RYE PARK WIND FARM

Bird and Bat Adaptive Management Plan

Development Consent No. 6693

EPBC Approval 2020-8837

May 2023

umwelt

renewables

Rye Park Wind Farm

Document Title: Rye Park Wind Farm Bird and Bat Adaptive Management Plan
Revision: 8
Date: 15 May 2023

Document History and Status

Revision	Date	Description	By	Review	Approved
6	24/04/2023	Further revision for regulatory review	Bill Wallach (Umwelt)	J Beckett (Tilt Renewables)	J Shuker (Tilt Renewables)
7	03/05/2023	Final for regulatory review	Bill Wallach (Umwelt)	J Beckett (Tilt Renewables)	J Shuker (Tilt Renewables)
8	15/05/2023	Final for regulatory review (incorporating additional requested edits)	Bill Wallach (Umwelt)	J Beckett (Tilt Renewables)	J Shuker (Tilt Renewables)

Declaration of Accuracy

I declare that:

1. To the best of my knowledge, all the information contained in, or accompanying this Rye Park Wind Farm Bird and Bat Adaptive Management Plan is complete, current and correct.
2. I am duly authorised to sign this declaration on behalf of the Applicant / approval holder of the EPBC Approval.
3. I am aware that:
    a) Section 490 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence for an approval holder to provide information in response to an approval condition where the person is reckless as to whether the information is false or misleading.
    b) Section 491 of the EPBC Act makes it an offence for a person to provide information or documents to specified persons who are known by the person to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) where the person knows the information or document is false or misleading.
    c) The above offences are punishable on conviction by imprisonment, a fine or both.

Signed:  Date: 15/05/2023

Full Name & Title: Tom Villiers, Executive General Manager – Delivery

Organisation: Tilt Renewables

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Australian Government
Department of Climate Change, Energy, the Environment and Water

EPBC ref: 2020/8837

Mr James Beckett
Rye Park Renewable Energy Pty Ltd
james.beckett@tiltrenewables.com

Approval of Bird and Bat Adaptive Management Plan for Rye Park Wind Farm

Dear Mr Beckett

Thank you for your email dated 15 May 2023 to the Department of Climate Change, Energy, the Environment and Water, seeking approval of the R*ye Park Wind Farm Bird and Bat Adaptive Management Plan,* Rev. 8, dated 15 May 2023, in accordance with conditions 8-10 of the above project under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Officers of the department have advised me on the Bird and Bat Adaptive Management Plan and the requirements of the conditions of the approval for this project. On this basis, and as a delegate of the Minister for the Environment and Water (the Minister), I have decided to approve the R*ye Park Wind Farm Bird and Bat Adaptive Management Plan,* Rev. 8, dated 15 May 2023. This plan must now be implemented.

As you are aware, the department has an active monitoring program which includes monitoring inspections, desk top document reviews and audits. Please ensure that you maintain accurate records of all activities associated with, or relevant to, the conditions of approval so that they can be made available to the department on request.

Should you require any further information please contact the Post Approvals Section, attention Kimberley Glover, by email at PostApproval@dcceew.gov.au.

Yours sincerely

Rachel Short

Branch Head
Environmental Assessments (Vic, Tas) and Post Approvals Branch

8 June 2023

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Acronyms and Abbreviations

Abiotic	Physical rather than biological, e.g., climate
Abundance	Number of individuals per species
AGL	Above ground level
Barotrauma	Bodily injury caused by changes in barometric (air) pressure.
BAM	Biodiversity Assessment Method
BBAMP	Bird and Bat Adaptive Management Plan (this document)
BC Act	*Biodiversity Conservation Act 2016 (NSW)*
BCS	Biodiversity, Conservation and Science Directorate (of DPE)
Biotic	A living organism
Carrion	Dead and decaying flesh of animals
DAWE	The former Department of Agriculture, Water and the Environment (now known as the Department of Climate Change, Energy, the Environment and Water)
DCCEEW	Department of Climate Change, Energy, the Environment and Water
The Developer	Rye Park Renewable Energy Pty Ltd, and having the same meaning as Approval Holder under the EPBC Approval
The Development	The Rye Park Wind Farm Project as described in the EPBC Approval and the Development Consent, as modified or varied from time to time
Development Consent	Development Consent SSD 6693 granted under the EP&A Act for 77 wind turbines with a 200 m tip height, as modified from time to time
DPE	Department of Planning and Environment
DPIE	The former Department of Planning, Industry and Environment (now known as the Department of Planning and Environment)
Diurnal	Daytime; of or during the day
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Cth)*
EPBC Approval	EPBC 2020/8837 granted for the Action under the EPBC Act, as varied from time to time.
EMS	Environmental Management Strategy
Fecundity	Potential reproductive output
km	Kilometres
m	Metres
Mortality	Death rate
NPW Act	*National Parks and Wildlife Act 1974 (NSW)*
NSW	New South Wales
Original Development Consent	Development Consent SSD 6693 granted under the EP&A Act on 22 May 2017
Project Area	means all of the area marked in blue and labelled as 'Project Area - Road Upgrades' as shown in Appendix A of the EPBC 2020/8837, and the area outlined in black and labelled as 'Development Corridor - Wind Farm', the areas marked in blue and labelled as 'Project Area – Road Upgrades' and the areas outlined in

	green and labelled as 'Development Corridor - Permanent Met Masts' as shown in Appendix B of the EPBC 2020/8837
RSA	Rotor swept area
Strike	An impact between bird or bat and wind turbine blade or associated infrastructure
Transect (survey)	A straight-line survey of pre-determined length from which observations are made
website	means a set of related web pages located under a single domain name attributed to the Developer and available to the public

1.0 Introduction

1.1 Background

The Rye Park Wind Farm (the Development) is located to the west of Rye Park, to the north-west of Yass and south-east of Boorowa, in New South Wales (NSW), and is owned by Rye Park Renewable Energy Pty Ltd (the Developer).

Development Consent (SSD 6693) (the Development Consent) was granted by the NSW Planning Assessment Commission (PAC, now known as the Independent Planning Commission) under the *Environmental Planning & Assessment Act 1979* (EP&A Act) on 22 May 2017, and a modification (MOD 1) approved on the 15 April 2021. A further modification to the Development Consent was approved by a delegate of the Minister on 23 September 2022.

The Development has also been granted approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC 2020/8837 or the EPBC Approval) on 1 June 2021, with a subsequent variation to the EPBC Approval granted on 30 June 2022.

This Bird and Bat Adaptive Management Plan (BBAMP) addresses the requirements of the Development Consent (Schedule 3 Condition 23) and the EPBC Approval (Conditions 8 – 11). The Development will be carried out generally in accordance with the Environmental Impact Statement (EIS) and the Development Consent as per Schedule 2 Condition 2 of the Development Consent.

Construction of the Development commenced in late-2021, with the commissioning of the Development proposed to commence from May 2023 prior to the operation of the Development from early 2024.

All conditions listed within Development Consent and EPBC Approval will be adhered to and implemented throughout the life of the Development.

1.2 Purpose and Objective of this BBAMP

This BBAMP presents a strategy to monitor and mitigate impacts including to birds and bats attributable to the construction and operation of the Development.

The overall objective of this BBAMP is:

> *To ensure the Development does not result in a significant impact on birds and bats by retaining viable local populations of threatened species.*

An assessment of the likelihood and consequence of direct impacts such as blade strike and indirect impacts was conducted for 13 species that are listed under the EPBC Act and/or the *Biodiversity Conservation Act 2016* (BC Act) and one non-listed species (refer to Section 4.0). Five species, namely black falcon (*Falco subniger*), little eagle (*Hieraaetus morphnoides*), superb parrot (*Polytelis swainsonii*), white-throated needletail (*Hirundapus caudacutus*) and large bentwing bat (*Miniopterus schreibersii oceanensis*) were identified as being a 'High' risk while a further six, namely wedge-tailed eagle (*Aquila audax*), painted honeyeater (*Grantiella picta*), white-fronted chat (*Epthianura albifrons*), dusky woodswallow (*Artamus cyanopterus*), eastern false pipistrelle (*Falsistrellus tasmaniensis*) and yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) were identified as being a 'Moderate' risk.

The environmental objectives of this BBAMP, including a table of commitments to achieve these objectives are outlined in Section 2.0.

Details of the Development Consent and EPBC Approval in relation to the BBAMP and where the specific requirements have been addressed are summarised in Table 1 and Table 2 respectively.

Table 1: Bird and Bat Adaptive Management Plan – Schedule 3 Condition 23 of the Development Consent

Requirement	Where addressed in this BBAMP
Prior to the commissioning of any wind turbines, the Applicant must prepare a Bird and Bat Adaptive Management Plan for the development in consultation with BCS, and to the satisfaction of the Planning Secretary. This plan must include:	This Plan
(a) at least 12 months' worth of baseline data on threatened and 'at risk' bird and bat species and populations in the locality that could be affected by the development;	Section 3.0 - Table 5
(b) a detailed description of the measures that would be implemented on site for minimising bird and bat strike during operation of the development, including: • minimising the availability of raptor perches; • prompt carcass removal; • controlling pests; and • using best practice methods for bat deterrence, including managing potential lighting impacts;	Section 7.0 - Tables 11 and 12
(c) trigger levels for further investigation of the potential impacts of the project on particular bird or bat species or populations;	Section 6.0
(d) an adaptive management program that would be implemented if the development is having an adverse impact on a particular threatened or 'at risk' bird and/or bat species or populations; including the implementation of measures to: • reduce the mortality of those species or populations; or • enhance and propagate those species or populations in the locality;	Section 6.0
(e) a detailed program to monitor and report on the effectiveness of these measures, and any bird and bat strikes on site; and	Section 6.0
(f) provisions for a copy of all the raw data collected as part of the monitoring program to be submitted to BCS and the Planning Secretary.	Section 8.1 - Table 13
Following the Planning Secretary's approval, the Applicant must implement the Bird and Bat Adaptive Management Plan.	Noted

Table 2: Bird and Bat Adaptive Management Plan - Conditions 8 - 11 of the EPBC Approval

Requirement	Where addressed in this BBAMP
8. To minimise impacts to EPBC Act listed bird and bat species during commissioning and operation of the wind farm, the approval holder must submit a Bird and Bat Adaptive Management Plan (BBAMP) for the Minister's approval prior to the commencement of commissioning. The BBAMP must ensure that the commissioning and operation of wind turbines is managed, monitored and limited such that impacts to EPBC Act listed bird and bat species are reliably detected, quantified, reported and responded to.	This Plan
9. The approval holder must not commence commissioning unless the Minister has approved the BBAMP in writing. The approval holder must implement the approved BBAMP.	Noted
10. The BBAMP must be consistent with the department's Environmental Management Plan Guidelines, and must include:	Details below
a. The environmental objectives of the BBAMP, relevant EPBC Act protected matters and a reference to where each relevant EPBC Act approval condition is addressed in the BBAMP;	Section 2.0 - Tables 2 and 3
b. A table of commitments made in the BBAMP to achieve the environmental objectives, and a reference to where the commitments are detailed in the BBAMP;	Section 2.0 - Table 4
c. An assessment of risks to achieving the BBAMP environmental objectives and strategies that will be applied to manage risks;	Section 2.0
d. A proposed program of monitoring to detect or reliably estimate all collisions with EPBC Act listed bird and bat species. The approval holder must provide evidence that the proposed methods, frequency, and timing of monitoring will provide statistically reliable detection or reliable estimates of all collisions with EPBC Act listed bird and bat species. The monitoring program must specify:	Section 5.0 - Tables 9 and 10
i. measurable performance indicators;	Section 8.0 - Table 13

Requirement	Where addressed in this BBAMP
ii. triggers for corrective actions;	Section 6.0
iii. the timing and frequency of monitoring to detect triggers and changes in the performance indicators;	Section 5.0
iv. mortality monitoring, including carcass searches, carcass persistence trials and scavenger trials methodologies;	Section 5.4 - 5.6
v. proposed corrective actions if triggers are reached, including, but not limited to, ceasing operation of specific wind turbines;	Sections 6.1.2, 6.2.2 and 7.0
e. Measures, and their timing, to avoid and mitigate impacts, including, but not limited to:	Section 7.0
i. measures to minimise impacts associated with lighting (such as preventing the attraction of EPBC Act listed bird and bat species to locations with high risk of collision with turbines);	
ii. measures to minimise the risks to EPBC Act listed bird and bat species from turbine strike (such as bird and insect deterrents, low wind speed curtailment, ceasing operation of specific wind turbines during specific times, and/or permanent decommissioning of specific turbines); and	
iii. procedures for dealing with any EPBC Act listed bird and bat species that require relocation or are injured within the project area;	Section 5.8.1
f. How the effectiveness of mitigation measures will be monitored and analysed, and decisions made regarding adaptive measures to achieve the environmental objectives of the BBAMP;	Section 8.0
g. Reporting and review mechanisms, and documentation standards to demonstrate compliance with the BBAMP. This must include how monitoring data and analysis of monitoring results will be reported and published, and a procedure for reporting the death or injury of any EPBC Act listed bird and bat species to the department;	Section 6.1 and 8.0
h. A proposal for how any residual significant impact to an EPBC Act listed bird and bat species will be offset by the approval holder in accordance with the EPBC Act Environmental Offsets Policy.	Section 7.0
11. The approval holder must provide an evaluation, prepared by a suitably qualified person, of the effectiveness of the measures implemented to avoid and mitigate impacts to EPBC Act listed bird and bat species within the project area from turbine strike, and report against triggers for corrective actions, in each compliance report required under condition 29.	Section 8.0

1.3 Site Description

The Development is located north of Yass and east of Boorowa NSW, on the edge of the Southern Tablelands and the South West Slopes Bioregions (Figure 1). The Project Area boundary is made up of the estate boundaries of involved properties. It spans approximately 37 kilometres (km) along a prominent NNW – SSE aligned ridge from a location 17 km east of Boorowa at its northern boundary to a location 11 km north-east of Yass at its southern boundary. The Development is located within three local government areas, namely Yass Valley, Hilltops and Upper Lachlan.

The Development is located in a highly fragmented landscape characterised by broadscale loss of native ecological communities, particularly grasslands and woodlands that typically occur on the lower slopes and plains of this region. The lower slopes of the area primarily comprise farmland containing scattered paddock trees and areas of remnant Blakely's red gum (*Eucalyptus blakelyi*) - yellow box (*E. melliodora*) grassy woodland. The upper slopes and ridge tops generally contain extensive patches of dense shrubland dominated by sifton bush (*Cassinia arcuata*) and open dry forest dominated by brittle gum (*E. mannifera*), broad-leaved peppermint (*E. dives*), red stringybark (*E. macrorhyncha*) and inland scribbly gum (*E. rossii*).

The assemblage of bird and bat species that occur within the Project Area is typical of locations containing areas of remnant open dry forest and box-gum woodland within the highly fragmented, agricultural matrix landscape of the NSW South West Slopes and western Southern Tablelands.

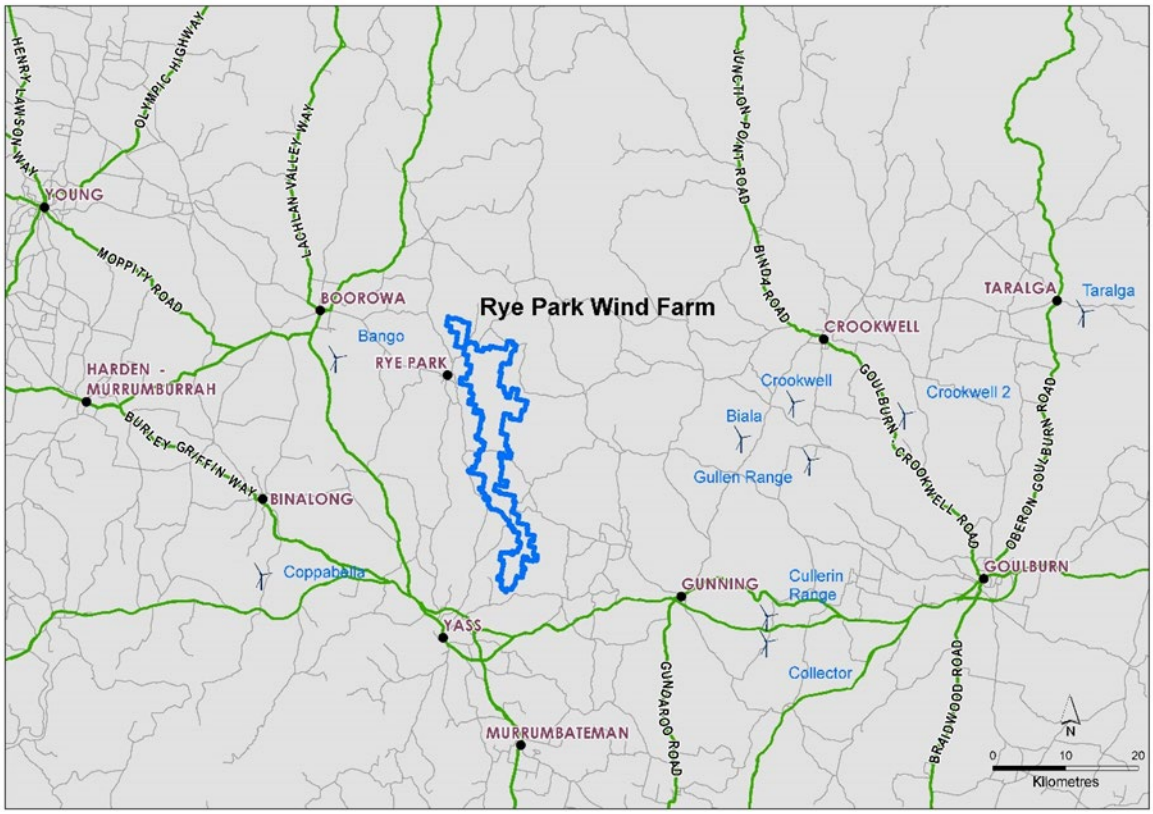

Figure 1: Development Location

1.4 Overview of the Development

The main components of the Development are as follows:

- 66 wind turbines, each with:
    - a capacity to generate up to approximately 6 MW
    - three blades mounted on a tubular steel tower, with a combined height of blade and tower limited to a maximum tip height of 200 m. The blades are 81 m long with a rotor diameter of 162 m, and hub height of 119 m.
    - crane hardstand area, and related turbine lay down area.
- A new 33 kV wind farm collection substation in the northern section of the Project site.
- A new 330 kV wind farm connection substation located adjacent to the existing TransGrid 330 kV transmission line in the southern section of the Project site.
- A temporary construction compound at the northern section of the Project site.
- A temporary construction compound to facilitate the upgrades on the TransGrid owned existing 330kV Transmission Line at the southern section of the Project site.
- A new overhead powerline approximately 30 km in length, rated at up to 330 kV (nominal) capacity, running north-south along the length of the wind farm between the two substations. The powerline would be mounted on a single pole type structure and will either be single-circuit or double-circuit as required.
- Underground and overhead 33 kV electrical cabling linking the wind turbines to the on-site collection substations and connection substation.
- Operation and maintenance facility incorporating a control room and equipment storage at the northern section of the Project site.
- Temporary concrete batching plants and construction facilities.

- Access tracks required for each wind turbine and the related ancillary facilities above.
- Minor upgrades to local roads, as required for the delivery of the wind turbines.
- Up to six temporary meteorological masts and up to six permanent monitoring masts for wind speed verification, weather and general monitoring purposes. The permanent monitoring mast may be either static guyed or un-guyed structures and will be to a minimum height of the wind turbine hubs (119 m).

A detailed overview of the development can be found in the Environmental Management Strategy Rye Park Wind Farm (RPWF-PLN-0001) (EMS).

As described in the EMS, the pre-construction final layout is shown on the revised final layout plans prepared in accordance with Schedule 2 Condition 10 of the Development Consent and Condition 12 of the EPBC Approval.

The final layout is submitted to the relevant departments, and will be available on the Development's website (www.ryeparkwf.com.au), including:

- details on the micro-siting of any wind turbines and/or ancillary infrastructure
- the GPS coordinates of the wind turbines

The developed layout will continue to be refined through the detailed design / construction stages. It is noted that micro-siting of the wind turbines is permitted under Schedule 2 Condition 8 of the Development Consent and the conditions of the EPBC Approval.

1.5 Legislation and Other Environmental Management Requirements

Legislation and guidelines relevant to this BBAMP includes:

- BC Act;
- EPBC Act;
- *National Parks and Wildlife Act 1974* (NPW Act); and
- Department of the Environment Environmental Management Plan Guidelines (2014).

1.6 Consultation

This Plan has been prepared in consultation with the Biodiversity, Conservation and Science Directorate (BCS) of the Department of Planning and Environment (DPE, previously known as the Department of Planning, Industry and Environment (DPIE)) and the Department of Climate Change, Energy, the Environment and Water (DCCEEW, previously known as the Department of Agriculture, Water and the Environment (DAWE)).

Consultation has been undertaken with BCS and DCCEEW in the preparation of this BBAMP, with specific comments in relation to a previous version of the BBAMP (received in June 2021) and further consultation between December 2022 and April 2023 being incorporated into this version of the BBAMP.

2.0 Environmental Objectives

2.1 Environmental Objectives and Commitments

In accordance with Condition 10(a) and 10(b) of the EPBC Approval, the environmental objectives of this BBAMP, and associated commitments to achieve these environmental objectives are outlined in Table 3 and Table 4 respectively.

Table 3: Environmental Objectives of the BBAMP

Environmental Objectives	
Operational Phase Monitoring	• To detail survey methods to monitor any changes or trends in bird and bat occurrence, abundance or behaviour during pre-construction and operational phases to enable assessment of whether any such changes may be influenced by the operation of the Development. • To detail a carcass detection program to monitor and record the number of incidences of blade / infrastructure strike or barotrauma resulting in bird or bat mortality to facilitate assessment of the significance of any findings. • To detail carcass persistence and detectability trials to inform estimation of mortality rates.
Bird and Bat Risk Assessment	• To estimate relative levels of collision or barotrauma risk for certain 'at risk' species.
Impact Triggers	• To identity unacceptable impacts on bird and bat species considered to be at highest risk of significant impacts.
Mitigation Strategy and Reporting Requirements	• To provide a summary of management actions required in the event that an impact trigger is met. • To provide details on mitigation measures to manage bird and bat strike or barotrauma at the Project.
Reporting Requirements and BBAMP Review	• To detail reporting requirements relating to bird and bat surveys, carcass search surveys and impact triggers. • To provide details of the review of this BBAMP.

Table 4: Commitments to Achieving the Environmental Objectives of this BBAMP

Environmental Objectives	Commitments	Where addressed in this BBAMP
Pre-operational Phase Monitoring	• It is noted that the full carcass search program cannot commence from the onset of commissioning of the Development due to the incremental nature of construction of turbines across the Development (i.e. access and workplace health and safety limitations). The Developer will undertake an interim carcass search program following completion of construction of turbine clusters once all construction activities and associated exclusion areas have been removed across that cluster of wind turbines and commissioning of the wind turbine cluster is commenced. • This interim carcass search program will be undertaken at turbine clusters that include specific wind turbines that are part of the full carcass search program. The Developer will undertake this program as detailed in Section 5.4 of this BBAMP. • This interim program will increase incrementally as more turbine clusters are constructed. For the avoidance of doubt, the interim carcass search program will commence no later than the start of superb parrot breeding season of 2023, being September, should the commissioning of the Development have commenced by this point in time. • In recognition of the increased risk of turbine impacts on avifauna in the timeframe immediately following the construction of	Section 5.4 and 5.8

Environmental Objectives	Commitments	Where addressed in this BBAMP
	individual wind turbines, irrespective of being fully 'commissioned', carcass searches will occur following construction and prior to 'commissioning' through incidental searches undertaken by the Developer's personnel and contractors (following additional training) approved to work within construction exclusion zones. While these searches are not formally part of the full carcass search program, it is a core component of the BBAMP to ensure impacted avifauna can be recorded prior to commencement of the full carcass search program (refer to Section 5.8).	
Operational Phase Monitoring	• The Developer will undertake surveys by suitably qualified and trained ecologists to monitor any changes or trends in bird and bat occurrence, abundance, or behaviour during pre-construction and operational phases to enable assessment of whether any such changes may be influenced by the operation of the Development. The Developer will undertake these surveys, using suitably qualified and trained ecologists, as detailed in Section 6.0 of this BBAMP.	Section 5.0
	• The Developer will undertake a detailed program using suitably qualified and trained ecologists to monitor and record the number of incidences of blade / infrastructure strike or barotrauma resulting in bird or bat mortality to facilitate assessment of the significance of any findings. The Developer will undertake this program as detailed in Section 6.0 of this BBAMP.	Section 5.0
	• The Developer will undertake carcass persistence and detectability trials by conservation dogs (or by suitably qualified and trained ecologists, as a back-up option only) to inform estimation of mortality rates. The Developer will undertake this program as detailed in Section 6.5 and Section 6.6 of this BBAMP.	Sections 5.5 and 5.6
Bird and Bat Risk Assessment	• The Developer has undertaken a bird and bat risk assessment that has estimated the relative levels of collision or barotrauma risk for perceived 'at risk' species.	Section 4.0
Impact Triggers	• The Developer has identified unacceptable impacts on bird and bat species considered to be at highest risk of significant impacts. The Developer will follow the impact trigger and response procedures for both threatened and non-threatened species as detailed in Section 7.0 of this BBAMP.	Section 6.0
Mitigation Strategy and Reporting Requirements	• The Developer has provided a summary of management actions required in the event that an impact trigger is met. The Developer will follow these management actions in the event that an impact trigger is met as detailed in Section 7.0. • The Developer has provided details on mitigation measures to manage bird and bat strike or barotrauma associated with the Development. The Developer will consider these mitigation measures to manage bird and bat strike or barotrauma as detailed in Section 7.0.	Sections 6.0 and 7.0
Reporting Requirements and BBAMP Review	• The Developer has provided detailed reporting requirements relating to bird and bat surveys, carcass search surveys and impact triggers. The Developer will undertake these reporting requirements as detailed in Section 8.0.	Section 8.1
	• The Developer has provided details of the review of this BBAMP. The Developer will undertake review of this BBAMP as detailed in Section 8.2.	Section 8.2

2.2 Risks to Achieving the Environmental Objectives

A summary of potential risks that could inhibit the BBAMP achieving its environmental objectives in accordance with the EPBC Approval are provided below:

- Equipment failure, including but not limited to vehicles and microbat recording devices, could potentially result in reduced survey data for a particular survey program;
- Ecologist illness and/or COVID-19 pandemic restrictions and controls (including state or federal implemented) could potentially result in revised survey scheduling and personnel scheduling (possibly at late notice);
- Environmental conditions, including excessively wet weather or flooding, bushfires, excessively hot temperatures (>40 degrees Celsius), lightning and thunderstorms could present operational safety limitation posing a risk to survey scheduling;.
- Operational and maintenance work proposed to wind turbines or other infrastructure could pose a risk through access prevention; and
- Potential loss of survey data could pose a risk to successfully estimating the relative levels of collision or barotrauma risk for certain species.

There are no identified risks considered to have the potential to compromise the BBAMPs ability to implement the mitigation strategy or reporting requirements or successfully report on the methods and results of the BBAMP or outcome of future reviews of the BBAMP.

As described above, most potential risks of the BBAMP not achieving the environmental objectives relate to the operation phase of the monitoring, specifically being survey scheduling and resourcing. These are risks posed to any ecological monitoring program and from our experience in implementing such monitoring across multiple industries throughout the country, they are short-term risks and not considered likely to compromise the success of the BBAMP. The risk is often identified prior to it occurring and the necessary responsive action can be identified in a timely manner. For example, a survey can be readily rescheduled, or an alternative ecologist resource can be mobilised. All this is possible without compromising the integrity of the monitoring survey program or subsequent statistical analysis.

As per the Evaluating Risk (Section 4) section of the Environmental Management Plan Guidelines (DoE 2014), the potential risks described above are considered to represent a 'Low' risk rating to the environmental objectives of the BBAMP not being met. Their likelihood of occurring is considered to be '*Possible*', as they might occur during the life of the BBAMP; and their consequence is considered to be '*Minor*' as the risks are considered to be short-term and they are unlikely to compromise the integrity of the monitoring program or mitigation measures.

3.0 Pre-construction Bird and Bat Survey

Bird and bat surveys were conducted for the Development during 2011-2013 and 2018-2019 are detailed below in Section 3.1 and 3.2 respectively. A description of the methods of the 2018-2019 pre-construction bird and bat surveys that must be adhered to during the operational monitoring is presented in Appendix A and outlined in Section 5.2 and 5.3.

3.1 Bird Surveys

3.1.1 2011 – 2013 Surveys

A series of general and targeted diurnal bird surveys were conducted within the Project Area during November 2011, April 2012, July 2013, and November 2013 (NGH Environmental 2014). Targeted swift parrot surveys comprising a total of 10 transect surveys, or area searches of 45 minute or 60-minute duration, were undertaken during July 2013. Targeted superb parrot surveys comprising 25 x 1 km transects of 60-minute duration and 72 person hours' worth of superb parrot flight path mapping were undertaken during November 2013. Ninety-eight (98) bird species were recorded within the Project Area during the 2011-2013 surveys including nine threatened species listed under the BC Act and/or the EPBC Act.

3.1.2 2018 – 2019 Surveys

Umwelt conducted bird surveys during November 2018, January/February 2019, March 2019 and July 2019 in accordance with condition 23a of Schedule 3 of the Original Development Consent. The survey methodology was determined through consultation with BCS.

A total of 348 general transect surveys at 44 sites, 48 vantage point surveys at seven sites, 60 targeted superb parrot surveys at 15 sites and 50 nocturnal surveys at 18 sites were undertaken. A total of 196 incidental observations of threatened species or raptors were recorded. One hundred and fifteen (115) bird species were recorded within the Project Area during the 2018-2019 surveys including 11 threatened species listed under the BC Act and/or the EPBC Act.

In total, 124 bird species have been recorded within the Project Area, including 14 threatened species listed under the EPBC Act and/or the BC Act as detailed in Table 5.

3.2 Microbat Surveys

3.2.1 2011 – 2013 Surveys

A survey to determine the assemblage of microbat species that occur within the Project Area was conducted through use of bat detectors, recording 12 species including three listed under the BC Act.

3.2.2 2018 – 2019 Surveys

Umwelt conducted bat monitoring during November 2018 and from January to April 2019 in accordance with condition 23a of Schedule 3 of the Original Development Consent. The survey methodology was determined through consultation with BCS. Anabat Swifts were deployed at 23 ground-level (1-2 metres (m) above ground level (AGL)) and six elevated (c. 45 m AGL) sites. A total of 12 species were recorded including four species listed under the BC Act.

In total, 17 microbat species including four threatened species listed under the BC Act have been recorded within the Project Area. These species are further detailed in Table 5.

Table 5: Bird and bat species listed under the EPBC Act and/or the BC Act recorded within the Project Area

Species name	Scientific name	EPBC Act Status	BC Act Status
Birds			
dusky woodswallow	*Artamus cyanopterus*	-	Vulnerable

Species name	Scientific name	EPBC Act Status	BC Act Status
brown treecreeper	*Climacteris picumnus victoriae*	-	Vulnerable
varied sittella	*Daphoenositta chrysoptera*	-	Vulnerable
white-fronted chat	*Epthianura albifrons*	-	Vulnerable
black falcon	*Falco subniger*	-	Vulnerable
painted honeyeater	*Grantiella picta*	-	Vulnerable
little eagle	*Hieraaetus morphnoides*	-	Vulnerable
white-throated needletail	*Hirundapus caudacutus*	Vulnerable / Migratory / Marine	-
hooded robin	*Melanodryas cucullata*	-	Vulnerable
flame robin	*Petroica phoenicea*	-	Vulnerable
scarlet robin	*Petroica boodang*	-	Vulnerable
superb parrot	*Polytelis swainsonii*	Vulnerable	Vulnerable
speckled warbler	*Pyrrholaemus sagittatus*	-	Vulnerable
diamond firetail	*Stagonopleura guttata*	-	Vulnerable
Bats			
eastern false pipistrelle	*Falsistrellus tasmaniensis*	-	Vulnerable
large bentwing bat	*Miniopterus orianae oceanensis*	-	Vulnerable
southern myotis	*Myotis macropus*	-	Vulnerable
yellow-bellied sheathtail bat	*Saccolaimus flaviventrus*	-	Vulnerable

4.0 Bird and Bat Risk Assessment

This risk assessment at Appendix B was prepared in accordance with requirements of the 'assessing prescribed biodiversity impacts' section of the Biodiversity Assessment Method (BAM), as required under the BC Act. Species assessed in this report were selected based on conservation listing status and recorded flight and abundance data collected during pre-construction bird and bat utilisation surveys during 2011-2013 (NGH 2014) and during 2018-19 within the Project Area. At the request of BCS, 14 species were considered in this assessment comprising 13 threatened species (including nine bird and four bat species) and one non-threatened bird species (wedge-tailed eagle). The comprehensive risk assessment is presented in Appendix B with a summary in the following sections.

It is noted that the risk assessment relevant to this Plan is directly relevant to collision or barotrauma risk with the operational wind turbines constructed as part of the Development. Other relevant risks to the potential impacts to the population of a species (e.g. fire prevention, waste management and control of feral pests) are addressed in other management plans relevant to the Development, including the Rye Park Wind Farm Biodiversity Management Plan (RPWF-PLN-0003) and the Rye Park Wind Farm Emergency Plan (RPWF-PLN-0004).

4.1 Overview of Risk Assessment Approach

The risk assessment follows the approach typically used for estimating risk to birds and bats at wind farms whereby qualitative estimates designed to provide indicative levels of risk are determined using a risk matrix which considers likelihood and consequence of blade strike or indirect impacts (e.g. barotrauma). The relative risk of blade strike or barotrauma was estimated using two criteria to ascribe likelihood of risk and four criteria to ascribe consequence of risk. The criteria of likelihood and risk are defined in Table 6 and Table 7 respectively.

Table 6: Criteria used to ascribe likelihood of risk

Criteria	Description
A	Known or likely frequency of flights within rotor swept area (RSA) height
B	Status or frequency of occurrence within the Project Area

Table 7: Criteria used to ascribe consequence of risk

Criteria	Description
C	Highly localised or concentrated population (for whole or part of lifecycle), such that siting of wind farm could have significant consequence to regional, national or international populations
D	Impact on population relative to demographic capacity to replace fatalities (i.e., generalised combination of dispersal capacity of potential replacements, fecundity and generation time)
E	Known or estimated size of national or global population
F	Listed conservation status under the EPBC Act and/or the BC Act

4.2 Summary of Risk Assessment Results

Of the 14 species assessed, five are a 'High' risk, six are a 'Moderate' risk and three are a 'Minor' risk of being impacted by the Development (refer to Table 8). The resultant risk rating for these species is primarily due to their relative abundance in the Project Area, their predicted or observed flight behaviour in the Project Area and their known susceptibility to blade strike or barotrauma at wind farms in south-east Australia in the context of the potential consequence of risk for each (as estimated through ascribed ratings for Criteria C, D, E and F).

Due to the findings of this risk assessment, the bird and bat monitoring program and the mitigation and adaptive management strategy described in this BBAMP will have a particular emphasis on effectively monitoring and managing risk of collision of the 11 species assessed as 'Moderate' or 'High' risk of being impacted by the Development.

Table 8: Risk Assessment Results Summary

Common Name	Latin Name	Likelihood	Consequence	Risk Rating
black falcon	*Falco subniger*	High	Moderate	High
little eagle	*Hieraaetus morphnoides*	High	Moderate	High
superb parrot	*Polytelis swainsonii*	High	Moderate	High
white-throated needletail	*Hirundapus caudacutus*	High	Moderate	High
large bentwing bat	*Miniopterus schreibersii oceanensis*	High	Moderate	High
wedge-tailed eagle	*Aquila audax*	High	Low	Moderate
painted honeyeater	*Grantiella picta*	Moderate	Moderate	Moderate
white-fronted chat	*Epthianura albifrons*	High	Low	Moderate
dusky woodswallow	*Artamus cyanopterus*	High	Low	Moderate
eastern false pipistrelle	*Falsistrellus tasmaniensis*	Moderate	Moderate	Moderate
yellow-bellied sheathtail bat	*Saccolaimus flaviventris*	Moderate	Moderate	Moderate
brown treecreeper	*Climacteris picumnus victoriae*	Low	Moderate	Minor
varied sittella	*Daphoenositta chrysoptera*	Moderate	Low	Minor
southern myotis	*Myotis macropus*	Low	Moderate	Minor

5.0 Bird and Bat Monitoring Program

5.1 Roles and Responsibilities

Meeting the objectives of this BBAMP is ultimately the responsibility of the Developer, with the roles and responsibilities of this BBAMP being consistent with the EMS. Oversight of the implementation of this BBAMP will require ongoing liaison between the Developer, BCS and DCCEEW.

The Developer will engage a suitably qualified ecologist who will be responsible for a number of tasks related to bird and bat monitoring and management. The ecologist may choose to engage a sub-contractor that specialises in the operational phase bird and bat surveys, particularly relating to statistical analysis, modeling and carcass searches.

The ecologist will ensure the bird and bat monitoring program is conducted in line with the requirements of the BBAMP, and the incidental bird and bat carcass find protocol and injured bird and bat find protocol are adhered to.

The Developer will be responsible for implementation of mitigation measures as discussed in Section 7.0. The Developer's reporting requirements are outlined in Section 8.0.

The ecologist (or the nominated sub-contractor) will be responsible for organising and undertaking the operational phase bird and bat surveys, the carcass persistence and detectability trials, and implementing the carcass search program.

The ecologist will be responsible for the management and analysis of the data collected during these surveys, and reviewing this BBAMP and preparing reports relevant to the bird and bat monitoring program (see Section 8.0 and Section 9.0).

5.2 Bird Surveys

Bird surveys are to be conducted in February, April, July and November during the first year, third year and fifth year within three months of commencement of wind farm operation, that is, once all of the following have occurred:

- All turbines are commissioned and tested (including testing dependent on wind conditions);
- All turbines have been handed over from the Supply and Installation Contractor to the Developer; and
- Australian Energy Market Operator testing is complete (grid compliance testing).

For work, safety and logistical reasons, it is not possible to commence monitoring surveys until the above-described commencement of wind farm operation. Prior to this occurring, the site remains under construction including establishment of work exclusion zones due to construction and/or testing work. For the purpose of reporting, any observation of a bird or birds flying at RSA height constitutes 'at risk behaviour'.

The survey approach and method must be consistent with that of the bird surveys conducted in 2018-2019 to allow robust comparison of results. An outline of the survey approach is provided below, and a detailed description of the survey method is provided in Appendix A.

5.2.1 Vantage point surveys

Vantage point surveys are to be conducted at the five sites that were surveyed during the pre-construction surveys in 2018/19. Vantage point surveys are to be conducted during February, April, July and November of the first, third and fifth year. Each site will be surveyed for one hour on two occasions per seasonal survey round, once in the late morning (i.e. between 9:30 and 12:00) and once in the early afternoon (i.e. between 12:00 and 15:30). Total vantage point survey effort over the three survey years will be 120 hours.

The objective of these surveys is to collect information on flight activity and behaviour from prominent locations both at turbine locations (treatment sites) and at least 500 m away from turbine locations (control sites).

The nature of vantage point surveys (high vantage, focus on aerial activity) lend themselves to targeting certain threatened and non-threatened at-risk species, including:

- Black falcon (year-round);
- Little eagle (year-round);

- Wedge-tailed eagle (year-round);
- Superb parrot (November); and
- White-throated needletail (November and February).

These species therefore do not have specific and individual targeted surveys proposed as the implementation of a detailed and regular vantage point survey program is suitably appropriate for the species.

5.2.2 Transect surveys

Standard two-hectare 20-minute surveys are to be conducted at 16 sites twice per seasonal survey round. Transect surveys are to be completed at a subsect of the sites that were surveyed during the pre-construction surveys in 2018/2019. While 44 sites were surveyed as part of these original surveys, the reduction to 16 sites is considered appropriate given factors such as the reduction in the number of turbines and the nature and objective of the surveys. The objective of these surveys is to collect data on relative abundance and to a lesser degree, flight behaviour, of bird species across different vegetation types within the Project Area.

5.2.3 Targeted superb parrot surveys

Standard two-hectare 20 minute transect surveys are to be conducted at 15 sites twice during each November. Targeted superb parrot surveys are to be completed at the same 15 sites that were subject to the pre-construction surveys in 2018/19. The objective of these surveys is to gather information on relative abundance, flight activity and behaviour of superb parrot in areas where superb parrot are known or are likely to occur in the central and southern part of the Project Area.

Hollow bearing trees identified as suitable for superb parrot recorded within the Project Area, as part of the implementation of the Rye Park Wind Farm Biodiversity Management Plan (RPWF-PLN-0003), that are within 200 m of wind turbines will be monitored twice during each November, once within an hour of sunrise and once in the hour preceding sunset. Monitoring will consist of observing all hollows within the particular trees for a period of 15 minutes, recording all bird species and numbers of birds tending to the hollows. Should any superb parrot land in the tree or enter the hollow, the following additional information will be recorded:

- Likely gender of bird(s);
- Approximate age of bird(s); juvenile, immature or mature; and
- Behaviour of bird(s); basking, grooming/cleaning, feeding adults, or adults feeding young.

The objective of this survey is to gather information on the use of hollows and breeding activity in proximity to wind turbines (i.e. within 200 m) and whether any changes occur to hollow usage and breeding activity during operation of the Development, during the monitoring period. If the following superb parrot observations are recorded during these targeted surveys, further monitoring of the relevant hollow bearing trees and/or wind turbines would be undertaken (as described below):

- Confirmation of superb parrot individuals using hollow bearing trees within 200 m of wind turbines on two occasions flying at or within 10 m of RSA; and
- Two or more observations of flocks of at least 10 individuals flying at or within 10 m of RSA.

The following monitoring would be implemented only in the circumstances described above:

- Where relevant, a remote survey camera would be mounted facing the confirmed hollow confirmed to be used for breeding to record bird activity (visitation, feeding, flight practice of young, etc.);
- Additional weekly carcass monitoring through the month of November of all wind turbines within 200 m of the confirmed breeding hollow;
- The combination of the two monitoring components above will determine if the breeding event is successful or not as well as potentially determine if an adult breeding bird was lost during breeding season;
- Monitoring will occur for the month of November;
- If the breeding event of monitoring breeding hollow is successful, then not further action is required; and

- If the breeding event of monitoring breeding hollow is unsuccessful and a dead or injured superb parrot is recorded within 200 m of the breeding hollow an appropriate mitigation approach will be developed in consultation with BCS and DCCEEW.

Further to the measures identified above, the Developer will also prepare and implement a Superb Parrot Population Monitoring Program (SPPMP) in accordance with Condition 18 of the EPBC Approval. The SPPMP will support the recovery objectives and actions described in the National Recovery Plan for the species and be prepared and implemented in collaboration with the National Superb Parrot Recovery Team.

The SPPMP will increase contemporary knowledge of superb parrot habit use and breeding ecology within the south-west slopes of NSW Important Bird Area in accordance with Condition 20 of the EPBC Approval.

5.3 Bat Surveys

Bat surveys will be conducted in January, February, March, April and November during the first year of wind farm operations, and subsequently in the third year and fifth year of wind farm operations. The specific timing of bat surveys targeting the large bentwing-bat migration period (as further detailed below in Section 5.3.1) will be based on consultation with BCS to confirm the timing of peak migration periods for the species in the first, third- and fifth-year survey effort.

The survey approach, timing, location and effort will be consistent with the bat surveys undertaken during 2018-2019 to allow comparison of data collected during the two monitoring events. An outline of the survey approach is presented in Table 9 and in the following sections, while a detailed description of the survey method (including equipment installation) is provided in Appendix A.

Table 9: Survey Effort within RSA

Height of Survey	Number of Sites	Number of Nights	Month/s of Survey	Survey Nights
Hub	3	10	January, November	60
Hub	3	14	April	42
Hub	3	59	February, March	177
Total at-height survey nights				279
Ground	3	10	January, November	60
Ground	3	14	April	42
Ground	3	59	February, March	177
Total ground survey nights				279
Grand total survey nights				**558**

5.3.1 Monitoring within the RSA

Monitoring will be undertaken at wind turbine hub-height of approximately 119 m at three wind turbines, to assess bat activity within the RSA of wind turbines. Bat detectors will be deployed at each of these wind turbines each survey year for:

- 10 nights in January, November, and the first fortnight of April; and
- The duration of February and March. A minimum of 10 nights of data corresponding with the peak large bentwing-bat migration period for that year must be analysed. Confirmation of peak migration periods will be sought through consultation with BCS each survey year to confirm surveys are completed when the species is known to be dispersing from maternity caves. This is consistent with the pre-construction surveys of 2018/19. For this reason, it is possible that the timing of these targeted surveys may not be consistent across each survey year should peak migration vary between years.

Bat detectors will be installed at hub height on the wind turbines by an appropriately qualified person with guidance provided by an ecologist. Bat detectors will specifically be mounted on the galvanised steel mesh platform on the hub, with the detector being aimed to the rear of the turbine. Should a selected wind turbine not be available for installation of a bat detector in a given survey period (e.g., if the hub has been removed for maintenance), a neighbouring wind turbine will be used.

All detectors used will be set to collect full-spectrum data. Call analysis will also consider full-spectrum data.

5.3.2 Ground Level Monitoring

Monitoring will be undertaken at a height of approximately 1-3 m at the base of a wind turbine, or in proximity to, the three wind turbines to assess bat activity below the RSA of wind turbines. Bat detectors will be deployed at each of these wind turbines each survey year for:

- 10 nights in January, November, and the first fortnight of April; and
- The duration of February and March.

The monitoring will include a minimum of 10 nights of data corresponding with the peak large bentwing-bat migration period for that year (as advised by BCS).

All detectors used will be set to collect full-spectrum data. Call analysis will also consider full-spectrum data.

5.4 Carcass Search Program

In recognition of the potential impacts to avifauna during the commissioning phase of the Development, the Developer will undertake a staged commencement to the carcass search program as follows:

- Interim carcass search program:
    - The Developer will undertake an interim carcass search program following completion of construction of turbine clusters[1] once all construction activities and associated exclusion areas have been removed across that cluster of wind turbines[2] and commissioning of the wind turbines is commenced. This will ensure that monitoring commences at wind turbines that are part of the full program as soon as the commissioning of the wind turbines commences (and pose a risk to avifauna). Further detail is provided in Section 5.4.1.
    - This interim carcass search program will be undertaken at turbine clusters that include specific wind turbines that are part of the full carcass search program (refer to Section 5.4.1).
    - This interim program will increase incrementally as more turbine clusters are constructed. For the avoidance of doubt, the interim carcass search program will commence no later than the start of superb parrot breeding season of 2023, being September, should the commissioning of the Development have commenced by this point in time.
    - In recognition of the increased risk of turbine impacts on avifauna in the timeframe immediately following the commencement of commissioning of wind turbines, irrespective of being fully 'commissioned', carcass searches will occur following the commencement of commissioning through incidental searches undertaken by the Developer's personnel and contractors (following additional training) approved to work within construction exclusion zones. While these searches are not formally part of the full carcass search program, it is a core component of the BBAMP to ensure impacted avifauna can be recorded prior to commencement of the full carcass search program. In the case of incidental finds, the protocol described in Section 5.8 will be implemented.
- Full carcass search program:

[1] Clusters of wind turbines are denoted by their relevant wind turbine number across 7 different cluster groupings (A to G). The naming convention of the wind turbines identifies the cluster of relevant wind turbines (refer to Appendix D).

[2] The Developer's Project Director, Delivery is responsible for identifying with the relevant environmental representatives and the ecologists when clusters of wind turbines are available for safe and unimpeded access to undertake the interim carcass search program.

- The full carcass search program will run for five years starting within three months of commencement of operation of the wind farm and once all construction activities and associated exclusion areas have been removed.
- The carcass search program will be reviewed for efficacy after two years. As part of this review, BCS and DCCEEW will be consulted to determine whether or not it is appropriate to discontinue the carcass search program based on the findings of the first two years of monitoring activities as detailed in the relevant annual reporting and major review of the BBAMP (refer to Section 8.0).

The key objective of the carcass searches is to estimate the frequency of bird and bat mortality due to collision associated with the Development from which the total number of collisions can be determined. Reporting requirements relevant to the carcass search program are described in Section 8.1.

A permit must be obtained prior to commencement of the carcass search program from DPE under the *National Parks and Wildlife Act 1974* to keep carcasses of native species.

5.4.1 Turbines to be Searched

Searches will be undertaken at 33 turbines (i.e., half of the turbines to be constructed) throughout the five year carcass search program. The same turbines will be searched throughout the carcass search program, with the turbines to be searched having been selected with consideration of the following:

- Spatial coverage across the Development;
- Representation of different vegetation types and landscape positions, ensuring dominant Plant Community Types (PCT351) and condition zones were more heavily represented, while also ensuring that those less common were also captured[3]; and
- Location relative to predicted areas of higher collision risk as determined from the pre-construction bird utilisation surveys (i.e., such as superb parrot habitat)[4].

There are issues surrounding monitoring surveys while active construction and commissioning activities are being undertaken on the wind farm as commissioning of specific turbines occurs progressively in parallel with active construction activities of other wind turbines. For workplace health and safety and logistical reasons, it is likely that the ecologists will not have access to certain areas of the wind farm during commissioning activities related to the establishment of work exclusion zones due to construction and/or testing work.

Following the completed construction of wind turbine clusters and associated exclusion areas have been removed, an interim carcass search program will be implemented prior to operation (refer to Section 5.4) with protocol being implemented in the case of incidental finds (refer to Section 5.8). The Data Collection and Carcass Find Protocol outlined in Section 5.4.5 must be adhered to.

The same wind turbines that are part of the full carcass search program will be monitored as part of the interim program, meaning the whole turbine cluster will not be monitored in detail. However, incidental searches will be undertaken throughout the whole turbine cluster by the Developer and its contractors (following additional training) approved to work within construction exclusion zones. While these searches are not formally part of the carcass search program, it is a core component of the BBAMP to ensure impacted avifauna can be recorded prior to commencement of the carcass search program despite the site still being limited by construction activities and exclusion areas. Further detail is provided below in Section 5.8.

A list of turbines to be searched and an outline of potential search constraints that may affect carcass detectability at each is provided in Appendix C. A map depicting all turbine locations within the Project Area is presented in Appendix D.

[3] PCT351 Brittle Gum - Broad-leaved Peppermint - Red Stringybark open forest in the north-western part (Yass to Orange) of the South Eastern Highlands Bioregion is the dominant Plant Community Type interacting with approved turbine locations, occurring across five condition classes.

[4] All five turbines within 500 m of a superb parrot record in the southern section of the Development were selected as part of the carcass search program.

5.4.2 Search Area and Survey Frequency

The size of the search area and the method in which carcass searches will be conducted is consistent with current standard practice at wind farms in New South Wales (Nature Advisory 2020). The turbine specifications of the Development and the findings of Hull and Muir (2010), Huso and Dalthorp (2014) and Prakash and Markfort (2020) were considered in the determination of the most appropriate search area. Given the maximum blade tip height (200 m) and the rotor diameter (162 m), an area with a radius of 120 m comprising an inner and outer search area (with radii 60 m and 120 m, respectively) will be surveyed at each of the selected sites. This search area is illustrated in Figure 2.

Figure 2: Illustration of carcass search area

When the BBAMP undergoes the major review in years three and five (detailed in Section 8.2) following of commencement of operation, a thorough review of current literature will be undertaken to determine if there is any recent research supporting a change to search areas of carcass surveys, whether that be to the inner or outer search zones or increasing the search zone scale. Changes to search areas will be made in consultation with BCS and DCCEEW and be reliant on the presence of current and scientifically based research.

The interim and full carcass search programs will be conducted once per month as follows:

- The inner and outer search areas will be surveyed once per month throughout the year. The order of turbines searched will be randomised between surveys; and
- Additional carcass searches will also be undertaken in the Superb Parrot breeding season (October to December) to specifically target the species across both the inner and outer search areas[5]. The additional carcass searches will only occur once the wind turbines are commissioned and will be subject to the construction schedule in relation to the progress of turbine construction activities.

[5] This will only occur at the six wind turbines considered to pose the highest risk to the species (being T119, T120, T122, T124, T125 and T142), due to presence of potential breeding habitat, known nest trees and frequent utilisation.

If the monthly survey event in September to April identifies any carcass or feather spot of superb parrot, white-throated needletail and/or large bentwing-bat, a second survey in the months of September to April will be undertaken. This would be completed four days after the first survey event and would be carried out within 120m radius of the turbine. The potential need for this additional monthly survey relates to these warmer months being when these target threatened species within the Project Area are either present or more active.

The frequency of carcass search surveys may be altered, in consultation with BCS, if the findings of the carcass persistence trial (after one full Autumn and Spring trial, see Section 5.5) indicate that it would be necessary or appropriate.

5.4.3 Unsearchable Areas

Dense shrubland or dry forest may remain within the carcass search area (r = 120 m) following vegetation clearance for the development of the hardstand, roads and other infrastructure. At such areas, it is possible that there may be some searcher efficacy or carcass detectability (if humans are used to search for carcasses rather than dogs) limitations across the search zones. However, human monitoring will only occur in the event that conservation dogs are not available for any given survey (i.e. human monitoring is the backup). Furthermore, unsearchable areas, should they be identified, are likely to be very limited. No areas considered unsearchable for conservation dogs are present in carcass search areas.

If present, areas within the carcass search area deemed unsearchable at each turbine included in the carcass search program must be mapped and a corrective function to estimate total carcass numbers applied. The method through which to estimate the number of carcasses likely to have fallen in the entire search area (in cases where its entirety is not searched) should be determined through consultation with BCS in consideration of current peer-reviewed methods.

A corrective function will not be applied for monitoring undertaken with trained conservation dogs or if unsearchable areas are not identified.

5.4.4 Search Method

Use of trained conservation dogs

Trained conservation dogs will be used as the default if available and the climatic conditions of the site and the terrain of the search areas are suitable for a dog to conduct searches safely and effectively. Given the location of the Development in the Southern Tablelands, maximum daily temperatures are typically suitable throughout much of the year for working dogs. Surveys conducted during December to February may need to be scheduled around hot weather. The terrain of the search areas is suitable for access by a dog and handlers given the lack of rocky outcrops and steep slopes in search areas within the Project Area.

During each turbine search a dog and handler would traverse the search area along paths spaced by approximately 20 - 30 m from one another depending on wind speed. The spacing of the paths within this range would be determined by the handler as they see fit during each survey. The dog would be fitted with a GPS unit to provide a measure of coverage completed during each survey. Dog handlers will be trained and experienced in identification of all bird and bat species that may occur within the Project Area and understand the data collection and carcass find protocol detailed in Section 5.4.5. The detectability of carcasses through use of trained dogs would be assessed as specified in Section 5.6.

Use of ecologists

If a trained dog is unavailable carcass searches will be conducted by ecologists experienced in identification of carcasses of bird and bat species that may occur within the Project Area. This is a back-up option only. At each turbine search area, the observer will walk transects spaced by 6 m within the inner search area and 12 m within the outer search area. The observer will record their movement along transects using a handheld GPS device. The detectability of carcasses by ecologists conducting carcass searches would be assessed as specified in Section 5.6.

5.4.5 Data Collection and Carcass Find Protocol

During the carcass search surveys and the carcass persistence trials, data will be collected and recorded on the data sheets provided in Appendix E, Appendix F and Appendix G (namely the Carcass Search Survey Data Sheet, the Dead or Injured Bird/Bat Data Sheet and the Carcass Persistence Trial Data Sheet respectively), or data may be recorded using an online data collection program such as ESRI's ArcGIS Survey using all fields present in the survey data sheets.

For each turbine search during the carcass search surveys, the Carcass Search Survey Data Sheet must be completed (Appendix E). Along with collection of basic survey and weather information there are some factors that will require careful estimation and ongoing consideration throughout each individual turbine search, namely, the extent of different ground substrates and the extent of the search area that is accessible/searchable.

In the event that a bird or bat carcass or featherspot is detected during a carcass search survey, the carcass or featherspot[6] must be collected, photographed and stored (if a carcass), its location must be recorded on a GPS device and the Deceased or Injured Bird/Bat Data Sheet (Appendix E) must be completed. Handling and collection of carcasses will be undertaken as follows:

- The carcass must be removed from the site by a person wearing rubber gloves, and double bagged in plastic bags;
- The carcass must be photographed in such a way that it can be further identified, i.e., on a white background with an item or measure for scale and adequate lighting;
- A label with the date, turbine number, species same (if known) and a unique specimen code (i.e., GALAH01) must be placed in the second bag to allow cross-reference to the corresponding completed Deceased or Injured Bird/Bat datasheet; and
- The carcass will be transported to a freezer (likely located at the Operations and Maintenance Facility) where it will be retained for the purpose of either a second opinion on its identification, or for use in carcass persistence trials or carcass detectability trials.

In cases where featherspots or carcasses are not able to be identified by the contracted ecologist, the following process will be undertaken:

1. Photos of the featherspot or carcass will be analysed by the lead ecologist (including any colleagues) to definitively identify the find, including circumstances where the lead ecologist allocated the identification to likely or probable confidence levels;
2. If the lead ecologist is still unable to definitively identify the featherspot or carcass (including likely or probably confidence levels), they will only further attempt to definitively identify the featherspot or carcass if the find could potentially result in an impact trigger being met (either there is potential it could be a threatened species or would trigger a non-threatened species impact trigger); and
3. Methods to further definitively identify the featherspot or carcass could then involve sending photos of the find and/or the find itself to a species specialist or museum, or send for DNA testing.

If used, DNA swabs would be sent to the Australian Museum (Australian Centre for Wildlife Genomics) for analysis. DNA swabs are not proposed to be used for carcasses or featherspots unless there is a potential it could be a threatened species or would trigger a non-threatened species impact trigger.

At the conclusion of the carcass search program any carcasses of interest may be made available to the Australian Museum or disposed of if deemed appropriate in consultation with BCS.

[6] A featherspot is defined as a collection of five or more feathers closely positioned in a way that suggests a carcass had been present at that precise location.

All data collected during the carcass search program will be entered into a database. Data pertaining to incidental findings (i.e., completed Deceased or Injured Bird/Bat Data Sheets for incidental finds by site personnel) must also be kept in this database. A second database which will serve as an inventory of carcasses collected is to be maintained by the Environmental Representative within which records detailing whether carcasses are retained, disposed of or sent off-site (i.e., to an authority such as or the Australian Museum) will be managed.

All reporting requirements, including timeframes, are detailed in Sections 6 and 8.

5.5 Carcass Persistence Trial

Birds and bats injured or killed through collision with turbines may be removed from search areas by scavengers such as raptors, ravens, and a suite of introduced mammals. To estimate persistence rates of different sized carcasses beneath turbines within the Project Area (to aid estimation of mortality rates of birds and bats impacted by turbines) a carcass persistence trial will be undertaken.

A carcass persistence trial will be carried out by ecologists during the Years 1 and 2 Spring and Autumn carcass survey program. The trial will be conducted over two years to account for interannual variation in species presence. The carcass persistence trial (i.e., both spring and autumn) will be conducted at 20 turbines which are to be selected using a random number generator prior to the commencement of the trial. A total of 10 bird carcasses (comprising five small-medium sized carcasses and five large carcasses) and 10 bat carcasses will be deployed within 60 m of turbine bases. The 20 carcasses used in the spring trial may not be reused in the autumn trial.

Surrogate carcasses will be used for carcass persistence trials. Small and very small sized surrogate carcasses should be chosen to be similar in size to the target species of this BBAMP, being parrot, needletail and microbats. Surrogate carcasses must be marked to prevent confusion with carcasses that are not part of the trial. A Carcass Persistence Trial Data Sheet (Appendix F) must be completed for each turbine included in the carcass persistence trial.

Remote sensing cameras will be deployed to record persistence of carcasses with each camera being set to record three images when movement is detected. Use of remote-sensing cameras as opposed to using human observers has several advantages including lower survey effort and the ability to determine the exact time of carcass removal.

Each trial will run for 30 days during which time the cameras and the carcasses will be checked at 5 days and 15 days (either of these visits may be timed to coincide with a carcass search survey). If a carcass has been removed within the first fortnight it may be replaced by another. Carcasses are deemed to be removed when they no longer occur in the Search Zones (Inner and Outer).

If the inspections on day 5 and/or day 15 find a carcass has been moved outside of the field of view from the remote sensing camera but remains within the Search Zones (Inner and Outer), it is not deemed to be removed. In such a case, the camera will be re-located to the new position of the carcass.

The use of remote sensing cameras may be replaced with another suitably efficient and accurate method if one should become available. Such a change to the carcass persistence trial methodology would be undertaken in consultation with BCS.

Quantifying the mean and confidence interval of the time to removal of carcasses is required for input into calculation of mortality estimates. Carcass persistence would be examined through survival analysis using statistical software to estimate the survival function. The analysis would include:

- Fitting a range of carcass persistence distributions to determine the best fit;
- Testing for the significance of the covariates for carcass size and suite strata; and
- Generating an estimate for each significant covariate group.

Reporting requirements relevant to the carcass persistence trials are described in Section 8.

5.6 Carcass Detectability Trial

The detectability of carcasses under turbines can vary depending on a range of factors such as efficacy of the observer, size of the carcass and type of ground cover. Given this, carcass detectability trials will be undertaken to determine the efficacy of the dog and handler or the ecologist undertaking searches at finding carcasses within the Project Area. Determining the probability of the selected trained dog or observers detecting a carcass and how it may vary depending on turbine site ground conditions or carcass size is important to ascertain the correction factor needed to accurately estimate total number of collisions.

A carcass detectability trial will be conducted during the Year 1 spring and autumn carcass survey program (Table 4.2). These trials can be undertaken concurrently with the carcass persistence trials and/or the carcass search surveys to maximise survey efficiency.

The carcass detectability trial will be conducted at 20 turbines which are to be selected using a random number generator prior to the commencement of the trial. During each trial (i.e., for both the spring and the autumn trial) approximately 10 bird carcasses (comprising five small-medium sized carcasses and five large carcasses) and 10 bat carcasses will be tossed onto the ground within the inner search area by a person not involved in searches for carcasses. The same carcasses used in the carcass persistence trial may be used in the carcass detectability trial if the carcass persistence and carcass detectability trials are conducted consecutively rather than concurrently. The searcher will not be aware of the number or location of carcasses deployed. The number and type of carcasses detected during the trials will be compared with the number and type of carcasses placed in the search areas for such trials.

Reporting requirements relevant to the carcass detectability trial are described in Section 8.

5.7 Transmission Line Carcass Search

If more than five white-throated needletail individuals are recorded at a single location (i.e. within a 40 m radius) within 500 m of a section of overhead transmission line during any of the February bird surveys, an additional carcass search along adjacent transmission line will be conducted. Records of five or less individuals at a single location will not warrant the additional survey.

When required, a 200-metre-long walked meandering transect will be completed directly beneath the overhead wires of the transmission line constructed for the Project. The meandering transect will involve a visual search of the ground stratum, generally 10 m either side of the transect, for white-throated needletail carcasses or potential featherspots.

This method is proposed to be completed separately to the carcass search due to the timing of the surveys and requirement for survey to occur directly following the species being identified in the airspace of the Project. If the species is recorded at multiple bird survey locations, a maximum of three white-throated needletail meandering transects will be required per the survey program.

5.8 Incidental Bird and Bat Carcass Find Protocol

Throughout the operational lifetime of the Development, if a carcass or a featherspot is discovered incidentally by site personnel the Dead or Injured Bird/Bat Data Sheet must be completed (Appendix E) and the find reported to the Environmental Representative. If the impacted species found incidentally is a threatened species or wedge-tailed eagle, notification of the impact must adhere to the reporting requirements and timeframes described below in Section 6.1.2 and Section 6.2.2.

The Developer will provide additional training to key personnel, including the Environmental Representative as minimum, to assist with the identification of carcasses and/or featherspots as well as the carcass find protocol (refer to Section 5.4.5).

The incidental bird and bat carcass find process also forms part of the interim carcass search program described in Section 5.4 to allow turbine impacts on birds and bats to be identified prior to the commencement of the formal carcass search program at the start of operations.

In addition to opportunistic incidental finds, the developer commits to trained environmental representatives undertaking targeted incidental searches for white-throated needletail following the commencement of operation of the Development. This will involve trained staff slowly driving (<10km/hr) wind farm access tracks intersecting with transmission lines and one third of constructed wind turbines following the occurrence of large storm fronts associated with changes to barometric pressures such as thunderstorms and lightning storms passing over the Development between November and March when the white-throated needletail has the potential to utilise airspace within the Development.

If a carcass is discovered incidentally at any stage during the operation of the Development, the carcass may be handled and removed in accordance with the carcass find protocol (Section 5.4.5). Any injured birds or bats must be handled in accordance with the injured bird and bat protocol (Section 5.8.1). All full-time employed site personnel must be trained in the process to be followed in the event that injured or deceased birds or bats or featherspots are discovered incidentally. Copies of the Dead or Injured Bird/Bat Data Sheet must be available for use by all site personnel.

5.8.1 Injured Bird and Bat Find Protocol

If an injured bird or bat is discovered the Environmental Representative must be notified within 2 hours of the finding (allowing time for ecologists to deal with capture, labelling, data capture, reduced phone service…etc). The Environmental Representative will be responsible for organising the recovery and/or treatment or euthanasia of the animal. Where possible all injured birds should be placed into a ventilated box or cloth bag by a person wearing rubber gloves to minimise stress and assist transportation.

If required, local veterinarians, wildlife carers or the contracted ecologist should be contacted by the Environmental Representative to discuss whether release, rehabilitation or euthanasia is the most appropriate action. If it is determined that the animal should not be released at the site or euthanasia by the Environmental Representative is not possible recovery or euthanasia by a veterinarian or wildlife carer should be arranged. Contact details are provided below, however other appropriately qualified veterinarians and wildlife carers may be used:

- WIRES – 1300 094 737; or
- Boorowa Vet Clinic, 110 Marsden Street, Boorowa, NSW – (02) 6385 3877.

Site staff are prohibited from touching or handling any bats (injured or otherwise). A qualified and appropriately vaccinated ecologist or wildlife carer must be called to handle any bats. Only persons vaccinated against Australian Bat Lyssavirus may handle injured bats.

5.9 Mortality Estimation

All data will be analysed to estimate mortality rates and the annual number of collisions for each bird and bat species. Estimates of the number of carcasses per wind turbine per year will also be determined and 95% confidence intervals around total annual estimates and rates of mortality calculated.

Symbolix Pty Ltd (Symbolix) undertook a review of the proposed carcass detection and mortality estimation methods detailed in this BBAMP and have concluded that survey program represents standard statistical practice and the survey design will provide data suitable for estimating mortality at the Development. This BBAMP considers the suggested amendments made by Symbolix as part of this review. A summary of the statistical analysis that will be undertaken for the mortality estimation is provided below, however the full review by Symbolix is provided in Appendix H.

Mortalities at turbine i during search j are estimated by (Huso, Dalthorp, and Korner-Nievergelt (2015) and references therein)

$$\hat{M}_{ij} \cong \frac{C_{ij}}{(\hat{g}_{ij})}$$

Where:

- C_{ij} *is the number of carcasses found*
- $\hat{g}_{ij}$ *is the estimate of the detection probability for that search and wind turbine.*

For a given wind turbine, $\hat{g}_{ij}$ is a function of:

$$\hat{g}_{ij} \cong a_i r_{ij} p_{ij}$$

- a_i is the fraction of total carcasses within the searched area
- r_{ij} is the fraction of the carcasses that fell at the wind turbine (i) but have not been lost to scavenge or decay before search (j). This is a function of the rate of decay and the search interval, relative to the expected time to scavenge (Huso 2011).
- p_{ij} is the probability that an existing carcass will be detected by the searcher.

Searcher efficiency (p_{ij}) will be reported as a mean and variance measure. Searcher efficiency will be modelled using logistic regression as this allows binary data to be modelled accounting for covariates such as carcass size and time of year. The probability of success in the carcass detectability trial i as $\pi\ (x_i)$ where x_i is a vector of covariates. The relationship between the probability of success and the log odds will be modelled using the logistic model:

$$\text{logit}\ [\pi\ (x_i)] = \beta x_i$$

Where:

- Logit [·] denotes the log-odds function logit $(\rho) = ln \frac{\rho}{1-\rho})$
- β is a vector of regression coefficients.

As $\pi\ (x_i)$ is free to vary with each trial, this allows the mean to be modelled in a flexible manner depending on carcass size and so on. The estimates of regression coefficients β, are obtained via maximum likelihood estimates which is the standard method of estimation in GLMs. Both estimates of the mean, and standard errors of those estimates, are obtained by this technique. This allows significance testing of covariates and reporting of confidence intervals.

5.10 Survey Schedule

An overview of the survey schedule for the different survey components of the bird and bat monitoring program is provided below in Table 10.

Table 10: Survey Schedule

Component	Survey	Timing	Initial Duration	Potential Extension (total duration)[1]
Pre-commencement of operation	**Carcass search surveys (interim program)**	Following construction of turbine clusters once all construction activities and associated exclusion areas have been removed (refer to Section 5.4).	During construction, prior to commencement of operation of the Development	Nil
Post-commencement of operation	**Bird surveys**	February, April, July and November during the first year, third year and fifth year following commencement of operation.	Three years (across five years)	Two years (totalling five years)
	Bat surveys	During the first year, third year and fifth year following commencement of operation at the following times: • 10 days during January, November and the first fortnight of April; and • Throughout February and March.	Three years (across five years)	Two years (totalling five years)
	Carcass search surveys (full program)	Twice each month from September to April and once per month from May to August. Commencing within three months of commencement of operation of the wind farm and once all construction activities and associated exclusion areas have been removed.	Five years[2]	Nil
	Carcass persistence trial	During the first autumn and spring of the year/s following commencement of operation.	Two years	Nil
	Carcass detectability trial	During the first autumn and spring of the year/s following commencement of operation.	One year	Nil
	Incidental bird and bat finds	Will be conducted opportunistically through the operational life of the Project. Targeted incidental searches for white-throated needletail will be undertaken following the occurrence of large storm fronts associated with changes to barometric pressures such as thunderstorms and lightning storms passing over the Project between November and March when the white-throated needletail has the potential to utilise the Project airspace.	Operational life of Project	Nil

[1] The requirement to extend the length of monitoring of any given component of the BBAMP will be made through review of the BBAMP as nominated in Section 8.2 in consultation with BCS and/or DCCEEW.

[2] Review of the carcass search program to be undertaken with BCS and DCCEEW following two years (refer to Section 5.4) and discontinued following review if deemed appropriate by the Developer, BCS and DCCEEW.

6.0 Impact Triggers and Response Procedure

This section defines impact trigger thresholds for threatened and non-threatened bird and bat species, as well as the processes to be followed in cases where trigger thresholds are met. The main objective of setting impact trigger thresholds is to prevent the operation of the Development resulting in significant impacts on the viability of the local population of threatened and non-threatened bird and bat species.

For the purposes of this BBAMP, post-trigger assessment of impacts on threatened and/or migratory species is to be conducted with reference to the species' total population and local population. For non-listed species, assessment of impacts is to be conducted with reference to the species' local population only.

Total population refers to the estimated total Australian population or, in the case of international migrants, the relevant subspecies' entire population. Local population refers to the estimated population in the Project Area. Density is to be estimated using data from the pre-construction surveys in combination with existing density estimates from primary literature (preferably from temperate woodland in south-eastern Australia where distinction is made between different habitat types). Local population estimates are to be derived using vegetation mapping for the Project. Estimates should take into consideration population dynamic assumptions such as, but not limited to, seasonal or inter-annual fluctuations in abundance in the Project Area. The local population of a given species is to be estimated by the contracted ecologist if an impact trigger for that species is met.

The procedure for responding to an impact trigger threshold being met must be adhered to for the operational lifetime of the Development. Impact trigger thresholds and reporting procedures similar to those incorporated into recent BBAMPs for other wind farms in NSW are provided here.

This BBAMP does not ascribe numerical values to what should be considered an adverse impact at the total population and/or the local population scale. Rather, this BBAMP describes an assessment process through which an ecologist first prepares an impact investigation that examines whether the event may be regular or may constitute, or lead to, an adverse impact on the species' local or total population. The findings of this impact investigation determines whether consultation with BCS and/or DCCEEW regarding the need for additional monitoring or mitigation action is required. The minimum requirements of the impact investigation report are detailed below:

- Specify the particular impact trigger level that was recorded including the species and number of individuals;
- Specify the date/s and location/s of recovered carcasses/featherspot;
- Discuss any potentially influential ecological factors that may have contributed to the impact trigger such as recent climate, weather, presence of prey species/foraging opportunities or seasonal factors (i.e., migration);
- Estimate whether the event is likely to be rare or regular; and
- Verify whether or not the species has been impacted (including number of individuals and frequency) at neighbouring wind farms within a 10 km radius of the Project by accessing their publicly available annual BBAMP reports. Neighbouring wind farms within this radius will be considered at the time the impact trigger is recorded to consider any future wind farms.

6.1 Threatened Species

6.1.1 Impact Triggers

The impact trigger threshold for species listed as threatened under the EPBC and/or the BC Act is the detection of one carcass, injured individual or featherspot under or near a turbine or transmission line. This includes finds during any of the surveys and incidental finds by site personnel.

6.1.2 Response and Reporting Requirements

In the event that an impact trigger threshold for threatened species is met[7], it is the responsibility of the person who discovered the carcass, injured individual or featherspot to notify the relevant Environmental Representative upon discovery (allowing for identification, if required). At that point, the Developer must then notify BCS and/or DCCEEW of the event within one working day (i.e. the following working day), depending on whether the species is listed under the BC Act and/or EPBC Act.

Notification of an impact trigger to a BC Act listed species to BCS will be completed by the Developer's relevant Environmental Representative to the regional BCS office responsible for the Development (rog.south@environment.nsw.gov.au).

Notification of an impact trigger to an EPBC Act listed species to DCCEEW will be completed by the Developer's relevant Environmental Representative to the DCEEWW monitoring and audit area mailbox (epbcmonitoring@dcceew.gov.au).

Following notification of the initial impact trigger consultation with BCS/DCCEEW will include (but not be limited to) the following:

- An initial online or in-person meeting within 5 working days (excluding government shutdown periods) of the impact trigger being recorded, with the consultation stakeholders specified above. Should the impact trigger or consultation period occur during government shutdown periods, this meeting is required to occur within 5 working days following conclusion of the shutdown period, and
- Additional online or in-person meetings may be required depending on the nature of the consultation. The specific timeframe of this additional consultation will be determined in the initial meeting.

The reporting process and decision-making framework depicted in Figure 3 must then be followed. Impact trigger reporting requirements are described in Section 8.

[7] If further identification (including DNA testing) is required to determine the species of a carcass, then the impact trigger will occur from the date the species of the carcass is confirmed as a threatened species.

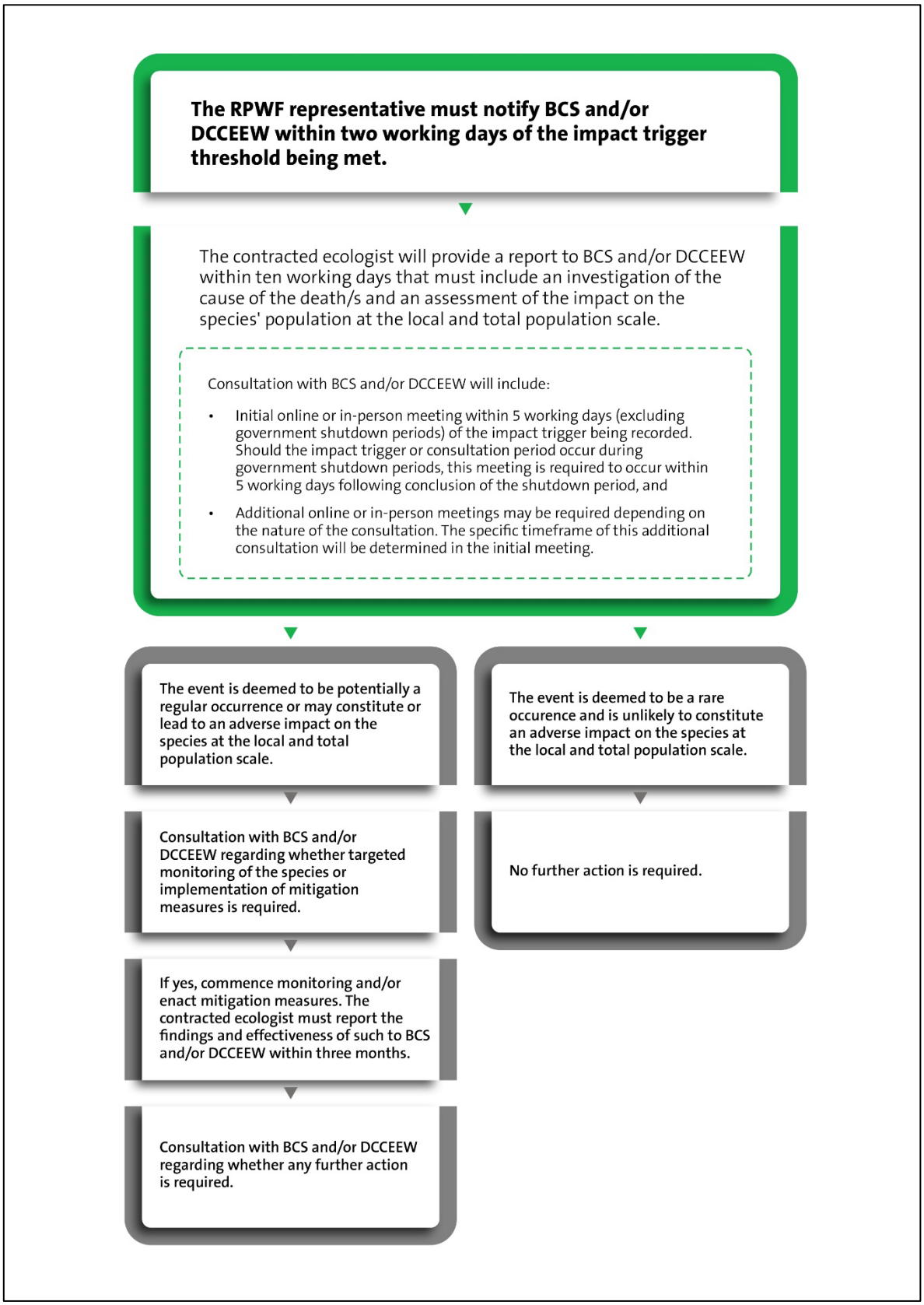

Figure 3: Threatened Species Impact Trigger Response Procedure

6.2 Non-threatened Species

6.2.1 Impact Trigger

The impact trigger threshold for the wedge-tailed eagle is the detection of two or more carcasses, injured individuals or featherspots under or near the same or adjacent turbines (i.e. turbines not separated by another) during carcass searches in any two consecutive months. It is noted that the impact trigger is deliberately different to the response and reporting requirements for impacts on wedge-tailed eagle.

The impact trigger threshold for non-threatened species, except wedge-tailed eagle, introduced species and the seven native species listed below in this section, is the detection of three or more carcasses, injured individuals or featherspots under or near the same or adjacent turbines during carcass searches in any two consecutive months.

The impact trigger threshold for non-threatened species does not apply to introduced species or the following native species:

- sulphur-crested cockatoo (*Cacatua galerita*);
- little corella (*Cacatua sanguinea*);
- galah (*Eolophus roseicapilla*);
- little raven (*Corvus mellori*);
- Australian raven (*Corvus coronoides*);
- Australian magpie (*Cracticus tibicen*); and
- Australasian pipit (*Anthus novaeseelandiae*).

No management actions are triggered because of mortality of introduced species or the seven native species listed above.

6.2.2 Response and Reporting Requirements

If an impact trigger threshold for non-threatened species is met it is the responsibility of the person who discovered the carcass, injured individual or featherspot to notify the Environmental Representative upon discovery from which point the Developer must then notify BCS of the event as follows:

- In relation to wedge-tailed eagles, the Developer must then notify BCS of the either detection of one carcass, injured individual or featherspot under or near a turbine or an impact trigger threshold event within 1 working day (i.e. the following working day); and
- For all other non-threatened species, if an impact trigger threshold for non-threatened species (except wedge-tailed eagle) is met it is the responsibility of the person who discovered the carcass, injured individual or featherspot to notify the Environmental Representative upon discovery from which point the Developer must then notify BCS of the event within five working days.

Notification of an impact trigger to a wedge-tailed eagle or other non-threatened species to BCS will be completed by the Developer's relevant Environmental Representative to the regional BCS office responsible for the Project (rog.south@environment.nsw.gov.au).

The reporting process and decision-making framework depicted in Figure 4 must then be followed. Impact trigger reporting requirements are described in Section 8.

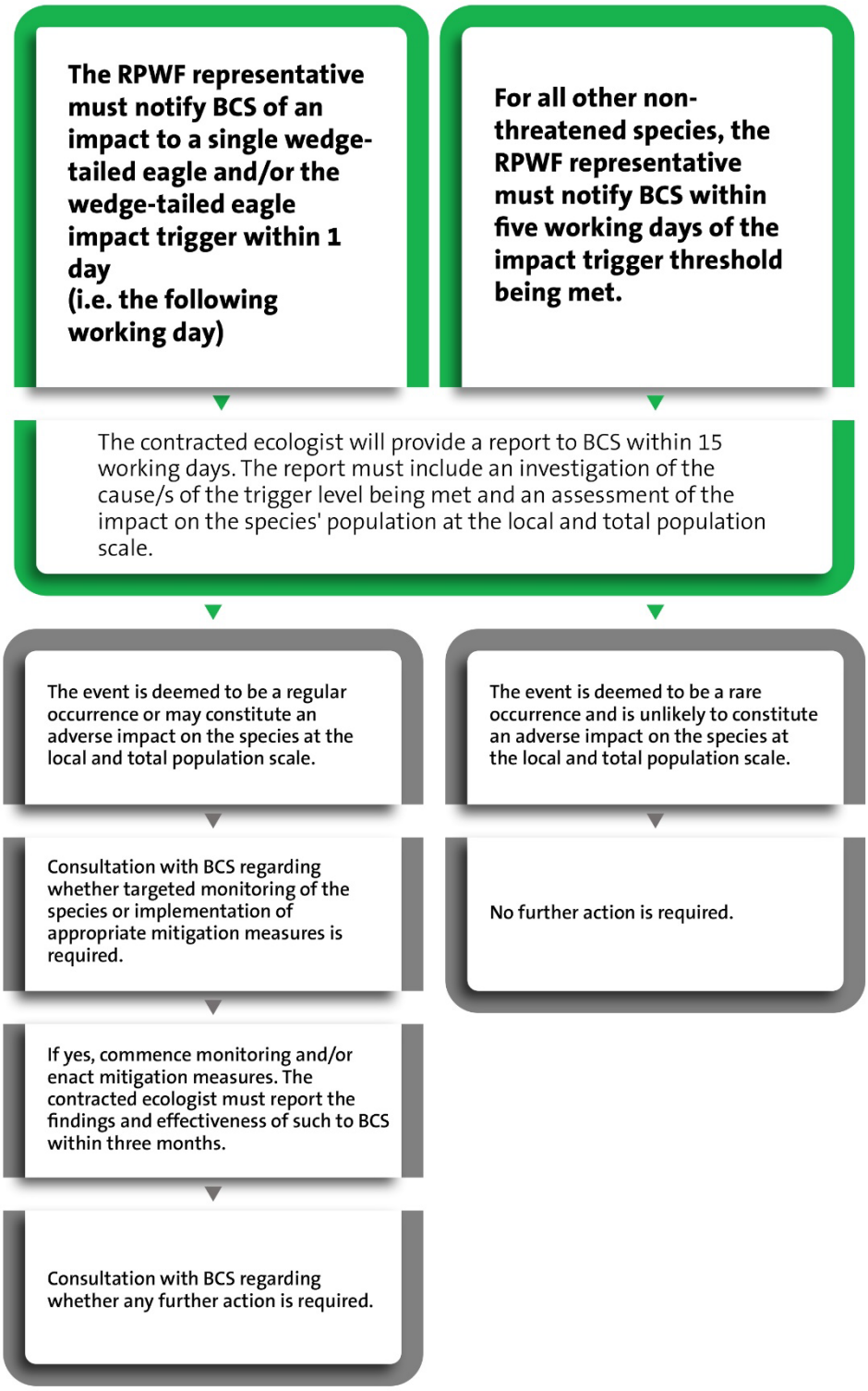

Figure 4: Non-threatened Species Impact Trigger Response Procedure

7.0 Mitigation Measures

The purpose of this section is to provide details of mitigation measures to manage risk of the Development leading to a significant impact on birds and bats. The ongoing, preventative mitigation measures the Developer has committed to and will implement as part of the Development are identified in Table 11. Being an adaptive management plan, the mitigation measures provided below will be susceptible to change during the life of the BBAMP as monitoring results are realised, technological advances occur across the industry and new or alternative mitigation measures become available.

Table 11: Ongoing, Preventative Mitigation Measures

Mitigation Measure	Description	Timing	Relevant Species
Carrion Removal Program	Removal of carrion around turbines mitigates the risk of carrion feeders such as wedge-tailed eagle colliding with turbines. A carrion removal program will run for the operational lifetime of the Development and will apply to any carcass found within 200 m of turbines other than those of birds and bats. The following procedure will be adopted[8]: • The Environmental Representative or another suitable person will be appointed as the carrion removal coordinator. This person will be responsible for undertaking monthly inspections by vehicle and/or on foot of all areas within 200 m of turbines. All full-time employed site personnel will be trained on the carrion removal procedure. • If a bird or bat carcass is found the protocol outlined in Section 5.4.4 and 5.7 will be followed. If a non-bird or non-bat carcass is found the carcass must be disposed of at least 500 m from turbines in a manner that will not attract scavengers. • The location and date of discovery and date of removal of all non-bird or bat carcasses will be recorded and maintained in a database by the carrion removal coordinator. • Any feral or overabundant native animal control program implemented must include the removal of all carcasses from the Development. • Any carrion detected incidentally outside the carrion removal inspection is to be removed in a timely manner. Following two years of operation the carrion removal program may be adjusted, subject to consultation with BCS and/or DCCEEW. An annual summary of carcass detection and removal will be provided in each Annual Report (refer to Section 8.3).	Operational life of the Development, to be reviewed after two years, from the commencement of BBAMP monitoring.	• Wedge-tailed eagle • Black falcon • Little eagle • Any other raptor species known to scavenge recorded through monitoring
Pest Animal Control	Pest animal control will be conducted as part of the environmental management of the Project as outlined in the Rye Park Wind Farm Biodiversity Management Plan (RPWF-PLN-0003).	Operational life of the Development	• N/A
Lighting and Deterrents	Artificial lights on tall, man-made structures such as communication towers are known to increase collision risk for birds and bats. Steady-burning lights on communication towers increase the risk of collision for nocturnal migrants (Longcore et al. 2008), however communication towers with red strobe, red flashing, and white strobe lights result in less mortality than towers with steady-burning lights (Gehring et al. 2009). If lighting of wind turbines is required, the Developer will commit to a lighting solution that minimises potential impacts to avian species. The Developer will consider strobe/flashing lighting should it be acceptable to relevant aviation authorities (i.e. Civil Aviation Safety Authority).	Operational life of the Development	• All bird and bat species
Superb Parrot Mitigation Measures	Prepare and implement a SPPMP in accordance with Condition 18 of the EPBC Approval. The SPPMP will support the recovery objectives and actions described in the National Recovery Plan for the species	Prior to commissioning of the Development in	• Superb parrot

[8] Carrion may be removed by farmers onsite in accordance with their existing farming and bio-security practises. The procedure will also consider consultation with landholders any specific landholder requirements in line with relevant land agreements for the Development.

Mitigation Measure	Description	Timing	Relevant Species
	and be prepared and implemented in collaboration with the National Superb Parrot Recovery Team. The SPPMP will increase contemporary knowledge of superb parrot habit use and breeding ecology within the south-west slopes of NSW Important Bird Area in accordance with Condition 20 of the EPBC Approval.	accordance with Condition 19 of the EPBC Approval.	

A range of potential mitigation measures that may be considered should a threatened or non-threatened impact trigger be met and the investigation has deemed the event to be a regular occurrence or constitute an adverse impact on the species at the local or total population scale include but are not limited to those identified in Table 12.

Table 12: Potential mitigation measures for consideration through BCS and DCCEEW consultation

Potential Mitigation Measure	Description	Timing	Relevant Species
Acoustic and Ultrasonic deterrents	• Prepare a testing and monitoring program for the implementation of acoustic and/or ultrasonic deterrent devices. • Implementation will be targeted to particular wind turbines where impact triggers have been recorded, not Project wide, unless it is deemed impacts are Project wide. • Particular technology and devices to be used will be made strictly through consultation with BCS and/or DCCEEW with consideration of current technology.	Within 6-months of the agreed mitigation approach.	• Threatened bird and bats
Transmission Line Warning Markers	• Installation of transmission line warning markers to allow for white-throated needletails to visualise the transmission lines during flight. • Installation would be considered along sections of the transmission lines where white-throated needletail impact triggers are recorded. • Installation may consider marker balls, flags or rotating markers.	Prior to the next migration event of the white-throated needletail following agreement of the mitigation approach.	• White-throated needletail
Use of radar systems	• Prepare a testing and monitoring program for the implementation of radar systems (IdentiFlight or similar) to detect and monitor bird flight for particular species (which would be determined based on impact triggers) • Installation may be wind turbine specific, clusters of wind turbines or Project wide; but would be guided by the impact triggers recorded. • Radars would be used to control wind turbine speeds and even shut-down wind turbines if collision is deemed likely.	Within 12-months of the agreed mitigation approach.	• Wedge-tailed eagle • Black falcon • Little eagle • Superb parrot
Altered land management practices	• Modification of existing land management practices within the Project Area and adjacent land to reduce attraction of species to the Project Area. • Consideration to be given to land management in close proximity to wind turbines such as locations of lambing ewes, raptor perch management (removal of regularly used tree branches), reduction of grain stock feeding and relocation of farm dams. • Relevant mitigation measures subject to evidence of utilisation of land/feature and agreement with relevant landowners, noting the Developer does not have agreements in place with relevant parties that allow for such measures.	Within 3-months of the agreed mitigation approach and agreement of the landowner.	• Wedge-tailed eagle • Black falcon • Little eagle
GPS-tracking of large bent-wing bat	• Prepare a testing and monitoring program for the GPS-tracking of large bent-wing bat individuals departing and/or returning to the known maternity cave south of the Development. • The program would be designed to provide insight into the extent to which the species is interacting with the Development during migration events, as well as the timing of interaction.	During the next migration event of the large bent-wing bat following agreement of the	• Large bent-wing bat

Potential Mitigation Measure	Description	Timing	Relevant Species
	• This will allow analysis of whether or not wind turbine mitigation measures, such as alteration of cut-in speeds or temporary shutdowns, should occur at particular times of the year. • GPS-tracking would only occur for a sub-set of individuals from the maternity cave population, not all individuals. • The program would be prepared in consultation with the species assessment officer of BCS and suitably trained and qualified consultants. • The program should be implemented by suitably trained and qualified consultants, with specific experience in GPS-tracking of avifauna, ideally bat species.	mitigation approach.	

Painting of turbine blades	• Prepare a testing and monitoring program for painting single blades of wind turbines black.
	• The program will be prepared in consultation with BCS with consideration of current scientific literature at the time for the suitability of this mitigation measure.
	• This mitigation measure will only be implemented using a sub-set of wind turbines to allow for analysis of results to determine whether the measure successfully manages impacts to avifauna.
	• The particular wind turbines sub-set to be tested will be selected based on the impact triggers recorded but also visual impacts.
	• This mitigation measure is also reliant on the Developer confirming it is possible with relation to the following matters:
	  ○ Visual impacts
	  ○ Turbine warranty specifics
	  ○ Energy generation efficiency
	  ○ Modification to the Development Consent to allow for the implementation of the mitigation measure.
		Within 12-months of modification of the Development Consent to allow for the mitigation measure	• Wedge-tailed eagle
			• Black falcon
			• Little eagle

Offsetting and/or Funding of Conservation Programs	• Offsetting impacts of turbine strike may be considered in consultation with BCS and/or DCCEEW if the implementation of other mitigation measures are found to not adequately minimise or remove impact triggers. • The types of measures considered includes, but is not limited to, the management or improvement of habitat of breeding sites away from the subject site to improve breeding productivity, funding a conservation measure, research project or other offsets as may be agreed by BCS and DCCEEW.	Within 12-months of the agreed mitigation approach	• Threatened bird and bat species
Altering wind turbine cut-in speeds	• Prepare a testing and monitoring program to alter wind turbine cut-in speeds on wind turbines to reduce impacts on large bent-wing bat or other microbat species found to be impacted. • The altered cut-in speeds will consider the Bennett *et al.* (2022) journal article, or any other more current journal article at the time of the impact trigger. • The program should start with a sub-set of wind turbines associated with the impact triggers. • The program should start with occurring at distinct times of year when impact triggers are deemed most likely, being migration events or breeding season. • The program will be designed to be scalable if required, both in a sense of number of applicable wind turbines and particular cut-in speeds used. A cut-in speed of 4.5 m/s will not be the starting point, but rather a potential result. • The program will be prepared in consultation with BCS and/or DCCEEW. • This mitigation measure could also be considered for threatened bird species but would require testing and monitoring as the current literature only relates to its effectiveness to microbat	Within 6-months of the agreed mitigation approach	• Large bent-wing bat

Potential Mitigation Measure	Description	Timing	Relevant Species
	species. This would only occur following consultation with BCS and/or DCCEEW.		
Temporary shutdown of turbines	• Wind turbine shutdowns will only be considered and implemented as a last resort option should the implementation of the above or any other mitigation measure fail to reduce or remove the occurrence of impact triggers. • Wind turbines identified for shutdowns will be restricted to those associated with particular impact triggers. • Wind turbine shutdowns will only be considered for specific times of year or time of day.	Within 3-months of the agreed mitigation approach	• Superb parrot • Large bent-wing bat • White-throated needletail

Other novel measures will be developed or considered in response to specific requirements and based on the current technologies at the time of the impact. This BBAMP deliberately does not limit the consideration of mitigation measures to ensure that current and relevant research and technologies can be considered at the time of the impact. This is critical to ensuring the BBAMP remains current moving through the operation of the Development and is fit-for-purpose.

These mitigation measures and associated timing are to be determined if the threatened and non-threatened impact trigger response procedure determines that an impact trigger will potentially be a regular occurrence or may constitute, or lead to, an adverse or significant impact on the local or total population of a species. The additional mitigation measures if determined to be necessary must be compliant with the requirements of the Development Consent and EPBC Approval.

Where there are no mitigation measures that can be implemented to meet the objective of this BBAMP (being the Project does not result in a significant impact on birds and bats), the Developer should offset such impacts with a view of the Development having a net-zero impact or overall benefit on threatened bird and bat populations.

Mitigation measures, including the potential to offset impacts will be investigated when an impact trigger has been met to ensure the appropriate species-specific mitigation action is taken. In accordance with the reporting process and decision-making framework depicted in Figure 3 and Figure 4. Determination of the appropriateness and feasibility of such measures will be undertaken in consultation with BCS and DCCEEW.

The mitigation measures may be subject to modification through consultation with BCS in response to monitoring findings or continuing improvements in the understanding contributory factors relevant to bird and bat strike or barotrauma risk.

8.0 Reporting and Review

8.1 Reporting

The reporting requirements of this BBAMP are identified in Table 13, which align with the relevant reporting requirements of the Development Consent and EPBC Approval.

The reporting identified in this BBAMP is in addition to any incident or non-compliance notifications required by the Development Consent and which are further detailed in the EMS.

Table 13: Reporting Requirements

Report	Description	Timing	Performance Criteria	Responsible Person (s)
Carcass Search Program	Following each year of the carcass search program, the program findings will be compiled and submitted to the Planning Secretary and BCS, and/or the Environment Minister and DCCEEW within two months of survey completion. The report will detail species struck including: • Total carcasses/featherspots detected of each species, • Locations of carcasses/featherspots detected, • Dates carcasses/featherspots were detected, and • Details of any carcass/featherspots detections that triggered impact levels. Statistical analysis will be undertaken to provide estimates of the annual total number of collisions for each species in consideration of the carcass search area and effort and the observed carcass persistence times and observer detectability rates. A second report detailing the findings of the entire carcass search program must be submitted to the Planning Secretary and BCS, and/or the Environment Minister and DCCEEW within two months of completion of 24 months of surveys.	Annually for five years, within two months of survey completion.	Carcass Search Program conducted in accordance with method described in Section 5.4.	RPWF Environmental Representative • Submission of carcass search program reports Contracted Ecologist: • Completion of the carcass search program
Impact Trigger Reporting	BCS and/or DCCEEW must be notified when impact triggers are met (Section 6.0), depending on whether or not the species impacted is BC Act and/or EPBC Act listed. The report compiled by the contracted ecologist must then be submitted to the BCS and/or DCCEEW within 10 working days for threatened species or 15 working days for non-threatened species of the incident being reported detailing: • The impact trigger level that was reached, • The species and number of individuals involved in the impact trigger, • The date/s and location/s of recovered carcasses/featherspot, • Any identified ecological factors contributing to the impact trigger such as recent climate, weather, presence of prey species/foraging opportunities or seasonal factors (i.e., migration), and • Whether the event is likely to be rare or regular or may constitute an adverse impact on the species at the local or total population scale Verify whether or not the species has been impacted (including number of individuals and frequency) at neighbouring wind farms within a 10 km radius of the Project by accessing their publicly available annual BBAMP reports. Neighbouring wind farms within this radius will be considered at the time the impact trigger is recorded to consider any future wind farms. In cases where further monitoring or implementation of mitigation measures is deemed necessary through consultation with BCS and/or DCCEEW, the findings and effectiveness of such must be reported to the Planning Secretary and BCS, and/or the Environment Minister and DCCEEW within three months of the commencement of monitoring or the implementation of mitigation measures or within another specified timeframe as determined through consultation with BCS and/or DCCEEW.	If an impact trigger occurs in accordance with Section 6.0	Impact trigger reporting completed in accordance with content and timing requirements described in Section 6.0.	RPWF Environmental Representative • Impact trigger breach notification Contracted Ecologist • Preparation of impact trigger reporting

Report	Description	Timing	Performance Criteria	Responsible Person (s)
Annual Report (State)	Annual Reports are required each year for three years from the commencement of operation. The first Annual Report will be submitted to the Planning Secretary and BCS following completion of the first year of the carcass search program and the bird and bat surveys. The first Annual Report will: • Analyse, summarise, and provide commentary on data collected throughout the preceding year's bird and bat monitoring program (including the bird and bat surveys, carcass search surveys, carcass persistence trial and carcass detectability trial). Discussion on the findings of the bird and bat survey must include comparison with baseline data and interpretation of the findings in the context of regional conditions. • Analyse, summarise, and provide commentary on data collected from impact trigger events, and analyse collision rates relative to impact trigger levels. • If implemented, document the nature and timing of mitigation measures and assess potential impacts of such. • Report on any environmental (abiotic and biotic) factors or significant events that contributed to the data collected. A second Annual Report will be submitted to the Planning Secretary and BCS following completion of the two-year carcass search program. The second Annual Report will: • Analyse, summarise, and provide commentary on data collected throughout the preceding year's carcass search program. • Analyse, summarise, and provide commentary on data collected from impact trigger events, and analyse collision rates relative to impact trigger levels. • If implemented, document the nature and timing of mitigation measures and assess potential impacts of such. • Report on any environmental (abiotic and biotic) factors or significant events that contributed to the data collected. A third Annual Report will be submitted to the Planning Secretary and BCS following completion of the bird and bat surveys during the third year of operation. The third Annual Report will: • Analyse, summarise, and provide commentary on data collected during the third operational year survey. This report must include comparison with baseline data and year one data and interpretation of the findings in the context of regional conditions. • Analyse, summarise, and provide commentary on data collected from impact trigger events, and analyse collision rates relative to impact trigger levels. • If implemented, document the nature and timing of mitigation measures and assess potential impacts of such. • Report on any environmental (abiotic and biotic) factors or significant events that contributed to the data collected. A final Annual Report will be submitted to the Planning Secretary and BCS following completion of the bird and bat surveys during the fifth year of operation. The final Annual Report will: • Analyse, summarise, and provide commentary on data collected during the third operational year survey. This report must include comparison with baseline data and year one data and interpretation of the findings in the context of regional conditions.	Annually for three years and once following the fifth year of bird and bat monitoring	Annual reports to be submitted to the Planning Secretary and BCS within three months of completion of annual monitoring. Annual reports to include all information referred to description column within this table. All raw data collected as part of the monitoring program will be provided to the Planning Secretary and BCS with the annual reports.	RPWF Environmental Representative • Submission of Annual Reports Contracted Ecologist • Preparation of Annual Reports

Report	Description	Timing	Performance Criteria	Responsible Person (s)
	• Analyse, summarise, and provide commentary on data collected from impact trigger events, and analyse collision rates relative to impact trigger levels. • If implemented, document the nature and timing of mitigation measures and assess potential impacts of such. • Report on any environmental (abiotic and biotic) factors or significant events that contributed to the data collected.			
Annual Report (Commonwealth)	Annual compliance reporting required by Condition 29 of the EPBC Approval is to include a summary of the bird and bat monitoring program as well as any relevant findings and reporting that has been prepared in the relevant reporting period.	Annually	Annual reports to be submitted to DCCEEW from the date of the commencement of the Development and published on the Development's website within 60 business days.	RPWF Environmental Representative • Submission of Annual Reports

8.2 Review

This BBAMP and its implementation will be reviewed on an as needs basis during operation of the Development and prior to decommissioning. The review will consider the following:

- Developer, site personnel and relevant agency comments;
- Efficacy of management practices and mitigation strategies;
- Complaints;
- Incident reports;
- Changes in organisational structure;
- Changes in novel monitoring and mitigation strategies; and
- Changes in legislation and standards.

Further to the above, specific milestones for review of the BBAMP and the carcass search program have been identified, with these milestones being presented in Table 14.

Table 14: Bird and Bat Monitoring Program Review

Review	Description	Milestone	Timing
Carcass Search Program Review	A review of the carcass search program will be undertaken following two years of operation. The review will consider: • Methods and reliability of carcass detection • Value and use of data collected Based on the outcome of the review, the program may be discontinued if deemed appropriate through consultation with BCS and DCCEEW.	Once, following two years of operation	Completion of a review of the carcass search program within three months of submission of the carcass search program findings.
BBAMP Minor Review	A minor review will be undertaken after the first year of commencement of operation, following the completion of the annual report, with the review summary and amendments to monitoring and mitigation strategies issued as an appendix to the BBAMP. The minor review will: • Confirm roles and responsibilities identified in Section 1.5 are current and appropriate as the Project progresses. • Summarise and assess observations made during any monitoring surveys, highlighting any confirmed impact triggers. • Assess management and mitigation strategies against observations and analyses presented in the annual report, and where appropriate provide improvements or adaptations to monitoring and management actions. • Introduce novel monitoring and mitigation strategies identified throughout the preceding year (if available). This will only require consultation with BCS and DCCEEW if the identified changes relate to monitoring survey methods.	Once after the first year, following completion of the first annual report	Completion of the BBAMP minor review within two months of submission of the first annual report.
BBAMP Major Review	A major review will be undertaken after three and five years of commencement of operation. The major review will: • Review roles and responsibilities identified in Section 1.5 and update with any organisational or operational changes. • Summarise and assess observations made during the bird and bat monitoring program and carcass search program, and trigger impact reports, and make any resultant adjustments to management and mitigation strategies. • Recalculate species risk using the risk assessment methodology (Section 3.0) based on observations made and species struck during the preceding two years. • Introduce novel monitoring and mitigation strategies identified throughout the preceding years that have not already been implemented. Consultation with occur with BCS and DCCEEW following this review.	After the third year, following completion of the annual report. After the fifth year, following the completion of the annual report	Completion of the BBAMP major review within four months of submission of the third year of annual monitoring. Completion of the BBAMP major review within four months of submission of the fifth year of annual monitoring.

Furthermore. as per Schedule 5 Condition 2 of the Development Consent, the BBAMP will be reviewed in response to:

- An incident,
- Submission of relevant reporting (refer to Section 8.1), or
- Modification to the conditions of the Development Consent.

Where the review results in the revision to the BBAMP, consultation with BCS and DCCEEW will be undertaken as relevant, and, then the revised document/s will be submitted to the Planning Secretary and DCCEEW for approval in accordance with Condition Schedule 5, Condition 2 of the Development Consent and Condition 35 of the EPBC Approval.

Once approved, a copy of the revised document/s will be uploaded to the Development's website (www.ryeparkwf.com.au).

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Appendix A: Bird and Bat Survey Method

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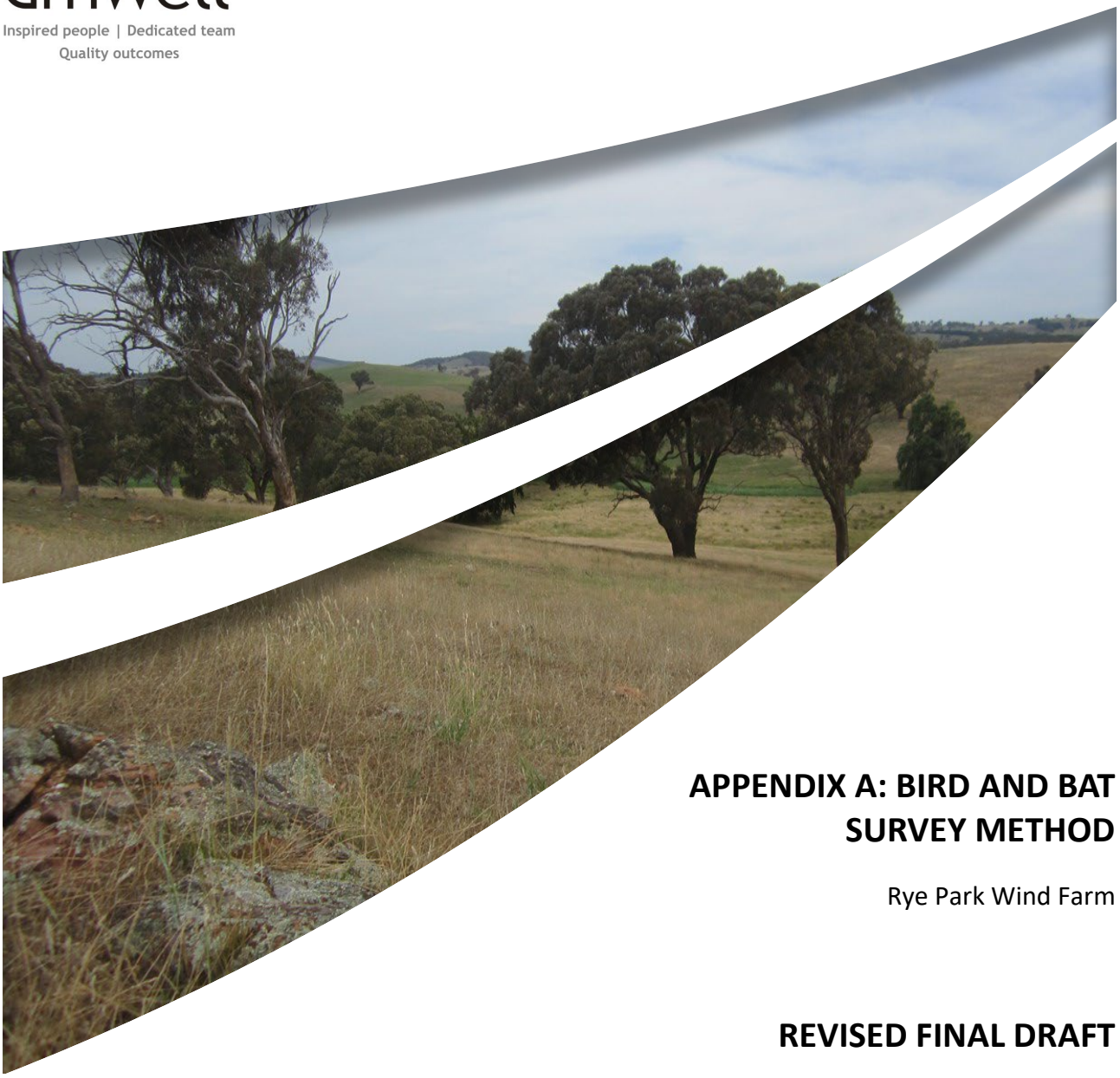
Quality outcomes



APPENDIX A: BIRD AND BAT SURVEY METHOD

Rye Park Wind Farm

REVISED FINAL DRAFT

March 2021

APPENDIX A: BIRD AND BAT SURVEY METHOD

Rye Park Wind Farm

REVISED FINAL DRAFT

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Tilt Renewables

Project Director: Travis Peake
Project Manager: Bill Wallach
Date: March 2021

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
1	David Moore	19/03/2021	David Moore	19/03/2021
2	Bill Wallach		Bill Wallach	

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1.0 Introduction

This document details the survey approach and method to be followed during operational phase bird and bat surveys to be conducted at Rye Park Wind Farm (RPWF). The methods outlined in this document are consistent with that followed during pre-construction bird and bat surveys conducted during 2018/19.

1.1 Background

Condition 23 of Schedule 3 of the NSW Development Consent identified the following requirement relevant to this document:

Prior to the commissioning of any wind turbines, the Applicant must prepare a Bird and Bat Adaptive Management Plan for the development in consultation with BCS, and to the satisfaction of the Planning Secretary. This plan must include:

(a) *at least 12 months' worth of baseline data on threatened and 'at risk' bird and bat species and populations in the locality that could be affected by the development;*

This requirement was met through the completion of 12 months of bird and bat surveys across RPWF during 2018/19. Data collected during the pre-construction surveys will be compared with the findings of the operational phase bird and bat surveys to assess any changes in bird and bat diversity, activity and relative abundance.

2.0 Bird Surveys

2.1 Vantage Point Surveys

Vantage point surveys will be conducted at the five sites that were surveyed during the pre-construction surveys in 2018/19 (**Table 2.1** and **Figure 2.1**). Vantage point surveys are to be conducted during February, April, July and November of the first, third and fifth year following commencement of operation (as described in Section 5.2 of the BBAMP). Each site will be surveyed for one hour on two occasions per seasonal survey round, once in the late morning (i.e. between 9:30 and 12:00) and once in the early afternoon (i.e. between 12:00 and 3:30) to minimise sampling bias. The following weather-related variables must be recorded during each survey; temperature (℃), precipitation (none, showers, light rain, rain, other), cloud cover (fine, scattered cloud (<30% cover), partly cloudy (30-90% cover), cloudy (>90% cover)) and wind speed (still, light (<11 km/hr), gentle – moderate (11-28 km/hr), fresh wind (29-38 km/hr)). Surveys should not be conducted during rain or whilst wind speeds exceed 40 km/h.

During each vantage point survey, a single observer will record the following information per observation:

- species and abundance
- observation type
- distance and direction from the observer (to the nearest 10 m and 10°)
- approximate height of the observed bird above ground level (AGL) (to the nearest 10 m)
- direction of flight (to the nearest 10°)
- flight pattern (not flying, local movement, directional flight, circling, stooping, varied, other)
- behaviour (flight, foraging, perching, mating, aggressive interactions, hollow inspection, nesting, on station).

Table 2.1. Vantage Point Survey Sites

Survey Site Name	Easting	Northing	Control/Impact
VPI01	684717	6152633	Impact
VPI03	682335	6175070	Impact
VPI04	680372	6180384	Impact
VPC03	682328	6162387	Control
VPC04	684229	6188215	Control

2.2 Transect Surveys

Standard two-hectare 20 minute transect surveys (bird utilisation surveys) are to be conducted at 16 sites (**Table 2.2** and **Figure 2.1**). Each survey site comprises an area measuring 400 metres (m) long by 50 m wide. Transect surveys are to be conducted during February, April, July and November of the first, third and fifth year within three months of commencement of operation (as described in Section 5.2 of the BBAMP) (**Table 2.4**). Surveys will be undertaken during the three hours after dawn and the three hours before dusk. Each transect will be surveyed twice per seasonal survey round within different survey time intervals (one in the morning and one in the afternoon) to minimise sampling bias. The same weather information recorded during the vantage point surveys will be recorded during each transect survey. Surveys should not be conducted during rain or whilst wind speeds exceed 40 km/h.

During each transect survey, a single observer will record the following information per observation within the survey area:

- species and abundance
- observation type
- distance and direction from the observer (to the nearest 10 m and 10°)
- approximate height of the observed bird AGL (to the nearest 10 m)
- direction of flight (to the nearest 10°)
- flight pattern (not flying, local movement, directional flight, circling, stooping, varied, other)
- behaviour (flight, foraging, perching, mating, aggressive interactions, hollow inspection, nesting, on station).

All raptors or threatened species detected outside of the survey area will be recorded and the information outlined above collected for each observation.

Table 2.2. Transect Survey Sites

Site Name	Previous Site Name	Control / Impact	Start Point (Easting)	Start Point (Northing)	End Point (Easting)	End Point (Northing)
TS_C01	BU_C02	Control	684333	6153579	684726	6153504
TS_C02	BU_C05	Control	685286	6156501	685395	6156116
TS_C03	BU_C06	Control	680197	6167392	680588	6167304
TS_C04	BU_C09	Control	681427	6170326	681377	6169929
TS_C05	BU_C12	Control	683298	6174769	683245	6174356
TS_C06	BU_C16	Control	679654	6180988	680036	6180868
TS_C07	BU_C17	Control	678996	6183233	679105	6182848
TS_C08	BU_C18	Control	675709	6185620	675818	6185235
TS_I01	BU_I03	Impact	684721	6152512	684830	6152127
TS_I02	BU_I07	Impact	685898	6156162	685977	6155770
TS_I03	BU_I08	Impact	681463	6167975	681572	6167590

Site Name	Previous Site Name	Control / Impact	Start Point (Easting)	Start Point (Northing)	End Point (Easting)	End Point (Northing)
TS_I04	BU_I09	Impact	681684	6170190	682078	6170126
TS_I05	BU_I15	Impact	682694	6175490	682803	6175105
TS_I06	BU_I24	Impact	676037	6186113	676146	6185728
TS_I07	BU_I21	Impact	679913	6182261	680022	6181876
TS_I08	BU_I23	Impact	678884	6181383	679284	6181372

2.3 Targeted Superb Parrot Surveys

Targeted two-hectare 20 minute transect surveys are to be conducted at 15 sites (**Table 2.3** and **Figure 2.1**). Superb parrot surveys are to be conducted in the same manner as the transect surveys described in **Section 2.2**. Superb parrot surveys are to be conducted twice during November of the first, thirds and fifth year within three months of commencement of operation (as described in Section 5.2 of the BBAMP) (**Table 2.4**). Note that one round of superb parrot surveys at the following sites also counts as one round (i.e. the Spring round) of general bird transect surveys (see **Table 2.4**)

- TS_C01
- TS_C02
- TS_C03
- TS_C04
- TS_I02
- TS_I03
- TS_I04

Table 2.3. Superb parrot survey sites

Site Name	Previous Site Name	Control / Impact	Start Point (Easting)	Start Point (Northing)	End Point (Easting)	End Point (Northing)
TS_C01	SP_C01	Control	684333	6153579	684726	6153504
TS_C04	SP_C02	Control	685541	6154594	685249	6154867
TS_C05	SP_C03	Control	685751	6155633	686062	6155381
TS_C02	SP_C04	Control	685286	6156501	685395	6156116
TS_C03	SP_C05	Control	680197	6167392	680588	6167304
TS_C06	SP_C06	Control	680973	6167430	680939	6167023
TS_C07	SP_C07	Control	681116	6168936	681509	6168866
TS_C04	SP_C08	Control	681427	6170326	681377	6169929

Site Name	Previous Site Name	Control / Impact	Start Point (Easting)	Start Point (Northing)	End Point (Easting)	End Point (Northing)
TS_I05	SP_I01	Impact	684721	6152512	684830	6152127
TS_I06	SP_I02	Impact	684516	6153064	684906	6152974
TS_I07	SP_I03	Impact	684831	6153214	685231	6153215
TS_I08	SP_I04	Impact	685779	6154507	685635	6154134
TS_I02	SP_I05	Impact	685898	6156162	685977	6155770
TS_I03	SP_I06	Impact	681463	6167975	681572	6167590
TS_I04	SP_I07	Impact	681684	6170190	682078	6170126

If the following superb parrot observations are recorded during these targeted surveys, further monitoring of the relevant hollow bearing trees and/or wind turbines would be undertaken (described below):

- confirmation of superb parrot individuals using hollow bearing trees within 200 m of wind turbines on two occasions flying at or within 10 m of RSA
- two or more observations of flocks of at least 10 individuals flying at or within 10 m of RSA

The following monitoring would be implemented only in the circumstances described above:

- Where relevant, a remote survey camera would be mounted facing the confirmed hollow confirmed to be used for breeding to record bird activity (visitation, feeding, flight practice of young…etc)
- Additional weekly carcass monitoring through the month of November of all wind turbines within 200 m of the confirmed breeding hollow
- The combination of the two monitoring components above will determine if the breeding event is successful or not as well as potentially determine if an adult breeding bird was lost during breeding season
- Monitoring will occur for the month of November
- If the breeding event of monitoring breeding hollow is successful, then not further action is required

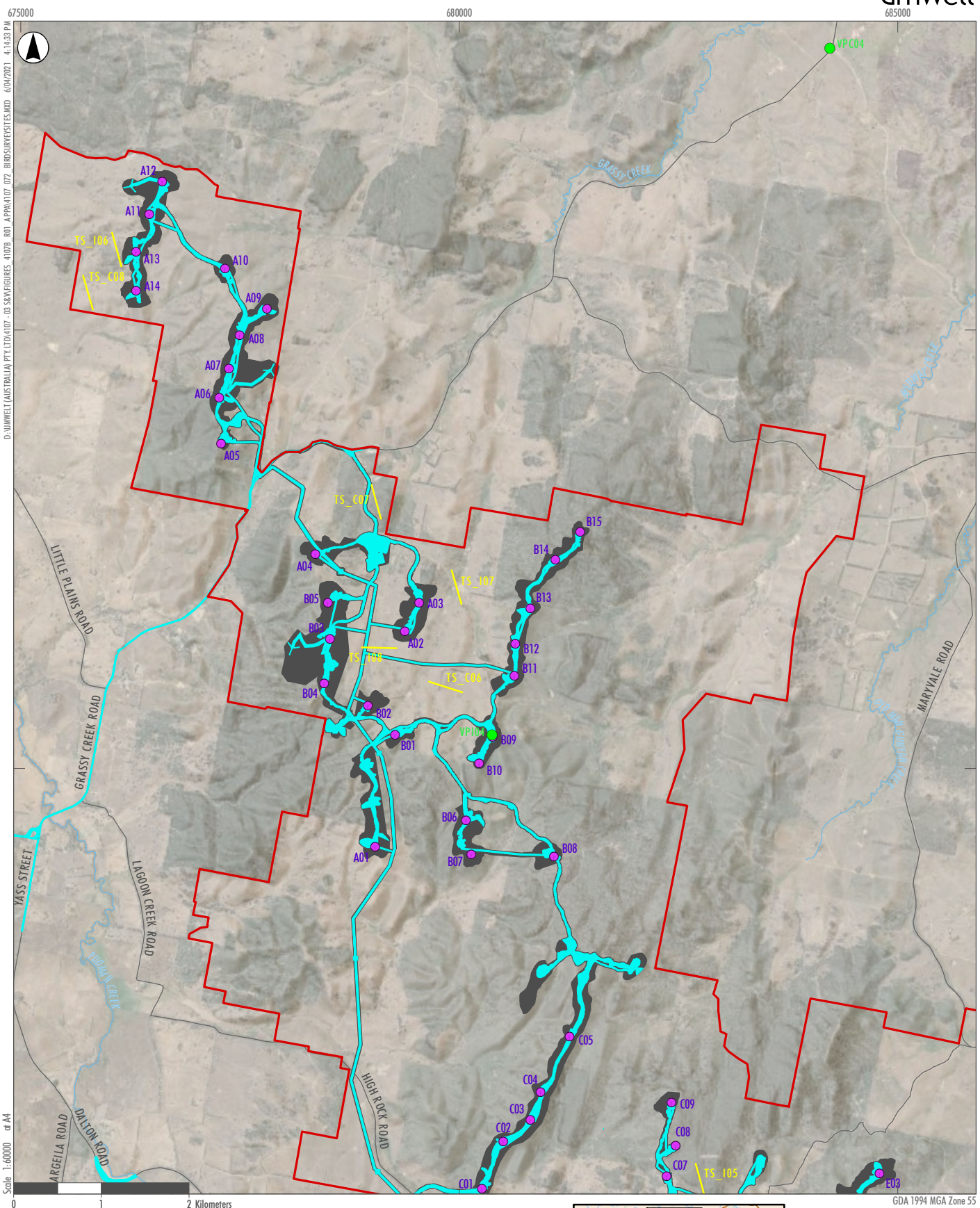
2.4 Summary of Bird Survey Effort

Below is a summary of bird survey effort, including which survey round applies to which Site (**Table 2.4**). **Figure 2.1** displays the location of each survey site.

Table 2.4. Overall bird survey schedule for each survey year

Site Name	Previous Site Name	February	April	July	November #1	November #2
TS_C01	BU_C02 SP_C01	Yes	Yes	Yes	Yes	Yes
TS_C02	BU_C05 SP_C04	Yes	Yes	Yes	Yes	Yes
TS_C03	BU_C06	Yes	Yes	Yes	Yes	Yes

Site Name	Previous Site Name	February	April	July	November #1	November #2
	SP_C05					
TS_C04	BU_C09 SP_C08	Yes	Yes	Yes	Yes	Yes
TS_C05	BU_C12	Yes	Yes	Yes	Yes	No
TS_C06	BU_C16	Yes	Yes	Yes	Yes	No
TS_C07	BU_C17	Yes	Yes	Yes	Yes	No
TS_C08	BU_C18	Yes	Yes	Yes	Yes	No
TS_I01	BU_I03	Yes	Yes	Yes	Yes	No
TS_I02	BU_I07 SP_I05	Yes	Yes	Yes	Yes	Yes
TS_I03	BU_I08 SP_I06	Yes	Yes	Yes	Yes	Yes
TS_I04	BU_I09 SP_I07	Yes	Yes	Yes	Yes	Yes
TS_I05	BU_I15	Yes	Yes	Yes	Yes	No
TS_I06	BU_I19	Yes	Yes	Yes	Yes	No
TS_I07	BU_I20	Yes	Yes	Yes	Yes	No
TS_I08	BU_I24	Yes	Yes	Yes	Yes	No
TS_C04	SP_C02	No	No	No	Yes	Yes
TS_C05	SP_C03	No	No	No	Yes	Yes
TS_C06	SP_C06	No	No	No	Yes	Yes
TS_C07	SP_C07	No	No	No	Yes	Yes
TS_I05	SP_I01	No	No	No	Yes	Yes
TS_I06	SP_I02	No	No	No	Yes	Yes
TS_I07	SP_I03	No	No	No	Yes	Yes
TS_I08	SP_I04	No	No	No	Yes	Yes



Legend

- Rye Park Wind Farm Project Area
- March 2021 Indicative Development Footprint
- March 2021 Development Corridor
- Turbine Locations
- Raod
- Watercourses

Umwelt Bird Surveys

- Vantage Point Surveys
- Survey Transects

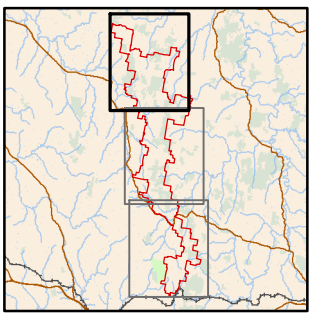
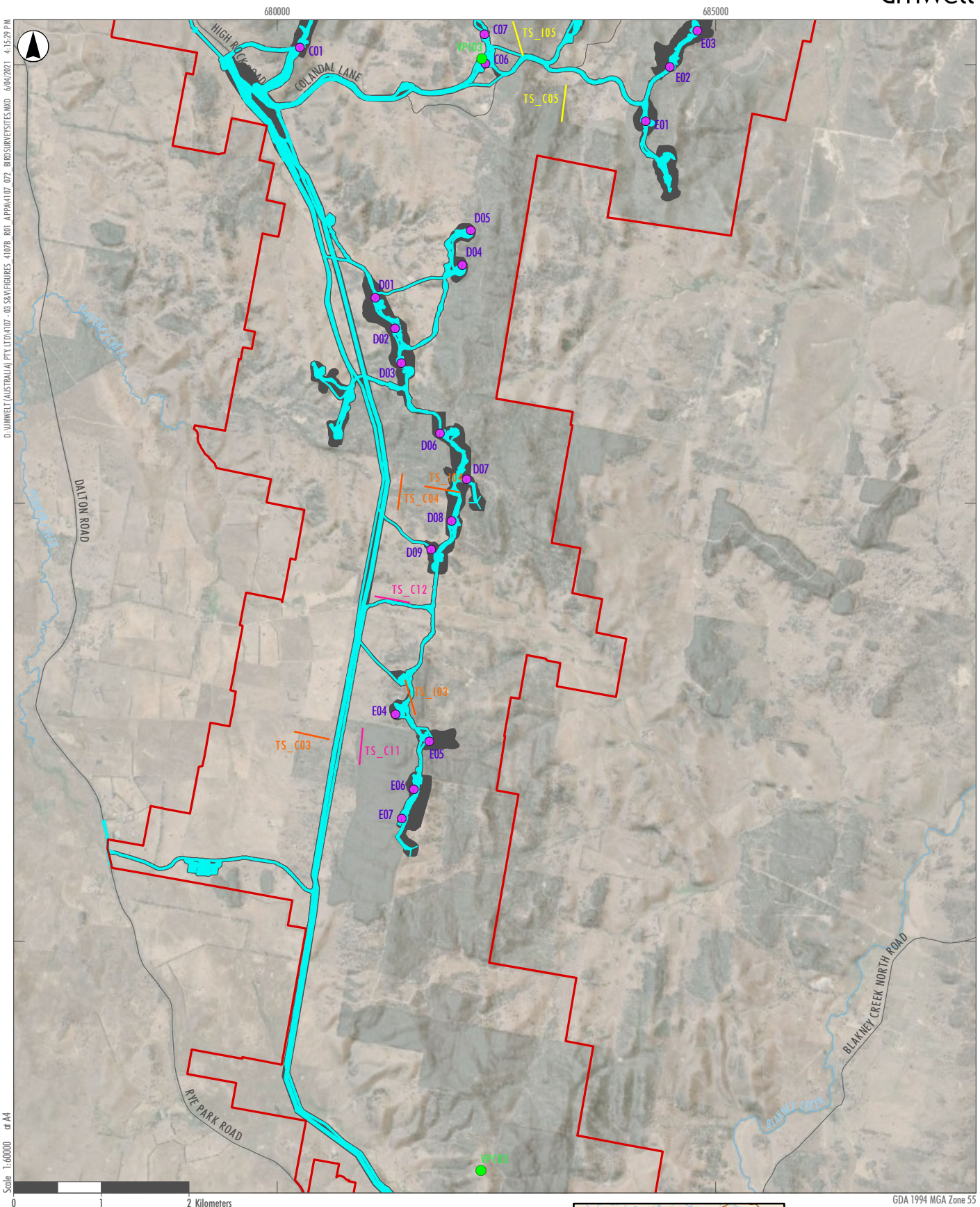


FIGURE 2.1.1

Bird Survey Sites

Image Source: ESRI Basemap (2020) Data source: Geoscience Australia; NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- Rye Park Wind Farm Project Area
- March 2021 Indicative Development Footprint
- March 2021 Development Corridor
- Turbine Locations
- Raod
- Watercourses

Umwelt Bird Surveys

- Vantage Point Surveys
- Survey Transects
- Targeted Superb Parrot Surveys
- Transect and Targeted Superb Parrot Surveys

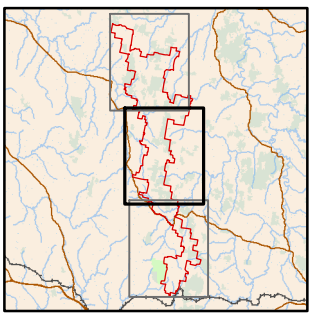
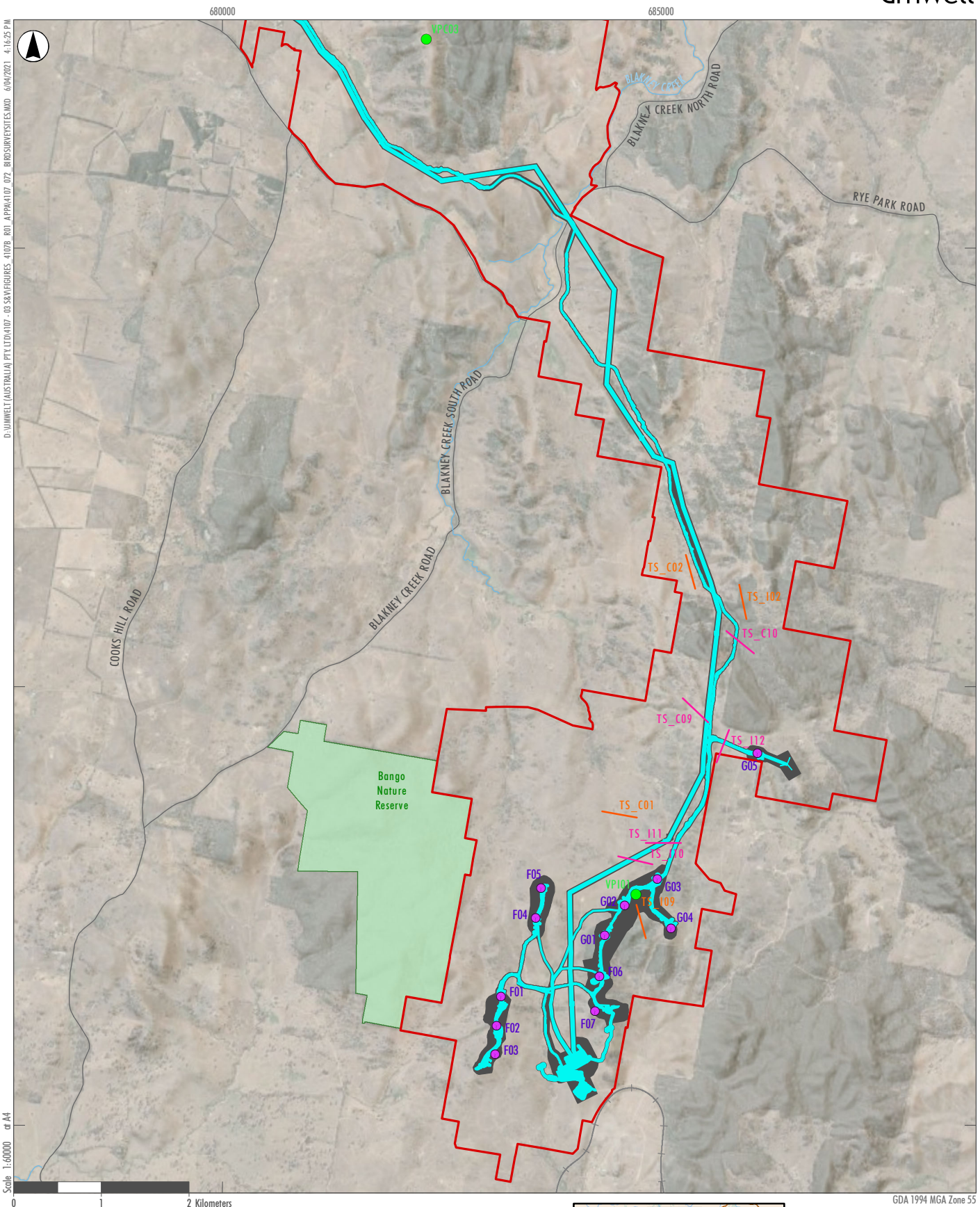


FIGURE 2.1.2

Bird Survey Sites

Image Source: ESRI Basemap (2020) Data source: Geoscience Australia; NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- Rye Park Wind Farm Project Area
- March 2021 Indicative Development Footprint
- March 2021 Development Corridor
- Turbine Locations
- Nature Reserve
- Raod
- Railway
- Watercourses

Umwelt Bird Surveys

- Vantage Point Surveys
- Targeted Superb Parrot Surveys
- Transect and Targeted Superb Parrot Surveys

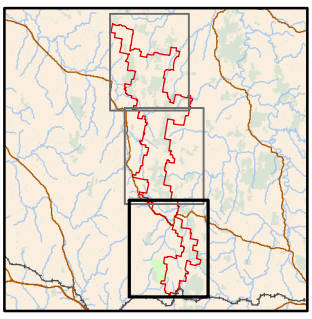


FIGURE 2.1.3

Bird Survey Sites

Image Source: ESRI Basemap (2020) Data source: Geoscience Australia; NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)

2.5 Incidental Observations

All incidental observations of raptors and threatened species in the RPWF area are to be recorded by ecologists during any component of the BBAMP survey program, being all bird survey components, bat survey equipment deployment and carcass surveys. Incidental observations would be made strictly outside the survey times of formal observational bird survey components. Information including the location of the bird, flight height and behaviour and the standard weather condition variables consistent with the data collection approach of the formal surveys is to be recorded.

3.0 Bat Surveys

3.1 Method

Bat surveys are to be conducted at three wind turbines that will be located as close as possible to those monitored during the pre-construction surveys in 2018-19 (**Table 3.1**). The meteorological masts used during the pre-construction surveys will not remain on-site during the operation of the Project, i.e. the existing meteorological masts will be deconstructed during the construction of the Project.

Bat surveys will be conducted during three seasons (i.e. February, March, April and November) during the first year , third year and fifth year. Monitoring will be conducted by deploying bat detectors at ground level and at approximately 45 m AGL.

The data collected should be analysed by an ecologist experienced in identifying calls of species that occur in the region.

3.1.1 Monitoring within the rotor swept area (RSA)

Monitoring will be undertaken at hub-height of approximately 119 m at three wind turbines to assess bat activity within the RSA of wind turbines (**Table 3.1** and **Figure 3.1**).

Bat detectors will be deployed at each of the sites, each survey year for:

- 10 nights in January, November, and the first fortnight of April
- the duration of February and March. A minimum of 10 nights of data corresponding with the peak large bentwing-bat migration period for that year must be analysed. Confirmation of peak migration periods will be sought from BCD each year.

The deployment of the bat detectors onto the six masts capable of supporting microphones would be conducted as follows:

- one bat detector deployed within the RSA (i.e. at hub height, approximately 119 m AGL)
- units would be pre-programmed to automatically commence recording 30 minutes before sunset and will automatically stop recording 30 minutes after sunrise. It will involve a minimum of 10 survey nights for the spring season.

Bat detectors will be installed at hub height on the wind turbines by an appropriately qualified person with guidance provided by an ecologist. Bat detectors will specifically be mounted on the galvanised steel mesh platform on the hub, with the detector being aimed to the rear of the turbine. Should a selected wind turbine not be available for installation of a bat detector in a given survey period (e.g., if the hub has been removed for maintenance), a neighbouring wind turbine will be used.

3.1.2 Ground level monitoring

Monitoring will be undertaken at a height of approximately 1-3 m at the base of, or in proximity to, the three wind turbines to assess bat activity below the RSA of wind turbines. These sites would be the same as those described above in **Section 3.1.1** (**Table 3.1** and **Figure 3.1**). Bat detectors will be deployed at each of the three sites, each survey year for:

- 10 nights in January, November, and the first fortnight of April
- the duration of February and March. A minimum of 10 nights of data corresponding with the peak large bentwing-bat migration period for that year must be analysed. Confirmation of peak migration periods will be sought from BCD each year.

The deployment of the bat detectors at ground level would be conducted as follows:

- bat detectors would be deployed for 10 nights
- detectors would be set up in potential flyways, where possible, between 1 – 2 m off the ground and microphones angled vertically or within 45 degrees of vertical and
- bat detectors will be pre-programmed to automatically commence recording 30 minutes before sunset and will automatically stop recording 30 minutes after sunrise.

Table 3.1. Bat Survey Sites

Turbine ID	General Location in the Project	Previous Site Name	Position (m AGL)
D06	Central	BG_IRP3	1-3
G03	South	N/A	1-3
A04	North	BG_IRP6	1-3
D06	Central	BM_IRP3	~ 119
G03	South	N/A	~ 119
A04	North	BM_IRP6	~ 119

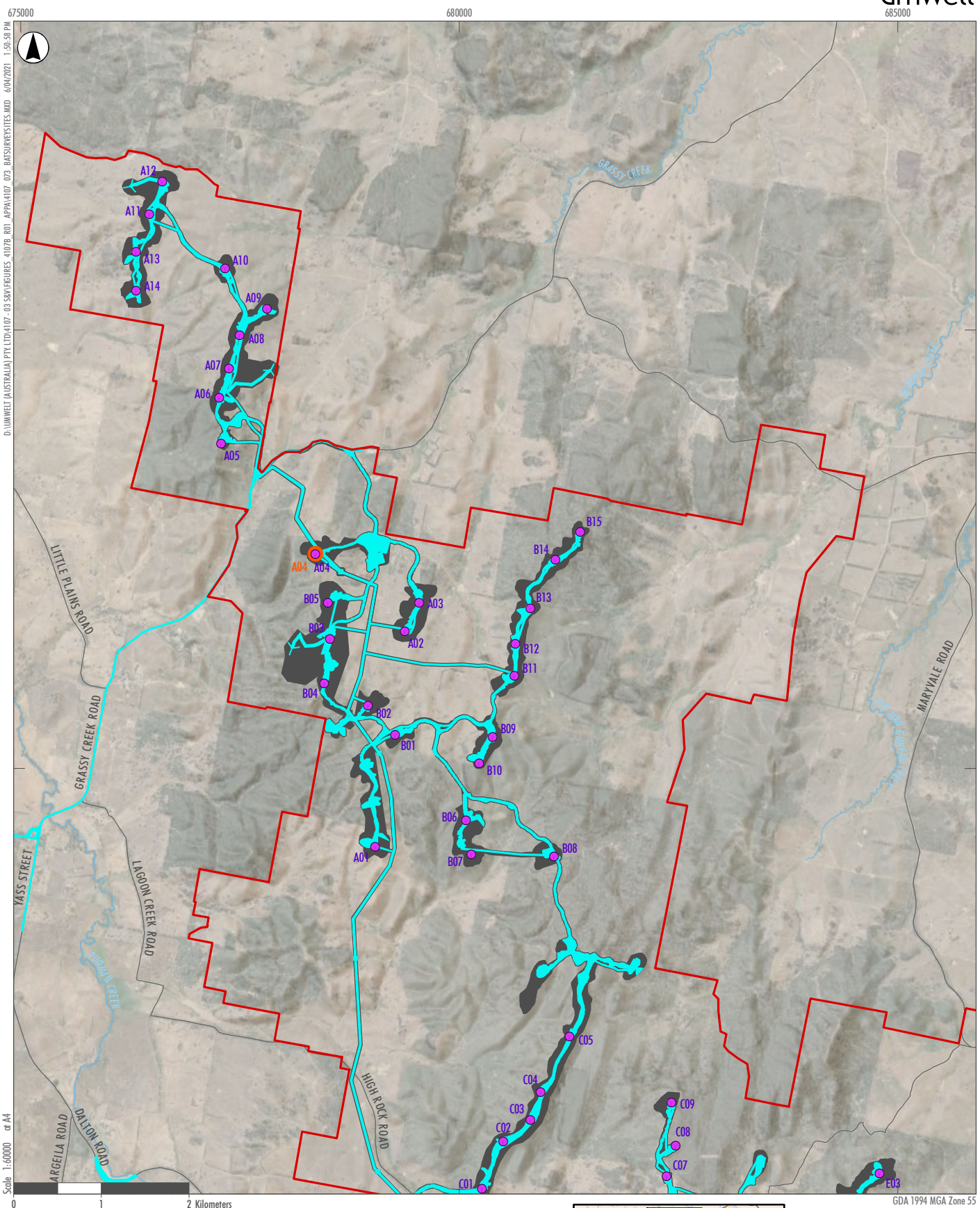
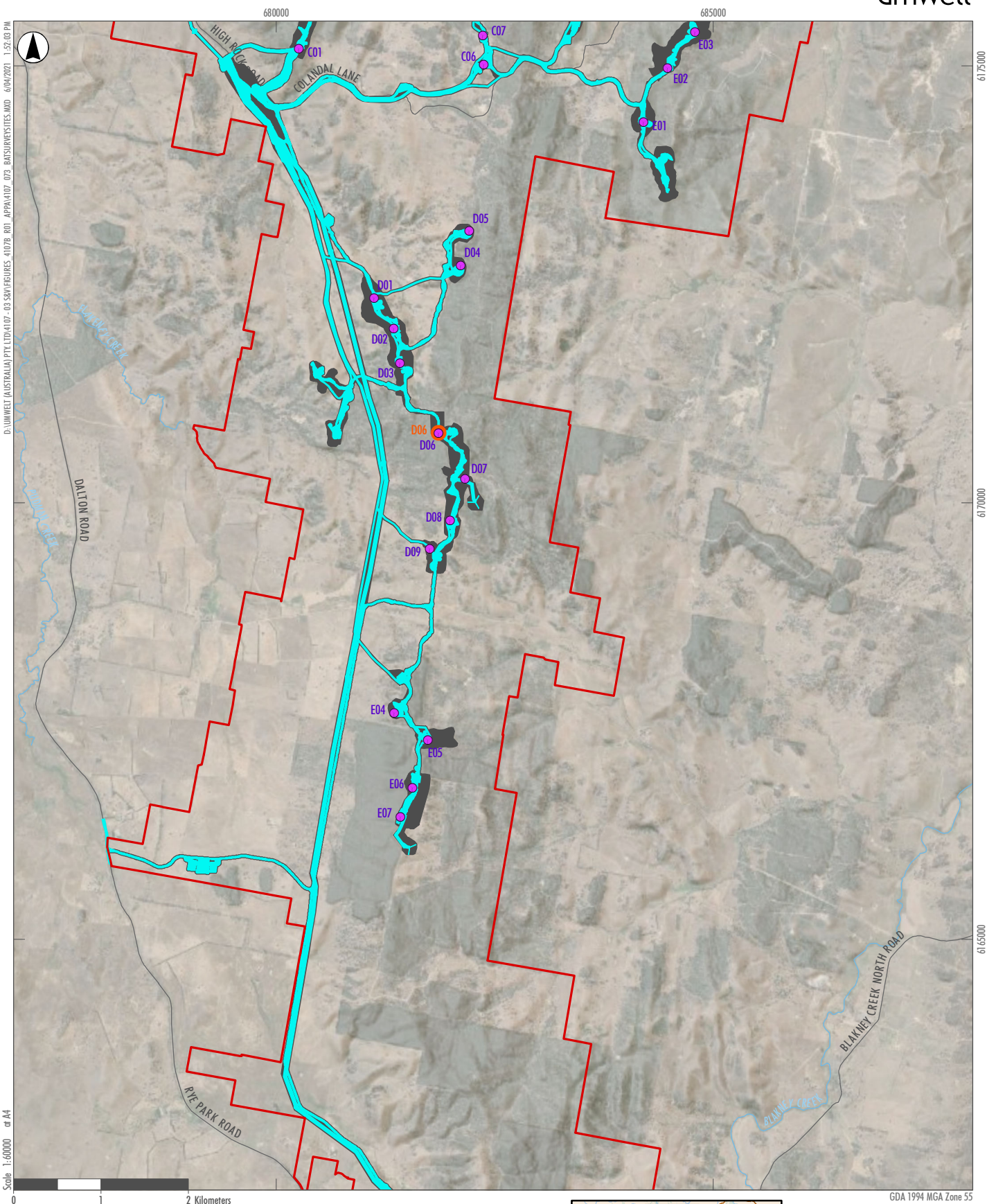


FIGURE 3.1.1

Bat Survey Sites

Image Source: ESRI Basemap (2020) Data source: Geoscience Australia; NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- Rye Park Wind Farm Project Area
- March 2021 Indicative Development Footprint
- March 2021 Development Corridor
- Turbine Locations
- Raod
- Watercourses
- Bat Survey Sites

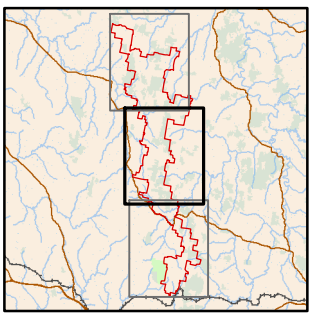
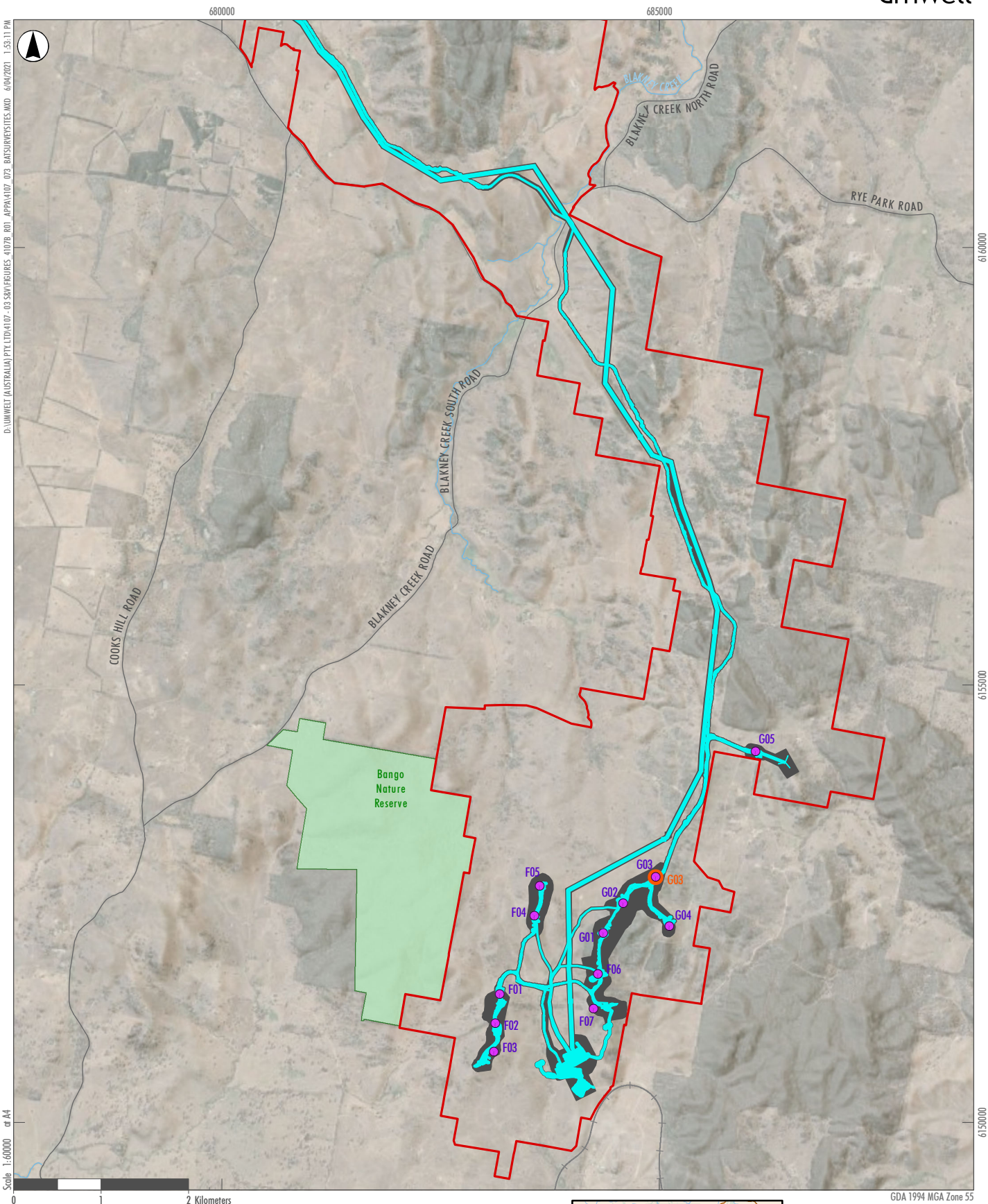


FIGURE 3.1.2

Bat Survey Sites

Image Source: ESRI Basemap (2020) Data source: Geoscience Australia; NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- Rye Park Wind Farm Project Area
- March 2021 Indicative Development Footprint
- March 2021 Development Corridor
- Turbine Locations
- Nature Reserve
- Raod
- Railway
- Watercourses
- Bat Survey Sites

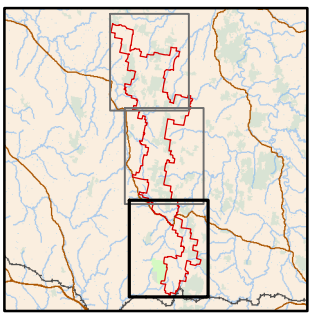


FIGURE 3.1.3

Bat Survey Sites

Image Source: ESRI Basemap (2020) Data source: Geoscience Australia; NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)

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Appendix B: Bird and Bat Risk Assessment

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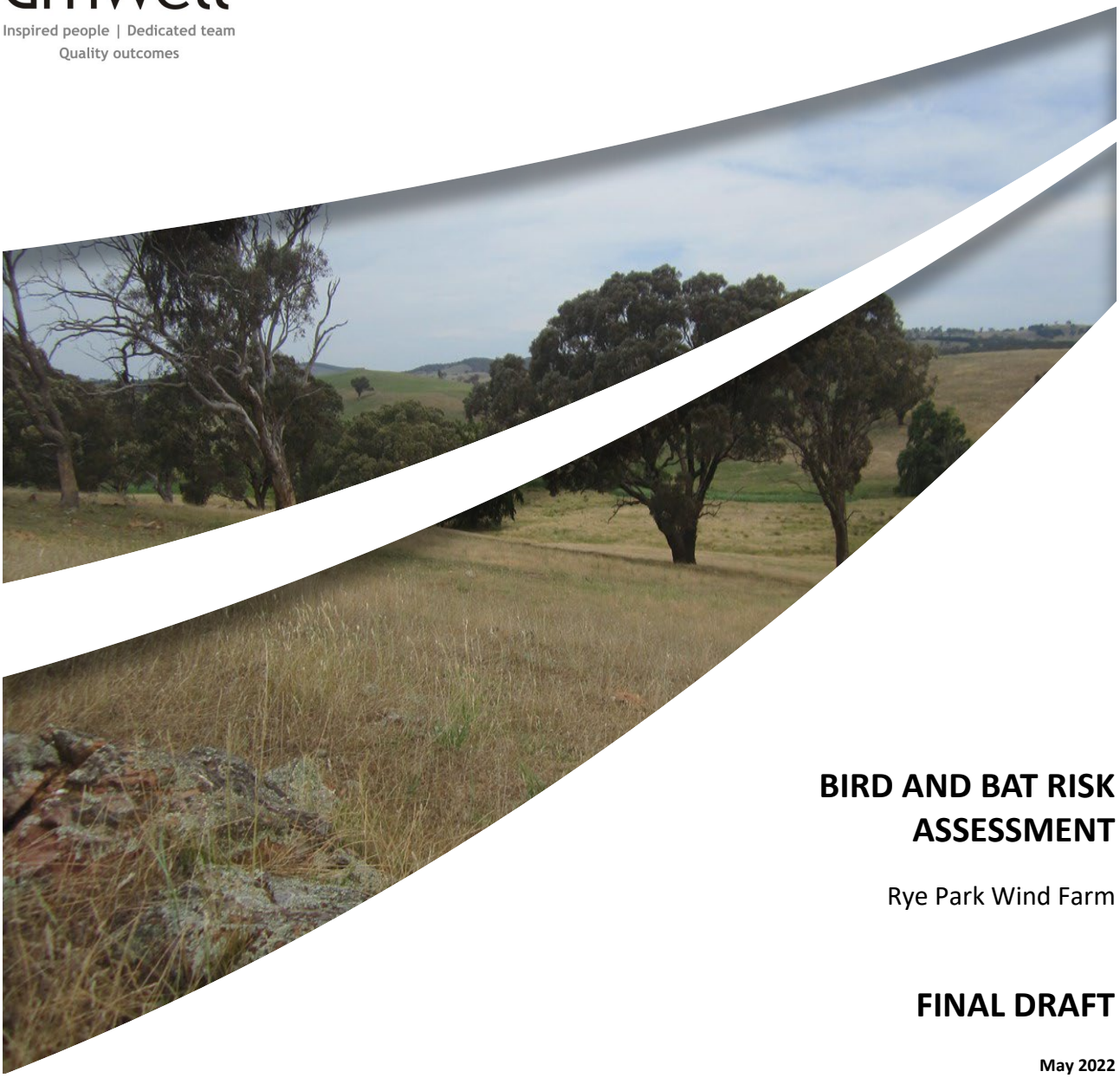
Inspired people | Dedicated team
Quality outcomes



BIRD AND BAT RISK ASSESSMENT

Rye Park Wind Farm

FINAL DRAFT

May 2022

BIRD AND BAT RISK ASSESSMENT

Rye Park Wind Farm

FINAL DRAFT

Prepared by
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on behalf of
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This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
1	David Moore	19 March 2020	David Moore	1 March 2020
2	Bill Wallach		Bill Wallach	

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1.0 Introduction

This document has been prepared to assess collision risk for specific 'at risk' species in accordance with requirements of the 'assessing prescribed biodiversity impacts' section of the Biodiversity Assessment Method as required under the *Biodiversity Conservation Act 2016* (BC Act). Species assessed in this report were selected based on recorded flight and abundance data collected during pre-construction bird and bat utilisation surveys during 2011-2013 (NGH 2014) and during 2018-19 by Umwelt in the Rye Park Wind Farm (RPWF) Project Area. At the request of the Biodiversity and Conservation Division, 14 species were considered in this assessment comprising 13 threatened species (including nine bird and four bat species) and one non-threatened bird species (wedge-tailed eagle).

2.0 Method

To ascertain the likelihood and consequence of impacts on aerial species, a risk-based assessment approach applied by Lumsden *et al.* (2019) for assessing turbine collision risk has been followed. The assessment considers the likelihood of blade strike based on recorded flight behaviours and assesses consequence using a range of measures associated with population ecology, abundance and conservation status.

2.1 Risk Assessment Method

The relative risk of blade strike for the fourteen species assessed here was estimated using two criteria to ascribe likelihood of risk and four criteria to ascribe consequence of risk (**Table 2.1, Table 2.2**). These six criteria were employed by Lumsden *et al.* (2019). Each criterion was either adopted unchanged or was adjusted for the purposes of this current assessment as appropriate to ensure the particulars of each criterion was relevant to specific aspects of the Project such as geographic location. For the purposes of this assessment, Criterions A, C and F were slightly altered, Criterion B was substantially altered, and the thresholds and spatial scale for Criterion E were adjusted.

Table 2.1 Criteria used to ascribe likelihood of risk

A	B
Known or likely frequency of flights within RSA height	Status or frequency of occurrence in the Project Area

Table 2.2 Criteria used to ascribe consequence of risk

C	D	E	F
Highly localised or concentrated population (for whole or part of lifecycle), such that siting of wind farm could have significant consequence to regional, national or international populations	Impact on population relative to demographic capacity to replace fatalities (i.e., generalised combination of dispersal capacity of potential replacements, fecundity and generation time)	Known or estimated size of national or global population	Listed conservation status under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or the BC Act

Each species was ranked either low, moderate or high for each criterion depending on which is most appropriate in consideration of the assessed species' ecology and observed or predicted utilisation of the Study Area. Descriptions for each ranking are outlined in (**Table 2.3**).

Criterion A (flight height) was assessed by identifying the frequency of flights observed between 30 m and 200 m in the Study Area, and assessing this with consideration of observed and reported flight behaviour from elsewhere in Australia. Given that flight height data for bird and bat species in Australia is scant and observation data from pre-construction surveys at wind farms sites is largely unavailable, estimates of flight height require an adequate number of observations from the assessed site coupled with consideration of expert opinion on known flight behaviour for each species assessed. This Criterion is important as flight height is the primary variable through which a relative estimate of collision risk can be reached.

Criterion B (status in Project Area) was assessed by determining the status or estimating the frequency of occurrence in the Project Area. This Criterion is included as it is an essential component for estimating overall blade strike risk.

Criterion C (geographic population concentration) was assessed by estimating the degree to which a species' population may be concentrated due to site related factors such as geographic location, habitat type, proximity to important habitat or roost locations (i.e., significant wetlands, roost caves) and how this relates to the specific landscape in which the Project Area is located. Lumsden *et al*. (2019) noted that this criterion is intended to account for situations where the degree to which a taxon is geographically concentrated may influence the risk posed by the particular location of a wind farm. Where large flocks or aggregations are involved the concentration of individuals may be for short seasonal periods but may nonetheless substantially heighten risk to a large portion of a species' total population. This is particularly important if a large proportion of a species' population passes through a localised area, such as a migratory corridor, over the course of each seasonal passage.

Criterion D (demographic resilience) was assessed through consideration of known aspects of each assessed species breeding biology and, most specifically, the nature of species' life-history traits. This criterion is included in the risk assessment as it is necessary to estimate the capacity to which a species' may replace individuals lost to mortality resulting from blade strike.

Criterion E (population size) is included to account for the variation in the significance of mortality of a given number of individuals between species as a result of the large variation in assessed species' national or global populations. This, when assessed in combination with Criterion D provides a measure through which the relative vulnerability of a species to loss of individuals can be estimated.

Criterion F (listed conservation status) refers to the status of bird and bat species listed under the EPBC Act or the BC Act. In instances where a species listing differs between Acts, for example one that is listed vulnerable under the EPBC Act and endangered under the BC Act, the most threatened listing category is selected for the purposes of this assessment. Species listed as migratory and/or marine under the EPBC Act are not assigned a rank for this criterion.

Table 2.3 Descriptions of each ranking for Criterion A-F

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low	Species that do not or rarely fly at RSA height	Species that rarely occur in the Project Area.	Species that are widely distributed within areas of suitable habitat and the habitat itself is relatively widely dispersed	Species that form breeding territories and that have a reasonable proportion of the population as nonbreeding 'floaters' that can rapidly replace breeding territorial adults if lost; species that may or may not form breeding territories and that are short-lived and have high fecundity; species that have capacity for long range or widespread juvenile or sub-adult dispersal	Total population (i.e., whether that corresponds to the national population of Australian endemics or a migrant's global population) is estimated to number more than 20,000 individuals	Species not listed or listed as near threatened or data deficient under the EPBC Act or the BC Act
Moderate	Species which regularly fly below RSA height and occasionally fly at RSA height	Species that occasionally occur in, or occasionally move through the Project Area	Species that may be more widespread or have greater flexibility in the range of suitable habitat availability, but where a high proportion of their population is likely to be concentrated at sites where they do occur	Species with life-history characteristics that sit between the low and high descriptions here	Total population is estimated to number between 5,000 and 20,000 individuals	Species listed as vulnerable under the EPBC Act or the BC Act
High	Species in which a high proportion of flight activity is at RSA height	Species that regularly occur in, or regularly move through the Project Area	Bat species that have major aggregations at a few caves, or bird or bat species that have either very restricted distributions or those where a substantial proportion of a population may move through certain areas (i.e., migratory pathways)	Species that form breeding territories but where there is limited capacity for a lost breeding adult to be readily replaced; species that do not form breeding territories and that are long-lived and/or have low fecundity; species that may have short-distance juvenile or sub-adult dispersal capacity only	Total population is estimated to number less than 5,000 individuals	Species listed as endangered or critically endangered under the EPBC Act or the BC Act

2.2 Estimating Overall Risk

Estimates of overall risk for each assessed species were determined by following an approach similar to that employed by Lumsden *et al*. (2019), with the most notable exception being the difference in spatial scale for which resulting estimates of risk are intended to be relevant to (i.e., state-wide vs site-specific). Elements of the likelihood and consequence of collision were combined to form an overall qualitative risk category ('low'/'moderate'/'high') specific to the Project for the likelihood of collision and the consequence of collision. Likelihood of collision questions (Criterion A and B) and consequence of collision questions (Criterion C to F) were combined in a generally additive process to determine whether the overall likelihood and consequence of collisions was 'low', 'moderate' or 'high'.

For the overall estimate of **likelihood of collision** to be considered 'high', then at least Criterion A or Criterion B must be considered 'high' and neither could be considered 'low'. To be considered 'low', the rank for both these criteria must be 'low'. All other combinations are considered 'moderate'.

For the overall estimate of **consequence of collision**, the modal response of Criterion C, Criterion D, Criterion E and Criterion F was used as the estimate. In cases where responses are evenly spread between two risk ratings, the higher risk rating was designated. In cases where the risks were spread across all three levels, 'low'; ''moderate' and 'high', a 'moderate' risk was selected. The exception was in cases where the risk associated with criterion C for localised concentration was 'high'. It was considered that the consequences of high mortality due to wind turbine collisions for species that have a limited distribution and/or are highly concentrated is sufficiently large such that, if a species risk associated with this element was 'high', the consequences of collision should also be set to 'high', irrespective of the risks of the other criteria.

Once the overall risk levels for the likelihood and consequence of collision specific to the Project had been assigned for a species, the results were then placed into a risk matrix to determine the level of concern (**Table 2.4**). Five categories of risk were used, namely 'negligible', 'low', 'moderate', 'high' and 'severe', based on the combination of the scores for likelihood and consequence.

Table 2.4 Risk matrix

		Consequence of collisions		
		Low	Moderate	High
Likelihood of collisions	Low	Negligible	Minor	Moderate
	Moderate	Minor	Moderate	High
	High	Moderate	High	Severe

3.0 Species-specific risk assessments

The rate of impact per turbine per year is not quantitatively estimated here given the lack of information on key relevant factors such as turbine avoidance. Where available, mortality estimates from other Australian wind farms have been considered for each aerial species within the responses below. Mortality estimates include data from two of 15 Victorian wind farms at which mortality monitoring has been undertaken and mortality rates for particular species determined (Moloney *et al.* 2019). However, it is emphasised that mortality rates are likely to vary considerably between wind farms, depending on a range of variables such as their proximity to key habitat features (e.g., important cave roosts), turbine size, landscape position and the inherent spatial variability in species abundance and utilisation of airspace (Richardson 2000, Drewitt and Langston 2006, Krijgsveld *et al.* 2009). For this reason, it is not advisable to extrapolate or predict mortality estimates provided in Moloney *et al.* (2019) for other wind farms such as the Project. However, the consideration of available mortality data is important when considering estimating relative risk for a species.

3.1 Threatened and/or migratory birds

3.1.1 Summary of Flight Observations

Of the 14 threatened species recorded in the Project Area, nine were observed flying on at least one occasion during Umwelt's 2018/19 surveys, and six were recorded flying between 25m and 200m above ground level (AGL) (**Table 3.1**).

Table 3.1 Number of observations of threatened species by flight height

Species name	Not flying	<10	10-19	20-29	30-39	40-59	60-79	80-99	100-149	150-199	200-249	250-299	>300
dusky woodswallow	10	0	2	0	0	2	2	1	0	0	0	0	0
varied sittella	2	0	3	3	0	0	0	0	0	0	0	0	0
white-fronted chat	42	9	9	7	8	11	0	0	0	0	0	0	0
black falcon	0	0	1	0	0	1	0	1	0	0	0	0	0
little eagle	0	0	0	0	0	0	1	0	0	1	0	0	0
painted honeyeater	0	2	1	0	0	0	0	0	0	0	0	0	0
white-throated needletail	0	0	0	0	2	7	4	1	0	1	1	0	0
hooded robin	2	1	0	0	0	0	0	0	0	0	0	0	0
flame robin	2	0	0	0	0	0	0	0	0	0	0	0	0
scarlet robin	36	2	2	0	0	0	0	0	0	0	0	0	0
superb parrot	8	5	7	4	4	2	0	0	0	0	0	0	0
speckled warbler	4	0	0	0	0	0	0	0	0	0	0	0	0
brown treecreeper	Flight behaviour/height not recorded (NGH 2014). Brown treecreeper are likely to very rarely fly above 20m AGL.												
diamond firetail	Flight behaviour/height not recorded (NGH 2014). Diamond firetail are likely to very rarely fly above 20m AGL.												

3.1.2 Black falcon

3.1.2.1 Information on black falcon from Australian wind farms

There is one published record of blade strike of black falcon in the available literature (Wood 2015, Moloney *et al.* 2019). Over a two-year monitoring period from March 2013 to February 2015 one deceased black falcon was detected at Macarthur Wind Farm in south-western Victoria (Wood 2015). It was noted that the black falcon had a relatively low occurrence on the wind farm site having not been recorded during pre or post construction surveys and was therefore unlikely to be significantly impacted by collision with wind turbines (at that wind farm) (Wood 2015). This case highlights that though a lack of records from pre-construction surveys at a wind farm may be interpreted as indicating a lower likelihood of blade strike, the risk of blade strike for highly mobile species considered to be 'unlikely to occur' or 'rare' in the region should not be discounted.

3.1.2.2 Status and flight behaviour in the Project Area

Black falcon were recorded on three occasions during bird utilisation surveys conducted in 2018/19 (**Figure 5.1**). All three observations were from February 2019 in open woodland on lower slopes of the landscape:

- 5 February 2019: one black falcon was observed foraging at RSA height at an average of 80 m AGL, 4 kms north-east of the Project Area at a control vantage point.
- 6 February 2019: a pair were observed circling at RSA height (at an average of 50 m AGL) on the western slopes of the Project Area, 800 m west of proposed turbine #84 before departing to the south.
- 8 February 2019: one bird was incidentally observed flying rapidly at 10 m AGL, 2 km west of the Project Area near the southern portions of the Project.

Black falcons were not recorded in the Project Area during bird utilisation surveys conducted during 2011 - 2013 (NGH 2014).

Based on the broad habitat requirements, high mobility and wide-ranging distribution of this species, there is potential for this species to occur at any location within the Project Area. The black falcon is likely to spend a high proportion of time at RSA height whilst flying within the Project Area.

3.1.2.3 Likelihood and Consequence of Impacts

The overall risk rating for black falcon is high, based on a high likelihood and moderate consequence of collisions (**Table 3.2**). The high likelihood of collisions is based on this species' flight behaviour though it is noted that given black falcon only occasionally occur in the Project Area the rate of collisions is likely to be relatively low. Rationale for responses to each criterion is as follows:

a) A high proportion of the black falcon's flight activity is at RSA height.

b) The black falcon occasionally occurs in the Project Area.

c) The black falcon is widely distributed within areas of suitable habitat across its range and the habitat itself is relatively widely dispersed.

d) The life-history characteristics of the black falcon overlap with certain aspects of both the descriptions for a 'low' and 'high' rating for Criterion D (Marchant and Higgins 1993).

e) In 2009, the national population of black falcon was estimated between 1,000 to 10,000 individuals, roughly equating to 670 – 6,700 mature individuals, although the data quality is reported as being poor (Birdlife International 2020). Hence, Criterion E is conservatively assigned 'high'.

f) The black falcon is listed as vulnerable in NSW under the BC Act.

The black falcon's risk rating of high largely reflects the potentially high consequence of low frequencies of blade strike in the Project Area.

Table 3.2 Black falcon risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low			X			
Moderate		X		X		X
High	X				X	
Risk Rating						
Likelihood	High	**Consequence**	Moderate	**Risk Rating**	High	

3.1.3 Little eagle

3.1.3.1 Information on little eagle from Australian wind farms

Moloney *et al.* (2019) reported one record of blade strike of little eagle from post-construction mortality monitoring of 15 wind farms in Victoria from 2003 to 2018. Smales (2014), reported two records of blade strike of little eagle from eight wind farms in south-eastern Australia (i.e., Victoria and South Australia). It is likely that these reports are referring to the same record of blade strike in Victoria.

3.1.3.2 Status and flight behaviour in the Project Area

Little eagle were recorded twice in the Project Area during surveys conducted in 2018/19 (**Figure 5.1**):

- 9 November 2018: one bird was observed foraging approximately 750 m north-east of proposed turbine #18 at 150 m AGL.
- 1 February 2019: one bird was observed flying east to west over the main ridge, at approximately 60 m AGL at proposed turbine #80.

Little eagles were not recorded in the Project Area during bird utilisation surveys conducted during 2011 - 2013 (NGH 2014).

Based on the broad habitat requirements, high mobility and wide-ranging distribution of this species, there is potential for this species to occur at any location within the Project Area. As with other raptors, the little eagle is likely to spend a high proportion of time at RSA height whilst flying within the Project Area.

3.1.3.3 Likelihood and Consequence of Impacts

The overall risk rating for little eagle is high, based on a high likelihood and moderate consequence of collisions (**Table 3.3**). The high likelihood of collisions is based on this species' flight behaviour though it is noted that given little eagle only occasionally occur in the Project Area the rate of collisions is likely to be relatively low. Rationale for responses to each criterion is as follows:

a) A high proportion of the little eagle's flight activity is at RSA height.

b) The little eagle occasionally occurs in the Project Area.

c) The little eagle is widely distributed within areas of suitable habitat across its range and the habitat itself is relatively widely dispersed.

d) The life-history characteristics of the little eagle overlap with certain aspects of both the descriptions for a 'low' and 'high' rating for Criterion D (Marchant and Higgins 1993).

e) In 2009, the population of little eagle was estimated to number 10,000 to 100,000 individuals, based upon an estimate made by Ferguson and Christie (2001), although the data quality is listed as poor (Birdlife International 2020). Given the uncertainty of this estimate and the decline of little eagle in NSW (Barrett et al. 2007) and the ACT (Olsen and Fuentes 2005) Criterion E was assigned 'moderate' (based on the lower population estimate).

f) The little eagle is listed as vulnerable in NSW under the BC Act.

The little eagle's risk rating of high largely reflects the potentially high consequence of low frequencies of blade strike in the Project Area.

Table 3.3 Little eagle risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low			X			
Moderate		X		X	X	X
High	X					
Risk Rating						
Likelihood	High	**Consequence**	Moderate	**Risk Rating**	High	

3.1.4 Superb parrot

3.1.4.1 Information on superb parrot from Australian wind farms

There are no records of blade strike of superb parrot in the available literature from Victoria (Moloney *et al.* 2019) which is unsurprising given the lack of wind farms in the superb parrot's range in north-eastern Victoria. There are no records of blade strike of superb parrot in the available data collected in south-eastern NSW to date (BCS unpublished data). In south-eastern NSW, there are three operational wind farms which may present a risk to superb parrot, namely Cullerin Range, Gunning and Gullen Range. These three wind farms are located at the current eastern edge of the superb parrot's range in the Southern Tablelands region.

Given the location of the Project and considering the construction of the Bango Wind Farm an increase in the risk of blade strike to superb parrot in south-eastern NSW is likely to result. Research to be conducted

on the movement of superb parrots in the Yass region including at the under construction Bango Wind Farm is likely to improve understanding of the susceptibility of this species to blade strike and indirect impacts resulting from the operation of turbines (Rayner 2019).

3.1.4.2 Status and flight behaviour in the Project Area

Superb parrots were frequently recorded in box-gum woodland in the lower-lying parts of the landscape immediately west of the Project Area during the 2011-13 surveys (NGH 2014) and the 2018/19 surveys. The species was observed in various locations in the Project Area during both the 2011/2013 and 2018/2019 survey periods. The majority of records during both surveys were concentrated in an area in the southern portion of the Project Area.

During 2011-2013, NGH (2014) documented regular superb parrot flights near proposed turbines #106, 107, 109 and 110 where an observer watched activity from a dedicated vantage point. In response to this finding, proposed turbines #106, 107, 109 and 110 were removed from the proposed layout. Additional records, including breeding pairs were detected to the north of proposed turbines #119, 120, 122, 124, 125 and 142. The majority of superb parrot records during 2018/2019 were also recorded within this area.

Superb parrots were recorded on 30 occasions during 2018/2019 bird surveys (**Figure 5.1**), with survey effort focussed immediately north (in the range of approximately 200 to 1000 m north) of proposed turbines #119, 120, 122, 124, 125 and 142. These six proposed turbines are likely to pose the highest risk to superb parrots in the Project Area. Active breeding was not detected during 2018/19, however, given surveys were generally restricted to a specific area in which transects designed to monitor movements were walked, breeding in nearby suitable habitat may have gone undetected.

Other notable records made during the 2018/2019 survey, include two records from the northern portion of the Project Area (all other records for the species in the Project Area during 2018/19 were from the southern areas) and one from control site VPC04 to the north-east of the Project Area. These records are detailed below:

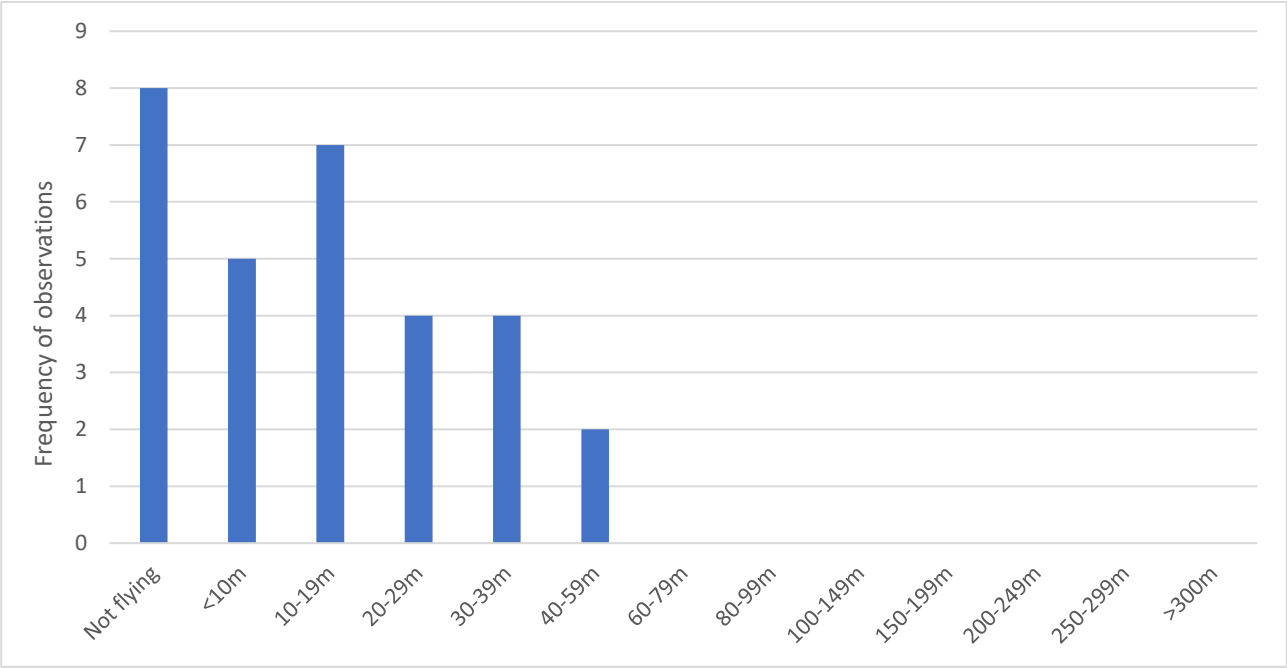
- 30 January 2019: three superb parrots were observed flying in a northerly direction at 15 m AGL in the north-eastern section of the Project Area 500 m east of proposed turbine #22 and 700 m west of proposed turbine #136.
- 30 January 2019: a group of five superb parrots were observed perched in the far northern section of the Project area, 600 metres west of proposed turbine #4.
- 30 January 2019: one individual was recorded at a ‘control’ vantage point north-east of the Project Area (VPC04) flying north-east at 40 m AGL.

Further to the above, ten incidental superb parrot observations (2018/19 surveys) were made in the vicinity of Dalton Road and Little Plains Road approximately 1-2.5 km west of the Project Area. These observations confirm similar records made NGH (2014) during 2011-2013 in this area.

Of the records made the 2018/19 surveys, superb parrots were observed in flight on 22 occasions (**Graph** 3.1). A summary of these observations is provided below:

- 18% (4/22) of flights were of individuals or flocks flying between 20-29m AGL, 18% (4/22) at 30-39m AGL and 9% (2/22) at 40-49m AGL whilst the remaining 55% (12/22) of flights were below 20 m AGL.
- In the southern section of the Project Area superb parrot were observed in flight on 14 occasions. 43% (6/14) of flights were below 20 m AGL, 29% (4/14) were at 20-29 m AGL, 21% (3/14) were at 30-39 m and one was at 40 m AGL.

Based on observations from elsewhere in their range it is expected that the observed maximum flight of 40 m AGL does not correspond with the maximum flight height of this species. Further, the true frequency of flights above 20 m AGL relative to the number of flights below 20 m AGL is likely to be higher than depicted in **Graph 3.1**.



Graph 3.1 Frequency of superb parrot observations in each height class

3.1.4.3 Likelihood and Consequence of Impacts

The overall risk rating for superb parrot is high, based on a high likelihood and moderate consequence of collisions (**Table 3.4**). Rationale for responses to each criterion is as follows:

a) The superb parrot regularly flies below RSA height and occasionally flies at RSA height.

b) The superb parrot regularly occurs in the Project Area.

c) The superb parrot's range is relatively restricted, and the extent of its habitat has been reduced substantially since European settlement. Superb parrot are known to congregate in areas of remaining habitat particularly in the south-eastern portion of their range during spring and summer. Furthermore, a large proportion of their total population occurs and moves through the region in which the Project Area is located.

d) The life-history characteristics of the superb parrot overlap with certain aspects of both the descriptions for a 'low' and 'high' rating for Criterion D (Higgins 1999).

e) There are several estimates of total superb parrot population size. Higgins (1999) estimated that there were less than 5,000 breeding pairs, Garnett and Crowley (2000) estimated a total of 5000 adult birds, Baker-Gabb (2011) estimated a total of 5,000 to 8,000 individuals and Garnett et al. 2011 estimated there to be well over 10,000 individuals. Based on these population estimates Criterion E was assigned 'moderate'.

f) The superb parrot is listed as vulnerable under the EPBC Act and the BC Act.

Table 3.4 Superb parrot risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low						
Moderate	X		X	X	X	X
High		X				
Risk Rating						
Likelihood	High	**Consequence**	Moderate	**Risk Rating**	High	

3.1.5 White-throated needletail

3.1.5.1 Information on white-throated needletail from Australian wind farms

The white-throated needletail is particularly vulnerable to blade strike (Hull *et al.* 2013). Five birds have been found during post-construction mortality monitoring conducted at 15 wind farms in Victoria from 2003 to 2018 (Moloney *et al.* 2019). There are 11 records of blade strike of white-throated needletail at both Bluff Point Wind Farm and at Studland Bay Wind Farm in north-west Tasmania (Hull *et al.* 2013). White-throated needletail are known to have collided with wind turbines in south-east NSW, with much of the data collected in this region being not publicly available (BCS unpublished data). Despite this, there are six records of deceased white-throated needletail at Capital Wind Farm from 2012/13 on the Atlas of Living Australia.

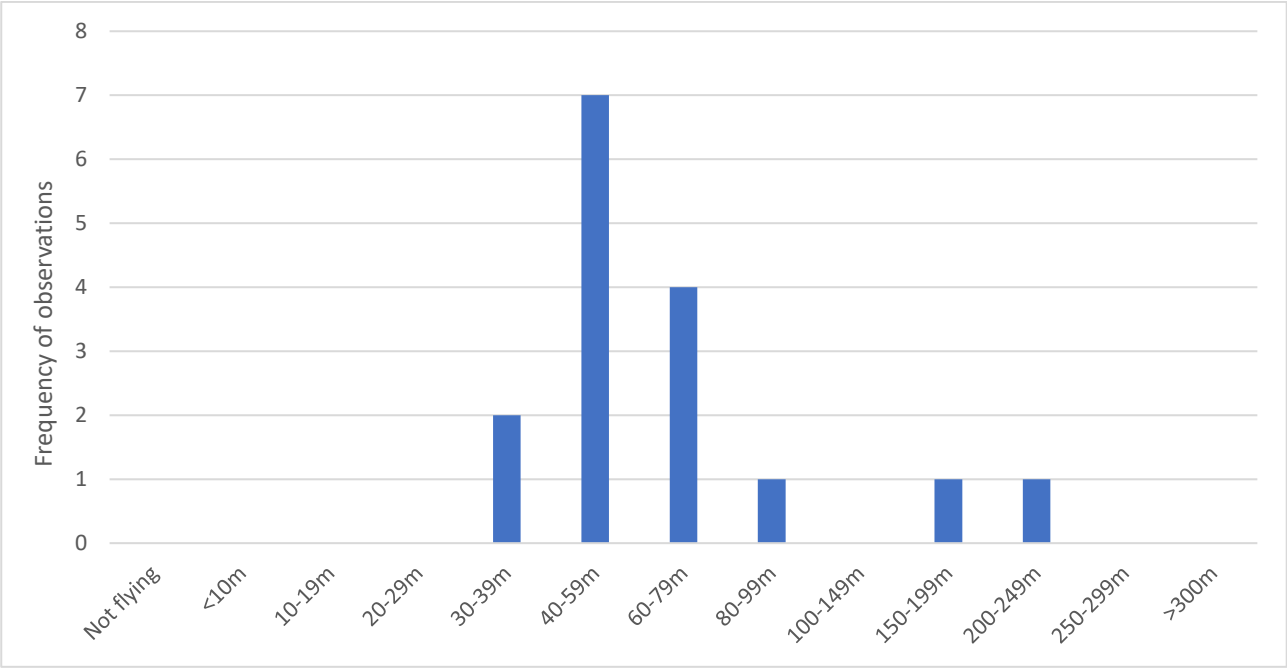
3.1.5.2 Status and flight behaviour in the Project Area

White-throated needletails were recorded on 16 occasions in the Project Area in February/March 2019 (**Figure 5.1**). These observations were not concentrated in any particular section of the Project Area, although the majority were instances of foraging above or moving through the higher sections of the Project Area (i.e., 700 m above sea level). White-throated needletail were not recorded in the Project Area during bird utilisation surveys conducted during 2011 - 2013 (NGH 2014).

A summary of the white-throated needletail observations made within the Project Area is presented below:

- 4-6 February 2019: a flock of 24 individuals, 500 m west of proposed turbine #69 was observed circling at approximately 200 m AGL. There were a further seven observations during the next two days including an observation of 13 birds flying south at 60 m AGL near proposed turbine #120 in the southern section of the Project Area and 15 birds flying east at the same height above Grassy Creek Road in the northern section of the Project Area.
- 13 – 15 February 2019: six observations, including one of a flock of 55 individuals flying around proposed turbines #80 and #82 at RSA height.
- 14 February 2019: 41 individuals were observed flying directly along the ridge in a southerly direction at RSA height over a period of 15 minutes near three proposed turbines removed from the layout (#102, 103 and 104).
- 8 March 2019: Two observations comprising five and six individuals, observed at a control vantage point (VPC03) north of Blakney Creek South Road and between proposed turbines #83 and #84.

Each observation of white-throated needletails in the Project Area was of individuals or flocks flying at RSA height (**Graph 3.2**). The majority of observations were of birds flying between 40 - 80 m AGL with 83% (165/200) of observed individuals occurring within this height range. Although not recorded during the surveys, white-throated needletails would also forage below and above RSA in the Project Area.



Graph 3.2 Frequency of observations of white-throated needletail in each height class.

3.1.5.3 Likelihood and Consequence of Impacts

The overall risk rating for white-throated needletail is high, based on a high likelihood and moderate consequence of collisions (**Table 3.5**). The rationale for responses to each criterion is as follows:

a) A high proportion of the white-throated needletail's flight activity is at RSA height.

b) Based on the observations of this species in the Project Area, Criterion B could either be assigned 'moderate' or 'high' because this species could either be an occasional or a regular seasonal visitor in the Project Area each year. Regardless, because a rating of 'low' for Criterion B is not considered, the overall likelihood of collision is automatically deemed 'high' due to the 'high' rating assigned for Criterion A.

c) Although the white-throated needletail has a very large range it is noted that because a large proportion of this species' population may occur at specific preferred foraging areas or use particular migratory paths there is a high degree of variability in the likelihood of collisions between locations across its distribution in eastern Australia.

d) The location of the Project Area in the western section of its range in south-eastern NSW suggests that it is unlikely that a high proportion of this species' population occurs in the Project Area annually. However, observations from the Project Area indicate that the NNW-SSE aligned ridge running the length of the Project Area is potentially an important landscape feature in a regional context for white-throated needletail.

e) The life-history characteristics of the white-throated needletail overlap with certain aspects of both the descriptions for a 'low' and 'high' rating for Criterion D (Higgins 1999).

f) The total population of white-throated needletail has not been estimated (Birdlife International 2020). The population size of the nominate subspecies that migrates to Australia is likely to comprise approximately 10,000 individuals (DoE 2015).

g) The white-throated needletail is listed as vulnerable and migratory under the EPBC Act.

Table 3.5 White-throated needletail risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low						
Moderate		X	X	X	X	X
High	X					
Risk Rating						
Likelihood	High	**Consequence**	Moderate	**Risk Rating**	High	

3.1.6 White-fronted chat

Information on white-fronted chat from Australian wind farms

There are no published records of blade strike of white-fronted chats in the available literature in Victoria (Moloney *et al.* 2019), south-east New South Wales (BCS unpublished data) or in north-west Tasmania (Hull *et al.* 2013). This is despite having a wide distribution in southern Australia, a preference for open landscapes in which the majority of wind farms are situated and a tendency to occasionally fly above the typical minimum RSA height. Given the survey effort of post-construction monitoring to date, scavenger rates in open landscapes and the small size of this species amongst other factors it is plausible that instances of blade strike have gone undetected at Australian wind farms.

A review of literature identified that the species may actively avoid turbines, with an observation of turbine avoidance from Codrington Wind Farm in south-western Victoria. Meredith *et al.* (2002) reported a 100% turbine avoidance rate for the species at this location. However, given that the context of the situation in which this observation was made is unknown (i.e., the survey effort, number of observed flights, habitat type and all other relevant factors are unspecified) little can be drawn from this observation other than the conclusion that white-fronted chat do indeed avoid turbines (though the question of the rate at which they do remains unanswered).

Status and Flight Behaviour in the Project Area

White-fronted chats were regularly recorded in the northern half of the Project Area during bird utilisation surveys conducted in 2018/19, from four distinct areas of occupancy (**Figure 4.1**). These areas supported suitable habitat for the species, being open areas containing isolated patches of low bracken. Across all surveys conducted during 2018/2019, white-fronted chats were recorded on 86 occasions, occurring in flocks of up to 28 individuals. 90% of observations were recorded in the particular areas highlighted in **Figure 4.1**, including one record of an active nest.

White-fronted chats were recorded on four occasions in the Project Area during bird utilisation surveys conducted during 2011 - 2013 (NGH 2014).

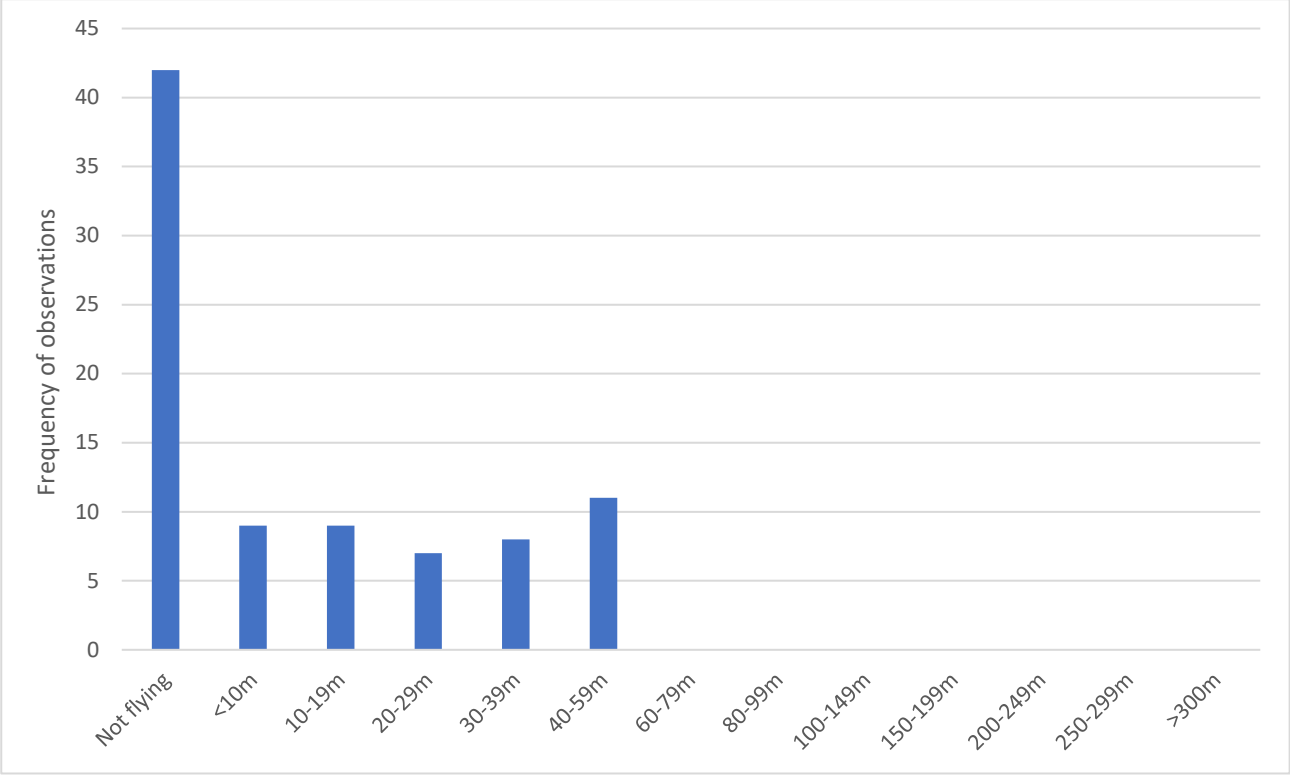
Based on the extent of occupied habitat and the proportion of potential habitat surveyed it is likely that white-fronted chats most frequently occur at 25 proposed turbine locations in the Project Area (**Figure 4.1, Table 3.6**). Movement between the four areas of occupancy is considered likely, given the relatively short

distances and absence of barriers. For this reason, the occurrence of white-fronted chat is unlikely to be restricted to these 25 identified proposed turbine locations alone, although abundance and flight records appear to be greatest in such areas throughout the 2018/19 surveys.

Table 3.6 Proposed turbines located within likely white-fronted chat area of occupancy

Area	Turbines
North-western area	1, 2, 3, 4, 5, 7, 9, 151
North-eastern area	18, 21, 22, 25, 26, 30, 31, 36, 39, 135, 136, 137, 138
High Rock Rd property	73, 74,
Flakney Creek Rd area	82, 83

Whilst white-fronted chats tended to spend a considerable amount of time foraging on the ground or perched on low shrubs or fences (49% of observations), the species was also regularly recorded flying at or above 30 m AGL in the Project Area (**Graph 3.3**). On eight occasions (18% of observed flights), individuals or flocks were recorded flying at between 30-39 m AGL and on 11 occasions (25% of observed flights), they were recorded between 40-59 m AGL. Observed flights at RSA height were typically undertaken by individuals, pairs or larger groups across a distance of several hundred metres at a time. Of the observed flights at and above 40 m AGL three were of a single bird, six were of pairs and the remaining two comprised flocks of 10 and 16 individuals.



Graph 3.3 Frequency of observations of white-fronted chat in each height class.

Likelihood and Consequence of Impacts

The overall risk rating for white-fronted chat is moderate, based on a high likelihood and low consequence of collisions (**Table 3.7**). The rationale for responses to each criterion is as follows:

a) The white-fronted chat regularly flies below RSA height and occasionally flies at RSA height.

b) The white-fronted chat is a resident in the Project Area and frequently occurs in areas where turbines are proposed.

c) The white-fronted chat is widely distributed within areas of suitable habitat across its range and the habitat itself is relatively widely dispersed.

d) The white-fronted chat is not long-lived, has relatively high fecundity and a high capacity to replace individuals lost (Higgins et al. 2001).

e) There are no estimates of the total population of white-fronted chat (Birdlife International 2020) however given their large area of occupancy its population is likely to exceed 20,000 individuals.

f) The white-fronted chat is listed as vulnerable in NSW under the BC Act.

Table 3.7 White-fronted chat risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low			X	X	X	
Moderate	X					X
High		X				
Risk Rating						
Likelihood	High	**Consequence**	Low	**Risk Rating**	**Moderate**	

3.1.7 Brown treecreeper

Information on brown treecreeper from Australian wind farms

There are no published records of blade strike of brown treecreepers in the available literature in Victoria (Moloney *et al.* 2019) or south-east New South Wales (BCS unpublished data), though it is noted that the majority of wind farms monitored in Victoria are on the south-western edge or outside of this species' distribution.

3.1.7.1 Status and flight behaviour in the Project Area

Brown treecreepers were not recorded in the Project Area in 2018/19 despite extensive surveys across suitable habitat. Brown treecreeper were recorded on six occasions in the Project Area during bird utilisation surveys conducted during 2011 - 2013 (NGH 2014). All observations were of birds near proposed turbines #102, 103 and 104 (which have since been removed from the layout). Each observation was of birds below 20 m AGL (NGH 2014).

3.1.7.2 Likelihood and Consequence of Impacts

The overall risk rating for brown treecreepers is minor, based on a low likelihood and moderate consequence of collisions (Table 3.8). The rationale for responses to each criterion is as follows:

a) Based on observations from the Project Area and knowledge of this species' flight behaviour from elsewhere, the brown treecreeper is unlikely to fly at RSA height in the Project Area.

b) The surveys conducted in 2011-2013 and 2018/19 indicate that the brown treecreeper is currently an uncommon/rare visitor or resident in the Project Area. This species has declined considerably in the greater region during the past three decades (Reid 1999, Trail and Duncan 2000, COG 2020) to the point that certain sites that were formerly occupied are now irregularly visited or no longer support brown treecreeper (e.g., as documented in parts of the ACT) (COG 2020).

c) The brown treecreeper is widely distributed within areas of suitable habitat across its range and the habitat itself is relatively widely dispersed.

d) The brown treecreeper is not long-lived and has relatively high fecundity, though appears to have a limited capacity to replace individuals lost in certain fragmented landscapes such as the region in which the Project Area is located (Higgins et al. 2001).

e) The population size of the brown treecreeper is unknown (Birdlife International 2020), though it is likely to exceed 20,000 individuals based on the size of its distribution in eastern Australia (c. 3.3 million km^2). Due to the estimated extent of occurrence of the south-eastern subspecies (*C. p melanotus*) of approximately 600,000 km2 (Garnett et al. 2011) and its decline Criterion E is conservatively assigned 'moderate' because the population of this subspecies may number between 5,000 and 20,000 individuals.

f) The brown treecreeper is listed as vulnerable in NSW under the BC Act.

Table 3.8 Brown treecreeper risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low	X	X	X			
Moderate				X	X	X
High						
Risk Rating						
Likelihood	Low	**Consequence**	Moderate	**Risk Rating**	Minor	

3.1.8 Varied sittella

3.1.8.1 Information on varied sittella from Australian wind farms

There are no published records of blade strike of varied sittellas in the available literature in Victoria (Moloney *et al.* 2019) or south-east New South Wales (BCS unpublished data).

3.1.8.2 Status and flight behaviour in the Project Area

Varied sittellas were observed on eight occasions in the Project Area in 2018/19 (**Figure 5.1**) comprising three records in the far southern section of the Project Area, four records in the central section and one in the northern section. Of these eight observations, two were at proposed turbines #80 and 150 in the central section of the Project Area. Observations were not concentrated in any particular area of the

Project Area. Varied sittella may occur in any area of woodland (including open woodland supporting scattered paddock trees) or dry forest in the Project Area.

All observations during 2018/19 were of groups foraging or moving between paddock trees at or below canopy height. A total of 1/6 (17%) flight observations were of birds flying at 10 m AGL, 2/6 (33%) at 15 m AGL and 3/6 (50%) at 20 m AGL. Varied sittellas were recorded on four occasions between 0 – 20 m AGL in the Project Area during bird utilisation surveys conducted during 2011-2013 (NGH 2014).

3.1.8.3 Likelihood and Consequence of Impacts

The overall risk rating for varied sittella is minor, based on a moderate likelihood and low consequence of collisions (Table 3.9). The rationale for responses to each criterion is as follows:

a) Based on observations from the Project Area and knowledge of this species' flight behaviour from elsewhere varied sittella are likely to rarely fly at RSA height in the Project Area.

b) The varied sittella is a resident in the Project Area.

c) The varied sittella is widely distributed within areas of suitable habitat across its range and the habitat itself is relatively widely dispersed.

d) The varied sittella is not long-lived, has relatively high fecundity and a high capacity to replace individuals lost (Higgins and Peter 2002).

e) The total population of varied sittella is unknown (Birdlife International 2020) though it is likely to exceed 20,000 individuals given its very large distribution across the Australian mainland (c. 9.2 million km2) (Birdlife International 2020).

f) The varied sittella is listed as vulnerable in NSW under the BC Act.

Table 3.9 Varied sittella risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low	X		X	X	X	
Moderate						X
High		X				
Risk Rating						
Likelihood	Moderate	**Consequence**	Low	**Risk Rating**	Minor	

3.1.9 Painted honeyeater

3.1.9.1 Information on painted honeyeater from Australian wind farms

There are no published records of blade strike of painted honeyeaters in the available literature in Victoria (Moloney *et al.* 2019) or south-east New South Wales (BCS unpublished data). The majority of wind farms monitored in Victoria are on the south-western edge or outside of this species' distribution.

3.1.9.2 Status and flight behaviour in the Project Area

Painted honeyeaters were not recorded in the Project Area in 2018/19 despite extensive surveys in suitable habitat. Painted honeyeaters were recorded on seven occasions in the Project Area during bird utilisation surveys conducted during November 2013 (NGH 2014). Six of these observations were of birds in flowering

mistletoe in an area of box-gum woodland in the southern section of the Project Area, west of four proposed turbines (#106, 107, 109 and 110) that have since been removed from the layout. It was estimated that 10-12 individuals were present in this particular area during November 2013 (NGH 2014). The southernmost record is approximately 800 m north of proposed turbine #120. The other observation during November 2013 was from an area of box-gum woodland in the central section of the Project Area approximately 800 m north-west of proposed turbine #143. Flight data was only recorded for two observations. Both flight records were of individuals below 10 m AGL (NGH 2014).

3.1.9.3 Likelihood and Consequence of Impacts

The overall risk rating for painted honeyeater is moderate, based on a moderate likelihood and moderate consequence of collisions (**Table 3.10**). The rationale for responses to each criterion is as follows:

a) Based on observations from the Project Area and knowledge of this species' flight behaviour from elsewhere, painted honeyeaters are likely to regularly fly below and occasionally fly at RSA height in the Project Area.

b) The painted honeyeater is an uncommon/rare visitor, most likely to occur during spring and summer when mistletoe is flowering in the Project Area.

c) The painted honeyeater is widely distributed within areas of suitable habitat across its range and the habitat itself is relatively widely dispersed.

d) The painted honeyeater is not long-lived, has relatively high fecundity and a high capacity to replace individuals lost (Higgins et al. 2001).

e) Garnett et al. (2011) estimated a declining population of between 2,500 and 10,000 mature individuals, roughly equivalent to 3,750 - 15,000 individuals in total. Taking a precautionary approach, the lower estimate has been accepted and Criterion E is assigned 'high'.

f) The painted honeyeater is listed as vulnerable under the EPBC Act and the BC Act.

Table 3.10 Painted honeyeater risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low		X	X	X		
Moderate	X					X
High					X	
Risk Rating						
Likelihood	Moderate	**Consequence**	Moderate	**Risk Rating**	Moderate	

3.1.10 Dusky woodswallow

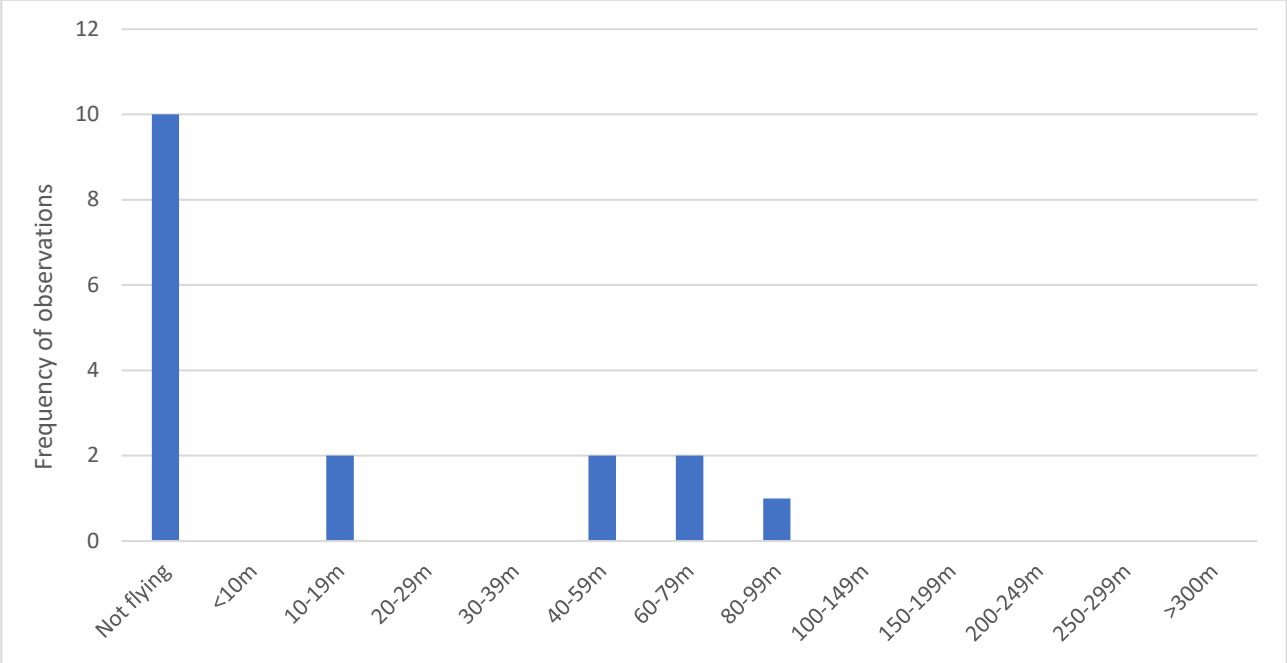
3.1.10.1 Information on dusky woodswallow from Australian wind farms

Moloney *et al.* (2019) reported one record of blade strike of dusky woodswallows at Victorian wind farms from post-construction mortality monitoring from 2003 to 2018. Smales (2014) also reported one record of blade strike from a total of eight wind farms in south-eastern Australia (i.e., Victoria and South Australia). It is likely that these reports are referring to the same record.

3.1.10.2 Status and flight behaviour in the Project Area

Dusky woodswallows were recorded on 17 occasions in the Project Area in 2018/19 (**Figure 5.1**). These observations were not concentrated in any particular section of the Project Area although dusky woodswallows were more frequently seen at a vantage survey point (VPI04) at proposed turbine #31 than at any other vantage point of transect. Dusky woodswallows were recorded on three occasions in the Project Area during bird utilisation surveys conducted during 2011 - 2013 (NGH 2014).

Of all observations in 2018/2019, 58% (10/17) were of dusky woodswallows perched, whilst 71% (5/7) of flight records comprised flocks or individuals foraging at RSA height between 40-100 m AGL (**Graph 3.4**).



Graph 3.4 Frequency of observations of dusky woodswallow in each height class.

3.1.10.3 Likelihood and Consequence of Impacts

The overall risk rating for dusky woodswallow is moderate, based on a high likelihood and low consequence of collisions (**Table 3.11**). The rationale for responses to each criterion is as follows:

a) A high proportion of the dusky woodswallow's flight activity is at RSA height.

b) The dusky woodswallow regularly occurs in the Project Area.

c) The dusky woodswallow is widely distributed within areas of suitable habitat across its range and the habitat itself is relatively widely dispersed.

d) The dusky woodswallow is not long-lived, has relatively high fecundity and a high capacity to replace individuals lost (Higgins et al. 2006).

e) The total population of the dusky woodswallow is unknown (Birdlife International 2020) though it is likely to exceed 20,000 individuals.

f) The dusky woodswallow is listed as vulnerable in NSW under the BC Act.

Table 3.11 Dusky woodswallow risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low			X	X	X	
Moderate						X
High	X	X				
Risk Rating						
Likelihood	High	**Consequence**	Low	**Risk Rating**	Moderate	

3.2 Non-threatened birds

3.2.1 Wedge-tailed eagle

3.2.1.1 Information on wedge-tailed eagle from Australian wind farms

The wedge-tailed eagle is commonly reported during mortality monitoring events at wind farms in Australia. Moloney *et al.* (2019) report wedge-tailed eagle as the second most frequently recorded bird species found dead during monitoring from 2003 to 2018 across 15 wind farms in Victoria, with 58 carcasses detected and equating to 10% of all birds found. Using this data, Moloney *et al.* (2019) calculated mortality estimates of 0.06 (95% CI: 0.02 – 0.41) and 0.1 (95% CI: 0 - 0.2) individuals per turbine per year at two Victorian wind farms.

At two wind farms in north-western Tasmania, 18 wedge-tailed eagle carcasses were recorded during monitoring conducted for three and six years at Bluff Point Wind Farm and Studland Bay Wind Farm respectively (Hull *et al.* 2013). This particular monitoring program modelled a mortality estimate of 1.5 and 1.1 collisions per annum at Bluff Point (37 turbines) and Studland Bay (25 turbines). A 95% turbine avoidance rate closely approximated the observed mean annual mortality rate of 1.6 and 1.1 individuals per annum at each wind farm respectively (Smales *et al.* 2013).

Wedge-tailed eagles are known to have collided with wind turbines in south-east NSW however the total number of fatalities detected in this region is not publicly available (BCS unpublished data). Six wedge-tailed eagle carcasses were recorded under turbines at Gullen Range Wind Farm during monthly monitoring of 30-32 (of 73 turbines) conducted from January – June 2015 (BLA, 2016).

3.2.1.2 Status and flight behaviour in the Project Area

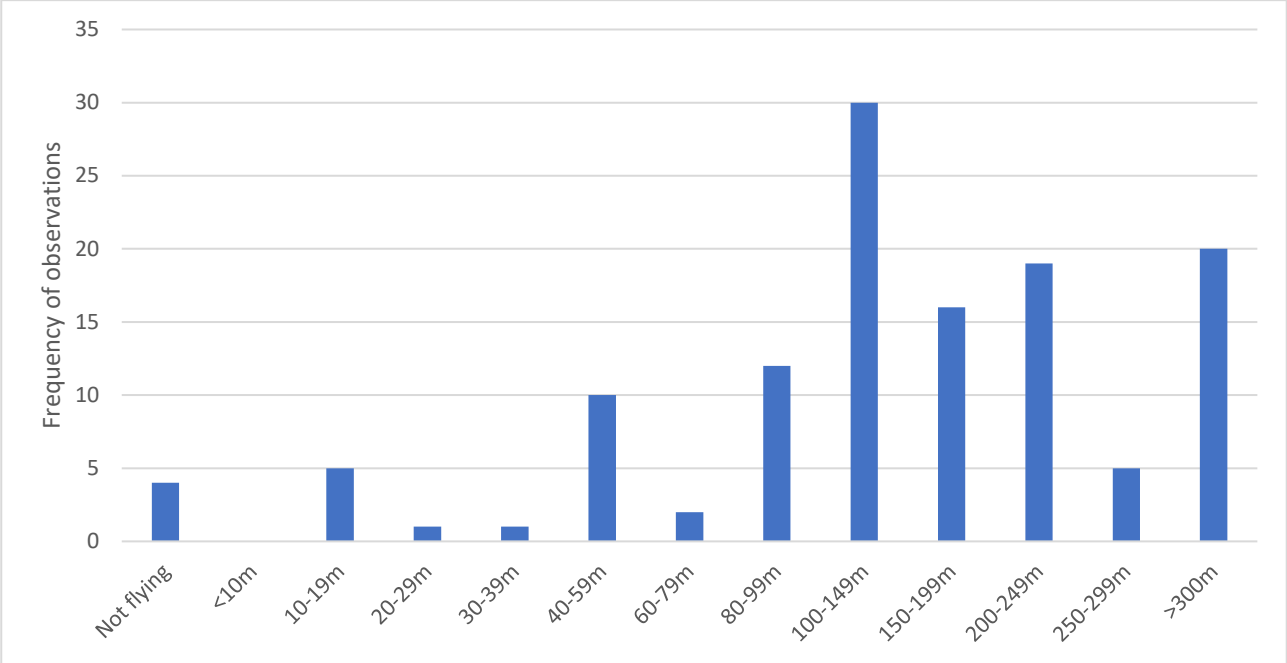
Wedge-tailed eagle were observed throughout the Project Area and recorded on 125 occasions during the 2018/19 bird utilisation surveys (**Figure 5.2**). No nests were recorded in the Project Area during these surveys, though one active nest was recorded on the boundary of the Project Area 1.5 km south-east of proposed turbine #87. NGH (2014) recorded wedge-tailed eagle on 14 occasions in the Project Area during bird utilisation surveys conducted during 2011 - 2013. One inactive wedge-tailed eagle nest was recorded in the central section of the Project Area, resulting in proposed turbine #91 being removed from the layout and proposed turbine #92 being shifted south (NGH 2014).

A summary of wedge-tailed eagle observations made during the 2018/19 survey is presented below:

- 64% (80/125) of observations were of individuals, 29% (36/125) were of pairs, 6% (7/125) were of three birds and less than 2% (2/125) were of four birds.
- Wedge-tailed eagles were recorded in flight on 121 occasions:

- Observed flights were almost exclusively of individuals or pairs soaring, displaying or circling above 40 m AGL (92% of observations) (**Graph 3.5**).
- 74% of flights (90/121) were recorded between 30 – 200 m.

- Of the vantage point sites surveyed during each season (five sites), wedge-tailed eagles were recorded during 60% (24/40) of surveys (Umwelt 2018 /19).



Graph 3.5 Frequency of wedge-tailed eagle observations in each height class.

Wedge-tailed eagle observations were distributed fairly consistently between the three 'impact' vantage points, lower at one 'control' site VPC03 and higher 'control' site VPC04 (**Table 3.12**). The higher number of observed wedge-tailed eagle at VPC04, may be attributed to landscape factors and the layout of elevated ridges surrounding the observer location. VPC03's position differed markedly in that it was positioned on a prominent high point along the dominant ridgeline of the Project Area and there were no other elevated areas (e.g., hills or ridges) within detection distance to the east or west.

Wedge-tailed eagle were regularly recorded regardless of wind speed at the three 'impact' vantage points although it is noted that no surveys were conducted in the early morning prior to thermals becoming active, meaning that very few surveys were conducted in still conditions (**Table 3.13**).

Table 3.12 Summary of wedge-tailed eagle observations at 'impact' and 'control' vantage survey points

	VPI01	VPI03	VPI04	VPC03	VPC04
Proportion of surveys detected	50% (4/8)	88% (7/8)	50% (4/8)	25% (2/8)	75% (6/8)
Number of individuals observed	13	14	12	6	24

Table 3.13 Summary of wedge-tailed eagle observations at vantage point surveys by recorded wind speed

	<11km/h	11-28km/h	29-38km/h	39-61km/h
Proportion of surveys detected	64% (7/11)	43% (6/14)	75% (9/12)	66% (2/3)
Number of individuals observed	20	14	24	11
Number of records / survey	1.8	1.0	2	3.7

3.2.1.3 Likelihood and Consequence of Impacts

The overall risk rating for wedge-tailed eagle is moderate, based on a high likelihood and low consequence of collisions (**Table 3.14**). The rationale for responses to each criterion is as follows:

a) A high proportion of the wedge-tailed eagle's flight activity is at RSA height.

b) The wedge-tailed eagle is a common resident in the Project Area.

c) The wedge-tailed eagle is widely distributed within areas of suitable habitat across its range and the habitat itself is relatively widely dispersed.

d) The life-history characteristics of the wedge-tailed eagle overlap with certain aspects of both the descriptions for a 'low' and 'high' rating for Criterion D however overall, they average out between the two and hence Criterion D is assigned 'moderate' (Marchant and Higgins 1993).

e) The total population of wedge-tailed eagle is described as very large by Birdlife International (2020) and given this species very large distribution (c. 10.6 million km^2) the total population is likely to exceed 20,000 individuals.

f) The subspecies of wedge-tailed eagle that occurs in the Project Area is not listed as threatened under the EPBC Act or the BC Act.

The wedge-tailed eagle's risk rating of moderate reflects the moderate level of impact that a potentially high frequency of blade strike in the Project Area is likely to have on this species' total population.

Table 3.14 Wedge-tailed eagle risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low			X		X	X
Moderate				X		
High	X	X				
Risk Rating						
Likelihood	High	**Consequence**	Low	**Risk Rating**	Moderate	

3.3 Threatened bats

3.3.1 Large bent-winged bat

3.3.1.1 Information on large bent-winged bat from Australian wind farms

There are no published records of blade strike of large bent-winged bats in the available literature in Victoria (Moloney *et al.* 2019) or south-east New South Wales (BCS unpublished data). The majority of wind farms monitored to date in Victoria are located outside of this species' distribution. There are eight published records of blade strike of the closely related southern bent-winged bat in the available literature in Victoria (Moloney *et al.* 2019). A mortality model for southern bent-winged bat generated a mortality rate estimate of 0.1 individuals per turbine per year (95% CI 0-0.5) for one particular wind farm (Moloney *et al.* 2019).

Large bent-winged bats are known to have collided with wind turbines in south-east NSW however data collected in this region is not publicly available (BCS unpublished data).

3.3.1.2 Status and flight behaviour in the Project Area

Three confirmed large bent-winged bat calls were recorded during the 2018/19 survey. Each of these records were from ground level, 250 m south-west of proposed turbine #124 (**Figure 5.3**). During the November 2011 and April 2012, 41 large bent-winged bats were recorded in the Project Area (NGH 2014). The majority of these calls were from the central section of the Project Area between proposed turbines #80 and #143 (NGH 2014). The species was also recorded in the southern section of the Project Area near the removed turbines #104 and 105 and in the northern section of the Project Area near proposed turbines #9 and #25.

As very few confident large bent-winged bat identifications were made from the data collected in 2018/19, unresolved calls that may have been from large bent-winged bats were pooled to create a "possible large bent-winged bat" dataset (**Appendix A**). This allowed for the comparison of data within and outside the bent-winged bat migration period.

A total of 1107 sample nights were included in the analyses from 30 different sites. Overall, there was no spike in activity during the autumn migration season. The data suggest that whilst the Project Area is located within an area that large bent-winged bats migrate through (Dwyer 1969) there is no evidence that a highly utilised autumn migratory path intersects the Project Area.

3.3.1.3 Likelihood and Consequence of Impacts

The overall risk rating for large bent-winged bat is high, based on a high likelihood and moderate consequence of collisions (**Table 3.15**). The rationale for responses to each criterion is as follows:

a) Based on available data large bent-winged bats are likely to occasionally fly at RSA height in the Project Area.

b) The number of large bent-winged bat records in 2011-2013 and in 2019, indicate that this species either occasionally or regularly occurs in the Project Area. Criterion B is conservatively assigned 'high' here.

c) Large bent-winged bats congregate in large numbers at a few caves in the region the nearest being a maternity cave located at Wee Jasper approximately 45 kilometres south-west of the Project Area. There was no spike in activity of confirmed or potential large bent-winged bat calls during the migration period in autumn 2019. Hence, Criterion C is assigned 'moderate'.

d) The life-history characteristics of the large bent-winged bat overlap with certain aspects of both the descriptions for a 'low' and 'high' rating for Criterion D.

e) It is likely that the total population of large bent-winged bats is over 20,000 individuals (Churchill 1998, Pennay *et al.* 2011).

f) The large bent-winged bat is listed as vulnerable in NSW under the BC Act.

Table 3.15 Large bent-winged bat risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low					X	
Moderate	X		X	X		X
High	X	X				
Risk Rating						
Likelihood	High	**Consequence**	Moderate	**Risk Rating**	High	

3.3.2 Yellow-bellied sheathtail bat

3.3.2.1 Information on yellow-bellied sheathtail bat from Australian wind farms

There are no published records of blade strike of yellow-bellied sheathtail bats in the available literature from post-construction monitoring conducted in its range in south-eastern Australia (BCS unpublished data, Moloney *et al.* 2019).

3.3.2.2 Status and flight behaviour in the Project Area

The yellow-bellied sheathtail bat was recorded in the Project Area during both the 2011-2013 and 2018/2019 survey events.

Calls for yellow-bellied sheathtail bats were recorded during the 2018/19 surveys, with 14 calls recorded from five locations (**Figure 5.3**). Seven calls were detected from ground level in wooded habitat approximately 1.3 km north of proposed turbine #145. One call from ground level and two calls at 45 m AGL were also recorded at proposed turbine #31. Single calls were recorded from ground level and at 45 m AGL near proposed turbine #80. Single calls were also recorded from ground level near proposed turbine #69 and from ground level near proposed turbine #2.

During the 2011-2013 survey, four yellow-bellied sheathtail bat calls were recorded at one location near proposed turbine #80. NGH (2014) considered this species to be an occasional seasonal visitor in the Project Area.

3.3.2.3 Likelihood and Consequence of Impacts

The overall risk rating for yellow-bellied sheathtail bat is moderate, based on a moderate likelihood and moderate consequence of collisions (**Table 3.16**). The rationale for responses to each criterion is as follows:

a) The yellow-bellied sheathtail bat is likely to regularly fly below RSA height and occasionally fly at RSA height.

b) The yellow-bellied sheathtail bat is likely to occasionally occur in or move through the Project Area. NGH (2014) considered this species to be an occasional seasonal visitor in the Project Area. The data collected during the 2018/19 survey support this.

c) The yellow-bellied sheathtail bat is widely distributed within areas of suitable habitat across its range and the habitat itself is relatively widely dispersed.

d) The life-history characteristics of the yellow-bellied sheathtail bat overlap with certain aspects of both the descriptions for a 'low' and 'high' rating for Criterion D.

e) Very little is known about the ecology of the yellow-bellied sheathtail bat though given its very large distribution (Churchill 2008) its population is likely to exceed 5,000 individuals and may possibly be over 20,000. Given the migratory nature of individuals that occur in south-eastern Australia coupled with the lack of any population estimates Criterion E is conservatively assigned 'moderate'.

f) The yellow-bellied sheathtail bat is listed as vulnerable in NSW under the BC Act.

Table 3.16 Yellow-bellied sheathtail bat risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low			X			
Moderate	X	X		X	X	X
High						
Risk Rating						
Likelihood	Moderate	**Consequence**	Moderate	**Risk Rating**	Moderate	

3.3.3 Southern myotis

3.3.3.1 Information on southern myotis from Australian wind farms

There are no records of blade strike of southern myotis in the available literature from post-construction monitoring conducted in its range in south-eastern Australia (BCS unpublished data, Moloney *et al.* 2019).

3.3.3.2 Status and flight behaviour in the Project Area

One southern myotis call was recorded in the Project Area during the 2018/19 bat surveys from ground level near proposed turbine #18 on 12 November 2018. NGH (2014) considered the likelihood of occurrence of this species in the Project Area unlikely.

3.3.3.3 Likelihood and Consequence of Impacts

The overall risk rating for southern myotis is minor, based on a low likelihood and moderate consequence of collisions (**Table 3.17**). The rationale for responses to each criterion is as follows:

a) The southern myotis is likely to rarely fly at RSA height.

b) The southern myotis is likely to rarely occur in the Project Area due to the Project Area's location relative to this species' known range in the region coupled with the vegetation present and the number of records from bat surveys conducted in the Project Area to date.

c) The southern myotis is widely distributed within areas of suitable habitat across its range and the habitat itself is relatively widely dispersed.

d) The life-history characteristics of the southern myotis overlap with certain aspects of both the descriptions for a 'low' and 'high' rating for Criterion D.

e) The southern myotis has a large distribution in northern and eastern Australia where it is generally uncommon (Churchill 2008). Given the lack of any population estimates Criterion E is conservatively assigned 'moderate'.

f) The southern myotis is listed as vulnerable in NSW under the BC Act.

Table 3.17 Southern myotis risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low	X	X	X			
Moderate				X	X	X
High						
Risk Rating						
Likelihood	Low	**Consequence**	Moderate	**Risk Rating**	Minor	

3.3.4 Eastern false pipistrelle

3.3.4.1 Information on eastern false pipistrelle from Australian wind farms

There are 28 records of dead eastern false pipistrelles found at Victorian wind farms during post-construction mortality monitoring from 2003 to 2018 (Moloney *et al.* 2019). Moloney *et al.* 2019 calculated mortality estimates of 1.6 (95% CI: 0.6 – 2.9) individuals per turbine per year at one wind farm.

3.3.4.2 Status and flight behaviour in the Project Area

The eastern false pipistrelle was recorded once in the Project Area during the 2018/19 bat surveys, from ground level near proposed turbine #69 (**Figure 5.3**). Four eastern false pipistrelle calls have previously been recorded at one location near proposed turbine #80 (NGH 2014). This relatively low number of detections is probably a result of the Project Area's location corresponding to the western edge of the eastern false pipistrelle's known range in the region.

3.3.4.3 Likelihood and Consequence of Impacts

The overall risk rating for eastern false pipistrelles is moderate, based on a moderate likelihood and moderate consequence of collisions (**Table 3.18**). The rationale for responses to each criterion is as follows:

a) The eastern false pipistrelle likely regularly flies below RSA height and occasionally flies at RSA height.

b) The eastern false pipistrelle is considered to rarely or occasionally occur in the Project Area due to the Project Area's location relative to this species' known range in the region coupled with the vegetation present in the Project Area and the low number of records from bat surveys conducted in the Project Area to date.

c) The eastern false pipistrelle is widely distributed within areas of suitable habitat across its range and the habitat itself is relatively widely dispersed.

d) The life-history characteristics of the eastern false pipistrelle overlap with certain aspects of both the descriptions for a 'low' and 'high' rating for Criterion D

e) Given the lack of any population estimates for eastern false pipistrelles Criterion E is conservatively assigned ‘moderate’.

f) The eastern false pipistrelle is listed as vulnerable in NSW under the BC Act.

Table 3.18 Eastern false pipistrelle risk assessment

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	Criterion F
Low			X			
Moderate	X	X		X	X	X
High						
Risk Rating						
Likelihood	Moderate	**Consequence**	Moderate	**Risk Rating**	Moderate	

4.0 Conclusion

Of the 14 species assessed five are considered a high risk, six are considered a moderate risk and three are considered a minor risk of being impacted by the Project (**Table 4.1**). The resultant risk rating for these species is primarily due to their relative abundance in the Project Area, their predicted or observed flight behaviour in the Project Area and their known susceptibility to blade strike at wind farms in south-east Australia in the context of the potential consequence of risk for each (as estimated through ascribed ratings for Criterion C, D, E and F). For each of the five species assigned an overall risk rating of high, the likelihood of collisions was considered high whilst the consequence of collisions was considered moderate.

The risk rating for the black falcon and little eagle largely reflects the potentially high consequence of small numbers of instances of blade strike of this species. The risk rating for white-throated needletail largely reflects the high likelihood of collision of birds in the Project Area given their known susceptibility to blade strike at other wind farms in Australia and the number and nature of observations in the Project Area during 2018/19. The risk rating for superb parrot and large bent-winged bat partly reflects the high importance of the greater region for both species, combined with factors such as the number and nature of observations in the Project Area.

Due to the findings of this risk assessment the bird and bat monitoring program and the mitigation and adaptive management strategy described in the BBAMP will have a particular emphasis on effectively monitoring and managing risk of collision of the eleven species considered a moderate or high risk of being impacted by the Project.

Table 4.1 Risk Assessment Summary

Common Name	Latin Name	Likelihood	Consequence	Risk Rating
little eagle	*Hieraaetus morphnoides*	High	Moderate	High
black falcon	*Falco subniger*	High	Moderate	High
wedge-tailed eagle	*Aquila audax*	High	Low	Moderate
superb parrot	*Polytelis swainsonii*	High	Moderate	High
white-throated needletail	*Hirundapus caudacutus*	High	Moderate	High
white-fronted chat	*Epthianura albifrons*	High	Low	Moderate
brown treecreeper	*Climacteris picumnus victoriae*	Low	Moderate	Minor
varied sittella	*Daphoenositta chrysoptera*	Moderate	Low	Minor
painted honeyeater	*Grantiella picta*	Moderate	Moderate	Moderate
dusky woodswallow	*Artamus cyanopterus*	High	Low	Moderate
large bent-winged bat	*Miniopterus schreibersii oceanensis*	High	Moderate	High
yellow-bellied sheathtail bat	*Saccolaimus flaviventris*	Moderate	Moderate	Moderate
southern myotis	*Myotis macropus*	Low	Moderate	Minor
eastern false pipistrelle	*Falsistrellus tasmaniensis*	Moderate	Moderate	Moderate

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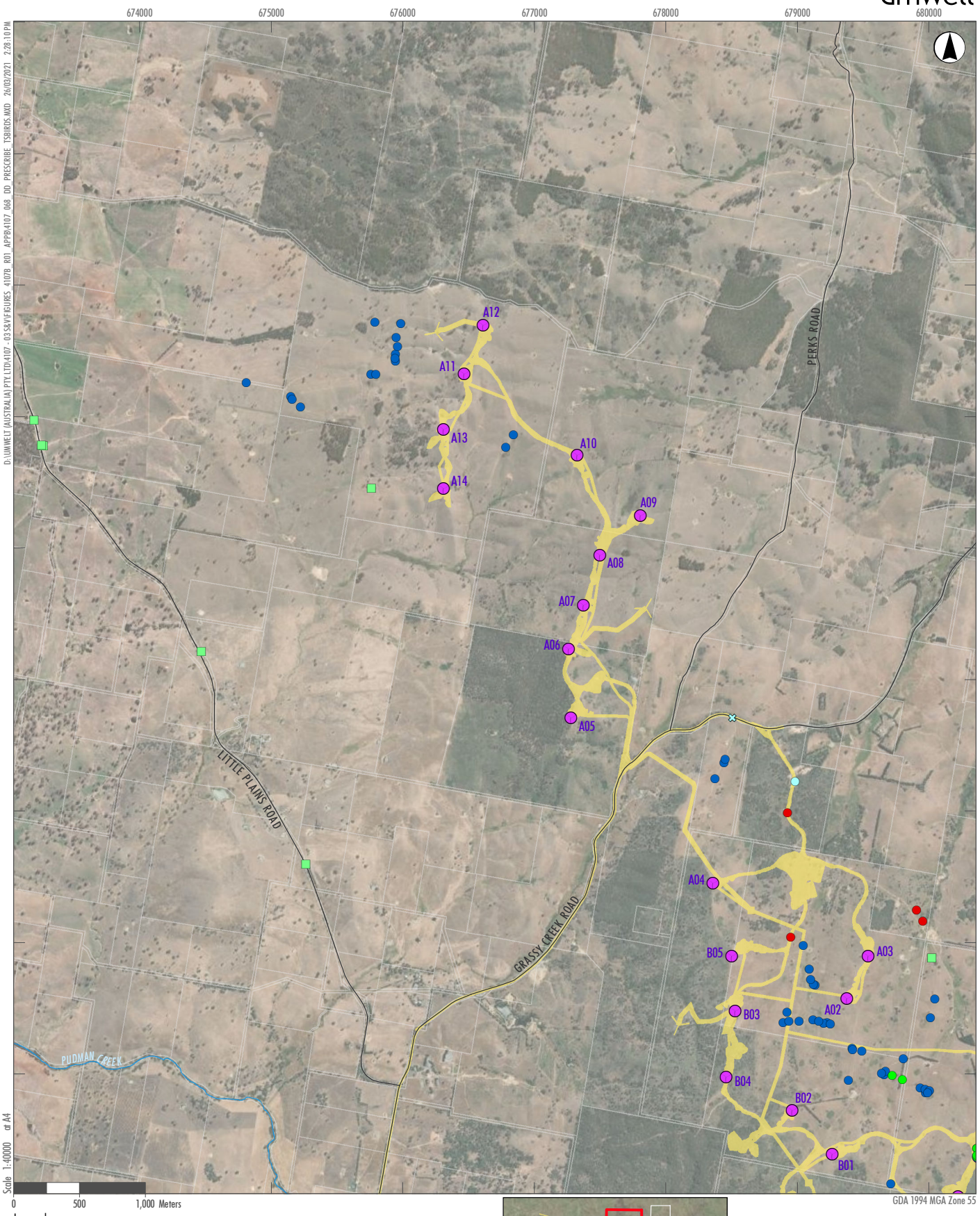

Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses

EPBC Act Species

- White-throated Needletail

NSW BC Act & EPBC Act Species

- Superb Parrot

NSW BC Act Species

- Dusky Woodswallow
- Varied Sittella
- Black Falcon
- Little Eagle
- Hooded Robin
- Scarlet Robin
- Flame Robin
- Speckled Warbler
- White-fronted Chat

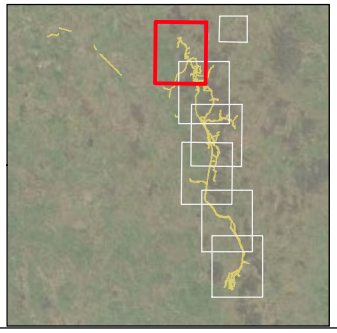

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)

FIGURE 5.1.1

Location of Threatened Bird Species Records in the Project Area (2018 /19 Bird Utilisation Surveys)

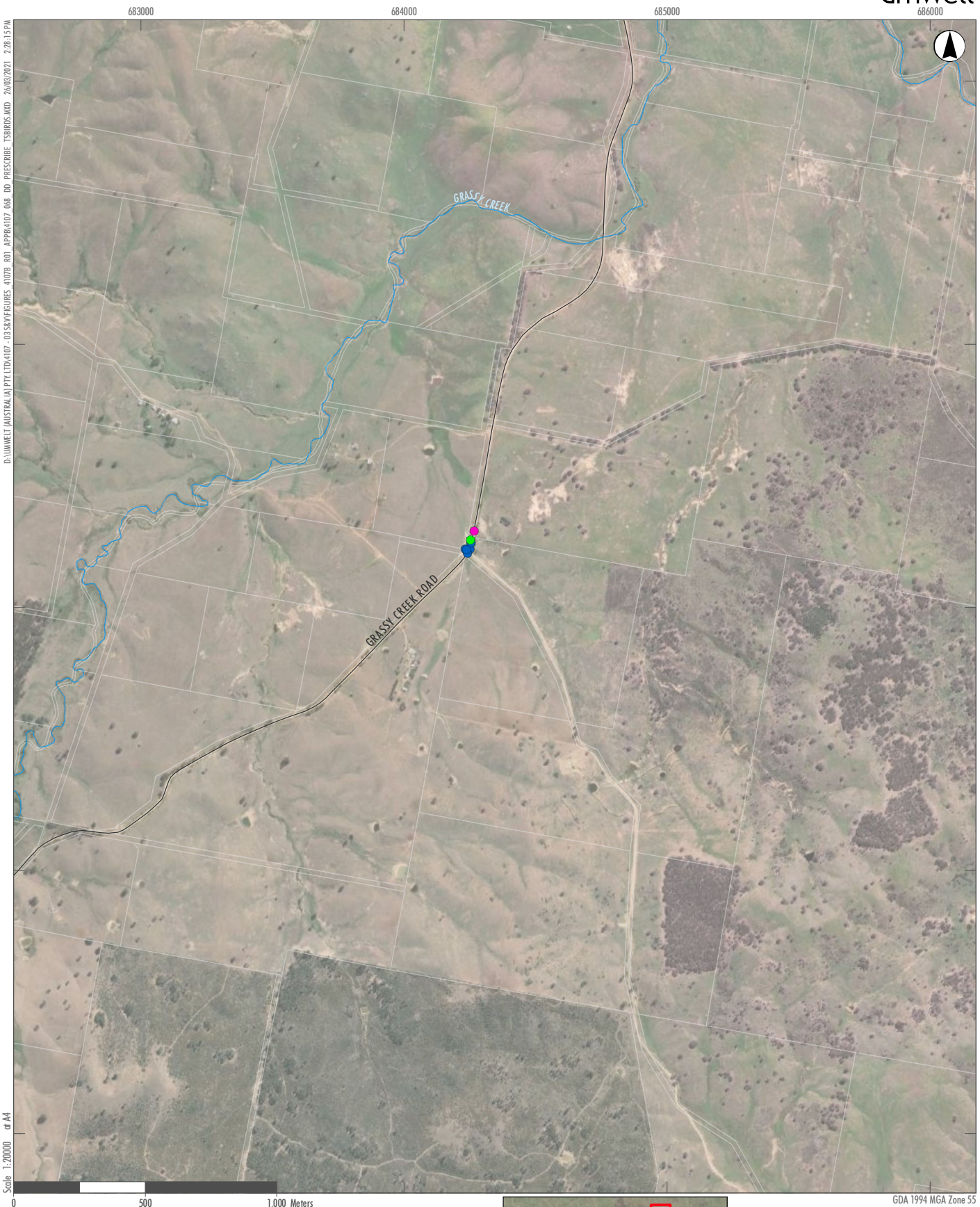

FIGURE 5.1.2

Location of Threatened Bird Species Records in the Project Area (2018 /19 Bird Utilisation Surveys)

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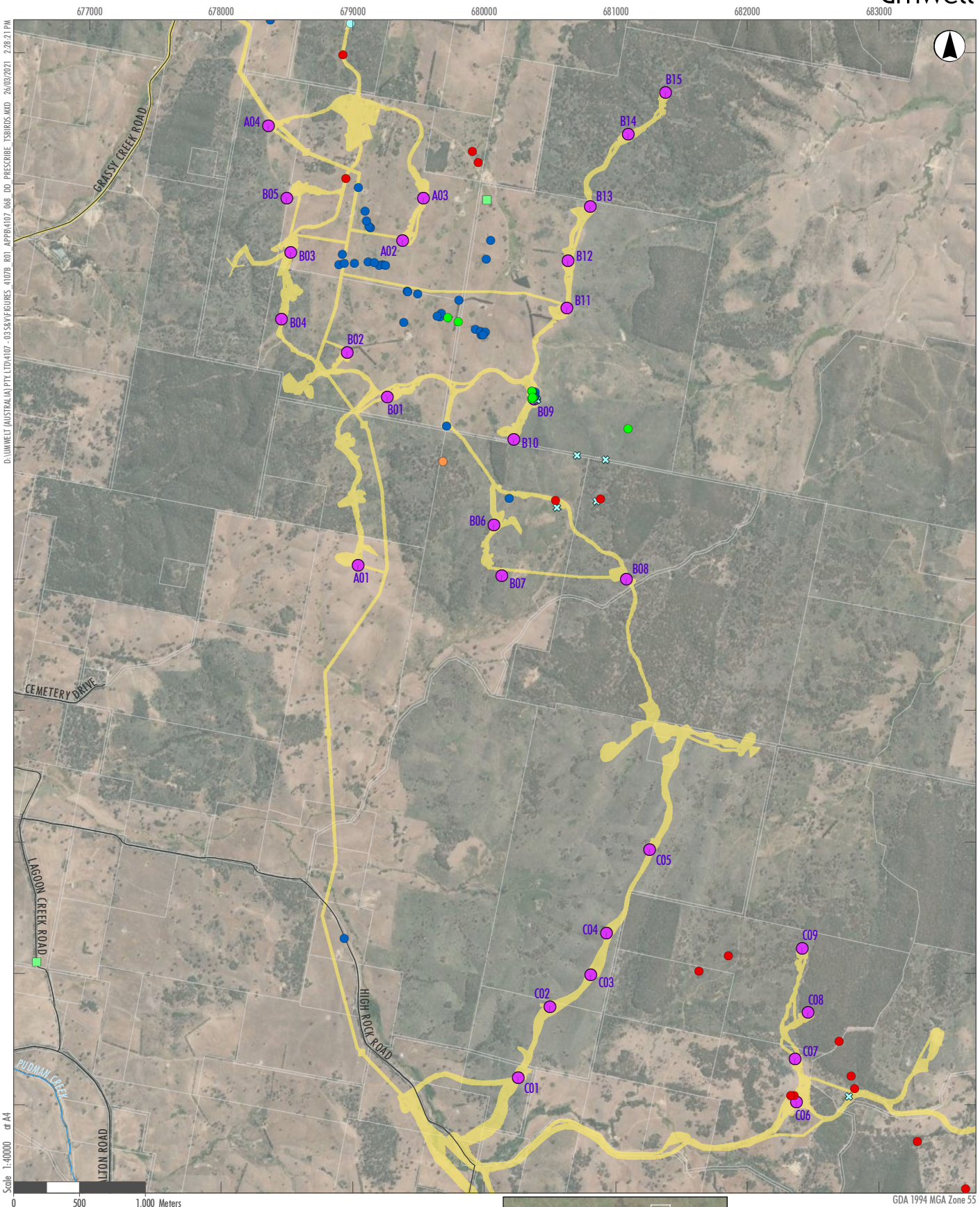

Legend

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- Watercourses

EPBC Act Species

- White-throated Needletail

NSW BC Act & EPBC Act Species

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NSW BC Act Species

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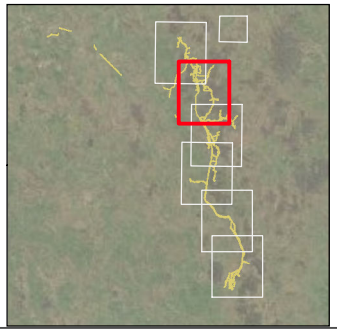

FIGURE 5.1.3

Location of Threatened Bird Species Records in the Project Area (2018 /19 Bird Utilisation Surveys)

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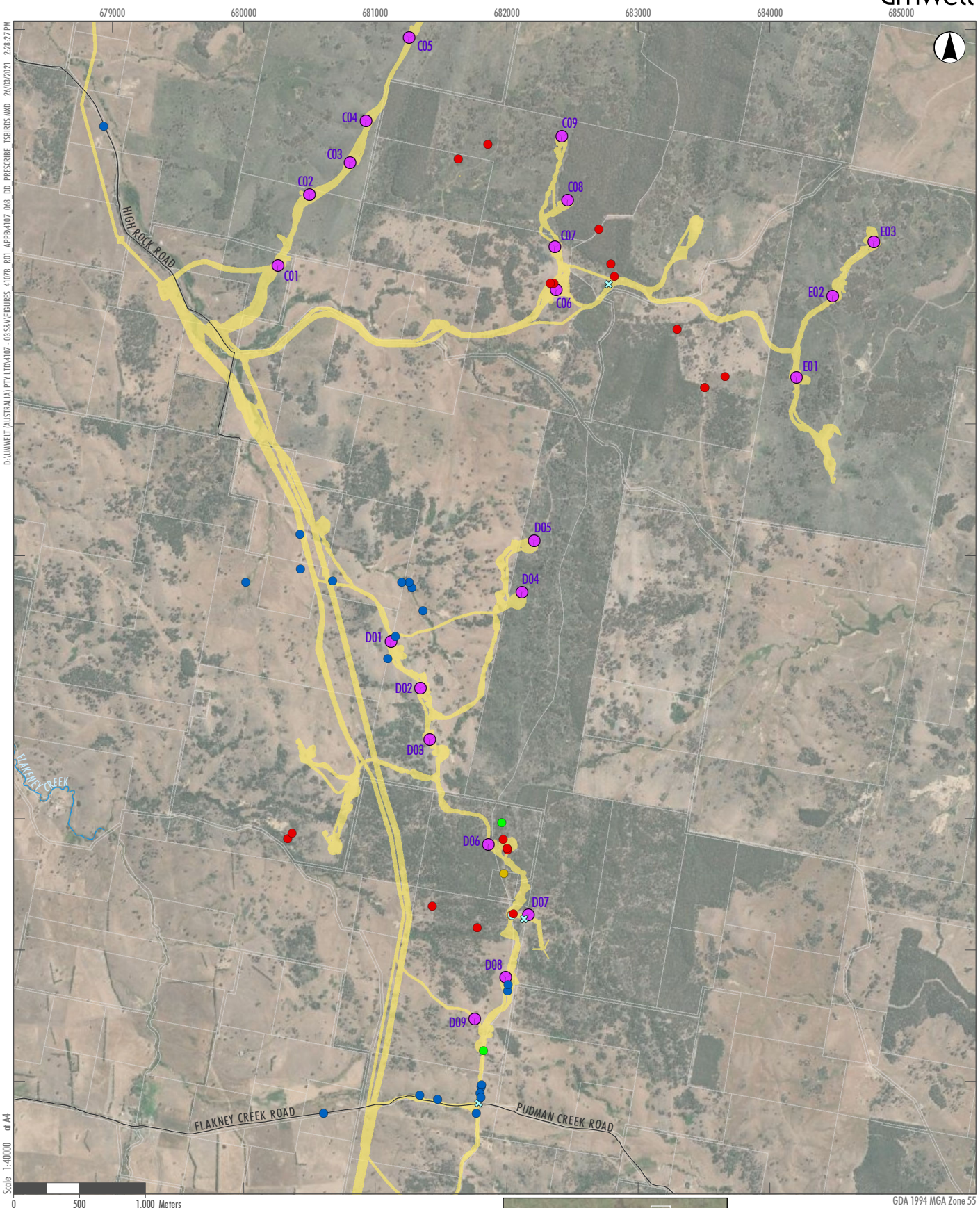

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EPBC Act Species

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NSW BC Act Species

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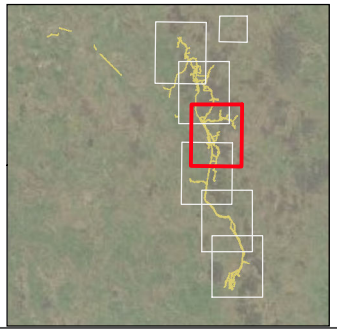

FIGURE 5.1.4

Location of Threatened Bird Species Records in the Project Area (2018 /19 Bird Utilisation Surveys)

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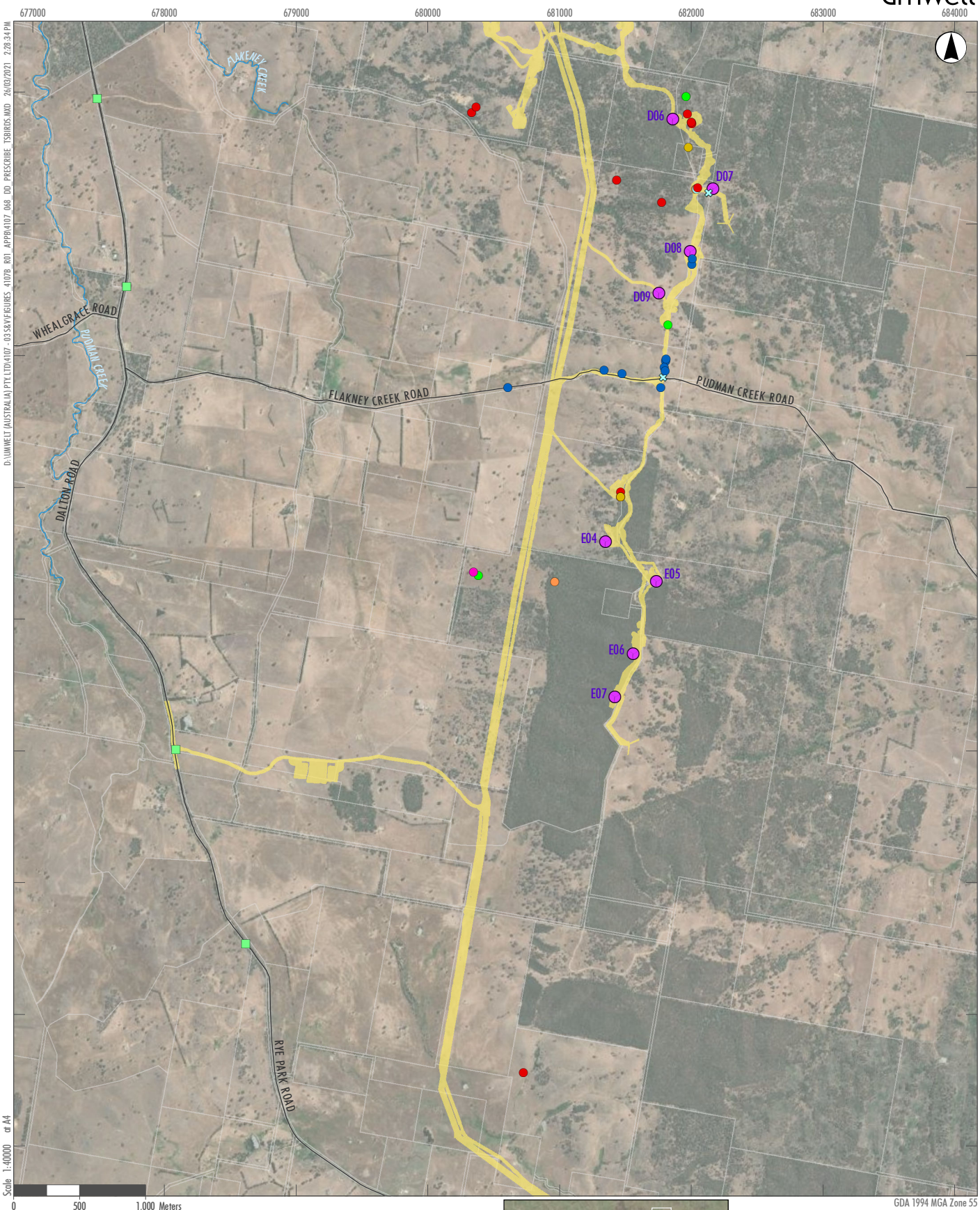

Legend

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- Property Boundaries
- Watercourses

EPBC Act Species

- White-throated Needletail

NSW BC Act & EPBC Act Species

- Superb Parrot

NSW BC Act Species

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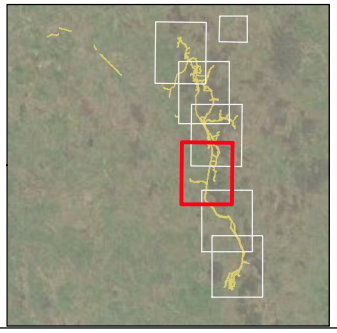

FIGURE 5.1.5

Location of Threatened Bird Species Records in the Project Area (2018 /19 Bird Utilisation Surveys)

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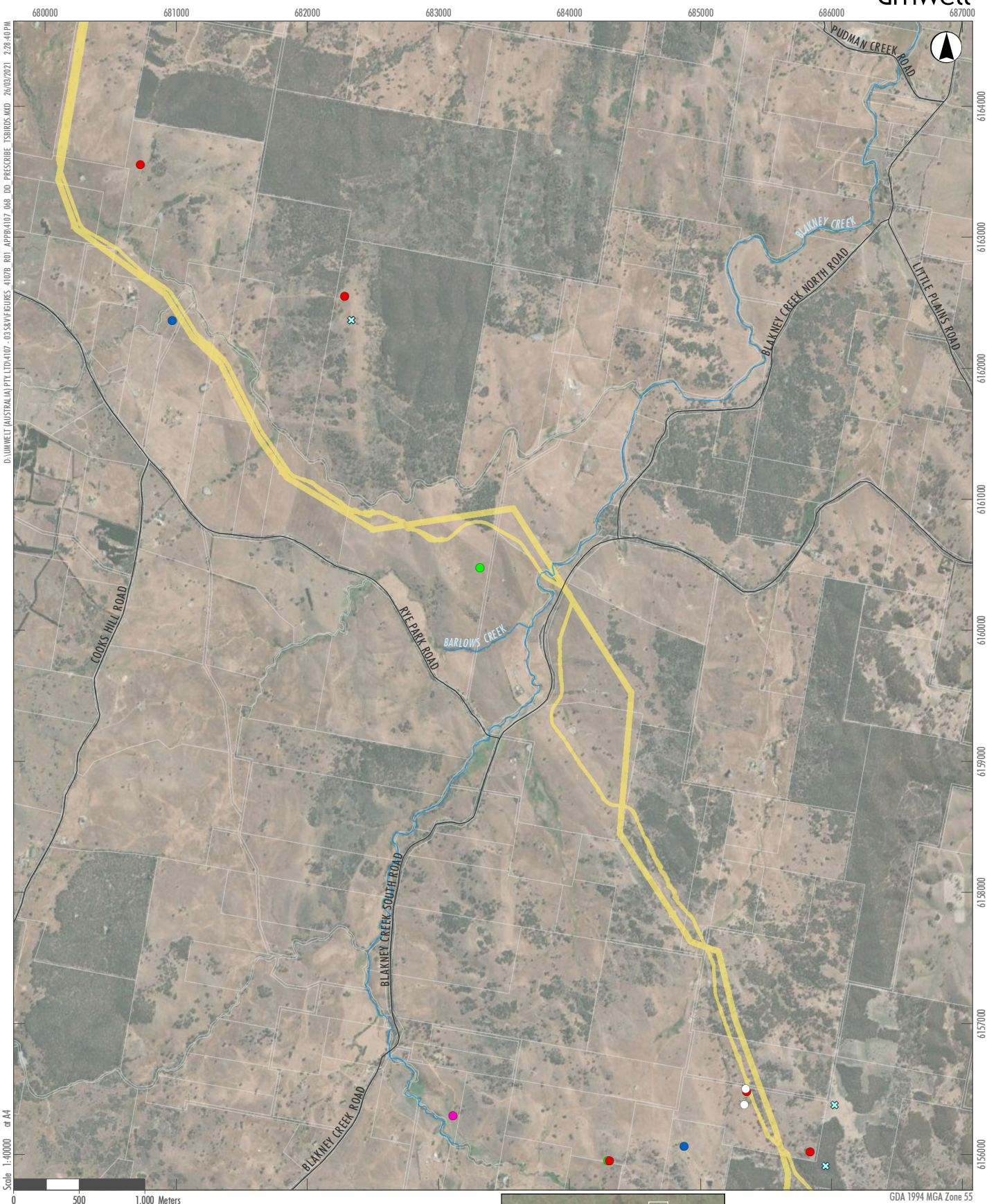

Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses

EPBC Act Species

- White-throated Needletail

NSW BC Act Species

- Dusky Woodswallow
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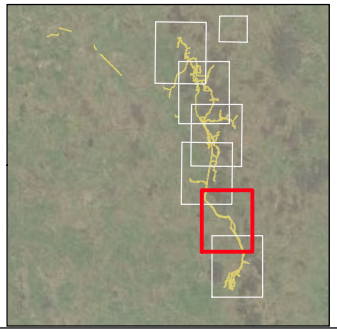

FIGURE 5.1.6

Location of Threatened Bird Species Records in the Project Area (2018 /19 Bird Utilisation Surveys)

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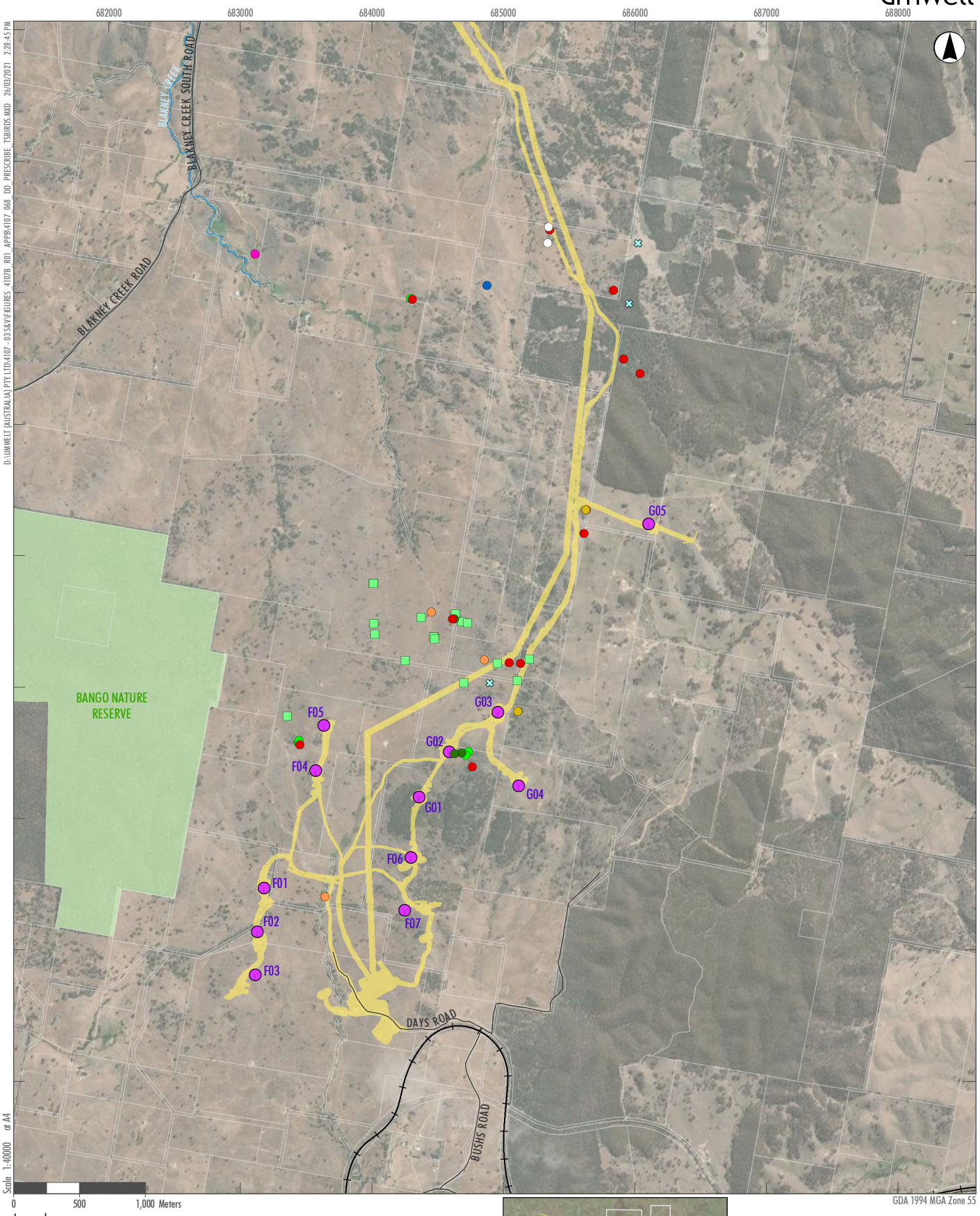

Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses
- Railways
- NPWS Estate

EPBC Act Species

- White-throated Needletail

NSW BC Act & EPBC Act Species

- Superb Parrot

NSW BC Act Species

- Dusky Woodswallow
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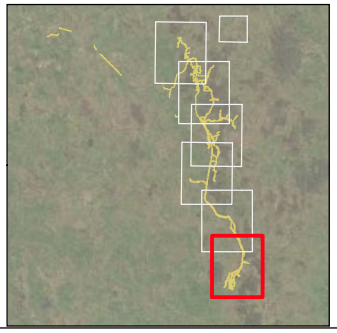
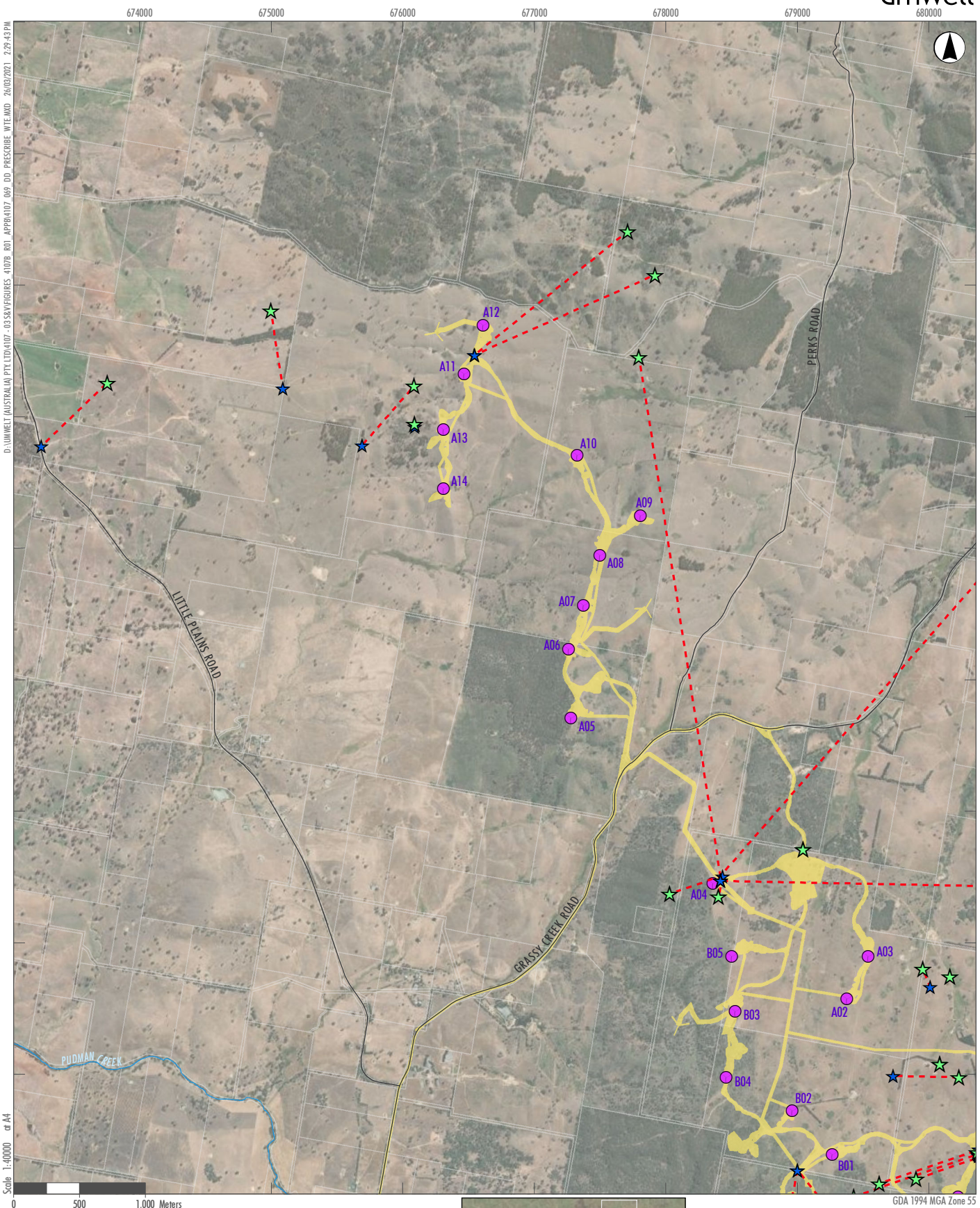


FIGURE 5.1.7

Location of Threatened Bird Species Records in the Project Area (2018 /19 Bird Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses
- Observer Location
- Observer Direction and Distance of Wedge-Tailed Eagle Sighting
- Wedge-Tailed Eagle Location

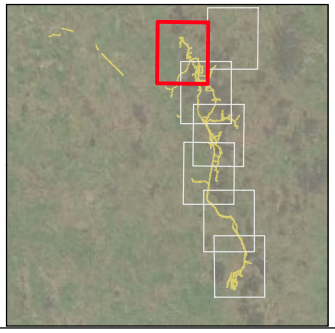
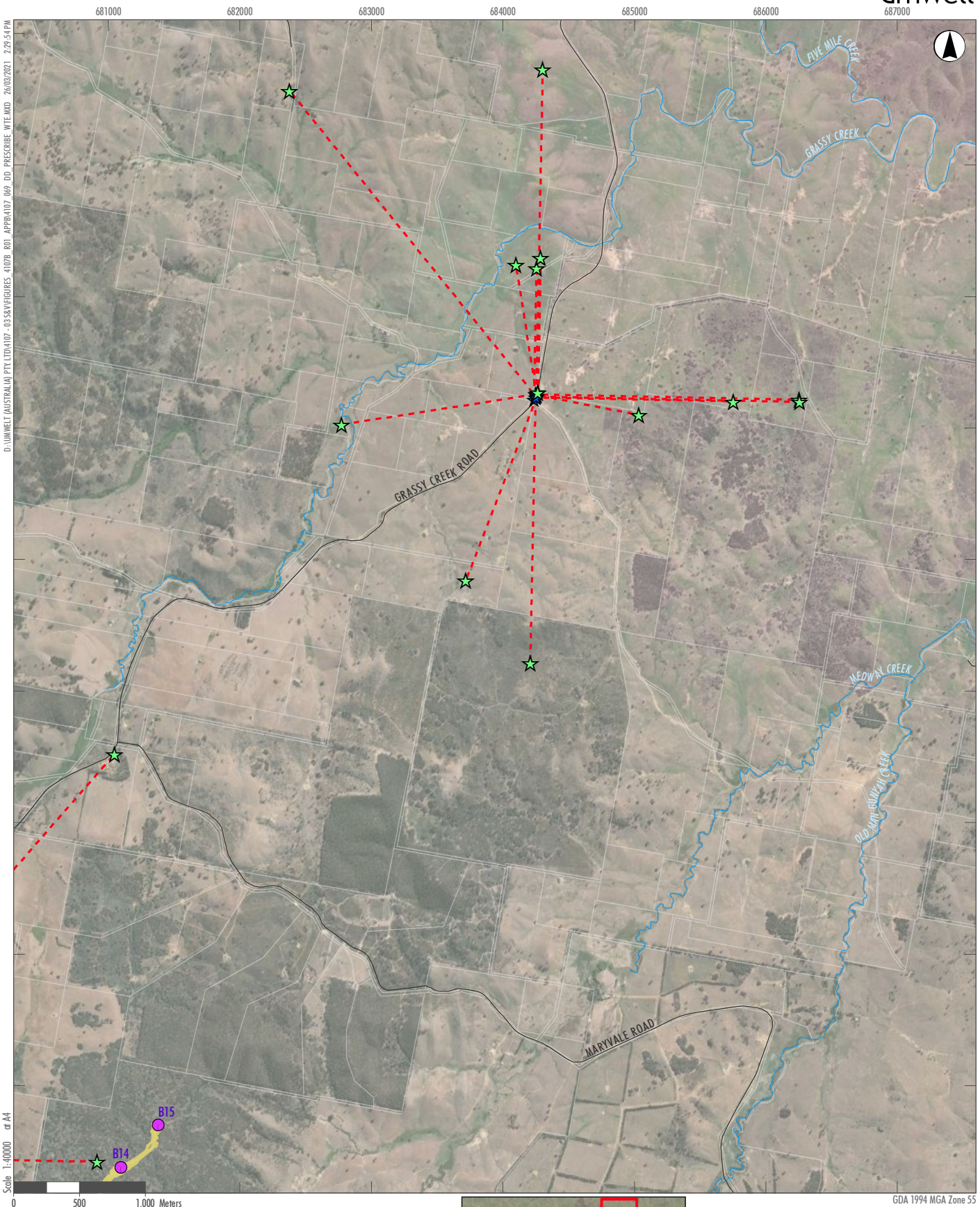


FIGURE 5.2.1

Location of Wedge-Tailed Eagles Records in the Project Area (2018 / 19 Bird Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses
- Observer Location
- Observer Direction and Distance of Wedge-Tailed Eagle Sighting
- Wedge-Tailed Eagle Location

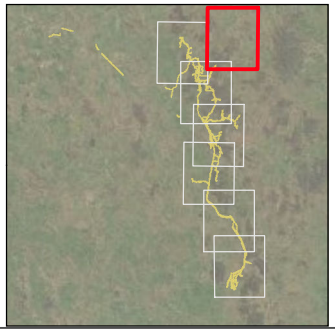
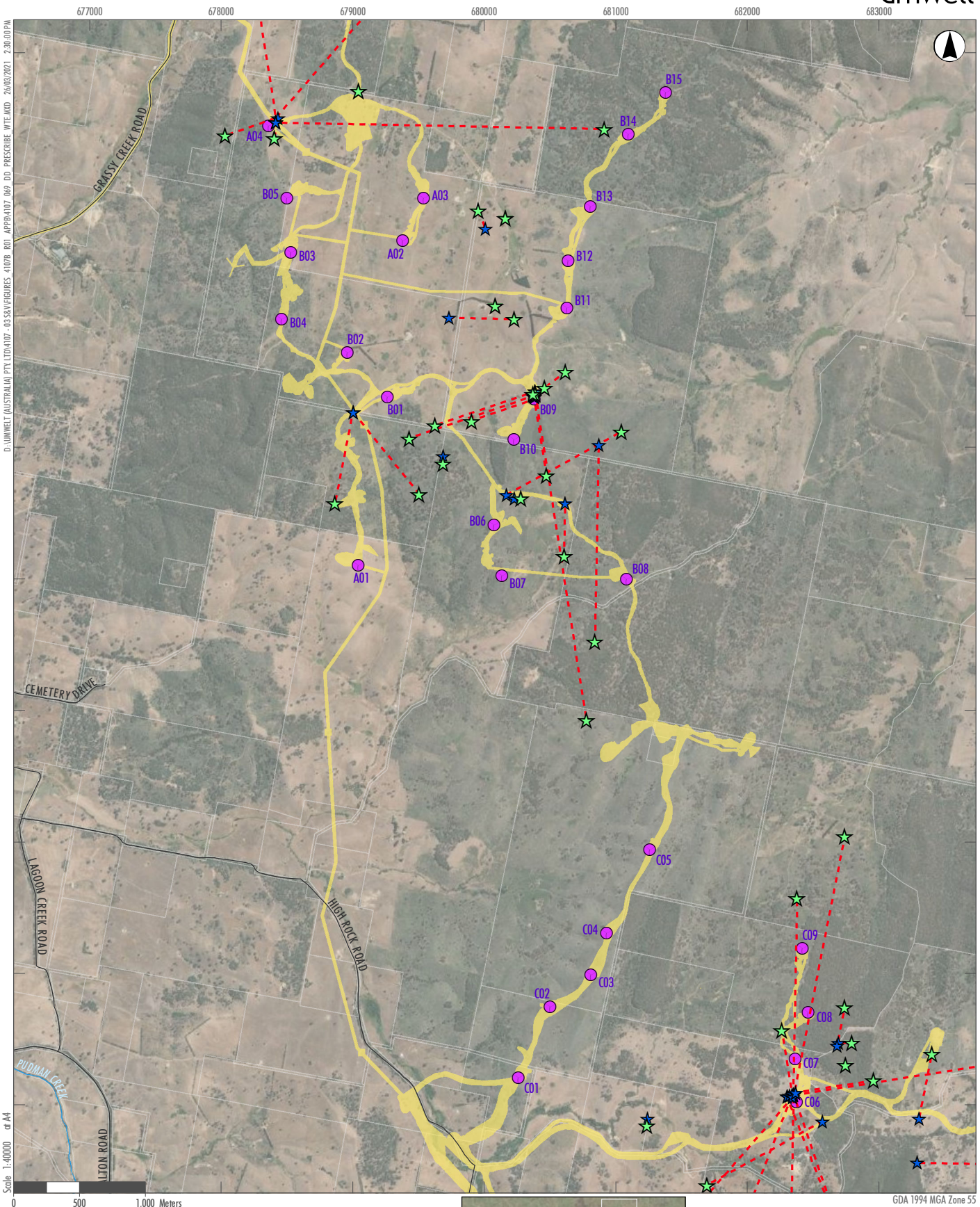


FIGURE 5.2.2

Location of Wedge-Tailed Eagles Records in the Project Area (2018 / 19 Bird Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



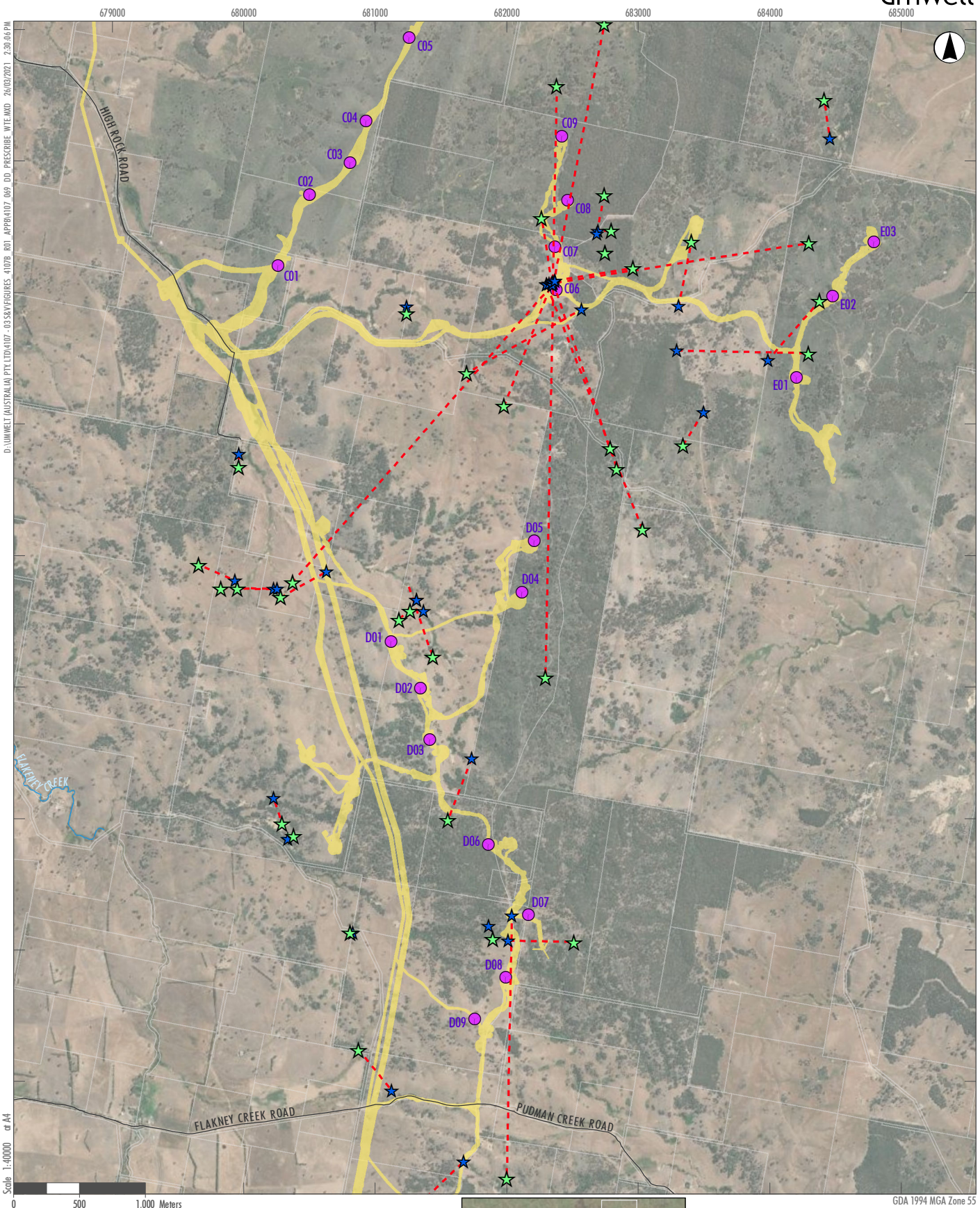
Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses
- Observer Location
- Observer Direction and Distance of Wedge-Tailed Eagle Sighting
- Wedge-Tailed Eagle Location

FIGURE 5.2.3

Location of Wedge-Tailed Eagles Records in the Project Area (2018 / 19 Bird Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses
- Observer Location
- Observer Direction and Distance of Wedge-Tailed Eagle Sighting
- Wedge-Tailed Eagle Location

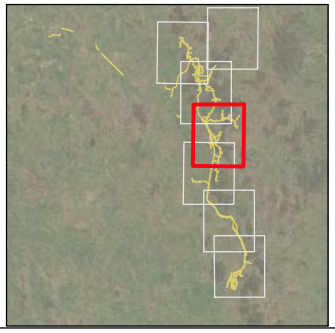
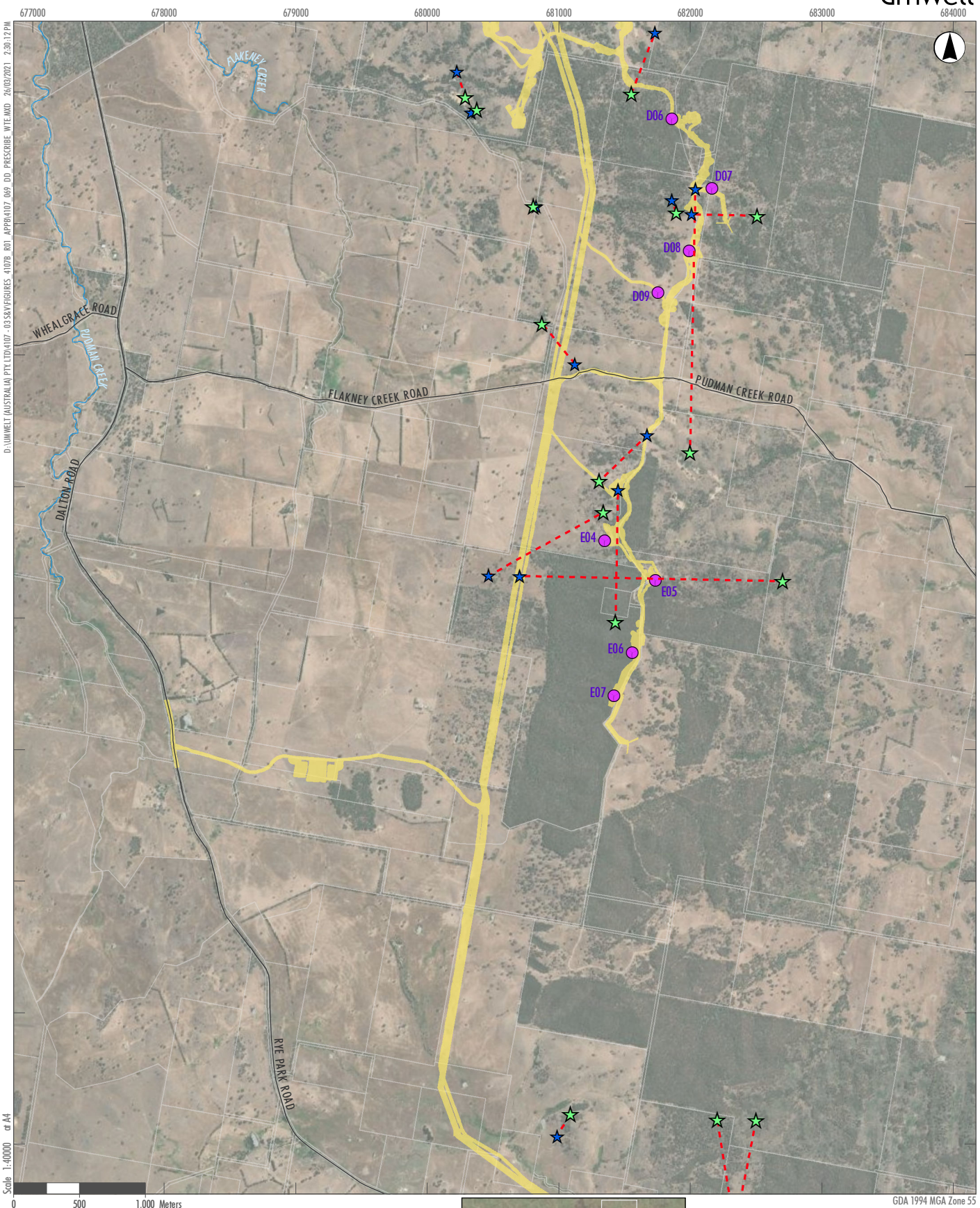


FIGURE 5.2.4

Location of Wedge-Tailed Eagles Records in the Project Area (2018 / 19 Bird Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses
- Observer Location
- Observer Direction and Distance of Wedge-Tailed Eagle Sighting
- Wedge-Tailed Eagle Location

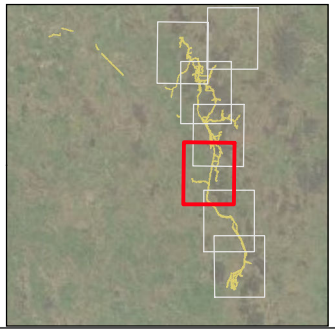
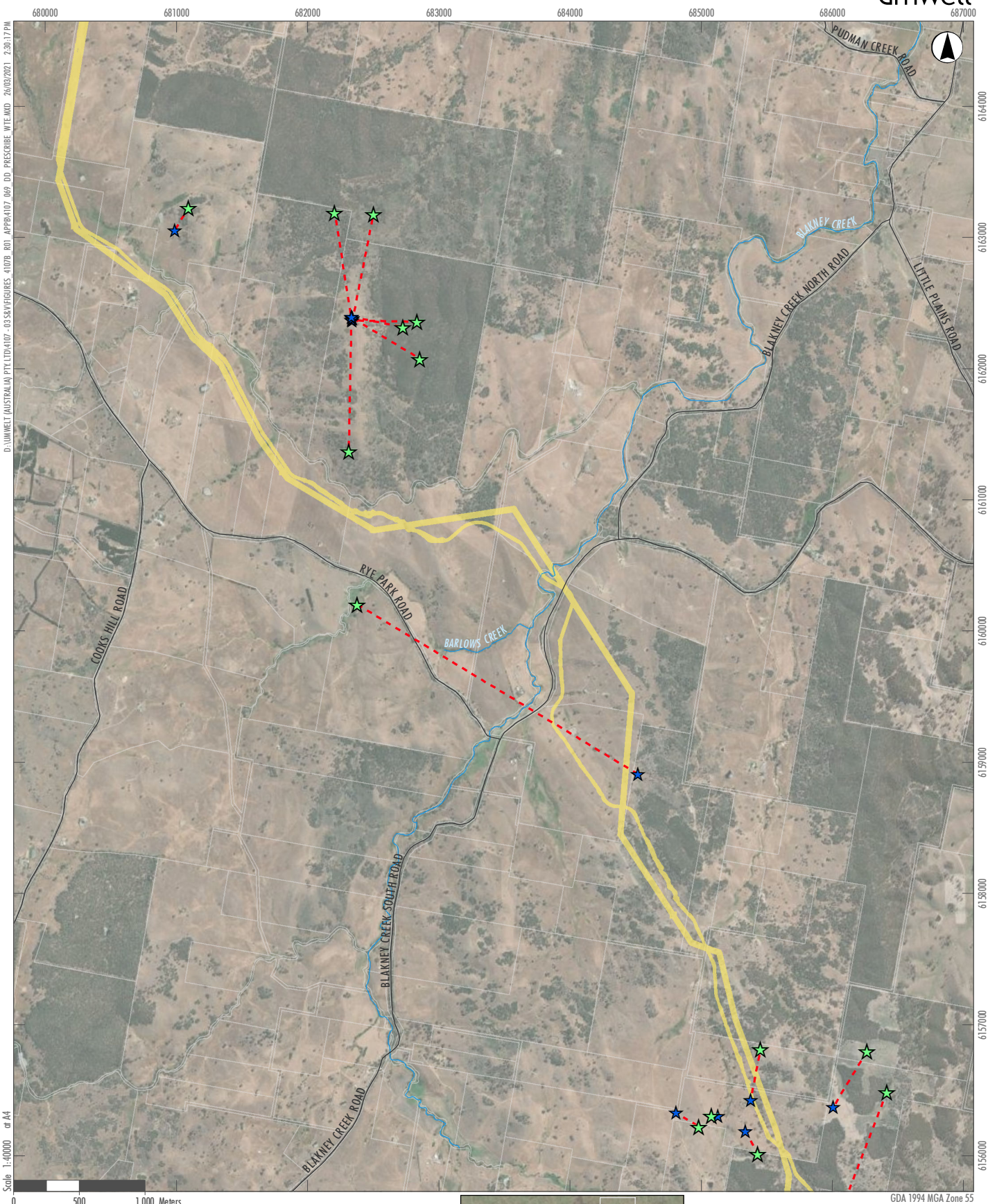


FIGURE 5.2.5

Location of Wedge-Tailed Eagles Records in the Project Area (2018 / 19 Bird Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses
- Observer Location
- Observer Direction and Distance of Wedge-Tailed Eagle Sighting
- Wedge-Tailed Eagle Location

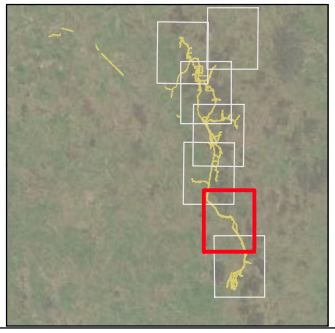
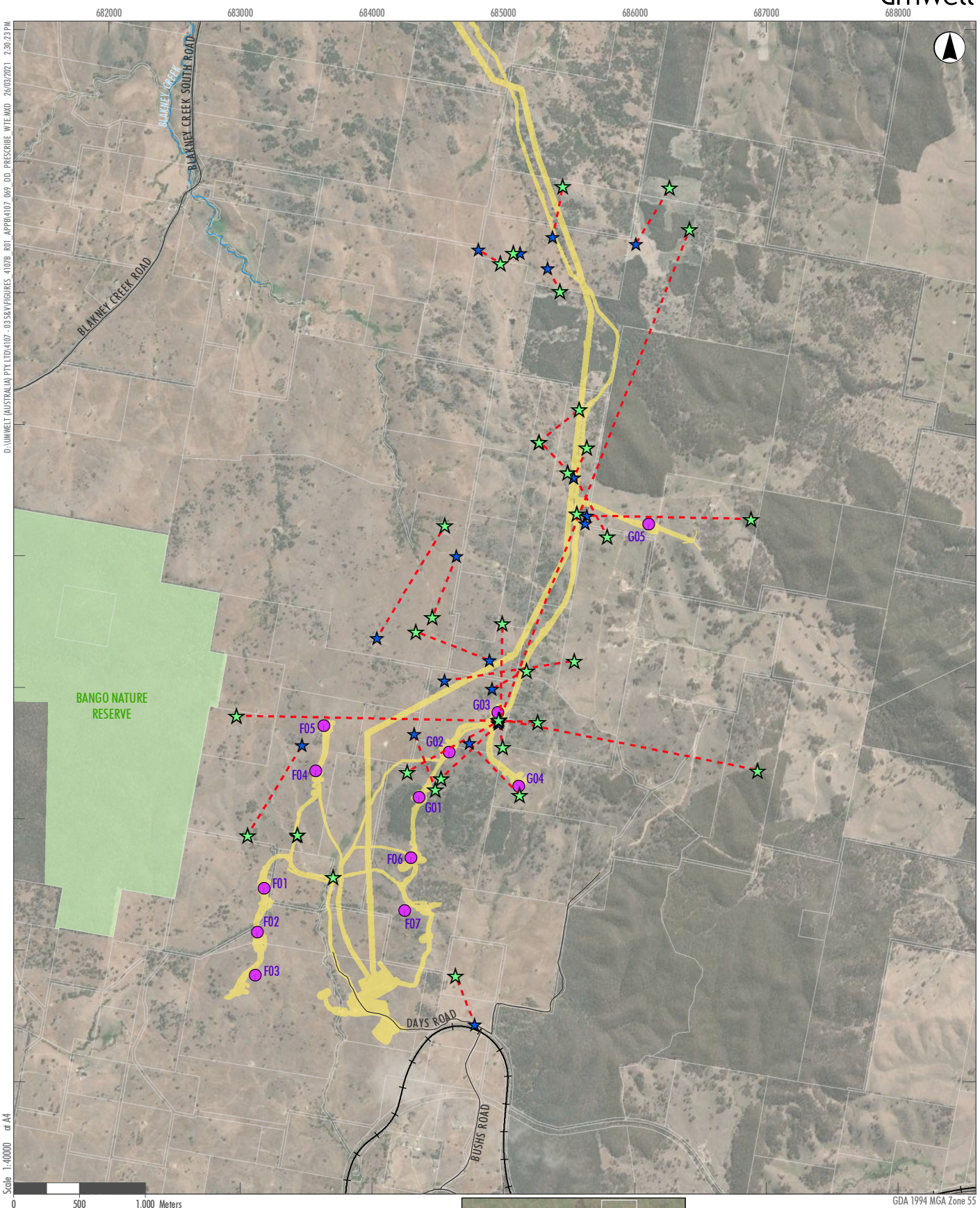


FIGURE 5.2.6

Location of Wedge-Tailed Eagles Records in the Project Area (2018 / 19 Bird Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses
- Railways
- NPWS Estate
- Observer Location
- Observer Direction and Distance of Wedge-Tailed Eagle Sighting
- Wedge-Tailed Eagle Location

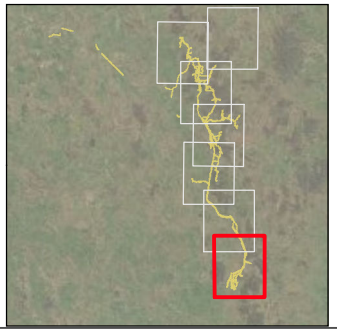
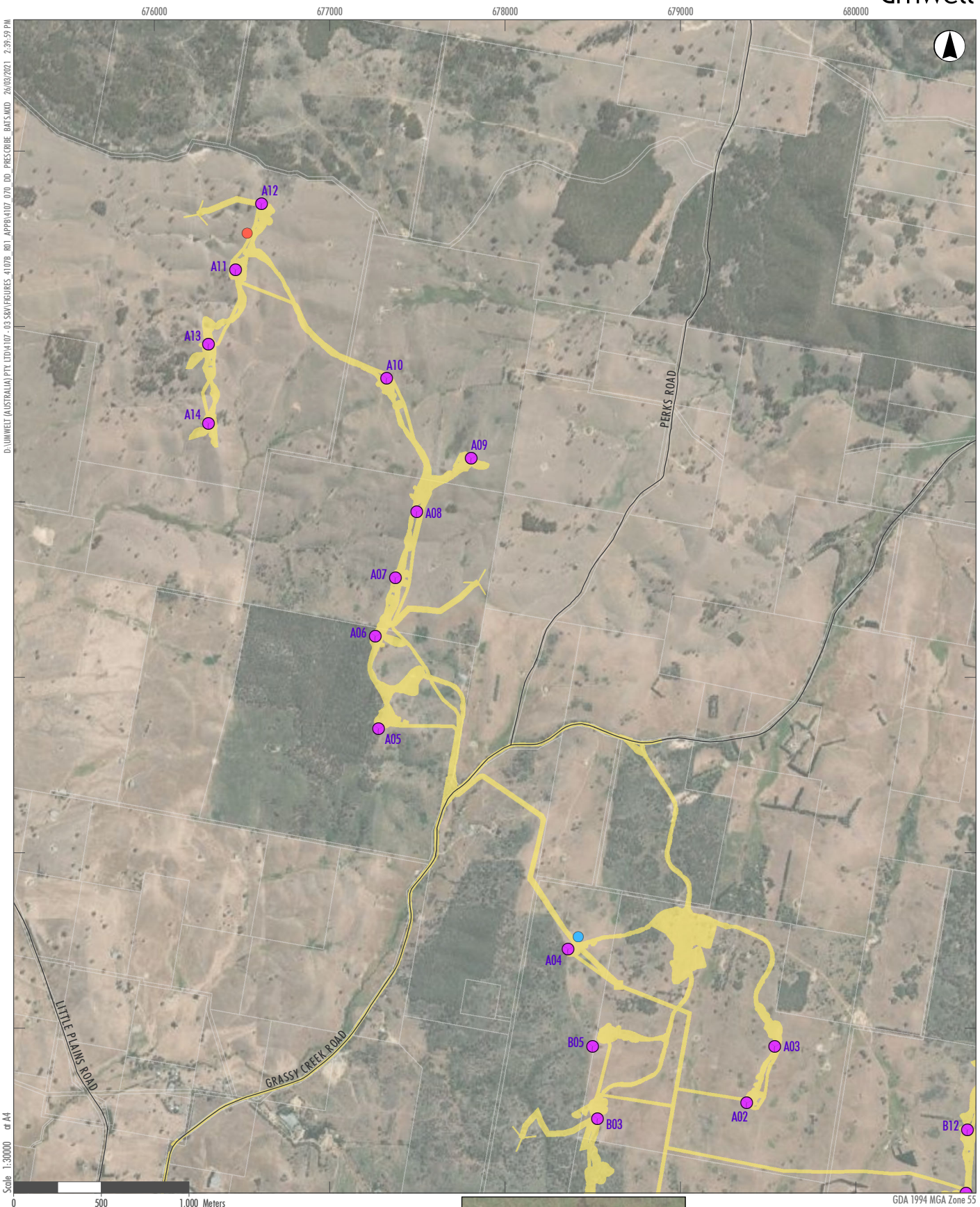


FIGURE 5.2.7

Location of Wedge-Tailed Eagles Records in the Project Area (2018 / 19 Bird Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses

Threatened Bat Records

- Myotis macropus (Southern myotis)
- Saccolaimus flaviventris (Yellow-bellied sheathtail bat)

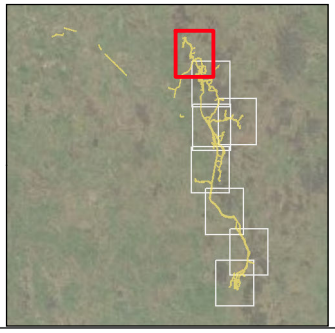
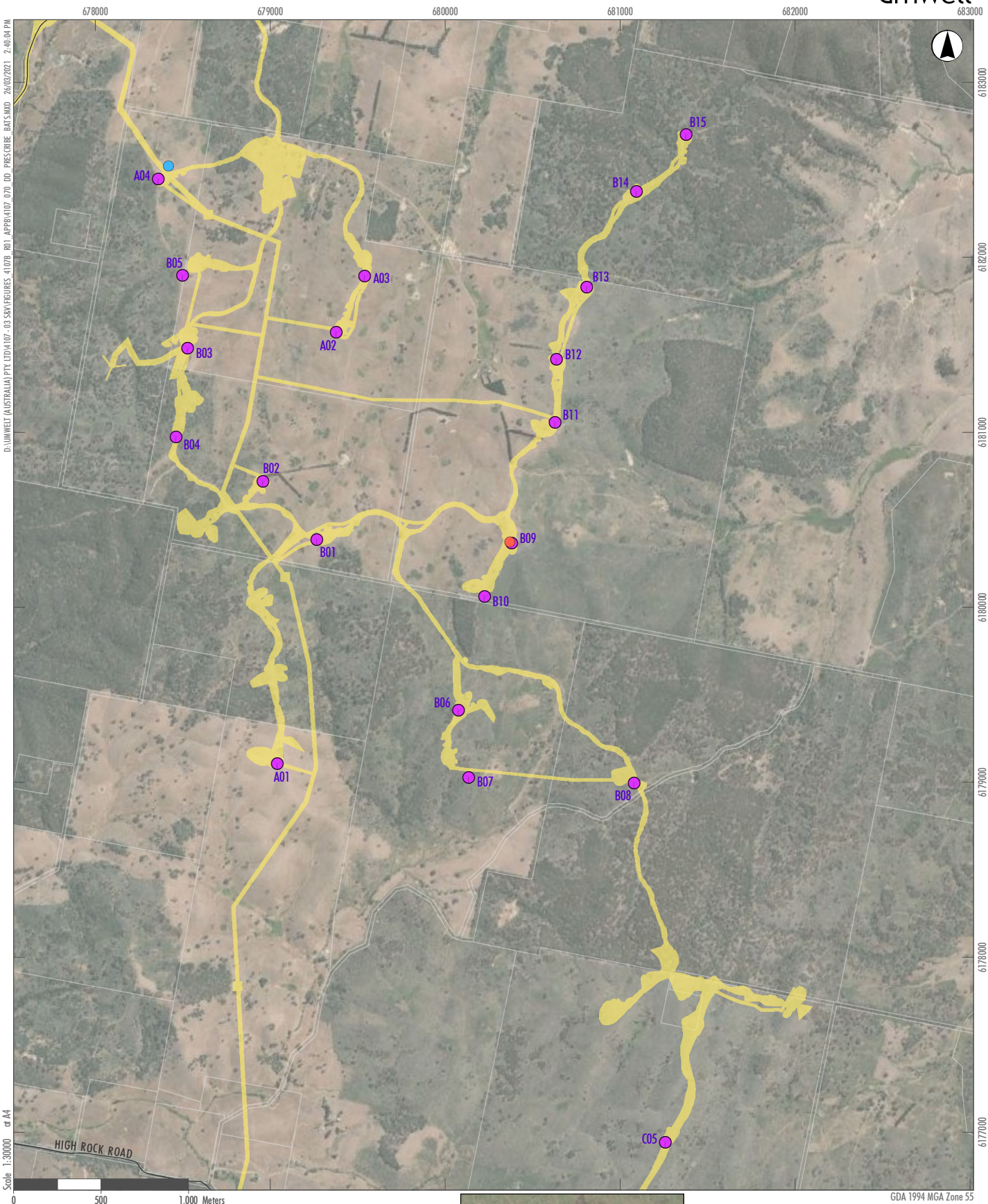


FIGURE 5.3.1

Location of the Threatened Bat Species in the Project Area (2018 / 19 Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses

Threatened Bat Records

- Myotis macropus (Southern myotis)
- Saccolaimus flaviventris (Yellow-bellied sheathtail bat)

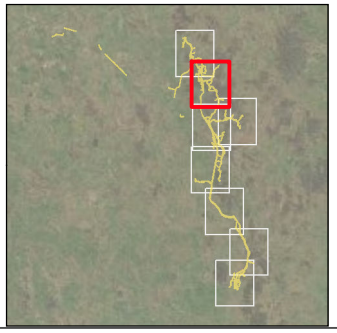
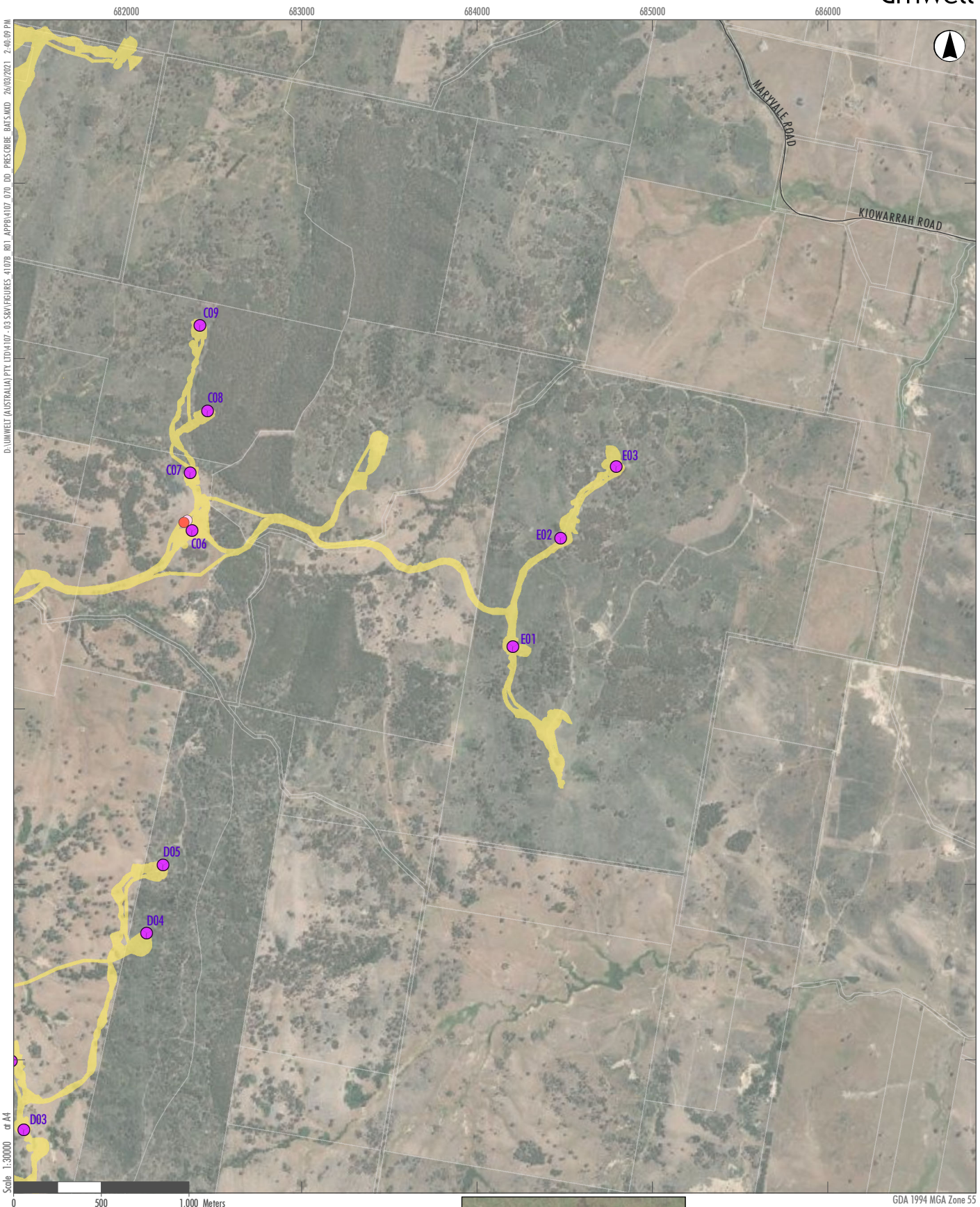


FIGURE 5.3.2

Location of the Threatened Bat Species in the Project Area (2018 / 19 Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses

Threatened Bat Records

- Falsistrellus tasmaniensis (Eastern false pipistelle)
- Saccolaimus flaviventris (Yellow-bellied sheathtail bat)

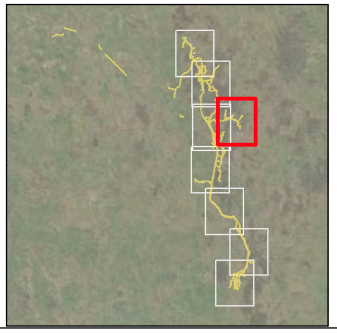
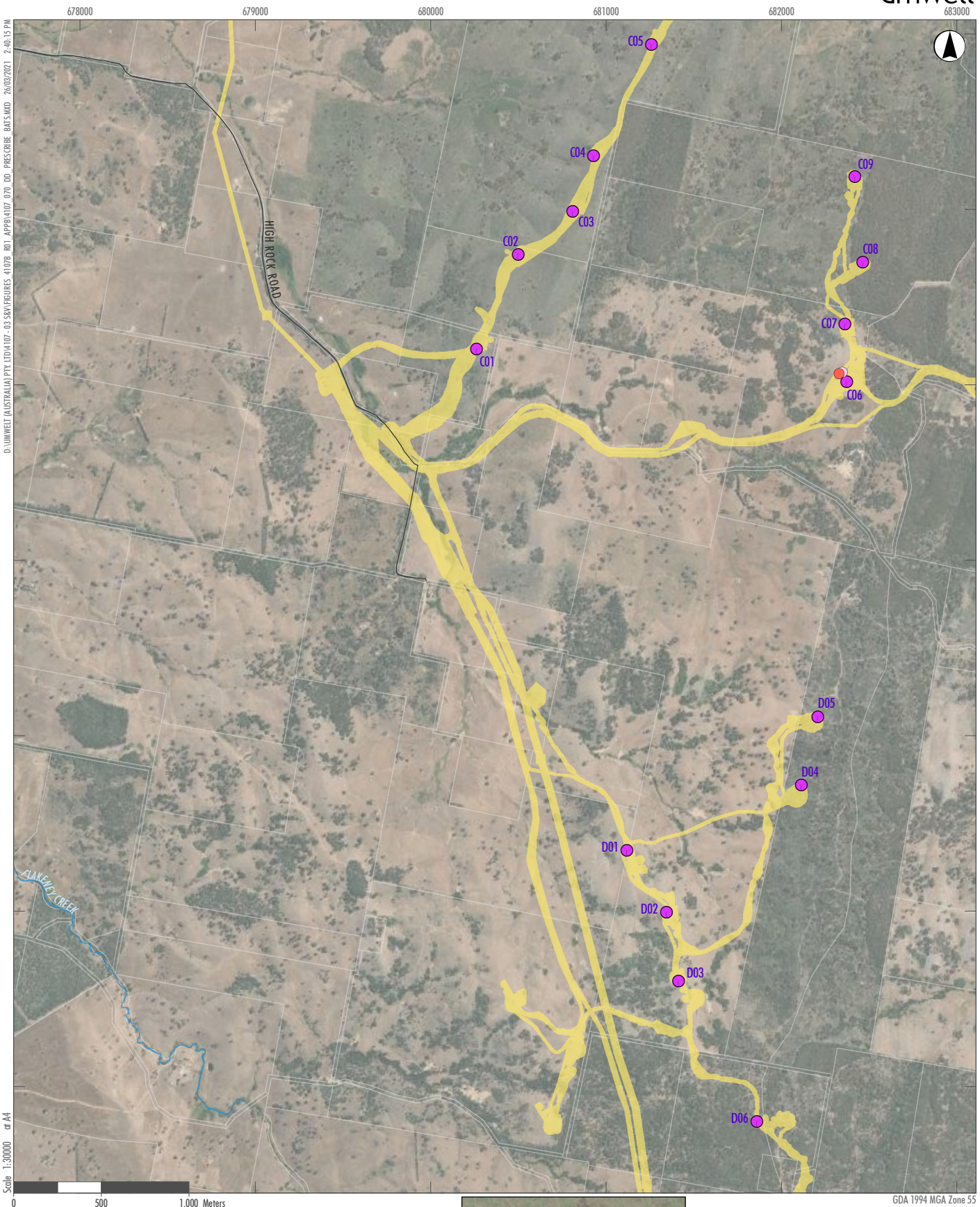


FIGURE 5.3.3

Location of the Threatened Bat Species in the Project Area (2018 / 19 Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses

Threatened Bat Records

- Falsistrellus tasmaniensis (Eastern false pipistelle)
- Saccolaimus flaviventris (Yellow-bellied sheathtail bat)

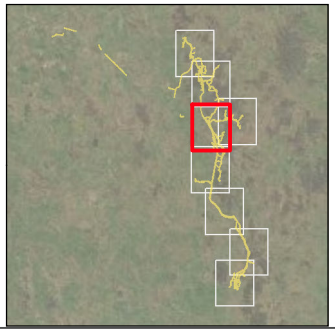
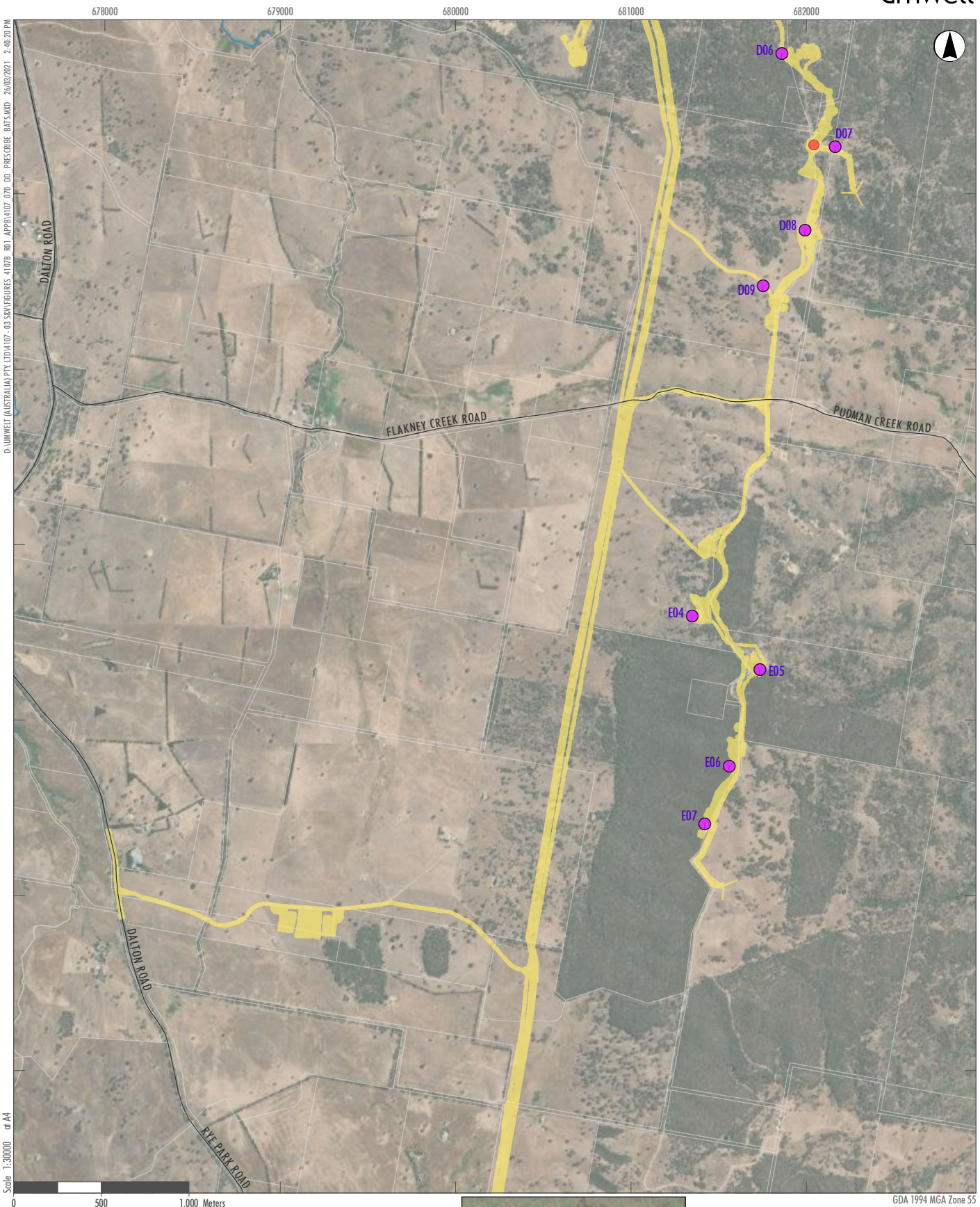


FIGURE 5.3.4

Location of the Threatened Bat Species in the Project Area (2018 / 19 Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses

Threatened Bat Records

- Saccolaimus flaviventris (Yellow-bellied sheathtail bat)

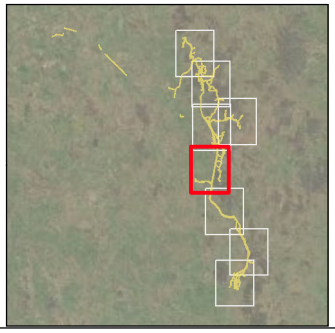


FIGURE 5.3.5

Location of the Threatened Bat Species in the Project Area (2018 / 19 Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)

FIGURE 5.3.6

Location of the Threatened Bat Species in the Project Area (2018 / 19 Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)

Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses

Threatened Bat Records

- Saccolaimus flaviventris (Yellow-bellied sheathtail bat)

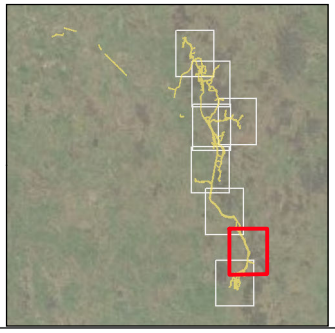
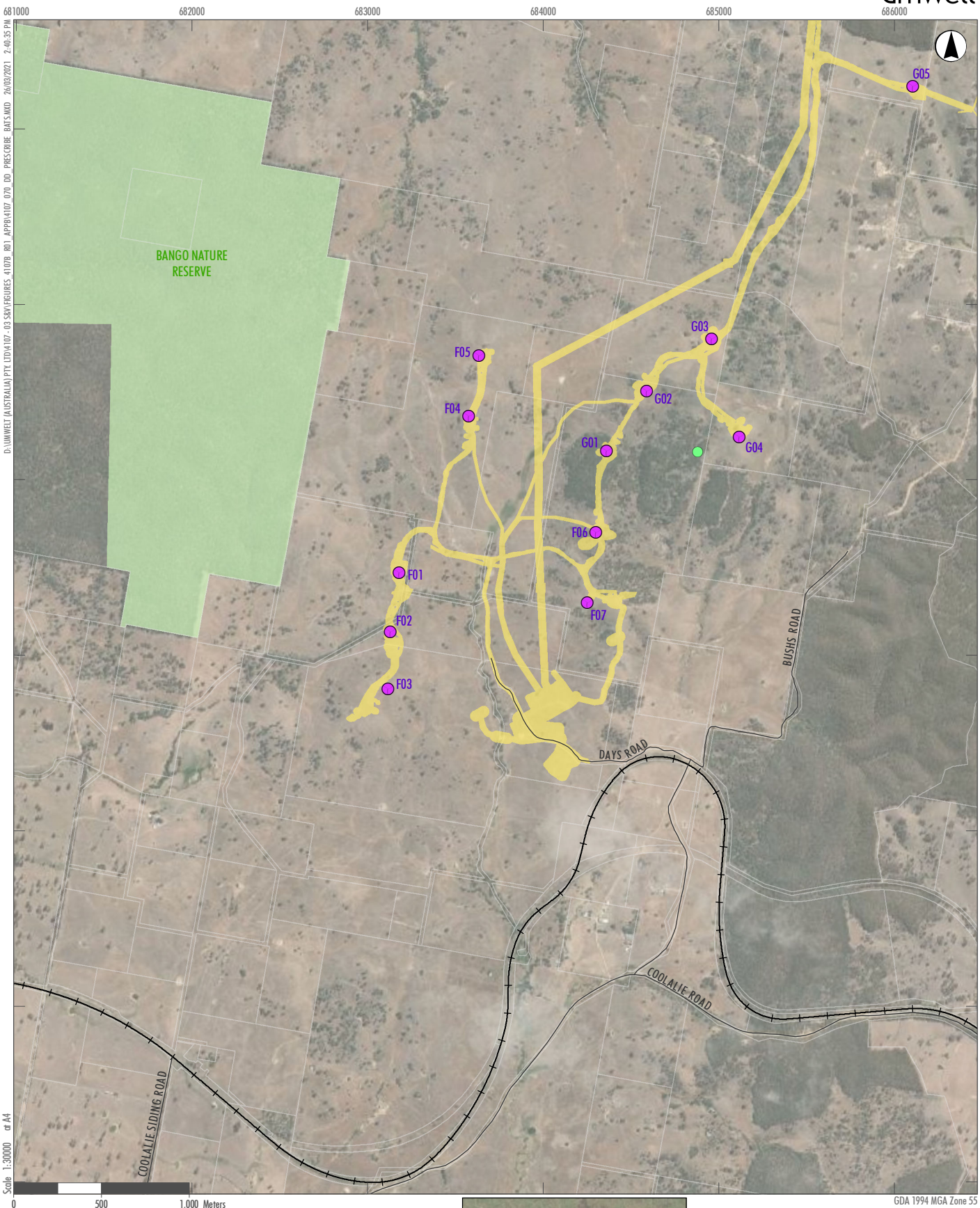


FIGURE 5.3.7

Location of the Threatened Bat Species in the Project Area (2018 / 19 Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- March 2021 Indicative Development Footprint
- Turbine Locations
- Property Boundaries
- Watercourses
- Railways
- NPWS Estate

Threatened Bat Records

- Miniopterus orianae oceanensis (Large bent-winged bat)

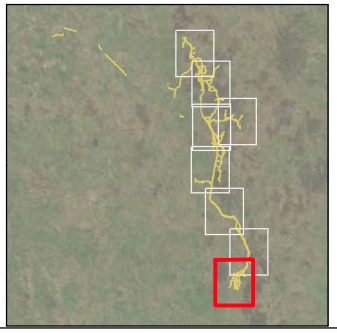


FIGURE 5.3.8

Location of the Threatened Bat Species in the Project Area (2018 / 19 Utilisation Surveys)

Image Source: ESRI Basemap (2020) Data source: NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)

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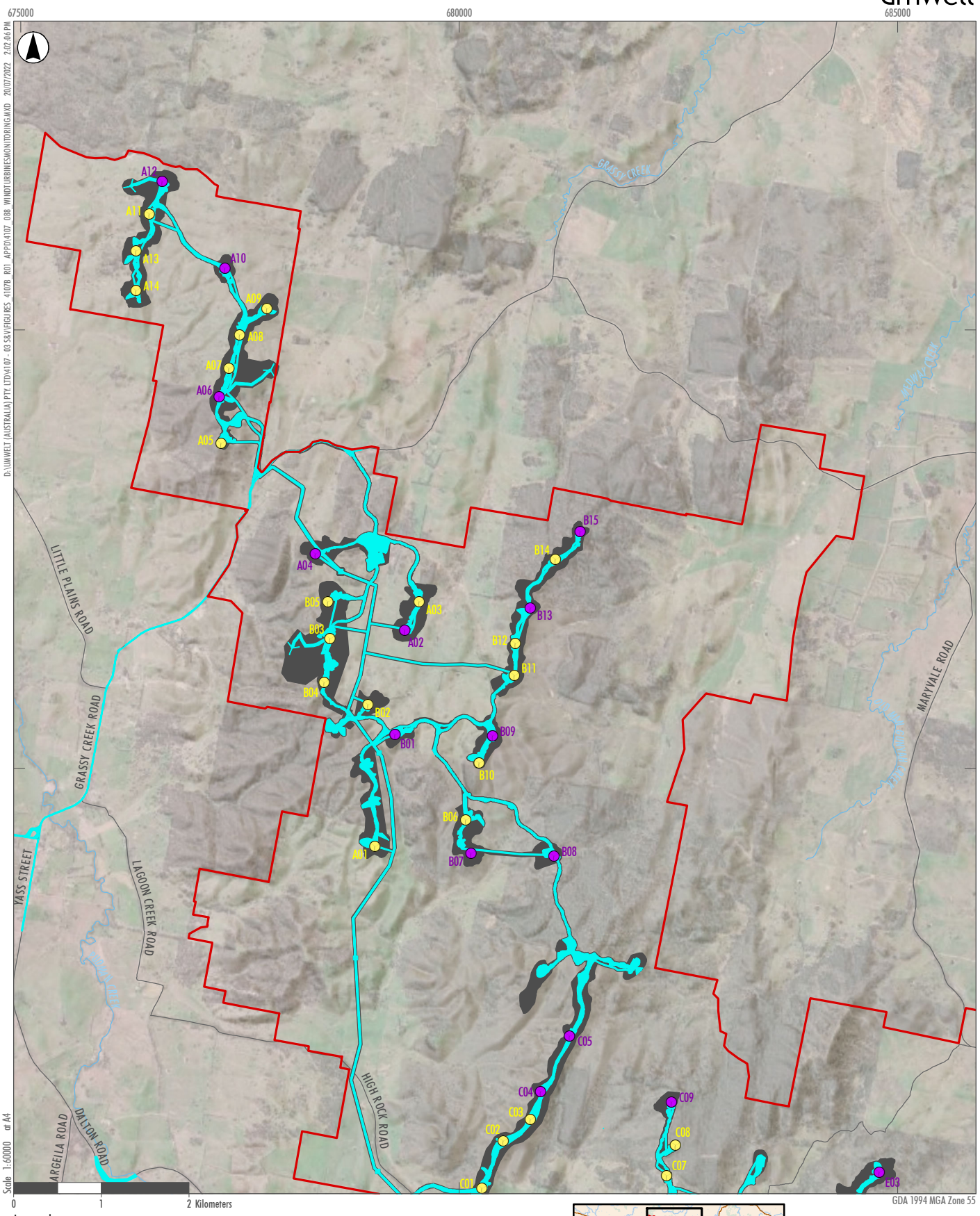
Appendix C: Selected Wind Turbines for Monitoring

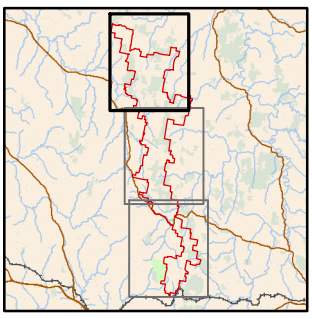
Turbine Number			Potential Site-specific Carcass Search Constraints for Human Observers
A12			-
A06			PCT 351 Dry Forest present in search area
B15			PCT 351 Dry Forest present in search area
A04			PCT 351 Sifton Bush Shrubland possibly present in search area
A02			-
B09			PCT 351 Sifton Bush Shrubland present in search area
B07			PCT 351 Dry Forest and Sifton Bush Shrubland present in search area
B08			PCT 351 Dry Forest and Sifton Bush Shrubland present in search area
C05			PCT 351 Sifton Bush Shrubland present in search area
C09			PCT 351 Dry Forest and Sifton Bush Shrubland present in search area
C04			PCT 351 Dry Forest and Sifton Bush Shrubland present in search area
E03			PCT 351 Dry Forest and Sifton Bush Shrubland present in search area
C06			-
D05			PCT 351 Dry Forest and possibly Sifton Bush Shrubland present in search area
D02			-
D07			PCT 351 Dry Forest present in search area
E04			PCT 351 Dry Forest present in search area
E06			PCT 351 Dry Forest present in search area
F05			-
G03			PCT 351 Sifton Bush Shrubland possibly present in search area
F04			-
G04			-
G01			PCT 351 Dry Forest present in search area
F01			Small patch of PCT 351 Dry Forest present in search area
F02			-
F03			-
B01			PCT 351 Dry Forest and Sifton Bush Shrubland present in search area
B13			PCT 351 Sifton Bush Shrubland present in search area
G02			PCT 351 Acacia Shrubland possibly present in search area
G05			-
E01			PCT 351 Dry Forest and Sifton Bush Shrubland present in search area
D06			PCT 351 Dry Forest present in search area
A10			-

Appendix D: Map of Selected Wind Turbines for Monitoring



Legend

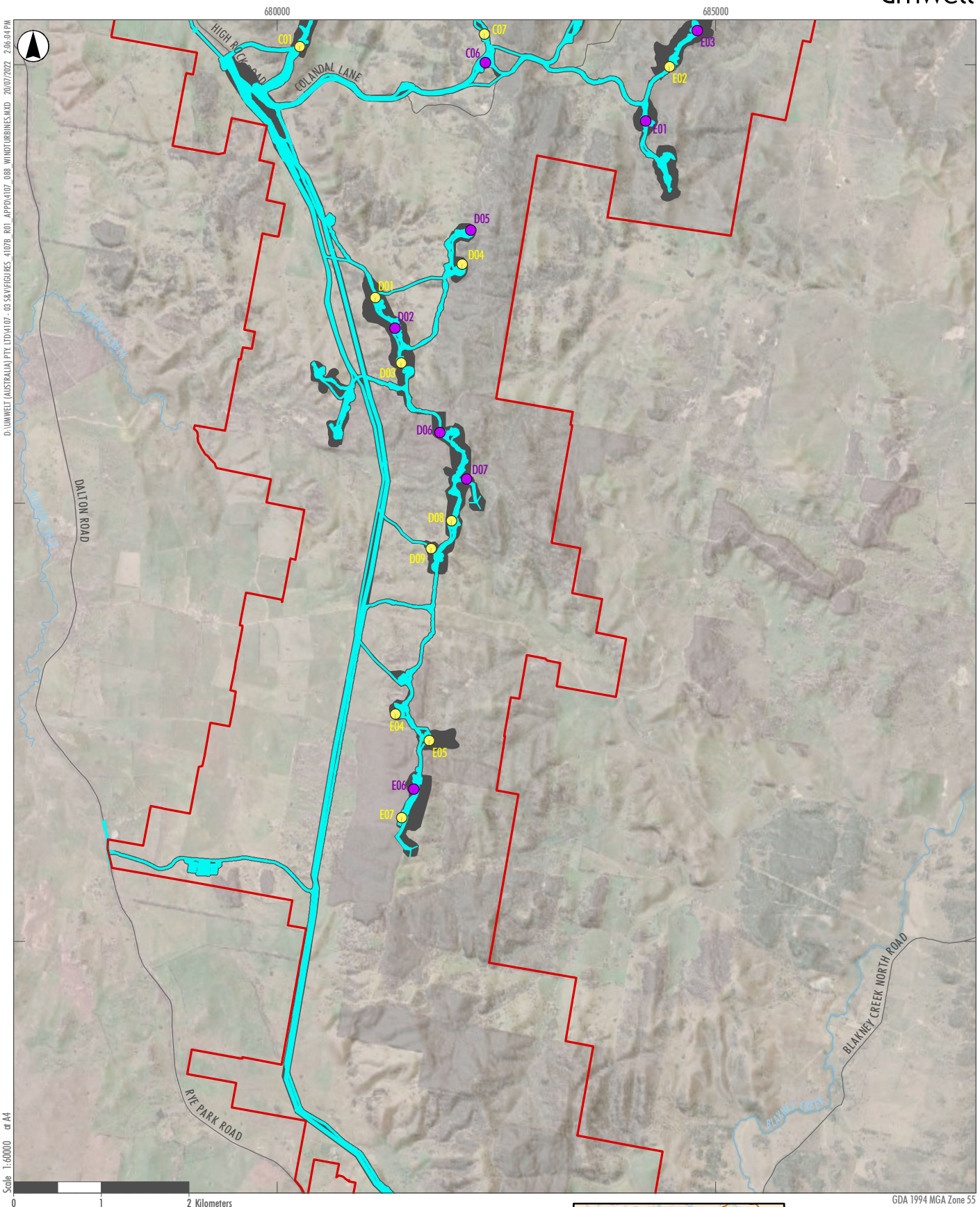
- Rye Park Wind Farm Project Area
- March 2021 Indicative Development Footprint
- March 2021 Development Corridor
- Raod
- Watercourses
- No carcass searches to be undertaken at turbines
- Carcass searches at turbines to be undertaken



APPENDIX D.1.1

Map of Selected Wind Turbines for Monitoring

Image Source: ESRI Basemap (2020) Data source: Geoscience Australia; NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)

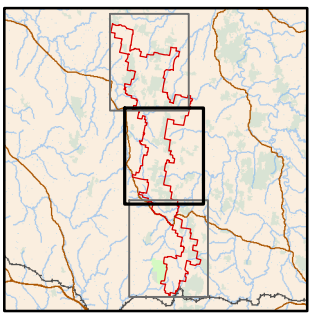


D:\UMWELT (AUSTRALIA) PTY LTD\4107 - 03 S&V\FIGURES_4107B_R01_APPD\4107_088_WINDTURBINES.MXD 20/07/2022 2:06:04 PM

Scale 1:60000 at A4

Legend

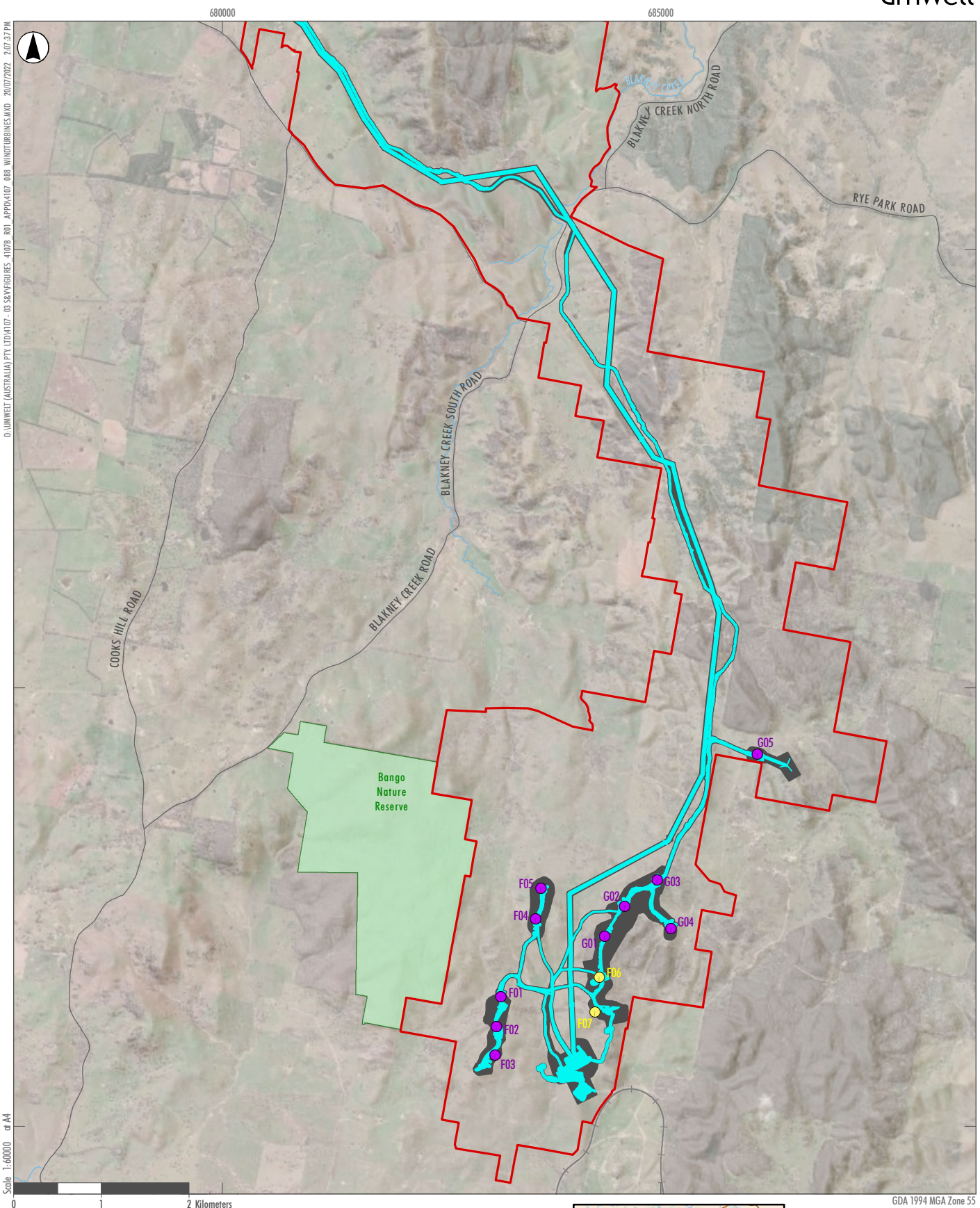
- Rye Park Wind Farm Project Area
- March 2021 Indicative Development Footprint
- March 2021 Development Corridor
- Raod
- Watercourses
- No carcass searches to be undertaken at turbines
- Carcass searches at turbines to be undertaken



APPENDIX D.1.2

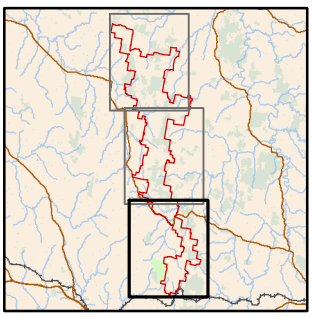
Map of Selected Wind Turbines for Monitoring

Image Source: ESRI Basemap (2020) Data source: Geoscience Australia; NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)



Legend

- Rye Park Wind Farm Project Area
- March 2021 Indicative Development Footprint
- March 2021 Development Corridor
- Nature Reserve
- Raod
- Railway
- Watercourses
- No carcass searches to be undertaken at turbines
- Carcass searches at turbines to be undertaken



APPENDIX D.1.3

Map of Selected Wind Turbines for Monitoring

Image Source: ESRI Basemap (2020) Data source: Geoscience Australia; NSW LPI (2020); Rye Park Renewable Energy Pty Ltd (2020)

Appendix E: Carcass Search Survey Data Sheet

APPENDIX E Carcass Search Survey Data Sheet

SURVEY DETAILS

Date:	Observers/Personnel (Company):
Start time: / Finish time:	
Turbine ID:	

Survey Methodology

Dog ID

Human observers

Incidental (Any bird or bat turbine mortality observed outside a routine survey)

Ground visibility: High ☐ Moderate ☐ Poor ☐

Was entire search area covered? Yes ☐ No ☐

NOTE: If not, estimate area covered as a percentage of total search area: _____%

Survey limitations (eg. long grass, any areas that were inaccessible / not surveyed and why):

Weather details

Temperature:

Precipitation: Fine ☐ Showers ☐ Rain ☐

Wind strength: Calm ☐ Breeze ☐ Moderate ☐ Strong ☐

Wind direction: | Cloud cover (%):

Turbine bird and bat mortality record

Dead/injured bird or bat record?	If yes, record total number:	Bird and Bat carcass / injury datasheet complete?	Photographs taken?
Yes ☐ No ☐		Yes ☐ No ☐	Yes ☐ No ☐

Additional notes

Appendix F: Dead or Injured Bird / Bat Data Sheet

APPENDIX F Dead or Injured Bird/Bat Data Sheet

DATE AND LOCATION

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Date:	Observers/Personnel (Company):
Time animal was found:	
Turbine ID:	

Easting-Northing of carcass

E: ..... N: .....

Detection

Survey Method:
NOTE: Turbine survey datasheet must also be completed.

Dog search ☐ Human search intensity ☐ Incidental ☐

Distance of carcass / injured animal from observer when first detected: ..... (m)	Behavioural change in dog (if applicable): ....

Approximate distance and orientation of carcass / injured animal to wind turbine: ..... (m) ..... (x°)

Describe ground visibility within a 1m radius of where carcass / injured animal was found: ....

Carcass / injured animal photographed? Yes ☐ No ☐	**Photo and camera details** Camera number: ..... Photo numbers: ..... File location: .....

Weather details at time of detection (please circle):

Temperature:

Precipitation: Fine ☐ Showers ☐ Rain ☐

Wind strength: Calm ☐ Breeze ☐ Moderate ☐ Strong ☐

Wind direction:	Cloud cover (%):

Carcass / injured animal information and condition:

Species (if unknown, closest taxonomic group, eg. raptor, bat):

Age:	Unknown ☐	Adult ☐	Juvenile ☐
Sex:	Unknown ☐	Male ☐	Female ☐
Condition:	Dead (carcass) ☐	Injured but alive ☐	Feather spot (> 10 feathers) ☐
Degree of decay:	Fresh ☐	More than 1 week ☐	Very old/highly decayed ☐

Describe conditions and type of any injuries evident:	Describe evidence of scavenging if any: ....

Appendix G: Carcass Persistence Trial Data Sheet

-

APPENDIX G Carcass Persistence Trial Data Sheet

SURVEY AND TURBINE DETAILS

Date:	Observers/Personnel (Company):
Time:	
Turbine ID:	

Ground visibility: High ☐ Moderate ☐ Poor ☐

Description of ground visibility (eg. grass height, rock cover): .....

Carcass deployment record:

Carcass type	Unique carcass identifier:	Direction from turbine base	Distance from turbine base:	Easting / Northing:	Notes:
				E: N:	
				E: N:	
				E: N:	
				E: N:	
				E: N:	
				E: N:	
				E: N:	
				E: N:	
				E: N:	
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Additional notes

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Appendix H: Rye Park Wind Farm BBAMP statistical review

symbolix

making your data work harder

To: Bill Wallach
Umwelt (Australia) Pty Limited
Via email

Ref #: UMWRYEP20230418
Date: 18 April 2023
CC:

Re: Rye Park Wind Farm BBAMP statistical review

Dear Bill,

Thank you for requesting our review of the proposed carcass detection and mortality estimation methods for Rye Park Windfarm, NSW. We understand that Umwelt Pty Limited (Umwelt) have prepared a Bird and Bat Adaptive Management Plan (BBAMP) to fulfill the requirements of the Development Consent (Schedule 3 Condition 23) and the EPBC Approval (Conditions 8 – 11).

This letter outlines the scope of the review and our appraisal of the study methods.

Scope of works

Symbolix were engaged by Umwelt to carry out the following tasks:

- Review the proposed mortality study design within the draft BBAMP[1] (Rye Park Renewable Energy Pty Ltd 2023). Our review primarily focuses on Section 5, which includes the relevant subsections:
  - 5.4 Carcass Search Program
  - 5.5 Carcass Persistence Trial
  - 5.6 Carcass Detectability Trial
  - 5.7 Transmission Line Carcass Search
  - 5.8 Incidental Bird and Bat Carcass Find Protocol
  - 5.9 Mortality Estimation
  - 5.10 Survey Schedule
- Prepare a letter advising on the efficacy of the proposed design, referencing statistical adequacy

[1] 20230320 - RPWF - BBAMP - Rev 7 (Agency Comment on Final Draft)_Symbolix.docx

About the reviewers

Symbolix is an Australian business specialising in data science and statistical analysis services. We have provided these services to the Australian Wind Energy Industry since 2004. We have provided statistical methods, models and advice throughout all stages of the wind farm lifecycle; from pre-approvals, BBAMP plan design and operational monitoring.

Our wind farm research work has been published in the Australasian Journal of Environmental Management, Austral Ecology, New Zealand Journal of Zoology, and Wildlife Society Bulletin. Our research has also been presented at industry and research conferences in Australia, New Zealand and Europe.

Our principle reviewer for this work is Dr Julia Ryeland, with guidance from Dr Elizabeth Stark.

Elizabeth is a co-founder of Symbolix. She has over a decade's experience supporting environmental practice through data and analytics. She is a current Board member of the Environment Institute of Australia & NZ (the professional body for environmental professionals) and a member of the American Ecological Association. Elizabeth has delivered a number of projects for environmental management and has previously lead a project for DEECA (Vic) to deliver a state-wide analysis of wind farm post-construction data from multiple sites in Victoria.

Julia has a PhD in avian ecology, and has worked in bird and bat management throughout her career. She is experienced in environmental analysis and consulting at wind farms, being a primary analyst on a number of collision risk, bird utilisation, and population viability analyses across Tasmania and Victoria.

Appraisal of the mortality study program

What determines a statistically valid monitoring program

A good statistical sampling design must balance four broad considerations (Kish 1995):

- **Goal orientation:** The design must reflect the goal; e.g. to determine the mortality rate across the whole site we should sample randomly from the whole site (rather than bias to certain areas).
- **Measurability:** The design must support statistical inference/estimation, including the ability to determine measures of statistical variability (e.g. standard errors). In this project, we want to ensure the design will support the application of a Horvitz-Thompson style estimator (analytical or algorithmic) for mortality estimation.
- **Practicality:** The design must be practical. For example, assuring 95%+ detection probability is not practical within the bounds of OH&S requirements using dogs or humans (e.g. see Moloney and Smales (2019) for modelling of detection probabilities). However, collecting robust data to enable a Horvitz-Thompson style estimate of mortality

(see next section) is practical and feasible.

- **Economy:** This is economy in the broad sense of not over-sampling beyond the point required by our objectives. For instance, we will obtain a more precise estimate of the time to scavenger loss with 200 carcass trials then 20, but there is a point of diminishing returns where the extra information gathered is not justified by the effort (when such effort could potentially be used on actual conservation outcomes).

What are the goals for the Mortality Study?

From the state and federal conditions of approval, the BBAMP is required to identify 'at-risk' species of bird and bat, implement mitigation measures and a monitoring program (including management triggers).

The approval holder must "provide evidence that the proposed methods, frequency, and timing of monitoring will provide statistically reliable detection or reliable estimates of all collisions" with 'at risk' species including State and EPBC Act listed bird and bat species.

The monitoring program must ensure statistical reliability by, at a minimum, specifying the following (included in BBAMP Section 1.2 - Table 1 and 2):

- measurable performance indicators.
- triggers for corrective actions.
- the timing and frequency to detect triggers and changes in performance indicators.
- mortality monitoring, including carcass searches, carcass persistence trials and scavenger trials methodologies.

This letter will assess the design based on **current understanding of best practice for estimating mortality from carcass search programs.** For clarity, we outline that approach first.

Standard approach to estimation

To assess measurability, we need to establish the metric the data will feed. Mortalities at turbine i during search j $\hat{M}_{ij}$ are estimated by (Huso, Dalthorp, and Korner-Nievergelt (2015) and references therein)

$$\hat{M}_{ij} \cong \frac{C_{ij}}{\hat{g}_{ij}} \tag{1}$$

where

- C_{ij} is the number of carcasses found
- $\hat{g}_{ij}$ is the estimate of the detection probability for that search and turbine

For a given turbine, $\hat{g}_{ij}$ is a function of

$$\hat{g}_{ij} \cong a_i p_{ij} r_{ij} \tag{2}$$

- a_i is the fraction of total carcasses within the searched area
- p_{ij} is the probability that an existing carcass will be detected by the searcher
- r_{ij} is the fraction of the carcasses that arrived at turbine i but have not been lost to scavenge or decay before search j. This is a function of the rate of decay and the search interval, relative to the expected time to scavenge (Huso 2011)

We directly take $\mathbf{C}$ from the field observation data, and estimate $\hat{\mathbf{a}}$, $\hat{\mathbf{r}}$ and $\hat{\mathbf{p}}$ from a specific field survey design. It's important to highlight that this approach does not require that all or even most carcasses are found. We allow for loss of carcasses through scavenging and for some carcasses not being detected during surveys through $\hat{\mathbf{p}}$ and $\hat{\mathbf{r}}$. Therefore this approach depends upon scavenger efficiency trials and searcher efficiency trials being performed in accordance with best practices, as outlined below, to obtain good estimates of scavenge rate and detectability. Additionally, appropriate survey design is important so that we can be confident that the carcasses found are a representative sample of the population of all carcasses.

These components estimate $\hat{M}$ (and confidence bounds) for the site and time period.

Now that we have outlined the framework, we assess the suitability of each component of the proposed design against that framework.

Coverage factor

To estimate mortality, we require a ratio of the area searched to the (modelled) density of carcass - i.e. the 'coverage factor'. The density of carcasses as a function of distance will be estimated from methods in Hull and Muir (2010).

Searcher efficiency

The searcher efficiency (proportion of carcasses found) will be reported as a mean and variance measure (standard error and/or 95% confidence interval), potentially grouped by relevant covariates.

We model searcher efficiency using logistic regression. Logistic regression allows binary data (i.e. success = carcass found, failure = carcass missed) to be modelled, accounting for covariates such as carcass size and time of year.

A brief summary of the Generalised Linear Model (GLM) regression techniques are presented here, but we suggest referring to Agresti (2002) or a similar text for more detail. We refer to the probability of success in a trial i as $\pi(x_i)$ where x_i is a vector of covariates. We model the relationship between the probability of success and the log odds using the logistic model:

$$\text{logit}[\pi(x_i)] = \beta x_i \tag{3}$$

where

- logit$[\cdot]$ denotes the log-odds function $\text{logit}(p) = \ln \frac{p}{1-p}$
- β is a vector of regression coefficients.

As $\pi(x_i)$ is free to vary with each trial, this allows the mean to be modelled in a flexible manner depending on carcass size and so on. The logistic function is used because it allows probabilities (which are necessarily bounded between 0 and 1) to be modelled by a linear combination of predictor variables, without getting nonsensical outcomes like probabilities greater than 1.

The estimates of regression coefficients $\hat{\beta}$, are obtained via maximum likelihood estimates, which is the standard method of estimation in GLMs. Both estimates of the mean, and standard errors of those estimates, are obtained by this technique. This allows significance testing of covariates and reporting of confidence intervals.

Scavenger efficiency

The time to scavenge will be reported as a mean and variance measure (standard error and/or 95% confidence interval), potentially grouped by relevant covariates.

Time to scavenge will be estimated using survival analysis - we use the methods of Therneau and Grambsch (2000). Survival analysis is the standard statistical technique dealing with time-to-event data (in this case, "survival" can be interpreted as how long a carcass "survives" in field before taken by a scavenger or decay). It models the probability that a carcass will persist after a certain period of time.

A few key reasons why survival analysis is used over other techniques like simply taking the average are:

- It can account for censored data, generally one of:
  - when the exact time of scavenge is known within an interval, but not exactly; or
  - the carcass persists at the end of the trial.
- It can account for covariates, e.g. carcass size or ground type.
- It allows choosing different hazard rates, which are functions describing how risk changes with time.

There is sizable evidence (Stark and Muir 2020) that the log-normal hazards is the best description of carcass persistence, in an Australian context.

Survival regression is based around GLM modelling, so also uses maximum likelihood estimation. Standard errors and confidence intervals can be obtained for the mean times to scavenge.

What is the proposed design?

Coverage and search effort

The proposed carcass search survey design includes:

- 2 years of survey, commencing 3 months after commencement of wind farm operations (reviewed after 2 years and extended if deemed necessary).
- Searches carried out at 33 turbines (50% of all turbines).
- Carcass searches carried out once monthly.
- A search area with a radius of 120 m around each turbine, comprising of an inner (60 m radius) and outer (120 m radius) area.
- The order of turbines searched will be randomised between surveys.
- Additional carcasses searches in the Superb Parrot (*Polytelis swainsonii*) breeding season at the six turbines identified to be in the highest risk areas.
- If the monthly survey in September to April identifies any carcass or feather spot of Superb Parrot, White-throated Needletail (*Hirundapus caudacutus*) and/or Large Bent-winged Bat

(*Miniopterus orianae oceanensis*), a second survey of radius 100 m in will be undertaken that month

Detection dogs will be preferentially used (if available and practicable), which will traverse along paths 20-30m apart. Alternatively, humans observers will be used whom will traverse transects in the search area at 6m apart in the inner search area and 12m in the outer search area.

For each carcass found, a photo, GPS location and the specimen will be collected.

If more than five White-throated Needletail individuals are recorded at a single location (i.e. within a 40 m radius) within 500 m of a section of overhead transmission line during any of the February bird utilisation surveys, an additional carcass search along adjacent transmission line is proposed. This will involve a 200 m walked meandering transect directly beneath the overhead wires of the transmission line constructed for the Project. It should be noted that these transmission line searches cannot be included in the mortality estimation.

Searcher efficiency

Each proposed 'carcass detectability trial' (or searcher efficiency trials) design includes:

- Surrogate carcasses laid within 60 m of turbine bases.
- Carcasses deployed at 20 randomly selected turbines.
- A total of 10 bird carcasses (comprising five small-medium sized carcasses and five large carcasses) and 10 bat carcasses to be deployed.
- Carcasses 'tossed onto the ground' within the inner search area by a person not involved in searches for carcasses.
- The searcher not being aware of the number or location of carcasses deployed

Two trials will be conducted during the Year 1 - one in Spring and the other in Autumn. They will be concurrent with the carcass persistence trials.

Scavenger efficiency

Each proposed 'carcass persistence trial' (or scavenger efficiency trials) design includes:

- Surrogate carcasses laid within 60 m of turbine bases.
- Carcasses deployed at 20 randomly selected turbines.
- A total of 10 bird carcasses (comprising five small-medium sized carcasses and five large carcasses) and 10 bat carcasses to be deployed.
- Scavenging identified through the deployment of remote sensing cameras at each carcass, programmed to taken three images upon detection of movement. These will be deployed for 30-days (checked manually at day 15 and 30). It is proposed that carcasses will be replaced if removed in less than a fortnight.

Four trials will be carried out, twice per year (in year 1 and 2), once in Spring and once in

Autumn each year.

Appraisal of the design

Sampling stratification

All three component surveys are based on a single geographical site stratum.

As outlined in the BBAMP the Development is located in a 'highly fragmented landscape' characterised by a mixture of remnant open dry forest, box-gum woodland and cleared agricultural land. However, following vegetation clearance for the development of the hardstand, roads and other infrastructure, the carcass search areas (120 m around 33 turbines) will comprise of two broad vegetation types: shrubland and dry forest. The BBAMP states that "searcher efficacy or carcass detectability (particularly if humans are used to search for carcasses rather than dogs) may be variable across the search area". If these vegetation types have differing visibility (influencing detectability) or species composition (potentially influencing scavenging rates), the ***searcher efficiency*** and ***scavenger efficiency*** trial survey design should be stratified by these vegetation types.

Currently, the 20 turbines to be included in the scavenger and search efficiency trials are randomly selected from across the site. We would advice ensuring that this includes a proportional representation of the habitat types. For example, if 60% of the 66 turbines are situated in shrubland and 40% in dry forest, 60% of turbines included in the efficiency trials should be randomly selected from all turbines situated in shrubland (and the rest randomly selected from turbines situated in dry forest). This would equate to 12 turbines in shrubland randomly selected for efficiency trials.

During the carcass search surveys, selected turbines should be maintained within the pool, and consistently revisited. This helps to reduce variance in any estimates.

Selection of turbines for carcass searches does not require stratification from a statistical standpoint. However, it will not create undesired bias if these are also stratified and sampled proportional to the number of turbines in each stratum.

Statistical suitability

Carcass searches

Search fraction

The proposed carcass surveys will sample 50% of turbines (minimum). There is no strict statistical rule for the right number of turbines sampled (except there must be more than two per stratum to capture statistical variation). It is more important to ensure the turbines are

selected at random within each stratum (as discussed above). This is the only way to enable an un-biased estimate of mortality.

We also recommend the same turbines are searched at roughly the same time each month. Having a consistent minimum time between searches minimises the variability in estimating the chance a carcass has been lost to scavengers since the last survey.

The survey (as proposed in the BBAMP) complies with these suggestions.

To calculate the fall zone coverage for analysis, a spatial file of all 'unsearchable areas' will need to be provided.

Search method

To reduce variability in carcass detectability, it is ideal to use a single survey method which is typically using detection dogs for carcasses searches. We understand that trained dogs may not always be available during the survey period, or may be unable to be used due to climatic and terrain conditions. The BBAMP indicates that the terrain across the search areas is suitable for humans and dogs and that the climate is typically suitable for using dogs. As such, dogs should be used under most circumstances, given the known improvement in detection when using dogs.

If the survey does included the use of both human observers and detection dogs, the searcher efficiency trials will need to be modified. We have outline these modifications below ('Searcher efficiency trials').

Although it it is not always possible, as much as practicable, the time spent searching for carcasses at each turbine should be consistent by the human observer or dog handler maintaining a consistent walking pace. This should also be done for the searcher efficiency trials. Ensuring each area has a relatively even search effort helps reduce the variability in detection across areas.

Survey timing and duration

The BBAMP specifies monthly carcass searches. This will provide an unbiased estimate of mortality if the data is analysed and sufficient to provide overall estimates of all birds and all bats. While we can do individual species level estimates, there is naturally more variance when doing estimation based upon low counts. Therefore we recommend that impact triggers do not require statistical estimation, but are based on finding the carcass of a species of concern (which we note is what the BBAMP states).

Regarding the adequacy of a two-year survey period (or if longer is needed), there is little published data discussing trends in post construction monitoring, but Symbolix have provided analysis of around a dozen Australian post-construction monitoring programs. In our experience there is little gained in extending the survey program (unless this is part of an agreed action following the results of the initial years). The first two years are usually sufficient to understand the magnitude of the mortality onsite (generally speaking).

The additional breeding season surveys for Superb Parrot at the highest risk turbines, will make the survey effort non-random survey effort across turbines and potentially non-representative across the site as a whole. As such, additional surveys may need to be analysed separately from the main mortality estimation (e.g. a stratified analysis).

Searcher efficiency trials

The number of replicates (2 trials, each with 20 carcasses - 10 birds and 10 bats) proposed is statistically reasonable for the searcher efficiency.

Figure 1 has been calculated (Clopper (1934)) as a scenario to highlight the issues with detectability trials. The coarse black line shows us the estimated efficiency, given a field trial of known sample size, and some number of detections. The 95% confidence window is shown by the grey shaded area. The jaggedness of all curves is a known effect, due to the nature of a dichotomous variable (i.e. "I found it/I did not find it").

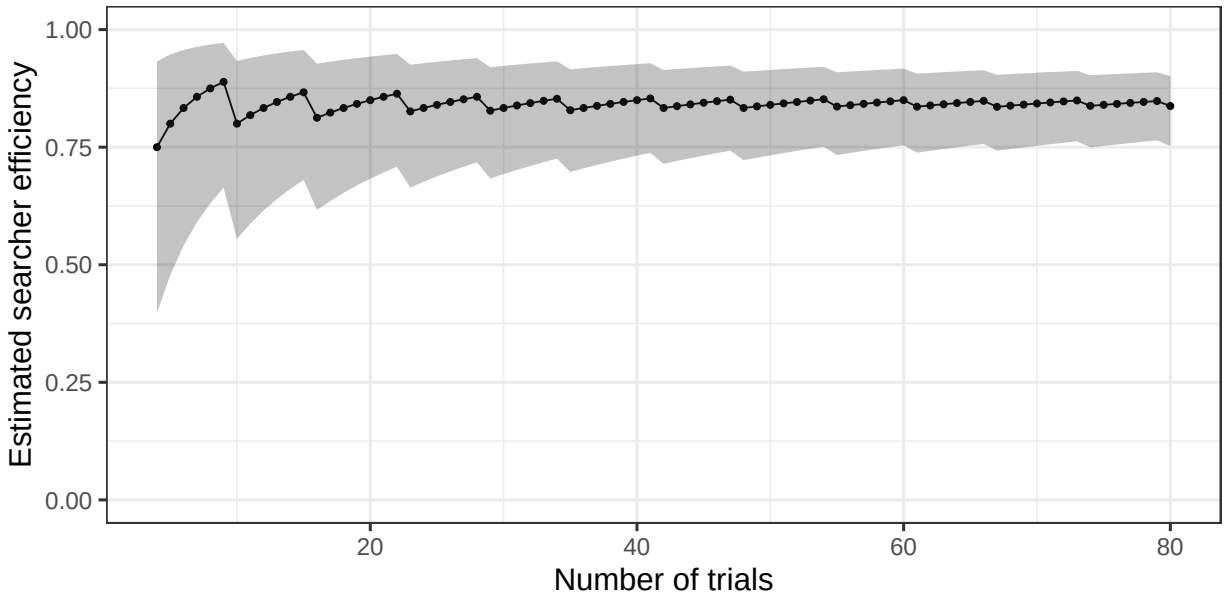

Figure 1: Estimated searcher efficiency (proportion of carcasses found) with 95% confidence bound for a given number of trials. Assumes the overall efficiency of 84.3%, which is a result from Stark and Muir (2020).

There is little precision gain for adding more than 15-20 replicates for a given species class. Although the mechanism for generating time to scavenge is different to searcher efficiency, a similar result holds in that case also. In this case, we will have 20 bird and 20 bat carcasses trialed by the end of the first year, which is sufficient effort.

However, the searcher efficiency (proportion of carcasses found) needs to be determined for each search method used. If both human observers and trained dogs are used for the carcass detection, searcher efficiency trials will need to be repeated with the human observed and the trained dog. If human observers are used, carcasses should be deployed in both the inner and

outer search area, as detection may differ in these areas with the variable transect spacing.

Scavenger efficiency trials

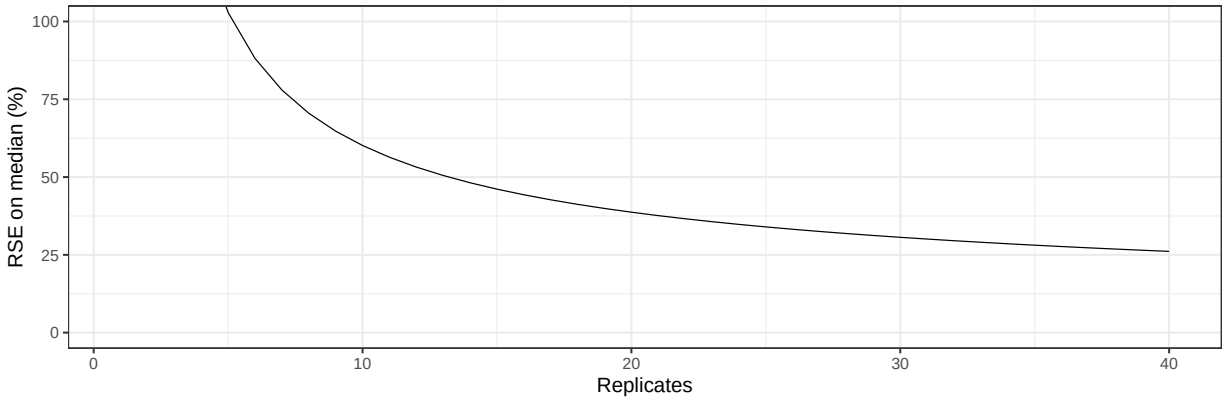

Figure 2: Relative standard error (RSE) on the median scavenge time, versus number of trials.

Although scavenger efficiency will be analysed using standard survival study methods to account for the uncertainty in measuring time of loss (Kaplan and Meier (1958), Therneau and Grambsch (2000)), using motion-trigger remote sensing camera will improve accuracy of carcass scavenging times. As such, this is an ideal method for determining scavenger efficiency.

The number of replicates proposed (80 carcasses split into 4 trials, with 10 birds and 10 bats per trial) is statistically reasonable for the scavenger efficiency. We can see that the relative standard error on the median scavenge time, has diminishing returns from 15-20 carcasses (Figure 2).

We would not recommend using the same carcasses across seasons, as the age of the carcass may influence the probability of scavenging. It is also not necessary to replace the carcass if it is removed in less than a fortnight from deployment as the two scavenging rates at this location will then be confounded. It is suitable to use the same carcass for first the searcher efficiency trials and then the scavenger efficiency trials (within a single season) as proposed, assuming that the cameras are deployed after the searcher trials.

Mortality estimation

The proposed estimator of mortality included in Section 5.9 'Mortality Estimation' of the BBAMP aligns with the methods we recommend. We would, however, recommend that this method is explained in more detail with the equations for searcher efficiency also included. This can be taken from the wording provided in this letter.

Final remarks

The survey program represents standard statistical practice and, except for some small suggested amendments, the survey design will provided data suitable for estimating mortality at Rye Park Wind Farm. It is consistent with other sites in Queensland, NSW and Victoria, which enables future combined analysis.

Regards,

Dr Elizabeth Stark

Managing Director - Symbolix Pty Ltd;

e: estark@symbolix.com.au; m: 0412 075 235.

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