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Crudine Ridge Wind Farm Bird and Bat Adaptive Management Plan Implementation Report Year Three

Squadron Energy

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Abbreviations

Abbreviation	Description
BBAMP	Bird and Bat Adaptive Management Plan
BC Act	<i>Biodiversity Conservation Act 2016</i>
BCS	NSW Biodiversity, Conservation and Science Group of the NSW Department of Climate Change, Energy, the Environment and Water
BUS	Bird utilisation Surveys
CRWF	Crudine Ridge Wind Farm
ELA	Eco Logical Australia Pty Ltd
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
Cwth DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DPE	NSW Department of Planning and Environment (now DPHI)
DPHI	NSW Department of Planning, Housing and Infrastructure
MNES	Matters of National Environmental Significance
NSW	New South Wales
RSA	Rotor swept area
SSD	State Significant Development

1. Introduction

Eco Logical Australia (ELA) was engaged by Squadron Energy (formerly CWP Renewables) for the Year Three implementation of the Bird and Bat Adaptive Management Plan (BBAMP) for the Crudine Ridge Wind Farm (CRWF) project. This report details the results of Year Three operational phase monitoring, that was undertaken from October 2023 to July 2024.

1.1. Background

CRWF is located 45 kilometres south of Mudgee and 45 kilometres north of Bathurst in the central tablelands of New South Wales (NSW).

In May 2016, the NSW Department of Planning and Environment (DPE; now NSW Department of Planning, Housing and Infrastructure (DPHI)) issued approval for the CRWF project, approving up to 77 turbines. The Commonwealth Minister for the Department of Climate Change, Energy, the Environment and Water (Cwth DCCEEW) issued approval of up to 37 turbines on 4 April 2017, selected from 57 approved turbine locations, under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The overall aim of the BBAMP is to provide a program for monitoring the impacts on birds and bats and a strategy for managing and mitigating any significant impacts arising from the operation of CRWF. Specific BBAMP objectives are outlined below (see Section 1.3, CRWF BBAMP 2017).

- To provide baseline data on bird and bat populations that could potentially be affected by the CRWF, particularly identified at-risk species and groups.
- To implement a monitoring program capable of detecting any significant changes to the population of 'at-risk' birds and bats that can reasonably be attributed to the operation of the project.
- To directly record impacts on birds and bats through a robust carcass search sampling protocol and prompt carcass removal.
- To document an agreed decision-making framework that outlines the specific actions to be taken and possible mitigation measures implemented to understand and reduce any impacts on bird and bat populations, or in the event that an impact trigger is detected.
- To detail specific monitoring for 'at-risk' bird and bat groups.
- Minimising raptor activity in the area through controlling pests and minimising availability of raptor perches.
- Using best practice methods for bat deterrence; including managing potential lighting impacts.
- To detail specific and potential mitigation measures and related implementation strategies to mitigate any detected significant impacts on birds and bats.
- To identify matters to be addressed in periodic internal reports on the outcomes of monitoring, the application of the decision-making framework, mitigation measures adopted and their result/s.

1.2. Purpose of this monitoring reports

Squadron Energy developed a BBAMP (CRWF BBAMP 2017) to satisfy the requirements of Condition 22, Schedule 3 of the NSW State Significant Development (SSD) 6697 Conditions of Consent. The BBAMP was also prepared to satisfy Condition 1 (a) of the Commonwealth Approval EPBC Ref: 2011/6206. Implementation of the approved BBAMP is required in accordance with Condition 22, Schedule 3 of the NSW SSD6697 and Condition 9 of Commonwealth Approval EPBC Ref: 2011/6206.

Following the completion of Year One and Year Two of BBAMP implementation monitoring, a revised monitoring program was submitted to the NSW Biodiversity, Conservation and Science Group of the NSW Department of Climate Change, Energy, the Environment and Water (BCS) as part of the Year Two annual BBAMP report. BCS provided written support of the revised monitoring program on 16 August 2023, with the ongoing monitoring comprising the following components:

- Seasonal carcass monitoring undertaken during the middle month of each season (i.e. January, April, July, October) across all 37 turbines, within a 60 m radius inner search zone of each turbine.
- Incidental carcass monitoring and collection carried out by CRWF operational staff.
- Raptor, threatened and migratory species flight path tracking during seasonal monitoring.
- Targeted surveys for raptor breeding activity during winter (July) and spring (October) across the CRWF site and within 2 km of the site.

The Commonwealth DCCEEW also provided agreement to the revised monitoring program as part of an updated BBAMP, on 17 July 2024.

Table 1 below outlines the specific statutory requirements of the BBAMP which underlie the operational phase monitoring program and the associated methodology and performance measures applicable to the monitoring undertaken during Year Three of the BBAMP implementation.

Table 1: Statutory requirements of the BBAMP and their relevant methods of assessment and performance measures

Statutory Requirements	Performance Measures	Assessment Methodology	How Condition is fulfilled
NSW SSD6697 Conditions of Consent, Schedule 3			
Condition 22(c): include a detailed program to monitor and report on: <ul style="list-style-type: none"> • the effectiveness of these measures and plans; and • bird and bat strike annually, or as otherwise directed by the Secretary. 	Operational phase mortality surveys undertaken quarterly at all 37 turbines for at least two years, with a review after Year 4 to determine if a change in the methodology is required.	Carcass monitoring	Recording and notification of relevant triggers as detailed below. Threatened species: A bird or bat species (or recognisable parts thereof) listed as threatened (not migratory) under the Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> or NSW <i>Threatened Species Conservation Act 1995</i> (now BC Act), is found dead or injured within 150 m of a wind turbine during any mortality search or incidentally by wind farm personnel (Section 6.1.1, CRWF BBAMP 2017). Non-threatened species: A total of four or more bird or bat

Statutory Requirements	Performance Measures	Assessment Methodology	How Condition is fulfilled
			carcasses or parts thereof, of the same nonthreatened species are recorded at the same turbine over two successive monitoring events (excluding ravens, magpies, sulphur-crested cockatoos, corellas, and introduced species) (Section 6.2.1, CRWF BBAMP 2017).
Commonwealth Approval – EPBC Ref: 2011/6206			
Condition 1 (a): implement the above NSW Conditions of Approval, where Management Plans: means the Biodiversity Management Plan, Biodiversity Offsets Management Plan, and Bird and Bat Adaptive Management Plan.	As above	As above	As above

Table 2 below outlines the specific statutory requirements of the BBAMP were completed in Year One and Year Two of operational phase monitoring program. As, such these monitoring activities are closed and not applicable to Year Three of the BBAMP implementation.

Table 2: Statutory requirements of the BBAMP and their relevant methods of assessment and performance measures completed in Year One and Year Two of operational phase monitoring

Statutory Requirements	Performance Measures	Assessment Methodology	Triggers for investigation
NSW SSD6697 Conditions of Consent, Schedule 3			
Condition 22(b): develop a Bird and Bat Adaptive Management Plan (BBAMP) that includes: <ul style="list-style-type: none"> Baseline data on bird and bat populations in the locality that could potentially be affected by the development, particularly ‘at risk’ species and threatened species; A detailed description of the measures that would be implemented on site for minimising bird and strike during operation of the development. 	Baseline bird and bat surveys completed; Bird Utilisation Surveys (BUS) (operational phase) undertaken in Year One as detailed in the BBAMP; Detail mitigation measures in approved BBAMP.	Completion of baseline surveys as per the methodology specified in Section 2.1.1 of the CRWF BBAMP	Completion of baseline surveys. Completion of operational phase surveys.

Statutory Requirements	Performance Measures	Assessment Methodology	Triggers for investigation
<p>Condition 22(c): include a detailed program to monitor and report on:</p> <ul style="list-style-type: none"> the effectiveness of these measures and plans; and bird and bat strike annually, or as otherwise directed by the Secretary. 	<p>Scavenger and detector efficiency trials undertaken in Year One (Table 12, CRWF BBAMP 2017).</p>	<p>Scavenger and detector efficiency (observer) trials</p>	<p>Scavenger and observer trials successfully undertaken</p>

2. Methods

2.1. Seasonal carcass monitoring

In Year Three, quarterly (seasonal) carcass monitoring was implemented at all 37 turbines listed in Table 3 below. Carcass searches were undertaken via transects spaced every six metres, within a search area of 60 m radius from each turbine (Figure 1), targeting the detection of carcasses of bat and bird species. The monitoring was conducted over three to four field days in October 2023, January, April and July 2024, by ELA ecologists trained in the carcass search methodology and experienced with regards to the bat and bird species of the NSW central tablelands.

Table 3: Turbines visited during carcass monitoring

	Pyramul turbine cluster		Sallys Flat turbine cluster
A1	A17	A34	A87
A2	A20	A35	A89
A4	A21	A38	A94
A6	A22	A43	A95
A7	A23	A44	A100
A8	A24	A47	A102
A9	A26	A52	A103
A10	A29		A104
A13	A31		A105
A14	A32		A106

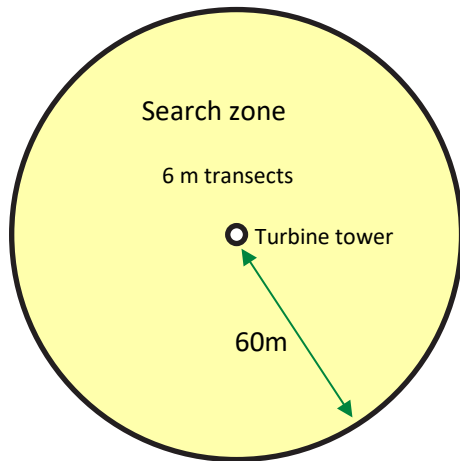


Figure 1: 60m carcass search zones underneath the turbines

For each carcass detected, the following variables were recorded in the carcass search data sheet:

- GPS position, distance in metres and compass bearing of the carcass from the wind turbine tower.
- Substrate and vegetation beneath the carcass (e.g. hard-stand, long grass)
- Species, age, number, sex (if possible), signs of injury and estimated date of strike
- Weather (including recent extreme weather events, if any), visibility, maintenance to the turbine and any other factors that may affect carcass discovery; and
- notification of ecologists within two business days of the find for identification.

2.2. Incidental carcass monitoring and collection

All bird and bat carcasses found incidentally by wind farm personnel were recorded and photographed and data collected consistent with the carcass detection protocol outlined in the above paragraph. Data and photographs were shared with ELA ecologists for identification, with ELA advising whether the carcass should be stored in the onsite freezer or disposed of (where identification had been determined and the species was non-threatened).

2.3. Raptor, threatened and migratory species flight path tracking

The flight paths of raptors and listed threatened and migratory species (e.g. *Hirundapus caudacutus* (White-throated Needletail)) were actively recorded during all field surveys completed during Year Three monitoring. This includes during both seasonal (January, April, July and October) carcass monitoring and targeted breeding surveys in July and October. The following information was recorded for each raptor, threatened and migratory species flight observed during field surveys:

- Date, location and duration of observation period
- Time and duration of flight
- Number and age of birds observed

- Flight height above ground
- Flight height relative to turbine: below Rotor Swept Area (RSA), within RSA, above RSA
- Flight behaviour (e.g. flapping, kiting, circling, gliding or diving)
- Habitat over which the flight was observed
- Other occasional behaviours observed and to be recorded may include feeding, terrestrial displays, fighting and perching.

2.4. Targeted raptor breeding surveys

Roaming searches were undertaken within a 2 km buffer of the wind farm footprint (see Figure 4) to identify raptor nests during the typical breeding season of *Aquila audax* (Wedge-tailed Eagle) from July to November (Squadron Energy 2017). This corresponded to the survey periods in October 2023 and July 2024 during the Year Three monitoring program. Targeted search areas within the 2 km buffer were the focus of these breeding surveys based upon records of raptor activity, including the location of adult pairs, and suitable breeding habitat (Figure 4). Suitable breeding habitat included mature woodland and dry sclerophyll forest with tall trees in prominent landscape positions, including ridgelines and upper hillsides.

Surveys within the targeted search areas were undertaken on foot to visually identify individual nests, with information regarding location, shape, dimensions and activity (presence/absence/signs of use) documented where nests were recorded. All raptor flight paths, consistent with the methodology described above in Section 2.3, were also recorded during these targeted surveys.

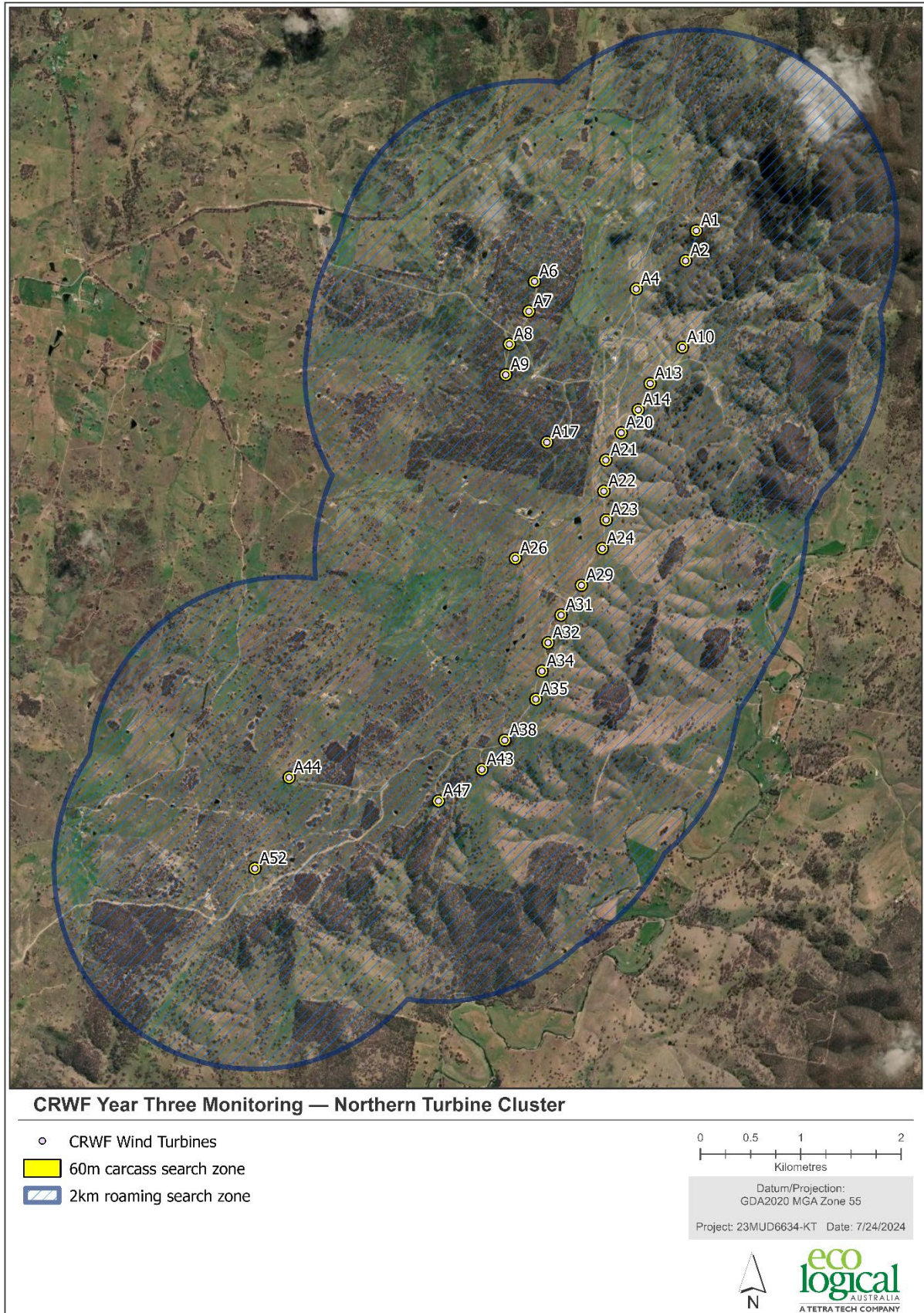


Figure 2: Northern portion (Pyramul cluster) of Year Three monitoring zone

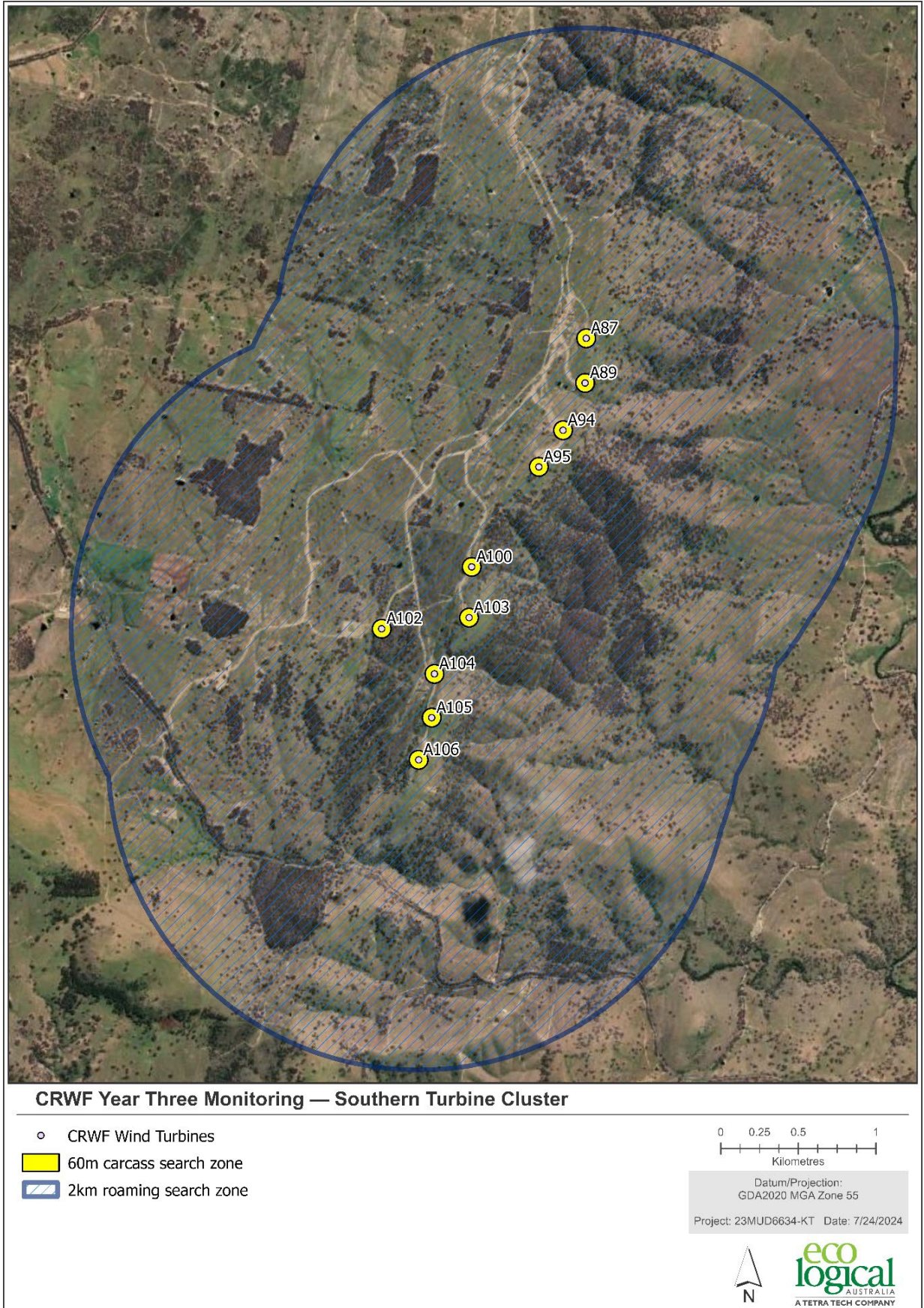


Figure 3: Southern portion (Sallys Flat cluster) of Year Three monitoring zone

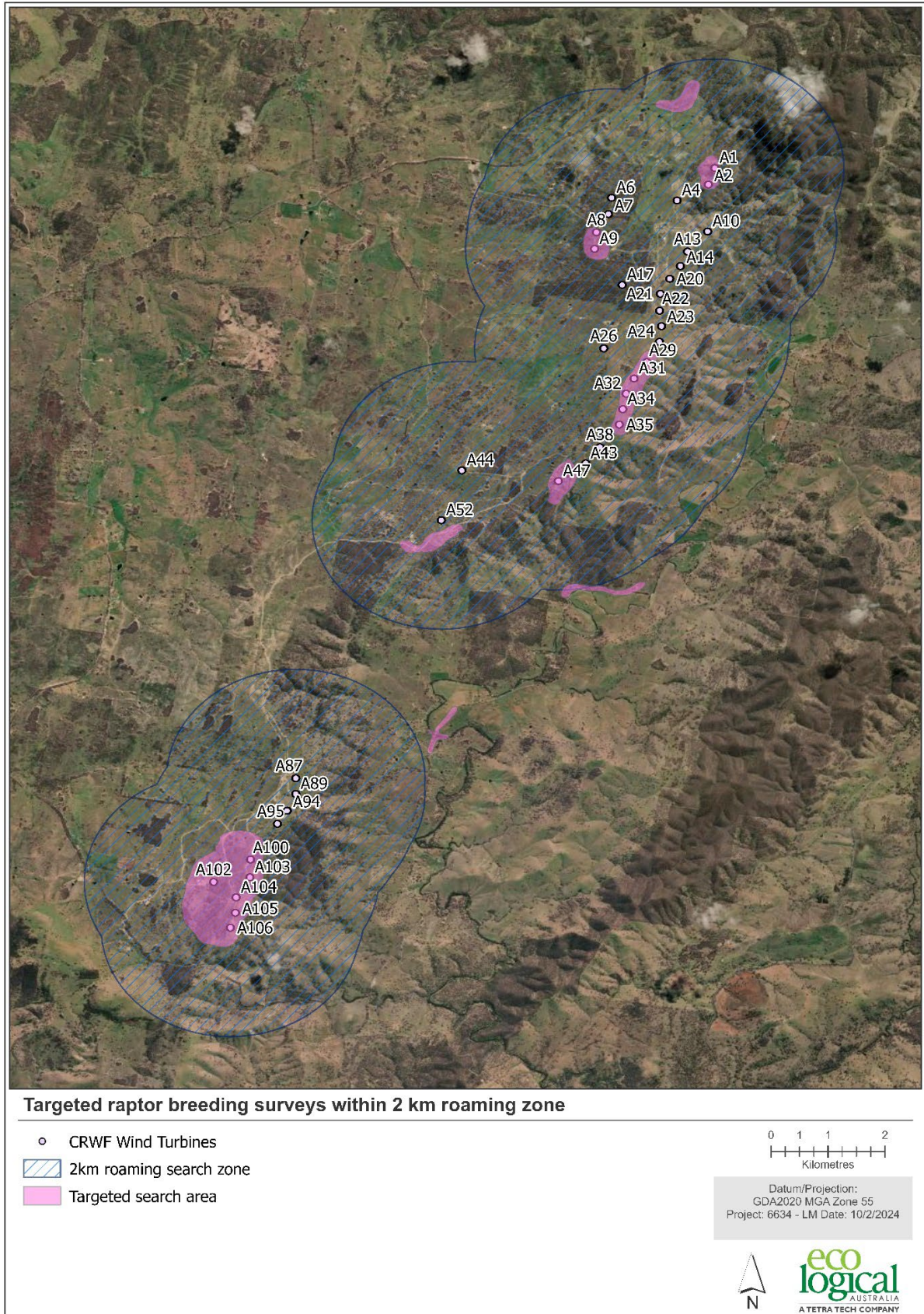


Figure 4: Targeted search zones for raptor breeding activity during Year Three monitoring

3. Results

3.1. Seasonal and incidental carcasses monitoring

A total of 30 bird and eight bat carcasses were recorded during Year Three of the CRWF BBAMP implementation monitoring, inclusive of both formal and incidental monitoring. Bird carcasses were recorded from a total of five bird species, whilst bat carcasses were recorded from three microchiropteran (microbat) species. Three unidentified bird and one unidentified microbat carcasses were also recorded (Table 4).

The most common bird species recorded was Wedge-tailed Eagle, with a total of seventeen carcasses recorded, including the first adult of the species (recorded in July 2024) since the commencement of monitoring. Three *Falco berigora* (Brown Falcon) were recorded, one of which was a juvenile, with no other raptor species recorded. The most common bat species recorded was *Austronomus australis* (White-striped Freetail-bat), with a total of three carcasses recorded. Wedge-tailed Eagle and White-striped Freetail-bat were the only two species recorded during both formal and incidental monitoring, with all other species recorded during formal monitoring only. Locations of carcasses found during the formal monitoring are shown in Figure 5 and Figure 6.

No impact triggers were identified for non-threatened species, as the required four or more carcass threshold for a species at a single turbine over two successive monitoring events, was not exceeded. No listed threatened species were recorded during carcass monitoring, therefore, the threatened species impact trigger was also not exceeded. Detailed carcass monitoring results are presented in Appendix A, with a summary of all carcasses recorded during Year One to Year Three of monitoring presented in Appendix B.

Table 4: Bird and bat carcasses recorded during Year Three of carcass monitoring

Common Name	Scientific Name	Quantity	Turbine location(s)
Birds			
Australian Magpie	<i>Cracticus tibicen</i>	4	A10, A23, A87, A103
Brown Falcon	<i>Falco berigora</i>	3	A7, A23, A29
Magpie-lark	<i>Grallina cyanoleuca</i>	1	A47
Silveryeye	<i>Zosterops lateralis</i>	2	A29, A100
Wedge-tailed Eagle	<i>Aquila audax</i>	17	A21, A22, A23, A34, A35, A38, A47, A52, A89, A104, A106
Unidentified bird	Aves (class)	3	A20, A24, A103
Bats – Microchiroptera			
Gould’s Wattle Bat	<i>Chalinolobus gouldii</i>	2	A32, A106
Little Forest Bat	<i>Vespadelus vulturnus</i>	2	A4, A44
White-striped Freetail-bat	<i>Austronomus australis</i>	3	A10, A23, A94
Unidentified microbat	Microchiroptera (suborder)	1	A47

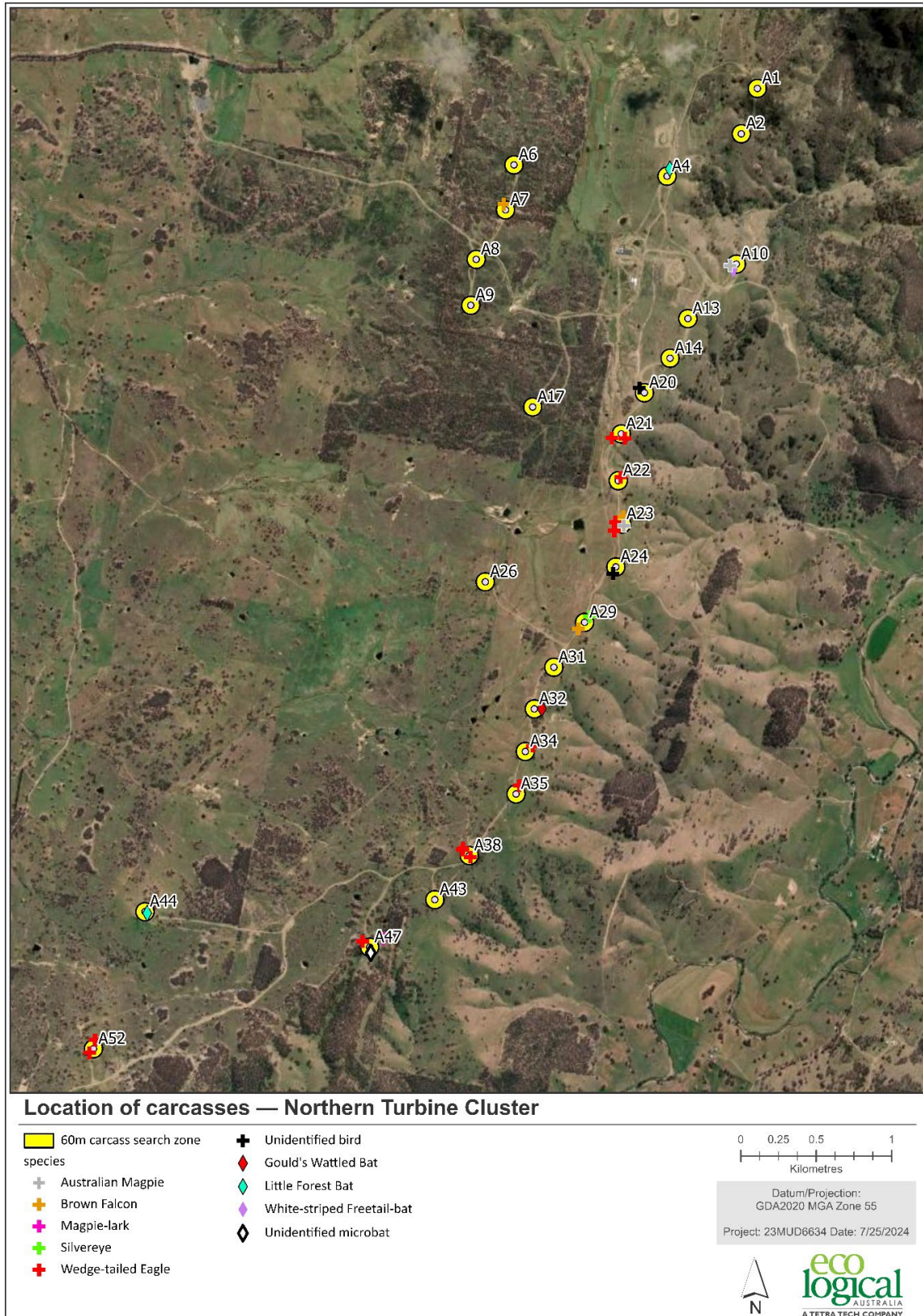


Figure 5: Location of carcasses — Northern turbine cluster

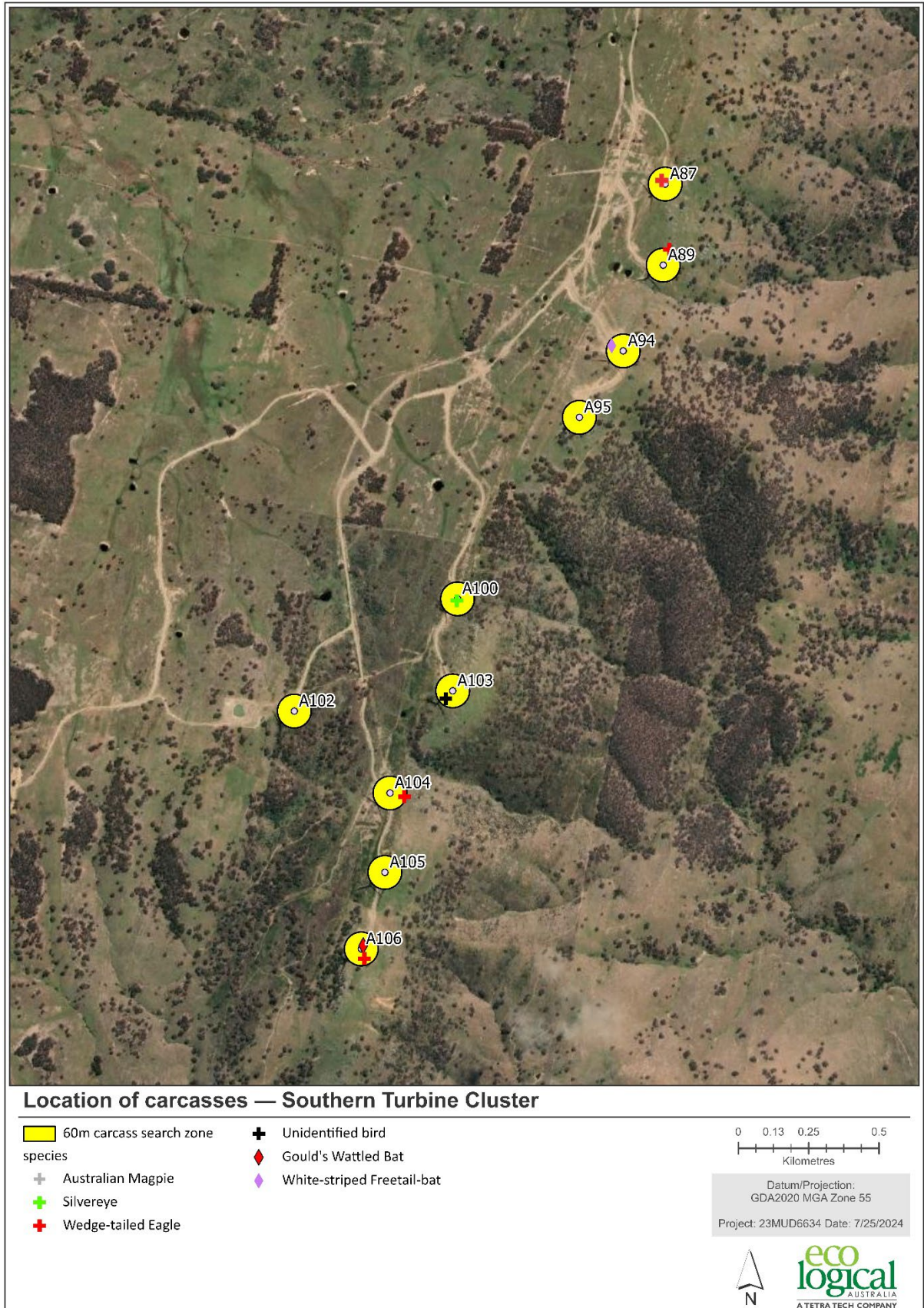


Figure 6: Location of carcasses — Southern turbine cluster

Across Year Three carcass monitoring, the number of bird carcasses recorded peaked during spring 2023, with a total of 14 carcasses recorded (Figure 7). The overall quantities of bird carcasses recorded were similar across summer (eight bird carcasses) and winter (six bird carcasses), whilst autumn 2024 recorded the lowest quantity of carcasses (two bird carcasses). This trend is consistent with Year One when the highest number of carcasses was also recorded in spring (ELA 2022), with spring in Year Two recording the second highest bird carcass count (ELA 2023). Spring is the predominant bird breeding period in south-eastern Australia (Menkhorst et al 2019), including for the two species with the highest recorded carcass numbers across Year One to Year Three monitoring, *Cracticus tibicen* (Australian Magpie) and Wedge-tailed Eagle.

Bat carcasses were less commonly recorded in Year Three compared to bird carcasses, with only three (spring), four (summer) and one (autumn) bat carcasses recorded during quarterly monitoring (Figure 6). The small increase in bat carcasses recorded during summer was likely driven by overall increased microbat activity in south-eastern Australia during the summer period, with this period coinciding with breeding and migratory events of *Vespadelus vulturnus* (Little Forest Bat) and White-striped Freetail-bat (Churchill 2008), which were the two bat species most commonly recorded through Year One to Year Three carcass monitoring. This result of heightened summer microbat mortality was also consistent with Year One and Year Two, during which the summer period also recorded the higher number of bat carcasses (ELA 2022; ELA 2023).

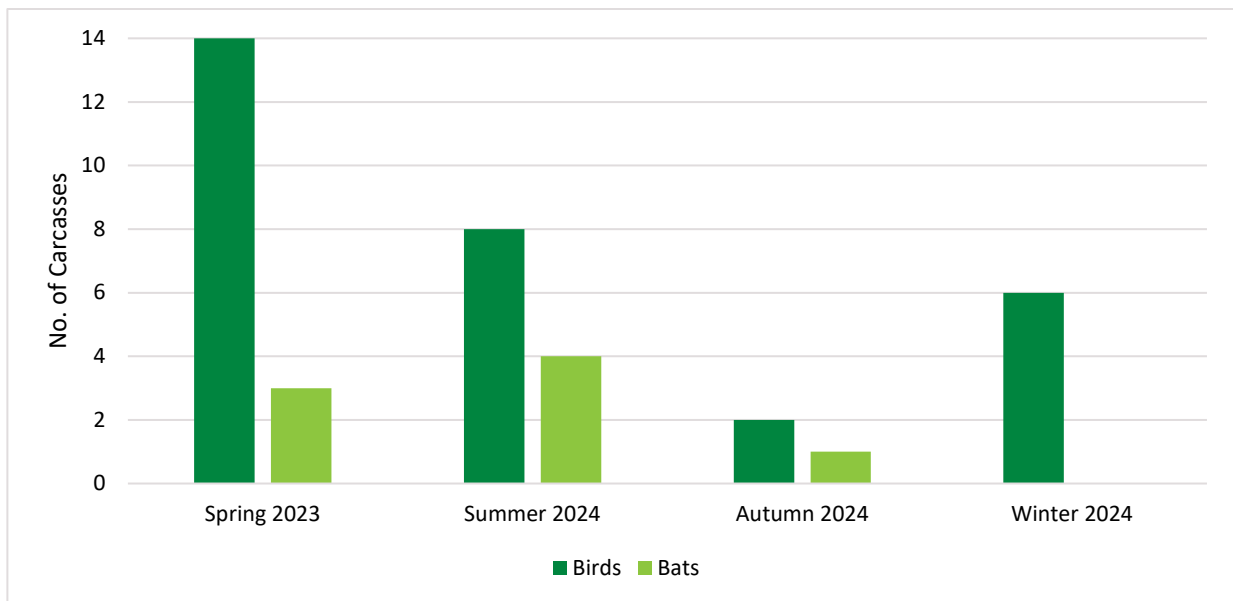


Figure 7: Bird and bat carcass seasonality from Year Three of carcass monitoring (both formal and incidental)

3.2. Raptor, threatened and migratory species flight path tracking

The flight paths of six raptor species were recorded during Year Three of CRWF operational monitoring (Table 5) and are mapped in Figure 8 and Figure 9 below. The species recorded included *Hieraaetus morphnoides* (Little Eagle), which is listed as vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act). The Little Eagle was recorded opportunistically 2 km south of turbine A47 (Figure 8), which was the first record of the species since the commencement of monitoring at CRWF. A pair and three individual Brown Falcons were also recorded, along with a pair of *Accipiter fasciatus* (Brown Goshawks). A total of 32 Wedge-tailed Eagle flights were recorded in Year Three, which included five

observations of adult pair flights, as well as a single group of eight individual Wedge-tailed Eagles observed flying together in a group.

The Wedge-tailed Eagle has been by far the most common and abundant raptor recorded since the commencement of monitoring in Year One, with a total of 79 flights tracked (Table 5). This species has been recorded across the full extent of CRWF throughout the three years of monitoring (Figure 8 and Figure 9), however, both single individuals and adult pairs are most frequently recorded in the far northern (near turbines A1 to A17) section, and the western half of the Sallys Flat cluster (near turbine A102) of the CRWF site, as well as areas near turbine A52. Wedge-tailed Eagle flights during Year Three monitoring were recorded both within and above the RSA.

Table 5: Observed raptor flights during Year Three and Year One to Two (combined) monitoring. V indicates listed Vulnerable threatened species under the NSW BC Act

Common Name	Scientific Name	Year 3			Year 1 - 2	
		Below RSA	Within RSA	Above RSA	Total flights	Total flights
Black Kite	<i>Milvus migrans</i>				0	1
Black-shouldered Kite	<i>Elanus axillaris</i>		1		1	1
Brown Falcon	<i>Falco berigora</i>	2	3		5	1
Brown Goshawk	<i>Accipiter fasciatus</i>		2		2	1
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>				0	2
Little Eagle (V)	<i>Hieraaetus morphnoides</i>	1			1	0
Nankeen Kestrel	<i>Falco cenchroides</i>		1		1	13
Square-tailed Kite (V)	<i>Lophoictinia isura</i>				0	1
Wedge-tailed Eagle	<i>Aquila audax</i>		17	15	32	47
Whistling Kite	<i>Haliastur sphenurus</i>				0	1

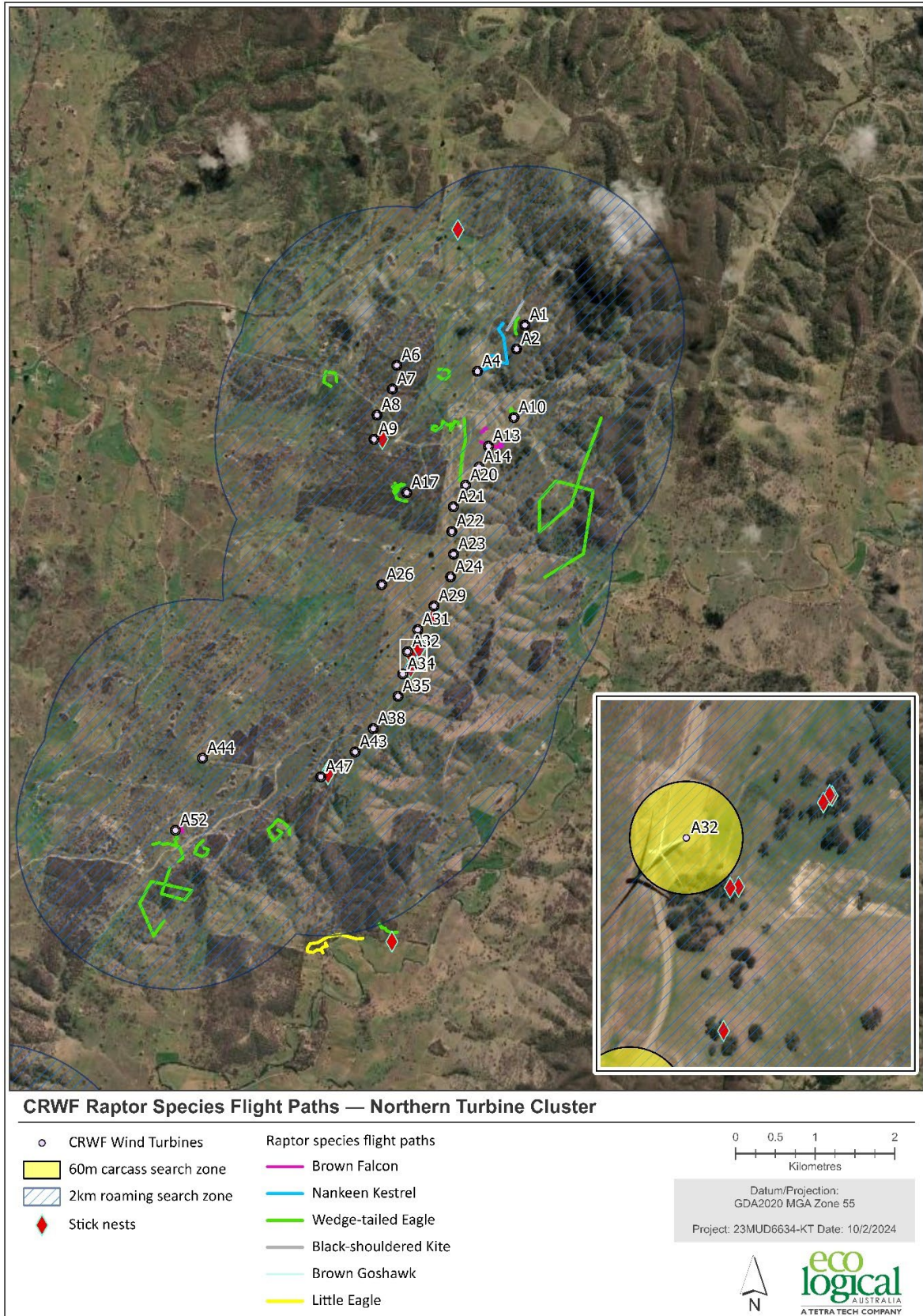


Figure 8: Raptor flight paths adjacent to northern portion of turbines

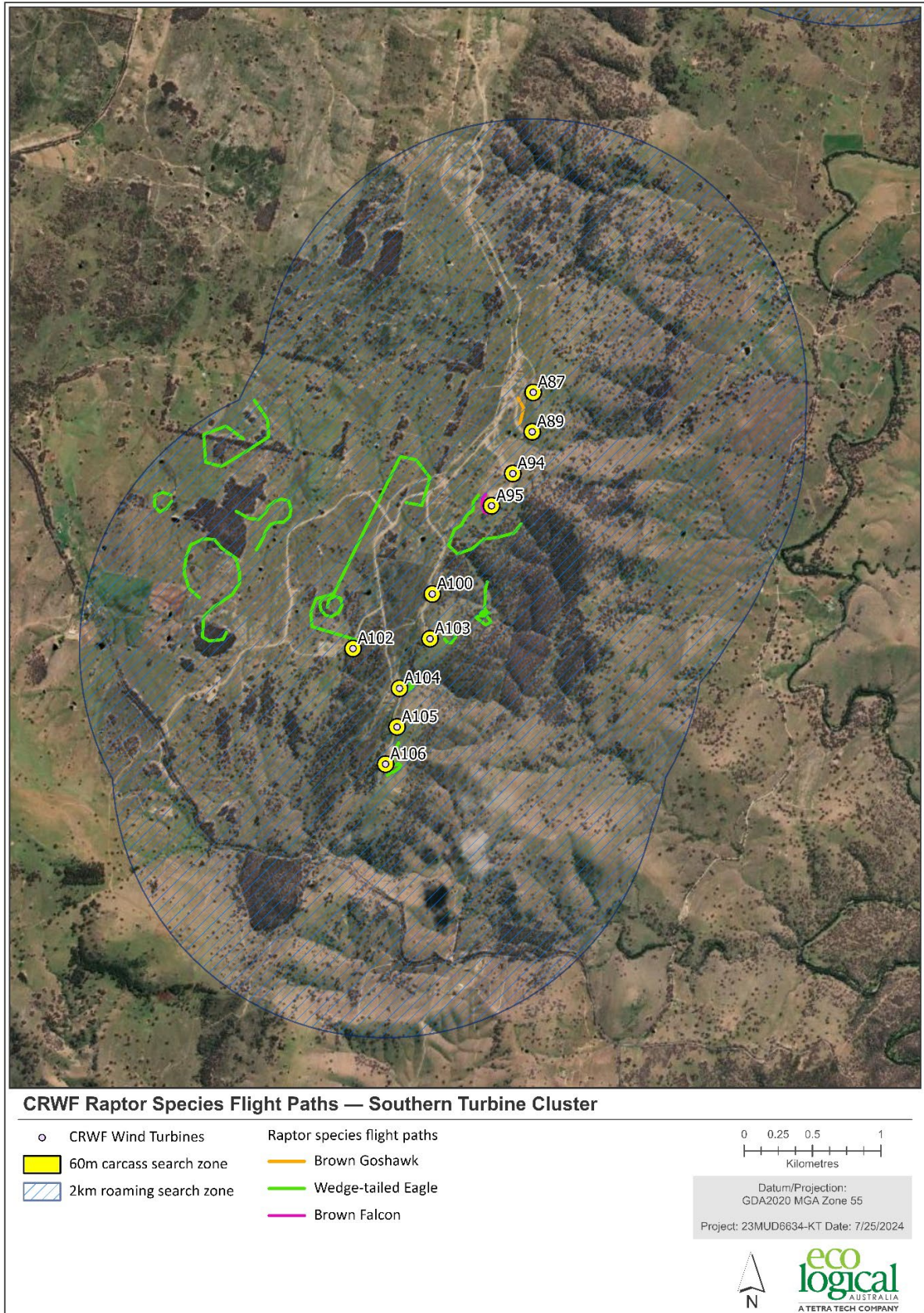


Figure 9: Raptor flight paths adjacent to southern portion of turbines

3.3. Targeted raptor breeding surveys

During Year Three monitoring, pairs of Brown Falcons, Brown Goshawks and Wedge-tailed Eagles, as well as a larger group of eight Wedge-tailed Eagles were observed flying together, which indicates the presence of potential breeding pairs within the wind farm vicinity. Additionally, pairs of Wedge-tailed Eagles have been consistently recorded flying across the CRWF site during Year One and Year Two monitoring, however, they have never been recorded flying to or from a nest tree. This evidence of breeding activity is also supported by the observation of juvenile / sub-adult Brown Falcon and Wedge-tailed Eagle flying within the site.

Nest searches were undertaken for Wedge-tailed Eagle and other raptor species during October 2023 and July 2024, within targeted search zones within a 2 km buffer of the CRWF. No confirmed active Wedge-tailed Eagle nests or nests of other raptor species were recorded during the surveys. Two relatively large-sized (>60 cm diameter and 70-75 cm diameter), potential raptor stick nests were recorded near turbine A32 (approximately 75 m and 160 m, south-east and north-east of the turbine – see Figure 8) and were inactive at the time of survey. One nest showed signs of previous use with whitewash present on the ground below the nest in spring 2023, however, the nest was recorded as partially falling apart during the July 2024 monitoring period. As these nests are at the lower end of the typical size range for Wedge-tailed Eagle (0.7 – 1.8 m; BirdLife Australia 2023), they may not have been previously utilised, or suitable for use by this species. Both nests are located in small patches (0.23 ha and 0.58 ha) of grassy dry sclerophyll forest, positioned just on the upper hillside of the main ridgeline on which the majority of turbines are located.

3.4. Raptor activity analysis

Results of Year Three monitoring must be interpreted with some caution in comparison with Year One and Year Two monitoring, as the survey methodology and effort were updated for Year Three. Methodology updates included reduced monitoring frequency (quarterly carcass surveys, compared to monthly previously) and reduced carcass search areas (100 m radius reduced to 60 m radius). The proportion of turbines searched increased, however, from 19 turbines (50%) to all 37 turbines (100%). With a decrease in monitoring frequency, opportunistic raptor flight tracking decreased accordingly, however, targeted raptor breeding surveys (and flight tracking) increased from one survey period (spring only) in Year One and Year Two, to two survey periods (winter and spring) in Year Three. As an example, the influence of survey effort on raptor flight numbers can be observed in Figure 9 below, with raptor flight activity increasing in spring 2023 and winter 2024, coinciding with targeted raptor surveys completed during these seasons.

Notwithstanding the updates to the monitoring methodology, analysis of raptor activity incorporating carcass detections and flight activity, does reveal several trends. Across all monitoring years, flight activity and carcass numbers are positively correlated for both Wedge-tailed Eagle and all other raptor species. Across each of Year One (autumn 2022), Year Two (summer 2022/23) and Year Three (spring 2023), both Wedge-tailed Eagle observations and carcasses were highest during the same season (Figure 10). Flight activity and carcass mortality were also positively correlated for all other raptor species, with spring 2021 recording the highest number of flights (seven) and carcasses (four) across Year One and Year Two, whilst spring 2023 and summer 2024, recorded the highest number of flights (three and four, respectively) and carcasses (two and one, respectively) for Year Three (Figure 10).

The overall number of Wedge-tailed Eagle carcasses recorded in Year Three (17 carcasses) increased compared to both Year One (5 carcasses) and Year Two (7 carcasses) monitoring. No Wedge-tailed Eagle carcasses were recorded in the first two seasons of monitoring during Year One, with at least one carcass recorded in all seasons since, with the exception of spring 2022 (Figure 10). The three seasons with the highest recorded Wedge-tailed Eagle carcasses being spring 2023, summer 2023 and winter 2024, all occurred during Year Three monitoring. All other raptor species carcass numbers have remained relatively consistent across all three years of monitoring in comparison (Figure 10).

As Wedge-tailed Eagle flight activity has not increased in Year Three, compared to Year One and Year Two of operational phase monitoring (Figure 10), the increased carcass numbers may be reflective of the suitability of the updated methodology for monitoring Wedge-tailed Eagle carcasses. The updated methodology was designed to balance survey efficiency with carcass detectability, with the Wedge-tailed Eagle specifically in mind given the prolonged persistence and relatively large size of the species' carcass. As such, the decreased survey frequency and search area of the updated monitoring methodology is unlikely to reduce overall detectability of Wedge-tailed Eagle carcasses, whilst searching all 37 turbines likely increased overall detectability.

The effectiveness of the updated monitoring methodology to record Wedge-tailed Eagle mortality can be seen in comparing Year Three results to the species' mortality estimates calculated at the conclusion of Year One and Year Two monitoring (Symbolix 2023). The upper estimate (95% confidence interval) of Wedge-tailed Eagle mortality from Year One and Year Two combined was 27 Wedge-tailed Eagles, or 13.5 per year. The 17 Wedge-tailed Eagles recorded during Year Three monitoring, is therefore closer to the annual mortality estimate, compared to the mean number of Wedge-tailed Eagles carcasses (6) recorded during Year One and Year Two of monitoring.

Across the three years of monitoring, adult Wedge-tailed Eagle pairs have been consistently recorded across the CRWF site and appear to remain breeding within the vicinity of the wind farm. During Year Three, adult pairs of Brown Falcon and Brown Goshawk were also recorded, whilst juvenile / sub-adult Brown Falcons were also recorded in flight and carcass monitoring.

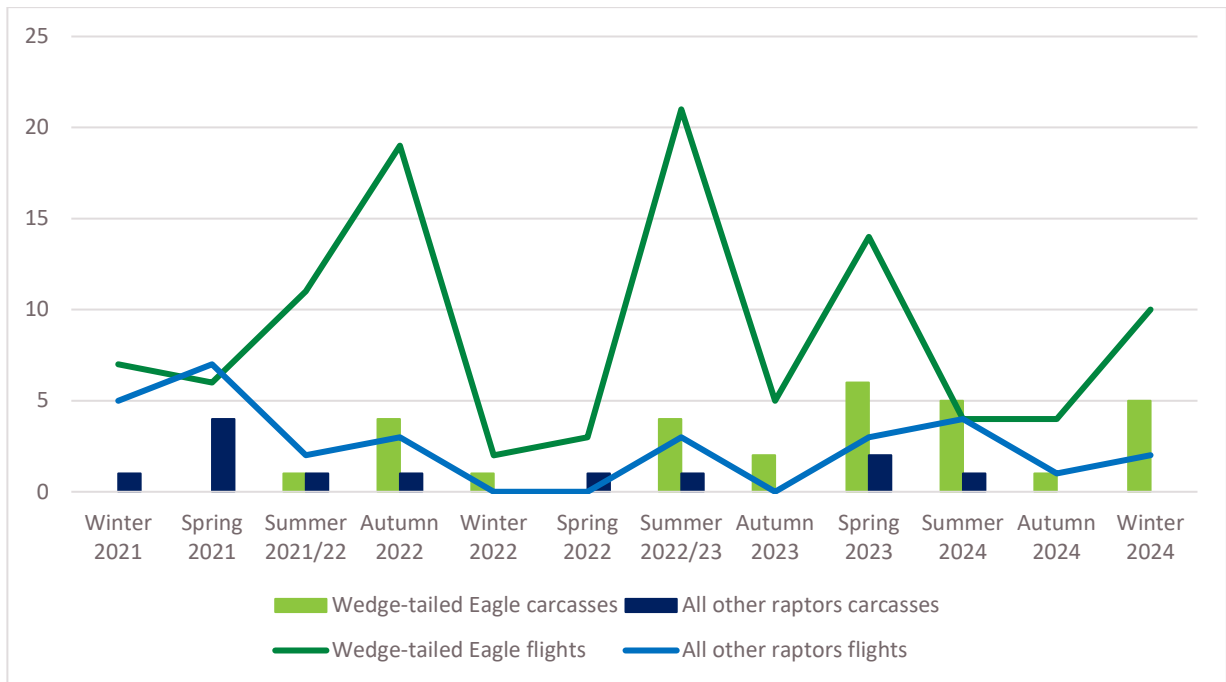


Figure 10: Wedge-tailed Eagle and all other raptor species flights and mortality since Year One

4. Discussion

The CRWF BBAMP outlines the monitoring requirements and performance criteria to be achieved with regards to the management of bird and bat species. The following section provides a summary of progress against each monitoring requirement and/or performance criteria relevant to Year Three implementation of the BBAMP.

4.1. Progress of management objectives and completion criteria

Table 6 below details the specific management objectives and performance criteria relevant to the BBAMP monitoring program, along with a comment regarding relevant results and adherence based on Year Three monitoring. All CRWF management objectives and performance criteria are currently being achieved.

Table 6: Management objectives and performance criteria and relevant results from Year Three monitoring

Management objectives	Management activities	Performance criteria	Comments
Mortality monitoring	All 37 turbines to be searched every three months to 60 m in accordance with the search protocol. Survey methodology was revised from Year Two.	Operational phase mortality surveys undertaken quarterly at all 37 turbines for at least two years, with a review after Year Four to determine if a change in the methodology is required	Year Three of carcass mortality monitoring successfully completed across all 37 turbines. No threatened species or non-threatened species impact triggers initiated from Year Three results.
Annual report	Preparation of annual reports to be submitted to relevant State departments after the completion of yearly monitoring activities.	Annual reports to be delivered within three months of completion of yearly monitoring. Annual reports to include results of yearly monitoring, any impact triggers or unacceptable impacts identified, mitigation measures implemented, application of the decision-making framework and recommendations for the following year.	This annual report (to be provided to relevant State department) details all relevant results from Year Three implementation monitoring.
Mitigation measures to reduce risk	Carrion removal program – stock and kangaroo carcasses will be removed from within 200 m of wind turbines on a monthly basis and disposed of. Restrict lambing and grain stock feeding within 200 m of turbines. Pest control program – implement rabbit control if the carrion removal program suggests rabbit carcasses are an issue, subject to landowner agreement.	Carcasses removed and activity recorded in management log book; No increase in raptor mortality during lambing season or due to grain feeding; Monitor effectiveness of rabbit control and where bird mortality is clearly related to rabbit numbers, increase effectiveness of rabbit control. Mortality at turbines near light sources does not significantly exceed that at unlit turbines.	Dead carcasses of birds, bats and sheep were removed and properly disposed of. Lambing does not occur in paddocks within 200 m of the CRWF operational turbines. Only one individual Rabbit recorded during Year Three monitoring, indicating effectiveness of current rabbit control. All turbines are located away from major light sources.

Management objectives	Management activities	Performance criteria	Comments
	<p>Minimise external and internal lighting.</p> <p>Where required - use of visual deterrents (e.g. marker balls and/or flags) on overhead powerlines where they cross waterways.</p>	<p>No incidental records of bird mortality from powerline collision around waterways.</p>	<p>No incidental records of bird mortality have been recorded underneath powerlines around waterways.</p>

5. Conclusion and Recommendations

5.1. General conclusions

Year Three operational phase monitoring of the CRWF BBAMP was successfully implemented from October 2023 to July 2024. The purpose of the monitoring program is to monitor the impacts from the operation of the CRWF on birds and bats through a range of methodologies, and effectively mitigate and manage any significant risks or impacts which arise.

Formal quarterly carcass monitoring was undertaken across all 37 turbines within a 60 m search zone. A total of 29 bird carcasses and/or identifiable remains from at least six species were recorded during formal monitoring, with an additional one bird carcass recorded incidentally. Wedge-tailed Eagle recorded the highest mortality during Year Three, with a total of 17 carcasses recorded. In no instances were four or more carcasses from the same non-threatened bird species recorded at the same turbine during successive searches and as such, the impact trigger for non-threatened species was not exceeded in Year Three monitoring. Additionally, no threatened bird species carcasses were recorded and as a result, the impact trigger for threatened species was also not exceeded.

All six recorded bird species are considered locally common and along with being non-threatened under State and Commonwealth legislation, are also listed as Least Concern under the International Union for Conservation of Nature (IUCN) Red List of threatened species (IUCN 2024). As a result, the risk rating for bird species recorded during Year Three carcass monitoring is proposed to remain unchanged. The overall risk rating for Wedge-tailed Eagle was updated following the completion of Year Two monitoring from 'Moderate' to 'High' and it is recommended that the risk rating remain as 'High'.

A total of seven bat carcasses and/or identifiable remains from at least three microbat species were recorded during formal monitoring, with an additional one microbat carcass recorded incidentally. White-striped Freetail-bat recorded the highest mortality during Year Three, with a total of 3 carcasses, with no species recording four or more carcasses in total or at the same turbine during successive searches. As such, the impact trigger for non-threatened bat species was not exceeded in Year Three of monitoring. Additionally, no threatened bat species carcasses were recorded and as a result, the impact trigger for threatened species was also not exceeded.

All three recorded bat species are considered locally common and along with being non-threatened under State and Commonwealth legislation, are also listed as Least Concern under the IUCN Red List of threatened species (IUCN 2024). As a result, the risk rating for bat species recorded during Year Three carcass monitoring is proposed to remain unchanged.

With no threatened bird or bat species listed as Matters of National Environmental Significance (MNES) under the EPBC Act recorded during Year Three monitoring, the risk rating for relevant MNES species is also proposed to remain unchanged.

A total of six raptor species' flight activities were monitored and tracked within the 2 km buffer zone in Year Three of CRWF operational monitoring. Across the three years of monitoring, increased flight activity appears to be positively correlated with increased raptor mortality for both Wedge-tailed Eagle and all other raptor species combined (see Figure 9). The overall number of Wedge-tailed Eagle carcasses recorded in Year Three has increased compared to Year One and Year Two. This may be the

result of the updated carcass monitoring methodology which has been re-designed to maximise detectability of the species under a reduced monitoring frequency. Adult Wedge-tailed Eagle pairs along with sub-adult birds, have been consistently recording flying within and in proximity to the CRWF across all three years of operational monitoring and indicate the species' continued presence and potential breeding activity within the vicinity of the CRWF.

Further seasonal monitoring (with increased survey effort – see Section 5.3 below) in Year Four will be undertaken to record any further Wedge-tailed Eagle carcasses and an updated mortality estimate for the species will also be calculated at the completion of Year Four monitoring.

5.2. General recommendations

Given the successful implementation of Year Three of the CRWF BBAMP monitoring program, Squadron Energy are considered compliant with the relevant approval conditions with regard to birds and bats, as detailed in the BBAMP. Whilst a mortality impact trigger event did not eventuate, the following measures are proposed in response to Wedge-tailed Eagle mortality recorded during Year Three:

- Where three Wedge-tailed Eagle carcasses are recorded at the same turbine during a monitoring event, a follow up survey will be completed at this turbine the following month to monitor for any additional carcasses.
- Additional training of CRWF site personnel and contactors will be implemented regarding the identification of wildlife and livestock carcasses and pest animal occurrences (particularly European Rabbit and Brown Hare), along with the procedure for their prompt removal. This will ensure that measures are being implemented during the daily to monthly operation of the CRWF to reduce the potential for increased Wedge-tailed Eagle and other raptor species activity.

Given the results of Year Three monitoring and recommendations provided by BCS, it is recommended that the current monitoring program be updated for Year Four of CRWF operations, with recommended updates detailed in Section 5.3 below.

5.3. Monitoring methodology recommendations

Carcass searches will be increased during both summer and autumn monitoring periods to account for potential increases in bird and bat mortality during these seasons of typical peak microbat and flying-fox activity in the region, and sub-adult Wedge-tailed Eagle dispersal. To implement this increased survey frequency, an additional survey period during both summer (February 2025) and autumn (March 2025) is recommended, such that monitoring will be completed on a monthly basis from January 2025 through to April 2025. This increased survey effort is designed to increase the detectability of microbat species and Wedge-tailed Eagle recorded during from Year One to Year Three carcass searches, along with relevant BC Act and EPBC Act listed threatened species identified in the CRWF BBAMP.

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Appendix A: Carcass monitoring data

Table 7: Seasonal and opportunistic carcass monitoring data — Year Three of operational phase monitoring

Date	Common Name	Species Group	Turbine Number	Distance from Turbine (m)	Direction from Turbine	Ground-cover	Monitoring methodology
23/10/2023	Australian Magpie	Bird	A10	41	SW	-	Formal
23/10/2023	White-striped Freetail-bat	Bat	A10	40	SW	-	Formal
23/10/2023	Brown Falcon	Bird	A23	48	N	-	Formal
23/10/2023	Brown Falcon	Bird	A7	40	N	-	Formal
23/10/2023	Unknown bird	Bird	A20	48	NW	-	Formal
23/10/2023	Wedge-tailed Eagle	Bird	A22	28	NE	-	Formal
24/10/2023	Australian Magpie	Bird	A103	36	SE	-	Formal
24/10/2023	Silvereye	Bird	A100	6	S	-	Formal
24/10/2023	Unidentified bird	Bird	A103	57	SW	-	Formal
24/10/2023	Wedge-tailed Eagle	Bird	A104	53	SE	-	Formal
24/10/2023	White-striped Freetail-bat	Bat	A94	44	NW	-	Formal
25/10/2023	Magpie-lark	Bird	A47	107	NE	-	Formal
25/10/2023	Wedge-tailed Eagle	Bird	A35	34	NW	-	Formal
25/10/2023	Wedge-tailed Eagle	Bird	A38	60	NW	-	Formal
25/10/2023	Wedge-tailed Eagle	Bird	A38	62	NW	-	Formal
25/10/2023	Wedge-tailed Eagle	Bird	A38	12	SE	-	Formal
25/10/2023	Unidentified bat	Bat	A47	39	SE	Grass and rock	Formal
22/01/2024	Little Forest Bat	Bat	A04	50	N	Grass	Formal
22/01/2024	Australian Magpie	Bird	A23	10	SE	Bare ground	Formal
22/01/2024	Brown Falcon	Bird	A29	30	S	Pad	Formal
22/01/2024	Wedge-tailed Eagle	Bird	A23	20	Scattered	Pad	Formal
23/01/2024	Gould's Wattled Bat	Bat	A106	15	N	Pad	Formal
23/01/2024	Australian Magpie	Bird	A87	20	W	Bare ground	Formal
23/01/2024	Little Forest Bat	Bat	A44	5	W	Pad	Formal
23/01/2024	Wedge-tailed Eagle	Bird	A34	60	N	Bare ground	Formal
23/01/2024	Wedge-tailed Eagle	Bird	A47	60	NW	Grass	Formal
23/01/2024	Wedge-tailed Eagle	Bird	A89	55	N	Grass	Formal
30/01/2024	White-striped Freetail-bat	Bat	A23	-	-	-	Incidental

Date	Common Name	Species Group	Turbine Number	Distance from Turbine (m)	Direction from Turbine	Ground-cover	Monitoring methodology
12/03/2024	Wedge-tailed Eagle	Bird	A52	20	-	Hardstand	Incidental
22/04/2024	Wedge-tailed Eagle	Bird	A21	60	E	Grass	Formal
24/04/2024	Gould's Wattled Bat	Bat	A32	40	E	Grass	Formal
24/04/2024	Silvereye	Bird	A29	60	N	Grass	Formal
16/07/2024	Unidentified bird	Bird	A24	60	SW	Grass	Formal
16/07/2024	Wedge-tailed Eagle	Bird	A21	62	SW	Grass	Formal
16/07/2024	Wedge-tailed Eagle	Bird	A23	65	SW	Grass	Formal
18/07/2024	Wedge-tailed Eagle	Bird	A106	42	S	Grass	Formal
18/07/2024	Wedge-tailed Eagle	Bird	A52	60	N	Grass	Formal
18/07/2024	Wedge-tailed Eagle	Bird	A52	39	SW	Grass	Formal

Appendix B: Bird and bat carcass summary data

Table 8: Bird and bat carcass totals recorded during formal and informal monitoring across both Year One to Year Three

Common Name	Scientific Name	Year One	Year Two	Year Three	Total
Birds					
Australian Magpie	<i>Cracticus tibicen</i>	9	7	4	20
Australian Raven	<i>Corvus coronoides</i>	1	-	-	1
Australian Wood Duck	<i>Chenonetta jubata</i>	1	3	-	4
Brown Falcon	<i>Falco berigora</i>	2	-	3	5
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	-	2	-	2
Crested Pigeon	<i>Ocyphaps lophotes</i>	-	1	-	1
Eastern Rosella	<i>Platycercus eximius</i>	-	1	-	1
Galah	<i>Eolophus roseicapilla</i>	1	-	-	1
Magpie-lark	<i>Grallina cyanoleuca</i>	-	1	1	2
Nankeen Kestrel	<i>Falco cenchroides</i>	5	-	-	5
Pacific Black Duck	<i>Anas superciliosa</i>	1	-	-	1
Silveryeye	<i>Zosterops lateralis</i>	-	-	2	2
Wedge-tailed Eagle	<i>Aquila audax</i>	5	7	17	29
Unknown bird	Aves (class)	-	1	3	4
Bats – Microchiroptera					
Gould’s Wattled Bat	<i>Chalinolobus gouldii</i>	-	2	2	4
Large Forest Bat	<i>Vespadelus darlingtoni</i>	1	-	-	1
Little Broad-nosed Bat	<i>Scotorepens greyii</i>	-	1	-	1
Little Forest Bat	<i>Vespadelus vulturnus</i>	5	4	2	11
Southern Forest Bat	<i>Vespadelus regulus</i>	-	1	-	1
Southern Free-tailed Bat	<i>Mormopterus planiceps</i>	1	1	-	2
White-striped Freetail-bat	<i>Austronomus australis</i>	9	4	3	16
Unknown microbat	Microchiroptera (suborder)	3	2	1	6
Bats – Megachiroptera					
Little Red Flying-fox	<i>Pteropus scapulatus</i>	1	-	-	1

