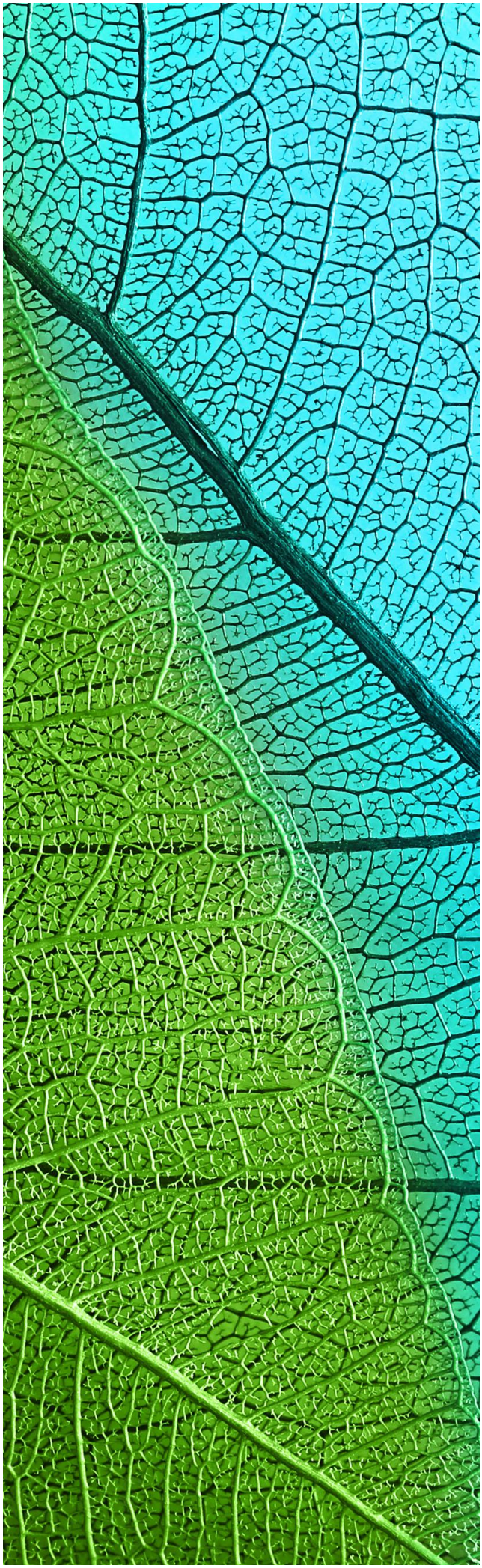

Karara Wind Farm

Bird and Bat Adaptive Management Plan

Prepared for ACCIONA Energy Australia Global Pty Ltd

April 2021
Report No. 20033 (3.3)

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1. Introduction

1.1. Background

The Karara Wind Farm is proposed to be located 50 kilometres south-west of Warwick, in south-east Queensland. It is proposed to have up to 20 wind turbine generators with a maximum tip height of approximately 285 metres.

Approval has not yet been granted for this project. This Bird and Bat Adaptive Management Plan (BBAMP) will accompany the development application. Precedented approvals with conditions of similar wind farm developments include the requirement of a BBAMP to be prepared. Section 1.2 outlines the expected conditions this BBAMP intends to address.

This BBAMP was prepared by a team of suitably qualified ecologists from Nature Advisory (formerly Brett Lane & Associates Pty Ltd) including; Cara Cappelletti (Technical Officer), Curtis Doughty (Senior Zoologist), Bernard O'Callaghan (Director) and Brett Lane (Principal Ecologist).

1.2. Requirements of this Bird and Bat Adaptive Management Plan (BBAMP)

Recent wind farm approvals in Queensland have provided guidance on the likely expectations of the Commonwealth and State decision-makers in relation to management of bird and bat impacts of wind farms.

Based on past approvals of similar wind farms, the key requirements that this BBAMP seeks to address in relation to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are presented below:

- *(a) the* [Bird and Bat Management Plan] *environmental objectives, for relevant protected matter(s) and a reference to EPBC Act approval conditions to which the Plan refers;*
- *(b) a table of commitments made in the Plan to achieve the objectives, and a reference to where the commitments are detailed in the Threatened Bird and Bat Management Plan;*
- *(c) reporting and review mechanisms, and documentation standards to demonstrate compliance with the Plan;*
- *(d) an assessment of risks to achieving the Plan's environmental objectives and risk management strategies that will be applied;*
- *(e) impact avoidance, mitigation and/or repair measures, and their timing; and*
- *(f) a monitoring program, which must include:*
  - *i. measurable performance indicators;*
  - *ii. trigger values for corrective actions;*
  - *iii. the timing and frequency of monitoring to detect changes in the performance indicators and timely detection of trigger values;*
  - *iv. mortality monitoring; and*
  - *v. proposed corrective actions if trigger values are reached.*
- *(g) provide any links to other plans or conditions of approval (including State/Territory approval conditions).*
- *(h) details of mitigation measures to minimise impacts on EPBC Act listed threatened bird and bat species including but not limited to:*

i. measures to minimise impacts associated with lighting, such as preventing the attraction of EPBC Act listed threatened bird and bat species and prey species to locations with high risk of collision with turbines;

ii. measures to minimise the risk of turbine collision with EPBC Act listed threatened bird and bat species, such as, but not limited to, bird and insect deterrents and low wind speed curtailment.

(i) details of how the effectiveness of mitigation measures will be monitored and reported as part of the annual compliance reporting;

(j) procedures for dealing with any EPBC Act listed threatened bird and bat species require relocation or are injured on the wind farm site;

(k) a program of monitoring and reporting to determine the effectiveness of management measures and inform adaptive implementation of management measures to minimise the impacts to EPBC Act listed threatened bird and bat species."

(l) *determine and justify trigger levels for the requirement to provide and offset for a significant residual impact on EPBC Act listed threatened bird and bat species.*

This plan incorporates a process and trigger levels (including justification) for determining if a significant impact has occurred to EPBC Act listed bird and bat species.

The Queensland Department of State Development, Tourism and Innovation (DSDTI) approval conditions are likely to require the bird and bat adaptive management plan to address the following:

(i) "identification of at risk' bird and bat groups (i.e. all threatened and common species), seasons, and areas within the project site which may attract high levels of mortality;
(ii) incorporate baseline data, including additional pre-operational surveys;
(iii) the identification of threshold (trigger) levels for species;
(iv) identification of mitigation measures and implementation strategies in order to reduce impacts on bird and bat groups;
(v) monitoring requirements; and
(vi) a decision-making framework, including the trigger for operational shut-down."

The proponent will submit the BBAMP to (DSDMIP) for approval and operate the development in accordance with the conditions and the BBAMP.

1.3. Compliance

The table below (Table 1) summarises where this BBAMP would address the likely approval conditions of both the Commonwealth approval and Queensland approval.

Table 1: Sections within the BBM Plan that respond to recent Commonwealth and State wind farm approval conditions in Queensland

Condition number	Permit condition requirements	BAM Plan Sections
EPBC Act approval conditions		
(a)	*The Threatened Bird and Bat Management Plan environmental objectives, for relevant protected matter(s) and a reference to EPBC Act approval conditions to which the Threatened Bird and Bat Management Plan refers*	1.3 and 1.4
(b)	*A table of commitments made in the Threatened Bird and Bat Management Plan to achieve the objectives, and a reference to where the commitments are detailed in the Threatened Bird and Bat Management Plan*	Table 1
(c)	*Reporting and review mechanisms, and documentation standards to demonstrate compliance with the Threatened Bird and Bat Management Plan*	4.5
(d)	*An assessment of risks to achieving the Threatened Bird and Bat Management Plan's environmental objectives and risk management strategies that will be applied*	5 and 6
(e)	*Impact avoidance, mitigation and/or repair measures, and their timing*	5
(f)	*A monitoring program, which must include:* *i. measurable performance indicators;* *ii. trigger values for corrective actions;* *iii. the timing and frequency of monitoring to detect changes in the performance indicators and timely detection of trigger values;* *iv. mortality monitoring; and* *v. proposed corrective actions if trigger values are reached*	4.2
(g)	*provide any links to other plans or conditions of approval (including State/Territory approval conditions).*	1.2
(h)	*details of mitigation measures to minimise impacts on EPBC Act listed threatened bird and bat species including but not limited to:* *i. measures to minimise impacts associated with lighting, such as preventing the attraction of EPBC Act listed threatened bird and bat species and prey species to locations with high risk of collision with turbines;* *ii. measures to minimise the risk of turbine collision with EPBC Act listed threatened bird and bat species, such as, but not limited to, bird and insect deterrents and low wind speed curtailment.*	5 and 6.3
(i)	*details of how the effectiveness of mitigation measures will be monitored and reported as part of the annual compliance reporting*	6.4

Condition number	Permit condition requirements	BAM Plan Sections
EPBC Act approval conditions		
(j)	*procedures for dealing with any EPBC Act listed threatened bird and bat species require relocation or are injured on the wind farm site;*	4.4
(k)	*A program of monitoring and reporting to determine the effectiveness of management measures and inform adaptive implementation of management measures to minimise the impacts to EPBC Act listed threatened bird and bat species*	4.1, 4.2 and 4.5
(l)	*Determine and justify trigger levels for the requirement to provide and offset for a significant residual impact on EPBC Act listed threatened bird and bat species*	6.1, 6.2 and 6.4
Queensland Planning Act approval conditions		
	Prepare a Bird and Bat Adaptive Management Plan (BBAMP) certified by a suitably qualified ecologist. The BBAMP must include:	
(i)	*Identification of at risk' bird and bat groups (i.e. all threatened and common species), seasons, and areas within the project site which may attract high levels of mortality*	3.5
(ii)	*incorporate baseline data, including additional pre-operational surveys*	2
(iii)	*the identification of threshold (trigger) levels for species*	6.1.1 and 6.2.1
(iv)	*identification of mitigation measures and implementation strategies in order to reduce impacts on bird and bat groups*	5 and 6.3
(v)	*monitoring requirements*	4.1 and 4.2
(vi)	*a decision-making framework, including the trigger for operational shut-down*	6

1.4. BBAMP objectives

The overall aim of this BBAMP is to monitor the wind farm's impacts on bird and bat species, to identify if species of concern are significantly impacted and to outline a strategy for managing and mitigating any significant impacts on these species during the operation of the project.

This BBAMP will be implemented as the wind farm commences commissioning and groups of turbines become operational (i.e. feeding power into grid which may be specific groups of turbines as wind turbines are installed).

The aim of this BBAMP will be achieved by establishing monitoring and management procedures consistent with the methods outlined by the Australian Wind Energy Association (AusWEA 2005) and endorsed in the Clean Energy Council's Best Practice Guidelines (CEC 2018). The Queensland State Code 23 – Wind Farm Development (Department of Infrastructure, Local Government and Planning 2017) Performance Outcome (PO) 5 requires the preparation of a Preliminary BBAMP to be included in the development application under State Code 23.

The specific objectives of this BBAMP, derived from recent conditions of approval, are:

- To implement a monitoring program to estimate the impact of the project on at-risk birds and/or bats that can reasonably be attributed to the operation of the project (Section 4.2);
- To directly record impacts on birds and bats through a statistically-based program of carcass searches (Section 4.3);
- To document an agreed decision-making framework that identifies *impact triggers* requiring a management response (Section 6.1 and 6.2);
- To detail potential mitigation measures and related implementation strategies to reduce impacts on birds and bats (Section 6.3); and
- To identify matters to be addressed in periodic reports on the outcomes of monitoring, the application of the decision-making framework, mitigation measures and their success (Section 6.4).

This plan adopts an adaptive management approach. Therefore, management measures set out in this BBAMP can be amended to ensure effective mitigation is implemented in response to the findings of monitoring. A suitably qualified ecologist will design any amended monitoring, as well as train personnel undertaking the monitoring program, analyse and interpret data, formulate adaptive management measures and prepare reports.

This BBAMP has been developed based on the experience gained from the preparation and implementation of management plans to monitor and mitigate the impact of wind farm operations on birds and bats at numerous wind farms in Queensland, New South Wales and Victoria. At the time of writing, Nature Advisory has prepared and/or implemented management plans for the following wind farms Coopers Gap in Queensland, White Rock, Cullerin Range, Gullen Range, Taralga, Capital and Woodlawn wind farms in NSW (BL&A 2011a & c, 2014, 2016), and Bald Hills, Macarthur, Berrybank, Crowlands, Hawkesdale, Lal Lal, Mt Gellibrand, Mt Mercer, and Ryan's Corner wind farms in Victoria (BL&A 2009, 2011b, 2012a-d, 2013a-c).

The approach developed for monitoring impacts on birds and bats has been refined from experience gained from other BBAMPs, their preparation, data review, and feedback from regulators and approval authorities, including both Commonwealth and State governments. This

BBAMP has incorporated learnings and experience from past plans and incorporates the 'best practice' approach to monitoring a wind farm's impacts on birds and bats.

To ensure the efficacy of this adaptive management program, all activities undertaken will be subject to regular review and reporting by a suitably qualified expert (see Section 6.4).

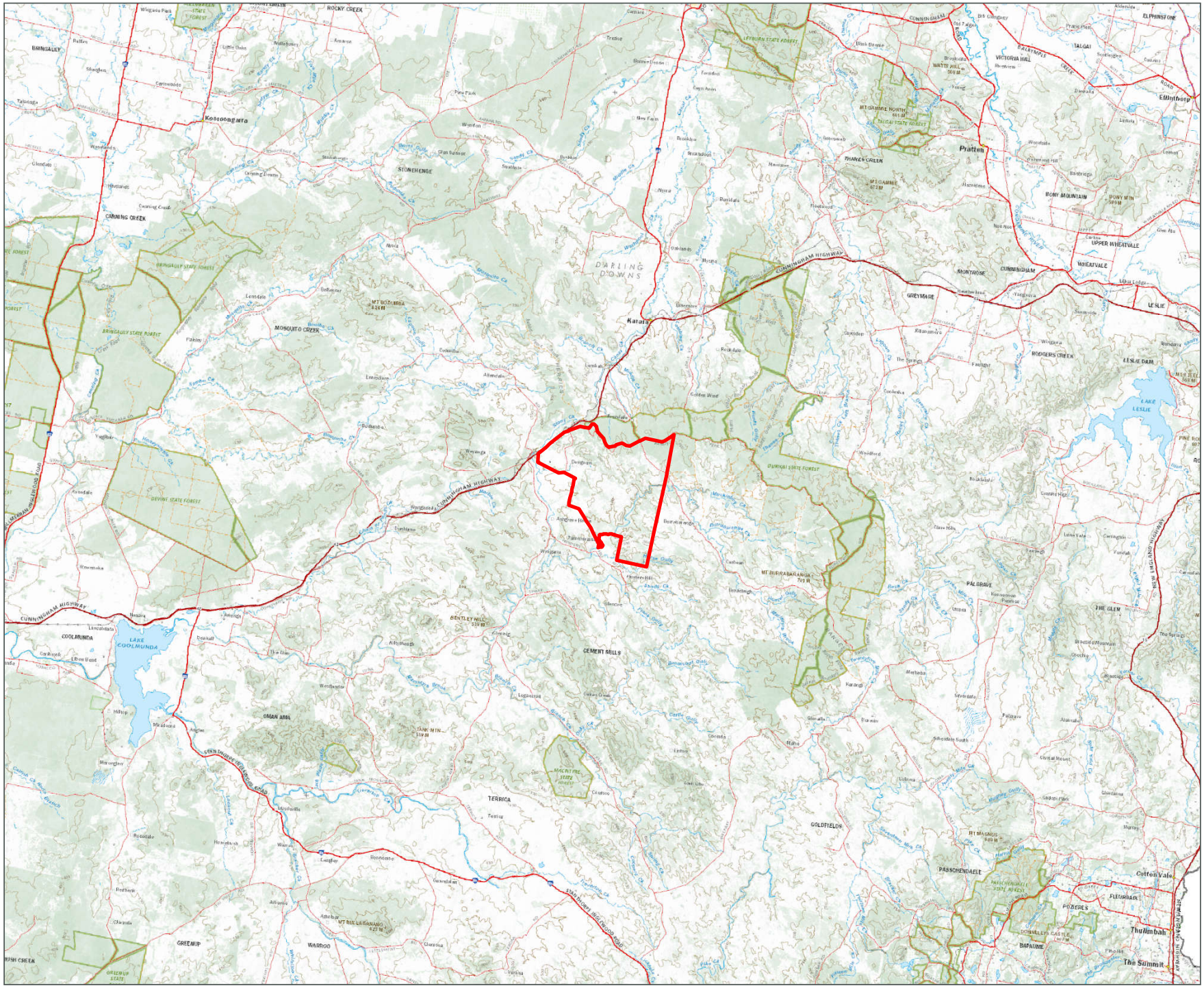

Figure 1: Regional Location of Karara Wind Farm

Project: Karara Wind Farm
Client: ACCIONA Energy Australia Pty Ltd
Date: 12/04/2021

Karara Wind Farm Boundary

N

Metres
0 4,200

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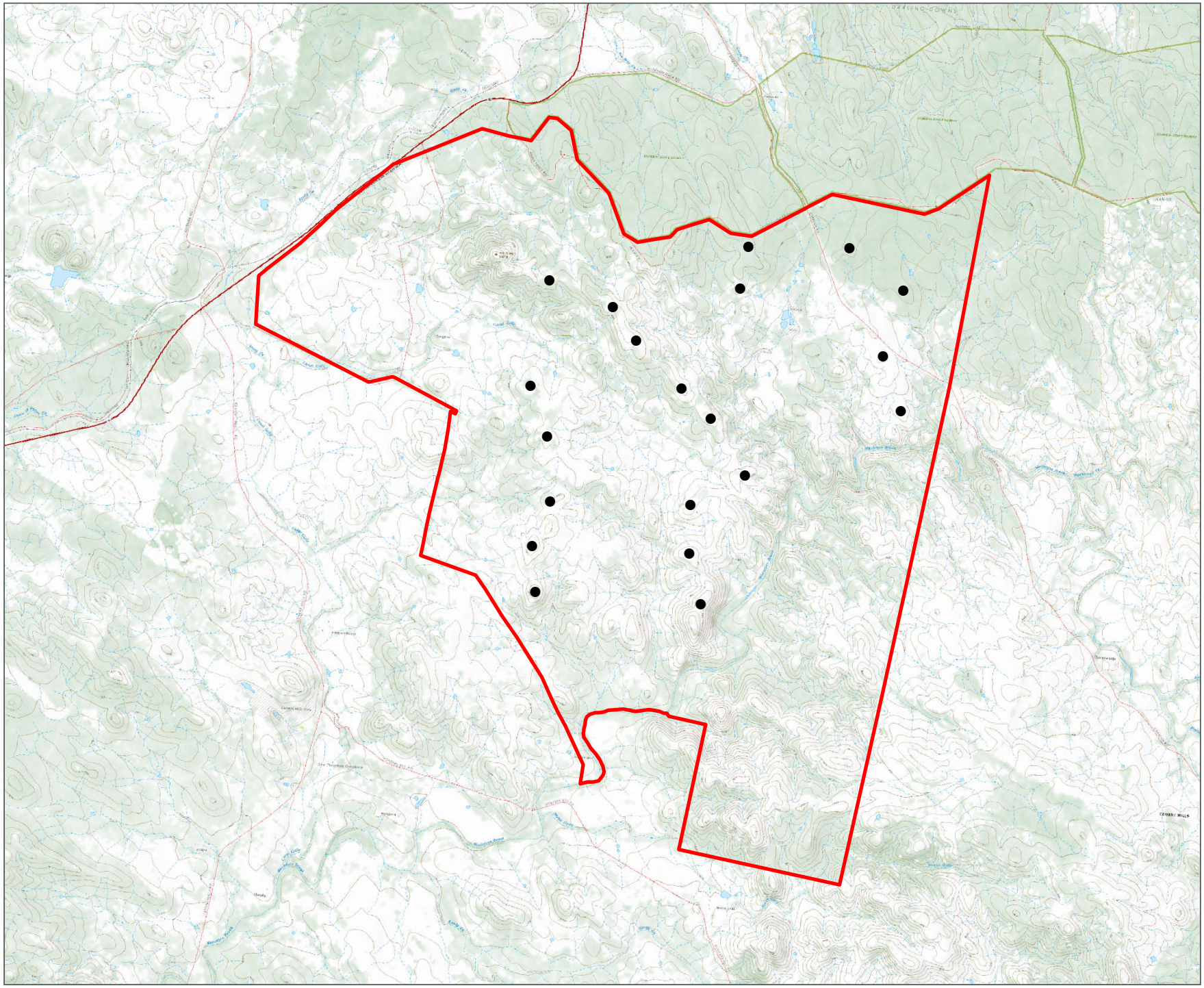

Figure 2: Proposed Wind Turbine Layout

Project: Karara Wind Farm
Client: ACCIONA Energy Australia Pty Ltd
Date: 12/04/2021

Karara Wind Farm Boundary
Proposed Wind Turbine

N

Metres
0 800

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1.5. Site description

Karara Wind Farm is proposed to be located approximately 50 kilometres south west of Warwick, 160 kilometres southwest of Brisbane and 170 kilometres west of the Gold Coast. It falls within the Southern Down Regional Council and Goondiwindi Regional Council Local Government Areas. The land is predominantly used for sheep farming and other agricultural purposes.

The project site is located within the Nandewar Northern Complex of the New England Tableland bioregion. The study area is dominated by Narrow-leaved Ironbark (*Eucalyptus crebra*), White Box (*E. albens*), Tumble-down Red Gum (*E. dealbata*) and Silver-leaved Ironbark (*E. melanophloia*). It lies 45 kilometres from Wondul Range National Park and is adjacent to the Durikai State Forest.

The study area ranges in elevation from 500-600 metres above sea level. It is moderately fragmented and has been heavily cleared, though areas are designated for revegetation.

Five broad fauna habitat types occur on the site (GHD 2020): low eucalypt woodland on rocky hills, mixed eucalypt woodland/forest, ironbark open woodland with a grassy understorey, riparian woodland, and low shrubby regrowth (regrowth woodland with a shrubby understorey). Remaining land, not part of these habitat types, includes cleared or heavily modified grazing land and artificial dams. Heavy clearing and fragmentation have severely reduced habitat for, and therefore diversity of birds and bats. Some areas of remnant vegetation and woodland are, nonetheless, of moderate to high quality.

2. Pre-construction Bird and Bat Information

Acciona Energy Australia Global Pty Ltd (Acciona) engaged GHD to undertake a desktop review and field surveys to determine the potential impacts to birds and bats within the study area from the proposed wind farm. These are outlined in detail in the Karara Wind Farm Bird and Bat Utilisation Report (GHD 2020) and summarised below. Acciona engaged Nature Advisory to undertake targeted threatened woodland bird surveys and habitat mapping as well as bird utilisation surveys within the study area which are also summarised below. The methods comprise studies of the MacIntyre Wind Energy Precinct study area that is now split into MacIntyre Wind Farm and Karara Wind Farm. Surveys were distributed across the original study area, including the Karara Windfarm footprint.

These investigations provide valuable information and contribute to the risk-assessment (Section 3) which identifies the 'at-risk' species from the operation of the project.

2.1. Pre-construction survey methods

Field surveys for Karara Wind Farm were undertaken as part of the development of the MacIntyre Wind Energy Precinct in accordance with the Queensland State Code 23 for Wind Farm Development (DILGP 2017) and generally in accordance with the EPBC Act survey guidelines by AECOM (2011-2012), EHP (2017-2018), and GHD (2018-2019). Habitat assessment surveys were undertaken based on vegetation quality and structure that may influence nesting or roosting opportunities for birds and bats (GHD 2020).

Targeted habitat mapping for Regent Honeyeater, Painted Honeyeater and Swift Parrot was undertaken based on the presence of habitat characteristics for each species as detailed in the Conservation Advice for Regent Honeyeater, Painted Honeyeater and Swift Parrot and the National Recovery Plans for Regent Honeyeater and Swift Parrot (Nature Advisory 2021b). Targeted surveys for Regent Honeyeater, Painted Honeyeater and Swift Parrot have also been conducted within the project area (Nature Advisory 2021b).

Bird and bat habitat assessments were conducted on the following dates.

Birds

- 12-15 December 2011 at 51 sites (AECOM)
- 26-30 October 2018 at 203 sites (GHD)
- 22-30 May 2020 (Nature Advisory)
- 15-19 June 2020 (Nature Advisory)
- 21-24 July 2020 (Nature Advisory).

Bats

- 12-15 December 2011 at 51 sites (AECOM)
- 26-1 November 2018 at 203 sites (GHD).

In addition, bird surveys were conducted using the following methods.

- Bird Utilisation Surveys (BUS) - fixed-point sites using 2 ha bird census method involved 20 minutes surveying a 2-hectare area and recording all birds seen or heard. The surveys targeted conservation significant species

- Aerial bird surveys were conducted to determine the potential of bird-turbine collision. This was done by two observers surveying the airspace for two 20-minute periods. All birds observed within 200m were recorded
- Fixed point bird surveys for 10 minutes recording all bird species and numbers of individual birds heard or observed within 100 metres (targeting Regent Honeyeater, Painted Honeyeater and Swift Parrot)
- Fixed point bird surveys for 15 minutes recording all bird species and numbers of individual birds heard or observed within 200 metres
- Driving/flushing surveys was done throughout the study area for easy detection of small ground-dwelling species. A total of 1,476 km was driven across all surveys
- Nocturnal spotlighting and call playback were undertaken on 8 nights for potential occurrence of owls and nightjars. The active searches coincided with the setup of bat detectors
- Incidental observations of all birds flying higher than 20m were recorded. Actual Rotor Swept Area (RSA) height was not confirmed at the time of the surveys.

Dates and details for bird surveys undertaken at the study area are outlined below.

- 21-23 November 2012 – Bird utilisation 18 fixed-point sites (AECOM)
- 23-27 October 2017 – Bird utilisation 8 fixed-point sites (EHP)
- 31 October – 1 November – Targeted and flushing surveys (GHD)
- 14-18 January 2019 – Bird utilisation 64 fixed-point sites (GHD)
- 21-25 January 2019 – Bird utilisation aerial surveys 18 sites (GHD)
- 23-30 May 2020 – Bird utilisation 12 fixed-point sites 2 sites (Nature Advisory)
- 22 September – 2 October 2020 – Bird Utilisation 12 fixed-point sites 5 sites (Nature Advisory)
- 3-8 December 2020 – Bird Utilisation 12 fixed-point sites 5 sites (Nature Advisory)
- 1-6 February 2021 – Bird Utilisation 12 fixed-point sites 5 sites (Nature Advisory).

Bats were surveyed using stationary bat detectors (bat utilisation surveys) and harp trapping.

Bat detector surveys were conducted using Anabats set at 28 sites. They were placed based on habitat type and possible distance to turbine at 1-2m height and left over-night. Recorded echolocation calls were analysed by a specialist sub-consultant. Harp trapping was undertaken using six two-bank harp traps set in suitable habitat for conservation significant microbat species (GHD 2020). Dates the Anabats and harp traps were deployed included the following.

- 12-15 December 2011 & 21-23 November 2012 – Bat Utilisation (Anabats) 5 sites (AECOM)
- 23-27 October 2018 –Bat Utilisation (Anabats) 5 sites (EHP)
- 14-18 January 2019 – Bat Utilisation (Anabats) 8 sites & 2 nights of spotlighting (GHD)
- 21-25 January 2019 – Bat Utilisation (Anabats) 10 sites & 2 nights of spotlighting (GHD)

- 4-8 February 2019 – Bat Utilisation (Anabats) repeated at 15 sites, harp traps at 12 sites & 2 nights of spotlighting (GHD).

Vehicle based spotlighting and stationary dusk surveys at higher elevation were undertaken to target species of flying-fox, namely, the Grey-headed Flying-fox. Each watch was done by two observers for one hour. Coinciding with this, nocturnal active searches and call playback were done for owls and nightjars, targeting the Powerful Owl. All observations and incidental finds were recorded. Spotlighting took place on two nights during the following periods.

- 26 October - 1 November 2018 (GHD)
- 14-18 January 2019 (GHD)
- 21-25 January 2019 (GHD)
- 4-8 February 2019 (GHD).

2.2. Pre-construction survey results

Across the bird surveys in the MacIntyre Wind Energy Precinct 141 bird species were recorded (AECOM, GHD, EHP, Nature Advisory). Species with the most abundant observations included White-browed Woodswallow (*Artamus superciliosus*), Noisy Miner *(Manorina melanocephala)*, Noisy Friarbird (*Philemon corniculatus*), Torresian Crow *(Corvus orru),* Weebill (*Smicrornis brevirostris*), Little Lorikeet *(Glossopsitta pusilla)*, Peaceful Dove *(Geopelia striata)*, Scaly-breasted Lorikeet *(Trichoglossus chlorolepidotus),* Common Bronzewing *(Phaps chalcoptera)* and Grey Shrikethrush *(Colluricincla harmonica)* (Nature Advisory 2021a, GHD 2020).

Eight species of raptor were recorded at the study area. Most common raptor species included the Nankeen Kestrel *(Falco cenchroides)*, Wedge-tailed Eagle *(Aquila audax)* and Whistling Kite *(Haliastur sphenurus).* A total of 71 of 113 observations of raptors were recorded flying at RSA height.

The majority of bird observations recorded at the study area occurred below RSA height. One threatened species was observed flying at RSA height, the White-throated Needletail *(Hirundapus caudacutus).*

During GHD field surveys, 15 microbat species were identified from the anabat recorders and harp traps. In addition, 12 microbat species were recorded during AECOM bat surveys. The bat call analyses revealed the most common microbat species to be Little Forest Bat *(Vespadelus vulturnis),* Eastern Free-tailed Bat (*Ozimops ridei*), Yellow-bellied Sheath-tailed Bat *(Saccolaimus flaviventris),* Little Broad-nosed Bat *(Scotorepens greyii)* and Bristle-faced Freetailed Bat *(Stirostris eleryi).* One Little Red Flying-fox *(Pteropus scapulatus)* was flying at approximate RSA height. No Grey-Headed Flying-fox or other listed bat species were observed during field surveys.

Three bird species and five bat species of conservation significance were present or likely to occur within the study area. This was based on field surveys, database searches and habitat suitability. Listed species confirmed present include the following.

- Squatter Pigeon
- White-throated Needletail
- Glossy Black Cockatoo.

Species considered likely to occur include the following.

- Regent Honeyeater

- Painted Honeyeater
- Swift Parrot
- Powerful Owl
- Grey-headed Flying Fox.

In addition, the EPBC Act Project Matters Search Tool (PMST) identified seven migratory species as potentially occurring within the Project site, including the following.

- Fork-tailed Swift
- Oriental Cuckoo
- White-throated Needletail
- Black-faced Monarch
- Yellow Wagtail
- Satin Flycatcher
- Rufous Fantail.

The likelihood of occurrence of these state and Commonwealth-listed species on the wind farm site, having regard to the habitats present and the species' habitat preferences, are discussed in Section 3. A more detailed discussion on Regent Honeyeater, Painted Honeyeater and Swift Parrot is below.

2.2.1. Targeted surveys for Regent Honeyeater, Painted Honeyeater and Swift Parrot

Specific assessments were carried out for key threatened birds targeted with potential to occur in Karara Wind Farm and the wider region. The species of concern are listed below, including their status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

- Regent Honeyeater (*Anthochaera phrygia*) - Critically Endangered
- Painted Honeyeater (*Grantiella picta)* - Vulnerable
- Swift Parrot (*Lathamus discolor)* - Critically Endangered
- White-throated Needletail (*Hirundapus caudacutus*) – Migratory and Vulnerable

A report titled "*Karara Wind Farm - EPBC Act threatened birds - habitat and regional assessment and targeted surveys*" (Nature Advisory 2021b) has been prepared. This report was based on data obtained from a review of background information, including documents prepared under the EPBC Act and previous ecological reporting for the study area, as well as field surveys conducted by Nature Advisory Pty Ltd between the 22nd and 30th of May, 15th and 19th of June and 21st and 24th of July, 2020.

Previous records and reports indicate that the targeted threatened species occur in the region at times. While extensive clearing has occurred within the study area, patches of remnant vegetation remain, some of which provides habitat for some of the targeted species. The quality and extent of this habitat has been characterised and mapped.

Regent Honeyeater habitat (0.620 hectares, which is also considered habitat critical to the survival of the species) and Swift Parrot habitat (0.408 hectares) has been mapped within the development

footprint. This represents a very small proportion of the development footprint and study area. The removal of this habitat is considered acceptable as evidence indicates these species are likely more consistently to utilise habitat adjacent to the study area and elsewhere in the region, particularly habitat in larger forest blocks that occur outside the study area, rather than habitat within the study area itself. It is noted that no Painted Honeyeater or White-throated Needletail habitat is proposed to be removed. Regent Honeyeater, Painted Honeyeater and Swift Parrot were also not recorded during targeted surveys for the species.

The results of these surveys were reviewed in the Risk Assessment in the following section.

2.3. Recommendations and further pre-construction surveys

2.3.1. Bird utilisation surveys

The requirement for the bird utilisation survey is based on the highly likely requirement by the Commonwealth Department of Agriculture, Water, and the Environment (DAWE) or undertake bird utilisation surveys and collect baseline data in accordance with a Before-After-Control-Impact (BACI) design. It is expected that DAWE will require baseline surveys of the site be undertaken before the project becomes operational for as long as possible and over multiple seasons. The bird utilisation survey method is described below. To the extent that the construction timetable allows, two wet season and two dry season surveys will be undertaken before the last turbines are commissioned and the project reaches practical completion.

- Each site survey will follow the procedure below.
  - Establishment of between 5 bird survey points (4 impact sites and 1 reference site).
  - 15-minute point-based surveys counting and documenting the distance and flight height of each observed bird in accordance with a BACI sampling design involving two counts of each site in each of four periods of the day (early morning, late morning, early afternoon and late afternoon) corresponding to different periods of bird activity (a total of eight surveys per site). This schedule will ensure that all points are visited equally at different times of day to allow for time-of-day differences in bird movements and activity.
  - During this period, all bird species and numbers of individual birds observed within 200 metres will be recorded. The species, the number of birds and the height of the bird when first observed will be documented. For species of concern (threatened species, waterbirds and raptors), the minimum and maximum heights will be recorded.
  - Each survey point will be counted eight times each survey over the four survey periods (i.e. two wet season and two dry season surveys) at different times of the day.
  - Compilation of a bird species lists for the site from the formal counts and incidental observations, and mapping of the location (and recording of behaviour) of any rare or threatened species.
- Collation and analysis of the survey data and preparation of a brief baseline report summarising the methods and findings, including the following.
  - A statement of the methods used for the investigation, including any limitations, where applicable
  - A summary tabulation of the results of the survey listing species observed in rank order at each point
  - A map of the site showing the location of the survey points.

At the minimum it is anticipated that four seasonal surveys (two wet season and two dry season) will be required for up to two years until practical completion of the wind farm. The first year of surveys has been carried out. The ability to achieve seasonal baseline data across one or more full years will be dependent on the construction schedule and other project drivers but it is anticipated that two years of surveys will be possible before practical completion and commencement of operation of the last wind turbines.

3. Bird and Bat Risk Assessment

3.1. Introduction to the risk assessment

The aim of this risk assessment is to guide the development of the BBAMP for the project by identifying those species or groups considered potentially at risk from either collision with turbine blades or disturbance by operating turbines. The outcomes of this risk assessment enable more targeted monitoring and management measures to be included, focussing on species and groups at greater risk.

Wind farm impacts on birds and bats can arise from three potential pathways listed below.

- Direct collision of birds and bats with transmission lines and towers or turbine blades at rotor swept area (RSA) heights.
- Indirect impacts, including:
  - Disturbance effects that exclude birds and bats from habitat; and
  - Barrier effects that limit bird and bat movements between essential resources, such as foraging and roosting areas.

The risk assessment has followed the procedure for risk assessment of AS/NZS ISO 31000 2009. The assessment has been undertaken as follows.

- Species or groups of concern have been short-listed based on their likelihood of occurrence at the Project site
- Two impact pathways have been assessed: a) collision with turbine blades; and b) indirect effects (including both disturbance and barrier effects)
- Impact likelihood criteria have been developed and applied to each impact pathway for each species or group of concern
- Impact consequence criteria have been developed and applied to each impact pathway for each species or group of concern
- The risk level for each species or group of concern from the two impact pathways has been determined consistent with a risk matrix (Section 3.4).

This risk assessment considers barotrauma for bats as a direct result of turbine blades at RSA in the same way as collisions, and does therefore not address this aspect of risk as a separate issue.

3.2. Information sources

To ascertain the species of concern that may occur on the project site the following sources were used.

- The Queensland Government Wildlife Online search database (Department of Environment and Science (DES) 2020 using a 60km search region centred over the Project site, with a central point of latitude and longitude of: -28.3997 151.5989
- The EPBC Act Protected Matters Search Tool (PMST) (DOEE 2020) using a search region that included the project site, with a 20km radius from the central point of latitude and longitude of -28.3997 151.5989
- The Ecological Assessment Report for the Project (GHD 2020)

- The Bird Utilisation Survey Baseline Report for the Project (Nature Advisory 2021a)
- The EPBC Act threatened birds - habitat and regional assessment and targeted surveys for the Project (Nature Advisory 2021b).

3.3. Species and groups of concern

Species of concern include the following.

- Bird and bat species occurring in the area of the study area listed as threatened or migratory under legislation *Nature Conservation Act 1992* (NCA) and/or the EPBC Act or according to an authoritative source e.g., IUCN Red List or Birdlife Australia
- Species known to be particularly prone to collision with operating turbines or sensitive to disturbance from wind farms (from over 7,000 turbine searches in Victoria, New South Wales and Tasmania by Nature Advisory at other wind farms [unpublished data])
- Species for which a population concentration, or a population of significance, occurs on the Project site and that species may exhibit 'risk behaviour' and potentially interact with operating turbines.

From the foregoing information sources, a list of species with potential to occur in the search region was generated. Of these, a shortlist of species of concern was then generated based on the likelihood of occurrence on the project site itself given the habitat present and occurrence of the species in the search region.

The original site assessments (GHD 2020) identified listed threatened and migratory species likely to occur on the Project site, some of which were detected during on-site fauna survey work. Although this has been taken into consideration, a number of additional species and groups, including non-threatened species/groups, have been identified through the current review that were not originally considered.

Experience at other wind farms in Australia has shown that some microbats, such as the Gould's Wattled Bat and various raptor species, particularly Wedge-tailed Eagle, are susceptible to frequent collision with turbine blades due to their flight behaviour (Nature Advisory, unpublished data). As such, these two species have been included as species of concern in the risk assessment.

The short-listed species and groups are given in Table 2.

Table 2: Risk assessment - Assessed bird and bat species

EPBC Act Listed Migratory Species
▪ Common Sandpiper ▪ Curlew Sandpiper ▪ Fork-tailed Swift ▪ Latham's Snipe ▪ Osprey ▪ Pectoral Sandpiper ▪ Rufous Fantail ▪ Satin Flycatcher ▪ Sharp-tailed Sandpiper
EPBC Act listed threatened birds
▪ White-throated Needletail (EPBC: Vulnerable)
EPBC Act and NC Act listed threatened birds
▪ Australian Painted Snipe (NC Act & EPBC: Endangered) ▪ Painted Honeyeater (NC Act & EPBC: Vulnerable) ▪ Red Goshawk (NC Act: Endangered & EPBC Act: Vulnerable) ▪ Regent Honeyeater (NC Act: Endangered & EPBC Act: Critically endangered) ▪ Squatter Pigeon (NC Act & EPBC: Vulnerable) ▪ Swift Parrot (NC Act: Endangered & EPBC Act: Critically endangered)
NC Act listed threatened birds
▪ Glossy Black-Cockatoo (NC Act: Vulnerable) ▪ Powerful Owl (NC Act: Vulnerable)
EPBC and NC Act listed threatened bats
▪ Corben's Long-eared Bat (NC Act & EPBC: Vulnerable) ▪ Grey-headed Flying-Fox (EPBC: Vulnerable) ▪ Large-eared Pied Bat (NC Act & EPBC: Vulnerable)
Other species or groups of species of concern (i.e. common species)
▪ Yellow-bellied Sheathtail Bat ▪ Little Red Flying-Fox ▪ White-striped Freetail Bat ▪ Gould's Wattled Bat ▪ Wedge-tailed Eagle ▪ Other raptor species (including: Brown Falcon, Brown Goshawk, Nankeen Kestrel, Pacific Baza, Peregrine Falcon, Square-tailed Kite and Whistling Kite)

The risk assessment process was applied to all the foregoing species and groups.

3.4. Risk assessment process

The risk assessment process was based on the Risk Evaluation Matrix Model used to measure the overall risk of a potential impact event, in this case birds or bats striking turbine blades or being deterred from using part of the wind farm due to disturbance. The assessment is based on the *likelihood* of that event and, should it occur, its *consequences*. This model is currently used across a wide range of industry sectors, in particular for assessing environmental risk. The Risk Evaluation Matrix Model also complies with the ISO31000 Risk Assessment Standard.

The assessment requires criteria to be developed for likelihood and consequence. These criteria are provided respectively in Table 3 and Table 4. Table 5 shows the risk levels used and how they are determined from the assessed likelihood and consequence levels.

Table 3: Likelihood criteria for a risk event to occur

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

Table 4: Consequence Criteria

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

Table 5: Risk matrix defining risk level based on likelihood and consequence

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

The relevant likelihood and consequence levels were determined by using data recorded from the project site and with reference to any available information on the local, regional and wider status of the species and bird groups concerned. It also was informed by previous Nature Advisory monitoring at over 17 wind farms in eastern Australia and the carcass data generated over the last 15 years at those wind farms.

3.5. Risk assessment results

Table 6 provides the results of the likelihood and consequence assessment based on the inputs from the aforementioned sources and includes the following information as part of the risk assessment process.

- Species of group and reasons for inclusion
- Threatened species status
- Hazard or source event
- Likelihood and consequence scores
- Risk rating
- Comments relating to risk rating scores.

Table 6 includes a summary of the previous findings for each considered species or group and their relevance to the assessment.

Table 6: Risk Assessment for birds and bats at Karara Wind Farm

Common Name	Reason for inclusion	Threatened species status	Hazard of source event	Likelihood of risk event	Consequence	Risk rating	Comments
Birds							
Australian Painted Snipe *(Rostratula australis)*	Species or species habitat likely to occur	NC Act & EPBC Act: Endangered	Collision with operating turbine	Rare	Moderate	Negligible	This species is widespread throughout QLD though is rare usually being recorded in the Murray-Darling Basin. Generally, inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum or cane grass or sometimes tea-tree (Melaleuca). Sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber (DAWE 2020). It has not been recorded from the study area or in the search region. This species is considered highly unlikely to occur and unlikely to collide with turbines is unlikely to be subject to any indirect disturbance.
			Indirect disturbance including barrier effects	Rare	Moderate	Negligible	
Common Sandpiper *(Actitis hypoleucos)*	Species or species habitat likely to occur	EPBC Act: Migratory NC Act: Special least concern	Collision with operating turbine	Rare	Negligible	Negligible	This species inhabits a wide range of coastal or inland wetlands with varying levels of salinity; mainly muddy margins or rocky shores of wetlands (Higgins & Davies 1996). In eastern Australia usually occur along the coastline. No suitable habitat on site and it has not been recorded on the study area or in the search region. It is considered unlikely to collide with turbines or be subject to any indirect disturbance.
			Indirect disturbance including barrier effects	Rare	Negligible	Negligible	
Curlew Sandpiper *(Calidris ferruginea)*	Species or species habitat likely to occur	EPBC Act: Critically endangered & migratory NC Act: Endangered	Collision with operating turbine	Rare	Negligible	Negligible	This species occurs along the coast or on large inland lakes and swamps (Higgins and Davies 1996). No suitable habitat occurs on site and it has not been recorded in the study area or in the search region. It is considered unlikely to collide with turbines or be subject to any indirect disturbance.
			Indirect disturbance including barrier effects	Rare	Negligible	Negligible	
Fork-tailed Swift *(Apus pacificus)*	Species or species habitat likely to occur	EPBC Act: Migratory NC Act: Special least concern	Collision with operating turbine	Likely	Low	Low	This species is known to follow storm systems and fronts. It typically flies at and above RSA height. Loss of a small number of individuals each year is not considered to be of significance as the species is still numerous in Australia. This species has not been recorded on the site though has been recorded within the 60km search radius and is considered likely to occur there regularly during the non-breeding season. This species will fly between turbines, which are not considered to cause any indirect disturbance.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Glossy Black-Cockatoo *(Calyptorhynchus lathami)*	Species or species habitat likely to occur	Vulnerable NC Act	Collision with operating turbine	Unlikely	Low	Negligible	The Glossy Black-Cockatoo typically feeds on the cones of she-oak trees, nests in hollows in eucalypts and usually flies at or below canopy height. This species has been recorded in the study area and in the surrounding search region. It has been observed in proximity (100 m) to turbines on other wind farms in eastern Australia with no collision incidents. It is considered unlikely that this species would fly into turbines or that the turbines would cause any kind of indirect disturbance.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Latham's Snipe *(Gallinago hardwickii)*	Species or species habitat likely to occur	EPBC Act: Migratory NC Act: Special least concern	Collision with operating turbine	Unlikely	Low	Negligible	Latham's Snipe breeds mostly in Japan and migrates to Australia from late August and stays until March. While in Australia it occupies wetlands and roosts in nearby dense vegetation during the day. It may occur in very small patches of habitat, such as alpine bogs and roadside ditches (Higgins and Davies 1996). Some birds may pass through the study area stopping at vegetated farm dams, but the area provides no extensive habitat so visits are likely to be rare. It is therefore considered to be unlikely to collide with turbines in the area or be disturbed indirectly. Should a collision occur, there would be little impact on the overall population, estimated at a minimum 25,000 birds (Wetlands International 2018).
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Osprey *(Pandion haliaetus)*	Species or species habitat likely to occur	EPBC Act: Migratory NC Act: Special least concern	Collision with operating turbine	Unlikely	Negligible	Negligible	The Osprey is a water dependant raptor that favours coastal areas, typically large river mouths, lagoons and lakes (OEH 2020). No suitable habitat occurs on site and it has not been recorded in the study area or in the search region. It is considered unlikely to collide with turbines or to be disturbed indirectly.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	
Painted Honeyeater *(Grantiella picta)*	Species or species habitat likely to occur	NC Act & EPBC Act: Vulnerable	Collision with operating turbine	Unlikely	Low	Negligible	This species is strongly associated with mistletoe around the margins of open forests and woodlands; it occurs from Gulf of Carpentaria to southern Victoria and eastern South Australia, mostly inland of the Great Divide (Higgins *et al*. 2001). It has not been recorded on the study area and only a single record has been documented from the search region.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	

Common Name	Reason for inclusion	Threatened species status	Hazard of source event	Likelihood of risk event	Consequence	Risk rating	Comments
							This species usually flies within the tree canopy so would be unlikely to be affected by turbines and would rarely visit the study area.
Pectoral Sandpiper *(Calidris melanotos)*	Species or species habitat likely to occur	EPBC Act: Migratory NC Act: Special least concern	Collision with operating turbine	Rare	Negligible	Negligible	This species occurs along the coast or on large inland lakes and swamps. It has not been recorded on the study area or in the search region. It is unlikely to collide with turbines or to be subject to indirect disturbance.
			Indirect disturbance including barrier effects	Rare	Negligible	Negligible	
Powerful Owl *(Ninox strenua)*	Species or species habitat likely to occur	NC Act: Vulnerable	Collision with operating turbine	Likely	Low	Low	Suitable habitat for this species occurs on and adjacent to the study area in the form of eucalypt woodlands. It is known to occur in the Durikai State Forest to the east and no individuals were detected during field surveys (GHD 2020). There are areas of potential foraging habitat along the northern boundary of the Karara Wind Farm site in the woodland habitat that is connected to Durikai State Forest. Some small patches of potential foraging habitat are also located within the balance of the Karara Wind Farm site. For most of its life, the Powerful Owl restricts its activities to forested habitat and does not fly often over open country (Higgins 1999; Soderquist *et al*. 2002). Dispersing juvenile owls may fly longer distances, including over open country. With some proposed turbines located within woodland connective with Durikai State Forest, it is likely that a collision may occur. Indirect disturbance from turbines is expected to be less of a problem.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Red Goshawk *(Erythrotriorchis radiatus)*	Species or species habitat likely to occur	EPBC Act: Vulnerable NC Act: Endangered	Collision with operating turbine	Unlikely	Low	Negligible	This raptor is sparsely distributed from northern Western Australia to north-eastern Queensland and south to north-east New South Wales. It occurs in open woodland and forest habitats preferring habitats with high abundance of birds as a food source, permanent water and are often found in riparian habitats along watercourses (OEH 2020). Suitable habitat is limited within the study area and therefore the species is unlikely to occur. It has not been recorded on the study area or in the surrounding search region. It is unlikely to collide with turbines or to be subject to indirect disturbance.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Regent Honeyeater *(Anthochaera phrygia)*	Species or species habitat likely to occur	EPBC Act: Critically endangered NC Act: Endangered	Collision with operating turbine	Rare	High	Low	Inhabits dry eucalypt forests and River Sheoak near rivers and creeks on inland slopes of the Great Dividing Range (DAWE 2020). It has not been recorded on the study area though there are several records on neighbouring land (in particular to the south-west of the Karara Wind Farm within riparian vegetation along Macintyre Brook) so it may occasionally occur. In the rare event that a Regent Honeyeater would collide with a turbine the consequences would be high due to the small population of this species. A collision would be unlikely due to the low occurrence of the species in the area and the fact that the species rarely flies at RSA. However, as a migratory species it may travel at greater heights. It is unlikely that the proposed wind farm would cause any indirect disturbance to this species.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Rufous Fantail *(Rhipidura rufifrons)*	Species or species habitat likely to occur	EPBC Act: Migratory NC Act: Special least concern	Collision with operating turbine	Unlikely	Low	Negligible	Occurs in wetter forests, woodlands and gullies along the coast and ranges along the eastern seaboard of mainland Australia. Sometimes occur on the inland slopes, especially on migration (Higgins *et al*. 2006). No records on site though there are several observations from the search region. This species usually forages in the foliage or understorey layers and given limited suitable habitat it is unlikely to be impacted by turbines.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Satin Flycatcher *(Myiagra cyanoleuca)*	Species or species habitat likely to occur	EPBC Act: Migratory NC Act: Special least concern	Collision with operating turbine	Unlikely	Low	Negligible	This species occurs in forest and woodlands along the eastern seaboard of Australia including Tasmania (Higgins *et al*. 2006). After breeding in south-eastern Australia, it migrates to north Queensland and New Guinea during autumn and winter. Has been recorded in the study area on one occasion (GHD 2020). This species is fairly common and so any collisions with turbines in the study area are unlikely to cause measurable impacts to its population. Indirect disturbance is considered to be unlikely as the site is outside its usual migration route.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Sharp-tailed Sandpiper *(Calidris acuminata)*	Species or species habitat likely to occur	EPBC Act: Migratory NC Act: Special least concern	Collision with operating turbine	Rare	Negligible	Negligible	This species occurs along the coast or on large inland lakes and swamps (Higgins and Davies 1996). No suitable habitat occurs on site and it has not been recorded on the study area or in the search region. It is considered unlikely to collide with turbines or to be indirectly disturbed by the project.
			Indirect disturbance including barrier effects	Rare	Negligible	Negligible	

Common Name	Reason for inclusion	Threatened species status	Hazard of source event	Likelihood of risk event	Consequence	Risk rating	Comments
Squatter Pigeon (southern subspecies) *(Geophaps scripta scripta)*	Species or species habitat likely to occur	NC Act & EPBC Act: Vulnerable	Collision with operating turbine	Unlikely	Low	Negligible	This species inhabits terrestrial environments in tropical open dry woodlands and less often in savanna (Higgin and Davies 1996). This species has been recorded on site and in the search region. It spends the majority of its time on the ground, is not typically a high-flying bird and is considered unlikely to collide with turbines or to be subject to any indirect disturbance.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Swift Parrot *(Lathamus discolor)*	Species or species habitat likely to occur	EPBC Act: Critically endangered NC Act: Endangered	Collision with operating turbine	Rare	High	Low	The species breeds in Tasmania and migrates to the mainland of Australia in April. There are records of it occurring in QLD in some years during the non-breeding season (DAWE 2020). It spends winter inland of the Great Divide feeding on eucalypts, particularly Mugga Ironbark and box species. It has not been recorded on the study area though there are several records from the search region. This species has the potential to occur in the study area. This species generally flies at and below canopy height and collision is considered unlikely. Furthermore, the turbines are unlikely to cause any indirect disturbance. Any collision would have serious consequences given the small size of the population.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Wedge-tailed Eagle *(Aquila audax)*	Species or species habitat likely to occur	N/A	Collision with operating turbine	Almost certain	Low	Low	The Wedge-tailed Eagle is the species most exposed to collision risk due to its common habit of soaring and circling at height while foraging. Several birds of this species have been struck at other wind farms in eastern Australia. Disturbance is not an issue, with the eagle breeding successfully as close as 200 metres from operating wind turbines.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	
White-throated Needletail *(Hirundapus caudacutus)*	Species or species habitat likely to occur	EPBC Act: Vulnerable and Migratory NC Act: Vulnerable	Collision with operating turbine	Likely	Low	Low	This species is known to follow storm systems and fronts. Occasional mortality has been reported at other wind farms where it occurs. It typically flies at and above RSA height. Loss of a small number of individuals each year is not considered to be of significance as the species is still numerous in Australia. It has been recorded in the study area and in the search region and is considered likely to occur regularly during the non-breeding season. This species will fly between turbines and is not considered to be subject to any indirect disturbance.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	
Other Raptors	Species or species habitat likely to occur	N/A	Collision with operating turbine	Almost certain	Low	Low	The Black Kite, Brown Falcon, Brown Goshawk, Little Eagle, Nankeen Kestrel, Pacific Baza, Peregrine Falcon, Square-tailed Kite and Whistling Kite have been recorded at the study area (Nature Advisory 2021a, GHD 2020). These species fly at RSA heights and some of these species are known to have collided with turbines. The widespread and common status of these species makes population impacts unlikely. These species appear not to be deterred by the presence of operating wind turbines and most species occur regularly at other wind farms in eastern Australia.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	
Bats							
Corben's Long-eared Bat *(Nyctophilus corbeni)*	Species or species habitat likely to occur	NC Act & EPBC Act: Vulnerable	Collision with operating turbine	Unlikely	Low	Negligible	This species is distributed across the Murray-Darling basin with the Pilliga Scrub region being a stronghold for the species (OEH 2020). It occurs in a wide variety of habitats usually associated with water courses and permanent water (Churchill 2008). It roosts in tree hollows, crevices and under loose bark. This species has not been recorded on the study area or in the search region, though there are some records from state parks further to the west. It is slow-flying and agile, prefers to fly in the understorey foraging on non-flying prey and will even crawl along the ground to hunt (OEH 2020). It is unlikely to fly at RSA height and therefore unlikely to collide with turbines. The turbines are not considered to cause any indirect disturbance.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	
Gould's Wattled Bat *(Chalinolobus gouldii)*	Species or species habitat likely to occur	N/A	Collision with operating turbine	Almost certain	Negligible	Negligible	A common and widespread species. Juveniles disperse from December or January which may result in higher rates of collision. It nests in tree hollows or buildings and flies within the canopy and sub canopy but will pass over open areas and can forage up to 15km from roosts (Churchill 2008). It has been recorded in the study area and it has been recorded colliding with turbines at other wind farms. As a common and widespread species population impacts are unlikely. The turbines are not considered to cause any indirect disturbance.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	
Grey-headed Flying-Fox *(Pteropus poliocephalus)*	Species or species habitat likely to occur	EPBC Act: Vulnerable	Collision with operating turbine	Unlikely	Low	Negligible	Foraging habitat exists within the study area and it may use the area occasionally as it moves in conjunction with flowering and fruiting seasons. There are two Little Red Flying-Fox camps within 45 km of the study area. Grey-headed Flying-Fox may join these camps from time to time in low numbers but it is unlikely to occur in large numbers. The species flies at RSA height when travelling to foraging sites from roosting sites which could bring it into contact with turbines. Given the low numbers likely to occur on the site, the development is unlikely to have a significant impact on the species' population. Estimates
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	

Common Name	Reason for inclusion	Threatened species status	Hazard of source event	Likelihood of risk event	Consequence	Risk rating	Comments
							from 2005 of this population total around 674,000 (DAWE 2020) so the potential loss of the occasional individual is unlikely to be of ecological significance. The turbines are not considered to cause any indirect disturbance.
Large-eared Pied Bat *(Chalinolobus dwyeri)*	Species or species habitat likely to occur	NC Act & EPBC Act: Vulnerable	Collision with operating turbine	Unlikely	Low	Negligible	This species has a patchy distribution across Qld in well-timbered areas containing gullies (OEH 2020). It has not been recorded on the study area or in the search region and is considered unlikely to occur (GHD 2020). They fly relatively slowly at low to mid-canopy level. It is unlikely to collide with turbines and turbines are not considered to cause any indirect disturbance.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	
Little Red Flying-Fox *(Pteropus scapulatus)*	Species or species habitat likely to occur	N/A	Collision with operating turbine	Likely	Negligible	Negligible	Foraging habitat exists within the study area and it may use the area occasionally as it moves in conjunction with flowering and fruiting seasons. There are two Little Red Flying-Fox camps within 45 km of the study area. This species has been observed foraging in trees in the study area (GHD 2020). The species flies at RSA height when travelling to foraging sites from roosting sites which could result in collision with turbines. Given the high abundance of this spices across its distribution the potential loss of the occasional individual is unlikely to be of ecological significance. The turbines are not considered to cause any indirect disturbance.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	
White-striped Freetail Bat *(Austronomus australis)*	Species or species habitat likely to occur	N/A	Collision with operating turbine	Almost certain	Low	Low	This species roosts in trees and is widespread across Qld. It occurs in a variety of habitats, including urban areas, woodland, shrubland, open agricultural land with scattered trees, grasslands and deserts (Churchill 2008). It is fast-flying and not designed for manoeuvrability. It often flies at RSA heights. This species has been recorded at the study area and regularly collides with turbines at other wind farms in eastern Australia. Given the high abundance of this species across its distribution the loss of individuals is unlikely to pose a significant risk to the species' population. The turbines are not considered to cause any indirect disturbance.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	
Yellow-bellied Sheathtail Bat *(Saccolaimus flaviventris)*	Species or species habitat likely to occur	N/A	Collision with operating turbine	Likely	Negligible	Negligible	This species is a wide-ranging bat that occurs across northern and eastern Australia. It more commonly occurs in the northern areas of the country. It roosts in tree hollows, buildings and in treeless landscapes and is known to utilise mammals' burrows (OEH 2020). It forages for flying insects and is known to fly high and fast over the tree canopy (Churchill 2008) and can fly at RSA heights. This species has been recorded from the study area and in the surrounding search region. This puts it at risk of collision with turbines though the risks are considered negligible due to its stable status in Qld. Turbines are not considered to cause any indirect disturbance.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	

3.6. Conclusions from the risk assessment

Risks to the majority of species of concern at the project site have been assessed as negligible. Six bird species and one bat species have been identified as having a low risk rating of being affected by collision with operating turbines once the project is constructed. Five out of the seven species are listed under the NC Act and/or EPBC Act.

Wedge-tailed Eagle and other raptors

The Wedge-tailed Eagle is the species most exposed to collision risk due to its common habit of soaring and circling at height while foraging. Several birds of this species have been struck at other wind farms in eastern Australia. Disturbance is not an issue, with the eagle breeding successfully as close as 200 metres from operating wind turbines.

Other raptor species such as Black Kite, Brown Falcon, Brown Goshawk, Little Eagle, Nankeen Kestrel, Pacific Baza, Peregrine Falcon, Square-tailed Kite and Whistling Kite, observed at the project site, may also be at risk of collision with turbine blades. As widespread and common species, population consequences are predicted to be negligible.

Fork-tailed Swift

This species typically flies at and above RSA height. Loss of a small number of individuals each year is not considered to be of significance as the species is still numerous in Australia. This species has not been recorded in the study area though has been recorded in the broader search region and is considered likely to occur there regularly during the non-breeding season (October to April). This species will fly between turbines, which are not considered to cause any indirect disturbance. As widespread and common species, population consequences of collision are predicted to be negligible.

Powerful Owl

Suitable habitat for this species occurs on and adjacent to the study area in the form of eucalypt woodlands. It is known to occur in the Durikai State Forest to the east. No individuals were detected during field surveys (GHD 2020). Areas of suitable habitat occur along the northern boundary of the Karara Wind Farm in the old growth forest/woodland habitat that is connected to Durikai State Forest. A total of 20 turbines are currently proposed in this habitat which increases the risk of turbine collision for this species. For most of its life, the Powerful Owl restricts its activities to forested habitat and does not fly often over open country (Higgins 1999; Soderquist et al. 2002). Dispersing juvenile owls are likely to fly longer distances, including over open country. With proposed turbines located within old growth woodland there is potential for a collision but indirect disturbance from turbines may be less of a problem, evidenced by successful breeding of Powerful Owls in NSW within 1 km of turbines.

Regent Honeyeater

Inhabits dry eucalypt forests and River Sheoak near rivers and creeks on inland slopes of the Great Dividing Range (DAWE 2020). It has not been recorded on the site. Several records occur on neighbouring land so it may occasionally occur on the site, although suitable and potential habitat on the site is limited in extent (Nature Advisory 2021b). In the rare event that a Regent Honeyeater collided with a turbine the consequences would be high due to the small population of this species and its critically endangered status. A collision would be unlikely due to the low occurrence of the species in the area and the fact that the species rarely flies at RSA. However, as a migratory species it may fly higher when moving longer distances. It is unlikely that the proposed wind farm would cause any indirect disturbance to this species.

Swift Parrot

The Swift Parrot breeds in Tasmania and migrates to the mainland of Australia in April. There are records of it occurring in QLD in some years during the non-breeding season (DAWE 2020). It spends winter inland of the Great Dividing Range feeding on eucalypts, particularly Mugga Ironbark and box species. It has not been recorded on the site though there are several records from the wider search region. This species has the potential to occur on the site, although suitable and potential habitat is limited in extent (Nature Advisory 2021b). This species generally flies at and below canopy height and collision is considered unlikely. Furthermore, the turbines are unlikely to cause any indirect disturbance. Any collision would have serious consequences given the small size of the population and its critically endangered status.

White-throated Needletail

This species typically flies at and above RSA height. Loss of a small number of individuals is not considered to be of significance as the species is still numerous in Australia. It has been recorded on the site and in the search region and is considered likely to occur regularly during the non-breeding season. This species has been observed to fly between turbines and is not considered to be subject to any indirect disturbance, despite propositions to the contrary (TSSC 2019). Collision related impact is considered to affect only a small number of individuals (TSSC 2019), as evidenced by the small number recorded at Australian wind farms (e.g. Hull et al (2013) and observations of Nature Advisory).

White-striped Freetail Bat

This species is fast flying and often flies at RSA heights. This species has been recorded on the site and regularly collides with turbines at other wind farms in eastern Australia. Given the high abundance of this species across its distribution the loss of individuals is unlikely to pose a significant risk to the species' population. The turbines are not considered to cause any indirect disturbance.

4. Commissioning and Operational Phase Monitoring

The main components to implement the BBAMP are summarised below.

- A statistically robust carcass monitoring program (random or stratified random sampling design) to detect birds and bats that collide fatally with operating turbines, as a basis for an estimate of overall bird and bat mortality rates at the project (Section 4.3.8)
- Specific management contingencies for key species and groups identified in the risk assessment and/or initiated due to a specific *impact trigger* (Section 6)
- Mitigation measures to reduce the possible interactions between birds and bats, and operating turbines (Section 6.3).

Sections 4.1 to 4.4 describe the survey methodologies to be implemented once the project is commissioned (i.e. is operational). Monitoring during the commissioning phase will focus on opportunistic monitoring of turbines for carcasses (incidental finds) with reporting through the incidental carcass find protocol (see Section 4.3.4). Turbine searches will commence once the specific stages of the wind farm are commissioned.

Formal carcass searches (statistically designed sampling) will be carried out for a total of 24 months on each stage. BBAMP implementation will be reviewed and all monitoring data gathered will be compiled after the first and second years. The findings will be used to report on the impact of the wind farm on bird and bat species and to determine if further monitoring (or other activities) will be required in subsequent years to address identified risks and impacts.

4.1. Operational Bird Utilisation Surveys

A comprehensive baseline pre-commissioning bird utilisation survey (BUS) will be undertaken as outlined above (see Section 2.3.1).

Surveys will be repeated when the wind farm is fully operational for Karara Wind Farm. The surveys will be completed over the first year of operation using the methodology described in Section 2.3.1 but will focus on 4 impact points and one reference site.

The requirement for additional BUS surveys will be assessed and recommended in the first-year annual report. These surveys will seek to demonstrate whether the site continues to be utilised by the range of species identified in the pre-commissioning surveys and assess any changes in abundance or behaviour.

The data from the BUS surveys will be available for analysis to determine if there are changes in bird utilisation at the site.

4.2. Monitoring 'at risk' groups

The species from key 'at risk' species have been identified through the risk assessment (Section 3). These are summarised below.

- Wedge-tailed Eagle
- Fork-tailed Swift
- Powerful Owl
- Regent Honeyeater
- Swift Parrot

- White-throated Needletail
- White-striped Freetail Bat.

Impacts on any of these species will be identified in the carcass searches described in Section 4.3 below. In addition, specific monitoring will be undertaken for some of these species of concern and is discussed further below.

In the event that threatened birds or bats are found during carcass searches, or incidentally, an appropriate response will be identified as described in the procedure in Section 6 of this BBAMP.

4.2.1. Fork-tailed Swift, White-throated Needletail, Regent Honeyeater, Swift Parrot, Wedge-tailed Eagle and other raptors

Once the wind farm is fully operational and carcass monitoring commences, regular monthly monitoring will be undertaken of flight movements of the Wedge-Tailed Eagle, Fork-tailed Swift, Regent Honeyeater, Swift Parrot, White-throated Needletail and raptors. This observational data will contribute to determining whether operating turbines affect the behaviour of these species. This raptor monitoring will encompass incidental monitoring of Wedge-tailed Eagle and other raptors integrated into the monthly carcass monitoring program during the first two years of operation, and will be undertaken by trained staff (see also Section 4.3.2.). Observations will be recorded as the searchers move through the wind farm.

Information recorded will include, as a minimum, the following.

- Date location and duration of observation period
- Time and duration of flight
- Number of birds, and approximate age (if known)
- Flight height above ground (range)
- Habitat over which the flight was observed
- Flight behaviour observed, included soaring, directional flight (flapping), kiting, circling, gliding and diving
- Other occasional behaviours included feeding, territorial displays, fighting and perching.

A monitoring data form is included in Appendix 1. Flight paths will be plotted as accurately as possible on large-scale aerial photographs of the project site.

In addition, nesting activity will also be incidentally recorded. Any eagle nests observed will be recorded by GPS location and revisited during the breeding season (in August to December) to monitor nesting activity and outcome.

The monitoring of birds as outlined above is likely to vary with potentially higher utilisation in the wet and early dry seasons. However, consistent monitoring across all seasons will enable the identification of possible seasonal changes.

A series of adaptive management measures are proposed in this BBAMP to reduce the potential for high numbers of raptors using the project site. These are outlined in Section 5.

4.2.2. Other bird species

All other bird species were considered to be at a 'negligible' risk from Karara Wind Farm. These species would be subject to the standard protocols that operate once the BBAMP comes into effect, namely, any bird found during the carcass searches (Section 4.3) or incidentally by Operations staff

will be reported and stored in a freezer on-site for confirmation of its identity and for use in scavenger trials. The incidental discovery of carcasses by Operations staff will be subject to the recording requirements described in section 4.2.5.

In the event the carcass of a listed species is identified incidentally, the protocols outlined in Section 6 will be implemented.

4.3. Carcass Searches

The purpose of carcass searches is to determine the actual impact of the project on birds and bats by attempting to estimate the annual number of birds and bats that collide fatally with operating turbines. Mortality rates can be estimated for all bird species combined, and all bat species combined. If threatened species are found underneath a turbine, the mortality rate for that particular threatened species may also be estimated, subject to sufficient data being available.

Mortality is defined as any dead bird or bat detected under a turbine and within a distance of the turbine in which carcasses could potentially fall if struck. Detection can be either during the formal carcass searches (designed to generate an estimate in accordance with a statistically rigorous sampling design) or at other times (incidental observation, often by Operational staff or by ecologist on site outside of formal carcass searches). A protocol is triggered whenever a carcass is found, either within the formal searches or incidentally to collect consistent and useful data on the fatality event (see below).

Collision by birds and bats with operating turbines will be monitored through a statistically rigorous carcass-search program for a minimum period of two years which will commence when the wind farm becomes fully operational. This will ensure statistically useable and robust results are generated from the carcass monitoring program that include an estimate of both bird and bat mortality rates, together with an estimate of sampling precision.

It will be assumed that any intact dead bird or bat, or bird feather spot (defined as a clump of five feathers or more), detected beneath an operating turbine has died as a result of collision or interaction with turbine blades, unless there are obvious signs of another cause of death. Feather spots will be assumed to be remains of a bird carcass after scavenging and the scavenger correction factor will not be applied to them (see later).

Additional incidental monitoring of mortality from blade strike by wind farm personnel at operating wind farms typically serves to:

- provide supplementary data that can inform adaptive management of the collision risk i.e. patterns of mortality related to seasonal changes or local conditions; and
- detect mortality of threatened and non-threatened bird and bat species, which can be used to understand actual bird and bat impacts.

The search protocol outlined below has been designed to detect species that have fatally collided with operating turbines at other wind farms. The consistent application of this protocol will ensure that statistically robust, spatially and temporally consistent data are collected on bird and bat mortality at the site, in a manner comparable with other, similarly monitored wind farms.

To derive accurate mortality rates, it is essential that the monitoring program is scientifically and statistically robust. Several factors, such as carcass scavenging and carcass detectability, can affect mortality rate estimates and must be measured and included in any estimate of overall mortality rates for the site.

A scavenged carcass may increase the variability in mortality rate estimates and thus carcasses will be assessed for possible scavenging (i.e. evidence of animal disturbance to the carcass) and rates will be estimated from experimental trials (Sections 4.2.6).

Human or canine detectability of carcasses is also a potential confounding variable and protocols have been developed to control this factor in the final mortality estimates. Section 4.2.7 provides more detail on this issue.

The practical considerations that have informed the design of the carcass search program and associated trials are listed below.

- Very few carcasses are found under turbines in Australia compared with Northern Hemisphere wind farms (on average, less than half the number in the Northern Hemisphere based on Nature Advisory data across ten wind farms in Australia)
- Carcasses of a suitable range of sizes for scavenger and detectability trials are difficult to source and usually involve a combination of carcasses found under operating turbines and those found along roads and other legal sources. Note that it is illegal to source un-cleaned carcasses from poultry producers
- For statistical reasons, it is likely to be very difficult to determine more than the grossest of differences in scavenging rate or detectability across the year and there is no evidence in the literature for significant differences between seasons in scavenger activity. Therefore, annual scavenger and detectability correction factors will be generated and applied
- It is known that detectability will be easier in short grass at the dry time of the year compared with in longer grass at the wet time of the year, and detectability trials will be scheduled at both times to provide representative correction factors.

Similar methods have been recommended in a number of other approved bird and bat monitoring programs in Queensland, New South Wales and Victoria (see Section 1.4 for examples). Implementation of bird and bat monitoring programs in Australia is still developing (since 1998), and the techniques described here are based on lessons from a number of such programs already implemented; for example, Hull et al. (2013) Nature Advisory findings from fifteen bird and bat impact monitoring projects, knowledge of experimental design and statistical analysis, and recent feedback to Nature Advisory from the DAWE.

After two years of mortality monitoring, a detailed report will be prepared for the Proponent detailing a review of the mortality detection program and providing recommendations for the future in response to any revised or newly identified risks at the site, including risks and impacts on EPBC Act listed migratory and resident species – see Section 4.5 for reporting requirements. The following Sections are outlined below.

- **Turbine selection for survey** (Section 4.3.1): how the turbines will be selected for the search
- **Search protocol for ecologists** (Section 4.3.2): the size of area beneath turbines to be searched and how this area will be systematically searched and results recorded
- **Searching with scent dogs** (Section 4.2.3): Searching protocol to be implemented if scent dogs are chosen to undertake carcass searches
- **Carcass detection protocol** (Section 4.3.4): The process of recording a carcass and what to do with it

- **Incidental carcass protocol:** (Section 4.2.5): outlining the procedure to be adopted in the event of an incidental carcass or feather spot find by Construction or Operation personnel outside the formal carcass-searches
- **Scavenger rates and trials** (Section 4.2.6): definition of scavenging and how experimental trials will be conducted
- **Detectability (observer) trials** (Section 4.2.7): definition of detectability and the experimental trial methodology

4.3.1. Turbine selection

The project comprises a maximum of 20 turbines. These turbines will be progressively commissioned over a 6-12-month period.

It is proposed that a minimum of 50% of the turbines will be searched monthly, totalling at least 10 turbines. Turbines will be stratified into groups (strata) representing parts of the project site with different habitats and different limitations on search areas (see Section 4.2.5). Within these strata, a minimum of three turbines will be selected randomly, so that each turbine in a stratum will have an equal chance of being selected. The selection of the 10 turbines to be included in the search will be made prior to the commencement of the first search and will remain the same throughout the monitoring period.

4.3.2. Search protocol

All searches will be undertaken by personnel trained and regularly assessed by the supervising ecologist to ensure they implement the required monitoring methods effectively and consistently, and are able to identify any carcasses (or evidence of collision, such as feather spots) found under wind turbines.

The search area beneath each turbine has been determined as the area to find bats and medium to large bird carcasses with turbines of this size (Hull & Muir 2010). Based on the Hull and Muir model (2010) 95% of bat carcasses are expected to be found within 74 metres of the turbine, and carcasses of medium to large birds are expected to be reasonably evenly distributed out to 122 metres. Carcasses of very large birds (Wedge-tailed Eagle) may be found a little further out, but 95% are expected to be within 130 metres of the turbine.

Given this evidence, inner and outer circular search zones have been designated. The inner zone targets the detection of carcasses of bats and small to medium and large sized birds. In the inner zone, a circle is formed with a 70-metre radius from the turbine and transects are spaced every 6 metres (Figure 3). The outer zone will comprise the zone between the 70 metre and 130 metre radius circles. Although they may be recorded in the inner zone, the outer zone will ensure the adequate detection of carcasses of medium to larger sized birds, which can fall further away from turbines. Search transects in the outer zone are spaced at 12 metres and carried out from the edge of the inner zone out to the edge of the outer zone.

Given that the defined transect spacing and total search area are based on experience and evidence from previous studies (Arnett *et al*. 2005, Hull and Muir 2010) they are considered to be ample to detect bats and the bird species of concern identified in the risk assessment.

Areas under many turbines are located on steep hills and with difficult to access terrain. Search areas under some turbines are densely treed. For these reasons, turbine searches within 130 metres will

only cover hardstands and sections of access tracks and roads within treed and/or steep areas that cannot be accessed safely. The results will be stratified regarding this factor.

The order of turbines searched will be randomized between searches. All carcasses found will be recorded using the form provided in Appendix 2.

After the first year of monitoring the results will be reviewed to determine if a second, follow-up search, a 'pulse search' will be undertaken. Pulse searches are implemented if bats or small birds are consistently observed as casualties under turbines. Animals of this size are more easily scavenged so pulse searches are designed to try and record the rate at which species that are more easily scavenged are being struck.

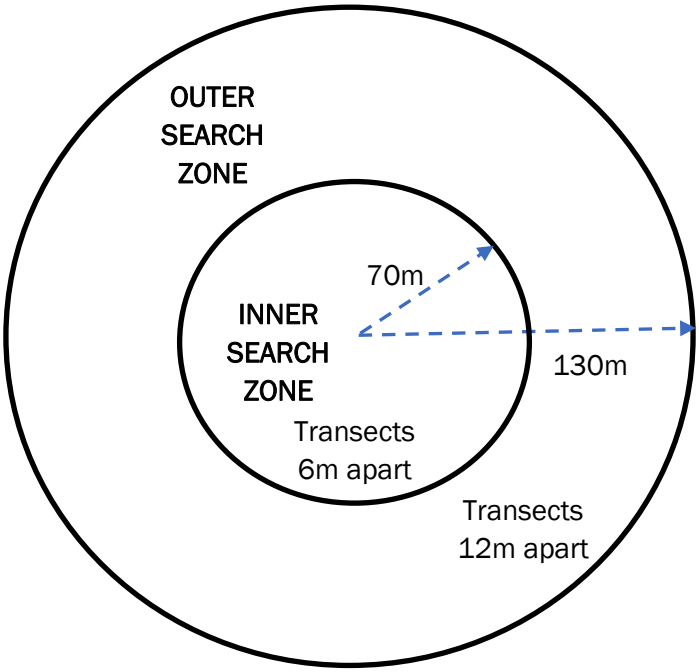


Figure 3: Inner and outer carcass search zones underneath turbines

4.3.3. Searching with scent dogs

Trained scent dogs are another option that could be used to undertake the carcass searches. However, this will depend upon the availability of trained dogs and dog handlers with the appropriate skills to undertake the searches. The suitability of using trained scent dogs will be determined by the ecologist.

Although scent dogs may have a better rate of detection, this factor can be corrected in the searcher efficiency trials outlined below (Section 4.2.7). Some land holders also prefer that dogs not be used at certain times of the year, depending on land use.

A search protocol using scent dogs is provided below:

- The search area will remain the same (a 130-metre radius) however the transects used to search the radius will be modified for the effective use of scent dogs.
    - Under ideal conditions (moderate wind, no rain, mild temperature), 30 metre transects will be walked at a slow pace by the handlers into the wind allowing the dog to zig zag across the transect either side to a distance of 15 metres or more, and cover the entire search

area. When walking with the wind (i.e. during the return transect); the handler will walk more slowly than when walking into the wind, allowing the dog to move ahead and zig zag back towards the handler.

- The transect width will be reduced in less ideal conditions that might affect the dog's ability to track scent (high wind, rain). The handler will make decisions of the reduction in transect size (e.g. 20 or 10 metres) based on research by Bennet (2014).
- A GPS collar will be fitted to the dog which will allow the handler to track movements in real time and allow the handler to ensure the entire search area has been effectively covered by the dog.
- Search areas will be loaded onto GPS prior to commencing searches to allow the handler to see the exact borders of the area and the dog's movements within it.

Upon finding a carcass, the carcass detection protocol below will be followed.

4.3.4. Carcass detection protocol (operation phase)

If a carcass is detected (a 'find') the following variables will be recorded in the Carcass Search Data Sheet (see Appendix 2).

- Position of carcass in relation to the turbine i.e. distance in metres and compass bearing of the carcass from the base of the turbine
- Substrate and vegetation, particularly if it was found on a track or hard-stand area without vegetation as this may assist in quantifying the number of carcasses not found in areas where ground cover makes carcasses less visible
- Species, age, number, sex (if possible), signs of injury and estimated date of strike
- Weather (including recent extreme weather events, if any), visibility, maintenance of the turbine and any other factors that may affect carcass discovery
- If the species is not able to be immediately identified (e.g. an incidental find, and there is not an ecologist on site), photographs must be provided to the qualified ecologist within 2 business days of the find, for identification purposes. The ecologist must reply within 2 business days, for the possible reporting of an impact, as outlined in Section 6.

The carcass will be handled according to standard procedures, as follows.

- The carcass will be removed from the turbine site to avoid re-counting
- The carcass will be handled by personnel wearing rubber gloves, packed into a plastic bag and then placed in a second plastic bag;
- The carcass will be clearly labelled by including a copy of its completed Carcass Search Data Sheet in the second plastic bag to ensure that its origin can be traced at a later date, if required
- The double-bagged carcass will be transferred to an on-site freezer (at the project site office) for storage. The carcass will be available for a second opinion on the species identity, if necessary, and for use in scavenger and detectability trials (Sections 4.3.6 and 4.3.7). The freezer will only be used for holding carcasses and not for other uses.

The monitoring program will need to obtain under a NC Act authority (Scientific Purposes Permit) for keeping remains of native wildlife. This authority will also detail the most appropriate disposal methods.

4.3.5. Incidental carcass protocol

While the ecologist is on site undertaking monitoring, carcasses may be found under turbines not selected for the formal monitoring program. Personnel working at the project site may from time to time find also carcasses within the project site during construction, commissioning, day-to-day operations and maintenance activities. In these cases, the carcass will be handled according to the Carcass Detection Protocol outlined in Section 4.3.4. All Construction and Operation personnel will be made aware of this carcass handling protocol as part of their Site training and induction.

A Carcass Search Data Sheet (Appendix 2) will be completed for each carcass found incidentally.

This Incidental Carcass Protocol is valid for the life of the project.

4.3.6. Scavenger rates and trials

It will be important to ascertain the rate at which carcasses are removed by scavengers. This can be used to develop a 'correction factor' that informs the estimate of Karara Wind Farm's impacts on birds and bats (mortality rate). Scavengers can include ground-based animals, such as foxes, wild dogs, and rats (more likely to detect carcasses by scent), as well as aerial scavengers such as birds of prey, magpies and corvids (more likely to detect them visually). The scavenger trials described below are designed to ascertain the scavenging rate, usually expressed as the average carcass duration in the field.

An intact carcass will be defined as a carcass that does not appear to have been scavenged by a vertebrate scavenger. A partially eaten carcass will be any skeletal or flesh remains found. Feather spots for birds and fur spots for bats will be defined by their presence and the absence of any other remains (a feather spot being a cluster of five or more feathers). Intact or partial carcasses and feather/fur spots will all be recorded as a 'find'. However, the scavenger correction factor will not be applied to fur and feather spots as these are most likely to represent the remains of carcasses after they have been scavenged.

Scavenger trials will be undertaken twice during the first year of monitoring. The objective of having two trials is to account for different vegetation conditions, so one will be held when the grass is long and one when the grass is short. The two periods for scavenger trials are shown in the Table 7, below.

Table 7: Timing for scavenger trials

Vegetation condition	Likely time period
Short grass	Dry season
Long grass	Wet season

Each scavenger trial will be undertaken by a trained person (see Section 4.4) to determine the rate of carcass loss by scavengers. The search area for scavenger trials will be limited to 70 metres from the base of the turbine (the inner search zone – Figure 3) and will be located at the previously randomly selected operating turbines that are searched on a regular basis.

To identify potentially different scavenging rates, three categories of carcass will be used (Table 8). Based on current mortality estimation requirements, every endeavour will be made to find all

carcasses required for each category. Improvements on this described method would require an impractical and unlikely availability of required carcass numbers, and do not lead to a commensurate improvement in the statistical power of estimates. In addition, large birds (raptor size) may be substituted with data from previous grouped studies.

Table 8: Number of replicates for each scavenger trial

Micro-bat	Medium sized birds	Large birds (large raptor size)
10	5	Up to 5

For scavenger trials in each season, twenty carcasses in total will be randomly placed under different turbines. An infrared motion camera will be placed within 1–5 metres form carcass pointed at the carcass. The infrared camera will remain in the field for 5 days when it will be first checked. Then it will be retrieved by day 30 if the carcass still remains. The images will be downloaded and analysed.

Additional information on scavenger trials is provided below.

- The timing of searches is based on experience and regulatory approval at several other wind farms where scavenger trials have been undertaken that show almost all carcasses have been scavenged within ten days. More frequent monitoring than that proposed herein will not significantly affect the estimated scavenging rate and its impact on mortality estimates
- A mix of carcass sizes (if available) will be obtained for use in the scavenger trials. Where carcasses of a species of concern cannot be found, a similar-sized and coloured substitute will be used to reduce bias by visual predators
- Latex gloves will always be worn while handling carcasses to minimise contact with human scent, which may alter predator responses around carrion and to minimise disease risk to the handler;
- At each trial site, one carcass (or more) will be placed randomly within the 70-metre search area. Carcasses will be thrown in the air and allowed to land on the ground to simulate at least some of the fall and allow for ruffling of fur or feathers
- Carcasses used in the trials will have their coordinates recorded to ensure that they are not confused with an actual fatality found under a turbine during the trial searches
- Notes will be taken on the state of remaining carcasses in each search.

Conducting two scavenger trials at seasonally different times is designed to account for occasional seasonal changes in carrion use by some scavenger species. Previous studies have found that Red Fox are reliant on rabbits and carrion in agricultural and forested areas e.g. Brunner *et al*. 1975, Catling 1988, Molsher *et al.* 2000. Feral cats show uniform use of carrion throughout the year, whereas fox prey type is dependent on availability (Catling 1988). Catling (1988) found that foxes ate more carrion in winter/spring compared with summer/autumn, when they fed on adult rabbits. However, Molsher *et al*. (2000) found that there was no overall significant difference between seasons for carrion use by foxes. Seasonal differences only occurred in other prey types (not carrion), such as lambs, invertebrates and reptiles, as these are only available at certain times of the year.

4.3.7. Detectability (searcher efficiency) trials

As humans rely on visual cues to determine carcass location, the two seasonal visibility categories of low and high grass cover will be compared (as described in Section 6). Only one carcass search will

be required if dogs are used for carcass searches, as their sense of smell is not impaired by high grass.

To account for searcher variability in detecting carcasses, only personnel who have carried out monthly searches at the project site will be involved in the detectability (searcher efficiency) trials. Detection efficiency (percentage of carcasses detected) will then be incorporated into later analyses that derive mortality estimates. The number of carcasses to be employed in each trial is detailed in Table 9 and explained below. The carcass controller (a person not involved in monthly carcass searches) will throw each carcass into the air and allow it to land on the ground to simulate at least some of the fall and the potential ruffling of fur and feathers. The carcass controller will note the placement of carcasses (via GPS) and is free to decide where and how many are deployed under each turbine. However, all carcasses will be located within the inner 70 metre search zone.

Table 9: Number of replicates per season for detectability trials, given two factors of size and visibility

Season	Micro-bat	Medium sized birds	Large birds (large raptor size)
Wet season - Long grass / vegetated	10	5	5
Dry season - Short grass	10	5	5

Analysis of past trials from other wind farms indicates that there is a large confidence interval on the estimate of searcher efficiency, even for a high number of trials (plus or minus ten percent even with 50 replicates). This means that only relatively large seasonal changes in detection (~20- 30% or more) will be resolvable from normal background variation. Sampling will be undertaken during the two periods that represent the greatest change in vegetation cover (therefore visibility), using a number of carcasses that is logistically manageable and aligned with the number and timing of scavenger trials. Statistical confidence analysis indicates that this will result in a reasonably precise detectability estimate after one year, and optimal precision after two, although a second year of trials is not currently planned.

Any substitute carcasses for these trials will be of both similar size, colour and form to the species being represented or species of concern (e.g. brown mice rather than birds should be substituted for bats as birds do not have the same body shape, colour and appearance).

After the planned detectability trials, the need and frequency of further detectability trials will be reviewed by the suitably qualified ecologist.

4.3.8. Analysis of results and mortality estimation

The results of the carcass searches will be analysed to provide information on:

- The species, number, age and sex (if possible) of birds and bats being struck by the turbine blades;
- Results of scavenger and detectability trials;
- Separate estimated annual mortality rates for all birds and all bats (and for particular species, if required) including an estimate of the number of carcasses per turbine per year; and
- Any detected spatial or temporal variation in the number of bird and bat strikes.

The search results will be detailed in the first annual report. In addition to cumulative search results, the analysis and mortality estimates will be detailed in the second annual report. The latter will also identify if further monitoring is required.

Statistically robust projections of bird and bat mortality for the entire project site will be presented in the second-year report, based on the results of carcass searches. It is acknowledged that this is a current and dynamic aspect of research and that the outcomes from such programs may be equally dynamic. The proposed program is designed to provide an acceptably accurate and precise estimate of project related bird and bat mortality, over the first two years of operation. Example of current best practice statistical analysis are outlined in Huso *et al*. (2016; 2017).

All data will be analysed to provide the average estimated mortality of birds and bats, their standard error (variability) and ranges for the Project. The mortality rate of each species (if estimates for individual species are possible) and size class detected will be calculated. If possible, the standard error and range of these estimates will be reported. Note that it may not be possible practically to provide this due to the likely low number of carcasses detected and where this is an issue, it will be reported.

The estimated mortality rate will be generated by modelling the scavenger losses and results of the detectability (searcher efficiency) trials, and using sampling inference to account for the periods between turbine searches and unsearched turbines. The data from the scavenger and detectability trials will be analysed using relevant techniques based on Generalised Linear Modelling (GLM) and (censored) Survival Analysis. Censored measurements are only partially known, such as the exact time of mortality or the exact time to scavenge loss e.g. Kaplan & Meier (1958). In addition to providing mortality estimates, this analysis will determine, where possible if any of the factors e.g. size class or habitat stratification of turbine sites are significant.

4.4. Personnel involved

This Section outlines the personnel involved in implementing the BBAMP and any training required for the field work and report writing. All personnel working on the requirements of the BBAMP will be familiar with the Plan, Site policies and procedures, and other administrative matters, e.g. OH&S and technical and field methods. The operators must ensure that suitably qualified and trained people are engaged to supervise and implement the monitoring program.

Any person undertaking searches will be trained by a qualified ecologist. The searcher will receive training from the ecologist in the following areas.

- Turbine searches, including transect spacing in inner and outer zones, number and location of turbines to search and transect search methods
- Equipment usage, such as GPS
- Data recording
- Carcass storage
- Species identification.

Where a scent-dog is used to search for carcasses, this will be undertaken by a handler fully trained in this method. The same dog/s and handler will be reasonably required to undertake all carcass searches for the duration of this program. There may be more than one dog involved in these searches.

The qualified ecologist will supervise the initial carcass search to ensure that field methods are being undertaken correctly and undertake an audit after the first three months to ensure that methods are being implemented correctly. The qualified ecologist will also be responsible for identifying any recorded carcasses from photographs or from specimens transferred to the on-site freezer after searches.

The first searcher efficiency trial will be initiated and set up by the supervising ecologist, who will, if required, train a separate person (the 'carcass controller') to run follow-up searcher efficiency trials. This training will include the following.

- Correct preparation and handling of trial carcasses
- Correct methods for the random placement of trial carcasses within a randomly selected sub-set of the search areas.

If for some reason a searcher is unable to undertake the monthly searches as planned (due to illness etc.) a back-up person will be identified in advance. If a back-up person is required to undertake searches, they will also be trained and supervised and will participate in searcher efficiency trials.

The scavenger trials will be set up by the supervising ecologist, with searches being undertaken by a trained searcher.

Analysis of mortality data will be undertaken by the supervising ecologist with support from a statistician.

Annual reports and all investigations resulting from an impact trigger (see Section 6) will be prepared by the supervising ecologist.

4.5. Injured & deceased bird and bat handling protocol

All on-site staff and monitoring personnel will be advised of the correct procedure for assisting injured wildlife. Construction and Operations personnel who find injured wildlife will be required to report the find to the Project's Responsible Officer, who will organise recovery of, and treatment for the animal. If safe to do so, place the animal immediately into a dark place e.g. box or cloth bag for transfer to the nearest wildlife carer or veterinarian.

All persons who handle injured or dead animals must wear gloves and understand the applicable OH&S requirements. Special care[1] should be taken to avoid bat borne viruses (i.e. Australian Bat Lyssavirus and Hendra Virus), including that only people with appropriate vaccinations should handle bats (living or deceased).

Contact details of local veterinary staff and wildlife carers are provided below to ensure that if injured wildlife is found and cannot readily be released back to the wild, they are treated accordingly and in a timely manner.

[1] Queensland Government (2017) Bats and Human Health http://conditions.health.qld.gov.au/HealthCondition/condition/14/217/14/Bats-human-health, accessed 28/06/18

Table 10: Vet and wildlife carer details for the local region

Name	Phone	Location/Address	Bats (Y/N?)
Condamine Veterinary Clinic	(07) 4667 1176	185 Bracker Rd, Warwick QLD 4370	No
F.A.U.N.A.	(07) 5466 4144	90 Mount Berryman Rd, Mount Berryman QLD 4341	Yes
Warwick Veterinary Clinic	(07) 4661 1105	4 Albert St, Warwick QLD 4370	No
Currumbin Wildlife Hospital	(07) 5534 0813	27 Millers Dr, Currumbin QLD 4223	Yes
Australia Zoo Wildlife Hospital	(07) 5436 2097	1638 Steve Irwin Way, Beerwah QLD 4519	Yes

4.6. Reporting

Reports will be completed on an annual basis for the first two years with brief monthly summary reports of carcass searches to be provided to the operator of the wind farm. Further reporting will be agreed with the regulator, for example reporting to agencies if impact triggers are met. An annual report will be prepared within three months of the completion of the first year of monitoring. This annual report will focus on presenting the results of the mortality searches including any impacts to threatened bird and bat species, any management measures implemented (e.g. stock, feral and native animal carcass removal) and recommended refinements to monitoring activities, if required. Annual reporting will include assessments of significance (against the EPBC Act Significant Impact Guidelines 1.1) for any EPBC Act listed threatened bird or bat species which was recorded in the project area within the reporting period, but which was not assessed in the pre-approval ecological assessment report (see Section 6.1 for resulting trigger levels).

The second annual report will present the first full analysis of data collected and will be presented within three months of the end of the second year of monitoring. Matters to be addressed in the second annual report include, but will not be limited to the following.

- 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 *impact triggers*, and application of the decision-making framework and relevant adaptive management measures
- A summary of stock, feral and native animal 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 the following.
  - Bird risk reduction measures
  - Any further recommendations for reducing mortality, if necessary
  - Whether the level of mortality was unacceptable for affected listed species of birds or bats of concern
  - Usage of the project area by species of concern at more than negligible risk and factors influencing this i.e. climatic, geographical and infrastructure
  - Analysis of the effectiveness of the decision-making framework
  - Recommendations about further monitoring.

Apart from these routine reports, specific reporting will be generated in a timely way under this BBAMP in response to an impact trigger. The details are provided in Section 6.

5. Mitigation Measures to Reduce Risk

Mitigation involves the prevention, avoidance and/or reduction of the risk of an *impact trigger* occurring or continuing to occur. An *impact trigger* is defined in Section 6 as a threshold of impact on birds or bats that triggers an investigation and/or management response. This section outlines such measures.

The overall objective of mitigation measures is to ensure that the operation of the project does not lead to significant impacts on threatened or protected birds and bats. Any future novel or new mitigation measures that are identified to be of potential benefit for birds and bats at the project site should be incorporated into the BBAMP as part of an adaptive management approach. Major revisions to the BBAMP shall be communicated to DSDMIP and any variation to the BBAMP needs to be applied for under the EPBC Act to the relevant Minister in accordance with Section 143A of the Act, unless the changes are not likely to result in a new or increased impact.

5.1. Carrion removal program and stock forage control

Land-use and stock management below and around turbines can influence the presence and behaviour of native birds on site. Examples that could elevate bird collision rates include the following.

- Grain feeding can attract parrots and cockatoos
- Carrion can attract raptors.

This Section proposes mitigation measures to address these matters.

A low risk to Wedge-tailed Eagle has been identified for the project. The Wedge-tailed Eagle and other raptors forage for carrion (the fresh or decaying flesh of a dead animal) and also on small mammals and rabbits. In order to reduce the risk of raptors colliding with turbine blades, a regular carrion removal program will be implemented during commissioning and operations, to reduce the attractiveness of the Project site to raptors and therefore reduce the potential for fatal collisions by this group of birds. This program will focus on an area of a minimum of 200 metres around turbines, where safe, feasible and practical. The procedures below will be adopted for the project (subject to the landowners' consent).

- A designated suitable person will be appointed (such as a Construction team supervisor, Operations team leader) to perform the function of Carrion Removal Coordinator, who will ensure the activities described below occur.
  - Educate project staff and landowners to report any stock, introduced or native mammal and bird carcasses within 200 metres of any turbine (to be recorded as incidental finds) that may attract raptors e.g. kangaroos, cattle, pigs, goats, foxes, rabbits
  - Opportunistic observations by Construction and Operations personnel during normal inspections and work routines to identify and report carcasses of stock, feral or native animals so that timely collection can be undertaken to remove them
  - Any carcasses and/or remains found that are within 200 metres of turbines, will be collected and disposed of as soon as possible, in a manner that will avoid attracting raptors close to turbines
  - Consult with the Project's Responsible Officer in relation to the appropriate disposal of collected carrion, to be located at least 200 metres away from the closest turbine

  - Construction and Operations personnel will be required to notify the Carrion Removal Coordinator immediately following identification of carrion on site
  - Carcass occurrence and removal will be recorded in dedicated carcass removal register maintained by the Project's Responsible Officer
- In order to reduce collision risks to birds, where practical and with Landowner agreement, the practice of grain feeding of stock within 200 metres of turbines should be avoided as it attracts parrots and cockatoos, increasing collision risk with turbine blades
- Any feral animal control on the Project site should involve the timely removal and appropriate disposal of resulting carcasses
- If a large active pest animal presence is observed during monitoring surveys, it may be necessary to conduct an integrated control program (to reduce site attractiveness to Wedge-tailed Eagle). Any control program will require cooperation and agreement from the Landowners
- An annual summary of carcass removal based on the Project's 'dedicated carcass removal register' will be provided in the annual reports.

The need for continuation of the carcass removal program and effort required will be assessed after one year of operation. In general, the criteria for continuation will be based on the frequency of carcass finds. For example, if carcass frequency is particularly low e.g. one or two per quarter/turbine outside of turbine search zones (i.e. not beneath turbines) the program may be discontinued or reduced considerably. Alternatively, if peaks occur at specific times or locations where there are turbines with intervening periods of low numbers, the effort may be focussed on the peak periods and/or locations.

5.2. Lighting on turbines and buildings

It has long been known that sources of artificial light attract birds, as evidenced by night-migrating birds in North America and Europe. Lighting is probably the most important factor under human control that affects mortality rates of birds and bats colliding with all structures (Longcore, *et al*. 2008). Most bird mortality at communication towers in the Northern Hemisphere for example, occurs in poor weather with low cloud in autumn and spring, i.e. during migration periods (Longcore, *et al.* 2008).

It is postulated that bright lights may temporarily blind birds, particularly those accustomed to flying at night or in low light conditions causing them to fly toward the light source and collide with the lit structure (Gauthreaux and Belser 2006). Bats may also be attracted to the increased numbers of insects that may congregate near bright light sources.

Measures to reduce the impact of lighting include using low pressure sodium or mercury lamps with UV filters to reduce brightness. The colour of lighting may also be important. Some studies have found that red lights resulted in a lower mortality than white lights (Longcore *et al*. 2008), but more recent research on oil rigs at sea suggests that blue or green lights may result in lower mortality than red or white lights (American Bird Conservancy 2014).

For the above reasons, building lighting will be baffled and directed to avoid excessive light spillage and security lighting will be baffled to direct it towards the area requiring lighting and not skyward or laterally beyond the target area.

6. Impact Triggers and Decision-Making Framework

This section identifies the circumstances that will result in notification, further investigation and additional mitigation for both threatened and non-threatened birds and bats (*impact trigger*). If an impact trigger is met, there must be an investigation of the cause of the impact and whether the event was likely to be a one-off occurrence or occur regularly. Regular reporting and consultation with relevant regulators is called for under these circumstances within the context of an adaptive mangement framework..

The *impact trigger* may be an unacceptable impact in itself or may, if it continues, lead to an unacceptable impact if it continues.

Note that the approach developed in this Section is based on that approved for numerous bird and bat monitoring programs for wind farms in Queensland, New South Wales and Victoria, and up to date feedback from regulators on the implementation of approved plans (see Section 1.4 for details).

Ultimately, the Project Owner will be responsible for implementation of this BBAMP and the decision-making that goes with it, with technical support provided by a qualified ecologist.

6.1. Threatened species

6.1.1. Definition of impact trigger

Under this program, the circumstances that define an *impact trigger* for threatened birds and/or bats are detailed below:

***Impact Trigger* for Threatened Species** occurs if a threatened bird or bat species (or recognisable parts thereof) listed as threatened or migratory under the Commonwealth EPBC Act (as defined within the Project approval conditions) or QLD NC Act is found dead or injured under or close to a turbine during any mortality search or incidentally during commissioning or operation.

6.1.2. Decision making framework and reporting

If a threatened species *impact trigger* occurs, an adaptive management framework will be triggered as outlined below and in Figure 4.

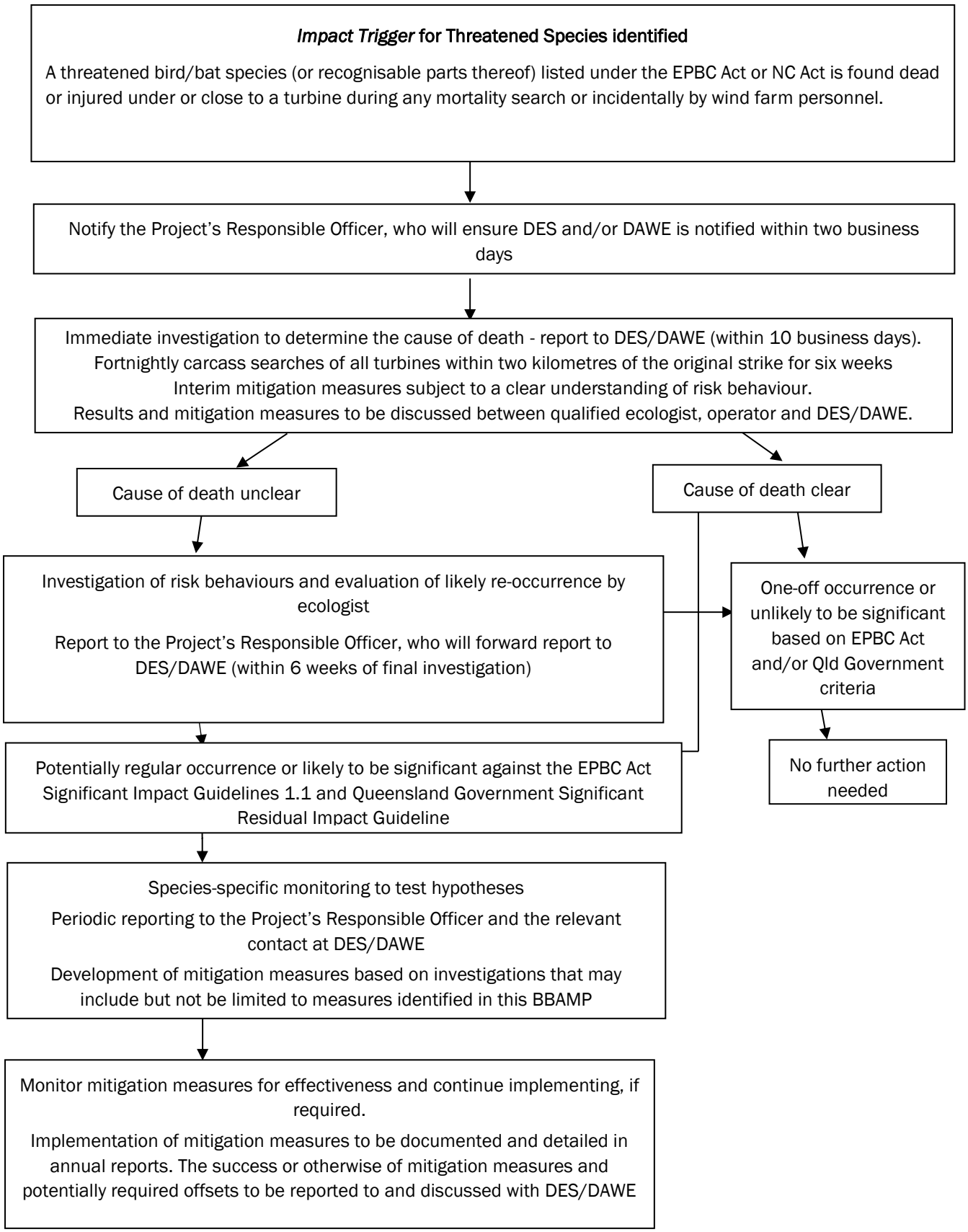
- Immediate reporting of the occurrence of an *impact trigger* to the Project's Responsible Officer, who will report it to the relevant statutory planner at DES and/or DAWE within two business days of the species being identified by a qualified ecologist.
- Intensification of turbine carcass searches (using the standard methods in Section 4.3.2 and 4.3.3 to include all turbines within two kilometres of the strike searched fortnightly for six weeks.
- Immediate investigation (to be completed within ten business days) by an ecologist to determine, if possible, the circumstances that lead to the death or injury. If the cause of death is considered to be due to turbine blade collision, an investigation will be undertaken to identify any particular risk behaviours that could have led to the collision. The likelihood of further occurrences will be evaluated based on this information and again after six weeks based on the intensified carcass searches.
- The investigation will identify, if possible, the most effective practicable mitigation and will ensure that the mitigation is implemented as soon as feasible. The investigation will aim to

provide a clear understanding of the cause of the impact, where required, informed by on-site investigations of the occurrence of the species on the Project site

- If, following this investigation, the fatality is deemed to be a one-off occurrence, or the ongoing impact is unlikely to be significant at a species population scale, further action is not considered necessary. This decision will be made in consultation with DES and/or DAWE (as relevant) and will be determined based on available evidence and using a precautionary approach. Note that the successful execution of this requirement relies upon the regulatory authority/ies providing timely and definitive input to this process
- If the on-site investigation suggests that the *impact trigger* may represent circumstances leading to a significant impact (with reference to the EPBC Act Significant Impact Guidelines 1.1 or the relevant Queensland Government Significant Residual Impact Guideline), species-specific monitoring and mitigation will be required. During species-specific monitoring and mitigation, periodic reports may be provided by Karara Wind Farm to DES and DAWE (as advised);
- The project is likely to be required to determine and justify trigger levels which will require an offset for significant residual impacts on EPBC Act listed threatened bird and bat species. Trigger levels will differ depending on the specific situation. Offsets may be proposed for those species that are considered to have a significant residual impact as a result of Project operation, following assessment against the Significant Impact Guidelines 1.1
- Responsive mitigation measures will be developed and implemented in a timely manner. Examples of mitigation measures may include but are not limited to those outlined in Sections 5 and 6.3.

Any evaluation of impacts and decisions regarding mitigation measures and further investigations required will be undertaken in consultation with DES/DAWE (as detailed in Figure 4). Any required investigation, and recommended mitigation measures will be summarised in the annual reports.

Figure 4: Decision making framework for identifying and mitigating *impact triggers* for threatened species



6.2. Non-threatened (protected) species

6.2.1. Definition of Impact Trigger

The circumstances that define an *impact trigger* and significant impact for non-threatened birds and/or bats which are also protected (NC Act) under this BBAMP is detailed below.

***Impact Trigger* for Non-threatened Species:** A total of four or more bird or bat carcasses, or parts thereof, of the same non-threatened species in two successive carcass searches (two or more per month for 2 months) at the same turbine.

Where population numbers are known and reported by DES or where habitat extent is known, the **definition of a significant impact** on non-threatened species is any impact that is likely to reduce the viability of the population of the affected species in the bioregion.

6.2.2. Decision making framework

In the event that an *impact trigger* for non-threatened species is detected the following steps will be followed.

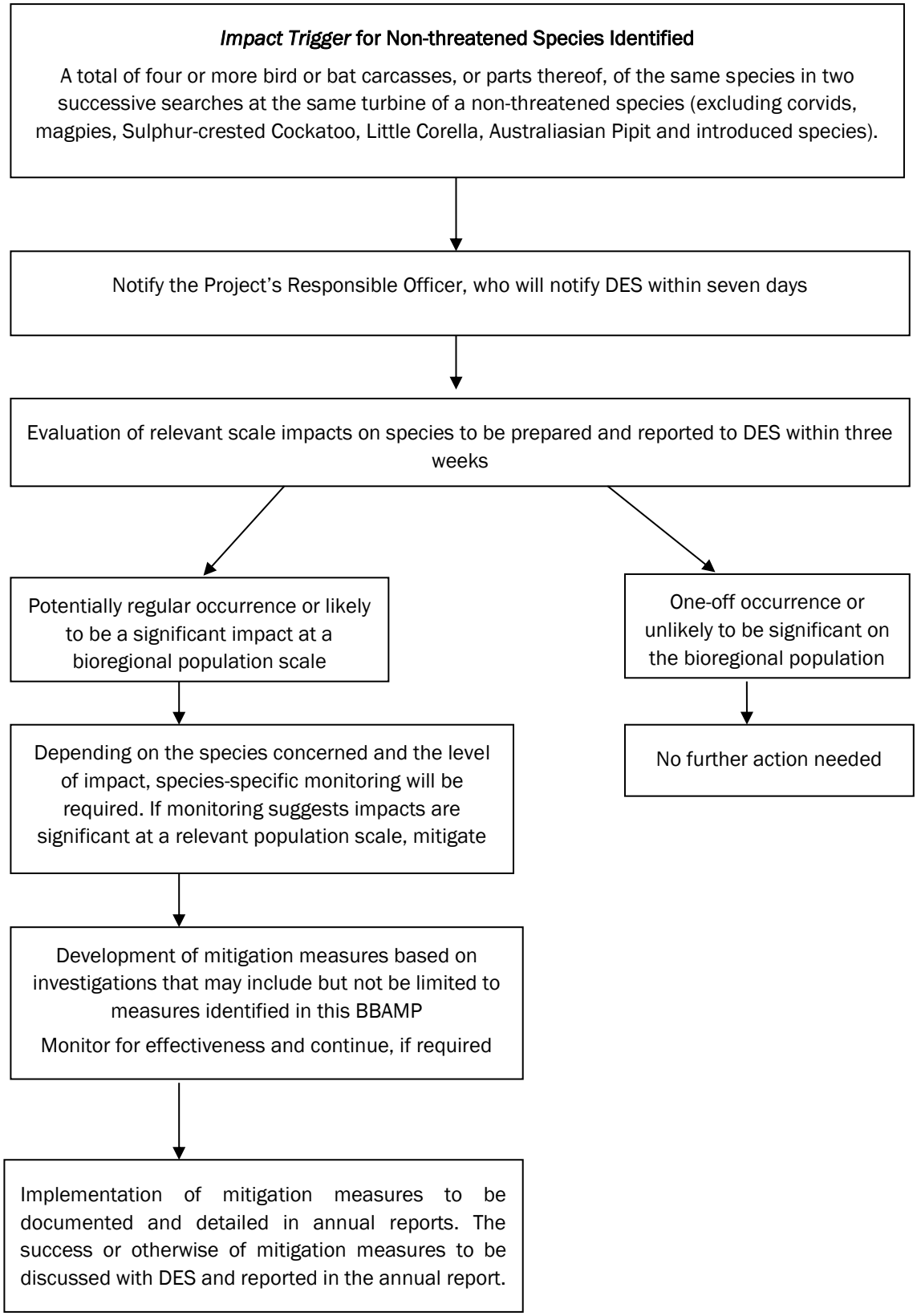
- DES will be **notified** of the *impact trigger* within seven days of recording the event
- An **evaluation** of impacts to the non-threatened species' bioregional population will be undertaken
- A **report** on the investigation will be delivered to the relevant statutory personnel at DES within three weeks.

If the evaluation indicates that the event was a one-off occurrence or is unlikely to be a significant impact for the species in question, no further action will be necessary (as outlined in Figure 5).

If the event is deemed to be a potentially regular occurrence or likely to lead to a significant impact on the species in question, species-specific monitoring may be required (Figure 5). If further monitoring confirms that impacts are likely to lead to a significant impact on the species, additional mitigation measures will be required. Potential mitigation measures are outlined in Table 11, however the most effective mitigation measures will be determined based on the species involved and the outcome of investigations.

Any required investigation, and recommended mitigation measures, will be detailed in annual reports.

Figure 5: Decision making framework for identifying and mitigating *impact triggers* for non-threatened species



6.3. Supplementary mitigation measures

Supplementary mitigation measures may be implemented in the event that an *impact trigger* occurs and investigations indicate that additional measures are warranted. The purpose of supplementary mitigation measures will be to prevent the impact from continuing to occur at a scale that leads to a significant impact (i.e. at the bioregional population scale). Specific mitigation measures will be implemented depending on the nature, cause and significance of the impact recorded and in response to the results of investigations of the event and of the species concerned on the project site.

Although it is unknown what supplementary mitigation measures may be required in response to a particular situation, some hypothetical examples are provided in Table 11. These are examples of issues which have been encountered and addressed at other wind farms. Should these be implemented as a management response for the project, the response of birds and bats to these measures will be monitored and recorded in the annual report or, in the case of threatened species, in accordance with the reporting schedule in Figure 4.

Mitigation of confirmed significant impacts will occur using measures evaluated as being most likely to reduce impacts to an acceptable level. Measures include those presented here where they are found likely to be effective, but will not be limited to these, having regard to the evolving nature of wind farm bird and bat impact mitigation measures.

6.4. Specific management objectives, activities, timing and performance criteria

Table 12 summarises specific management objectives, activities, timing and performance criteria for the implementation of this BBAMP. It can be used for monitoring and reporting.

Table 11: Supplementary mitigation measures in the event of an *impact trigger* occurring – illustrative examples only

Hypothetical cause of impact	Mitigation Measure[2]	Likelihood of impact continuing following mitigation	Time to implementation
Foraging source identified that attracts threatened species and 'at risk' species to impact areas	Consider the use of acoustics e.g. bird deterrent devices / irregular noise to discourage birds from foraging in this location where such noise would not impact neighbours	Low	Implement at appropriate times
	Encourage species into alternative areas outside of the Project boundary, where available, through the use of social attraction techniques off-site (decoys and audio playback systems)		Implement according to agreed plan
	Remove the foraging resource proximate to turbines (in accordance with any necessary approvals)	Low	Implement according to agreed plan
Farming practice attracts threatened species to risky areas e.g. grain feeding of stock within 200m of turbines	Investigate whether farming practice is a contributing factor and if so, liaise with the Landowner to relocate the issue farming practice further from turbines to reduce risk	Low	Immediately
Wind/rain/fog causing low visibility	If low visibility at the project site is identified as contributing to the repeated mortality of threatened fauna from turbine strike, carcass searches may be repeated during periods of low visibility to measure mortality rates and to validate hypothesis. If validated, further mitigation measures such as temporary turbine curtailment of those turbines found to cause the problem may be necessary during periods of extreme low visibility – to be implemented only in the event that threatened species are experiencing or are likely to experience significant impacts and other mitigation measures are ineffective	Low	During specific low visibility conditions identified as the cause of significant impacts on threatened species
Attraction to lights on the Project site	Avoid high intensity lighting within the project site e.g. consider use of light hoods or switch off lighting temporarily while species is on or near the Project site. Alternative measures include: • Synchronise any flashing lights; • Use blue, green or even red rather than white or yellow lights; • Remove aviation lights, where practicable if allowed by aviation authorities; and/or • All building lights switched off except when needed for service work	Low	If lights can be switched off, this should occur immediately. Alternative measures should be implemented as soon as practicable after recording the *impact trigger*
Attraction to small dams on site	Subject to Landowner agreement, fill in dam and provide alternative stock watering arrangements (e.g. establish replacement dam further from turbines)	Low	Implement as soon as possible after recording the *impact trigger* if the dam is identified as the cause of the problem
Nest site close to turbine	Discourage nesting close to turbines in subsequent years	Low	Prior to breeding season
Perching/foraging close to turbines	Minimise perching opportunities near turbines	Low	Implement according to agreed plan

[2] Note that the mitigation measures in this table are examples of what may be possible. Ultimately, the chosen mitigation measure will be identified as part of the impact-trigger investigations shown in Figures 5 and 6, and may not include any of these examples if they are not relevant.

Table 12: Specific management objectives, activities, timing and performance criteria

Management objectives	Management activities and controls	Timing	Performance criteria for measuring success of methods	Responsibility	Completed (yes/no)
Pre-construction surveys	Obtaining pre-construction baseline bird and bat utilisation data	Pre-construction ▪ Bird survey ▪ Bat survey	▪ Bird utilisation surveys undertaken as summarised in this BBAMP - see Section 2.3.1 ▪ Bat utilisation surveys undertaken as summarised in this BBAMP- see Section 2.1 and 2.2	Ecologist	Partially completed
Mortality monitoring	Incidental carcass searches and records	Commissioning and operational phases – ongoing	▪ All incidental carcass finds of birds and bats recorded	Operational staff of wind farm	
	Up to 34 turbines to be surveyed each month to 130m radius, in accordance with the inner and outer zone search protocol. The same turbines will be searched each month for a period of two years.	Operational phase (once commissioning completed) monthly until end of two years in total	▪ Operational phase mortality surveys undertaken monthly at 34 turbines, for at least two years, with a review after the first year to determine if a change in methodology is required	Ecologist	
	Calculating annual mortality of birds and bats per turbine, based on monitoring activities. Mortality estimates should include correction factors from scavenger and detector efficiency trials. The need for further surveys will be reviewed based on the results of the first two years of monitoring	Commissioning and Operational phases, at the end of each year of mortality monitoring	▪ Scavenger and detector efficiency trials (2 of each) undertaken within the first year of monitoring	Ecologist	
Annual Reports	Preparation of Annual BBAMP Reports	Operational phases – within three months of the completion of carcass searches in years one and two, and each following year of operations	▪ Annual reports for the first two years delivered within three months of completion of yearly monitoring ▪ Annual reports to include (but not be limited to) results of monitoring surveys for that year, any *impact triggers* or significant impacts identified, mitigation measures implemented, application of the decision-making framework and recommendations for the following year ▪ Estimates of mortality for birds and bats made after 2 full years of monitoring and reported in 2nd annual report (See section 4.3.8) ▪ Further annual reports to DAWE as required	Project's Responsible Officer + Ecologist	
Mitigation measures to reduce risk	Carrion removal program – subject to Landowner agreement, stock and kangaroo carcasses should be removed from within 200m of turbines on a monthly basis and disposed of appropriately	During commissioning and operational phases	▪ Carcasses removed ▪ Activity recorded in dedicated register ▪ Increase frequency of stock and kangaroo carcass removal and disposal if required	Project's Responsible Officer	
	Subject to Landowner agreement, restrict lambing to paddocks at least 200m from turbines if sheep are present		▪ No increase in raptor mortality during lambing season		
	Subject to Landowner agreement, stock should not be fed grain within 200m of a turbine		▪ No increase in bird mortality due to grain feeding		
	Pest control program – Implement rabbit or other pest control if the carrion removal program suggests such pests are an issue, (subject to Landowner consultation)		▪ Monitor effectiveness of rabbit or other pest control, and where bird mortality is clearly related to their numbers, increase the effectiveness of control		
Mitigation measures to reduce risk	Minimising external lighting. when required. There should only be low levels of lighting on the Project site during operation, where allowed. Avoid or minimise permanent lighting on the turbine entrance, buildings and sub-stations to avoid light spillage and visibility from above	During commissioning and operational phases	▪ If mortality at turbines near light sources significantly exceeds that of activity at unlit turbines, type and duration of lighting will need to be reviewed, subject to security and OH&S limitations	Project's Responsible Officer	
	Baffle security lighting to avoid light spillage and visibility from above				

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Appendix 1: Raptor monitoring Data Sheet

Karara Wind Farm

Observer:

Observation No.	Species	Date	Start time	Finish time	No. of birds	Age	Flight height (m)	Flight Direction	Flight behaviour	Notes (include Approx. distance of fly over wind farm)

Notes: **Flight Behavior**: Soaring (flying in a circular pattern within a thermal); flapping (flight powered by wing beat), gliding (straight flight path without wing beat), kitting (motionless flight of a bird within an updraft), hovering, or perching.

Appendix 2: Carcass Data Sheet

KARARA WIND FARM - BIRD AND BAT MORTALITY MONITORING PROGRAM CARCASS SEARCH DATA-SHEET*				
Please fill out all details above the heavy line for each site searched All details below the line are required if a carcass is found Refer to Section 4.2.4 Carcass Detection Protocol **Do not move a carcass until the details below have been completed**				
MWF				
Date:				
Start Time:				
Finish Time:				
Turbine Number:				
Wind direction and strength in preceding 24 hours:				
Any unusual weather conditions in last 48 hours?				
Distance of Carcass from Tower (m):				
Bearing of Carcass from Tower (magnetic deg):				
Preliminary Species Identification:				
Photo Taken**	Yes / No			
Signs of injury:				
How old is carcass estimated to be (tick category):	<24 hrs	1-3 days	> 3 days	Other
Other Notes (i.e. sex/age of bird) and substrate:				
Post Find Actions: ▪ Place carcass in sealable plastic bag then wrap it in newspaper and into another plastic bag (with copy of this sheet within) and take to freezer at site office. ▪ Contact project ecologist to confirm identification of carcass				
* One form should be completed for each carcass found				
** Please attach photo to this form				