DUNDONNELL WIND FARM

BAT AND AVIFAUNA MANAGEMENT PLAN

PLANNING AND ENVIRONMENT ACT 1987
PLANNING SCHEME MOYNE
PERMIT NO. 2015/23858/A
ENDORSED PLAN
SHEET 1 OF 70
SIGNED S. Menzies FOR
MINISTER FOR PLANNING
DATE: 8/1/19

Dundonnell Wind Farm Pty Ltd

ENDORSED TO COMPLY
WITH CONDITION
52 + 55a
OF PLANNING PERMIT
2015/23858/A

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November 2018

Report No. 17185 (2.7)

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1. EXECUTIVE SUMMARY

A Planning Permit (Planning permit No. 105/23858) was approved in 2016 for the construction of the Dundonnell Wind Farm near Dundonnell, approximately 23 kilometres northeast of Mortlake and 21 kilometres west of Derrinallum. It comprises 80 turbines over an area of around 4,200 hectares (Figure 1). A Bat and Avifauna Management Plan (BAM Plan) of at least five years duration for the wind farm has been prepared to satisfy conditions 52, 53 and 55a of the Planning Permit.

A risk assessment was conducted to identify those species of birds and bat at higher risk from the proposed wind farm. This risk assessment identified that most species were at negligible risk. However, the following species were considered as species at a greater than negligible risk.

- White-throated Needletail – low risk;
- Wedge-tailed Eagle - moderate risk;
- Other raptor species - low risk;
- Southern Bent-wing Bat – moderate risk; and
- Yellow-bellied Sheathtail Bat – low risk.

Operational monitoring of bird and bat collision with turbines at the Dundonnell Wind Farm will commence when the last turbine constructed is operational. To ensure statistical rigour, carcass searches of a final maximum fixed random sub-set of 27 out of 80 turbines on the wind farm will be carried out. The list of turbines to be searched can be found in Appendix 1. This detailed search regime will apply each year in the first five years following the final wind turbine commencing operations.

In years three and four, an alternative search regime will apply to all turbines consistent with the Brolga monitoring protocol. The Brolga monitoring protocol involves visual searches for Brolga carcasses monthly under all turbines based on a less intense search method accounting for the much higher detectability of Brolga carcasses given their size and pale colour. Brolga monitoring will continue for the life of the project.

It is anticipated that this monitoring will identify any impacts to the foregoing species and will determine if there is a need for adaptive management in response to unacceptable impacts and if further monitoring is required.

Searcher efficiency and scavenger trials will be undertaken to quantify these two sources of systematic error so that an accurate mortality rate at the wind farm can be estimated. This BAM Plan also includes monthly monitoring to record Wedge-tailed Eagle, White-throated Needletail and Peregrine Falcon flights and breeding activity for the first five years of monitoring.

This Plan also includes two on-going operational protocols, namely:

- Incidental carcass protocol; and
- Injured bird and bat protocol.

It also includes the annual reporting requirements for the five-years of monitoring. This BAM Plan proposes that a comprehensive review of its implementation and

results be undertaken after the second year of monitoring is completed. It is proposed that the Dundonnell Wind Farm proponent and the Responsible Authority determine the methods and need for ongoing monitoring after the second year of reporting, informed by the findings of the first two years of monitoring and assessment. At the conclusion of five years a further review of impacts and further monitoring requirements will be undertaken. It is noted that Brolga monitoring is required for the life of the project.

A range precautionary mitigation measures is proposed, including but not limited to:

- Carrion removal within 250 metres of turbines;
- Pest animal management, if required; and
- Minimising grain feeding of stock within 250 metres of turbines.

The BAM Plan proposes impact triggers in response to adverse impacts, beyond those expected, for threatened and non-threatened species, for which specific actions will be taken, with timeframes. These impact triggers are:

- ***Impact Trigger for Threatened Species*** - A threatened bird/bat species (or recognisable parts thereof) listed under the EPBC Act or FFG Act is found dead or injured under or close to a wind turbine during any mortality search or incidentally by wind farm personnel.
- ***Impact Trigger for Non-threatened Species:*** In any two successive monthly carcass searches, two or more bird or bat carcasses (or recognisable parts thereof) of a non-threatened species, other than ravens, magpies and introduced species, are found at the same turbine (i.e. a total of four or more carcasses of the same species during two successive searches at the same turbine).

The specific actions to be taken should these triggers occur include:

- Reporting the occurrence of an impact trigger to Responsible Authorities;
- Immediate investigation (to be completed within 10 days) of the possible causes of the impact by an appropriately qualified ecologist;
- Further action and responses to be agreed with Responsible Authority; and
- If needed, responsive mitigation measures to be developed and implemented in a timely manner.

The BAM Plan proposes possible mitigation measures that could be included should they be found to be necessary.

Finally, the BAM Plan has a monitoring and evaluation table that proposes specific management objectives, activities, timing and performance criteria.

2. INTRODUCTION

2.1. Background

Dundonnell Wind Farm Pty Ltd (the Proponent), a subsidiary of Tilt Renewables Limited has engaged Brett Lane and Associates Pty. Ltd (BL&A) to prepare a Bat and Avifauna Management Plan (BAM Plan) for the Dundonnell Wind Farm.

The proposed Dundonnell Wind Farm (The Project) is located near Dundonnell, approximately 23 kilometres northeast of Mortlake and 21 kilometres west of Derrinallum and comprises an area of around 4,200 hectares (Figure 1).

The Department of Environment, Land, Water and Planning (DELWP) Minister of Planning gave approval for a Planning Permit (Planning Permit No. 105/23858) for up to 96 turbines, with a maximum height of up to 165m, on 10 June 2016.

Written consent from the Minister for Planning was obtained to allow for an increase the maximum height of the turbine blade tip to up to 189 metres from the ground when vertical and to reduce the number of turbines to 88.

The final wind farm will comprise 80 turbines with a maximum tip height of 189 metres and minimum blade ground clearance of 39 metres (rotor diameter of 150 metres) with a hub height of 114 metres.

Conditions 52 and 53 of the Planning Permit require the preparation of a BAM Plan and are presented below:

"Bat and Avifauna Management Plan

52. Before the development starts, a bat and avifauna management plan (BAM Plan) must be prepared in consultation with DELWP - Environment Portfolio to the satisfaction of the responsible authority. When approved, the plan will be endorsed by the responsible authority and will then form part of the permit. On endorsement, the endorsed BAM Plan must be placed on the project website for a minimum period of five years.

The BAM Plan must include:

> *a. a statement of the objectives and overall strategy for managing and mitigating any significant native bird and bat strike arising from the wind energy facility operations;*
>
> *b. a general bat and avifauna monitoring program (excluding Brolga) of at least five years duration that:*
>
> > *i. commences on the commissioning of the last turbine of the first stage of the use and development approved by this permit or such other time approved by the responsible authority;*
> >
> > *ii. requires carcass searches using an acceptable sample of species to be undertaken to ascertain the species, number, age and sex (if possible), date and location of any bird or bat strike;*
> >
> > *iii. records the number and species, age and sex (if possible), date and location of any bird or bat strike;*
> >
> > *iv. records any seasonal and yearly variation in the number of bird and bat strikes; and*

v. determines whether further detailed investigations of any potential impacts on native birds and bats are warranted. Any further detailed investigations required are to be undertaken in consultation with DELWP - Environment Portfolio and to the satisfaction of the responsible authority;

vi. records the activity of Peregrine Falcons in and around Mt Fyans Wildlife Reserve, including fatalities, and whether they continue to use the reserve for habitat and breeding.

c. procedures for the reporting of any native bird and bat strikes to the responsible authority and to DELWP - Environment Portfolio within seven days of becoming aware of any strike;

d. information on the efficacy of searches for carcasses of birds and bats, and, where practicable, information on the rate of removal of carcases by scavengers, so that correction factors can be determined to enable calculations of the total number of mortalities;

e. procedures for the regular removal of carcasses likely to attract raptors to areas near turbines;

f. procedures for periodic reporting, within agreed timeframes, of the findings of the monitoring to the responsible authority, DELWP - Environment Portfolio and public reporting via the project website; and

g. procedures for developing measures and thresholds, in consultation with DELWP - Environment Portfolio and to the satisfaction of the responsible authority, to offset any significant impacts detected through the monitoring program, including:

i. turbine operation management; and

ii. taking into account the measures to be implemented in the Brolga compensation plan (described in condition 55 below

53. Following the completion of each year of the monitoring program referred to in condition 52, a report must be submitted to the responsible authority and DELWP - Environment Portfolio setting out the findings of the program to the satisfaction of the responsible authority. After consideration of this report, the responsible authority may direct that further investigation of potential or actual impacts on native birds and bats is to be undertaken, in which case:

a. the extent and details of the further investigation must be developed in consultation with DELWP - Environment Portfolio and to the satisfaction of the responsible authority;

b. the investigation must be carried out to the satisfaction of the responsible authority; and

c. all reports and investigation results under this condition must be placed on the project website for a minimum period of five years".

Condition 55 (a) of the planning permit requires a Brolga Monitoring Plan to be prepared, as presented below:

"55. Before the development starts:

a. A Brolga monitoring plan must be prepared in consultation with DELWP – Environment Portfolio to the satisfaction of the responsible authority. When approved, the plan will be endorsed by the responsible authority and will then form part of the permit. On endorsement, the endorsed Brolga monitoring plan must be placed on the project website for a minimum period of five years. The plan must:

i. be implemented for the life of the wind energy facility, but otherwise be consistent with the requirements of condition 52;

ii. identify the location of potentially at risk Brolga breeding, migration and flocking activities;

iii. include recommendations in relation to a mortality rate for Brolga which would trigger the requirement for responsive mitigation measures to be undertaken by the operator of the wind energy facility, developed in consultation with DELWP - Environment Portfolio to the satisfaction of the responsible authority."

This BAM Plan provides information on the likelihood of occurrence of bird and bat species of concern and presents the results of the risk assessment that shortlists species on which monitoring should focus. It then describes the monitoring activities to be implemented, including bird and bat utilisation surveys, carcass search and correction factor studies, and the Brolga monitoring program. In addition, on-going procedures for dealing with bird carcass finds under turbines and injured birds on site are also presented. This is followed by a decision-making framework for adaptive management and description of options for mitigating the impacts of the project on birds and bats should these be found to be unacceptable. Detailed monitoring of bird and bat impacts (except Brolga) applies for the first five years of the project while the protocols and management measures detailed in this Plan apply for operational life of the wind farm, as does Brolga monitoring.

This Plan is divided into the sections described below.

Section 3 details the pre-construction bird and bat monitoring programs.

Section 4 provides a risk assessment identifying species of concern that this monitoring program needs to address.

Section 5 details the aims and methodology of the post-construction utilisation surveys and the post-construction (operational) mortality monitoring for species of concern.

Section 6 presents the Brolga monitoring program for the project.

Section 7 specifies mitigation measures to reduce risk to any species of concern.

Section 8 describes impact triggers and a decision-making framework based on adaptive management to investigate and mitigate unacceptable impacts on birds and bats should these occur.

This investigation was undertaken by a team from Brett Lane & Associates Pty Ltd (BL&A), comprising Jackson Clerke (Zoologist), Inga Kulik (Senior Ecologist & Project Manager) and Brett Lane (Principal Consultant).

2.2. Bat and Avifauna Management Plan Objectives

The aim and objectives of the Plan are considered in this section. The Plan aims to provide *an overall strategy for managing and mitigating any significant bird and bat impacts arising from wind farm operations*.

This is 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 "Best Practice Guidelines" (CEC 2013).

The objectives of the Plan are specified in more detail below:

- Monitor the presence and behaviour of birds and bats and their mortality on and near the wind farm in the first five years of wind farm operations;
- Ascertain the occurrence of any seasonal and yearly variation in the number of bird and bat strikes;
- Ascertain wind farm impacts on species of concern identified in the risk assessment;
- Monitor the impacts of the project on the Brolga for the life of the project;
- Detail information on the efficiency of searches for carcasses of birds and bats and the rate of removal of carcasses by scavengers, so that correction factors can be determined to enable calculations of the total number of bird and bat mortalities;
- Define impact triggers that require a response involving at least investigation and, if required, mitigation of wind farm impacts on birds and bats, in consultation with DELWP and to the satisfaction of the Responsible Authority;
- Describe mitigation options that may be appropriate (subject to investigation) to reduce the risk of bird and bat collision with operating wind turbines in response to an impact trigger;
- Detail procedures for the regular removal of stock and other carcasses likely to attract raptors and predators for the life of the project;
- Detail procedures for dealing with bird carcasses under turbines and injured birds on site for the life of the project; and
- Detail procedures for periodic reporting, within agreed timeframes, of the findings of the monitoring to DELWP.

This Plan has incorporated learning and experience from the preparation and implementation of other similar plans for wind farm projects throughout Australia (BL&A, unpublished data) and, as a result, represents/reflects/presents the latest approaches to monitoring wind farm impacts on birds and bats.

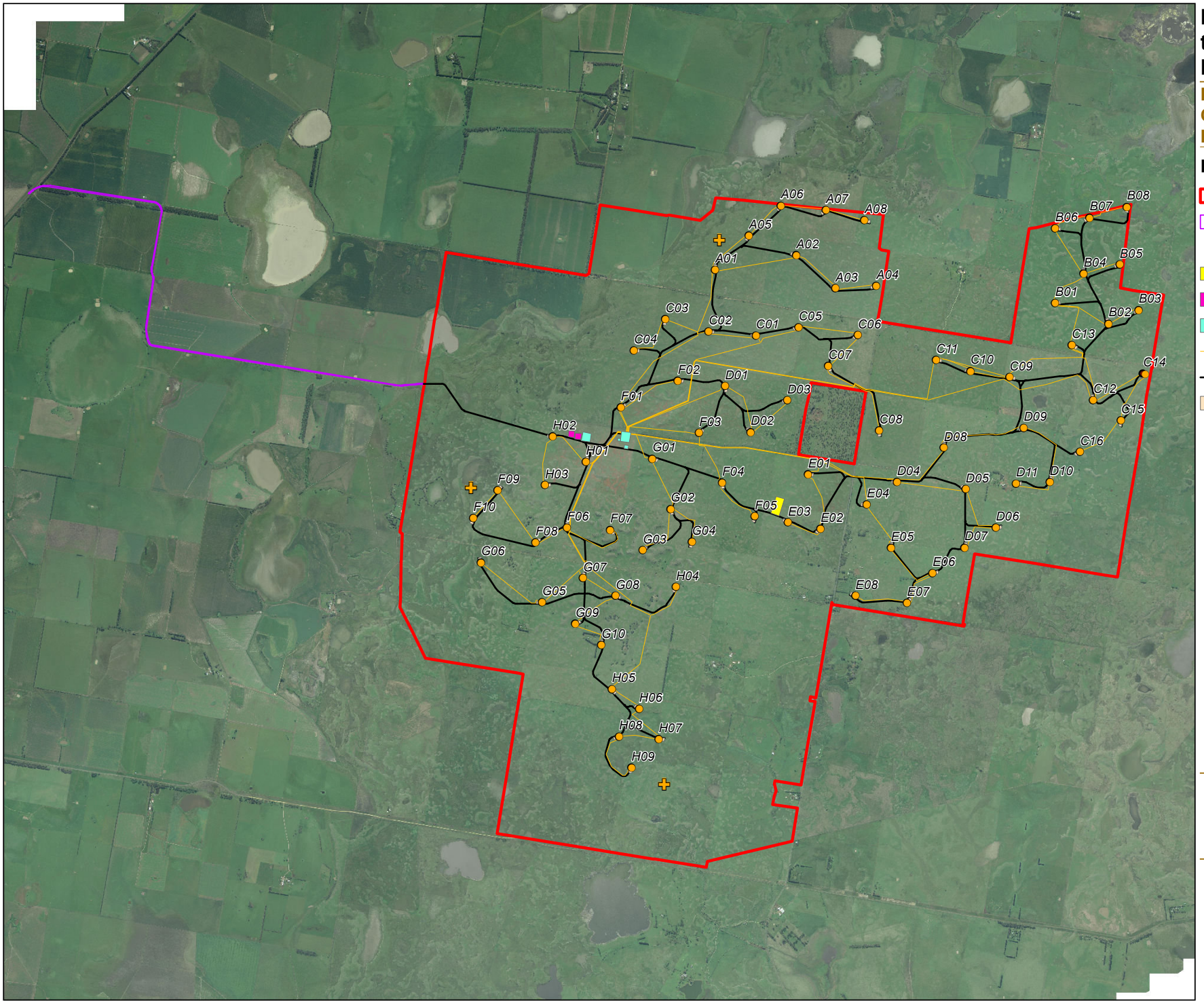

Figure 1: Overview of the Dundonnell Wind Farm site

Project: Dundonnell Wind Farm
Client: Dundonnell Wind Farm
Date: 1/11/2018

Legend

- Project boundary
- Main Access
- 80 Turbine Layout
- Batching plant
- Construction compound
- Laydown areas
- Underground cabling
- Access Tracks
- Hard Stand Foundation
- Permanent Met Masts

APPROVED FOR THE MINISTER FOR PLANNING

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2.3. Site Description

The proposed Dundonnell Wind Farm site (see Figure 1) is located within the Victorian Volcanic Plains bioregion and falls within the Glenelg Hopkins Catchment Management Authority (GHCMA 2006) catchment. It is located in Moyne Shire and comprises of land owned by eleven landowners. The Mount Fyans Nature Reserve is situated in the central part of the wind farm site but was excluded from any development.

Generally, the wind farm site (approximately 4,200 ha) comprises a series of volcanic magma flows which have formed a mosaic of moderate to abrupt basalt ridges (barriers). The vast majority of the wind farm site was dominated by improved pasture (comprising introduced grass species) and typical introduced agricultural and environmental weeds. Remnant native vegetation was limited to scattered, small patches of shallow wetland, including Plains Grassy Wetland, Aquatic Herbland and Plains Sedgy Wetland, numerous small areas of Stony Knoll Shrubland on the tallest of barriers and along the road reserves, small patches of Plains Grassland and Plains Grassy Woodland, and scattered River Red Gum trees.

The major site access road is to be constructed on flatter land to the west of the wind farm, which has been subject to more intense agricultural activities. Here also, improved pasture, introduced agricultural and environmental weeds and extensive cropping dominate the landscape. Remnant vegetation in this area was limited to small patches of Plains Grassland and shallow Plains Grassy Wetland.

Land-use is dominated by grazing and cropping agriculture and the site has therefore been highly modified from its pre-European state and, with a small number of exceptions where native vegetation has persisted, it is considered unlikely to support threatened bird and bat species apart from the Brolga on an ongoing basis.

2.4. Compliance summary

Table 1 details which sections of the BAM Plan comply with each of the requirements outlined in the anticipated Conditions of Approval for the project. The conditions of approval have been abbreviated but their full and correct wording can be found in Section 2.1 above.

Table 1: Sections within the BAM Plan that respond to conditions of approval for Dundonnell Wind Farm

Condition number	Permit condition requirements	BAM Plan Section/s
52 (a)	*a statement of the objectives and overall strategy for managing and mitigating any significant native bird and bat strike arising from the wind energy facility operations.*	2.2
52 (b)	*a general bat and avifauna monitoring program (excluding Brolga) of at least five years duration.*	5

Condition number	Permit condition requirements	BAM Plan Section/s
52 (c)	*procedures for the reporting of any native bird and bat strikes to the responsible authority and to DELWP - Environment Portfolio within seven days of becoming aware of any strike.*	5.2.3 & 5.2.7
52 (d)	*information on the efficacy of searches for carcasses of birds and bats, and, where practicable, information on the rate of removal of carcases by scavengers, so that correction factors can be determined to enable calculations of the total number of mortalities.*	5.2.4, 5.2.5 & 5.2.9
52 (e)	*procedures for the regular removal of carcasses likely to attract raptors to areas near turbines.*	6
52 (f)	*procedures for periodic reporting, within agreed timeframes, of the findings of the monitoring to the responsible authority, DELWP - Environment Portfolio and public reporting via the project website.*	5.3
52 (g)	*recommendations in relation to a mortality rate for specified species which would trigger the requirement for responsive mitigation measures to be undertaken by the operator of the wind energy facility, to the satisfaction of the responsible authority and DELWP.*	7
52 (h)	*procedures for developing measures and thresholds, in consultation with DELWP - Environment Portfolio and to the satisfaction of the responsible authority, to offset any significant impacts detected through the monitoring program.*	8.1.2 & 8.2.2
53	*Following the completion of each year of the monitoring program referred to in condition 52, a report must be submitted to the responsible authority and DELWP - Environment Portfolio setting out the findings of the program to the satisfaction of the responsible authority. After consideration of this report, the responsible authority may direct that further investigation of potential or actual impacts on native birds and bats is to be undertaken.*	5.3

Condition number	Permit condition requirements	BAM Plan Section/s
55 (a)	*A Brolga monitoring plan must be prepared in consultation with DELWP – Environment Portfolio to the satisfaction of the responsible authority.*	6

3. PRE-CONSTRUCTION MONITORING

3.1. Previous investigations

Investigations that have informed the preparation of this BAM Plan consisted of a number of targeted and desktop studies for bird and bat species that have been consolidated in the following report, prepared for the project Environment Effects Statement and modification application respectively:

- Brett Lane and Associates Pty Ltd (BL&A) 2015, Dundonnell Wind Farm – Flora and Fauna Assessment, Report for Trustpower Australia Pty Ltd, Report Number 9184 (5.16), February 2015; and
- Brett Lane and Associates Pty Ltd (BL&A) 2017, Dundonnell Wind Farm – Proposed turbine modifications, impacts on birds and bats. Report Number 9184 (34.4), September 2017.

Information gathered during these investigations has provided a baseline measure of bird and bat activity (unaffected by development) with which to compare the potential impacts of the wind farm after construction. These previous monitoring activities are described below.

- A ***Fauna Assessment*** was undertaken in two phases. First, a Level 1 overview field survey was undertaken in December 2009. This included the assessment of the likelihood of listed threatened fauna species being present on the site to direct targeted surveys. Second, targeted surveys were undertaken between 2010 and 2013 of species for which potentially suitable habitat was likely to be affected by the proposed development to ascertain to what extent, if any, the proposed wind farm would impact these.
- A ***Bird Utilisation Survey*** (BUS) was undertaken over five days between November 27th and December 4th, 2009 using seven survey points. Best practice methods were used, which are consistent with the "Level One" bird risk assessment requirements (AusWEA 2005). At each survey point an ornithologist recorded all bird species in a 200-metre radius for 15 minutes. Data recorded included species, number of individuals, distance from the centre point and flight height. Methods and a map of the survey points are provided in Appendix 1.
- A detailed Brolga **investigation** of the behaviour and numbers of this species on and within 10 kilometres of the wind farm site was undertaken for the development application. A map summarising the location of Brolga breeding and flocking sites within 5 kilometres of the wind farm is provided later in this report as Figure 3.
- ***Migratory Bird Surveys*** were undertaken during four survey periods: summer 2010/11, summer 2012/13, winter 2013 and spring 2013. The listed migratory bird surveys focussed on all wetlands within the radius of investigation holding water during the survey period and where migratory birds would potentially occur or have been recorded in the past based on historical database records or information from local landholders.
- Four ***Bat Survey*** programs were conducted for the Dundonnell Wind Farm project. One in November 2009 (one week), March 2011 (four weeks), mid February to April 2013 (ten weeks) and late September to late November 2013

(eight weeks). Over these four surveys, a total of 833 Anabat-nights of recording were made from 29 sites across the proposed Dundonnell Wind Farm site, totalling 9,532 Anabat-hours. Two sites were devoted entirely to record bat movements and flight heights at two wind masts. At each wind mast three concurrent recordings were made from the ground at the mast, and at 25 and 50 metres above the ground during the summer/autumn 2013 survey. The remaining 27 sites were distributed over the wind farm site and represented the different habitats within the site, with four of the initial sites being located outside the finalised wind farm boundary.

The above surveys provided the basis for the bird and bat risk assessment for the Dundonnell Wind Farm.

4. RISK ASSESSMENT

4.1. Sources of information and species of concern

To ascertain the species of concern that may occur on the DDWF site (Figure 1), the following sources were used:

- Records from the Victorian Biodiversity Atlas (VBA) (DELWP 2017), using an approximate 20-kilometre search radius region centred over the proposed DDWF site (searched on 25 October 2017) with central point -37.8513°S, 142.9738°E;
- The EPBC Act Protected Matters Search Tool (PMST) using a search region that included the proposed site with central point -37.8513°S, 142.6772°E and a 20-kilometre radius buffer zone (Department of the Environment and Energy 2017); and
- Ecological assessments undertaken to date at DDWF compiled in BL&A (2015).

At the time this plan was prepared, no operational wind farms occurred within 40 kilometres of the Dundonnell Wind Farm, the closest being Oaklands Hill Wind Farm approximately 45 kilometres to the northwest.

4.1.1. Species and groups of concern

Species of concern include the following:

- Species listed as threatened on legislation or according to an authoritative source;
- Species known to be particularly prone to collision with operating turbines or sensitive to disturbance;
- Species for which a population concentration, or a population of significance, occurs on the site and that may exhibit "risk behaviour" and potentially interact with the operation of the wind farm; and
- Native bird and bat species known to occupy the DDWF site considered to have a higher than normal tendency to collide with wind turbines (BL&A 2015).

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 DDWF site itself given the habitat present on the site and occurrence of the species in the search region.

The original site assessments (BL&A 2015) identified listed threatened and migratory species likely to occur on the site, some of which were detected during on-site fauna surveys. Although this has been taken into consideration, a number of additional species and groups, including non-threatened species/groups that were not originally considered, have been identified through the current review process.

The detailed rationale for the inclusion of the shortlisted species and groups can be found in Section 4. The short-listed species and groups are listed below (Table 2).

Table 2: Risk assessment - Assessed bird and bat species

EPBC Act Listed Migratory Species
▪ Cattle Egret (*Ardea ibis*) - M (JAMBA, CAMBA)
▪ Common Greenshank (*Tringa nebularia*) - M (JAMBA, CAMBA, ROKAMBA, Bonn Convention (A2H))
▪ Common Sandpiper (*Charadrius bicinctus*) - M (Bonn Convention (A2H))
▪ Curlew Sandpiper (*Calidris ferruginea*) - CE, M (JAMBA, CAMBA, ROKAMBA, Bonn Convention (A2H))
▪ Double-banded Plover (*Charadrius bicinctus*) - M (Bonn Convention (A2H))
▪ Eastern Great Egret (*Ardea modesta*) - M (JAMBA, CAMBA)
▪ Glossy Ibis (*Plegadis falcinellus*) - M (CAMBA, Bonn (A2S))
▪ Latham's Snipe (*Gallinago hardwickii*) - M (JAMBA, CAMBA, ROKAMBA, Bonn A2H)
▪ Marsh Sandpiper (*Tringa stagnatilis*) - M (JAMBA, CAMBA, ROKAMBA, Bonn Convention (A2H))
▪ Pectoral Sandpiper (*Calidris melanotos*) - M (JAMBA, ROKAMBA, Bonn (A2H))
▪ Red-necked Stint (*Calidris ruficollis*) - M (JAMBA, CAMBA, ROKAMBA, Bonn Convention (A2H))
▪ Sharp-tailed Sandpiper – (*Calidris acuminate*) - M (JAMBA, CAMBA, ROKAMBA, Bonn Convention (A2H))
▪ White-bellied Sea-Eagle (*Haliaeetus leucogaster*) - M (CAMBA)
EPBC Act and FFG Act listed threatened birds
▪ Eastern Great Egret (*Ardea modesta*) - M - EPBC, Vulnerable – FFG Act
▪ White-bellied Sea-Eagle (*Haliaeetus leucogaster*) – M – EPBC, Threatened – FFG Act
EPBC Act and FFG Act listed threatened bats
▪ Southern Bent-wing Bat (Miniopterus schreibersii bassanii) – Critically Endangered – EPBC, Threatened – FFG Act
FFG Act listed threatened birds
▪ Baillon's Crake (*Porzana pusilla palustris*)
▪ Blue-billed Duck (*Oxyura australis*)
▪ Brolga (*Grus rubicunda*)*
▪ Freckled Duck (*Stictonetta naevosa*)
▪ Gull-billed Tern (*Gelochelidon nilotica macrotarsa*)
▪ Little Egret (*Egretta garzetta nigripes*)
FFG Act listed threatened bats
▪ Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)

*The risk for Brolga (*Grus rubicunda*) has been assessed through collision risk modeling

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

Note that in the non-listed species of birds, only a selection of the full species diversity was assessed for impacts. This selection is considered to cover all foraging guilds that may experience impacts, e.g. raptors other than Wedge-tailed Eagle and listed threatened raptors, and waterbirds.

4.2. Risk assessment process

The objective of this risk assessment is to guide the development of the BAM Plan for the Project by identifying those species or groups considered potentially at risk from either collision with turbines or disturbance by the operation of the wind farm. The outcomes of this risk assessment enable more targeted monitoring and management measures to be included in the BAM Plan, focussing on species and groups at greater risk.

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 wind turbine blades or being deterred from using part of the wind farm due to disturbance. The Risk Evaluation Matrix Model also complies with the ISO 31000 Risk Assessment Standard.

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 for assessing environmental risk. The assessment requires criteria to be developed for likelihood and consequence. These criteria are provided 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*

4.3. 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 information below as part of the risk assessment process:

- Environmental value to be protected
- Reasons for inclusion
- Threatened species status
- Impact pathway
- Consequence score and likelihood scores
- Risk rating, and
- Comments relating to risk rating scores.

Table 6 includes a summary of the findings for each considered species or group and their relevance to the assessment. These rely on previous assessments undertaken by BL&A (2015) at DDWF.

Some non-listed waterbird species were recorded during the original ecological assessment (BL&A 2015), namely Masked Lapwing, Straw-necked Ibis, White-faced Heron, Silver Gull and White-necked Heron. These common species have been treated together as 'waterbirds' in the risk assessment species table. This group excludes rare species and the Brolga, which were either ruled out as being subject to any impact during the original project planning assessment, or that are subject to a separate response (i.e. the Brolga).

The risk associated with wind turbine collision and indirect effects at the DDWF for most birds and bats was rated as **negligible**. The exceptions are described below.

The **White-throated Needletail** flies regularly at or above turbine height and flocks may pass over the DDWF site during the summer months. Collisions have been recorded at wind farms elsewhere in NSW and Australia. The risk to this species from the DDWF is considered to be **low** as the species is widespread and numerous in eastern and south-eastern Australia. Recent evidence suggests the species overall population is in decline, however this is primarily related to the widespread and continued loss of breeding habitat in Siberia (Tarburtin 2014). It is unlikely that the occasional loss of individuals due to collision with turbines will significantly contribute to population decline.

Given the occurrence of collisions involving **Wedge-tailed Eagle** (WTE) at many wind farms, this species is addressed in this risk assessment. There is a low incidence of disturbance and WTEs consistently inhabit most wind farms, including successful

breeding within 200 metres of operating turbines (BL&A, unpubl. data). Thus, risks to this species arise from likely collisions but not indirect disturbance. The risk to the Wedge-tailed Eagle from turbine collision was therefore considered to be **moderate**.

Based on experience with other wind farms in eastern Australia collisions of commonly occurring raptor species are likely. Commonly occurring raptor species recorded to collide with turbines include **Nankeen Kestrel, Whistling Kite, Brown Falcon** and **Black-shouldered Kite** (BL&A, unpubl. data). These species appear not to be deterred by the presence of operating wind turbines and occur regularly at other wind farms in Victoria. Overall, the risk from collision with turbines to these raptors is considered to be **low** as these species are widespread and have a common status that makes significant population impacts very unlikely.

Two threatened bat species were recorded at the wind farm site in low numbers. An estimated 10,000 to 15,000 Southern Bent-wing Bats breed in Victoria and given the low number of calls from this species recorded at the wind farm site during the four surveys it is unlikely to be active in significant numbers in the area. Thus, risks to this species arise from likely collisions but not indirect disturbance. The risk to the Southern Bent-wing Bat from turbine collision was therefore considered to be **moderate**.

The Yellow-bellied Sheathtail Bat was recorded during fieldwork from DDWF (BL&A 2015) but is a rare vagrant to Victoria during late summer and autumn with its main population occurring in tropical and sub-tropical Australia. When foraging for insects, it flies high and fast over the forest canopy, but lower in more open country. The risk to this species from collision at the DDWF is considered to be **low** as the species is will only be affected in low numbers.

Table 6: Bird and Bat Risk Assessment – Dundonnell Wind Farm

Value to be Protected	Reasons for Inclusion	Threatened species status	Impact Pathway	Likelihood of Risk Event	Consequence	Risk Rating	Comments
Listed Bird Species likely to occur at DWF							
Baillon's Crake *Porzana pusilla palustris*	This species was recorded at the Dundonnell WF site (BL&A 2015)	FFG Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	One individual recorded in the proposed wind farm. Due to the low numbers of the species in the area and low habitat availablility within the site, impacts from DDWF on this species are considered to be unlikely.
		Threatened	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Blue-billed Duck *Oxyura australis*	Species or species habitat likely to occur within area	FFG Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Recent records of the species exist in the region and the site. However due to the low availability of habitat within the site, it is not expected that the species will frequent the site in significant numbers. It is unlikely the wind farm with have a significant impact on the species.
		Threatened	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Common Greenshank *Tringa nebularia*	This species was recorded at the Dundonnell WF site (BL&A 2015)	EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Recorded on site in the western areas in wetlands and creeks. Turbine infrastructure will not be built near these areas. Wetland habitat within the proposed wind farm site is considered to be limited in extent and routine movements of migratory shorebirds (BL&A 2015) within these wetlands would not bring them near any wind farm infrastructure.
		Migratory	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Common Sandpiper *Charadrius bicinctus*	This species was recorded at the Dundonnell WF site (BL&A 2015)	EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Habitats utilised by most migratory bird species likely to occur at DDWF were found to occur away from areas where turbines and associated infrastructure are proposed to be located, on large, open, saline wetlands several kilometres to the northeast of the proposed wind farm. Wetland habitat within the proposed wind farm site is considered to be limited in extent and routine movements of migratory shorebirds (BL&A 2015) within these wetlands would not bring them near any wind farm infrastructure.
		Migratory	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Curlew Sandpiper *Calidris ferruginea*	Species or species habitat likely to occur within area	EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Habitats utilised by most migratory bird species likely to occur at DDWF were found to occur are situated away from areas where turbines and associated infrastructure are proposed to be located, on large open saline wetlands several kilometres to the northeast of the proposed wind farm. Wetland habitat within the proposed wind farm site is considered to be limited in extent and routine movements of migratory shorebirds (BL&A 2015) within these wetlands would not bring them near any wind farm infrastructure.
		Migratory	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Double-banded Plover *Charadrius bicinctus*	This species was recorded at the Dundonnell WF site (BL&A 2015)	EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Habitats utilised by most migratory bird species likely to occur at DDWF were found to occur are situated away from areas where turbines and associated infrastructure are proposed to be located, on large open saline wetlands several kilometres to the northeast of the proposed wind farm. Wetland habitat within the proposed wind farm site is considered to be limited in extent and routine movements of migratory shorebirds (BL&A 2015) within these wetlands would not bring them near any wind farm infrastructure.
		Migratory	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Eastern Great Egret *Ardea modesta*	This species was recorded at the Dundonnell WF site (BL&A 2015)	FFG Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	This species has been recorded in the radius of investigation and has the potential to occur at the wind farm site due to the presence of suitable habitat. This species wades in shallow water foraging for food. However due to the limited extent of wetland habitat within the site, it is unlikely that this species occurs regularly or in significant numbers.
		Migratory, Threatened (FFG)	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	

Value to be Protected	Reasons for Inclusion	Threatened species status	Impact Pathway	Likelihood of Risk Event	Consequence	Risk Rating	Comments
Freckled Duck *Stictonetta naevosa*	Species or species habitat likely to occur within area	FFG Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	This species may occur in the wind farm due to suitable habitat being available. However due to the limited of suitable wetland habitat within the site, it is unlikely that this species occurs regularly or in significant numbers.
		Threatened	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Glossy Ibis *Plegadis falcinellus*	Species or species habitat likely to occur within area	EPBC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	This species has been recorded in the radius of investigation and has the potential to occur at the wind farm site due to the presence of suitable habitat. This species wades in shallow water foraging for food. However due to the limited extent of habitat within the site, it is unlikely that this species occurs regularly or in significant numbers.
		Migratory	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Gull-billed Tern *Gelochelidon nilotica macrotarsa*	Species or species habitat likely to occur within area	FFG Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	This species may occur in the wind farm due to suitable habitat being available. However due to the limited extent of habitat within the site, it is unlikely that this species occurs regularly or in significant numbers.
		Threatened	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Latham's Snipe *Gallinago hardwickii*	This species was recorded at the Dundonnell WF site (BL&A 2015)	EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Recorded on site in the western areas in wetlands and creeks. Turbine infrastructure will not be built near these areas. Wetland habitat within the proposed wind farm site is considered to be limited in extent and routine movements of migratory shorebirds (BL&A 2015) within these wetlands would not bring them near any wind farm infrastructure.
		Migratory	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Little Egret *Egretta garzetta nigripes*	This species was recorded at the Dundonnell WF site (BL&A 2015)	FFG Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	This species has been recorded in the radius of investigation and has the potential to occur at the wind farm site due to the presence of suitable habitat. This species wades in shallow water foraging for food. However due to the limited extent of habitat within the site, it is unlikely that this species occurs regularly or in significant numbers.
		Threatened	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Marsh Sandpiper *Tringa stagnatilis*	Species or species habitat likely to occur within area	EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Habitats utilised by most migratory bird species likely to occur at DDWF were found to occur are situated away from areas where turbines and associated infrastructure are proposed to be located, on large, open, saline wetlands several kilometres to the northeast of the proposed wind farm. Wetland habitat within the proposed wind farm site is limited in extent and routine movements of migratory shorebirds (BL&A 2015) within these wetlands would not bring them near any wind farm infrastructure.
		Migratory	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Pectoral Sandpiper *Calidris melanotos*	Species or species habitat likely to occur within area	EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Habitats utilised by most migratory bird species likely to occur at DDWF were found to occur are situated away from areas where turbines and associated infrastructure are proposed to be located, on large, open, saline wetlands several kilometres to the northeast of the proposed wind farm. Wetland habitat within the proposed wind farm site is considered to be limited in extent and routine movements of migratory shorebirds (BL&A 2015) within these wetlands would not bring them near any wind farm infrastructure.
		Migratory	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Red-necked Stint *Calidris ruficollis*	This species was recorded at the Dundonnell WF site (BL&A 2015)	EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Habitats utilised by most migratory bird species likely to occur at DDWF were found to occur are situated away from areas where turbines and associated infrastructure are proposed to be located, on large open saline wetlands several kilometres to the northeast of the proposed wind farm. Wetland habitat within the proposed wind farm site is considered to be limited in extent and routine movements of migratory shorebirds (BL&A 2015) within these wetlands would not bring them near any wind farm infrastructure.
		Migratory	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	

Value to be Protected	Reasons for Inclusion	Threatened species status	Impact Pathway	Likelihood of Risk Event	Consequence	Risk Rating	Comments
Sharp-tailed Sandpiper *Calidris acuminata*	This species was recorded at the Dundonnell WF site (BL&A 2015)	EPBC Act Migratory	Collision with operating wind turbines.	Unlikely	Low	Negligible	The Sharp-tailed Sandpiper is a listed migratory species and was recorded during the initial overview assessment in 2009. Since then the wind farm boundary has been modified and this record lies outside the current wind farm site. The large flock of Sharp-tailed Sandpiper was observed at a vegetated wetland in the northern half of the 10-kilometre radius of investigation. Wetland habitat within the proposed wind farm site is limited in extent and routine movements of migratory shorebirds (BL&A 2015) within these wetlands would not bring them near any wind farm infrastructure.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
White-bellied Sea-Eagle *Haliaeetus leucogaster*	This species was recorded at the Dundonnell WF site (BL&A 2015)	EPBC Act, FFG Act Migratory, Threatened (FFG)	Collision with operating wind turbines.	Rare	Negligible	Negligible	The White-bellied Sea-Eagle was observed briefly on one afternoon flying across the wind farm site. This species does not occur regularly at the site and would have been moving to some of the larger wetlands in the region. It is unlikely that the wind farm would have a significant impact on the species.
			Indirect disturbance, including barrier effects.	Rare	Negligible	Negligible	
White-throated Needletail *Hirundapus caudacutus*	Species or species habitat likely to occur within area	Listed migratory species EPBC Act	Collision with operating wind turbines.	Likely	Low	Low	The White-throated Needletail is known to follow storm systems and fronts. On other wind farms in its range it has been found to collide occasionally with turbines. It typically flies at and above RSA height. Recent data suggests the species population is in decline and estimates that there has been a 74% decline in observed numbers of the species since the 1950s, primarily due to deforestation of its breeding grounds in Siberia (Tarburton 2014). Other factors responsible for species mortalities, are unlikely to be responsible for the decrease in abundance in Australia (Tarburton 2014). Estimates of the population (Higgins 1999), published in 1999, put numbers in the tens of thousands and it is considered to still be abundant in some areas of Australia (DOE 2015b). The loss of a small number of individuals each year is unlikely to have a significant impact on the species or significantly contribute to the species continuing decline.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Wedge-tailed Eagle *Aquila audax*	This species was recorded at the Dundonnell WF site (BL&A 2015)	N/A	Collision with operating wind turbines.	Almost certain	Moderate	Moderate	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 south eastern Australia. Disturbance is not an issue, with the eagle breeding successfully as close as 200 metres from operating wind turbines. The regular incidence of collisions has the potential to affect the regional population (to be confirmed through further monitoring).
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Other raptors	Commonly occurring raptor species were recorded at the Dundonnell WF site	N/A	Collision with operating wind turbines.	Likely	Low	Low	Turbine strikes by commonly occurring raptors, such as Brown Falcon, Nankeen Kestrel and Black-shouldered Kite are likely, based on experience at other wind farms in south-eastern Australia. 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 occur regularly at other wind farms in VIC and NSW.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Waterbirds	Commonly occurring waterbird species were recorded at the Dundonnell WF site	N/A	Collision with operating wind turbines.	Unlikely	Low	Negligible	There are few wetlands within the proposed wind turbine layout and the low waterbird count results reflect this. The low counts were probably also drought-related but there is very little waterbird habitat on the proposed wind farm site. Therefore, impacts on waterbirds from the proposed wind farm are unlikely to be significant.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Brolga *Antigone rubicunda*	This species was recorded at the Dundonnell WF site (BL&A 2015)	FFG Act	Collision with operating wind turbines.	Risk was assessed through collision risk modelling and found to be the loss of one bird every second year for the life of the wind farm.			Risks, potential impacts and compensation (offsets) for Brolga have been addressed in detail in BL&A report 9184 (4.12).
			Indirect disturbance, including barrier effects.	Turbine-free buffers for flocking sites have been applied including a 300m disturbance buffer.			

Value to be Protected	Reasons for Inclusion	Threatened species status	Impact Pathway	Likelihood of Risk Event	Consequence	Risk Rating	Comments
Listed Bat Species likely to occur at DWF							
Southern Bent-wing Bat *Miniopterus schreibersii bassanii*	This species was recorded at the Dundonnell WF site (BL&A 2015)	EPBC Act, FFG Act Critically Endangered	Collision with operating wind turbines.	Likely	moderate	moderate	An estimated 10,000 to 15,000 Southern Bent-wing Bats breed in Victoria and given the low number of calls from this species recorded at the wind farm site during the four surveys it is unlikely to be active in significant numbers in the area. Construction and operation of a wind farm at Dundonnell is highly unlikely to have a significant impact on the population of the Southern Bent-wing Bat
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris*	This species was recorded at the Dundonnell WF site (BL&A 2015)	FFG Act Threatened	Collision with operating wind turbines.	Likely	Low	Low	This species was recorded during fieldwork from DDWF (BL&A 2015) but is a rare vagrant to Victoria during late summer and autumn with its main population occurring in tropical and sub-tropical Australia. When foraging for insects, it flies high and fast over the forest canopy, but lower in more open country. There is one record to date of this species striking wind turbines, and it will fly at RSA height. The low numbers in the region make it unlikely to encounter turbines regularly or be regularly affected by them.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	

Notes: FFG Act = Flora and Fauna Guarantee Act; EPBC Act = Environment and Protection of Biodiversity and Conservation Act

4.4. Conclusions from the Risk Assessment for Dundonnell Wind Farm

The surveys of the Project site and surrounding wind farm sites to date, combined with the knowledge generated at operating wind farms elsewhere in Australia (BL&A unpubl. data), indicate that collision rates are typically very low and this risk assessment indicates that no significant population-wide impacts are anticipated for species of concern. The majority of threatened or listed birds that have been recorded or are likely to occur at the wind farm site are waterbirds and two species of raptors that are grassland specialists.

There are few wetlands within the proposed wind turbine layout and the low waterbird count results reflects this (BL&A 2015). Very little waterbird habitat occurs on the wind farm site, therefore impacts on waterbird species from the wind farm are unlikely to be significant.

The risk that migratory bird species will collide with the turbines is considered low given the geographical distribution of habitats away from the elevated country on which the wind farm is to be constructed (main movement likely to be north-south within these habitats rather than across the wind farm site) and the usual behaviour of shorebirds when moving more than 1-2 kilometres (and when migrating) of rapidly climbing to flight heights higher than wind turbines. Consequently, the likely very low number of shorebirds colliding with turbines would not represent a significant impact on the populations of the species that regularly occur.

Raptors are known to be vulnerable to collision with operating wind turbines. A number of raptor species have been recorded at the Project site during surveys. The Wedge-tailed Eagle is the most exposed to collision risk due to its common habit of soaring and circling at height while foraging. Nankeen Kestrel, Brown Falcon, Peregrine Falcon and Black-shouldered Kite may also occasionally collide with turbines. The risks to Wedge-tailed Eagle and "raptors" as a group are addressed in this BAM Plan.

White-throated Needletail is a migratory species with similar flight behaviour to raptors. It flies regularly at or above turbine height and flocks may pass over the DDWF site during the summer months. Collisions have been recorded at wind farms elsewhere in south eastern Australia. The risk to this species from the DDWF is considered to be *low* as the species is widespread and numerous in eastern and south-eastern Australia. Recent evidence indicates the species population may be declining, due to deforestation in its breeding grounds in Siberia (Tarburton 2014). It is unlikely that occasional collisions with turbines at DDWF will significantly contribute to population declineas it is listed as secure both at a state and Commonwealth level, although it is a listed migratory species at the Commonwealth level.

In regards to threatened bat species at DDWF, given their low activity levels on the proposed wind farm site compared with common and widespread species, it is concluded that the two threatened species do not occur at the proposed wind farm site in numbers of significance at a population level. The operation of the proposed wind farm is unlikely to put their population at significant risk, but could impact on a small number of individuals. The risk to Southern Bent-wing Bat is considered moderate and the risk to Yellow-bellied Sheathtail Bat is considered low.

No birds or bats were considered to be at risk from indirect effects, such as disturbance or barrier effects.

This risk assessment indicates the following groups should be the focus of monitoring in the BAM Plan:

- Wedge-tailed Eagle and other raptors;
- White-throated Needletail;

- Southern Bentwing Bat; and
- Yellow-bellied Sheathtail Bat.

5. OPERATIONAL MONITORING PROGRAM

This section of the plan describes the objectives and methods of the post construction mortality monitoring program to be undertaken once the Dundonnell Wind Farm commences operations and for at least five years duration. The program will be conducted for an initial period of two years. After two years, a review of the results of monitoring and implementation will be conducted and an agreement will be reached with the Regional Director of DELWP on the ongoing level of monitoring required for the remaining three years and thereafter. A further period of carcass monitoring will be implemented in the fifth year of operations to confirm patterns from the initial period of monitoring.

The main focus of the plan is monitoring bird and bat fatality resulting from collisions with turbines and is achieved by conducting carcass searches for birds and bats under turbines.

Following the first two years of monitoring, an annual mortality estimate for birds and bats will be calculated using a statistical model that incorporates ecologically relevant information, including the results of carcass searches using the pulsed survey design, and the results of the scavenger and searcher efficiency trials. These factors will assist in reducing the uncertainty on the mortality estimate. The mortality estimate will be undertaken by a qualified statistician. In the third, fourth and fifth year, carcass searches will be undertaken to validate these findings.

In addition, any survey requirements triggered by one of the impact triggers in Section 8 may initiate further field investigations.

The second annual report will include a detailed evaluation of this program against the performance criteria in Table 10 and recommendations of monitoring requirements in years three and four, before the fifth full year of carcass monitoring.

5.1. Bird Surveys

5.1.1. Monitoring 'at risk' groups

The key "at risk" species and groups have been identified through the risk assessment (Section 4).

Birds of Prey (Raptors) – the risk assessment considers Wedge-tailed Eagle (WTE) to be at **moderate** risk of impact from turbine collision and other raptors to be **low** risk of such impact.

The three other species identified as at **low** or **medium** risk were:

- White-throated Needletail – at **low** risk;
- Southern Bentwing Bat – at **moderate** risk; and
- Yellow-bellied Sheathtail Bat at **low** risk.

Data gathered at Dundonnell and other wind farm sites in agricultural landscapes in south eastern Australia indicates that the White-throated Needletail occurs sporadically during summer and early autumn, and generally so infrequently that gathering meaningful monitoring data is impossible. In addition, the comprehensive pre-approval surveys of bats undertaken at the Dundonnell Wind Farm (BL&A 2016) indicated very little activity on the site by these bat species, therefore it is also likely for this species that gathering meaningful and informative data on its activity on the site is unlikely to be practical.

All three species will therefore be monitored for mortality through the carcass searches, which have been designed to detect both bats and medium-sized birds (see section 5.2).

5.1.2. Wedge-tailed Eagles and other raptors

After operations commence, monthly monitoring of WTE flight movements and breeding activity will be undertaken to determine whether operating turbines affect the behaviour of eagles. This raptor monitoring will be incorporated into the monthly carcass monitoring program. Any raptor observed during these searches will have the following information recorded, as a minimum:

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

Flight paths will be plotted as accurately as possible on large-scale aerial photographs of the site.

The occurrence of White-throated Needletail (assessed as low risk) will also be recorded during monthly monitoring.

The known nesting location of Peregrine Falcon, situated in Mount Fyans Wildlife Reserve in the centre of the wind farm site (excluded from turbine areas), will be monitored for breeding activity which may give an indication of possible impacts on this species from the operation of the wind farm. Monitoring will involve monthly inspection of the nest site during and immediately after the Peregrine Falcon breeding season (August to December) to ascertain the stage of breeding (e.g. incubation, chick rearing, fledging) and the breeding outcome (successful or not).

A series of adaptive management measures are proposed in this BAM Plan to reduce the potential for high numbers of raptors to use the site. These are outlined in Section 6.

5.2. Carcass search program

The purpose of carcass searching is to determine the impact of the proposed wind farm on bats and birds (i.e. number of deaths per year). Collision by birds and bats with wind turbines will be monitored through a formal carcass-search program for five years after operations commence. The mortality rate will be calculated based on the numbers of dead birds and bats detected under wind turbines during scheduled carcass searches. Carcasses detected outside formal searches, such as during carrion searches and incidental finds by wind farm personnel will be recorded and can represent impact triggers, with commensurate responses (see section 8), but will not contribute to calculating the bird and bat mortality rates for the project.

It is assumed that any dead bird or bat detected beneath a turbine and within the “search zone” has died as a result of collision or interaction with a turbine. Hull and Muir (2010) have clearly identified a zone around turbines in which carcasses are predicted to fall. If carcasses

are found outside the designated search zone, it will not be possible definitively to attribute it to turbine collision.

Fatality monitoring aims to detect patterns (e.g. peak times) as a basis for determining an adaptive management trigger and informing adaptive mitigation. The consistent application of this protocol will ensure that statistically robust, spatially and temporally consistent data on all bird and bat mortality is collected. The statistical basis of the proposed monitoring program is addressed in a statistical appendix to this plan (see Appendix 2).

The following sections outline:

- **Turbine selection:** how the wind turbines will be selected for a search;
- **Search protocol:** the size of area beneath turbines to be searched and how this will be undertaken;
- **Scavenger rates and trials**: definition of scavenging and how experimental trials will be conducted;
- **Detectability**: definition of detectability and the experimental trial methodology; and
- **Analysis:** general outline of how the data will be analysed.

A suitably experienced and qualified ecologist will oversee and be involved in the implementation of the program, including the carcass searches, searcher efficiency trials and scavenger trials.

The searches will be conducted by personnel trained by qualified ecologists experienced in these methods.

5.2.1. Turbine Selection

The target population are the turbines themselves and the sample population will be **one-third** of the entire turbine number. Therefore, 27 turbines have been selected to be searched each month as part of the monitoring program from the 80 turbines in the wind farm (see Appendix 3). Turbines will be selected at random so each turbine has an equal chance of being selected. Once turbines have been selected they will not be changed. An additional turbine (number 038) will be searched so that all four turbines close to the Mount Fyans reserve, an area which the Peregrine Falcon uses for habitat and breeding, can be searched. This number has been determined based on what will provide the most accurate mortality rate given high variability shown on other wind farms, and to maximise reliability of searches. Each turbine that is selected for the searches will have the following recorded, regardless of whether a carcass is found:

- location (easting, northing);
- location in row;
- curvature of row;
- distance to nearest turbine;
- identification number of nearest turbine;
- local vegetation, including the following information which will identify visibility limitations:
    - a general description of the vegetation, including vegetation type (e.g. remnant forest versus open, grazed pasture);
    - estimated average height of the vegetation; and

- vegetation density;

- distance to key habitat features, such as woody vegetation, wetlands, escarpment, etc.

Carcass searches will be conducted monthly for five years.

Searches will be undertaken by qualified ecologists experienced in these studies or on-site personnel trained in the required search methods by these ecologists. A training and quality assurance program will be developed to ensure that personnel concerned are implementing survey procedures correctly and maintaining data recording and curation standards.

5.2.2. Search method

The search area beneath each turbine has been determined to best detect bats and medium to large bird carcasses, based on the turbine dimensions (Hull & Muir 2010). Based on the Hull and Muir model (2010) 95% of bat carcasses are found within 65 metres of the turbine, and carcasses of medium to large birds are reasonably evenly distributed out to 100 metres. Carcasses of very large birds (Wedge-tailed Eagle) may be found a little further out, but 95% are within 115 metres of the turbine.

Advice was sought from Symbolix Pty Ltd, statistical consultants (see Appendix 2) on whether the change in turbine size compared with the 2010 investigation would alter the search zone. This concluded that a 120-metre search radius was adequate.

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 60-metre radius from the turbine and transects are spaced every four metres across this circle (Figure 3), equating to a search involving two metres of ground either side of the observer walking the transect.

The outer zone will comprise the zone between the 60-metre and 120-metre radius circles. Although they are still 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 (see Figure 2). Given that the defined transect spacing and total search area are based on experience and evidence from previous studies (e.g. Arnett *et al*. 2005, Hull and Muir 2010) they are considered to be ample to detect bats and the bird species of concern arising out of the risk assessment.

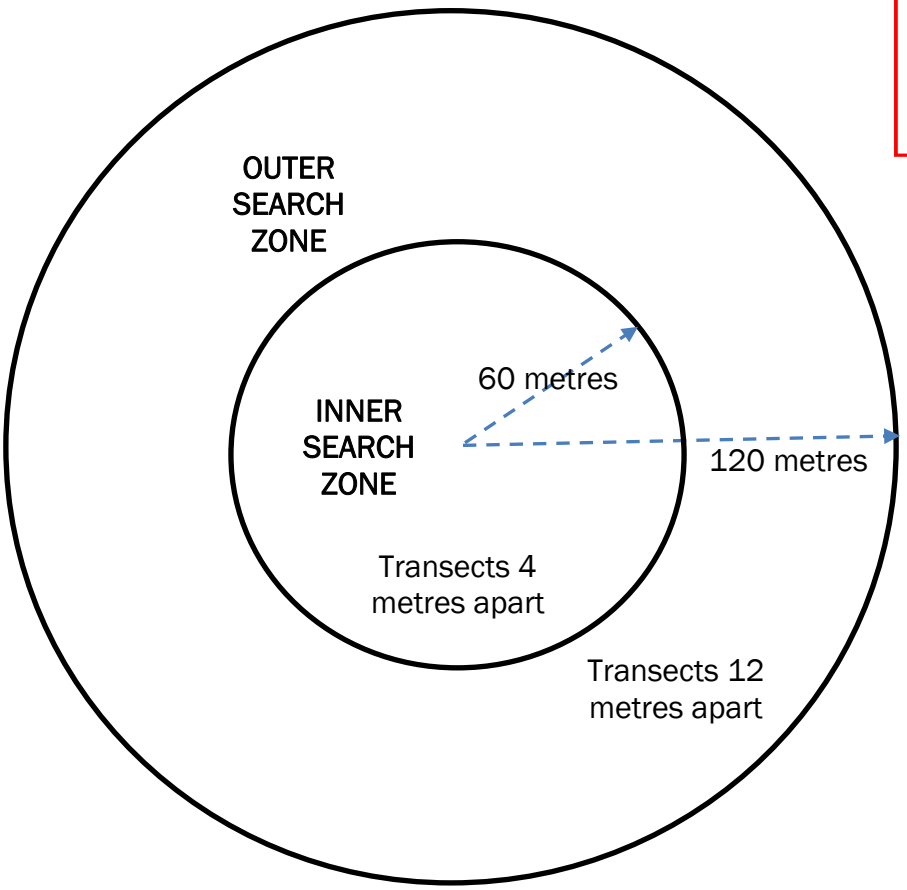
All 27 turbines will be searched out to 120 metres once per month. A second follow-up search, a 'pulse search' will be undertaken to 60 metres once a month within several days of the first search to detect additional mortality of bats and birds. The order of turbines searched will be randomized between searches.

The results of all searches will be recorded in a carcass search data sheet (see Appendix 1). The data sheets will be filled out for every site search undertaken, to ensure details of all searches are recorded, including those during which no carcasses were found (likely to be for most searches).

The search method will involve either:

- Searches on foot along pre-determined transects by a trained searcher; or
- Searches by a trained scent dog.

Figure 2: Inner and outer carcass search zones underneath the turbines



The walking search method will involve trained observers walking the two zones. Each observer will walk along transects at the spacing indicated above for each zone. To ensure that all other possible confounding variables are controlled, qualified observer behaviour will be standardised (i.e. clothing, speed). Observers will use hand held GPS to record their search transects and monitor their progress. GPS devices can be used to measure distance from the base of a turbine and periodically ensure observers are maintaining accurately spaced transects. This will ensure that the same areas are surveyed each search. Shape files of search transects will be made available to the responsible authority and DELWP upon request.

The searcher will walk the area at approximately 30–60 metres per minute (or faster if ground cover does not limit visibility of carcasses) and search thoroughly for dead birds, bats and remains along the transects outlined above. Searching will commence in the morning once the sun is high enough to permit good ground visibility and progress until the last turbine and reference area has been searched or until the sun gets too low for good ground visibility. The searcher will carry a GPS and the search route will be recorded.

The alternative method involving a scent dog will be undertaken by commencing the search on the downwind side of the search area and steadily moving forward in left and right sweeps across the 120 m search area, moving forward every 10-20 metres. The scent dog will carry a GPS tracker and the search route will be recorded.

In addition to the search protocol, searchers will observe areas beyond the search radius (up to 140m from the turbines) with binoculars to detect any large birds, such as Wedge-tailed Eagles and Brolgas, which may have fallen further away from the turbines. Birds of this size

are easily detectible from a distance. If a carcass is detected in this manner and can reasonably be attributed to the turbine being searched, i.e. it is not hundreds of metres away, it will be included in the carcass search results to be analysed. If not, it will be considered as an incidental find which is not included in the formal carcass search results. Such finds are however considered in implementing impact trigger responses described in section 8.

5.2.3. Carcass detection protocol

If a carcass is detected (a 'find') the following variables will be recorded in the carcass search data sheet (see Appendix 2):

- GPS position, distance in metres and compass bearing of the carcass from the wind turbine tower;
- The carcass will be photographed where it is found, before it is moved or handled;
- Substrate and vegetation under the carcass will be recorded, 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; and
- Weather (including recent extreme weather events, if any), visibility, maintenance to the turbine and any other factors that may affect carcass discovery.

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

- The carcass will be removed from the site to avoid re-counting;
- The carcass will be handled by personnel wearing rubber gloves, packed into a plastic bag, wrapped in newspaper and put into a second plastic bag;
- The carcass will be clearly labelled to ensure that its origin can be traced at a later date, if required; and
- The carcass will be transferred to a freezer at the site office for storage so a second opinion on the species identity may be sought, if necessary, and for use in scavenger and/or detectability trials.

Any native bird or bat strike will be reported to the responsible authority and to DELWP – Environmental Portfolio within seven days of it being detected, except where required in section 8.

All bird and bat carcasses (not used for scavenger trials) found beneath turbines during searches and incidental finds will be retained (frozen) by the wind farm operator for at least 12 months and dealt with in accordance with wildlife permit permissions. Any carcasses not required for searcher efficiency and scavenger trials will be offered to DELWP prior to disposal.

It will be necessary for the wind farm operator to obtain a permit from DELWP under the state *Wildlife Act 1975* to handle and keep native wildlife (even dead wildlife) as part of the monitoring program. An application for this permit will be submitted in a timely manner to ensure approval has been obtained prior to commissioning of the turbines by the proponent.

5.2.4. Scavenger Trials

Estimates of carcass removal by scavengers (expressed as the average carcass duration) are used to correct for the fact that scavenging reduces the number of detected bird and bat

carcasses under wind turbines. It is necessary to conduct scavenger trials to estimate the length of time bird and bat carcasses remain detectable before being scavenged. Two scavenger trials will be conducted, one when vegetative ground cover is high and lush (September/October), and one when vegetative ground cover is low (March/April).

One set of scavenger trials (two seasons) will be conducted in the first two years of operation of the wind farm. To determine the scavenge rates on birds and bats, the following categories of carcass will be used. These are:

- Category 1 – Microbats/small birds;
- Category 2 – Medium/large birds; and
- Category 3 –Equivalents to the Brolga (e.g. turkeys);

A procedure for the scavenger trials is provided below.

- The trials will be conducted at ten randomly-selected impact sites.
- At each trial site, at least one carcass will be placed randomly within the inner search radius area around the turbine.
- A mix of small, medium/ large native birds (collected during carcass searches and from road-sides) and some bat carcasses (if available) will be obtained for use in the scavenger trial (see Table 7). In the absence of available native carcasses, substitutes of similar size and colour may be used such as quail and mouse carcasses. Ten carcasses will be used in each size category over the two seasons.
- An initial trial of the scavenging rate for ten turkey carcasses will be undertaken in the first month of wind farm operations to determine how long large carcasses remain *in situ*. It is not considered that cleared turkey carcasses (the only readily available large bird carcass) are representative of the Brolga. It is more likely that large wild birds like the Brolga will persist and not be scavenged by removal from the site.[1]
- Carcasses used in the trial 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 evidence remaining at sites where trial carcasses have been scavenged (e.g. scavenger scats, bones, feather[s], animal parts and type of scavenging, if visible, such as tearing, pecking, complete removal of carcass, partial removal of carcass, bird or mammal predator evidence).
- Notes will be taken on the daily state of remaining carcasses.
- Latex gloves will be worn at all times while handling carcasses to minimise contact with human scent, which may alter predator responses around carrion and to minimise disease risk to the handler.
- The mean persistence of carcasses before scavenging will be calculated and a correction factor developed accordingly, including an estimate of error.
- Scavenger trials will be conducted in two different seasons during the first two years of monitoring.

[1] Trials by BL&A at two sites (one in Victoria and on ine NSW) using ten Wedge-tailed Eagle carcases each (n = 20), showed that all but one persisted on the ground (in a gradually deteriorating state) and was visually detectable for at least one month.

Table 7: Scavenger/efficiency trials given two factors of size and visibility (spring and autumn)

	Micro-bat /small bird	Medium/large	Brolga equivalent
Long grass (spring)	10 carcasses	10 carcasses	10 carcasses
Short grass (autumn)	10 carcasses	10 carcasses	10 carcasses

The statistical context for the proposed carcass numbers is provided in the statistical appendix (see Appendix 2).

Each of the carcasses will be checked daily for the first five days, then every second day for the next six days and then every three days until they disappear or at 30 days (see Table 8).

In addition, ten of the carcasses will be monitored using automatic cameras, which will detect and time-stamp the activity of scavengers. After two years, the results from this will be compared with the results of visual monitoring of the remaining 10 carcasses to see if the presence of the camera, potentially acting as a perch for visual scavengers in particular, might bias the scavenging rate estimate.

Table 8: Scavenger trial search timetable

Day
Day 1
Day 2
Day 3
Day 4
Day 5
Day 7
Day 9
Day 11
Day 14
Day 17
Day 20
Day 23
Day 26
Day 29
Day 30

5.2.5. Searcher efficiency trial

Searcher efficiency trials will be conducted concurrently with scavenger trials. Carcasses placed under turbines for scavenger trials will be used for efficiency trials. This is due to the difficulty of obtaining sufficient carcasses for trials.

The efficiency trial will enable an estimate of the percentage of carcasses found by searchers. Data collected at other wind farms indicates that the detection of bats is very similar to that of small birds (Johnson *et al*. 2003).

The procedure for the searcher efficiency trial is presented below.

- Personnel conducting searches will not know the location of carcasses until after the searcher efficiency trial (i.e. the trail will be 'blind') but the GPS coordinates of carcasses will have been recorded so that the observer(s) can later be shown the carcass for the scavenger trial.

- Personnel conducting searches are to apply the same search method as intended for normal carcass searches.
- A total of 20 carcasses plus 10 Brolga equivalent visual models (Table 7) will be used during each efficiency trials.
- Carcasses will be placed in search areas before the observer's first search but on the same day, thereby minimising the chances of a carcass being removed by a scavenger before the searcher can find it (see section 5.2.4).
- Carcasses will have their GPS coordinates recorded to avoid the possibility of being counted in subsequent carcass searches or incidental collections.
- Any substitute carcasses for these trials will be of both similar size, colouration and form to the species being represented or species of concern (i.e. brown mice rather than birds should be substituted for bats as birds do not have the same body shape, colour and texture).
- The mean proportion of placed carcasses found by searchers will be calculated and a correction factor derived.

In addition to the procedure described above, the efficacy of six-metre spaced search transects for bats will be tested by searching the inner zone at both four-metre and six-metre search transect spacings. Under turbines where bats or mice are placed, two observers will undertake searches, half of the searches by the same person will be at six metre spacing and half at four metre spacing (i.e. at each such turbine, one observer will search using the four metre spacing and the other will do so using the six metre spacing, with both observers using each spacing on each half of their searches). If a scent dog is to be used for carcass searches, no such trial will be required.

All data will be analyzed to provide a report on the findings of the carcass searches combined with scavenger data and trained observer trials. The seasonal and annual mortality (if possible) of each size group detected will be calculated.

An additional searcher efficiency trial will be undertaken as described in Section 7.2 for the Brolga (using the Category 3 carcasses described in Section 5.2.4) as part of a trial to ascertain the effectiveness of a number of search methods.

5.2.6. Using scavenge and detectability rate to estimate mortality rate

Information from Symbolix (statistical analysts):

Scavenger trial data is collected by placing carcasses in the field and checking, at specified intervals, if they are lost to scavenge. At Dundonnell each trial will use 10 small, medium and large carcasses to reflect the range of sizes in the vicinity. The time to scavenge (and its relevant confidence interval) is estimated using Survival Analysis techniques (Kaplan & Meier, 1958). This follows current best practice (see for example the review article Huso et al 2017).

To account for different size classes, we test for statistical significance using generalised linear modelling (implemented using the R package `survival`) which ensures that the overall scavenger rate reflects the different size classes (or allows us to use separate rates for each if separate mortality estimate is required for each class).

The mortality estimate itself is implemented using a monte-carlo simulation, which simulates a range of potential mortalities and the known survey protocol to generate the distribution of

actual mortalities that could have resulted in the number of mortalities found in the field (Stark et al, in press).

One of the inputs of this model is the mean and confidence interval of the time to scavenge. It is common to estimate birds and bats separately as there is often a clear significant difference in the scavenger and detection rates between the two. On most sites, there is not enough detected carcasses to justify estimating different size bird classes separately so a combined scavenger rate is used. If the carcass list is dominated by a particular size class and there is a significant difference between the loss rates of size classes, we can choose the detection and scavenger rate that best represents the cohort. In practice, this has rarely been necessary.

5.2.7. Incidental Carcass Protocol

Personnel operating the Dundonnell Wind Farm may occasionally find carcasses within the wind farm site. In this case, the person concerned will respond in the way described below.

Over the operational life of the wind farm, the site manager will immediately be informed and, for each carcass, will:

- Photograph the carcass where it is found and record all details on the Bird and Bat Carcass sheet (Appendix 2).
- Complete the carcass record sheet prior to removing the carcass.
- Wear protective latex or rubber gloves to remove or mark the carcass once details have been recorded to avoid recounting (if within 250m of a turbine it must be removed). Only dispose of carcass if the species can be readily identified. If the species cannot be readily identified, then the carcass must be placed in a sealed plastic bag or appropriate container and clearly labelled before storing in the on-site dedicated freezer so that it can be preserved until it is identified by a suitably qualified expert and for use in scavenger and/or detectability trials;
- Before disposal, carcasses will be made available to DELWP staff if not required to be provided to any other institution.
- All alive, but injured wildlife, must be transported to the nearest veterinary clinic (see section 5.2.7).

Landholders at Dundonnell Wind Farm should also be included in incidental carcass protocol. Where willing to participate, upon a landholder detecting a bird or bat carcass on the wind farm they should report this to wind farm staff who can then follow the protocol outlined above.

Any native bird or bat strike will be reported to the responsible authority and to DELWP – Environmental Portfolio within seven days of it being detected.

All bird and bat carcasses (not used for experimental trials) found beneath turbines during searches, as well as incidental finds, will be retained (frozen) for at least 12 months and dealt with in accordance with wildlife permit permissions.

5.2.8. Injured Bird and Bat Protocol

All on-site staff and monitoring personnel will be advised of the correct procedure for assisting injured wildlife. Wind farm personnel who find injured wildlife will be required to report the find to the wind farm site manager, who will be required to place the animal immediately into

a dark place (e.g. box or cloth bag, if safe to do so) for transfer to the nearest wildlife carer or veterinarian.

If raptors, such as Wedge-tailed Eagles are being handled, heavy bricklayer's gloves should be worn and the bird grasped above the talons to avoid injury to the handler. Strong eye protection should also be worn if larger birds, particularly long-necked waterbirds, are being handled.

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

- Mortlake Veterinary Centre, 72 Dunlop St, Mortlake, (03) 5599 2612
- Para-tech Veterinary Services, 76 Hucker Rd, Wickliffe, (03) 5350 3252
- Wildlife Victoria, 1300 094 535

If these services are unavailable in the future, alternatives will be identified, as required.

This protocol is valid for the operational life of the wind farm.

5.2.9. Analysis of results and mortality estimation

The results of the mortality monitoring surveys will be analysed to provide information on:

- The species, number, age and sex (if possible) of birds and bats found under turbines;
- Any seasonal or yearly variation in the number of bird and bat strikes;
- After two years and five years, an estimate of the annual number of birds and bats that collide with wind turbines;

The results will be detailed in the relevant annual reports and will provide a basis for identifying if further, detailed investigations or mitigation measures are required.

Modern, statistically robust projections of bird and bat mortality for the entire wind farm site will be presented, based on the data collected from mortality 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 current program is designed to provide an acceptably accurate and precise estimate of wind farm related bird and bat mortality within two years, so a full analysis and estimate will be provided in the second annual report, together with recommendations on the scope of future monitoring.

All data will be analysed to provide the average estimated mortality of birds and bats, their standard error (variability) and ranges for the Dundonnell Wind Farm. The seasonal and annual mortality of each species (if estimates of individual species are possible) and size class detected will be calculated, where sufficient carcasses were detected for a statistically robust estimate. If possible, the standard error and range of these estimates will be reported.

The estimated mortality rate will be generated by modelling the scavenger losses and results of the observer efficiency trials. 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 (see, for example, KaPlan & Meier (1958)). In addition to providing mortality estimates, this analysis will determine if any of the factors (i.e. size class or habitat at turbine sites) are significant.

It is difficult to provide the actual format (e.g. fatalities/turbine/year) of the results, in this BAM Plan, as it is subject to the results of the experimental trials and the variability of the data. As the results cannot be predicted (no pilot studies are available), results will be reported in a way that gives as much information as possible but with an accurate interpretation of the data. As stated above, it will be possible to provide the number, average (with attendant standard error) and other basic statistics of recorded fatalities per study population for the sampling time/effort. All species carcass data will be analysed and presented, where possible, with species-specific information.

5.3. Routine Reporting and Review Meetings

5.3.1. Regular reporting

Annual reports will be submitted to DELWP. Matters to be addressed in the report include, but will not be limited to:

- A description of the BAM Plan activities undertaken during the reporting year;
- A summary of search methodologies and searches undertaken;
- Details and results of the carcass searches including incidental bird and bat carcass finds;
- Determination of collision morality rates and comparison with the expected mortality rate (Brolga);
- A comparison of pre- and post-construction bird and bat utilisation surveys and consideration of any impacts from the construction and operation of the wind farm;
- The results of species-specific monitoring during the operation of the wind farm, i.e. monthly monitoring of Wedge-tailed Eagle flight movements and breeding activity, Peregrine Falcon breeding activity within Mt Fyans Wildlife Reserve (August to December) and Brolga breeding and flocking monitoring.
- Any identified impact triggers and/or recommended updates to the BAM Plan risk assessment.
- Any recommended changes to search effort based on the results of the surveys.

5.3.2. First five years of reporting

An annual report will be prepared within three months of the completion of each year of the five years of operational phase monitoring. Each annual report will focus on presenting the results of the mortality searches and incidental carcass observations, and documenting any impact triggers and associated adaptive management (section 8). All annual reports will address the matters listed in the project's Planning Permit condition (specifically condition 53).

The second annual report will present the first full analysis of all data collected. Matters to be addressed in this full report include, but will not be limited to:

- 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 (number impacted per turbine per year) based on statistical analysis;
- Seasonal and annual variation in the number and composition of bird and bat strikes, where detectable;
- Any other mortality recorded on site but not during designated carcass searches (i.e. incidental records by site personnel);
- Identification of any unacceptable impacts or impact triggers, and application of the decision-making framework and relevant adaptive management measures.
- A summary of livestock carcass removal for the purposes of predator reduction;
- Details of any landowner feral animal control programs and their timing;
- A discussion of the results, including:
    - Whether indirect impacts on bird and bat use of the site are of significance at a regional, state or national level, or if species of concern have been affected.
    - Bird risk reduction measures.
    - Any further recommendations for reducing mortality, if necessary.
    - Whether the level of mortality was unacceptable for affected listed ('at risk') species of birds or bats.
    - Usage of the wind farm area by 'at risk' species and factors influencing this (i.e. climatic, geographical and infrastructure).
    - Analysis of the effectiveness of the decision-making framework.
    - Recommendations for further monitoring.

Once available, this report will be discussed at a review meeting with the Program Manager Regional Planning DELWP (or their delegate), and the Responsible Authority. The results of the carcass searches (including the scavenger and observer efficiency trials) will be reviewed and refinements to the monitoring program will be evaluated and refined, based on discussion with DELWP.

Following DELWP – Environment Portfolio's review and acceptance of the reporting the report will be made publicly available on the project website.

All annual reports will address all requirements of planning permit condition 53 and be sent to bsw.planning@delwp.vic.gov.au.

6. MITIGATION MEASURES TO REDUCE RISK

Mitigation involves the prevention, avoidance and/or minimisation of the adverse impacts on birds and bats. Mitigation is undertaken as part of a response to an impact trigger (defined in Section 8 as a threshold of impact on birds or bats that triggers an investigation and/or management response) occurring or continuing to occur. While the wind farm is considered to present a mostly negligible to low risk to birds (moderate for WTE) and bats, proactive mitigation measures will be implemented to minimise bird and bat collision with wind turbines and to address any specific project approval conditions.

This section outlines current mitigation commitments that are known to reduce the attractiveness of wind farm sites to some 'at risk' birds.

Further mitigation measures are explored in Section 8.3 that may be implemented in response to a particular impact occurring.

6.1. Carrion removal

Regular carrion removal from within 250 metres of turbines will be implemented to assist in reducing the attractiveness of the site to raptors and therefore reduce the chances of fatal collisions by this group of birds. Carrion is defined as the dead and decaying flesh of an animal that often serves as a food source for animals.

To provide for the regular removal of carcasses likely to attract raptors to areas near turbines the procedures below will be adopted.

- Site personnel shall notify the Site Manager immediately of any identified carrion within 250 metres of an operating turbine.
- Designate a suitable person (such as a wind farm employee or landowner) to perform the function of Carrion Removal Coordinator who will undertake the following activities:
    - Ongoing inspections of the wind farm site to search for any stock, introduced or native mammal and bird carcasses that may attract raptors (e.g. kangaroos, foxes, rabbits, dead stock). This search will be undertaken via vehicle and using binoculars to look for large carcasses within 250 metres of each turbine.
    - The Site Manager is responsible for notifying the landowner so that any carcasses and/or remains found that are within 250 metres of turbines, can be collected and disposed of as soon as possible, in a manner that will avoid attracting raptors close to turbines.
    - The Site Manager shall continue to consult with landowners in relation to the appropriate disposal of collected carrion, to be located at least 250 metres away from the closest turbine.
    - Carcass occurrence and removal will be recorded by the Site Manager.
- If a large number of rabbit carcasses are incidentally observed during pre- or post-construction monitoring surveys, it may be necessary to conduct an integrated rabbit control program within 250 metres of turbines. Methods to control rabbits include burrow destruction, poisoning and shooting (DPI 2014). Any rabbit control program will require agreement from the landowner.
- An annual summary of carcass removal, based on records will be provided in the annual monitoring reports.

6.2. 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 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 structure (Gauthreaux and Belser 2006). They would appear prone to saturation of their retinas, causing temporary blindness when subjected to bright light (Beier 2006) and mortality of both birds and bats can result from collisions with lit structures. Birds can also become disoriented or 'trapped' in the field of light (Longcore *et al.* 2008).

Bats are also 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 other recent research on gas drilling rigs at sea suggests that blue or green lights may result in lower mortality than red or white lights (Poot et al. 2008).

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.

7. BROLGA MONITORING PROGRAM

This section of the plan provides a program for monitoring the occurrence of and impacts of the wind farm on the state threatened Brolga (*Grus rubicundus*). This program addresses the requirements of project planning permit condition 55 (a). This permit condition required the proponent to:

- Identify the location of potentially 'at risk' Brolga breeding, migrating and flocking activities; and
- Define a mortality rate for the Brolga that would trigger responsive management measures.

This program involves a combination of field observations of Brolga activity on and around the wind farm and monitoring for Brolga carcasses under turbines. These components of the program are described separately below.

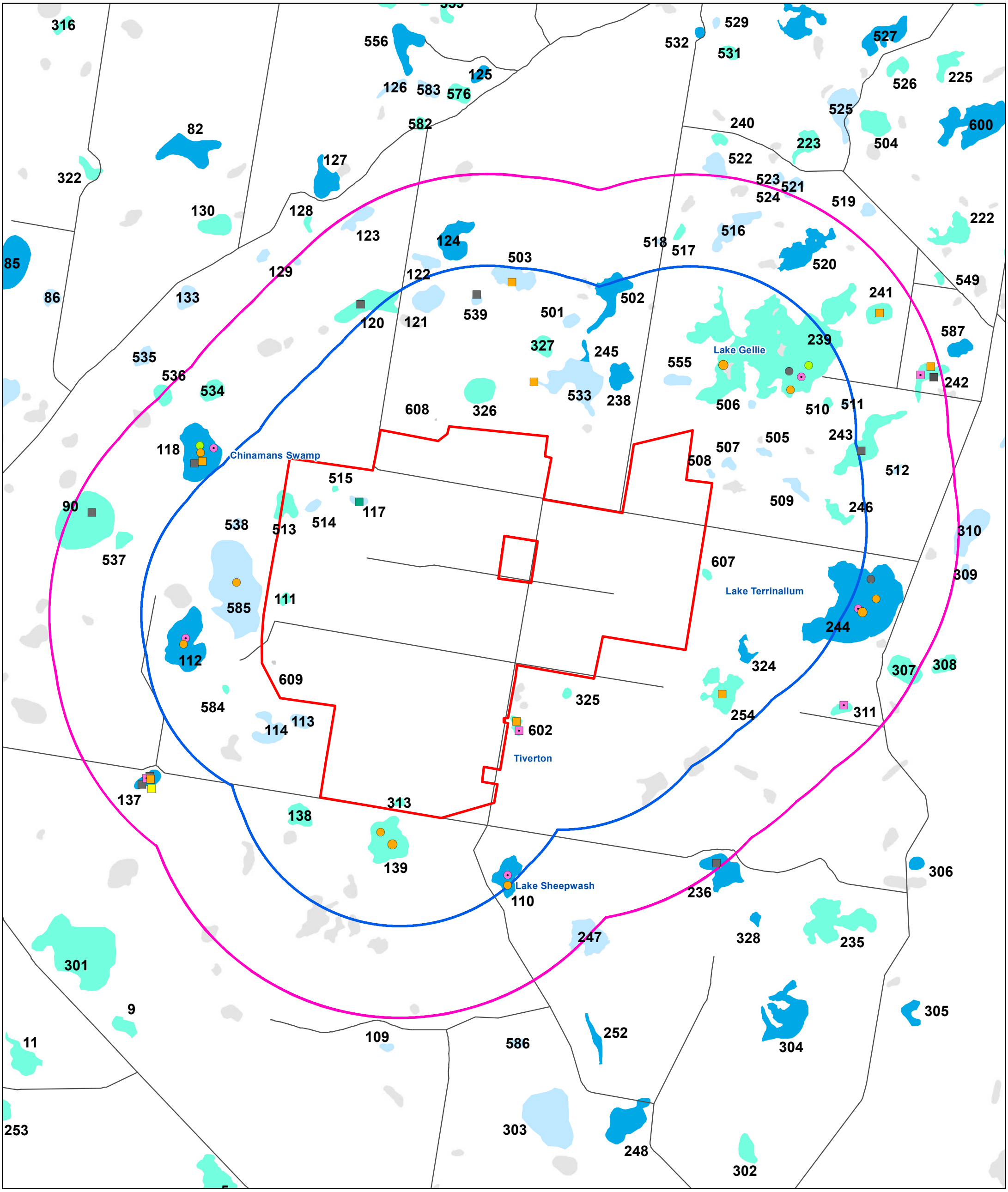
7.1. Monitoring Brolga behaviour

Brolga activity changes seasonally. From July to December, Brolgas occur on smaller, ephemeral wetlands and breed as territorial pairs. From January to June, pairs and young birds move to larger, permanent wetlands where they form large flocks (between five and 250 birds) to roost at night, moving out from these flocking roost sites into the surrounding countryside to forage on wetlands and crops and, less frequently, pasture. Movements between breeding and flocking sites and between flocking sites can occur for over 100 kilometres over a period of several days (I. Veltheim, pers. comm.).

DSE's (2012) *Interim Guidelines for the assessment, avoidance, mitigation and offsetting of wind farm impacts on the Victorian Brolga population* indicate that there is a possibility of Brolga interactions with turbines where Brolgas flock within five kilometres of wind farms and when they breed within 3.2 kilometres of wind farms. Monitoring 'at risk' Brolgas therefore involves visiting known and potential flocking habitats within five kilometres of the wind farm during the flocking season (January to June) and known and potential breeding habitats within 3.2 kilometres of the wind farm (July to December). Habitats that are potentially suitable have been mapped in BL&A (2015) – see Figure 3. Suitable habitats (both intact wetlands that have not been permanently drained and known historical flocking and breeding sites) will be searched once per month within five kilometres of the wind farm in the flocking season and within 3.2 kilometres of the wind farm in the breeding season. Any landholder or other records of flocking outside the usual flocking season will also trigger a survey requirement out to 5 kilometres from the wind farm.

If breeding (two Brolgas engaged in breeding activities at a nesting site) or flocking Brolgas are detected, this will trigger four days of continuous daylight observations of movement patterns, in which the following information will be recorded:

- Time of beginning and end of observation period;
- Weather conditions;
- Number of Brolgas using the habitat;
- Behaviour of birds (e.g. foraging, resting, displaying, etc.);
- Observed flights, including start and end times, as well as flight path (mapped), height (including range), interaction with turbines and habitat and activity at destination (where observable); and
- Interactions with other sites and Brolgas.



Legend

- Wind Farm Boundary
- 5km WTG buffer
- 3.2km WTG buffer
- Roads

Wetland Quality (2011)

- High
- Low
- Moderate
- Not accessible

VBA

- Traditional Flocking
- Breeding

DSE Unpublished 2010

- Traditional Flocking
- Breeding

Sheldon

- Traditional Flocking

Landowner

- Traditional Flocking
- Breeding

BL&A 2009-2015 Investigations

- Traditional Flocking
- Breeding

BL&A 2007-2008 Investigations

- Breeding

I. Veltheim 2010

- Breeding

Birdlife

- Breeding

Kilometers
0 1 2 4

N

APPROVED FOR THE MINISTER FOR PLANNING

SHEET 44 OF 70

Figure 3: Historical Brolga records

Project: Dundonnell Wind Farm

Client: Dundonnell Wind Farm Pty Ltd

Project No.: 9184	Date: 16/10/2018	Created By: M. Ghasemi

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www.ecologicalresearch.com.au

Should breeding activity be detected within 3.2 kilometres of the wind farm then two-day, fortnightly observations will ensue to collect the following information:

- Observations of breeding behaviour; and
- The number of young successfully fledged.

These data will be included in the annual reporting to DELWP. Any observed adverse outcome of turbine interactions (collision, death, injury) will be described in detail and reported within two business days to DEWLP's regional manager, consistent with the impact trigger and reporting requirements in section 8 of this plan.

7.2. Monitoring Brolga mortality

The Brolga is a large, conspicuous bird. Should one collide with a turbine the carcass will be very visible, except perhaps during the late breeding season when grass height could obscure a carcass. Given this, it is proposed to undertaken a visual inspection of a zone within 120 metres of every turbine on the wind farm each month. This will be done on foot or on an ATV or by using a trained search dog across the same search area as other monitoring, namely 120 metres, but at 12-metre transect spacing given the detectability of Brolga. Note that where formal carcass searches are undertaken on the sub-set of randomly selected formal carcass search turbines this search need not be repeated. From year 6, the agreed Brolga search method will then apply to all turbines.

During the searcher efficiency trials for this BAM Plan, large carcasses that resemble the Brolga or carcass surrogates that visually resemble the Brolga (e.g. foam models) will be placed randomly under the selected trial turbines. In addition, an equivalent number of massed grey feathers (resembling feather spots from a Brolga) will also be placed under these turbines.

All visual search methods described above (i.e. excluding the search dogs, which search by scent) will be tested for their effect on detectability. A total of 10 such 'carcasses' will be deployed and ten 'feather spots'. These will be different from the scavenger efficiency trial large carcasses described in section 5.2.4. The formal BAM search method, the 12-metre walked transect and the 12 metre ATV transect will be tested for differences in detectability. Four different searchers will be compared (two qualified ecologists experienced in formal carcass searches and two wind farm personnel who could be engaged to undertake the searches under the supervision of a qualified ecologist). Once the trial is completed the results will be presented to DELWP and a decision made on the most effective search method to detect Brolga casualties for the balance of the project life.

The monthly Brolga searches of each turbine in the wind farm will be undertaken for the life of the project under the supervision of a qualified ecologist.

The search path (walking, ATV or search dog) for each search area will be recorded by GPS, archived and provided as an electronic file to DELWP to accompany each annual report.

Results from BL&A's monitoring at a number of wind farms show that large bird carcasses (e.g. Wedge-tailed Eagle) last at least a month in almost all cases and are readily detected. (BL&A unpubl. data). This is based on two carcass duration trials with ten eagles each at a site in Victoria and another in New South Wales. Brolgas are expected to have a similar carcass duration and, as they are pale in colour, higher visual detectability. Therefore, monthly visual inspection of search areas is considered adequate for detecting Brolga carcasses under wind turbines.

The collision risk modelling of the revised layout and worst case turbine specifications (166m blade diameter) undertaken by BL&A (2017) indicated that at 90% avoidance, 24 Brolgas may be affected, at 95% avoidance rate, 12-13 birds and at 99% avoidance, 2-3 birds. These impacts are summarised below for the 95% avoidance rate in Table 9. This rate is in the middle range of estimates (i.e. between 90 and 99 percent avoidance). By setting the trigger for revisiting wind farm Brolga impacts and offsetting at this middle level, any possibility that impacts are exceeding the approved level is more likely to be detected earlier.

Table 9: Modelled Brolga collision risk for the Dundonnell Wind Farm (Source: Symbolix 2017)

	Permitted layout 88WTG, 142m Rotor diameter	Revised layout 88WTG, 166m Rotor diameter
Average annual collision rate (95% avoidance)	**0.36**	**0.49**
After one year	0 – 2	0 – 2
After 10 years	0 – 7	1 – 9
After 25 years	4 – 13	7 – 18

Should monitoring find that the project Brolga impacts exceed the approved rate of mortality that is being offset through the Brolga Compensation Plan (see BL&A 2018) then additional offsetting would be required through an increase in the target number of fledged young birds produced in the Brolga Compensation Plan. This amendment would be dealt with through the consultative group established under that plan and would require the approval of the Responsible Authority.

8. IMPACT TRIGGERS AND DECISION-MAKING FRAMEWORK

This section provides a framework for responding to detected impacts on birds and bats of concern. It describes 'impact triggers' for both threatened and non-threatened birds and bats that require notification, further investigation and additional mitigation ('impact triggers'). If an impact trigger event occurs, there must be an investigation into the cause of the impact, and whether the event was likely to be a one-off occurrence or a regular event.

The impact trigger may be an unacceptable impact in itself or may indicate the potential for an unacceptable impact.

Note that the approach developed in this section is based on the preparation of numerous bird and bat monitoring programs in both NSW and Victoria, and up-to-date feedback from regulators on the implementation of approved Plans.

8.1. Threatened Species

8.1.1. Definition of impact trigger

Generally, an impact trigger is where there is evidence of death or injury to birds and/or bats by collision or other interaction with turbines. Under this program, the circumstances that define an impact trigger for threatened birds and/or bats are detailed below.

Impact trigger for threatened species: A threatened bird/bat species (or recognisable parts thereof) listed under the EPBC Act, FFG Act (including Brolga) or on the *Advisory List of Threatened Vertebrate Fauna in Victoria 2013* (DSE 2013) is found dead or injured under or close to a wind turbine during any mortality search or incidentally by wind farm personnel.

8.1.2. Decision-making framework

If a threatened species impact trigger event occurs, further investigation will immediately be required and the decision-making framework outlined below and in Figure 4 will be followed.

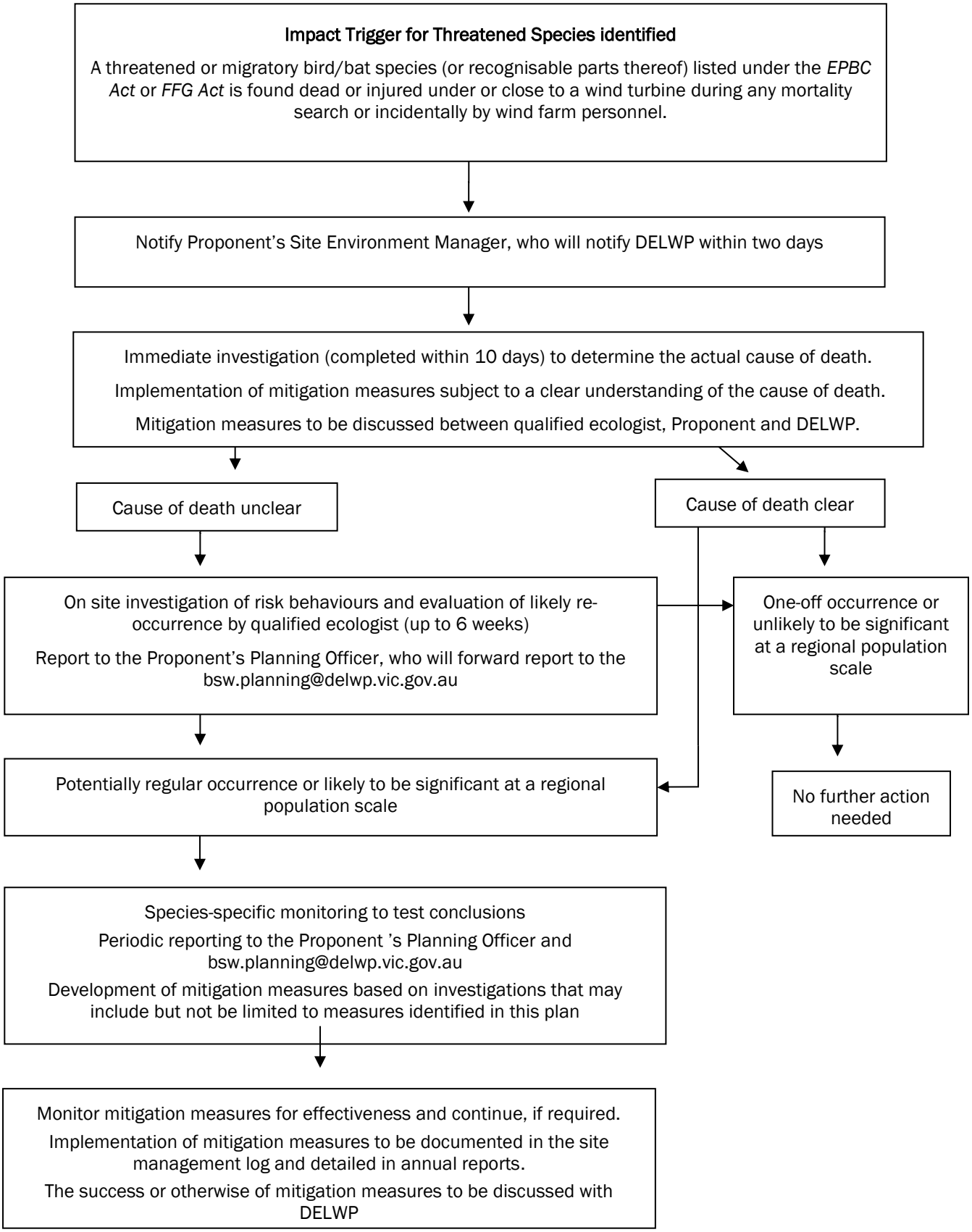
- Immediate reporting of the occurrence of an impact trigger to the proponent's Site Environment Manager, who will report it to the relevant statutory Planner at DELWP within two business days of it being recorded.
- Immediate investigation by an appropriately qualified ecologist to determine the cause of death or injury (in the unlikely event that the animal was, for example, shot). If the cause of death is due to turbine collision, an investigation will be undertaken to identify any particular risk behaviours that could have led to the collision and an evaluation of the likelihood of further occurrences. The impact trigger may be one-off or a cluster of events.
- The rapid investigation will assess the most effective mitigation and will ensure that the mitigation is implemented correctly and quickly, if possible, subject to a clear understanding of the cause of the impact.
- If the fatality is deemed to be a one-off occurrence or the ongoing risk is unlikely to be significant at a population scale, further action is not considered necessary. This decision will be made in consultation with DELWP and will be determined based on available evidence and using a precautionary approach.
- If the cause of the impact trigger is not clear, further onsite investigation of risk behaviours and evaluation of likely re-occurrence will be required over the following weeks (up to six weeks). If these investigations suggest that the impact trigger was a one-off event or the ongoing risk is unlikely to be significant at a population scale, no further action would be

necessary. This decision will be determined in consultation with DELWP, based on available evidence and using a precautionary approach.

- If the onsite investigation suggests that the impact trigger may be a regular occurrence, species-specific monitoring may be required as agreed with DELWP. During the monitoring period, periodic reports will be provided to the Proponent and DELWP.
- Responsive mitigation measures will be developed and implemented as needed and in a timely manner. Examples of mitigation measures may include but are not limited to those outlined in sections 6 and 8.3.

Any evaluation of impacts and decisions regarding mitigation measures and further investigations required will be undertaken in consultation with DELWP. Any required investigation, and recommended management and supplementary mitigation measures, will be documented in the site management log and detailed in annual reports. Documentation and records will be made available to DELWP upon request.

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



8.2. Non-threatened Species

8.2.1. Definition of impact trigger

The circumstances that define an impact trigger for non-threatened birds and/or bats under this BAM Plan are detailed below. Note that impacts on common farmland birds, including magpies, ravens and introduced bird species are not considered of conservation significance and are therefore not subject to adaptive mitigation and will not constitute an impact trigger.

Impact Trigger for Non-threatened Species: In any two successive monthly carcass searches, two or more bird or bat carcasses (or parts thereof) of a non-threatened species, other than ravens, magpies and introduced species, are found at the same turbine (i.e. a total of four or more carcasses of the same species in two successive searches at the same turbine).

Note that although the impact trigger does not include ravens, magpies or introduced species, detected mortalities for these species will still be recorded and reported as part of the annual reporting process.

8.2.2. Decision Making Framework

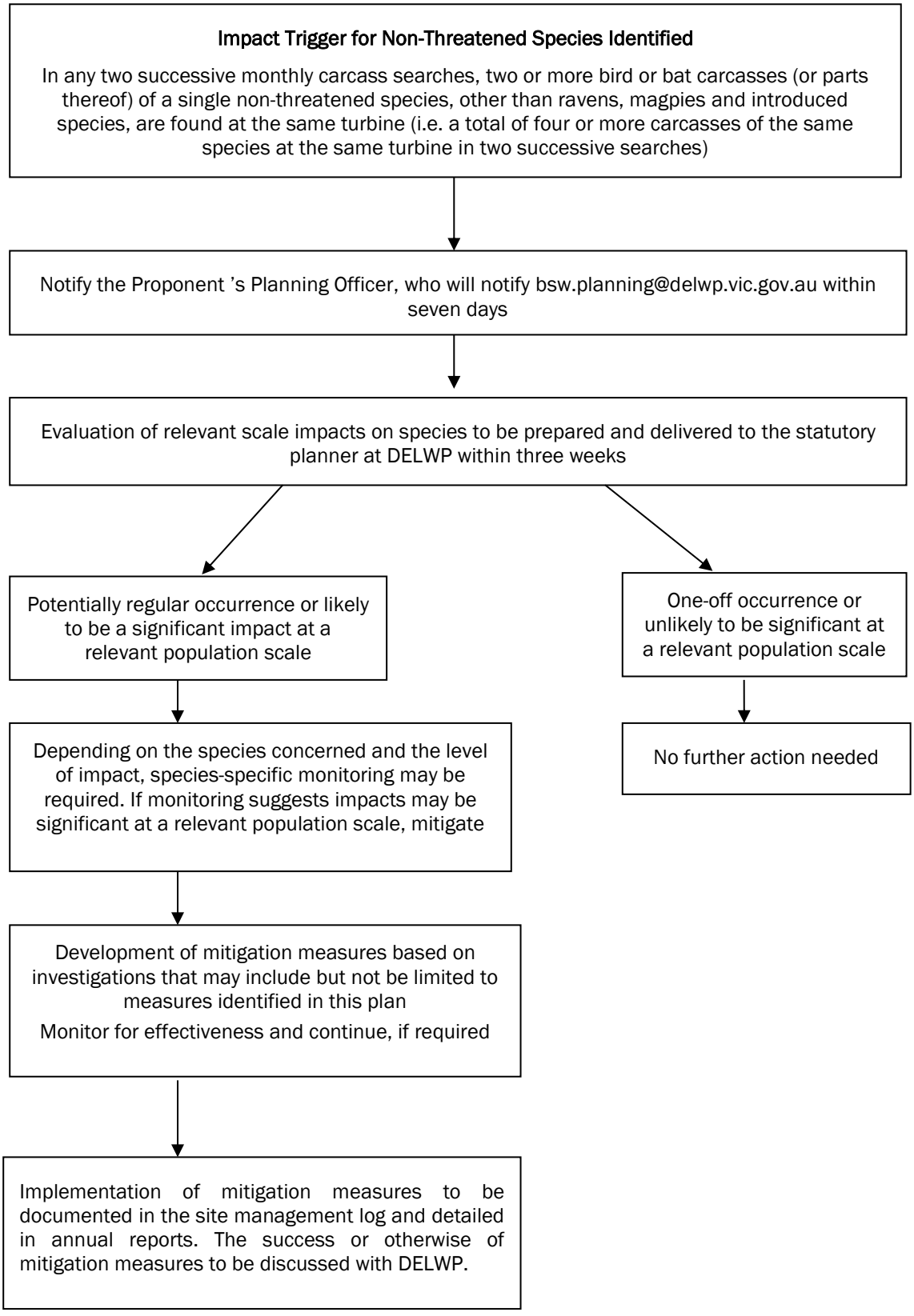
In the event that an impact trigger for non-threatened species is detected, an evaluation of impacts to the non-threatened species will be undertaken. DELWP will be notified of the impact trigger within seven days of recording the event. An appropriate scale to consider population effects of the impact trigger will be agreed between DELWP and the proponent on a case-by-case basis with consideration given to the species in question.

A report on the investigation will be delivered to the relevant statutory personnel at DELWP within three weeks. If the evaluation indicates that the event was a one-off occurrence or is unlikely to be an unacceptable impact at a relevant population scale 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 an unacceptable impact to the species in question, species-specific monitoring may be required (Figure 5). If further monitoring confirms that there is high potential for an unacceptable impact on the species, mitigation measures will be required. Potential mitigation measures are outlined in section 8.3, however specific mitigation measures will be determined based on the species involved and the outcome of investigations.

Any evaluation of impacts and decisions regarding mitigation measures and further investigations required will be undertaken in consultation with DELWP. Any required investigation, and recommended management and supplementary mitigation measures, will be documented in the site management logs and detailed in annual reports. This log will be available for inspection by DELWP.

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



8.3. Supplementary Mitigation Measures

Supplementary mitigation measures will be implemented in consultation with DELWP when an impact trigger requires them. The purpose of supplementary mitigation measures will be to prevent the impact from continuing to occur, if possible. Specific mitigation measures will be implemented depending on the nature, cause and significance of any impact recorded and in response to the results of targeted investigations of the event and of the species concerned on the wind farm site, as detailed in the preceding sub-sections.

It is difficult at this stage to know what issues may contribute to an unacceptable impact. Therefore, possible examples of impacts and potential mitigation measures specific to the impact trigger, and the time taken to implement these measures, are detailed in Table 10. Note that in implementing mitigation measures, a suite of measures that may or may not include those in Table 10 would need to be implemented, depending on the circumstances.

Although it is unknown what supplementary mitigation measures may be required in response to a particular situation, some hypothetical examples are provided in Table 10 below. These are examples of potential issues not considered to-date but describe useful and tested responses from other wind farms in addressing the issues.

The purpose of investigations will clearly be to identify the most relevant and effective mitigation measures that are appropriate.

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

Table 11 summarises specific management objectives, activities, timing and performance criteria for the implementation of this Plan. It can be used for monitoring and reporting on the implementation of this Plan.

Table 10: Supplementary mitigation measures in the event of an unacceptable impact trigger occurring

Hypothetical cause of impact	Possible Mitigation Measure[2]	Likelihood of impact continuing following mitigation	Time to implementation
Foraging source identified that attracts threatened species to impact areas	Use acoustics (i.e. loud music/irregular noise) to discourage birds from foraging in this location	Low	Implement as soon as possible and no later than two days after recording the impact.
	Encourage species into alternative areas outside of the wind farm boundary, where available, through the use of social attraction techniques offsite (decoys and audio playback systems)		
	Investigate and, if considered appropriate, remove foraging habitat from the wind farm site, subject to approval.		Before removal of foraging habitat is undertaken, alternative mitigation measures should prove to be ineffective in reducing collision risk to acceptable levels.
	Turbine curtailment		Immediately
Farming practice attracts threatened species to risky areas (e.g. grain feeding of stock)	Modify farming practice and remove attraction	Low	Immediately
Wind/rain/fog causing low visibility	Where low visibility is identified as an issue, carcass searches will be repeated during periods of low visibility to measure mortality rates.	Low	Immediately
Attraction to lights on the wind farm site	Avoid high intensity lighting within the wind farm site (e.g. use of light hoods) or switch off lighting temporarily while species is on or near the wind farm site. Alternative measures include: • Synchronise any flashing lights, • Use red rather than white or yellow lights, or • Remove lights	Low	If lights can be switched off, this should occur immediately. Alternative measures should be implemented no later than ten days after recording the impact trigger.
Attraction to small dams on site	Fill in dam and provide alternative stock watering arrangements	Low	Implement within ten days of recording the impact trigger, if possible.

[2] Note that the mitigation measures in this table are examples of what may be possible.

Table 11: Specific management objectives, activities, timing and performance criteria

Management objectives	Management activities and controls	Timing	Performance criteria for measuring success of methods	Responsibility
Baseline surveys	Obtaining post-construction bird and bat mortality data	Post-construction	• As needed based on results of the mortality monitoring – to be agreed with DELWP	Proponent Ecological Consultant
Mortality monitoring	27 turbines to be surveyed each month as specified in section 5.2.	Post-construction	• Post-construction mortality surveys undertaken monthly at 27 turbines for five years • Ongoing Brolga searches of each turbine undertaken each month • The monitoring methods will be reviewed after two years of monitoring ▪ The methods or need for further monitoring will be assessed after five years	Proponent Ecological and Statistical Consultants
	All turbines to be searched visually each month for Brolga carcasses. Trials to be implemented to ascertain the most effective, efficient method for detecting Brolga carcasses.	Post construction	• Monthly search reports documenting search effort • Trial of three alternative methods (see Section 7.2) • Agreement after two years on the final method • All Brolgas affected by the project detected and documented.	Proponent Ecological and Statistical Consultants
	Calculating annual mortality of birds and bats per turbine based on post-operational repetition of monitoring activities. Annual mortality estimates should be made after the second year of monitoring and should include correction factors from scavenger and detector efficiency trials	Post-construction – at the end of the second and fifth years of mortality monitoring	• Scavenger and detector efficiency trials undertaken • Estimates of mortality for birds and bats made after two years and five years of monitoring • Ongoing estimate of Brolga mortality made each year.	Proponent Ecological and Statistical Consultants
Annual Reports	Preparation of Annual Reports to be submitted to DELWP	Post-construction	• Annual reports 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 unacceptable impacts identified, mitigation measures implemented, application of the decision-making framework and recommendations for the following year	Proponent Ecological and Statistical Consultants
Farming mitigation measures to reduce risk	Carrion removal program - stock and kangaroo carcasses will be removed from within 250 metres of wind turbines on a monthly basis and disposed of	Post construction	• Carcasses removed • Activity recorded in management log book • Increase frequency of stock and kangaroo carcass removal and disposal if required	Proponent/ Operator
	Where landholder agreement can be obtained, stock will not be fed grain underneath turbines within 250 metres of wind turbines		• No increase in bird mortality due to grain underneath turbines	Proponent/ Participating landowners
Other mitigation measures to reduce risk	Pest control program - Implement rabbit control if the carrion removal program suggests rabbit carcasses are an issue	During construction and operation	• Monitor effectiveness of rabbit control and, where bird mortality is clearly related to rabbit numbers, increase the effectiveness of rabbit control	Proponent Pest control contractor
	Habitat improvement or protection to encourage animals to use habitats away from turbines		• Birds at risk attracted to areas where risk is reduced • Limited light spillage beyond operating areas.	Proponent/ Operator
	Baffle lights on buildings and sub-stations to avoid light spillage and visibility from above			
	Baffle security lighting to avoid light spillage and visibility from above			

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Appendix 1: Method for bird utilisation survey and map of survey points

Dundonnell Wind Farm – bird utilisation survey method

A Bird Utilisation Survey (BUS) was undertaken over five days between November 27th and December 4th, 2009. Best practice methods were used, which are consistent with the "Level One" bird risk assessment requirements of the Australian interim standards on bird risk assessment at wind farms (AusWEA 2005).

Initially, the survey recorded birds from 10 impact and two reference points; but later there was a significant reduction in the wind farm investigation area. The reduction in size resulted in only five impact sites remaining within the wind farm boundary (Figure 4–1). The main analysis of bird usage of the wind farm site has therefore been restricted to the current wind farm site (impact sites 1, 3, 4, 5 and 6).

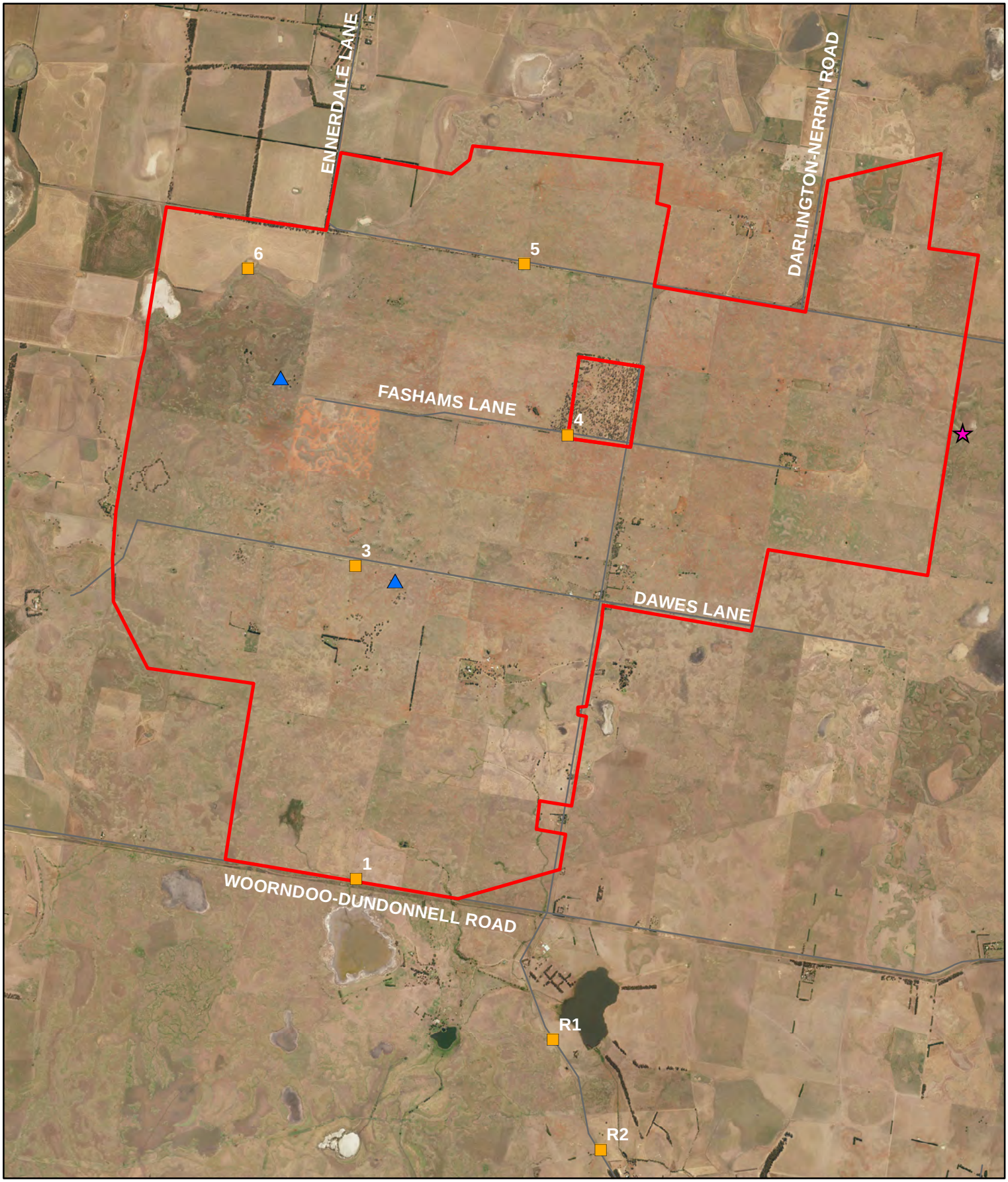
The two reference points remained as such, as they were not included in the later wind farm layout.

Where possible, survey points were evenly spaced across the wind farm site in areas where turbines were most likely to be placed and were located on elevated ground allowing a clear view of surrounding areas. The location of surveys is shown on the next page.

At each survey point an ornithologist recorded all bird species in a 200 metre radius for 15 minutes. Data recorded included species, number of individuals, distance from the centre point and flight height. Flight height was classified as:

- Below rotor swept area (RSA): 0–22 metres
- At RSA: 23–165 metres
- Above RSA: > 165 metres.

This was repeated ten times over the survey period. Survey times were randomised to allow for time-of-day differences in bird movements and activity. In addition to the observations during the BUS, incidental observations of waterbirds and raptors were recorded while travelling between survey points. Flight height was also recorded for these observations.



0 0.5 1 2 Kilometers

Legend

- Wind Farm Site
- BUS Points (R1 & R2 are reference points)

Wedge-tailed Eagle Nest

- Active
- Inactive

APPROVED FOR THE MINISTER FOR PLANNING

SHEET 60 OF 70

Figure 4-1: Bird observation points

Project: Dundonnell Wind Farm

Client: TrustPower Pty Ltd

Project No.: 9184	Date: 24/06/2014	Created by: B. Lane / M. Ghasemi

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Appendix 2: Statistical Appendix

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To: Annabelle Stewart
Brett Lane & Associates
via email

Ref #: BLAMERCL20120612
Date: 12th June, 2012
CC: Brett Lane

Re: **On generating Mortality estimates in Australia/New Zealand**

Dear Annabelle,

In response to recent conversations about mortality searches in Australia we have compiled the following overview of mortality estimation for wind farms. This letter outlines the background information that has guided our recent advice. This information forms part of our ongoing research in the field and is currently under preparation as part of a journal paper.

We note that mortality searches and estimation is an area of ongoing research. As such our advice is guided by a combination of statistical tests, current best practice, and practices on-ground at other Australian wind farms (as this increases the ability to compare sites in future).

Estimating mortality

Simply put, all approximations amount to accounting for the area surveyed (as a proportion of the area of concern) and accounting for the probability of detection, which consists of the searcher efficiency confounded with the probability of sample loss.

Attesting to the speed of output and effort of exploration in this space, there are multiple approaches to choose from and no clear supreme option. As a starting list, one might use: raw detection count, simple probabilistic scaling, Johnson et al. 2003, Kerns & Kerlinger 2004, Schoenfeld 2004 , Jain et al. 2007, Baerwald and Barclay 2009, Huso 2010 through to Korner-Nievergelt et al. 2011.

The amount of effort that has gone into these methods should be acknowledged, and not taken lightly. However, there remain issues, and application to local wind farms should be done with knowledge, care, and an adaptive attitude that allows later techniques to be applied.

Sampling effort – sampling fraction

This is the simple question of how many wind turbine generators (WTGs) to include in the sample. We do not specify a set fraction, as sampling fraction corrections are a staple of any mathematician, with history of application and correction extending well into last century (See for example Kish 1965 for an excellent overview). Issues such as stratification, clustering and sampling methods are all well established.

Best here is a logistic choice, being the most WTGs that can be consistently and meaningfully surveyed. Stratification considerations need also be applied, with the barest minimum being two WTG's per stratum (under a specific paired design), with a realistic preference for a minimum of 6 randomly selected WTGs per stratum to adequately capture variation.

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Sampling to optimise mortality estimation

It is common to come across complicated arguments for stratification and large surveying efforts when what is really desired is coverage, i.e. a sample that captures the background variability. Mortality sampling should be unbiased, and have coverage. This is again, a problem that is not unique to wind farms, and has simple, well-heeled solutions that do not contribute to the issues of mortality monitoring.

Our recommendations for carcass searches are simply based on published research of how far a carcass might fall from a given turbine (Hull & Muir 2010). The pulsed survey timing (one month for all species with a second survey 2-3 days later for small, readily scavenged species) is an attempt to reduce bias in mortality estimation due to scavenge rates much smaller than time between searches.

Detectability and scavenge loss

The two main contributors to a mortality estimate (regardless of the method used) are the detector efficiency and the sample loss rate due to scavengers. To determine these two parameters, one should be aware of the statistical difference between power and confidence.

Power is only necessary if one wishes to "difference" the inputs, i.e. work with the difference between winter and summer parameters. For most instances, stakeholders are more concerned with confidence, or the resulting uncertainty in the measurement of a parameter.

Detector efficiency

As one is unlikely to be trying to determine the difference in detector efficiency between seasons or detectors, it is usually entered as a single parameter in mortality estimation. [1]

The issue of replicates for determining optimal replication and coverage is explored below. In this case a replicate is a single carcass of a given size class.

[1] On a technical note, it has been shown that having a non-constant detectability leads to a bias in the current field of estimators (Huso 2010 and Korner-Nievergelt et al. 2011). Consequently, incorporating changeable searcher efficiency will result in less variance in the output, but almost assuredly at the cost of a consistent bias in the projection.

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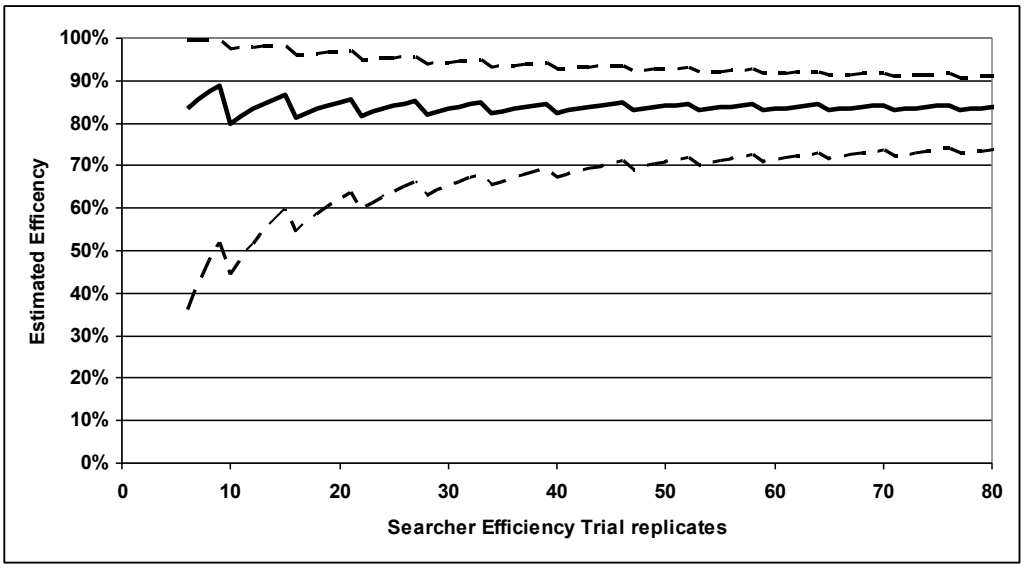

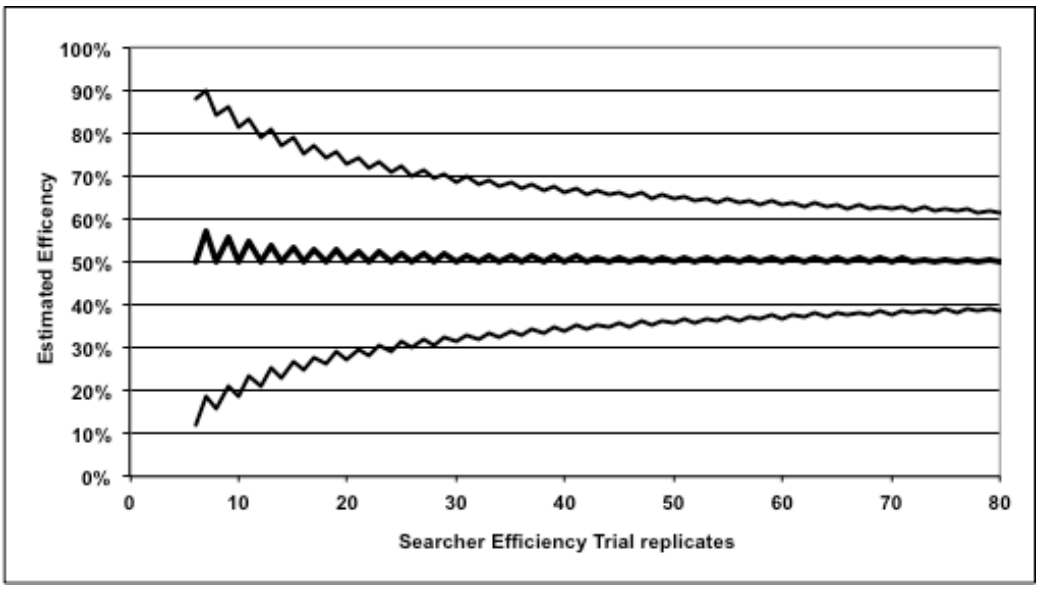

Figure 1 : Estimated searcher efficiency and 95% confidence bounds for N trials. Assumes searcher efficiency of 83.7% (top) and 50% (bottom).

The above chart (Figure 1) has been calculated (Cloppers & Pearson 1934) as a scenario to highlight the issues with detectability trials. We have assumed that the "true" observer efficiency is 83.7% (top) and 50% (bottom). The relative size of the confidence interval is not sensitive to the actual observer efficiency.

Note that, like most measures, detectability cannot be precisely measured in integer counts until at least one thousand replicates have been performed. Consequently, the coarse black line shows us the estimated efficiency, given a field trial of known sample size, and some number of detections. The 95% confidence window is shown by the dashed lines. The jaggedness of all curves is a known effect, due to the nature of a dichotomous variable (i.e. "I found it/I did not find it").

Notice that 10 replicates is the minimum amount of effort to have a meaningful measure. This indicates why 10 replicates is a commonly used rule of thumb for minimum effort, and is an enforced minimum in recent software estimators (Bispo et al 2010). Note also, that there is very little to be gained in trialling more than 40 samples.

At this point, it may be worth considering differencing a covariate, such as spring/autumn. The effort required to separate detectability in autumn from spring can be deduced formally from a power analysis. However, the above chart indicates that you will be unlikely to be able to split the two seasons (to 95% confidence) unless the difference between the average detectability is greater than 20-30% (even with 20 replicates in each season).

Given that there is a possibility of a large difference between autumn and spring, and surveying in both also allows coverage of the year, we suggest two detectability surveys timed for maximum detectability difference. Because of the natural variability within a survey, splitting data collection into multiple surveys is unlikely to improve either confidence or power for the additional cost.

We also suggest 20 replicates per carcass size class per year (10 in spring, 10 in autumn), which will provide a reasonable detectability estimate after one year, and optimal after two. This balances statistical confidence with the logistic difficulties in sourcing carcasses.

Scavenge loss rate

The issues attached to determining a loss rate are not as awkward as those of the searcher efficiency, due to the nature of the variable. However, the loss rate is intimately connected to the accuracy of the projections, possibly much more so than the searcher efficiency.

Loss of the sample, and the resulting correction term in mortality estimates, is affected by the shape of the loss curve as well as its average value, as follows:

There are basically three processes through which the sample can be lost, and these interact intimately with the surveying frequency.

1) The loss rate is a constant over time (known as an exponential form)
2) The loss rate is initially very low, then accelerates (can be considered the "olfactory" scavenger's form)
3) The loss rate is highest initially, then diminishes (the "visual" scavenger form)

Whether one is determining the shape, or the expectation, "windows" are very important. That is, we cannot ever know the exact time of loss, only the interval in which it occurs.

What is often overlooked though, is the fact that irrespective of the form of loss, interval uncertainty "costs" more at the lower end of the scale than at the upper. For instance, if the time at loss is 6 hours, being uncertain to plus or minus twelve hours is catastrophic to the utility of the datum point. If the loss was at five days, knowing to plus or minus twelve hours amounts to little additional loss of insight. This is the case even for the simplest assumption of constant loss rate (exponential).

So, for scavenger trials, one needs to focus on an uneven time sample, to generate the information. Check the samples early and often, then taper off the effort.

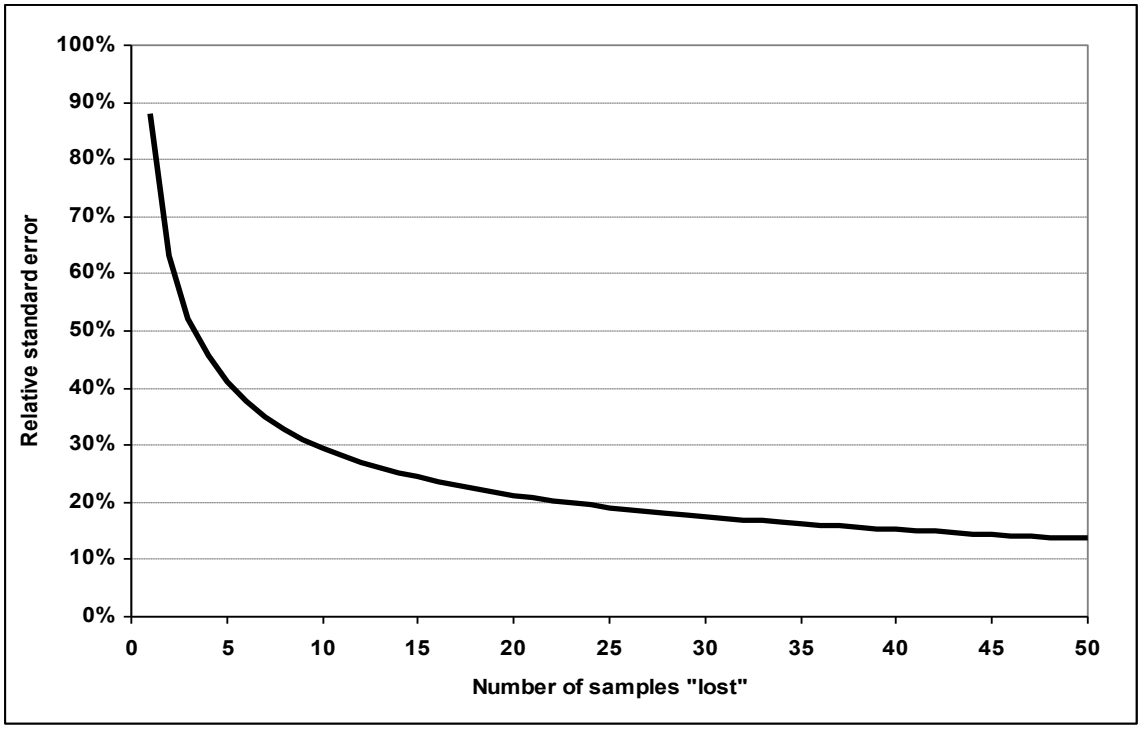

Figure 2 : Simple RSE of average loss time, assuming N losses in the trial period

To determine how many replicates are needed for confidence in the loss rate estimate, we take the simplest loss scenario – a constant rate of loss. Without a pilot study, this is a reasonable scenario to base the survey design upon, as it is the 'middle ground' of the three scenarios above and the most commonly assumed form in mortality estimation. Under this assumption, Figure 2 is the analytical relationship between the number of carcasses lost in a survey period and the relative standard error (RSE) in the average estimate.

The mathematical properties of the constant rate of loss scenario (Poisson distribution) mean that the actual survey length does not come into play. That is, a loss of 10 carcasses over one month yields the same RSE as the loss of 10 carcasses over a week, or three months. Nor is the RSE affected by changes in the survey interval length throughout the month. For an informative exposition of this distribution we suggest Engelhart. 1994.

From Figure 2 we can see that 10 replicates is a good start and any more than 40 or 50 trials produces diminishing returns. As for the searcher efficiency, we wish to treat the two size classes independently, and so are interested in our resolution confidence (above chart) and not the resolution power.

Considering these points, running scavenge trials concurrently with detectability trials (10 replicates, twice per year) is reasonable to establish the rate and 'shape' of scavenge for the purpose of mortality estimation.

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Summary

We hope that the technical information provided here will assist in understanding the statistical considerations that underpinned the management recommendations we have provided as inputs to recent BAM plans.

Regards,

Dr Stuart Muir
Director, Design & Analysis; Symbolix Pty Ltd

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Appendix 3: List of fixed random turbine numbers to be searched plus additional Mount Fyans turbine (italicised)

B08
B06
B05
A03
B01
B03
C03
B02
C06
C01
C13
C07
F02
C12
D03
D02
C15
C08
C16
D08
H01
E01
D04
F09
G02
G04
E06
D01
E08
E07
G05
G10
H08

Appendix 4: Carcass and feather spot record form

Please fill out details in this form for each bird/bat carcass found. Injured wildlife must be transported to the nearest veterinary and or / wildlife rescue and care.

ARARAT WIND FARM – MORTALITY MONITORING PROGRAM: CARCASS 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.					
Collector:		**Date:**	**Start Time:**	**Finish Time:**	
Turbine identifier:					
Vegetation	**Description** (incl. veg type):				
	Ave. height:	**Density:** Very Dense / Dense / Moderate / Sparse / Very Sparse			
Temperature:		**Wind direction/speed:**	**Humidity:**		
Search purpose (e.g. scavenger trial):		**If scheduled search; search completed: Yes / No**			
Onsite works in last 5 days:					
Weather conditions in last 5 days:					
Comments:					
Carcass details	**Time:**	**Coordinates:**	**Substrate:**		
Distance from Tower(m):		**Bearing from Tower (deg):**			
Species common name: **Scientific name:**			**Age/sex?:**		
Photo Taken*	Yes / No				
Carcass condition: Intact, Scavenged, Feather spot:	**Describe:**				
Signs of injury:					
How old is carcass estimated to be (tick category):	<24 hrs	1-3 days	> 3 days	Other	
Other Notes: (incl. presence of stock or other factors affecting results)					

Post Find Actions:

1. Place carcass in sealable plastic bag then wrap it in newspaper and take to freezer at site office.
2. One form should be completed for each carcass found
3. **Please attach photo to this form

Photos

Take the photograph with the carcass in situ with a ruler (or other item at hand) next to it to allow measurements to be made.

Take a photo of:

- Photo of the carcass / feather spot as found in relation to the turbine
- Photo of top and bottom sides of carcass
- Photo of spread wing

Post find actions

Verbally notify the Proponent's Site Manager and provide a copy of this report to them within the same shift as the carcass has been found (or the next business day if a weekend or public holiday).

PLANNING and ENVIRONMENT ACT
MOYNE PLANNING SCHEME

PERMIT NO. 2015/23858/A
Conditions 52, 53, 55a Where this addendum's provisions are inconsistent with those of the main Bat and Avifauna Management Plan, the addendum's provisions prevail
ENDORSED PLAN
Sheet 1 of 2
Signed: for
MINISTER FOR PLANNING
Date: 17/06/2021

Addendum to the Dundonnell Wind Farm Bat and Avifauna Management Plan

From: Eliza Budd (Environmental Planner)

Subject: Addendum to the Dundonnell Wind Farm Bat and Avifauna Management Plan

Date: 10 December 2020

1. Background

Tilt Renewables (on behalf of Dundonnell Wind Farm Pty Ltd) (the Proponent) have prepared this addendum to ensure clarity on particular items within the Bat and Avifauna Management Plan (BAMP) as required by Condition 52, 53 and 55(a) of Planning Permit No. 2015/23858 that was endorsed by the Minister for Planning on 8 January 2019.

Upon recent review of the BAMP[1], it has been identified that several items would benefit from clarification to more effectively achieve the intended aims of the BAMP.

2. Items to be Clarified

2.1. Choice from options for carcass search method (BAMP section ref. 5.2.2)

The BAMP provides two options for the carcass search method; people on foot or using trained dogs. The Proponent proposes to use trained dog and handler teams only.

The use of trained dogs and handler teams has been shown to be more effective and efficient compared to human-only spotters, using sent to detect carcasses rather than visual cues which is particularly advantageous in tall and/or dense vegetation.

2.2. Methods for carcass persistence (scavenger) trails (BAMP section ref. 5.2.4)

The BAMP proposes that carcass persistence (scavenger) trials are to be undertaken by people frequently checking placed carcasses.

The Proponent proposes to use automated cameras for the carcass persistence (scavenger) trails as they present numerous benefits over using people. The use of cameras are far more precise for determining the duration of carcass persistence (i.e. to either a precise time, or to within an interval of one hour, rather than an interval measured in days) which is key to informing the estimation of total collisions. This method also has capacity for identification of scavengers and minimises the potential for scavengers to follow human scent trails.

Checks of the cameras will still occur to ensure that carcasses are truly scavenged and not just removed from the camera frame.

2.3. Separating searcher efficiency trials from carcass persistence trials (BAMP section ref. 5.2.5)

The BAMP requires that searcher efficiency trials be undertaken concurrently with the carcass persistence trials.

The Proponent believes these trials do not need to be undertaken concurrently as carcasses in persistence trials using cameras are not compatible with the requirements for 'blind' searcher efficiency trials.

The Proponent proposes to undertake the searcher efficiency trials during the routine searches with carcasses placed by a person independent of dog and handler teams.

2.4. Work health and safety aspects re injured wildlife (BAMP section ref. 5.2.7)

The BAMP stipulates that all injured wildlife are to be transported to the nearest veterinary clinic.

[1] Review of the BAMP has been undertaken by Biosis who are implementing the BAMP on behalf of the Proponent.

The Proponent seeks to clarify that the handling of injured bats and avifauna will be done in accordance with requirements of work health and safety. Live raptors and bats will be handled only by experienced wildlife carers or zoologists using personal protective equipment (PPE) appropriate to fully prevent personal injury. Bats have potential to carry viruses that are potentially fatal to humans. Live bats will be handled only by personnel who have been immunized for rabies virus and have a current adequate level of immunity. No live bats are to be handled by wind farm site personnel.

2.5. Contingencies around monitoring Brolga behavior within prescribed distances of the wind farm (BAMP section 7.1)

The BAMP states that monitoring 'at risk' Brolgas involves visiting known and potential flocking habitats within five kms of the wind farm during the flocking season (January to June) and known and potential breeding habitats within 3.2 kilometers of the wind farm (July to December).

The Proponent acknowledges that the ability to monitor these wetlands will be contingent on obtaining permission from these landholders to access their properties. The Proponent proposes to maintain a log containing clear records of contact (or attempts to contact) with landowners within the buffer areas identified in the BAMP that will be provided to Moyne Shire Council annually.

2.6. Choice of methods to be tested for monitoring for Brolga mortality (BAMP section ref. 7.2)

The BAMP provides three optional methods for Brolga mortality searches; by people on foot, the use of trained dogs or by people using all-terrain vehicles.

The Proponent proposes to evaluate the effectiveness of surveyors on foot using binoculars and surveys using dog teams to ascertain the preferred method and not test the of all-terrain vehicles due to the multiple work health and safety risks they pose.

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MOYNE PLANNING SCHEME

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ENDORSED PLAN
Sheet 2 of 2

Signed: for
MINISTER FOR PLANNING
Date: 17/06/2021