SAPPHIRE WIND FARM

BIRD AND BAT ADAPTIVE MANAGEMENT PROGRAM

CWP Renewables Pty Ltd

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1. INTRODUCTION

1.1. Background

The Sapphire Wind Farm (SWF) project is located 18 kilometres west of Glen Innes and 28 kilometres east of Inverell in the northern tablelands of New South Wales (Figure 1). In 2007 Sapphire Wind Farm Pty Ltd (SWF Pty Ltd) proposed a 159 turbine wind farm in the northern Tablelands of NSW. The NSW Department of Planning and Environment (DPE) and the Commonwealth Department of the Environment (DotE) approved the Wind Farm in June 2013 and December 2014 respectively.

In January 2016, SWF Pty Ltd requested a Modification to the approval to reduce the number of turbines from 159 to up to 109 turbines and increase the maximum tip height to 200m and rotor diameter to 126m. The DPE and the DotE approved the Modification request in June 2016. The Project will proceed to construction in late 2016 with a refined design which involves the construction of 75 turbines at locations approved in the Modification.

Condition C6 of the NSW approval requires the preparation of a Bird and Bat Adaptive Management Program (BBAMP), these requirements are outlined in the following section. Element (d) requires the proponent to identify 'at risk' bird and bat groups, seasons and/or areas within the project site which may attract high levels of mortality. This BBAMP has been prepared for review by the Office of Environment and Heritage (OEH).

1.2. Requirements of BBAMP

The specific requirements of the BBAMP are presented below extracted from the approval conditions.

1.2.1. NSW state provisions

"Bird and Bat Monitoring and Management

*C6. Prior to the commencement of construction, the Proponent shall prepare and submit for the approval of the Director-General a **Bird and Bat Adaptive Management Program**, which takes into account bird/ bat monitoring methods identified in the current editions of AusWEA Best Practice Guidelines for the Implementation of Wind Energy Projects in Australia and Wind Farm and Birds: Interim Standards for Risk Assessment. The Program shall be prepared and implemented by a suitably qualified expert, approved by the Director-General. The Program shall incorporate **Monitoring, and a Decision Matrix** that clearly sets out how the Proponent will respond to the outcomes of monitoring. It shall:*

- ***(a)*** *incorporate an ongoing role for the suitably qualified expert;*
- ***(b)*** *set out monitoring requirements in order to assess the impact of the project on bird and bat populations, including details on survey locations, parameters to be measured, frequency of surveys and analyses and reporting. The monitoring program shall be capable of detecting any changes to the population of birds and/ or bats that can reasonably be attributed to the operation of the project, that is, data may be required to be collected prior to the commencement of construction;*

(c) incorporate a decision making framework that sets out specific actions and when they may be required to be implemented to reduce any impacts on bird and bat populations that have been identified as a result of the monitoring;

(d) identify 'at risk' bird and bat groups, seasons (such as wet seasons where bird species may be attracted to nearby wetlands) and/or areas within the project site which may attract high levels of mortality and include monthly mortality assessments and periodic local population census' and bird utilisation surveys;

(e) identify potential mitigation measures and implementation strategies in order to reduce impacts on birds and bats such as minimising the availability of raptor perches, swift carcass removal, pest control including rabbits, use of deterrents, and sector management including switching off turbines that are predicted to or have had an unacceptable impact on bird/bat mortality at certain times; and

(f) identify matters to be addressed in periodic reports in relation to the outcomes of monitoring, the application of the decision making framework, the mitigation measures identified, progress with the implementation of such measures, and their success.

The Reports referred to under part (f) shall be submitted to the Director-General and OEH on an annual basis for the first five years of operation and every two years thereafter (unless otherwise agreed to by the Director-General), and shall be prepared within two months of the end of the reporting period. The Director-General may, at the request of the Proponent at anytime, vary the reporting requirement or period by notice in writing to the Proponent.

The Proponent is required to implement reasonable and feasible mitigation measures as identified under part (e) where the need for further action is identified through the Bird and Bat Adaptive Management Programme, or as otherwise agreed with the Director-General."

This BBAMP fulfils the requirements of Condition C6 of the Project Approval and subject to BBAMP approval by DPE will be implemented during the development and initial operation of the SWF

On 30 September 2016, the Secretary approved, under condition C6 of the Project Approval, the appointment of representatives of Brett Lane and Associates Pty Ltd (BL&A) as the suitably qualified expert to undertake the BBAMP.

1.2.2. EPBC Act - Commonwealth provisions

In addition, the Commonwealth Government has issued Conditions of Approval for the project which require that SWF undertake to compensate for impacts on habitat for the Regent Honeyeater and Swift Parrot, the approval holder must contribute no less than $250 000 (GST exclusive) in funding towards research by an appropriate institution, to assist in building the body of knowledge regarding these species and how they interact with, and are impacted by, wind farms. The expected outcomes and milestones of this research must:

- 1) be consistent with the relevant Recovery Plans for the species;

- 2) take into account any results from the BBAMP referred to in Condition C6 of the NSW Minister for Planning and Environment's approval of the proposed action (as outlined above); and
- 3) be made available to The Department, relevant state government agencies and to the public within 20 business days of their approval and published on the approval holder's website throughout the duration of the research project and action.

This BBAMP will also address the EPBC related conditions.

1.2.3. Compliance Summary

The following table details which sections of this BBAMP addresses specific requirements outlined in the relevant Condition of Approval C6 above.

Table 1: Sections within the BBAMP that respond to Condition of Approval C6 for Sapphire Wind Farm.

Condition number	Abbreviated condition details	BBAMP Section/s
C6 (a)	*Incorporate an ongoing role for the suitably qualified expert*	1.1
C6 (b)	*Set out monitoring requirements in order to assess the impact of the project on bird and bat populations including details on survey locations, parameters to be measured, frequency of surveys and analyses and reporting.*	4.1 to 4.6
C6 (c)	*Incorporate a decision making framework that sets out specific actions and when they may be required to be implemented to reduce any impacts on bird and bat populations that have been identified as a result of the monitoring*	6.1, 6.2
C6 (d)	*identify 'at risk' bird and bat groups….and include monthly mortality assessments and periodic local population censuses and bird utilisation surveys;*	3.5
C6 (e)	*Identify potential mitigation measures and implementation strategies in order to reduce impacts on birds and bats….*	5
C6 (f)	*Identify matters to be addressed in periodic reports…*	4.7, 6.4
C6	*Submit reports to the Secretary on an annual basis …*	4.7, 6.4

1.3. BBAMP Objectives

The overall aim of this BBAMP is to provide a program for monitoring the impacts on birds and bats from the SWF and an overall strategy for managing and mitigating any significant bird and bat impacts arising from the operation of SWF.

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's Best Practice Guidelines (CEC 2013).

The specific objectives of this BBAMP, derived from the conditions of approval, are set out below.

- To implement a monitoring program capable of detecting any changes to the population of at-risk birds and/ or bats that can reasonably be attributed to the operation of the project, including pre- and post-construction (operational phase) presence;
- To directly record impacts on birds and bats through carcass surveys;
- To document an agreed decision-making framework that outlines the specific actions to be taken and possible mitigation measures implemented to understand and reduce any impacts on bird and bat populations identified as a result of the monitoring, or in the event that an impact trigger[1] is detected;
- To detail specific monitoring for 'at risk' bird and bat groups, such as the Wedge-tailed Eagle, and include monthly mortality assessments, periodic local population censuses and bird utilisation surveys;
- To detail specific and potential mitigation measures and related implementation strategies to reduce impacts on birds and bats; and
- To identify matters to be addressed in periodic reports on the outcomes of monitoring, the application of the decision making framework, mitigation measures and their success.

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

- Operational phase carcass searches under operating turbines
- Statistical analysis of the results of carcass searches and
- Reporting.

This management program uses an adaptive management approach. Therefore, management measures can be amended to ensure more effective management and mitigation are implemented in response to the findings of monitoring. Personnel undertaking the carcass searches will be adequately trained to undertake the monitoring. The expert approved by the Secretary of the Department of Planning and Environment (DPE) will be in charge of the design of monitoring, as well as training of personnel, data analysis, interpretation, formulating adaptive management measures and reporting.

This BBAMP is based on the experience gained from the preparation and implementation of approved management plans to monitor and mitigate the impacts of

[1] Definition of 'impact trigger' and 'unacceptable impact' is detailed in section 6.2.1

wind farm operation on birds and bats at numerous wind farms in New South Wales and Victoria. At the time of writing, BL&A has prepared and/or implemented approved management plans for White Rock, Cullerin, Gullen Range, Taralga, Capital I and Woodlawn wind farms in NSW (BL&A 2011a & c, 2014, 2016), and Bald Hills, Macarthur, Berrybank, Crowlands, Hawkesdale, Lal Lal, Mt Gellibrand, Mt Mercer, Mortlake South and Ryan's Corner wind farms in Victoria (BL&A 2009, 2011b, 2012a-d, 2013a-c).

The approach developed for monitoring impacts on birds and bats has been refined from experience gained from other BBAMPs, their preparation, data review, and feedback from regulators and approval authorities. This BBAMP has incorporated learning and experience from past plans, and incorporates the latest approaches to monitoring wind farm impacts on birds and bats.

In order to ensure the efficacy of this adaptive management program, all activities undertaken will be subject to regular review and reporting by the suitably qualified expert who is approved by the DPE.

1.4. Consultations in the development of the BBAMP

The Office of Environment and Heritage (OEH) was consulted in the development of this plan. This consultation included:

- Provision of a draft risk assessment to OEH for review to provide the basis and direction in the development of the BBAMP;
- Letter from OEH Coffs Harbour dated 23rd September 2016 providing comments and feedback on the risk assessment[2]; and
- A productive on-site meeting at SWF with Dmitri Young and Nicky from the OEH Regional Office in Coffs harbour on the 12 October 2016 to review layout and discuss the BBAMP.

[2] Dimitri Young, Acting Senior Manager, and Nicky Owner, Conservation Planning Officer, North East Region, Regional Operations Group, Office of Environment and Heritage, Coffs Harbour

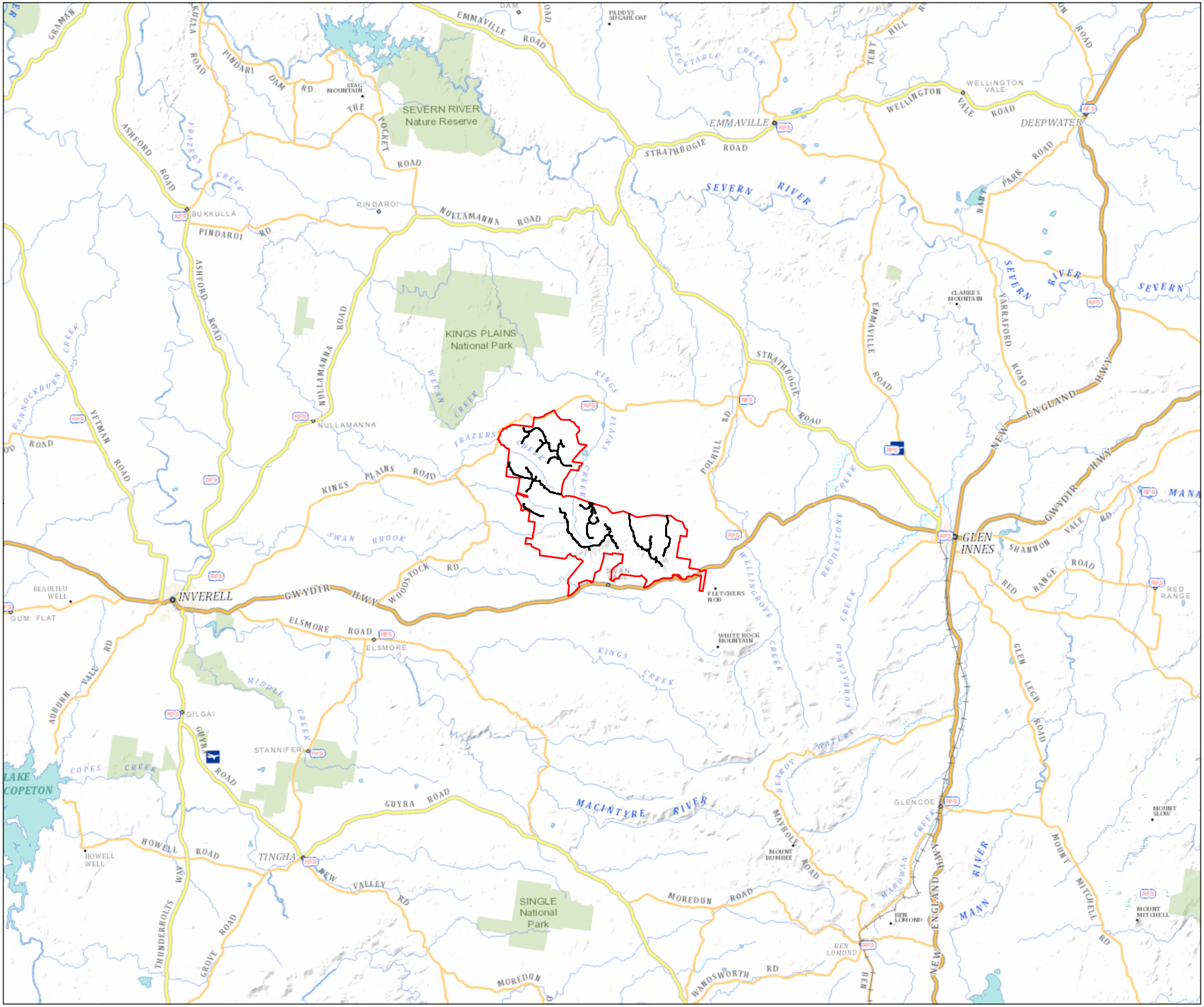

Figure 1: Locality map

Project: Sapphire Wind Farm BBAMP
Client: CWP Renewables Pty Ltd
Date: 7/09/2016

Legend

- Study area
- Turbines
- Access tracks

N

Kilometers
0 5 10

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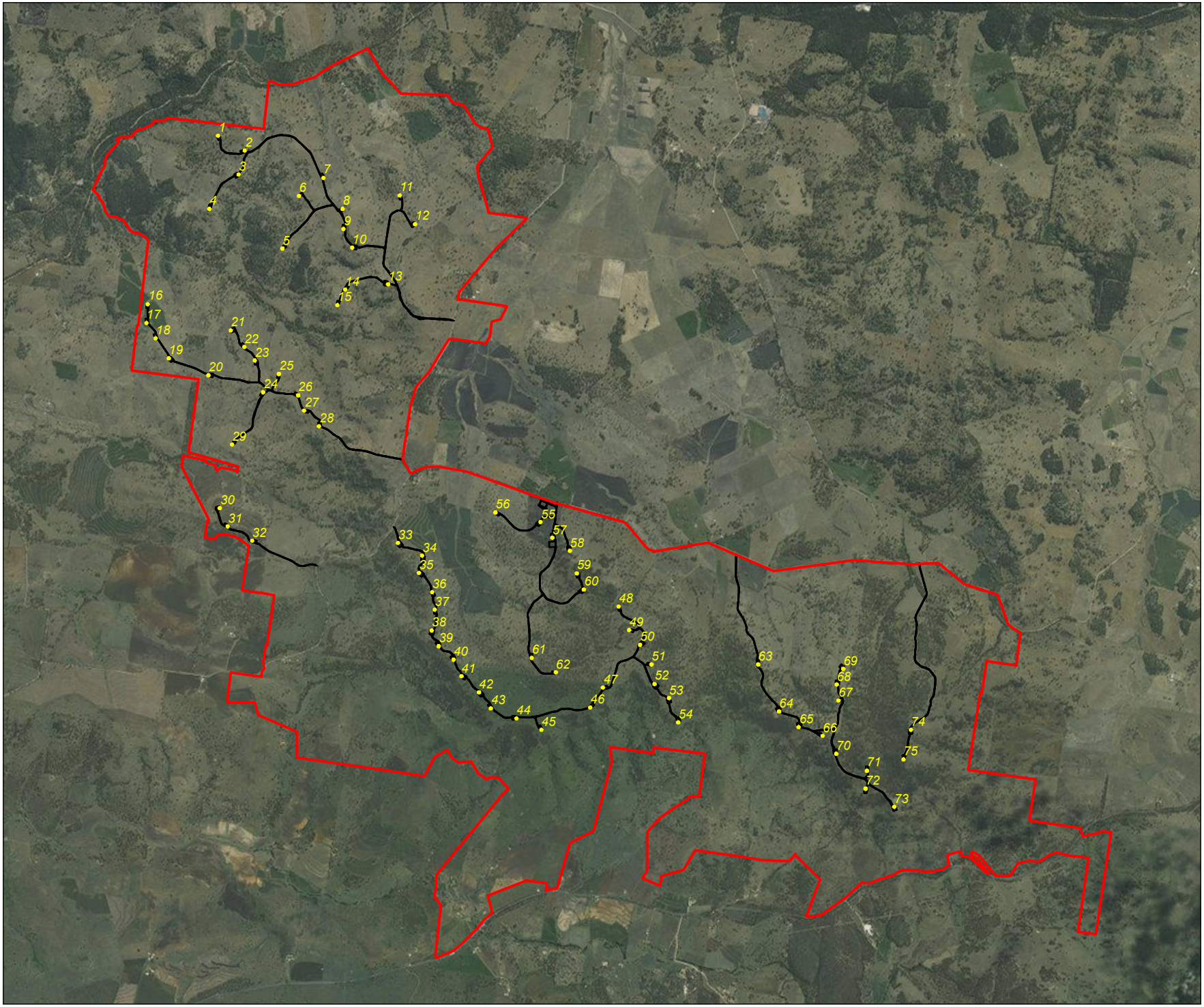

Figure 2: Sapphire Wind Farm turbine layout

Project: Sapphire Wind Farm BBAMP
Client: CWP Renewables Pty Ltd
Date: 7/09/2016

Legend

- Study area
- Turbines
- Access tracks

N

Kilometers

0 2

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1.5. Site Description

The Sapphire Wind Farm site is located in the Northern Tablelands region of NSW (Figure 1), in the Kings Plain district. The proposed turbines will extend 10 kilometres north-south and 15 kilometres east-west. The individual turbine positions are on land with elevations ranging from 750 metres to 1,100 metres Australian Height Datum (AHD).

It lies on a series of higher ridges that have been used for decades for sheep and cattle grazing. The majority of the area has been either completely or partly cleared of its original native vegetation. As a consequence of the long grazing history, this vegetation lacks a diverse understorey and indigenous ground cover, and introduced pasture grasses have come to dominate the ground cover. Much of the area has been subject either to past clearing or selective timber-getting. Consequently some of the trees are of a comparatively young age, or are of a species that have fewer hollows suitable for hollow-dependent fauna, such as possums, gliders and large owls.

The avifauna of the site is typical of this part of NSW, with canopy-dwelling honeyeaters and insectivores dominating. Knowledge of the bat fauna in the region is developing as more survey work is done as part of assessments for proposed wind farms in the area. Some of the slopes of some of the steeper ridges still support a relatively intact tree canopy that would provide foraging habitat for insectivorous bats. More details of the birds and bats of the site can be found in section 2 of this Program.

Habitat quality for birds and bats is considered to be low in the largely cleared parts of the site, moderate in most wooded areas and moderate to high in the wooded slopes in the southern and north-western parts of the site.

1.6. Pre-construction investigations of birds and bats at Sapphire wind farm

During the pre-approval and pre-construction phases of the development, investigations were undertaken by EcoLogical Australia Pty Ltd (ELA). The data was collected during surveys between 27th October 2008 and the 21st January 2011. The methods and results of these investigations were included in the Ecological Assessment Report (ELA 2011) for the SWF Ecological Assessment 2011 and are summarised in section 2.

1.7. Additional information

This BBAMP was prepared by a team from Brett Lane & Associates Pty Ltd including; Curtis Doughty (Senior Zoologist), Jackson Clerke (Zoologist), Bernard O'Callaghan (Senior Ecologist and Project Manager) and Brett Lane (Principal Consultant).

2. PRE-CONSTRUCTION BIRD AND BAT INFORMATION

The results of investigations documented in Section 1.6 above are summarised in this section of the BBAMP. This information has informed the risk assessment in Section 3.

2.1. Bird surveys

2.1.1. Bird survey methodology

The methods and results of the bird surveys are outlined in the ecological assessment report by ELA (2011). The data were collected from five survey periods between 27th October 2008 and the 15th May 2009.

Bird surveys were undertaken by ELA (2011) and included the following.

- A total of 48 diurnal bird surveys were undertaken throughout the wind farm site, using the two hectare – 20 minute approach adopted from the Birdlife Australia methodology
- Incidental observations were also made while traversing around the site
- Call playback for nocturnal birds over 11 nights; and
- Spotlighting for 16 person hours.

2.1.2. Results

A total of 83 bird species were recorded during surveys, two of which were introduced. These species are listed in Appendix E of ELA (2011). The study area supports potential foraging habitats throughout all seasons and breeding as well as roosting habitat for a wide variety of bird species. Hollow bearing trees, suitable for breeding and roosting by birds and bats also occurred in a variety of areas. Habitat for wetland bird species was limited primarily to farm dams. Key findings include:

- No owl species were recorded;
- Raptor species recorded included:
    - *Falco cenchroides* (Nankeen Kestrel);
    - *Aquila audax* (Wedge-tailed Eagle);
    - *Elanus axillaris* (Black-shouldered Kite);
    - *Accipiter fasciatus* (Brown Goshawk); and
    - *Haliastur sphenurus* (Whistling Kite);
- Seven threatened species were recorded in the study area:
    - *Climacteris picumnus victoriae* (Brown Treecreeper);
    - *Stagonopleura guttata* (Diamond Firetail);
    - *Melanodryas cucullata cucullata* (Hooded Robin);
    - *Glossopsitta pusilla* (Little Lorikeet);
    - *Petroica boodang* (Scarlet Robin);
    - Pyrrholaemus saggitatus (Speckled Warbler); and
    - Neophema pulchella (Turquoise Parrot).

- Six other threatened bird species for which the study area is likely to provide potential habitat are listed below. None were recorded.
    - *Anthochaera phrygia* (Regent Honeyeater);
    - *Circus assimilis* (Spotted Harrier);
    - Daphoenositta chrysoptera (Varied Sittella);
    - Hieraaetus morphnoides (Little Eagle);
    - *Lophoictinia isura* (Square-tailed Kite); and
    - *Lathamus discolor* (Swift Parrot).
- Twelve listed migratory species were identified as potentially occurring from an EPBC Act protected matters search within the study area. Of these, potential habitat occurred for seven species. None were recorded during surveys.

The bird utilisation surveys are considered a suitable level of effort to provide the basis of a program to monitor the impacts of the wind farm on birds.

2.2. Bat Utilisation studies

2.2.1. Bat survey methodology

The methods and results of the Microbat surveys are outlined in ELA (2011). The data were collected from three survey periods between 1st and 3rd December 2008, 4th and 15th May, and 20th and 29th September 2009. These surveys totalled 60 Anabat recording nights.

2.2.2. Results

Twenty-two microbat species were detected for which habitat was present across the study area. Detection averaged 55 calls per night. Appendix F in ELA (2011) provides a full species list and flight height recordings. Key findings included:

- The most common species recorded included:
    - *Chalinolobus morio* (Chocolate Wattled Bat);
    - *Chalinolobus gouldii* (Gould's Wattled Bat);
    - *Vespadelus* spp.; and
    - *Miniopterus schreibersii oceansis* (Eastern Bentwing-bat);
- Six threatened bat species were recorded;
    - *Falsistrellus tasmaniensis* (Eastern False Pipistrelle);
    - *Miniopterus schreibersii* (Eastern Bentwing-bat);
    - *Mormopterus norfolkensis* (Eastern Freetail-bat);
    - *Saccolaimus flaviventris* (Yellow-bellied Sheathtail-bat);
    - *Scoteanax rueppellii* (Greater Broad-nosed Bat); and
    - *Vespadelus troughtoni* (Eastern Cave Bat);

- Hollow-bearing trees within the study area provide roosting habitat for the majority of threatened bat species recorded. However, there were no caves recorded, required by Eastern Bentwing-bat or Eastern Cave Bat for roosting.

The 60 Anabat recording nights are considered a reasonable level of effort to provide the basis of a program to monitor the impacts of the wind farm on bats.

3. RISK ASSESSMENT FOR SAPPHIRE WIND FARM

3.1. Introduction to the risk assessment

The aim of this risk assessment is to guide the development of the BBAMP for the SWF 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 BBAMP, focussing on species and groups at greater risk.

Wind farm impacts on birds and bats can arise from three potential pathways:

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

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

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

This chapter presents the results of this risk assessment under the headings below.

Section 3.2 summarises the sources of information used to understand the likelihood of occurrence of each species or group on the SWF site and their likely behaviour on the site;

Section 3.3 provides an overview of the risk assessment method adopted, including the likelihood and consequence criteria and the risk matrix;

Section 3.4 presents the results and conclusions of the risk assessment and identifies the focus for the BBAMP for SWF.

3.2. Introduction to the Risk Assessment for Sapphire Wind Farm

To ascertain the species of concern that may occur on the SWF site the following sources were used:

- The NSW Bionet Atlas Search tool (OEH 2016a), using a 40 by 40 kilometre search region centred over the proposed SWF site (searched in August 2016)

- The EPBC Act Protected Matters Search Tool (PMST) using a search region that included the proposed site and a 15 kilometre buffer zone (Department of the Environment and Energy 2016) and
- The Ecological Assessment of the SWF site during 2010 and 2011 (ELA 2011).

There are currently no operational wind farms within 50 kilometres of the study area. However, there are plans for other wind farms within the Glen Innes Region, notably the White Rock Wind Farm (currently under construction) and the Glen Innes Wind Farm (proposed). The publically available documentation on these planned wind farms was scrutinised and has been incorporated into this risk assessment.

3.3. 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 species may exhibit "risk behaviour" and potentially interact with the operation of the wind farm; or
- Native bird and bat species known to occupy the SWF site and are considered to have moderate to high collision risk (ELA 2011).

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 SWF site itself given the habitat present on the site and occurrence of the species in the search region (see Appendix 1).

The original site assessments (ELA 2011) identified listed threatened and migratory species likely to occur on the site, some of which were detected during on-site fauna survey work. Although this has been taken into consideration, a number of additional species and groups, including non-threatened species/groups, have been identified through the current review that were not originally considered. The detailed rationale for the inclusion of the shortlisted species and groups can be found in Section 3.3. The short-listed species and groups are listed below in Table 2.

Table 2: Risk assessment - Assessed bird and bat species

EPBC Act Listed Migratory Species
▪ Fork–tailed Swift ▪ White-Throated Needletail.
EPBC Act and TSC Act listed threatened birds
▪ Painted Honeyeater (Vulnerable – EPBC & Vulnerable – TSC) ▪ Regent Honeyeater (Critically Endangered – EPBC & TSC) ▪ Swift Parrot (Endangered – EPBC & Critically Endangered TSC Act)
EPBC Act and TSC Act listed threatened bats
▪ Corben's Long-eared Bat (Vulnerable – EPBC & TSC Act)
TSC Act listed threatened birds
▪ Barking Owl (Vulnerable)

▪ Black–chinned Honeyeater (Vulnerable) ▪ Brown Treecreeper (Vulnerable) ▪ Diamond Firetail (Vulnerable) ▪ Dusky Woodswallow (Vulnerable) ▪ Hooded Robin (Vulnerable) ▪ Little Eagle (Vulnerable) ▪ Little Lorikeet (Vulnerable) ▪ Powerful Owl (Vulnerable) ▪ Scarlet Robin (Vulnerable) ▪ Speckled Warbler (Vulnerable) ▪ Spotted Harrier (Vulnerable) ▪ Square–tailed Kite (Vulnerable) ▪ Turquoise Parrot (Vulnerable) ▪ Varied Sittella (Vulnerable)
TSC Act listed threatened bats
▪ Eastern Bent-wing Bat (Vulnerable) ▪ Eastern Cave Bat (Vulnerable) ▪ Eastern False Pipistrelle (Vulnerable) ▪ Eastern Freetail Bat (Vulnerable) ▪ Greater Broad-nosed Bat (Vulnerable) ▪ Yellow-bellied Sheathtail-bat (Vulnerable). ▪ Little Pied Bat (Vulnerable)
Bird species (NSW Parks and Wildlife Act)
▪ Wedge–tailed Eagle ▪ Musk lorikeet ▪ Crimson rosella ▪ Eastern rosella ▪ Nankeen kestrel ▪ Black-shouldered kite ▪ Brown goshawk ▪ Whistling kite ▪ Brown falcon ▪ Australian wood duck ▪ Australian pipit ▪ White-winged chough ▪ Kookaburra ▪ Australian magpie ▪ Spotted pardalote ▪ Tawny frogmouth ▪ Waterbirds – includes ducks, herons, swans, ibis and other wetland associated species
Bat species (NSW Parks and Wildlife Act)
▪ Gould's wattled bat ▪ Southern freetail bat ▪ Lesser long-eared bat ▪ Eastern broad-nosed bat ▪ White-striped Freetail bat

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

3.4. Risk Assessment Process

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

The Risk Evaluation Matrix Model also complies with the ISO31000 Risk Assessment Standard (Rollason *et al* 2010).

The assessment requires criteria to be developed for likelihood and consequence. These criteria are provided respectively in Table 3 and Table 4.

Table 5 shows the risk levels used and how they are determined from the assessed likelihood and consequence levels.

Table 3: Likelihood criteria for a risk event to occur

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

Table 4: Consequence Criteria

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

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

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

The relevant likelihood and consequence levels were determined by using data recorded from the wind farm site and with reference to any available information on the local and regional status of the species and bird groups concerned.

3.5. Risk Assessment Results

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

- Environmental value to be protected
- Reasons for Inclusion
- Threatened species status
- Hazard or source event
- Consequence score and likelihood scores
- Risk rating
- Comments relating to risk rating scores

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

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

The White-throated Needletail flies regularly at turbine height and flocks may pass over the SWF site during the summer months. Collisions have been recorded at wind farms elsewhere in NSW and Australia. The risk to this species from the SWF is considered to be **low** as the species is widespread and numerous in eastern and south-eastern Australia.

The Regent Honeyeater inhabits dry box-ironbark eucalypt forests near rivers and creeks on inland slopes of the Great Dividing Range. This species usually flies within the tree canopy and would rarely fly at RSA height. It has not been recorded in vicinity for 20 years, however is a possible "rare" visitor to area. However, given the consequence of the loss of one individual the risk rating is **low.**

No threatened bat species was considered as a risk rating above **negligible**.

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 there is a presence of WTEs at 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 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, 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 NSW. 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 which makes population impacts unlikely.

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

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard or Source Event	Likelihood of Risk Event	Consequence	Risk Rating	Comments
Barking Owl *Ninox connivens*	Species or species habitat likely to occur within area	Vulnerable TSC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend into closed forest and more open areas. Although common in parts of northern Australia, the species has declined greatly in southern Australia and now occurs in a wide but sparse distribution in NSW (OEH 2016b). It is unlikely that this species commonly flies within the height range of the turbine blades for this proposal however, should turbine strike occur to individuals flying within the turbine blade height, it is highly likely that only a very small number of birds would be affected.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Black-chinned Honeyeater *Melithreptus gularis gularis*	Species or species habitat likely to occur within area	Vulnerable TSC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	Prefers open woodland and forest dominated by box-ironbark (Higgins *et al* 2001). This species has the potential to occur at the SWF site although it does not regularly fly at RSA height.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Brown Treecreeper *Climacteris picumnus victoriae*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable TSC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	It occurs in woodlands dominated by eucalyptus, especially stringybarks or other rough-barked eucalypts, usually with open grassy understorey (Higgins *et al.* 2001). This species has been recorded at the SWF site and usually occurs in the lower canopy and would not fly at RSA height.
			Indirect disturbance, including barrier effects.	Unlikely	Unlikely	Negligible	
Diamond Firetail *Stagonopleura guttata*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable TSC Act	Collision with operating wind turbines.	Rare	Negligible	Negligible	Found in box-ironbark forests and woodlands and also occurs along watercourses and in farmland areas (Emison *et al.* 1987; Tzaros 2005). This species has been recorded at the SWF site and has been recorded regularly inhabiting farmland around wind turbines in southern NSW where it has never been observed flying at RSA height or colliding with turbines.
			Indirect disturbance, including barrier effects.	Rare	Negligible	Negligible	
Dusky Woodswallow *Artamus cyanopterus cyanopterus*	Species or species habitat likely to occur within area	* Vulnerable TSC Act	Collision with operating wind turbines.	Rare	Negligible	Negligible	Occurs in dry open sclerophyll forests and woodlands, usually dominated by eucalypts. Often found on the edges or in clearings of forest and woodland and sometimes recorded in shrubland and heathland and other various modified landscapes (Higgins et al 2006). This species may occasionally fly at RSA height but usually flies within the canopy.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Fork-tailed Swift *Apus pacificus*	Species or species habitat likely to occur within area	Listed migratory species EPBC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	Aerial, over inland plains, sometimes above foothills or in coastal areas, over cliffs and urban areas (Higgins 1999). Occurs over a wide part of Australia and infrequently in the area, often following weather fronts. Flies at turbine height. Collision likely to be infrequent due to irregularity of occurrence. Small numbers possibly affected do not represent a significant proportion of the total population, estimated as at least in the tens of thousands (Department of the Environment 2015b).
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Hooded Robin *Melanodryas cucullata cucullata*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable TSC Act	Collision with operating wind turbines.	Rare	Negligible	Negligible	Occur mostly in open Grey Box, White Box, Yellow Box, Yellow Gum and Ironbark woodlands with pockets of saplings or taller shrubs, an open shrubby understorey, sparse grasses and patches of bare ground and leaf-litter, with scattered fallen timber (Higgins and Peter 2002; Tzaros 2005). This species generally confines itself to areas of wooded country and does not fly at RSA height.
			Indirect disturbance, including barrier effects.	Rare	Negligible	Negligible	
Little Eagle *Hieraaetus morphnoides*	Species or species habitat likely to occur within area	Vulnerable TSC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	The Little Eagle is distributed throughout the Australian mainland except in the most densely forested parts of the Great Dividing Range (Marchant and Higgins 1993). Turbine strikes of this raptor species could occur, however the species has not been recorded at the SWF site and has only been recorded in very low numbers (three) in the surrounding areas. The species has not been recorded colliding with wind turbines and occurs in NSW at very low population densities so regular collision is unlikely. In the 1990s, the Little Eagle was estimated globally as numbering tens of thousands to as many as 100 000 birds (Ferguson-Lees & Christie 2001), but in recent decades, the Little Eagle is believed to have undergone a moderate reduction in population size in NSW (OEH species listing advice).
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Little Lorikeet	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable	Collision with operating wind turbines.	Rare	Negligible	Negligible	The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat (OEH 2016b). Little Lorikeet are at risk colliding with turbines given their fast flight patterns and that they may fly at RSA height particularly when moving between

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard or Source Event	Likelihood of Risk Event	Consequence	Risk Rating	Comments
Glossopsitta pusilla		TSC Act	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	feeding areas (ELA 2011). There are no records of Little Lorikeets colliding with wind turbines. Their wide distribution and episodic occurrence in the area coinciding with eucalypt flowering events, which are sporadic, ensures they would only occasionally be likely to collide with turbines.
Painted Honeyeater *Grantiella picta*	Species or species habitat likely to occur within area	Vulnerable EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Inhabits box-ironbark forests and woodlands and mainly feeds on the fruits of mistletoe. Strongly associated with mistletoe around the margins of open forests and woodlands. Occurs at few localities. (Higgins *et al*. 2001; Tzaros 2005). This species usually flies within the tree canopy and would rarely visit the SWF site.
		Vulnerable TSC Act	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Powerful Owl *Ninox strenua*	Species or species habitat likely to occur within area	Vulnerable	Collision with operating wind turbines.	Unlikely	Low	Negligible	The Powerful Owl occurs, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to the tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing (OEH 2016b). This species inhabits open and tall wet sclerophyll forests with sheltered gullies and old growth forest with dense understorey. It is also found in dry forests with box and ironbark eucalypts and River Red Gum. Large old trees with hollows are required by this species for nesting (Higgins 1999; Soderquist *et al*. 2002). For most of its life, the Powerful Owl restrict its activities to forested habitat and do not fly often over open country. Dispersing juvenile owls may fly longer distances, including over open country, such as where turbines are located. The lack of records at SWF and in nearby areas, possibly due to the sparse nature of the woodland in the area, make collision and disturbance an unlikely event.
		TSC Act	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Regent Honeyeater *Anthochaera phrygia*	Species or species habitat likely to occur within area	Critically endangered EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Inhabits dry box-ironbark eucalypt forests near rivers and creeks on inland slopes of the Great Dividing Range. It could also occur in small remnant patches or in mature trees in farmland or partly cleared agricultural land (Higgins *et al*. 2001). This species usually flies within the tree canopy and would rarely visit the SWF site.
		Endangered TSC Act	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Scarlet Robin *Petroica boodang*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable	Collision with operating wind turbines.	Rare	Negligible	Negligible	The Scarlet Robin lives in open forests and woodlands in Australia. During winter, it will visit more open habitats such as grasslands and will be seen in farmland and urban parks and gardens at this time. Flight height studies at the SWF site (ELA 2011) indicate that Scarlet Robin flies at heights of 20 metres or less. This is below the RSA height.
		TSC Act	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Speckled Warbler *Chthonicola sagittata*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	It inhabits dry eucalypt forests and woodlands, especially those with box-ironbark eucalypt associations. It is also found in River Red Gum woodlands (Higgins and Peter 2002; Tzaros 2005). This species has been recorded at the SWF site however it does not fly at RSA height.
		TSC Act	Indirect disturbance, including barrier effects.	Unlikely	Unlikely	Negligible	
Spotted Harrier *Circus assimilis*	Species or species habitat likely to occur within area	Vulnerable	Collision with operating wind turbines.	Unlikely	Unlikely	Negligible	The Spotted Harrier prefers open woodlands that do not obstruct low flight, and natural and exotic grasslands in arid and semi arid areas (Higgins and Davies 1996). Turbine strikes may occur as there is one instance of the species colliding with a wind turbine elsewhere in NSW. Due to the irregular occurrence of this species on the SWF site, this may only happen rarely. The widespread distribution of this species in Australia makes it highly unlikely that a rare collision event would have any population consequences.
		TSC Act	Indirect disturbance, including barrier effects.	Unlikely	Unlikely	Negligible	
Square-tailed Kite *Lophoictinia isura*	Species or species habitat likely to occur within area	Vulnerable	Collision with operating wind turbines.	Unlikely	Unlikely	Negligible	It occurs mainly in open forests and woodlands and in NSW it utilises habitats with Woolybutt, Spotted Gum, peppermint, early regrowth after logging, eucalypt forest with shrubby understorey and box-ironbark woodland. Never plentiful, clearing has greatly reduced suitable forest and woodland habitat (Marchant and Higgins 1993). Few records from the surrounding region (five) dating from 1994 - 2012. Due to the irregular occurrence of this species on the SWF site, this may only happen rarely. The widespread distribution of this species in Australia makes it highly unlikely that a rare collision event would have any population consequences.
		TSC Act	Indirect disturbance, including barrier effects.	Unlikely	Unlikely	Negligible	
Swift Parrot *Lathamus discolor*	Species or species habitat likely to occur within area	Critically endangered EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Prefers a narrow range of eucalypts in NSW, including White Box, Red Ironbark, Mugga Ironbark, Grey Box and Yellow Gum as well as River Red Gum when this species supports abundant 'lerp'. Breeds in Tasmania and migrates to the mainland of Australia for the autumn, winter and early spring months. It lives mostly north of the Great Dividing Range (Emison *et al*. 1987; Higgins 1999; Kennedy and Tzaros 2005). Potential to occur at the SWF site however there are no records from the surrounding region.
		Endangered TSC Act	Indirect disturbance, including barrier effects.	Unlikely	Unlikely	Negligible	

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Turquoise Parrot *Neophema pulchella*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable TSC Act	Collision with operating wind turbines.	Rare	Low	Negligible	Occur in eucalypt woodlands and open forests, with ground cover of grasses and sometimes low understorey of shrubs; usually in native grassy forests and woodlands composed of mixed assemblages of native pine and a variety of eucalypts. Also occur in savannah woodlands and riparian woodlands (Higgins 1999). This species flies fast and at a range of heights from high to low, depending on activity (ELA 2011) and may be susceptible to colliding with turbines. It has been recorded at the SWF site (ELA 2011).
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Varied Sittella *Daphoenositta chrysoptera*	Species or species habitat likely to occur within area	Vulnerable TSC Act	Collision with operating wind turbines.	Rare	Negligible	Negligible	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. (OEH 2016b). It inhabits eucalypt forests and woodlands flying at canopy level. The Varied Sittella forages in groups, flying into the tree canopy and working down the branches and the trunk, probing through the bark in search of insects (Pizzey & Knight 2003). This species would not fly at RSA height.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Wedge-tailed Eagle *Aquila audax*	This species was recorded at the Sapphire WF site (ELA 2011)	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 NSW. 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	
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	Known to follow storm systems and fronts. Occasional mortality on other wind farms in its range and elsewhere. It typically flies at and above RSA height. Loss of a small number of individuals each year is not considered to be of significance as the species is numerous in Australia (OEH 2016b), although no estimates of population are available.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Other raptors	Common occurring raptor species were recorded at the Sapphire 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 NSW.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Waterbirds	Common occurring waterbird species were recorded at the Sapphire WF site	N/A	Collision with operating wind turbines.	Unlikely	Low	Negligible	Habitats on the SWF site for waterbirds are limited to small farm dams. No large concentrations of waterbirds occur nearby. Experience at other wind farms in NSW indicates few waterbirds collide with turbines, even near large waterbird concentrations (e.g. Lake George), where birds confine most of their activities to the wetlands and don't move across farmland frequently.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Corben's Long-eared Bat *Nyctophilus corbeni*	This species is assumed to occur at the Sapphire WF site (ELA 2011)	Vulnerable EPBC Act Vulnerable TSC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Known to occur in urban, agricultural semi-arid and tall wet forest habitats (OEH 2016b). Occurs in a range of habitats from rainforest to arid shrubland, roosts in tree-hollows. There are scattered records of this species across the New England Tablelands and North West Slopes. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. A very small number of this species was recorded at the nearby Glen Innes Wind Farm in 2007 (Richards 2008). There are no records of this species striking wind turbines to date, although it has the potential to fly at RSA height. The low numbers in the region make it unlikely to encounter turbines regularly or be regularly disturbed by them.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Eastern Bentwing Bat *Miniopterus schreibersii oceanensis*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable TSC Act	Collision with operating wind turbines.	Likely	Low	Low	Roosts in caves during the day, dispersing over a range of habitats at night. Its feeding areas tend to be associated with forests, wetlands and waterways. This species could collide with turbines as it is known to fly at RSA height. It is likely that small numbers of this species occur in the region. The nearest maternity site is approximately 80 km away so impacts on breeding females are unlikely. Population consequences are therefore considered to be low.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Eastern Cave Bat *Vespadelus troughtoni*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable TSC Act	Collision with operating wind turbines.	Likely	Low	Low	The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range. Very little is known about the biology of this uncommon species (OEH 2016b). It uses air space above creeks and in spaces between trees, interspersed with occasional rapid flights across paddocks (ELA 2011). It is not known if it flies at RSA height in open country.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	

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Eastern False Pipistrelle *Falsistrellus tasmaniensis*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable TSC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Prefers moist habitats with trees taller than 20 m. Roosts in tree hollows but has also been found roosting in buildings or under loose bark. Flies within or just below the canopy in gaps, along tracks, and also in open areas (ELA 2011).
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Eastern Freetail Bat *Mormopterus norfolkensis*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable TSC Act	Collision with operating wind turbines.	Likely	Low	Low	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. It occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range (OEH 2016b). It flies preferably in open spaces in woodland or forest (ELA 2011). It has been recorded flying at RSA height (BL&A, unpubl. data) and may encounter turbines but none have been recorded colliding with operating wind turbines to date.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Greater Broad-nosed Bat *Scoteanax rueppellii*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable TSC Act	Collision with operating wind turbines.	Rare	Negligible	Negligible	This species is generally associated with forested riparian habitats such as in gullies along creeks and rivers below canopy height (OEH 2016b). It was recorded during surveys at the SWF site, however it is considered unlikely regularly occur where turbines are located or at turbine height.
			Indirect disturbance, including barrier effects.	Rare	Negligible	Negligible	
Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable TSC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Known to occur in urban, agricultural semi-arid and tall wet forest habitats (OEH 2016b). Occurs in a range of habitats from rainforest to arid shrubland, roosts in tree-hollows. There are scattered records of this species across the New England Tablelands and North West Slopes. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country.It was recorded from the SWF site. There are no records of this species striking wind turbines to date, although it has the potential to fly at RSA height. The low numbers in the region make it unlikely to encounter turbines regularly or be regularly disturbed by them.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Gould's Wattled Bat *Chalinolobus gouldii*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Negligible	Negligible	Common and widespread species. Juveniles will disperse from December or January which may result in higher mortalities. Not migratory. Nests in tree hollows or buildings. Flys within canopy and sub canopy, will pass over open areas and can forage up to 15km from roosts (ELA 2011)
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Little Pied Bat *Chalinolobus picatus*	This species was recorded at the Sapphire WF site (ELA 2011)	Vulnerable TSC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	This species was not recorded on site (ELA 2011) and SWF is situated beyond the species predicted range (OEH 2016) making it unlikely to occur on site. Juveniles will disperse from March which may result in higher mortalities. Not migratory. Nests in tree hollows or buildings and caves, will roost near water. Flys within canopy, can forage up to 34km from roosts (ELA 2011)
			Indirect disturbance, including barrier effects.	Rare	Negligible	Negligible	
Southern Freetail Bat *Mormopterus planiceps*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Negligible	Negligible	Widespread and common species utilising a range of environments. Juveniles will disperse from December or January which may result in higher mortalities. Nests in tree hollows or buildings. Flys above the canopy and along roads and edges and can forage up to 12km from roosts (ELA 2011)
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Eastern Broad-nosed Bat *Scotorepens orion*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Negligible	Negligible	Common species occuring east of the Great Dividing Range. Juveniles likely disperse from December which may result in higher mortalities. Not migratory. Nests in tree hollows or buildings. Flight behaviour unknown can forage in a variety of habitats (ELA 2011)
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
White-striped Freetail Bat *Tadarida australis*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Almost certain	Low	Low	Found across Australia. Migrates to northern regions during winter, does not hibernate. Flies above the canopy and roosts in hollows. Ranges up to 50kms in a night. Juveniles disperse from january which may result in higher mortalities (ELA 2011)
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Musk Lorikeet *Glossopsitta concinna*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Negligible	Negligible	Widespread in south eastern Australia (Birdlife Australia 2016). Woodland species inhabiting tall eucalypt forests, may fly high at times. Not migratory (ELA 2011)
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Crimson Rosella *Platycercus elegans*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Negligible	Negligible	Common species occuring from southern Queensland to south eastern Australia (Birdlife Australia 2016). Woodland species, may fly high at times. Not migratory (ELA 2011)
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Eastern Rosella *Platycercus eximius*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Negligible	Negligible	Common species occuring from southern Queensland to south eastern Australia (Birdlife Australia 2016). Woodland species, may fly high at times. Not migratory (ELA 2011)
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	

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Nankeen Kestrel *Falco cenchroides*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Low	Low	Wide spread and common to grasslands (Birdlife Australia 2016) and known to hover at RSA height. Thought to be partially migratory (ELA 2011)
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Black-shouldered Kite *Elanus axillaris*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Low	Low	High flying and soaring species, nomadic in nature (Birdlife Australia 2016). Common to grass and woodlands (ELA 2011). Low records on site make it unlikey to encounter turbines.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Brown Goshawk *Accipiter fasciatus*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Low	Low	Found across Australia. High flying and soaring species, nomadic in nature. Juveniles tend to move north when dispersing uring winter. Common to grass and woodlands (ELA 2011).Low records on site make it unlikey to encounter turbines.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Whistling Kite *Haliastur sphenurus*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Low	Low	Widespread across the mainland (Birdlife Australia 2016). High flying and soaring species, nomadic in nature. Common to grass and woodlands (ELA 2011). Low records on site make it unlikey to encounter turbines.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Australian Wood Duck *Chenonetta jubata*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Negligible	Negligible	Common species to farmlands and grassland occurring around water sources such as dams (Birdlife Australia 2016). Records exist of this species struck by turbines exist at other sites (BL&A unpub. data)
			Indirect disturbance, including barrier effects.	Rare	Negligible	Negligible	
Australian Pipit *Anthus novaeseelandiae*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Unlikey	Negligible	Negligible	Common and widespread species to a variety of habitats. Feeds on the ground and perches on low shrubs and rocks (Birdlife Australia 2016). It is unlikey to encounter turbines.
			Indirect disturbance, including barrier effects.	Rare	Negligible	Negligible	
White-winged Chough *Corcorax melanorhamphos*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Negligible	Negligible	Woodland species staying mainly within treed areas between the canopy and ground level (Birdlife Australia 2016). This species occasionally encounters turbines (BL&A unpub. data)
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Laughing Kookaburra *Dacelo novaeguineae*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	Common woodland and grassland species. Flys mainly at canopy height but may fly higher over open spaces (Birdlife Australia 2016).
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Brown Falcon *Falco berigora*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Low	Low	Usually forages from perches but occasionally will hover or soar and great height. Known to move according to conditions in the region (Birdlife Australia 2016). Common to agricultural areas.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Australian Magpie *Cracticus tibicen*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Negligible	Negligible	Widespread species common to agricultural areas and woodlands (Birdlife Australia 2016). Known to fly at RSA height and collides with turbines (BL&A unpub. data)
			Indirect disturbance, including barrier effects.	Rare	Negligible	Negligible	
Spotted Pardalote *Pardalotus punctatus*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	Small woodland bird that prefers to stay within established eucalypt canopy (Birdlife Australia 2016). It is unlikely to encounter turbines.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Tawny Frogmouth *Podargus strigoides*	This species was recorded at the Sapphire WF site (ELA 2011)	Not listed	Collision with operating wind turbines.	Likely	Negligible	Negligible	Nocturnal species, breeds from August to December. Known to catch insects in flight (Birdlife Australia 2016). This species occasionally encounters turbines (BL&A unpub. data)
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	

Notes: TSC Act = Threatened Species Conservation Act; EPBC Act = Environment and Protection of Biodiversity and Conservation Act; * = Preliminary Determination by the NSW Scientific Committee.

3.6. Conclusions from the Risk Assessment for Sapphire Wind Farm

The surveys of the SWF 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.

Raptors are known to be vulnerable to collision with operating wind turbines. A number of raptor species have been recorded at the SWF 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 and Black-shouldered Kite may also be of a low risk to collision with turbines.

White-throated Needletail is a migratory species considered to have similar flight behaviour to raptors. It should be noted that White-throated Needletail is listed as a migratory species under the EPBC Act and is unlikely to be locally common. Its conservation status is listed as secure both at a state and Commonwealth level, although it is a listed migratory species at the Commonwealth level.

The Regent Honeyeater usually flies within the tree canopy and would rarely fly at RSA height. It has not been recorded in the vicinity of the SWF for 20 years, however is a possible “rare” visitor to area. The risk rating of low is considered as highly conservative given the lack of records at the site. However, the SWF partnership with ANU to understand the distribution of this important species will further inform the risk profile.

Many of the species listed under the TSC Act screened in this risk assessment are not evaluated to be at risk from the operation of SWF. Threatened woodland birds and bats do not regularly fly at RSA height and therefore do not encounter turbines very often.

This risk assessment indicates that a small proportion of the species and groups of concern (three out of 21 birds) have more than a negligible risk rating of being affected by collision with operating turbines once the SWF is constructed. No birds or bats are at risk from indirect effects, such as disturbance or barrier effects.

The BBAMP for the SWF will therefore focus on monitoring for collisions of the White-throated Needletail, Wedge-tailed Eagle and other raptors with turbines.

4. OPERATIONAL PHASE SURVEYS

A range of approaches will be utilised post-construction, i.e. the operational phase of the project, to meet the requirements of the relevant condition of approval (C6).

The main approaches to implementing the BBAMP will be:

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

Sections 4.1 to 4.3 describe the survey methodologies to be implemented once Sapphire wind farm becomes operational.

Carcass-searches are expected to be carried out for a total of two years following commencement of the operational phase of the SWF with a review and compilation of all monitoring data gathered in the first year to determine if further, more targeted, surveys will be required in the second year, or if reduced monitoring effort is justified.

4.1. Monitoring 'at risk' groups

Experience from other wind farms indicates that ongoing bird utilisation surveys (BUS) provide varying levels of information. A baseline was generated in the initial surveys in 2011 on bird utilisation of the site. A review of this information combined with information from other sources has been collated in the risk assessment and is considered to provide an adequate pre-construction baseline to compare future changes.

Thus, it is not recommended that additional "general" operational phase BUS surveys be undertaken at SWF. More specific and targeted monitoring of "at risk" groups as presented below, and also monitoring (linked to impact triggers) would provide more useful information within an adaptive management framework for addressing the bird and bat impacts of the wind farm.

The key "at risk" groups have been identified through the risk assessment (see Section 3). These include:

- **Wedge-tailed Eagles (WTE).** A moderate risk to WTE has been assessed (Table 6). Accordingly, it is important that mitigation measures are implemented, where practicable, to reduce WTE being attracted to the vicinity of the turbines and that further information is compiled on the WTE population on the wind farm site and the flight behaviours that could present a risk to WTE.
- **Other raptors and White-throated Needletail.** On site occurrence of these species will be recorded during the targeted eagle surveys described below.

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

4.1.1. Birds of Prey (Raptors)

After operations commence, monthly monitoring of eagle flight movements and breeding activity is required to determine whether operating turbines affect the behaviour of eagles. This will inform the level of risk to the local population from possible impacts of the wind farm. This raptor monitoring can be incorporated into the initial two-year monthly carcass monitoring program and will initially operate for the first two years of operational monitoring.

Information recorded will include, as a minimum:

- Date location and duration of observation period,
- Time and duration of flight,
- No. and age of birds,
- Flight height above ground (range),
- Flight behaviour,
- Habitat over which the flight was observed,
- Flight behaviour observed included soaring, directional flight (flapping), kiting, circling, gliding and diving, and
- 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 monitoring of birds as outlined above is likely to vary with potentially higher utilisation in spring-summer- autumn. However, consistent monitoring across all seasons will enable the identification of possible seasonal changes.

A series of adaptive management measures are proposed in this BBAMP to reduce the potential for high numbers of raptors to use the site. These are outlined in Section 4 below.

4.1.2. Migratory Species

White-throated Needletail typically flies at and above RSA height. The initial two-year monthly carcass monitoring will monitor their presence and any impacts likely to occur from the SWF (see section 3.3).

In addition, during the monthly carcass monitoring searches, if a flock of Needletails moves through the site, the numbers of birds and the zone of movement (where ascertainable) will be plotted on the large scale aerial photographs of the site.

The same information will be recorded for any observed flight paths of needletails as described above for raptors.

4.1.3. Regent Honeyeater and Swift Parrot

As an undertaking of the Commonwealth Government Conditions of Approval for the SWF, the proponent are to provide funds to a research institution to undertake specific research to build the body of knowledge regarding the Regent Honeyeater and Swift Parrot species and how they interact with, and are impacted by, wind farms.

There were no Regent Honeyeater and Swift Parrot recorded on-site during the initial assessment of the wind farm, however given the low number of individuals of these species and their wide-ranging migratory behaviour, this is not considered as unusual. Thus, funding

will be provided to contribute to the implementation of the relevant Recovery Plans for the species. This will include an assessment across the broader landscape of the potential for the interaction between these species and wind farms.

One focussed site survey will be undertaken to determine the presence or absence of these two species on-site during a suitable season in the first two years of operation of the wind farm. In addition, it will seek to identify any suitable habitat for these species within the wind farm. If suitable habitat is identified, turbines close to this habitat will be included in the monthly turbine monitoring program.

4.2. Post-construction Bird Utilisation Surveys

Pre-construction (Environmental Assessment) surveys were conducted at SWF. These surveys will be repeated once with monitoring in Spring and Summer-Autumn to replicate the initial surveys. These surveys will seek to demonstrate whether the site continues to be utilised by the range of species identified in the pre-construction (Environmental Assessment) surveys. These surveys should consider the finding of the initial Bird Utilisation Survey and consider incorporating elements to determine if the wind farm changes the pattern of use of the site by species.

4.3. Bat Surveys

Initial pre-construction phase surveys (ELA 2011) detected a variety of bat species across three seasons: May (autumn), September (spring) and December (summer), including a number of TSC Act listed species. No threatened bat species was assessed as above a negligible risk (Table 6), therefore operational phase bat surveys are not considered necessary.

The need for operational phase bat surveys will be guided by the results of the carcass searches. In this respect, if a significant impact trigger is identified through routine carcass monitoring (see Section 6), additional surveys may be needed to inform a management response.

In addition, the utilisation of the wind farm site by bats is expected to be very low due to the lower temperature in winter and higher in spring and summer. However, a prudent approach is to continue mortality monitoring over the winter period to ensure an annual understanding of the pattern of mortality.

4.4. Carcass searches

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

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

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

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

Ongoing monitoring of mortality from blade strike at operating wind farms typically serves to (i) provide data that can inform adaptive management of the collision risk (i.e. patterns of mortality related to seasonal changes or local conditions); and (ii) detect mortality of threatened and non-threatened bird and bat species, which can be used to understand actual bird and bat impacts.

The search protocol has been designed to detect optimally key species of interest and also any other species that have fatally collided with turbines. The consistent application of this protocol will ensure that statistically robust, spatially and temporally consistent data are collected on bird and bat mortality.

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

A scavenged carcass may increase the variability in mortality rate estimates and thus carcasses will be assessed for possible scavenging and rates will be estimated from experimental trials (section 4.4.3).

Human detectability of carcasses is also a potential confounding variable and protocols have been developed to control for this factor in the final mortality estimates. Section 4.4.4 provides more detail on these issues.

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

- Very few carcasses are found under wind turbines in Australia compared with Northern Hemisphere wind farms (i.e. on average, less than half the number in the Northern Hemisphere based on BL&A data across ten wind farms);
- Carcasses of a suitable range of sizes for scavenger and detectability trials are difficult to source and usually involve a combination of carcasses found under turbines and those found along roads and other legal sources. It is illegal to source un-cleaned carcasses from poultry producers.
- For statistical reasons, it is likely to be very difficult to determine more than the grossest of differences in scavenging rate or detectability across the year and there is no evidence in the literature for significant differences between seasons in scavenger activity. Therefore, annual scavenger and detectability correction factors will be generated and applied.

- It is known that detectability will be easier in short grass at the dry time of the year compared with in longer grass at the wet time of the year, and trials have been scheduled accordingly.

Similar methods have been recommended in a number of other approved bird and bat monitoring programs in New South Wales and Victoria (see section 1.1 for examples). Implementation of bird and bat monitoring programs in Australia is still developing (since 1998), and the techniques described here are based on the number of programs already implemented (e.g. Hull *et al*. 2013, BL&A unpubl. data from ten projects), knowledge of experimental design and statistical analysis, and recent feedback from the regulatory authorities.

Mortality detection is proposed to be carried out for two years of SWF operation. After two years of mortality monitoring, a detailed report will be prepared reviewing the mortality detection program and providing recommendations for the future in response to confirmed issues.

The following sections outline:

- **Turbine site selection for survey** (Section 4.4.1): how the wind turbines will be selected for a search
- **Search protocol** (section 4.4.2): the size of area beneath turbines to be searched and how this area will be systematically searched and results recorded
- **Scavenger rates and trials** (Section 4.4.3): definition of scavenging and how experimental trials will be conducted
- **Detectability and trials** (Section 4.4.4): definition of detectability and the experimental trial methodology
- **Incidental search protocol:** (Section 4.4.5): outlining the procedure to be adopted in the event of an incidental carcass or feather spot find by wind farm personnel outside the formal carcass-searches.
- **Analysis and mortality estimation** (Section 4.4.6): general outline of how the data will be analysed to gain estimates of bird and bat mortality.

4.4.1. Turbine Selection

Turbines will be selected based on the rules below, which are based on a 'stratified random' sampling design.

- Each turbine within a stratum has an equal chance of being selected for the searches (randomly selected by number generation table);
- No stratum can have less than three turbines; and
- Once the turbines have been selected, the selection will not change.

The results from each stratum will be analysed separately to establish if there are differences in estimated mortality between them. They will then be combined for a whole-of-wind-farm mortality estimate using appropriate statistical methods for stratified estimates with constant selection probabilities within strata.

To ensure a valid dataset for statistical analysis, the mortality detection search will be based on 18 turbines (representing 25 % of the stage 1 turbines at the SWF), split into the four

operational areas of SWF (North east, North west, South East and South West – comprising the two chains of ridges).

The number of turbines searched has been determined based on what will provide the most accurate mortality rate given the high variability in detected carcasses shown on other wind farms, and that humans will have search limits (e.g. OH&S). Each turbine that is selected for the searches will have the following recorded:

- Location (easting, northing)
- Distance to nearest turbine
- Identification number of nearest turbine
- Local vegetation (type, height, and density during each search to document change in vegetation cover over time)
- Distance to key habitat feature, such as dam/wetland or waterway, or woodland remnant.

4.4.2. Search protocol

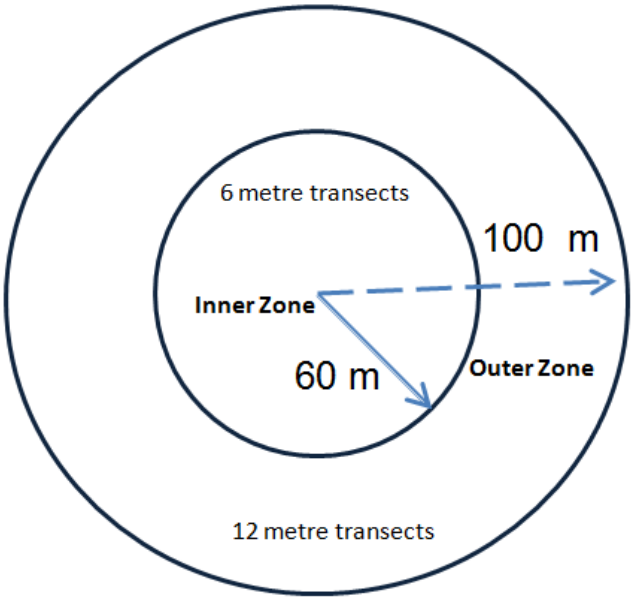
The search area beneath each turbine has been determined to best detect bats and medium to large bird carcasses, based on the turbine dimensions (Hull & Muir 2010). Based on the Hull and Muir model (2010) 95% of bat carcasses are found within 65 metres of the turbine, and carcasses of medium to large 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.

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 six metres across this circle (Figure 3).

The outer zone will comprise the zone between the 60 metre and 100 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 4). 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.

In each stratum, all sampled turbines will be searched out to 100 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 selected turbines will be searched monthly and the order of turbines searched will be randomized, however the same turbines will be searched each month.

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



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;
- Substrate and vegetation, particularly if it was found on a track or hard-stand area without vegetation as this may assist in quantifying the number of carcasses not found in areas where ground cover makes carcasses less visible;
- Species, age, number, sex (if possible) signs of injury and estimated date of strike; and
- Weather (including recent extreme weather events, if any), visibility, maintenance to the turbine and any other factors that may affect carcass discovery.
- If the species is not able to be immediately identified as there is not a qualified ecologist on-site (i.e. an incidental find), photographs will be provided to the qualified ecologist within 2 business days of the find for identification and the ecologist must reply within 5 business days for the possible reporting of an impact on a threatened species within 2 business days of confirmation..

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;
- The carcass will be clearly labelled to include the carcass 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.

It may be necessary for the wind farm operator to obtain a permit from OEH under the *National Parks and Wildlife Act 1974* to handle and keep native wildlife (even dead wildlife) as part of the monitoring program. An application for this permit may need to be submitted in a timely manner to ensure approval has been obtained prior to commissioning of the turbines. It is likely that personnel undertaking activities consistent with this BBAMP once approved by DPE will not be acting illegally in handling and keeping wildlife carcasses. However, this will be clarified in advance of this requirement with OEH.

4.4.3. Scavenger rates and trials

It will be important to ascertain the rate at which carcasses are removed by scavengers. This can be used to develop a 'correction factor' that informs the estimate of wind farm impacts on birds and bats. Scavengers can include ground-based animals, such as foxes and rats (more likely to detect carcasses by scent), as well as aerial scavengers such as birds of prey and ravens (more likely to detect them visually). The scavenger trial described below is designed to ascertain the scavenging rate, usually expressed as average carcass duration.

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

Scavenger trials will be undertaken twice for the first year of operational phase monitoring. The objective of having two trials is to account for different vegetation conditions, so one will be held when the grass is long and one when the grass is short. The two periods for scavenger trials are shown in the Table 8, below.

Table 7: Timing for scavenger trials

Vegetation condition	Likely time period	Weather	Stocking
Short grass	Winter (July)	Cold weather	Heavy stock levels
Long grass	Late Spring (November)	Follow rain and higher temperatures	Light stock levels

After the scavenger trials, the need and frequency of further scavenger and detectability trials will be reviewed and discussed with OEH.

Scavenger Trials

Scavenger Trials will be undertaken by a trained person (4.5) to determine the probability of scavenging loss, and the nature of scavenger removal (e.g. an early peak in scavenging, or scavenging that peaks after carcasses have been in place for a period of time). The search area for scavenger trials will be the same as in the search protocol (above) and will be located under operating turbines, selected based on the methodology outlined in section 4.4.2.

To determine potentially different scavenging rates on birds and bats, four size categories of carcass will be used. Different scavengers are active at different times of day and this will be accounted for by placing carcasses out during the early morning and late afternoon. This will reduce the potential for bias in the search intervals. Based on current mortality estimation software requirements, every endeavour will be made to find ten carcasses of each size category (Table 8). Improvements on this method would require an impractical and unlikely availability of required carcass numbers, and do not lead to a commensurate improvement in the statistical power of estimates. In addition, large birds (raptor size) may be substituted with data from previous grouped studies with approval from OEH.

Table 8: Number of replicates for each scavenger trial

Time	Micro-bat	Small birds	Medium sized birds	Large birds (large raptor size)
Early Morning	5	5	5	5
Late Afternoon	5	5	5	5

The trials will be conducted at the same randomly-selected turbine sites used for mortality searches (see section 5.4.1). Five carcasses from each category (twenty carcasses in total) will be randomly placed under different turbines in the morning (i.e. one carcass per turbine) and also in the afternoon (this may vary based on depending upon operational requirements). The carcasses will be checked twice daily for the first three days, then daily for two days, then every 48 hours for the following four days and then every three days until they disappear or at the end of 30 days (see Table 9).

Table 9: Scavenger trial search timetable

Day (Time)
Day 1: Early morning
Day 1: Late afternoon
Day 2: Early morning
Day 2: Late afternoon
Day 3: Early morning
Day 3: Late afternoon
Day 4: Anytime
Day 5: Anytime
Day 7: Anytime
Day 9: Anytime
Day 12: Anytime
Day 15: Anytime
Day 18: Anytime
Day 21: Anytime
Day 24: Anytime
Day 27: Anytime
Day 30: Anytime

Additional procedures for scavenger trials are provided below.

- The timing of searches is based on experience and regulatory approval at a number of other wind farms (BL&A unpublished records) where scavenger trials have been undertaken that show almost all carcasses have been scavenged within five to ten days. More frequent monitoring than that proposed herein will not significantly affect consideration of scavenging and its impact on mortality estimates.
- A mix of small and medium to very large bird and bat carcasses (if available) will be obtained for use in the scavenger trial. Where carcasses of the species of concern cannot be found, a similar-sized and coloured substitute will be used to reduce bias by visual predators.
- 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.
- At each trial site, one carcass (or more) will be placed randomly within the 60 metre search area, depending on the search protocol for that turbine. Carcasses will be thrown in the air and allowed to land on the ground to simulate at least some of the fall and allow for ruffling of fur or feathers.
- Carcasses used in the 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 carcasses have been scavenged (e.g. scavenger scats, bones, feathers, 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 state of remaining carcasses in each search.

Conduct of two scavenger trials at seasonally different times is designed to account for occasional winter/spring increase in carrion use by some scavenger species. Previous

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

Scavenger trials for large raptors will only be conducted once per year due to lack of availability of suitable carcasses for a technically sound trial. Experience from other wind farms indicates a low level of scavenging of these carcases and a high level of detectability that is consistent across the year.

The number of carcasses per animal and size category is based on obtaining a reasonable level of statistical confidence in the estimate of average carcass duration, as reflected in software requirements for current mortality estimation processes, whilst seeking to minimise the number of carcasses used, as they can be difficult to source. Large numbers of carcasses (e.g. on-site, road-kill) are difficult to obtain and it may be very complicated to find alternative sources (e.g. farmed and culled animals). It is also possible that large numbers of carcasses, more size categories and more replicates may attract more scavengers to the area. Previous studies (e.g. Molsher *et al*. 2000) have shown that fox prey use is related to availability and therefore more foxes may be attracted to the area if more carcasses are used, thereby biasing the resulting correction factor. In addition, raptors are potentially more susceptible to collision when preying on carrion beneath turbines. However, it is necessary to conduct these trials under turbines as some scavengers may alter their behaviour in response to the turbines. The final scavenger trial design is therefore a necessary compromise between high numbers of trials and practicality whilst ensuring a statistically-valid trial design without altering either the behaviour of scavengers or birds that may collide with turbines.

4.4.4. Detectability (Observer) trials

As outlined above, all searches will be supervised by a qualified ecologist and undertaken by trained ecologists or personnel trained and regularly assessed by the ecologist.

Detectability trials will be undertaken to assess the probability that a searcher will detect an existing carcass, given the prescribed mortality search protocol detailed for monthly carcass searches in section 4.4.2(i.e. searching along the six metre and 12 metre transects). The most efficient use of time is therefore to conduct the detectability trials concurrently with the monthly searches. As humans are reliant on visual cues to determine carcass location, the two visibility categories of low and high grass cover will be compared (as described in section 4.4.4).

To account for observer variability in detecting carcasses, only personnel who have carried out monthly searches at SWF will be involved in the detectability trials. Detection efficiency (percentage of carcasses detected) will then be incorporated into later analyses that derive mortality estimates. The number of carcasses to be employed in each trial is detailed in Table 10 and explained below. The carcass controller (a person not involved in monthly carcass searches who can act consistent with this method) will throw each carcass into the air and allow it to land on the ground to simulate at least some of the fall and the potential ruffling of fur and feathers. The carcass controller will note the placement of carcasses (via GPS) and

is free to decide how many are deployed under each turbine, however all bats should be located within the inner, 60 metre search zone.

Table 10: Number of replicates per season for detectability trials, given two factors of size and visibility

Time	Micro-bat	Small birds	Medium sized birds	Large birds (large raptor size)
Long grass / vegetated	5	5	5	5
Short grass	5	5	5	5

Analysis indicates that there is a large confidence interval on the estimate of searcher efficiency, even for a high number of trials (plus or minus ten percent even with 50 replicates). This means that only relatively large seasonal changes in detection (~20 - 30% or more) will be resolvable from normal background variation. Sampling will be undertaken during the two periods that represent the greatest change in vegetation cover (therefore visibility), using a number of carcasses that is logistically manageable and aligned with the number and timing of scavenger trials. Statistical confidence analysis indicates that this will result in a reasonably precise detectability estimate after one year, and optimal precision after two.

Any substitute carcasses for these trials will be of both similar size, colour 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 appearance).

If sufficient carcasses cannot be obtained, then stuffed, realistic-looking artificial substitutes may be used. As humans are entirely visual searchers, it is not essential to use real carcasses as long as the substitutes appear similar once on the ground. Additionally, the artificial substitutes will not attract scavengers and should not increase the likelihood of raptor collisions and the number of introduced predators on site. As these trials can be undertaken separately from scavenger trials, artificial substitutes may be ideal (i.e. mice substitutes for bats). Note, however, that it is considered to be more time efficient and cost effective to undertake scavenger and detectibility (observer) trials concurrently.

4.4.5. Incidental Carcass Protocol

Personnel at the Sapphire Wind Farm may from time to time find carcasses within the wind farm site during normal day-to-day O&M activities. In this case, the carcass will be handled according to the carcass detection protocol outlined in section 4.4.2. All wind farm personnel will be made aware of this carcass handling protocol as part of their HS&E training and induction. If the find is made within five days prior to a scheduled carcass search, the carcass will be left *in situ* but photographed and its position recorded (GPS). A carcass search data sheet (Appendix 2) will be completed for each incidental carcass found.

4.4.6. Analysis of results and mortality estimation

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

- The species, number, age and sex (if possible) of birds and bats being struck by the turbines.

- Any variation in the number of bird and bat strikes.

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

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, if required.

All data will be analysed to provide the average estimated mortality of birds and bats, their standard error (variability) and ranges for the SWF. The mortality rate of each species (if estimates of individual species are possible) and size class detected will be calculated after two years of data have been collected. If possible, the standard error and range of these estimates will be reported. Note that it may not be possible practically to provide this due to the likely low number of carcasses detected. Where this is an issue, it will be reported. Mortality estimates will also take into consideration the actual operational time of the turbines (obtained from the project operator).

The estimated mortality rate will be generated by modelling the scavenger losses and results of the human detectability trials, and using sampling inference to account for the selection and stratification of turbines. The data from the scavenger and detectability trials will be analysed using relevant techniques based on Generalised Linear Modelling (GLM) and (censored) Survival Analysis. Censored measurements are only partially known, such as the exact time of mortality or the exact time to scavenge loss (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 stratification of turbine sites) are significant, where possible.

4.5. Personnel Involved

This section of the plan outlines the personnel involved and any training required for the field work and report writing necessary for this BBAMP. All personnel working on this Plan will be trained thoroughly, including background theoretical training, knowledge of policies and other administrative matters (e.g. OH&S) and technical and field methods. SWF will ensure that it engages suitably qualified and trained people to supervise and implement the monitoring program.

BL&A has been approved by DPE as suitably experienced and qualified ecologists in relation to the implementation of this BBAMP. BL&A will oversee in detail and be leading site implementation of the program including the carcass searches, searcher efficiency trials and scavenger trials. Any person undertaking searches will be trained and supervised by approved ecologist who is familiar with the techniques and has applied them at other sites. The searcher will receive training from the qualified ecologist in the following areas:

- Turbine searches i.e. transect spacing in inner and outer zones, number and location of turbines to search and transect search methods
- Equipment usage i.e. GPS
- Data recording

- Species identification

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

The first searcher efficiency trial will be initiated and set up by the ecologist, who will also train a separate person (the 'carcass controller') to run searcher efficiency trials. Training will include:

- Correct preparation and handling of trial carcasses
- Correct methods for the random placement of trial carcasses within a randomly selected sub-set of the search areas, and
- The need to place trial carcasses without the searcher knowing they are being placed.

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

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

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

Annual reports and all investigations resulting from an impact trigger (see section 6) will be prepared by the approved qualified ecologist and subject to an internal peer review process.

4.6. 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.

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

- Glen Innes Veterinary Surgery, 220 Herbert St, Glen Innes NSW 2370 Phone:(02) 6732 1988
- WIRES, 02 6778 4994 or 1300 094 737
- RSPCA: Glen Innes Volunteer Branch, Phone: 0487 824 790
- Northern Tablelands Wildlife carers: 1800-008-290

This Injured Bird and Bat Protocol is valid for the operational life of the wind farm.

4.7. Reporting and Review Meetings

In accordance with Project Approval Condition C6, reports will be submitted to the Secretary and OEH on an annual basis. An annual report will be prepared within three months of the completion of the first year of operation phase monitoring. This annual report will focus on presenting the results of the mortality searches, analysis and recommending refinements to monitoring activities, if required. The second annual report will present the first full analysis of 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 (avifauna 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 (ie. climatic, geographical and infrastructure).
    - Analysis of the effectiveness of the decision-making framework.
    - Recommendations for further monitoring.

4.7.1. Review of BBAMP and adjustment of monitoring regimes

The BBAMP will be reviewed and reported upon on an annual basis for the first five years and every two years after that, unless a different agreement is reached with the Secretary, The reporting will focus on the BBAMP in terms of its effectiveness together with consideration of the intensity of effort and resourcing, and emerging understanding of the level of risk to avifauna.

At the end of the first year of operation phase monitoring, overall summary assessment will be made of all the data obtained during this phase, and details of the management practices

implemented, as well as recommended adjustments to the second year of monitoring. The results of the review and its implications will be discussed with OEH.

Annual reports prepared beyond the first year will include the results of any monitoring activities undertaken for that year and a discussion regarding any impact triggers or unacceptable impacts identified, mitigation measures implemented and application of the decision making framework (see section 6). As this management plan is adaptive, further refinements to the program will be included in annual reports following the first year of operational phase monitoring and will be based on the outcomes of monitoring surveys and any impacts, in consultation with OEH.

5. MITIGATION MEASURES TO REDUCE RISK

Mitigation involves the prevention, avoidance and/or reduction of the risk of an impact trigger occurring or continuing to occur. An '*impact trigger*' is defined in section 6 as a threshold of impact on birds or bats that triggers an investigation and/or management response. This section outlines measures that will be undertaken during operation of the wind farm to prevent or reduce the potential for an impact to occur, and addresses condition of approval C6 (e).

The overall objective of mitigation measures is to ensure that the operation of SWF does not lead to significant impacts on threatened or non-threatened birds and bats. Any future novel or new mitigation measures that are identified to be of potential benefit for birds and bats at the Sapphire Wind Farm should be incorporated into the plan as part of adaptive management, in consultation with the OEH.

5.1. Carrion removal program and stock forage control

Land-use and stock management below and around turbines can influence the presence and behaviour of native birds on site. Examples include:

- Grain feeding can be an "attractant" for parrots; and
- Carrion and rabbits can be an "attractant" to raptors in the area.

Thus, this section proposes possible mitigation measures to address these matters.

A moderate risk to WTE has been identified for SWF. The WTE and other raptors forage for carrion (dead and decaying flesh of an animal) and also on small mammals, rabbits, etc. In order to reduce the risk of raptors colliding with turbines, a regular carrion removal program will be implemented during operations, to reduce the attractiveness of the site to raptors and therefore reduce the potential for fatal collisions by this group of birds. This program will focus on an area of a minimum of 200 metres around turbines, where safe, feasible and practical. The procedures below will be adopted:

- A designated suitable person will be appointed (such as a wind farm employee or landowner) to perform the function of Carrion Removal Coordinator who will undertake the activities described below.
    - Monthly inspections of the wind farm site to search for any stock, introduced or native mammal and bird carcasses (to be recorded as incidental finds) that may attract raptors (e.g. kangaroos, pigs, goats, foxes, rabbits, dead stock). This search will be undertaken via vehicle and visual checks in addition to using binoculars to look for large carcasses within 200 metres of each turbine.
    - Additional, opportunistic observations by operators during normal inspections and work routines and by landowners as they travel around their properties provides further opportunity to identify and report carcasses of stock or feral animals so that timely collection can be undertaken to remove them. This can be addressed by operator and landowner protocols.
    - Any carcasses and/or remains found that are within 200 metres of turbines, will be collected and disposed of as soon as possible, in a manner that will avoid attracting raptors close to turbines.

- Consult with landowner or site or asset manager in relation to the appropriate disposal of collected carrion, to be located at least 200 metres away from the closest turbine.
- Wind energy facility maintenance staff and landowners will be required to notify the Carrion Removal Coordinator immediately following identification of carrion on site in between monthly searches.
- Carcass occurrence and removal will be recorded in a "management log book" maintained by SWF asset manager.

- During lambing season (usually late autumn / winter) young lambs are susceptible to death. Therefore, if possible and subject to agreement of landowners, lambing will be restricted in paddocks at least 200 metres away from turbines, where practicable, to reduce the risk that raptors (Wedge-tailed Eagles in particular) are attracted close to the turbines.
- In order to reduce collision risks to birds, where practical and with landowner agreement, the practice of grain feeding of stock within 200 metres of turbines should be minimised as it could cause draw additional parrots and other birds to the site.
- Any feral animal control on the wind farm site should involve the removal and appropriate disposal of resulting carcasses in a timely manner.
- If a large active rabbit presence is observed during monitoring surveys, it may be necessary to conduct an integrated rabbit control program (to reduce site attractiveness to Wedge-tailed Eagles) within 200 metres of turbines. Methods to control rabbits include borrow destruction, poisoning and shooting. Any rabbit control program will require cooperation and agreement from the landowner.
- An annual summary of carcass removal, based on the 'management log' will be provided in the annual monitoring reports.

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

5.2. Lighting on turbines and buildings

It has long been known that sources of artificial light attract birds, as evidenced by night-migrating birds in North America and Europe. Lighting is probably the most important factor under human control that affects mortality rates of birds and bats colliding with all structures (Longcore, et al. 2008). Most bird mortality at communication towers 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 more recent research on oil rigs at sea suggests that blue or green lights may result in lower mortality than red or white lights (American Bird Conservancy 2014).

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

6. IMPACT TRIGGERS AND DECISION-MAKING FRAMEWORK

This section identifies the circumstances that will result in notification, further investigation and additional mitigation for both threatened and non-threatened birds and bats ('impact triggers'). If an impact trigger is met, there must be an investigation into the cause of the impact, and whether the event was likely to be a one-off occurrence or occur regularly.

The impact trigger may be an unacceptable impact in itself, or may lead to an unacceptable impact.

Note that the approach developed in this section is based on the preparation of numerous bird and bat monitoring programs for wind farms in both New South Wales and Victoria, and up to date feedback from regulators on the implementation of approved plans (see section 1.1 for details).

Ultimately, the asset manager will be responsible for implementation of this BBAMP and the decision-making that goes with it, with technical support provided by the approved expert.

6.1. Threatened Species

6.1.1. Definition of Impact Trigger and Unacceptable Impact

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 and unacceptable impact 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 Commonwealth *EPBC Act* or NSW *Threatened Species Conservation Act 1995*, is found dead or injured under or close to a wind turbine during any mortality search or incidentally by wind farm personnel.

Definition of Unacceptable Impact on Threatened Species:

- Where population numbers are known and reported by OEH for the period concerned, an unacceptable impact is any impact that is likely to reduce the total species' population by more than 1% over a five year period; OR
- Where population numbers are not known, an unacceptable impact is more than three carcasses found of one threatened species over a two month period.

6.1.2. Decision Making Framework and Reporting

If a threatened species impact trigger occurs, further investigation will immediately be triggered and the decision making framework outlined below and in Figure 4 will be followed. This section complies with Condition C6 of the conditions of approval.

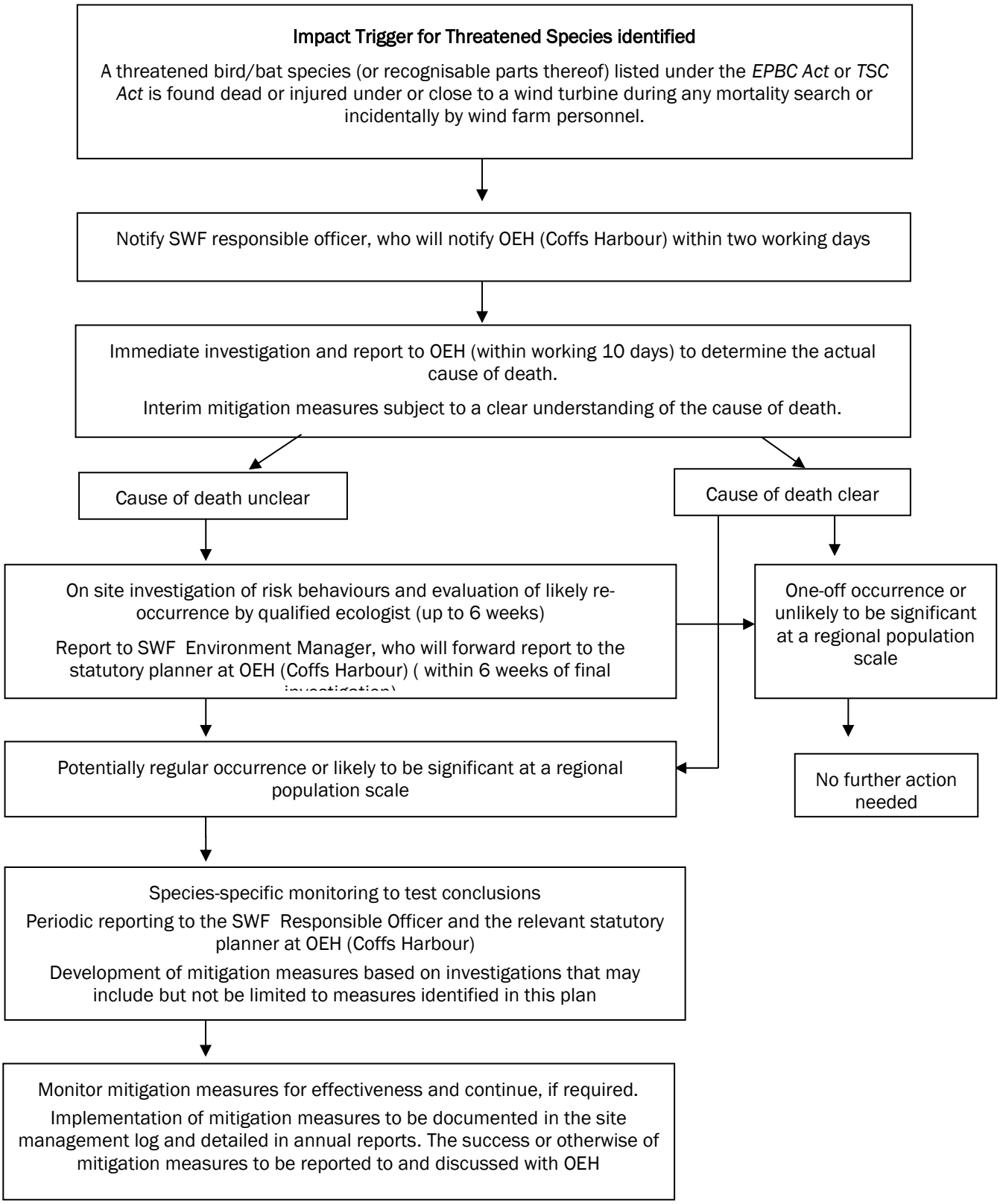
- Immediate reporting of the occurrence of an impact trigger to SWF's responsible manager, who will report it to the relevant statutory planner at OEH (Coffs Harbour) within two business days of it being recorded;
- Immediate investigation (to be completed within 10 days) by an appropriately qualified ecologist to determine the cause of death or injury. If the cause of death is considered to be 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 cluster events.

- The rapid 10 day investigation will assess, if possible, the most effective mitigation and will ensure that the mitigation is implemented correctly and quickly. The investigation will aim to provide a clear understanding of the cause of the impact, where required, informed by on-site investigations of the occurrence of the species on the wind farm site.
- If following this investigation, 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 OEH and will be determined based on available evidence and using a precautionary approach. Note that the successful execution of this requirement relies upon OEH providing timely and definitive input to this process.
- If the cause of the impact trigger is not clear, further on-site investigation of risk behaviours and evaluation of likely re-occurrence will be required over the following 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 OEH, based on available evidence.
- If the onsite investigation suggests that the impact trigger may be a regular occurrence, species-specific monitoring may be required. During the species-specific monitoring period, periodic reports will be provided to SWF and OEH.
- Responsive mitigation measures will be developed and as agreed with relevant agencies implemented in a timely manner. Examples of mitigation measures may include but are not limited to those outlined in Sections 5 and 6.3.

Any evaluation of impacts and decisions regarding mitigation measures and further investigations required will be undertaken in consultation with OEH. Any required investigation, and recommended management and supplementary mitigation measures, will be documented in the project management log and detailed in annual reports. This log will be available for inspection by OEH or on the request of the Secretary DPE.

It is recommended that the DPE approved specialist for implementation of the BBAMP be responsible for advising CWPAW on the implementation of this decision-making framework and to discuss decision making with OEH and DPE.

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



6.2. Non-threatened Species

6.2.1. Definition of Impact Trigger and Unacceptable Impact

The circumstances that define an impact trigger and significant impact for non-threatened birds and/or bats under this Management Plan is detailed below. Note that only those native species not listed as protected in the Glen Innes, Severn and Inverell local government areas, namely Sulphur-crested Cockatoos, galahs, crows and ravens and introduced bird species are not considered of conservation significance and are therefore not subject to adaptive mitigation or this impact trigger.

Impact Trigger for Non-threatened Species: A total of four or more bird or bat carcasses, or parts thereof, of the same species in two successive searches at the same turbine of a non-threatened species (excluding ravens, magpies, White Cockatoos, corellas, pipits and introduced species.).

Where population numbers are known and reported by OEH for the period concerned, the **definition of an unacceptable impact** on non-threatened species is any impact that is likely to:

- lead to a greater than 50% reduction over a five year period in the immediate population (i.e. local population, where known) that utilises the wind farm; AND
- act in an ongoing way to reduce the wider, regional population (where known) by more than 30% over a five year period; OR
- reduce the total species' population (where known) by more than 10% over a five year period.

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

6.2.2. Decision Making Framework

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

- OEH (Coffs Harbour) 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 OEH and the proponent on a case-by-case basis with consideration given to the species in question.
- An **evaluation** of impacts to the non-threatened species will be undertaken.
- A **report** on the investigation will be delivered to the relevant statutory personnel at OEH (Coffs Harbour) within three weeks.

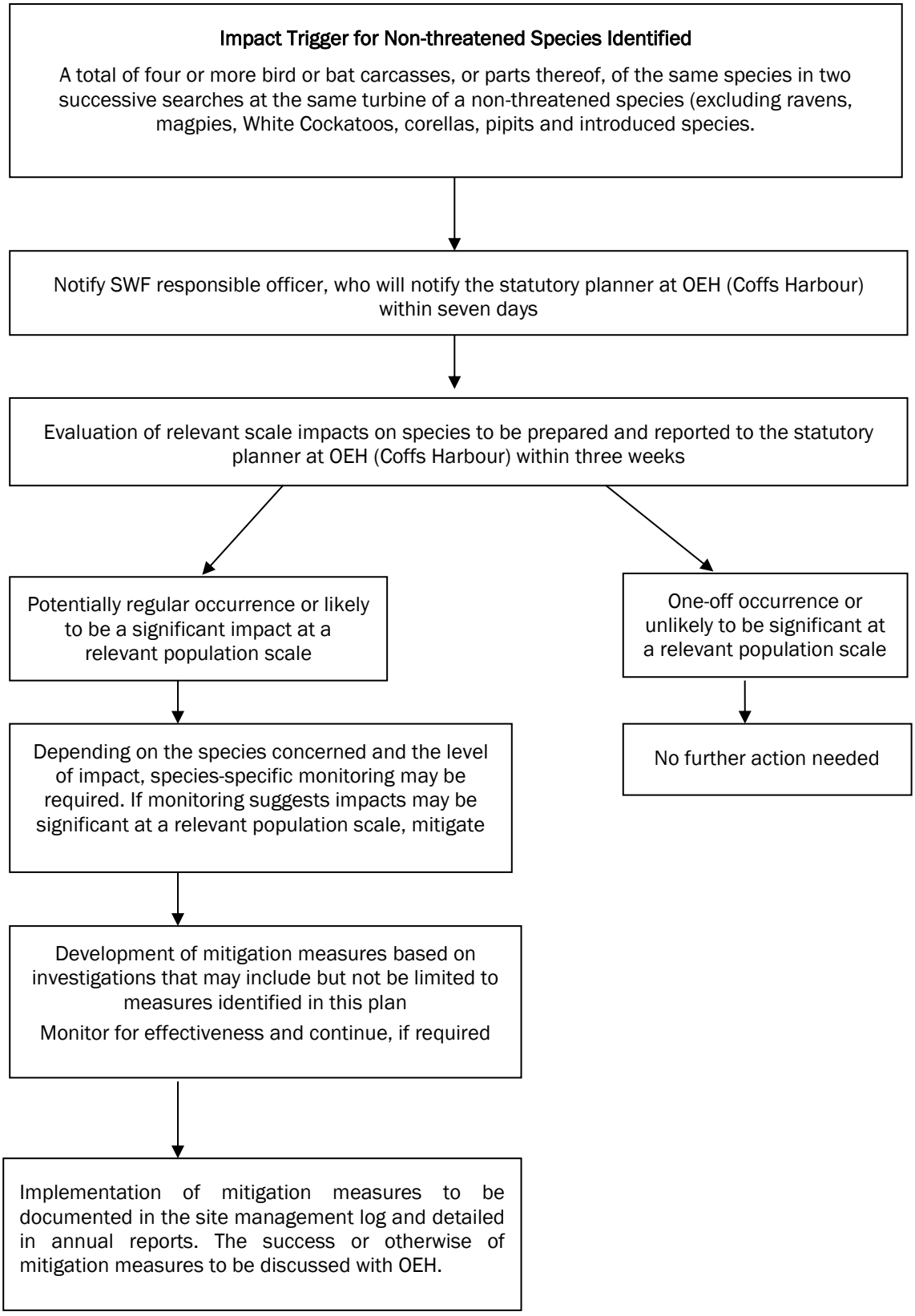
If the evaluation indicates that the event was a one-off occurrence or is unlikely to be an unacceptable impact at a relevant population scale for the species in question, no further action will be necessary (as outlined in Figure 4).

If the event is deemed to be a potentially regular occurrence or likely to lead to an unacceptable impact on the species in question, species-specific monitoring may be required (Figure 4). If further monitoring confirms that impacts are likely to lead to an unacceptable impact on the species, mitigation measures will be required. Potential

mitigation measures are outlined in Table 11, 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 and agreement from OEH. 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 OEH or on the request of the Secretary DPE.

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



6.3. Supplementary Mitigation Measures

Supplementary mitigation measures will be implemented in consultation with OEH in the event that an impact trigger occurs. The purpose of supplementary mitigation measures will be to prevent the impact from continuing to occur. Specific mitigation measures will be implemented depending on the nature, cause and significance of any impact recorded and in response to the results of investigations of the event and of the species concerned on the wind farm site.

It is difficult at this stage to know what the cause of an unacceptable impact trigger will be, 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 11. Note that in implementing mitigation measures, a suite of measures that may or may not include those in Table 11 would need to be implemented, depending on management response to particular 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 11 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. Should these be implemented as a management response at SWF the response of birds and bats to these measures will be recorded.

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

In the event that turbine shutdown as a mitigation approach for a specific species management objective is considered necessary by DPE, it will be based on specific advice from OEH and agreed with the proponent. Turbine shutdown should be considered as a last resort, once all mitigation options are exhausted. This information should include, but not be limited to:

- Ongoing acceptable impacts, including the level of risk to the species' regional and overall populations, where known;
- The findings of detailed investigations undertaken in response to the impact trigger, focussing on the species' use of the immediate area around affected turbines;
- Clear scope for on-going monitoring to identify triggers for turbine shut-down;
- Agreed triggers for turbine shutdown and restart; and
- Reporting and consultation arrangements.

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

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

Table 11: Supplementary mitigation measures in the event of an unacceptable impact trigger occurring

Hypothetical cause of impact	Mitigation Measure[3]	Likelihood of impact continuing following mitigation	Time to implementation
Foraging source identified that attracts threatened species and "at risk" species to impact areas	Consider the use of acoustics (ie. loud music/irregular noise) to discourage birds from foraging in this location where such noise would not impact neighbours	Low	Implement as soon as possible.
	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)		Implement according to agreed plan
Farming practice attracts threatened species to risky areas (e.g. grain feeding of stock)	Investigate whether farming practice is a contributing factor and if so, subject to landowner agreement relocate farming further from turbines to reduce risk	Low	Immediately
Wind/rain/fog causing low visibility	If low visibility at the site is identified as an issue, carcass searches may be repeated during periods of low visibility to measure mortality rates. Temporary shutdown of those turbines found to cause the problem may be necessary during periods of extreme low visibility – to be implemented only in the event that threatened species are experiencing unacceptable impacts.	Low	Immediately low visibility is identified as the cause of unacceptable impacts on threatened species.
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, where practicable • All lights switched off except when needed for service work	Low	If lights can be switched off, this should occur immediately. Alternative measures should be implemented as soon as practicable after recording the impact trigger.
Attraction to small dams on site	Subject to landowner agreement, fill in dam and provide alternative stock watering arrangements	Low	Implement as soon as possible after recording the impact trigger if the dam is the cause of the problem.
Nest site close to turbine	Discourage nesting close to turbines	Low	Prior to breeding season.

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

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

Management objectives	Management activities and controls	Timing	Performance criteria for measuring success of methods	Completed (yes/no)
Baseline surveys	Obtaining pre-construction baseline bird and bat utilisation data	Pre-construction • Bird survey (planned) • Bat survey complete (in progress)	• Bird utilisation surveys (point count and transect surveys) undertaken as described in this BBAMP – 2016/2017 • Bat utilisation surveys undertaken as described in this BBAMP.	
	Obtaining operational phase bird and bat mortality data	Operational phase	• As per results of the mortality monitoring in this BBAMP.	
Mortality monitoring	18 turbines to be surveyed each month to 100 metres in accordance with the inner- and outer zone search protocol. The same turbines will be searched each month for a period of 24 months, following which the need for further surveys will be reviewed based on the results of the first two years of monitoring.	Operational phase monthly until end of 24 months	• Operational phase mortality surveys undertaken monthly at at least 18 turbines for at least two years, with a review after the first years to determine if a change in the methodology is required.	
	Calculating annual mortality of birds and bats per turbine based on operational phase repetition of monitoring activities. Mortality estimates should include correction factors from scavenger and detector efficiency trials.	Operational phase at the end of the first two years of mortality monitoring	• Scavenger and detector efficiency trials undertaken • Estimates of mortality for birds and bats made after full year of monitoring	
Annual Reports	Preparation of Annual Reports to be submitted to Secretary and OEH for the first two years after the completion of a year's monitoring activities.	Operational phase– after years one and two.	• Annual reports for the first two years delivered within three months of completion of yearly monitoring. • Annual reports to include (but not be limited to) results of monitoring surveys for that year, any impact triggers or unacceptable impacts identified, mitigation measures implemented, application of the decision-making framework and recommendations for the following year. • Further annual reports upon agreement	
Mitigation measures to reduce risk	Carrion removal program - stock and kangaroo carcasses will be removed from within 200 metres of wind turbines on a monthly basis and disposed of.	During operation	• Carcasses removed • Activity recorded in management log book • Increase frequency of stock and kangaroo carcass removal and disposal if required	
	Subject to landowner agreement, restrict lambing to paddocks at least 200m from turbines.		• No increase in raptor mortality during lambing season	
	Subject to landowner agreement, stock will not be fed grain underneath turbines		• No increase in bird mortality due to grain underneath turbines	
Mitigation measures to reduce risk	Pest control program - Implement rabbit control if the carrion removal program suggests rabbit carcasses are an issue, subject to landowner agreement	During operation	• Monitor effectiveness of rabbit control and, where bird mortality is clearly related to rabbit numbers, increase the effectiveness of rabbit control	
	Habitat improvement or protection to encourage animals to use habitats away from turbines.	During operation	Protection of offset site located in woodland habitat.	
	Minimising external lighting. If required. There are only low levels of lighting on the wind farm during operation.		If mortality at turbines near light sources significantly exceeds that of activity at unlit turbines, type and duration of lighting will need to be reviewed, subject to security and OH&S limitations.	
	Remove permanent 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.			
	Use of deterrents – Where required, overhead powerlines should have marker balls and/or flags where they cross waterways		No incidental records of bird mortality from power line collision around waterways.	

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Appendix 1: Threatened Bird and Bat Species likelihood of occurrence at the Sapphire Wind Farm

Common Name	Scientific Name	TSC	EPBC	Habitat	Number of records	Likelihood of occurrence
Australian Painted Snipe	*Rostratula australis*	E	CE	Generally inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia* or canegrass or sometimes tea-tree (*Melaleuca*). Sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber.	0	No suitable habitat on site - **unlikely to occur.**
Barking Owl	*Ninox connivens*	V		Eucalyptus dominated forests and woodlands, commonly near water-bodies, such as streams and rivers, and requires hollow trees for nesting and trees with dense foliage for roosting (Higgins 1999).	7	Suitable dry woodland and forest habitat on site. **Potential to occur.**
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	V		Typically occurs in open forests and woodlands dominated by box and ironbark eucalypts (Higgins *et al* 2001).	12	Suitable dry woodland and forest habitat on site. **Potential to occur.**
Black-faced Monarch	*Monarcha melanopsis*		M (Bonn)	Rainforests, eucalypt woodlands, coastal scrub and damp gullies (Higgins et al. 2006).	0	No suitable habitat on site - **unlikely to occur.**
Black-necked Stork	*Ephippiorhynchus asiaticus*	E		Inhabits tropical and warm-temperate terrestrial wetlands, estuarine and littoral habitats and occasionally grassland and woodlands (Marchant and Higgins 1990).	1	No suitable habitat on site - **unlikely to occur.**
Black-throated Finch (southern subspecies)	*Poephila cincta cincta*	E	E	Dry , open, grassy woodland and forest (Higgins *et al* 2006).	1	No recent or regular records in the search region, species virtually extinct in NSW. **Unlikely to occur.**
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V		Woodlands dominated by eucalyptus, especially Stringybarks or other rough-barked eucalypts usually with open grassy understorey (Higgins et al. 2001)	64	Suitable dry woodland and forest habitat on site. **Recorded on site.**
Diamond Firetail	*Stagonopleura guttata*	V		Commonly found in box-ironbark forests and woodlands and also occurs along watercourses and in farmland areas. Widespread but scattered. Populations had declined in Victoria since the 1950s. (Emison et al. 1987; Tzaros 2005).	39	Suitable dry woodland and forest habitat on site. **Recorded on site.**
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V*		Dry open sclerophyll forests and woodlands, usually dominated by eucalypts. Often found on the edges or in clearings of forest and woodland and sometimes recorded in shrubland and heathland and other various modified landscapes (Higgins *et al* 2006).	30	Suitable dry woodland and forest habitat on site - **likely to occur.**
Fork-tailed Swift	*Apus pacificus*		M (CAMBA, JAMBA, ROKAMBA)	The species can occur in wet sclerophyll forest but mainly prefers open forest or plains. It is almost exclusively aerial and feeds up to hundreds on metres above the ground, but can feed among open forest canopy. The species breeds internationally and seldom roosts in trees and is unlikely to be impacted by the development (Higgins et al 2006).	0	Suitable habitat on site - **potential to occur.**
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V		The species is dependent on Allocasuarina; prefer woodlands dominated with allocasuarina or open eucalypt forests with middle stratum of allocasuarina (Higgins 1999).	11	No suitable habitat on site - **unlikely to occur.**
Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*	V		Occur mostly in open Grey Box, White Box, Yellow Box, Yellow Gum and Ironbark woodlands with pockets of saplings or taller shrubs, an open shrubby understorey, sparse grasses and patches of bare ground and leaf-litter, with scattered fallen timber. The population has declined throughout range, especially since the early 1980s. This species typically occurs north of the great divide in shrubland or woodland dominated by acacias. (Higgins and Peter 2002; Tzaros 2005).	5	Suitable dry woodland and forest habitat on site. **Recorded on site.**
Latham's Snipe	*Gallinago hardwickii*		M (CAMBA, JAMBA, ROKAMBA)	Occurs in wide variety of permanent and ephemeral wetlands; it prefers open freshwater wetlands with dense cover nearby, such as the edges of rivers and creeks, bogs, swamps, waterholes. The species is wide spread in southeast Australia and most of its population	1	No suitable habitat on site - **unlikely to occur.**

Common Name	Scientific Name	TSC	EPBC	Habitat	Number of records	Likelihood of occurrence
				occurs in Vic. Except in the northwest of the state (Naarding 1983; Higgins and Davies 1996).		
Little Eagle	*Hieraaetus morphnoides*	V		Over wooded and forested lands and open country of Aust. Range extending into arid zone. Most abundant in open forest and woodland.	3	Suitable habitat on site - **potential to occur.**
Little Lorikeet	*Glossopsitta pusilla*	V		Mainly dry, open sclerophyll forests and woodlands, usually dominated by Eucalyptus. Often near waterbodies such as creeks, lakes and swamps.	55	Suitable dry woodland and forest habitat on site. **Recorded on site.**
Painted Honeyeater	*Grantiella picta*	V	V	Inhabits box-ironbark forests and woodlands and mainly feeds on the fruits of mistletoe. Strongly associated with mistletoe around the margins of open forests and woodlands. Occurs at few localities. Uncommon breeding migrant from further north, arriving in October and leaving in February. (Higgins et al. 2001; Tzaros 2005).	0	Suitable habitat on site - **potential to occur.**
Powerful Owl	*Ninox strenua*	V		Open and tall wet sclerophyll forests with sheltered gullies and old growth forest with dense understorey. They are also found in dry forests with box and ironbark eucalypts and River Red Gum. Large old trees with hollows are required by this species for nesting. In Victoria, the Powerful Owl is widespread, having been recorded from most of the state. However, throughout its range it is uncommon and occurs in low densities. (Higgins 1999; Soderquist et al. 2002).	4	Suitable habitat on site - **potential to occur.**
Red Goshawk	*Erythrotriorchis radiatus*	CE	V	Woodland and forest with a mosaic of vegetation types, large population of birds and permanent water in the tropical and warm-temperate coastal and sub-coastal areas (Marchant and Higgins 1993).	0	The site is outside its natural distribution range - **unlikely to occur.**
Regent Honeyeater	*Anthochaera phrygia*	CE	CE	Inhabits dry box-ironbark eucalypt forests near rivers and creeks on inland slopes of the Great Dividing Range. It could also occur in small remnant patches or in mature trees in farmland or partly cleared agricultural land (Higgins et al. 2001).	4	Suitable habitat on site - **potential to occur.**
Rufous Fantail	*Rhipidura rufifrons*		M (Bonn)	Primarily found in dense, moist habitats. Less often present in dry sclerophyll forests and woodlands (Higgins et al. 2006).	0	No suitable habitat - **unlikely to occur.**
Satin Flycatcher	*Myiagra cyanoleuca*		M (Bonn)	Tall forests and woodlands in wetter habitats but not in rainforest (Higgins et al. 2006)	0	No suitable habitat - **unlikely to occur.**
Scarlet Robin	*Petroica boodang*	V		Eucalypt woodlands forest with open understorey (Higgins and Peter 2002).	15	Suitable open woodland and forest habitat on site. **Recorded on site.**
Speckled Warbler	*Chthonicola sagittata*	V		Inhabits dry eucalypt forests and woodlands, especially those with box-ironbark eucalypt associations. It is also found in River Red Gum woodlands. The species is uncommon; populations have declined since the 1980s. (Higgins and Peter 2002; Tzaros 2005).	38	Suitable habitat on site. **Recorded on site.**
Spotted Harrier	*Circus assimilis*	V		It prefers open woodlands that do not obstruct low flight, and natural and exotic grasslands in arid and semi arid areas (Higgins and Davies 1996).	0	Suitable habitat on site - **potential to occur.**
Square-tailed Kite	*Lophoictinia isura*	V		It occurs mainly in open forests and woodlands and in NSW it utilises habitats with Woolybutt, Spotted Gum, peppermint, early regrowth after logging, eucalypt forest with shrubby understorey and box-ironbark woodland. Never plentiful, clearing has greatly reduced suitable forest and woodland habitat (Marchant and Higgins 1993).	5	Suitable habitat on site - **potential to occur.**
Squatter Pigeon	*Geophaps scripta scripta*	E	V	In tropical dry sclerophyll woodlands and less often savannas. Almost always near permanent water such as rivers, creeks and waterholes (Higgins and Davies 1996).	0	No suitable habitat on site and out of normal distribution range - unlikely to occur.
Swift Parrot	*Lathamus discolor*	E	CE	Prefers a narrow range of eucalypts in NSW, including White Box, Red Ironbark, Mugga Ironbark, Grey Box and Yellow Gum as well as River Red Gum when this species supports abundant 'lerp'. Breeds in Tasmania and migrates to the mainland of Australia for the autumn, winter and early spring months. It lives mostly north of the Great Dividing Range (Emison et al. 1987; Higgins 1999; Kennedy and Tzaros 2005).	0	Suitable habitat on site - **potential to occur.**

Common Name	Scientific Name	TSC	EPBC	Habitat	Number of records	Likelihood of occurrence
Turquoise Parrot	*Neophema pulchella*	V		Occur in eucalypt woodlands and open forests, with ground cover of grasses and sometimes low understorey of shrubs; usually in native grassy forests and woodlands composed of mixed assemblages of native pine and variety of eucalypts. Also occur in savannah woodlands and riparian woodlands. In Vic. Recorded in East Gippsland and northern and north-eastern districts. (Higgins 1999).	40	Suitable open woodland and forest habitat on site. **Recorded on site.**
Varied Sittella	*Daphoenositta chrysoptera*	V		Eucalypt woodland and forest with a shrubby and/or grassy understorey (Higgins and Peter 2002).	13	Suitable habitat on site - **potential to occur.**
White-throated Needletail	*Hirundapus caudacutus*		M (CAMBA, JAMBA, ROCAMBA)	Aerial, over all habitats, but probably more over wooded areas, including open forest and rainforest. Often over heathland and less often above treeless areas such as grassland and swamps or farmland (Higgins 1999).	1	Suitable habitat on site - **potential to occur.**
Yellow Wagtail	*Motacilla flava*		M (CAMBA, JAMBA, ROCAMBA)	Extremely uncommon migrant. Few sightings in Victoria. Mostly occurs in well-watered open grasslands on the fringes of wetlands. Roosts in mangroves and other dense vegetation (DotE 2015).	0	No suitable habitat - unlikely to occur.
Corben's Long-eared Bat	*Nyctophilus corbeni*	V	V	Dry woodland and shrubland communities in semi-arid regions (Menkhorst 1995).	9	Suitable habitat on site - **potential to occur.**
Eastern Bentwing Bat	*Miniopterus schreibersii oceanensis*	V		Roosts in caves during the day, dispersing over a range of habitats at night. Its feeding areas tend to be associated with major drainage systems (Menkhorst 1995).	4	Suitable habitat on site. **Recorded on site.**
Eastern Cave Bat	*Vespadelus troughtoni*	V		Tropical mixed woodland and wet sclerophyll forest on the coast and the dividing range but extend into drier forest of the western slopes and inland areas (Churchill 1998).	Recorded	Suitable habitat on site. **Recorded on site.**
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V		Sclerophyll forests from the Great Dividing Range to the coast, prefer wet habitats where trees are greater than 20 metres high (Churchill 1998).	Recorded	Suitable habitat on site. **Recorded on site.**
Eastern Freetail Bat	*Mormopterus norfolkensis*	V		Dry eucalypt woodland and forest east of the Great Dividing Range (Churchill 1998).	Recorded	Suitable habitat on site. **Recorded on site.**
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V		Prefers moist gullies in mature coastal forest, or rainforest, lying between the Great Dividing Range and the coast. Also recorded in gullies of open woodland, wet and dry sclerophyll forests (Churchill 1998).	Recorded	Suitable habitat on site. **Recorded on site.**
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	Brisbane, Newcastle, Sydney and Melbourne are occupied continuously. Elsewhere, during spring, they are uncommon south of Nowra and widespread in other areas of their range. Roosts in aggregations of various sizes on exposed branches. Roost sites are typically located near water, such as lakes, rivers or the coast. Roost vegetation includes rainforest patches, stands of Melaleuca, mangroves and riparian vegetation, but colonies also use highly modified vegetation in urban and suburban.	0	No breeding sites in the study area - **unlikely to occur.**
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	Dry sclerophyll woodland and forest and also occur in sub-alpine woodland, the edge of rainforest and wet sclerophyll forest (Churchill 1998).	0	Outside its normal distribution range - **unlikely to occur.**
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	V		Known to occur from urban, agricultural semi-arid and tall wet forest habitats (Menkhorst 1995).	Recorded	Suitable habitat on site. **Recorded on site.**

Notes: TSC = threatened species status under the TSC Act: CE = critically endangered; E = endangered; V = vulnerable; * = Preliminary Determination by the NSW Scientific Committee; **EPBC**= threatened species status under EPBC Act: CE = critically endangered; E = endangered; V = vulnerable; M = listed migratory taxa; Bonn = Bonn Convention - Convention on the Conservation of Migratory Species of Wild; CAMBA - China- Australia Migratory Birds Agreement; JAMBA - Japan-Australia Migratory Birds Agreement; ROKAMBA - Republic of Korea Australia Migratory Birds Agreement.

Appendix 2: Carcass Search Data Sheet

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