EPURON

# APPENDIX J

## Aviation Safety

BOWMANS CREEK
**WIND FARM**

environmental impact statement

February 2021

# BOWMANS CREEK WIND FARM

## AVIATION IMPACT ASSESSMENT

*Prepared for Hansen Bailey Pty Ltd*

AVIATION PROJECTS

AVIATION PROJECTS

# DOCUMENT CONTROL

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| 1.3 | Final Report – transmission line | 24 Feb 2021 | | |

# COPYRIGHT AND DISCLAIMER NOTICE

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# ACRONYMS

| | |
|---|---|
| AGL | above ground level |
| AHD | Australian Height Datum |
| AIP | Aeronautical Information Package |
| ALARP | as low as reasonably practicable |
| AMSL | above mean sea level |
| ARP | Aerodrome Reference Point |
| CAR | Civil Aviation Regulation (1988) |
| CASA | Civil Aviation Safety Authority |
| CASR | Civil Aviation Safety Regulation (1998) |
| CFIT | controlled flight into terrain |
| ERSA | En Route Supplement Australia |
| ICAO | International Civil Aviation Organization |
| IFR | instrument flight rules |
| IMC | instrument meteorological conditions |
| MOS | Manual of Standards |
| MSA | minimum sector altitude |
| OLS | obstacle limitation surface |
| PANS-OPS | Procedures for Air Navigation Services - Aircraft Operations |
| RPT | regular public transport |
| VFR | visual flight rules |
| VMC | visual meteorological conditions |

# UNITS OF MEASUREMENT

| | | |
|---|---|---|
| ft | feet | (1 ft = 0.3048 m) |
| km | kilometres | (1 km = 0.5399 nm) |
| m | metres | (1 m = 3.281 ft) |
| nm | nautical miles | (1 nm = 1.852 km) |

# EXECUTIVE SUMMARY

## INTRODUCTION

Epuron Projects Pty Ltd (Epuron) is seeking approval for the construction, operation, maintenance, and decommissioning of the Bowmans Creek Wind Farm (BCWF).

The Project is located at Bowmans Creek, approximately 10 km east of Muswellbrook and 120 km from the Port of Newcastle in New South Wales (NSW).

Epuron seeks State Significant Development (SSD) Development Consent approval under Division 4.7 of Part 4 of the Environmental Planning & Assessment Act 1979 (EPA Act) for the Project (SSD 10315). Epuron also seeks an Approval from the Commonwealth Department of Agriculture, Water and the Environment (DAWE) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The two Applications are supported by the 'Bowmans Creek Wind Farm Environmental Impact Statement' (EIS) (Hansen Bailey, 2020). This Assessment supports the EIS.

The Project extends predominantly across two Local Government Areas (LGAs), being the Muswellbrook and Singleton Council LGAs. A small number of turbines are additionally proposed in the Upper Hunter Shire LGA.

HB has engaged Aviation Projects to prepare an Aviation Impact Assessment (AIA) for the proposed Project and formally consult with aviation agencies, before submitting the EIS to accompany the Development Application for the project.

The AIA reviews potential impacts and provide aviation safety advice in respect of relevant requirements of air safety regulations and procedures and undertake consultation with relevant aviation agencies.

*Project description*

The proposed Project as relevant to this Assessment will comprise of the following:

- up to 60 wind turbines;
- maximum overall height (tip height) of the wind turbines is up to 220 m AGL;
- highest wind turbine is T46 with ground elevation of 691 m Australian Height Datum (AHD) and overall height of 911 m (2988 ft above mean sea level (AMSL)); and
- two existing temporary wind monitoring towers (WMT) with a maximum height of up to 110 m (361 ft) AGL, which have been reported to Airservices Australia. These WMTs may be relocated over the project life, as required.

## CONCLUSIONS

*Regulatory requirements*

The following regulatory requirements apply:

- There is no regulatory requirement for lighting of obstacles lower than 150 m (492 ft) AGL that are not within the vicinity of an aerodrome.

- With respect to MOS 139 Chapter 8 Division 10 8.109, the proposed wind turbines and wind monitoring towers must be reported to CASA if they are considered a hazardous obstacle.
- Wind turbines and wind monitoring towers must be marked in accordance with respect to MOS 139 Chapter 8 Division 10 8.110.
- Wind turbines must be lit in accordance with MOS 139 Chapter 9 Division 4 9.3 and 9.31, unless an aeronautical study assesses they are of no operational significance.

*Planning considerations*

There are no provisions for airfields included in the Muswellbrook Local Environmental Plan 2009, the Singleton Local Environmental Plan 2013 and the Upper Hunter Local Environmental Plan 2013.

*Consultation*

An appropriate and justified level of consultation was undertaken with relevant parties. Consultation is detailed in Section 5.

*Aviation Impact Statement*

Based on the proposed Project layout and overall turbine blade tip height limit of 220 m AGL, the blade tip elevation of the highest wind turbine, which is T46, will not exceed 911 m AHD (2988 ft AMSL) and:

- will not penetrate any OLS surfaces of Cessnock, Maitland and Scone Airports;
- will not penetrate PAN-OPS surfaces at Cessnock, Maitland and Scone Airports;
- will not have an impact on nearby designated air routes;
- will not have an impact on the grid LSALT;
- will not have an impact on prescribed airspace;
- is wholly contained within Class G airspace, but within lateral extent of the Restricted Area R583B and the Danger Area D600 and may impact military fly training within these two areas; and
- is outside the clearance zones associated with civil aviation navigation aids and communication facilities.

Airservices Australia response is copied below:

> *Airspace Procedures*
>
> *With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at the various heights provided, the wind turbines and masts will not affect any sector or circling altitude, nor any instrument approach or departure procedure at Scone or Maitland Airport.*
>
> *The wind farm will not affect any air route LSALT.*
>
> *Note that procedures not designed by Airservices at Scone or Maitland Airport were not considered in this assessment.*

*Communications/Navigation/Surveillance (CNS) Facilities*

*This wind farm, to a maximum height of 884m (2900ft) AHD, will not adversely impact the performance of Precision/Non-Precision Navigational Aids, HF/VHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.*

*Vertical Obstacle Notification*

*As soon as construction commences, the proponent must complete the Vertical Obstacle Notification Form for tall structures and submit the completed form to VOD@airservicesaustralia.com. For further information regarding the reporting of tall structures, please contact (02) 6268 5622, email VOD@airservicesaustralia.com or refer to the web link below:*

*http://www.airservicesaustralia.com/services/aeronautical-information-and-management-services/part-175/*

During project briefings with Muswellbrook Shire Council, Singleton Council and Upper Hunter Shire Council the councils were informed of the Project and no aviation issues were raised.

*Aircraft operator characteristics*

Aircraft will be required to navigate around the Project site in low cloud conditions where aircraft need to fly at 500 ft AGL.

The Proponent will engage with local aerial agricultural and aerial firefighting operators to develop procedures, which may include, but not be limited to stopping the rotation of the wind turbine rotor blades prior to the commencement of the subject aircraft operations within the Project area.

Wind turbines are generally not a safety concern to aerial agricultural operators. WMTs remain the primary safety concern to aerial agricultural operators, who have expressed a general desire for these towers to be more visible.

<u>Aerial and aircraft operators:</u> Epuron discussed with local aerial and aircraft operators the proposed Project in relation to different aspects and received comments noted in Section 5. In general, stakeholders do not oppose the development of the Project.

<u>Private aerodromes:</u> If operational, both circuit directions for ALA 1, ALA 4 and the western circuit of ALA 2 would be impacted by the Project. The Proponent should consult with land hosts of ALA 1, ALA 2 and ALA 4 to address potential impacts on the aerodromes circuit operations of these ALAs.

Also, the effects of wake turbulence could be noticeable while performing circuits for ALA 1, ALA 2, ALA 4 and ALA 13. The Proponent should consult with land hosts of ALA 1, ALA 2, ALA 4 and ALA 13 to address potential effects of wake turbulence from the nearest WTGs.

<u>Emergency services:</u> Epuron advised that multiple attempts were made on 28 April 2020 to consult with the RFDS Executive General Manager, Marketing & Stakeholders Relations and the RFDS's bases located in Dubbo, Bankstown and Mascot. No formal response has been received.

Epuron discussed with Westpac Life Saver Rescue Helicopter Service (WLSRHS) the proposed Project on 28 April 2020. In principle, WLSRHS has no significant concerns about the Project.

*Hazard lighting and marking*

The following conclusions apply to hazard marking and lighting:

- With respect to MOS 139 Chapter 8 Division 10 8.109, the proposed wind turbines and wind monitoring towers must be reported to CASA if they are considered a hazardous obstacle. Wind turbines and wind monitoring towers must be marked in accordance with respect to MOS 139 Chapter 8 Division 10 8.110.
- Wind turbines must be lit in accordance with MOS 139 Chapter 9 Division 4 9.3 and 9.31, unless an aeronautical study assesses they are of no operational significance.
- **Aviation Projects has assessed that the Project will not require obstacle lighting to maintain an acceptable level of safety to aircraft**.
- CASA has advised that it will only review assessments referred to it by a planning authority or agency.
- During initial email consultation (dated 12 February 2020) the Department of Defence was informed of the Project but has not provided feedback since then. Multiple follow up emails were sent between April and September 2020, and no formal response has been received.
- With respect to marking of turbines, a white colour (unless otherwise agreed by the Secretary) will provide sufficient contrast with the surrounding environment to maintain an acceptable level of safety while lowering visual impact to the neighbouring residents.
- There are two WMTs at a maximum height of up to 110 m (361 ft) AGL. The WMTs are marked with aviation marker balls and have been reported to Airservices Australia.
- If further WMTs are installed, consideration should be given to marking any WMT according to the requirements set out in MOS 139 Section 8 Division 10 Obstacle Markings (as modified by the guidance in NASF Guideline D).
- The proponent is recommended to consider potential adverse impacts from the overhead power line route on aerial application operations. Consultation should occur with pilots involved in intentional and legal low-level operations, within the vicinity of the Project and associated power line corridors.

*Risk Assessment*

A summary of the level of risk associated with the Project, under the proposed treatment regime, with specific consideration of the effect of obstacle lighting, is provided in Table 12.

## RECOMMENDATIONS

*Notification and reporting*

1. 'As constructed' details of wind turbine and wind monitoring tower coordinates and elevations should be provided to Airservices Australia, using the following email address: vod@airservicesaustralia.com.
2. Any obstacles above 110 m AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents. With respect to crane operations during the construction of the Project, a notification to the NOTAM office may include, for example, the following details:
   a. The planned operational timeframe and maximum height of the crane; and
   b. Either the general area within which the crane will operate and/or the planned route with timelines that crane operations will follow.
3. Details of the wind farm should be provided to local and regional aircraft operators prior to construction for them to consider the potential impact of the wind farm on their operations. Specifically, details should be provided to the New South Wales Regional Airspace and Procedures Advisory Committee for consideration by its members in relation to VFR transit routes in the vicinity of the wind farm.

*Operation*

4. The Proponent should engage with local aerial agricultural operators and aerial firefighting operators in developing procedures for such aircraft operations in the vicinity of the Project.

*Marking of turbines*

5. The rotor blades, nacelle and the supporting mast of the wind turbines should be painted white, typical of most wind turbines operational in Australia.

*Lighting of turbines*

6. Aviation Projects has assessed that the Project will not require obstacle lighting to maintain an acceptable level of safety to aircraft.

*Marking of wind monitoring towers*

7. Wind monitoring towers should be marked according to the requirements set out in MOS 139 Chapter 8 Division 10 Obstacle Markings (as modified by the guidance in NASF Guideline D).

*Marking of overhead transmission lines and poles*

8. Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial agriculture operators and marked in accordance with MOS 139 Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8).

*Micrositing*

9. Alteration to the siting of a turbine of wind monitoring towers will not be more than 100 m or within survey boundary, and micrositing will address any consequential changes to the Project components. The potential micrositing of the turbines and wind monitoring towers have been considered in the assessment with the estimate of the overall maximum height being based on the highest ground level is within 100 m or within survey boundary of the nominal turbine position. The micrositing of the turbines and wind monitoring towers will not result in a change in the maximum overall blade tip height of the Project. No further assessment is likely to be required from micrositing and the conclusions of this aviation impact assessment remain the same.

*Triggers for review*

10. Triggers for review of this risk assessment include:

    a. prior to construction to ensure the regulatory framework has not changed;

    b. following any significant changes to the context in which the assessment was prepared, including the regulatory framework; and

    c. following any near miss, incident or accident associated with operations considered in this risk assessment.

# 1. INTRODUCTION

### 1.1. Situation

Epuron is seeking approval for the construction, operation, maintenance, and decommissioning of the BCWF.

The Project is located at Bowmans Creek, approximately 10 km east of Muswellbrook and 120 km from the Port of Newcastle in NSW.

Epuron seeks SSD Development Consent approval under Division 4.7 of Part 4 of the Environmental Planning & Assessment Act 1979 (EPA Act) for the Project (SSD 10315). Epuron also seeks an Approval from the Commonwealth DAWE under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The two Applications are supported by the 'Bowmans Creek Wind Farm Environmental Impact Statement' (EIS) (Hansen Bailey, 2020). This Assessment supports the EIS.

The Project extends predominantly across two LGAs, being the Muswellbrook and Singleton Council LGAs. A small number of turbines are additionally proposed in the Upper Hunter Shire LGA.

The Project will generally involve the construction, operation, maintenance, and decommissioning comprised of:

- up to 60 wind turbine sites consisting of:
  - a three-blade rotor mounted onto a tubular tower;
  - crane hardstand area; and
  - turbine laydown area;
- electricity infrastructure:
  - up to three substations;
  - a 330 kv transmission line to transmit the generated electricity into the existing Transgrid network;
  - connections between the wind turbines and the substations, which will include a combination of underground reticulation cables and overhead powerlines;
- ancillary infrastructure;
  - operation and Maintenance Facility (O&M Facility);
  - construction compound and storage facilities;
  - unsealed access tracks within the Project Boundary;
  - ongoing use of existing and additional monitoring masts and other monitoring;
  - temporary construction facilities (including concrete batching plant, laydown areas and rock crushing facilities);
  - minor upgrades to the road network to facilitate delivery of oversized loads (such as wind turbine components) to the Project; and

- administrative activities (including boundary adjustments and subdivisions).

This Assessment generally applies to the Project Boundary unless otherwise stipulated in this Assessment and the EIS Project Description.

The proposed BCWF is referred as the Project throughout this report.

HB has engaged Aviation Projects to prepare an AIA for the proposed Project and formally consult with aviation agencies, before submitting the EIS to accompany the Development Application for the project.

The AIA reviews potential impacts and provide aviation safety advice in respect of relevant requirements of air safety regulations and procedures and undertake consultation with relevant aviation agencies.

### 1.2. Purpose and Scope

The purpose and scope of work is to prepare an AIA in accordance with the SEARs and relevant guidelines for consideration by Airservices Australia, CASA and Department of Defence and progress any ongoing dialogue through the planning process.

The assessment will specifically respond to the:

- *Environmental Planning and Assessment Act 1979*; and
- National Airports Safeguarding Framework (NASF) Guideline D: *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers*.

Assistance will be provided in support of stakeholder consultation and engagement in preparing the assessment and negotiating acceptable mitigation to identified impacts.

### 1.3. Methodology

In undertaking this task, Aviation Projects has:

1. confirmed the scope and deliverables;
2. reviewed client material;
3. attended initial kick-off meeting with HB via teleconference;
4. conducted a site visit to properly investigate aviation safety aspects of the proposed BCWF site;
5. reviewed relevant regulatory requirements and information sources;
6. assessed potential impacts on aviation safety as per SEARs;
7. identified aviation assets and activities within the vicinity of the Project, and identify any aviation constraints to Obstacle Limitation Surfaces (OLS), PAN-OPS surfaces and designated airspace;
8. prepared a draft aviation impact assessment and supporting technical data that provides evidence and analysis for the planning application to demonstrate that appropriate risk mitigation strategies have been identified. The draft aviation impact assessment report will include an Aviation Impact Statement (AIS) and a qualitative risk assessment to determine need for obstacle lighting and of applicable aspects for client review and acceptance before submission to external aviation regulators;

9. consulted with aviation regulators, consisting of Airservices Australia, CASA and the Department of Defence;
10. consulted with Muswellbrook, Singleton and Upper Hunter Shire Councils, and aerodrome operators of the nearest aerodromes to seek endorsement of the proposal to change instrument procedures;
11. consulted/engaged with stakeholders to understand issues for assessment in this aviation impact assessment report; and
12. finalised the aviation impact assessment report for client acceptance when response(s) received from involved stakeholder(s) for client review and acceptance.

### 1.4. Aviation Impact Statement

The AIS includes the following specific requirements as advised by Airservices Australia:

Aerodromes:

- Specify all registered/certified aerodromes that are located within 30 nm (55.56 km) of the Site;
- Nominate all instrument approach and landing procedures at these aerodromes;
- Review the potential effect of the Project operations on the operational airspace of the aerodrome(s);

Air Routes:

- Nominate air routes published in ERC-L & ERC-H which are located near/over the Site and review potential impacts of Project operations on aircraft using those air routes;
- Specify two waypoint names located on the routes which are located before and after the obstacles;

Airspace:

- Nominate the airspace classification where the Site is located; and

Navigation/Radar:

- Nominate radar navigation systems with coverage overlapping the site.

### 1.5. Stakeholders

An appropriate and justified level of consultation was undertaken with the following parties and considered in the preparation of this report (see Section 5 for detailed discussion):

- Airservices Australia;
- aircraft operators;
- aerial operators;
- aerodrome operators;
- Civil Aviation Safety Authority;

- Department of Defence;
- Muswellbrook Shire Council;
- Royal Flying Doctor Service;
- Singleton Council;
- Upper Hunter Shire Council;
- Westpac Life Saver Rescue Helicopter Service; and
- other stakeholders where noted.

### 1.6. Material reviewed

Material provided by the Proponent for preparation of this assessment included:

- HB, Conceptual Development Map, Conceptual Development Map_200511.pdf, received 8 May 2020;
- HB, turbine layout, *BOW_EIS_Turbine_Layout_points.shp*, received August 2020;
- HB, site boundary, *BOW_EIS_Site_Boundary_14April20.kmz*, received 8 May 2020;
- HB, WMT layout, *BOW Permanent Met Masts 141019.kmz*, received 8 May 2020;
- HB, *200811 BOW Turbine Elevation.xls*, dated 11 August 2020;
- Epuron, *Epuron_Masts_July18_updated_Feb2020.xlsx*, received 8 May 2020;
- HB, Bowmans Creek Wind Farm Project schedule, *4132215_Baseline Schedule_26.08.19 v3.pdf*, received 26 August 2019;
- HB, Bowmans Creek Wind Farm Turbine inputs, *20190826 Turbine inputs for Technical reports.xlsx*, received 26 August 2019;
- HB, Bowmans Creek Site Boundary, *M_BOW_Site_Boundary.kmz*, received 1 October 2019;
- HB, Bowmans Creek Final SEARS, *Ref 6 - 190723 BOW Final SEARS.pdf*, received 1 October 2019;
- HB, Bowmans Creek Turbine layout, *Ref 18 - Turbine layout 011019.kmz*, received 1 October 2019;
- HB, Bowmans Creek Turbine and Mast elevations, *Ref 114 & 118 - BOW Turbine & Mast Elevation 181019.xlsx*, received 19 October 2019;
- HB, Bowmans Creek Wind Farm Conceptual Project Layout, 23 02 2021; and
- HB, Bowmans Creek Wind Farm, transmission line, *BOW_EIS_Proposed_Powerline_08Feb21.*

### 1.7. References

References used or consulted in the preparation of this report include:

- Airservices Australia, Aeronautical Information Package; including AIP Book, Departure and Approach Procedures and En Route Supplement Australia dated 07 November 2019;

- Airservices Australia, Designated Airspace Handbook, effective 07 November 2019;
- Bureau of Meteorology, NSW/ACT Radar Sites Table and Information, http://www.bom.gov.au/australia/radar/nsw_radar_sites_table.shtml;
- Civil Aviation Safety Authority, Civil Aviation Regulations 1998 (CAR);
- Civil Aviation Safety Authority, Civil Aviation Safety Regulations 1998 (CASR);
- Civil Aviation Safety Authority, Civil Aviation Advisory Publication (CAAP) 92-1(1): Guidelines for aeroplane landing areas, dated July 1992;
- Civil Aviation Safety Authority, Civil Aviation Advisory Publication (CAAP) 166-01 (v4.2): Operations in the vicinity of non-controlled aerodromes, dated February 2019;
- Civil Aviation Safety Authority, Manual of Standards Part 173 – Standards Applicable to Instrument Flight Procedure Design, version 1.5, dated March 2016;
- Civil Aviation Safety Authority, *Part 139 (Aerodromes) Manual of Standards 2019*, dated 5 September 2019;
- Civil Aviation Safety Authority, Advisory Circular (AC) 139-08 v2.0: *Reporting of Tall Structures*, dated March 2018;
- Department of Infrastructure and Regional Development, Australian Government, National Airport Safeguarding Framework, Guideline D *Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation*, dated June 2013;
- Department of Planning, Industry and Environment, NSW Government, *NSW Wind Farm Guideline for State significant wind energy development*, December 2016;
- Department of Planning, Industry and Environment, NSW State Government, *Planning Secretary's Environmental Assessment Requirements, Application Number SSD 10315,* issued 23 July 2019;
- Department of Planning, Industry and Environment, NSW State Government, Wind Energy: Visual Assessment Bulletin – For State significant wind energy development, December 2016;
- International Civil Aviation Organization (ICAO) Doc 8168 Procedures for Air Navigation Services—Aircraft Operations (PANS-OPS);
- ICAO Standards and Recommended Practices, Annex 14—Aerodromes;
- Muswellbrook Shire Council, Muswellbrook Local Environmental Plan 2009, current version, 28 February 2019;
- OzRunways, aeronautical navigation charts extracts, dated 09 October 2019;
- Singleton Shire Council, Singleton Local Environmental Plan 2013, published 06 September 2013;
- Standards Australia, ISO 31000:2018 *Risk management - Guidelines*; and
- Upper Hunter Shire Council, Upper Hunter Local Environmental Plan 2013, published 23 December 2013.

# 2. BACKGROUND

## 2.1. Site overview

An overview of the proposed Project layout and site area relative to nearby localities is provided in Figure 1 (source: HB, Google Earth).

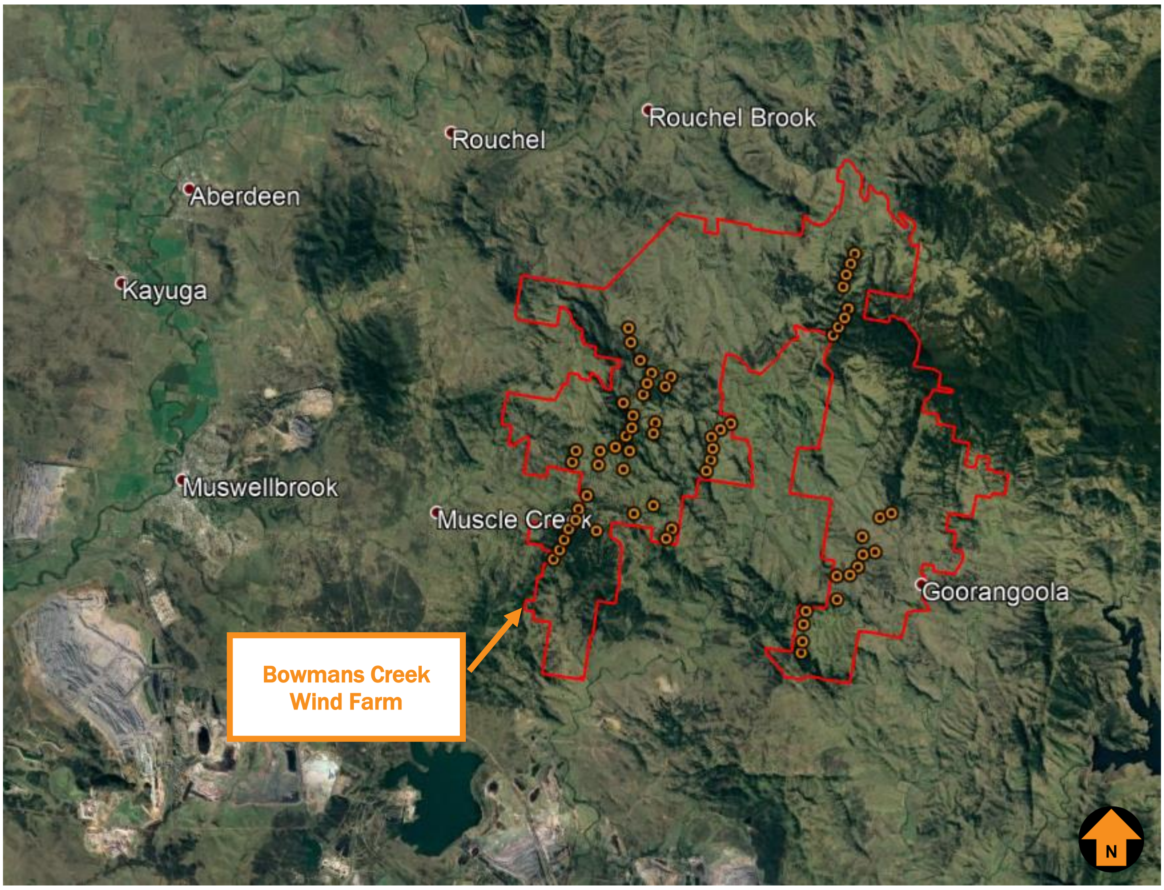


Figure 1 Proposed Project site overview

The Project is located approximately 10 km east of Muswellbrook and 90 km north west of Newcastle, within the boundaries of Muswellbrook Shire, Singleton Shire and with a small number of proposed turbines in the Upper Hunter Shire in NSW.

Refer to Figure 2 for the proposed Project layout (source: HB, Epuron).

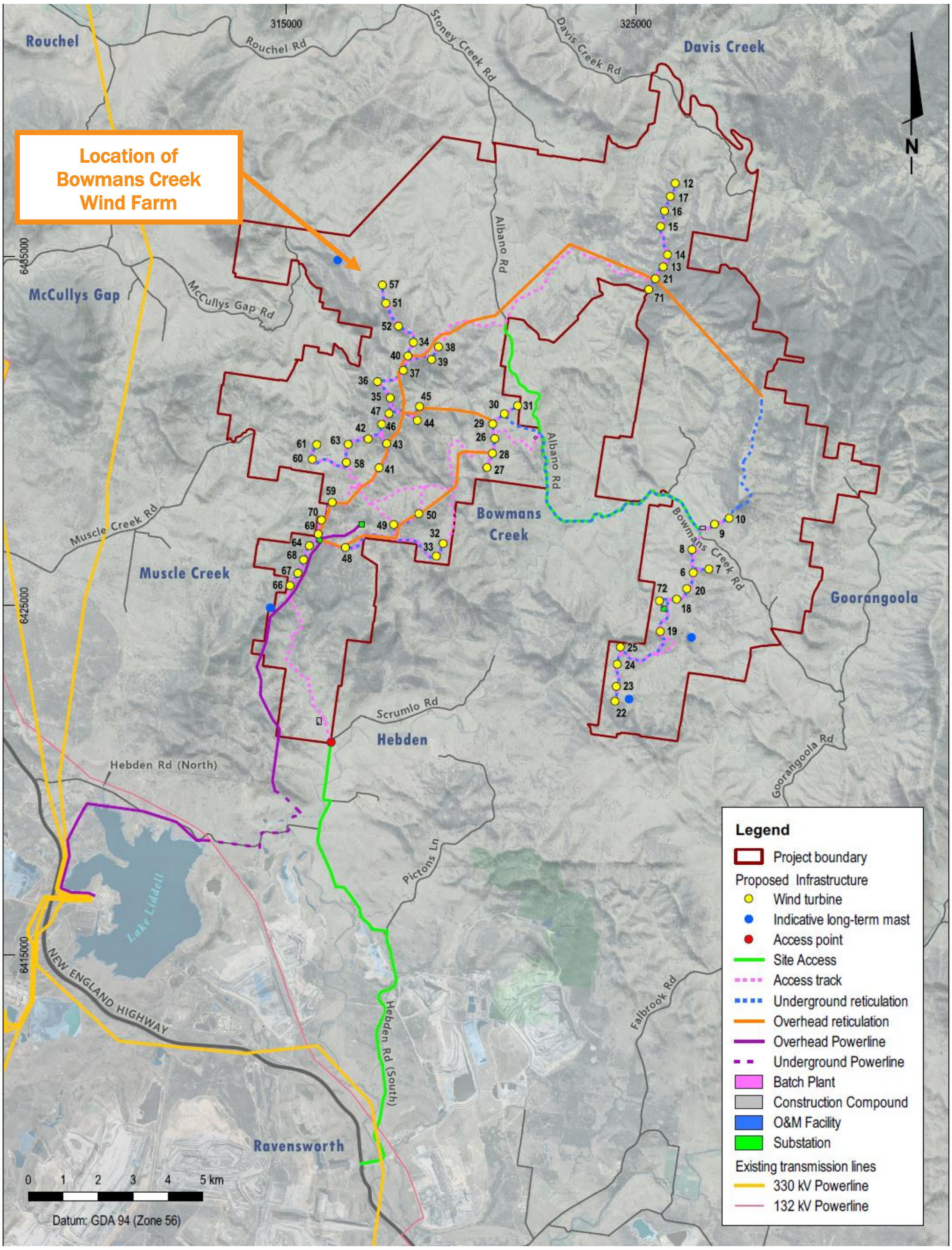


Figure 2 Proposed Project layout

# 3. EXTERNAL CONTEXT

## 3.1. Planning context

The Bowmans Creek Wind Farm has been developed by Epuron in accordance with the NSW Guideline for State significant wind energy development. The role of the NSW Department of Planning, Industry and Environment (DPIE) is to coordinate the planning process according to the applicable regulations, and in partnership with individual people, community groups, businesses and industry groups, other organisations, local councils, and State and Commonwealth Government agencies. The legal framework includes the Environmental Planning and Assessment Act 1979 and Environmental Planning and Assessment Regulation 2000.Development projects such as wind farms in NSW must submit a development application for approval by the Minister for Planning and Public Spaces.

## 3.2. Wind Energy Guideline

Wind Energy Guideline 2016 (the Guideline) provides the community, industry and regulators with guidance on the planning framework for the assessment of large-scale wind energy development proposals that are State significant development (SSD).

This Guideline identifies the key planning considerations relevant to wind energy development in NSW. It will assist stakeholders in the design and siting of SSD wind energy projects. It will also guide the assessment and evaluation, determination of wind energy development proposals, and, where approved, their construction and operation. The Guideline is not intended to be a comprehensive 'how to' manual for wind energy development, nor will all issues be relevant for every proposal. However, the NSW Government's intention is that this Guideline becomes the key reference document for decision-making on SSD wind energy development in NSW.

This Guideline delivers on the Government's commitment in the *NSW Renewable Energy Action Plan* (2013) to implement wind energy planning guidelines in NSW.

SSD wind energy projects will generally be assessed like any other SSD project.

Based on the Wind Energy Guideline 2016, the proponent needs to consider potential safety hazards for aircraft through intrusion of the wind turbines into the airspace and potential effects on navigation instruments.

## 3.3. Muswellbrook Shire Council

The *Muswellbrook Local Environmental Plan 2009* (Muswellbrook LEP, dated 28 February 2019) does not include provisions for airfields.

## 3.4. Singleton Shire Council

The *Singleton Local Environmental Plan 2013* (Singleton LEP, dated 6 September 2013) does not include provisions for airfields.

## 3.5. Upper Hunter Shire Council

The *Upper Hunter Local Environmental Plan 2013* (Upper Hunter LEP, dated 23 December 2013) does not include provisions for airfields.

### 3.6. Planning Secretary's Environmental Assessment Requirements

The EIS for the development must comply with the requirements in Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

The EIS must include an assessment of aviation safety. Table 1 details the relevant section(s) of the report in which the nominated issues are addressed.

Table 1 Reference to assessment requirements

| *Key issues* | *Section of the AIA* |
|---|---|
| Aviation Safety: | |
| assess the impact of the development under the National Airports Safeguarding Framework Guideline D: Managing Wind Turbine Risk to Aircraft, | Section 6 and Section 10 |
| provide associated height and co-ordinates for each turbine assessed; | Annexure 1 |
| assess potential impacts on aviation safety, including cumulative effects of wind farms in the vicinity, potential wake / turbulence issues, the need for aviation hazard lighting, considering, defined air traffic routes, aircraft operating heights, approach/departure procedures, radar interference, communication systems, navigation aids; | Section 3, 6 and 10 |
| identify aerodromes within 30 km of the turbines and consider the impact to nearby aerodromes and aircraft landing areas; | Section 6 |
| address impacts on obstacle limitation surfaces, and | Section 6 |
| assess the impact of the turbines on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the turbines and transmission line; | Section 4, 5 and 7 |

### 3.7. Aircraft operations at non-controlled aerodromes

Civil Aviation Advisory Publications (CAAP) provide guidance, interpretation and explanation on complying with the Civil Aviation Regulations 1988 (CAR) or Civil Aviation Orders (CAO). CAAP 166-01 v4.2 – *Operations in the vicinity of non-controlled aerodromes* – provides guidance with respect to CAR 166. The purpose of this CAAP is to support Common Traffic Advisory Frequency (CTAF) procedures. It provides guidance on a code of conduct (good airmanship) to allow flexibility for pilots when flying at, or in the vicinity of, non-controlled aerodromes.

CAAP 166-01 v4.2 paragraph 2.1.4 states the following:

> *2.1.4 CASA strongly recommends the use of 'standard' traffic circuit and radio broadcast procedures by radio-equipped aircraft at all non-controlled aerodromes. These procedures are described in the Aeronautical Information Publication (AIP) and Visual Flight Rules Guide (VFRG), and discussed in Section 5 of this CAAP (Standard traffic circuit procedures) and Section 7 (Radio broadcasts).*

The standard circuit consists of a series of flight paths known as *legs* when departing, arrival or when conducting circuit practice. Illustrations of the standard aerodrome traffic circuit procedures are provided in Figure 3 and Figure 4.

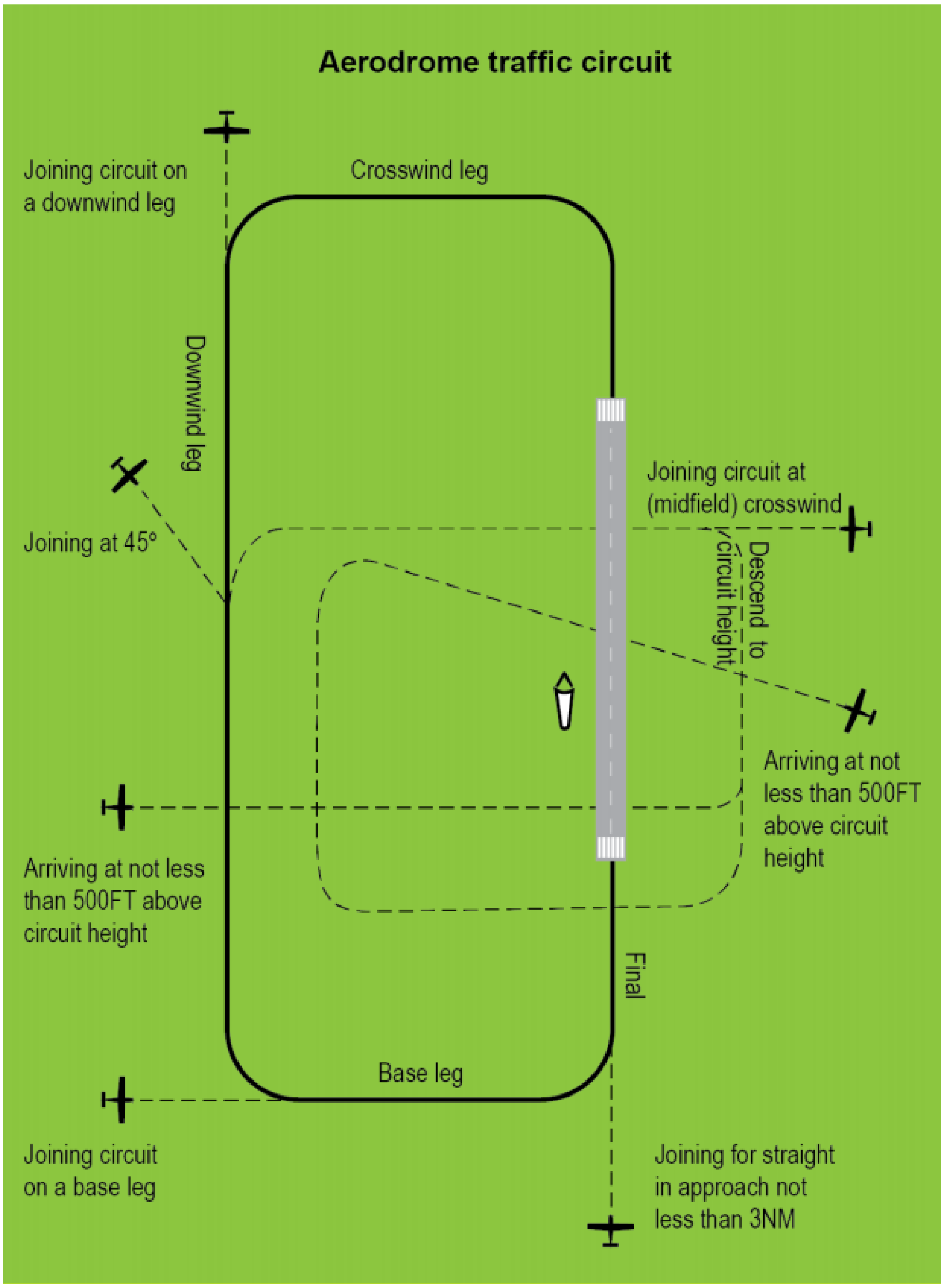


Figure 3 Aerodrome standard traffic circuit, showing arrival and joining procedures

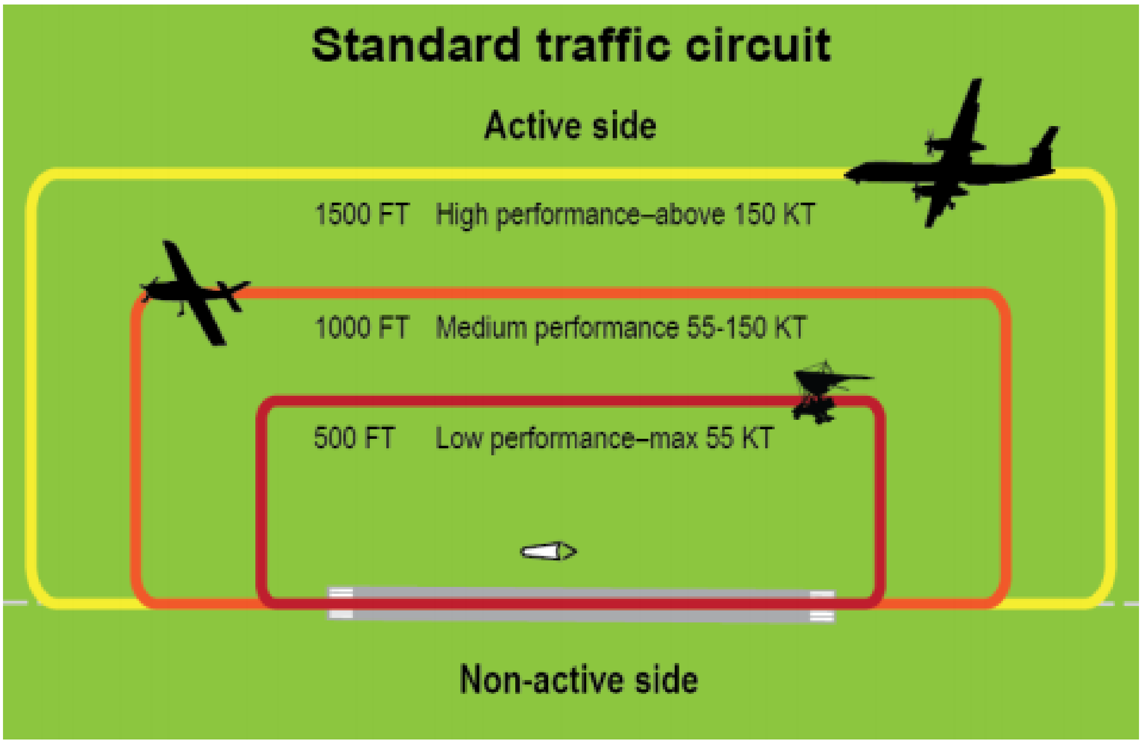


Figure 4 Lateral and vertical separation in the standard aerodrome traffic circuit

CAAP 166-01 v4.2 paragraph 5.4.1 makes reference to a distance that is "normally" well outside the circuit area and where no traffic conflict exists, which is at least 3 nm (5556 m). The paragraph is copied below:

> *5.4 Departing the circuit area*
>
> *5.4.1 Aircraft should depart the aerodrome circuit area by extending one of the standard circuit legs or climbing to depart overhead. However, the aircraft should not execute a turn to fly against the circuit direction unless the aircraft is well outside the circuit area and no traffic conflict exists. This will normally be at least 3 NM from the departure end of the runway, but may be less for aircraft with high climb performance. In all cases, the distance should be based on the pilot's awareness of traffic and the ability of the aircraft to climb above and clear of the circuit area.*

## 3.8. Rules of flight

### 3.8.1. Flight under Day Visual Flight Rules (VFR)

According to Aeronautical Information Publication (AIP) the meteorological conditions required for visual flight in the applicable (class G) airspace at or below 3000 ft AMSL or 1000 ft AGL whichever is the higher are: 5000 m visibility, clear of clouds and in sight of ground or water.

Civil Aviation Regulation (1988) 157 (Low flying) prescribes the minimum height for flight. Generally speaking aircraft are restricted to a minimum height of 500 ft AGL above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas, and 1000 ft AGL over built up areas.

These height restrictions do not apply if through stress of weather or any other unavoidable cause it is essential that a lower height be maintained.

Flight below these height restrictions is also permitted in certain other circumstances.

#### 3.8.2. Night VFR

With respect to flight under the VFR at night, Civil Aviation Regulations (1988) 174B states as follows:

> *The pilot in command of an aircraft must not fly the aircraft at night under the V.F.R. at a height of less than 1000 feet above the highest obstacle located within 10 miles of the aircraft in flight if it is not necessary for take-off or landing.*

#### 3.8.3. IFR (Day or night)

According to CAR 178, flight under the instrument flight rules (IFR) requires an aircraft to be operated at a height clear of obstacles that is calculated according to an approved method. Obstacle lights on structures not within the vicinity of an aerodrome are effectively redundant to an aircraft being operated under the IFR.

### 3.9. Aircraft operator characteristics

#### 3.9.1. Passenger transport operations

Regular public transport (RPT) and passenger carrying charter operations are generally operated under the IFR.

#### 3.9.2. Private operations

Private operations are generally conducted under day or night VFR, with some IFR. Flight under day VFR is conducted above 500 ft AGL.

#### 3.9.3. Aerial agricultural operations

Aerial agricultural operations including such activities as fertiliser, pest and crop spraying are generally conducted under day VFR below 500 ft AGL; usually between 6.5 ft (2 m) and 100 ft (30.5 m) AGL.

Due to the nature of the operations conducted, aerial agriculture pilots are subject to rigorous training and assessment requirements in order to obtain and maintain their licence to operate under these conditions.

The Aerial Agricultural Association of Australia (AAAA) has a formal risk management program which is recommended for use by its members.

#### 3.9.4. Aerial fire fighting

Aerial firefighting operations (firebombing in particular) are conducted in Day VFR, sometimes below 500 ft AGL. Under certain conditions visibility may be reduced/limited by smoke/haze.

Most aerial firefighting organisations have formal risk management programs to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained. For example, pilots require specific training and approvals, additional equipment is installed in the aircraft, and special procedures are developed.

#### 3.9.5. Emergency services/RFDS

Aeromedical and other emergency services operations are generally conducted under the IFR, except when arriving/departing a destination that is not serviced by instrument approach aids or procedures.

Most emergency aviation services organisations have formal risk management programs to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained.

For example, pilots and crew require specific training and approvals, additional equipment is installed in the aircraft, and special procedures are developed.

### 3.10. Cumulative impacts

The Project is not surrounded by any other wind farms and therefore will have no cumulative impacts to aviation safety.

# 4. INTERNAL CONTEXT

## 4.1. Wind farm description

The wind farm is situated in an area comprised mainly of farming properties on high terrain. Figure 5 shows a view looking north from Albano Road near the locality of Bowmans Creek towards the proposed Project site.


Figure 5 Albano Road looking north at the proposed Project site

A northern view taken from Old Goorangoola Road is shown in Figure 6.


Figure 6 A northern view taken from Old Goorangoola Road

Figure 7 shows a view taken standing on Albano Road looking to the north west towards the Project area.

Figure 7 North western view towards the Project area taken from Albano Road

### 4.2. Wind turbine description

The maximum blade tip height of the proposed wind turbines will be up to 220 m AGL. The maximum ground elevation for the proposed T46 wind turbine is 691 m AHD, which results in a maximum overall height of 911 m AHD (2988 ft AMSL) located west of Albano Road.

Figure 8 demonstrates the proposed Project layout highlighting the highest WTG in red colour (source: HB, Google Earth).

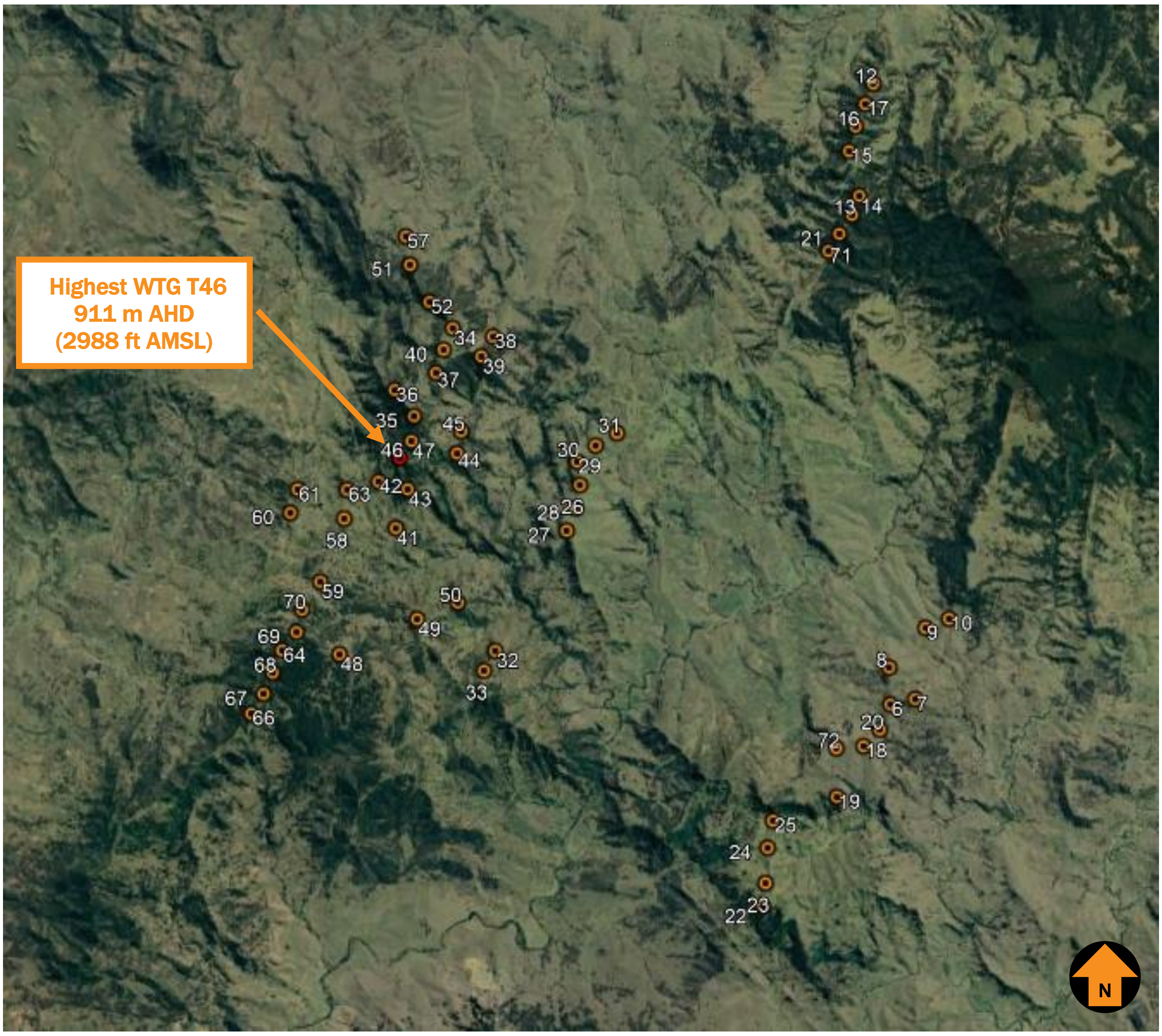


Figure 8 Proposed Project layout and highest wind turbine

'Micrositing of turbines' and wind monitoring towers means an alteration to the siting of a turbine or wind monitoring towers by not more than 100 m or within survey boundary, and any consequential changes to access tracks and internal power cable routes. The potential micrositing of the turbines and wind monitoring towers have been considered in the assessment with the estimate of the overall maximum height being based on the highest ground level is within 100 m or within survey boundary of the nominal turbine position. The micrositing of the turbines and wind monitoring towers is likely to not result in a change in the maximum overall blade tip height of the Project.

The coordinates and ground elevations of the Project wind turbines are listed in Annexure 1.

### 4.3. Wind monitoring tower description

Multiple Utility Installations being nominal 110 m guyed lattice WMTs exist at the site. The masts are guyed at several levels in three directions.

The highest overall ground level for the WMT is approximately 672 m AHD, resulting in a maximum overall height of 782 m AHD (2566 ft AMSL).

The WMTs were constructed in 2018 and were reported to Airservices Australia for entry into Vertical Obstruction Database.

The Proponent advised that additional monitoring equipment including performance monitoring masts may also be required.

Figure 9 shows the location of the proposed WMTs as white triangles (source: HB and Google Earth).

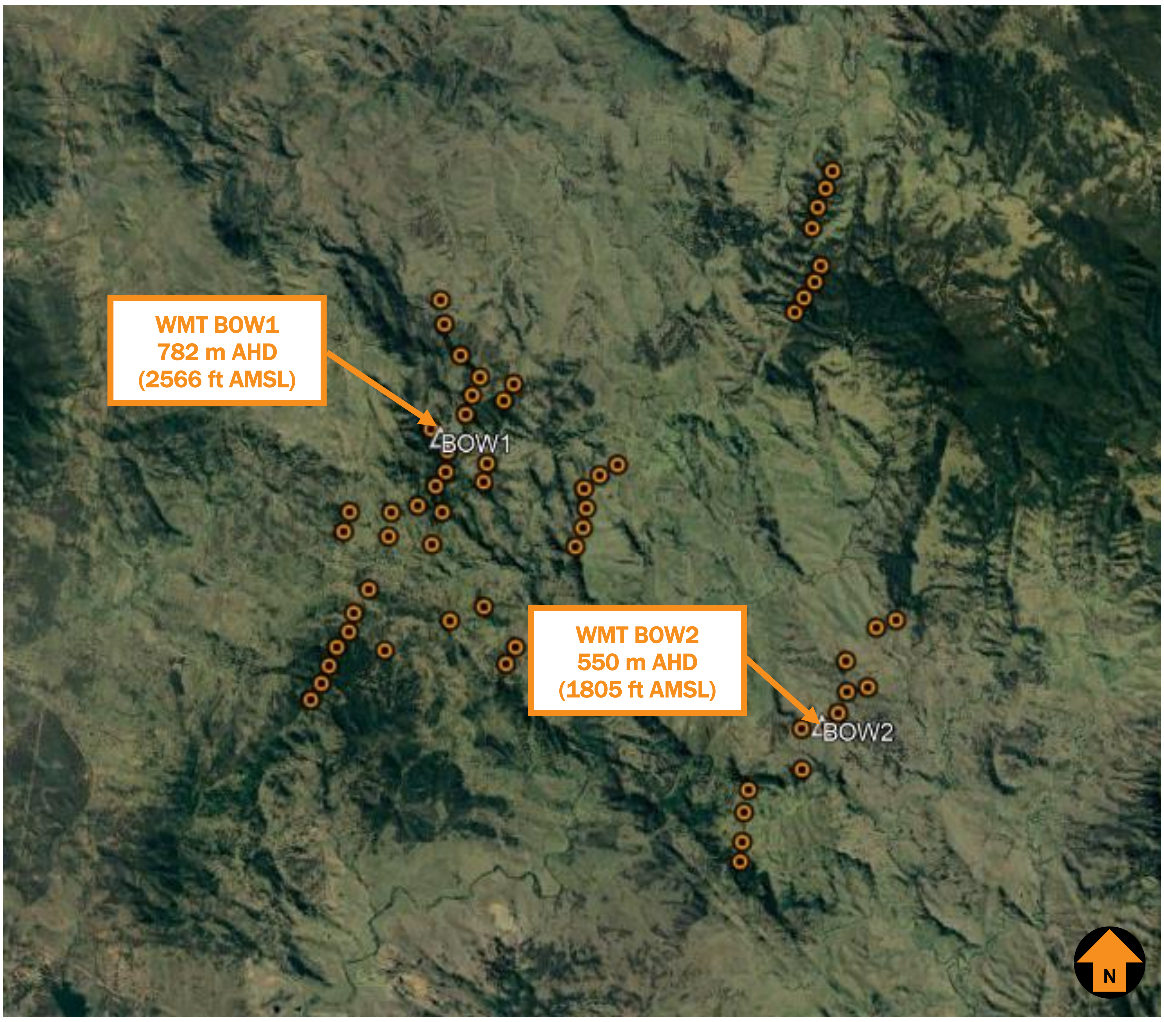


Figure 9 Proposed wind monitoring towers

The details of the proposed WMTs are provided in Table 2 (source: HB).

Table 2 Wind monitoring tower details

| Details | WMT BOW1 | WMT BOW2 |
|---|---|---|
| Location (Lat, Lon) | 151.06635, -32.24099 | 151.15266, -32.296717 |
| Ground elevation at site (approximate) | 672 m AHD (2205 ft AMSL) | 440 m AHD (1444 ft AMSL) |
| Height of tower AGL | 110 m (361 ft) | 110 m (361 ft) |
| Height of tower AHD | 782 m AHD<br>(2566 ft AMSL) | 550 m AHD<br>(1805 ft AMSL) |
| Lighting | Nil | Nil |
| Marking | Aviation marker balls | Aviation marker balls |
| Design | Triangular galvanised lattice structure | Triangular galvanised lattice structure |
| Commissioning date | 11 Aug 2018 | 23 Aug 2018 |
| Reported to Airservices Australia? | 26 July 2018 | 26 July 2018 |

### 4.4. Grid transmission alignment

To export the electricity generated from the Project, a new physical connection to the existing electricity network will be required. Sufficient capacity exists within the network to transmit the electricity to the required load centres.

The Muswellbrook Shire contains key components of the State's electricity network with transmission infrastructure in place to facilitate the transmission of electricity from Liddell and Bayswater power stations to the major load centres of Newcastle, Sydney and Brisbane.

The alignment of the transmission line extends from Substation 1b to the Liddell substation adjacent to Lake Liddell. Electricity infrastructure will include the following:

- Up to three substations;
- A 330 kv transmission line to transmit the generated electricity into the existing TransGrid network; and
- Connections between the wind turbines and the substations, which will include a combination of underground reticulation cables and overhead powerlines.

The proposed poles will be up to a maximum height of 45 m AGL for transmission line and 15 m AGL for reticulation poles.

Figure 10 show the Project layout and boundary relative to the proposed transmission line (source: HB, Google Earth). The white section is overhead, and the magenta section is underground.

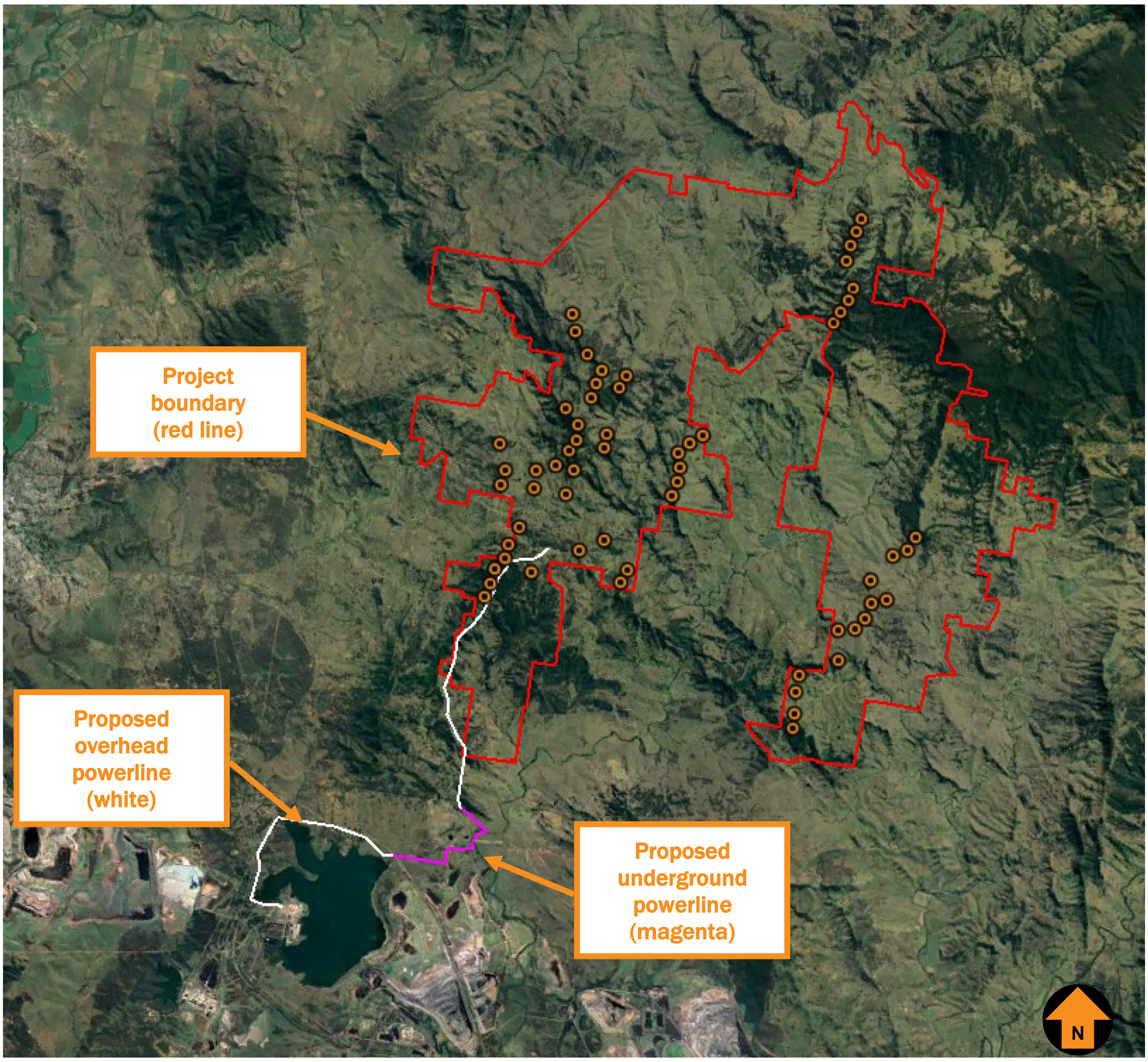


Figure 10 The transmission line

# 5. CONSULTATION

The following stakeholders were consulted.

- Airservices Australia;
- aircraft operators;
- aerial operators;
- aerodrome operators;
- Civil Aviation Safety Authority;
- Department of Defence;
- Muswellbrook Shire Council;
- Royal Flying Doctor Service;
- Singleton Council;
- Upper Hunter Shire Council;
- Westpac Life Saver Rescue Helicopter Service; and
- other stakeholders where noted.

Details and results of the consultation activities are provided in Table 3.

Note: Most of the stakeholders were consulted by Epuron and Hansen Bailey. Aviation Projects consulted with Airservices Australia, CASA, Department of Defence and assisted Hansen Bailey to provide a response to Airspeed Aviation.

Table 3 Stakeholder consultation details

| *Agency/Contact* | *Activity/Date* | *Issues Raised During Consultation* | *Action Proposed* |
|---|---|---|---|
| Airservices Australia | 12 February 2020,<br>Email to Airservices Australia | During initial consultation Aviation Projects advised Airservices Australia about the Project. In an email response dated 24 March 2020, Mr Williams Zhao (Advisor Airport Development) advised the following:<br>***Airspace Procedures***<br>*With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at the various heights provided, the wind turbines and masts will not affect any sector or circling altitude, nor any instrument approach or departure procedure at Scone or Maitland Airport.*<br>*The wind farm will not affect any air route LSALT.*<br>*Note that procedures not designed by Airservices at Scone or Maitland Airport were not considered in this assessment.*<br>***Communications/Navigation/Surveillance (CNS) Facilities***<br>*This wind farm, to a maximum height of 884m (2900ft) AHD, will not adversely impact the performance of Precision/Non-Precision Navigational Aids, HF/VHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.*<br>***Vertical Obstacle Notification***<br>*As soon as construction commences, the proponent must complete the Vertical Obstacle Notification Form for tall structures and submit the completed form to VOD@airservicesaustralia.com.* | Once construction commences, complete Vertical Obstacle Notification Form – **to be completed** |

| Agency/Contact | Activity/Date | Issues Raised During Consultation | Action Proposed |
|---|---|---|---|
| Pays Air Service Scone<br>(Aircraft operator) | 24 April 2020,<br>phone conversation | Epuron consulted with Pays Air Service regarding the proposed Project, and received comments noted in line with each discussion item. Where relevant, references have been made to sections within the report as applicable to stakeholder concerns.<br>Discussed items, responses and applicable reference are noted below:<br>• General - No major issues, have discussed with chief pilot;<br>• Other air strips - Various private air strips in area;<br>• Activities undertaken within area - Main activity undertaken within area is firefighting;<br>• Cables/supporting structure in project boundary that require marking (refer to paragraph 8.7) - No major issues re cables etc – best to have markers on cables, aerial wires, beacons on infrastructure to assist in poor visibility conditions; noted there would be standards to comply with;<br>• Recommendations/comments - No major issues; and<br>• Other people to contact. | No further action required |
| Airspeed Aviation, Scone (Aircraft Operator) | 28 and 29 April 2020 via phone and email | Epuron consulted with Ben Wyndham (Chief Pilot and Managing Director of Airspeed Aviation) regarding the Project and received the following comments:<br>*The project is in close proximity to GPS landing procedures for Scone airport. These published procedures are used several times a week and are pivotal to the ongoing utility of the airport as a significant item of public transportation infrastructure which supports over 100 local skilled jobs and facilitates over $30m of local commerce.* | No further action required |

| Agency/Contact | Activity/Date | Issues Raised During Consultation | Action Proposed |
| --- | --- | --- | --- |
| | | *Any impact on the procedure will be vigorously opposed.*<br><br>*Airspeed is not an aerial Ag operator but I am aware of several farms in that area that rely upon aerial pasture improvement.*<br><br>*I have cc'd David Boundy, from local ag operator SuperAir, into this reply for his comment.*<br><br>*The wind farms are on the direct track between Scone NDB SCO and waypoint OLTIN. Currently there is a Lowest Safe Altitude (LSALT) on that track of 4200'. I expect that this will be affected by several hundered or a thousand feet?*<br><br>*That track is used extensively by flight training organisations in Scone, Cessnock, Maitland and Warnervale as a night-flying training route. A rise in the LSALT may render it unusable for night VFR aircraft both in the training and private flying scenarios.*<br><br>*Additionally, a rise in LSALT will present a problem for unpressurised IFR training aircraft and charter aircraft through winter, which will be forced to operate at higher altitudes into possible icing conditions.*<br><br>*Overall, subject to further information from Epuron, I can see a potential for significant impact from this project on the safety and amenity of air navigation in the Upper Hunter Valley.*<br><br>In relation to the issues specifically noted by Mr Wyndham, Aviation Projects provided the following response in the dated 12 May 2020: | |

| Agency/Contact | Activity/Date | Issues Raised During Consultation | Action Proposed |
|---|---|---|---|
| | | 1. *The highest wind turbine will have a maximum overall height of 2900 ft AMSL. This is 300 ft below the minimum obstacle clearance height of 3200 ft AMSL – no impact* (refer to paragraph 6.18).<br>2. *The LSALT will not be impacted by the project* (refer to paragraph 6.18).<br>3. *The LSALT will not be impacted by the project* (refer to paragraph 6.18). | |
| Scone Aero Club | 24 April 2020, phone conversation | Epuron consulted with Scone Aero Club regarding the proposed Project, and received comments noted in line with each discussion item. Where relevant, references have been made to sections within the report as applicable to stakeholder concerns.<br>Discussed items, responses and applicable reference are noted below:<br>• General - No major issues, no impacts;<br>• Other air strips - Various private air strips in area;<br>• Activities undertaken within area – if on the flight routes Scone to Maitland or Maitland to Armidale you fly over south western corner – no impacts to this;<br>• Cables/supporting structure in project boundary that require marking (refer to paragraph 8.7*).* - No major issues re cables etc – best to have navigation lighting – suggest not on tips of turbines but on nacelle *(*refer to Section 12*).* – would suggest having beacon on highest nacelle or at the end or start of each string of turbines – Stakeholder noted there would be standards to comply with;<br>• Recommendations/comments - No major issues; and<br>• Other people to contact. | No further action required |

| Agency/Contact | Activity/Date | Issues Raised During Consultation | Action Proposed |
| --- | --- | --- | --- |
| Timberline | 29 and 30 April 2020, phone conversation | Epuron consulted with Timberline regarding the proposed Project, and received comments noted in line with each discussion item. Where relevant, references have been made to sections within the report as applicable to stakeholder concerns.<br><br>Discussed items, responses and applicable reference are noted below:<br>• General - No issues;<br>• Other air strips - Various private air strips in area;<br>• Activities undertaken within area – firefighting, VIP/corporate charter, construction transport;<br>• Cables/supporting structure in project boundary that require marking (refer to paragraph 8.7) - No major issues;<br>• Recommendations/comments - No major issues; and<br>• Other people to contact. | No further action required |
| Super Air | 29 April 2020 phone conversation | Epuron consulted with Super Air regarding the proposed Project, and received comments noted in line with each discussion item. Where relevant, references have been made to sections within the report as applicable to stakeholder concerns.<br><br>Discussed items, responses and applicable reference are noted below:<br>• Concerned that Aviation reports for EIS are legislation focussed only;<br>• Experienced issues with windfarms at Glenn Innes and getting turbines turned off to spread super/seed for landowners; | |

| Agency/Contact | Activity/Date | Issues Raised During Consultation | Action Proposed |
|---|---|---|---|
| | | • Concern at landholder agreements made with no formal agreements in place in the development stage, which leaves landholder & super spreader at a disadvantage when asking for turbines to be turned off during operation stage to permit spreading;<br>• Suggests the proponent and landholder formally agree in contractual form so it is clear re impacts of wind farm on super/seed spreading and how and who pays for any increased costs;<br>• Issues re wind farms saying to landholders do not use planes use ground spreaders which causes financial hardship/issues for aerial super spreaders;<br>• Turbines slow the application of super and seeds – windfarm needs to compensate landholder for this additional cost;<br>• Provided an email: "The major point to be able in the first place to carry out safe operations is that the wind turbines are not spinning and been placed in the feather position. Note:- the logistics of this has to be decided that the morning of operations has to be discussed and planned between aerial ag company, wind farm operator and the actual land holder;"<br>• Refer to and consider the AAAA Windfarm Policy March 2011;<br>• Refer to and consider the AAAA Windfarm National Windfarm Operating Protocols 2014;<br>• Activities undertaken within area – super and seed spreading; and<br>• Cables/supporting structure in project boundary that require marking - No major issues re cables etc. | |

| Agency/Contact | Activity/Date | Issues Raised During Consultation | Action Proposed |
|---|---|---|---|
| **Civil Aviation Safety Authority** | 26 March 2020,<br>Email to Airspace Protection | During email consultation (26 March 2020) CASA was informed about the Project.<br>In an email response dated 31 March 2020, from Matthew Windebank (Team Leader – Airfield Infrastructure & Development), CASA advised the following:<br>*It remains CASA's position that we will only provide formal response to finalised plans as referred to us by a planning authority.* | No further action required; Project will be referred to CASA by planning authority |
| **Department of Defence** | 12 February 2020,<br>Email to Department of Defence | During email consultation (dated 12 February 2020) the Department of Defence was informed of the Project. Feedback is yet to be provided. Follow up phone calls and emails were sent between April and September 2020, and no formal response has been received. | No further action required; Project will be referred to Department of Defence by planning authority |
| **Muswellbrook Shire Council** | 1 May 2020 | During project briefing Muswellbrook Shire Council were informed of the Project, no aviation issues were raised | No further action required |
| **Royal Flying Doctor Service** | 28 April 2020 | Epuron advised that multiple attempts were made to consult with the RFDS Executive General Manager, Marketing & Stakeholders Relations on 28 April 2020.<br>Telephone calls were made to RFDS's bases located in Dubbo, Bankstown and Mascot.<br>None of the phone calls were answered nor an answering machine facility available to leave a message at the RFDS bases.<br>No formal response has been received. | No further action required |
| **Singleton Council** | 6 May 2020, | HB advised that during a project briefing with Singleton Council, the council did not raise any aviation issues from the proposed Project. | No further action required |

| Agency/Contact | Activity/Date | Issues Raised During Consultation | Action Proposed |
|---|---|---|---|
| | project briefing meeting | | |
| **Upper Hunter Shire Council** | 28 April 2020, project briefing meeting | HB advised that during a project briefing with Upper Hunter Shire Council, the council did not raise any aviation issues from the proposed Project. | No further action required |
| **Westpac Life Saver Rescue Helicopter Service** | 1 May 2020, phone conversation | Epuron consulted with Westpac Life Saver Rescue Helicopter Service on 28 April 2020 regarding the proposed Project, and received comments noted in line with each discussion item. Where relevant, references have been made to sections within the report as applicable to stakeholder concerns.<br><br>Discussed items, responses and appliable reference are noted below:<br><br>• General – no issues;<br>• Other air strips;<br>• Activities undertaken within area;<br>• Cables/supporting structure in project boundary that require marking (refer to paragraph 8.7);<br>• Recommendations/comments – regulatory authorities will advise re safety; no issues or impacts to operations; and<br>• Other people to contact. | No further action required |

# 6. AVIATION IMPACT STATEMENT

### 6.1. Nearby certified/registered aerodromes

The Project site is located within 30 nm (55.56 km) of three registered airports Cessnock Airport (YCNK), Maitland Airport (YMND) and Scone Airport (YSCO).

RAAF Base Williamtown (YWLM) is located outside of the 30 nm (55.56 km) radius and will not be impacted by the proposed Project in terms of issues associated with airspace protection.

Cessnock Airport is located approximately 55 km (29.7 nm) south east of wind turbine T22, Maitland Airport is located approximately 54 km (29 nm) south east of wind turbine T22 and Scone Airport is located approximately 30 km (16 nm) north west of wind turbine T57.

The location of Cessnock Airport, Maitland Airport, Scone Airport and RAAF Base Williamtown relative to the Project site is shown in Figure 11 (source: OzRunways, WAC Chart, dated 09 October 2019).

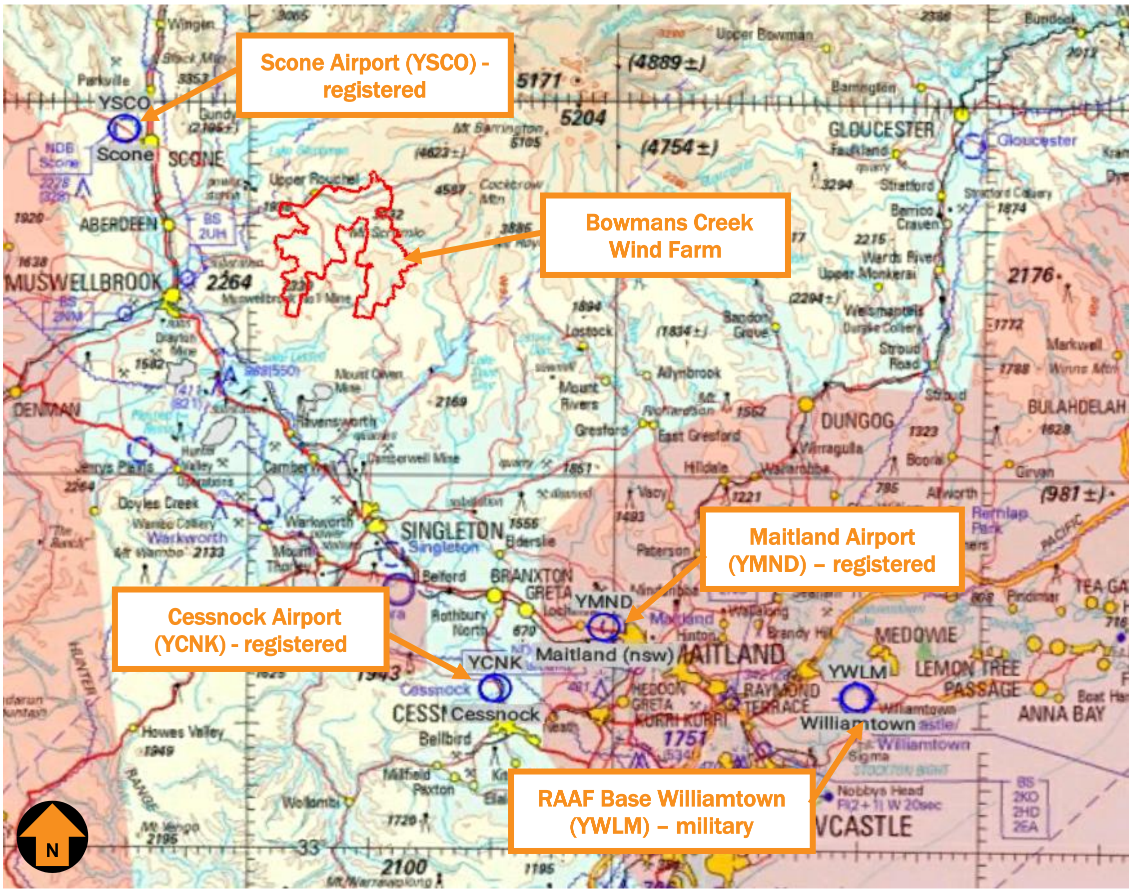


Figure 11 The proposed Project site relative to nearby registered/certified and military airports

Figure 12 shows 30 nm buffer areas (including 25 nm MSAs plus 5 nm buffer areas) for Cessnock, Maitland and Scone Airports (source: HB, Google Earth).

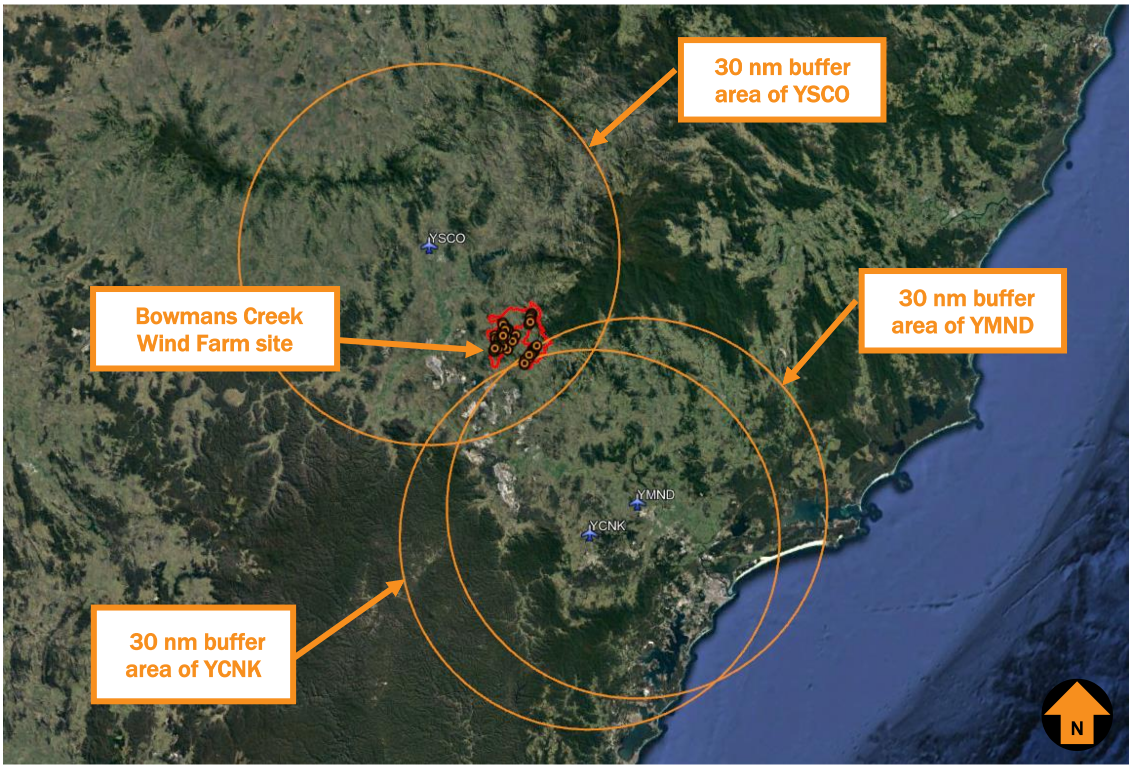


Figure 12 Cessnock, Maitland and Scone Airports – 30 nm buffer areas

### 6.2. Cessnock Airport

Cessnock Airport (YCNK) is a registered, code 2, non-instrument approach runway, operated by Cessnock City Council, with a published aerodrome elevation of 64 m AHD (210 ft AMSL) (source: Airservices Australia, FAC YCNK-1, dated 15 August 2019).

Cessnock Airport has one runway 17/35 of sealed surface with a length of 1097 m, width 23 m and runway strip 90 m.

Figure 13 shows the Cessnock Airport (YCNK) runway layout (source: AsA, FAC YCNK-2, dated 27 February 2020).

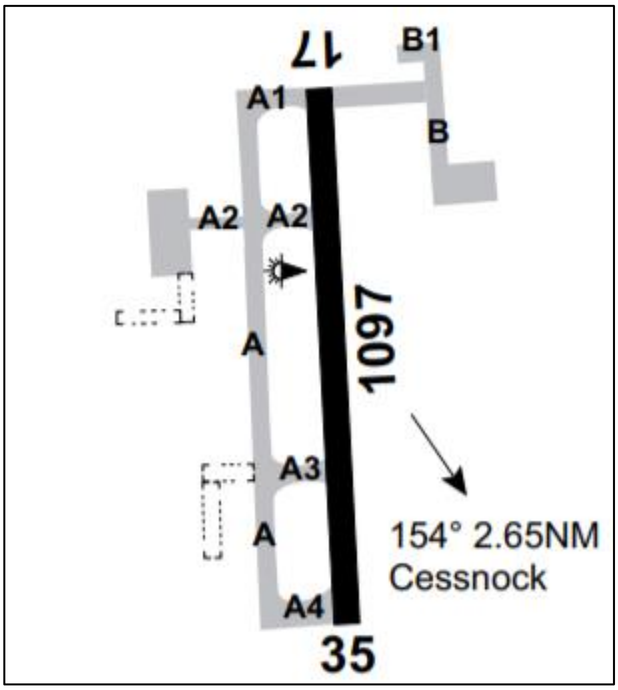


Figure 13 Cessnock Airport (YCNK) runway layout

Cessnock Airport's Aerodrome Reference Point (ARP) coordinates published in Airservices Australia's Designated Airspace Handbook (DAH) are Latitude 32°47'15"S and Longitude 151°20'30"E.

### 6.3. Instrument procedures – Cessnock Airport

A check of the AIP via the Airservices Australia website showed that Cessnock Airport is not served by instrument or non-precision approach procedures (source: Airservices Australia, FAC YCNK-1, dated 15 August 2019).

### 6.4. PANS-OPS surfaces – Cessnock Airport

Cessnock Airport is not served by served by instrument or non-precision approach procedures therefore there are no PANS-OPS surfaces.

### 6.5. Circling areas - Cessnock Airport

All turbines are located beyond the horizontal extent of aerodrome circling areas at Cessnock Airport (source: AsA, AIP, ENR 1.5-4, paragraph 1.7.6, dated 07 November 2019).

### 6.6. Obstacle limitation surfaces – Cessnock Airport

The maximum horizontal distance that an obstacle limitation surface (OLS) may extend for an aerodrome in Australia is 15 km (8.1 nm) from the edge of a runway strip.

Cessnock Airport is located approximately 55 km (29.7 nm) south east of wind turbine T22. Therefore, the Project will not impact the Cessnock Airport's OLS.

### 6.7. Maitland Airport

Maitland Airport (YMND) is a registered, code 2, non-precision approach runway, operated by Royal Newcastle Aero Club, with a published aerodrome elevation of 26 m AHD (85 ft AMSL) (source: Airservices Australia, Aerodrome Chart, dated 15 August 2019).

Maitland Airport has three runways:

- runway 05/23 sealed unrated surface with a length of 1226 m, width 15 m and runway strip 80 m;
- runway 08/26 sealed unrated surface with a length of 1011 m, width 10 m and runway strip 60 m; and
- runway 18/36 grass surface with a length of 422 m, width 18 m and runway strip 60 m.

Figure 14 shows the Maitland Airport (YMND) runway layout (source: AsA, Aerodrome Chart MNDA01-160, dated 15 August 2019).

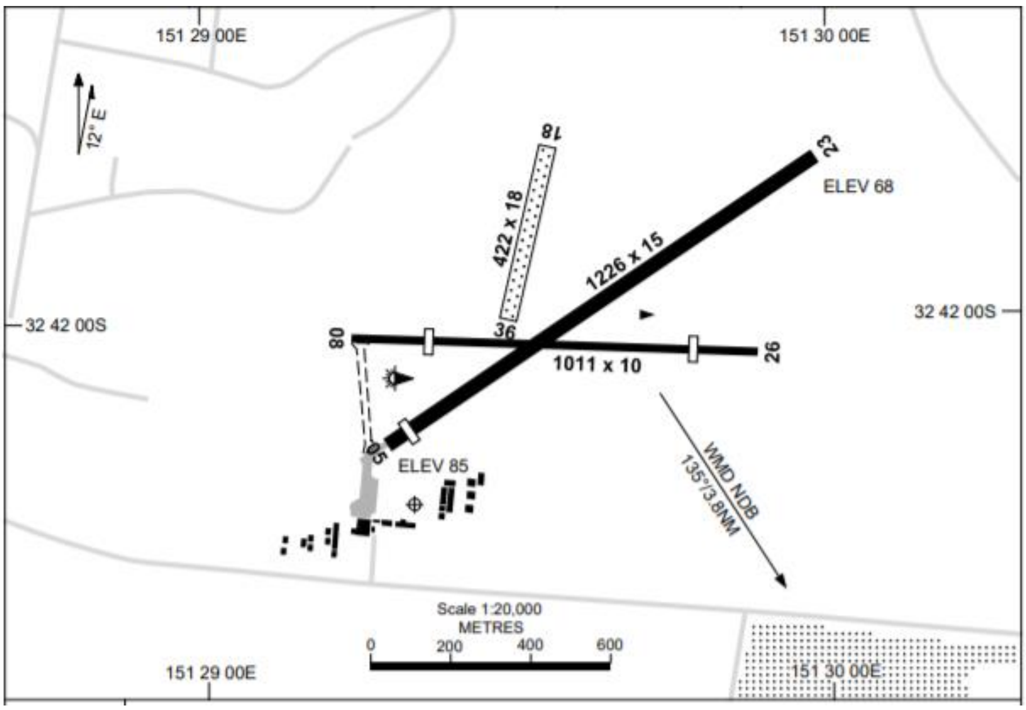


Figure 14 Maitland Airport (YMND) runway layout

Maitland Airport's ARP coordinates published in Airservices Australia's DAH are Latitude 32°42'15"S and Longitude 151°29'20"E.

Maitland Airport has low intensity runway lights (LIRL) and runway edge light available from 1730 till 2130 UTC.

### 6.8. Instrument procedures –Maitland Airport

A check of the AIP via the Airservices Australia website showed that Maitland Airport's is served by non-precision terminal instrument flight procedures, as per Table 4 (source: Airservices Australia, effective 15 August 2019). Procedure charts for Maitland Airport are designed by Airservices Australia.

Table 4 Maitland Airport (YMND) aerodrome and procedure charts

| *Chart name* | *Effective date* |
|---|---|
| AERODROME CHART (AsA) | 15 August 2019 (MNDAD01-160) |
| RNAV- W (GNSS) (AsA) | 15 August 2019 (MNDGN01-160) |

### 6.9. PANS-OPS surfaces –Maitland Airport

An image of the MSA published for Maitland Airport is shown in Figure 15.

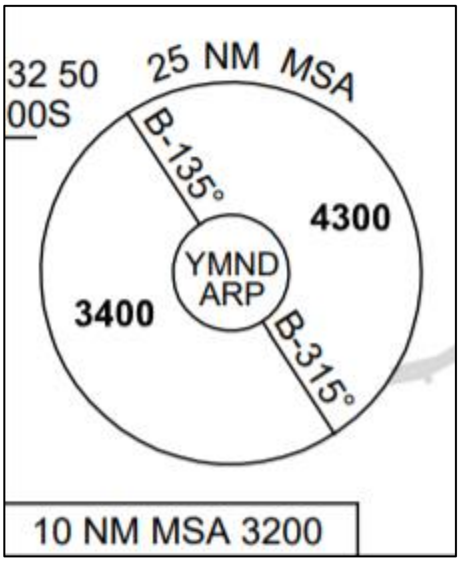


Figure 15 MSA at Maitland Airport

The Manual of Standards 173 *Standards Applicable to Instrument Flight Procedure Design* (MOS 173), requires that a minimum obstacle clearance (MOC) of 1000 ft (305 m) below the published MSA is maintained.

Obstacles within 15 nm (10 nm MSA + 5 nm buffer) and within 30 nm (25 nm MSA + 5 nm buffer) of Maitland Airport's ARP define the height at which an aircraft can fly when within 10 nm and 25 nm.

The Project is located outside of the 10 nm MSA but within the 25 nm MSA of Maitland Airport.

Figure 16 shows the 10 nm and 25 nm MSAs (+ 5 nm buffer areas) of Maitland Airport relative to the Project (source: HB, Google Earth).

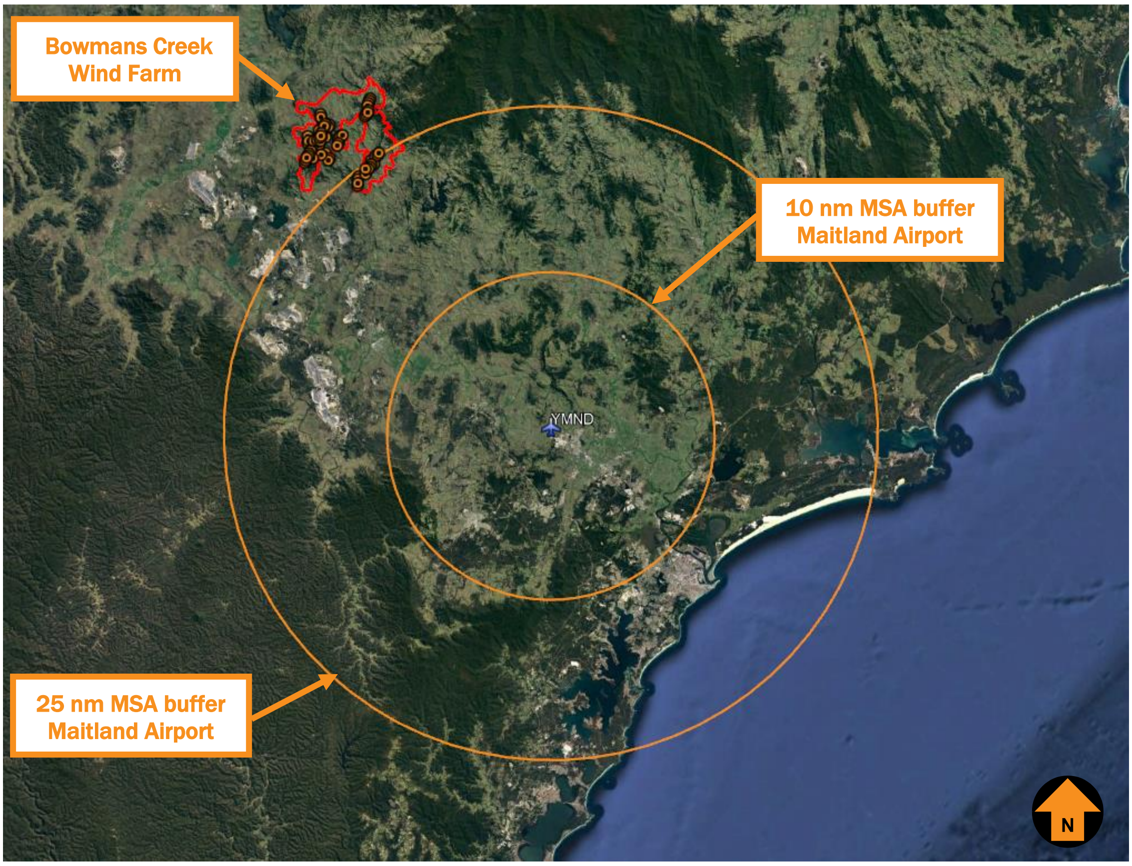


Figure 16 Maitland Airport (YMND) MSA sectors

A close up of the wind turbines located within 30 nm (25 nm MSA + 5 nm buffer) of Maitland Airport is shown in Figure 17 (source: HB, Google Earth).

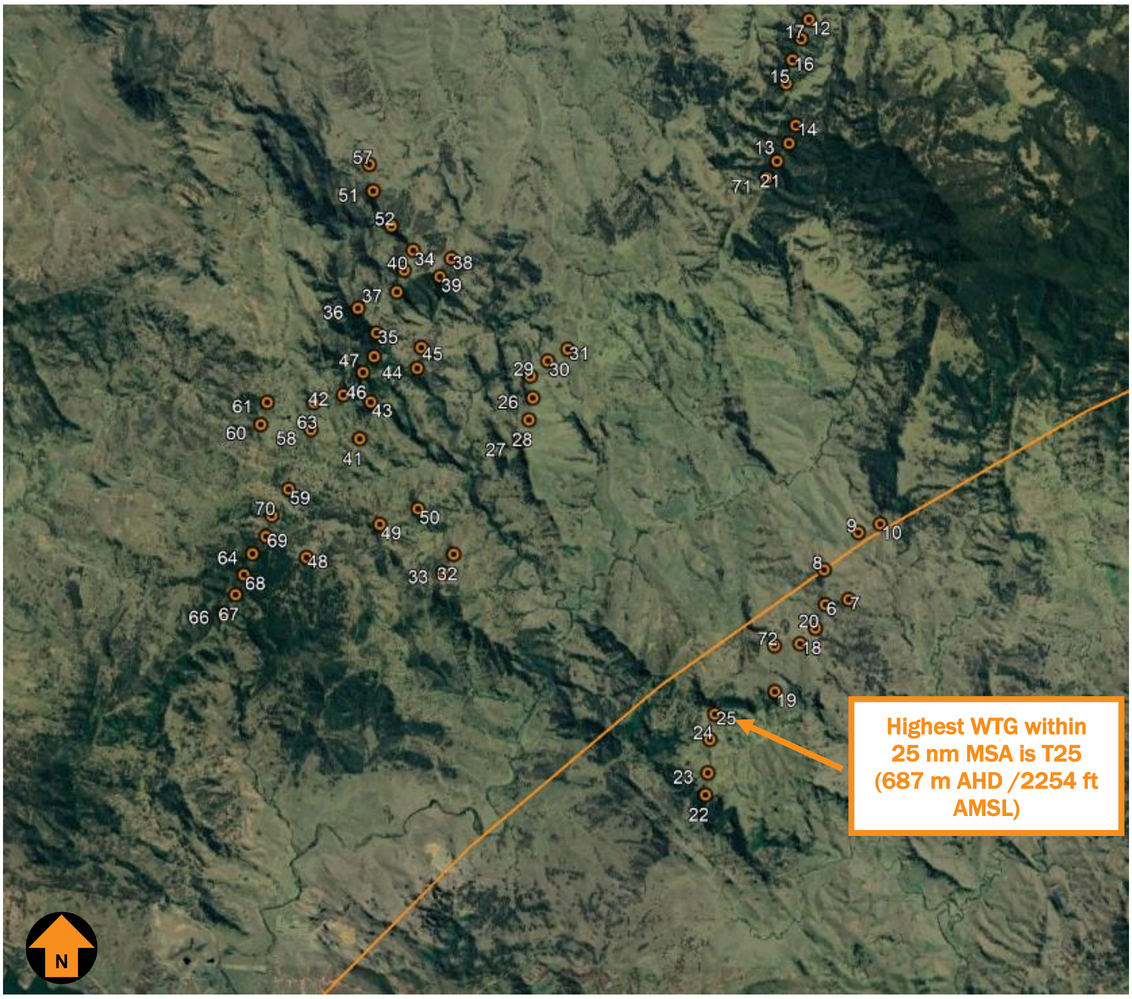


Figure 17 A close up of Maitland Airport's 25 nm MSA sector

The highest WTGs located inside of the horizontal extent of the 25 nm MSA of Maitland Airport (+ 5 nm buffer area) is T25.

The maximum overall height for T25 wind turbines is approximately 687 m AHD (2254 ft AMSL).

An impact analysis of Maitland Airport's MSA is provided in Table 5.

Table 5 Maitland Airport MSA impact analysis

| MSA | Minimum altitude | MOC | Impact on airspace design | Potential solution | Impact on aircraft ops |
|---|---|---|---|---|---|
| 10 nm | 3200 ft AMSL 975 m AHD | 2200 ft AMSL (671 m AHD) | Nil (outside of 10 nm MSA) | Not required | Nil |
| 25 nm (sector B135° and B315°) | 4300 ft AMSL (1311 m AHD) | 3300 ft AMSL (1006 m AHD) | Nil (below the controlling surface) | Not required | Nil |
| 25 nm (sector B315° and B135°) | 3400 ft AMSL (1036 m AHD) | 2400 ft AMSL (731 m AHD) | Nil (below the controlling surface) | Not required | Nil |

The highest wind turbine located in the sector between bearings B315°and B135°of the 25 nm MSA and in the 5 nm buffer of the sector between bearings B135° and B315° is wind turbine T25 which will be below the 25 nm MSA MOC of Maitland Airport by approximately 44 m (146 ft). Therefore, the Project will not impact the 10 nm and 25 nm MSA of Maitland Airport.

### 6.10. Circling areas - Maitland Airport

All turbines are located beyond the horizontal extent of category A and category B circling areas at Maitland Airport (source: AsA, AIP, ENR 1.5-4, paragraph 1.7.6, dated 07 November 2019).

### 6.11. Obstacle limitation surfaces – Maitland Airport

For Code 2 non-precision runway the maximum lateral extent of the OLS is up to 4700 m for the conical surface.

The closest proposed wind turbine T22 is located approximately 54 km (29 nm) north west from Maitland Airport. Therefore, the Project site is located outside the horizontal extent of any obstacle limitation surfaces and will not impact the OLS of Maitland Airport.

### 6.12. Scone Airport

Scone Airport (YSCO) is a registered, code 2, non-precision approach runway, operated by Upper Hunter Shire Council, with a published aerodrome elevation of 227 m AHD (745 ft AMSL) (source: Airservices Australia, Aerodrome Chart SCOAD01-160, 15 August 2019).

Scone Airport has one sealed runway 11/23 with a length of 1404 m, width 30 m and runway strip 90 m.

Figure 18 shows the Scone Airport (YSCO) runway layout (source: AsA, FAC YSCO-1, dated 07 November 2019).

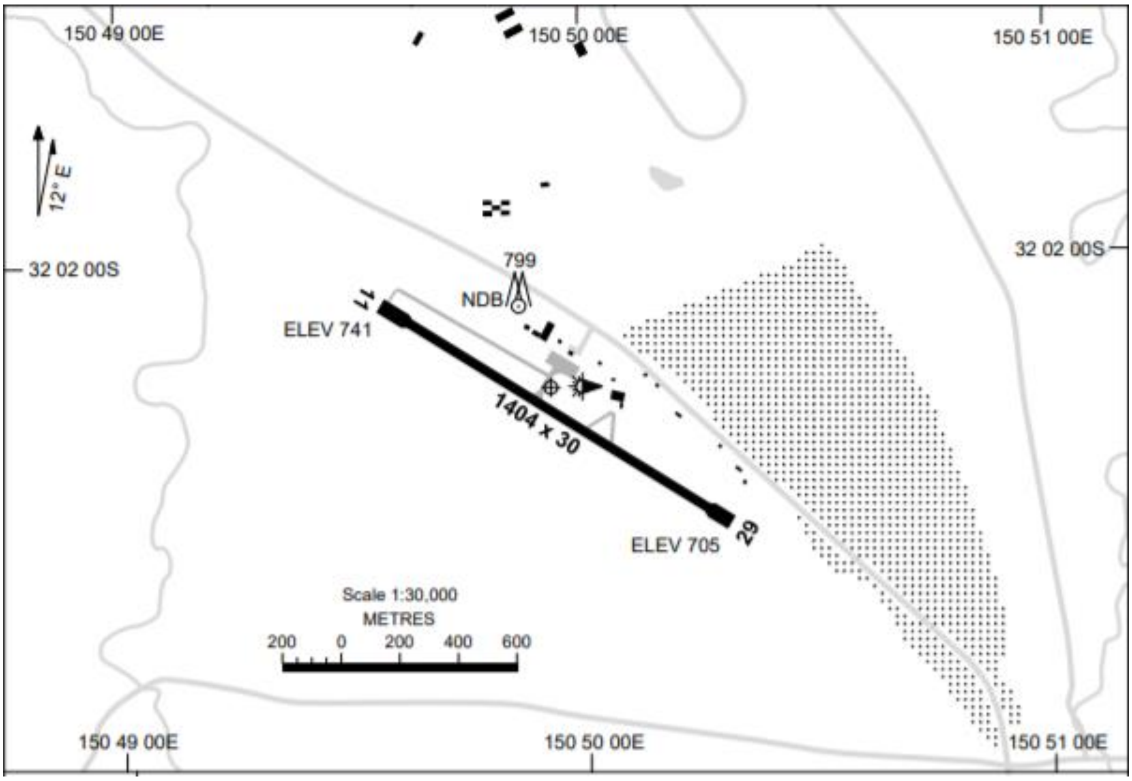


Figure 18 Scone Airport (YSCO) runway layout

Scone Airport's ARP coordinates published in Airservices Australia's DAH are Latitude 32°02'14"S and Longitude 150°49'56"E.

Scone Airport has aerodrome lighting and radio navigation and landing aids (a non-directional (radio) beacon NDB).

### 6.13. Instrument procedures – Scone Airport

A check of the AIP via the Airservices Australia website showed that Scone Airport is served by non-precision terminal instrument flight procedures, as per Table 6 (source: Airservices Australia, effective 15 August 2019).

Procedure charts for Scone Airport are designed by Airservices Australia.

Table 6 Scone Airport (YSCO) aerodrome and procedure charts

| Chart name | Effective date |
|---|---|
| AERODROME CHART (AsA) | 15 August 2019 (SCOAD01-160) |
| NDB-A (AsA) | 15 August 2019 (SCONB01-160) |
| RNAV-Z GNSS RWY 29 (AsA) | 15 August 2019 (SCOGN01-160) |

### 6.14. PANS-OPS surfaces – Scone Airport

An image of the MSA published for Scone Airport is shown in Figure 19.

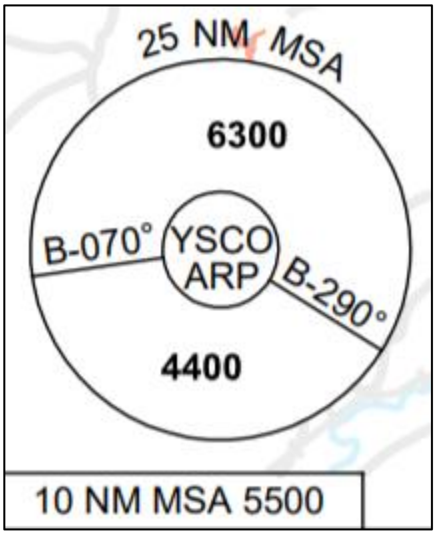


Figure 19 MSA at Scone Airport

The Manual of Standards 173 *Standards Applicable to Instrument Flight Procedure Design* (MOS 173), requires that a minimum obstacle clearance (MOC) of 1000 ft below the published MSA is maintained.

Obstacles within 15 nm (10 nm MSA + 5 nm buffer) and within 30 nm (25 nm MSA + 5 nm buffer) of Scone Airport's ARP define the height at which an aircraft can fly when within 10 nm and 25 nm.

The Project boundary is located within the 10 nm MSA and the 25 nm MSA of Scone Airport. However, the closest WTGs are located outside the 10 nm MSA.

Figure 20 shows the 10 nm and 25 nm MSAs (+ 5 nm buffer areas) of Scone Airport relative to the Project (source: HB, Google Earth).

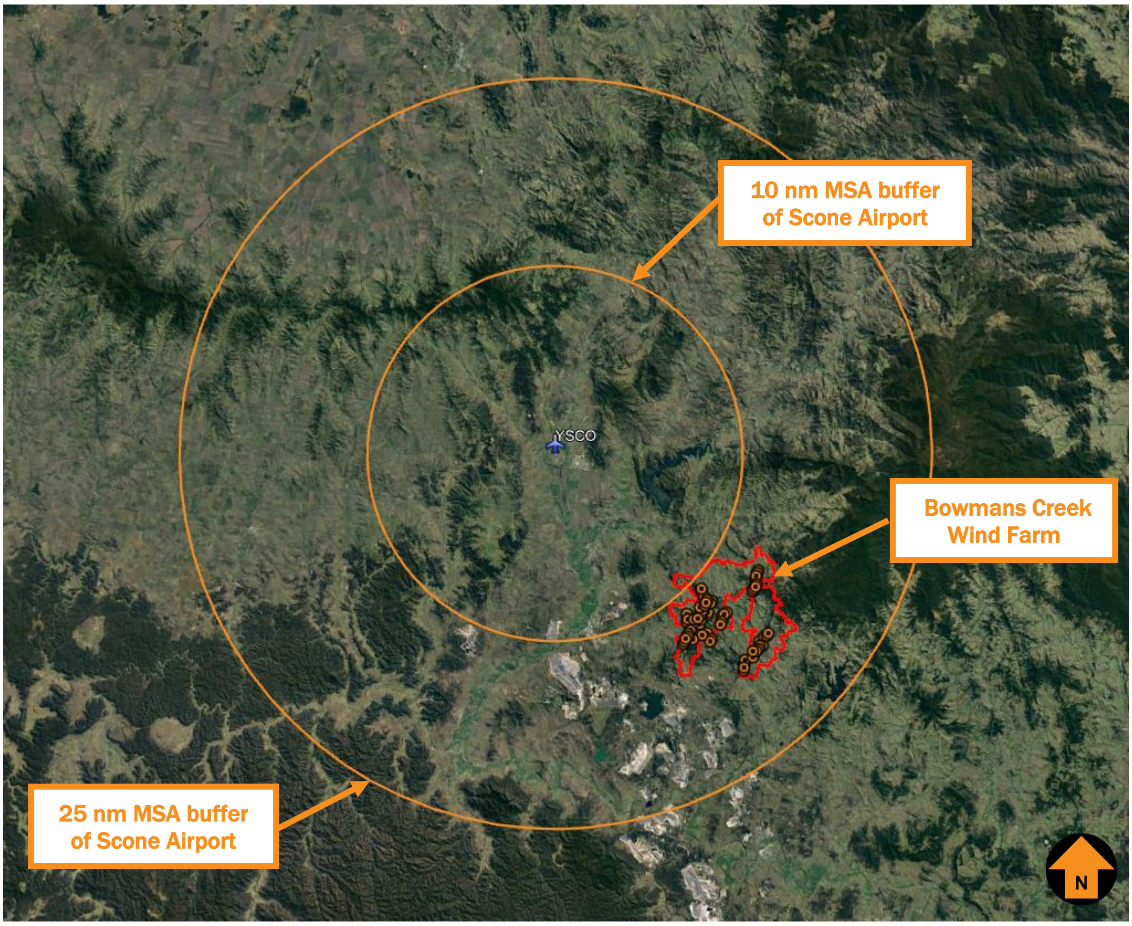


Figure 20 Scone Airport (YSCO) MSA sectors

A close up of the wind turbines and the project boundary located within 30 nm (25 nm MSA + 5 nm buffer) of Scone Airport is shown in Figure 21 (source: HB, Google Earth).

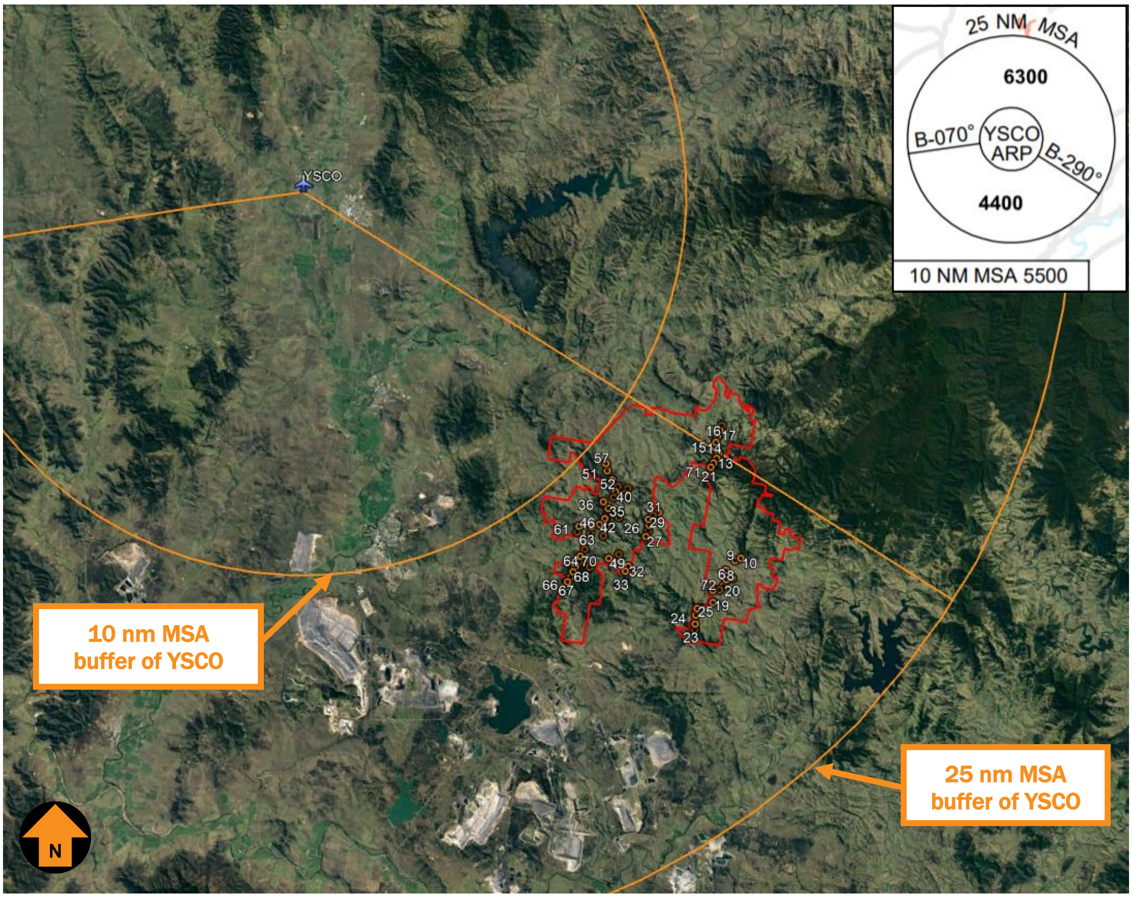


Figure 21 A close up of Scone Airport's 25 nm MSA sector (including 5 nm buffer)

The highest WTG located inside of the horizontal extent of the 25 nm MSA of Scone Airport (+ 5 nm buffer area) is T46.

The maximum overall height for wind turbine T46 is approximately 911 m AHD (2988 ft AMSL).

An impact analysis of Scone Airport's MSA is provided in Table 7.

Table 7 Scone Airport MSA impact analysis

| MSA | Minimum altitude | MOC | Impact on airspace design | Potential solution | Impact on aircraft ops |
|---|---|---|---|---|---|
| 10 nm | 5500 ft AMSL (1676 m AHD) | 4500 ft AMSL (1372 m AHD) | Nil (below the controlling altitude) | N/A | N/A |
| 25 nm (sector B070° and B290°) | 6300 ft AMSL (1920 m AHD) | 5300 ft AMSL (1615 m AHD) | Nil (below the controlling altitude) | N/A | N/A |
| 25 nm (sector B290° and B070°) | 4400 ft AMSL (1341 m AHD) | 3400 ft AMSL (1036 m AHD) | Nil (below the controlling altitude) | N/A | N/A |

Therefore, the Project will not impact the 10 nm and 25 nm MSA of Scone Airport.

### 6.15. Circling areas - Scone Airport

All turbines are located beyond the horizontal extent of category A, category B and category C circling areas at Scone Airport (source: AsA, AIP, ENR 1.5-4, paragraph 1.7.6, dated 07 November 2019).

The maximum horizontal distance that category C circling area may extend for an aerodrome in Australia is 4.2 nm (7.8 km) from the threshold of each usable runway.

The closest proposed wind turbine T57 is located approximately 29.6 km (16 nm) south east from Scone Airport. Therefore, the Project site is located outside the horizontal extent of circling areas at Scone Airport and will have no impact.

### 6.16. Obstacle limitation surfaces – Scone Airport

For Code 2 non-precision runway the inner horizontal surface extends up to 4700 m for the conical surface at Scone Airport.

The closest proposed wind turbine T57 is located approximately 29.6 km (16 nm) south east from Scone Airport. Therefore, the Project site is located outside the horizontal extent of any OLS and will not impact the OLS of Scone Airport.

### 6.17. Nearby aircraft landing areas

As a guide, an area of interest within a 3 nm radius of an aircraft landing area (ALA) is used to assess potential impacts of proposed developments on aircraft operations at or within the vicinity of the ALA.

A search on OzRunways, which sources its data from Airservices Australia (AIP), returned 3 uncertified aerodromes within close proximity to the Project site. The aeronautical data provided by OzRunways is approved under CASA CASR Part 175.

Epuron provided the locations of 9 other ALAs nearby the Project site.

Given the proposed WTGs are located outside a nominal 3 nm buffer of ALA 6, ALA 7, ALA 8, ALA 9, ALA 10, ALA 11 and ALA 12, these ALAs will not be impacted by the Project.

The details of identified/nearby ALAs to the nearest turbine are shown in Table 8.

Table 8 Nearby aircraft landing areas

| ALA Name | ICAO code | Registration status | Distance from the nearest WTG | Location relative to the nearest WTG | Nearest WTG | Impact on the OLS | Impact on flight circuit(s) | Potential wake turbulence from WTGs |
|---|---|---|---|---|---|---|---|---|
| ALA 1 | N/A | uncertified | 300 m | east | T31 | Nil | Likely | Likely |
| ALA 2 | N/A | uncertified | 1 km (0.6 nm) | south east | T26 | Nil | Likely | Likely |
| ALA 3 | N/A | uncertified | 3.3 km (1.8 nm) | south west | T71 | Nil | Nil | Nil |
| ALA 4 | N/A | uncertified | 530 m | north west | T9 | Nil | Likely | Likely |
| ALA 5 | N/A | uncertified | 3.5 km (1.9 nm) | south west | T57 | Nil | Nil | Nil |
| ALA 6 | N/A | uncertified | 12 km (6.5 nm) | south | T22 | Nil | Nil | Nil |
| ALA 7 | N/A | uncertified | 13.6 km (7.3 nm) | south east | T22 | Nil | Nil | Nil |
| ALA 8 | N/A | uncertified | 7 km (3.7 nm) | north east | T12 | Nil | Nil | Nil |
| ALA 9 | N/A | uncertified | 25 km (13.6 nm) | south west | T67 | Nil | Nil | Nil |
| ALA 10 | YWKW | uncertified | 27 km (14.6 nm) | south west | T22 | Nil | Nil | Nil |
| ALA 11 | YSGT | uncertified | 31 km (16.7 nm) | south | T22 | Nil | Nil | Nil |
| ALA 12 | YDOC | uncertified | 37 km (20 nm) | south | T22 | Nil | Nil | Nil |
| ALA 13 | N/A | uncertified | 2.2 km (1.2 nm) | south east | T7 | Nil | Nil | Likely |

Figure 22 shows nearby ALAs relative to the Project boundary and layout (source: OzRunways, Epuron, Google Earth).

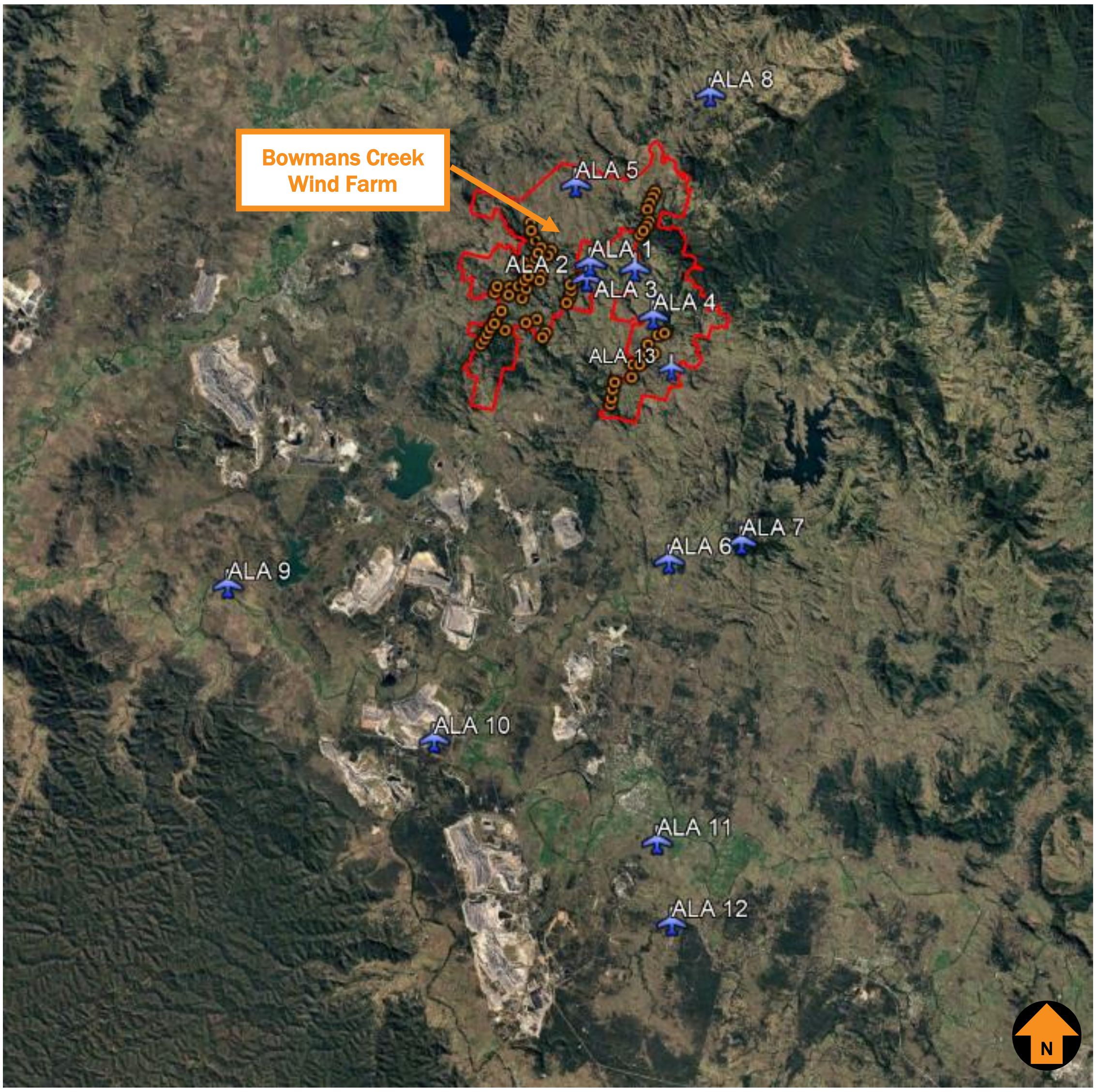


Figure 22 Proposed Project site area relative to nearby ALAs

However, some of the WTGs are located inside a nominal 3 nm buffer of ALA 1, ALA 2, ALA 3, ALA 4, ALA 5 and ALA 13. Further analysis of potential impacts of the Project on aircraft operations at these ALAs is presented below.

Figure 23 shows a close up of likely impacted ALAs with the 3 nm radii of these ALAs in pumpkin colour (source: OzRunways, Epuron, Google Earth).

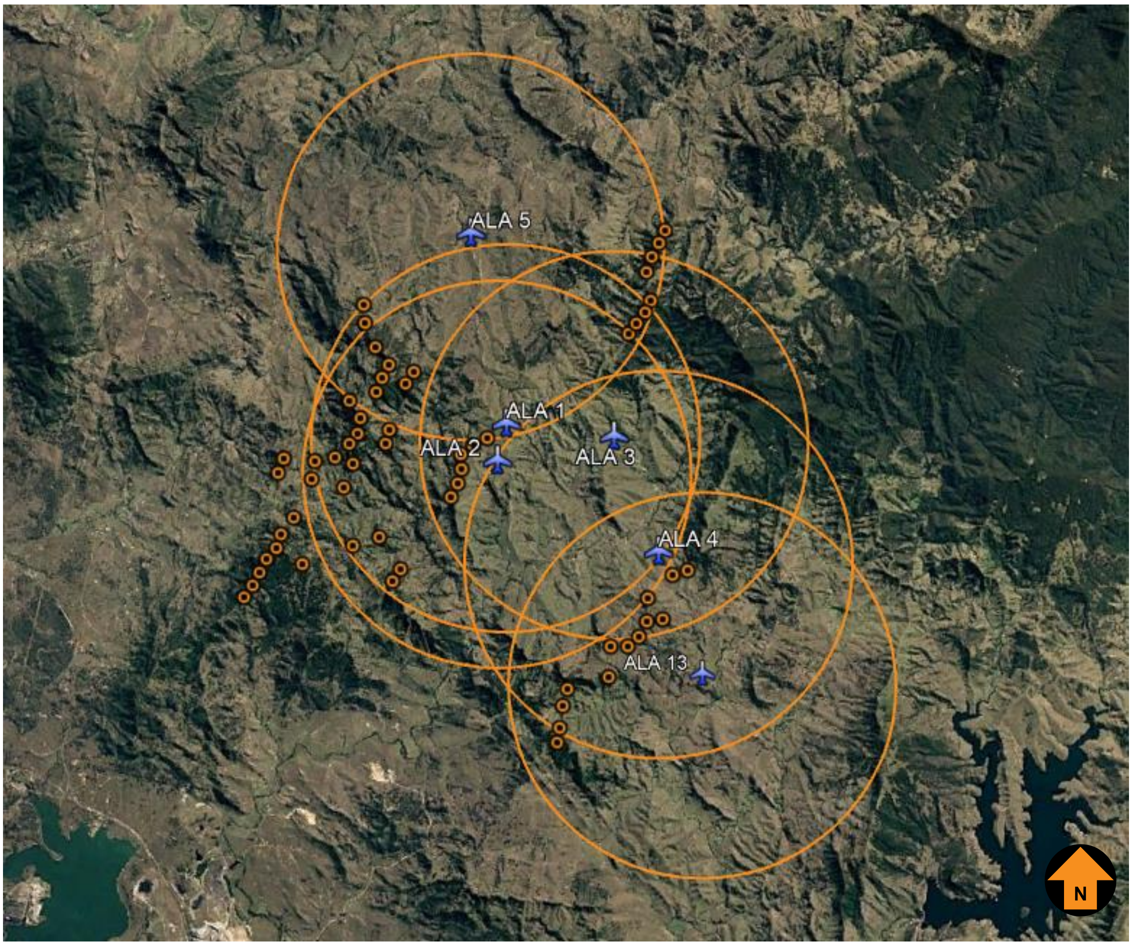


Figure 23 Proposed Project site area relative to ALA 1, ALA 2, ALA 3, ALA 4, ALA5 and ALA 13

<u>Approach and take-off surfaces</u>

As a means of providing guidance to ALA operators, CASA has published recommended practices in its Civil Aviation Advisory Publication (CAAP) 92-1(1) *Guidelines for aeroplane landing areas*.

The purpose of the CAAP 92-1(1) guidance is described as follows:

> *These guidelines set out factors that may be used to determine the suitability of a place for the landing and taking-off of aeroplanes. Experience has shown that, in most cases, application of these guidelines will enable a take-off or landing to be completed safely, provided that the pilot in command:*
>
> *a. has sound piloting skills; and*
>
> *b. displays sound airmanship.*

A copy of CAAP 92-1(1) Figure 2A – *Single engine and Centre-Line Thrust Aeroplanes not exceeding 2000 kg MTOW (day operations),* which shows the physical characteristics applicable to the circumstances, is provided in Figure 24.

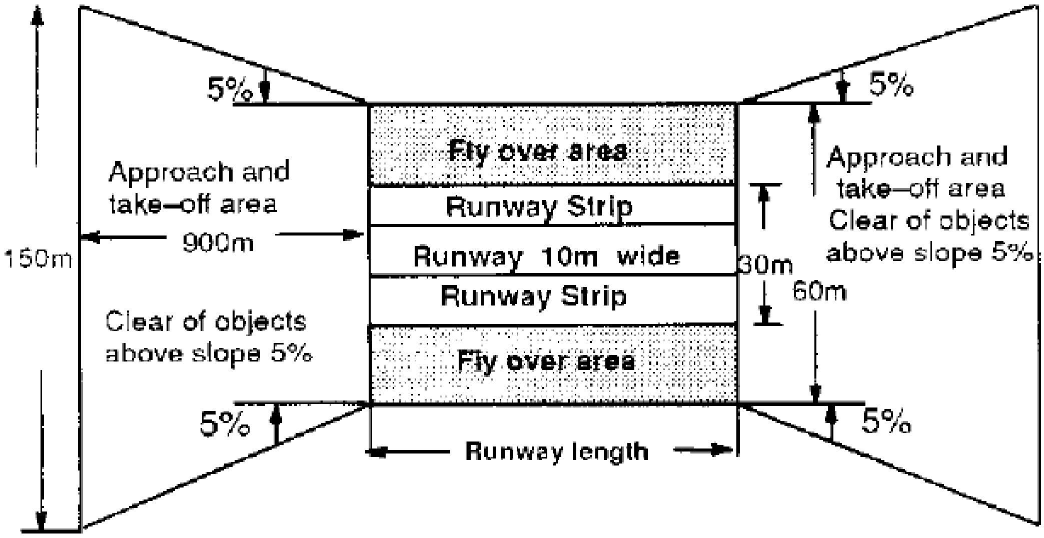


Figure 24 CAAP 92-1(1) Figure 2A

The approach and take-off surfaces for each runway end commence at the runway end (threshold) at a distance of 30 m either side of the runway centreline and diverge at a rate of 5% to a distance of 900 m. The surfaces increase in height at a rate of 5%, or 5 m in every 100 m.

All WTGs are located outside of the approach and take-off surface of ALA 1, ALA 2, ALA 3, ALA 4, ALA 5 and ALA 13. Therefore, the approach and take-off surfaces of these ALAs will not be impacted by the Project.

<u>Aerodrome circuits</u>

For the purpose of this AIA the wind turbines located in proximity to ALA 1, ALA 2, ALA 3, ALA 4, ALA 5 and ALA 13 have been analysed to identify any potential impacts on the aerodrome's circuit operations.

The analysis of flight circuits is based on the recommendations provided in the CASA Advisory Publications (CAAP) 92 1(1) and (CAAP) 166-01 v4.2.

For the purposes of the aerodromes circuit operations of ALA 1, ALA 2, ALA 4 and ALA 13, the following design parameters have been adopted:

- 1 nm upwind to achieve at least 500 ft AGL;
- 1 nm abeam the runway for downwind spacing;
- 45° relative position from the threshold for the turn from downwind onto the base leg; and
- Roll out at 1 nm final, not below 500 ft AGL.

Figure 25, Figure 26, Figure 27 and Figure 28 show a close up of the nearest wind turbines relative to ALA 1, ALA 2, ALA 4 and ALA 13 showing the indicative flight circuits for operations and 3 nm radii of these ALAs (source: HB and Google Earth).

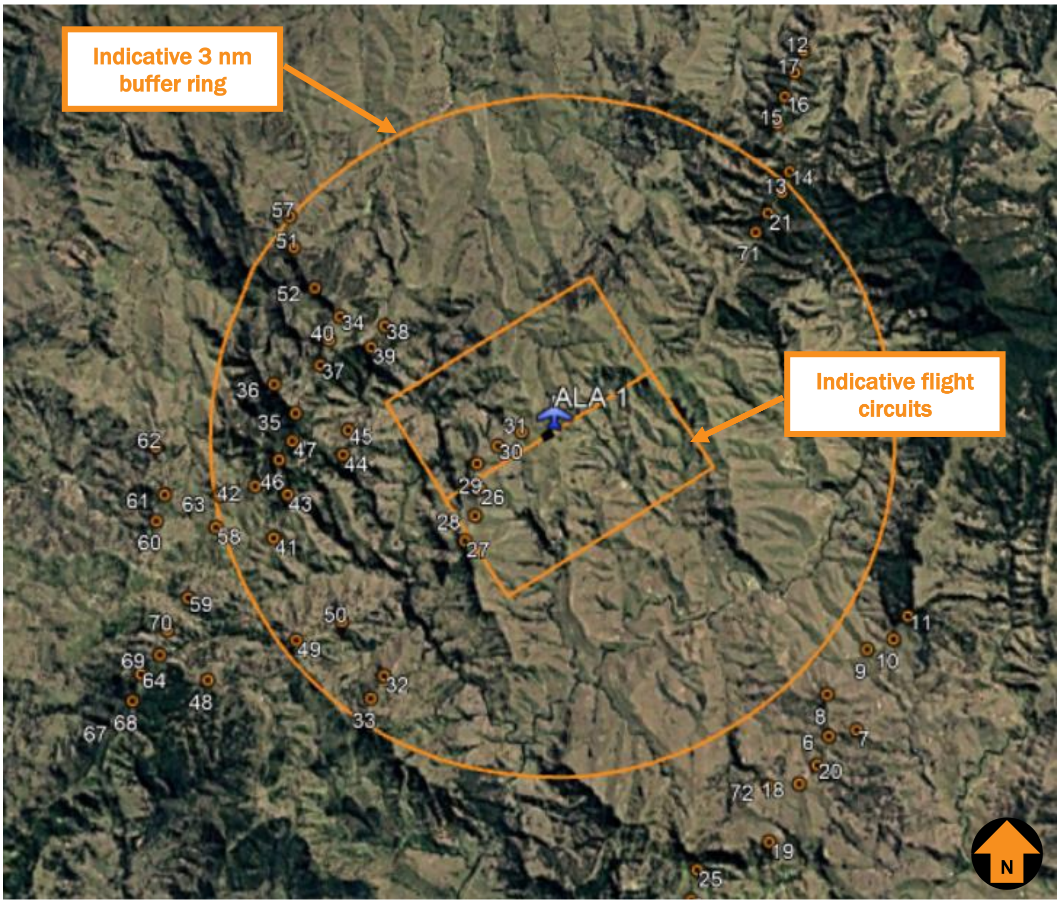


Figure 25 ALA 1 relative to the proposed WTGs

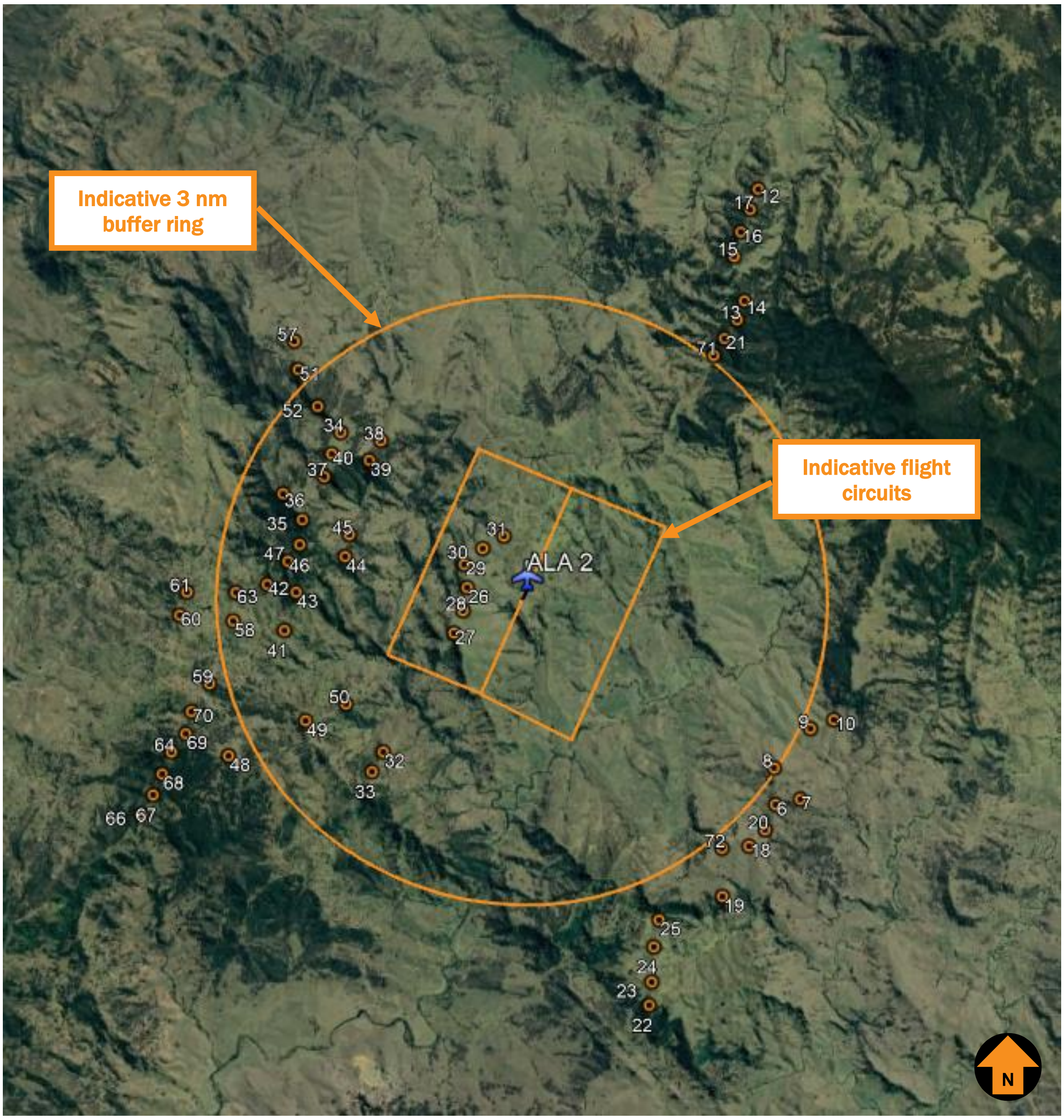


Figure 26 ALA 2 relative to the proposed WTGs

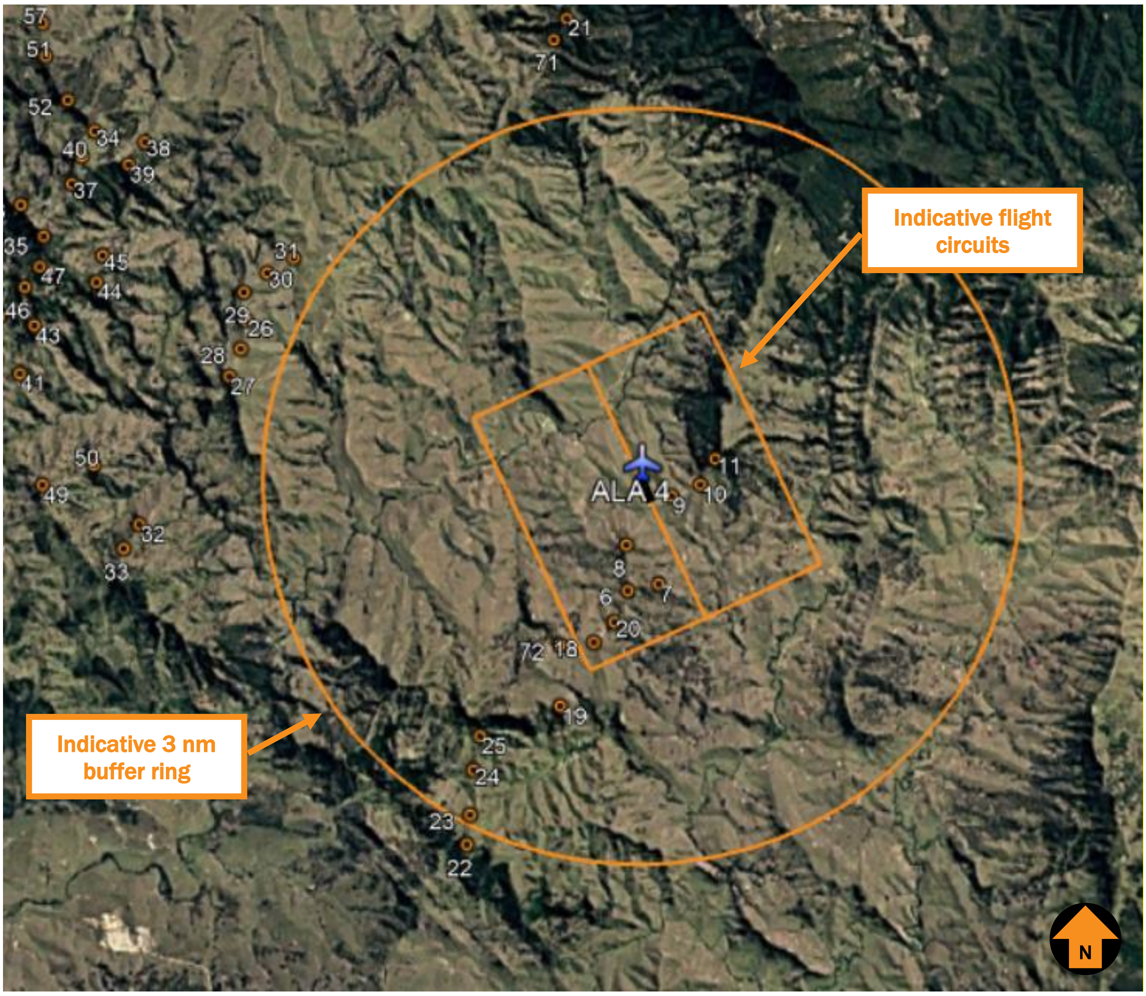


Figure 27 ALA 4 relative to the proposed WTGs

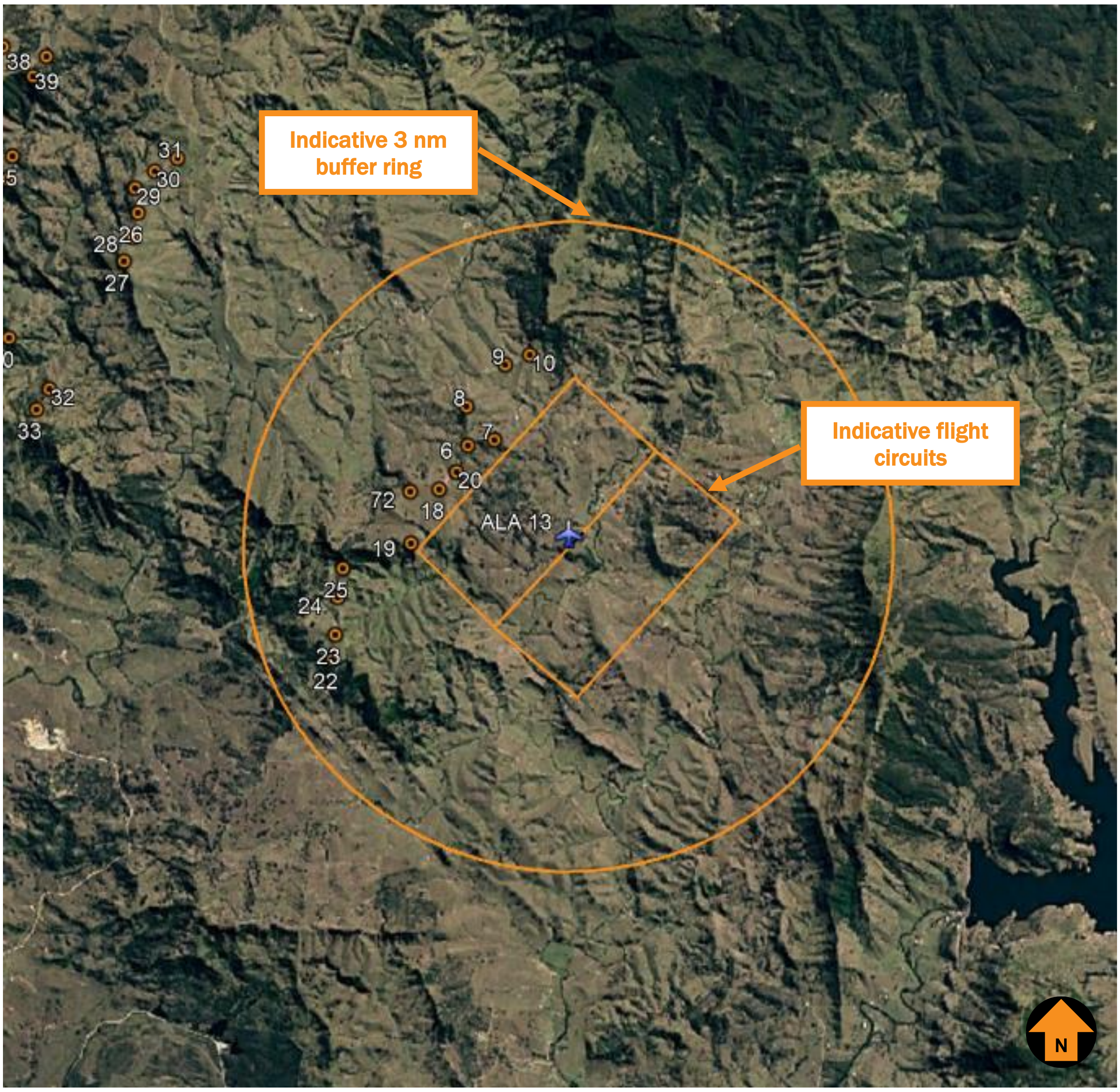


Figure 28 ALA 13 relative to the proposed WTGs

Epuron advises that ALA 2 and ALA 4 are located on land associated with the Project and it is not known if these ALAs are used. However, if operational, both circuit directions for ALA 4 and the western circuit of ALA 2 would be impacted by the Project.

If operational, both circuit directions for ALA 1 would be impacted by the Project.

Aerodrome circuits of ALA 13 will not be impacted by the Project.

The Proponent should consult with land hosts of ALA 1, ALA 2 and ALA 4 to address potential impacts on the aerodromes circuit operations of these ALAs.

<u>Further discussion of the potential impacts from wake turbulence is presented below</u>

Consideration should be given to recommendations outlined in the NASF Guideline D – *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers*.

NASF Guideline D provides guidance to State/Territory and local government decision makers, airport operators and developers of wind farms to jointly address the risk to civil aviation arising from the development, presence and use of wind farms and wind monitoring towers.

Guidance regarding wind turbine wake turbulence states:

> *Wind farm operators should be aware that wind turbines may create turbulence which noticeable up to 16 rotor diameters from the turbine. In the case of one of the larger wind turbines with a diameter of 125 metres, turbulence may be present two kilometres downstream. At this time, the effect of this level of turbulence on aircraft in the vicinity is not known with certainty. However, wind farm operators should be conscious of their duty of care to communicate this risk to aviation operators in the vicinity of the wind farm…*

The effects of wake turbulence could be noticeable while performing circuits for ALA 1, ALA 2, ALA 4 and ALA 13. Further investigation will be required to determine the impact, if any, of wake turbulence at ALA 1, ALA 2, ALA 4 and ALA 13.

The Proponent should consult with land hosts of ALA 1, ALA 2, ALA 4 and ALA 13 to address potential effects of wake turbulence from the nearest WTGs.

To facilitate the flight planning of aerial application operators, details of the Project, including location and height information of wind turbines, wind monitoring towers and overhead powerlines should be provided to landowners so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information.

### 6.18. Air routes and LSALT

MOS 173 requires that a minimum obstacle clearance of 1000 ft below the published lowest safe altitude (LSALT) is maintained along each air route.

The Project is solely located in the area with a grid lowest safe altitude of 6600 ft AMSL (2012 m AHD) with a MOC surface of 5600 ft AMSL (1707 m AHD).

The highest wind turbine is T46, with a maximum overall height of 911 m AHD (2988 ft AMSL) and is below the LSALT MOC of 5600 ft AMSL by approximately 796 m (2612 ft AMSL). Therefore, the proposed Project will not affect the grid LSALT of 6600 ft AMSL.

Figure 29 provides the grid LSALT and air routes in proximity to the proposed Project (source: ERC Low National, OzRunways, 09 October 2019).

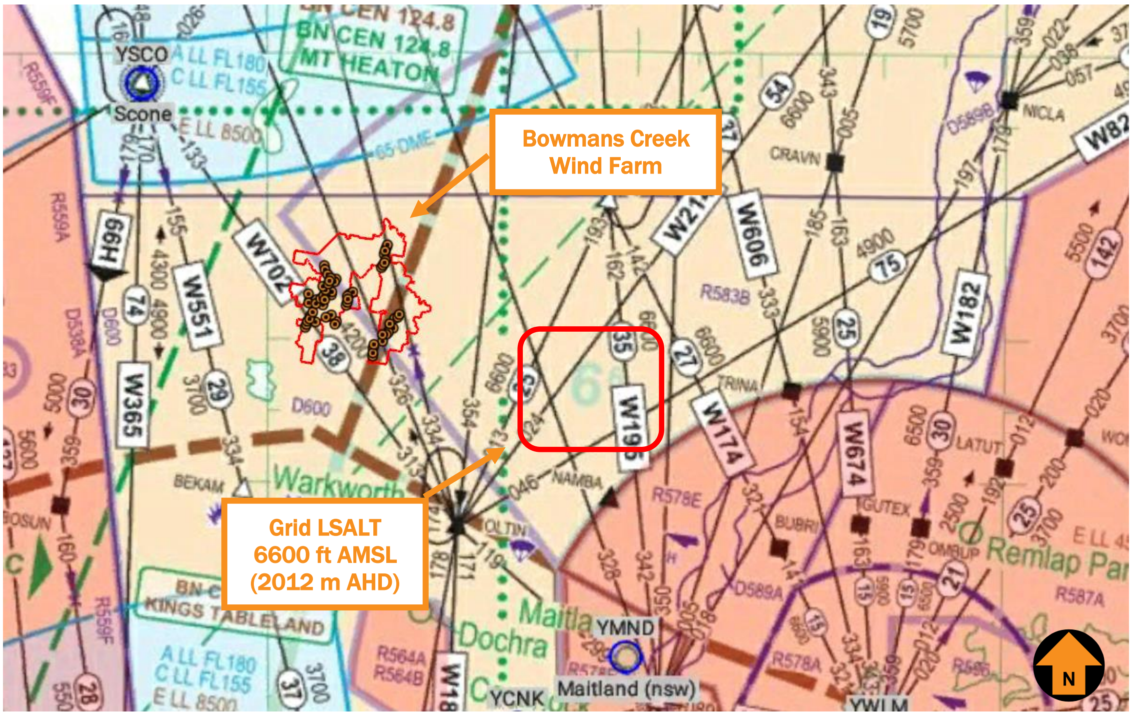


Figure 29 Air routes in proximity to the proposed Project

An impact analysis of the surrounding air routes is provided in Table 9.

Table 9 Air route impact analysis

| *Air route* | *Waypoint pair* | *Route LSALT* | *MOC* | *Impact on airspace design* | *Potential solution* | *Impact on aircraft ops* |
|---|---|---|---|---|---|---|
| W702 | YSCO and OLTIN | 4200 ft AMSL | 975 m AHD 3200 ft AMSL | Nil | Not required | Nil |
| W298 | YMOR and OLTIN | 6500 ft AMSL | 1676 m AHD 5500 ft AMSL | Nil | Not required | Nil |
| W130 | OLTIN and YSTW | 6200 ft AMSL | 1585 m AHD 5200 ft AMSL | Nil | Not required | Nil |

Note: MOC is the height above which obstacles would impact on LSALTS or air routes.

The Project will not impact on route or grid LSALTs.

### 6.19. Airspace Protection

The Project site is located outside controlled airspace (wholly within Class G airspace) but within the Restricted Area R583B and the Danger Area D600 associated with RAAF Base Williamtown military restricted airspace.

The restrictions of the Restricted Area R583B on the airspace is detailed below:

- military flying area along the arc of a circle of 25 nm centred on 32°47'49"S and 151°49'59"E (Williamstown Terminal Area Chart (TAC)) which is vertically restricted from surface up to 10,000 ft AMSL;
- hours of activity as detailed by NOTAM; and
- operated by No 453 Squadron at RAAF Base Williamtown.

The restrictions of the Danger Area D600 on the airspace is detailed below:

- military jet corridor which is vertically restricted from surface up to 8,000 ft AMSL;
- hours of activity as detailed by NOTAM; and
- operated by No 453 Squadron at RAAF Base Williamtown.

Figure 30 shows the Project location in relation to the Restricted Area R583B and the Danger Area D600 of RAAF Base Williamtown (source: OzRunways, Hybrid VFR, dated 09 October 2019).

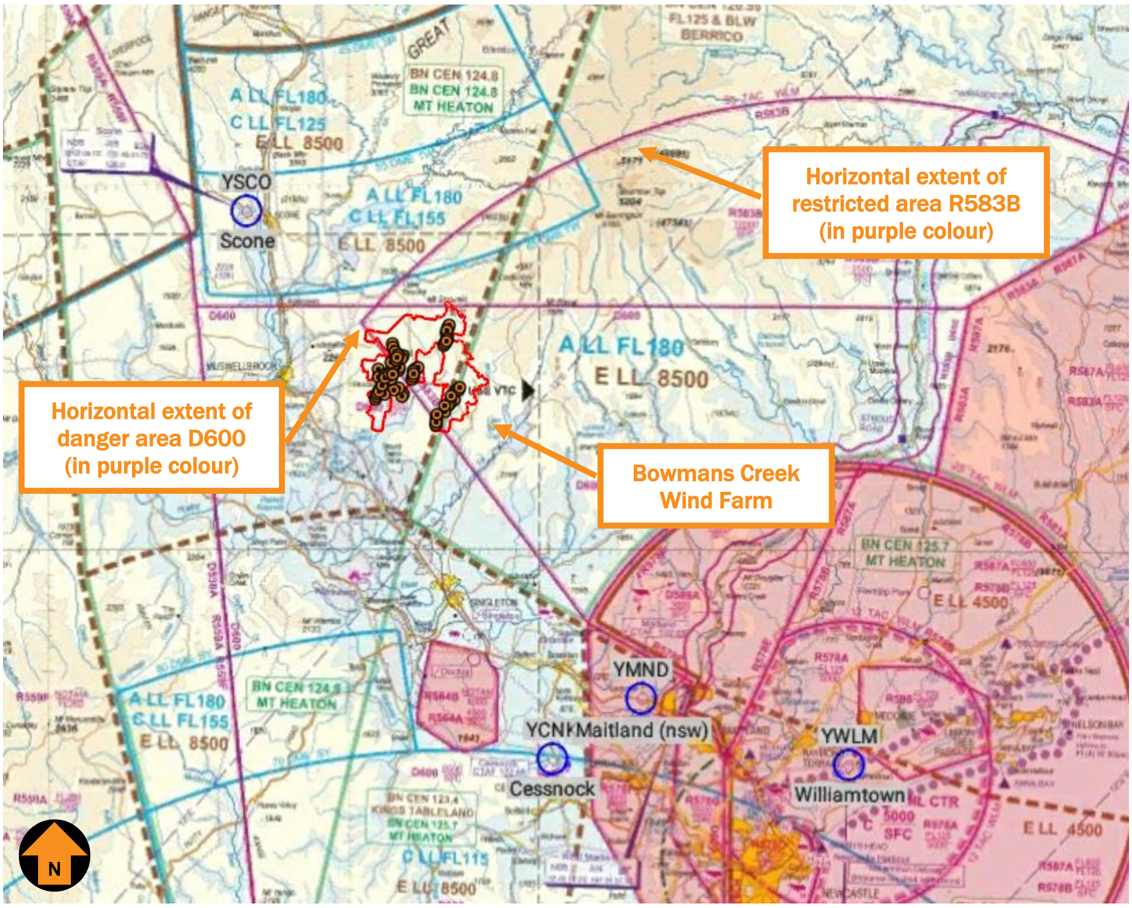


Figure 30 The Project site location and surrounding airspace

All turbines within the Restricted Area R583B and the Danger Area D600 will be within the applicable vertical restriction limits. Therefore, the Proponent should consult with the Department of Defence on any potential impacts of the proposed Project on military flying training in these two areas.

### 6.20. Aviation facilities

The wind turbines of the Project will not penetrate any protection areas associated with aviation facilities. The closest aviation facility is an NDB at Scone Airport located approximately 29 km (16 nm) to the north east from the Project and will not be impacted.

### 6.21. Radar

Airservices Australia currently requires an assessment of the potential for wind turbines to affect radar line of sight.

With respect to aviation radar facilities, the following radars were identified in proximity from the Project site:

- Cecil Park SSR and Cecil Park Primary Surveillance Radar (PSR) located approximately 175 km (95 nm) south west;
- Sydney SSR and Sydney PSR located approximately 181 km (98 nm) south; and
- Williamtown tactical air command located approximately 84 km (45 nm) south east.

The EUROCONTROL guidelines for assessing the potential impact of wind turbines on surveillance sensors identifies the PSR and SSR safeguarding and assessments ranges.

The EUROCONTROL guidelines state:

> *When outside the radar line of sight of a PSR, the impact of the wind turbine (3-blades, 30-200 m height, and horizontal rotation axis) is considered to be tolerable.*
>
> *When further than 16 km from an SSR the impact of a wind turbine (3-blades, 30-200 m height, and horizontal rotation axis) is considered to be tolerable.*

The proposed Project site is located in Zone 4 and outside the radar line of sight of Cecil Park PSR/SSR and Sydney PSR/ SSR, and will not interfere with the serviceability of these aviation facilities. However, it is unlikely that the Project will impact Cecil Park PSR/SSR and Sydney PSR/ SSR

The potential impact of wind turbines on military L-Band Radar and TACAN (Tactical Air Navigation) and other potential aviation radars located at RAAF Base Williamtown should be discussed with the Department of Defence. However, it is unlikely that the Project will impact on aviation radars at RAAF Base Williamtown.

This conclusion is based on the grounds that the project is located approximately 82 km north west from the RAAF Base Williamtown, the proposed wind turbines are shielded by natural terrain and outside of the assessment ranges for radar line of sight assessment criteria.

### 6.22. Bureau of Meteorology

With respect to the Bureau of Meteorology (BoM) radars, the closest weather radar is the Newcastle radar located at Lemon Tree Passage (latitude 32.730°S, longitude 152.027 E) approximately 95 km (51 nm) south east from the Project site (source: BoM, NSW radar information).This is a  WSR 74 S Band Doppler which operates 24 hours per day.

It is unlikely that the Project will impact the Newcastle radar.

### 6.23. Airservices Australia

Airservices Australia response is copied below:

> *Airspace Procedures*
>
> *With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at the various heights provided, the wind turbines and masts will not affect any sector or circling altitude, nor any instrument approach or departure procedure at Scone or Maitland Airport.*
>
> *The wind farm will not affect any air route LSALT.*
>
> *Note that procedures not designed by Airservices at Scone or Maitland Airport were not considered in this assessment.*
>
> *Communications/Navigation/Surveillance (CNS) Facilities*
>
> *This wind farm, to a maximum height of 884m (2900ft) AHD, will not adversely impact the performance of Precision/Non-Precision Navigational Aids, HF/VHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.*
>
> *Vertical Obstacle Notification*
>
> *As soon as construction commences, the proponent must complete the Vertical Obstacle Notification Form for tall structures and submit the completed form to VOD@airservicesaustralia.com. For further information regarding the reporting of tall structures, please contact (02) 6268 5622, email VOD@airservicesaustralia.com or refer to the web link below:*
>
> *http://www.airservicesaustralia.com/services/aeronautical-information-and-management-services/part-175/*

### 6.24. Muswellbrook Shire Council

HB advised that during a project briefing with Muswellbrook Shire Council, the council did not raise any aviation issues from the proposed Project.

### 6.25. Singleton Shire Council

HB advised that during a project briefing with Singleton Shire Council, the council did not raise any aviation issues from the proposed Project.

### 6.26. Upper Hunter Shire Council

HB advised that during a project briefing with Upper Hunter Shire Council, the council did not raise any aviation issues from the proposed Project.

### 6.27. Summary

Based on the proposed Project layout and overall turbine blade tip height limit of 220 m AGL, the blade tip elevation of the highest wind turbine, which is T46, will not exceed 911 m AHD (2988 ft AMSL) and:

- will not penetrate any OLS surfaces of Cessnock, Maitland and Scone Airports;
- will not penetrate PAN-OPS surfaces at Cessnock, Maitland and Scone Airports;
- will not have an impact on nearby designated air routes;
- will not have an impact on the grid LSALT;
- will not have an impact on prescribed airspace;
- is wholly contained within Class G airspace, but within lateral extent of the Restricted Area R583B and the Danger Area D600 and may impact military fly training within these two areas; and
- is outside the clearance zones associated with civil aviation navigation aids and communication facilities.

The list of wind turbines (obstacles), showing coordinates and elevation data that are applicable to this AIS, are provided in Annexure 1.

# 7. AIRCRAFT OPERATOR RULES AND CHARACTERISTICS

## 7.1. Rules of flight

### 7.1.1. Flight under Day Visual Flight Rules (VFR)

According to Aeronautical Information Publication (AIP) the meteorological conditions required for visual flight in the applicable (class G) airspace at or below 3000 ft AMSL or 1000 ft AGL whichever is the higher are: 5000 m visibility, clear of clouds and in sight of ground or water.

Civil Aviation Regulation (1988) 157 (Low flying) prescribes the minimum height for flight. Generally speaking aircraft are restricted to a minimum height of 500 ft AGL above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas, and 1000 ft AGL over built up areas.

These height restrictions do not apply if through stress of weather or any other unavoidable cause it is essential that a lower height be maintained.

Flight below these height restrictions is also permitted in certain other circumstances.

### 7.1.2. Night VFR

With respect to flight under the VFR at night, Civil Aviation Regulations (1988) 174B states as follows:

> *The pilot in command of an aircraft must not fly the aircraft at night under the V.F.R. at a height of less than 1000 feet above the highest obstacle located within 10 miles of the aircraft in flight if it is not necessary for take-off or landing.*

### 7.1.3. IFR (Day or night)

According to CAR 178, flight under the instrument flight rules (IFR) requires an aircraft to be operated at a height clear of obstacles that is calculated according to an approved method. Obstacle lights on structures not within the vicinity of an aerodrome are effectively redundant to an aircraft being operated under the IFR.

## 7.2. Flying training, private, recreational and gliding operations

Flying training may be conducted under either the instrument flying rules (IFR) or visual flying rules (VFR). Other general aviation operations under either IFR or VFR are also likely to be conducted at various aerodromes in the area.

Operations conducted under the visual flight rules (VFR) are required to remain in visual meteorological conditions (VMC) (at least 5000 m horizontal visibility at a similar height of the wind turbines) and clear of the highest point of the terrain by 500 ft vertical distance and 600 m horizontal distance. In VMC, the wind turbines will likely be sufficiently conspicuous to allow adequate time for pilots to avoid the obstacles. VFR operators will most likely avoid the Project area once wind turbines are erected.

Flight under day VFR is conducted above 500 ft (152.4 m) above the highest point of the terrain within a 600 m radius (300 m for helicopters), unless the operation is approved to operate below 500 ft above the highest point of the terrain.

It is expected that the wind turbines will be sufficiently visually conspicuous to pilots conducting VFR operations within the vicinity of the Project to enable appropriate obstacle avoidance manoeuvring.

IFR and Night VFR (which are required to conform to IFR applicable altitude requirements) aircraft operations are addressed in Section 6.

## 7.3. Military operations

There may be some high-speed low-level military jet aircraft and helicopter operations conducted in the area.

During initial email consultation (dated 12 February 2020) the Department of Defence was informed of the Project but have not provided feedback since then. Follow up emails were sent from May to September 2020, and no formal response has been received.

## 7.4. Aerial agricultural operations

Aerial agricultural operations including such activities as fertiliser, pest and crop spraying are generally conducted under day VFR below 500 ft AGL; usually between 6.5 ft (2 m) and 100 ft (30.5 m) AGL.

There may be some aerial application operations conducted in the area.

Due to the nature of the operations conducted, aerial agriculture pilots are subject to rigorous training and assessment requirements in order to obtain and maintain their licence to operate under these conditions.

The Aerial Agricultural Association of Australia (AAAA) has a formal risk management program which is recommended for use by its members.

The impact of the proposed turbines on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the Project was assessed.

### 7.4.1. Aerial Agricultural Association of Australia

In previous consultation with the Aerial Agricultural Association of Australia (AAAA), Aviation Projects has been directed to the AAAA Windfarm Policy (dated March 2011) which states in part:

> *As a result of the overwhelming safety and economic impact of wind farms and supporting infrastructure on the sector, AAAA opposes all wind farm developments in areas of agricultural production or elevated bushfire risk.*
>
> *In other areas, AAAA is also opposed to wind farm developments unless the developer is able to clearly demonstrate they have:*
>
> *1. consulted honestly and in detail with local aerial application operators;*
>
> *2. sought and received an independent aerial application expert opinion on the safety and economic impacts of the proposed development;*
>
> *3. clearly and fairly identified that there will be no short or long term impact on the aerial application industry from either safety or economic perspectives;*

*4. if there is an identified impact on local aerial application operators, provided a legally binding agreement for compensation over a fair period of years for loss of income to the aerial operators affected; and*

*5. adequately marked any wind farm infrastructure and advised pilots of its presence.*

AAAA had developed National Windfarm Operating Protocols (adopted May 2014). These protocols note the following comments:

*At the development stage, AAAA remains strongly opposed to all windfarms that are proposed to be built on agricultural land or land that is likely to be affected by bushfire. These areas are of critical safety importance to legitimate and legal low-level operations, such as those encountered during crop protection, pasture fertilisation or firebombing operations.*

*However, AAAA realises that some wind farm proposals may be approved in areas where aerial application takes place. In those circumstances, AAAA has developed the following national operational protocols to support a consistent approach to aerial application where windfarms are in the operational vicinity.*

The protocols list considerations for developers during the design/build stage and the operational stage, for pilots/aircraft operators during aircraft operations and discusses economic compensation. NASF Guideline D is included in the Protocols document as Appendix 1, and AAAA Aerial Application Pilots Manual – excerpts on planning are provided as Appendix II.

It is recommended that the operator of the wind farm follows the AAAA National Windfarm Operating Protocols to address the risk that the Project may pose on aviation safety, with respect to Operational Considerations, in the area of the Project development.

#### 7.4.2. Local aerial application operators

Local aerial application operators consulted in previous studies have stated that a wind farm would, in all likelihood, prevent aerial agricultural operations in that particular area, but that properties adjacent to the wind farm would have to be assessed on an individual basis.

Aerial application operators generally align their positions with the AAAA policies.

Based on previous studies, and subject to the results of consultation with AAAA and any further consultation with local aerial application operators, it is reasonable to conclude that safe aerial application operations would be possible on properties within the Project site and neighbouring the Project site (except for those discussed in Section 6.17), subject to final turbine locations, and subject to a case-by-case assessment and by following recommendations provided in this report.

To facilitate the flight planning of aerial application operators, details of the Project, including location and height information of wind turbines, wind monitoring towers and overhead powerlines should be provided to landowners so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information.

The use of helicopters enables aerial application operations to be conducted in closer proximity to obstacles than would be possible with fixed wing aircraft due to their greater manoeuvrability.

A multiple aerial operators have been consulted. Their concerns are documented in Section 5

## 7.5. Aerial firefighting

Aerial firefighting operations (firebombing in particular) are conducted in Day VFR, sometimes below 500 ft AGL. Under certain conditions visibility may be reduced/limited by smoke/haze.

Most aerial firefighting organisations have formal risk management programs to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained. For example, pilots require specific training and approvals, additional equipment is installed in the aircraft, and special procedures are developed.

The Australasian Fire and Emergency Services Council (AFAC) developed a national position on wind turbines: *Wind Farms and Bush Fires Operations*, version 2.0, dated 30 October 2014.

Of specific interest in this document is the paragraph copied below:

> *Aerial firefighting operations will treat turbine towers similar to other tall obstacles. Pilots and Air Operations Managers will assess these risks as part of routine procedures. Risks due to wake turbulence and the moving blades should also be considered. Wind turbines are not expected to pose unacceptable risks.*

## 7.6. Emergency services

### 7.6.1. Royal Flying Doctor Service

Royal Flying Doctor Service (RFDS) and other emergency services operations are generally conducted under the IFR, except when arriving/departing a destination that is not serviced by instrument approach aids or procedures.

Most emergency aviation services organisations have formal risk management programs to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained.

For example, pilots and crew require specific training and approvals, additional equipment is installed in the aircraft, and special procedures are developed.

Epuron advised that multiple attempts were made to consult with RFDS, but no response has been received.

### 7.6.2. Westpac Life Saver Rescue Helicopter Service

Epuron consulted with Westpac Life Saver Rescue Helicopter Service (WLSRHS) on the proposed Project and advised that WLSRHS has no concerns with the Project and that the Project will not impact on their operations.

# 8. HAZARD LIGHTING AND MARKING

Based on the risk assessment it has been concluded that aviation lighting is not required for the Project, but relevant lighting standards and guidelines are summarized below.

## 8.1. Civil Aviation Safety Authority

In considering the need for aviation hazard lighting and marking, the applicable regulatory context was determined.

The Civil Aviation Safety Authority (CASA) regulates aviation activities in Australia. Applicable requirements include the Civil Aviation Regulations 1988 (CAR), Civil Aviation Safety Regulations 1998 (CASR) and associated Manual of Standards (MOS) and other guidance material. Relevant provisions are outlined in further detail in the following section.

## 8.2. Civil Aviation Safety Regulations 1998, Part 139—*Aerodromes*

In areas remote from an aerodrome, CASR 139.365 requires the owner of a structure (or proponents of a structure) that will be 110 m or more above ground level to inform CASA. This is to allow CASA to assess the effect of the structure on aircraft operations and determine whether or not the structure will be hazardous to aircraft operations.

### 8.2.1. Manual of Standards Part 139—Aerodromes

Chapter 9 sets out the standards applicable to Visual Aids Provided by Aerodrome Lighting.

Section 9.30 provides guidance on Types of Obstacle Lighting and Their Use:

1. *The following types of obstacle lights must be used, in accordance with this MOS, to light hazardous obstacles:*
    - a. *low-intensity;*
    - b. *medium-intensity;*
    - c. *high-intensity;*
    - d. *a combination of low, medium or high-intensity.*
2. *Low-intensity obstacle lights:*
    - a. *are steady red lights; and*
    - b. *must be used on non-extensive objects or structures whose height above the surrounding ground is less than 45 m.*
3. *Medium-intensity obstacle lights must be:*
    - a. *flashing white lights; or*
    - b. *flashing red lights; or*
    - c. *steady red lights.*

*Note CASA recommends the use of flashing red medium-intensity obstacle lights.*

4. *Medium-intensity obstacle lights must be used if:*
    a. *the object or structure is an extensive one; or*
    b. *the top of the object or structure is at least 45 m but not more than 150 m above the surrounding ground; or*
    c. *CASA determines in writing that early warning to pilots of the presence of the object or structure is desirable in the interests of aviation safety.*

*Note For example, a group of trees or buildings is regarded as an extensive object.*

5. *For subsection (4), low-intensity and medium-intensity obstacle lights may be used in combination.*
6. *High-intensity obstacle lights:*
    a. *must be used on objects or structures whose height exceeds 150 m; and*
    b. *must be flashing white lights.*
7. *Despite paragraph (6) (b), a medium-intensity flashing red light may be used if necessary, to avoid an adverse environmental impact on the local community.*

Sections 9.31 (8) and (9) provide guidance on obstacle lighting specific to wind farms:

8. *Subject to subsection (9), for wind turbines in a wind farm, medium-intensity obstacle lights must:*
    a. *mark the highest point reached by the rotating blades; and*
    b. *be provided on a sufficient number of individual wind turbines to indicate the general definition and extent of the wind farm, but such that intervals between lit turbines do not exceed 900 m; and*
    c. *all be synchronised to flash simultaneously; and*
    d. *be seen from every angle in azimuth.*

*Note: This is to prevent obstacle light shielding by the rotating blades of a wind turbine and may require more than 1 obstacle light to be fitted.*

9. *If it is physically impossible to light the rotating blades of a wind turbine:*
    a. *the obstacle lights must be placed on top of the generator housing; and*
    b. *a note must be published in the AIP-ERSA indicating that the obstacle lights are not at the highest position on the wind turbines.*
10. *If the top of an object or structure is more than 45 m above:*
    a. *the surrounding ground (ground level); or*
    b. *the top of the tallest nearby building (building level); then the top lights must be medium-intensity lights, and additional low-intensity lights must be:*

*c. provided at lower levels to indicate the full height of the structure; and*

*d. spaced as equally as possible between the top lights and the ground level or building level, but not so as to exceed 45 m between lights.*

8.2.2. Advisory Circular 139-08 v2—Reporting of Tall Structures

In Advisory Circular (AC) 139-08 v2—*Reporting of Tall Structures*, CASA provides guidance to those authorities and persons involved in the planning, approval, erection, extension or dismantling of tall structures so that they may understand the vital nature of the information they provide.

Airservices Australia has been assigned the task of maintaining a database of tall structures, the top measurement of which is:

a) 30 metres or more above ground level—within 30 kilometres of an aerodrome; or

b) 45 metres or more above ground level elsewhere.

The purpose of notifying Airservices Australia of these structures is to enable their details to be provided in aeronautical information databases and maps/charts etc used by pilots, so that the obstacles can be avoided.

The proposed wind turbines must be reported to Airservices Australia. This action should occur once the final layout after micrositing is confirmed and prior to construction.

### 8.3. International Civil Aviation Organisation

Australia, as a contracting State to the International Civil Aviation Organisation (ICAO) and signatory to the Chicago Convention on International Civil Aviation (the Convention), has an obligation to implement ICAO's standards and recommended practices (SARPs) as published in the various annexes to the Convention.

Annex 14 to the Convention – *Aerodromes, Volume 1,* Section 6.2.4 provides SARPs for the obstacle lighting and marking of wind turbines, which is copied below:

*6.2.4 Wind turbines*

*6.2.4.1 A wind turbine shall be marked and/or lighted if it is determined to be an obstacle.*

*Note 1.– Additional lighting or markings may be provided where in the opinion of the State such lighting or markings are deemed necessary.*

*Note 2. – See 4.3.1 and 4.3.2*

*Markings*

*6.2.4.2 Recommendation. – The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines should be painted white, unless otherwise indicated by an aeronautical study.*

*Lighting*

*6.2.4.3 Recommendation. – When lighting is deemed necessary, in the case of a wind farm, i.e. a group of two or more wind turbines, the wind farm should be regarded as an extensive object and the lights should be installed:*

*a) to identify the perimeter of the wind farm;*

*b) respecting the maximum spacing, in accordance with 6.2.3.15, between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;*

*c) so that, where flashing lights are used, they flash simultaneously throughout the wind farm;*

*d) so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located; and*

*e) at locations prescribed in a), b) and d), respecting the following criteria:*

*i) for wind turbines of less than 150 m in overall height (hub height plus vertical blade height), medium-intensity lighting on the nacelle should be provided;*

*ii) for wind turbines from 150 m to 315 m in overall height, in addition to the medium-intensity light installed on the nacelle, a second light serving as an alternate should be provided in case of failure of the operating light. The lights should be installed to assure that the output of either light is not blocked by the other; and*

*iii) in addition, for wind turbines from 150 m to 315 m in overall height, an intermediate level at half the nacelle height of at least three low-intensity Type E lights, as specified in 6.2.1.3, should be provided. If an aeronautical study shows that low-intensity Type E lights are not suitable, low-intensity Type A or B lights may be used.*

*Note. — The above 6.2.4.3 e) does not address wind turbines of more than 315 m of overall height. For such wind turbines, additional marking and lighting may be required as determined by an aeronautical study.*

*6.2.4.4 Recommendation. — The obstacle lights should be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.*

*6.2.4.5 Recommendation. — Where lighting is deemed necessary for a single wind turbine or short line of wind turbines, the installation should be in accordance with 6.2.4.3 e) or as determined by an aeronautical study.*

As referenced in Section 6.2.4.3(e)(iii), Section 6.2.1.3 is copied below:

*6.2.1.3 The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked shall be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object, or by an adjacent object, additional lights shall be provided on that adjacent object or the part of the object that is shielding the light, in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.*

As referenced in Section 6.2.4.3(b), Section 6.2.3.15 is copied below:

*6.2.3.15 Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and* *a) low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45 m; and*

*b) medium-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 900 m.*

Section 4.3 Objects outside the obstacle limitation surfaces states the following:

*4.3.1 Recommendation.— Arrangements should be made to enable the appropriate authority to be consulted concerning proposed construction beyond the limits of the obstacle limitation surfaces that extend above a height established by that authority, in order to permit an aeronautical study of the effect of such construction on the operation of aeroplanes.*

*4.3.2 Recommendation. — In areas beyond the limits of the obstacle limitation surfaces, at least those objects which extend to a height of 150 m or more above ground elevation should be regarded as obstacles, unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes.*

*Note. — This study may have regard to the nature of operations concerned and may distinguish between day and night operations.*

ICAO Doc 9774 Manual on Certification *of Airports* defines an aeronautical study as:

*An aeronautical study is a study of an aeronautical problem to identify potential solutions and select a solution that is acceptable without degrading safety.*

### 8.4. Light characteristics

If obstacle lighting is required, installed lights should be designed according to the criteria set out in the applicable regulatory material and taking CASA's recommendations into consideration in the case that CASA has reviewed this risk assessment and provided recommendations.

The characteristics of the obstacle lights should be in accordance with the applicable standards in MOS 139.

The characteristics of low and medium intensity obstacle lights specified in MOS 139, Chapter 9, are provided below.

MOS 139 Chapter 9 Division 4 – Obstacle Lighting section 9.32 outlines Characteristics of Low Intensity Obstacle Lights.

*1. Low-intensity obstacle lights must have the following:*

*a. fixed lights showing red;*

*b. a horizontal beam spread that results in 360-degree coverage around the obstacle;*

*c. a minimum intensity of 100 candela (cd);*

*d. a vertical beam spread (to 50% of peak intensity) of 10 degrees;*

*e. a vertical distribution with 50 cd minimum at +6 degrees and +10 degrees above the horizontal;*

f. *not less than 10 cd at all elevation angles between –3 degrees and +90 degrees above the horizontal.*

*Note: The intensity requirement in paragraph (c) may be met using a double-bodied light fitting. CASA recommends that double-bodied light fittings, if used, should be orientated so that they show the maximum illuminated surface towards the predominant, or more critical, direction of aircraft approach.*

2. *To indicate the following:*

   a. *taxiway obstacles;*

   b. *unserviceable areas of the movement area; low-intensity obstacle lights must have a peak intensity of at least 10 cd.*

MOS 139 Chapter 9 Division 4 – Obstacle Lighting section 9.33 outlines Characteristics of Medium Intensity Obstacle Lights.

1. *Medium-intensity obstacle lights must:*

   a. *be visible in all directions in azimuth; and*

   b. *if flashing — have a flash frequency of between 20 and 60 flashes per minute.*

2. *The peak effective intensity of medium-intensity obstacle lights must be 2 000 ☐ 25% cd with a vertical distribution as follows:*

   a. *for vertical beam spread — a minimum of 3 degrees;*

   b. *at -1-degree elevation — a minimum of 50% of the lower tolerance value of the peak intensity;*

   c. *at 0 degrees elevation — a minimum of 100% of the lower tolerance value of the peak intensity.*

3. *For subsection (2), vertical beam spread means the angle between 2 directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the peak intensity.*

4. *If, instead of obstacle marking, a flashing white light is used during the day to indicate temporary obstacles in the vicinity of an aerodrome, the peak effective intensity of the light must be increased to 20 000 ± 25% cd when the background luminance is 50 cd/$m^2$ or greater.*

### 8.5. Visual impact of night lighting

Annex 14 Section 6.2.4 and MOS 139 9.4.3.4A are specifically intended for wind turbines and recommends that medium intensity lighting is installed.

Generally accepted considerations regarding minimisation of visual impact are provided below for consideration in this aeronautical study:

- To minimise the visual impact on the environment, some shielding of the obstacle lights is permitted, provided it does not compromise their operational effectiveness;

- Shielding may be provided to restrict the downward component of light to either, or both, of the following:
    - such that no more than 5% of the nominal intensity is emitted at or below 5 degrees below horizontal; and
    - such that no light is emitted at or below 10 degrees below horizontal;
- Where two lights are mounted on a nacelle, dynamic shielding or light extinction of one light at a time, for the period that a blade is passing in front of the light, is permissible, providing that at all times at least one light can be seen, without interruption, from every angle of azimuth;
- If flashing obstacle lighting is required, all obstacle lights on a wind farm should be synchronised so that they flash simultaneously; and
- A relatively small area on the back of each blade near the rotor hub may be treated with a different colour or surface treatment, to reduce reflection from the rotor blades of light from the obstacle lights, without compromising the daytime visibility of the overall turbine.

### 8.6. Marking of turbines

ICAO Annex 14 Vol 1 Section 6.2.4.2 recommends that the rotor blades, nacelle and upper 2/3 of the supporting mast of the wind turbines should be painted a shade of white, unless otherwise indicated by an aeronautical study.

It is generally accepted that a shade of white colour will provide sufficient contrast with the surrounding environment to maintain an acceptable level of safety while lowering visual impact to the neighbouring residents.

### 8.7. Wind monitoring towers

The details of the WMTs were introduced in Section 4.3 of this report.

Consideration could be given to marking any WMTs according to the requirements set out in MOS 139 Chapter 8 Division 10 Obstacle Markings; specifically:

> *8.110 (5) As illustrated in Figure 8.110 (5), long, narrow structures like masts, poles and towers which are hazardous obstacles must be marked in contrasting colour bands so that the darker colour is at the top; and the bands are, as far as physically possible, marked at right angles along the length of the long, narrow structure; and have a length ("z" in Figure 8.110 (5)) that is, approximately, the lesser of: 1/7 of the height of the structure; or 30 m.*

> *8.110 (7) Hazardous obstacles in the form of wires or cables must be marked using 3-dimensional coloured objects attached to the wire or cables. Note: Spheres and pyramids are examples of 3-dimensional objects. (8) The objects mentioned in subsection (7) must: be approximately equivalent*

NASF Guideline D suggests consideration of the following measures specific to the marking and lighting of WMTs:

- the top 1/3 of wind monitoring towers to painted in alternating contrasting bands of colour. Examples of effective measures can be found in the Manual of Standards for Part 139 of the Civil Aviation Safety Regulations 1998. In areas where aerial agriculture operations take place, marker balls or high visibility flags can be used to increase the visibility of the towers;
- marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires;
- ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation; or
- a flashing strobe light during daylight hours.

### 8.8. Overhead power lines

There is no regulatory requirement to mark or light power poles or overhead transmission lines.

According to the AAAA *Powerlines Policy* dated March 2011:

> *Most agricultural land in Australia is crisscrossed with powerlines and aerial application companies and pilots put enormous effort into managing these hazards safely, generally using a risk identification, assessment and management process in line with Australian Standard AS4360/ISO 3[1]000.*
>
> *The agricultural pilot curriculum mandated by CASA includes training for the safe management of powerlines and AAAA has been active in providing ongoing professional development for application pilots that includes a focus on planning, risk management and a knowledge of human factors relevant to managing powerlines in a low-level aviation environment.*
>
> *AAAA runs a specific training course for aerial application pilots entitled 'Wire Risk Management' to address these issues.*

Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial agriculture operators and if required to be marked in accordance with MOS 139 Chapter 8 Division 10 section 8.110 Marking of hazardous obstacles, specifically:

> *(7) Hazardous obstacles in the form of wires or cables must be marked using 3-dimensional coloured objects attached to the wire or cables.*
>
> *Note Spheres and pyramids are examples of 3-dimensional objects.*
>
> *(8) The objects mentioned in subsection (7) must:*
>
>> *(a) be approximately equivalent in size to a cube with 600 mm sides; and*
>>
>> *(b) be spaced 30 m apart along the length of the wire or cable*

Following consultation with aerial operators, if a risk assessment is required, the proponent should follow AS 3891.2:2018 *Air navigation – Cables and their supporting structures – Marking and safety requirements Part 2: Low level aviation operations,* for structure, guidance and marking requirements.

A new powerline will be required to connect the Project to the existing electricity grid, which has one connection point within 10 km from the Project. Epuron is currently considering connecting to the 330kV Tamworth to Liddell powerline owned by Transgrid.

Further details on the powerline design are provided in Section 4.4. of this report.

# 9. ACCIDENT STATISTICS

### 9.1. General aviation operations

The general aviation (GA) operation type is considered by the Australian Transport Safety Bureau (ATSB) to be all flying activities that do not involve scheduled (RPT) and non-scheduled (charter) passenger and freight operations. It may involve Australian civil (VH–) registered aircraft, or aircraft registered outside of Australia. General aviation encompasses:

- Aerial work. This includes flying for the purposes of agriculture (spraying and spreading), mustering, search and rescue, fire control, or survey and photography;
- Flying training; and
- Private, business and sports aviation. Sports aviation includes gliding, parachute operations, ballooning, warbird operations, and acrobatics.

### 9.2. ATSB occurrence taxonomy

The ATSB uses a taxonomy of occurrence sub-type. Of specific relevance to the subject assessment are terms associated with **terrain collision**. Definitions sourced from the ATSB website are provided below:

- **Collision with terrain**: Occurrences involving a collision between an airborne aircraft and the ground or water, where the flight crew were aware of the terrain prior to the collision.
- **Controlled flight into terrain (CFIT):** Occurrences where a serviceable aircraft, under flight crew control, is inadvertently flown into terrain, obstacles, or water without either sufficient or timely awareness by the flight crew to prevent the event.
- **Ground strike:** Occurrences where a part of the aircraft drags on, or strikes, the ground or water while the aircraft is in flight, or during take-off or landing.
- **Wirestrike:** Occurrences where an aircraft strikes a wire, such as a powerline, telephone wire, or guy wire, during normal operations.

### 9.3. National aviation occurrence statistics 2008-2017

The Australian Transport Safety Bureau recently published a summary of aviation occurrence statistics for the period 2008 to 2017 (AR-2018-030) Final, 21 December 2018.

According to the report, there were no fatalities in high or low capacity RPT operations during the period 2008-2017. In 2017 there was 21 fatalities from 93 accidents in general aviation operations.

Of the 337 fatalities recorded in the 10-year period, almost two thirds (206 or 61.12%) occurred in the general aviation segment. On average, there were 1.44 fatalities per aircraft associated with a fatality in this segment. The fatalities to aircraft ratio ranges from 1 to 1.7:1. Whilst it can be inferred from the data that the majority of fatal accidents are single person fatalities, it is reasonable to assert that the worst credible effect of an aircraft accident in the general aviation category will be multiple fatalities.

A breakdown of aircraft and fatalities by general aviation sub-categories is provided in Table 10 (source: ATSB).

Table 10 Number of fatalities by GA sub-category – 2008 to 2017

| *Sub-category* | *Aircraft assoc. with fatality* | *Fatalities* | *Fatalities to aircraft ratio* |
|---|---|---|---|
| Agriculture | 19 | 19 | 1:1 |
| Mustering | 14 | 15 | 1.07:1 |
| Search and rescue | 2 | 2 | 1:1 |
| Fire control | 2 | 2 | 1:1 |
| Survey and photography | 5 | 8 | 1.6:1 |
| Other aerial work | 3 | 5 | 1.66:1 |
| Flying training | 11 | 17 | 1.545:1 |
| Private/business | 68 | 116 | 1.7:1 |
| Sport aviation (excluding gliding) | 4 | 4 | 1:1 |
| Gliding | 10 | 12 | 1.2:1 |
| Totals | 138 | 200 | 1.44:1 |

According to the ATSB report, the number of fatal accidents per million departures for GA aircraft over the 10-year reporting period ranged between 3.6 in 2016 and 10.8 in 2008. Figure 31 refers to Fatal Accident Rate by operation type per million departures over the 10-year period (source: ATSB).

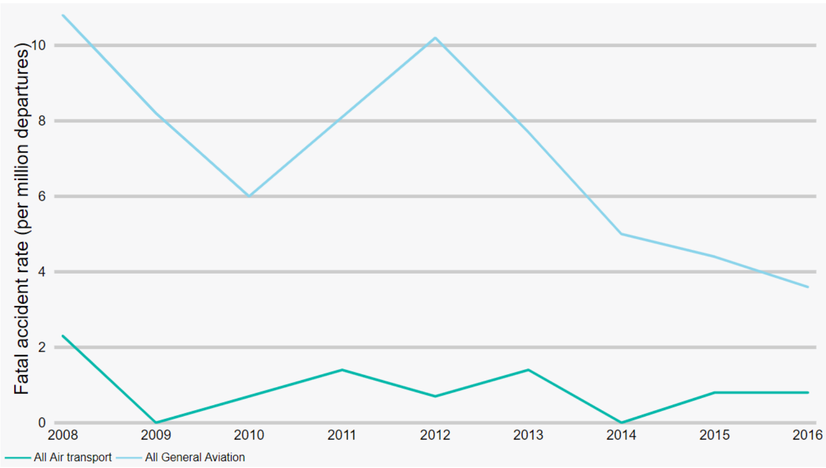


Figure 31 Fatal Accident Rate (per million departures) by Operation Type

In 2015, there were 10 fatal accidents and 12 fatalities involving GA aircraft, resulting in a rate of 4.4 fatal accidents per million departures and 8.4 fatal accidents per million hours flown.

In 2016, there were 1,920,000 departures, and 1,301,000 hours flown by VH-registered general aviation aircraft in Australia, with 7 fatal accidents and 10 fatalities. Based on these results, in 2016 there were 3.6 fatal accidents per million departures and 5.4 fatal accidents per million hours flown. A summary of fatal accidents from 2008-2017 by GA sub-category is provided in Table 11 (source: ATSB).

Table 11 Fatal accidents by GA sub-category – 2008 -2017

| Sub-category | Fatal accidents | Fatalities |
|---|---|---|
| Aerial work | 47 | 54 |
| Aerial agriculture | 19 | 19 |
| Aerial mustering | 14 | 15 |
| Search and rescue | 2 | 2 |
| Fire control | 2 | 2 |
| Survey and photography | 5 | 8 |
| Flying training | 11 | 17 |
| Private/business | 68 | 116 |
| Sports | 4 | 4 |
| Foreign registered | 1 | 1 |
| Totals | 173 | 238 |

Over the 10-year period, there were 17,331,000 general aviation departures in Australia, during which time no aircraft collided with a wind turbine or a wind monitoring tower.

Of the 26,373 incidents, serious incidents and accidents in GA operations in the 10-year period, 1378 (5.22%) were terrain collisions.

There is an underlying fatality rate for GA operations that is considered tolerable within Australia's regulatory and social context.

### 9.4. Worldwide accidents involving wind farms

To provide some perspective on the likelihood of a VFR aircraft colliding with a wind turbine, a summary of the four accidents that involved an aircraft colliding with a wind turbine, and the relevant factors applicable to this assessment, is incorporated in this section.

Global Wind Energy Council reports on its website there were 341,320 wind turbines operating around the world at the end of 2016.

Australia's Clean Energy Council reports on its website there were 94 wind farms in Australia at the end of 2018.

Aviation Projects has researched public sources of information, accessible via the world wide web, regarding aviation safety occurrences associated with wind farms. Occurrence information published by Australia, Canada, Europe (Belgium, Denmark, France, Germany, Norway, Sweden and The Netherlands), New Zealand, the United Kingdom and the United States of America was reviewed.

Of the four known accidents, one was caused by inflight separation of the majority of the right canard and all of the right elevator resulting from a failure of the builder to balance the elevators per the kit manufacturer's instructions. The accident occurred overhead a wind farm, and the aircraft struck a wind turbine on its descent. This accident is not applicable to the circumstances under consideration.

There have been two accidents involving collision with a wind turbine during the day.

Only one of these (Melle, Germany 2017) resulted in a single fatality, as the result of a collision with a wind turbine steel lattice mast at a very low altitude during the day with good visibility and no cloud. If the mast was solid and painted white, then it more than likely would have been more visible than if it was equipped with an obstacle light.

In the other case (Plouguin, France, 2008), the pilot decided to descend below cloud in an attempt to find the destination aerodrome. The aircraft was in conditions of significantly reduced horizontal visibility in fog where the top of the turbine was obscured by cloud. The turbines became visible too late for avoidance manoeuvring and the aircraft made contact with two turbines. The aircraft was damaged but landed safely.

In both cases, is difficult to conclude that obstacle lighting would have prevented the accident.

The other fatal accident occurred at night in IMC and is not applicable to the circumstances under consideration.

There is one other accident mentioned in a database compiled by an anti-wind farm lobby group, which suggests a Cessna 182 collided with a wind turbine near Baraboo, Wisconsin, on 29 July 2000. The NTSB database records details of an accident involving a Cessna 182 that occurred on 28 July 2000 in the same area, but suggests that the accident was caused by IFR flight into IMC encountered by the pilot and exceeding the design limits of the aircraft. A factor was flight to a destination alternate not performed by the pilot. No mention is made of wind turbines or a wind farm.

A summary of the four accidents is provided in Annexure 2.

# 10. RISK ASSESSMENT

A risk management framework is comprised of likelihood and consequence descriptors, a matrix used to derive a level of risk, and actions required of management according to the level of risk.

The risk assessment framework used by Aviation Projects and risk event description is provided in **Annexure 3.**

A summary of the level of risk associated with the proposed Project, under the proposed treatment regime, with specific consideration of the effect of obstacle lighting, is provided in Table 12.

Table 12 Risk assessment summary

| *Risk Element* | *Consequence* | *Likelihood* | *Risk* | *Actions Required* |
|---|---|---|---|---|
| Aircraft collision with wind turbine | Catastrophic | Unlikely | 7 | **Acceptable without obstacle lighting (ALARP).**<br>Communicate details of the Project to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction. |
| Aircraft collision with wind monitoring tower | Catastrophic | Unlikely | 7 | **Acceptable without obstacle lighting (ALARP).**<br>Although there is no obligation to do so, consideration has been made for marking the wind monitoring towers according to the requirements set out in MOS 139 Chapter 8 Division 10 Obstacle Markings, specifically 8.110 (5), (7) and (8).<br>Details of wind monitoring towers have been communicated to local and regional operators and to CASA and Airservices Australia following construction. |
| Avoidance manoeuvring leads to ground collision | Catastrophic | Unlikely | 7 | **Acceptable without obstacle lighting (ALARP).**<br>Communicate details of the Project to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction. |
| Effect on crew | Minor | Possible | 5 | **Acceptable without obstacle lighting (ALARP).**<br>Communicate details of the Project to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction. |
| Visual impact from obstacle lights | Moderate | Likely | 7 | **Acceptable without obstacle lighting** (zero risk of visual impact from obstacle lighting).<br>If lights are installed, design to minimise impact. |

# 11. CONCLUSIONS

The results of this study are summarised as follows:

## 11.1. Project description

The proposed Project will comprise of the following as relevant to this Assessment:

- up to 60 wind turbines;
- maximum overall height (tip height) of the wind turbines is up to 220 m AGL;
- highest wind turbine is T46 with ground elevation of 691 m AHD and overall height of 911 m (2988 ft AMSL); and
- two existing temporary WMTs with a maximum height of up to 110 m (361 ft) AGL, which have been reported to Airservices Australia. These WMTs may be relocated over the project life, as required.

## 11.2. Regulatory requirements

The following regulatory requirements apply:

- There is no regulatory requirement for lighting of obstacles lower than 150 m (492 ft) AGL that are not within the vicinity of an aerodrome.
- With respect to MOS 139 Chapter 8 Division 10 8.109, the proposed wind turbines and wind monitoring towers must be reported to CASA if they are considered a hazardous obstacle.
- Wind turbines and wind monitoring towers must be marked in accordance with respect to MOS 139 Chapter 8 Division 10 8.110.
- Wind turbines must be lit in accordance with MOS 139 Chapter 9 Division 4 9.3 and 9.31, unless an aeronautical study assesses they are of no operational significance.

## 11.3. Planning considerations

There are no provisions for airfields included in the Muswellbrook Local Environmental Plan 2009, the Singleton Local Environmental Plan 2013 and the Upper Hunter Local Environmental Plan 2013.

## 11.4. Consultation

An appropriate and justified level of consultation was undertaken with relevant parties.

### 11.5. Aviation Impact Statement

Based on the proposed Project layout and overall turbine blade tip height limit of 220 m AGL, the blade tip elevation of the highest wind turbine, which is T46, will not exceed 911 m AHD (2988 ft AMSL) and:

- will not penetrate any OLS surfaces of Cessnock, Maitland and Scone Airports;
- will not penetrate PAN-OPS surfaces at Cessnock, Maitland and Scone Airports;
- will not have an impact on nearby designated air routes;
- will not have an impact on the grid LSALT;
- will not have an impact on prescribed airspace;
- is wholly contained within Class G airspace, but within lateral extent of the Restricted Area R583B and the Danger Area D600 and may impact military fly training within these two areas; and
- is outside the clearance zones associated with civil aviation navigation aids and communication facilities.

Airservices Australia response is copied below:

> *Airspace Procedures*
>
> *With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at the various heights provided, the wind turbines and masts will not affect any sector or circling altitude, nor any instrument approach or departure procedure at Scone or Maitland Airport.*
>
> *The wind farm will not affect any air route LSALT.*
>
> *Note that procedures not designed by Airservices at Scone or Maitland Airport were not considered in this assessment.*
>
> *Communications/Navigation/Surveillance (CNS) Facilities*
>
> *This wind farm, to a maximum height of 884m (2900ft) AHD, will not adversely impact the performance of Precision/Non-Precision Navigational Aids, HF/VHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.*
>
> *Vertical Obstacle Notification*
>
> *As soon as construction commences, the proponent must complete the Vertical Obstacle Notification Form for tall structures and submit the completed form to VOD@airservicesaustralia.com. For further information regarding the reporting of tall structures, please contact (02) 6268 5622, email VOD@airservicesaustralia.com or refer to the web link below:*

*http://www.airservicesaustralia.com/services/aeronautical-information-and-management-services/part-175/*

During project briefings with Muswellbrook Shire Council, Singleton Council and Upper Hunter Shire Council the councils were informed of the Project and no aviation issues were raised.

### 11.6. Aircraft operator characteristics

Aircraft will be required to navigate around the Project site in low cloud conditions where aircraft need to fly at 500 ft AGL.

The Proponent will engage with local aerial agricultural and aerial firefighting operators to develop procedures, which may include, but not be limited to stopping the rotation of the wind turbine rotor blades prior to the commencement of the subject aircraft operations within the Project area.

Wind turbines are generally not a safety concern to aerial agricultural operators. WMTs remain the primary safety concern to aerial agricultural operators, who have expressed a general desire for these towers to be more visible.

Aerial and aircraft operators: Epuron discussed with local aerial and aircraft operators the proposed Project in relation to different aspects and received comments noted in Section 5. In general, stakeholders do not oppose the development of the Project.

Private aerodromes: If operational, both circuit directions for ALA 1, ALA 4 and the western circuit of ALA 2 would be impacted by the Project. The Proponent should consult with land hosts of ALA 1, ALA 2 and ALA 4 to address potential impacts on the aerodromes circuit operations of these ALAs.

Also, the effects of wake turbulence could be noticeable while performing circuits for ALA 1, ALA 2, ALA 4 and ALA 13. The Proponent should consult with land hosts of ALA 1, ALA 2, ALA 4 and ALA 13 to address potential effects of wake turbulence from the nearest WTGs.

Emergency services: Epuron advised that multiple attempts were made on 28 April 2020 to consult with the RFDS Executive General Manager, Marketing & Stakeholders Relations and the RFDS's bases located in Dubbo, Bankstown and Mascot. No formal response has been received.

Epuron discussed with Westpac Life Saver Rescue Helicopter Service (WLSRHS) the proposed Project on 28 April 2020. In principle, WLSRHS has no significant concerns about the Project.

### 11.7. Hazard lighting and marking

The following conclusions apply to hazard marking and lighting:

- With respect to MOS 139 Chapter 8 Division 10 8.109, the proposed wind turbines and wind monitoring towers must be reported to CASA if they are considered a hazardous obstacle. Wind turbines and wind monitoring towers must be marked in accordance with respect to MOS 139 Chapter 8 Division 10 8.110.
- Wind turbines must be lit in accordance with MOS 139 Chapter 9 Division 4 9.3 and 9.31, unless an aeronautical study assesses they are of no operational significance.
- **Aviation Projects has assessed that the Project will not require obstacle lighting to maintain an acceptable level of safety to aircraft.**
- CASA has advised that it will only review assessments referred to it by a planning authority or agency.
- During initial email consultation (dated 12 February 2020) the Department of Defence was informed of the Project but has not provided feedback since then. Multiple follow up emails were sent between April and September 2020, and no formal response has been received.

- With respect to marking of turbines, a white colour will provide sufficient contrast with the surrounding environment to maintain an acceptable level of safety while lowering visual impact to the neighbouring residents.
- There are two WMTs at a maximum height of up to 110 m (361 ft) AGL. The WMTs are marked with aviation marker balls and have been reported to Airservices Australia.
- If further WMTs are installed, consideration should be given to marking any WMT according to the requirements set out in MOS 139 Section 8 Division 10 Obstacle Markings (as modified by the guidance in NASF Guideline D).
- The proponent is recommended to consider potential adverse impacts from the overhead power line route on aerial application operations. Consultation should occur with pilots involved in intentional and legal low-level operations, within the vicinity of the Project and associated power line corridors.

### 11.8. Risk assessment

A summary of the level of risk associated with the proposed Project, under the proposed treatment regime, with specific consideration of the effect of obstacle lighting, is provided in Table 12 (Section 10).

# 12. RECOMMENDATIONS

Recommended actions resulting from the conduct of this assessment are provided below.

Notification and reporting

1. ‘As constructed’ details of wind turbine and WMT coordinates and elevations should be provided to Airservices Australia, using the following email address: vod@airservicesaustralia.com
2. Any obstacles above 110 m AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents. With respect to crane operations during the construction of the Project, a notification to the NOTAM office may include, for example, the following details:
    a. The planned operational timeframe and maximum height of the crane; and
    b. Either the general area within which the crane will operate and/or the planned route with timelines that crane operations will follow.
3. Details of the wind farm should be provided to local and regional aircraft operators prior to construction in order for them to consider the potential impact of the wind farm on their operations. Specifically, details should be provided to the New South Wales Regional Airspace and Procedures Advisory Committee for consideration by its members in relation to VFR transit routes in the vicinity of the wind farm.

Operation

4. The Proponent should engage with local aerial agricultural operators and aerial firefighting operators in developing procedures for such aircraft operations in the vicinity of the Project.

Marking of turbines

5. The rotor blades, nacelle and the supporting mast of the wind turbines should be painted white, typical of most wind turbines operational in Australia.

Lighting of turbines

6. **Aviation Projects has assessed that the Project will not require obstacle lighting to maintain an acceptable level of safety to aircraft.**

Marking of wind monitoring towers

7. Wind monitoring towers should be marked according to the requirements set out in MOS 139 Chapter 8 Division 10 Obstacle Markings (as modified by the guidance in NASF Guideline D).

Marking of overhead transmission lines and poles

8. Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial agriculture operators and marked in accordance with MOS 139 Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8).

Micrositing

9. Alteration to the siting of a turbine of wind monitoring towers will not be more than 100 m or within survey boundary, and micrositing will address any consequential changes to the Project components. The potential micrositing of the turbines and wind monitoring towers have been considered in the assessment with the estimate of the overall maximum height being based on the highest ground level is within 100 m or within survey boundary of the nominal turbine position. The micrositing of the turbines and wind monitoring towers will not result in a change in the maximum overall blade tip height of the Project. No further assessment is likely to be required from micrositing and the conclusions of this aviation impact assessment remain the same.

Triggers for review

10. Triggers for review of this risk assessment are provided for consideration:
    a. prior to construction to ensure the regulatory framework has not changed;
    b. following any significant changes to the context in which the assessment was prepared, including the regulatory framework; and
    c. following any near miss, incident or accident associated with operations considered in this risk assessment.

# ANNEXURES

1. Turbine coordinates and heights
2. Summary of four worldwide accidents
3. Risk framework

# ANNEXURE 1 – TURBINE COORDINATES AND HEIGHTS

Source: Hansen Bailey, *200811 BOW Turbine Elevation.xls*, dated 11 August 2020.

Note: The highest wind turbine is highlighted in bold pumpkin colour.

| WTG ID | Easting | Northing | Base Elevation (m AHD) | Maximum Tip Height (m AGL) | Wind turbine tip height (m AHD) | Wind turbine tip height (ft AMSL) |
|---|---|---|---|---|---|---|
| 6 | 326641 | 6425938 | 400 | 220 | 620 | 2033.2 |
| 7 | 327090 | 6426042 | 416 | 220 | 636 | 2087.2 |
| 8 | 326607 | 6426600 | 448 | 220 | 668 | 2191.4 |
| 9 | 327253 | 6427327 | 377 | 220 | 597 | 1959.9 |
| 10 | 327671 | 6427498 | 408 | 220 | 628 | 2060.7 |
| 12 | 326127 | 6437085 | 526 | 220 | 746 | 2447.7 |
| 13 | 325782 | 6434694 | 635 | 220 | 855 | 2806.9 |
| 14 | 325907 | 6435040 | 622 | 220 | 842 | 2761.8 |
| 15 | 325709 | 6435849 | 571 | 220 | 791 | 2596.1 |
| 16 | 325821 | 6436296 | 591 | 220 | 811 | 2660.8 |
| 17 | 325986 | 6436709 | 566 | 220 | 786 | 2578.4 |
| 18 | 326167 | 6425180 | 435 | 220 | 655 | 2150.7 |
| 19 | 325701 | 6424256 | 436 | 220 | 656 | 2150.8 |

| WTG ID | Easting | Northing | Base Elevation (m AHD) | Maximum Tip Height (m AGL) | Wind turbine tip height (m AHD) | Wind turbine tip height (ft AMSL) |
|---|---|---|---|---|---|---|
| 20 | 326457 | 6425481 | 405 | 220 | 625 | 2050.3 |
| 21 | 325559 | 6434354 | 618 | 220 | 838 | 2751.0 |
| 22 | 324402 | 6422259 | 435 | 220 | 655 | 2148.3 |
| 23 | 324441 | 6422683 | 459 | 220 | 679 | 2226.3 |
| 24 | 324468 | 6423318 | 413 | 220 | 633 | 2078.4 |
| 25 | 324556 | 6423809 | 467 | 220 | 687 | 2253.7 |
| 26 | 320963 | 6429776 | 560 | 220 | 780 | 2558.7 |
| 27 | 320742 | 6428949 | 557 | 220 | 777 | 2550.2 |
| 28 | 320897 | 6429356 | 523 | 220 | 743 | 2436.6 |
| 29 | 320906 | 6430194 | 553 | 220 | 773 | 2535.2 |
| 30 | 321236 | 6430487 | 515 | 220 | 735 | 2410.3 |
| 31 | 321617 | 6430718 | 509 | 220 | 729 | 2391.7 |
| 32 | 319486 | 6426773 | 457 | 220 | 677 | 2219.7 |
| 33 | 319292 | 6426414 | 525 | 220 | 745 | 2442.9 |
| 34 | 318636 | 6432530 | 616 | 220 | 836 | 2744.4 |
| 35 | 317972 | 6430942 | 684 | 220 | 904 | 2967.5 |

| WTG ID | Easting | Northing | Base Elevation (m AHD) | Maximum Tip Height (m AGL) | Wind turbine tip height (m AHD) | Wind turbine tip height (ft AMSL) |
|---|---|---|---|---|---|---|
| 36 | 317607 | 6431408 | 674 | 220 | 894 | 2933.4 |
| 37 | 318345 | 6431731 | 657 | 220 | 877 | 2876.2 |
| 38 | 319354 | 6432404 | 528 | 220 | 748 | 2452.9 |
| 39 | 319155 | 6432041 | 621 | 220 | 841 | 2758.5 |
| 40 | 318479 | 6432142 | 673 | 220 | 893 | 2928.9 |
| 41 | 317652 | 6428942 | 495 | 220 | 715 | 2346.1 |
| 42 | 317341 | 6429767 | 589 | 220 | 809 | 2653.5 |
| 43 | 317872 | 6429637 | 599 | 220 | 819 | 2688.7 |
| 44 | 318747 | 6430296 | 604 | 220 | 824 | 2704.0 |
| 45 | 318812 | 6430696 | 579 | 220 | 799 | 2621.9 |
| 46 | 317729 | 6430189 | 691 | 220 | 911 | 2987.8 |
| 47 | 317937 | 6430494 | 688 | 220 | 908 | 2978.4 |
| 48 | 316690 | 6426659 | 593 | 220 | 813 | 2668.5 |
| 49 | 318072 | 6427316 | 562 | 220 | 782 | 2564.2 |
| 50 | 318791 | 6427627 | 498 | 220 | 718 | 2356.6 |
| 51 | 317846 | 6433652 | 606 | 220 | 826 | 2709.4 |

| WTG ID | Easting | Northing | Base Elevation (m AHD) | Maximum Tip Height (m AGL) | Wind turbine tip height (m AHD) | Wind turbine tip height (ft AMSL) |
|---|---|---|---|---|---|---|
| 52 | 318208 | 6432995 | 617 | 220 | 837 | 2747.7 |
| 57 | 317749 | 6434174 | 548 | 220 | 768 | 2520.5 |
| 58 | 316718 | 6429096 | 526 | 220 | 746 | 2449.1 |
| 59 | 316312 | 6427955 | 532 | 220 | 752 | 2465.7 |
| 60 | 315743 | 6429184 | 472 | 220 | 692 | 2271.3 |
| 61 | 315870 | 6429605 | 526 | 220 | 746 | 2446.1 |
| 63 | 316770 | 6429613 | 539 | 220 | 759 | 2490.6 |
| 64 | 315658 | 6426711 | 560 | 220 | 780 | 2559.2 |
| 66 | 315103.5 | 6425568 | 497 | 220 | 717 | 2352.5 |
| 67 | 315329 | 6425926 | 521 | 220 | 741 | 2430.0 |
| 68 | 315493 | 6426309 | 555 | 220 | 775 | 2543.8 |
| 69 | 315911 | 6427045 | 573 | 220 | 793 | 2601.9 |
| 70 | 316004 | 6427446 | 553 | 220 | 773 | 2536.1 |
| 71 | 325370 | 6434047 | 543 | 220 | 763 | 2504.6 |
| 72 | 325676 | 6425133 | 425 | 220 | 645 | 2116.4 |

# ANNEXURE 2 –SUMMARY OF WORLDWIDE ACCIDENTS

| *ID* | *Description* | *Date* | *Location* | *Fatalities* | *Flight rules* | *Turbine height* | *Obstacle lighting* | *Cause of accident* | *Relevant to obstacle lighting at night* |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Diamond DA320-A1<br>D-EJAR<br>Collided with a wind turbine approximately 20 m above the ground, during the day in good visibility. The mast was grey steel lattice, rather than white, although the blades were painted in white and red bands. | 02 Feb 2017 | Melle, Germany | 1 | Day VFR<br>No cloud and good visibility | Not specified | Not specified | Not specified | Not applicable |

| ID | Description | Date | Location | Fatalities | Flight rules | Turbine height | Obstacle lighting | Cause of accident | Relevant to obstacle lighting at night |
|---|---|---|---|---|---|---|---|---|---|
| 2 | The Piper PA-32R-300, N8700E, was destroyed during an impact with the blades of a wind turbine tower, at night in IMC.<br>The wind turbine farm was not marked on either sectional chart covering the accident location; however, the pilot was reportedly aware of the presence of the wind farm. | 27 Apr 2014 | 10 miles south of Highmore, South Dakota | 4 | Night IMC<br>Low cloud and rain | 420 ft AGL overall | Fitted but reportedly not operational on the wind turbine that was struck | The NTSB determined the probable cause(s) of this accident to be the pilot's decision to continue the flight into known deteriorating weather conditions at a low altitude and his subsequent failure to remain clear of an unlit wind turbine.<br>Contributing to the accident was the inoperative obstruction light on the wind turbine, which prevented the pilot from visually identifying the wind turbine. | An operational obstacle light may have prevented the accident |

| ID | Description | Date | Location | Fatalities | Flight rules | Turbine height | Obstacle lighting | Cause of accident | Relevant to obstacle lighting at night |
|---|---|---|---|---|---|---|---|---|---|
| 3 | Beechcraft B55<br>The pilot was attempting to remain in VMC by descending the aircraft through a break in the clouds. The pilot, distracted by trying to visually locate the aerodrome, flew into an area of known wind turbines.<br>After sighting the turbines, he was unable to avoid them. The tip of the left wing struck the first turbine blade, followed by the tip of the right wing striking the second turbine.<br>The pilot was able to maintain control of the aircraft and landed safely. | 04 Apr 2008 | Plougin, France | 0 | Day VFR<br>The weather in the area of the wind turbines had deteriorated to an overcast of stratus cloud, with a base between 100 ft to 350 ft and tops of 500 ft. | 328 ft AGL hub height, 393 ft AGL overall | Not specified | This pilot reported having been distracted by a troubling personal matter which he had learned of before departing for the flight.<br>The wind farm was annotated on aeronautical charts. | Not applicable |

| ID | Description | Date | Location | Fatalities | Flight rules | Turbine height | Obstacle lighting | Cause of accident | Relevant to obstacle lighting at night |
|---|---|---|---|---|---|---|---|---|---|
| 4 | VariEze N25063<br>The aircraft collided with a wind turbine following in-flight separation of the majority of the right canard and all of the right elevator | 20 July 2001 | Palm Springs, USA | 2 | Day VFR | N/A | N/A | The failure of the builder to balance the elevators per the kit manufacturer's instructions | Not applicable |

# ANNEXURE 3 –RISK FRAMEWORK

A risk management framework is comprised of likelihood and consequence descriptors, a matrix used to derive a level of risk, and actions required of management according to the level of risk.

The risk assessment framework used by Aviation Projects has been developed in consideration of ISO 31000:2018 *Risk management—Guidelines* and the guidance provided by CASA in its SMS for Aviation guidance material, which is aligned with the guidance provided by the International Civil Aviation Organization (ICAO) in Doc 9589 *Safety Management Manual*, Third Edition, 2013. Doc 9589 is intended to provide States (including Australia) with guidance on the development and implementation of a State safety programme (SSP), in accordance with the International Standards and Recommended Practices (SARPs), and is therefore adopted as the primary reference for aviation safety risk management in the context of the subject assessment.

Section 2.1 *The concept of safety* defines safety as follows [author's underlining]:

> *2.1.1 Within the context of aviation, safety is "the state in which the possibility of harm to persons or of property damage is reduced to, and maintained <u>at or below, an acceptable level</u> through a continuing process of hazard identification and safety risk management."*

### Likelihood

Likelihood is defined in ISO 31000:2018 as the chance of something happening. Likelihood descriptors used in this report are as indicated below.

Likelihood Descriptors

| *No* | *Descriptor* | *Description* |
|---|---|---|
| 1 | Rare | It is almost inconceivable that this event will occur |
| 2 | Unlikely | The event is very unlikely to occur (not known to have occurred) |
| 3 | Possible | The event is unlikely to occur, but possible (has occurred rarely) |
| 4 | Likely | The event is likely to occur sometimes (has occurred infrequently) |
| 5 | Almost certain | The event is likely to occur many times (has occurred frequently) |

### Consequence

Consequence is defined as the outcome of an event affecting objectives, which in this case is the safe and efficient operation of aircraft, and the visual amenity and enjoyment of local residents.

Consequence descriptors used in this report are as indicated in table below.

Consequence Descriptors

| No | Descriptor | People Safety | Property/Equipment | Effect on Crew | Environment |
|---|---|---|---|---|---|
| 1 | Insignificant | Minor injury – first aid treatment | Superficial damage | Nuisance | No effects or effects below level of perception |
| 2 | Minor | Significant injury – outpatient treatment | Moderate repairable damage – property still performs intended functions | Operations limitation imposed.<br>Emergency procedures used. | Minimal site impact – easily controlled.<br>Effects raised as local issues, unlikely to influence decision making. May enhance design and mitigation measures. |
| 3 | Moderate | Serious injury - hospitalisation | Major repairable damage – property performs intended functions with some short-term rectifications | Significant reduction in safety margins. Reduced capability of aircraft/crew to cope with conditions. High workload/stress on crew. Critical incident stress on crew. | Moderate site impact, minimal local impact, and important consideration at local or regional level, possible long-term cumulative effect.<br>Not likely to be decision making issues. Design and mitigation measures may ameliorate some consequences. |
| 4 | Major | Permanent injury | Major damage rendering property ineffective in achieving design functions without major repairs | Large reduction in safety margins. Crew workload increased to point of performance decrement. Serious injury to small number of occupants. Intense critical incident stress. | High site impact, moderate local impact, important consideration at state level. Minor long-term cumulative effect.<br>Design and mitigation measures unlikely to remove all effects. |
| 5 | Catastrophic | Multiple Fatalities | Damaged beyond repair | Conditions preventing continued safe flight and landing.<br>Multiple deaths with loss of aircraft | Catastrophic site impact, high local impact, national importance. Serious long-term cumulative effect.<br>Mitigation measures unlikely to remove effects. |

**Risk matrix**

The risk matrix, which correlates likelihood and consequence to determine a level of risk, used in this report is shown in table below.

Risk Matrix

| | | CONSEQUENCE | | | | |
|---|---|---|---|---|---|---|
| | | INSIGNIFICANT 1 | MINOR 2 | MODERATE 3 | MAJOR 4 | CATASTROPHIC |
| LIKELIHOOD | ALMOST CERTAIN 5 | 6 | 7 | 8 | 9 | 10 |
| | LIKELY 4 | 5 | 6 | 7 | 8 | 9 |
| | POSSIBLE 3 | 4 | 5 | 6 | 7 | 8 |
| | UNLIKELY 2 | 3 | 4 | 5 | 6 | 7 |
| | RARE 1 | 2 | 3 | 4 | 5 | 6 |

**Actions required**

Actions required according to the derived level of risk are shown in table below.

Actions Required

| | |
|---|---|
| 8-10 | **Unacceptable Risk** - Immediate action required by either treating or avoiding risk. Refer to executive management. |
| 5-7 | **Tolerable Risk** - Treatment action possibly required to achieve As Low As Reasonably Practicable (ALARP) - conduct cost/benefit analysis. Relevant manager to consider for appropriate action. |
| 0-4/5 | **Broadly Acceptable Risk** - Managed by routine procedures, and can be accepted with no action. |

### Risk Identification

The primary risk being assessed is that of aviation safety. Based on an extensive review of occurrence data and input from stakeholders, the significant risks that are manifested by the Project have been identified for further assessment:

- there is potential for an aircraft to collide with a wind turbine (CFIT);
- there is potential for an aircraft to collide with a wind monitoring tower (CFIT);
- there is potential for a pilot to initiate manoeuvring in order to avoid colliding with a wind turbine or monitoring tower resulting in collision with terrain; and
- there is potential for the hazards associated with the Project to invoke operational limitations or procedures on operating crew.

It should be noted that according to guidance provided by the Commonwealth Department of Infrastructure and Regional Development, and in line with generally accepted practice, the risk to be assessed should primarily be associated with passenger transport services. The risk being assessed herein is primarily associated with smaller aircraft likely to be flying under the VFR, and so the maximum number of passengers exposed to the nominated consequences is likely to be limited.

The secondary risk being assessed is the visual impact that obstacle lights (if fitted) will have on the surrounding residents.

### Risk Analysis, Evaluation and Treatment

For the purpose of considering applicable consequences, the concept of worst credible effect has been used. Untreated risk is first evaluated, then, if the resulting level of risk is unacceptable, further treatments are identified to reduce the level of risk to an acceptable level.

Each of the five risk events are considered in separate tables in the following pages.

| Risk ID: | 1. Aircraft collision with wind turbine (CFIT) |
|---|---|

**Discussion**

An aircraft collision with a wind turbine would result in harm to people and damage to property. Property could include the aircraft itself, as well as the wind turbine.

There have been four reported occurrences worldwide of aircraft collisions with a component of a wind turbine structure since the year 2000 as discussed in Section 9. These reports show a range of situations where pilots were conducting various flying operations at low level and in the vicinity of wind farms in both IMC and VMC. No reports of aircraft collisions with wind farms in Australia have been found.

In consideration of the circumstances that would lead to a collision with a wind turbine:

- GA VFR aircraft operators generally don't individually fly a significant number of hours in total, let alone in the area in question;
- There is a very small chance that a pilot, suffering the stress of weather, will continue into poor weather conditions (contrary to the rules of flight) rather than divert away from it, is not aware of the wind farm, will not consider it or will not be able to accurately navigate around it; and
- If the aircraft was flown through the wind farm, there is still a very small chance that it would hit a wind turbine.

Refer to the discussion of worldwide accidents at Section 9.4.

There are no known aerial agriculture operations conducted at night in the vicinity of the Project.

If a proposed object or structure is identified as likely to be an obstacle, details of the relevant proposal must be referred to CASA for CASA to determine, in writing:

(a) whether the object or structure will be a hazard to aircraft operations; and

(b) whether it requires an obstacle light that is essential for the safety of aircraft operations

The Project is clear of the obstacle limitation surfaces of any aerodrome.

**Consequence**

If an aircraft collided with a wind turbine, the worst credible effect would be multiple fatalities and damage beyond repair. This would be a Catastrophic consequence.

| Consequence | Catastrophic |
|---|---|

**Untreated Likelihood**

There have been four reports of aircraft collisions with wind turbines worldwide, which have resulted in a range of consequences, where aircraft occupants sustained minor injury in some cases and fatal injuries in others. Similarly, aircraft damage sustained ranged from minor to catastrophic. One of these accidents resulted from structural failure of the aircraft before the collision. Only two relevant accidents occurred during the day, and only one resulted in a single fatality. It is assessed that collision with a wind turbine resulting in multiple fatalities and damage beyond repair is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.

| | |
|---|---|
| ***Untreated Likelihood*** | Possible |

***Current Treatments (without lighting)***

- The Project is clear of the obstacle limitation surfaces of any aerodrome.
- Aircraft are restricted to a minimum height of 500 ft (152.4 m) AGL above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas. The proposed turbines will be a maximum of 220 m (722 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 68 m (222 ft) above aircraft flying at the minimum altitude of 152.4 m (500 ft) AGL.
- In the event that descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines.
- If cloud descends below the turbine hub, obstacle lighting would be obscured and therefore ineffective.
- Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles which are within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).
- Aircraft authorised to intentionally fly below 152.4 m (500 ft) AGL (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities.
- The wind turbines are typically coloured white (unless otherwise agreed by the Secretary) so they should be visible during the day.
- The 'as constructed' details of wind turbines are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts.
- Because the turbines are above 110 m AGL, there is a statutory requirement to report the towers to CASA.

***Level of Risk***

The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8.

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| ***Current Level of Risk*** | 8 - Unacceptable |

***Risk Decision***

A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.

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| ***Risk Decision*** | Unacceptable |

***Proposed Treatments***

The following treatments which can be implemented at little cost will provide an acceptable level of safety:

- Details of the Project should be communicated to local and regional aircraft operators prior to, during and following construction to heighten their awareness of its location and so that they can plan their operations accordingly. Specifically:
    - Provide the details to the New South Wales Regional Airspace and Procedures Advisory Committee for consideration by its members in relation to VFR transit routes in the vicinity of the wind farm.
    - Engage with local aerial agricultural and aerial firefighting operators to develop procedures, which may include, for example, stopping the rotation of the wind turbine rotor blades prior to the commencement of the subject aircraft operations within the Project area.
    - Arrangements should be made to publish details of the wind farm in ERSA for surrounding aerodromes.

***Residual Risk***

With the additional recommended treatments, the likelihood of an aircraft collision with a wind turbine resulting in multiple fatalities and damage beyond repair will be Unlikely, and the consequence remains Catastrophic, resulting in an overall risk level of 7 - Tolerable.

It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified.

In the circumstances, the level of risk under the proposed treatment plan is considered as low as reasonably practicable (ALARP).

It is our assessment that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a wind turbine, without obstacle lighting on the turbines of the Project.

However, the Proponent may consider other factors in its decision as to whether obstacle lighting should be installed.

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| ***Residual Risk*** | 7 - Tolerable |

| *Risk ID:* | 2. Aircraft collision with a wind monitoring tower (CFIT) |
|---|---|

***Discussion***

An aircraft collision with a WMT would result in harm to people and damage to property.

Hansen Bailey advises that there are two (2) existing WMTs with a maximum height of up to 110 m (361 ft) AGL.

The towers are steel lattice masts (at or below the wind turbine hub height) and were installed at different locations around the Project site.

The existing WMTs have high visibility aviation marker balls up on the top-level guy wires.

The location of the existing WMTs and other applicable details have been advised to Airservices Australia. Any additional WMTs will be reported to Airservices Australia.

There are a few instances of aircraft colliding with a WMT, but they were all during the day with good visibility, and none was in Australia.

There is a relatively low rate of aircraft activity in the vicinity of the wind farm.

There are no known aerial agriculture operations conducted at night in the vicinity of the wind farm.

For objects at a height of 110 m AGL or more and outside the OLS of an aerodrome, CASA must be notified.

Obstacle lighting may be required unless CASA, in an aeronautical study, assesses it as being shielded by another lit object or that it is of no obstacle significance.

***Consequence***

If an aircraft collided with a WMT, the worst credible effect would be multiple fatalities and damage beyond repair. This would be a Catastrophic consequence.

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| ***Consequence*** | Catastrophic |

***Untreated Likelihood***

There are a few occurrences of an aircraft colliding with a WMT, but all were during the day with good visibility when obstacle lighting would arguably be of no effect, and none was in Australia. It is assessed that collision with a wind monitoring tower without obstacle lighting that would be effective in alerting the pilot to its presence is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.

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| ***Untreated Likelihood*** | Possible |

***Current Treatments***

- The WMT locations will be advised to CASA and Airservices Australia.
- Aircraft are restricted to a minimum height of 152.4 m (500 ft) AGL above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas. The WMTs will likely be at a maximum height of 110 m (361 ft) AGL, which will be 139 ft (42 m) below the minimum height of 500 ft AGL for an aircraft flying at this height.

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| • In the event that descending cloud forces an aircraft lower than 152.4 m (500 ft) AGL, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of the tower.<br>• Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).<br>• Aircraft authorised to intentionally fly below 152.4 m (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities.<br>• The towers are constructed from grey steel.<br>• Since the towers will be higher than 110 m AGL, there is a statutory requirement to report them to CASA. |
| ***Level of Risk***<br>The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8. |
| ***Current Level of Risk*** — 8 - Unacceptable |
| ***Risk Decision***<br>A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management. |
| ***Risk Decision*** — Unacceptable |
| ***Proposed Treatments***<br>The following treatments which can be implemented at little cost will provide an acceptable level of safety:<br>• Details of any additional WMTs when they are constructed should be advised to Airservices Australia.<br>• Consideration could be given to marking any wind monitoring towers according to the requirements set out in MOS 139 Section 8.10 Obstacle Markings (as modified by the guidance in NASF Guideline D); specifically:<br>*8.10.2.6 Masts, poles and towers must be marked in contrasting bands with the darker colour at the top, as shown in Figure 8.10-3. The bands must be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less.*<br>*8.10.2.8 Wires or cable obstacles must be marked using three-dimensional coloured objects such as spheres and pyramids, etc; of a size equivalent to a cube with 600 mm sides, spaced 30 m apart.*<br>• Ensure details of any additional WMTs on the Project site have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators before, during and following construction. |

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| ***Residual Risk***<br>With the additional recommended treatments, the likelihood of an aircraft collision with a WMT resulting in multiple fatalities and damage beyond repair will be Unlikely, and the consequence remains Catastrophic, resulting in an overall risk level of 7 – Tolerable.<br>It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified, other than if the WMT exceeds 150 m AGL in height and is not in relatively close proximity to a wind turbine.<br>In the circumstances, the level of risk under the proposed treatment plan is considered as low as reasonably practicable (ALARP).<br>It is our assessment that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with the WMTs, without obstacle lighting on the WMT of the Project. | |
| ***Residual Risk*** | 7 - Tolerable |

| *Risk ID:* | 3. Harsh manoeuvring leads to controlled flight into terrain (CFIT) |
|---|---|

***Discussion***

An aircraft colliding with terrain as a result of manoeuvring to avoid colliding with a wind turbine would result in harm to people and damage to property.

There are a few ground collision accidents resulting from manoeuvring to avoid wind farms, but none in Australia, and all were during the day.

The Project is clear of the obstacle limitation surfaces of any aerodrome.

Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas.

The proposed turbines will be a maximum of 220 m (722 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 68 m (222 ft) above aircraft flying at the minimum altitude of 152.4 m (500 ft) AGL.

Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines.

If cloud descends below the turbine hub, obstacle lighting would be obscured and therefore ineffective.

Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).

Aircraft authorised to intentionally fly below 152.4 m (500 ft) AGL (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities.

***Assumed risk treatments***

- The wind turbines are typically coloured white so they should be visible during the day.
- The 'as constructed' details of wind turbines are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts.
- Since the turbines will be higher than 110 m AGL, there is a statutory requirement to report the turbines to CASA.

***Consequence***

If an aircraft collided with terrain, the worst credible effect would be multiple fatalities and damage beyond repair. This would be a Catastrophic consequence.

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| ***Consequence*** | Catastrophic |

***Untreated Likelihood***

There are a few ground collision accidents resulting from manoeuvring to avoid wind farms, but none in Australia, and all were during the day. It is assessed that a ground collision accident following manoeuvring to avoid a wind turbine is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.

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| ***Untreated Likelihood*** | Possible |

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| ***Current Treatments (without lighting)***<br>• The Project is clear of the obstacle limitation surfaces of any aerodrome.<br>• Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas.<br>• Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines.<br>• If cloud descends below the turbine hub, obstacle lighting would be obscured and therefore ineffective.<br>• Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).<br>• Aircraft authorised to intentionally fly below 152.4 m (500 ft) AGL (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities.<br>• The rotor blades, nacelle and the supporting mast of the wind turbines should be painted white, typical of most wind turbines operational in Australia.<br>• The 'as constructed' details of wind turbines are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts.<br>• Since the turbines will be higher than 110 m AGL, there is a statutory requirement to report the turbines to CASA. | |
| ***Level of Risk***<br>The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8. | |
| ***Current Level of Risk*** | 8 – Unacceptable |
| ***Risk Decision***<br>A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management. | |
| ***Risk Decision*** | Unacceptable |
| ***Proposed Treatments***<br>The following treatments which can be implemented at little cost will provide an acceptable level of safety:<br>• Ensure details of the Project have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators before, during and following construction. | |

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| • Although there is no requirement to do so, the Proponent may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for their safe operation within the Project area. |

***Residual Risk***

With the additional recommended treatments, the likelihood of ground collision resulting from manoeuvring to avoid a wind turbine resulting in multiple fatalities and damage beyond repair will be Unlikely, and the consequence remains Catastrophic, resulting in an overall risk level of 7 – Tolerable.

It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified.

In the circumstances, the level of risk under the proposed treatment plan is considered as low as reasonably practicable (ALARP).

It is our assessment that there is an acceptable level of aviation safety risk associated with the potential for ground collision resulting from manoeuvring to avoid a wind turbine, without obstacle lighting on the turbines of the Project.

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| ***Residual Risk*** | 7 - Tolerable |

| Risk ID: | 4. Effect of the Project on operating crew |
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**Discussion**

Introduction or imposition of additional operating procedures or limitations can affect an aircraft's operating crew.

There are no known aerial agriculture operations conducted at night in the vicinity of the Project.

**Consequence**

The worst credible effect a wind farm could have on flight crew would be the imposition of operational limitations, and in some cases, the potential for use of emergency procedures. This would be a Minor consequence.

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| Consequence | Minor |

**Untreated Likelihood**

The imposition of operational limitations is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.

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| Untreated Likelihood | Possible |

**Current Treatments (without lighting)**

- The Project is clear of the obstacle limitation surfaces of any aerodrome.
- Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas.
- Wind turbines will be a maximum of 220 m (722 ft) AGL at the top of the blade tip, so the rotor blade at its maximum height will be approximately 68 m (222 ft) above aircraft flying at the minimum altitude of 152.4 m (500 ft) AGL.
- In the event that descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines.
- Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines.
- If cloud descends below the turbine hub, obstacle lighting would be obscured and therefore ineffective.
- Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).

| | |
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| • Aircraft authorised to intentionally fly below 152.4 m (500 ft) AGL (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities.<br>• The rotor blades, nacelle and the supporting mast of the wind turbines should be painted white, typical of most wind turbines operational in Australia.<br>• The 'as constructed' details of wind turbines are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts.<br>• Since the turbines will be higher than 110 m AGL, there is a statutory requirement to report the turbines to CASA. | |
| ***Level of Risk***<br>The level of risk associated with a Possible likelihood of a Minor consequence is 5. | |
| ***Current Level of Risk*** | 5 - Tolerable |
| ***Risk Decision***<br>A risk level of 5 is classified as Tolerable: Treatment action possibly required to achieve ALARP - conduct cost/benefit analysis. Relevant manager to consider for appropriate action. | |
| ***Risk Decision*** | Accept, conduct cost benefit analysis |
| ***Proposed Treatments***<br>Given the current treatments and the limited scale and scope of flying operations conducted within the vicinity of the Project, there is likely to be little additional safety benefits to be gained by installing obstacle lighting, other than if a WMT exceeds 150 m AGL in height and is not in relatively close proximity to a wind turbine.<br>However, the following treatments, which can be implemented at little cost, will provide an additional margin of safety:<br>• Ensure details of the Project have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators before, during and following construction.<br>• Although there is no requirement to do so, the Proponent may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for such aircraft operations in the vicinity of the Project. | |
| ***Residual Risk***<br>Notwithstanding the current level of risk is considered tolerable, the additional recommended treatments will enhance aviation safety. The likelihood remains Possible, and consequence remains Minor. In the circumstances, the risk level of 5 is considered as low as reasonably practicable (ALARP).<br>It is our assessment that there is an acceptable level of aviation safety risk associated with the potential for operational limitations to affect aircraft operating crew, without obstacle lighting on the turbines of the Project. | |

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| ***Residual Risk*** | 5 – Tolerable |

| ***Risk ID:*** | 5. Effect of obstacle lighting on neighbours |
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***Discussion***

This scenario discusses the consequential impact of a decision to install obstacle lighting on the wind farm.

Installation and operation of obstacle lighting on wind turbines or WMT can have an effect on neighbours' visual amenity and enjoyment, specifically at night and in good visibility conditions.

If the wind turbines or WMTs will be higher than 150 m (492 ft) AGL, the wind turbines must be regarded as obstacles unless CASA assess otherwise. In general, objects outside an OLS and above 110 m would require obstacle lighting unless CASA, in an aeronautical study, assesses it is shielded by another lit object or it is of no operational significance.

***Consequence***

The worst credible effect of obstacle lighting specifically at night in good visibility conditions would be:

Moderate site impact, minimal local impact, important consideration at local or regional level, possible long-term cumulative effect. Not likely to be decision making issues. Design and mitigation measures may ameliorate some consequences. This would be a Moderate consequence.

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| ***Consequence*** | Moderate |

***Untreated Likelihood***

The likelihood of moderate site impact, minimal local impact is Almost certain - the event is likely to occur many times (has occurred frequently).

| | |
|---|---|
| ***Untreated Likelihood*** | Almost certain |

***Current Treatments***

If the wind turbines or WMTs will be higher than 150 m (492 ft) AGL, they must be regarded as obstacles unless CASA assess otherwise. In general, objects outside an OLS and above 110 m would require obstacle lighting unless CASA, in an aeronautical study, assesses it is shielded by another lit object or it is of no operational significance.

***Level of Risk***

The level of risk associated with an Almost certain likelihood of a Moderate consequence is 8.

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| ***Current Level of Risk*** | 8 - Unacceptable |

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| ***Risk Decision***<br>A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management. | |
| ***Risk Decision*** | Unacceptable |
| ***Proposed Treatments***<br>Not installing obstacle lighting would completely remove the source of the impact.<br>If lighting is required, there are impact reduction measures that can be implemented to reduce the impact of lighting on surrounding neighbours, including:<br>• reducing the number of wind turbines with obstacle lights;<br>• specifying an obstacle light that minimises light intensity at ground level;<br>• specifying an obstacle light that matches light intensity to meteorological visibility; and<br>• mitigating light glare from obstacle lighting through measures such as baffling.<br>There are impact reduction measures that can be implemented to reduce the impact of lighting on surrounding neighbours. These measures are designed to optimise the benefit of the obstacle lights to pilots while minimising the visual impact to those on the ground.<br>Consideration may be given to activating the obstacle lighting via a pilot activated lighting system.<br>An option is to consider using Aircraft Detection Lighting Systems (referred in the United States Federal Aviation Administration Advisory Circular AC70/7460-1L CHG1 – *Obstruction Marking and Lighting*). Such a system would only activate the lights when an aircraft is detected in the near vicinity and deactivate the lighting once the aircraft has passed. This technology reduces the impact of night lighting on nearby communities and migratory birds and extends the life expectancy of obstruction lights. | |
| ***Residual Risk***<br>Not installing obstacle lights would clearly be an acceptable outcome to those affected by visual impact.<br>Consideration of visual impact in the lighting design should enable installation of lighting that reduces the impact to neighbours.<br>The likelihood of a Moderate consequence remains Likely, with a resulting risk level of 7 – Tolerable.<br>It is our assessment that visual impact from obstacle lights can be negated if they are not installed, but if obstacle lights are to be installed, they can be designed so that there is an acceptable risk of visual impact to neighbours. | |
| ***Residual Risk*** | 7 - Tolerable |

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