April 2026

AVIATION IMPACT ASSESSMENT

MACORNA WIND FARM

Prepared for Cogency Australia

AVIATION PROJECTS

DOCUMENT CONTROL

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AVIATION PROJECTS

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ACRONYMS

AAAA	Aerial Application Association of Australia
AC	Advisory Circular
AFAC	Australasian Fire and Emergency Services Council
AGL	above ground level
AHD	Australian Height Datum
AIA	aviation impact assessment
AIP	Aeronautical Information Package
AIS	aviation impact statement
ALA	aircraft landing area
ALARP	as low as reasonably practicable
AMSL	above mean sea level
ARP	Aerodrome Reference Point
AS	Australian Standards
ATSB	Australian Transport Safety Bureau
BoM	Bureau of Meteorology
CAAP	Civil Aviation Advisory Publications
CAO	Civil Aviation Orders
CAR	Civil Aviation Regulation (1988)
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation (1998)
CFIT	controlled flight into terrain
CNS	communications, navigation and surveillance
CTAF	common traffic advisory frequency
DAH	Designated Airspace Handbook
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
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
RPT	regular public transport
RSR	route surveillance radar
SSR	secondary surveillance radar
VFR	visual flight rules
VFRG	visual flight rules guide
VMC	visual meteorological conditions
WMTs	wind monitoring towers
WTGs	wind turbine generators

UNITS OF MEASUREMENT

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

DEFINITIONS

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

NOTES

Nil

EXECUTIVE SUMMARY

Introduction

The Macorna Wind Farm (MAWF) is a proposed approximately 820.8 megawatt (MW) wind farm comprised of up to 114 wind turbine generators (WTGs) (the Project). The turbines are proposed to be the Vestas V172 7.2 MW with a hub height of up to 166 metres (m), and a tip height of up to 252 m (826.8 ft) above ground level (AGL).

Atmos Renewables (Atmos) on behalf of the Macorna SPV – Atmos MWV Pty Ltd as trustee for the Atmos MHV Trust (Proponent) is the Project's implementing organisation.

The Project is proposed to be located within and surrounding the locality of Macorna in the Gannawarra Shire and Loddon local government areas, within Victoria's Loddon Mallee Region. The Project comprises 26 landholdings. The Project Area is approximately 23,000 hectares (ha), with an expected development or construction footprint of approximately 749.75 ha.

Cogency, on behalf of Atmos, has engaged Aviation Projects to prepare an Aviation Impact Assessment (AIA) to assess the likely impacts of the development of the Project on aviation operations in the proposed location and formally consult with aviation agencies.

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

This AIA report includes an Aviation Impact Statement (AIS) as required by Airservices Australia and a qualitative risk assessment to determine the need for obstacle lighting.

Project description

Key features of the Macorna Wind Farm most relevant to this AIA include:

- Maximum of 114 wind turbine generators (WTGs) with a maximum tip height of 252 m AGL and a rotor diameter (RD) of up to 172 m.
- The ground elevation for the highest WTG location, WTG 113, is 86.4 m Australian Height Datum (AHD), which, with a 252 m WTG height, results in a maximum overall height of 338.4 m AHD (1110.2 ft above mean sea level (AMSL)).
- Up to seven permanent meteorological masts (met masts)
- Underground cabling (low voltage (LV) and medium voltage (MV)) and overhead transmission lines (MV and high voltage (HV)) within the Project Area

Conclusions

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

Planning considerations

1. The proposed Project satisfies the planning provisions. It will not create incompatible intrusions or compromise the safety of existing airports.

Aviation Impact Statement (AIS)

2. There is one certified airport located within 30 nm (56 km) of the Project Site, Kerang Airport (YKER):

a. The WTGs would not impact the OLS surfaces.

b. The WTGs would not impact the IFR circling areas.

c. The WTGs would impact the 10 nm MSA requiring it to be raised by 300 ft to 2100 ft.

d. The WTGs would impact the 25 nm MSA requiring it to be increased by 100 ft to 2100 ft or sectorised for the wind farm area. The increase in the 25 nm MSA would require a proportional increase in the commencement altitude, minimum holding altitude and final missed approach altitude for the approach procedures.

e. The WTGs would impact the RNP RWY 32 initial. All initial legs would need to be raised by 100 ft and the nominal flight path will need to be raised to 2100 ft.

f. The applicable approach procedures would require assessment by Global Airspace Solutions.

3. The WTGs would impact two grid LSALTs:

    a. The 2000 ft grid LSALT would need to be raised by 200 ft to 2200 ft

    b. The 2100 ft grid LSALT would need to be raised by 100 ft to 2200 ft

4. The WTGs would not impact any air route LSALT

5. The Project Site is located within Class G airspace and outside all controlled airspace, Prohibited, Restricted and Danger areas

6. The WTGs will not impact aviation navigation facilities

7. The WTGs will not impact the ATC radar systems. The Project is outside the line-of-sight of the Mt Macedon enroute surveillance radar (RSR), which is the nearest radar, and would not impact this facility.

8. The WTGs must be reported to CASA, and construction details must be provided to Airservices

Uncertified Aerodromes

9. There are no known uncertified aerodromes identified within 3 nm of the Project WTGs.

Obstacle lighting risk assessment

10. 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.

11. Over the 16-year period between 2010-2026, no aircraft has collided with a WTG in Australia.

Consultation

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

The consultation process will commence after the client approves the Final Draft AIA and authorises its release to those agencies. Feedback will be documented in this report.

This report will be updated and finalised based on the feedback received during the consultation process.

Summary of key recommendations

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

CONSTRUCTION PHASE

Notification and reporting

1. Details of WTGs and met masts 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. This NOTAM must include survey height and location coordinates.

   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. Obstacles 30 m or more AGL should be reported to Airservices Australia as soon as the development reaches the maximum height, following the same process outlined in 2 above

5. 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.

6. 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

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

Lighting of WTGs

8. It is not a formal requirement to light the WTGs outside the vicinity of a certified aerodrome. 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. CASA will determine whether obstacle lighting is recommended for the WTGs.

Marking of wind monitoring towers

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

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

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

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

Lighting of wind monitoring towers

10. Consideration should be given to lighting temporary and permanent WMTs installed prior to WTG installation and WMTs that are not in close proximity (within 900 m) to a WTG, with medium intensity steady red obstacle lighting at the top of the WMT mast. Characteristics for medium-intensity obstacle lighting are contained in MOS 139, Section 9.33.

Overhead transmission line

11. 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 Australian Standard AS 3891.2:2018.

Micrositing

12. 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.

Triggers for review

13. 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.

OPERATING PHASE

Aerial firefighting

14. Aerial firefighting is one component of firefighting operations, with standardised practices for aviation activities around wind farms. During both construction and operation of the Wind Farm, the Proponent or operator, respectively, should ensure that:

    a. Liaison with the relevant fire and land management agencies is ongoing and effective

    b. Relevant WTGs are shut down immediately, or as soon as practicable, during emergency firefighting operations to utilise airspace within the project site to fight fires.

c. 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 in some circumstances to stop and lock the WTG blades in a Y configuration due to the time needed to stop and lock the WTG and the risk to personnel having to climb into the WTG tower as a bush fire approaches. If circumstances do not allow the above to be implemented, WTG blades can be feathered to effectively stop or reduce the rotation rate of the WTG to a very slow speed.

DECOMMISSIONING PHASE

15. Advice of removal of obstructions following decommissioning including coordinates and obstacle information should be provided to Airservices Australia, so they can be removed from the vertical obstacle database 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. This should be provided to Airservices Australia following decommissioning.
16. Any temporary construction equipment used in the decommissioning should be reported to Airservices Australia NOTAM office.

1. INTRODUCTION

1.1. Project Overview

The Macorna Wind Farm (MAWF) is a proposed approximately 820.8 megawatt (MW) wind farm comprised of up to 114 wind turbine generators (WTGs) (the Project). The turbines are proposed to be the Vestas V172 7.2 MW with a hub height of up to 166 metres (m).

Atmos Renewables (Atmos) on behalf of the Macorna SPV – Atmos MWV Pty Ltd as trustee for the Atmos MHV Trust (Proponent) is the Project's implementing organisation.

The Project is proposed to be located within and surrounding the locality of Macorna in the Gannawarra Shire and Loddon local government areas, within Victoria's Loddon Mallee Region. The Project comprises 26 landholdings. The Project Area is approximately 23,000 hectares (ha), with an expected development or construction footprint of approximately 749.75 ha.

Cogency, on behalf of Atmos, has engaged Aviation Projects to prepare an Aviation Impact Assessment (AIA) to assess the likely impacts of the development of the Project on aviation operations in the proposed location and formally consult with aviation agencies.

1.2. Purpose and Scope

The purpose and scope of the work are to prepare an AIA for consideration by Airservices Australia, CASA, and the Department of Defence and support the EES referral.

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

- Victorian Government, Department of Transport and Planning, Planning Guidelines for Development of Wind Energy Facilities, September 2023
- Civil Aviation Safety Authority, Civil Aviation Safety Regulations 1998 (CASR)
- Civil Aviation Safety Authority, Advisory Circular (AC) 139.E-05 v1.1 Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome, October 2022
- NASF Guideline D: Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers, dated 12 July 2012
- Aviation Impact Statement (AIS) requirements as advised by Airservices Australia

1.3. Methodology

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

- Conducted a site visit to properly investigate aviation safety aspects of the project
- Reviewed client material
- Reviewed relevant regulatory requirements and information sources, as detailed in Annexure 1
- Identified aviation assets and activities within the vicinity of the Project, and conducted an assessment of the Project to identify any aviation constraints and potential impacts to:
    - Certified aerodromes within 30 nm (55.5 km) of the Project
    - Uncertified aerodromes within 3 nm (5.6 km) of the Project

  - Military aerodromes and associated Special Use Airspace (SUA)
  - Other SUA in the vicinity of the Project
  - Aviation communication, navigation and surveillance services
- Prepared a draft aviation impact assessment and supporting technical data that provides evidence and analysis for the EES Referral to demonstrate that appropriate risk mitigation strategies have been identified. The draft aviation impact assessment report includes an Aviation Impact Statement (AIS) and a qualitative risk assessment to determine the need for obstacle lighting and of applicable aspects for client review and acceptance before submission to aviation stakeholders
- Consult with relevant aviation stakeholders, including Airservices Australia, the Department of Defence, and Global Airspace Solutions, relevant aerodrome operators, and other applicable aviation stakeholders

  Provide a revised AIA that documents the findings of the analysis, including technical data that provides evidence of the analysis for the EES process to demonstrate that appropriate mitigation strategies have been identified.

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:

- Shape files for the following:
  - MAWF_Benches_251215
  - MAWF_CivilDesign_V003_251215

- MAWF_HVDesign_V002_251215
- MAWF_InternalRoads_251217
- MAWF_WTGLayout_V006J_251215
- MAWF_WTGLayout_V006J_251215

1.6. Links to other EES Technical Studies

This report does not rely on any other technical studies prepared for the Project's EES.

1.7. Aviation study area

The study area for this assessment is defined as areas within 30 nautical miles (55.6 kilometres) of the Project area. This lateral distance has been chosen to comply with the requirements of Airservices Australia to identify potential impacts to certified aerodromes.

2. BACKGROUND

2.1. Site Overview and Context

The Project Site boundary is approximately 8.3 km southeast of Kerang Aerodrome, located within the Shire of Gannawarra and Shire of Loddon Local Government Areas (LGAs).

An overview of the project relative to Kerang Aerodrome is provided in Figure 1 (source: Cogency, Google Earth).

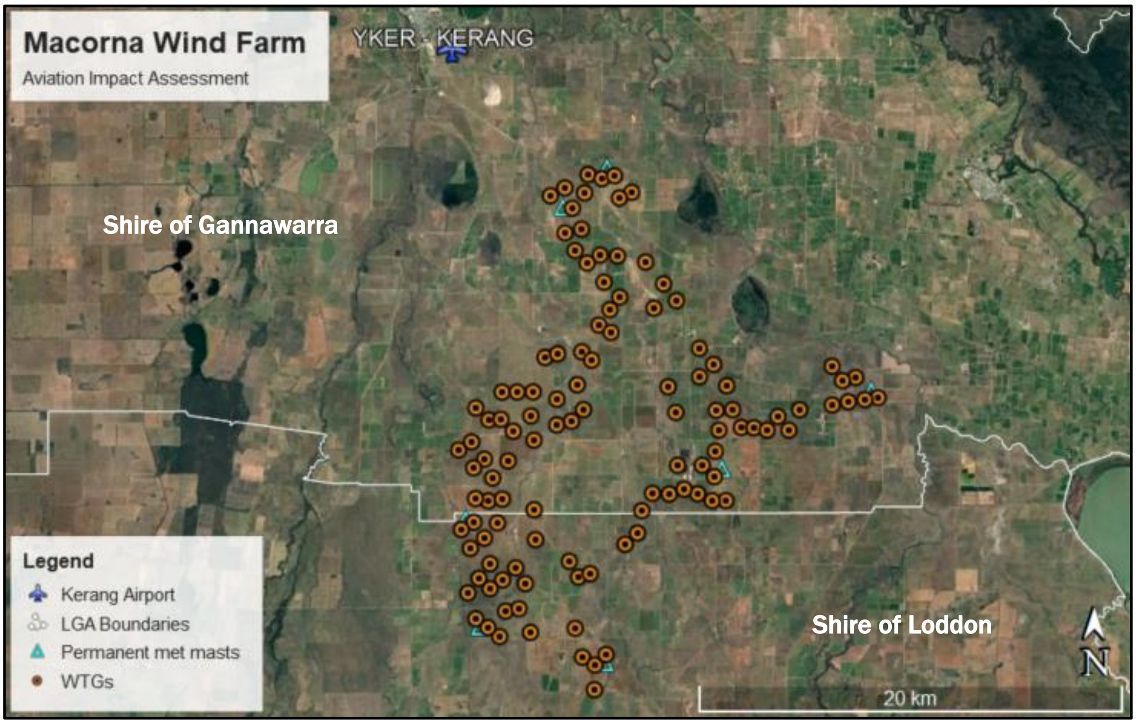

Figure 1 Project overview

2.2. Project Description

The Project involves constructing, operating, maintaining and decommissioning the Macorna Wind Farm, including a final layout of up to 114 wind turbine generators (WTGs).

The WTGs will have a rotor diameter of up to 172 m, with a maximum tip height of 252 m AGL.

The ground elevation for the highest WTG location (WTG 113) is 86.4 m AHD, which, with a 252 m WTG height, results in a maximum overall height of 338.4 m AHD (1110.2 ft AMSL).

3. CHARACTERISATION OF THE EXISTING ENVIRONMENT

3.1. National Airports Safeguarding Framework

The National Airports Safeguarding Advisory Group (NASAG) was established by Commonwealth Department of Infrastructure, Transport, Regional Development, Communications, Sports and the Arts 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.

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. Victorian Department of Transport and Planning

The Victorian Department of Transport and Planning publishes the Development of Wind Energy Facilities Policy and Planning Guidelines dated September 2023.

> *The Minister for Transport and Planning is the responsible authority for a permit application or amendment to a permit relate to the use and development of land for an energy generation facility (including a wind energy facility) with an installed capacity of 1 megawatt or greater and a utility installation used to:*
>
> - *Transmit or distribute electricity*
> - *Store electricity if the installed capacity is 1 megawatt or greater.*

Paragraph 4.3.5 of the guideline refers to Aviation Safety Issues, including:

The height of wind energy turbines can be substantial, resulting in potential impacts on nearby airfields and air safety navigation. Applicants should address aircraft safety issues by considering the site's proximity to airports, aerodromes, or landing strips.

Applicants should consult with the Civil Aviation Safety Authority (CASA) for wind energy facility proposals that:

• are within 30 kilometres of a declared aerodrome or airfield

• infringe the obstacle limitation surface around a declared aerodrome

• include a building or structure that the top of which will be 110 metres or more above natural ground level (the height of a wind turbine is determined by the tip of the turbine blade when vertically above ground level).

Early engagement with aviation safety organisations like CASA is encouraged as aviation safety is a complex area of wind energy facility assessment.

The guidelines provide a framework to ensure proposals for wind energy facilities are thoroughly assessed, including other considerations and approvals required in the planning process.

5.1.5 Aircraft safety

The height of wind energy turbines can be substantial, resulting in potential impacts on nearby airfields and air safety navigation. A responsible authority should consider the site's proximity to airports, aerodromes or landing strips, and ensure that any aircraft safety issues are identified and addressed appropriately.

Although the Civil Aviation Safety Authority (CASA) is not a formal referral authority for wind energy facility permit applications, a responsible authority should nevertheless consult with CASA concerning aircraft safety impacts of a wind energy facility proposal, particularly proposals that:

- *are within 30 kilometres of a declared aerodrome or airfield*
- *infringe the obstacle limitation surface around a declared aerodrome*
- *include a building or structure, the top of which will be 110 metres or more above natural ground level (the height of a wind turbine is that reached by the tip of the turbine blade when vertically above ground level).*

Other private airstrips may not be identified by consultation with CASA. These may be determined using aerial photographs, discussions with the relevant council, or consultation with local communities.

A responsible authority should ensure that the proponent has consulted CASA appropriately about aircraft safety and navigation issues. It is recommended that the proponent consults and receives approval from CASA before lodging their application for ease of process. Refer to Section 4.3.5 of these guidelines for more detail.

CASA may recommend appropriate safeguards to ensure aviation safety. These may include changes to turbine locations, turbine heights and/or the provision of aviation safety lighting. A responsible authority should ensure that any concerns raised by CASA are appropriately reflected in permit conditions.

Aviation safety lighting can impact the amenity of the surrounding area. Responsible authorities may consider the following impact reduction measures (subject to CASA requirements and advice):

- *reducing the number of wind turbines 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 (fittings that absorb or screen light glare).*

This aviation impact assessment considers the application of the guidelines in relation to potential impacts on aviation.

3.3. Shire of Gannawarra Planning Scheme

The Shire of Gannawarra Planning Scheme objective for airport and airfields (18.02-7S) aligns with the State of Victoria:

> *To strengthen the role of Victoria's airports and airfields within the state's economic and transport infrastructure, guide their siting and expansion, and safeguard their ongoing, safe and efficient operation.*
>
> *18.02-7L Kerang Airport (02/03/2022)*
>
> *Strategy*
>
> *Ensure use and development maintains and improves Kerang airport's levels of service and capacity.*
>
> *Ensure use and development is consistent with the Obstacle Limitation Surface Plan, Plan Sheet 2 of 2, Number F1359 (Price Merrett and Associates Pty Ltd, 1999) which is incorporated in this planning scheme,*

A screenshot of the planning scheme online map with the Kerang Airport Environs Overlay (AEO) in purple is shown in Figure 2, and the Kerang Airport obstacle limitation surface (OLS) is shown in Figure 3. Airport Obstacle Limitation Surfaces (OLS) are prescribed in the Civil Aviation Safety Regulations (CASR) Part 139 Manual of Standards (MOS), and this information in relation to Kerang Airport is provided in section 6.3.1.

The Macorna Wind Farm WTGs would be outside the Kerang Airport Environs Overlay and outside the Kerang Airport OLS.

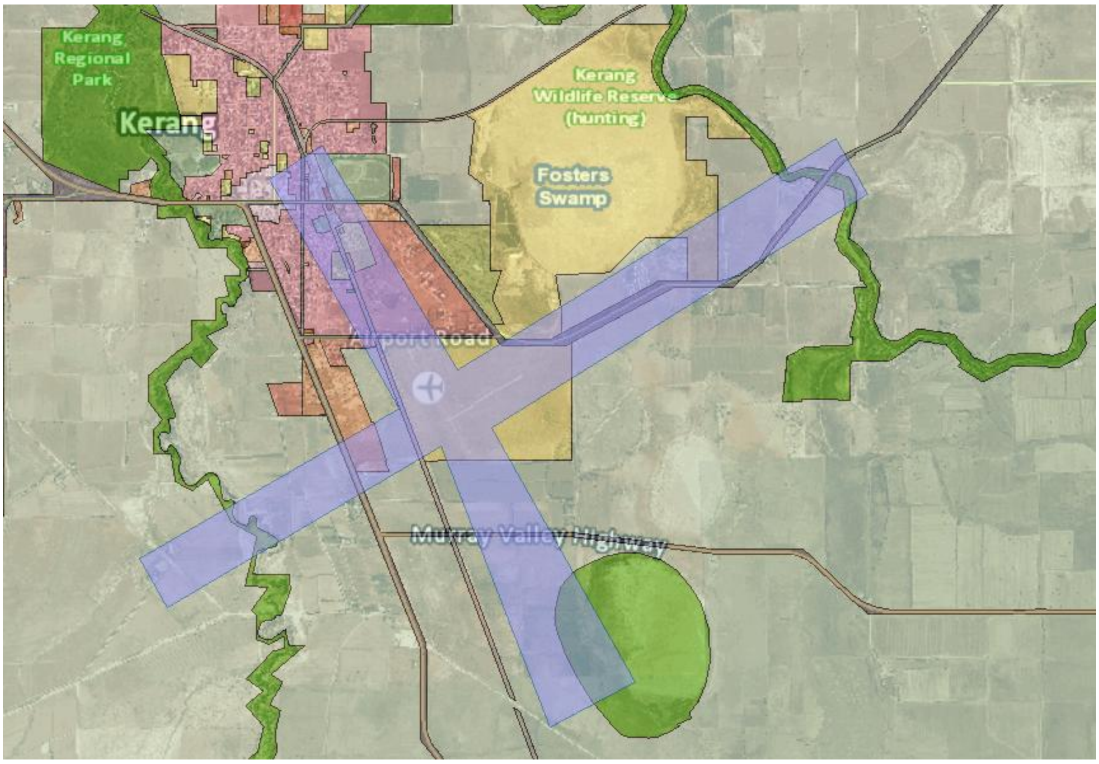

Figure 2 Kerang Airport Environ Overlay (in purple)

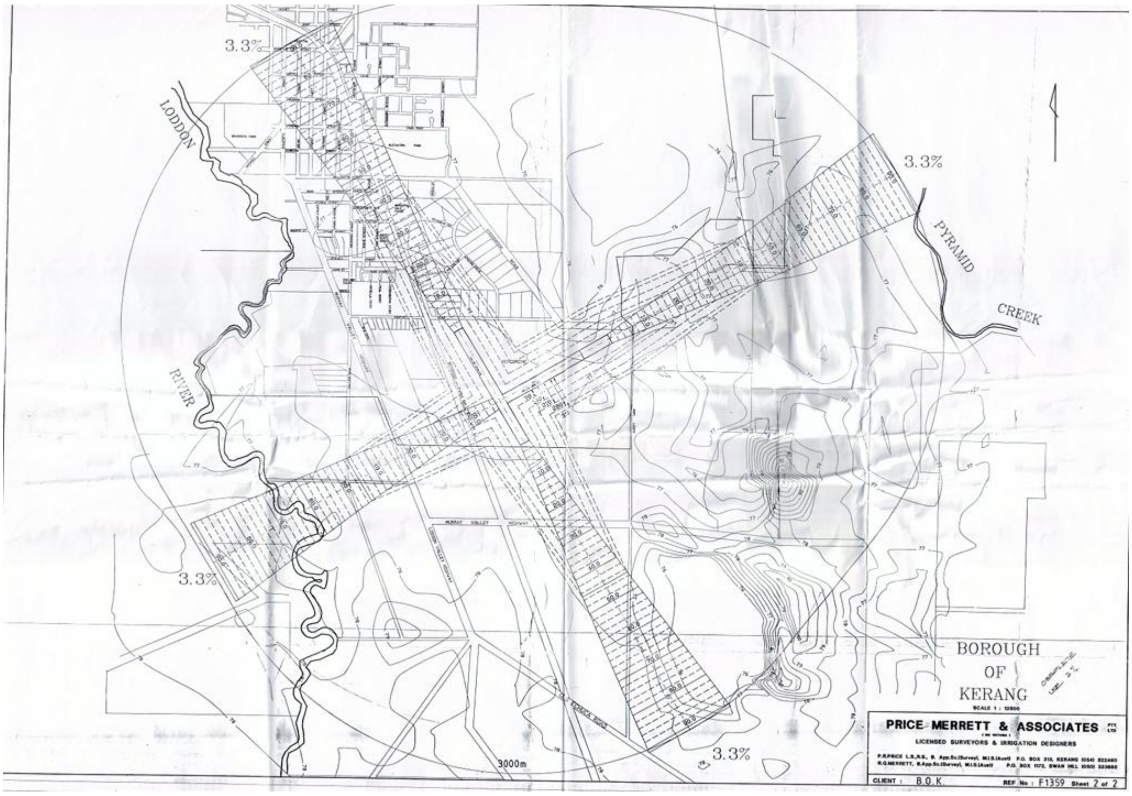

Figure 3 Kerang Airport OLS

3.4. Shire of Loddon Planning Scheme

The Shire of Loddon Planning Scheme objective for airport and airfields (18.02-7S) aligns with that of the Shire of Gannawarra and the State of Victoria:

> *To strengthen the role of Victoria's airports and airfields within the state's economic and transport infrastructure, guide their siting and expansion, and safeguard their ongoing, safe and efficient operation.*

It includes strategy for Bendigo Airport, which is beyond the area of the Macorna Wind Farm.

3.5. Civil Aviation Safety Authority (CASA)

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

3.5.1. 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.

3.5.2. 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 4 and Figure 5.

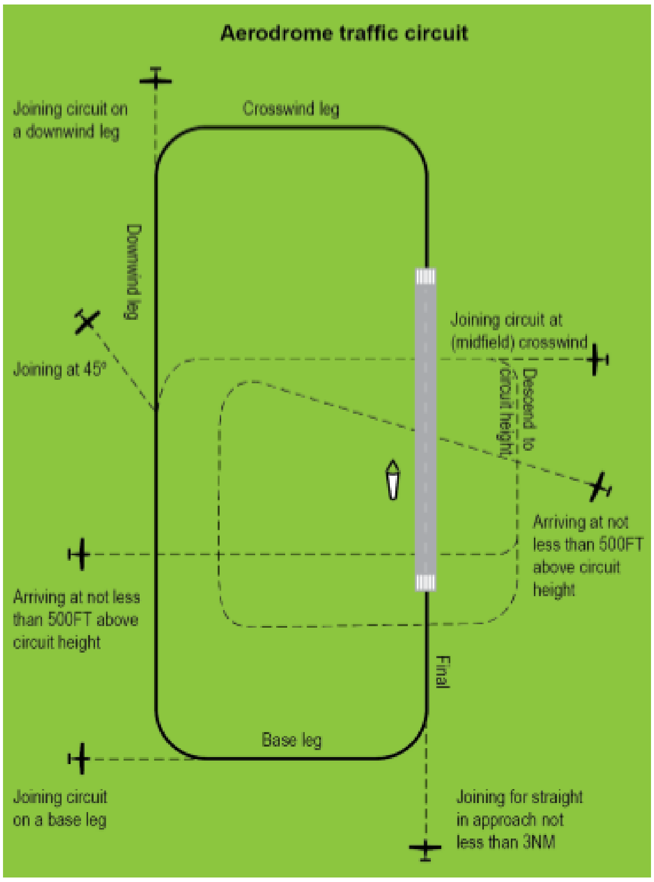

Figure 4 Aerodrome standard traffic circuit, showing arrival and joining procedures

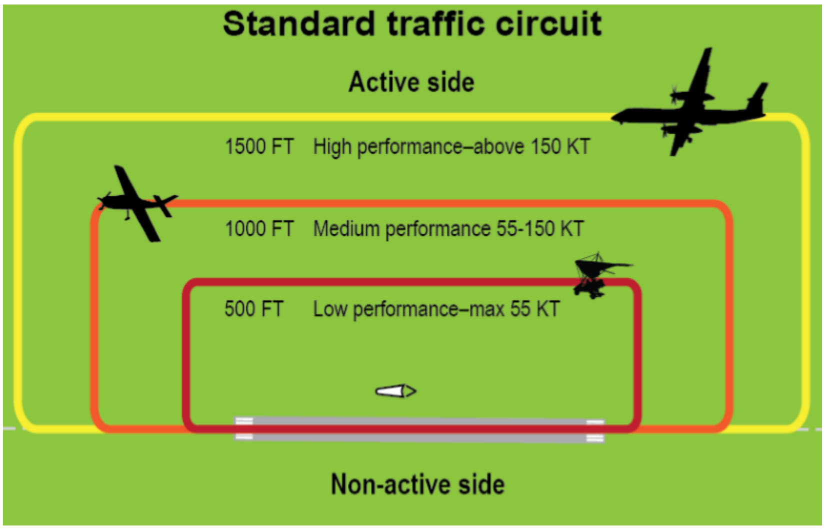

Figure 5 Lateral and vertical separation in the standard aerodrome traffic circuit

Paragraph 7.11 of AC 91-10 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.*

3.6. Rules of flight

3.6.1. 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.

3.6.2. 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).

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

According to CASR Part 91, flight under the IFR requires an aircraft to be operated at a height clear of obstacles that is calculated according to an approved method.

Obstacle lights on structures not within the vicinity of an aerodrome are effectively redundant to an aircraft being operated under the IFR.

3.7. Aircraft operator characteristics

Flying training may be conducted under either the 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. There are minimum visibility (eg 5 km in Class G) and distance from cloud requirements.

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.

3.8. Passenger transport operations

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

3.9. Private operations

Private operations are generally conducted under day or night VFR, with some IFR. Flight under day VFR is conducted above 500 ft AGL in areas outside city and township built-up areas.

3.10. 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.

3.11. 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.

3.11.1. Aerial Agricultural Association of 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.*

3.11.2. Aerial application operators

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

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

3.11.3. Emergency services

3.11.4. Royal Flying Doctor Service

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

3.11.5. Aerial firefighting

Aerial firefighting is one component of firefighting operations, with standardised practices for aviation activities around wind farms. 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 (AFAC) 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 WTG blades in a Y configuration due to the time needed to stop and lock the WTG 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 WTG to a very slow speed.

4. INTERNAL CONTEXT

4.1. Wind turbine generator (WTG) description

The Project Site boundary is approximately 8.3 km southeast of Kerang Aerodrome, located within the Shire of Gannawarra and Shire of Loddon Local Government Areas (LGAs).

Figure 6 and Figure 7 provide views of the Project Site during our site visit. (Source: Aviation Projects)

Figure 6 Project Site from the corner of Old Echuna and Guy Roads

Figure 7 Project Site from Campbells Rd near Walder Rd

The Project Site will comprise up to 114 WTGs, the maximum blade tip height of which will be 252 m above ground level (AGL).

The ground elevation for the highest WTG location (WTG 113) is 86.4 m AHD, which, with a 252 m WTG height, results in a maximum overall height of 338.4 m AHD (1110.2 ft AMSL).

Figure 8 illustrates the Project Site layout identifying the highest WTG location, WTG 113 (source: Cogency, Google Earth).

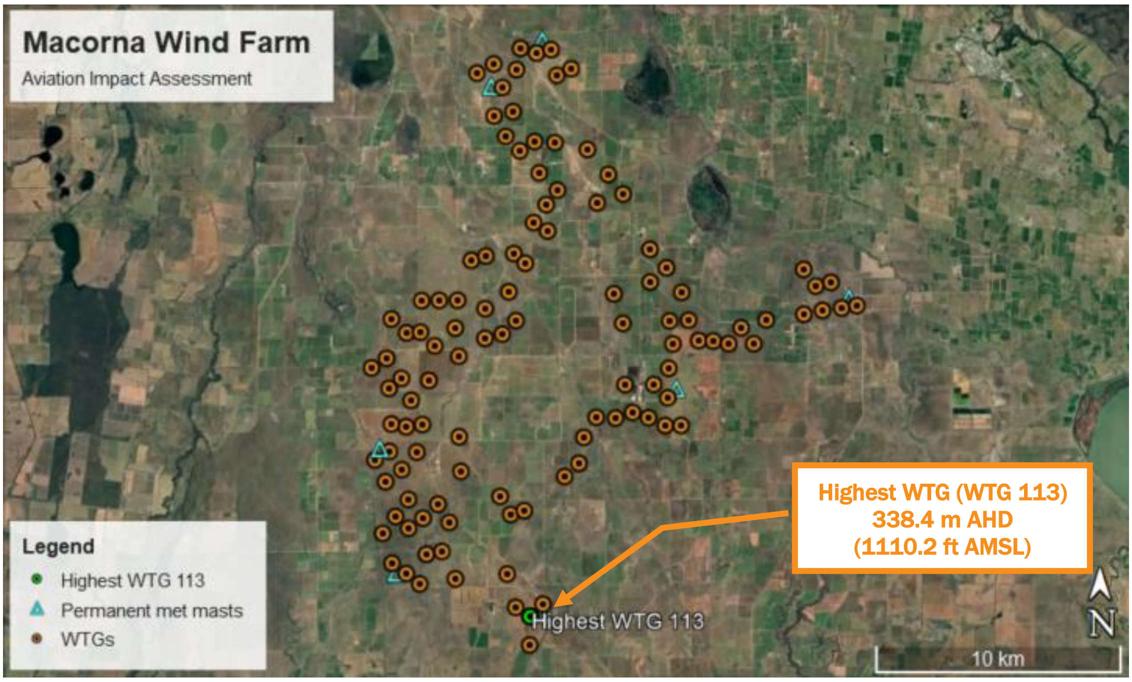

Figure 8 Project layout and highest WTG location

'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 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 Site.

This AIA assumes a maximum blade tip height of 252 m AGL is implemented at all WTG locations.

5. CONSULTATION

The following list of stakeholders were identified as requiring consultation:

1. Airservices Australia
2. Department of Defence
3. Gannawarra Shire Council (Kerang Airport Operator)
4. VIC Country Fire Authority (CFA)
5. Royal Flying Doctor Service

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*
Airservices Australia				
Department of Defence				
Global Airspace Solutions				
Gannawarra Shire Council				
VIC Country Fire Authority (CFA)				
Royal Flying Doctor Service				

6. AVIATION IMPACT STATEMENT

6.1. Overview

The Aviation Impact Statement (AIS) provides the information required by Airservices Australia for their assessment. All wind farm proposals submitted to Airservices Australia must include an AIS. Potential safety risks include (but are not limited to) impacts on flight procedures and aviation communications, navigation, and surveillance (CNS) facilities.

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

- The operation of certified aerodromes within 30 nm of the wind farm
- Grid and air route LSALTs
- Airspace protection
- Aviation navigation facilities
- ATC surveillance radar installations

6.2. Nearby certified aerodromes

A certified aerodrome is an aerodrome regulated by the Civil Aviation Safety Authority (CASA) under CASR Part 139 with defined standards established in CASR Part 139 MOS.

There is one certified aerodrome located within 30 nm of the proposed site: Kerang Airport (YKER).

The 30 nm radius represents the 25 nm minimum sector altitude (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 Kerang Airport is shown in Figure 6 (Source: Cogency, Google Earth). The red circle represents a 30 nm radius from the airport's aerodrome reference point (ARP).

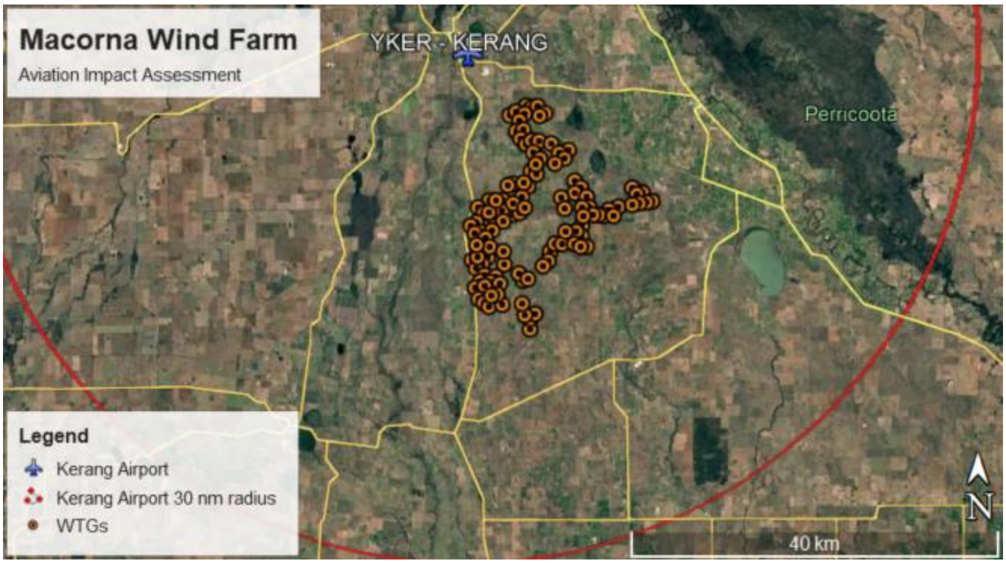

Figure 9 Location of Certified Airports in relation to Project Site

6.3. Kerang Airport (YKER)

Kerang Airport (YKER) is operated by the Gannawarra Shire Council, with a published aerodrome elevation of 77.7 m AHD (255 ft AMSL) (Source: Airservices Australia ERSA, 9 July 2026).

Kerang Airport's aerodrome reference point (ARP) coordinates published in the AIP Designated Airspace Handbook (DAH) are Latitude 35°45'05" S and Longitude 143°56'22" E (Source: DAH, effective 9 July 2026).

6.3.1. Obstacle Limitation Surfaces (OLS)

OLS are established for each certified aerodrome runway. For the Code 1 non-precision runways at Kerang Airport, the maximum lateral extent of the OLS is up to 3.5 km for the conical surface and 1.6 km for the take-off and 2.5 km for the approach surfaces.

The closest WTG is approximately 8.5 km (4.6 nm) southeast of Kerang Airport's ARP, which is beyond the horizontal extent of the obstacle limitation surfaces.

6.3.2. Instrument approach procedures

A check of the Aeronautical Information Package (AIP) shows that Kerang Airport is serviced by two non-precision instrument flight procedures (source: AIP, effective 9 July 2026). Table 2 identifies the aerodrome chart designed by Airservices Australia and procedure charts for Kerang Airport designed by Global Airspace Solutions.

Table 2 Kerang Airport (YKER) aerodrome and procedure charts

Chart name	*Effective date*	*Designer*
AERODROME CHART	19 March 2026 (Am 186)	Airservices Australia
RNP RWY 14	27 November 2025 (Am 185)	Global Airspace Solutions
RNP RWY 32	27 November 2025 (Am 185)	Global Airspace Solutions

6.3.3. MSA surfaces

The MSA applies to each instrument approach procedure at Kerang Airport. An image of the MSA published for Kerang Airport is shown in Figure 10 (source: Airservices Australia, 9 July 2026).

The CASR Part 139 Manual of Standards requires a minimum obstacle clearance (MOC) of 984 ft to be applied above the highest terrain or obstacle within the applicable segment. Obstacles within the 10 nm MSA and 25 nm MSA of Kerang Airport's aerodrome reference point (ARP), and within a 5 nm buffer area, define the minimum height at which an IFR aircraft can fly when within 10 nm and 25 nm of the airport when no in visual flight conditions.

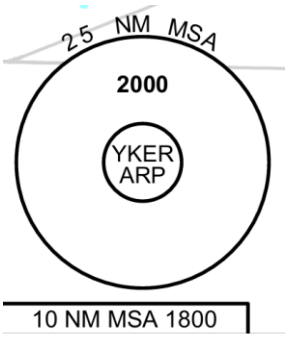

Figure 10 Kerang Airport 10 nm MSA and 25 nm MSA

The Project Site is located laterally within both the 10 nm MSA and 25 nm MSA (Source: Cogency, Airservices Australia, Google Earth). Figure 11 (source: Cogency, AIP, Google Earth) shows Kerang Airport's 10 nm MSA (10 nm + 5 nm buffer area) and 25 nm MSA (25 nm + 5 nm buffer area) from the ARP, and related PANS-OPS surface height.

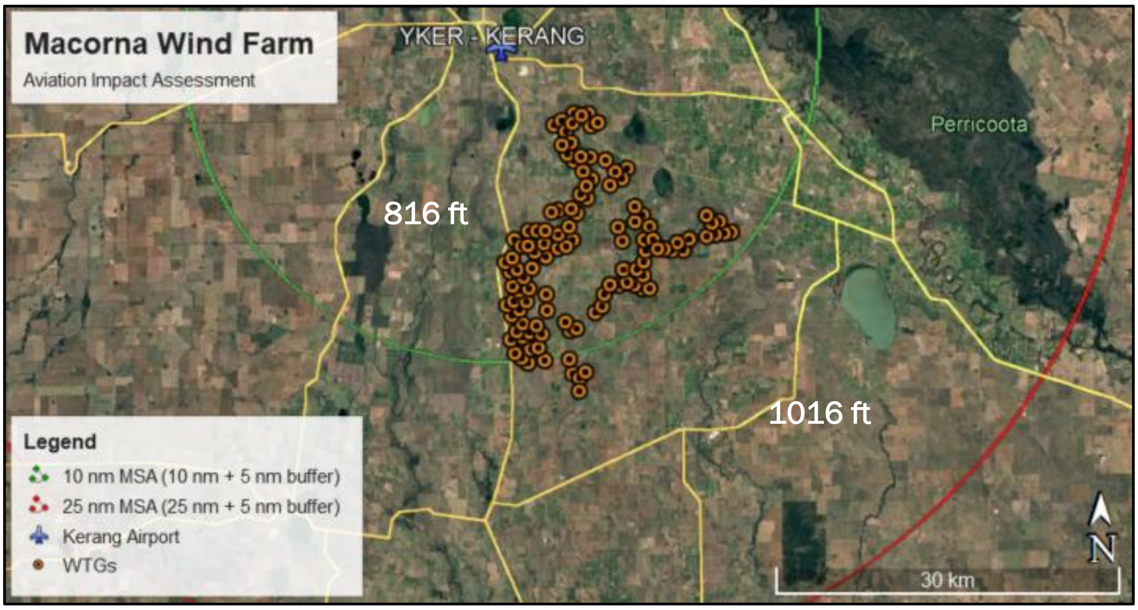

Figure 11 Kerang Airport MSA

The 10 nm MSA is 548.6 m AHD (1800 ft AMSL), with a protection surface elevation of 248.7 m AHD (816 ft AMSL).

The highest WTG within the 10 nm MSA is WTG 108, which is 337.5 m AHD (1107.4 ft AMSL). It is higher than the 10 nm MSA protection surface by 291.4 ft. The Kerang Airport 10 nm would need to be raised by 300 ft to 2100 ft.

The 25 nm MSA is 609.6 m AHD (2000 ft AMSL), with a protection surface elevation of 309.7 m AHD (1016 ft AMSL).

The highest WTG within the 25 nm MSA is WTG 113, which is 338.4 m AHD (1110.2 ft AMSL). It is higher than the 25 nm MSA protection surface by 94.2 ft. The Kerang Airport 10 nm would need to be raised by 100 ft to 2100 ft.

The increase to the 25 nm MSA would require a proportional increase in the commencement altitude, minimum holding altitude and final missed approach altitude for the approach procedures. There is sufficient distance between the procedures' initial approach fixes to accommodate the minimum altitude increase without affecting aircraft operations or efficiency.

Table 3 Kerang Airport MSA Analysis

MSA	Minimum altitude (ft AMSL)	PANS-OPS surface (ft AMSL)	Impact on airspace design	Potential solution	Impact on aircraft ops
10 nm	1800	816	Infringes by 291.4 ft	Increase the 10 nm MSA by 300 ft to 2100 ft	Minor
25 nm	2000	1016	Infringes by 94.2 ft	Increase the 25 nm MSA by 100 ft to 2100 ft	Minor

6.3.4. IFR circling areas

A circling approach is an extension of an instrument approach to the specified circling minima (lowest altitude permitted without visual reference to the ground) at which point the pilot will visually manoeuvre the aircraft to align with the runway for landing. Typically, a circling approach is only conducted where there is no runway-aligned instrument procedure or if the runway used for the approach procedure is not suitable for landing.

Circling areas are established by the instrument flight procedure designer based on ICAO specifications related to the performance category of the designed aircraft. The circling area is determined by drawing an arc centred on the threshold of each usable runway and joining these arcs by tangents. Kerang Airport’s instrument flight procedures provide for the most demanding aircraft category, Category B.

The radii for each relevant category of aircraft are provided below:

- Category A – 1.68 nm / 3.11 km
- Category B – 2.66 nm / 4.93 km

The Project Site is located 7.9 km (4.3 nm) from the threshold of Runway 32 and is beyond the circling area for all runway ends at Kerang Airport.

The Project Site will not impact circling areas established for instrument flight procedures.

6.3.5. PANS-OPS Surfaces

A detailed assessment of the PANS-OPS surfaces associated with the published instrument approach procedures was undertaken.

The Project would not infringe Kerang Airport's RNP RWY 14 approach protection surfaces. As mentioned in Section 6.3.3, the increase to the 25 nm MSA would require a proportional increase in the commencement altitude, minimum holding altitude and final missed approach altitude for the approach procedure.

The Project would infringe Kerang Airport's RNP RWY 32 approach protection surfaces for each of the initial legs. All initial legs would need to be raised by 100 ft and the nominal flight path will need to be raised to 2100 ft. As mentioned in Section 6.3.3, the increase to the 25 nm MSA would require a proportional increase in the commencement altitude, minimum holding altitude and final missed approach altitude for the approach procedure. Figure 12 shows the procedure in relation to the project WTGS (source: Cogency, AIP, Google Earth)

Table 4 Kerang Airport PANS-OPS Assessment

Kerang Airport Instrument Approach Title	*Minimum Altitude over Project Site (ft AMSL)*	*PANS-OPS Surface (ft AMSL)*	*Impact on the procedure by WTGs*	*Potential solution*	*Impact on aircraft ops*
RNP RWY 14	N/A	N/A	Nil – Protection surfaces finish over the Project and WTGs that interact with the procedure are below the protection surface.	N/A	N/A
RNP RWY 32	Initial: 2000	Initial: 1016	Varius levels of impact across the three initial legs. All legs will need to be raised by 100ft to MOCA and nominal flight path will need to be raised to 2100ft.	Raise identified MOCA. Consultation with procedure designer required	Low – Moderate

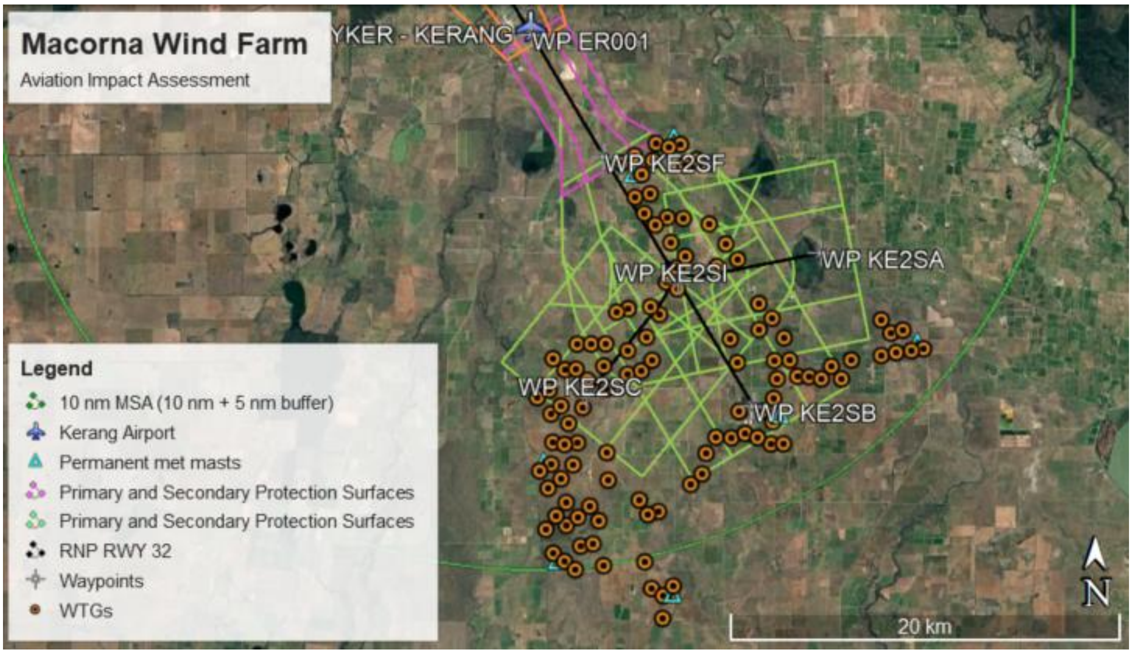

Figure 12 Kerang Airport RNP RWY 32 in relation to Project WTGs

The Aviation Impact Assessment would require consultation with the flight procedure design organisation, Global Airspace Solutions. Costs to complete this assessment would be charged directly to the client, after a request for a quote.

Amendments to instrument flight procedures require prior approval from the aerodrome operator, and a commercial agreement between the proponent and Global Airspace Solutions to amend the procedures.

6.4. Grid and Air routes LSALT

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

6.4.1. Grid LSALT

The Project Site is located within four airspace grids:

- LSALT of 2000 ft AMSL provides clearance above obstacles with heights up to 1000 ft AMSL.
- LSALT of 2100 ft AMSL provides clearance above obstacles with heights up to 1100 ft AMSL.
- LSALT of 3400 ft AMSL provides clearance above obstacles with heights up to 2400 ft AMSL.
- LSALT of 4100 ft AMSL provides clearance above obstacles with heights up to 3100 ft AMSL.

An impact analysis of the surrounding grids is provided in Table 5. Figure 13 shows the grid LSALT in proximity to the Project Site (source: ERC Low National, OzRunways, January 2026, Google Earth).

Table 5 Grid LSALT impact analysis

Grid LSALT (ft AMSL)	*Protection Surface (ft AMSL)*	*Infringement*	*Potential Solution*	*Impact on Aircraft Operations*
2000	1000	Highest WTG 103 infringes by 107.4 ft	Raise LSALT by 200 ft to 2200 ft	Minor
2100	1100	Highest WTG 113 infringes by 110.2 ft	Raise LSALT by 100 ft to 2200 ft	Minor
3400	2400	Nil	N/A	N/A
4100	3100	Nil	N/A	N/A

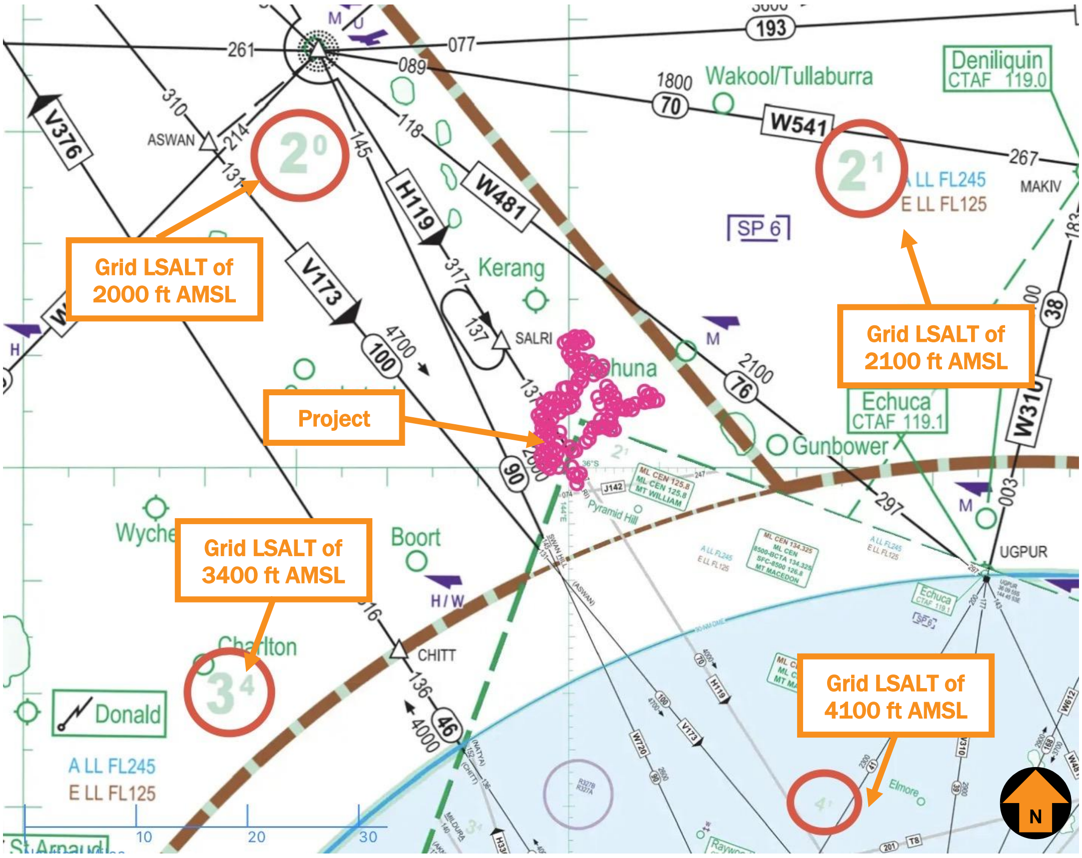

Figure 13 Grid LSALT in proximity to the Project Site

The WTGs would impact the Grid LSALTs of two grids, requiring the 2000 ft grid LSALT to be raised by 200 ft to 2200 ft and the 2100 ft grid LSALT to be raised by 100 ft to 2200 ft.

6.4.2. Air Route LSALTs

A protection area of 7 nm laterally on either side of an air route, and 5 nm laterally on either side of a RNP 2 air route, is used to assess the LSALT for the air route.

An impact analysis of the surrounding air routes is provided in Table 6. The WTGs are beneath the air route protection surface. It will not impact any air route LSALT.

Table 6 Air route LSALT impact analysis

Air route	*Waypoint pair*	*Route LSALT (ft AMSL)*	*Protection Surface (ft AMSL)*	*WTGs Infringement*
H119	SALRI DORSU	4000	3000	Nil
J142	NONUP BORTO	7000	6000	Nil
V173	ASWAN DORSU	4700	3700	Nil
W720	SWH NDB TELIP	2600	1600	Nil

6.5. Airspace Protection

The Project Site is located within Class G airspace, which is uncontrolled airspace. The site is not located in any Prohibited areas, Danger areas, or Restricted Areas.

The Project Site will not have an impact on controlled or designated airspace.

6.6. 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.

6.7. ATC Radar installations

Airservices Australia requires an assessment of the potential for the WTGs to affect radar line of sight. The closest radar facility to the Project Site is Mt Macedon En-route Surveillance Radar (RSR), which is located approximately 158 km to the south.

EUROCONTROL guidelines for assessing the potential impact of WTGs 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 the Mt Macedon RSR and will not impact this facility.

6.8. AIS Summary

Based on the WTG layout and maximum blade tip height of up to 252 m AGL, the blade tip elevation of the highest WTG, which is WTG 113, would not exceed 338.4 m AHD (1110.2 ft AMSL):

- There is one certified airport located within 30 nm (56 km) of the Project Site, Kerang Airport (YKER):
    - The WTGs would not impact the OLS surfaces.
    - The WTGs would not impact the IFR circling areas.
    - The WTGs would impact the 10 nm MSA requiring it to be raised by 300 ft to 2100 ft.
    - The WTGs would impact the 25 nm MSA requiring it to be increased by 100 ft to 2100 ft or sectorised for the wind farm area. The increase in the 25 nm MSA would require a proportional increase in the commencement altitude, minimum holding altitude and final missed approach altitude for the approach procedures.
    - The WTGs would impact the RNP RWY 32 initial. All initial legs would need to be raised by 100 ft and the nominal flight path will need to be raised to 2100 ft.
    - The applicable approach procedures would require assessment by Global Airspace Solutions.
- The WTGs would impact two grid LSALTs:
    - The 2000 ft grid LSALT would need to be raised by 200 ft to 2200 ft
    - The 2100 ft grid LSALT would need to be raised by 100 ft to 2200 ft
- The WTGs would not impact any air route LSALT
- The Project Site is located within Class G airspace and outside all controlled airspace, Prohibited, Restricted and Danger areas
- The WTGs will not impact aviation navigation facilities
- The WTGs will not impact the ATC radar systems
- The WTGs must be reported to CASA, and construction details must be provided to Airservices

7. UNCERTIFIED AERODROMES

7.1. 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 9 July 2026
- OzRunways – which sources its data from Airservices Australia. 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 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.

There are no known uncertified aerodromes within 3 nm of the Project WTGs.

8. WAKE TURBULENCE

8.1. 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…*

For the purpose of the wake turbulence analysis, a 172 m rotor diameter has been used. Based on this scenario and utilising 16 rotor diameter distance from the WTGs, the effects of wake turbulence could be noticeable from 2752 m of the WTGs.

Wake turbulence from the Project WTGs would not impact any known aerodromes.

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 planning authority provides the details of the wind farm, along with this report, to CASA, CASA will provide a recommendation regarding obstacle lighting.

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). A later version of this report is not yet available. Aviation Projects subscribes to the ATSB occurrence reports. There have been no collisions or incidents involving wind farms since 2019.

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 7 (source: ATSB).

Table 7 Number of fatalities by General Aviation sub-category – 2010 to 2019

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

Figure 14 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.

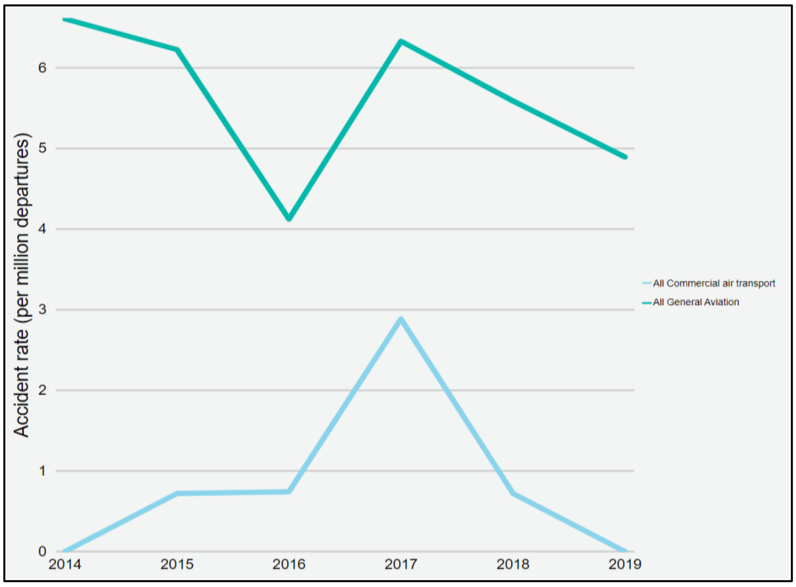

Figure 14 Fatal Accident Rate (per million departures) by Operation Type

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 8 (source: ATSB).

Table 8 Fatal accidents by GA sub-category – 2010 -2019

Sub-category	*Fatal accidents*	*Fatalities*
Agricultural spreading/spraying	13	13
Agricultural mustering	11	12
Other agricultural	1	1
Survey and photographic	5	10
Search and rescue	2	2
Firefighting	2	2
Other aerial work	3	4
Instructional flying	11	19
Own business travel	3	5
Sport and pleasure flying	53	94
Other general aviation flying	11	12
Total	115	174

Over the 16-year period, 2010-2026, no aircraft has collided with a WTG 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 2024, Total installations of 117GW in 2023 represents a 50% year-on-year increase from 2022.

Based on the Australia's Clean Energy Council statistics there were 110 wind farms in Australia at 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 WTG because the pilot believed his friend was working on the WTG. 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.

There is one accident occurred in near Nettersheim, Kreis Euskirchen, North Rhine Westphalia, Germany in August 2024. Unconfirmed information suggests that the aircraft impacted a WTGin poor visibility conditions. The accident resulted in one fatality.

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 proposed by the Project.

Based on an extensive review of accident statistics data (see summary in Section 10 above) and stakeholders who were consulted during the preparation of this AIA (see Section 5), 4 identified risk events associated with WTGs and 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, Sports 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 9 through to Table 12.

Table 9 Aircraft collision with WTGs

Risk ID:	1. Aircraft collision with WTGs (CFIT)

Discussion

An aircraft collision with a WTG would result in harm to people and damage to property. 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 10. 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.

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 the obstacle OLS of any aerodrome.

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 10). Similarly, aircraft damage sustained ranged from minor to catastrophic. One of these accidents resulted from 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 the obstacle OLS of any certified aerodrome. • Aircraft are restricted to a minimum height of 500 ft (152.4 m) AGL above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas. The proposed WTGs would be a maximum height of 252 m (826.8 ft) at the top of the blade tip. The rotor blade at its maximum height would be approximately 99.6 m (326.8 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft). • 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.	
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
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable
Recommended Treatments The following treatments which can be implemented at little cost will provide an acceptable level of safety: • Details of the Project should be communicated to local and regional aircraft operators prior to construction to heighten their awareness of its location and so that they can plan their operations accordingly. Specifically: a. 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. b. 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 c. 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.	

d. 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 WTG, without obstacle lighting on the WTGs of the Project.**	
Residual Risk	7 - Tolerable

Table 10 Harsh manoeuvring leading to controlled flight into terrain

<table>
<tr><td>Risk ID:</td><td colspan="2">2. Harsh manoeuvring leads to controlled flight into terrain (CFIT)</td></tr>
<tr><td colspan="3">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 would be a maximum of 252 m (826.8 ft) at the top of the blade tip. The rotor blade at its maximum height would be approximately 99.6 m (326.8 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 all WTGs can be noted on aeronautical maps and charts
• Since the WTGs would be higher than 100 m AGL, there is a statutory requirement to report the WTG to CASA.</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td colspan="2">Consequence</td><td>Catastrophic</td></tr>
<tr><td colspan="3">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 10). 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.</td></tr>
<tr><td colspan="2">Untreated Likelihood</td><td>Possible</td></tr>
</table>

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 would be a maximum of 252 m (826.8 ft) at the top of the blade tip. The rotor blade at its maximum height would be approximately 99.6 m (326.8 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 would 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.
Level of Risk The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8.

Current Level of Risk	8 – Unacceptable
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable
Recommended Treatments The following treatments which can be implemented at little cost will provide an acceptable level of safety: • 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.	
With the additional recommended treatments, the likelihood of ground collision resulting from manoeuvring to avoid 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 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 WTG, without obstacle lighting on the WTGs of the Project.**	
Residual Risk	7 – Tolerable

Table 11 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 would 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 would be a maximum of 252 m (826.8 ft) at the top of the blade tip. The rotor blade at its maximum height would be approximately 99.6 m (326.8 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.
- 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 so they should be visible during the day.

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, without obstacle lighting on the Project WTGs.**	
Residual Risk	5 – Tolerable

Table 12 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 would 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 Not installing obstacle lighting would completely remove the source of the impact. 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

12. CONCLUSIONS

The key conclusions of this AIA are summarised as follows:

12.1. Planning considerations

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

12.2. Aviation Impact Statement

- There is one certified airport located within 30 nm (56 km) of the Project Site, Kerang Airport (YKER):
  - The WTGs would not impact the OLS surfaces.
  - The WTGs would not impact the IFR circling areas.
  - The WTGs would impact the 10 nm MSA requiring it to be raised by 300 ft to 2100 ft.
  - The WTGs would impact the 25 nm MSA requiring it to be increased by 100 ft to 2100 ft or sectorised for the wind farm area. The increase in the 25 nm MSA would require a proportional increase in the commencement altitude, minimum holding altitude and final missed approach altitude for the approach procedures.
  - The WTGs would impact the RNP RWY 32 initial. All initial legs would need to be raised by 100 ft and the nominal flight path will need to be raised to 2100 ft.
  - The applicable approach procedures would require assessment by Global Airspace Solutions.
- The WTGs would impact two grid LSALTs:
  - The 2000 ft grid LSALT would need to be raised by 200 ft to 2200 ft
  - The 2100 ft grid LSALT would need to be raised by 100 ft to 2200 ft
- The WTGs would not impact any air route LSALT
- The Project Site is located within Class G airspace and outside all controlled airspace, Prohibited, Restricted and Danger areas
- The WTGs will not impact aviation navigation facilities
- The WTGs will not impact the ATC radar systems. The Project is outside the line-of-sight of the Mt Macedon enroute surveillance radar (RSR), which is the nearest radar, and would not impact this facility.
- The WTGs must be reported to CASA, and construction details must be provided to Airservices

12.3. Aircraft operator characteristics

Aircraft would 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 an aerodrome.

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

WMTs remain the primary safety concern to aerial agricultural operators, who have expressed a general desire for these towers to be more visible.

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.
- 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 aircraft has collided with a WTG in Australia.
- CASA will review the proposed WTG development and may make a recommendation regarding obstacle lighting.
- With respect to marking of WTGs, a low reflective off-white or white 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 13.

Table 13 Summary of Residual Risks

Identified Risk	*Consequence*	*Likelihood*	*Risk*	*Actions Required*
Aircraft collision with WTGs	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.

Identified Risk	*Consequence*	*Likelihood*	*Risk*	*Actions Required*
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.

CONSTRUCTION PHASE

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 above 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. Obstacles 30 m or more AGL should be reported to Airservices Australia as soon as the development reaches the maximum height, following the same process outlined in 2 above
5. 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.
6. 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

7. 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

8. It is not a formal requirement to light the WTGs. 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. CASA will determine whether obstacle lighting is recommended for the WTGs.

Marking of wind monitoring towers

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

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

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

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

Lighting of wind monitoring towers

10. Consideration should be given to lighting temporary and permanent WMTs installed prior to WTG installation and WMTs that are not in close proximity (within 900 m) to a WTG, with medium intensity steady red obstacle lighting at the top of the WMT mast. Characteristics for medium-intensity obstacle lighting are contained in MOS 139, Section 9.33.

Overhead transmission line

11. 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 Australian Standard AS 3891.2:2018.

Micrositing

12. 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

Triggers for review

13. 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

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

OPERATING PHASE

Aerial firefighting

14. Aerial firefighting is one component of firefighting operations, with standardised practices for aviation activities around wind farms. The developer or operator should consider the guidance contained in the National Council for Fire and Emergency Services, Wind Farms and Bushfire Operations to ensure:

    a. Liaison with the relevant fire and land management agencies is ongoing and effective

    b. Relevant WTGs are shut down immediately, or as soon as practicable, during emergency operations

c. 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 in some circumstances 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. If circumstances do not allow the above to be implemented, WTG blades can be feathered to effectively stop or reduce the rotation rate of the turbine to a very slow speed.

DECOMMISSIONING PHASE

15. Advice of removal of obstructions following decommissioning including coordinates and obstacle information should be provided to Airservices Australia, so they can be removed from the vertical obstacle database 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. This should be provided to Airservices Australia following decommissioning.
16. Any temporary construction equipment used in the decommissioning should be reported to Airservices Australia NOTAM office.

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
    - Aeronautical Information Package, effective 9 July 2026
    - Designated Airspace Handbook and Aeronautical Charts, effective 9 July 2026.
- Civil Aviation Safety Authority
    - Civil Aviation Regulations 1988 (CAR)
    - Civil Aviation Safety Regulations 1998 (CASR)
    - CASR Part 139 (*Aerodromes) Manual of Standards 2019 (as amended)*, 11 December 2025
    - CASR Manual of Standards Part 173– *Standards Applicable to Instrument Flight Procedure Design*, version 1.8, 11 August 2022
    - Advisory Circular (AC) 91-02 V1.2, *Guidelines for aeroplanes with MTOW not exceeding 5700 kg – suitable places to take off and land*, November 2022
    - Advisory Circular (AC) 91-10 v1.7: *Operations in the vicinity of non-controlled aerodromes*, April 2026
    - Advisory Circular 139.E-01 v1.0 —*Reporting of Tall Structures*, December 2021
    - Advisory Circular (AC) 139.E-05 v1.1 *Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome,* October 2022.
- Department of Infrastructure, Transport, Regional Development, Communications and Arts, Australian Government, National Airport Safeguarding Framework, Guideline D *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers*, dated July 2012.
- International Civil Aviation Organization (ICAO):
    - Annex 14—*Aerodromes*
    - Doc 8168 *Procedures for Air Navigation Services—Aircraft Operations* (PANS-OPS).
- OzRunways, dated April 2026
- Standards Australia, ISO 31000:2018 *Risk management – Guidelines*

ANNEXURE 2 – DEFINITIONS

Term	*Definition*
Aerial Agricultural Operator	Specialist pilot and/or company who are required to have a commercial pilot's licence, an agricultural rating and a chemical distributor's licence
Aerodrome	A defined area on land or water (including any buildings, installations, and equipment) intended to be used either wholly or in part for the arrival, departure, and surface movement of aircraft.
Aerodrome facilities	Physical things at an aerodrome which could include: 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.

Term	Definition
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 micrositing is confirmed and prior to construction.

International Civil Aviation Organisation

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

Annex 14 to the Convention – *Aerodromes, Volume 1,* Section 6.2.4 provides SARPs for the obstacle lighting and marking of 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 ☐ 25% cd with a vertical distribution as follows:*

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

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

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

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

4. *If, instead of obstacle marking, a flashing white light is used during the day to indicate temporary obstacles in the vicinity of an aerodrome, the peak effective intensity of the light must be increased to 20 000 ± 25% cd when the background luminance is 50 cd/m² or greater.*

Visual impact of night lighting

Annex 14 Section 6.2.4 and 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 5
LIKELIHOOD	ALMOST CERTAIN 5	6	7	8	9	10
	LIKELY 4	5	6	7	8	9
	POSSIBLE 3	4	5	6	7	8
	UNLIKELY 2	3	4	5	6	7
	RARE 1	2	3	4	5	6

Actions required

Actions required according to the derived level of risk are shown in Table 4.

Table 4 Actions Required

8-10	Unacceptable Risk	Immediate action required by either treating or avoiding risk. Refer to executive management as appropriate for Project Risk Framework.
5-7	Tolerable Risk	Treatment action possibly required to achieve As Low As Reasonably Practicable (ALARP). Relevant manager, as appropriate to the Project Risk Framework, 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 COORDINATES AND HEIGHTS

Table 14 WTG Coordinates and Heights

Reference file: WTG_260318.csv

WTG ID	Coordinates (X)	Coordinates (Y)	Base Elevation (m AHD) *	Tip Height (m AGL)	Max Height (m AHD)	Max Height (ft AMSL)
1	229939.8	6033483	78.1	252	330.1	1083.0
2	231185.7	6033466	78.2	252	330.2	1083.4
3	230598.3	6033309	78.2	252	330.2	1083.4
4	228864.5	6032823	78.2	252	330.2	1083.2
5	232026.9	6032711	78.6	252	330.6	1084.5
6	229801.1	6032616	78.5	252	330.5	1084.3
7	228193.7	6032431	78.4	252	330.4	1083.9
8	231453.9	6032428	78.6	252	330.6	1084.6
9	229249.1	6031877	78.6	252	330.6	1084.6
10	229709.8	6030908	78.8	252	330.8	1085.5
11	228941	6030710	78.8	252	330.8	1085.5
12	229440.2	6029895	79.2	252	331.2	1086.6
13	230624.6	6029718	79.3	252	331.3	1086.8
14	231450.1	6029697	79.1	252	331.1	1086.2
15	232783.9	6029450	79.6	252	331.6	1087.8
16	230031	6029326	79.2	252	331.2	1086.7
17	233665	6028457	80.0	252	332.0	1089.3
18	230850.2	6028449	79.7	252	331.7	1088.2
19	231612.4	6027769	79.9	252	331.9	1089.1
20	234290.5	6027681	79.9	252	331.9	1089.0
21	233244.9	6027296	79.6	252	331.6	1088.0
22	231171.4	6027169	80.0	252	332.0	1089.1
23	230676.3	6026426	80.0	252	332.0	1089.3
24	231257.7	6026100	80.2	252	332.2	1089.7
25	235446.3	6025470	80.2	252	332.2	1090.0
26	229908.8	6025146	80.7	252	332.7	1091.5

WTG ID	Coordinates (X)	Coordinates (Y)	Base Elevation (m AHD) *	Tip Height (m AGL)	Max Height (m AHD)	Max Height (ft AMSL)
27	228768.9	6025018	80.1	252	332.1	1089.5
28	228180.9	6024829	80.5	252	332.5	1090.9
29	241731.1	6024819	80.5	252	332.5	1090.9
30	230384.7	6024768	81.1	252	333.1	1092.7
31	236141.7	6024740	80.2	252	332.2	1090.0
32	242852.8	6024326	80.7	252	332.7	1091.6
33	242241	6024160	80.6	252	332.6	1091.3
34	235494.7	6024143	80.9	252	332.9	1092.3
35	236791	6023760	80.9	252	332.9	1092.1
36	234029.9	6023628	81.2	252	333.2	1093.1
37	229744.5	6023594	80.7	252	332.7	1091.7
38	243935.8	6023413	80.6	252	332.6	1091.2
39	243322.3	6023298	81.1	252	333.1	1092.8
40	227667.9	6023194	81.7	252	333.7	1094.7
41	242543.1	6023180	81.1	252	333.1	1092.8
42	226922	6023167	81.5	252	333.5	1094.0
43	226206.4	6023141	81.5	252	333.5	1094.2
44	241790	6023004	81.0	252	333.0	1092.6
45	228805	6022881	81.4	252	333.4	1093.8
46	240264.5	6022733	81.0	252	333.0	1092.4
47	237105.1	6022641	80.9	252	332.9	1092.3
48	236330.7	6022587	81.4	252	333.4	1093.9
49	234430.9	6022435	81.1	252	333.1	1092.9
50	230072.7	6022429	81.3	252	333.3	1093.6
51	239250.1	6022386	80.9	252	332.9	1092.2
52	224992.2	6022362	82.4	252	334.4	1097.0
53	227604.4	6022062	81.8	252	333.8	1095.1
54	229530.5	6021872	81.3	252	333.3	1093.6
55	226191	6021860	81.9	252	333.9	1095.5
56	237541	6021823	81.5	252	333.5	1094.0

WTG ID	Coordinates (X)	Coordinates (Y)	Base Elevation (m AHD) *	Tip Height (m AGL)	Max Height (m AHD)	Max Height (ft AMSL)
57	238132.8	6021820	81.1	252	333.1	1092.9
58	225628.2	6021817	81.9	252	333.9	1095.6
59	239785.5	6021758	81.3	252	333.3	1093.5
60	238757.8	6021728	81.3	252	333.3	1093.5
61	228831.3	6021679	81.5	252	333.5	1094.3
62	236491	6021660	81.7	252	333.7	1094.8
63	226790.4	6021318	82.8	252	334.8	1098.3
64	227781	6020925	82.1	252	334.1	1096.3
65	224841	6020760	82.1	252	334.1	1096.0
66	236350.7	6020663	82.0	252	334.0	1095.8
67	224242.3	6020359	82.3	252	334.3	1096.9
68	235754.9	6019992	82.4	252	334.4	1097.0
69	225471.1	6019967	82.6	252	334.6	1097.6
70	234592	6019954	82.2	252	334.2	1096.6
71	226592.3	6019915	82.7	252	334.7	1098.2
72	224975.4	6019546	82.5	252	334.5	1097.3
73	236344.9	6019472	82.6	252	334.6	1097.6
74	225888.3	6019087	83.0	252	335.0	1099.0
75	234934.9	6018836	82.2	252	334.2	1096.5
76	235581.8	6018642	82.8	252	334.8	1098.5
77	233452.9	6018601	82.7	252	334.7	1098.0
78	234242.7	6018591	82.5	252	334.5	1097.3
79	236917.9	6018365	83.1	252	335.1	1099.3
80	236276.8	6018342	82.9	252	334.9	1098.9
81	226376	6018116	83.3	252	335.3	1099.9
82	225112.2	6018103	83.3	252	335.3	1100.2
83	225715.2	6018011	83.5	252	335.5	1100.7
84	232974.2	6017771	83.2	252	335.2	1099.7
85	227891	6017660	83.0	252	335.0	1099.0
86	226182.2	6016992	83.9	252	335.9	1102.0

WTG ID	Coordinates (X)	Coordinates (Y)	Base Elevation (m AHD) *	Tip Height (m AGL)	Max Height (m AHD)	Max Height (ft AMSL)
87	225065.5	6016988	83.9	252	335.9	1102.0
88	232801.2	6016717	83.2	252	335.2	1099.6
89	224484.3	6016629	84.1	252	336.1	1102.6
90	225591.6	6016263	84.2	252	336.2	1102.9
91	228003	6016258	84.6	252	336.6	1104.3
92	232235.5	6016169	83.6	252	335.6	1101.1
93	224941	6015760	84.6	252	336.6	1104.2
94	229629.1	6015289	84.3	252	336.3	1103.5
95	225891	6015060	84.4	252	336.4	1103.8
96	227105.4	6014905	84.8	252	336.8	1105.1
97	230628.1	6014738	84.4	252	336.4	1103.5
98	230080.5	6014566	84.6	252	336.6	1104.4
99	225391	6014360	85.1	252	337.1	1106.0
100	226512.4	6014321	84.8	252	336.8	1105.0
101	227587.2	6014179	84.8	252	336.8	1104.9
102	225930.9	6013893	85.2	252	337.2	1106.4
103	224891	6013660	85.5	252	337.5	1107.4
104	227322.9	6012994	85.0	252	337.0	1105.8
105	226692.4	6012862	85.3	252	337.3	1106.6
106	225301	6012460	85.5	252	337.5	1107.3
107	230004.4	6012153	85.4	252	337.4	1107.0
108	225891	6012060	85.5	252	337.5	1107.3
109	227900.1	6011902	85.5	252	337.5	1107.3
110	226451.7	6011655	85.6	252	337.6	1107.7
111	231496.1	6010968	86.0	252	338.0	1109.0
112	230391	6010810	85.8	252	337.8	1108.2
113	230991	6010460	86.4	252	338.4	1110.2
114	231001.2	6009303	86.3	252	338.3	1110.0

* Base Elevation is from Aerial Lidar Survey with vertical accuracy of +/- 10 cm

Table 15 Permanent Met Mast Coordinates and Heights

Reference File: PPT_WMT_Masts_260318.csv

Met Mast ID	Coordinates (X)	Coordinates (Y)	Base Elevation (m AHD)	Mast Height (m AGL)	Max Height (m AHD)	Max Height (ft AMSL)
PP1	231424.5	6010540	86.2	166	252.2	827.6
PP2	230786.4	6033796	78.4	166	244.4	801.7
PP3	228754.7	6031867	78.7	166	244.7	802.7
PP4	236649.5	6019810	82.3	166	248.3	814.7
PP5	243571.4	6023681	80.7	166	246.7	809.4
PP6	225448.2	6012041	85.9	166	251.9	826.4
PP7	224632.5	6017057	83.9	166	249.9	819.8

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