December 2021

AVIATION IMPACT ASSESSMENT

# PALING YARDS WIND FARM

*Prepared for Global Power Generation Australia Pty Ltd c/- Tract Consultants Pty Ltd*

AVIATION PROJECTS

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## DOCUMENT CONTROL

Document Title: Paling Yards Wind Farm – Aviation Impact Assessment

Reference: 100403-02

Prepared by: KP Smit / C Abela

Reviewed by: K Tonkin

Released by: C Abela

Revision History

| *Version* | *Description* | *Transmitted* | *Reviewed by* | *Date* |
|---|---|---|---|---|
| 0.1 | First Draft | 01 April 2021 | Tract/GPG | 07 May 2021 |
| 0.2 | Revised Draft | 18 May 2021 | Tract | 09 August 2021 |
| 0.3 | Revised Draft | 24 August 2021 | Tract/GPG | 01 September 2021 |
| 0.4 | Final Draft | 10 November 2021 | Tract/GPG | 03 December 2021 |
| 1.0 | Final | 03 December 2021 | | |

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# ACRONYMS

| | |
|---|---|
| AAAA | Aerial Application Association of Australia |
| AC | Advisory Circular |
| AFAC | Australasian Fire and Emergency Services Council |
| AGL | above ground level |
| AHD | Australian Height Datum |
| AIA | aviation impact assessment |
| AIP | Aeronautical Information Package |
| AIS | aviation impact statement |
| ALA | aircraft landing area |
| ALARP | as low as reasonably practicable |
| AMSL | above mean sea level |
| ARP | Aerodrome Reference Point |
| AS | Australian Standards |
| AsA | Airservices Australia |
| ATSB | Australian Transport Safety Bureau |
| BoM | Bureau of Meteorology |
| CAAP | Civil Aviation Advisory Publications |
| CAO | Civil Aviation Orders |
| CAR | Civil Aviation Regulation (1988) |
| CASA | Civil Aviation Safety Authority |
| CASR | Civil Aviation Safety Regulation (1998) |
| CFIT | controlled flight into terrain |
| CNS | communications, navigation and surveillance |
| CTAF | common traffic advisory frequency |
| DAH | Designated Airspace Handbook |
| DME | distance measuring equipment |
| DPIE | Department of Planning, Industry and Environment |
| ERC-H | en-route chart high |

| | |
|---|---|
| ERC-L | en-route chart low |
| ERSA | En Route Supplement Australia |
| GA | general aviation |
| GNSS | global navigation satellite system |
| ICAO | International Civil Aviation Organization |
| IFR | instrument flight rules |
| IMC | instrument meteorological conditions |
| LGA | local government area |
| LSALT | lowest safe altitude |
| MOC | minimum obstacle clearance |
| MOS | Manual of Standards |
| MSA | minimum sector altitude |
| NASAG | National Airports Safeguarding Advisory Group |
| NASF | National Airports Safeguarding Framework |
| NDB | non-directional radio beacon |
| OLS | obstacle limitation surface |
| PANS-OPS | Procedures for Air Navigation Services - Aircraft Operations |
| RAAF | Royal Australian Air Force |
| RFDS | Royal Flying Doctor Service |
| RNAV | area navigation |
| RPT | regular public transport |
| RSR | route surveillance radar |
| SARPs | standards and recommended practices |
| VFR | visual flight rules |
| VFRG | visual flight rules guide |
| VHF | very high frequency |
| VOR | VHF omni-directional radio range |
| VMC | visual meteorological conditions |
| WMTs | wind monitoring towers |

| | |
|---|---|
| WTGs | wind turbine generators |

## 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) |

## DEFINITIONS

Definitions of key aviation terms are included in **Annexure 2**.

## NOTES

5 m error budget has been applied for an assessment of the wind turbines maximum height.

# EXECUTIVE SUMMARY

**Introduction**

Tract Pty Ltd (Tract) on behalf of Global Power Generation Australia (formerly known as Union Fenosa Wind Australia (GPG)) is seeking State Significant Development (SSD) Consent under Division 4.7 of Part 4 of the *Environmental Planning & Assessment Act 1979* (EP&A Act) for the proposed Paling Yards Wind Farm (the Project).

The Project comprises up to 47 wind turbine generators (WTGs). The maximum tip height of the WTG will be up to 240 m above ground level (AGL). The Project site is located approximately 60 km south of Oberon and 60 km north of Goulburn within the Oberon local government area (LGA) in the Central Tablelands of New South Wales (NSW).

The Project site is proposed to cover 4 landholdings known as 'Mingary Park', 'Middle Station', ‘Hilltop’ and 'Paling Yards', which comprise a total of approximately 4,600 hectares.

Tract on behalf of GPG has engaged Aviation Projects to prepare an Aviation Impact Assessment (AIA) to assess the potential aviation safety impacts associated with the proposal to support the proposed SSD application and formally consult with aviation agencies. The SSD application will be submitted to the Department of Planning, Industry and Environment (DPIE) for approval.

This AIA assesses the potential aviation impacts, provides aviation safety advice in respect of relevant requirements of air safety regulations and procedures, and informs and documents consultation with relevant aviation agencies.

This AIA report includes an Aviation Impact Statement (AIS) and a qualitative risk assessment to determine the need for obstacle lighting and of applicable aspects for client review and acceptance before submission to external aviation regulators.

**Project description**

The proposed Project will comprise the following:

- up to 47 wind turbines
- maximum overall height (tip height) of the wind turbines is up to 240 m AGL
- highest wind turbine is PY-34 and PY-38 with ground elevation of 1050 m Australian Height Datum (AHD) and overall height of 1295 m (4249 ft above mean sea level (AMSL)) (including a 5 m error budget)
- one proposed permanent WMT with a maximum height of up to 160 m (525 ft) AGL, which will be reported to Airservices Australia.

**Conclusions**

Based on a comprehensive analysis and assessment detailed in this report, the following conclusions were made:

*Planning considerations*

The Oberon Council's Local Environmental Plan does not incorporate any reference to the development of wind farms or the protection of aeronautical infrastructure.

The Upper Lachlan Environmental Plan 2010 does not affect this AIA for the Project. Crookwell Airport is only referenced in the Upper Lachlan Environmental Plan 2010, is not a certified airport and remains outside the 3 nm area of interest from the Project area.

*Certified airports*

1. The Project site is beyond 30 nm (55.56 km) of any certified airports. The closest certified airport is Goulburn Airport (YGLB) located approximately 69 km (37.3 nm) south of the Project.
2. The Project will not impact the 25 nm MSAs of any certified airport, and therefore there will not be any impacts on the instrument flight procedures.

*Obstacle Limitation Surfaces*

3. The Project is located outside the horizontal extent of obstacle limitation surface (OLS) for certified airports. Therefore, the Project will have no impact any OLS surfaces.

*Aircraft Landing Areas (ALAs)*

4. 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.
5. A search on OzRunways, which sources its data from Airservices Australia (AIP) and Aircraft Owners and Pilots Association (AOPA) Australia Airfield Directory, returned with 4 nearby ALAs from the Project site.
6. Proposed WTGs are located outside a nominal 3 nm buffer of three of the ALAs, so these ALAs will not be impacted by the Project. ALA 1 is the only identified landing area which has proposed WTGs within the nominal 3 nm buffer around the air strip.
7. The proposed WTGs are located outside the horizontal extent of approach and take-off surfaces at ALA 1. Therefore, the Project will not impact approach and take-off surfaces of the ALA.
8. None of the proposed WTGs are located inside the horizontal extent of indicative flight circuits of ALA 1. Therefore, the flight circuit of this ALA will not be impacted by the Project.
9. It is likely that the identified ALAs are predominantly used by aerial application operators. The aerial application operators would likely use an abbreviated circuit pattern.
10. The effects of wake turbulence could be noticeable operating at ALA 1.
11. Tract and GPG should engage with land hosts and aerial operators of ALA 1 to address potential effects of wake turbulence from the nearest WTGs.

*Air Routes and Lowest Safe Altitude*

12. Paling Yards Wind Farm is located in the area with a grid lowest safe altitude (LSALT) of 1737 m AHD (5700 ft AMSL) with a minimum obstacle clearance (MOC) surface of 1433 m AHD (4700 ft AMSL). The highest wind turbine is PY-34 and PY-38 with a maximum overall height of 1295 m (4249 ft AMSL) is below the LSALT MOC of 4700 ft AMSL.
13. The Project will not impact any of the nearby air routes.

Airspace

14. The Project is located outside of controlled airspace (wholly within Class G airspace).

*Aviation Facilities*

15. The Project will not penetrate any protection areas associated with aviation facilities.

*Radar*

16. The closest aviation radar facility is the Mount Boyce Route Surveillance Radar (RSR), which is located approximately 72.5k km (39 nm) northeast of the Project. The second closest radar facility is Cecil Park Primary Surveillance Radar (PSR), located approximately 100 km (54 nm) east of the Project.
17. The Project is located in Zone 4 (accepted zone) and outside the radar line of sight of both radar facilities and will not interfere with the serviceability of the aviation facility. Therefore, it is unlikely that the Project will impact the Mount Boyce RSR or Cecil Park PSR.

**Aviation Impact Statement**

18. Based on the Project layout and overall turbine blade tip height limit of 240 m AGL, the blade tip elevation of the highest wind turbine, which is wind turbine PY-34 and PY-38, will not exceed 1295 m (4249 ft AMSL).
19. This AIS concludes that the Project:
    a. will not penetrate any OLS surfaces
    b. will not penetrate any PANS-OPS surfaces
    c. will not have an impact on nearby designated air routes
    d. will not have an impact on the grid LSALT of 5700 ft AMSL
    e. will not have an impact on prescribed airspace
    f. is wholly contained within Class G airspace
    g. is outside the clearance zones associated with aviation navigation aids and communication facilities.

**Obstacle lighting risk assessment**

20. Aviation Projects has undertaken a safety risk assessment of the Project and concludes that WTGs and WMTs will not require obstacle lighting to maintain an acceptable level of safety to aircraft.

**Consultation**

21. An appropriate and justified level of consultation was undertaken with relevant parties. Refer to Section 5 for details of the stakeholders consulted and a summary of the consultation.

**Summary of key recommendations**

A summary of the key recommendations of this AIA is set out below.

The full list of recommendations and associated details are provided in Section 11 'Recommendations' at the end of this report.

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. Department of Defence should be consulted if there is any subsequent modification in the wind turbine height or scale of development, using the following email address: land.planning@defence.gov.au;
3. To facilitate the flight planning of aerial application operators, the location and height of WTGs and WMTs 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.
4. Tract/GPG should consider engaging with local aerial agricultural operators and aerial firefighting operators in developing procedures for such aircraft operations in the vicinity of the Project, noting that there is no statutory requirement to do so.
5. Details of the final Project layout should be provided to local and regional aircraft operators prior to construction in order for them to plan their operations.
6. The rotor blades, nacelles and towers of the WTGs should be painted in white, typical of most wind turbines operational in Australia.
7. Consideration should be given to marking the temporary and permanent wind monitoring towers according to the requirements set out in Manual of Standards (MOS) 139 Section 8.10 (as modified by the guidance in NASF Guideline D). Aviation marker balls and painting the top 1/3 of WMTs structures in red and white bands is considered to be an acceptable mitigation strategy.

# 1. INTRODUCTION

## 1.1. Situation

Tract Pty Ltd (Tract) on behalf of Global Power Generation Australia (formerly known as Union Fenosa Wind Australia (GPG)) is seeking technical expertise and advice for a proposed Wind Farm facility known as 'Paling Yards Wind Farm' (the Project).

Tract and GPG previously lodged a 'Critical Infrastructure Project' application (SSD-6699) in January 2014. A range of technical reports and material were submitted previously as part of the SSD-669 application. Changes and amendments to the Environmental Planning and Assessment Act 1979 (EP&A Act) and policy/guidelines for wind energy by the NSW State Government saw the assessment and submission response process become prolonged.

After further discussions with the Department of Planning, Industry and Environment (DPIE), a decision was made by GPG to withdraw the previous application in June 2020 and prepare a new State Significant Development (SSD) application to respond to the new wind energy policy guidelines adequately. A proposed new wind turbine layout design has been prepared as a result of next-generation turbine technology becoming available.

The Project site is located approximately 60 km south of Oberon and 60 km north of Goulburn within the Oberon local government area (LGA) in the Central Tablelands of New South Wales (NSW).

The Project site is proposed to cover 4 landholdings known as 'Mingary Park', 'Middle Station', 'Hilltop' and 'Paling Yards', which comprise a total of approximately 4,600 hectares.

The Project will comprise of approximately 47 wind turbine generators (WTGs) with maximum tip height of 240 m above ground level (AGL).

Tract has requested Aviation Projects prepare an aviation impact assessment (AIA) for the proposed Project development. This aviation impact assessment will review 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.

The Project site requires an aviation assessment undertaken in accordance with the Environmental Planning and Assessment Act 1979, relevant regulations, and in consideration of the NSW Wind Energy Guideline for State significant wind energy development 2016 and other relevant guidance and regulatory requirements such as the National Airports Safeguarding Framework (NASF) Guideline D: Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers and specific requirements as advised by Airservices Australia.

The AIA and supporting technical data will provide evidence and analysis for the planning application to demonstrate that appropriate risk mitigation strategies have been identified.

## 1.2. Purpose and Scope

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

The assessment specifically responds to the:

- Environmental Planning and Assessment Act 1979

- 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

Aviation Projects conducted the task in accordance with the following methodology:

- confirm the scope and deliverables with Tract
- review client material
- conduct a site visit to properly investigate aviation safety aspects of the proposal
- review relevant regulatory requirements and information sources
- prepare a draft AIA 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 AIA report includes an 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
- identify risk mitigation strategies that provide an acceptable alternative to night lighting. The risk assessment was completed following the guidelines in *ISO 31000:2018 Risk Management –Guidelines*
- consult with relevant Council(s), Part 173 procedure designers and aerodrome operators of the nearest aerodrome/s to seek endorsement of the proposal to change instrument procedures (if applicable)
- consult/engage with stakeholders to negotiate acceptable outcomes (if required)
- finalise the AIA report for client acceptance when response received from stakeholders 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 certified aerodromes that are located within 30 nm (55.56 km) of the Project
- 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 Project 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 – A, B, C, D, E, G etc where the Project is located

Navigation/Radar:

- Nominate radar navigation systems with coverage overlapping the site.

### 1.5. Material reviewed

Material provided by Tract for preparation of this assessment included:

- GPG – 220-0052-00-P-02_Paling Yards Wind Farm Planning Summary.pdf , dated 25/2/2021
- COC – 220-0052-00-P-03 Table of assumptions_15.12.20020.pdf , dated 15/12/2020
- NSW Government, Planning Industry & Environment, Rangoon Wind Farm (SSD-10476) Planning Secretary's Environmental Assessment Requirements, dated 4 September 2020
- Tract file PYWF_Base Layout_v1-01-20210120.kml , dated 25/2/2021
- Tract file WTG Locations, PW_WTG Layout_16-08-21 received via email, dated 19 August 2021
- Tract file PY-Coordinates-072821_Tract.xls, received via email, dated 01 September 2021
- Tract file 220-0052-00-P-03-2D01 Transmission Line.kmz received via email, dated 01 September 2021.

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# 2. BACKGROUND

### 2.1. Site overview

The Project site is located approximately 60 km south of Oberon and 60 km north of Goulburn within the Oberon local government area (LGA) in the Central Tablelands of New South Wales (NSW).

The Project site is proposed to cover 4 landholdings known as 'Mingary Park', 'Middle Station', ‘Hilltop’ and 'Paling Yards', which comprise a total of approximately 4,600 hectares.

An overview of the Project site in relation to Goulburn is provided in Figure 1 (source: GPG, Google Earth).

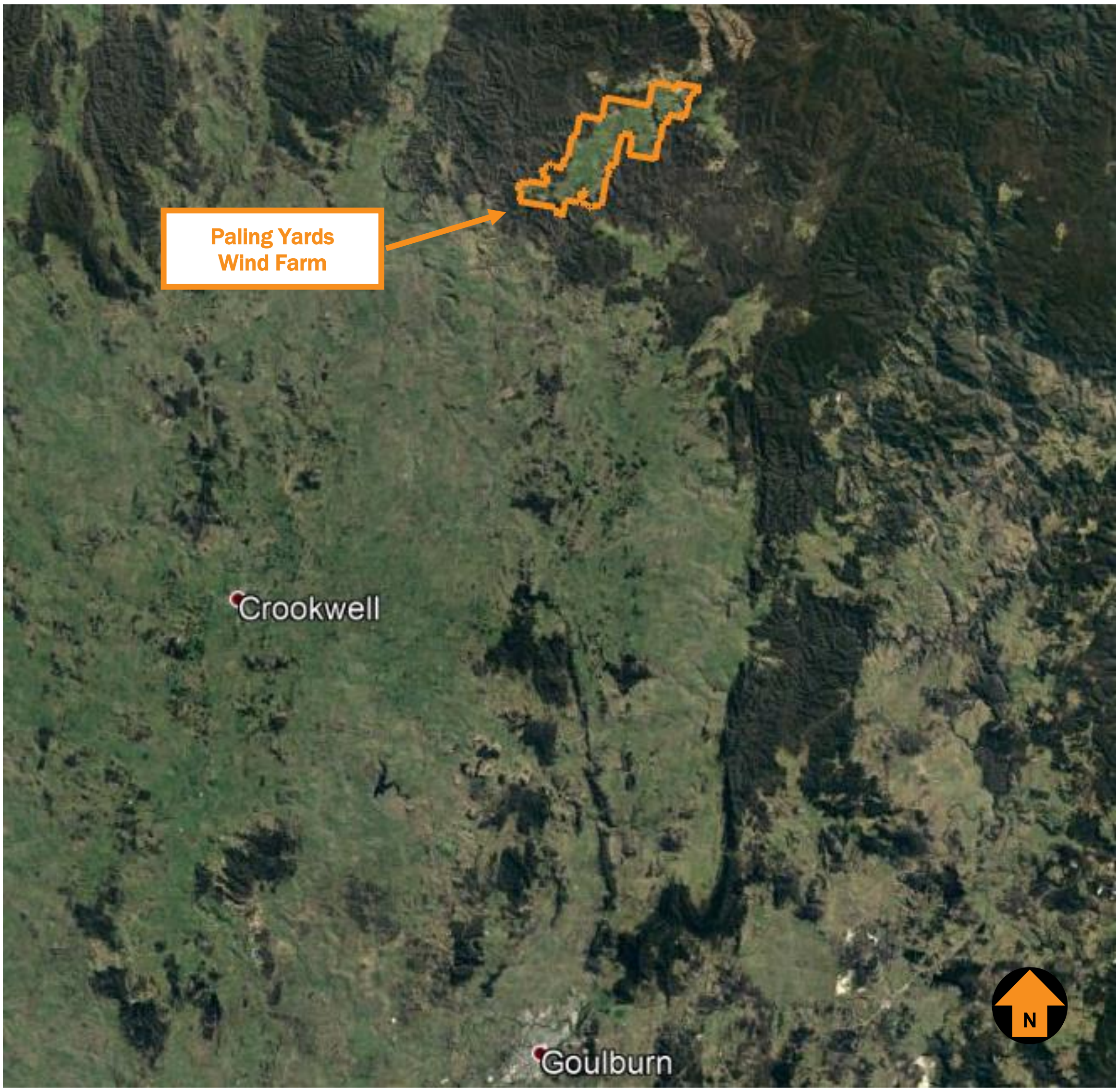


Figure 1 Project site overview

Figure 2 shows the boundary and layout of the WTGs of the Project.

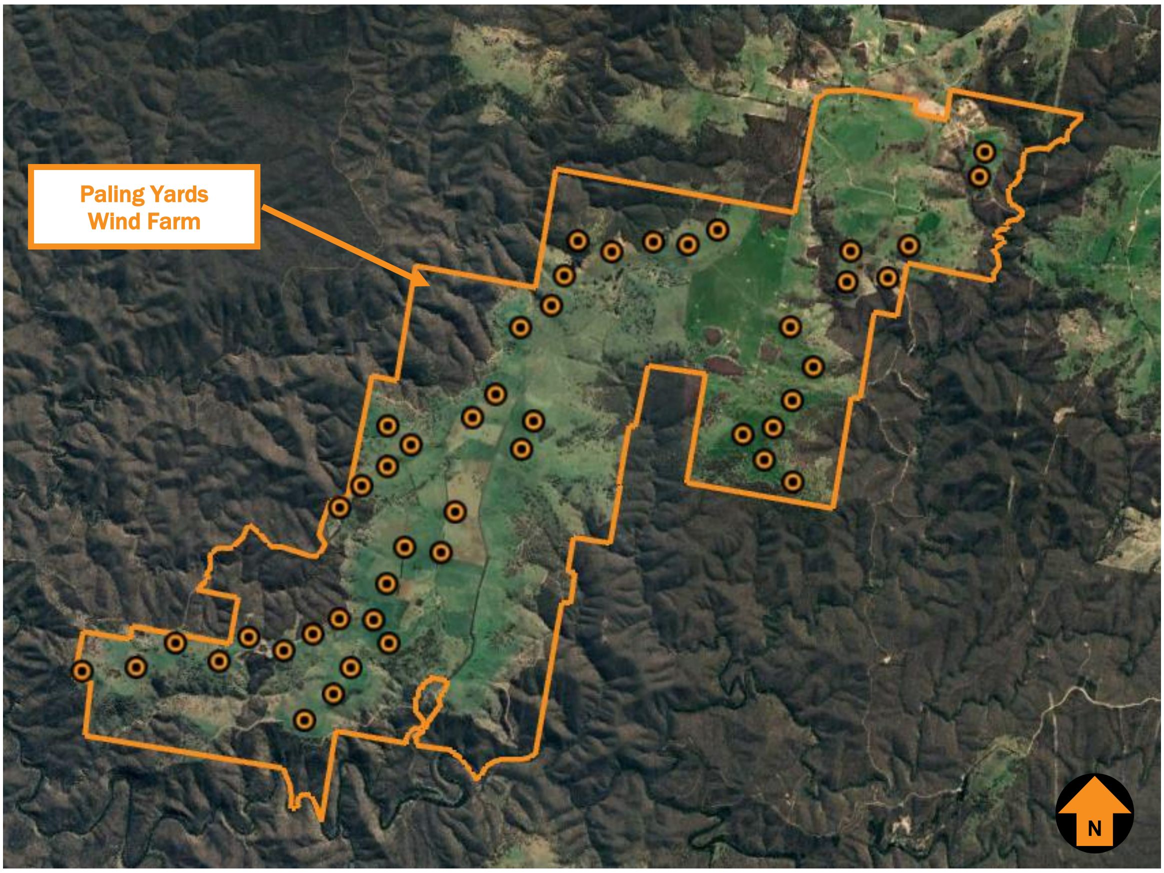


Figure 2 Project boundary and layout

### 2.2. Project description

The Project's key permanent and temporary components include but are not limited to:

- Approximately 47 wind turbines with a total height of 240 m
- Corresponding individual kiosks for the housing of equipment
- Three wind monitoring masts, fitted with various instruments such as anemometers, wind vanes, temperature gauges and other electrical equipment
- Obstacle lighting to selected turbines (if required)
- Wind farm and substation control room and facilities building
- On-site electrical substation and approximately 9.0 km of overhead power line up to 500 kV
- Removal of native vegetation and additional vegetation planting to provide screening (as required)

- Upgrade to existing local road infrastructure and internal unsealed tracks
- Temporary batching plant to supply concrete.

Figure 3 shows the location of the Project site within the boundaries of Oberon Council and bordering the Upper Lachlan Shire Council LGAs (source: Google Earth).

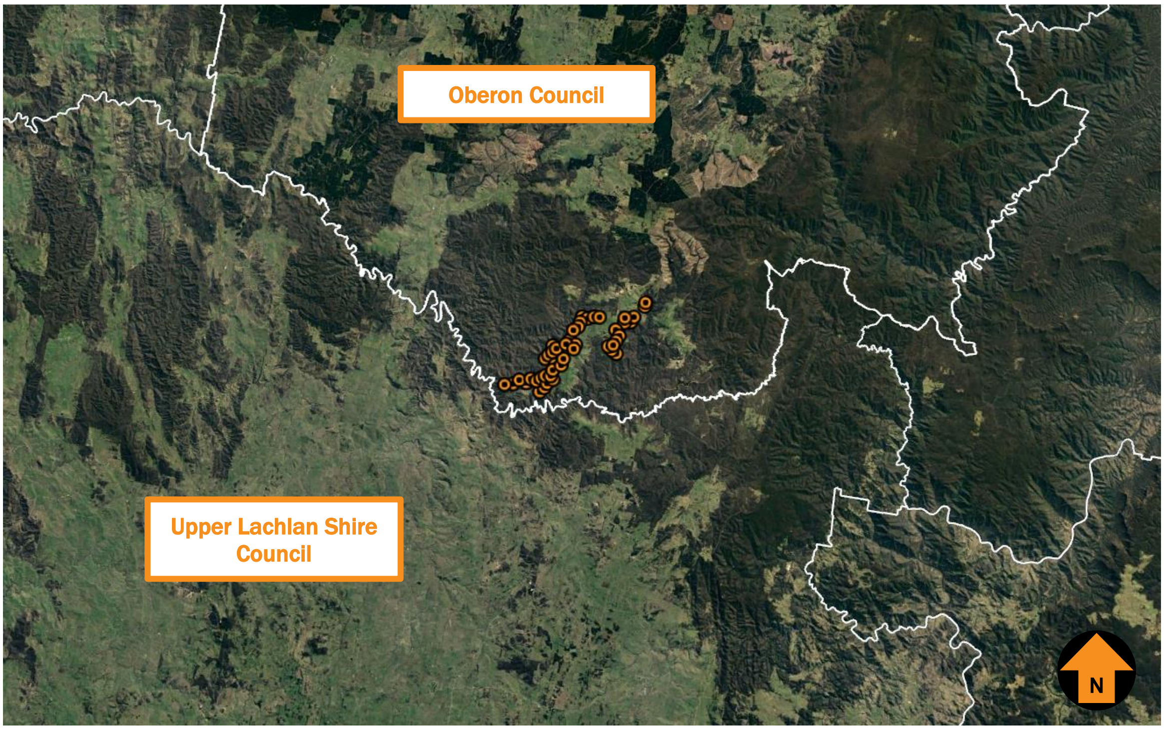


Figure 3 Project layout relative to LGAs

# 3. EXTERNAL CONTEXT

### 3.1. Planning context

Tract seeks to increase wind power production while protecting individuals, communities and the environment from adverse impacts from wind farms by complying with the NSW *Wind Energy Guideline for State significant wind energy developmen*t (2016).

The role of the NSW 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.

The Secretary's Environmental Assessment Requirements (SEARS) for the project relevant to this study are copied below for ease of reference:

> Hazards and Risks *– the EIS must include an assessment of the following:*
>
> - *Aviation Safety:*
>
> *- assess the impact of the development under the National Airports Safeguarding Framework Guideline D: Managing Wind Turbine Risk to Aircraft;*
>
> *- provide associated height and co-ordinates for each turbine assessed;*
>
> *- 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;*
>
> *- identify aerodromes within 30 km of the turbines and consider the impact to nearby aerodromes and aircraft landing areas;*
>
> *- address impacts on obstacle limitation surfaces; and*
>
> *- 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;*
>
> - *Bushfire - identify potential hazards and risks associated with bushfires / use of bushfire prone land, including the risks that a wind farm would cause bush fire and any potential impacts on the aerial fighting of bush fires and demonstrate compliance with Planning for Bush Fire Protection 2019;*

### 3.2. National Airports Safeguarding Framework

The National Airports Safeguarding Advisory Group (NASAG) was established by the Commonwealth Department of Infrastructure and Transport to develop a national land use planning framework called the National Airports Safeguarding Framework (NASF). The purpose of this framework is to enhance the current and future safety, viability, and growth of aviation operations at Australian airports through:

- the implementation of best practice in relation to land use assessment and decision making in the vicinity of airports
- assurance of community safety and amenity near airports
- better understanding and recognition of aviation safety requirements and aircraft noise impacts in land use and related planning decisions
- the provision of greater certainty and clarity for developers and landowners
- improvements to regulatory certainty and efficiency
- the publication and dissemination of information on best practice in land use and related planning that supports the safe and efficient operation of airports.

NASF Guideline D: *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers*, 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.

The methodology for preparing the risk assessment is contained in the NASF Guideline D *Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation*.

The risk assessment will have regard to all potential aviation activities within the vicinity of the Project site including recreation, commercial, civil (including for agricultural purposes) and military operations.

The AIS of this report identifies high level risks, risk mitigation measures and development constraints that are likely to be applicable to the aviation risk assessment.

### 3.3. Oberon Council

The *Oberon Local Environmental Plan 2013* (current version dated 14 July 2021) does not include any reference to airports, aerodromes, or other aviation facilities. Nor does it refer to the development of wind farms or other renewable energies. Instead, it refers to the *State Environmental Planning Policy (Infrastructure) 2007*, for guidance on the development of small wind turbine system. A small wind turbine system is defined as a system with a declared capacity to generate no more than 10kW.

The *Oberon Local Environmental Plan 2013* (current version dated 14 July 2021) does not include any provisions for aviation.

### 3.4. Upper Lachlan Shire Council

The Upper Lachlan *Environmental Plan 2010* (current version dated 14 July 2021) includes reference to airspace operations and noise with specific reference to Crookwell Airport,

The Upper Lachlan Environmental Plan 2010 does not affect this AIA for the Project. Crookwell Airport is only referenced in the Upper Lachlan Environmental Plan 2010, is not a certified airport and remains outside the 3 nm area of interest from the Project area. Crookwell Airport is approximately 22 nm (42 km) south-west of the Project boundary.

### 3.5. 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 4 and Figure 5.

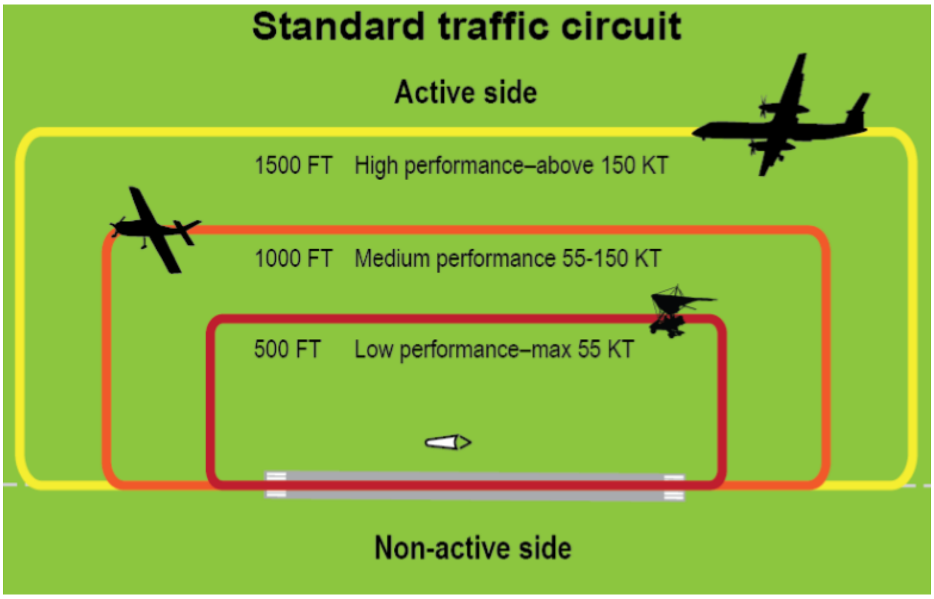


Figure 4 Lateral and vertical separation in the standard aerodrome traffic circuit

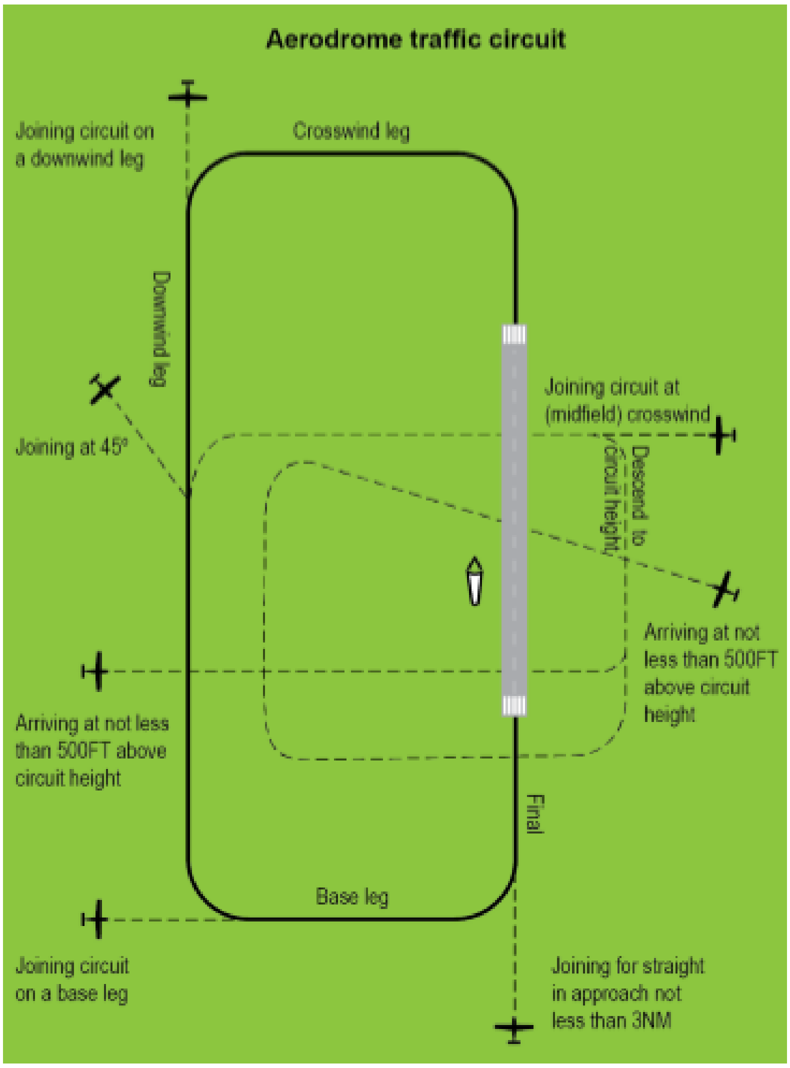


Figure 5 Aerodrome standard traffic circuit, showing arrival and joining procedures

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.*

## 3.6. Rules of flight

### 3.6.1. 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.

### 3.6.2. 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.*

### 3.6.3. Instrument Flight Rules (Day or night) (IFR)

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.

## 3.7. Aircraft operator characteristics

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 VFR are required to remain in visual meteorological conditions (VMC) (at least 5,000 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 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.

### 3.8. Passenger transport operations

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

### 3.9. 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.

### 3.10. Military operations

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

### 3.11. Aerial application 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.

Aerial application operations are conducted in the area.

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

The Aerial Application 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 will be assessed during stakeholder consultation.

Landowner comments about potential impacts to their operations are provided in Section 5.

### 3.12. Aerial Application Association of Australia

In previous consultation with the 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.

### 3.13. Local aerial application operators

Local aerial application operators consulted in previous studies undertaken by Aviation Projects 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 undertaken by Aviation Projects, 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, subject to final turbine locations and by implementing recommendations provided in this report.

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.

To facilitate the flight planning of aerial application operators, details of the proposal, 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.

Aerial application operator comments about potential impacts to their operations are provided in Section 5.

### 3.14. 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 3.0, dated 25 October 2018.

Of specific interest in this document is the paragraph copied from the Response section, copied below:

> *The developer or operator should ensure that:*
>
> - *liaison with the relevant fire and land management agencies is ongoing and effective*
> - *access is available to the wind farm site by emergency services response for on-ground firefighting operations*
> - *wind turbines are shut down immediately during emergency operations – where possible, blades should be stopped in the 'Y' or 'rabbit ear' position, as this positioning allows for the maximum airspace for aircraft to manoeuvre underneath the blades and removes one of the blades as a potential obstacle.*
>
> *Aerial personnel should assess risks posed by aerial obstacles, wake turbulence and moving blades in accordance with routine procedures.*

### 3.15. Emergency services - 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.

# 4. INTERNAL CONTEXT

### 4.1. Wind farm site description

The proposed wind farm is situated within a rural area surrounded by mountainous terrain.

Images of the site taken from locations noted in the figure titles are provided at Figure 6 and Figure 7.

Figure 6 Abercrombie Rd looking south-west over southern portion of wind farm site

Figure 7 Abercrombie Rd looking north-east over northern portion of wind farm site

### 4.2. Wind turbine description and layout

The maximum blade tip height of the proposed wind turbines will be up to 240 m AGL.

The maximum ground elevation for proposed wind turbines PY-34 and PY-38 is 1050 m AHD, which results in a maximum overall height of 1295 m (4249 ft AMSL) including a 5 m error budget.

Figure 8 shows the Project layout and site boundaries identifying the highest wind turbine PY-34 and PY-38 (source: GPG, Google Earth).

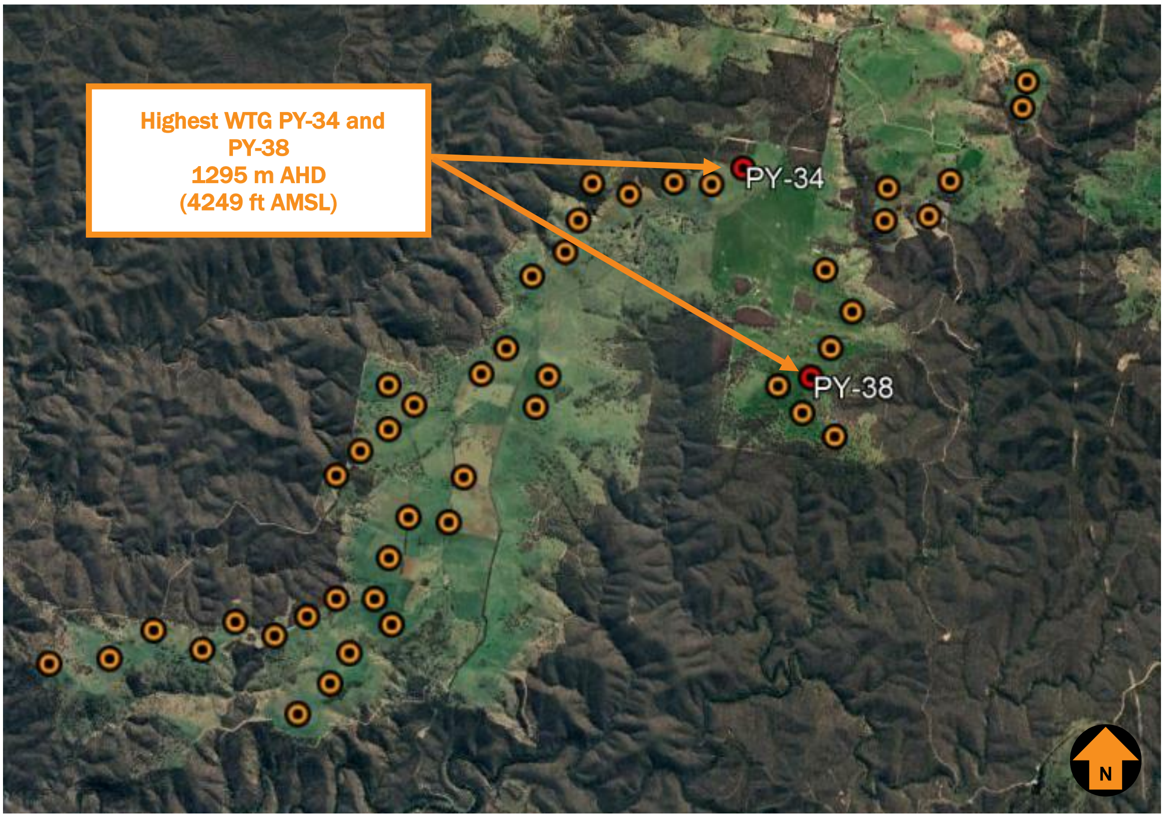


Figure 8 Project layout and highest wind turbine

The coordinates and ground elevations of the proposed wind turbines are listed in Annexure 3.

### 4.3. Wind monitoring tower description

There is one temporary wind monitoring tower located near the site for WTG PY-28, that is planned to be decommissioned once the wind farm is built. It is 80 m high and marked in red and white bands, but not equipped with an obstacle light. An image of the temporary WMT is provided at Figure 10.

Another 40 m high temporary WMT (PY01) is located in the centre of the western part of the project site. An image of this temporary WMT is provided at Figure 11.

One permanent WMT with a height of up to 160 m is proposed for the project. Its location is yet to be determined.

An overview of the location of the temporary WMTs is provided in Figure 9 (source: GPG, Google Earth).

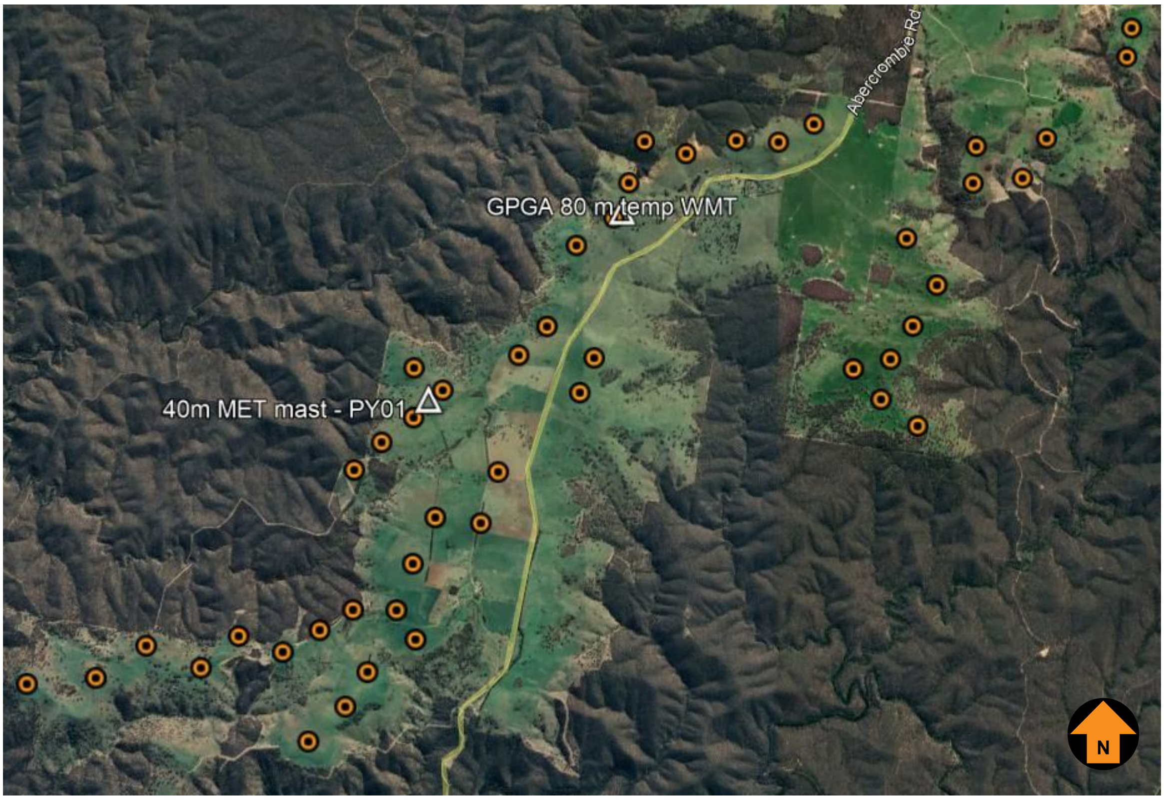


Figure 9 WMT locations

Figure 10 GPGA 80 m high temporary WMT near the location of WMT PY-28

Figure 11 PY01 40 m high temporary WMT located in the centre of the western section of site

### 4.4. Overhead transmission line

GPG proposes to link WTGs to the existing overhead transmission line on the eastern side of the Project Site.

Electrical connections between wind turbines and the on-site substation will be via underground cables linking segments of the Project areas.

Figure 12 shows the alignment of the overhead transmission lines in turquoise colour (source: GPG, Google Earth).

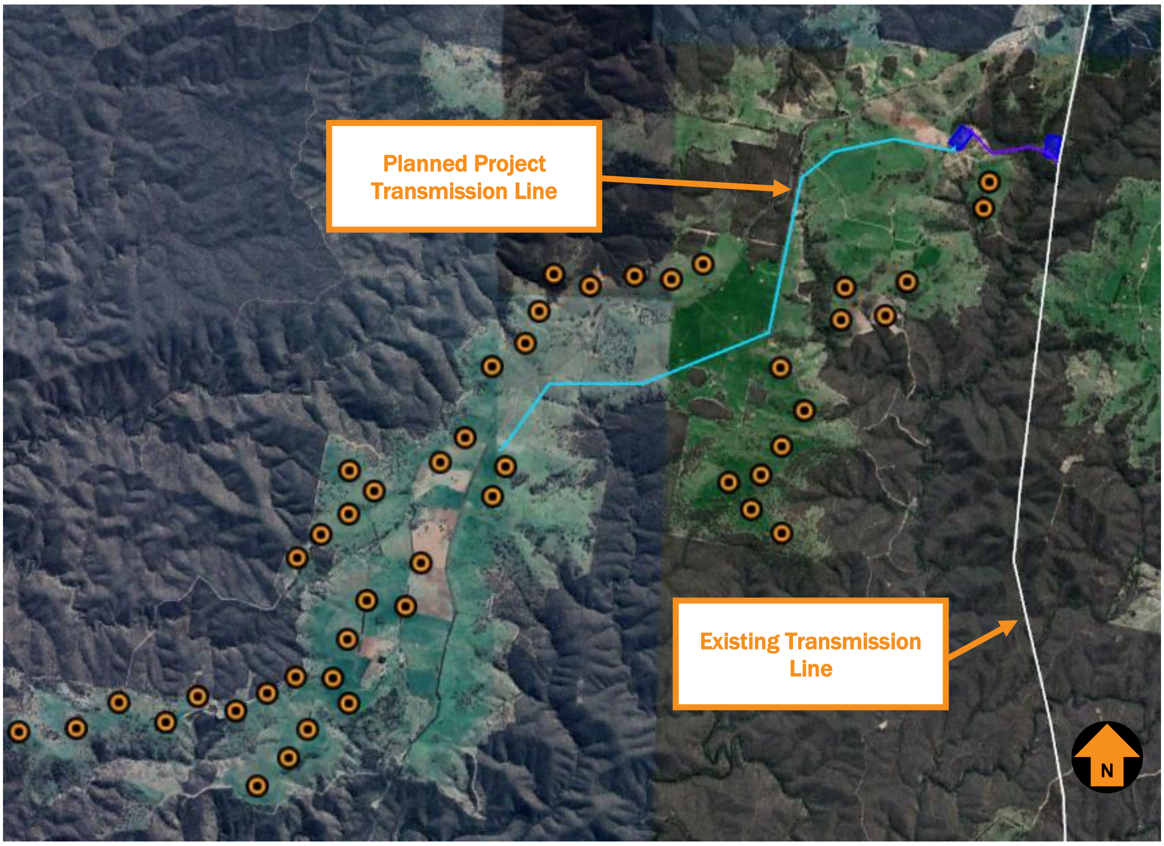


Figure 12 Overhead transmission lines (turquoise)

# 5. CONSULTATION

The stakeholders consulted include:

- Airservices Australia
- Civil Aviation Safety Authority
- Department of Defence
- NSW Rural Fire Service
- Oberon Council
- Royal Flying Doctor Service

Details and results of the consultation activities are provided in Table 1.

Copies of consultation responses are provided at Annexure 6.

Table 1 Stakeholder consultation details

| *Agency/Contact* | *Activity/Date* | *Response/ Date* | *Issues Raised During Consultation* | *Action Proposed* |
|---|---|---|---|---|
| Airservices Australia | Sent 17 September 2021 | Response received 08 November 2021 from William Zhao (Advisor Customer Engagement) | *…Airspace Procedures*<br>*With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at the position and heights supplied, the wind farm will not affect any sector or circling altitude, nor any instrument approach or departure procedure at any aerodrome.*<br>*Communications/Navigation/Surveillance (CNS) Facilities*<br>*We have assessed the proposal to a maximum height of 1295 m (4249 ft) AHD for any impacts to Airservices Precision/Non-Precision Navigation Aids, Anemometers, HF/VHF/UHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links and have no objections to it proceeding.*<br>*Summary*<br>*Based on the above assessment, our view is that the proposed wind farm would not have an impact on any Airservices designed instrument procedures, CNS facilities or ATC operations at any airport.*<br>*Vertical Obstacle Notification*<br>*As this proposed wind farm is in excess of 30m (99ft) AGL, we request that the proponent completes the Vertical Obstacle Notification Form for tall structures and submits it to VOD@airservicesaustralia.com as soon as the development reaches the maximum height.* | Completes the Vertical Obstacle Notification Form and submit to VOD@airservicesaustralia.com |

| *Agency/Contact* | *Activity/Date* | *Response/ Date* | *Issues Raised During Consultation* | *Action Proposed* |
|---|---|---|---|---|
| CASA | CASA has advised that it will only review assessments referred to it by a planning authority or agency. | | | No further action required. |
| Department of Defence | Sent 17 September 2021 | Reminder email sent 08 November 2021 | Nil response | Nil response |
| NSW RFS | Sent 17 September 2021 | Reminder email sent 08 November 2021<br>Response received 10 November 2021 from Scott Lornard Op Field Support | *...The NSW RFS has no further comments on the Paling Yards Wind Farm. Wind Farms are treated like any other potential hazard to aircraft operations.*<br>*Aerial firefighting strategies and tactics will be selected based on the fire location, what the fire is threatening and hazard in the area.* | No further action required. |
| Oberon Council | Sent 17 September 2021 | Received 19 October 2021 from | *...Thank you for the opportunity to comment, however at the stage we are not able to provide a thorough submission.* | No further action required. |

| Agency/Contact | Activity/Date | Response/ Date | Issues Raised During Consultation | Action Proposed |
|---|---|---|---|---|
| | | Nancy-Leigh Norris (Senior Town Planner) | *The development is State Significant under SEPP (State and Regional Development) 2011, therefore we will re-review when DPIE refers to Council during SEARs process.*<br>*The EIS is to consider environmental impacts (flora and fauna), visual impact and assessment of impacts of rural residential properties within the vicinity (and with views to the site).* | |
| RFDS | Sent 17 September 2021 | 24 September 2021 from Cameron Gibbs (Deputy Head of Flight Operations) | *....Thanks for considering us when assessing the viability of this project. We have reviewed the proposal with our flight operations and safety teams and found no issues arising that would impact RFDSSE operations.* | No further action required |

# 6. AVIATION IMPACT STATEMENT

### 6.1. Nearby certified aerodromes

The Project site is located outside a 30 nm (55.56 km) ring of any certified airport. The closest certified airport is Goulburn Airport located approximately 69 km (37.3 nm) south of the Project. The next closest certified airport is Bathurst Airport, located approximately 80 km (43.2 nm) north of the Project.

The location of the Project location relative to Goulburn and Bathurst Airport is shown in Figure 13 (source: GPG, OzRunways, Australian 250K Topographical Chart, (OzRunways database dated 12 August 2021)).

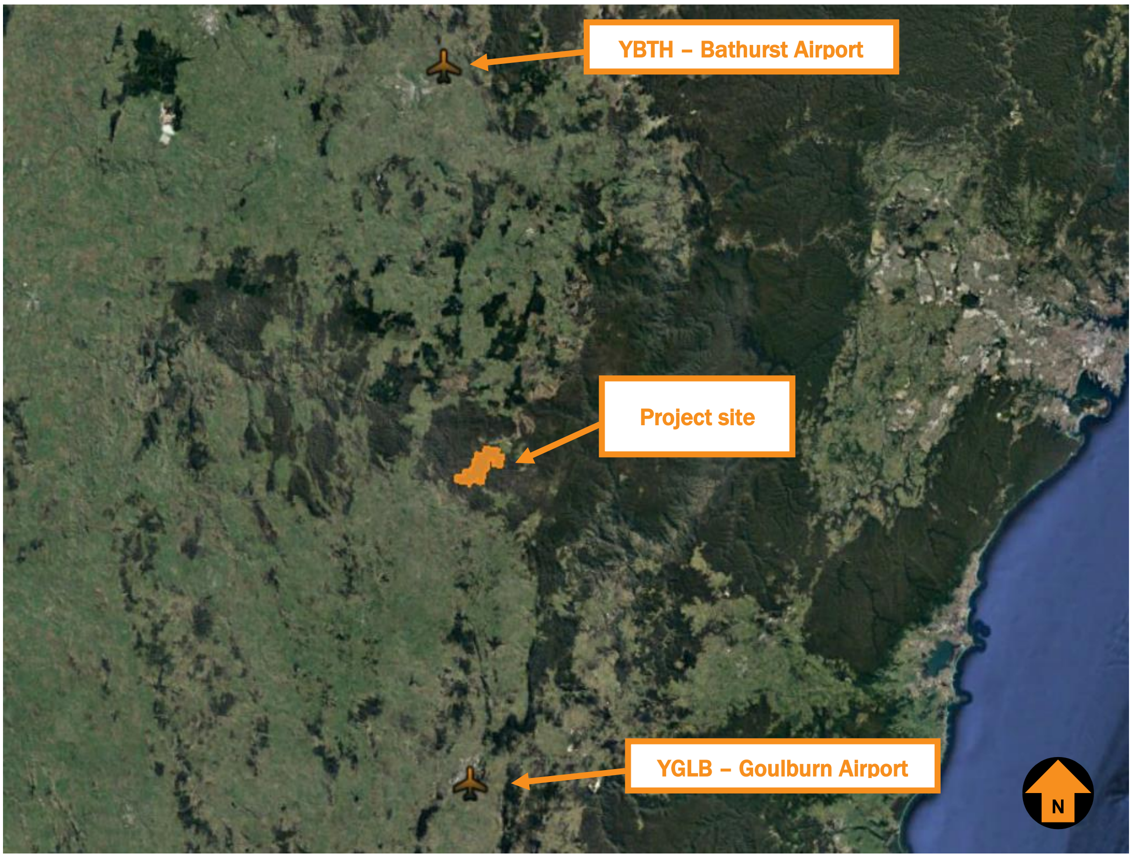


Figure 13 Project sites relative to nearby certified airports

Figure 14 shows buffer areas of 25 nm MSA (+5 nm buffer) of nearby certified airports (source: GPG, Google Earth).

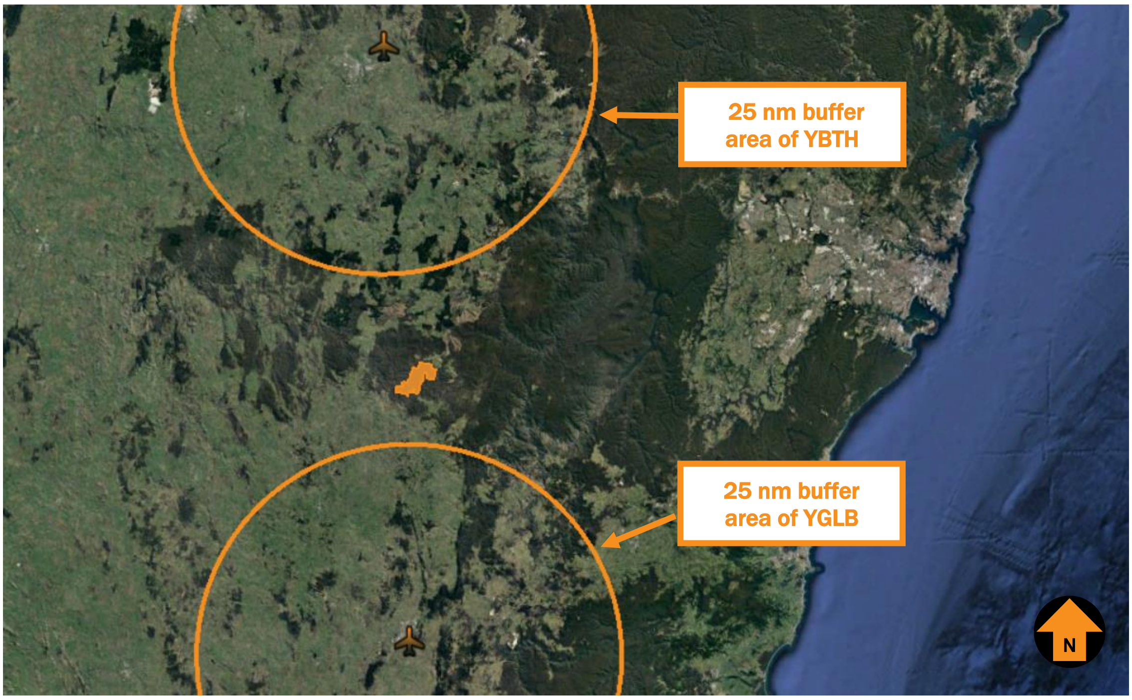


Figure 14 MSA buffer areas relative to the Project sites

Based on the distance between the nearest certified airports and the Project, it can be concluded that the Project will not penetrate any PANS-Ops surfaces.

### 6.2. Circling areas

All turbines are located beyond the horizontal extent of category A, category B and category C circling areas at Goulburn and Bathurst Airport (source: AsA, AIP, ENR 1.5-4, paragraph 1.7.6, AIP effective 17 June 2021).

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 Project is located outside the horizontal extent of circling areas of any certified airport. Therefore, the Project will not impact on circling areas of Goulburn and Bathurst Airports.

### 6.3. Obstacle limitation surfaces

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.

The Project is located outside the horizontal extent for Goulburn Airport OLS and Bathurst Airport OLS and will therefore have no impact on any airport obstacle limitation surfaces.

### 6.4. 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) and Aircraft Owners and Pilots Association (AOPA) Australia Airfield Directory, returned with 4 nearby ALAs from the Project site. The aeronautical data provided by OzRunways is approved under CASA CASR Part 175.

Figure 15 shows the location of nearby ALAs relative to the Project from identified ALAs (source: OzRunway, Google Earth).

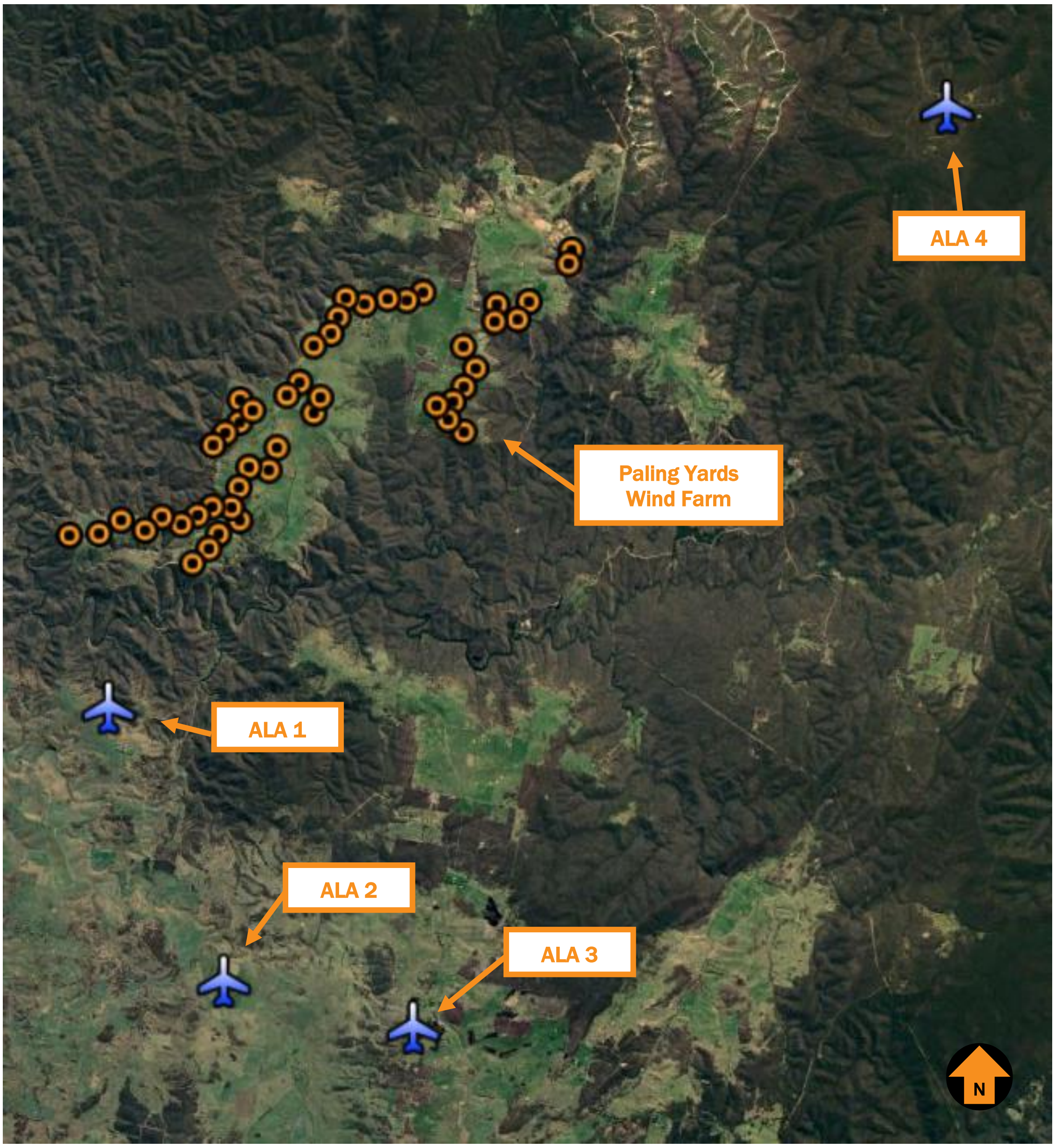


Figure 15 Project site relative to closest ALAs

Three out of the 4 identified ALAs are more than 3 nm from any WTG and are assessed as not being impacted. Refer to Figure 16, showing the ALAs with a 3 nm ring (source: GPG, Google Earth).

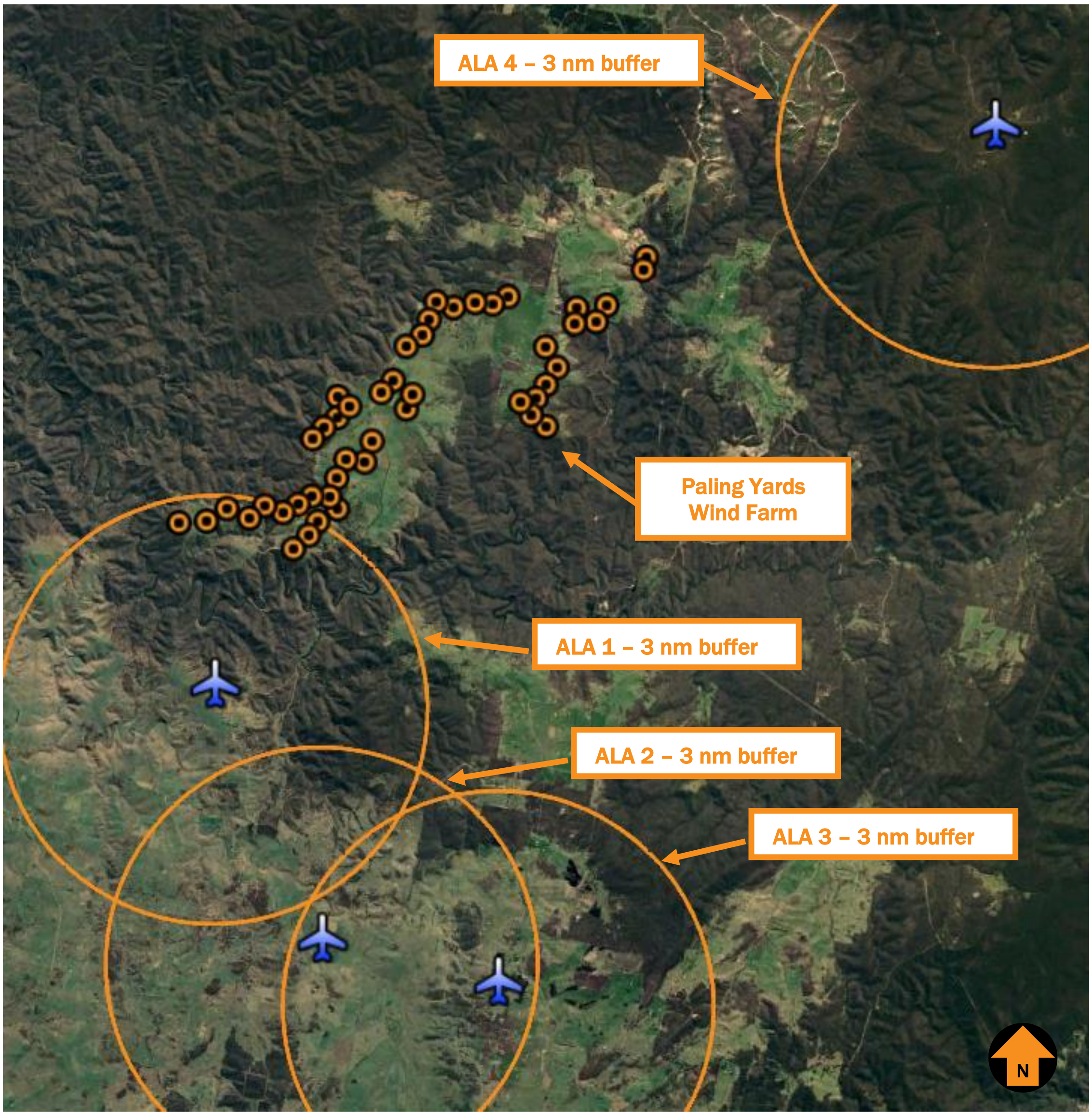


Figure 16 ALAs with 3 nm buffer

Proposed WTGs are located within a 3 nm radius of ALA 1.

The wind turbines located in close proximity to the runways and circuits of each affected ALA have been analysed to identify any potential impacts.

Approach and take off surfaces

The analysis of approach and take-off surfaces is based on the guidance published in the CASA 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 that may be applicable to the circumstances, is provided in Figure 17 (source: CAAP 92-1(1) Guidelines for aeroplane landing areas).

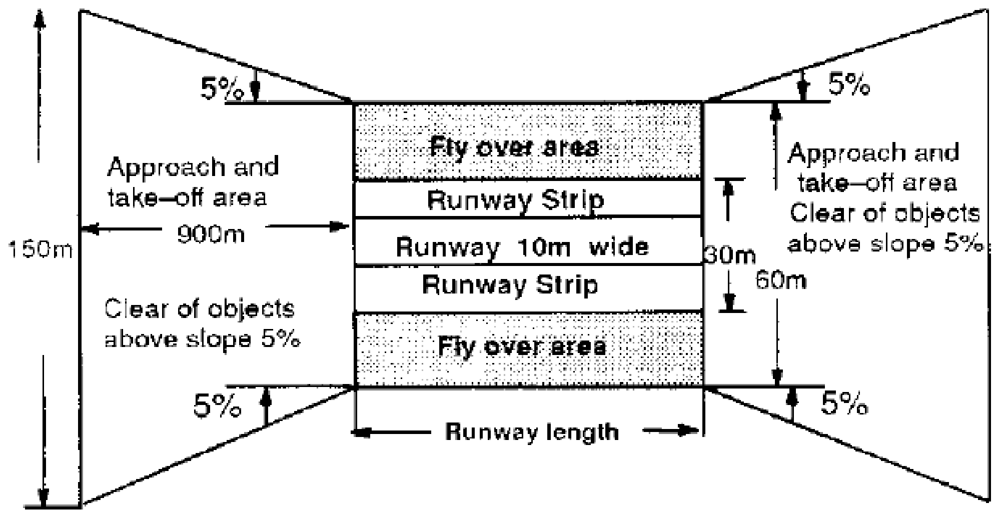


Figure 17 CAAP 92-1(1) Figure 2A

For these operations, 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.

For aerial application operations, the physical characteristics and obstacle limitation surfaces are considerably less restrictive.

A copy of CAAP 92-1(1) Figure 4 – *Dimensions – agricultural day,* which shows the physical characteristics applicable to aerial application operations, is provided in Figure 19 (source: CAAP 92-1(1) Guidelines for aeroplane landing areas).

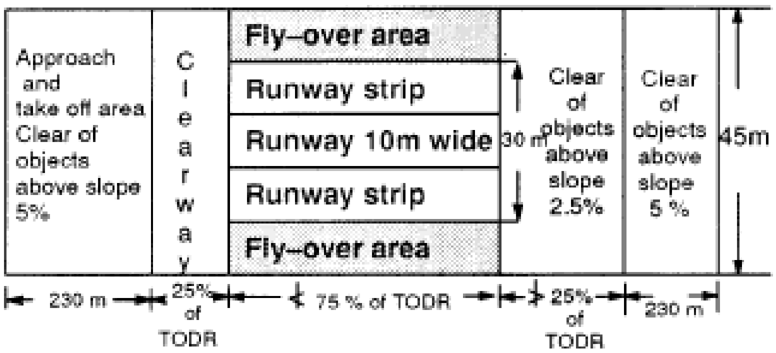


*Figure 4 - Dimensions - agricultural day operations*

Figure 18 CAAP 92-1(1) Figure 4

The proposed WTGs are located outside the horizontal extent of Figure 2A approach and take-off surfaces at ALA 1. Therefore, the Project will not impact Figure 2A approach and take-off surfaces of these ALAs.

<u>Aerodrome circuits</u>

For the purpose of this AIA the wind turbines located in proximity to ALA 1 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 flight circuit analysis, 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.

Aerial application operators will most likely conduct smaller circuits than this nominal arrangement.

Figure 19 shows a close up of the nearest wind turbines relative to ALA 1 showing the indicative flight circuits in white colour (source: GPG, Google Earth). Note that the northern indicative circuit would unlikely be feasible due to the high terrain in the area and so operations are most likely only conducted to the south of the ALA.

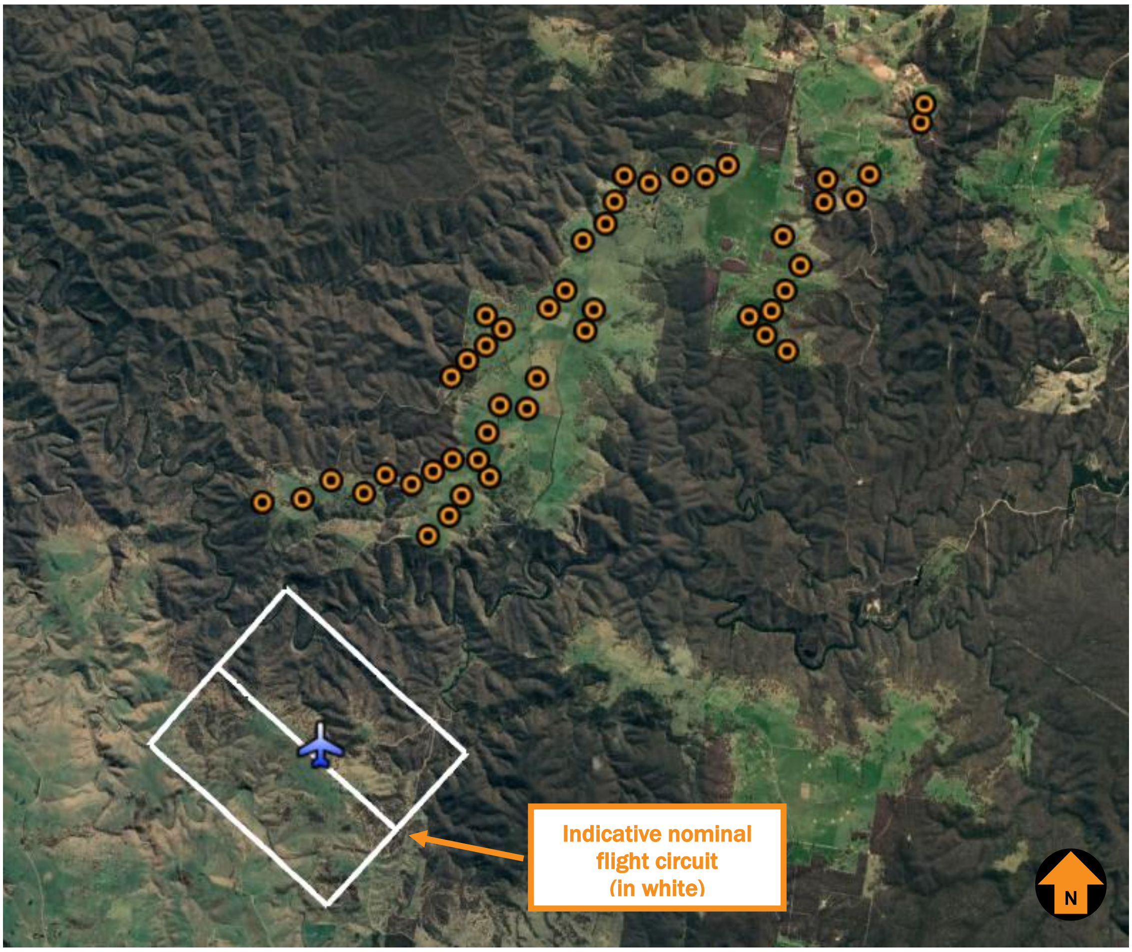


Figure 19 Indicative Flight Circuit – ALA 1

None of the proposed WTGs are located inside the horizontal extent of indicative flight circuits of ALA 1. Therefore, the flight circuits of this ALA will not be impacted by the Project.

### 6.5. Potential impacts from wake turbulence

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 170 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 in the northern circuit at ALA 1. Figure 20 refers.

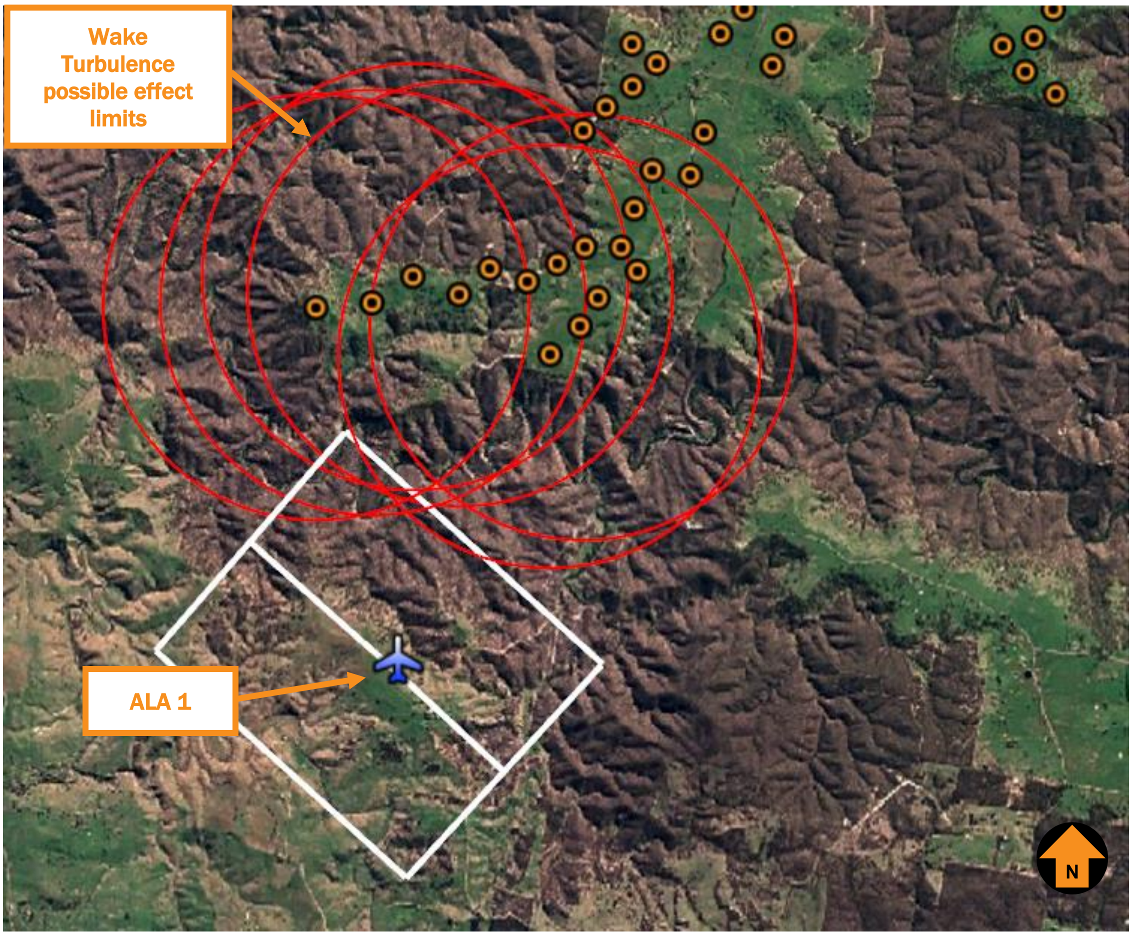


Figure 20 Wake turbulence possible effects in the northern circuit at ALA 1

### 6.6. Summary of ALA analysis

Some of the identified ALAs will most likely be used by aerial application operators.

CAAP 166-01 v4.2 *Operations in the vicinity of non-controlled aerodromes* provides guidance on standard aerodrome traffic. According to paragraph 3.6.2, which is copied below, it is expected that aerial application operators may not conform the standard aerodrome circuit.

> *3.6.2 Aerial application operations frequently involve low-level manoeuvring after take-off and prior to landing. These low-level manoeuvres are not required to conform to the standard traffic circuit.*

Tract and GPG should try and contact the landowners and aerial operators for the identified ALAs to inform them of potential impacts on the operation of their ALAs. Tract and GPG should engage with the landowner of ALA 1 and address the potential effects of wake turbulence from the nearby WTGs. Note the prevailing winds in the Project area are from the west to north-west which should limit the effects of wake turbulence to the northern circuit as depicted in Figure 20.

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 details of all identified ALAs are provided in Table 2.

Table 2 Nearby aircraft landing areas

| ALA Name | ICAO code | Registration status | Distance from the Project site | Location relative to the Project site | Nearest WTG | Impact on the OLS | Impact on flight circuit(s) | Potential wake turbulence from WTGs |
|---|---|---|---|---|---|---|---|---|
| ALA 1 | Nil | uncertified | 3.5 km (1.9 nm) | south | P6 | Nil | Nil | Possible in the northern circuit area |
| ALA 2 | Nil | uncertified | 10.6 km (5.7 nm) | south | P6 | Nil | Nil | Nil |
| ALA 3 | Nil | uncertified | 12.6 km (6.8 nm) | south | P21 | Nil | Nil | Nil |
| ALA 4 | Nil | uncertified | 12.5 km (6.8 nm) | east | P53 | Nil | Nil | Nil |

### 6.7. 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 located in the area with a grid lowest safe altitude of 1737 m AHD (5700 ft AMSL) with a MOC surface of 1433 m AHD (4700 ft AMSL).

The highest WTG, which is PY-34 and PY-38, with a maximum overall height of 1295 m (4249 ft AMSL) will be below the LSALT MOC of 4700 ft AMSL by approximately 138 m (451 ft).

Figure 21 provides the grid LSALTs and air routes in proximity to the Project site (source: GPG, OzRunways).

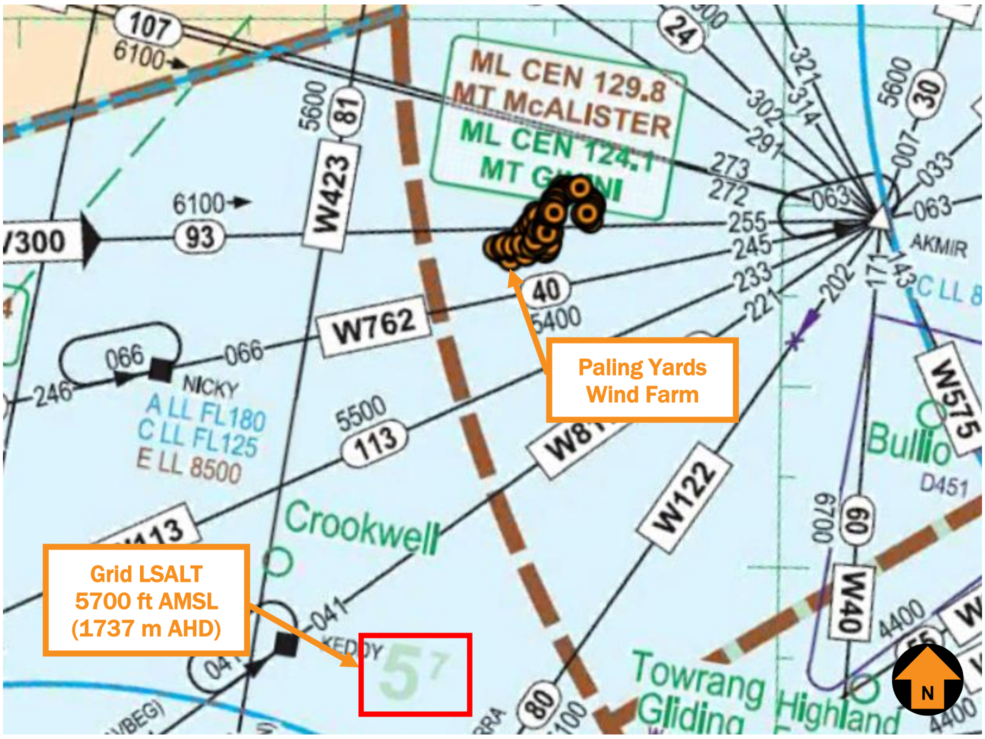


Figure 21 Air routes in proximity to the Project site

An impact analysis of the surrounding air routes is provided in Table 3.

Table 3 Air route impact analysis

| Air route | Waypoint pair | Route LSALT | MOC | Impact on airspace design | Potential solution | Impact on aircraft ops |
|---|---|---|---|---|---|---|
| W168 | AKMIR – CWR NDB | 5700 ft AMSL 1737 m AHD | 4700 ft AMSL 1433 m AHD | Nil | Nil | Nil |
| V180 | AKMIR – DERRY | 6100 ft AMSL 1859 m AHD | 5100 ft AMSL 1555 m AHD | Nil | Nil | Nil |
| V300 | AKMIR – SCAPA | 6100 ft AMSL 1859 m AHD | 5100 ft AMSL 1555 m AHD | Nil | Nil | Nil |
| W762 | AKMIR – NICKY | 5400 ft AMSL 1646 m AHD | 4400 ft AMSL 1341 m AHD | Nil | Nil | Nil |
| W113 | AKMIR – HAPPI | 5500 ft AMSL 1676 m AHD | 4500 ft AMSL 1372 m AHD | Nil | Nil | Nil |
| W423 | BTH NDB - CULIN | 5600 ft AMSL 1707 m AHD | 4600 ft AMSL 1402 m AHD | Nil | Nil | Nil |

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

### 6.8. Airspace

The Project is located outside of controlled airspace (wholly within Class G airspace) and is not located in any Prohibited, Restricted and Danger areas.

Therefore, the Project will not impact controlled airspace.

### 6.9. Aviation facilities

The following aviation facilities were identified in proximity to the Project:

- Radio Transmitter, located at Mt Edith, approximately 37.8 km (20.4 nm) northeast from the Project.
- Radio Transmitter, located at Mt Macalister, approximately 29.3 km (15.8 nm) south from the project.

The Project will not impact on any protection areas associated with these aviation facilities.

### 6.10. Radar

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

The closest aviation radar facility is the Mount Boyce Route Surveillance Radar (RSR), which is located approximately 72.5k km (39 nm) northeast of the Project. The second closest radar facility is Cecil Park Primary Surveillance Radar (PSR), located approximately 100 km (54 nm) east of the Project.

The Project is located in Zone 4 and outside the radar line of sight of the SSR. The EUROCONTROL guidelines state:

> *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.*

Therefore, it is unlikely that the Project will impact either the Mount Boyce (RSR) or the Cecil Park (PSR) radar facilities.

Note: Route Surveillance Radar (RSR) and Secondary Surveillance Radar (SSR) is the same radar system.

### 6.11. Bureau of Meteorology

With respect to the Bureau of Meteorology (BoM) radars, the closest weather radar is the radar located at Wollongong (latitude 34.264°S, longitude 150.874°E) approximately 100 km (54 nm) east of the Project (source: BoM, NSW radar information).

Therefore, it is unlikely that the Project will impact the WSR 74 S Band Doppler radar located at Grafton.

### 6.12. Consultation

An appropriate and justified level of consultation was undertaken with relevant parties, refer to Section 5 for details of the stakeholders and a summary of the consultation.

### 6.13. AIS summary

Based on the Project layout and overall turbine blade tip height limit of 240 m AGL, the blade tip elevation of the highest wind turbine, which is WTG PY-34 and PY-38, will not exceed 1295 m (4249 ft AMSL) and:

- will not penetrate any OLS surfaces
- will not penetrate any PANS-OPS surfaces
- will not have an impact on nearby designated air routes
- will not have an impact on the grid LSALTs of 5700 ft AMSL
- will not have an impact on prescribed airspace
- is wholly contained within Class G airspace
- is outside the clearance zones associated with aviation navigation aids and communication facilities.

### 6.14. Assessment recommendations

Based on the information contained within this section and the analysis conducted, the following recommendations are made:

Consultation should be undertaken with Airservices Australia to assess potential impacts of the Project.

The list of wind turbines (obstacles), showing coordinates and elevation data that are applicable to this AIS, is provided in Annexure 3.

# 7. HAZARD LIGHTING AND MARKING

Based on the risk assessment set out in Section 9 it has been concluded that aviation lighting is not required for WTGs and WMTs, but relevant lighting standards and guidelines are summarised in Annexure 5.

Refer to Section 0 for additional information regarding the existing WMTs.

# 8. ACCIDENT STATISTICS

This section establishes the external context to ensure that stakeholders and their objectives are considered when developing risk management criteria, and that externally generated threats and opportunities are properly taken into account.

### 8.1. General aviation operations

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

- Aerial work (activity type). Includes activity subtypes: agricultural mustering, agricultural spreading/spraying, other agricultural flying, photography, policing, firefighting, construction – sling loads, other construction, search and rescue, observation and patrol, power/pipeline surveying, other surveying, advertising, and other aerial work.
- Own business travel (activity type).
- Instructional flying (activity type). Includes activity subtypes: solo and dual flying training, and other instructional flying.
- Sport and pleasure flying (activity type). Includes activity subtypes: pleasure and personal transport, glider towing, aerobatics, community service flights, parachute dropping, and other sport and pleasure flying.
- Other general aviation flying (activity type). Includes activity subtypes: test flights, ferry flights and other flying.

### 8.2. 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.

### 8.3. National aviation occurrence statistics 2010-2019

The Australian Transport Safety Bureau recently published a summary of aviation occurrence statistics for the period 2010-2019 (AR-2020-014, Final - 29 April 2020).

According to the report, there were no fatalities in high or low capacity RPT operations during the period 2010-2019. In 2019, 220 aircraft were involved in accidents in Australia, with a further 154 aircraft involved in serious incidents (an incident with a high probability of becoming an accident). In 2019 there was 35 fatalities from 22 fatal accidents. There have been no fatalities in scheduled commercial air transport in Australia since 2005.

Of the 326 fatalities recorded in the 10-year period, almost two thirds (175 or 53.68%) occurred in the general aviation segment. On average, there were 1.51 fatalities per aircraft associated with a fatality in this segment. The fatalities to aircraft ratio ranges from 1.09 to 177:1. 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 4 (source: ATSB).

Table 4 Number of fatalities by GA sub-category – 2010 to 2019

| *Sub-category* | *Aircraft assoc. with fatality* | *Fatalities* | *Fatalities to aircraft ratio* |
|---|---|---|---|
| Aerial work | 37 | 44 | 1.18:1 |
| Instructional flying | 11 | 19 | 1.72:1 |
| Own business travel | 3 | 5 | 1.6:1 |
| Sport and pleasure flying | 53 | 94 | 1.77:1 |
| Other general aviation flying | 11 | 12 | 1.09:1 |
| Totals | 115 | 174 | 1.51:1 |

Figure 22 refers to Fatal Accident Rate by operation type per million departures over the 6-year period (source: ATSB).

Note the rates presented are not the full year range of the study (2010–2019). This was due to the availability of exposure data (departures and hours flown) which was only available between these years. According to the ATSB report, the number of fatal accidents per million departures for GA aircraft over the 6-year reporting period ranged between 6.6 in 2014 and 4.9 in 2019.

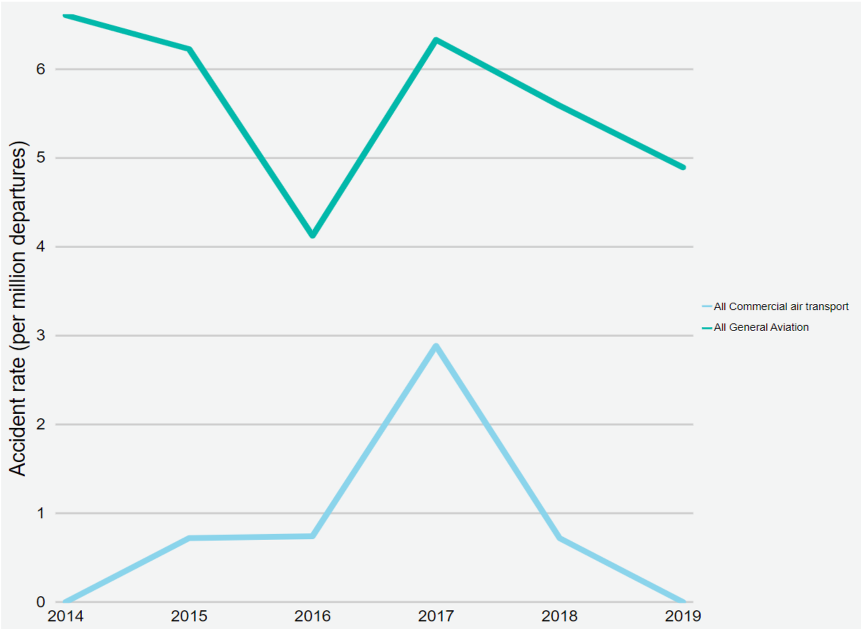


Figure 22 Fatal Accident Rate (per million departures) by Operation Type

In 2018, there were 9 fatal accidents and 9 fatalities involving GA aircraft, resulting in a rate of 5.6 fatal accidents per million departures and 7.7 fatal accidents per million hours flown.

In 2019, there were 1,760,000 landings, and 1,320,000 hours flown by VH-registered general aviation aircraft in Australia, with 8 fatal accidents and 17 fatalities. Based on these results, in 2019 there were 4.9 fatal accidents per million departures and 6.4 fatal accidents per million hours flown. A summary of fatal accidents from 2010-2019 by GA sub-category is provided in Table 5 (source: ATSB).

Table 5 Fatal accidents by GA sub-category – 2010 -2019

| *Sub-category* | *Fatal accidents* | *Fatalities* |
|---|---|---|
| Agricultural spreading/spraying | 13 | 13 |
| Agricultural mustering | 11 | 12 |
| Other agricultural | 1 | 1 |
| Survey and photographic | 5 | 10 |
| Search and rescue | 2 | 2 |
| Firefighting | 2 | 2 |
| Other aerial work | 3 | 4 |
| Instructional flying | 11 | 19 |

| *Sub-category* | *Fatal accidents* | *Fatalities* |
|---|---|---|
| Own business travel | 3 | 5 |
| Sport and pleasure flying | 53 | 94 |
| Other general aviation flying | 11 | 12 |
| Total | 115 | 174 |

Over the 10-year period, no aircraft collided with a wind turbine or a wind monitoring tower.

Of the 20,529 incidents, serious incidents, and accidents in GA operations in the 10-year period, 1404 (6.83%) were terrain collisions.

The underlying fatality rate for GA operations discussed above is considered tolerable within Australia's regulatory and social context.

### 8.4. 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.

Based on the statistic of the Global Wind Energy Council (GWEC) report 2016, there were 341,320 wind turbines operating around the world at the end of 2016. Since 2016, approximately 1.8 million MW had been installed worldwide. It would represent around 594,229 WTGs (at an average of 3 MW per WTG).

Based on the Australia's Clean Energy Council statistics there were 102 wind farms in Australia at the end of 2019.

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, it is difficult to conclude that obstacle lighting would have prevented the accident.

The other fatal accident occurred at night in instrument meteorological conditions (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 Table 6.

Table 6 Summary of accidents involving collision with a wind turbine

| 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. 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 |

# 9. 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 4.

### 9.1. Risk Identification

The primary risk being assessed is that of aviation safety associated with the proposed Rangoon Wind Farm and WMTs.

Based on an extensive review of accident statistics data (see summary in Section 8 above) and input from stakeholders, five (5) identified risk events associated with wind turbines and WMTs relate to aviation safety, and are listed as follows:

1. potential for an aircraft to collide with a wind turbine, controlled flight into terrain (CFIT)
2. potential for an aircraft to collide with a wind monitoring tower (CFIT)
3. potential for a pilot to initiate manoeuvring in order to avoid colliding with a wind turbine or monitoring tower resulting in collision with terrain
4. potential for the hazards associated with the Project to invoke operational limitations or procedures on operating crew
5. effect of obstacle lighting on neighbours.

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.

A fifth identified risk event associated with WTGs and WMTs is the potential visual impact associated with obstacle lighting (if fitted) on surrounding residents.

The five risk events identified here are assessed in detail in the following section.

### 9.2. 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.

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 Tables 15 to 19.

Table 7 Aircraft collision with wind turbine

| | |
|---|---|
| ***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 8. 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 do not 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
- 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 8.1.

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

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

The proposal is clear of the OLS 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 proposal is clear of the OLS 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 240 m (788 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 87 m (286 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft).
- 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 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 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 100 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.

| | |
|---|---|
| ***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.

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

***Recommended 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:<br>○ 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.<br>○ 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.<br>○ Arrangements should be made to publish details of the wind farm in ERSA for surrounding aerodromes. | |
| ***Residual Risk***<br>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**.<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.<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 a wind turbine, without obstacle lighting on the turbines of the Project.** | |
| ***Residual Risk*** | 7 - Tolerable |

Table 8 Aircraft collision with wind monitoring tower

| | |
|---|---|
| ***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.

GPG proposes to install one permanent WMT as part of the Paling Yards WF.

The proposed permanent WMTs:

- will be constructed of steel lattice and will be at a maximum of 160 m (525 ft) AGL in height
- will be installed at different locations around the Project
- will have visibility aviation marker balls up on the top-level guy wires
- the top 1/3 of the masts will be painted in contrasting colours (red/white/red)
- will be reported to Airservices Australia.

There are only a few instances of aircraft colliding with a WMT, but they were all during the day with good visibility, and no instance 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.

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

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

***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.

| | |
|---|---|
| ***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 were 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.

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

***Current Treatments***

- The existing temporary WMT location has been reported to CASA and Airservices Australia.
- The details of the proposed permanent WMT will be reported 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 WMT, at a maximum height of 160 m (525 ft) AGL, will be 7.6 m (25 ft) above the minimum height of 500 ft AGL for an aircraft flying at this height.
- In the event that descending cloud forces an aircraft lower than 152.4 m AGL (500 ft), 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.
- 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) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities.
- The towers are constructed from grey steel.
- Since the towers will be higher than 100 m AGL, there is a statutory requirement to report them to CASA.

***Level of Risk***

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

| | |
|---|---|
| ***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.

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

***Recommended Treatments***

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

- Details of the existing WMTs were reported to Airservices Australia when they were constructed.
- Details of the proposed permanent WMT will be reported to CASA and Airservices Australia.
- The proposed WMTs will have aviation marker balls and consideration will be made to MOS 139 Chapter 8 Division 10 Obstacle Markings (as modified by the guidance in NASF Guideline D); 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.*<br>*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 in size to a cube with 600 mm sides; and be spaced 30 m apart along the length of the wire or cable.*<br>• Details of the proposed and existing WMTs on the Project site will be communicated to local and regional aerodrome and aircraft operators before, during and following construction. | |
| ***Residual Risk***<br>With the additional recommended treatments, the likelihood of an aircraft colliding with a WMT resulting in multiple fatalities and damage beyond repair will be **Unlikely**. 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. Only if a 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 **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 WMTs of the Project.** | |
| ***Residual Risk*** | 7 - Tolerable |

Table 9 Harsh manoeuvring leading to controlled flight into terrain

| 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 proposal is clear of the OLS 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 240 m (788 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 87 m (286 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 100 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.

| | |
|---|---|
| ***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.

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

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

- The proposal is clear of the OLS 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 240 m (788 ft) at the top of the blade tip, so the rotor blade at its maximum height will be approximately 87 m (286 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft).
- 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 AGL (500 ft) (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, typical of most wind turbines operational in Australia, 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 100 m AGL, there is a statutory requirement to report the turbines to CASA.

***Level of Risk***

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

| | |
|---|---|
| ***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.

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

| |
|---|
| ***Recommended 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.<br>• Although there is no requirement to do so, Tract/GPG may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for their safe operation within the Project. |
| ***Residual Risk***<br>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**.<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.<br>In the circumstances, the level of risk under the proposed treatment plan is considered **ALARP**.<br>**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.** |

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

Table 10 Effect of Project on operating crew

| | |
|---|---|
| **Risk ID:** | 4. Effect of the Project on operating crew |
| **Discussion**<br><br>Introduction or imposition of additional operating procedures or limitations can affect an aircraft's operating crew.<br><br>There are no known aerial agriculture operations conducted at night in the vicinity of the Project. | |
| **Consequence**<br><br>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. | |
| **Consequence** | Minor |
| **Untreated Likelihood**<br><br>The imposition of operational limitations is unlikely to occur, but possible (has occurred rarely), which is classified as Possible. | |
| **Untreated Likelihood** | Possible |
| **Current Treatments (without lighting)**<br><br>• The proposal is clear of the OLS 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>• Wind turbines will be a maximum of 240 m (788 ft) at the top of the blade tip, so the rotor blade at its maximum height will be approximately 87 m (286 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft).<br>• 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.<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). | |

| | |
|---|---|
| • Aircraft authorised to intentionally fly below 152.4 m AGL (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 wind turbines are typically coloured white so they should be visible during the day.<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 100 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 benefit 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, Tract/GPG 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 **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 WTGs and WMTs of the Project.** | |
| ***Residual Risk*** | **5 - Tolerable** |

Table 11 Effect of obstacle lighting on neighbours

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

***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 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

In general, objects outside an OLS and above 100 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.

| | |
|---|---|
| *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 are 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 100 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.

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

| | |
|---|---|
| ***Risk Decision***<br><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 |
| ***Recommended Treatments***<br><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><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><br>Consideration may be given to activating the obstacle lighting via a pilot activated lighting system.<br><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><br>Not installing obstacle lights would clearly be an acceptable outcome to those potentially affected by visual impact.<br>If lighting is required, 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.** 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 |

# 10. CONCLUSIONS

The results of this study are summarised as follows:

### 10.1. Project description

The proposed Project will comprise the following:

- up to 47 wind turbines
- maximum overall height (tip height) of the wind turbines is up to 240 m AGL
- highest wind turbines are PY-34 and PY-38 with ground elevation of 1050 m AHD and overall height of 1295 m (4249 ft AMSL) (including a 5 m error budget)
- one proposed permanent WMT with a maximum height of up to 160 m (525 ft) AGL, which will be reported to Airservices Australia.

### 10.2. Regulatory requirements

The following regulatory requirements apply:

- 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.

### 10.3. Planning considerations

The Oberon Council's Local Environmental Plan does not incorporate any reference to the development of wind farms or the protection of aeronautical infrastructure.

The Upper Lachlan Environmental Plan 2010 does not affect this AIA for the Project. Crookwell Airport is only referenced in the Upper Lachlan Environmental Plan 2010, is not a certified airport and remains outside the 3 nm area of interest from the Project area.

### 10.4. Consultation

An appropriate and justified level of consultation will be undertaken with relevant parties. Refer to Section 5.

### 10.5. Aviation Impact Statement

Based on the Project layout and overall turbine blade tip height limit of 240 m AGL, the blade tip elevation of the highest wind turbine, which is WTG PY-34 and PY-38, will not exceed 1295 m (4249 ft AMSL) and:

- will not penetrate any OLS surfaces

- will not penetrate any PANS-OPS surfaces
- will not have an impact on nearby designated air routes
- will not have an impact on the grid LSALT of 5700 ft AMSL
- will not have an impact on prescribed airspace
- is wholly contained within Class G airspace
- is outside the clearance zones associated with aviation navigation aids and communication facilities.

### 10.6. 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.

GPG may consider engaging 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.

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.

### 10.7. 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 proposed 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.
- 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.
- Consideration should be given to marking the temporary and permanent WMTs according to the requirements set out in MOS 139 Section 8.10 (as modified by the guidance in NASF Guideline D). Specifically:
    - marker balls or high visibility flags or high visibility sleeves should be placed on the outside guy wires

- paint markings should be applied in alternating contrasting bands of colour to at least the top 1/3 of the mast
- ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation or
- a flashing strobe light during daylight hours.

### 10.8. Summary of risks

A summary of the level of residual risk associated with the proposed Project with the Recommended Treatments implemented, is provided in Table 12.

Table 12 Summary of Risks

| 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. 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. Department of Defence should be consulted if there is any subsequent modification in the wind turbine height or scale of development, using the following email address: land.planning@defence.gov.au;

3. Any obstacles above 100 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

    b. Either the general area within which the crane will operate and/or the planned route with timelines that crane operations will follow.

4. Details of the Project 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.

5. 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 transmission lines 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.

Operation

6. While not a statutory requirement, GPG should consider engaging 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

7. The rotor blades, nacelle and the supporting mast of the wind turbines should be painted white, typical of most wind turbines operational in Australia. No additional marking measures are required for WTGs.

Lighting of turbines

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

### Marking of wind monitoring towers

9. Consideration should be given to marking the temporary and permanent WMTs according to the requirements set out in MOS 139 Section 8.10 (as modified by the guidance in NASF Guideline D). Specifically:

    a. marker balls or high visibility flags or high visibility sleeves should be placed on the outside guy wires

    b. paint markings should be applied in alternating contrasting bands of colour to at least the top 1/3 of the mast

    c. ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation or

    d. a flashing strobe light during daylight hours.

### 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

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

# 12. ANNEXURES

1. References
2. Definitions
3. Turbine coordinates and heights
4. Risk Assessment Framework
5. CASA Regulatory Requirements – Lighting and Marking
6. Stakeholder consultation responses

# ANNEXURE 1 – 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 17 June 2021
- Airservices Australia, Designated Airspace Handbook, effective 17 June 2021
- 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 13 August 2020
- 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 and Environment, NSW Government, *NSW Wind Farm Guideline for State significant wind energy development*, December 2016
- Department of Planning and Environment, NSW State Government, Wind Energy: Visual Assessment Bulletin – For State significant wind energy development, December 2016
- Geoscience Australia, Electricity transmission lines in NSW, *ElectricityTransmissionLines_v2.kmz*, created 01 January 2015
- International Civil Aviation Organization (ICAO) Doc 8168 Procedures for Air Navigation Services—Aircraft Operations (PANS-OPS)
- ICAO Standards and Recommended Practices, Annex 14—Aerodromes
- New South Wales Government, *State Environmental Planning Policy (Infrastructure) 2007* (current version dated 22 January 2021)
- Oberon Council, *Oberon Local Environmental Plan 2013* (current version dated 14 July 2021)

- OzRunways, aeronautical navigation charts extracts, dated 17 June 2021
- Standards Australia, ISO 31000:2018 Risk management – Guidelines
- Upper Lachlan Shire Council, Upper Lachlan Local Environmental Plan 2021 (current version 14 July 2021).

# ANNEXURE 2 – DEFINITIONS

| *Term* | *Definition* |
|---|---|
| Aerial Agricultural Operator | Specialist pilot and/or company who are required to have a commercial pilot's licence, an agricultural rating and a chemical distributor's licence |
| Aerodrome | A defined area on land or water (including any buildings, installations, and equipment) intended to be used either wholly or in part for the arrival, departure, and surface movement of aircraft. |
| Aerodrome facilities | Physical things at an aerodrome which could include:<br>a. the physical characteristics of any movement area including runways, taxiways, taxilanes, shoulders, aprons, primary and secondary parking positions, runway strips and taxiway strips<br>b. infrastructure, structures, equipment, earthing points, cables, lighting, signage, markings, visual approach slope indicators. |
| Aerodrome reference point (ARP) | The designated geographical location of an aerodrome. |
| Aeronautical Information Publication (AIP) | Details of regulations, procedures, and other information pertinent to the operation of aircraft |
| Aeronautical Information Publication En-route Supplement Australia (AIP ERSA) | Contains information vital for planning a flight and for the pilot in flight as well as pictorial presentations of all licensed aerodromes |
| Civil Aviation Safety Regulations 1998 (CASR) | Contain the mandatory requirements in relation to airworthiness, operational, licensing, enforcement. |
| Instrument meteorological conditions (IMC) | Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, less than the minimum specified for visual meteorological conditions. |
| Manual of Standards (MOS) | The means CASA uses in meeting its responsibilities under the Act for promulgating aviation safety standards |
| National Airports Safeguarding Framework (NASF) | Framework has the objective of developing a consistent and effective national framework to safeguard both airports and communities from inappropriate on and off airport developments. |

| Term | Definition |
|---|---|
| Obstacles | All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight. |
| Runway | A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft. |
| Runway strip | A defined area including the runway and stopway, if provided, intended:<br>a. to reduce the risk of damage to aircraft running off a runway<br>b. to protect aircraft flying over it during take-off or landing operations. |
| Safety Management System | A systematic approach to managing safety, including organisational structures, accountabilities, policies and procedures. |

# ANNEXURE 3 – TURBINE COORDINATES AND HEIGHTS

Source: Tract/GPG, Paling Yards Wind Farm turbine co-ordinates, *received via email 01 September 2021*

Note: the WTG heights do not include a 5 m allowance for variance in site elevation

| *WTG ID* | *Easting* | *Northing* | *Proposed Ground Level* | *Tower Elevation* | *Blade Max Elevation* |
|---|---|---|---|---|---|
| PY-1 | 750790.660 | 6214083.060 | 890.000 | 1045.000 | 1130.000 |
| PY-2 | 751180.750 | 6214432.910 | 900.000 | 1055.000 | 1140.000 |
| PY-3 | 751425.000 | 6214787.110 | 920.000 | 1075.000 | 1160.000 |
| PY-4 | 751941.690 | 6215114.620 | 942.000 | 1097.000 | 1182.000 |
| PY-5 | 747801.120 | 6214761.190 | 898.000 | 1053.000 | 1138.000 |
| PY-6 | 748519.700 | 6214803.260 | 860.000 | 1015.000 | 1100.000 |
| PY-7 | 749054.780 | 6215129.110 | 870.000 | 1025.000 | 1110.000 |
| PY-8 | 749637.930 | 6214879.490 | 870.000 | 1025.000 | 1110.000 |
| PY-9 | 750045.990 | 6215202.860 | 870.000 | 1025.000 | 1110.000 |
| PY-10 | 750521.210 | 6215025.330 | 910.000 | 1065.000 | 1150.000 |
| PY-11 | 750915.000 | 6215238.130 | 910.000 | 1065.000 | 1150.000 |
| PY-12 | 751277.320 | 6215444.210 | 920.000 | 1075.000 | 1160.000 |
| PY-13 | 751742.910 | 6215430.490 | 947.000 | 1102.000 | 1187.000 |
| PY-14 | 751924.430 | 6215913.250 | 970.000 | 1125.000 | 1210.000 |
| PY-15 | 752167.150 | 6216398.800 | 971.000 | 1126.000 | 1211.000 |
| PY-16 | 752654.500 | 6216324.830 | 970.000 | 1125.000 | 1210.000 |
| PY-17 | 752852.050 | 6216862.800 | 980.000 | 1135.000 | 1220.000 |
| PY-18 | 751295.480 | 6216935.080 | 935.000 | 1090.000 | 1175.000 |
| PY-19 | 751591.770 | 6217222.470 | 952.000 | 1107.000 | 1192.000 |
| PY-20 | 751942.300 | 6217474.140 | 970.000 | 1125.000 | 1210.000 |
| PY-21 | 751952.910 | 6218024.610 | 980.000 | 1135.000 | 1220.000 |
| PY-22 | 752263.930 | 6217765.230 | 990.000 | 1145.000 | 1230.000 |
| PY-23 | 753090.490 | 6218123.510 | 997.500 | 1152.500 | 1237.500 |

| WTG ID | Easting | Northing | Proposed Ground Level | Tower Elevation | Blade Max Elevation |
|---|---|---|---|---|---|
| PY-24 | 753402.060 | 6218432.040 | 995.000 | 1150.000 | 1235.000 |
| PY-25 | 753741.320 | 6217698.590 | 1000.000 | 1155.000 | 1240.000 |
| PY-26 | 753904.370 | 6218068.550 | 1010.000 | 1165.000 | 1250.000 |
| PY-27 | 753741.380 | 6219320.430 | 990.000 | 1145.000 | 1230.000 |
| PY-28 | 754161.590 | 6219611.930 | 1000.000 | 1155.000 | 1240.000 |
| PY-29 | 754331.110 | 6220009.310 | 985.000 | 1140.000 | 1225.000 |
| PY-30 | 754518.230 | 6220469.600 | 980.000 | 1135.000 | 1220.000 |
| PY-31 | 754969.830 | 6220320.240 | 970.000 | 1125.000 | 1210.000 |
| PY-32 | 755526.920 | 6220445.700 | 995.000 | 1150.000 | 1235.000 |
| PY-33 | 755987.810 | 6220402.630 | 1040.000 | 1195.000 | 1280.000 |
| PY-34 | 756386.410 | 6220593.110 | 1050.000 | 1205.000 | 1290.000 |
| PY-35 | 757375.270 | 6217236.880 | 1030.000 | 1185.000 | 1270.000 |
| PY-36 | 756991.800 | 6217538.080 | 1030.000 | 1185.000 | 1270.000 |
| PY-37 | 756710.890 | 6217869.760 | 1035.000 | 1190.000 | 1275.000 |
| PY-38 | 757116.830 | 6217956.780 | 1050.000 | 1205.000 | 1290.000 |
| PY-39 | 757375.300 | 6218320.890 | 1030.000 | 1185.000 | 1270.000 |
| PY-40 | 757655.770 | 6218768.360 | 1020.000 | 1175.000 | 1260.000 |
| PY-41 | 757359.690 | 6219304.770 | 980.000 | 1135.000 | 1220.000 |
| PY-42 | 758117.960 | 6219898.140 | 1000.000 | 1155.000 | 1240.000 |
| PY-43 | 758168.300 | 6220296.900 | 1020.000 | 1175.000 | 1260.000 |
| PY-44 | 758672.130 | 6219951.090 | 942.000 | 1097.000 | 1182.000 |
| PY-45 | 758947.690 | 6220373.880 | 1023.500 | 1178.500 | 1263.500 |
| PY-46 | 759907.220 | 6221289.500 | 968.000 | 1123.000 | 1208.000 |
| PY-47 | 759979.160 | 6221613.670 | 983.500 | 1138.500 | 1223.500 |

# ANNEXURE 4 – RISK ASSESSMENT 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 Safety Management System (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 SARPs, and is therefore adopted as the primary reference for aviation safety risk management in the context of the subject assessment.

Section 2.1 of the ICAO Doc 9589 *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 in Table 1.

Table 1 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 2.

Table 2 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 3.

Table 3 Risk Matrix

| | | CONSEQUENCE | | | | |
|---|---|---|---|---|---|---|
| | | INSIGNIFICANT 1 | MINOR 2 | MODERATE 3 | MAJOR 4 | CATASTROPHIC 5 |
| 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 4.

Table 4 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. |

# ANNEXURE 5 – CASA REGULATORY REQUIREMENTS – LIGHTING AND MARKING

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.

### 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 100 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.

### 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.*

### 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.

### 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 OLS 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.*

**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/m² or greater.*

#### Visual impact of night lighting

Annex 14 Section 6.2.4 and MOS 139 Chapter 9 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
  - such that no light is emitted at or below 10 degrees below horizontal
- If a light would be shielded in any direction by an adjacent object or structure, the light so shielded may be omitted, provided that such additional lights are used as are necessary to retain the general definition of the object or structure
- If flashing obstacle lighting is required, all obstacle lights on a wind farm should be synchronised so that they flash simultaneously
- 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.

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.

Wind monitoring towers

The details of the WMTs were introduced in Section 0 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.

# ANNEXURE 6 – CONSULTATION RESPONSES

Find behind this page copies of consultation responses from the following agencies:

- Airservices Australia
- Civil Aviation Safety Authority
- Department of Defence
- NSW Rural Fire Service
- Royal Flying Doctor Service

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