

AVIATION IMPACT ASSESSMENT

TANDEGIN WIND FARM*Prepared for Collgar Renewables Pty Ltd*

DOCUMENT CONTROL

Document Title: Tandegin Wind Farm – Aviation Impact Assessment

Reference: 1010301-01

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Reviewed by: K Madden

Released by: L Wang

REVISION HISTORY

<i>Version</i>	<i>Description</i>	<i>Transmitted</i>	<i>Reviewed by</i>	<i>Date</i>
0.1	Draft Report	23 January 2026		
0.2	Second Draft	11 February 2026		
0.3	Final Draft	23 April 2026		
1.0	Final Report	04 August 2026		

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ACRONYMS

AAAA	Aerial Application Association of Australia
AC	Advisory Circular
AFAC	Australian and New Zealand Council for Fire and Emergency Services
AGL	Above Ground Level
AHD	Australian Height Datum
AIA	Aviation Impact Assessment
AIP	Aeronautical Information Package
AIS	Aviation Impact Statement
ALARP	As Low as Reasonably Practicable
AMSL	Above Mean Sea Level
ARP	Aerodrome Reference Point
AS	Australian Standards
ATSB	Australian Transport Safety Bureau
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
DAH	Designated Airspace Handbook
EIS	Environmental Impact Statement
ERC-H	En-route Chart High
ERC-L	En-route Chart Low
ERSA	En Route Supplement Australia
GA	General Aviation
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
nm	Nautical Miles
OHTL	Overhead Transmission Line
OLS	Obstacle Limitation Surface
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations
PSR	Primary Surveillance Radar
RAAF	Royal Australian Air Force
RFDS	Royal Flying Doctor Service
RNP	Required Navigation Performance
RSR	En-route Surveillance Radar
SSR	Secondary Surveillance Radar
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

UNITS OF MEASUREMENT

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

DEFINITIONS

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

NOTES

Nil

EXECUTIVE SUMMARY

Introduction

Collgar Renewables are proposing the Tandegin Wind Farm, which is located south of existing Tandegin Wind Farm in Merredin, Western Australia.

Collgar Renewables has requested Aviation Projects prepare an Aviation Impact Assessment (AIA) to support the development and planning process.

This AIA assesses the potential aviation impacts associated with the Project and 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) for Airservices Australia and a qualitative risk assessment to determine the need for obstacle lighting and marking for client review and acceptance before submission to external aviation regulators.

Project description

Tandegin Wind Farm includes the following:

- 50 wind turbines with a maximum (worst-case) overall height (tip height) of up to 261 m above ground level (AGL), a hub height of 170 m (557.7 ft) AGL, and a rotor diameter of up to 182 m
- The highest proposed wind turbine is WTG T-28 with a maximum tip height of 679.2 m AHD (2228.3 ft AMSL)
- Internal access tracks, temporary construction compound, an operations and maintenance building, and other ancillary infrastructure.

Conclusions

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

Planning considerations

- The Project, as proposed, satisfies the planning provisions and will not create incompatible intrusions or compromise the safety of existing airports and associated navigation and communication facilities.

Certified airports

- There are no certified airports located within 30 nm (56 km) of the Project Site.

Obstacle Limitation Surfaces (OLS)

- The Project is located outside the horizontal extent of the OLS of any certified aerodrome.

Uncertified Aerodrome

- There are two (2) uncertified aerodromes identified within 3 nm of the project site – Hooper Aerodrome and Unknown Aerodrome (1):
 - The proposed wind farm would be considered a potentially hazardous obstacle to both aerodromes

- When the wind blows from the east, downstream wake turbulence from the closer WTGs would extend into the circuit area of both aerodromes.
- Consultation with the landowner of Hooper Aerodrome has been undertaken. The aerodrome has been used occasionally for recreational flying only. From the landowner's perspective, the risk associated with the proposed wind turbine locations is low.
- Consultation with the owner/operator of Unknown Aerodrome (1) would be beneficial in understanding the potential extent of these impacts.

Air Routes and Lowest Safe Altitude (LSALT)

- The WTGs would impact the Grid LSALT 3000 ft AMSL, which needs to be raised to 3300 ft AMSL.
- The WTGs would not impact any air route LSALT.

Airspace

- The project site would be located within Class G airspace and outside all controlled airspace, Prohibited, Restricted, and Danger areas.

Aviation Facilities

- The WTGs would not penetrate any protection areas associated with aviation facilities.

Radar

- The project site would be located outside the area of interest to assess the potential impact of the development on surveillance radar. The Project will not impact the Kalamunda en-route surveillance radar (RSR) and Perth Primary Surveillance Radar (PSR) / Secondary Surveillance Radar (SSR).

Aviation Impact Statement (AIS)

Based on the WTG layout and maximum blade tip height of up to 261 m AGL, the blade tip elevation of the highest WTG, which is WTG T28, will not exceed 679.2 m AHD (2228.3 ft AMSL) and:

- There are no certified airports located within 30 nm (56 km) of the Project Site.
- The WTGs would impact the Grid LSALT 3000 ft AMSL, which needs to be raised to 3300 ft AMSL.
- The WTGs would not impact any air route LSALT.
- The project site would be located within Class G airspace and outside all controlled airspace, Prohibited, Restricted, and Danger areas.
- The WTGs would not impact aviation navigation facilities.
- The WTGs would not impact the ATC radar systems.
- The WTGs must be reported to CASA, and construction details must be provided to Airservices.

Obstacle lighting risk assessment

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

- Over the 16-year period between 2010-2026, no crewed aircraft collided with a WTG or a WMT in Australia.
- There is no regulatory requirement to mark or light power poles or overhead transmission lines.
- WA Department of Fire and Emergency Services normally recommends aviation obstacle lighting and markings be placed on the wind farms to protect emergency services aviation aircraft.

Consultation

Refer to **Section 5** for detailed responses from relevant aviation stakeholders once received.

The consultation process has been commenced. It will continue throughout the review of the Development Application.

The risk assessment has been updated, and this report has been finalised based on the feedback received during the consultation process. Received feedback has been documented in this report.

Summary of key recommendations

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

Notification and reporting

1. Details of WTGs 100 m or more AGL must be reported to CASA *as soon as practicable after forming the intention to construct or erect the proposed object or structure*, in accordance with CASR Part 139.165(1)(2). The notification should be provided to CASA via email to Airspace.Protection@casa.gov.au.
2. 'Final details of WTG coordinates and elevation should be provided to Airservices Australia at least two weeks prior to construction commencing, by submitting the form at this webpage: https://www.airservicesaustralia.com/wp-content/uploads/ATS-FORM-0085_Vertical_Obstruction_Data_Form.pdf to the following email address: vod@airservicesaustralia.com
3. Any obstacles 100 m or more AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents. With respect to crane operations during the construction of the Project, a notification to the NOTAM office may include, for example, the following details:
 - a. The planned operational timeframe and maximum height of the crane; and
 - b. Either the general area within which the crane will operate and/or the planned route with timelines that crane operations will follow.
4. Details of the wind farm should be provided to local and regional aircraft operators prior to construction in order for them to consider the potential impact of the wind farm on their operations.
5. To facilitate the flight planning of aerial application operators, details of the Project, including the 'as constructed' location and height information of WTGs 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.

Marking of WTGs

6. The rotor blades, nacelle, and supporting mast of the WTGs should be painted a low-reflective white or off-white, as is typical of most WTGs operational in Australia. No additional marking measures are required for WTGs.

Lighting of WTGs

7. CASA will determine whether obstacle lighting is recommended for the WTGs. Lighting the WTGs is not a formal requirement.
8. WA Department of Fire and Emergency Services normally recommends aviation obstacle lighting and markings be placed on the wind farms to protect emergency services aviation aircraft.

Micrositing

9. Providing the micrositing is within 100 m of the WTGs, it will not likely result in a change in the maximum overall blade tip height of the Project. No further assessment is likely to be required from micrositing and the conclusions of this AIA would remain the same.

Aerial firefighting

10. The developer or operator should ensure that:
 - a. Liaison with the relevant fire and land management agencies is ongoing and effective
 - b. Access is available to the wind farm site by emergency services response for on-ground firefighting operations
 - c. Wind turbines are shut down immediately during emergency operations.
 - d. 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. This may not always be possible due to the risk to equipment and personnel as a fire approaches or exists in or near to the WTGs.

Aviation Projects considers that it may be impractical to stop and lock the turbine blades in a Y configuration due to the time needed to stop and lock the turbine and the risk to personnel having to climb into the WTG tower as a bush fire approaches. WTG blades can be feathered to effectively stop or reduce the rotation rate of the turbine to a very slow speed.

Triggers for review

11. 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
 - a. Following any near miss, incident or accident associated with operations considered in this risk assessment.

1. INTRODUCTION

1.1. Situation

Collgar Renewables are proposing the Tandegin Wind Farm, which is located south of existing Tandegin Wind Farm in Merredin, Western Australia.

Collgar Renewables has requested Aviation Projects prepare an AIA to support the development and planning process.

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 AIS for Airservices Australia and a qualitative risk assessment to determine the need for obstacle lighting and other applicable mitigation for client review and acceptance before submission to external aviation agencies.

The AIA and supporting technical data will provide evidence and analysis supporting the development 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 support a development application to be submitted to the Department of Planning, Lands and Heritage through the State Development Assessment Unit.

The AIA specifically responds to the following key legislation, approvals, and guidance material:

- Civil Aviation Safety Authority, Civil Aviation Safety Regulations 1998 (CASR) and associated material
- NASF Guideline D: *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers*
- WA Government Department of Planning, Lands and Heritage, Position Statement: Renewable energy facilities, March 2020
- Other specific requirements as advised by Airservices Australia.

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:

- Confirmed the scope and deliverables with the Proponent (or representative)
- Reviewed client material
- Conducted a site visit to properly investigate aviation safety aspects of the proposed site
- Reviewed relevant regulatory requirements and information sources
- Prepared 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 included an Aviation Impact Statement (AIS) and a qualitative risk assessment to determine need for obstacle lighting and of applicable aspects for client review and acceptance before submission to external aviation regulators

- Identified risk mitigation strategies that provide an acceptable alternative to night lighting. The risk assessment has been completed following the guidelines in *ISO 31000:2018 Risk Management – Guidelines*
- Consulted with aviation regulators, consisting of Airservices Australia (and other CASR Part 173 procedure designers if applicable), and the Department of Defence
- Consulted with relevant Council(s), and aerodrome operators of the nearby aerodrome/s to seek endorsement of the proposal to change instrument procedures (if applicable).
- Consulted/engaged with stakeholders (including RFDS) to negotiate acceptable outcomes (if required)
- Finalised the AIA report for client acceptance when response received from stakeholders for client review and acceptance.

1.4. Aviation Impact Statement (AIS)

The AIS included in this report (see Section 6) includes the following specific requirements as advised by Airservices Australia:

Aerodromes:

- Specify all certified aerodromes that are located within 30 nm (55.6 km) of the project site
- Nominate all instrument approach and landing procedures at these aerodromes
- Review the potential effect of 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 site and review potential impacts of project operations on aircraft using those air routes.

Airspace:

- Nominate the airspace classification – A, C, D, E, G, etc, where the project site is located.

Navigation/Radar:

- Nominate air traffic control radar with coverage overlapping the project site
- Nominate aviation navigation systems in proximity to the project site.

1.5. Material reviewed

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

- Tandegin Wind Farm - Project area.kml
- Tandegin Rev.G 14-07-2026.shap
- Hooper - Airstrip.kml

- WTG Coordinates 23072026 ESL.xlsx

2. BACKGROUND

2.1. Site Overview

The Project Site is located within the Shire of Merredin Local Government Area (LGA). An overview of the Project Site is provided in Figure 1 (source: Collgar, Open TopoMap).

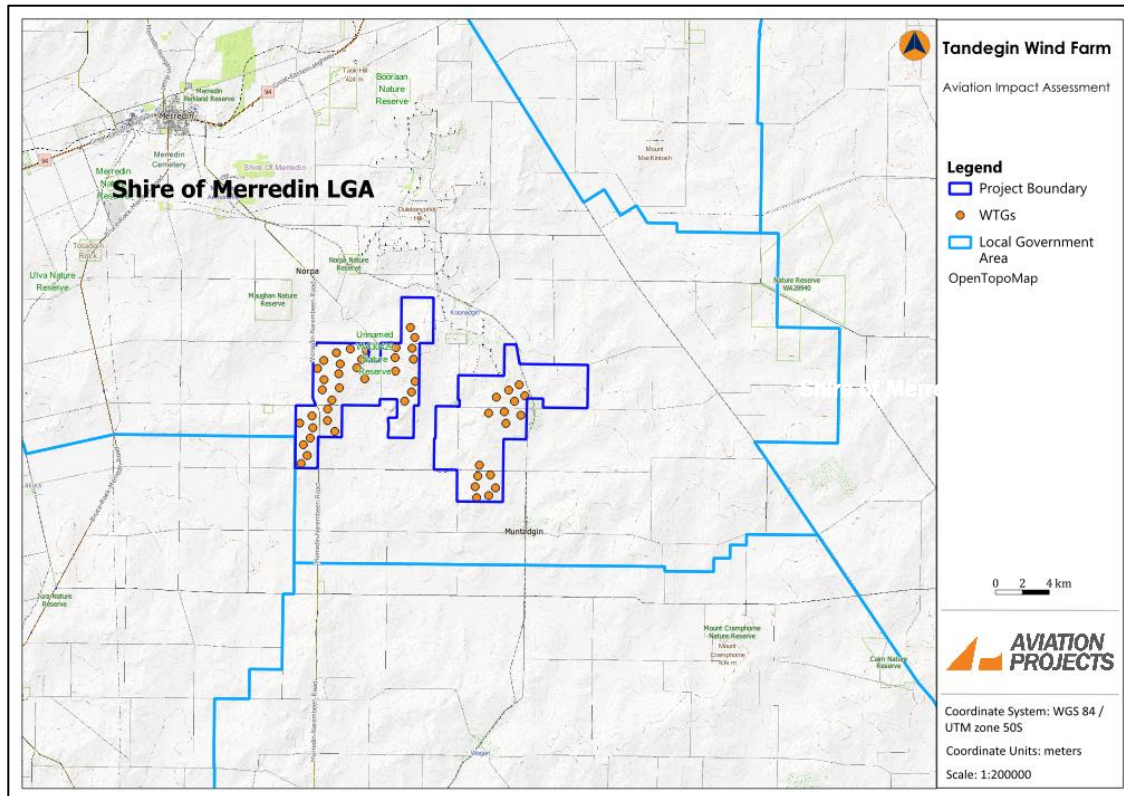


Figure 1 Project site overview

2.2. Project Description

The Project is proposed to include the development of wind turbines with a hub height of 170 m AGL, 182 m rotor diameter, and maximum tip height of 261 m AGL.

The ground elevation for the highest WTG location (WTG T28) is 418.2 m AHD, which, with a 261 m WTG height, results in a maximum overall height of 679.2 m AHD (2228.3 ft AMSL).

3. EXTERNAL CONTEXT

3.1. National Airports Safeguarding Framework

The National Airports Safeguarding Advisory Group (NASAG) was established by Commonwealth Department of Infrastructure and Transport to develop a national land use planning framework called the National Airports Safeguarding Framework (NASF). The purpose of the NASF 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 WMTs.

The methodology for preparing the risk assessment is contained in the NASF Guideline D Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers.

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.

NASF Guideline D strongly encourages consultation with aviation stakeholders in the early stages of wind farm development planning, including with aerodrome owners and operators, regional aircraft operators and CASA and Airservices.

3.2. Western Australia Government, Department of Planning, Lands and Heritage

The Western Australian Planning Commission administers responsibility for approving renewable energy facilities through local councils. The Department of Planning, Lands and Heritage has published *Position Statement: Renewable energy facilities* (March 2020) on behalf the Western Australia Planning Commission. These guidelines provide advice to inform planning decisions about a wind energy facility proposal.

The intent of this position statement is to:

- Outline the Western Australian Planning Commission (WAPC) requirements to support the consistent consideration and provision of renewable energy facilities within Western Australia
- Identify assessment measures to facilitate appropriate development of renewable energy facilities.

The position statement applies to the preparation and assessment of planning instruments including regional and local planning schemes and strategies.

The position statement supersedes Planning Bulletin 67 Guidelines for Wind Farm Development (2004).

Section 5.3.1 *Community Consultation* and Section 5.3.5 *Public and Aviation safety* are relevant to this assessment and are extracted below:

Section 5.3.1 Community Consultation

Early consultation with the community and stakeholders by the proponents is encouraged to ensure that the proposal is compatible with existing land uses on and near the site. The local government should be consulted with respect to the community consultation program. Relevant stakeholders may include:

- Air Services Australia
- Australian Wind Alliance
- Civil Aviation Safety Authority

5.3.5 Public and aviation safety

Proponents of wind turbine proposals should refer to the National Airports Safeguarding Framework (NASF) Guideline D: Managing the Risk to Aviation Safety of Wind Turbine Installation (Wind Farms) / Wind Monitoring Towers to determine any potential aviation safety risks and possible mitigation measures.

Any potential aviation safety risks identified require consultation with Civil Aviation Safety Authority (CASA), Air Services Australia and/or the Commonwealth Department of Defence.

The position paper defines Renewable energy facility as premises used to generate energy from a renewable energy source and includes any building or other structure used in, or relating to, the generation of energy by a renewable resource. It does not include renewable energy electricity generation where the energy produced principally supplies a domestic and/or business premises and any on selling to the grid is secondary.

An AIA would include consultation with relevant aviation stakeholders and address aviation-related matters included in the Position Statement.

3.3. Civil Aviation Safety Authority (CASA)

The following CASA publications inform pilots of their obligations at uncertified aerodromes in uncontrolled airspace.

3.3.1. Advisory Circular (AC) 91-02 V1.2, Guidelines for aeroplanes with MTOW not exceeding 5700 kg – suitable places to take off and land, dated November 2022

This AC provides guidance for pilots of:

- Aeroplanes with maximum take-off weight (MTOW) not exceeding 5700 kg that are operated under Part 91 of CASR, including experimental aircraft, and
- Light sport aircraft (LSA) under Part 103 of CASR.

Purpose

This AC provides guidance to assist aeroplane pilots when determining the suitability of a place to safely take off and land. It provides an overview of pilot responsibilities, discusses the relevant circumstances recommended to be considered and includes general information and advice to enhance the safety of taking off and landing at any place.

2 Introduction

2.2 Use of Aerodromes

2.2.1 Regulation 91.410 authorises a place for use as an aerodrome if: (i) it is suitable for the landing and taking-off of aircraft; and (ii) an aircraft can land at or take off from the place safely, having regard to all the circumstances of the proposed landing or take-off (including the prevailing weather conditions).

4.2.4 The examples below are two of many possible considerations:

- the obstacles surrounding the aerodrome have been accurately described and are still current (e.g. have the trees on final grown taller since last reported), and
- the information provided enables the pilot to judge whether or not a landing approach can be made from both runway directions.

3.3.2. AC 91-10 v1.7, Operations in the vicinity of non-controlled aerodromes, dated April 2026

This AC provides guidance on procedures that, when followed, will improve situational awareness and safety for all pilots when flying at, or in the vicinity of, non-controlled aerodromes.

7.2 Traffic circuit direction

7.2.1 The standard aerodrome traffic circuit facilitates the orderly flow. Unless an alternative requirement for an aerodrome is stated in the ERSA or NOTAMs, all turns must be made to the left (regulation 91.385).

7.2.2 When arriving at an aerodrome to land, the pilot will normally join the circuit on upwind, crosswind (midfield), or at or before mid-downwind. Landings and take-offs should be made on the preferred runway.

7.3.2 During initial climb-out, the turn onto crosswind should be appropriate to the performance of the aircraft but, in any case, not less than 500 ft above terrain so as to be at circuit height when turning downwind (regulation 91.390). Pilots may vary the size of the circuit depending on:

- the performance of the aircraft
- AFM/Pilot's Operating Handbook requirements
- company standard operating procedures
- other safety reasons.

7.8 Final approach

7.8.1 The turn onto final approach should be:

- completed by a distance and height that is common to all operations at the aerodrome
- commensurate with the speed flown in the circuit for all aircraft of the same type.

Illustrations of the standard aerodrome traffic circuit procedures provided in AC 91-10 v1.7. are shown in Figure 2 and Figure 3.

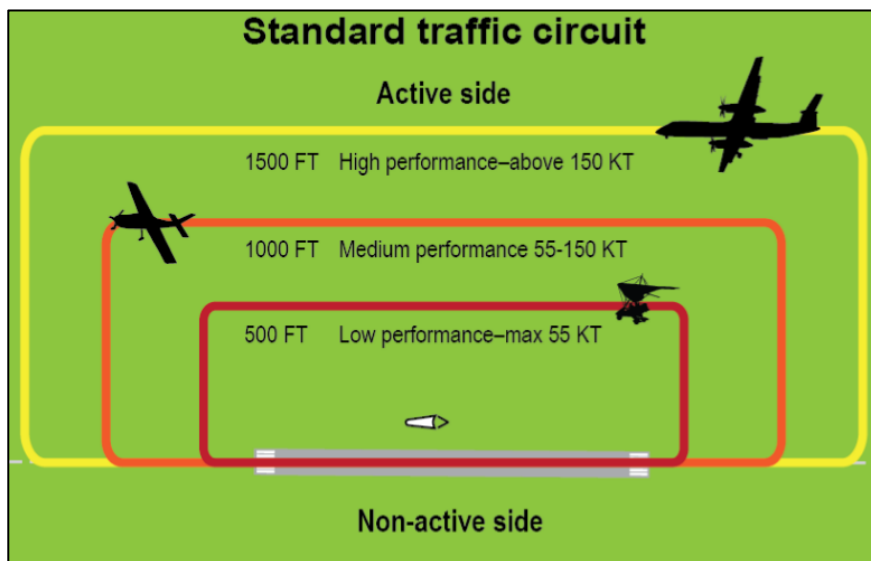


Figure 2 Lateral and vertical separation in the standard aerodrome traffic circuit

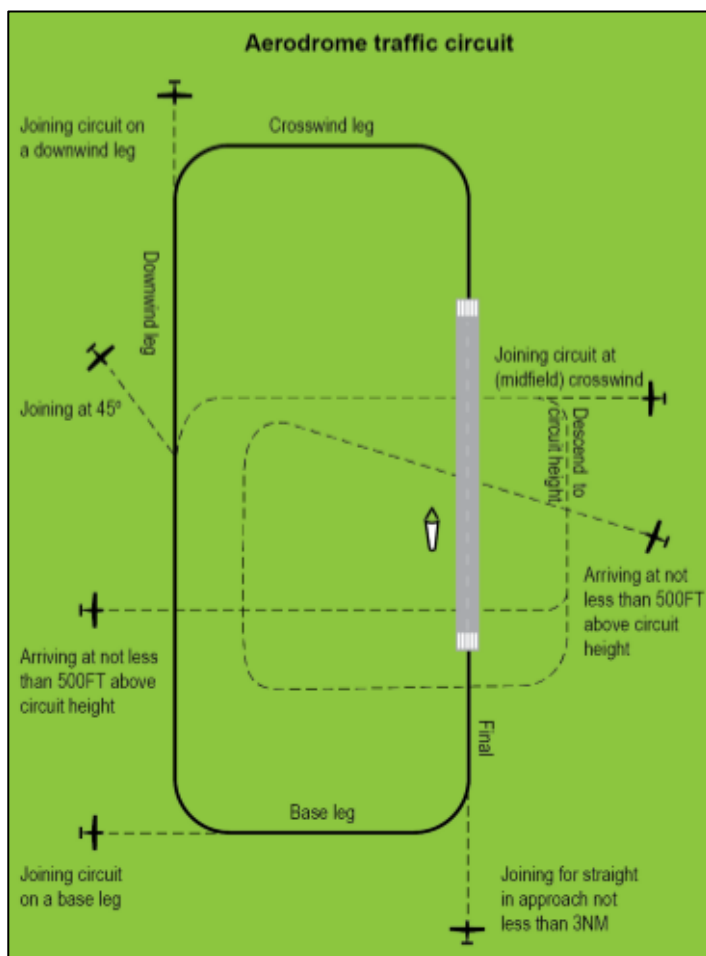


Figure 3 Aerodrome standard traffic circuit, showing arrival and joining procedures.

Paragraph 7.11 refers to a distance that is “normally” well outside the circuit area and where no traffic conflict exists, which is at least 3 nm. The paragraph is copied below:

7.11 Departing the circuit area

7.11.1 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 should be 500 ft or more above the circuit height and 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.

3.4. Rules of flight

3.4.1. Flight under Day Visual Flight Rules (Day VFR)

According to Australia’s Aeronautical Information Package (AIP) the meteorological conditions required for visual flight in the applicable (class G) airspace at or below 3,000 ft AMSL or 1,000 ft AGL (whichever is the higher) are: 5,000 m visibility, clear of clouds and in sight of ground or water.

CASR 91.267 (Minimum height rules—other areas) prescribes the minimum height for flight. Generally speaking, and unless otherwise approved, 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 300 m in visual flight during the day when not in the vicinity of built-up areas, and 1000 ft AGL over built up areas (within a horizontal radius of 600 m of the point on the ground or water immediately below the aeroplane). Flight below these height restrictions is also permitted in certain other circumstances.

3.4.2. Flight under Night Visual Flight Rules (Night VFR)

With respect to flight under the VFR at night CASR 91.277 requires that the pilot in command of an aircraft flying VFR at night must not fly below the appropriate lowest safe altitude (unless during take-off and landing operations, within 3 nm of an aerodrome).

3.4.3. Flight under Instrument Flight Rules (Day or Night) (IFR)

According to CASR 91, 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.

3.5. Aircraft operator characteristics

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

Flight under day VFR is conducted above 500 ft above the highest point of the terrain within a 300 m radius unless the operation is approved to operate below 500 ft above the highest point of the terrain.

It is expected that the proposed WTGs will be sufficiently visually conspicuous to pilots conducting VFR operations within the vicinity of the Project Site 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 to 8**.

3.6. Passenger transport operations

Scheduled and non-scheduled passenger transport operations are generally operated under the IFR.

3.7. 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 in areas outside city and township built-up areas. These operations are usually conducted at altitudes well above 500 ft AGL for passenger comfort and fuel efficiency.

3.8. Military operations

There may be some high-speed low-level military jet aircraft and helicopter operations conducted in the area. Military operations are conducted under separate but compatible regulations and standards, including obstacle separation requirements.

Refer to **Section 5** for a detailed response from the Department of Defence.

3.9. Aerial application operations

Aerial application 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 and 100 ft AGL.

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.

3.9.1. Aerial Application Association Australia (AAAA)

The Aerial Application Association Australia (AAAA) is the national peak advocacy and membership organisation for aviation companies, pilots and support staff who undertake aerial application work. The AAAA has a formal risk management program which is recommended for use by its members, to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained.

In previous consultation with the AAAA, Aviation Projects has been directed to the *AAAA Fact Sheet Wind Turbines and Aerial Application*, dated August 2025, and the *AAAA Tall Structures Policy*, dated March 2024.

The *AAAA Fact Sheet Wind Turbines and Aerial Application* outlines some considerations for operators completing aerial application near wind farms and the wind farm developers. This includes:

What are the issues?

- *Collision: Wind turbines pose a collision risk for aircraft operating at low altitudes (defined as below 500 feet above ground level). This is the height aerial application and firebombing aircraft operate at. Emergency aircraft (police, ambulance, search and rescue) also regularly operate below 500ft for emergency operation conditions. These operations can occur 24 hours per day.*
- *Blade rotation: Agricultural application is conducted when wind speed is between 3km/h and 20 km/h. Turbines typically start turning at around 11km/h but can turn at lower speeds. Blade rotation causes both distraction and collision risk. As such, any aerial application in a wind farm should only take place when the wind turbine blades have been locked in the "rabbit ears" (one blade aligned with the tower structure and two above the tower) position.*

- *Associated infrastructure: Wind turbines require powerlines, transformer yards and meteorological towers. These all create collision risks. Meteorological towers are considered to be the most significant risk to low level flight as they are typically difficult to see and discern from the surrounding areas.*
- *Best placement for Agricultural outcomes: Like every part of the farm, placement of a non-moving piece of infrastructure has some impact. Working with the developer can ensure that paddocks can be managed. Make sure that turbines are placed where aircraft and ground machinery can manoeuvre cleanly around the structure. Every additional manoeuvre costs, so placement to ensure long runs and easy turn areas is vital.*

Managing Collision Risk

All tall structures need to be marked in accordance with AS3891.1:2021 and the Civil Aviation Safety Regulations Part 139. Conforming to these standards is of minimum cost during the construction phase and dramatically improves aviation safety.

Once built – any aerial application in a wind farm should only take place when the wind turbine blades have been locked in the “rabbit ears” (one blade aligned with the tower structure and two above the tower) position.

The AAAA Tall Structures Policy, dated March 2024, states in part:

The development of tall structures in agricultural and bush fire prone areas can pose a direct threat to aviation safety, particularly where fixed and rotary aircraft may be requested to operate for agricultural or bush/grass fire control.

The absence of historical aircraft use in an area is considered an insufficient reason to discount the threat to Aviation Operations.

The AAAA will oppose any development application or similar process unless the proponent has:

- *Identified the structure as posing a low-level flying risk that needs to be managed on an ongoing basis*
- *Consulted honestly and in detail with local aerial application operators or the AAAA where a local operator cannot be identified*
- *Consulted with adjoining landowners regarding the impact on adjacent properties*
- *Included appropriate lighting and marking in the development proposal, consistent with providing a warning to low level flying*
- *Identified the process for advising of the location height and presence of the structure to the relevant authorities, and*
- *Ensure that the proposal is in keeping with CASA requirements for structures near aerodromes, including temporary landing areas.*

3.9.2. Aerial application operators

Aerial application 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 and 100 ft AGL.

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.

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, and the utilise the AAAA formal risk management programme.

Based on previous studies for other wind farm projects undertaken by Aviation Projects, and the results of consultation with AAAA and local aerial application operators, it is reasonable to conclude that safe aerial application operations would be possible on properties within the Project site and on neighbouring properties, subject to final WTG locations and by implementing recommendations provided in this report at Section 12.

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

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

3.10. Emergency services

3.10.1. Royal Flying Doctor Service

Royal Flying Doctor Service 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, in which case they would be operating day or night VFR.

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

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

3.10.2. Aerial firefighting

Aerial firefighting operations (firebombing in particular) are conducted under 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 has developed a national position on wind farms, their development and operations in relation to bushfire prevention, preparedness, response and recovery, set out in the document titled *Wind Farms and Bushfire Operations*, version 3.0, dated 25 October 2018.

Of specific interest in this document is the section extracted from under the 'Response' heading, copied below:

Wind farm operators should be responsible for ensuring that the relevant emergency protocols and plans are properly executed in an emergency event. During an emergency, operators need to react quickly to ensure they can assist and intervene in accordance with their planned procedures.

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.

Aviation Projects considers that it may be impractical to stop and lock the turbine blades in a Y configuration due to the time needed to stop and lock the turbine and the risk to personnel having to climb into the WTG tower as a bush fire approaches. WTG blades can be feathered to effectively stop or reduce the rotation rate of the turbine to a very slow speed.

4. INTERNAL CONTEXT

4.1. Wind farm site description

A site visit was conducted to the Tandegin Wind Farm project area in Tandegin, WA, as part of the Aviation Impact Assessment (AIA) in December 2025. The visit aimed to verify aviation-related infrastructure identified during desktop analysis and assess terrain characteristics and environmental conditions that may influence aviation safety and compliance throughout the project's construction and operational phases.

Access to the wind farm transitions from sealed regional highways to unsealed gravel service roads characteristic of rural and agricultural areas. The roads are trafficable but require caution due to loose gravel, dust, and periodic corrugation.

No certified or registered aerodromes were identified in the vicinity of the proposed assessment area. A private airstrip (Hooper Airstrip) was inspected externally from outside a fenced boundary; however, the strip itself was not visible due to surrounding agricultural cover.

No agricultural, general aviation, or low-flying aircraft were observed during the site visit. To ensure a comprehensive understanding of airspace usage and minimise potential conflicts, further engagement with key stakeholders, including private strip owners, recreational aviation groups, local government, and emergency service operators, is recommended.

Figure 4 and Figure 5 show the site visit photos of the Project Site.



Figure 4 Site Visit of the Project Area (1)



Figure 5 Site Visit of the Project Area (2)

4.2. Wind turbine generator description

The maximum blade tip height of the proposed wind turbines will be up to 261 m AGL, with a maximum hub height of 170 m and rotor diameter of 182 m.

Figure 6 demonstrates the Project layout, identifying the highest proposed wind turbine WTG-T28 (source: Collgar, Open TopoMap).

‘Micrositing’ of WTGs means an alteration to the siting of a WTG by not more than 100 m and any consequential changes to access tracks and internal power cable routes. The potential micrositing of the WTGs has been considered in the assessment, with the estimate of the overall maximum height being based on the highest ground level that is within 100 m of the nominal WTG position. The micrositing of the WTGs is not likely to result in a change in the maximum overall blade tip height of the Project.

This AIA assumes a maximum blade tip height of 261 m AGL is implemented at all WTG locations.

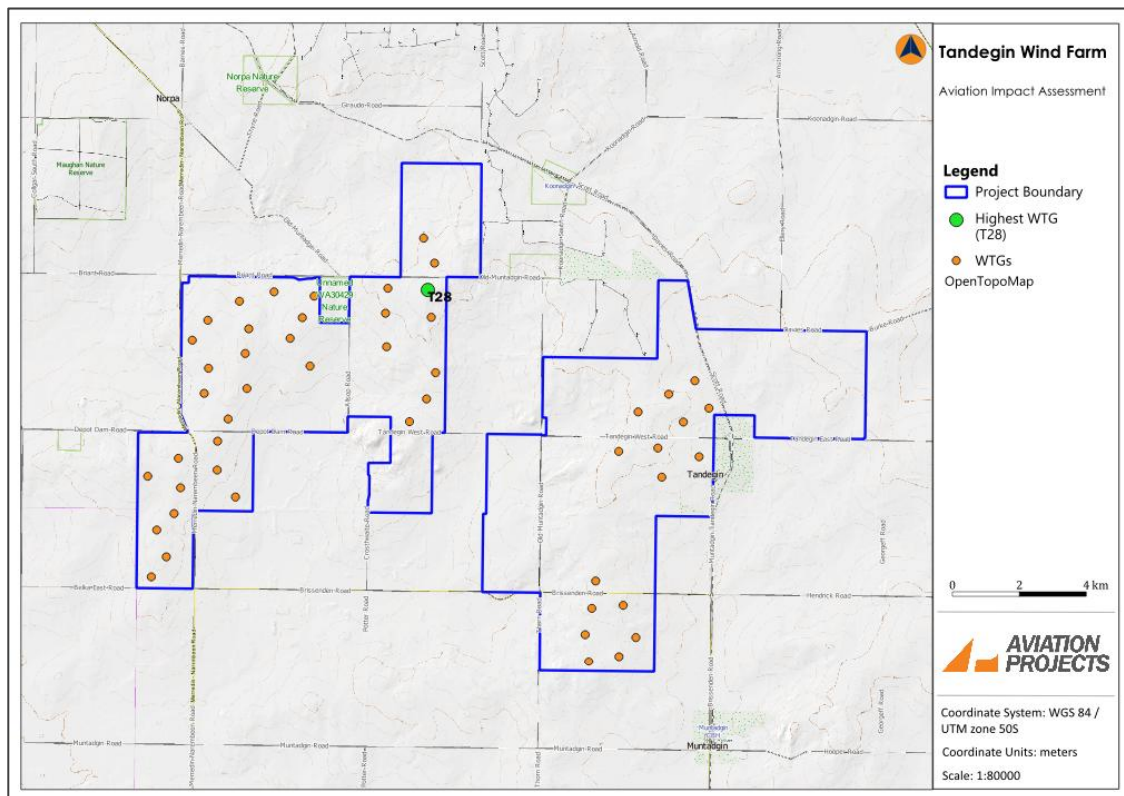


Figure 6 Proposed WTG locations and the highest elevation WTG (WTG-T28)

5. CONSULTATION

The following list of stakeholders was identified as requiring consultation:

1. Airservices Australia
2. Department of Defence.
3. Royal Flying Doctor Service
4. Western Australia Department of Fire and Emergency Services
5. Department of Biodiversity, Conservation and Attractions

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

Table 1 Stakeholder consultation details

Agency/Contact	Activity/Date	Response/Date	Issues Raised During Consultation	Action Proposed / Response
Airservices Australia	Email sent on 23 April 2026	Email received on 25 May 2026	Airspace Procedures With respect to procedures designed by Airservices Australia in accordance with ICAO PANS OPS and Doc 9905, at a maximum height of 420.2m (1379ft) AHD the wind farm will not affect any sector or circling altitude, nor any instrument approach or departure procedure at any aerodrome or any air routes. Note: Procedures not designed by Airservices Australia were not considered in this assessment. Communications/Navigation/Surveillance (CNS) Facilities We have assessed the proposed activity to the above specified height 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. Note: Meteorological instruments not owned by Airservices were not considered in this assessment. The Bureau can be contacted at airport.developments@bom.gov.au Air Traffic Control (ATC) Operations There are no additional instructions/concerns from ATC. Grid lowest safe altitude (LSALT) The proposed activity will penetrate the current Airservices-designed Grid LSALT as per the attached VOD assessment. Please advise the Vertical Obstacle Data (VOD) team at VOD@airservicesaustralia.com of any need to increase Grid LSALT heights at	Please advise the Vertical Obstacle Data (VOD) team at VOD@airservicesaustralia.com of any need to increase Grid LSALT heights at least two (2) weeks before construction commencing by supplying the below information: • Approved wind turbine locations • Elevations at the top of the highest point of the turbine in metres AHD • A copy of this email

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed / Response
			least two (2) weeks before construction commencing by supplying the below information: • Approved wind turbine locations • Elevations at the top of the highest point of the turbine in metres AHD • A copy of this email Vertical Obstacle Notification As this proposed activity is more than 30m (99ft) AGL, please follow the below notification process: 1. Complete the Vertical Obstacle Notification Form: ATS-FORM-0085_Vertical Obstruction Data Form.pdf (airservicesaustralia.com) 2. Submit completed form to: VOD@airservicesaustralia.com as soon as the development reaches the maximum height. For further information regarding the reporting of tall structures, please contact the VOD team: • Email - VOD@airservicesaustralia.com • Or refer to: Civil Aviation Safety Regulation Part 175 – Airservices and You - Airservices (airservicesaustralia.com) Summary The proposed activity does not impact Airservices operations or facilities, subject to the above conditions being met.	
Department of Defence	Email sent on 23 April 2026		On going, no response has been received as at 04 August 2026.	

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed / Response
Royal Flying Doctor Service	Email sent on 23 April 2026	Email received on 23 July 2026	Rfds has no issue with the proposed Tandegin Windfarm.	No action required
Western Australia Department of Fire and Emergency Services	Email sent on 23 April 2026	Email received on 24 April 2026 And email received on 26 May 2026	<u>Response received on 24 April 2026:</u> Thank you for your email. DFES Aviation Services have sent your query through to DFES Land Use Planning as our branch coordinates all requests for advice / comment on behalf of DFES in relation to a planning applications. I have touched base with the Shire of Merredin this morning as usually all requests for advice come directly from the Shire once a planning application has been lodged, they have confirmed that the Tandegin Wind Farm is still in the pre-lodgement phase. DFES are available to provide pre-lodgement advice or be involved in pre-lodgement consultation however it is important for us to know that it is not too early in the process and that the Shire is working with the proponent and supportive of the project, otherwise we can be expending resources on projects that never reach a formal development application. I understand there is a council meeting next week with Collgar where either I will attend or the Shire will relay to the proponent that any requests for information from DFES come through this email so we don't end up with uncoordinated advice. This meeting may also provide confirmation of the Shires ongoing support for the project. I am working with Aviation Services with regards to your specific query to see whether there is any advice we can provide you at this stage. Usually requests for advice in relation to planning proposals are given a timeframe of 20 working days as a minimum given it is not subject to the statutory planning timeframes as yet, however I will work with Aviation Services and let you	No action required at this stage

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed / Response
			know if we can either answer your query at this time or whether they need more time once I have touched base with them again. <u>Response received on 26 May 2026:</u> DFES has no specific technical advice regarding the submitted Aviation Impact Assessment as engagement at this early stage falls under the purview of Aerodrome and Aircraft Operators. Given no further information regarding the context of the site in terms of natural hazard management have been provided, we request that you please review and apply the applicable guidelines to your development plans: • The Australasian Fire and Emergency Service Authorities Council (AFAC) Wind Farm and Bushfire Operations position: https://www.afac.com.au/resources/wind-farms-and-bushfire-operations (please note a revision is currently underway). • The South Australian Country Fire Service (CFS) Guidelines for Wind Farms (based on the current AFAC position) which is also supported in principle by DFES: https://www.aec.gov.au/sites/default/files/documents/2022-06/cfs-guidelines-wind-farms.pdf • The Victorian CFA Design Guidelines and Model Requirements for Renewable Energy Facilities which is considered by DFES in its assessment of wind farm development applications: https://www.cfa.vic.gov.au/plan-prepare/building-planning-regulations/renewable-energy-fire-safety As previously advised, any requests for pre-lodgement advice should be sent to DFES Land Use Planning only at advice@dfes.wa.gov.au, we will liaise with DFES Aviation Services as required. The preference is also for any pre-lodgement advice	

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed / Response
			<i>to be submitted by the planning decision maker to ensure that in principle support for the project has already been received or is at least aware of the proposal.</i>	
Department of Biodiversity, Conservation and Attractions	Email sent on 23 April 2026	Email received on 7 May 2026	<i>Apologies in the delay in responding. I initially forwarded on your request to the DBCA aviation team but they have not been able to respond.</i> <i>Tandegin Wind Farm project is out of the normal operating area of DBCA managed water bombing aircraft, so aircraft are rarely used in this area.</i> <i>However, DBCA is in discussions with the owners of the Merredin Aerodrome in regard to possibly setting up the site for future water bomber reloading. This will put the Tandegin Wind Farm project in the water bomber response area.</i> <i>Whilst the proposed wind farm will currently have little impact on DBCA aviation activities we do have concerns that wind farms pose a high risk for any low-level aerial fire suppression operations.</i>	Response provided on 13 May 2026: The Merredin Aerodrome is located approximately 7.9 nm away from the closest WTG, therefore, the project is not expected to pose a risk to aircraft take-off and landing operations. Also based on AFAC guideline (V3.0), Wind farms are not expected to adversely affect fire behavior, nor create major ignition risks. Fire and land management agencies, wind farm developers, and operators have a shared interest in mitigating the following bushfire-related risks. Aerial firefighting operations have successfully been conducted within and in close proximity to wind farms in other states of Australia, in accordance with applicable risk management protocols, and it is

<i>Agency/Contact</i>	<i>Activity/Date</i>	<i>Response/ Date</i>	<i>Issues Raised During Consultation</i>	<i>Action Proposed / Response</i>
				expected that this would be the case at Tandegin Wind Farm.

6. AVIATION IMPACT STATEMENT

6.1. Overview

The NASF Guideline D: *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers* provides information to proponents and planning authorities to help identify any potential safety risks posed by WTG and wind monitoring towers (WMTs) from an aviation perspective.

Potential safety risks include (but are not limited to) impacts on flight procedures and aviation communications, navigation, and surveillance facilities which require assessment by Airservices Australia.

To facilitate these assessments all wind farm proposals submitted to Airservices Australia must include an Aviation Impact Statement (AIS).

This analysis considers the aeronautical impact of the WTGs and WMTs on the following:

- The operation of nearby certified aerodromes
- Grid and air route Lowest Safe Altitudes (LSALTS)
- Airspace protection
- Aviation navigation facilities
- ATC Radar installations
- Local aircraft operations.

6.2. Nearby certified aerodromes

A certified aerodrome is an aerodrome regulated by the Civil Aviation Safety Authority (CASA) under Part 139 of the Civil Aviation Safety Regulations (CASR), with defined standards established in Part 139 (Aerodromes) Manual of Standards (MOS) 2019.

There are no certified aerodromes located within 30 nm of the Project. The 30 nm radius represents the 25 nm MSA for aerodromes with terminal instrument flight procedures. The 25 nm MSA is determined by assessing obstacles within 30 nm (25 nm plus 5 nm buffer) of the aerodrome reference point or navigational aid on which the MSA is based.

The location of the Project Site relative to Cunderdin Aerodrome (YCUN) and Island Southern Cross Aerodrome (YSCR) is shown in Figure 7 (Source: Collgar, Open TopoMap). The orange circles around each airport represent a 30 nm radius from the aerodrome reference point.

The Project would not impact any certified aerodromes.

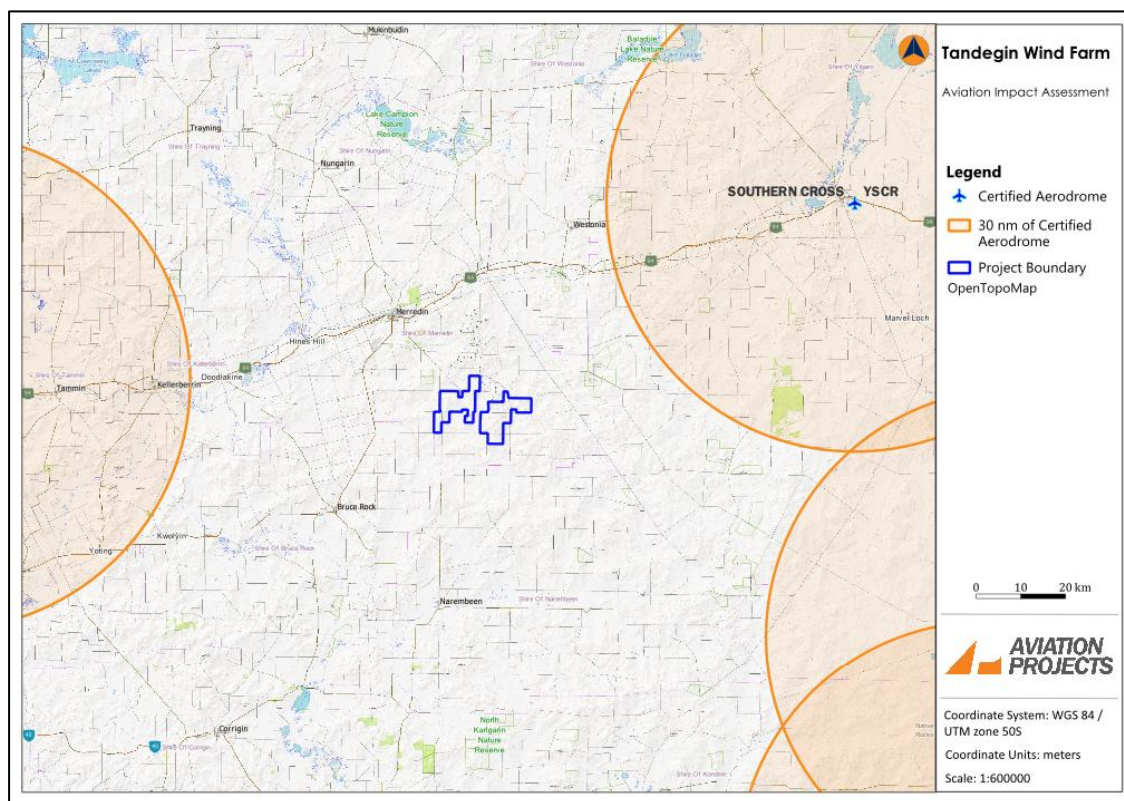


Figure 7 Location of Certified Airports in relation to Project Site

6.3. Grid and Air routes LSALT

MOS 173 requires that the published lowest safe altitude (LSALT) for a particular airspace grid or air route provide a minimum of 1000 ft clearance above the controlling (highest) obstacle within the relevant airspace grid or air route tolerances.

6.3.1. Grid LSALT

The WTGs would be located within the Grid LSALT of 914.4 m AHD (3000 ft AMSL) with a protection surface of 609.6 m AHD (2000 ft AMSL).

Figure 8 shows the grid LSALT in proximity to the project site (source: ERC Low National, OzRunways, Open TopoMap).

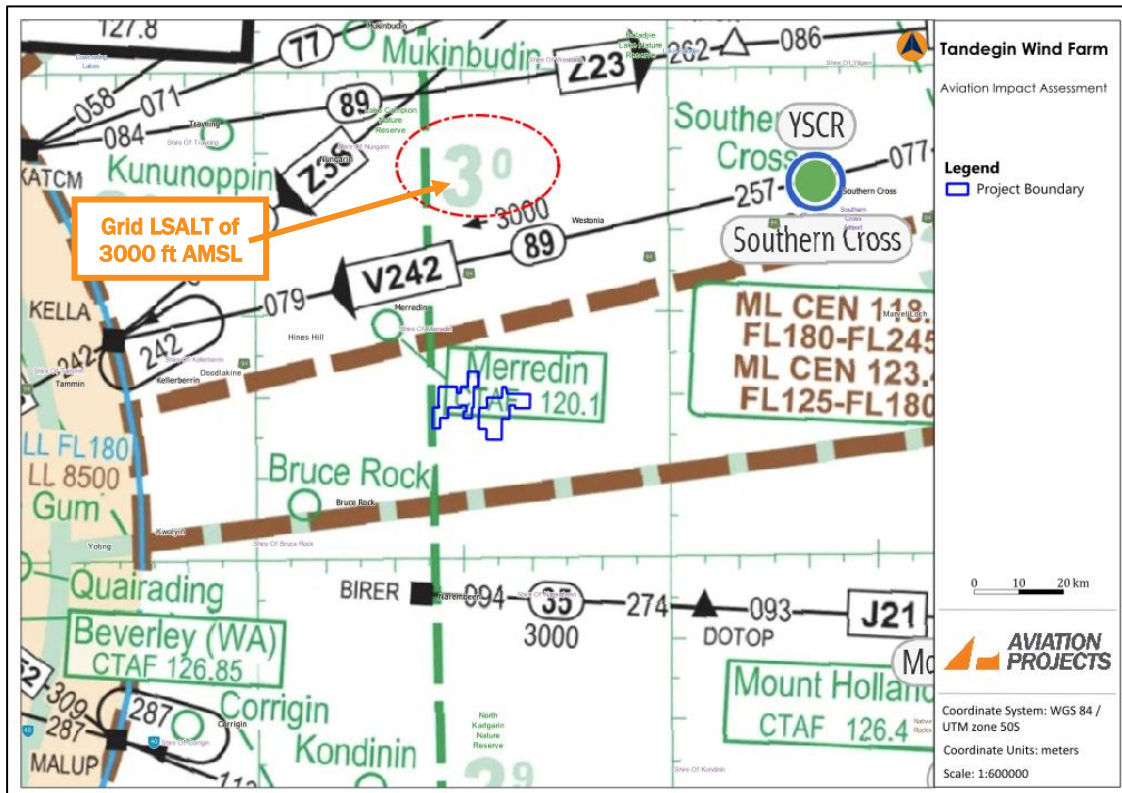


Figure 8 Grid LSALT in proximity to the project site

The highest WTG (WTG 28) would be 679.2 m AHD (2228.3 ft AMSL). It will be higher than the 3000 ft obstacle height limit by 69.6 m (228.3 ft). An impact analysis of the LSALTs applicable to the Project Site is provided in Table 2.

Therefore, the WTGs would impact the Grid LSALT of 3000 ft AMSL, which needs to be raised by 300 ft to 3300 ft AMSL.

Table 2 LSALT analysis

LSALT (ft AMSL)	Protection surface (ft AMSL)	Impact on airspace design	Potential solution	Impact on aircraft ops
3000	2000	The project impacts the surface by at least 228.3 ft	Raise LSALT by 300 ft to 3300 ft.	Minor

6.3.2. Air Route LSALTs

A protection area of 7 nm laterally on either side of an air route is used to assess the LSALT for the air route.

There are no air routes within 7 nm of the project site. Therefore, the Project Site would not impact any air route LSALT

6.4. Airspace Protection

The project site is located beneath Controlled Airspace A and C's vertical limit. Therefore, the project is within Class G airspace and outside of controlled airspace. The site is not located in any Prohibited areas, Danger areas, or Restricted Areas.

The Project will not affect controlled or designated airspace.

6.5. Aviation facilities

NASF Guideline G (Protection Aviation Facilities - Communication, Navigation and Surveillance (CNS)) and Part 139 MOS 2019 specify the area where the development of buildings and structures has the potential to cause unacceptable interference to CNS facilities.

The project site is located a sufficient distance away from nearby certified airports and aviation facilities and will not have an impact.

6.6. ATC Radar installations

Airservices Australia requires an assessment of the potential for the WTGs to affect the radar line of sight. The three closest radar facilities to the project site are:

- Kalamunda RSR is located approximately 220 km west.
- Perth PSR / SSR are located approximately 228 km west.

EUROCONTROL guidelines for assessing the potential impact of wind turbines on radar surveillance sensors stipulate the following assessment requirements:

Primary Surveillance Radar (PSR)

- Zone 1 0-500 m: Not permitted
- Zone 2 500 m – 15 km: Detailed assessment
- Zone 3: Further than 15 km but within maximum instrumented range and in radar line of sight: Simple assessment
- Zone 4: Anywhere within maximum instrumented range but not in radar line of sight or outside the maximum instrumented range: No assessment.

Secondary Surveillance Radar (SSR)

- Zone 1: 0 - 500 m: Not permitted
- Zone 2: 500 m - 16 km but within maximum instrumented range and in radar line of sight: Detailed assessment
- Zone 4: Further than 16 km or not in radar line of sight: No assessment.

(Zone 3 is not established for secondary surveillance radar)

The project site is outside the line-of-sight range of those radars and will not impact those facilities.

6.7. AIS Summary

Based on the WTG layout and maximum blade tip height of up to 261 m AGL, the blade tip elevation of the highest WTG, which is WTG T28, will not exceed 679.2 m AHD (2228.3 ft AMSL) and:

- There are no certified airports located within 30 nm (56 km) of the Project Site.
- The WTGs would impact the Grid LSALT 3000 ft AMSL, which needs to be raised to 3300 ft AMSL.
- The WTGs would not impact any air route LSALT.
- The project site would be located within Class G airspace and outside all controlled airspace, Prohibited, Restricted, and Danger areas.
- The WTGs would not impact aviation navigation facilities.
- The WTGs would not impact the ATC radar systems.
- The WTGs must be reported to CASA, and construction details must be provided to Airservices.

7. UNCERTIFIED AERODROMES

Uncertified aerodromes are not required to be listed or notified to CASA or Airservices Australia, leading to the potential for incomplete data regarding their operations and exact locations. They are not subject to CASR Part 139 regulations.

A search of aeronautical databases and publications was used to discover whether recognised uncertified aerodromes exist near the Project. The aviation datasets used for the search are:

- AIP aeronautical charts effective 09 July 2026
- OzRunways - which sources its data from Airservices Australia (AIP). The aeronautical data provided by OzRunways is approved under CASR Part 175

As a guide, an area of interest within a 3 nm radius of an uncertified aerodrome is used to assess the potential impacts of proposed developments on aircraft operations at or within the vicinity of the uncertified aerodrome. The 3 nm radius is considered to be the area in which aircraft are making preparations to join the circuit prior to landing and within which to manoeuvre after take-off to depart from the aerodrome.

Figure 9 Shows the location of nearby uncertified aerodromes relative to the project site and a nominal 3 nm buffer from the closer aerodrome (source: Open TopoMap).

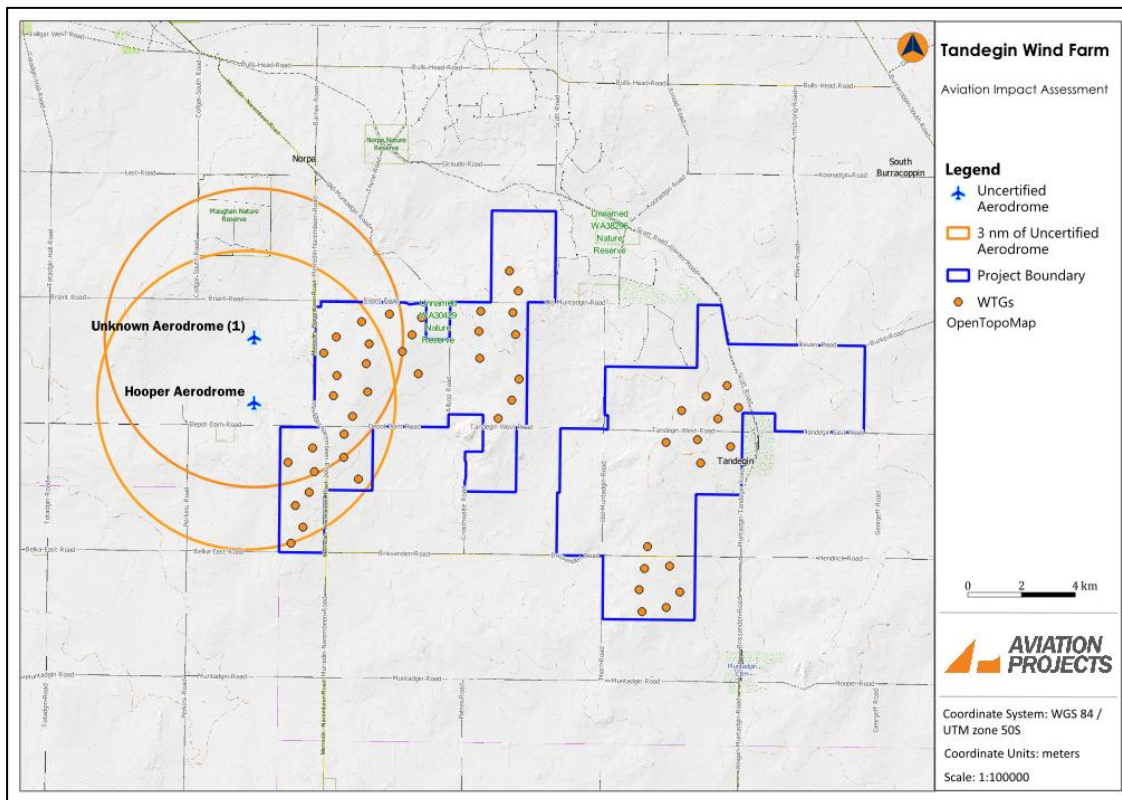


Figure 9 Uncertified aerodromes in the vicinity of the Project Site

Unknown Aerodrome (1) is identified through Google Earth satellite image. The Project Site is within a 3 nm radius of the aerodrome.

Collgar Renewables advised that another aerodrome, Hooper Aerodrome, is located close to the Project Site. The Project Site is within a 3 nm radius of the aerodrome.

7.1. Hooper Aerodrome

The Hooper Aerodrome is approximately 2.5 km west of the closest WTG. There is no information published about the uncertified aerodrome in aeronautical publications or publicly available information sources. Satellite imaging shows a potential runway, as shown in Figure 10 (Source: Google Earth).

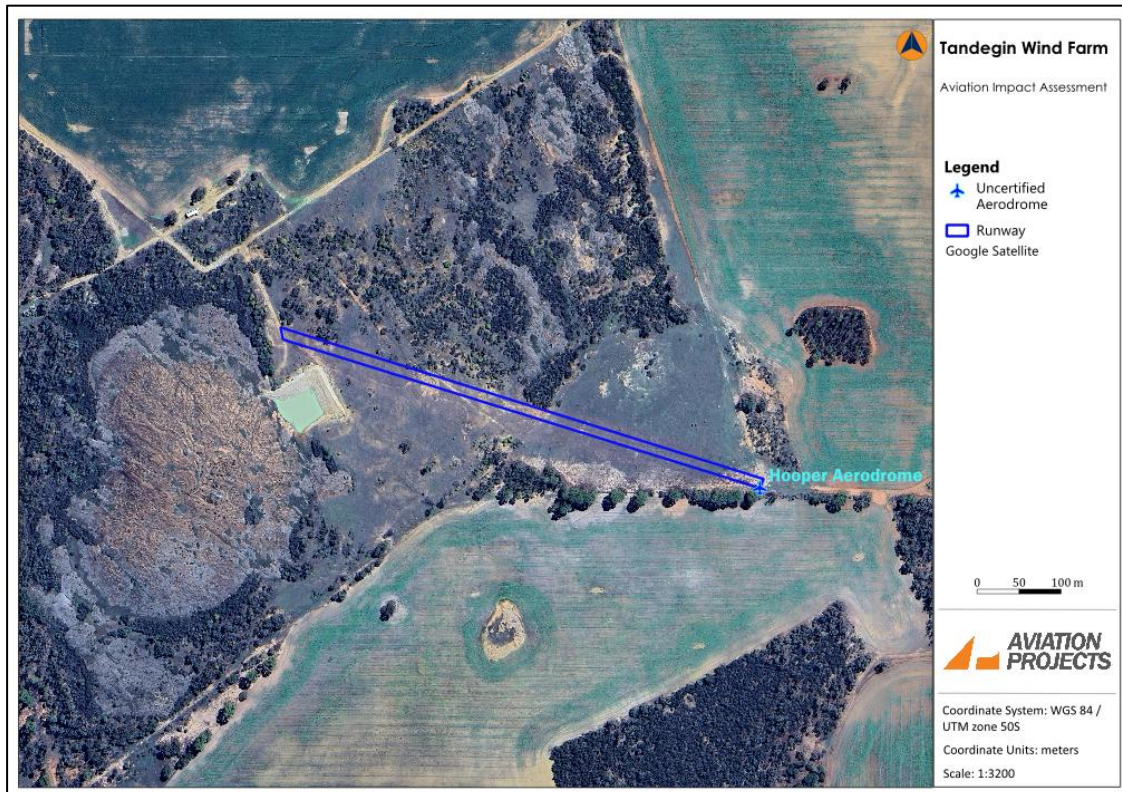


Figure 10 Close-up Google Earth image of Hooper Aerodrome's runway

Approximately 18 WTGs are proposed to be located within 3 nm of this aerodrome, as shown in Figure 11 (Source: Collgar, Open TopoMap).

Aircraft typically operate in circuit patterns when arriving and departing from an aerodrome. AC 91-10 'Operations in the vicinity of non-controlled aerodromes' describes the standard traffic circuit and heights at which aircraft should fly. This is shown in Figure 2 (Section 3.3.2).

In addition, various entry and departure procedures for aircraft joining and departing a standard traffic circuit are described. Figure 3 in Section 3.3.2 shows the standard arrival and joining procedures for a standard traffic circuit.

WTGs within a 3 nm radius of the aerodrome have similar ground elevations to the runway elevation. With maximum tip heights of 261 m/856.3 ft AGL, these WTGs would, therefore, be considered potentially hazardous obstacles for aircraft operating in the circuit area and would need to be considered by pilots intending to operate there to ensure that they can avoid them by prescribed margins.

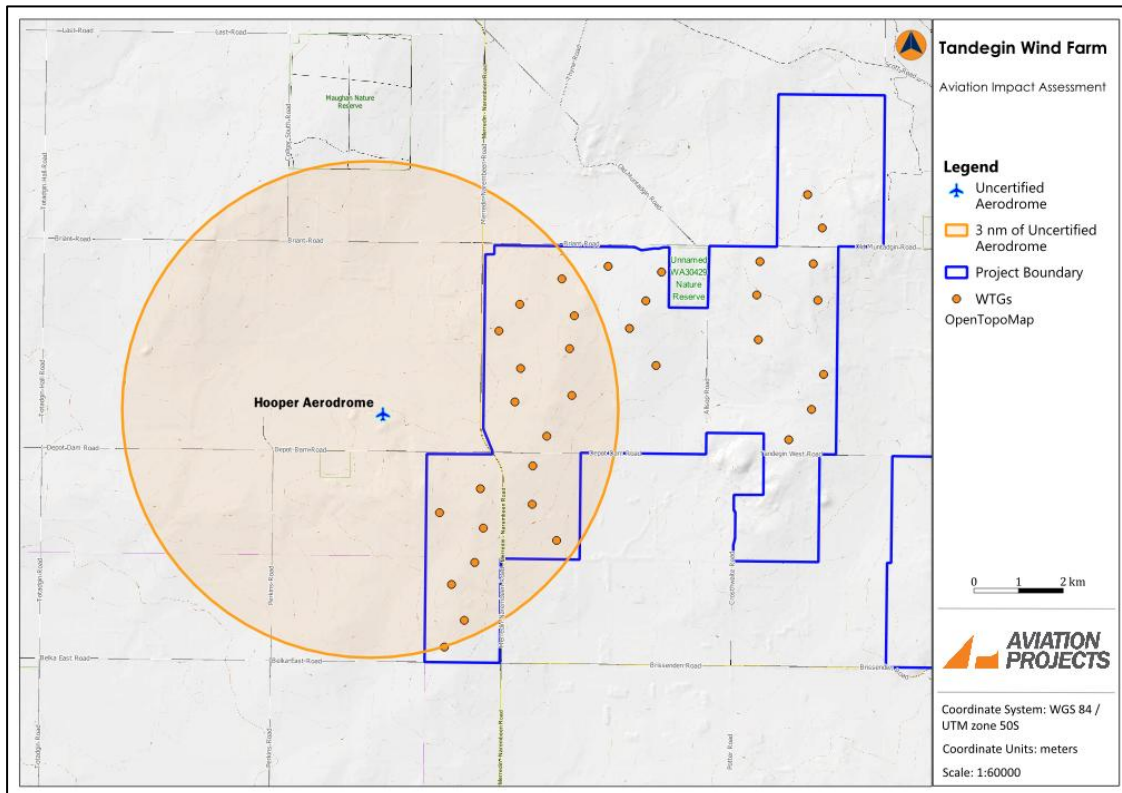


Figure 11 WTGs within 3 nm of Hooper Aerodrome

WTGs within 3 nm of the aerodrome that could be considered potentially hazardous obstacles are shown in Figure 12 (Source: Collgar, Open TopoMap). Consultation with the landowner would be required to determine the type of flight operations normally conducted there.

The standard circuit described in AC-91-10 normally consists of 5 'legs; upwind, crosswind, downwind, base and final.

The upwind leg is maintained after take-off until the aircraft reaches at least 500 ft above the runway before turning left and continuing to climb to circuit altitude. It normally takes 1 nm to climb to 500 ft and in any case a pilot can turn prior to 500 ft to avoid obstacles or high terrain.

The aircraft continues climbing to circuit altitude and this is usually reached during the crosswind leg or early in the downwind leg.

The normal circuit altitude maintained on the downwind leg is 1000 ft above the aerodrome for light aircraft or 500 ft for ultralight aircraft.

The pilot selects a point on the downwind where they turn onto the base leg, commence descent to position the aircraft on a slope that ensures they can reach the runway on a slope that allows them to land in the initial part of the runway and to avoid any obstacles such as trees and fences in close proximity to the runway end.

The downwind leg spacing is usually within 1 nm of the runway or closer, to allow the aircraft to reach the runway in the event of an engine failure.

A straight-in approach can be conducted if terrain and obstacle allow a normal descent profile to the runway. If a straight-in approach is not practical, then a standard circuit should be flown. Pilots need to be aware of the wind strength and direction prior to making a decision about which runway to land on so they would normally

overfly the aerodrome to observe a wind sock or other features that would indicate wind speed and direction to enable to aircraft to land as close to into-wind as possible.

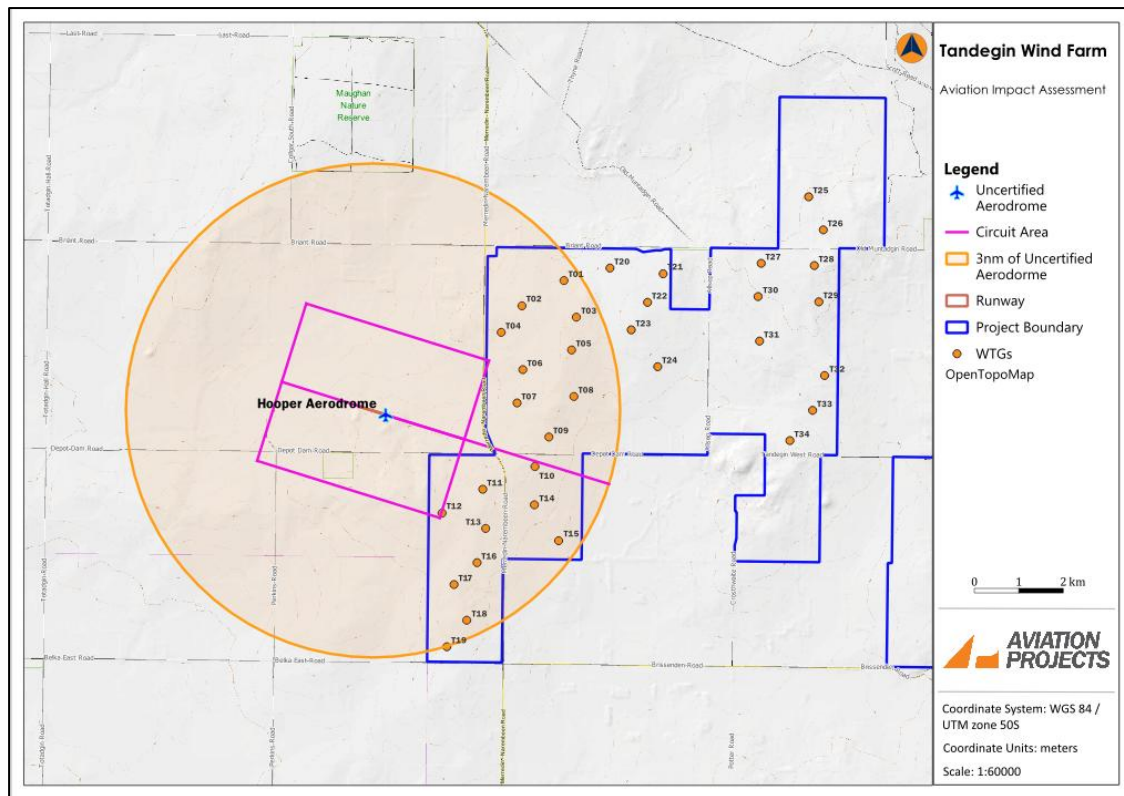


Figure 12 WTGs in relation to circuit operation of Hooper Aerodrome

There are no WTGs within the 1 nm circuit operation area of the aerodrome; however, WTG T12 would be very close to the edge of the circuit operation, and a few WTGs would be located close to the straight-in approach path.

Uncertified aerodromes do not have the same regulatory status and protections as certified aerodromes. Potential impacts upon an uncertified aerodrome caused by a wind farm would not preclude the regulatory approval of the wind farm under the Position Statement. However, it is highly recommended that any wind farm be designed to avoid, minimise, and/or mitigate impact(s) on private aerodromes.

Consultation with the landowner has been undertaken. The aerodrome has been used occasionally for recreational flying only. From the owner's perspective, the risk associated with the proposed wind turbine locations is low. The landowner noted that the turbines are sufficiently distant from the airstrip and would be highly visible, making them easy to avoid during flight operations. And the owner also confirmed that he only flies during daylight hours.

7.2. Unknown Aerodrome (1)

The Unknown Aerodrome is approximately 2.6 km west of the closest WTG. There is no information published about the uncertified aerodrome in aeronautical publications or publicly available information sources. Satellite imaging shows a prepared runway, as shown in Figure 13 (Source: Google Earth).



Figure 13 Close-up Open TopoMap image of Unknown Aerodrome (1)'s runway

Approximately 16 WTGs are proposed to be located within 3 nm of this aerodrome, as shown in Figure 14 (Source: Collgar, Open TopoMap).

There are no WTGs within the 1 nm circuit operation area of the aerodrome. Consultation with the landowner is recommended to determine their use of the aerodrome and identify a mitigation solution.

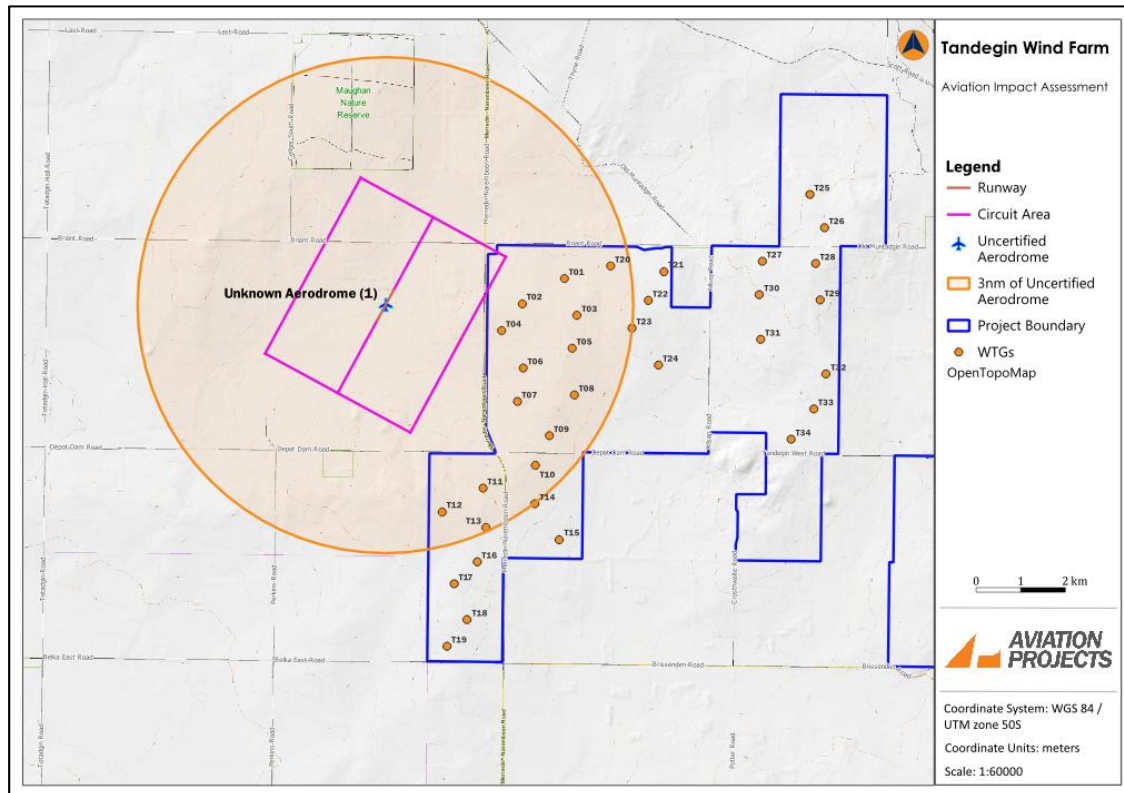


Figure 14 WTGs in relation to the circuit operation of Unknown Aerodrome (1)

8. POTENTIAL WAKE TURBULENCE IMPACTS

National Airports Safeguarding Framework (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 WMTs.

NASF Guideline D provides guidance regarding WTG wake turbulence which 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 150 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 key wording in the NASF guidance is “noticeable” and that “the level of turbulence in the vicinity is not known with certainty.”

There are many situations in aviation where pilots “notice” their aircraft moving away from the desired flight path or altitude and take appropriate action to maintain control of the aircraft with minimal input.

Pilot training standards are regulated by CASA to ensure that all qualified pilots have demonstrated to a suitably qualified and authorised check pilot that they can maintain control of their aircraft along the chosen flight path, across a significant range of atmospheric conditions that cause the aircraft to deviate from the pilot’s chosen flight path.

Aircraft are designed to withstand a significant variation in atmospheric disturbances to ensure airframe integrity is maintained. The limits of the airframe’s integrity are known by the pilot and considered in every flight activity. Significant weather events such as thunderstorms are avoided because of the likelihood of airframe limits being exceeded by the strong wind shear type conditions within, beneath and surrounding thunderstorm cells.

WTGs have been assessed in a limited number of studies, in which the highest classification of hazard is considered to be medium only within approximately 7 rotor diameters (RD) downwind of the wind turbine. There are no assessments that consider that the downwind turbulence is significant and outside the ability of the aircraft to endure the impacts and for the pilot to be able to control the aircraft using normal control inputs.

There also have been no reported aircraft accidents or incidents involving an aircraft encounter with the turbulence downwind of a WTG.

Assessment

A 182 m rotor diameter has been used for the wake turbulence analysis. Based on this scenario, NASF Guideline D suggests the effects of wake turbulence could be noticeable from the WTGs within 2912 m of the runway and the nominal circuit area, depending on wind direction.

Based on the results of published scientific studies which indicate that any medium level of turbulence would in most circumstances be confined to within 7 rotor diameters of a WTG, Aviation Projects considers that a conservative area of 10 rotor diameters is likely to be the maximum area where wake turbulence from WTGs would be noticed by pilots of light aircraft operating downstream of a WTG.

These studies also indicated that where any such turbulence is experienced, the pilot would be able to control the aircraft using normal control inputs.

Two of those studies are referred to below.

The European Academy of Wind Energy published an open access report titled “Do wind turbines pose roll hazards to light aircraft?” dated 2 November 2018. This study concluded:

In neutral conditions, the largest of these hazards are classified as medium hazards and exist 6.5 D downwind of the turbine in the bottom-left portion of the rotor disk. The highest hazards in the stable case also remained within the medium threshold and are located in two separate regions of the wake: approximately 4 D downwind in the bottom-right quadrant of the rotor and 6 D downwind in the top-left quadrant of the rotor.

The United Kingdom (UK) Civil Aviation Authority commissioned the University of Liverpool to conduct a *Wind Turbine Wake Encounter Study*, the results of which were published in March 2015.

At University of Liverpool, a full CFD method [4] was used with the HMB solver to study wind turbine wakes. The CFD results showed good agreement for the blade surface pressure distributions and flow field velocities with the wind tunnel measurements. The wake was then solved on a very fine mesh able to capture the wake vortices up to 8 radii downstream of the blades on the MEXICO wind turbine rotor.

In general, the LIDAR measurements captured the regular wake mean velocity patterns. Statistic LIDAR data indicate that the effects of wind turbine rotor wake, in term of velocity deficit, are limited within a downwind distance of 5D. This is generally in agreement with the results of the full CFD method and the velocity deficit models.

For a wind turbine with size similar to the WTN250, and using the Beddoes circulation formula, the off-line simulation results indicate that the wind turbine wake did not pose any hazards to the encountering aircraft 5 diameters further from the wind turbine. The dominant upset that the wake generated is a yawing moment on the aircraft. The wake generated crosswind, is smaller than the maximum crosswind of 17.75 ft/s for an airport (codes A-I or B-I) that is expected to accommodate single engine aircraft. These conclusions are in line with that found in the piloted flight simulation.

These two studies are the only major studies of their kind.

Wind farm designers and developers recognise the impact of downwind changes in wind strength and direction when designing the overall wind farm to ensure that the WTGs are located at minimum distances from each other in order to prevent turbulence from one or more WTGs affecting the operational efficiency of a downwind WTG or causing damage to the downwind WTG blades. The minimum distance between WTGs typical wind farms is approximately 800 m, a significantly shorter distance than either 16 RD or 10 RD presents.

The turbulence from a WTG could be described as a shear type turbulence which is caused by the difference of the free flow wind speed at the edge of the WTG rotor (the blade tip) being disrupted by the WTG blade being rotated by the wind and altering the wind speed within the rotor diameter moving downwind from the WTG. This shear type turbulence descends and weakens as it gets further away from the WTG. It is not a stream of turbulence being generated by the blades being turned by a mechanical force such as occurs with an aircraft propeller or ceiling fan in a house or factory.

The WTG blades change pitch, dependent on the wind strength, to maintain a constant rotor speed. They interfere with the natural wind flow and cause some degree of turbulence downwind of the WTG. A consistent theme among the studies was that the higher turbulence exists very close to the WTG and rapidly dissipates due to the effect of convection, mechanical turbulence from other sources such as the wind flowing over trees, buildings and terrain undulations.

The studies indicate that turbulence is likely to dissipate below a level that could be felt by pilots within 7 rotor diameters (RD) from the WTG. Aviation Projects considers that a more conservative value of 10 RD is best used to assess areas where the likely turbulence created downwind of a WTG would not be felt by or impact pilots of light aircraft.

The studies referenced above also indicate that aircraft controllability is maintained when experiencing the likely turbulence when the aircraft is approximately 6 RD from a WTG.

Table 3 Wake Turbulence Distances

1 RD (m)	7 RD (m)	10 RD (m)	16 RD (m)
182	1274	1820	2912

In conditions of high wind speed the WTGs are “parked” with the blades in a “feathered” condition to reduce the wind impact upon them. Turbulence from the “feathered” blades still exists but would be less than when the WTG is rotating. Other mechanical turbulence generated by trees, hills and other objects during high winds would significantly exceed and break up any minor turbulence from a stationary WTG.

Aircraft are designed to withstand significant turbulence according to aviation meteorological standards that are recognised and accepted worldwide. Even in recent circumstances with an airliner experiencing severe turbulence which injured passengers, the aircraft was controllable (except for the first part of the event where it descended rapidly) and has not suffered any significant damage (although it will undergo a major inspection). It was an encounter with severe turbulence far greater than normally experienced and is avoided wherever areas of severe turbulence is forecast or known to exist.

The downwind turbulence from WTGs beyond 7 RD may be felt by the pilot of a light aircraft but the pilot will only need to make minor control adjustments to maintain control of the aircraft’s attitude, altitude and heading. Such turbulence is likely to be classified as Light on an intensity scale published by the Australian Bureau of Meteorology shown in Figure 15.

Within the 7 RD boundary the turbulence is considered to create a medium hazard which is likely to equate to pilots experiencing “Moderate” turbulence in which the “*Pilot remains in control at all times.*” (Figure 15)

Intensity	Airspeed Fluctuations (kt/s)	Vertical Gust (ft/s)	G Load	Aircraft Reaction	Reaction Inside Aircraft
Light	5 – 14	5 - 19	0.15 – 0.49	Momentary slight and erratic changes in attitude and/or altitude. Rhythmic bumpiness.	Little effect on loose objects.
Moderate	15 – 24	20 - 35	0.50 – 0.99	Appreciable changes in attitude and/or altitude. Pilot remains in control at all times. Rapid bumps or jolts.	Unsecured objects move. Appreciable strain on seatbelts.
Severe	≥ 25	36 -49	1.0 – 1.99	Large abrupt changes in attitude and/or altitude. Momentary loss of control.	Unsecured objects are tossed about.
Extreme	≥ 25	≥ 50	> 2.0	Very difficult to control aircraft. May cause structural damage.	Occupants violently forced against seatbelts.

Figure 15 Turbulence intensities¹

¹ Bureau of Meteorology – Hazardous Weather Phenomena – Turbulence

Light and moderate turbulence can be generated by lines of trees near runways.

Turbulence may disturb an aircraft's attitude about its major axis, and cause rapid bumps or jolts to be experienced, but in most cases it does not significantly alter the aircraft's flight path. ²

Adverse turbulence from any source is most critical during initial climb after take-off until the aircraft is established in a climb and at the appropriate speed, and during final approach where the aircraft is configured for landing and operating at a slow speed prior to landing. The research studies indicate that adverse or severe turbulence is not created by WTGs outside the 5 RD distance.

8.1. Hooper Aerodromes

Figure 16 shows the relevant boundary WTGs and their respective 10 RD (1820 m) as circles in relation to the Hooper Aerodrome (sources: Collgar, Open TopoMap).

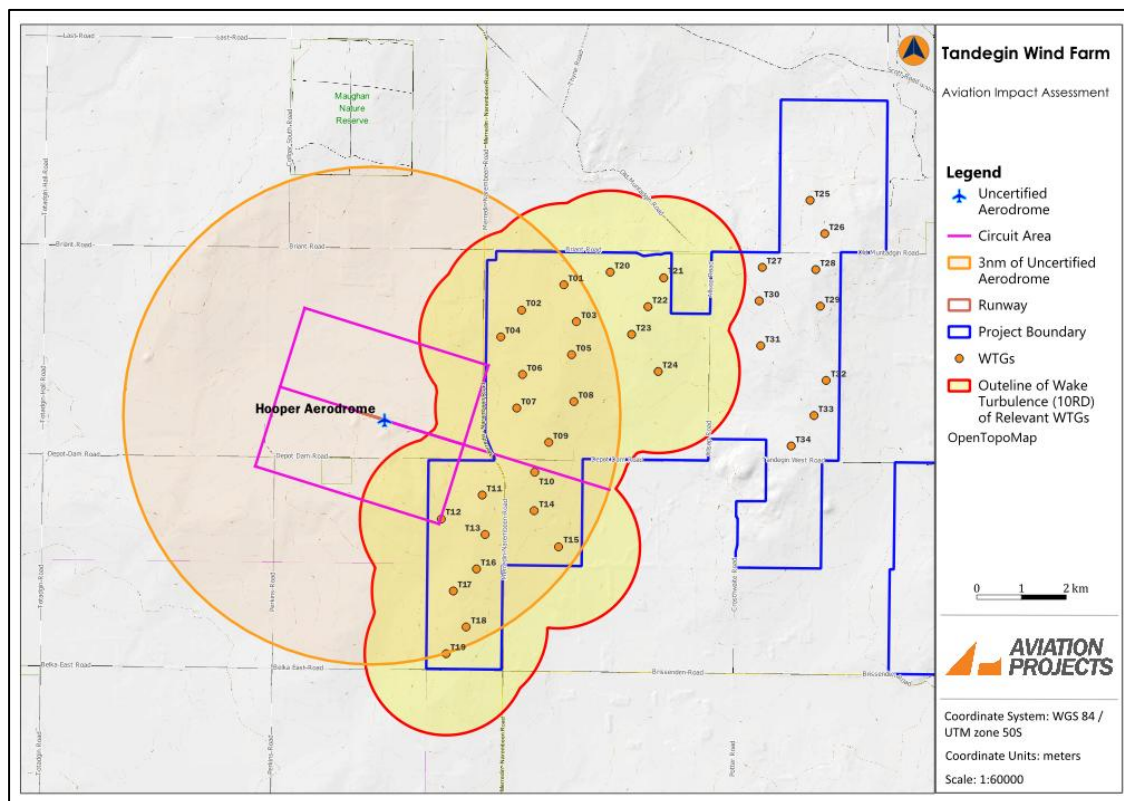


Figure 16 Possible extent of wake turbulence from WTGs in relation to Hooper Aerodrome

When the wind blows from the east, downstream wake turbulence from the closest WTGs will extend into the circuit area of the Hooper Aerodrome.

Consultation with the landowner has been undertaken. The aerodrome has been used occasionally for recreational flying only. From the owner's perspective, the risk associated with the proposed wind turbine locations is low.

² Bureau of Meteorology – Hazardous Weather Phenomena – Turbulence

8.2. Unknown Aerodrome (1)

Figure 17 shows the relevant boundary WTGs and their respective 10 RD (1820 m) as circles in relation to the Unknown Aerodrome (1) (sources: Collgar, Open TopoMap).

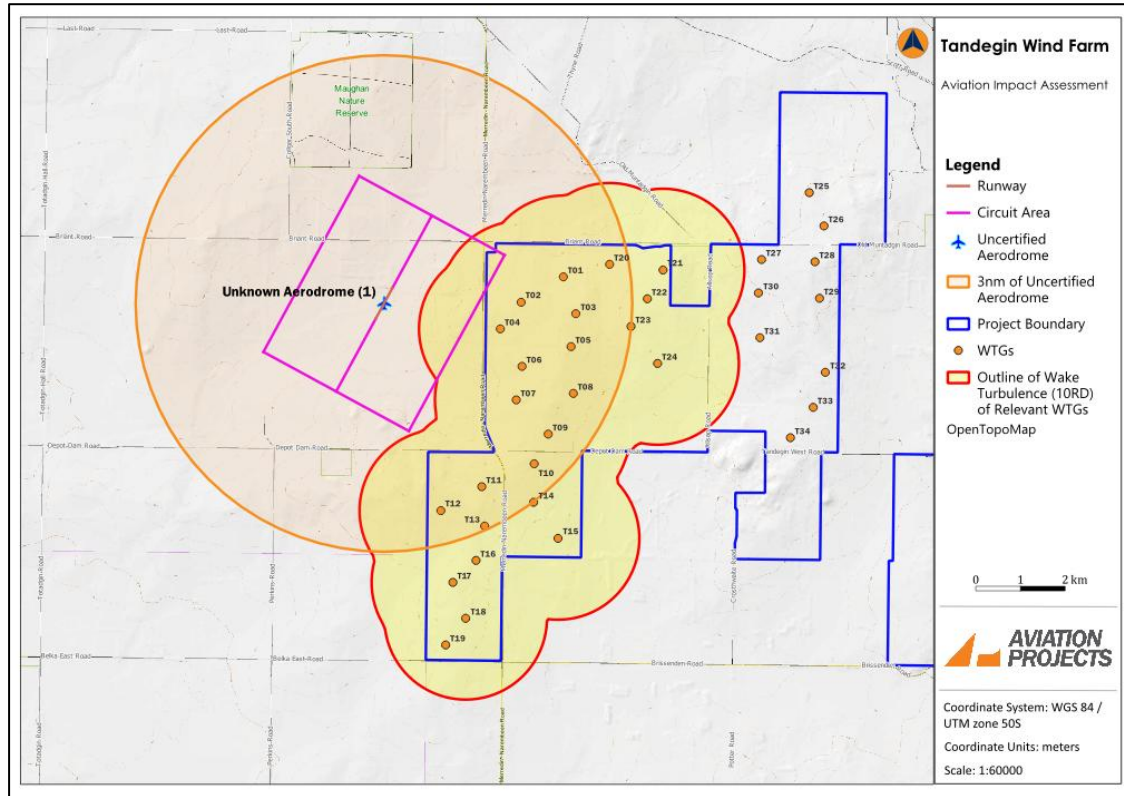


Figure 17 Possible extent of wake turbulence from WTGs in relation to Unknown Aerodrome (1)

When the wind blows from the east, downstream wake turbulence from the closest WTGs will extend into the circuit area of the Unknown Aerodrome (1).

Further consultation with the owner/operator of this aerodrome would be beneficial in understanding the potential extent of these impacts.

9. HAZARD LIGHTING AND MARKING

Based on the risk assessment set out in Section 11 It is concluded that aviation lighting is not likely to be required.

For completeness, relevant lighting standards and guidelines are summarised in Annexure 3.

Once the details of the wind farm, along with this report, are provided by the planning authority to CASA, CASA is likely to recommend obstacle lighting be fitted to sufficient obstacles to delineate the outline of the wind farm and the highest WTGs within it.

WA Department of Fire and Emergency Services normally recommends aviation obstacle lighting and markings be placed on the wind farms to protect emergency services aviation aircraft

10. 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.

10.1. 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.

10.2. 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.

10.3. National aviation occurrence statistics 2010-2019

The Australian Transport Safety Bureau (ATSB) published a summary of aviation occurrence statistics for the period 2010-2019 (AR-2020-047, Final - 4 November 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, and a further 154 aircraft involved in serious incidents (an incident with a high probability of becoming an accident). In 2019 there were 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 General Aviation sub-category – 2010 to 2019

<i>Sub-category</i>	<i>Aircraft assoc. with fatality</i>	<i>Fatalities</i>	<i>Fatalities to aircraft ratio</i>
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 18 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.

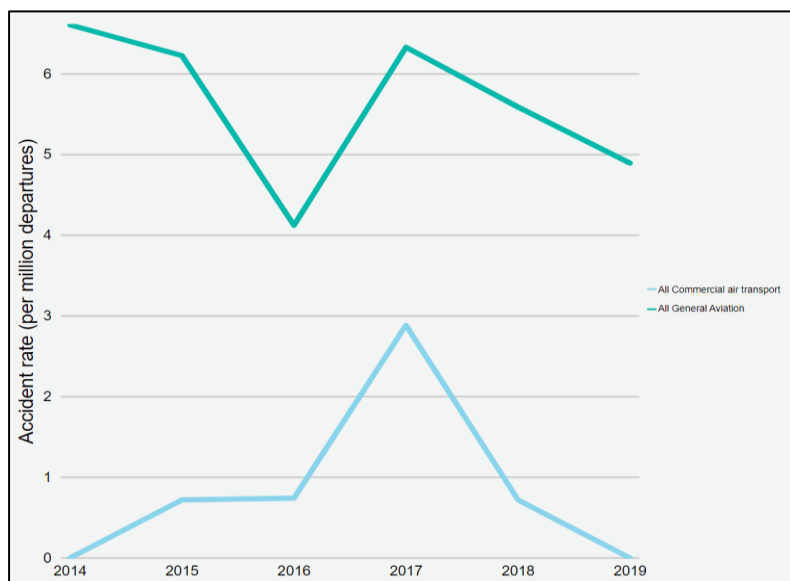


Figure 18 Fatal Accident Rate (per million departures) by Operation Type

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

<i>Sub-category</i>	<i>Fatal accidents</i>	<i>Fatalities</i>
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
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 WTG or a WMT in Australia.

Of the 20,529 incidents, serious incidents and accidents in GA operations in the 10-year period, 1,404 (6.83%) were terrain collisions.

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

10.4. Worldwide accidents involving wind farms

Worldwide since aviation accident statistics have been recorded, there have been a total of 5 aviation accidents involving a wind farm (i.e. where WTGs were erected). To provide some perspective on the likelihood of a VFR aircraft colliding with a WTG, a summary of the 5 accidents and the relevant factors applicable to this assessment is incorporated in this section.

Based on the statistics set out in the Global Wind Energy Council (GWEC) report 2023, approximately 77.6 GW of wind power had been installed worldwide around the world at the end of 2022.

Based on the Australia's Clean Energy Council statistics there were 110 wind farms in Australia as of 2023. 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.

The 5 recorded aviation accidents involving a wind farm are summarised as follows:

- One accident occurred in Texas, United States in October 2019 resulting in minor aircraft damage no injury to the pilot and significant injury to a person on the ground. The aircraft, an Air Tractor AT502, was returning from a local aerial application flight and was flown deliberately at low-level in close vicinity to a wind turbine generator (WTG) because the pilot believed his friend was working on the turbine. The aircraft collided with a tagline rope that was attached to a blade of the WTG and which was being held by a person working on the ground. The worker was thrown about 20 ft in the air and experienced significant non-life-threatening injuries. The aircraft sustained minor damage however the pilot landed the aircraft without further incident.
- One accident, which resulted in 2 fatalities, occurred in Palm Springs in 2001. This accident involved a wind farm but was not caused by the wind farm. The cause of the accident was the 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 above a wind farm, and the aircraft struck a WTG on its descent and therefore the cause of the accident was not attributable to the wind farm and not applicable to this AIA.
- Two accidents involving collision with a WTG were during the day, as follows:
 - One accident occurred in Melle, Germany in 2017 as the result of a collision with a WTG mounted on a steel lattice tower at a very low altitude during the day with good visibility and no cloud. The accident resulted in one fatality. If the tower was solid and painted white, as is standard on contemporary wind farms, then it more than likely would have been more visible than if it were to be equipped with an obstacle light which in all likelihood would not have been operating during daylight with good visibility conditions.
 - One accident occurred in Plouguin, France in 2008 when the pilot decided to descend below cloud in an attempt to find the destination aerodrome. The aircraft was flying in conditions of significantly reduced horizontal visibility in fog where the top of the WTGs were obscured by cloud. The WTGs became visible too late for avoidance manoeuvring and the

aircraft made contact with two WTGs. The aircraft was damaged but landed safely. No fatalities were recorded.

- In both of the above cases, it is difficult to conclude that obstacle lighting would have prevented the accidents.
- One fatal accident, near Highmore, South Dakota in 2014 occurred at night in Instrument Meteorological Conditions (IMC).

There is one other accident mentioned in a database compiled by an anti-wind farm lobby group (wind-watch.org), which suggests a Cessna 182 collided with a WTG 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. For this particular accident, NTSB found that the probable cause of the accident was VFR 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 in the NTSB database is made of WTGs or a wind farm.

11. 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**.

11.1. Risk Identification

The primary risk being assessed is aviation safety associated with the height and location of WTGs and WMTs proposed by the Project.

Based on an extensive review of accident statistics data (see summary in Section 8 above) and stakeholders who were consulted during the preparation of this AIA (see Section 5), 4 identified risk events associated with WTGs and WMTs relate to aviation safety or potential visual impact, and are listed as follows:

1. Potential for an aircraft to collide with a WTG, controlled flight into terrain (CFIT) (related to aviation safety).
2. Potential for a pilot to initiate manoeuvring in order to avoid colliding with a WTG or WMT resulting in collision with terrain (related to aviation safety).
3. Potential for the hazards associated with the Project to invoke operational limitations or procedures on operating crew (related to aviation safety).
4. Potential effect of obstacle lighting on neighbours (related to potential visual impact).

It should be noted that according to guidance provided by the Commonwealth Department of Infrastructure Transport, Regional Development, Communications and the Arts (Airspace and Air Traffic Management Risk Management Policy Statement), and in line with generally accepted practice, the risk to be assessed should primarily be associated with passenger transport services. Therefore, the risk being assessed herein is primarily associated with smaller aircraft likely to be flying under the VFR, and so the maximum number of passengers exposed to the nominated consequences is likely to be limited.

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

11.2. 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 residual level of risk to an acceptable level.

A summary of the level of risk associated with the Project, under the proposed treatment regime, with specific consideration of the effect of obstacle lighting, is provided in Table 6 through to Table 9.

Table 6 Aircraft collision with wind turbine generator (WTG)

Risk ID:	1. Aircraft collision with wind turbine generator (WTG) (CFIT)
Discussion An aircraft collision with a WTG would result in harm to people and property damage. Property could include the aircraft itself, as well as the WTG. There have been 5 reported occurrences worldwide of aircraft collisions with a component of a WTG 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 WTG: - GA VFR aircraft operators generally don't individually fly a significant number of hours in total, let alone in the area in question. - There is a very small chance that a pilot, suffering the stress of weather, will continue into poor weather conditions (contrary to the rules of flight) rather than divert away from it, is not aware of the wind farm, will not consider it or will not be able to accurately navigate around it. - If the aircraft was flown through the wind farm, there is still a very small chance that it would hit a WTG. Refer to the discussion of worldwide accidents in Section 10. There are no known aerial application operations conducted at night in the vicinity of the Project site. 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 Project site is clear of any aerodrome's OLS.	
Consequence If an aircraft collided with a WTG, 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 5 reports of aircraft collisions with WTGs worldwide, which have resulted in a range of consequences, where aircraft occupants sustained minor injury in some cases and fatal injuries in others (see Section 11). Similarly, aircraft damage sustained ranged from minor to catastrophic. One of these accidents resulted from the structural failure of the aircraft before the collision with the WTG. Only two relevant accidents occurred during the day, and only one resulted in a single fatality. It is assessed that collision with a WTG resulting in multiple fatalities and damage beyond repair is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.	
	Untreated Likelihood Possible

Current Treatments (without lighting)

- The Project site is clear of any certified aerodrome's obstacle limitation surfaces (OLS).
- 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 300 m in visual flight during the day when not in the vicinity of built-up areas. The proposed WTGs will be a maximum height of 261 m (856.3 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 108.6 m (356.3 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft).
- In the event that a descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5,000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs.
- Aircraft are restricted to a minimum height of 304.8 m (1,000 ft) above obstacles (including terrain) which are within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).
- Aircraft authorised to intentionally fly below 152.4 m (500 ft) AGL (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities undertaken specifically for and prior to undertaking such authorised flights. Any obstacle including WTGs in the path of the authorised flight would be specifically risk assessed during that process.
- The WTGs are typically coloured white so they should be visible to pilots during the day.
- Final details of WTG coordinates and elevation should be provided to Airservices Australia at least two weeks prior to construction commencing, so that the location and height of all WTGs can be noted on aeronautical maps and charts.
- Because the Project WTGs are proposed to be above 100 m AGL, there is a statutory requirement to report the WTGs to CASA and notified to Airservices Australia prior to construction.

Level of Risk

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

Current Level of Risk	8 - Unacceptable
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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
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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 construction to heighten their awareness of its location and so that they can plan their operations accordingly. Specifically:

○ The final layout details of WTGs are required to be notified to Airservices Australia so that the location and height of all WTGs can be noted on aeronautical maps and charts. ○ Because the Project WTGs are proposed to be above 100 m AGL, there is a statutory requirement to report the WTGs to CASA and notified to Airservices Australia prior to construction ○ Engage with local aerial agricultural and aerial firefighting operators to develop procedures, which may include, for example, stopping the rotation of the WTG blades prior to the commencement of the subject aircraft operations within the Project site. ○ Arrangements should be made to publish details of the Project in ERSA for surrounding aerodromes, which would involve notification to Airservices Australia.	
Residual Risk With the implementation of the Recommended Treatments listed above, the likelihood of an aircraft collision with a WTG resulting in multiple fatalities and damage beyond repair will be Unlikely, and the consequence remains Catastrophic, resulting in an overall risk level of 7 - Tolerable. It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified. In the circumstances, the level of risk under the proposed treatment plan is considered as low as reasonably practicable (ALARP). It is our assessment that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a wind turbine, without obstacle lighting on the turbines of the Project.	
	Residual Risk 7 - Tolerable

Table 7 Harsh manoeuvring leading to controlled flight into terrain

Risk ID:	2. 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 WTG would result in harm to people and damage to property. There are a few ground collision accidents resulting from manoeuvring to avoid wind farms, but none in Australia, and all were during the day. The Project is clear of the 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 300 m in visual flight during the day when not in the vicinity of built up areas. The proposed WTGs will be a maximum of 261 m (856.3 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 108.6 m (356.3 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 WTGs. 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 WTGs are typically coloured white so they should be visible during the day. • Final details of WTG coordinates and elevation should be provided to Airservices Australia at least two weeks prior to construction commencing, so that the location and height of WTGs can be noted on aeronautical maps and charts. • Since the WTGs will be higher than 100 m AGL, there is a statutory requirement to report the WTG 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 WTGs, but none in Australia, and all were during the day (see Section 11). It is assessed that a ground collision accident following manoeuvring to avoid a WTG is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.		
Untreated Likelihood		Possible

Current Treatments (without lighting)

- The Project is clear of the 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 300 m in visual flight during the day when not in the vicinity of built-up areas.
- WTGs will be a maximum of 261 m (856.3 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 108.6 m (356.3 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 WTGs.
- The WTGs and masts will be shown on aeronautical charts at the next publication cycle date available and NOTAMS prior to the publication date. This allows pilots to be aware of the existence of the wind farm at the pre-flight planning stage and during flight with reference to the aeronautical chart.
- If cloud descends below the WTG 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 WTGs are typically coloured white, typical of most WTGs operational in Australia, so they should be visible during the day.
- Final details of WTG coordinates and elevation should be provided to Airservices Australia at least two weeks prior to construction commencing, so that the location and height of wind farms can be noted on aeronautical maps and charts.
- Since the WTGs will be higher than 100 m AGL, there is a statutory requirement to report the WTGs 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
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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
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Recommended Treatments

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

- The WTGs and masts will be shown on aeronautical charts at the next publication cycle date available and NOTAMS prior to the publication date. This allows pilots to be aware of the existence of the wind farm at the pre-flight planning stage and during flight with reference to the aeronautical chart
- The final layout details of WTGs are required to be notified to Airservices Australia so that the location and height of all WTGs can be noted on aeronautical maps and charts.
- Because the Project WTGs are proposed to be above 100 m AGL, there is a statutory requirement to report the WTGs to CASA and notified to Airservices Australia prior to construction
- Ensure details of the Project WTGs have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators prior to construction.
- Although there is no requirement to do so, the Proponent may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for their safe operation within the Project site..

Residual Risk

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

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

In the circumstances, the level of risk under the proposed treatment plan is considered **ALARP**.

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

Residual Risk

7 – Tolerable

Table 8 Effect of the Project on operating crew

Risk ID:	3. Effect of the Project on operating crew	
Discussion Introduction or imposition of additional operating procedures or limitations can affect an aircraft's operating crew. There are no known aerial application operations conducted at night in the vicinity of the Project site.		
Consequence The worst credible effect a wind farm could have on flight crew would be the imposition of operational limitations, and in some cases, the potential for use of emergency procedures. This would be a Minor consequence.		
Consequence		Minor
Untreated Likelihood The imposition of operational limitations is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.		
Untreated Likelihood		Possible
Current Treatments • The Project 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 300 m in visual flight during the day when not in the vicinity of built-up areas. • The WTGs and masts will be shown on aeronautical charts at the next publication cycle date available and NOTAMS prior to the publication date. This allows pilots to be aware of the existence of the wind farm at the pre-flight planning stage and during flight with reference to the aeronautical chart. • WTGs will be a maximum of 261 m (856.3 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 108.6 m (356.3 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 WTGs. • 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 WTGs. • 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 WTGs are typically coloured white so they should be visible during the day. - Final details of WTG coordinates and elevation should be provided to Airservices Australia at least two weeks prior to construction commencing, so that the location and height of wind farms can be noted on aeronautical maps and charts. - Since the WTGs will be higher than 100 m AGL, there is a statutory requirement to report the WTGs to CASA.	
Level of Risk The level of risk associated with a Possible likelihood of a Moderate consequence is 5.	
Current Level of Risk	5 - Tolerable
Risk Decision A risk level of 6 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
Recommended Treatments WMTs installed prior to WTG installation and those that are not in relatively close proximity to a WTG should be lit to ensure they are visible in low light and deteriorating atmospheric conditions. (see Risk ID: 2) The following additional treatments will provide an additional margin of safety: - The final layout details of WTGs are required to be notified to Airservices Australia so that the location and height of all WTGs can be noted on aeronautical maps and charts. - Because the Project WTGs are proposed to be above 100 m AGL, there is a statutory requirement to report the WTGs to CASA and notified to Airservices Australia prior to construction - Ensure details of the Project WTGs and WMTs have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators prior to construction. - Although there is no requirement to do so, the Proponent may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for such aircraft operations in the vicinity of the Project site.	
Residual Risk Notwithstanding the current level of risk is considered Tolerable , the additional Recommended Treatments listed above will enhance aviation safety. The likelihood remains Possible , and consequence remains Minor . In the circumstances, the risk level of 5 is considered Tolerable . 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, and with obstacle lighting both WMTs and WTG	
Residual Risk	5 – Tolerable

Table 9 Effect of obstacle lighting on neighbours

Risk ID:	4. 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 WTGs 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 (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 WTGs or WMTs will be higher than 150 m (492 ft) AGL, they must be regarded as obstacles unless CASA assess otherwise. In general, objects outside an OLS and above 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		
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

As per the above safety risk assessment, the provision of lighting for the WTGs and permanent WMTs is not necessary to provide an acceptable level of safety. For temporary WMTs installed prior to WTG installation and WMTs that are not in close proximity to a WTG, obstacle lighting is recommended to ensure visibility in low light and deteriorating atmospheric conditions.

If CASA or a planning authority decide that obstacle lighting is required there are impact reduction measures that can be implemented to reduce the impact of lighting on surrounding neighbours, including:

- Reducing the number of WTGs with obstacle lights
- Specifying an obstacle light that minimises light intensity at ground level
- Specifying an obstacle light that matches light intensity to meteorological visibility
- Mitigating light glare from obstacle lighting through measures such as baffling.

These measures are designed to optimise the benefit of the obstacle lights to pilots while minimising the visual impact to residents within and around the Project site.

Consideration may be given to activating the obstacle lighting via a pilot activated lighting system.

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

Not installing obstacle lights would clearly be an acceptable outcome to those potentially affected by visual impact.

If lighting is required, consideration of visual impact in the lighting design should enable installation of lighting that reduces the impact to neighbours.

The likelihood of a **Moderate** consequence remains **Likely**, with a resulting risk level of **7 – Tolerable**.

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
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12. CONCLUSIONS

The key conclusions of this AIA are summarised as follows:

12.1. Planning considerations

The Project, as proposed, satisfies the planning provisions and will not create incompatible intrusions or compromise the safety of existing airports and associated navigation and communication facilities.

12.2. Aviation Impact Statement

Based on the WTG layout and maximum blade tip height of up to 261 m AGL, the blade tip elevation of the highest WTG, which is WTG T28, will not exceed 681.2 m AHD (2234.9 ft AMSL) and:

- There are no certified airports located within 30 nm (56 km) of the Project Site.
- The WTGs would impact the Grid LSALT 3000 ft AMSL, which needs to be raised to 3300 ft AMSL.
- The WTGs would not impact any air route LSALT.
- The project site would be located within Class G airspace and outside all controlled airspace, Prohibited, Restricted, and Danger areas.
- The WTGs would not impact aviation navigation facilities.
- The WTGs would not impact the ATC radar systems.
- The WTGs must be reported to CASA, and construction details must be provided to Airservices.

12.3. 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.

Aircraft flying at night in visual conditions are permitted to descend or climb to or from an appropriate minimum altitude when within 3 nm of the aerodrome. The existence of WTGs within the 3 nm area would require careful consideration of flight paths in the vicinity of the Hooper Aerodrome and Unknown Aerodrome (1), which would likely cause some flight restrictions in that area

WTGs are generally not a safety concern to aerial agricultural operators.

12.4. Hazard marking and lighting

The following conclusions apply to hazard marking and lighting:

- With respect to CASR Part 139 Division 139.E., the proposed WTGs must be reported to CASA.
- CASA will review the proposed WTG development and make a recommendation for obstacle lighting if required.
- With respect to marking of WTGs, an off-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.

12.5. Summary of risks

A summary of the level of residual risk associated with the Project with the Recommended Treatments implemented, is provided in Table 10.

Table 10 Summary of Residual Risks

<i>Identified Risk</i>	<i>Consequence</i>	<i>Likelihood</i>	<i>Risk</i>	<i>Actions Required</i>
Aircraft collision with wind turbine generator (WTG)	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Communicate details of the Project WTGs to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction.
Avoidance manoeuvring leads to ground collision	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Communicate details of the Project WTGs and WMTs 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) Communicate details of the Project WTGs and WMTs 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). If lights are installed, design to minimise impact.

13. RECOMMENDATIONS

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

Notification and reporting

1. Details of WTGs 100 m or more AGL must be reported to CASA as soon as practicable after forming the intention to construct or erect the proposed object or structure, in accordance with CASR Part 139.165(1)(2). The notification should be provided to CASA via email to Airspace.Protection@casa.gov.au.
2. Final details of WTG coordinates and elevation should be provided to Airservices Australia at least two weeks prior to construction commencing, by submitting the form at this webpage: https://www.airservicesaustralia.com/wp-content/uploads/ATS-FORM-0085_Vertical_Obstruction_Data_Form.pdf to the following email address: vod@airservicesaustralia.com
3. Any obstacles 100 m or more AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents. With respect to crane operations during the construction of the Project, a notification to the NOTAM office may include, for example, the following details:
 - a. The planned operational timeframe and maximum height of the crane; and
 - b. Either the general area within which the crane will operate and/or the planned route with timelines that crane operations will follow.
4. Details of the wind farm should be provided to local and regional aircraft operators prior to construction in order for them to consider the potential impact of the wind farm on their operations.
5. To facilitate the flight planning of aerial application operators, details of the Project, including the final location and height information of WTGs 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.

Marking of WTGs

6. The rotor blades, nacelle, and supporting mast of the WTGs should be painted a non-reflective white or off-white, as is typical of most WTGs operational in Australia. No additional marking measures are required for WTGs.

Lighting of WTGs

7. CASA will determine whether obstacle lighting is recommended for the WTGs. Lighting the WTGs is not a formal requirement.
8. WA Department of Fire and Emergency Services normally recommends aviation obstacle lighting and markings be placed on the wind farms to protect emergency services aviation aircraft.

Micrositing

9. Providing the micrositing is within 100 m of the planned WTGs it is not likely to result in a change in the maximum overall blade tip height of the Project. No further assessment is likely to be required from micrositing and the conclusions of this AIA would remain the same

Aerial firefighting

10. The developer or operator should ensure that:

- a. Liaison with the relevant fire and land management agencies is ongoing and effective
- b. Access is available to the wind farm site by emergency services response for on-ground firefighting operations
- c. Wind turbines are shut down immediately during emergency operations.
- d. 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. This may not always be possible due to the risk to equipment and personnel as a fire approaches or exists in or near to the WTGs.

Aviation Projects considers that it may be impractical to stop and lock the turbine blades in a Y configuration due to the time needed to stop and lock the turbine and the risk to personnel having to climb into the WTG tower as a bush fire approaches. WTG blades can be feathered to effectively stop or reduce the rotation rate of the turbine to a very slow speed.

Triggers for review

11. 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.

ANNEXURES

1. References
2. Definitions
3. CASA regulatory requirements – Lighting and Marking
4. Risk Framework
5. WTG coordinates and heights

ANNEXURE 1 – REFERENCES

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

- Airservices Australia
 - Airservices Australia, *Aeronautical Information Package (AIP)*, effective 03 September 2026.
 - Designated Airspace Handbook (DAH), effective 09 July 2026.
- Australian Government, Department of Infrastructure, Transport, Regional Development, Communications, the Arts and Sport (DITRD CAS), National Airport Safeguarding Framework, Guideline D *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers*, dated July 2012.
- Civil Aviation Safety Authority
 - Advisory Circular (AC) 91-02 V1.2, *Guidelines for aeroplanes with MTOW not exceeding 5700 kg – suitable places to take off and land*, dated November 2022.
 - AC 91-10 v1.7: *Operations in the vicinity of non-controlled aerodromes*, dated April 2026.
 - AC 139.E-01 v1.0—*Reporting of Tall Structures*, dated December 2021.
 - AC 139.E-05 v1.1 *Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome* (October 2022).
 - CASR Part 139 Manual of Standards (MOS) – *Aerodromes*.
 - CASR Part 173 MOS – *Standards Applicable to Instrument Flight Procedure Design*.
 - Civil Aviation Regulations 1988 (CAR).
 - Civil Aviation Safety Regulations 1998 (CASR).
- International Civil Aviation Organization (ICAO):
 - Doc 8168 *Procedures for Air Navigation Services—Aircraft Operations* (PANS-OPS).
 - Annex 14—*Aerodromes*.
- OzRunways, dated August 2026
- Standards Australia, ISO 31000:2018 *Risk management – Guidelines*
- Western Australia Government, Department of Planning, Lands and Heritage

ANNEXURE 2 – DEFINITIONS

<i>Term</i>	<i>Definition</i>
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: a. the physical characteristics of any movement area including runways, taxiways, taxilanes, shoulders, aprons, primary and secondary parking positions, runway strips and taxiway strips; 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)	The 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.
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.

<i>Term</i>	<i>Definition</i>
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: a. to reduce the risk of damage to aircraft running off a runway; and 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 – 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

CASR 139.165 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 must be given in written notice and contain information on the proposal, the height and location(s) of the object(s) and the proposed timeframe for construction. This is to allow CASA to assess the effect of the structure on aircraft operations and determine whether 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.E-01 v1.0—Reporting of Tall Structures

In Advisory Circular (AC) 139.E-01 v1.0—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. RAAF and Airservices Australia require information on structures which are:

- a) 30 metres or more above ground level—within 30 kilometres of an aerodrome; or
- b) 45 metres or more above ground level elsewhere for the RAAF, or
- c) 30 m or more above ground level elsewhere for Airservices Australia.

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 WTGs must be reported to Airservices Australia. This action should occur once the final layout after micro-siting 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 WTGs, 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 Part 139 MOS 2019.

The characteristics of low and medium intensity obstacle lights specified in Part 139 MOS 2019, Chapter 9, are provided below.

Part 139 MOS 2019 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.*

Part 139 MOS 2019 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 $2\,000 \pm 25\%$ 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 $20\,000 \pm 25\%$ cd when the background luminance is 50 cd/m² or greater.

Visual impact of night lighting

Annex 14 Section 6.2.4 and Part 139 MOS 2019 Chapter 9 are specifically intended for WTGs and recommends that medium intensity lighting is installed.

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

- To minimise the visual impact on the environment, some shielding of the obstacle lights is permitted, provided it does not compromise their operational effectiveness;
- Shielding may be provided to restrict the downward component of light to either, or both, of the following:
 - such that no more than 5% of the nominal intensity is emitted at or below 5 degrees below horizontal; and
 - such that no light is emitted at or below 10 degrees below horizontal;
- 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; and
- A relatively small area on the back of each blade near the rotor hub may be treated with a different colour or surface treatment, to reduce reflection from the rotor blades of light from the obstacle lights, without compromising the daytime visibility of the overall WTG.

Marking of WTGs

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 WTGs 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

Consideration could be given to marking any WMTs according to the requirements set out in Part 139 MOS 2019 Chapter 8 Division 10 Obstacle Markings; specifically:

8.110 Marking of Hazardous Obstacles

(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.

(7) Hazardous obstacles in the form of wires or cables must be marked using 3-dimensional coloured objects attached to the wire or cables. Note: Spheres and pyramids are examples of 3-dimensional objects.

(8) The objects mentioned in subsection (7) must:

- (a) be approximately equivalent in size to a cube with 600 mm sides; and*
- (b) be spaced 30 m apart along the length of the wire or cable.*

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 application 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.

Temporary WMTs installed prior to WTG installation and WMTs not in close proximity to a WTG should be lit with medium-intensity steady red obstacle lighting at the top of the WMT mast. Characteristics of medium-intensity obstacle lighting is contained in MOS 139, Section 9.33

Overhead transmission lines

Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial application operators and marked in accordance with Part 139 MOS 2019 Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8):

8.110 Marking of hazardous obstacles

(7) Hazardous obstacles in the form of wires or cables must be marked using 3-dimensional coloured objects attached to the wire or cables. Note: Spheres and pyramids are examples of 3-dimensional objects.

(8) The objects mentioned in subsection (7) must:

- (a) be approximately equivalent in size to a cube with 600 mm sides; and*
- (b) be spaced 30 m apart along the length of the wire or cable.*

ANNEXURE 4 – RISK FRAMEWORK

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

The risk assessment framework used by Aviation Projects has been developed in consideration of ISO 31000:2018 *Risk management—Guidelines* and the guidance provided by CASA in its 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 at or below, an acceptable level 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. Emergency procedures used.	Minimal site impact – easily controlled. 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. 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. Design and mitigation measures unlikely to remove all effects.
5	Catastrophic	Multiple Fatalities	Damaged beyond repair	Conditions preventing continued safe flight and landing. Multiple deaths with loss of aircraft	Catastrophic site impact, high local impact, national importance. Serious long-term cumulative effect. 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
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 – PROJECT TURBINE COORDINATES AND HEIGHTS

Reference file: WTG Coordinates 23072026 ESL.xlsx

<i>WTG ID</i>	<i>Easting (GDA2020 Zone 50)</i>	<i>Northing (GDA2020 Zone 50)</i>	<i>Base Elevation (m AHD)</i>	<i>Tip Height (m AHD)</i>	<i>Max Height (m AHD)</i>	<i>Max Height (ft AMSL)</i>
T01	633667.344	6498619.584	361.9	261.0	622.9	2043.8
T02	632723.000	6498051.000	370.0	261.0	631.0	2070.2
T03	633946.000	6497795.000	378.0	261.0	639.0	2096.6
T04	632257.569	6497454.942	359.0	261.0	620.0	2034.2
T05	633840.000	6497058.000	381.7	261.0	642.7	2108.7
T06	632743.662	6496616.275	361.6	261.0	622.6	2042.6
T07	632614.026	6495865.751	361.5	261.0	622.5	2042.5
T08	633891.093	6496011.266	364.1	261.0	625.1	2050.8
T09	633329.091	6495100.000	364.7	261.0	625.7	2052.7
T10	633015.062	6494436.143	369.2	261.0	630.2	2067.6
T11	631843.000	6493924.000	374.0	261.0	635.0	2083.2
T12	630926.941	6493388.106	370.2	261.0	631.2	2070.9
T13	631907.487	6493043.303	368.3	261.0	629.3	2064.7
T14	633002.000	6493575.000	357.9	261.0	618.9	2030.5
T15	633548.950	6492767.167	337.4	261.0	598.4	1963.3
T16	631713.959	6492273.033	358.1	261.0	619.1	2031.1
T17	631197.000	6491782.000	367.4	261.0	628.4	2061.8
T18	631482.000	6490979.000	363.4	261.0	624.4	2048.5
T19	631035.000	6490382.000	355.6	261.0	616.6	2023.1
T20	634702.639	6498900.704	364.4	261.0	625.4	2051.8
T21	635899.000	6498772.000	384.8	261.0	645.8	2118.9
T22	635547.000	6498129.000	385.0	261.0	646.0	2119.5
T23	635181.552	6497509.896	382.6	261.0	643.6	2111.7
T24	635775.834	6496681.701	362.9	261.0	623.9	2046.9
T25	639171.301	6500503.688	402.7	261.0	663.7	2177.4
T26	639498.925	6499759.141	414.4	261.0	675.4	2215.9
T27	638103.000	6499007.000	406.7	261.0	667.7	2190.7

<i>WTG ID</i>	<i>Easting (GDA2020 Zone 50)</i>	<i>Northing (GDA2020 Zone 50)</i>	<i>Base Elevation (m AHD)</i>	<i>Tip Height (m AHD)</i>	<i>Max Height (m AHD)</i>	<i>Max Height (ft AMSL)</i>
T28	639297.866	6498957.091	418.2	261.0	679.2	2228.3
T29	639399.802	6498140.271	406.3	261.0	667.3	2189.5
T30	638032.074	6498259.223	396.3	261.0	657.3	2156.6
T31	638065.840	6497257.734	382.8	261.0	643.8	2112.2
T32	639527.816	6496483.277	391.7	261.0	652.7	2141.5
T33	639258.000	6495699.000	376.3	261.0	637.3	2091.0
T34	638749.649	6494973.782	387.9	261.0	648.9	2128.9
T35	645580.280	6495312.376	405.9	261.0	666.9	2187.8
T36	646494.921	6495839.789	402.5	261.0	663.5	2176.9
T37	647275.638	6496244.055	389.7	261.0	650.7	2134.8
T38	647697.985	6495422.078	387.9	261.0	648.9	2128.9
T39	646932.162	6495008.829	395.1	261.0	656.1	2152.6
T40	647402.608	6493970.926	386.8	261.0	647.8	2125.2
T41	646170.596	6494230.720	406.0	261.0	667.0	2188.2
T42	646288.272	6493361.428	391.1	261.0	652.1	2139.5
T43	645002.000	6494131.000	406.4	261.0	667.4	2189.8
T44	644312.254	6490257.945	394.9	261.0	655.9	2151.8
T45	644196.508	6489440.736	397.1	261.0	658.1	2159.2
T46	645134.900	6489529.434	387.7	261.0	648.7	2128.4
T47	645513.521	6488566.528	377.0	261.0	638.0	2093.1
T48	643998.854	6488652.006	384.7	261.0	645.7	2118.3
T49	644107.332	6487849.067	392.0	261.0	653.0	2142.3
T50	645008.000	6487991.000	383.8	261.0	644.8	2115.6



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