	248	48	53	25	6	107	3	503
Vespadelus vulturnus Little Forest Bat	27	24	15	84	38	28	38	59	313
Miniopterus orianae *Large Bent-winged Bat*				4		1	4		9
Austronomus australis White-striped Freetail Bat	66	98	157	146	54	35	79	102	737
Ozimops planiceps South-Eastern Free-Tailed Bat	33	8	4	36	17	5	18	28	149
Ozimops ridei Ride's Free-Tailed Bat	26	33	36	182	55	35	843	60	1270
Total positively identified calls:	333	1173	1071	1198	842	451	2457	922	8447

Unresolved calls									
Chalinolobus gouldii Gould's wattled bat / ***Ozimops ridei*** Ride's Free-Tailed Bat	172	166	247	824	162	91	2595	189	4446
Chalinolobus morio Chocolate wattled bat / ***Vespadelus vulturnus*** Little Forest Bat	2	354	36	3	113	98		5	611
Falsistrellus tasmaniensis Eastern False Pipistrelle / ***Scotorepens greyii*** Little broad-nosed bat	8	39	66	16	18	5	118	11	281
Scotorepens orion Eastern broad-nosed bat / ***Scoteanax rueppellii*** Greater Broad-nosed Bat	2	14	9	83	32	6	21	9	176
Vespadelus spp.	31	808	147	141	553	128	807	377	2992
Vespadelus sp. / ***Miniopterus orianae*** Large Bent-winged Bat	1		8	8	2		22	2	43
Possible ***Saccolaimus flaviventris*** Yellow-bellied Sheath tail-bat								1	1
mixed spp-not identified-surplus	32	210	280	1002	186	33	259	47	2049
Site total:	581	2764	1864	3275	1908	813	6279	1563	19047

3.2.2 Threatened Microbat Species

The vast majority of calls identified were from common species that are not of conservation concern (i.e., are not listed as threatened under state or federal legislation). A total of three threatened species were positively identified, these include Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Large Bent-winged Bat (*Miniopterus orianae*). Additionally, Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) was 'possibly' identified, however, this was based on the analysis of a single call and not a reliable indication of the presents of the species.

Eastern False Pipistrelle and Greater Broad-nosed Bat are both well represented in the data, with significant levels of activity recorded across all survey locations. Large Bent-winged Bat is less well represented, with a total of 9 positively identified calls across 3 survey locations, and an additional 43 'possible' calls across 6 survey locations (see previous **Table 3-3**).

3.2.4 Review of May 2013 Microbat Survey (ERM, 2014)

In May 2013 (20-24th) ERM Australia undertook bat call detection surveys at the Paling Yards Wind Farm to obtain information regarding bat utilisation of the site. Surveys were conducted at 5 locations, totalling 18 unit nights and yielding a total of 2,981 bat calls for analysis. Of the calls analysed, 12 microbat species were identified with varying levels of confidence (5 definite (100%), 1 probable (>60%), 3 possible (20-60%), and 3 that could represent one of two species). This included 3 threatened species (Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Eastern Bent-winged bat (*Miniopterus orianae oceanensis*)), although none were a definite identification.

Of the threatened species recorded, only Eastern False Pipistrelle was identified at all five survey locations. There were 19 probable recordings, 2 possible recordings and 181 calls that were narrowed down to Eastern False Pipistrelle or Eastern broad-nosed bat (*Scotorepens orion*). Greater Broad-nosed Bat was recorded 4 times with a 'possible' (20-60%) confidence at a single survey location situated in an open pasture overlooking a wooded valley. Eastern Bent-winged bat was recorded at two survey locations. One of the recordings was assigned a 'possible' (20-60%) confidence, and an additional three recordings were determined to be the Eastern Bent-winged bat or the Large Forest Bat (*Vespadelus regulus*).

Note that the timing of the survey (late autumn) was not optimal for microbats and is expected to represent lower diversity and abundance than that observed during the summer and spring months.

3.2.1 Flying Foxes

Grey-headed Flying Fox was not recorded in the Subject Site and there are no BioNet records within 10 km of the Subject Site. A review of the Department of Agriculture, Water & Environment's *Interactive Flying-fox Web Viewer* indicates that the closest flying fox camp is at Thilmere, approx. 75 km east of the Subject Site. Overall, while its presence cannot be discounted, it is considered that this species would rarely occur in the Subject Site and collision risk would be very low (although future monitoring would ensure that this was the case).

3.3 Discussion of Impacts

3.3.1 Collision-related Mortality

Operational wind farms are recognised to pose a risk to bat species utilising the site resulting in collision with turbines and associated ancillary. These issues often result from sensory failure where bats are unable to visually or acoustically detect moving turbine blades. It has been hypothesised that bats are also drawn to turbines through the acoustics the turbines give off, the attraction of insects congregating around turbine lights or the promise of a potential roost where turbines have been mistaken for habitat (BL&A, 2011). This attraction effect only further compounds the issue, leading to further bat fatalities.

The species definitively identified throughout the survey belong to three families, including Rhinolophidae, Molossidae and Vespertilionidae. Rhinolophidae consisted of a single species the (Eastern Horseshoe Bat (*Rhinolophus megaphyllus*)), identified from a single call at one survey

location. Molossidae also consisted of a single species (White-striped Freetail Bat (*Austronomus australis*)) recorded at all survey locations with high levels of activity. The remaining definitively identified calls belonged to the Vespertilionidae family, which was well represented throughout the survey. The Vespertilionidae recordings included the three definitively identified threatened species including Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Large Bent-winged Bat (*Miniopterus orianae*).

The analysis of bat species' global vulnerability to collision mortality at wind farms undertaken by Thaxter *et al*, (2017) has been used to estimate the rated collision risk for each of the represented families. The highest average rate of collision was observed in the Molossidae family with approximately 0.78 bat collisions per turbine per year, followed by Emballonuridae, with 0.7 bat collisions per turbine per year. See **Table 3-5**.

The Thaxter et al, (2017) models predict much higher collision rates for bats than birds. These collision estimations are based on the collation of 888 bat collision fatalities observed at wind farms globally over a 10-year period and have the potential to provide valuable insight; however, these wind farms occur in Europe and North America and their statistics should be applied with caution to Australian conditions. These generalised estimations also do not take into account site-specific factors, species abundance and activity levels, or turbine specifications that have the potential to reduce or inflate actual observed fatality rates at the Paling Yards wind farm. It is also unclear the role barotrauma has in contributing to fatality rates in wind farms as opposed to death directly attributed to collision alone (see Section 3.3.2 of this report).

Table 3-5: Estimated Annual Collision-related Fatality Rates for Recorded Microchiropteran Bat Species

Family	Species Recorded within Survey Area	Thaxter et al. (2017) Annual Fatality Rate	Estimated Annual Fatality Rate
Emballonuridae	*Saccolaimus flaviventris* (Yellow-bellied Sheathtail Bat)+	0.7 bats per WTG.	32.9 bats.
Miniopteridae	*Miniopterus orianae oceanensis* (Large Bent-winged Bat)+	0.68 bats per WTG.	32 bats.
Molossidae	*Tadarida australis* (White-striped Freetail Bat), *Ozimops planiceps* (Southern Free-tailed Bat), *O. ridei* (Ride's Free-Tailed Bat)	0.78 bats per WTG.	36.7 bats.
Rhinolophidae	*Rhinolophus megaphyllus* (Eastern Horseshoe Bat)	0.64 bats per WTG.	30.1 bats.
Vespertilionidae	*Chalinolobus gouldii* (Gould's Wattled Bat), *Chalinolobus morio* (Chocolate Wattled bat), *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)+, *Nyctophilus* sp., *Scoteanax rueppellii* (Greater Broad-nosed Bat)+, *Scotorepens greyii* (Little Broad-nosed Bat), *S. orion* (Eastern Broad-nosed Bat), *Vespadelus darlingtoni* (Large Forest Bat), *V. regulus* (Southern Forest Bat), *V. vulturnus* (Little Forest Bat).	0.69 bats per WTG.	32.4 bats.

3.3.2 Barotrauma

Decompression hypothesis proposes that barotrauma results from a rapid reduction in air-pressure caused by the rotation of turbine blades. Barotrauma results in tissue damage to air-containing structures caused by a rapid or extreme change in pressure, and this often results in lung damage as they cannot accommodate the air expansion (Baerwald *et al.* 2008). Microbats have been identified as particularly vulnerable to these effects, often with fatal consequences. The Australian Bat Society has estimated the fatality rates range from 1.6 bats per turbine per year to over 90 bats per turbine per year.

4. MITIGATION AND HARM MINIMISATION

As indicated in this assessment, there are uncertainties around the ongoing impact of collision and barotrauma related mortalities. The current literature is focused on Europe and North America and the statistics from these studies should be applied with caution to Australian conditions. In order to address these uncertainties, a specific Bat and Bird Adaptive Management Plan (BBAMP) is to be developed with the objective of minimising the impacts of the operational wind farm. The BBAMP will outline the required monitoring measures, key thresholds for determining permissible impacts and corrective actions that are required to achieve the objective of the plan. The plan will additionally outline the roles and responsibilities of the proponent, operator and agencies implementing, assessing, and enforcing the plan. Monitoring should include assessments of monthly mortality and periodic BBUS. Appropriate mitigation measures will be identified (such as the regular removal of lamb carcasses during lambing season, to decrease the attraction of the area to feeding raptors).

The monitoring plan will be developed in consultation with the Office of Environmental Heritage (OEH) to ensure that the plan meets the requirements and standards set forth by the agency. The frequency of reporting collision data will be determined during the preparation of the monitoring programme. The adaptive management measures that can be implemented, should collision thresholds be exceeded, will be negotiated with the OEH when collision rates are detected. Bird and bat collision monitoring will be undertaken with consideration for the monitoring guidelines provided by the Australian Wind Energy Association.

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ADDENDUM REPORT

Collision Risk Assessment for Bird and Bat Strike

for the

Paling Yards Wind Farm

31 March 2023

CERTIFICATION

The following provides the qualifications of all personnel involved in this addendum report.

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Conflicts of Interest

The Accredited Assessors have signed an agreement to abide by the Accredited BAM Assessor Code of Conduct. The authors declare in accordance with the Assessors Code of Conduct that no actual, perceived, or potential conflicts of interest exist.

Disclaimer

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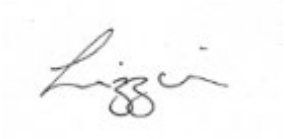

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TERMS & ABBREVIATIONS

BBAMP – Bird and Bat Adaptive Management Program

BBUS – Bird and Bat Utilisation Survey

BUS – Bird Utilisation Survey

BC Act – NSW *Biodiversity Conservation Act 2016*

BDAR – Biodiversity Development Assessment Report

Connectivity – The measure of the degree to which an area of native vegetation is linked with other areas of native vegetation.

DPE – Department of Planning and Environment

EPBC Act – Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

Habitat – An area or areas occupied, or periodically or occasionally occupied, by a species or ecological community, including any biotic or abiotic component.

NP – National Park.

Project – The Paling Yards Wind Farm proposal

Study area – The surveyed area of the site.

Subject Site – The area directly affected by the proposal, as shown in Figure 1-1 of this report. The Subject Site includes the footprint of the development and any ancillary works, facilities, accesses, or hazard reduction zones that support the construction or operation of the development or activity.

Threatened species – Critically endangered, endangered or vulnerable species as defined by Schedule 1 of the BC Act, or any such listed species under the EPBC Act.

WTG – Wind turbine generator.

EXECUTIVE SUMMARY

Hunter Ecology was contracted by ERM to prepare a collision risk assessment, regarding bird and bat strike for the Paling Yards Wind Farm, in response the Department of Planning and Environment's (DPE) additional information request, which states the following:

- *Regarding bird and bat strike, provide a risk rating for each turbine, including the following parameters:*
    i. *Proximity to potential microbat roosts and foraging habitat*
    ii. *Connectivity and likely movement pathways*
    iii. *Presence of raptor nests*
    iv. *Canopy buffer to rotor swept height.*

This collision risk assessment builds upon data collected and assessments undertaken in the Hunter Ecology (2021) Biodiversity Development Assessment Report (BDAR) and the Bird and Bat Utilisation Survey (BBUS) and has been expanded to include a risk assessment for each 'species of concern' in addition to the requested risk assessment for each turbine. Overall, the risk assessments aim to identify both species and turbines of 'moderate' or higher risk that would require prioritisation in terms of monitoring and implementation of appropriate mitigation measures.

The collision risk assessments were based on the Risk Evaluation Matrix Model which measures the overall risk of a potential impact event (i.e., the *likelihood* of an impact event and the *consequences* of that impact event). Various documents and guidelines were used to inform the assessment including: Moloney et al. (2019), which documents mortality monitoring of existing wind farms in Victoria; Lumsden et al. (2019), which provides criteria for assessing 'likelihood' and 'consequence' of turbine collision risk; and the Rollason et. al (2010) ISO 31000 Risk Assessment Framework.

The species risk assessment has determined the risk ratings to be either negligible, low or moderate. No species were rated at high or severe. The following species were determined to be at moderate risk:

- *Anthochaera phrygia* (Regent Honeyeater)
- *Aquila audux* (Wedge-tailed Eagle)
- *Callocephalon fimbriatum* (Gang-gang Cockatoo)
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
- *Hirundapus caudacutus* (White-throated Needletail)
- *Lathamus discolor* (Swift Parrot)
- *Miniopterus orianae oceanensis* (Large Bent-winged Bat)
- *Scoteanax rueppellii* (Greater Broad-nosed Bat)

The turbine risk assessment has also determined the risk rating to be either negligible, low or moderate, with none being high or severe. The following turbines were found to present a moderate risk:

- PY-1
- PY-5 to PY 29
- PY-32 to PY-38

It is recommended that the species and turbines assessed as having a moderate risk are prioritised in terms of monitoring and implementation of appropriate mitigation measures (although monitoring and mitigation should also take a broad, adaptive approach to deal with uncertainties around wind farm collision impacts).

As detailed in the BDAR, the Project proposes to develop a Bird and Bat Adaptive Management Program (BBAMP). The BBAP will outline monitoring measures, key thresholds for determining permissible impacts and corrective actions that are required to achieve the BBAMP objectives (which are essentially to minimise impacts on birds and bats during the operational phase). Monitoring would include assessments of monthly mortality and periodic BUS, and appropriate mitigation measures will be identified (such as the regular removal of lamb carcasses during lambing season, to decrease the attraction of the area to feeding raptors). Monitoring of impacts on microbats should take into account the recommendations documented in Rodrigues et al. (2014). The frequency of report strike data and the adaptive management measures that could be implemented, should strike thresholds be reached, will be negotiated with DPE. Monitoring would also be undertaken with consideration of the monitoring guidelines provided by the Australian Wind Energy Association.

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Tables

1. INTRODUCTION

1.1 Purpose & Scope

Hunter Ecology has been contracted by ERM to prepare a collision risk assessment, regarding bird and bat strike, for the Paling Yards Wind Farm ('the Project'). This is in response the Department of Planning and Environment's (DPE) additional information request, which states the following:

- *Regarding bird and bat strike, provide a risk rating for each turbine, include the following parameters:*
    - *v. Proximity to potential microbat roosts and foraging habitat*
    - *vi. Connectivity and likely movement pathways*
    - *vii. Presence of raptor nests*
    - *viii. Canopy buffer to rotor swept height.*

This collision risk assessment builds upon data collected and assessments undertaken in the Hunter Ecology (2021) Biodiversity Development Assessment Report (BDAR) and the Bird and Bat Utilisation Survey (BBUS). It has been expanded to include a risk assessment for each 'species of concern' in addition to the requested risk assessment for each turbine. Overall, the risk assessments aim to identify both species and turbines of 'moderate' or higher risk that would require prioritisation in terms of monitoring and implementation of appropriate mitigation measures.

1.2 Wind Turbine Specifications

The project comprises up to 47 wind turbine generators (WTG) and ancillary infrastructure. Each of the turbines consists of a tall tower with 3 long blades mounted at the top designed to capture wind (see **Figure 1-1** for turbine locations). **Table 1-1** provides the operational measures of the WTGs.

Table 1-1: Wind Turbine Specifications

Rotor sweep area (RSA)	72-240 m
Maximum chord width of rotor	4 m
Pitch angle of rotor	90°
Rotor diameter	158 m
Rotation period	6.18 m/s

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Figure 1.1 Project Layout

- Survey Area
- Development Footprint 12/2022
- Dwelling Location
- PYWF_WTG_Layout_v2_01_20210727
- PYWF_TL_v2_03_20221115
- PYWF_AccessRoad_v2_02_20221115
- PYWF_Existing_TL_v1_01_20210115
- PYWF_Site_Boundary_v2_01_20210727
- PYWF_Substation_v2_04_20221115

DATE : 05/12/2022
Map Version: 1.3

Aerial Imagery: NSW LPI Six Imagery 2019

Projected Coordinate System:
GDA 2020 Zone 55

Scale: 1:42,000

Dwelling locations digitised from geo-referenced image.
For illustration purposes only

0 800 1,600 2,400 3,200 4,000 8,000 Meters

2. Methodology

2.1 Field Surveys

This assessment has applied any relevant data collected during the field surveys for the BDAR and BBUS. These surveys included:

- **Fixed-Point Bird Count Method** – Bart Schiebaan and Lizzie Bowman of Hunter Ecology and Lorena Boyle of ERM, undertook two separate bird utilisation survey events representing the 2021 Summer (02/2021) and Spring (10/2021) survey events. Each survey event consisted of monitoring 20-24 fixed observation points strategically placed throughout development footprint. Each observation point was monitored for a period of 20 minutes, during this time any bird observations were recorded, including species and abundance, as well as flight height and distance from the observation point. For the purposes of this report, flight height relative to Rotor Sweep Area (RSA) height is presented and described below. These intervals are based on the height and RSA of the turbine design that is currently proposed for the development.
  A = Below RSA (<30 meters above ground level)
  B = Within RSA (30-240 meters above ground level)
  C = Above RSA (>240 meters above ground level)

  When a bird or large flock of birds were recorded flying at multiple height intervals including within the RSA (30-240 m), a conservative approach was taken, and the bird or birds were recorded as flying at RSA height.

  Note, that these surveys were undertaken prior to development of the latest specifications in previous **Table 1-1** when RSA encompassed a larger area than what is currently proposed. For the purposes of this report, the RSA is 30-240 m, when in fact, the minimum height of the RSA is now 72 m. Therefore, as it stands, the impacts described and assessed in this report may be less.

- **Bat Surveys** – Bat echolocation detection surveys were undertaken over seven nights in summer (3-9 February 2021). The timing of this survey is expected to have captured the peak biodiversity and abundance of microbat species within the development area. Bat echolocation detectors were deployed at five locations, using two Anabat Express and three Anabat Swift detectors. Detectors were pre-programmed to commence recording 30 minutes before dusk and ceased recording 30 minutes after sunrise. Targeted surveys for *Pteropus poliocephalus* (Grey-headed Flying Fox) were also undertaken in summer (3-10 February 2021) and spring (1-7 October 2022). These included nocturnal spotlighting and diurnal searches for colony camps.
- **Incidental Observations** – Effort was made to record any significant incidental observations, such as threatened bird species across the study area.

2.2 Collision Risk Assessment

A collision risk assessment was undertaken for both 'species of concern' and for each wind turbine. This was based on the Risk Evaluation Matrix Model which measures the overall risk of a potential impact event (i.e., the *likelihood* of an impact event (**Table 2.1**) and the *consequences* of that impact event (**Table 2.2**)). The Risk Evaluation Matrix Model applied in this assessment complies with the Rollason et. al (2010) ISO 31000 Risk Assessment Framework. Overall, the risk assessment was designed to identify both species and turbines of 'moderate' or higher risk that would require prioritisation in terms of monitoring and implementation of appropriate mitigation measures.

Table 2-1: Risk Likelihood Scale

Certain	It is very probable that the risk event could occur in any year (>95%).
Almost Certain	It is more probable than not that the risk event could occur in any year (>50%).
Likely	It is equally probable that the risk event could or could not occur in any year (50%).
Unlikely	It is less probable than not that the risk event could occur in any year (<50%).
Rare	It is improbable that the risk event could occur in any year (<5%). The risk event is only theoretically possible or would require exceptional circumstances to occur.

Table 2-2: Risk Consequence Scale

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

Table 2-3: Risk Matrix Defining Level of Risk from Likelihood x Consequence

		Consequence				
		Negligible	Low	Moderate	High	Severe
Likelihood	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

2.2.1 Species Risk Assessment

For the species risk assessment, a list of 'species of concern' was compiled. This included birds and bats with the following characteristics:

- Any threatened species listed under the *Biodiversity Conservation Act 2016* (BC Act) or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) recorded within the survey area.
- Any confirmed ecosystem credit species and species credit species identified in the BDAR.
- Species predicted to occur in the area that are known to be prone to collision, such as raptors and cockatoos.
- Any species recorded flying within the RSA of the turbines.
- Any microbats recorded via bat call detection surveys in the BDAR.

Each of these species was then give a risk rating in accordance with the Risk Evaluation Matrix Model.

The Risk Likelihood Scale rating for each species was determined under the guidance of both mortality monitoring of existing wind farms in Victoria (as reported in Moloney et al. (2019)) and by the criteria used to ascribe 'likelihood of risk' developed by Lumsden et al. (2019), which include the following:

A. Species known or likely frequency of flights within rotor swept height.
B. Habitat preference within general environments of wind farm site. Taxon frequents open areas coinciding with microenvironments suitable for turbines.

The Risk Consequence Scale rating for each species was determined under the guidance of the criteria used to ascribe 'consequence of risk' developed by Lumsden et al. (2019), which include the following:

C. Highly localised or concentrated population (for whole or part of lifecycle), such that siting of wind farm could have significant consequence to population.
D. Impact on population relative to demographic capacity to replace fatalities (i.e., generalised combination of dispersal capacity of potential replacements, fecundity and generation time).

E. Known or estimated size of population.
F. Listed conservation status under BC Act and EPBC Act.

2.2.2 Turbine Risk Assessment

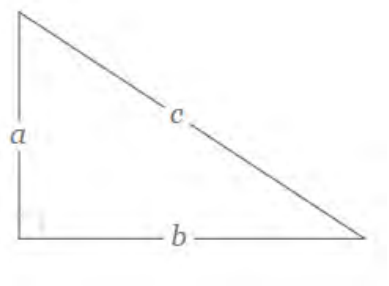
For the turbine risk assessment, turbines were individually assessed against the following parameters:

- Proximity to potential microbat roosts and foraging habitat
- Proximity to corridors and likely movement pathways
- Proximity to raptor nests
- Canopy buffer to RSA

Each turbine was then given a risk rating in accordance with the Risk Evaluation Matrix Model.

Note, canopy buffer to RSA was calculated using the following formula, where 'a' is the minimum RSA height (72 m) and 'b' is the distance to the nearest native trees.

$$c = \sqrt{a^2 + b^2}$$



Also note, assessing proximity to corridors and likely movement pathways is very difficult, as the site would generally be within range of the migration and local nomadic movements of several species. As stated in the BDAR, the Subject Site is situated between large tracks of forested land, including Abercrombie River NP to the west and north and a combination of state forest, private land and various nature reserves (including Blue Mountains National Park (NP) and Kanangra-Boyd NP) to the east and south. The areas of native vegetation within the Subject Site, whilst fragmented and highly disturbed by agriculture, contain some connectivity value. There are no specific corridors within the Subject Site; rather, all areas of native vegetation in the Subject Site would provide connectivity in the form of 'stepping stones'. Nevertheless, the results of the BUS were used to paint a picture of the general movement patterns of birds across the site. Turbines were assessed as being within proximity to the movement pathways of any bird species that that were recorded flying within RSA, or any threatened species observations regardless of flight height, within approx. 500 m of turbine.

3. Collision Risk Assessment Results

3.1 Species Risk Ratings

Table 3-1 provides the risk rating for each species of concern in accordance with the Risk Evaluation Matrix Model.

Table 3-1: Risk Ratings for Species of Concern

Species	Reasons for Inclusion	Threated Species Status*	Likelihood of Risk Event	Consequence	Risk Rating
Accipiter fasciatus Brown Goshawk	Recorded flying within RSA, but low incidence of records.	NA	Likely	Low	Low
Anthochaera phrygia Regent Honeyeater	Confirmed ecosystem credit species.	CE (BC Act and EPBC Act)	Unlikely	High	Moderate
Aquila audux Wedge-tailed Eagle	Recorded flying within RSA. Very abundant records.	NA	Almost certain	Moderate	Moderate
Artamus cyanopterus Dusky Woodswallow	Threatened species recorded below RSA.	V (BC Act)	Rare	Moderate	Negligible
Austronomus australis White-striped Freetail-Bat	Recorded via bat call detection surveys.	NA	Almost certain	Low	Low
Cacatua galerita Sulphur-crested Cockatoo	Recorded flying within RSA. Very abundant records.	NA	Almost certain	Low	Low
Callocephalon fimbriatum Gang-gang Cockatoo	Confirmed species credit species, recorded flying within RSA but low incidence of records.	V (BC Act)	Likely	Moderate	Moderate
Calyptorhynchus lathami Glossy Black-Cockatoo	Confirmed ecosystem credit species.	V (BC Act)	Unlikely	Moderate	Low

Chalinolobus gouldii Gould's Wattled Bat	Recorded via bat call detection surveys.	NA	Likely	Low	Low
Chalinolobus morio Chocolate Wattled Bat	Recorded via bat call detection surveys.	NA	Unlikely	Low	Negligible
Chenonetta jubata Australian Wood Duck	Waterbirds may be prone to collision.	NA	Unlikely	Low	Low
Chthonicola sagittata Speckled Warbler	Confirmed ecosystem credit species.	V (BC Act)	Rare	Moderate	Negligible
Circus assimilis Spotted Harrier	Confirmed ecosystem credit species.	V (BC Act)	Unlikely	Moderate	Low
Climacteris picumnus victoriae Brown Treecreeper (eastern subspecies)	Confirmed ecosystem credit species.	V (BC Act)	Rare	Moderate	Negligible
Corvus coronoides Australian Raven	Recorded flying within RSA. Abundant records.	NA	Almost certain	Low	Low
Cracticus tibicen Australian Magpie	Recorded flying within RSA. Very abundant records.	NA	Almost certain	Low	Low
Daphoenositta chrysoptera Varied Sittella	Confirmed ecosystem credit species.	V (BC Act)	Unlikely	Moderate	Low
Egretta novaehollandiae White-faced Heron	Waterbirds may be prone to collision.	NA	Likely	Low	Low
Elanus axillaris Bar-shouldered Kite	Recorded flying within RSA but low incidence of records.	NA	Likely	Low	Low
Eolophus roseicapilla Galah	Recorded flying within RSA. Abundant records.	NA	Almost certain	Low	Low

Falco berigora Brown Falcon	Recorded flying within RSA but low incidence of records.	NA	Likely	Low	Low
Falco cenchroides Australian Kestrel	Recorded flying within RSA, but low incidence of records.	NA	Likely	Low	Low
Falsistrellus tasmaniensis Eastern False Pipistrelle	Confirmed ecosystem credit species. Recorded via bat call detection surveys.	V (BC Act)	Likely	Moderate	Moderate
Glossopsitta pusilla Little Lorikeet	Confirmed ecosystem credit species.	V (BC Act)	Unlikely	Moderate	Low
Grantiella picta Painted Honeyeater	Confirmed ecosystem credit species.	V (BC Act and EPBC Act)	Unlikely	Moderate	Low
Haliaeetus leucogaster White-bellied Sea-Eagle	Confirmed ecosystem credit species.	V (BC Act)	Unlikely	Moderate	Low
Hieraaetus morphnoides Little Eagle	Confirmed ecosystem credit species.	V (BC Act)	Unlikely	Moderate	Low
Hirundapus caudacutus White-throated Needletail	Confirmed ecosystem credit species.	V (EPBC Act)	Likely	Moderate	Moderate
Lathamus discolor Swift Parrot	Confirmed ecosystem credit species.	E (BC Act), CE (EPBC Act)	Unlikely	High	Moderate
Melanodryas cucullata cucullata Hooded Robin (south-eastern form)	Confirmed ecosystem credit species.	V (BC Act)	Rare	Moderate	Negligible
Melithreptus gularis gularis Black-chinned Honeyeater (eastern subspecies)	Confirmed ecosystem credit species.	V (BC Act)	Unlikely	Moderate	Low
Miniopterus orianae oceanensis	Confirmed ecosystem credit species.	V (BC Act)	Likely	Moderate	Moderate

Large Bent-winged Bat					
Miniopterus schreibersii orianae Northern Bent-winged Bat	Recorded via bat call detection surveys.	NA	Likely	Low	Low
Ninox strenua Powerful Owl	Confirmed ecosystem credit species.	V (BC Act)	Unlikely	Moderate	Low
Ozimops planiceps Southern Free-tailed Bat	Recorded via bat call detection surveys.	NA	Unlikely	Low	Negligible
Ozimops ridei Ride's Free-Tailed Bat	Recorded via bat call detection surveys.	NA	Unlikely	Low	Negligible
Petroica boodang Scarlet Robin	Confirmed ecosystem credit species.	V (BC Act)	Rare	Moderate	Negligible
Petroica phoenicea Flame Robin	Confirmed ecosystem credit species.	V (BC Act)	Rare	Moderate	Negligible
Polytelis swainsonii Superb Parrot	Confirmed ecosystem credit species.	V (BC Act and EPBC Act)	Unlikely	Moderate	Low
Pteropus poliocephalus Grey-headed Flying-fox	Confirmed ecosystem credit species.	V (BC Act and EPBC Act)	Unlikely	Moderate	Low
Rhinolophus megaphyllus Eastern Horseshoe-bat	Recorded via bat call detection surveys.	NA	Unlikely	Low	Negligible
Saccolaimus flaviventris Yellow-bellied Sheathtail Bat	Recorded via bat call detection surveys.	V (BC Act)	Unlikely	Moderate	Low
Scoteanax rueppellii Greater Broad-nosed Bat	Confirmed ecosystem credit species. Recorded via bat call detection surveys.	V (BC Act)	Likely	Moderate	Moderate
Scotorepens greyii Little Broad-nosed Bat	Recorded via bat call detection surveys.	NA	Likely	Low	Low

Scotorepens orion Eastern Broad-nosed Bat	Recorded via bat call detection surveys.	NA	Likely	Low	Low
Stagonopleura guttata Diamond Firetail	Confirmed ecosystem credit species.	V (BC Act)	Rare	Moderate	Negligible
Strepera graculina Pied Currawong	Recorded flying within RSA. Abundant records.	NA	Almost certain	Low	Low
Vespadelus darlingtoni Large Forest Bat	Recorded via bat call detection surveys.	NA	Likely	Low	Low
Vespadelus regulus Southern Forest Bat	Recorded via bat call detection surveys.	NA	Likely	Low	Low
Vespadelus vulturnus Little Forest Bat	Recorded via bat call detection surveys.	NA	Likely	Low	Low

*** CE = critically endangered, E = endangered, V = vulnerable**

3.2 Turbine Risk Ratings

Table 3-2 provides the risk rating for each turbine in accordance with the Risk Evaluation Matrix Model.

Table 3-2: Turbine Risk Ratings

Turbine Ref. No.*	Proximity to potential microbat roosts and foraging habitat**	Proximity to corridors and likely movement pathways***	Proximity to raptor nests	Canopy buffer to RSA	Likelihood of Risk Event	Consequence	Risk Rating
PY-1	250 m	**Gang Gang Cockatoo**, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	260 m	Likely	Moderate	Moderate
PY-2	140 m	Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	157 m	Likely	Low	Low
PY-3	190 m	Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	203 m	Likely	Low	Low
PY-4	160 m	Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	175 m	Likely	Low	Low
PY-5	150 m	Wedge-tailed Eagle, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	166 m	Almost certain	Moderate	Moderate

PY-6	50 m	Wedge-tailed Eagle, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	88 m	Almost certain	Moderate	Moderate
PY-7	190 m	Wedge-tailed Eagle, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	203 m	Almost certain	Moderate	Moderate
PY-8	50 m	Wedge-tailed Eagle, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	88 m	Almost certain	Moderate	Moderate
PY-9	50 m	Wedge-tailed Eagle, Australian Magpie, Australian Raven, Australian Hobby	None recorded in the survey area, but likely to occur in the general area.	88 m	Almost certain	Moderate	Moderate
PY-10	90 m	Wedge-tailed Eagle, Australian Raven, Australian Hobby	None recorded in the survey area, but likely to occur in the general area.	115 m	Almost certain	Moderate	Moderate
PY-11	50 m	Wedge-tailed Eagle, Australian Raven, Australian Hobby	None recorded in the survey area, but likely to occur in the general area.	88 m	Almost certain	Moderate	Moderate
PY-12	50 m	Wedge-tailed Eagle, Australian Magpie, Australian Raven	None recorded in the survey area, but likely to occur in the general area.	88 m	Almost certain	Moderate	Moderate
PY-13	240 m	Wedge-tailed Eagle, Australian Magpie, Australian Raven	None recorded in the survey area, but likely to occur in the general area.	251 m	Almost certain	Moderate	Moderate

PY-14	500 m	Wedge-tailed Eagle, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	505 m	Almost certain	Moderate	Moderate
PY-15	415 m	Wedge-tailed Eagle, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	421 m	Almost certain	Moderate	Moderate
PY-16	380 m	Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Magpie, Galah	None recorded in the survey area, but likely to occur in the general area.	387 m	Almost certain	Moderate	Moderate
PY-17	140 m	Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Magpie, Galah	None recorded in the survey area, but likely to occur in the general area.	157 m	Almost certain	Moderate	Moderate
PY-18	85 m	Wedge-tailed Eagle, Pied Currawong, Dusky Woodswallow (not within RSA)	None recorded in the survey area, but likely to occur in the general area.	111 m	Almost certain	Moderate	Moderate
PY-19	90 m	Wedge-tailed Eagle, Pied Currawong, Dusky Woodswallow (not within RSA)	None recorded in the survey area, but likely to occur in the general area.	115 m	Almost certain	Moderate	Moderate
PY-20	100 m	Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Raven, Australian Kestrel, Pied Currawong	None recorded in the survey area, but likely to occur in the general area.	123 m	Almost certain	Moderate	Moderate
PY-21	140 m	Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Raven, Australian Kestrel, Pied Currawong	None recorded in the survey area, but likely to occur in the general area.	157 m	Almost certain	Moderate	Moderate

PY-22	140 m	Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Raven, Australian Kestrel, Pied Currawong	None recorded in the survey area, but likely to occur in the general area.	157 m	Almost certain	Moderate	Moderate
PY-23	140 m	Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Magpie, Australian Kestrel	None recorded in the survey area, but likely to occur in the general area.	157 m	Almost certain	Moderate	Moderate
PY-24	90 m	Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Magpie, Australian Kestrel	None recorded in the survey area, but likely to occur in the general area.	115 m	Almost certain	Moderate	Moderate
PY-25	200 m	Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Magpie, Australian Kestrel	None recorded in the survey area, but likely to occur in the general area.	213 m	Almost certain	Moderate	Moderate
PY-26	190 m	Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Magpie, Australian Kestrel	None recorded in the survey area, but likely to occur in the general area.	203 m	Almost certain	Moderate	Moderate
PY-27	250 m	Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Raven	None recorded in the survey area, but likely to occur in the general area.	260 m	Almost certain	Moderate	Moderate
PY-28	90 m	Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Magpie, Pied Currawong	None recorded in the survey area, but likely to occur in the general area.	115 m	Almost certain	Moderate	Moderate
PY-29	90 m	Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Magpie, Pied Currawong	None recorded in the survey area, but likely to occur in the general area.	115 m	Almost certain	Moderate	Moderate

PY-30	50 m	Sulphur-crested Cockatoo, Australian Raven, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	88 m	Almost certain	Low	Low
PY-31	100 m	Sulphur-crested Cockatoo, Australian Raven, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	123 m	Almost certain	Low	Low
PY-32	75 m	**Gang Gang Cockatoo**, Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Raven, Australian Magpie, Pied Currawong	None recorded in the survey area, but likely to occur in the general area.	104 m	Almost certain	Moderate	Moderate
PY-33	300 m	**Gang Gang Cockatoo**, Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Raven, Australian Magpie, Pied Currawong	None recorded in the survey area, but likely to occur in the general area.	309 m	Almost certain	Moderate	Moderate
PY-34	100 m	**Gang Gang Cockatoo**, Wedge-tailed Eagle, Sulphur-crested Cockatoo, Australian Raven, Australian Magpie, Pied Currawong	None recorded in the survey area, but likely to occur in the general area.	123 m	Almost certain	Moderate	Moderate
PY-35	50 m	Wedge-tailed Eagle, Australian Raven, Brown Falcon, Australian Magpie, Australian Kestrel, Bar-shouldered Kite, Galah	None recorded in the survey area, but likely to occur in the general area.	88 m	Almost certain	Moderate	Moderate
PY-36	70 m	Wedge-tailed Eagle, Australian Raven, Brown Falcon, Australian Magpie, Australian Kestrel, Bar-shouldered Kite, Galah	None recorded in the survey area, but likely to occur in the general area.	100 m	Almost certain	Moderate	Moderate
PY-37	100 m	Wedge-tailed Eagle, Australian Raven, Brown Falcon, Australian Magpie, Australian Kestrel, Bar-shouldered Kite, Galah	None recorded in the survey area, but likely to occur in the general area.	123 m	Almost certain	Moderate	Moderate

PY-38	190 m	Wedge-tailed Eagle, Australian Raven, Brown Falcon, Australian Magpie, Australian Kestrel, Bar-shouldered Kite, Galah	None recorded in the survey area, but likely to occur in the general area.	203 m	Almost certain	Moderate	Moderate
PY-39	50 m	Australian Raven, Brown Falcon, Australian Magpie, Australian Kestrel	None recorded in the survey area, but likely to occur in the general area.	88 m	Almost certain	Low	Low
PY-40	70 m	Australian Raven, Brown Falcon, Australian Magpie, Australian Kestrel	None recorded in the survey area, but likely to occur in the general area.	100 m	Almost certain	Low	Low
PY-41	70 m	Australian Raven, Brown Falcon, Australian Magpie, Australian Kestrel	None recorded in the survey area, but likely to occur in the general area.	100 m	Almost certain	Low	Low
PY-42	95 m	Brown Goshawk, Australian Raven, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	119 m	Almost certain	Low	Low
PY-43	70 m	Brown Goshawk, Australian Raven, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	100 m	Almost certain	Low	Low
PY-44	90 m	Brown Goshawk, Australian Raven, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	115 m	Almost certain	Low	Low
PY-45	200 m	Brown Goshawk, Australian Raven, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	213 m	Almost certain	Low	Low

PY-46	100 m	Brown Goshawk, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	123 m	Almost certain	Low	Low
PY-47	140 m	Brown Goshawk, Australian Magpie	None recorded in the survey area, but likely to occur in the general area.	157 m	Almost certain	Low	Low

*** Refer to Figure 1.1 Project Layout.**

**** Approximate distances measured from base of turbine.**

***** Species listed in this column are those that were recorded flying within RSA, or any threatened species observations regardless of flight height, within approx. 500 m of turbine.**

4. CONCLUSION & RECOMMENDATIONS

The species risk assessment has determined the risk ratings to be either negligible, low or moderate. No species were rated at high or severe. The following species were determined to be at moderate risk:

- *Anthochaera phrygia* (Regent Honeyeater)
- *Aquila audux* (Wedge-tailed Eagle)
- *Callocephalon fimbriatum* (Gang-gang Cockatoo)
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
- *Hirundapus caudacutus* (White-throated Needletail)
- *Lathamus discolor* (Swift Parrot)
- *Miniopterus orianae oceanensis* (Large Bent-winged Bat)
- *Scoteanax rueppellii* (Greater Broad-nosed Bat)

The turbine risk assessment has also determined the risk rating to be either negligible, low or moderate, with none being high or severe. The following turbines were found to present a moderate risk:

- PY-1
- PY-5 to PY 29
- PY-32 to PY-38

It is recommended that the species and turbines assessed as having a moderate risk are prioritised in terms of monitoring and implementation of appropriate mitigation measures (although monitoring and mitigation should also take a broad, adaptive approach to deal with uncertainties around wind farm collision impacts).

As detailed in the BDAR, the Project proposes to develop a Bird and Bat Adaptive Management Program (BBAMP). The BBAP will outline monitoring measures, key thresholds for determining permissible impacts and corrective actions that are required to achieve the BBAMP objectives (which are essentially to minimise impacts on birds and bats during the operational phase). Monitoring would include assessments of monthly mortality and periodic BUS, and appropriate mitigation measures will be identified (such as the regular removal of lamb carcasses during lambing season, to decrease the attraction of the area to feeding raptors). Monitoring of impacts on microbats should take into account the recommendations documented in Rodrigues et al. (2014). The frequency of report strike data and the adaptive management measures that could be implemented, should strike thresholds be reached, will be negotiated with DPE. Monitoring would also be undertaken with consideration of the monitoring guidelines provided by the Australian Wind Energy Association.

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