

Biala Wind Farm

Second Annual Report on the Implementation of the Bird and Bat Adaptive Management Program

**Prepared for Newtricity Developments
Biala Pty Ltd**

July 2023
Report No. 17162.5 (9.1)



**Nature
Advisory**

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1. Introduction

The Biala Wind Farm (BWF) is located 14.5 kilometres southwest of Crookwell and 8.5 kilometres east of Biala in the southern tablelands of New South Wales (NSW). Approval for the construction of the Biala Wind Farm was granted to Newtricity Developments Biala Property Ltd by the Department of Planning and Environment (DPE) on 12th April 2017 for a 31-turbine wind farm, subject to conditions (Figure 1).

Condition 21 (a) to (e) of consent schedule 3 of the NSW approval requires the preparation of a Bird and Bat Adaptive Management Program (BBAMP). The BBAMP was prepared to address all elements of the development consent schedule 3 Condition 21 and submitted for review by the Biodiversity, Conservation and Science Directorates (BCS) before finalisation and approval by the Secretary of the DPE.

Biala Wind Farm Pty Ltd engaged Nature Advisory (formerly Brett Lane and Associates) to implement the BBAMP. The specific objectives of this BBAMP, derived from the conditions of approval, are set out below.

- To implement a monitoring program to estimate the impact of the project on at-risk birds and bats that can reasonably be attributed to the operation of the project, including pre and post-construction (operational) phases data collection;
- To directly record impacts on birds and bats through carcass surveys;
- To document an agreed notification framework that identifies impact triggers requiring a management response, unacceptable impact thresholds and the kinds of management activities that should be considered;
- To detail mitigation measures and related implementation strategies to reduce impacts on birds and bats; and
- To identify matters to be addressed in periodic reports on the outcomes of monitoring, the application of the notification framework, mitigation measures and their success.

The strategy employed to ensure that any impact triggers and unacceptable impacts are detected includes the following:

- Pre-operational bird and bat utilisation surveys;
- Operational phase carcass searches under operating turbines;
- Operational bird and bat utilisation surveys;
- 'At risk' species monitoring;
- Statistical analysis of the results of carcass searches; and
- Reporting.

According to the BBAMP, the first two years of operation of the BWF will provide focused monitoring to inform impacts and mortality estimates on birds and bats at the wind farm. In addition, monitoring of 'at risk' species will also be undertaken to inform of ongoing risk from wind farm operations.

A first annual report was submitted to BCS in on July 25th 2022 and focused on presenting the results of the mortality searches, any management measures implemented and recommends refinements to monitoring activities.

This report constitutes the second annual report and is intended to present a full analysis of all data collected under operation phase surveys will be completed. This includes Bird Utilisation Surveys (BUS), Bat surveys and monitoring 'at-risk' species including; Powerful Owl and Superb Parrot, in addition to bird

and bat mortality impact assessments and estimates undertaken during the first 24 months of operational monitoring.

According to the BBAMP, the second annual report must provide:

- A brief description of the management prescriptions implemented and identification of any modifications made to the original management practices;
- The survey methods (including list of observers, dates, and times of observations);
- Results of carcass searches and incidental carcass observations;
- Estimates of bird and bat mortality rates (per turbine per year) based on statistical analysis;
- Seasonal and annual variation in the number and composition of bird and bat strikes, where detectable;
- Any other mortality recorded on site but not during designated carcass searches (i.e. incidental records by site personnel);
- Identification of any unacceptable impacts or impact triggers, and application of the notification framework and relevant adaptive management measures;
- A summary of livestock carcass removal for the purposes of predator reduction;
- Details of any landowner feral animal control programs and their timing;
- A discussion of the results, including:
 - Bird risk reduction measures;
 - Any further recommendations for reducing mortality, if necessary;
 - Whether the level of mortality for a species represents an ongoing adverse impact on a threatened or 'at risk' bird or bat species or population.
 - Usage of the wind farm area by species of concern at more than negligible risk and factors influencing this (ie. climatic, geographical and infrastructure);
 - Analysis of the effectiveness of the notification framework; and
 - Recommendations about further monitoring.

This operational monitoring program was undertaken during COVID restriction periods, which impeded travel and access to the site during 2021, and additionally while the wind farm was undertaking operational hold point testing, which meant that not all turbines could be operated consistently. This limited the numbers of turbines that could be safely searched, or that presented any risk to avifauna (due to being non-operational) per month. As such, this monitoring program has been undertaken in a staggered approach in which turbines that could be searched were, while those that could not were delayed until a later survey period. This has meant that some turbines have been searched for 24 months while others are still on going. See Section 3 for further information and limitation.

Therefore, the initial carcass search program has not fully concluded at this stage of operation. Without 24 months of operational data for all selected turbines, mortality estimates will lack statistical robustness and accuracy will decrease. The search program data currently available to this point has been analysed to identify any risks and impacts which have informed further recommendations. Upon completion of the carcass search program, data will be analysed again and mortality estimates undertaken at that time. This report will be updated and provided to the regulator within three months of that time, with final conclusions and recommendations.

This second annual report includes the following sections:

Section 2 provides the survey methods of the operational monitoring program for the first 24 months.

Section 3 provides results of the operational monitoring program.

Section 4 discusses the first year of monitoring at Biala Wind Farm and provides recommendations.

This investigation was undertaken by a team from Nature Advisory comprising Kaitlyn Spooner (Zoologist), Nashieli Garcia Alaniz (Senior Zoologist), Grace Fieg (Zoologist), Phillip Allen (Zoologist), Gavin Thomas (Senior Zoologist), Michael Sebastian (Zoologist), Joshua Brown (Zoologist) Divyang Rathod (Zoologist), Jackson Clerke (Zoologist and Project Manager) and Inga Kulik (Director).

Figure 1: Biala Wind Farm layout

Project: Biala Wind Farm
Client: Beijing Jingneng Clean Energy (Hong Kong) Co. Limited
Date: 14/07/2023

- Proposed turbines
- Proposed access track



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2. Survey methods

This section outlines the methods for the first 24 months of operational monitoring at BWF aimed at monitoring ‘at-risk’ groups. These groups are defined in the BBAMP as:

- Wedge-tailed Eagle (*Aquila audax*);
- Powerful owl (*Ninox strenua*);
- Super Parrot (*Polytelis swainsonii*);
- Other raptors and White-throated Needletail (*Hirundapus caudacutus*); and
- Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*) and Eastern Bent-wing Bat (*Miniopterus orianae oceanensis*).

2.1. Powerful Owl and Superb Parrot surveys

An investigation was undertaken to determine the presence of Superb Parrot or Powerful Owl potentially utilising BWF, and whether any trees in the development footprint (within 200 metres of any turbines) may have hollows being utilised by Superb Parrots or Powerful Owl for breeding purposes.

Superb Parrot is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1995* (EPBC Act) and *Biodiversity Conservation Act 2016* (BC Act). The Superb Parrot is an uncommon species that inhabits riverine woodland and open semi-cleared woodlands of the NSW inland slopes and plains, and a small area of northern Victoria. It is a gregarious bird, known to move and forage in flocks; although pairs are more common during the spring breeding season. The species migrates from the southern end of its range in spring and summer, spending winter further north.

Powerful Owl is listed as Vulnerable under the BC Act. It occurs in open and tall wet sclerophyll forests with sheltered gullies and old growth forest with dense understorey. It is also found in dry forests with box and ironbark eucalypts and River Red Gum. Large old trees with hollows are required by this species for nesting which is one of the reasons for its demise.

Roaming surveys were undertaken at the Biala Wind Farm during October and December of 2021, with the intention of observing and recording potential breeding and resource use of the Superb Parrot within 200m of wind turbines and infrastructure. During the surveys in October, observations also included searches for larger nesting hollows and searching for the presence of the Powerful Owl.

The following methodology was implemented during the targeted surveys:

- Day time surveys were undertaken across a total of seven days, between 13th and 16th October 2021 and 6th and 9th December 2021;
- All trees with hollows previously identified within 200 metres of infrastructure (ERM 2015) were surveyed for the presence of Superb Parrots and Powerful Owl;
- Surveys were undertaken using line transects through wooded areas where the vegetation structure would allow, and multiple smaller transects where it did not, within 200 metres of infrastructure;
- In cleared areas such as paddocks, individual trees were surveyed if they were within 200 metres of a wind turbine;
- Searches for the presence of Powerful Owl were extended to locations where the species has previously been identified on BWF;
- The observer walked at a rate of up to two km/hour;
- Any hollows above 10cm in diameter were recorded; and

- All Superb Parrot, Powerful Owl and other threatened species observations (if observed) were recorded and GPS locations taken.

2.2. Operational bird utilisation surveys

Two operation phase BUS have been undertaken at BWF during the first year of operation at BWF in October 2021 and March 2022, as per the BBAMP.

A full report including detailed methods and results is included as Appendix 1 to the report, and a summary of results is provided in Section 3.1.

2.3. Bat surveys

A bat survey was intended to be carried out during the first year of operations as per the BBAMP requirements, however this survey ultimately failed and usable data was not obtained for analysis. This survey was intended to capture the migration period of the Eastern (Large) Bent-wing Bat, which includes generally Autumn annually.

As such, a bat survey was undertaken during March 2023 during the second year of monitoring to account for this requirement. However, the results of this survey will take some time to have analysed by an independent expert and it is not expected that the results of this will be available for release until approximately September/November 2023. This will coincide with the finalisation of the carcass search program (Section 2.1) and will be reported on in the updated annual report.

Survey methods included a repeat of pre-construction survey methods (BL&A 2018) and consisted of installing five Songmeters (SM4s) at ground level for a minimum of two weeks. Recordings took place between 30 minutes after sunset (AEST) and 30 minutes prior to dawn when bat activity is expected to be the highest. Figure 2 below displays the locations of the Songmeters at BWF.

Limitations

One Songmeter was originally deployed on a Met Mast on site during the 2018 surveys, at a height of approximately 50 metres to detect microbats flying at height. This unit was deployed at ground level for this operational survey as rigging equipment, consisting of a system of pullies and ropes, was no longer in place (given this was five years prior) to enable a repeat of the survey. Though at height data will not be available, only two common species were previously recorded flying at height and all threatened species were recorded at ground level. Recorders at ground level should provide sufficient data on the usage of the site by threatened species.

Figure 3: Songmeter locations at BWF March 2023 survey


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Date: 14/07/2023

- Proposed turbines
- Proposed access track
- Songmeters



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2.4. Scavenger rates trial

Scavenger trials are designed to ascertain the rate at which scavengers remove carcasses from under turbines at BWF. The result is used to develop a correction factor to account for the number of birds and bats carcasses that may be potentially removed by scavengers before searchers are able to find them during a given monthly search. Scavengers can include ground-dwelling animals, such as foxes and rats (more likely to detect carcasses by scent), and aerial scavengers such as birds of prey and Ravens (more likely to notice them visually).

Scavenger trials were expected to be undertaken twice during the first year of operational phase monitoring under the BBAMP. Due to Covid restrictions on movement of staff and rolling illnesses, undertaking the trials was necessarily delayed. Scavenging trials were completed within the second 12 months of monitoring. It is not expected that undertaking the trial during the second year as opposed to the first will impact the results in any meaningful way.

Section 4.4.3 of the BBAMP details the methods for scavenger trials. The approach described in the BBAMP places the carcass in the search area, and then an observer comes back regularly to check on whether the carcass has been scavenged. A modified and improved methodology has been adopted for the scavenger trials where a motion sensor camera is used to monitor scavenger activity. A motion sensor camera is attached to a tree, fence post or star picket approximately three to four metres away from each randomly placed carcass. The camera recorded any scavenging activity in detail.

Each trial consisted of the same number of replicates as the efficiency trial, totalling 40 carcasses monitored (bird medium and large, and bats and bat substitutes). Trials were conducted on a rolling basis in which searches surveying BWF each month would place up to six cameras, as a result trials were not conducted as two distinct trials but rather across approximately two seasons to complete the required numbers. A study by Symbolix (2020) showed that at operating wind farms there was not a significant difference between seasons when conducting scavenger trials for either birds or bats. As such, there will not be any significant impacts to these correction factors in conducting the trials with this adopted method

The carcass is left for 30 days, after which the camera was collected, and scavenging activity reviewed. If the carcass remains on day 30, it was recorded as not scavenged. This method extends the method detailed in the BBAMP and will provide better quality information for the more detailed mortality analysis.

2.5. Detectability (Observer) trials

Detectability trials are conducted to test the average rate that the trained searchers detect carcasses under wind turbines. It is not expected that searchers will find every carcass under turbines each monthly survey, given the difficulties of varying terrain and vegetation. As such, the results of the trial enable a correction factor to be applied to mortality estimates that accounts for carcasses that were potentially missed.

Detectability trials were supervised by a qualified ecologist 'carcass controller' and undertaken by searchers regularly conducting the carcass monitoring program. To account for observer variability in detecting carcasses, only personnel conducting monthly searches at BWF undertook the detectability trials. Detection efficiency (percentage of carcasses detected) will be incorporated into later analyses that derive mortality estimates.

Two efficiency trials have been undertaken during the 24 months of the monitoring. These were intended to be undertaken during the first 12 months however, due to Covid 19 lockdowns and movement restrictions this was not achievable. Lockdowns led to difficulty in moving Nature Advisory staff between the ACT and NSW, a lack of resources due to rolling staff illnesses and being unable to access BWF due

to OHS policy. A second trial has since been completed during July 2022 of the second 12 months of monitoring. It is not expected that undertaking the trial during the second year of monitoring, as opposed to the first, will have any impact on this correction factor viability in mortality estimates.

During each trial, ecologists who regularly undertake carcass searching at BWF had 20 carcasses (10 bird including medium and large carcasses, and 10 bats or bat substitutes) each placed under turbines they searched without knowledge of locations. Each trial comprised ten bats and ten birds (Table 1) for each searcher. The detection of each carcass was recorded along with the carcass type, turbine number, and searcher.

Table 1: Number of carcasses employed in efficiency trials specifying vegetation condition

Searcher	Date	Turbine	No. of Birds	No. of Bats	Vegetation condition
April 2022 trial					
Searcher 1	27/04/2022	19	2	3	Short to medium grass
	28/04/2022	12	2	3	Tall clumps of grass, raining during the search
		14	3	2	Short grass, raining during the search
	29/04/2022	7	3	2	Medium grass
Searcher 2	27/04/2022	20	2	3	Short to medium grass
	28/04/2022	9	2	3	Short grass, raining during the search
		11	3	2	Short grass, raining during the search
	29/04/2022	8	3	2	Short to medium grass
July 2022 trial					
Searcher 1	18/07/2022	10	2	3	Short grass
	19/07/2022	14	3	2	Short grass
		4	3	2	Medium long thick grass
		6	2	3	Short grass
Searcher 2	18/07/2022	9	2	3	Long grass in patches
	19/07/2022	13	3	1	Short grass
		15	3	2	Short grass
		5	3	2	Medium grass

2.6. Carcass searches

The mortality detection program was implemented to determine the wind farm's impact on birds and bats at the site during the operational phase. Birds and bats are known to collide with operating turbines at wind farms and this program has been designed to monitor potential impacts provide procedures to determine whether any would be deemed as unacceptable under the BBAMP Section 6.

The results of the carcass search program will be used to estimate the overall impact BWF is having on birds and bats through direct mortality (Section 4.4.6 of the BBAMP). These estimates will be based on mortality observed during the 24-month survey period and correction detectability and scavenger rate trials. As noted in the section above, the 24 months of monitoring has not been completed at all turbines and as such estimates cannot be given until that time. See Section 3 below for further details on expected completion dates and reporting commitments.

Monitoring at BWF began as ‘Pre-operation phase’ surveys in November 2020 and continued until February 2021, during which all turbines were searched prior to the majority of turbines being operational. The pre-construction phase was designed to capture any impacts that may have occurred as a result of turbines coming on line before the wind farm was fully operation. The formal mortality detection program at BWF commenced in March 2021 and this report covers a period of 24 months from March 2021 to April 2023. During the months of July and August 2021 searches did not take place due to Covid-19 lockdown restrictions.

As stated in the BBAMP plan, carcass searches are expected to be carried out for two years immediately following the erection of the turbines (i.e., once turbines are spinning). Carcass searches have required a staggered monitoring approach as some turbines began operating before others and not all were operating consistently during monitoring (see Section 3.6).

The mortality detection search was based on all the 31 turbines established at Biala Wind Farm (Figure 1), including (Northeast (T01-T06), Northwest (T07-T17), Central (T18 – T29) and Southwest (T30 – T31), comprising all the ridges of the wind farm.

Turbines are initially searched to a radius of 120 metres once per month (where possible), followed by a 60-metre radius “pulse” search two to three days after the first search in the same month, to detect additional mortality of bats and birds. Pulse searches are undertaken from September to March.

All mortality detection searches were undertaken by trained and experienced zoologists from Nature Advisory. The methods for searches include:

- The inner zone: walking transects are spaced six meters apart and carried out up to 60- meters from the turbine tower; nearly all microbats and the majority of small to medium birds are expected to be found in this inner zone (Hull and Muir 2010); and
- The outer zone is between 60 and 120 metres of the turbine tower base to detect the medium and larger birds; walking transects are spaced 12 meters apart (Figure 3).

A mortality report (BBAMP Appendix 2) was completed when a dead bird or bat was detected under a turbine, and a photograph of the carcass was taken. When only feathers were seen, this was recorded as a feather spot. Feather spots are assumed to represent a bird that has collided with a turbine and was later scavenged.

On finding a dead bird, feather-spot or dead bat the searcher:

- Collected the information outlined in the mortality report;
- Removed it from the site to avoid re-counting; and
- Transferred fresh carcasses to a freezer at the site office for storage so they could be identified or identity verified and used later in observer efficiency and scavenger trials (see below).

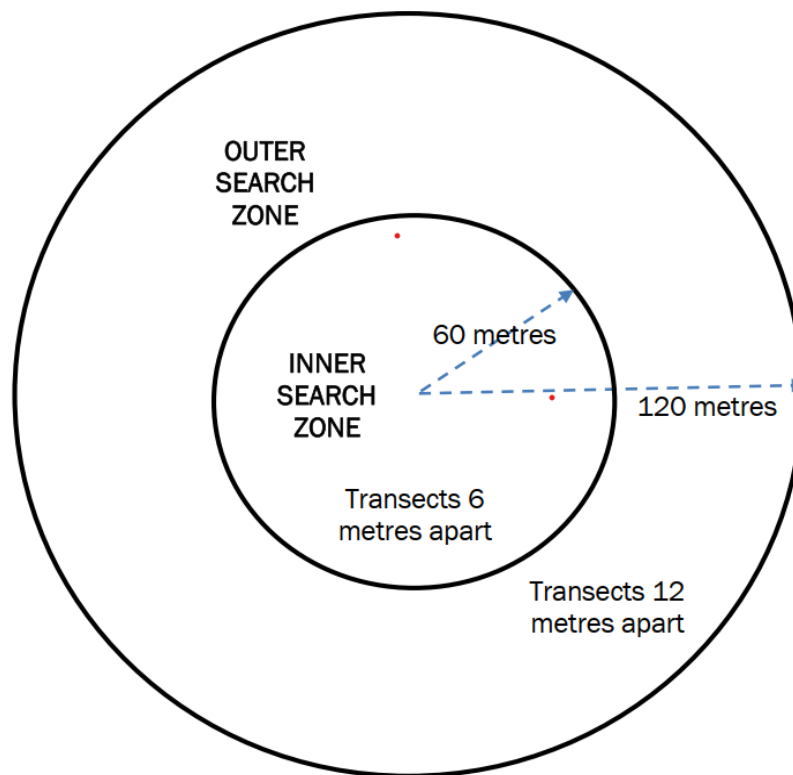


Figure 3: Inner and outer carcass search zones underneath the turbines.

An incidental record is a carcass found under a turbine outside of the formal mortality detection program (e.g. by wind farm personnel during routine inspections of infrastructure or turbine searches under a turbine not selected for monthly searches). These are not included in mortality estimates to be undertaken at the completion of the 24-month monitoring program but are included in annual reporting.

2.7. Raptor monitoring

Incidental monthly monitoring of raptor flights and breeding activity has been undertaken as raptors, particularly Wedge-tailed Eagle, have been identified in Section 4.1 of the BBAMP as 'at risk' at BWF.

The raptor monitoring was incorporated into the monthly mortality detection monitoring and aims to inform the ongoing level of risk to the local population to potential impacts.

Incidental reporting of all raptors observed is conducted across each field visit. Documentation of all raptor flights observed was plotted on a map. The following data was documented for each flight recorded during the monitoring program.

- Species;
- Number of birds
- Time first observed
- Time the bird/s flew out of sight or landed
- The location of the bird (either Air, perched or ground)
- Height of the bird when first observed
- The height range of the bird (minimum and maximum heights)
- The landscape the bird was observed in (either valley, slope or ridge)
- Flight behaviour (soaring, gliding, hovering, flapping, displaying, resting, mobbing, or foraging).

Any nesting activity was also intended to be recorded.

2.8. Carrion removal and pest control

Section 5 of the BBAMP outlines, two of which are required to be reported on; summary of livestock removal for the purposes of predator reduction and the details of any landowner feral animal control programs.

3. Results

Mortality detection was planned to be undertaken at each turbine once every month following the methods formerly described. However, the sampling effort could not be carried out uniformly as the operation of turbines was not regular during the monitoring months from September 2021 to January 2022. Turbine operation during these months was inconsistent across all turbines due to the requirements for BWF to commission all turbines without exceeding the Australian Energy Market Operator total export limit. This limit was equivalent to 10 turbines operating per month, with some minor overlap as selected turbines operating changed. The 10 turbines operating over the previous month leading up to the monthly search were searched as part of the monthly monitoring program.

Additional ‘hold-point’ testing conducted during February and March 2022 at some operating turbines meant that certain turbines could not be accessed during surveys as they could not be switched off (BWF OHS policy is that turbines cannot be approached while operating).

This limitation was described in the first annual report which received review and response by BSC on 3rd of August 2022. The staggered approach will not affect the viability of the mortality estimates and will be accounted for during analysis (Symbolix pers. comm. 17/12/2022).

Table 2 details the number of times each turbine has been sampled during the 24 months of monitoring to date, including initial and pulse search sampling, and those that remain. Eleven turbines have completed 24 months of initial surveys and are considered completed. These have ‘pulse’ searches which remain unimplemented. These were not able to be undertaken as the BBAMP states that these searches will only take place during September to March, which the staggered approach did not allow.

Pulse searches target bat activity primarily, which is why they are undertaken during the warmer months when microbats are most active. They provide additional information on frequency of finds by following up the initial search with a smaller supplementary search. It is not expected that there would be high bat mortality during this time and as such, these additional pulse searches are not considered necessary. Further pulse searches will be complete at initial turbines searches that fall during and post September 2023.

Each turbine will be searched a total of 24 times (plus corresponding pulse searches) at which time mortality estimates will be possible.

Table 2: Number of turbine searches completed or remaining

Turbine	Searches completed		Searches remaining	
	Initial	Pulse	Initial	Pulse
10	24	8	0	4
7	24	11	0	1
14	24	8	0	4
18	24	11	0	1
23	24	9	0	3
25	24	8	0	4
5	24	9	0	3
15	24	6	0	6
22	24	10	0	2
26	24	8	0	4
27	24	10	0	2
2	23	9	1	3

	Searches completed		Searches remaining	
4	23	10	1	2
6	23	7	1	5
8	23	10	1	2
16	23	8	1	4
24	23	7	1	5
1	22	7	2	5
21	22	8	2	4
28	22	8	2	4
29	22	8	2	4
12	21	9	3	3
13	21	8	3	4
20	21	9	3	3
9	20	10	4	2
17	20	7	4	5
19	20	9	4	3
3	19	9	5	3
31	19	6	5	6
11	18	8	6	4
30	18	6	6	6

3.1. Powerful Owl and Super Parrot surveys

No observations of Superb Parrot or Powerful Owl breeding activity or individuals were recorded during the surveys. Areas containing nesting hollows that would support breeding of Superb Parrot and/or Powerful Owls were recorded.

As notified to the BCS as a turbine unrelated mortality, one deceased Powerful Owl was detected in woodland approximately 360 metres from Turbine 1 during October 21 transect surveys. It was also found near a tree with whitewash, and several trees with large hollows had reasonably substantial amounts of whitewash adjacent to them. No owl pellets were found at any trees however, meaning owl breeding was not confirmed to be occurring or considered to be detected.

A total of 125 hollows were detected, with 89 hollows larger than 10cm and 36 hollows larger than 20cm. No nesting behaviour or other evidence (owl pellets or whitewash) for either target species was observed (Figure 4).

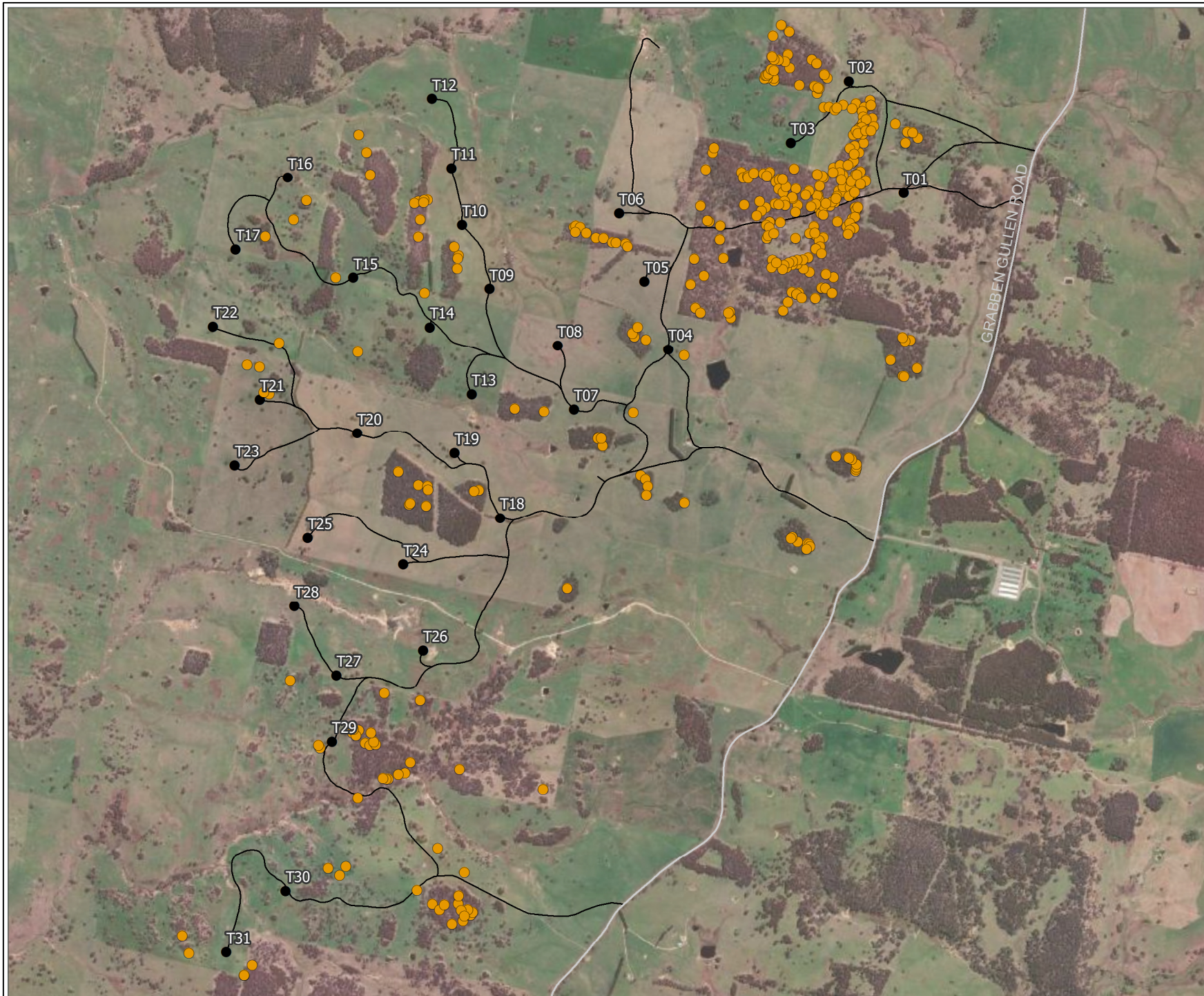
A number of incidental observations were also recorded of other species. The most common parrot species (which were observed near hollows) remain the Sulphur-Crested Cockatoo and the Crimson Rosella. Other parrots such as Galah and Australian King Parrots were observed infrequently. There were no Eastern Rosella seen on site during summer surveys. As with previous surveys, there were common passerine species observed such as the Australian Magpie, Australian Raven, Pied Currawong, and Red Wattlebird.

Two raptor species were recorded during the summer surveys. A single Black-Shouldered Kite (*Elanus axillaris*) was observed feeding in a tree near the primary entry road (leading to the main compound). A Wedge-tailed Eagle was observed SE of turbine 29 (50m from observer).

Figure 6: Hollow bearing trees at BWF

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- Proposed turbines
- Proposed access track
- Hollow bearing tree



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3.2. Operational bird utilisation surveys

A total of 95 species were recorded during the combined two survey phases. A total of 87 species were recorded at the impact survey points and 71 species at the reference survey points. Species recorded were predominantly farmland and bushland species with some records of raptors and waterbirds. The raw data will be displayed as an appendix to the BUS report. The five most common species observed at each stage of construction are shown in Table 3 below.

3.2.1. Abundance and Diversity

Table 3: Most common species at impact and reference points

Pre-construction		Post-construction	
Impact survey points	Reference survey points	Impact Survey points	Reference Survey points
Crimson Rosella	Common Starling	Sulphur-crested Cockatoo	Common Starling
Sulphur-crested Cockatoo	Raven Sp.	Little Raven	Australian Magpie
Australian Magpie	Welcome Swallow	Australian Magpie	Little Raven
Yellow-rumped Thornbill	Crimson Rosella	Common Starling	Sulphur-crested Cockatoo
Buff-rumped Thornbill	Australian Magpie	Crimson Rosella	Yellow-rumped Thornbill

The total number of birds observed during pre-construction phase was 7852, dropping substantially in the operational phase to 2615. Highly significant differences were observed in the results of a MANOVA test between stages of construction (abundance and diversity as dependent variables) (Table 4). The main effect of construction stage is statistically significant and has a large effect size ($F(1, 280) = 27.23$, $p < .001$; η^2 (partial) = 0.16, 95% CI [0.10, 1.00])

Table 4: Results from MANOVA test on Abundance and Diversity by Construction stage

	Df	Pillai	approx F	num DF	den DF	Pr(>F)
Stage	1	0.1633	27.227	2	279	1.579e-11
Residuals	208					

The results in Table 5 reveals that while there is no significant difference in the diversity of species at survey points between construction stages, there is a significant difference in bird abundance Table 6. The main effect of construction stage is statistically significant and medium effect size ($F(1, 280) = 38.03$, $p < .001$; $\eta^2 = 0.12$, 95% CI [0.07, 1.00])

Table 5: Results from ANOVA test on species diversity by stage of construction

	Df	Sum sq	Mean Sq	F value	Pr(>F)
Stage	1	35	34.70	2.348	0.127
Residuals	280	4138	14.78		

Table 6: Results from ANOVA test on species abundance by stage of construction

	Df	Sum sq	Mean Sq	F value	Pr(>F)
Stage	1	121.1	121.08	38.03	2.43e-09
Residuals	280	891.4	3.18		

3.2.2. Flight Heights

A chi-squared test for given probabilities was performed to analyses the flight height categories in all data (pre and post-construction combined), pre and post-construction. The results show that the data are not normally distributed, with a significant difference observed in each test (Table 7). Further investigation shows that the vast majority of species recorded fly below RSA height (Figure 5).

Table 7: Results from chi-squared test for given probabilities on flight height categories

Treatment	X-squared	Df	p-value
All data, both stages	18012	2	<0.001
Pre-construction	5025.9	1	<0.001
Post-construction	1296.5	1	<0.001

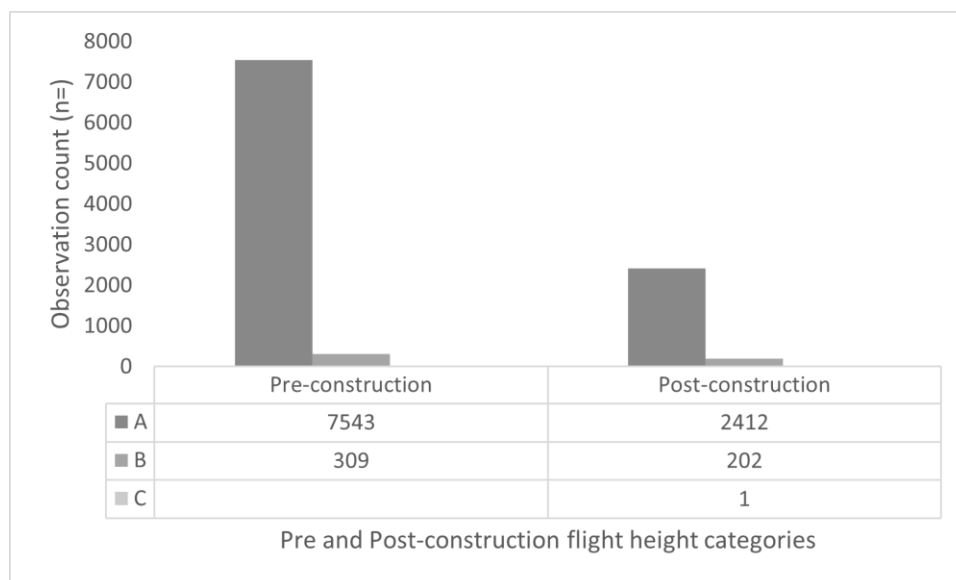


Figure 5: Flight height categories between pre and post construction at BWF

The five most common bird species flying at RSA heights are displayed in Table 8 below. In both pre and post construction phases, the Sulphur-crested Cockatoo was the most frequently recorded species flying at RSA. The species recorded flying at RSA are commonly fly at these heights, except for the Yellow-faced Honeyeater. It would be uncommon to see this species flying at RSA, and it is not likely to be at risk of turbine strike. The Wedge-tailed Eagle increased in the number of observations in the post construction phase. This species is commonly observed flying at this and greater heights on wind farms in NSW and is considered an at risk species.

Table 8: The five most common species flying at RSA heights, pre and post construction at BWF

Pre-construction	Post-construction
Sulphur-crested Cockatoo	Sulphur-crested Cockatoo
Raven. sp	Wedge-tailed Eagle
Nankeen Kestrel	Australian Raven
Galah	Galah
Yellow-faced Honeyeater	Rainbow Bee-eater

3.2.3. Threatened species

There were 57 records of threatened species across the pre and post construction phases, with 2 in pre-construction and 55 in post. These records consisted of three species.

Dusky Woodswallow (n=2)

Vulnerable under the BC Act. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and groundcover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland (Menkhorst *et al.*, 2017). Aerial foraging behaviour by this species places the

species at risk of turbine collision. No breeding behaviour has been observed on site. All observations were recorded pre-construction.

Scarlet Robin (n=4)

Vulnerable under the BC Act. The Scarlet Robin lives in open forests and woodlands in Australia. During winter, it visits more open habitats, such as grasslands, and can be seen in farmland and urban parks and gardens at this time (Higgins and Peter, 2002). This species forages on the ground or in the low branches of trees so would not fly at RSA heights. Nature Advisory has observed this species remaining on wind farm sites after turbines commence operation. All observations were recorded in post-construction.

White-fronted Chat (n=51)

This species inhabits open country, grasslands and low shrublands especially open wetlands and low fringing vegetation across southern Australia including southern NSW (Higgins et al. 2006; OEH 2021). The species has been recorded at several other wind farms in NSW, Victoria and South Australia by Nature Advisory, indicating a tolerance of operating wind turbines. It is unlikely to be affected by turbine collision as it rarely flies high enough, being a ground-feeding bird. All observations were recorded in post-construction.

3.3. Scavenging trials

The scavenger trial data was collected between September to November 2022, and February to April 2023. A total of 19 bats or bat proxies were deployed (sufficient bat carcasses could not be sourced early in the trials) and 21 bird carcasses (Table 9). Of the bird carcasses, seven were classed as large and the remainder as medium. This is due to insufficient carcass available to undertake the trials. Most carcasses collected during mortality searches were not suitable for scavenging trials due to decomposition and as such, the bulk of bird carcasses used were sourced from Myna and Starling control groups.

A further 10 failed attempts to capture data also occurred, due to equipment failure (not included below), resulting in lost carcasses and further contributing to differences from BBAMP requirements. It is likely that bird data will be aggregated, and it is not expected that not achieving the exact required number of carcasses and sizes outlined in the BBAMP will affect mortality estimates in a significant way.

3.4. Detectability trials

A detectability trial was undertaken during April 2022 with Searcher 1 detecting 60% of birds and 40% of bats and Searcher 2 detecting 80% of birds and bats.

During the second detectability trial in July 2022; Searcher 1 detected 70% of both birds and bats and Searcher 2 detecting 80% of birds and 90% of bats.

Table 10 provides results below.

Table 9: Scavenging trial results for BWF

Date Deployed	Turbine No.	Carcass type	Species	Date scavenged	Scavenger species	# days
12/09/2022	1	Large bird	Australian Magpie	Not scavenged	Not captured	>30
12/09/2022	13	Bat proxy	Mouse	20/09/2022	Red Fox	8
12/09/2022	24	Bat proxy	Mouse	20/09/2022	Raven sp.	8
12/09/2022	26	Bat proxy	Mouse	16/09/2022	Australian Magpie	4
12/09/2022	27	Bat proxy	Mouse	Not scavenged	NA	>30
12/09/2022	3	Large bird	Australian Magpie	Not scavenged	NA	>30
12/09/2022	14	Large bird	Australian Magpie	13/09/2022	Red Fox	1
12/09/2022	18	Medium bird	Collared Sparrowhawk	13/09/2022	Raven sp.	1
12/09/2022	25	Large bird	Australian Magpie	13/09/2022	Brow Goshawk/Collared sparrowhawk	1
17/10/2022	26	Bat proxy	Mouse	22/10/2022	Not captured	5
17/10/2022	27	Bat proxy	Mouse	18/10/2022	Laughing kookaburra	1
17/10/2022	3	Medium bird	Common Myna	22/10/2022	Not captured	5
17/10/2022	2	Medium bird	Common Myna	20/10/2022	Brown Goshawk	3
17/10/2022	1	Medium bird	Common Myna	18/11/2022	Australian Raven	<1
18/10/2022	24	Bat proxy	Mouse	19/10/2022	Not captured	1
18/10/2022	18	Large bird	Australian Magpie	19/10/2022	Red Fox	1
18/10/2022	25	Large bird	Australian Magpie	20/10/2022	Red Fox	2
20/10/2022	14	Bat proxy	Mouse	21/10/2022	Red Fox	1
20/10/2022	13	Medium bird	Common Myna	20/10/2022	Australian Raven	<1
16/11/2022	14	Bat	White-striped Freetail Bat	18/11/2022	Australian Raven	2
16/11/2022	18	Bat	White-striped Freetail Bat	16/11/2022	Australian Raven	<1
16/11/2022	27	Bat	White-striped Freetail Bat	17/11/2022	Australian Raven	<1
17/11/2022	3	Bat proxy	Mouse	17/11/2022	Australian Magpie	<1
17/11/2022	2	Bat proxy	Mouse	17/11/2022	NA	<1
17/11/2022	13	Bat proxy	Mouse	18/11/2022	Australian Magpie	1

Date Deployed	Turbine No.	Carcass type	Species	Date scavenged	Scavenger species	# days
17/11/2022	28	Bat	White-striped Freetail Bat	17/11/2022	Red Fox	<1
24/02/2023	27	Bat	Microbat sp.	Not scavenged	NA	>30
24/02/2023	25	Bat	Chocolate Wattled Bat	25/02/2023	Red Fox	1
24/02/2023	13	Bat	Microbat sp.	24/02/2023	Australian Magpie	<1
24/02/2023	3	Medium bird	Common Myna	25/02/2023	Red Fox	<1
28/03/2023	4	Medium bird	Common Myna	9/04/2023	Red fox	12
28/03/2023	6	Medium bird	Common Myna	28/03/2023	Rat sp.	<1
28/03/2023	6	Medium bird	Common Myna	28/03/2023	Rat sp.	<1
12/04/2023	6b	Bat proxy	Mouse	12/04/2023	Red Fox	<1
12/04/2023	5	Medium bird	Common Myna	16/04/2023	Red Fox	4
12/04/2023	6	Medium bird	Common Myna	13/04/2023	Not captured	1
13/04/2023	4	Large bird	Australian Magpie	16/04/2023	Red Fox	3
19/04/2023	4	Medium bird	Common Starling	20/04/2023	Raven sp.	2
19/04/2023	6	Medium bird	Common Myna	20/04/2023	Rat sp.	1
19/04/2023	6	Medium bird	Common Starling	20/04/2023	Rat sp.	1

Table 10: Detectability trials undertaken at BWF indicating the percentage of birds and bats detected.

April 2022 trial						July 2022 trial					
Searcher	Date	Turbine	No. of Birds found	No. of Bats found	Total	Searcher	Date	Turbine	No. of Birds found	No. of Bats found	Total
Searcher 1	27/04/2022	19	1/2	3/3	4/5	Searcher 1	18/07/2022	10	1/2	2/3	3/5
	28/04/2022	12	1/2	0/3	1/5		19/07/2022	14	2/3	2/2	4/5
	28/04/2022	14	2/3	0/2	2/5			4	2/3	1/2	3/5
	29/04/2022	7	2/3	1/2	3/5			6	2/2	2/3	4/5
		Total	6/10	4/10	10/20			Total	7/10	7/10	14/20
		Percentage	60%	40%	50%			Percentage	70%	70%	70%
Searcher 2	27/04/2022	20	2/2	3/3	5/5	Searcher 2	18/07/2022	9	2/2	3/3	5/5
	28/04/2022	9	3/3	2/2	5/5		19/07/2022	13	2/3	2/2	4/5
	28/04/2022	11	0/2	2/3	2/5			15	2/2	2/3	4/5
	29/04/2022	8	3/3	1/2	4/5			5	2/3	2/2	4/5
		Total	8/10	8/10	16/10			Total	8/10	9/10	17/20
		Percentage	80%	80%	80%			Percentage	80%	90%	85%

3.5. Preoperational carcass searches

Table 11 below displays the results from the pre-operational carcass monitoring. Mortalities included eight species from two microbats and six birds. No threatened species were detected.

Finds from pre-operational surveys are not included in formal mortality data, which is used to make mortality estimates, and are considered incidental.

Table 11: Pre-operational carcass search results

Date	Common Name	Scientific Name	Carcass type	*Find Reference	Turbine number	Distance from turbine (m)	Bearing from turbine (°)
25/11/2020	Nankeen Kestrel	<i>Falco cenchroides</i>	Carcass	C.20.11.1	18	29	132
25/11/2020	Brown Falcon	<i>Falco berigora</i>	Carcass	C.20.11.2	19	38	340
11/01/2021	White-striped Freetail Bat	<i>Austronomus australis</i>	Carcass	C.21.01.1	23	45	230
12/01/2021	Galah	<i>Eolophus roseicapilla</i>	Feather spot	FS.21.01.1	22	97	135
12/01/2021	Nankeen Kestrel	<i>Falco cenchroides</i>	Feather spot	FS.21.01.2	7	47	30
12/01/2021	Tree Martin	<i>Petrochelidon donigricans</i>	Carcass	C.21.01.2	5	47	170
12/01/2021	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	Carcass	C.21.01.3	5	9	0
12/01/2021	Singing Bushlark	<i>Miraafra javanica</i>	Carcass	C.21.01.4	5	16	20
14/01/2021	Crimson Rosella	<i>Platycercus elegans</i>	Carcass	C.21.01.5	18	24	350
17/02/2021	White-striped Freetail Bat	<i>Austronomus australis</i>	Carcass	C.21.02.1	18	54	ENE
18/02/2021	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	Carcass	C.21.02.2	12	51	55
18/02/2021	White-striped Freetail Bat	<i>Austronomus australis</i>	Carcass	C.21.02.3	14	58	NNW

3.6. Operational carcass searches

In the 24 months of monitoring at BWF, a total of 146 bird and bat carcasses were detected. This total consisted of 55 bird carcasses, including five incidental finds, 43 feather spots, and 46 bat carcasses. Table 12 and Figure 6 displays mortalities on a consecutive monthly basis. Detailed raw data of the carcass searches, including species, for the 24-month period is shown in Appendix 2.

Table 12: BWF bird and bat mortality

Year	Season	Month	Birds (incl. Feather Spots)	Bats	Total mortalities
Year 1	Autumn	March	2	5	7
		April	2	0	2
		May	5	0	5
	Winter	June	1	0	1
		July	0	0	0
		August	0	0	0
	Spring	September	1	0	1
		October	5	1	6
		November	3	0	3
	Summer	December	3	1	4
		January	4	2	6
		February	5	12	17
Year 2	Autumn	March	1	0	1
		April	4	4	8
		April	0	3	3
		May	3	1	4
	Winter	June	2	0	2
		July	7	0	7
		August	7	0	7
		August	1	0	1
	Spring	September	6	1	7
		October	7	2	9
		November	5	1	6
		November	1	0	1
	Summer	December	6	0	6
		January	6	2	8
		February	3	8	11
Year 3	Autumn	March	2	3	5
		April	2	3	5
		May	2	0	2
	Winter	June	1	0	1
Totals			97	49	146

Incidental finds are included separately as grey rows.

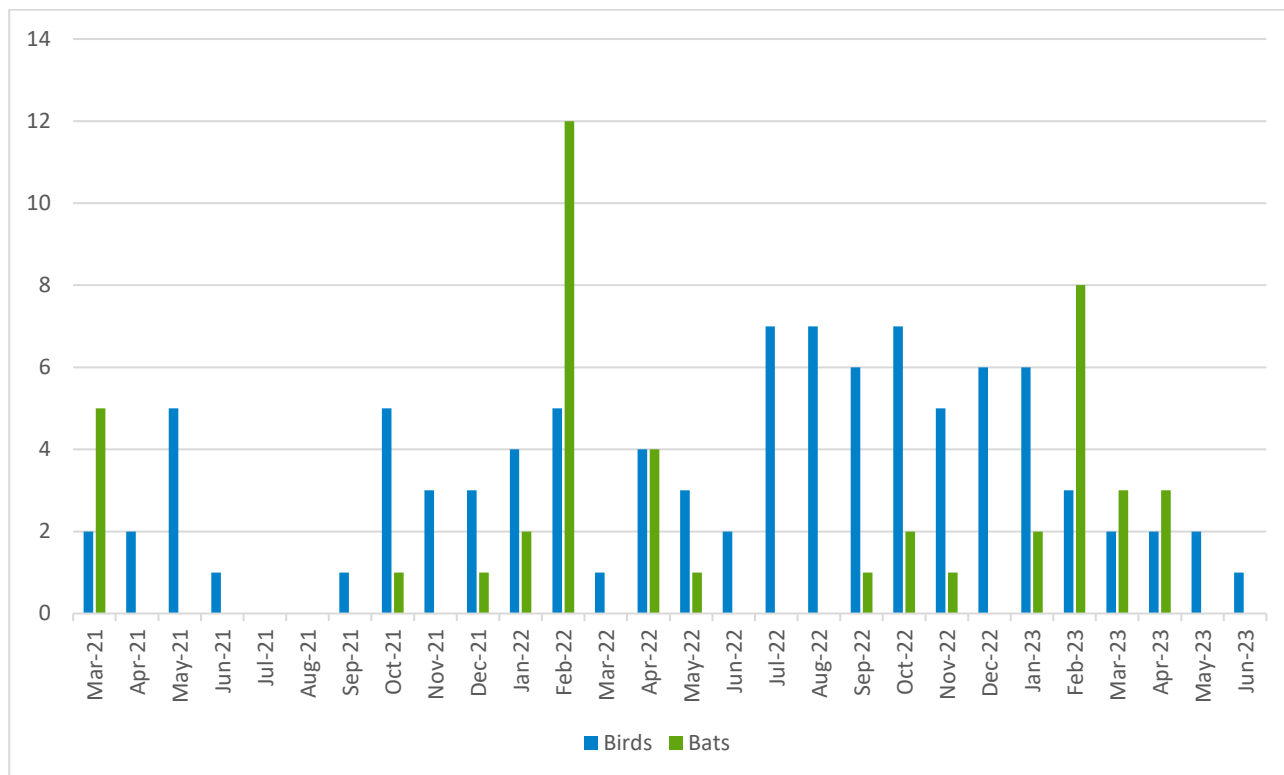


Figure 6: Breakdown of monthly bat and bird mortalities across the 24-month monitoring period. Incidental records have been excluded.

3.6.1. Bird mortality

A total of 98 bird strikes were recorded within the BWF site during the 24-month monitoring. A total of 22 different species were detected, including one not possible to identify the species due to the decomposed state. Detected bird mortality at BWF is summarised in Table 13 below, with species listed in ranked order of the number of carcasses found. Detailed information on each bird carcass and feather spot recorded during the monitoring period can be found in Appendix 2.

The highest mortality recorded was observed for Australian Magpie (24.5%), Crimson Rosella (19.4%), Nankeen Kestrel (10.2%) and Sulphur Crested Cockatoo (10.2%). Other species consisted of 5% of mortalities or less. No threatened species were detected during carcass searches.

During the first 12 months of monitoring, a total of 31 bird mortalities were detected, and 64 in the second. This appears to indicate a difference annually between the two years. The second year included 19 different bird species while the first included 10. So, the second year saw an increase in species diversity and numbers of impacts. Many Nankeen Kestrels were also included in the second year of monitoring.

There is also season variation, but this does not appear to be consistent. Winter saw very little impacts during the first year while some of the highest impacts occurred in winter during the second.

Table 13: Bird mortality recorded at Biala Wind Farm during the 24-month monitoring period

Common Name	Scientific Name	Carcass	Feather Spot	Incidental	Total	% of total
Australian Magpie	<i>Cracticus tibicen</i>	15	8	1	24	24.5
Crimson Rosella	<i>Platycercus elegans</i>	1	17	1	19	19.4
Nankeen Kestrel	<i>Falco cenchroides</i>	9	1		10	10.2
Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	2	8		10	10.2
Black-shouldered Kite	<i>Elanus axillaris</i>	5			5	5.1
Unidentified bird sp.	NA	3	2		5	5.1
Brown Goshawk	<i>Accipiter fasciatus</i>	4			4	4.1
Australian Wood Duck	<i>Chenonetta jubata</i>	1	1		2	2.0
Common Starling	<i>Sturnus vulgaris</i>	2			2	2.0
Galah	<i>Eolophus roseicapillus</i>		2		2	2.0
Grey Fantail	<i>Rhipidura albiscapa</i>	2			2	2.0
Laughing Kookaburra	<i>Dacelo novaeguinea</i>	2			2	2.0
Little Corella	<i>Cacatua sanguinea</i>		2		2	2.0
Australian Ibis	<i>Threskiornis moluccus</i>		1		1	1.0
Brown Falcon	<i>Falco berigora</i>	1			1	1.0
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	1			1	1.0
Grey Currawong	<i>Strepera versicolor</i>		1		1	1.0
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	1			1	1.0
Spotted Pardalote	<i>Pardalotus punctatus</i>	1			1	1.0
Tawny Frogmouth	<i>Podargus strigoides</i>	1			1	1.0
Wedge-tailed Eagle	<i>Aquila audax</i>	1			1	1.0
Wille Wagtail	<i>Rhipidura leucophrys</i>	1			1	1.0
Total					98	

3.6.2. Bat mortality

A total of 44 bat strikes were recorded within the BWF site during the 24-month monitoring. Bat mortality primarily occurred during summer and autumn. Seven different species were detected (including one megabat), one species identified to family level and one species of microbats were not possible to identify due to the decomposed and damaged state of remains. Detected bat mortality at BWF is summarised in Table 14 below, with species listed in ranked order of the number of carcasses found. Detailed information on each bat carcass recorded during the monitoring period can be found in Appendix 2.

The highest mortality comprised White-striped Freetail Bat (36.4%), Chocolate Wattled Bat (15.9%), Gould's Wattled Bat (13.6%) and species identified to *Vespertilio* family level only (11.4%). The remaining species, aside from unidentifiable individuals observed below 5% mortality.

Between the two years of monitoring to date, the first 12 months saw 21 bat mortalities and 30 in the second. This does not appear to indicate a large difference in annual variation for bats, however there is a definite seasonal variation for bats, which is to be expected. Microbats in south eastern Australia tend to enter a period of torpor and become largely inactive during the cooler months, while others are thought to migrate further north. Mortality appeared to peak during February during both years.

No threatened species were detected during the 24 months of monitoring.

Table 14: Bat mortality detection at Biala Wind Farm during the first-year monitoring period

Common Name	Scientific Name	Carcass	Incidental	Total	% of total
White-striped Free tail bat	<i>Tadarida australis</i>	14	2	16	36.4
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	7		7	15.9
Gould's Wattled Bat	<i>Chalinolo busgouldii</i>	6		6	13.6
Forest Bat sp.	<i>Vespadelus sp.</i>	4	1	5	11.4
Unidentified microbat	<i>Unidentified</i>	4		4	9.1
Large Forest Bat	<i>Vespadelus darlingtoni</i>	2		2	4.5
Southern Forest Bat	<i>Vespadelus regulus</i>	2		2	4.5
Little Forest Bat	<i>Vespadelus vulturinus</i>	1		1	2.3
Little Red Flying Fox	<i>Pteropus scapulatu</i>	1		1	2.3
Total				44	

3.6.3. Impact trigger summary

One non-threatened species trigger was detected during the monitoring program to date, which is defined under the BBAMP Section 6.2 as:

“Impact Trigger for Non-threatened Species: The trigger is defined as a total of four or more bird or bat carcasses, or parts thereof, of the same species in two successive searches at the same or adjacent turbine(s) of a non-threatened species (excluding species mentioned above).”

BCS was notified of the trigger on the 23rd June 2021. The non-threatened impact trigger occurred as three Crimson Rosella carcasses were found under turbine 13 and one Crimson Rosella carcass was found under turbine 14, immediately adjacent to turbine 13 during April and May 2021.

The procedure for a trigger outlined in Section 6 of the BBAMP was followed and a desktop investigation was undertaken (Nature Advisory 2021b). The investigation concluded that while there is a possibility that further Crimson Rosella fatalities will occur at Biala Wind Farm given the species successful breeding rates and a stable population, such fatalities are unlikely to have a significant impact on the species at a local, regional or national scale, and it is considered that this trigger is likely to be a one-off event. No additional actions were recommended.

No other triggers occurred during the 24 month monitoring program so far.

3.6.4. Incidental Powerful Owl find

During further surveys on site for Superb Parrot and Powerful Owl suitable hollow investigations, a deceased Powerful Owl was detected in woodland approximately 360 metres from Turbine 1 on the 15th October 2021. BCS was notified of the find, however the find is not considered a turbine related mortality, given the distance from turbines.

Inquiries were made with multiple organisations into the possibility of a necropsy to further understand factors leading to the mortality, including with veterinarians, zoos, and universities. However; given its advanced state of decomposition, each indicated that there would be little to learn from such a procedure at that point and could not provide any analysis.

The specimen has since been handed over to BCS.

3.7. Raptor monitoring

Five raptor species have been observed flying at the BWF site during the 24-month monitoring period (Table 15). A total of 76 observations were recorded, and flight paths have been plotted and presented in Figure 7. Of these observations; 44.7% were attributed to Nankeen Kestrel and another 42.1% to Wedge-tailed Eagle making these by far the most observed raptor species on site. Of these; approximately 26% of Nankeen Kestrel observations were of individuals flying at RSA height, while Wedge-tailed Eagles were observed at RSA height approximately 84% of the time.

The remaining species (Brown Falcon, Black-Shouldered Kite, and Swamp Harrier) flight observations tended towards below RSA but several were observed occasionally at this height.

No nesting activity attributed to any raptor species was detected at the wind farm incidentally.

Table 15: Incidental raptor observations during 24 months of monitoring at BWF

Flight number	Date	Species	Species count	Start time	End time	Duration (min)	Height range of bird	Comments	Behaviour
1	26/04/2021	Wedge-tailed Eagle	2	12:05	12:10	0:05	100 - 200	Near T 12 over cleared paddock	Soaring and powered flight (flapping)
2	30/04/2021	Wedge-tailed Eagle	1	7:30	7:37	0:07	10	Near T21 over cleared paddock close to ground	Gliding
3	26/05/2021	Nankeen Kestrel	1	8:45	8:47	0:02	0-5	Near T2 over cleared/woodland, from tree	Perching and powered flight (flapping)
4	26/05/2021	Wedge-tailed Eagle	1	12:30	12:35	0:05	100 - 200	Observed from turbine 26 soaring from turbine 29-28	Soaring and powered flight (flapping)
5	27/05/2021	Wedge-tailed Eagle	1	10:40	10:45	0:05	50 - 100	Soaring over woodlands in westerly direction, chased by birds, reappeared in paddock, South of turbine 31	Soaring and Feeding
6	23/06/2021	Nankeen Kestrel	1	10:54	10:56	0:02	40 - 50	Over gully near T6	Soaring and hovering
7	23/06/2021	Nankeen Kestrel	1	12:30	12:35	0:05	30 - 40	100m from turbine 7 circling towards turbine 8	Hovering and diving
8	20/10/2021	Brown Falcon	1	16:30	16:33	0:03	May-30	Soaring in circles close to T7.	Soaring
9	20/10/2021	Nankeen Kestrel	1	12:10	12:12	0:02	15-25	Flying and hovering over ground 200 south of turbine 9, then flew south over treeline	Powered flight and hovering
10	17/11/2021	Nankeen Kestrel	1	10:50	10:55	0:05	15-25	Flew across road near compound while I was driving to T7, perched for several min on tree ~15 m high.	Powered flight and perching
11	18/11/2021	Nankeen Kestrel	1	13:07	13:08	0:01	20-30	Flew across the road on the way to T26	Powered flight and gliding
12	14/12/2021	Wedge-tailed Eagle	1	10:37	10:38	0:01	50-70	Seen flying NW away from zoologist, along main road between site office and Lachlan Valley Way	Soaring, Powered Flight
13	20/01/2022	Wedge-tailed Eagle	2	15:50	15:53	0:03	40-70	Two circling 200 m and 180 degrees S of T20.	Soaring
14	24/02/2022	Wedge-tailed Eagle	1	10:49	10:53	0:04	150	Circling 280 degrees W and 1km away from T31	Soaring

Flight number	Date	Species	Species count	Start time	End time	Duration (min)	Height range of bird	Comments	Behaviour
15	25/02/2022	Wedge-tailed Eagle	1	11:00	11:01	0:01	40-70	Flew from just W of T16, across hardstand and to the E, then flew SW toward T17	Powered flight and soaring
16	31/03/2022	Nankeen Kestrel	1	15:25	15:26	0:01	20-30	Seen at T8, hovering. Flew SE to T9. Flew E beyond treeline.	Hovering, powered flight
17	31/03/2022	Wedge-tailed Eagle	1	12:38	12:40	0:02	30-70	Seen 300m W of T10, flew S beyond treeine	Gliding
18	6/04/2022	Black-shouldered Kite	1	9:19	9:20	0:01	Oct-40	Seen just NW of road between 16 and 17. Picture taken on map. Flew NW, then perched on tree just by road eating prey. Then flew NW to trees.	Gliding, Perching, Eating
19	6/04/2022	Black-shouldered Kite	2	13:58	14:01	0:03	0 - 30	E of road on way to 26 just before bend. Flew E	Hovering, powered flight, and hunting
20	6/04/2022	Wedge-tailed Eagle	2	16:07	16:09	0:02	100-200	Soaring 1 km W of T25.	Soaring
21	7/04/2022	Nankeen Kestrel	1	11:05	11:12	0:07	Dec-15	Perched on tree then flew S, perched on another tree south of T2.	Perching, powered flight
22	7/04/2022	Wedge-tailed Eagle	2	14:05	14:06	0:01	13-18	Chased by falcon north of T5.	Powered flight
23	8/04/2022	Wedge-tailed Eagle	1	12:27	12:27	0:00	15-30	Chased by magpie above woodlands N of T4, flying E then perched on tree in woodlands	Gliding, perching
24	28/04/2022	Nankeen Kestrel	1	12:48	12:52	0:04	30 - 60	Hovering near T24.	Powered flight and hovering.
25	18/05/2022	Nankeen Kestrel	1	13:04	13:08	0:04	0 - 60	Hovering NE of road between T27 and T28, swooped to ground, then flew past tree to N	Hovering, hunting, powered flight
26	18/05/2022	Wedge-tailed Eagle	2	9:44	9:48	0:04	40 - 150	Two eagles in the distance flying over a woodland patch S of T26.	Soaring, powered flight
27	19/05/2022	Nankeen Kestrel	1	13:15	13:16	0:01	25-35	Crossed the road between T11 and T12 flying east over woodland patch.	Gliding
28	19/05/2022	Wedge-tailed Eagle	1	14:30	14:30	0:00	130-130	Gliding near T16.	Gliding.
29	21/06/2022	Wedge-tailed Eagle	1	13:30	13:35	0:05	80-100	Near T21 and 20	gliding
30	22/06/2022	Nankeen Kestrel	1	10:45	10:46	0:01	20-30	Neat T20	circling

Flight number	Date	Species	Species count	Start time	End time	Duration (min)	Height range of bird	Comments	Behaviour
31	23/06/2022	Black-shouldered Kite	1	14:21	14:22	0:01	40-60	Direct flight over cleared paddock	flapping
32	23/06/2022	Brown Falcon	1	14:00	14:15	0:15	30-60	near T6	Hovering, powered flight
33	23/06/2022	Nankeen Kestrel	1	13:35	13:45	0:10	0-20	Near T28	Foraging
34	23/06/2022	Nankeen Kestrel	1	14:40	14:45	0:05	5 to 20	Near T28	Bird is flapping
35	23/06/2022	Wedge-tailed Eagle	1	12:30	12:35	0:05	50-100	Between T 2 and 3	powered flight
36	23/06/2022	Wedge-tailed Eagle	2	14:35	14:43	0:08	20-80	Direct flight over ridge	powered flight
37	24/06/2022	Wedge-tailed Eagle	2	11:00	11:46	0:46	80-110	Near T24	Gliding
38	15/08/2022	Wedge-tailed Eagle	1	15:28	15:28	0:00	80-110	None	Gliding
39	16/08/2022	Nankeen Kestrel	1	14:02	14:02	0:00	0-10	None	Powered (flapping) flight
40	16/08/2022	Wedge-tailed Eagle	1	9:40	9:41	0:01	80 -110	None	Gliding
41	17/08/2022	Nankeen Kestrel	1	13:51	13:51	0:00	20- 50	None	Powered (flapping) flight
42	17/08/2022	Wedge-tailed Eagle	1	11:48	11:58	0:10	100 -110	None	Soaring
43	18/08/2022	Nankeen Kestrel	1	11:28	11:34	0:06	20	None	Resting
44	18/08/2022	Unknown	1	12:31	12:31	0:00	20-30	None	Powered (flapping) flight
45	18/08/2022	Wedge-tailed Eagle	1	12:27	12:30	0:03	50-100	None	Gliding
46	5/09/2022	Nankeen Kestrel	2	13:29	13:33	0:04	0-20	Flew on right side of road toward T13, then looped around tubrine to other side of road and then headed W.	Powered (flapping) flight
47	5/09/2022	Nankeen Kestrel	1	13:33	13:33	0:00	Oct-25	Along slope	Hovering
48	6/09/2022	Nankeen Kestrel	1	12:55	12:55	0:00	Dec-15	Along ridge	Hovering
49	6/09/2022	Nankeen Kestrel	2	9:27	9:29	0:02	50-80	Heading toward compound. fieldmaps observation global ID {3EBE50FF-64A8-48EF-AFCE-87DBC08C9CC4}	Soaring
50	6/09/2022	Nankeen Kestrel	1	10:45	10:45	0:00	15 - 19	Along slope	Gliding
51	6/09/2022	Nankeen Kestrel	1	12:45	12:45	0:00	Oct-15	Over valley	Foraging (hunting)
52	7/09/2022	Nankeen Kestrel	1	14:02	14:06	0:04	Dec-18	Along slope	Gliding

Flight number	Date	Species	Species count	Start time	End time	Duration (min)	Height range of bird	Comments	Behaviour
53	7/09/2022	Wedge-tailed Eagle	1	12:32	12:36	0:04	100 - 200	Along slope	Soaring
54	8/09/2022	Black-shouldered Kite	1	11:55	12:00	0:05	Aug-15	Along slope	Powered (flapping) flight
55	8/09/2022	Nankeen Kestrel	1	15:02	15:03	0:01	30 - 30	Hovering right near main gate leaving site	Hovering
56	9/09/2022	Nankeen Kestrel	1	12:40	12:41	0:01	Dec-18	Over valley	Foraging (hunting)
57	9/09/2022	Nankeen Kestrel	1	13:10	13:12	0:02	Dec-15	Along ridge	Soaring
58	17/10/2022	Nankeen Kestrel	1	13:41	13:45	4:00	Oct-30	Nk is hovering, foraging over longer grassed area.	Foraging (hunting)
59	17/10/2022	Nankeen Kestrel	1	14:11	14:11	0:00	10-Dec	Nk crossed the track at the end of the hard stand, then headed towards T29's gate	Gliding
60	19/10/2022	Nankeen Kestrel	1	10:02	10:15	13:00	20	Along ridge	Resting
61	19/10/2022	Nankeen Kestrel	1	10:25	10:28	3:00	Dec-90	Along ridge	Displaying
62	19/10/2022	Nankeen Kestrel	1	11:25	11:28	3:00	20-80	NK returned to perch after interacting with other NK	Displaying
63	20/10/2022	Swamp Harrier	1	12:49	12:50	1:00	25-29	Along ridge	Powered (flapping) flight
64	14/12/2022	Nankeen Kestrel	2	11:45	11:50	0:05	30-40	Over plains	Hovering
65	10/02/2023	Wedge-tailed Eagle	2	9:45	9:50	0:05	50-70	Near T31, circling then out of site	Circling
66	10/02/2023	Wedge-tailed Eagle	1	10:45	10:50	0:05	20-30	Chased by magpie then circling. Near T3	Chased, circling
67	13/02/2023	Wedge-tailed Eagle	1	12:20	12:25	0:05	20-30	Juvenile, resting on power pole wires, near T24	Resting, powered (flapping) flight
68	9/03/2023	Brown Falcon	1	11:28	11:33	0:05	20-40	flew from near T24 towards T19, over woodland	Soaring and flapping
69	9/03/2023	Wedge-tailed Eagle	1	10:03	10:05	0:02	100-120	flew away from T28, soaring over woodland, adult	Soaring
70	10/03/2023	Wedge-tailed Eagle	1	10:17	10:20	0:03	100-120	flew between T24 and T26 and moved towards T27	Soaring and Circling
71	29/03/2023	Wedge-tailed Eagle	1	13:23	13:28	5:00	20 - 40	Flying through and above woodland west of T4. Eventually perched on tree	Soaring, gliding, perched

Flight number	Date	Species	Species count	Start time	End time	Duration (min)	Height range of bird	Comments	Behaviour
72	29/03/2023	Wedge-tailed Eagle	4	13:46	14:00	14:00	20 - 140	Multiple WTE flying from trees to open plains, two observed swooping each other. West of T4 & T5	Soaring, gliding, circling
73	18/04/2023	Nankeen Kestrel	1	15:58	16:03	0:05	003-30	Resting on road gate, then flew over field	Powered hovering
74	21/04/2023	Black-shouldered Kite	1	16:00	16:05	0:05		Over plains	Powered, hovering
75	26/04/2023	Wedge-tailed Eagle	1	12:55	13:00	0:05	70-90	Circling T26	Circling, soaring
76	26/04/2023	Wedge-tailed Eagle	2	15:11	15:14	0:03	50-80	East of T05 (W of T01)	Circling

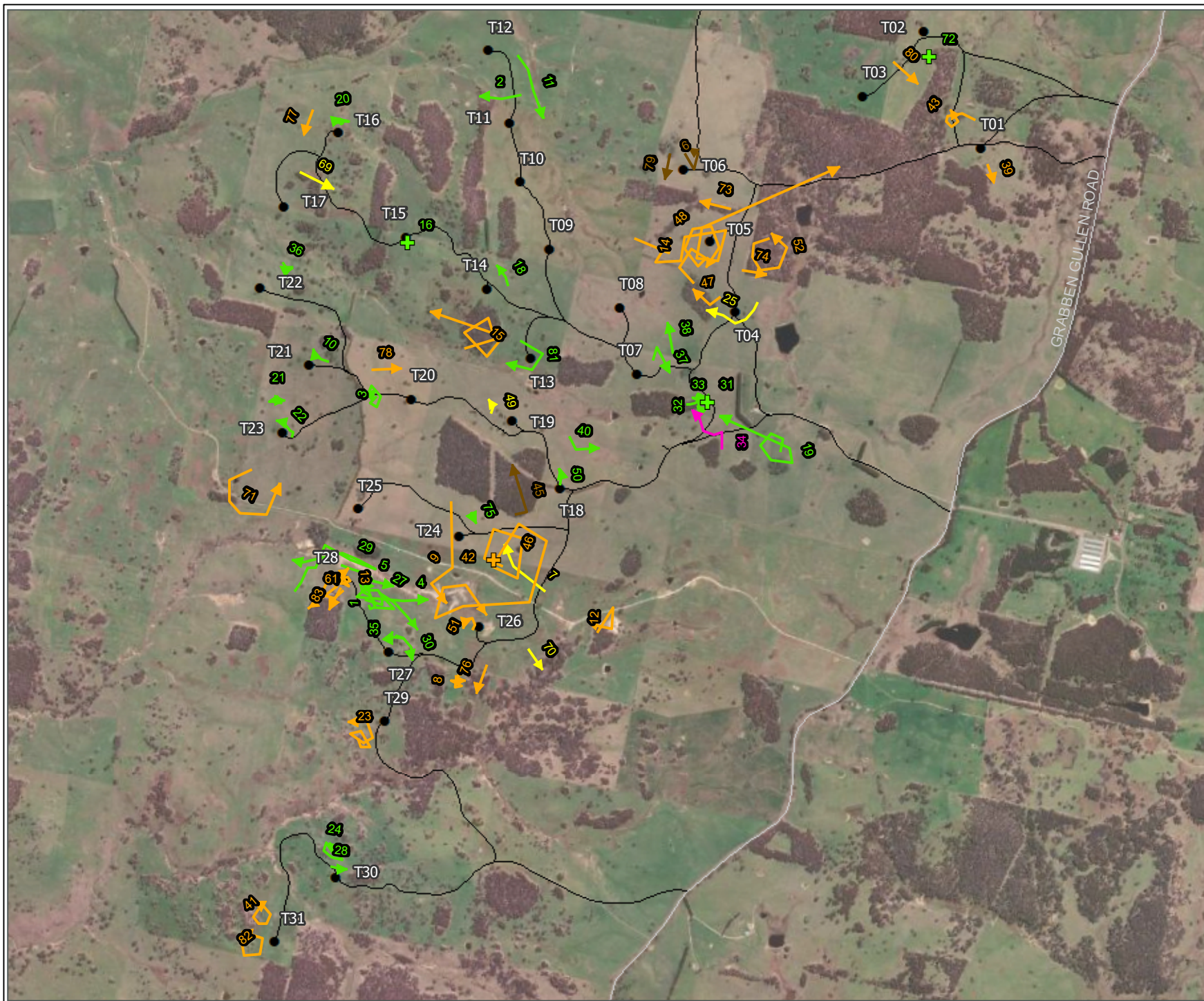


Figure 5: Incidental raptor flight paths to April 2023

Project: Biala Wind Farm
Client: Beijing Jingneng Clean Energy (Hong Kong) Co. Limited
Date: 21/07/2023

- Proposed turbines
- Proposed access track
- Perched observations**
 - ✚ Nankeen Kestrel
 - ✚ Wedge-tailed Eagle
- Flight path observations**
 - ➡ Black-shouldered Kite
 - ➡ Brown Falcon
 - ➡ Nankeen Kestrel
 - ➡ Swamp Harrier
 - ➡ Wedge-tailed Eagle



Metres
 0 400



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3.8. Carrion removal and pest control

BWF indicated that landholders on site undertake Fox baiting during winter (but not always) or shoot on site if possible/safe to do so. No rabbit control has been implemented or required.

A record of carrion removal has not be kept for specific carrion removal events. BWF indicated that site management will inform landholders who will attempt to remove carrion from within 200m of turbines within 24 hours.

4. Discussion and recommendations

The BBAMP unacceptable impacts definition (BBAMP Section 6) considers how species have been impacted at BWF in relation to the bio-regional population. The bioregion that includes BWF is the South Eastern Highlands (NPWS 2003).

Statistical estimates of mortality have yet to be undertaken. Once the mortality program is complete, estimated numbers will further inform species impacts and the below discussion and recommendations will be revisited.

4.1. Birds

The highest impacts observed for bird species were of Australian Magpie, Crimson Rosella, Nankeen Kestrel and Sulphur Crested Cockatoo, which together made up over 65% of detected mortalities. Each of these are common and widespread species in south eastern Australia, and to farmland environments. None have had populations quantified but all are considered as 'least concern' in terms of their threatened status (BirdLife International 2023). Sulphur Crested Cockatoo and Australian Magpie population trends are thought to be decreasing while Crimson Rosella and Nankeen Kestrel are increasing (BirdLife International 2023). It is not expected that any direct impacts detected on the species identified from BWF to date would affect the viability of the population in the bioregion.

A non-threatened impact trigger occurred for Crimson Rosella, and indeed it has continued to have some of the highest impacts on site. The numbers of identified hollows on site (Section 3.1) would provide suitable breeding opportunities for the species on site, which might account for their high numbers and mortalities at BWF. Given its common occurrence throughout the bioregion and high breeding success rates (up to 2.2 per nest (Higgins 1999)) despite its probable population decline nationally, it is unlikely that the impacts observed to date would indicate a reduction in population viability in the bioregion due to collisions at BWF.

It is not expected that the remainder of the impacted bird species, which are all common and widespread throughout south eastern Australia, would be significantly impacted at any population scale. This is due to the comparatively low numbers of the mortalities observed and secure population status of each.

4.2. BUS

In comparison to the mortality results; operational BUS indicated that the most common species utilising site were Sulphur-crested Cockatoo, Little Raven, Australian Magpie, Common Starling and Crimson Rosella. Meanwhile, the most commonly observed species flying at RSA height were Sulphur-crested Cockatoo, Wedge-tailed Eagle, Australian Raven, Galah and Rainbow Bee-eater (the latter being due to a single large flock passing through the site on a single occasion).

Sulphur-crested Cockatoo, Australian Magpie and Crimson Rosella were highly abundant and also formed the highest proportion of mortalities. However, Wedge-tailed Eagle, Australian Raven and Galah were observed exhibiting risk behaviour most commonly (excluding Cockatoo) and had very low mortality. This is surprising as Wedge-tailed Eagle is frequently a high mortality at wind farms in south-eastern Australia. Nankeen Kestrel also made up a high proportion of mortality but was not among the most frequently observed species or risk behaviours.

These findings support the utility of carcass searches to support risk assessments and inform species impacts on site, as it may be the case that some species behaviour may change in the presence of operating turbines. Species typically flying at RSA, such as Galah, for example may avoid turbines and not present as frequent mortality. And other risks to groups such as raptors may not be reflected by their abundance on site given their propensity to fly at RSA.

The BUS does indicate that a significant majority of species and individuals in general at BWF fly below RSA, and this is reflected in mortality results where most woodland species for example, had very little or no mortality.

Detected threatened species in the BUS continue to utilising the site with far more observations occurring during post construction than pre. These consisted of Dusky Woodswallow, Scarlet Robin and White-fronted Chat. All of these are generally woodland species that would be highly unlikely to fly at RSA. No Superb Parrots were observed during BUS.

Operational BUS indicates that diversity of species remains the largely same in comparison with pre construction, however, it also indicates that abundance of species is significantly lower during post construction. The reasons for this are not clear, as both operational BUS were undertaken during the first year of operation, it is highly unlikely that mortality impacts would be evident after a few months of operation, or to this extent. It is possible that the operation in general of BWF has impacted species utilisation of the site.

4.3. Raptors

During 2018 raptor surveys (Nature Advisory 2021a), 11 raptor species were observed, including; Wedge-tailed Eagle, Nankeen kestrel, Brown Falcon, Brown Goshawk, Black Shouldered Kite, Collared Sparrowhawk, Swamp Harrier, Australian Hobby, Little Eagle, Black Falcon, and Peregrine Falcon. Pre-construction BUS surveys observed a further species; Whistling Kite. The BBAMP identified these as an 'at-risk' ground in general. No further species have been identified.

The mortality monitoring detected six of these species as mortalities, including Nankeen Kestrel (10), Black-shouldered Kite (5), Brown Goshawk (4), Brown Falcon (1), Collared Sparrowhawk (1) and Wedge-tailed Eagle (1). Nankeen Kestrel was the most frequently observed raptor utilising the site during incidental raptor monitoring, and while tended to be observed flying below RSA, it evidentially frequently exhibits risk behaviours that lead to collision. They are known to collide with turbines frequently in south east Australia (Moloney *et. al.* 2019, Symbolix 2022) often making up a high proportion of the mortality.

During targeted raptor surveys undertaken in 2018, Nankeen Kestrel was one of the most frequently observed raptors during Spring but then was only observed a few times during winter and not at all during autumn. This may be reflected in the mortality data wherein most mortalities were detected during spring and summer, with only one other mortality occurring during winter, indicating some seasonality of impacts. Nankeen breeding takes place generally in autumn and so may spikes in mortality during spring and summer may be related to dispersing juveniles.

Many raptors, including Nankeen Kestrel, are known to respond to mouse plague events by producing large numbers of offspring (Hobbs 1971). Given the amount of rain in eastern Australian over the last several years, there has been several mouse plagues recorded, especially in NSW and Qld (DAFF 2023) during 2021 and 2022. Once a mouse plague has dispersed, so too will the Nankeen Kestrels that have bred in response and numbers are likely to increase in the surrounding regions. Nankeen Kestrels are known to be partly migratory and juveniles will disperse widely (Marchant & Higgins 1993). It is possible that favourable breeding conditions have increased the populations of Nankeen Kestrels which may account for the higher number of mortalities observed in the second year as opposed to the first, and the relatively high mortality compared with other raptors and observations. It is unlikely that impacts detected so far represent a reduction in the viability of the population in the bioregion.

Wedge-tailed Eagle is another species that frequently experiences high proportions of mortality at wind farms (Moloney *et. al.* 2019, Symbolix 2022). However, despite being the second most common raptor

observed utilising site and the majority of these observations being of RSA flights, only one mortality was detected indicating likely very low impacts to the species from BWF.

Black-shouldered Kite populations are thought to be increasing while Brown Goshawk decreasing (Birdlife International 2023) and both made a collective 10% of mortality. Both populations are considered secure currently and their range and abundance across the entire continent make it unlikely that BWF has reduced population viability at the bioregional level.

4.4. Powerful Owl and Superb Parrot

No impacts occurred for either of these species during mortality surveys. One Powerful Owl carcass was identified during the targeted surveys but this was found in woodlands well outside of the search radius of the nearest turbine, and as such should not be attributed to a collision impact.

Superb Parrot was not observed during operational BUS or incidentally during carcasses searches. This supports preconstruction data indicating very low utilisation of the site.

BWF hosts large numbers of hollow bearing trees above 10cm in diameter, which might offer opportunity for Superb Parrot to use however, no breeding activity was observed. Powerful Owl's require much larger, established hollows and a number were detected to be above 20cm in diameter. These could potentially be useful to the species; however, depth is also an important factor in hollows which could not be assessed from the ground. Given the species was detected incidentally on site, it remains suitable habitat for the species, though no active or past breeding sites were detected.

4.5. Microbats

Mortality of microbats consisted of primarily White-striped Freetail Bat, and Chocolate and Gould's Wattled Bats. The remainder consisted of three forest bat species; Large, Southern and Little (the *Vespadelus* sp. That could not be identified beyond family level can most likely be attributed to one of these). Several studies (Symbolix 2020, Moloney *et al.* 2019, Smales 2012) have identified these species as being particularly commonly impacted by wind farm operation and being over-represented in mortality data across several wind farms. Observations by Nature Advisory (unpublished data) at various wind farms in other parts of these species' range are consistent with these findings.

Currently, population estimates for Australian tree-roosting microbats are not available. This makes assessing overall population-level impacts on individual species caused by at operational wind farms problematic. Some inference can be made based on known roost sizes of certain species in a small area. For example; In Gould's Wattled Bats, core groups are typically made up of 8-20 individuals that also associate with multiple other similar-sized groups that use a network of roost trees spread across an area of several kilometres; in combination, this socially-connected local roosting population can include more than 200 bats (Godinho *et al.* 2015, Griffiths *et al.* 2019, Lumsden *et al.* 2020). In White-striped Freetail Bats, core groups typically comprise 5-10 individual bats that roost together over multiple years (Evans 2009, Griffiths *et al.* 2019) and these smaller groups also congregate in communal roosts with large groups that can contain 50-300 individuals (Rhodes 2007).

However, this does not inform what population numbers might be in such a large area as a bioregion. Without knowing the population, it is difficult to say what the significance of the impacts detected so far are. Once the mortality monitoring has been completed and mortality estimates are available, impacts to the above species will be revisited.

Yellow-bellied Sheath-tail Bat and Eastern Bent-wing Bat were identified as being at low risk and moderate risk respectively of impacts from BWF. Neither species was detected as impacts during the mortality

monitoring to date. Further bat survey results will provide further insights into the risk posed by the wind farm on both species by providing information on the species continued occurrence on site.

4.6. Analysis of the notification framework

The framework was required on one occasion; the Crimson Rosella non-threatened trigger. The process was adhered to and a preliminary investigation concluded there were unlikely to be significant impacts, and that the trigger was likely a one-off occurrence.

As a result, no further action was required and as such, only limited conclusions can be drawn about the effectiveness of the framework, given that its full implementation was not required. That said, the process performed its function satisfactorily and no further are necessary.

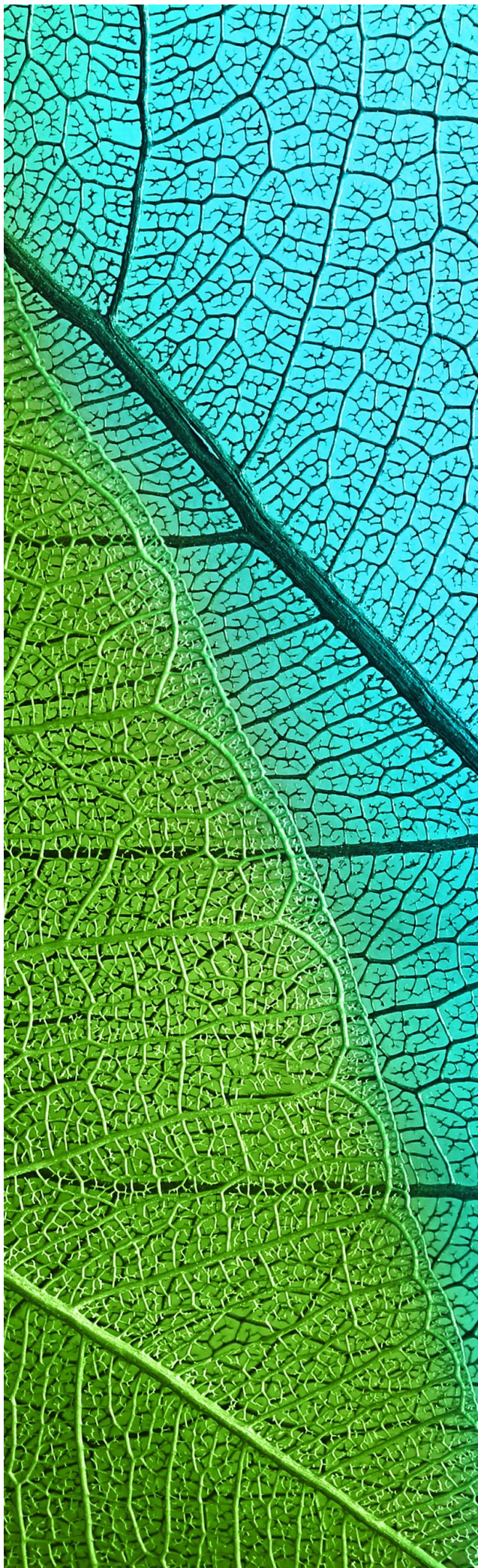
4.7. Recommendations

- The monitoring program will continue until completed (estimated December);
- Bat survey results will be provided at that time;
- Mortality estimates will be given at that time;
- Impacts will be reassessed at that time and further recommendations made;
- This annual report will be updated and resubmitted to BCS within three months of completion of the monitoring program.

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Biala Wind Farm

Bird Utilisation Survey – Pre and Post construction analysis

**Prepared for Newtricity
Developments Biala Pty Ltd.**

July 2023
Report No. 17162 (10.0)



**Nature
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1 Introduction

Nature Advisory Pty Ltd was engaged to undertake post-construction baseline bird and raptor surveys of the Biala Wind Farm (BWF) site via Bird Utilisation Surveys (BUS). The aim of the current study was to provide updated information on the diversity, abundance, and pattern of use of BWF by birds (including raptors), and to provide a comparison under the Bird and Bat Adaptive Management Plan (BBAMP) (Nature Advisory, 2021) with previous BUS undertaken on site prior to the construction and operation of BWF.

Nature Advisory (2018) undertook pre-construction BUS along with seasonal raptor surveys to understand the diversity, abundance and pattern of utilisation of BWF by bird groups.

Nature Advisory has since undertaken post-construction phase BUS during 2021 to provide an adequate baseline with which to identify continued utilisation of the site by birds and identify any changes since pre-construction phase.

All BUS were undertaken consistent with the requirements for a “Level Two” bird risk assessment in accordance with ‘Wind Farms and Birds – Interim Standards for Risk Assessment’ issued by the Australian Wind Energy Association (AusWEA, 2005). This approach has been endorsed in the Association’s latest Best Practice Guidelines (Clean Energy Council, 2018).

This report provides a comparison and analysis of all BUS data collected during pre and post construction phases, and is divided into the following sections.

Section 2 describes the methods used for the BUS.

Section 3 presents the assessment results.

Section 4 provides discussion and conclusions.

This investigation was undertaken by a team from Nature Advisory comprising Gavin Thomas (Senior Zoologist), Divyang Rathod (Zoologist), Philip Allen (Zoologist), Emma Loboda (GIS Analyst), Jackson Clerke (Senior Zoologist and Project Manager) and Inga Kulik (Director)

2 Bird Utilisation Surveys

2.1 Fixed-point bird count

The fixed-point bird count method involved an observer stationed at a survey point for 15 minutes. The adequacy of using 15 minutes as an interval to record the presence of birds during bird utilisation surveys was investigated in an earlier study at another wind farm study area (Brett Lane & Associates Pty Ltd, unpublished data). This showed that 82 to 100 percent (average 88 percent) of species actually seen in one hour of surveying were seen in the initial 15 minutes of the survey. Based on this result, the period of 15 minutes used in the formal bird utilisation surveys was considered adequate to generate representative data on the bird species in the area.

During this period, all bird species and numbers of individual birds observed within 200 metres were recorded. The species, the number of birds and the height of the bird when first observed were documented. For species of concern (threatened species and raptors), the minimum and maximum heights were recorded.

Flight height is presented as below, at or above rotor swept area (RSA) height detailed below.

- **A** = Below RSA (< 40 metres above ground)
- **B** = At RSA (40 – 190 metres above ground)
- **C** = Above RSA (> 190 metres above ground).

2.2 Timing of bird surveys

BUS have been undertaken by experienced zoologists in 2017, 2018 and 2021 across four seasons in pre-construction phase and two seasons during the post-construction phase during April and October 2021 to coincide seasonal dispersal and migration patterns of resident and migratory species. The dates are detailed below in 1.

The autumn survey was undertaken during the period in which many spring and summer migrants are passing through the wind farm on their return from the south. Spring surveys gather data on species richness during the time of year when spring/summer migrants may visit the wind farm and many species are moving south to breed.

Table 1: Pre- and post-construction BUS timing

Phase	Year	Season	Month/date
Pre-construction	2017	Spring	20th to 25th November
	2018	Summer	29th January to 2nd February
	2018	Autumn	16th to 20th April
	2018	Winter	30th July to 3rd August

Phase	Year	Season	Month/date
Post-construction	2021	Autumn	25th to 29th May
	2021	Spring	11th to 21st October

During the surveys, eight counts were made at each survey point (Figure 1). Refer to the BBAMP for a summary on pre-operation survey dates and times (Nature Advisory 2018) and

Table 3 indicates when each point was counted on each survey day during post-construction surveys. This schedule ensured that all points were visited at all times of day so that no time-of-day bird activity biases affected the pooled count data.

Table 2: Times when points were counted for each fixed-point bird count survey day in autumn 2021

Date	25/05/2021	26/05/2021	27/05/2021	28/05/2021	29/05/2021
Time	Day 1	Day 2	Day 3	Day 4	Day 5
7:30			BUS1	REF1	BUS6
8:00		BUS4	BUS2	REF2	BUS5
8:30		BUS6	BUS4	BUS6	BUS2
9:00			BUS3	BUS5	
9:30		REF2	BUS5	REF1	
10:00		BUS1	BUS6	BUS3	BUS1
10:30			REF2	BUS2	
11:00		REF1			
11:30	BUS4	BUS2	REF1	BUS1	
12:00				BUS2	
12:30		REF2	REF2	BUS4	
13:00		BUS2	BUS6		
13:30		BUS6	BUS5	BUS3	
14:00	BUS3	BUS4	BUS4	BUS2	
14:30		BUS5	BUS2		
15:00			BUS3	BUS1	
15:30	BUS5	BUS3	REF1	BUS4	
16:00			REF2	BUS3	
16:30	REF2	BUS1		REF1	

Table 3: Times when points were counted for each fixed-point bird count survey day in spring 2021

Date	11/10/2021	12/10/2021	13/10/2021	15/10/2021	16/10/2021
Time	Day 1	Day 2	Day 3	Day 4	Day 6

Date	11/10/2021	12/10/2021	13/10/2021	15/10/2021	16/10/2021
8:30		BUS1		BUS2	BUS1
9:00		BUS5	REF1	BUS3	BUS2
9:30		BUS6	BUS2	BUS4	
10:00		REF2	BUS3	REF1	
10:30		BUS1	BUS4	REF2	
11:00		REF1	BUS3	BUS6	
11:30		BUS2	BUS5	BUS5	
12:00		BUS3	BUS6		
12:30		BUS4	REF2		
13:00		BUS5	BUS1		
13:30		BUS6	BUS6		
14:00	BUS1	REF2	BUS5		
14:30		BUS6	BUS4		
15:00	BUS2		BUS3		
15:30	BUS3	BUS2	BUS2		
16:00	BUS4	BUS3	REF1		
16:30	REF1	BUS4	REF2		
17:00		BUS1			
17:30		REF1			

2.3 Locations of survey points

Seven fixed survey points were established during the spring survey; five impact and two reference points (Figure 1). The number of impact points was increased to six plus the two reference points for the summer, autumn and winter surveys of 2018 which was also used for the post-construction phase BUS survey in 2021 to allow direct comparative analysis of changes in bird abundance, richness and distribution following construction. The slight change and increase in the number of impact points was designed to better represent the wind farm habitats and focus on some of the turbines, which were close to remnant patches of native woodland.

Impact points are located at constructed turbines and reference points remain at least 500 metres away from impact points in areas of similar habitat. The survey points were distributed as evenly as possible (subject to access constraints) across the wind farm to maximise coverage in areas where wind turbines are likely to be sited. Impact points were positioned as far as possible on elevated ground, allowing at minimum a 270° view.

Table 4 below provides a description of the habitats associated with each impact and reference point. The survey points were distributed as evenly as possible (subject to access constraints) across the wind farm to maximise coverage in areas where wind turbines are sited.

Table 4: Habitat associated with each survey point

Survey point	Habitat
1	Located at turbine 30. A small stand of Red Stringybark (<i>Eucalyptus macrorhyncha</i>) is just to the east of the turbine. The surrounding grazed paddocks have many mature Red Stringybarks and a few scattered Yellow Box (<i>Eucalyptus melliodora</i>). Due to grazing no understorey is present.
2	Located at turbine 26. This location is an open heavily grazed paddock with a few old scattered mature trees. A minor erosion gully to the north-west of the turbine drains into a farm dam to the south-west. Saline groundwater is evident seeping to the surface in the erosion gully.
3	Located at turbine 20 on a small rise. This location is surrounded by grazed paddocks, containing rank introduced grasses. Previous cropping is also noted. A large stand of remnant woodland is located several hundred metres to the south-east of the turbine.
4	Located at turbine 11. This location is in a flat open grazed paddock, dominated by introduced grasses. A linear remnant section of woodland is located west of the turbine about 150 metres away. The woodland has little to no understorey except for some grasses and forbs.
5	Located at turbine 5. This location is surrounded by grazed paddocks, some with rank, tall, introduced grasses. Several scattered paddock trees are located with 100- 200 metres of the turbine. Remnant blocks of woodland are located to the east, north and west of the turbine within 200-500 metres.
6	Located at turbine 1. This location is surrounded by areas of mature forest to the south and west and grazed paddocks to the north and east. The forest has some understorey cover and is only lightly grazed. A significant number of hollow bearing trees occur in the forest surrounding the turbine.
R1	Located east of the wind farm. This location has close to a road. The location consists of mature open forest to the east and grazed paddocks to the west.
R2	Located on the access road within the wind farm boundary. The location consists of a remnant stand of mature eucalypts with a dense understorey of ferns and course woody debris. The location is surrounded by grazed paddocks.

Figure 1: BUS points

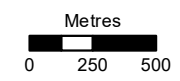
Project: Biala Wind Farm

Client: Beijing Jingneng Clean
Energy (Hong Kong) Co. Limited

Date: 02/09/2022

Legend

- ◇ BUS points
- Access track
- Turbine location



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2.4 Incidental observations

In addition to the observations during formalised, fixed-point counts, incidental observations of birds of concern (threatened species, raptors, waterbirds) were made whilst travelling throughout the wind farm site. Notes are also made on woodland birds observed in remnant woodlands and forest and any early morning and evening roosting movements. Emphasis was placed on observing birds that were moving through the site at RSA height.

2.5 Data preparation and statistical analysis

The data used in the analysis was collected during six BUS studies. For surveys were undertaken during the pre-construction phase and three surveys were undertaken during the post-construction phase. All observations were recorded in the pre-defined data sheets. Raw data were then entered into an Excel spreadsheet. Figures, tables and graphs were generated in Microsoft Excel and R (R Core Team 2020). First, the suitability of the survey method was checked using a cumulative species number graph (Figure 2). Chi-square distribution tests were used to investigate the distribution of individuals in height categories.

To investigate the variations of species diversity and abundance between pre and post-construction surveys conducted, multivariate analysis of variance (MANOVA) was performed, with species diversity and abundance as dependent factor and construction stage predicting parameter. Post-hoc tests were performed to analyse any significance found. Post-hoc tests to plot the distribution of the residuals and tests effect size were also performed. Abundance data were square root transformed to meet normal distribution in MANOVA and ANOVA tests. All statistical analyses were undertaken in R environment (R Core Team, 2018).

2.6 Raptor surveys

Pre-construction raptor surveys were undertaken by Nature Advisory (2018) as fixed point surveys at five locations at BWF. Timing of the surveys is provided below in Table 5 and detailed methods for the surveys are summarised in Nature Advisory (2018) bird and bat assessment for BWF. Results of the surveys are summarised in Section 3.5 of this report and are given for a basic comparison of raptor observations between the targeted raptor surveys and the recent operation BUS. Note that -post construction surveys are not targeted but included raptor observations from the same surveys points during general BUS.

Table 5: Seasonal raptor surveys

Phase	Year	Season	Month/date
Pre-construction	2018	Summer	29th January to 2nd February
	2018	Autumn	6th to 11th May
	2018	Winter	30th July to 3rd August
	2018	Spring	14th to 19th October 2018

2.7 Limitations

The BUS covered all four seasons in pre-construction phase, representing all key stages in the annual cycle of all birds. In spring, the weather was mostly fine with warm and sunny conditions prevailing, with moderate to light wind and little or no rain. Similar weather was encountered in summer but with some hot days. Autumn and winter weather were also fine with some cool days and some rain, but generally suitable for bird activity. Almost all of the possible types of birds including residents, summer visitors and transient migratory species were present reflecting the seasonal variations in the use of the wind farm site by birds.

The purpose of the surveys was to collect a range of data, including usage of the site by resident and migratory birds that may only occur at certain times of the year. For example, during autumn, birds such as magpies, starlings and ravens would be post-breeding, and could collect in larger feeding flocks at that time while such flocks disperse at other times of the year, especially during the breeding season.

The post-construction phase Autumn and Spring surveys were carried out during periods of time that were both affected by issues including Covid 19 restrictions and limitations due to severe weather events that had significant impacts on travel and site access, which affected the overall survey effort. The autumn survey was curtailed, and complete replicates were not completed. The spring survey was impacted as well and was carried out over a disjunct period of nine days.

For these reasons, the utilisation rates and species relative abundances recorded during the current surveys, once completed are considered to be representative of the site during the seasons and taking into consideration time-of-day variation in bird activity and species occurrence. They are therefore considered to provide a sound baseline with which to compare the bird impacts associated with the Biala Wind Farm.

3 Results

This section provides results and analysis between seasonal and phases of surveys (i.e., post-construction and pre-construction). Detailed surveys data for each survey is provided as a separate attachment to this report.

3.1 Survey Suitability

The cumulative number of species observed from the consecutive fixed-point bird counts conducted at the observation points during the survey period has been plotted (Figure 2). This indicated that the number of species levelled out after 20 surveys for most seasons, with exception being survey seven in Autumn 2022 leveling out after 40 surveys. This was due to rain during the early part of the survey, affecting the number of bird species present.

The combined results strongly suggested that the surveys collectively provided a representative picture of the diversity of bird species flying over the wind farm site.

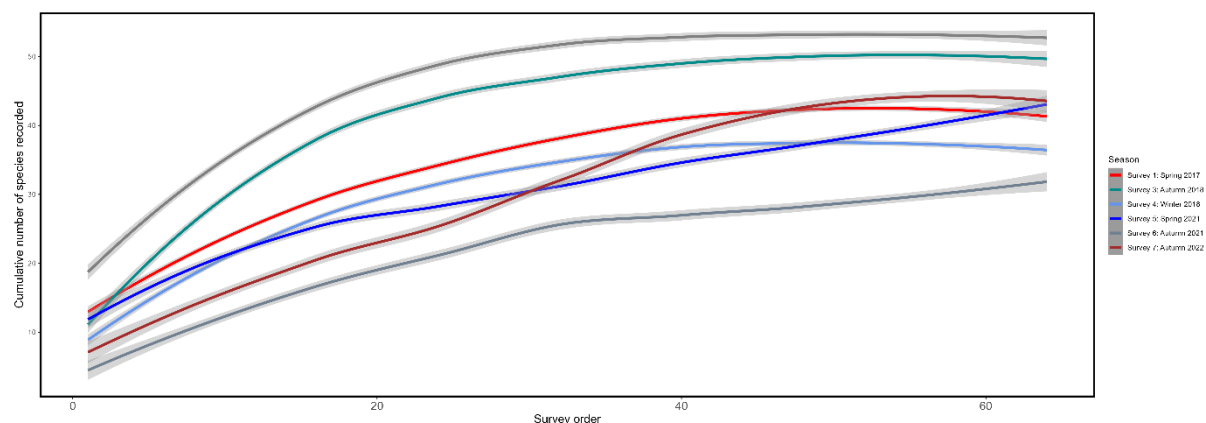


Figure 2. The cumulative number of species of birds recorded during consecutive counts for both pre (2017-2018) and post operations (2021-2022) BUS at BWF

3.2 Species Composition

Ninety-five species were recorded during the combined two survey phases. A total of 87 species were recorded at the impact survey points, and 71 species at reference survey points. Species recorded were predominantly farmland and bushland species with some records of raptors and waterbirds.

Species diversity varied between seasons, diversity was highest in spring and lower in autumn. Species composition (diversity) differs between months due to seasonal changes in presence and abundance, activity, changes in foraging behaviour and seasonal distribution of birds among various habitats.

The five most common species at the impact and reference survey points are presented in Table 6 below.

Table 6: Five most common bird species recorded at BUS points at Biala Wind Farm

Pre-construction		Post-construction	
Impact survey points	Reference survey points	Impact Survey points	Reference Survey points
Crimson Rosella	Common Starling	Sulphur-crested Cockatoo	Common Starling
Sulphur-crested Cockatoo	Raven Sp.	Little Raven	Australian Magpie
Australian Magpie	Welcome Swallow	Australian Magpie	Little Raven
Yellow-rumped Thornbill	Crimson Rosella	Common Starling	Sulphur-crested Cockatoo
Buff-rumped Thornbill	Australian Magpie	Crimson Rosella	Yellow-rumped Thornbill

During post-construction phase, the five species comprised 49% of all birds recorded at the impact survey points and 45% at the reference survey points. The total number of birds observed during pre-construction phase was 7852 and the total in the post-construction phase was 2615. Highly significant differences between stages of construction were observed when abundance and diversity are coupled as a dependent variable (Table 7). The main effect of construction stage is statistically significant and has a large effect size ($F(1, 280) = 27.23$, $p < .001$; η^2 (partial) = 0.16, 95% CI [0.10, 1.00])

Table 7 Results from MANOVA test on Abundance and Diversity by Construction stage

	Df	Pillai	approx F	num DF	den DF	Pr(>F)
Stage	1	0.1633	27.227	2	279	1.579e-11
Residuals	208					

The results in Table 8 reveals that while there is no significant difference in the diversity of species at survey points between construction stages, there is a significant difference in bird abundance Table 9. The main effect of construction stage is statistically significant and medium effect size ($F(1, 280) = 38.03$, $p < .001$; $\eta^2 = 0.12$, 95% CI [0.07, 1.00])

Table 8. Results from ANOVA test on species diversity by stage of construction

	Df	Sum sq	Mean Sq	F value	Pr(>F)
Stage	1	35	34.70	2.348	0.127

Residuals	280	4138	14.78		
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Table 9 Results from ANOVA test on species abundance by stage of construction

	Df	Sum sq	Mean Sq	F value	Pr(>F)
Stage	1	121.1	121.08	38.03	2.43e-09
Residuals	280	891.4	3.18		

3.3 Flight Heights

Bird heights were classified as below (< 40 metres), at (40-190 metres), and above (> 190 metres) RSA height. A summary of results of the species and number of birds recorded at the different flight heights are presented in Figure 3.

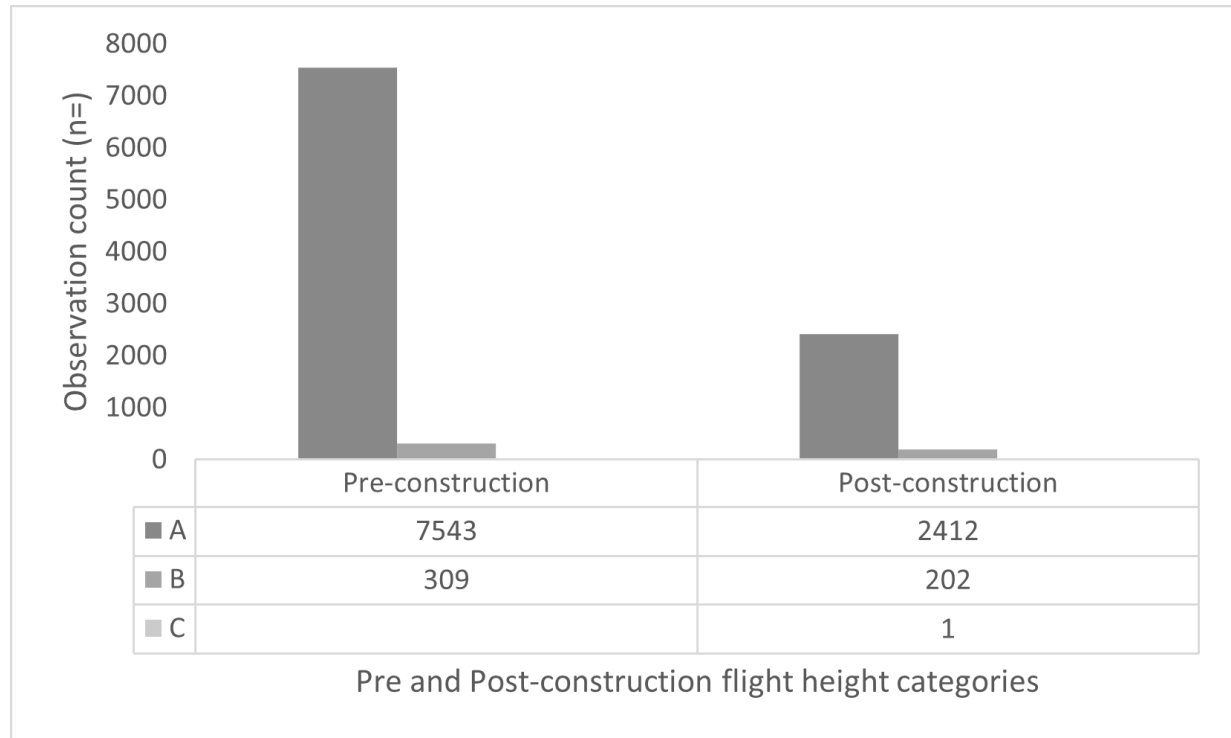


Figure 3. Flight height of birds in pre and post construction

The detailed height distribution of birds over the wind farm site is shown in the tables below during post-construction and pre-construction phases, and by impact and reference points. Table 10 shows a summary of height distribution at impact points during pre-construction and Table 11 shows the same for operation BUS. Table 12 shows height distribution at reference points for pre-construction and Table 13 shows this for post-construction BUS. Table 14 summarises height data all survey points for pre-construction and Table 15 shows this for post-construction phase.

The height distribution confirms that most birds flew below RSA height, or were either on the ground or in trees (from 1 to 20 metres height), therefore reducing collision risks between birds and operational wind turbines.

Table 10: Summary of number and height distribution of bird species at Impact Points recorded during pre-construction BUS Survey.

Species	Spring 2017			Summer 2018			Autumn 2018			Winter 2018			Totals		
	A	B	Total	A	B	Total	A	B	Total	A	B	Total	A	B	Total
Australasian Pipit	15	0	15	10	0	10	2	0	2	0	0	0	27	0	27
Australian Magpie	43	0	43	161	0	161	160	0	160	191	0	191	555	0	555
Australian Wood Duck	0	0	0	18	0	18	26	0	26	68	0	68	112	0	112
Black-faced Cuckoo-shrike	8	0	8	15	4	19	6	0	6	0	0	0	29	4	33
Black-shouldered Kite	0	0	0	0	0	0	0	1	1	0	0	0	0	1	1
Brown Falcon	3	1	4	5	2	7	3	0	3	0	2	2	11	5	16
Brown Goshawk	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1
Brown Thornbill	0	0	0	62	0	62	18	0	18	36	0	36	116	0	116
Brown-headed Honeyeater	0	0	0	36	0	36	31	0	31	42	0	42	109	0	109
Buff-rumped Thornbill	29	0	29	20	0	20	98	0	98	222	0	222	369	0	369
Collared Sparrowhawk	0	0	0	2	0	2	0	0	0	0	0	0	2	0	2
Common Bronzewing	0	0	0	2	0	2	0	0	0	2	0	2	4	0	4
Common Starling	161	0	161	49	0	49	33	0	33	65	0	65	308	0	308
Crimson Rosella	27	0	27	181	0	181	243	0	243	258	0	258	709	0	709
Dollarbird	1	0	1	2	0	2	0	0	0	0	0	0	3	0	3
Dusky Woodswallow	0	0	0	2	0	2	0	0	0	0	0	0	2	0	2
Eastern Rosella	3	0	3	2	0	2	4	0	4	5	0	5	14	0	14
Eastern Spinebill	0	0	0	4	0	4	16	0	16	6	0	6	26	0	26
Eastern Yellow Robin	0	0	0	0	0	0	2	0	2	0	0	0	2	0	2
Eurasian Skylark	3	1	4	2	0	2	0	0	0	0	0	0	5	1	6
Fairy Martin	61	5	66	0	0	0	0	0	0	0	0	0	61	5	66
Fuscous Honeyeater	0	0	0	0	0	0	10	0	10	0	0	0	10	0	10
Galah	24	2	26	5	2	7	24	0	24	5	2	7	58	6	64
Golden Whistler	0	0	0	0	0	0	6	0	6	0	0	0	6	0	6
Golden-headed Cisticola	3	0	3	0	0	0	0	0	0	0	0	0	3	0	3
Great Cormorant	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1
Grey Butcherbird	9	0	9	0	0	0	6	0	6	4	0	4	19	0	19
Grey Currawong	5	0	5	0	0	0	2	0	2	3	0	3	10	0	10
Grey Fantail	1	0	1	62	1	63	38	0	38	0	0	0	101	1	102
Grey Shrike-thrush	7	0	7	17	0	17	22	0	22	22	0	22	68	0	68
Laughing Kookaburra	8	0	8	62	0	62	46	0	46	71	0	71	187	0	187
Leaden Flycatcher	0	0	0	2	0	2	0	0	0	0	0	0	2	0	2
Little Pied Cormorant	0	0	0	0	0	0	0	0	0	2	0	2	2	0	2
Magpie-lark	2	0	2	8	0	8	20	0	20	10	0	10	40	0	40
Mistletoebird	1	0	1	2	0	2	1	0	1	0	0	0	4	0	4
Nankeen Kestrel	11	5	16	6	3	9	3	4	7	2	1	3	22	13	35
Noisy Friarbird	14	0	14	88	0	88	0	0	0	0	0	0	102	0	102
Olive-backed Oriole	0	0	0	3	0	3	0	0	0	0	0	0	3	0	3
Pacific Black Duck	0	0	0	0	0	0	2	0	2	0	0	0	2	0	2
Pied Currawong	2	0	2	9	1	10	10	0	10	2	0	2	23	1	24
Raven	23	0	23	41	2	43	82	16	98	45	4	49	191	22	213

Species	Spring 2017			Summer 2018			Autumn 2018			Winter 2018			Totals		
	A	B	Total	A	B	Total	A	B	Total	A	B	Total	A	B	Total
Red Wattlebird	11	0	11	26	0	26	14	2	16	14	0	14	65	2	67
Rufous Whistler	6	0	6	14	0	14	8	0	8	0	0	0	28	0	28
Sacred Kingfisher	1	0	1	3	0	3	0	0	0	0	0	0	4	0	4
Scarlet Robin	2	0	2	0	0	0	6	0	6	14	0	14	22	0	22
Silvereye	0	0	0	0	0	0	15	0	15	0	0	0	15	0	15
Spotted Pardalote	0	0	0	0	0	0	6	0	6	0	0	0	6	0	6
Straw-necked Ibis	0	0	0	0	0	0	16	0	16	0	0	0	16	0	16
Striated Pardalote	19	0	19	30	0	30	50	0	50	78	0	78	177	0	177
Striated Thornbill	1	0	1	110	0	110	70	0	70	122	0	122	303	0	303
Stubble Quail	2	0	2	4	0	4	0	0	0	0	0	0	6	0	6
Sulphur-crested Cockatoo	141	4	145	121	76	197	122	53	175	136	48	184	520	181	701
Superb Fairywren	6	0	6	64	0	64	41	0	41	138	0	138	249	0	249
Superb Parrot	2	0	2	0	0	0	0	0	0	0	0	0	2	0	2
Tree Martin	5	0	5	2	0	2	0	0	0	28	0	28	35	0	35
Varied Sittella	0	0	0	0	0	0	10	0	10	6	0	6	16	0	16
Wedge-tailed Eagle	0	0	0	0	2	2	0	3	3	0	0	0	0	5	5
Welcome Swallow	5	0	5	4	0	4	0	4	4	4	0	4	13	4	17
White-browed Scrubwren	0	0	0	0	0	0	0	0	0	6	0	6	6	0	6
White-eared Honeyeater	0	0	0	0	0	0	14	0	14	4	0	4	18	0	18
White-faced Heron	4	0	4	0	3	3	1	0	1	2	0	2	7	3	10
White-fronted Chat	8	0	8	0	0	0	0	0	0	0	0	0	8	0	8
White-naped Honeyeater	0	0	0	0	0	0	30	0	30	0	0	0	30	0	30
White-throated Gerygone	2	0	2	5	0	5	2	0	2	0	0	0	9	0	9
White-throated Treecreeper	8	0	8	86	0	86	51	0	51	85	0	85	230	0	230
White-winged Chough	0	0	0	0	0	0	59	0	59	16	0	16	75	0	75
Willie Wagtail	0	0	0	8	0	8	15	0	15	5	0	5	28	0	28
Yellow Thornbill	0	0	0	20	0	20	6	0	6	0	0	0	26	0	26
Yellow-faced Honeyeater	4	0	4	0	0	0	46	9	55	0	0	0	50	9	59
Yellow-rumped Thornbill	26	0	26	80	0	80	134	0	134	245	0	245	485	0	485
Grand Total	705	18	723	1470	96	1566	1630	92	1722	1964	57	2021	5769	263	6032

Notes: A = Below (<40 metres); B = At (40–190 metres); C = above RSA heights (>190 metres). Note that no bird was recorded flying over 190 m in this survey.

Table 11 : Summary of number and height distribution of bird species at Impact Points recorded during **post-construction** BUS Survey.

Species	Autumn			Spring			Grand Total
	A	B	Total	A	B	Total	
Australian Magpie	77	5	82	52	2	54	136
Australian Pipit	2	0	2	4	0	4	6
Australian Raven	49	4	53	3	0	3	56
Australian Wood Duck	1	0	1	19	0	19	20
Black-faced Cuckoo-shrike	0	0	0	6	0	6	6
Black-shouldered Kite	0	0	0	2	0	2	2

Species	Autumn			Spring			Grand Total
	A	B	Total	A	B	Total	
Brown Falcon	0	2	2	0	0	0	2
Brown Thornbill	1	0	1	0	0	0	1
Brown-headed Honeyeater	1	0	1	0	0	0	1
Common Starling	89	0	89	97	2	99	188
Crimson Rosella	41	0	41	53	0	53	94
Eastern Spinebill	4	0	4	4	0	4	8
European Skylark	0	0	0	2	1	3	3
Galah	8	2	10	22	3	25	35
Grey Fantail	1	0	1	8	0	8	9
Grey Shrike-thrush	3	0	3	10	0	10	13
Laughing Kookaburra	4	0	4	3	0	3	7
Leaden Flycatcher	0	0	0	2	0	2	2
Little Raven	0	0	0	60	2	62	62
Magpie-lark	21	0	21	13	0	13	34
Mistletoebird	0	0	0	2	0	2	2
Nankeen Kestrel	0	0	0	1	0	1	1
Noisy Friarbird	0	0	0	2	0	2	2
Pacific Black Duck	0	0	0	2	0	2	2
Pied Butcherbird	2	0	2	0	0	0	2
Pied Cormorant	0	0	0	0	1	1	1
Pied Currawong	0	0	0	5	0	5	5
Red Wattlebird	1	0	1	7	0	7	8
Rufous Whistler	0	0	0	7	0	7	7
Scarlet Robin	4	0	4	0	0	0	4
Silvereye	0	0	0	3	0	3	3
Striated Pardalote	0	0	0	10	0	10	10
Striated Thornbill	0	0	0	7	0	7	7
Sulphur-crested Cockatoo	46	45	91	217	58	275	366
Superb Fairy-wren	0	0	0	4	0	4	4
Wedge-tailed Eagle	1	8	9	0	2	2	11
Weebill	1	0	1	2	0	2	3
Welcome Swallow	0	0	0	9	0	9	9
White-browed Scrubwren	4	0	4	1	0	1	5
White-eared Honeyeater	1	0	1	0	0	0	1
White-fronted Chat	0	0	0	51	0	51	51
White-throated Treecreeper	7	0	7	15	0	15	22
Willie Wagtail	2	0	2	3	0	3	5
Yellow-faced Honeyeater	2	0	2	7	0	7	9
Yellow-rumped Thornbill	57	0	57	20	0	20	77
Grand Total	430	66	496	735	71	806	1302

Notes: A = Below (<40 metres); B = At (40–190 metres); C = above RSA heights (>190 metres). Note that no bird was recorded flying over 190 m in this survey.

Table 12: Summary of number and height distribution of bird species at Reference Points recorded during pre-construction BUS Survey.

Species	Spring 2017			Summer 2018			Autumn 2018			Winter 2018			Totals		
	A	B	Total	A	B	Total	A	B	Total	A	B	Total	A	B	Grand Total
Australasian Pipit	0	0	0	17	0	17	18	0	18	11	0	11	46	0	46
Australian Magpie	24	0	24	33	0	33	39	0	39	47	0	47	143	0	143
Australian White Ibis	0	0	0	0	0	0	5	0	5	0	0	0	5	0	5
Australian Wood Duck	17	0	17	0	0	0	0	0	0	4	0	4	21	0	21
Black-faced Cuckoo-shrike	6	0	6	7	0	7	5	0	5	0	0	0	18	0	18
Black-shouldered Kite	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1
Brown Falcon	0	0	0	0	2	2	2	0	2	1	0	1	3	2	5
Brown Thornbill	2	0	2	13	0	13	23	0	23	0	0	0	38	0	38
Brown-headed Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buff-rumped Thornbill	2	0	2	28	0	28	0	0	0	0	0	0	30	0	30
Common Blackbird	3	0	3	4	0	4	2	0	2	1	0	1	10	0	10
Common Bronzewing	0	0	0	0	0	0	0	0	0	2	0	2	2	0	2
Common Starling	26	0	26	31	2	33	114	0	114	97	0	97	268	2	270
Crimson Rosella	26	0	26	25	0	25	55	0	55	37	0	37	143	0	143
Eastern Rosella	0	0	0	0	0	0	3	2	5	0	0	0	3	2	5
Eastern Spinebill	2	0	2	0	0	0	4	0	4	10	0	10	16	0	16
Eastern Yellow Robin	0	0	0	2	0	2	0	0	0	0	0	0	2	0	2
Eurasian Skylark	0	0	0	0	0	0	0	0	0	16	0	16	16	0	16
European Goldfinch	1	0	1	10	0	10	0	0	0	0	0	0	11	0	11
Flame Robin	0	0	0	0	0	0	0	0	0	4	0	4	4	0	4
Galah	5	0	5	0	0	0	2	2	4	4	1	5	11	3	14
Grey Butcherbird	3	0	3	0	0	0	2	0	2	0	0	0	5	0	5
Grey Currawong	2	0	2	0	0	0	2	0	2	0	0	0	4	0	4
Grey Fantail	4	0	4	5	0	5	6	0	6	0	0	0	15	0	15
Grey Shrike-thrush	4	0	4	3	0	3	9	0	9	6	0	6	22	0	22
Laughing Kookaburra	1	0	1	4	0	4	3	0	3	10	0	10	18	0	18
Leaden Flycatcher	0	0	0	3	0	3	0	0	0	0	0	0	3	0	3
Magpie-lark	4	0	4	8	0	8	15	0	15	35	0	35	62	0	62
Masked Lapwing	0	0	0	2	0	2	0	0	0	0	0	0	2	0	2
Mistletoebird	5	0	5	1	0	1	0	0	0	0	0	0	6	0	6
Nankeen Kestrel	8	1	9	2	0	2	0	2	2	2	0	2	12	3	15
Noisy Friarbird	15	0	15	0	0	0	0	0	0	0	0	0	15	0	15
Olive-backed Oriole	4	0	4	1	0	1	0	0	0	0	0	0	5	0	5
Pacific Black Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pallid Cuckoo	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1
Pied Currawong	5	0	5	8	2	10	2	0	2	9	0	9	24	2	26
Raven	18	0	18	73	0	73	52	2	54	24	7	31	167	9	176
Red Wattlebird	17	0	17	2	0	2	6	0	6	2	0	2	27	0	27
Rufous Whistler	6	0	6	4	0	4	0	0	0	0	0	0	10	0	10
Scarlet Robin	0	0	0	0	0	0	4	0	4	4	0	4	8	0	8
Silvereye	0	0	0	6	0	6	0	0	0	0	0	0	6	0	6
Straw-necked Ibis	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1
Striated Pardalote	13	0	13	1	0	1	0	0	0	6	0	6	20	0	20
Striated Thornbill	3	0	3	10	0	10	12	0	12	40	0	40	65	0	65
Sulphur-crested Cockatoo	21	0	21	17	7	24	21	0	21	24	6	30	83	13	96
Superb Fairywren	16	0	16	11	0	11	3	0	3	5	0	5	35	0	35

Species	Spring 2017			Summer 2018			Autumn 2018			Winter 2018			Totals		
	A	B	Total	A	B	Total	A	B	Total	A	B	Total	A	B	Grand Total
Swamp Harrier	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1
Tree Martin	10	0	10	0	0	0	0	0	0	0	0	0	10	0	10
Tree Martin	0	0	0	0	4	4	0	0	0	0	0	0	0	4	4
Welcome Swallow	2	0	2	0	0	0	131	4	135	9	0	9	142	4	146
White-eared Honeyeater	0	0	0	0	0	0	4	0	4	0	0	0	4	0	4
White-faced Heron	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1
White-fronted Chat	0	0	0	2	0	2	30	0	30	20	0	20	52	0	52
White-naped Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Treecreeper	10	0	10	6	0	6	2	0	2	14	0	14	32	0	32
White-winged Chough	0	0	0	0	0	0	6	0	6	0	0	0	6	0	6
Willie Wagtail	1	0	1	1	0	1	9	0	9	2	0	2	13	0	13
Yellow-faced Honeyeater	15	0	15	0	0	0	11	0	11	0	0	0	26	0	26
Yellow-rumped Thornbill	8	0	8	16	0	16	58	0	58	0	0	0	82	0	82
Grand Total	309	1	310	357	18	375	662	12	674	446	15	461	1774	46	1820

Notes: A = Below (<40 metres); B = At (40–190 metres); C = above RSA heights (>190 metres). Note that no bird was recorded flying over 190 m in this survey.

Table 13: Summary of number and height distribution of bird species at Reference Points recorded during pre-construction BUS Survey.

Species	Autumn				Spring			Grand Total
	A	B	C	Total	A	B	Total	
Australian Magpie	22	0	0	22	33	0	33	55
Australian Raven	24	8	1	33	0	0	0	33
Australian Wood Duck	0	0	0	0	2	0	2	2
Black-faced Cuckoo-shrike	0	0	0	0	2	0	2	2
Brown Thornbill	4	0	0	4	6	0	6	10
Brown-headed Honeyeater	0	0	0	0	1	0	1	1
Common Starling	66	0	0	66	38	0	38	104
Crimson Rosella	3	0	0	3	21	0	21	24
Eastern Spinebill	0	0	0	0	1	0	1	1
European Skylark	0	0	0	0	1	4	5	5
Galah	0	0	0	0	0	2	2	2
Grey Shrike-thrush	2	0	0	2	11	0	11	13
Laughing Kookaburra	8	0	0	8	2	0	2	10
Little Corella	0	0	0	0	1	0	1	1
Little Raven	0	0	0	0	13	0	13	13
Magpie-lark	4	0	0	4	3	0	3	7
Mistletoebird	1	0	0	1	0	0	0	1
Noisy Friarbird	0	0	0	0	1	0	1	1
Pied Currawong	1	0	0	1	1	0	1	2
Red Wattlebird	0	0	0	0	10	0	10	10
Rufous Whistler	0	0	0	0	7	0	7	7
Striated Pardalote	0	0	0	0	2	0	2	2
Striated Thornbill	0	0	0	0	9	0	9	9
Sulphur-crested Cockatoo	12	1	0	13	34	1	35	48

Species	Autumn				Spring			Grand Total
	A	B	C	Total	A	B	Total	
Superb Fairy-wren	6	0	0	6	0	0	0	6
Weebill	0	0	0	0	2	0	2	2
White-faced Heron	0	0	0	0	1	0	1	1
White-naped Honeyeater	0	0	0	0	2	0	2	2
White-throated Treecreeper	2	0	0	2	7	0	7	9
Yellow-faced Honeyeater	0	0	0	0	1	1	2	2
Yellow-rumped Thornbill	3	0	0	3	21	0	21	24
Yellow-tailed Black-Cockatoo	5	0	0	5	0	0	0	5
Grand Total	163	9	1	173	233	8	241	414

Notes: A = Below (<40 metres); B = At (40–190 metres); C = above RSA heights (>190 metres). Note that no bird was recorded flying over 190 m in this survey.

Table 14: Summary of the number and height distribution of bird at the impact and reference point during pre-construction BUS Surveys.

Seasons	Observation Points	A	B	Grand Total
Spring 2017	BUS1	160	6	166
	BUS2	221	3	224
	BUS3	113	0	113
	BUS4	141	9	150
	BUS5	70	0	70
	Impact total	705	18	723
	REF1	183	0	183
	REF2	126	1	127
	Reference total	309	1	310
Summer 2018	BUS1	240	24	264
	BUS2	289	10	299
	BUS3	289	10	299
	BUS4	130	0	130
	BUS5	185	6	191
	BUS6	337	46	383
	Impact Total	1470	96	1566
	REF1	238	15	253
	REF2	119	3	122
	Reference total	357	18	375
Autumn 2018	BUS1	237	7	244
	BUS2	286	14	300
	BUS3	277	16	293
	BUS4	146	0	146
	BUS5	260	8	268
	BUS6	424	47	471
	Impact Total	1630	92	1722

Seasons	Observation Points	A	B	Grand Total
Winter 2018	REF1	262	2	264
	REF2	400	10	410
	Reference total	662	12	674
	BUS1	201	22	223
	BUS2	491	10	501
	BUS3	329	3	332
	BUS4	300	2	302
	BUS5	222	4	226
	BUS6	421	16	437
	Impact total	1964	57	2021
	REF1	182	9	191
	REF2	264	6	270
	Reference total	446	15	461
Grand Total		7543	309	7852

Notes: A = Below (<40 metres); B = At (40–190 metres); C = above RSA heights (>190 metres). Note that no bird was recorded flying over 190 m in this survey.

Table 15: Summary of the number and height distribution of bird at the impact and reference point during post-construction BUS Surveys.

Seasons	Observation Points	A	B	C	Grand Total
Autumn 2021	BUS1	65	0	0	65
	BUS2	158	4	0	162
	BUS3	17	2	0	19
	BUS4	36	8	0	44
	BUS5	56	4	0	60
	BUS6	98	48	0	146
	Impact Total	430	66	0	496
	REF1	98	5	1	104

Seasons	Observation Points	A	B	C	Grand Total
	REF2	65	4	0	69
	Reference Total	163	9	1	173
Spring 2021	BUS1	75	23	0	98
	BUS2	181	3	0	184
	BUS3	138	8	0	146
	BUS4	115	27	0	142
	BUS5	74	9	0	83
	BUS6	152	1	0	153
	Impact Total	735	71	0	806
	REF1	101	6	0	107
	REF2	132	2	0	134
	Reference Total	233	8	0	241
Grand Total		1561	154	1	1716

Notes: A = Below (<40 metres); B = At (40–190 metres); C = above RSA heights (>190 metres).

Table 16 and Table 17 summarises the species of birds found flying at RSA heights during the pre-construction and post-construction BUS surveys. Generally, such birds were large sized and included mostly cockatoos, large waterbirds and raptors. Occasionally, small passerines were also found at RSA heights, including those that exhibit behaviour that takes them to heights above 100 metres above ground, such as Eurasian Skylark, which perform courtship and territory defence flights at this height. Also, Fairy Martins and Welcome Swallows, when feeding on the wing might sometimes ascend to RSA heights.

The number of birds recorded flying at RSA heights varied between the seasons, mostly reflecting the abundance of these bird species and the pattern of their use of the wind farm site. The species found flying at RSA height constituted 2.5 percent of all birds utilising the impact points in spring 2017 as to 8.8 percent of all birds utilising the impact points in spring 2021 and 5.3 percent of all birds utilising the impact points in autumn 2017 as to 15.1 percent of all birds utilising the impact points in autumn 2021. Sulphur-crested Cockatoo flights were mostly recorded at RSA height.

Other birds regularly flying at RSA heights include ravens and raptors. Among the raptors, the Brown Falcon, Nankeen Kestrel and Wedge-tailed Eagle were the most abundant at RSA heights.

Table 16: Species flying at RSA at the impact sites during pre-construction phase BUS survey

Seasons	Species at RSA	Birds at RSA	all birds	% of RSA birds	%RSA of all birds at RSA	% RSA of flights of all birds
Spring 2017	Fairy Martin	5	66	7.6	27.8	0.7
	Nankeen Kestrel	5	16	31.3	27.8	0.7
	Sulphur-crested Cockatoo	4	145	2.8	22.2	0.6
	Galah	2	26	7.7	11.1	0.3
	Brown Falcon	1	4	25	5.6	0.1
	Eurasian Skylark	1	4	25	5.6	0.1
	Total of all spring birds	18	723	2.5	100	2.5
Summer 18	Sulphur-crested Cockatoo	76	197	38.6	79.2	4.9
	Black-faced Cuckoo-shrike	4	19	21.1	4.2	0.3
	Nankeen Kestrel	3	9	33.3	3.1	0.2
	White-faced Heron	3	3	100	3.1	0.2
	Brown Falcon	2	7	28.6	2.1	0.1
	Galah	2	7	28.6	2.1	0.1
	Raven	2	43	4.7	2.1	0.1
	Wedge-tailed Eagle	2	2	100	2.1	0.1
	Grey Fantail	1	63	1.6	1	0.1
	Pied Currawong	1	10	10	1	0.1
	Total of all summer birds	96	1566	6.1	100	6.1
Autumn 2018	Sulphur-crested Cockatoo	53	175	30.3	57.6	3.1
	Raven	16	98	16.3	17.4	0.9
	Yellow-faced Honeyeater	9	55	16.4	9.8	0.5
	Nankeen Kestrel	4	7	57.1	4.3	0.2

Seasons	Species at RSA	Birds at RSA	all birds	% of RSA birds	%RSA of all birds at RSA	% RSA of flights of all birds
	Welcome Swallow	4	4	100	4.3	0.2
	Wedge-tailed Eagle	3	3	100	3.3	0.2
	Red Wattlebird	2	16	12.5	2.2	0.1
	Black-shouldered Kite	1	1	100	1.1	0.1
	Total of all autumn birds	92	1722	5.3	100	5.3
Winter 2018	Sulphur-crested Cockatoo	48	184	26.1	84.2	2.4
	Raven	4	49	8.2	7	0.2
	Galah	2	7	28.6	3.5	0.1
	Brown Falcon	2	2	100	3.5	0.1
	Nankeen Kestrel	1	3	33.3	1.8	0
	Total of all winter birds	57	2021	2.8	100	2.8

Table 17: Species flying at RSA at the impact sites during **post-construction** phase BUS survey

Seasons	Species at RSA	Birds at RSA	All bird	%of RSA birds	%RSA of all birds at RSA	%RSA of flight of all birds
Autumn 2021	Australian Magpie	5	82	6.1	6.7	1.1
	Australian Raven	12	53	22.7	16	2.4
	Brown Falcon	2	2	100	2.7	0.4
	Galah	2	10	20	2.7	0.4
	Sulphur-crested Cockatoo	46	91	50.5	61.3	9.3
	Wedge-tailed Eagle	8	9	88.9	10.7	1.6
	Total of all autumn birds	75	496	15.1	100	15.1
Spring 2021	Australian Magpie	2	54	3.7	2.8	0.2
	Common Starling	2	99	2	2.8	0.2
	European Skylark	1	3	33.3	1.4	0.1
	Galah	3	25	12	4.2	0.4
	Little Raven	2	62	3.3	2.8	0.2
	Pied Cormorant	1	1	100	1.4	0.1
	Sulphur-crested Cockatoo	58	275	21.1	81.7	7.2
	Wedge-tailed Eagle	2	2	100	2.8	0.2
	Total of all spring birds	71	806	8.8	100	8.8

Other than the Sulphur-crested Cockatoo, the distribution of birds flying at RSA heights at each of the survey points was random. Birds were not prone to flying at RSA heights at one point more than others, indicating that risk to birds is likely to be uniformly distributed over the Biala Wind Farm. The Sulphur-crested Cockatoo was present in larger numbers at points BUS1, BUS4, and BUS 6 which habitat suggests a mix of resting/nesting and foraging behaviour. BUS 6, located at turbine 1 is in close proximity to open grassland and mature trees with hollow-bearing trees.

3.4 Threatened Species

Most birds found to utilise the wind farm site were common birds. There were 57 records of threatened species across the pre and post construction phases, with 2 in pre-construction and 55 in post. These species were listed as vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act):

Dusky Woodswallow (n=2)

Vulnerable under the BC Act. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and groundcover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland (Menkhorst *et al.*, 2017). Aerial foraging behaviour by this species places the species at risk of turbine collision. No breeding behaviour has been observed on site. All observations were recorded pre-construction.

Scarlet Robin (n=4)

Vulnerable under the BC Act. The Scarlet Robin lives in open forests and woodlands in Australia. During winter, it visits more open habitats, such as grasslands, and can be seen in farmland and urban parks and gardens at this time (Higgins and Peter, 2002). This species forages on the ground or in the low branches of trees so would not fly at RSA heights. Nature Advisory has observed this species remaining on wind farm sites after turbines commence operation. All observations were recorded in post-construction.

White-fronted Chat (n=51)

This species inhabits open country, grasslands and low shrublands especially open wetlands and low fringing vegetation across southern Australia including southern NSW (Higgins *et al.* 2006; OEH 2021). The species has been recorded at several other wind farms in NSW, Victoria and South Australia by Nature Advisory, indicating a tolerance of operating wind turbines. It is unlikely to be affected by turbine collision as it rarely flies high enough, being a ground-feeding bird. All observations were recorded in post-construction.

3.5 Raptors

Six raptor species were recorded during the pre-construction surveys as to four raptor species during the post-construction BUS (Table 18 and Table 19). The presence of these raptors varied between the seasons and generally they were recorded in low numbers.

The Nankeen Kestrel was the most abundant raptor species recorded during the pre-construction surveys with 54.2% of the total observations were seen flying at RSA height making them most at risk of collision. The second most abundant raptor species was the Brown Falcon comprising of 26.7% of total raptor observations.

Wedge-tailed Eagle was the most abundant raptor species at Biala Wind Farm during the post-construction surveys. It was seen regularly throughout the study area. The Wedge-tailed Eagles were more commonly observed at the survey points with open grassland. 83.3% of total observations were seen flying at RSA height. The Wedge-tailed Eagle is the most vulnerable species to collision with operating turbines because of their soaring habits while foraging. The number of raptors was low in relation to the total number of birds recorded during the survey. However, raptors formed approximately 8.9% of birds seen at RSA height. The percentage of raptors flying at the RSA height during pre-construction and post-construction surveys remained approximately the same even though the number of surveys were halved during the post-construction period.

Table 18: Raptor species recorded at Impact points during pre-construction surveys at Biala Wind Farm

Raptors	A	B	Grand Total	Total Raptor Flight (%)	Flights at RSA (%)	Flights recorded at RSA compared with all bird flights at RSA (%)	Flights recorded at RSA compared with all bird flights observed
Black-shouldered Kite	0	1	1	1.7%	4.2%	0.4%	0.02%
Brown Falcon	11	5	16	26.7%	20.8%	1.9%	0.08%
Brown Goshawk	1	0	1	1.7%	0%	0%	0%
Collared Sparrowhawk	2	0	2	3.3%	0%	0%	0%
Nankeen Kestrel	22	13	35	58.3%	54.2%	4.9%	0.22%
Wedge-tailed Eagle	0	5	5	8.3%	20.8%	1.9%	0.08%
Grand Total	36	24	60	100%	100%	9.1%	0.4%

Notes: A=below rotor swept area (RSA) height (<30 m); B= at RSA height (30-130 m); C= above RSA height (>130 m). Note that no Raptors were recorded flying over 190m.

Table 19: Raptor species recorded at Impact points during post-construction surveys at BWF

Raptors	A	B	Grand Total	Total Raptor Flight (%)	Flights at RSA (%)	Flights recorded at RSA compared with all bird flights at RSA (%)	Flights recorded at RSA compared with all bird flights observed
Black-shouldered Kite	2	0	2	12.5%	0%	0%	0%
Brown Falcon	0	2	2	12.5%	16.7%	1.6%	0.1%
Nankeen Kestrel	1	0	1	6.3%	0%	0%	0%
Wedge-tailed Eagle	1	10	11	68.7%	83.3%	7.3%	0.8%
Grand Total	4	12	16	100%	100%	8.9%	0.9%

Notes: A=below rotor swept area (RSA) height (<30 m); B= at RSA height (30-130 m); C= above RSA height (>130 m). Note that no Raptors were recorded flying over 190m.

4 Conclusions

A total of 95 species were recorded at BWF across both phases and all surveys. Post-construction BUS indicated that the most common species utilising site were Sulphur-crested Cockatoo, Little Raven, Australian Magpie, Common Starling and Crimson Rosella, making up 49% of birds recorded at impact points.

The most commonly observed species flying at RSA height were Sulphur-crested Cockatoo, Wedge-tailed Eagle, Australian Raven, Galah and Rainbow Bee-eater (the latter being due to a single large flock passing through the site on a single occasion). The majority of flights recorded were below RSA across all survey however, indicating typically low risk behaviour from the vast majority of species. Brown Falcon, Nankeen Kestrel and Wedge-tailed Eagle were the most abundant at RSA heights.

Species diversity was highest during spring across all surveys and species diversity and abundance was significantly higher during pre-construction surveys, but not different between the survey points.

Detected threatened species in the BUS continue to utilising the site with far more observations occurring during post construction than pre. These consisted of Dusky Woodswallow, Scarlet Robin and White-fronted Chat. All of these are generally woodland species that would be highly unlikely to fly at RSA. No Superb Parrots were observed during BUS.

Post-construction BUS indicates that diversity of species remains the largely same in comparison with pre construction, however, it also indicates that abundance of species is significantly lower during post construction.

5 References

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Appendix 2: Bird and Bat mortality data obtained during the first 24 months of monitoring

Date	Common Name	Scientific Name	Carcass type	Threatened Status	Find Reference	Turbine number	Distance from turbine (m)	Bearing from turbine (°)	Notes
24/03/2021	Australian Magpie	<i>Cracticus tibicen</i>	Bird	None	C21.3.1	19	116	126	>3 days, end of wing
24/03/2021	Little Red Flying Fox	<i>Pteropus scapulatu</i>	Bat	None	C21.3.3	28	118	310	Heavily scavenged, ribcage back, forearm splintered >3days
24/03/2021	White-striped Free tail bat	<i>Tadarida australis</i>	Bat	None	C21.3.2	24	95	258	None
25/03/2021	Gould's Wattled Bat	<i>Chalinolo busgouldii</i>	Bat	None	C21.3.4	6	48	230	Heavily decomposed, most fur missing
26/03/2021	Large Forest Bat	<i>Vespadelus darlingtoni</i>	Bat	None	C21.3.5	15	35	120	no signs of trauma
27/03/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS21.3.1	25	48	165	Scattered primary feathers and some body feathers >3days
29/03/2021	White-striped Free tail bat	<i>Tadarida australis</i>	Bat	None	C21.3.6	8	29	120	intact <24hours
27/04/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS21.4.1	13	24	140	colouring and size indicate crimson rosella, >3days
27/04/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS21.4.2	14	110	250	colouring and size indicate crimson rosella, >3days
24/05/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS21.5.1	11	88	120	Colouring indicate juvenile CR
25/05/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS21.5.2	13	69	100	colouring and size indicate crimson rosella
25/05/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS21.5.3	13	99	25	Most likely same feathers spread out by strong winds
26/05/2021	Australian Magpie	<i>Cracticus tibicen</i>	Feather Spot	None	FS21.5.4	25	56	180	>3 days
27/05/2021	Australian Magpie	<i>Cracticus tibicen</i>	Feather Spot	None	FS21.5.5	25	44	0	>3 days
23/06/2021	Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	Bird	None	C21.6.1	6	60	180	Black back and top of wings, white belly, webbed feet <70cm in size, Headless
27/09/2021	Laughing Kookaburra	<i>Dacelo novaeguinea</i>	Bird	None	C.21.09.1	18	8	150	>3 days, adult.
18/10/2021	Australian Magpie	<i>Cracticus tibicen</i>	Bird	None	C.21.10.2	14	42	100	Only one wing remaining.
18/10/2021	Black-shouldered Kite	<i>Elanus axillaris</i>	Bird	None	C.21.10.1	7	78	45	>3 days, adult.
19/10/2021	Australian Magpie	<i>Cracticus tibicen</i>	Bird	None	C.21.10.3	22	59	310	Only one wing remaining.
19/10/2021	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Bird	None	C.21.10.4	16	33	100	Only feathers and a few bone remnants remaining.
19/10/2021	Unidentified microbat	<i>Unidentified</i>	Bat	NA	C.21.10.5	16	58	185	Very old; too deteriorated to identify species. Forearm length 36 mm.
20/10/2021	Nankeen Kestrel	<i>Falco cenchroides</i>	Bird	None	C.21.10.6	7	42	155	>3 days old; head, wings, and one leg remaining.
16/11/2021	Brown Goshawk	<i>Accipiter fasciatus</i>	Bird	None	C.21.11.1	16	65	215	Very old and scavenged. Parts of wings, tail feathers, ad feet remaining. Barred primaries.
17/11/2021	Australian Wood Duck	<i>Chenonetta jubata</i>	Bird	None	C.21.11.2	7	66	40	Only one wing remaining. Wing in good condition.
18/11/2021	Nankeen Kestrel	<i>Falco cenchroides</i>	Bird	None	C.21.11.3	8	96	200	Only few feathers and part of body remaining.
14/12/2021	Unidentified bird sp.	NA	Feather Spot	NA	FS.21.12.1	14	50	90	A small clump of small brown feathers, including small flight feathers.
15/12/2021	Australian Magpie	<i>Cracticus tibicen</i>	Bird	None	C.21.12.1	16	71	140	Some bones, end of wing with feathers attached.
16/12/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS.21.12.2	13	34	90	A clump of long flight/tail feathers. Not collected.
16/12/2021	Large Forest Bat	<i>Vespadelus darlingtoni</i>	Bat	None	C.21.12.2	10	23	130	Adult, <24 hours since death
19/01/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	None	C.22.1.1	9	25	225	Bearing estimated (SW recorded). Ribcage and wings remain.
19/01/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	None	C.22.1.2	9	36	335	One leg and some tail feathers remaining.
19/01/2022	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS.22.1.2	25	60	90	Several wing feathers attached.
19/01/2022	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Feather Spot	None	FS.22.1.1	9	33	130	Bearing estimated (SE recorded). 20+ feathers
20/01/2022	White-striped Freetail bat	<i>Tadarida australis</i>	Bat	None	C.22.1.3	8	13	30	Intact, fresh. Free-tail.
21/01/2022	White-striped Freetail bat	<i>Tadarida australis</i>	Bat	None	C.22.1.4	8	18	260	Intact. 1-2 days old.
21/02/2022	White-striped Free tail bat	<i>Tadarida australis</i>	Bat	None	C.22.2.1	19	38	50	Intact. Fresh.
22/02/2022	Australian Ibis	<i>Threskiornis moluccus</i>	Feather Spot	None	FS.22.2.1	2	27	105	5-6 grey and white down feathers.
22/02/2022	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	Bat	None	C.22.2.3	1	14	230	Tiny microbat. > 1 day old. FA 34
22/02/2022	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	Bat	None	C.22.2.6	2	24	285	Fresh. FA 36.

Date	Common Name	Scientific Name	Carcass type	Threatened Status	Find Reference	Turbine number	Distance from turbine (m)	Bearing from turbine (°)	Notes
22/02/2022	Little Forest Bat	<i>Vespadelus vulturnus</i>	Bat	None	C.22.2.7	2	21	330	Fresh. FA 33.
22/02/2022	White-striped Free tail bat	<i>Tadarida australis</i>	Bat	None	C.22.2.2	1	10	130	Old, > 3 days
22/02/2022	White-striped Free tail bat	<i>Tadarida australis</i>	Bat	None	C.22.2.4	2	37	200	Fresh, < 1 day old.
22/02/2022	White-striped Free tail bat	<i>Tadarida australis</i>	Bat	None	C.22.2.5	2	8	130	Fresh, < 1 day old.
23/02/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	None	C.22.2.10	9	2	5	Magpie head. Old. Scattered feathers around.
23/02/2022	Brown Goshawk	<i>Accipiter fasciatus</i>	Bird	None	C.22.2.9	7	40	310	Very old and scavenged, >3 days. A few inner feathers and bones remaining.
23/02/2022	Southern Forest Bat	<i>Vespadelus regulus</i>	Bat	None	C.22.2.8	7	11	160	Old, > 1 day. Chocolate brown fur on back. FA 34.
23/02/2022	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Feather Spot	None	FS.22.2.2	9	48	35	More than 10 feathers.
24/02/2022	Southern Forest Bat	<i>Vespadelus regulus</i>	Bat	None	C.22.2.11	31	14	310	FA 31 mm.
24/02/2022	Unidentified microbat	NA	Bat	NA	C.22.2.12	14	95	110	FA 45
25/02/2022	Forest Bat sp.	<i>Vespadelus sp.</i>	Bat	NA	C.22.2.15	17	55	165	Very old, > 3 days. Part of one wing and part of body remaining. No head. FA indistinguishable
25/02/2022	Unidentified bird sp.	NA	Bird	NA	C.22.2.13	22	-	240	Just one blue, green and grey wing.
25/02/2022	White-striped Free tail bat	<i>Tadarida australis</i>	Bat	None	C.22.2.14	22	-	131	None
29/03/2022	Brown Goshawk	<i>Accipiter fasciatus</i>	Bird	NA	C.22.3.1	7	32	10	About 20 wing feathers and part of body remaining. Old
5/04/2022	Forest Bat sp.	<i>Vespadelus sp.</i>	Bat		C.22.3.3	28	8	105	FA 35mm. > 1 day old.
5/04/2022	White-striped Free tail bat	<i>Tadarida australis</i>	Bat	None	C.22.3.2	27	2	190	Fresh, intact. <1 day old.
5/04/2022	White-striped Free tail bat	<i>Tadarida australis</i>	Bat	None	INC.22.3.1	1	48	220	>3 days old. Found and reported by wind farm staff.
6/04/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	C.22.3.4	23	55	260	1-3 days old. Partial decomposed/scavenged.
6/04/2022	Forest Bat sp.	<i>Vespadelus sp.</i>	Bat	NA	INC.22.3.2	22	4	150	FA 35. Found and reported by wind farm staff.
6/04/2022	White-striped Free tail bat	<i>Tadarida australis</i>	Bat	None	C.22.3.5	29	18	140	Fresh, <1 day old, intact
6/04/2022	White-striped Free tail bat	<i>Tadarida australis</i>	Bat	None	INC.22.3.3	22	4	150	1 day old. Found and reported by wind farm staff.
7/04/2022	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Feather Spot	NA	FS.22.3.1	2	59	290	20 + feathers.
27/04/2022	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	NA	FS.22.4.1	25	52	NA	20-30 wing and inner feathers.
27/04/2022	White-striped Freetail Bat	<i>Tadarida australis</i>	Bat	None	C.22.4.1	20	48	160	Fresh, intact.
28/04/2022	Black-shouldered Kite	<i>Elanus axillaris</i>	Bird	NA	C.22.4.2	10	24	250	Wings and legs remaining.
28/04/2022	Common Starling	<i>Sturnus vulgaris</i>	Bird	NA	C.22.4.3	12	54	230	Mostly intact, 1-3 days old. Raining at time of collection.
28/04/2022	White-striped Freetail Bat	<i>Tadarida australis</i>	Bat	None	C.22.4.5	9	0	210	Inside the fence enclosing the base of the turbine.
28/04/2022	White-striped Freetail bat	<i>Tadarida australis</i>	Bat	None	C.22.4.4	15	23	0	No sign of injury. <1 day old.
18/05/2022	Black-shouldered Kite	<i>Elanus axillaris</i>	Bird	NA	C.22.5.2	19	85	324	> 3 days old. Mostly wing feathers and bones remaining.
18/05/2022	Gould's Wattled Bat	<i>Chalinolo busgouldii</i>	Bat	NA	C.22.5.1	23	95	222	>3 days, decayed and quite wet from rain. FA 45mm.
19/05/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	C.22.5.3	12	94	150	Wings and part of body remaining. > 3 days
19/05/2022	Little Corella	<i>Cacatua sanguinea</i>	Feather Spot	NA	FS.22.5.1	10	26	230	About 5 feathers. Too few feathers to confidently ID. Size and white colour indicated Little Corella.
23/06/2022	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	NA	FS.22.6.1	1	79	305	7+ feathers
23/06/2022	Wille Wagtail	<i>Rhipidura leucophrys</i>	Bird	None	C.22.6.1	1	49	265	Mostly intact, old, more than 3 days
18/07/2022	Nankeen Kestrel	<i>Falco cenchroides</i>	Bird	NA	C.22.7.1	12	14	225	Wings and one leg remaining. >3 days.
19/07/2022	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Feather Spot	NA	FS.22.7.1	2	58?	10?	Several weeks old.
19/07/2022	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Feather Spot	NA	FS.22.7.2	2	84?	10?	Less than a week old, some flesh still attached.
20/07/2022	Black-shouldered Kite	<i>Elanus axillaris</i>	Bird	NA	C.22.7.3	22	111	220	Wings and two legs remaining. >3 days.
20/07/2022	Common Starling	<i>Sturnus vulgaris</i>	Bird	NA	C.22.7.2	25	57?	280?	> 3 days old. No flesh on skull, part of beak missing. One leg remaining.
21/07/2022	Brown Goshawk	<i>Accipiter fasciatus</i>	Bird	NA	C.22.7.4	3	60	70	> 3 days old

Date	Common Name	Scientific Name	Carcass type	Threatened Status	Find Reference	Turbine number	Distance from turbine (m)	Bearing from turbine (°)	Notes
21/07/2022	Crimson Rosella	<i>Platycercus elegans</i>	Bird	NA	C.22.7.5	3	70	230	> 3 days old
9/08/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	INC.22.8.1	24	5	E	Found and reported by wind farm staff. Scavenged.
16/08/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	C.22.8.2	22	20	225	1 day old. Injury on chest.
16/08/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	C.22.8.3	22	117	205	1-3 days old. Injury on chest.
16/08/2022	Black-shouldered Kite	<i>Elanus axillaris</i>	Bird	NA	C.22.8.1	19	43	120	> 3 days old. Two wings, skull, and ribs remaining.
17/08/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	C.22.8.4	11	120	235	Fresh, <1 day old, intact.
17/08/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	C.22.8.6	12	33	185	>3 days, scavenged. Two wings, beak, and scattered feathers remaining.
17/08/2022	Tawny Frogmouth	<i>Podargus strigoides</i>	Bird	NA	C.22.8.5	4	84	104	>3 days old. Feathers and bones intact, no flesh remaining.
18/08/2022	Galah	<i>Eolophus roseicapillus</i>	Feather Spot	NA	FS.22.8.1	16	66	200	Four primary feathers and 2-3 down feathers.
5/09/2022	Australian Wood Duck	<i>Chenonetta jubata</i>	Feather Spot	None	FS.22.9.1	10	49	25	Mostly inner feathers, couple of wing feathers. Spread out across 1 m.
5/09/2022	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Bird	None	C.22.9.1	9	48	SE	> 3 days old, A few feathers and skull remaining.
7/09/2022	Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	Bird	None	C.22.9.2	28	28	31	Very fresh, < 1 day old. Broken neck.
7/09/2022	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Feather Spot	None	FS.22.9.2	28	44	S	20 + feathers scattered.
7/09/2022	Wedge-tailed Eagle	<i>Aquila audax</i>	Bird	None	C.22.9.3	31	31	SW	One foot. A single WTE feather has been found at the same turbine each of the last two previous searches, likely all part of the same very old carcass.
9/09/2022	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS.22.9.3	25	60	350	Old. Primary feathers, some secondary.
9/09/2022	Forest Bat sp.	<i>Vespedelus sp.</i>	Bat	None	C.22.9.4	25	30	5	Fresh. Mostly intact. No injuries apparent. Forearm 34-35mm.
18/10/2022	Brown Falcon	<i>Falco berigora</i>	Bird	None	C.22.10.2	7	59	20	Adult, scavenged, > 3 days.
18/10/2022	White-striped Freetail bat	<i>Tadarida australis</i>	Bat	None	C.22.10.1	24	3	245	> 3 days. Broken wing
19/10/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	None	C.22.10.3	12	32	165	> 3 days old. Some wing feathers and bones remaining.
19/10/2022	Galah	<i>Eolophus roseicapillus</i>	Feather Spot	None	FS.22.10.1	16	70	161	> 3 days old.
19/10/2022	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Feather Spot	None	FS.22.10.2	15	119	275	None
19/10/2022	Unidentified bird sp.	NA	Bird	NA	C.22.10.4	12	33	225	Mostly inner feathers remaining, not enough for conclusive identification.
20/10/2022	Nankeen Kestrel	<i>Falco cenchroides</i>	Bird	None	C.22.10.5	13	75	332	Adult. Just two wings and leg. < 3 days.
20/10/2022	Nankeen Kestrel	<i>Falco cenchroides</i>	Bird	None	C.22.10.7	4	43	62	> 3 days old.
20/10/2022	White-striped Freetail Bat	<i>Tadarida australis</i>	Bat	None	C.22.10.6	13	12	325	Fresh. < 3 days.
16/11/2022	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS.22.11.1	28	16	258	Many feathers in long grass
16/11/2022	Unidentified bird sp.	NA	Bird	NA	C.22.11.1	25	69	130	Old, quite disintegrated.
17/11/2022	Crimson Rosella	<i>Platycercus elegans</i>	Bird	None	INC.22.11.1	1	125	263	Many feathers two wings
17/11/2022	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS.22.11.2	28	44	50	A few wing feathers nestled in long grass next to hardstand.
17/11/2022	Forest Bat sp.	<i>Unidentified</i>	Bat	NA	C.22.11.2	27	19	90	Fresh, intact but maggots present. FA 29 mm.
17/11/2022	Nankeen Kestrel	<i>Falco cenchroides</i>	Bird	None	C.22.11.3	27	59	180	>3 days old. Mostly just wing remaining.
25/11/2022	Nankeen Kestrel	<i>Falco cenchroides</i>	Bird	None	C.22.11.1	2	24	190S	approx. 7 days. Wing + partial body present, wing - 17 cm
13/12/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	None	C.1.22.12.T1	1	85	NE	significant decay, still moist
13/12/2022	Nankeen Kestrel	<i>Falco cenchroides</i>	Feather Spot	None	FS.22.12.1	26	34	66	Feather spot on gravel base, group of tail feathers 2m away from rest of feathers
13/12/2022	Unidentified bird sp.	NA	Feather Spot	NA	FS.2.22.12.T1	1	80	NE	white feathers
14/12/2022	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS.22.12.3	18	22	210	Found in 3 clumps on bare/grass/weedy ground
14/12/2022	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS.22.12.4	18	73	100	found in between trees in long grass, not a large amount of feathers so probably been there a while
14/12/2022	Laughing Kookaburra	<i>Dacelo novaeguinea</i>	Bird	None	C.22.12.2	24	96	175	found in long grass only half of body, lots of feathers around, looks to be adult
9/01/2023	Australian Magpie	<i>Cracticus tibicen</i>	Feather Spot	None	FS.23.1.1	29	105	253W	Feathery spot, no body

Date	Common Name	Scientific Name	Carcass type	Threatened Status	Find Reference	Turbine number	Distance from turbine (m)	Bearing from turbine (°)	Notes
9/01/2023	Australian Magpie	<i>Cracticus tibicen</i>	Feather Spot	None	FS.23.1.2	29	102	245SW	Feathery spot, no body
9/01/2023	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS.23.1.3	30	114	255W	Feathery spot, no body
10/01/2023	Australian Magpie	<i>Cracticus tibicen</i>	Feather Spot	None	FS.23.1.4	31	101		Feathery spot, no body
11/01/2023	Nankeen Kestrel	<i>Falco cenchroides</i>	Bird	None	C.23.1.1	7	60	352W	Lower body bones present, <10 days
11/01/2023	Nankeen Kestrel	<i>Falco cenchroides</i>	Bird	None	C.23.1.3	5	71		Approx. 7 days old
11/01/2023	White-striped Freetail Bat	<i>Tadarida australis</i>	Bat	None	C.23.1.2	2	12	0N	Forearm 7.2cm, Approx. 3 days old
13/01/2023	White-striped Freetail Bat	<i>Falco cenchroides</i>	Bat	None	C.23.1.4	3	12	338N	<3 days old
6/02/2023	Australian Magpie	<i>Cracticus tibicen</i>	Feather Spot	None	FS.23.2.1	28	93	233SW	None
6/02/2023	White-striped Freetail Bat	<i>Tadarida australis</i>	Bat	None	C.23.2.1	24	92	84E	<8hr old, forearm=6cm
7/02/2023	Little Corella	<i>Cacatua sanguinea</i>	Feather Spot	None	FS.23.2.2	9	122	293NW	One clump of attached large feathers
8/02/2023	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	Bat	None	C.23.2.3	2	12	217SW	<2 days old, forearm=3.5cm
8/02/2023	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	Bat	None	C.23.2.2	3	44	112SE	<1 day old, forearm=4cm
8/02/2023	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	Bat	None	C.23.2.5	1	10	51NE	<2 days old, forearm=3.5cm
8/02/2023	White-striped Freetail Bat	<i>Tadarida australis</i>	Bat	None	C.23.2.4	1	12	293NW	<3 days old, forearm=7cm
8/02/2023	White-striped Freetail Bat	<i>Tadarida australis</i>	Bat	None	C.23.2.6	22	48	305NW	<3 days old, forearm~7cm
13/02/2023	Australian Magpie	<i>Cracticus tibicen</i>	Feather Spot	None	FS.23.2.3	24	56	301NW	Feathery spot, no body
13/02/2023	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	Bat	None	C.23.2.7	22	12	165S	1-2 days old, forearm=2.5cm
13/02/2023	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	Bat	None	C.23.2.8	11	36	38NE	<2 days old, forearm~3cm
8/03/2023	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	Bat	None	C.23.3.2	11	35	61NE	<12 hrs, forearm- 3.1cm, small injury on its back
8/03/2023	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Feather Spot	None	FS.23.3.1	12	20	101E	6-10 feathers found
8/03/2023	Unidentified microbat	NA	Bat	NA	C.23.3.1	15	1	180S	>5 days, on platform of T15, shown by workers, stuck to metal, FA 3.5 cm
9/03/2023	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	None	FS.23.3.2	15	48	80E	Approx 10 feathers
10/03/2023	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	Bat	None	C.23.3.3	10	6	183S	fresh body, less than 2 hrs
19/04/2023	Gray Fantail	<i>Rhipidura albiscapa</i>	Bird	None	C.23.4.1	2	49	90	found under large eucalypt at edge of woodland, adult bird
20/04/2023	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	Bat	None	C.23.4.3	22	17	349	FA = 3cm, >3 days old
20/04/2023	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	Bat	None	C.23.4.2	8	48	151	FA = 3.5cm, <12hr old
21/04/2023	Unidentified microbat	NA	Bat	None	C.23.4.4	18	48	11	>3 days old, FA = 4cm, found in long grass
26/04/2023	Spotted Pardalote	<i>Pardalotus punctatus</i>	Bird	None	C.23.4.5	28	26	182	<2 days old, female