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AVIATION IMPACT ASSESSMENT

DINAWAN WIND FARM

Prepared for EMM

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ACRONYMS

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

Spark Renewables Pty Ltd (Spark Renewables) proposes to develop the Dinawan Wind Farm (the Project). The Project includes the installation, operation, maintenance and decommissioning of up to approximately 200 wind turbine generators (WTGs) and associated infrastructure. The Project is on the traditional lands of the Wiradjuri people and several smaller nations of the Murrumbidgee plains, about halfway between the towns of Coleambally and Jerilderie. The Project lies within the Murrumbidgee and Edward River local government areas (LGAs) in New South Wales (NSW).

The Project is located within the South West Renewable Energy Zone (REZ), a region selected by the NSW Government for its significant potential for renewable energy generation and regional development.

The Project will connect to the Dinawan Substation, currently under construction as part of the Project EnergyConnect interconnector that will run between Robertstown in South Australia and Wagga Wagga in NSW. The substation and interconnector are a separate approved project that is being built by Transgrid.

The Project is a State significant development (SSD) pursuant to Schedule 1 of State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP). Accordingly, a development application (DA) and environmental impact statement (EIS) was submitted to the NSW Department of Planning, Housing and Infrastructure (DPHI) under Part 4 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). The EIS for the Project was publicly exhibited from 12 July 2024 to 8 August 2024.

Following the exhibition of the EIS, Spark Renewables has further refined the development footprint (including the WTG layout) and addressed feedback from key stakeholders with adjoining projects. As a result of these amendments to the project, an amendment report will be submitted to DPHI.

This Aviation Impact Assessment (AIA) forms part of the amendment report for the Project.

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.

Project description

Dinawan Wind Farm includes the following:

- Up to 200 WTGs with a maximum tip height of 280 m above ground level (AGL)
- Stage 1 – East: The ground elevation for the highest WTG location (WTG 125) is 112.5 m Australian height datum (AHD), which, with a 280 m WTG height, results in a maximum overall height of 392.5 m AHD (1287.7 ft above mean sea level (AMSL)).
- Stage 2 – West: The ground elevation for the highest WTG location (WTG 162) is 108.7AHD, which, with a 280 m WTG height, results in a maximum overall height of 388.7 m AHD (1275.1 ft AMSL).

Conclusions

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

Planning considerations

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

Certified airports

2. There is no certified airport located within 30 nm (56 km) from the Project

Obstacle Limitation Surfaces

3. The Project is located outside the horizontal extent of obstacle limitation surfaces (OLS) of any airport

Uncertified Aerodrome

4. There is one uncertified aerodrome within the Project Area – Goolgumbla Aerodrome. Spark Renewables will continue to engage with the owner of Goolgumbla Aerodrome in regard to the Project's potential impacts on the use of this facility.

Air Routes and Lowest Safe Altitude (LSALT)

5. The WTGs will impact the Grid LSALT, which need to be raised by 100 ft to 2300 ft AMSL
6. The WTGs will impact the air route LSALT:
    a. Q60, which need to be raised by 100 ft to 2300 ft AMSL.
    b. Q346, which need to be raised by 100 ft to 2300 ft AMSL.
    c. W419, which need to be raised by 200 ft to 2300 ft AMSL.
    d. W762, which need to be raised by 100 ft to 2300 ft AMSL.

Airspace

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

Aviation Facilities

8. The WTGs will not penetrate any protection areas associated with aviation facilities.

Radar

9. The Project Area is located outside of the Area of Interest for assessment of potential impact from the development on surveillance radar. The Project will not impact the Mt Babbara route surveillance radar (RSR) and Mt Macedon RSR radar.

Aviation Impact Statement (AIS)

10. Based on the WTG layout and maximum blade tip height of up to 280 m AGL, the blade tip elevation of the highest WTG, which is WTG 125, will not exceed 392.5 m AHD (1287.7 ft AMSL) and:
    a. There is no certified airport located within 30 nm (56 km) from the Project

b. There is one uncertified aerodrome within the Project Area – Goolgumbla Aerodrome. Spark Renewables will continue to engage with the owner of Goolgumbla Aerodrome in regard to the Project's potential impacts on the use of this facility

c. The WTGs will impact the Grid LSALT, which need to be raised by 100 ft to 2300 ft AMSL

d. The WTGs will impact the following air routes:

   i. Q60, which need to be raised by 100 ft to 2300 ft AMSL.

   ii. Q346, which need to be raised by 100 ft to 2300 ft AMSL.

   iii. W419, which need to be raised by 200 ft to 2300 ft AMSL.

   iv. W762, which need to be raised by 100 ft to 2300 ft AMSL.

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

f. The WTGs will not impact the aviation navigation facilities

g. The WTGs will not impact the closest ATC surveillance radar installations.

Obstacle lighting risk assessment

11. 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

12. Over the 15-year period between 2010-2025, no aircraft collided with a WTG or a wind monitoring tower (WMT) in Australia

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

Consultation

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

Consultation has already been completed as part of the EIS. Additional consultation will be completed as part of the relevant stakeholders' review of the amendment repro.

Summary of key recommendations

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

Notification and reporting

1. Details of WTGs exceeding 100 m 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)

2. 'As constructed' details of WTG coordinates and elevation should be provided to Airservices Australia, 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 above 100 m AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents. With respect to crane operations during the construction of the Project, a notification to the NOTAM office may include, for example, the following details:
    a. The planned operational timeframe and maximum height of the crane; and
    b. Either the general area within which the crane will operate and/or the planned route with timelines that crane operations will follow.
4. Details of the Project should be provided to local and regional aircraft operators prior to construction in order for them to consider the potential impact of the Project on their operations
5. To facilitate the flight planning of aerial application operators, details of the Project, including the 'as constructed' location and height information of WTGs and overhead transmission lines should be provided to landowners so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information
6. If this wind farm receives approval, Airservices Australia requests that the proponent advise the Vertical Obstacle team at VOD@airservicesaustralia.com of any requirement to increase Grid LSALT heights at least two (2) weeks prior to construction commencing.

Marking of WTGs and WMTs

7. The rotor blades, nacelle and supporting mast of the WTGs should be painted white, typical of most WTGs operational in Australia. No additional marking measures are required for WTGs
8. It is not mandatory to mark the WMTs however the following markings are recommended to be implemented in consideration of potential day VFR aerial work operations in accordance with NASF Guideline D:
    a. Obstacle marking for at least the top 1/3 of the mast and be painted in alternating contrasting bands of colour
    b. Marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires; and
    c. Guy wire ground attachment points in contrasting colours to the surrounding ground/vegetation.

Lighting of WTGs and WMTs

9. The recommendations for obstacle lighting on WTGs, in an aviation safety context, is outlined in the formal risk assessment process, as per NASF Guideline D guidance.
10. Consideration should be given to lighting temporary WMTs installed prior to WTG installation 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.

Micrositing

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

Aerial firefighting

12. 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. Access is available to the Project Area by emergency services for on-ground firefighting operations

    c. 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.

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.

1. INTRODUCTION

1.1. Situation

Spark Renewables proposes to develop the Dinawan Wind Farm. The Project includes the installation, operation, maintenance and decommissioning of up to approximately 200 WTGs and associated infrastructure. The Project is on the traditional lands of the Wiradjuri people and several smaller nations of the Murrumbidgee plains, about halfway between the towns of Coleambally and Jerilderie and lies within the Murrumbidgee and Edward River LGAs in NSW.

The project is within the South West REZ, a region selected by the NSW Government for its significant potential for renewable energy generation and regional development.

The Project will connect to the Dinawan Substation, currently under construction as part of the Project EnergyConnect interconnector that will run between Robertstown in South Australia and Wagga Wagga in NSW. The substation and interconnector are a separate approved project that is being built by Transgrid.

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Following the exhibition of the EIS, Spark Renewables has further refined the development footprint (including the WTG layout) and addressed feedback from key stakeholders with adjoining projects. As a result of these amendments to the project, an amendment report will be submitted to DPHI.

This Aviation Impact Assessment (AIA) forms part of the amendment report for the Project.

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.

1.2. Purpose and Scope

The purpose and scope of the work are to prepare an updated AIA with the latest layout for consideration by Airservices Australia, CASA, and the Department of Defence and support the development application.

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

- Department of Planning, Housing and Infrastructure – Wind Energy Guideline – November 2024
- National Airspace Safeguarding Framework Guideline D: *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers effective July 2012*
- CASR Part 139 – *Aerodromes*, Manual of Standards
- Specific requirements as advised by Airservices Australia.

1.3. Methodology

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

- Confirm the scope and deliverables

- Review client material
- Review relevant regulatory requirements and information sources
- Prepare a draft wind farm AIA with supporting technical data that provides evidence and analysis for the planning application to demonstrate that appropriate risk mitigation strategies have been identified. The draft AIA report will include an Aviation Impact Statement (AIS) for Airservices Australia and a qualitative risk assessment and applicable aspects for client review and acceptance before submission to external aviation regulators
- Identify risk mitigation strategies that may provide an acceptable alternative to night lighting for the wind farm. The risk assessment will be completed following the guidelines in ISO 31000:2018 Risk Management –Guidelines
- Consult with aviation regulators, consisting of Airservices Australia and the Department of Defence (if required)
- Consult with relevant Council (s) and aerodrome operators of the nearest aerodrome/s to seek endorsement of the proposal to change instrument procedures (if applicable)
- Consult/engage with stakeholders to negotiate acceptable outcomes (if required)
- Finalise the AIA report for client acceptance.

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 Area
- 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 en-route chart low (ERC-L) & en-route chart high (ERC-H) which are located near/over the Project Area 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 Area is located
- Any Special Use Airspace (SUA) in relation to the Project Area.

Navigation/Radar:

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

1.5. Material reviewed

The material provided by the Proponent for the preparation of this assessment includes:

- GIS Data of Dinawan Wind Farm
  - DevelopmentCorridorWind_02pg_EMM_20241213.shp
  - DevelopmentFootprintWind_03pg_EMM_20241213.shp
  - TurbineAndMetMast3D_20250114.shp
- WTG coordinates and ground elevation data
  - TurbineAndMetMast3D_20250114.xls.

2. BACKGROUND

2.1. Site Overview

The Dinawan Wind Farm includes WTGs and associated electrical infrastructure approximately halfway between Coleambally and Jerilderie within the South-West REZ in NSW.

The Project Area is within the Murrumbidgee and Edwards River LGAs of NSW.

The Project Area consists of two (2) project sections, designated Stage 1 - East and Stage 2 - West, as shown in Figure 1 (source: EMM, Google Earth).

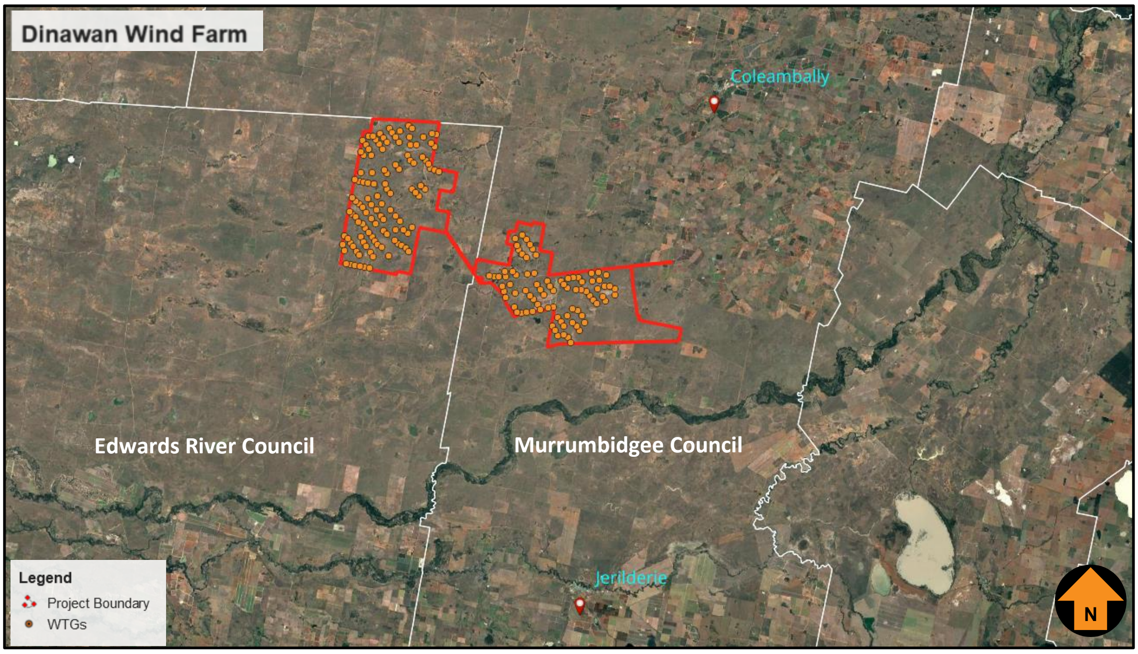

Figure 1 Project Area

2.2. Project Description

The Project involves constructing, operating, maintaining and decommissioning the Project, including a final layout of up to 200 WTGs.

The WTGs will have a rotor diameter of approximately 200 m, with a maximum tip height of 280 m AGL.

The ground elevation for the highest WTG location in Stage 1 – East (WTG 125) is 112.5 m AHD, which, with a 280 m WTG height, results in a maximum overall height of 392.5 m AHD (1287.7 ft AMSL).

The ground elevation for the highest WTG location in Stage 2 – West (WTG 162) is 108.7 m AHD, which, with a 280 m WTG height, results in a maximum overall height of 388.7 m AHD (1275.1 ft AMSL).

3. EXTERNAL CONTEXT

3.1. National Airports Safeguarding Framework

The National Airports Safeguarding Advisory Group (NASAG) was established by Commonwealth Department of Infrastructure, Transport, Regional Development, Communications 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 Area 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. Conargo Local Environmental Plan 2013

There are no relevant aviation safety considerations applicable to the Project under the Conargo Local Environmental Plan 2013, which applies to the portion of the Project within the Edward River LGA.

3.3. Jerilderie Local Environmental Plan 2012

There are no relevant aviation safety considerations applicable to the Project under the Jerilderie Local Environmental Plan 2012, which applies to the portion of the Project within the Murrumbidgee LGA.

3.4. Aircraft operations at non-controlled aerodromes

Advisory Circulars (ACs) provide advice and guidance from CASA to illustrate a means, but not necessarily the only means, of complying with the regulations or to explain certain regulatory requirements. AC 91-10 v1.1

Operations in the vicinity of non-controlled aerodromes provide guidance for pilots flying at or in the vicinity of non-controlled aerodromes with respect to CASR 91.

3.5. Civil Aviation Safety Authority (CASA)

CASA provides the following guidance to inform pilots of their obligations at non-certified aerodromes.

3.5.1. 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 v1.1, Operations in the vicinity of non-controlled aerodromes, dated November 2021

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 active runway or the runway most closely aligned into wind.

7.4.2 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.

7.7 Final approach

7.7.1 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 v1.1. are shown in Figure 2 and Figure 3.

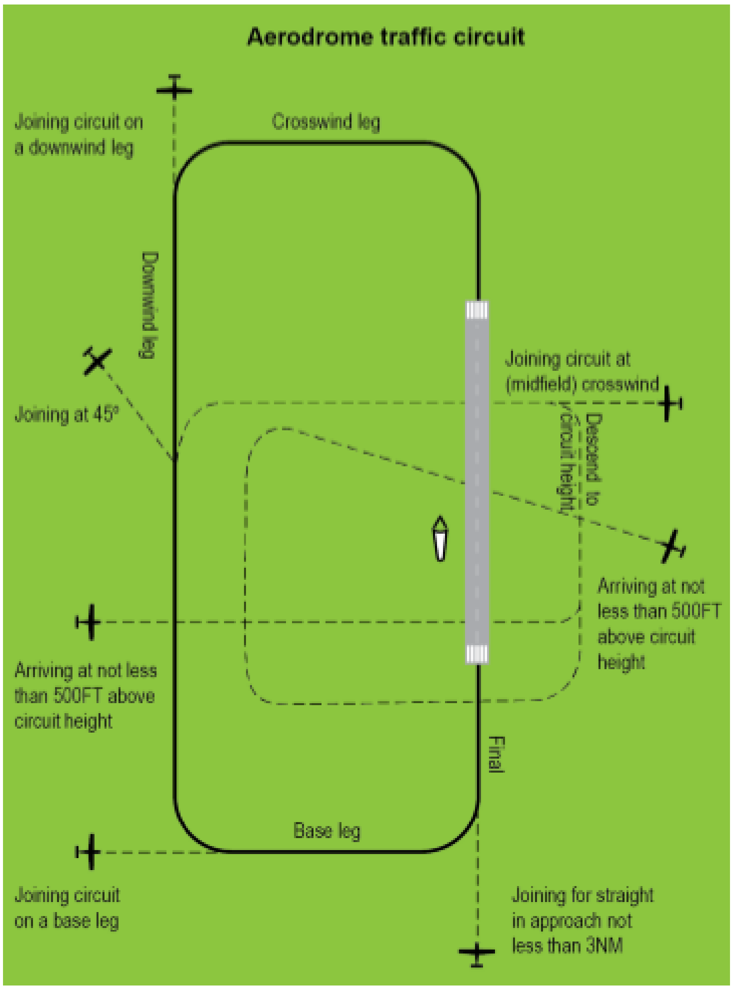

Figure 2 Aerodrome standard traffic circuit, showing arrival and joining procedures.

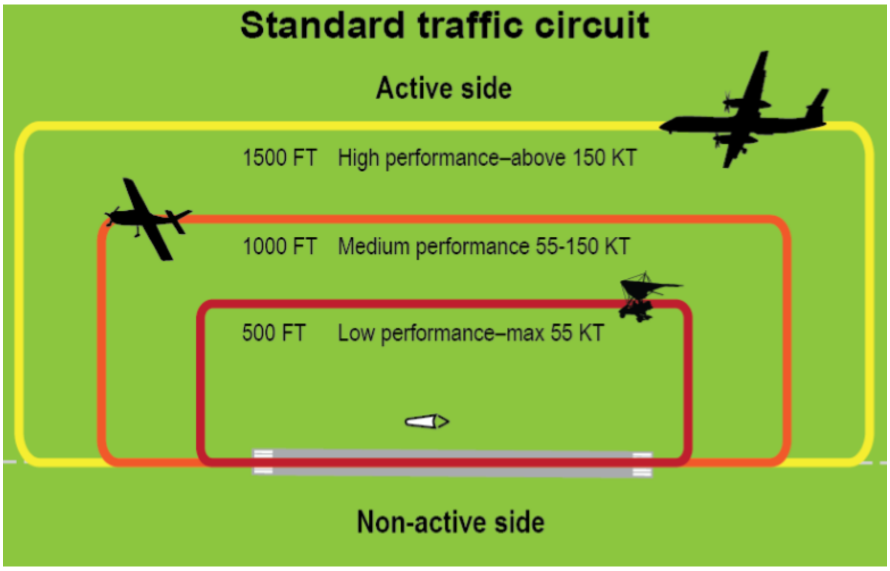

Figure 3 Lateral and vertical separation in the standard aerodrome traffic circuit

AC 91-10 v1.1. paragraph 7.10 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:

> *7.10 Departing the circuit area*
>
> *7.10.1 Aircraft should depart the aerodrome circuit area by extending one of the standard circuit legs or climbing to depart overhead. However, the aircraft should not execute a turn to fly against the circuit direction unless the aircraft is well outside the circuit area and no traffic conflict exists. This will normally be at least 3 NM from the departure end of the runway but may be less for aircraft with high climb performance. In all cases, the distance should be based on the pilot's awareness of traffic and the ability of the aircraft to climb above and clear of the circuit area.*

3.6. Rules of flight

3.6.1. Flight under Day Visual Flight Rules (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.

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

The Aerial Application Association of Australia (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.

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

3.11.1. Aerial Agricultural Association of Australia (AAAA)

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

> *As a result of the overwhelming safety and economic impact of wind farms and supporting infrastructure on the sector, AAAA opposes all wind farm developments in areas of agricultural production or elevated bushfire risk.*
>
> *In other areas, AAAA is also opposed to wind farm developments unless the developer is able to clearly demonstrate they have:*
>
> *1. consulted honestly and in detail with local aerial application operators;*
>
> *2. sought and received an independent aerial application expert opinion on the safety and economic impacts of the proposed development;*
>
> *3. clearly and fairly identified that there will be no short or long term impact on the aerial application industry from either safety or economic perspectives;*
>
> *4. if there is an identified impact on local aerial application operators, provided a legally binding agreement for compensation over a fair period of years for loss of income to the aerial operators affected; and*
>
> *5. adequately marked any wind farm infrastructure and advised pilots of its presence.*

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

> *At the development stage, AAAA remains strongly opposed to all windfarms that are proposed to be built on agricultural land or land that is likely to be affected by bushfire. These areas are of critical safety importance to legitimate and legal low-level operations, such as those encountered during crop protection, pasture fertilisation or firebombing operations.*
>
> *However, AAAA realises that some wind farm proposals may be approved in areas where aerial application takes place. In those circumstances, AAAA has developed the following national operational protocols to support a consistent approach to aerial application where windfarms are in the operational vicinity.*

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

3.11.2. Local aerial application operators

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

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

Based on previous studies 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 Area and on neighbouring properties, subject to final WTG locations and by implementing recommendations provided in this report at Section 12.

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

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

3.12. Emergency services

3.12.1. Royal Flying Doctor Service

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

3.12.2. Aerial firefighting

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

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

The Australasian Fire and Emergency Services Council (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.

4. INTERNAL CONTEXT

4.1. Wind farm site description

The Project Area is generally flat pastoral land.

A site visit was conducted on Thursday 17 August 2023. Travel was along public roads from Hay to Jerilderie including Jerilderie Road, North Boundary Road to Four Corners, Carrathool Road to Steam Plains, Mabins Well Road, McLennons Bore Road to Kidman Way to Bundure.

The area is generally flat scrub land with clumps of low grass and irregular tree coverage.

Figure 4 and Figure 5 show the area to the north of Steam Plains.

Figure 4 Project terrain north of Steam Plains along Carathool Road

Figure 5 Roadside cattle and general terrain along McLennons Bore Road

High tension powerlines run adjacent to the Project Area shown in Figure 6.

Figure 6 High Tension power line

Figure 7 Emus – "Dinawan"

4.2. Wind turbine generator (WTG) description

The Project Area will comprise up to 200 WTGs, the maximum blade tip height of which will be 280 m AGL

The ground elevation for the highest WTG location in Stage 1 – East (WTG 125) is 112.5 m AHD, which, with a 280 m WTG height, results in a maximum overall height of 392.5 m AHD (1287.7 ft AMSL).

The ground elevation for the highest WTG location in Stage 2 – West (WTG 162) is 108.7 m AHD, which, with a 280 m WTG height, results in a maximum overall height of 388.7 m AHD (1275.1 ft AMSL).

Figure 8 Illustrates the project layout identifying the highest WTG location of both stages, WTG 125 and WTG162 (source: Google Earth).

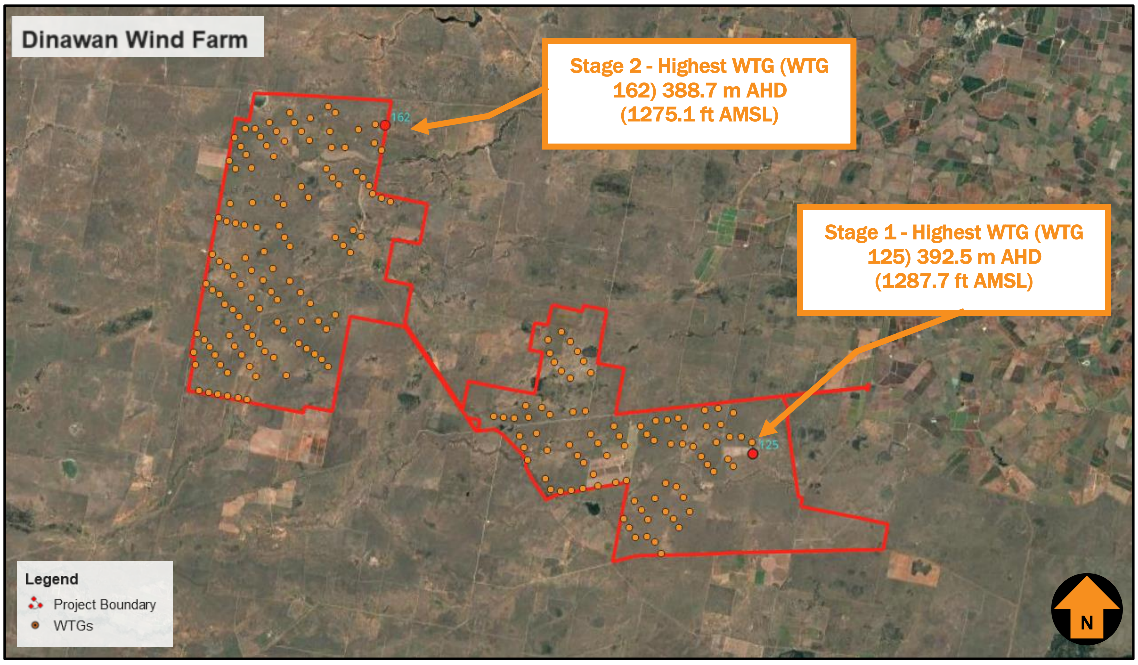

Figure 8 Project layout and highest WTG location

'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. 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 Project's maximum overall blade tip height. This AIA assumes a maximum blade tip height of 280 m AGL is implemented at all WTG locations.

4.3. Wind monitoring tower description

Nine (9) WMTs are proposed to be installed within the Project Area. Five (5) will be installed in Stage 1 and Four (4) in Stage 2. The location of the WMT is provided in Figure 9 (Source: EMM, Google Earth).

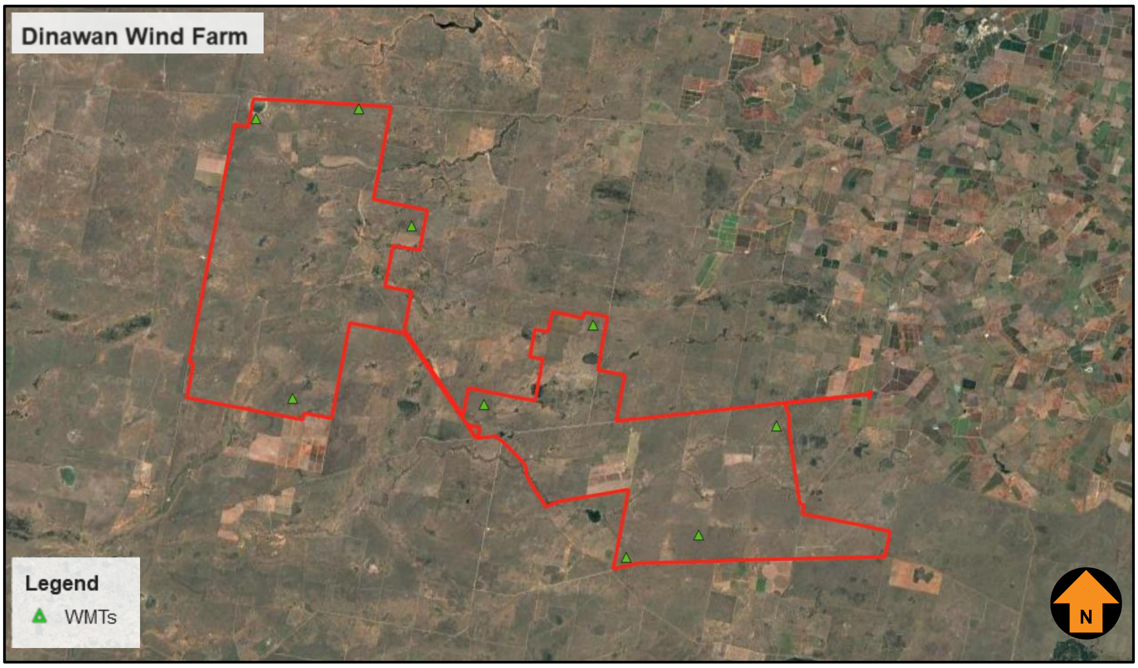

Figure 9 Location of the WMT

5. CONSULTATION

The following list of stakeholders were identified as requiring consultation:

1. Airservices Australia
2. Department of Defence
3. Owner of Goolgumbla Aerodrome

Aviation Projects has provided previous AIA (V1.0-040529) to Airservices Australia and Defence. Details and results of the consultation activities are provided in Table 1.

Spark Renewables will continue to engage with the owner of Goolgumbla Aerodrome in regard to the Project's potential impacts on the use of this facility.

Table 1 Stakeholder consultation details

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Action Proposed*
Airservices Australia	18 April 2024 Email Sent to Airservices Australia	03 June 2024 Email received from Alex Blight (Airspace Development & Protection Coordinator)	**Airspace Procedures** With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Doc 9905, at a height of 392.9m (1290ft) AHD, the wind farm will not affect any sector or circling altitude, nor any instrument approach or departure procedure at Narrandera aerodrome. The wind farm will affect the W419 air route. The W419 LSALT between VINOP and MAKIV will need to be increased to 2300ft. This change is not expected to adversely impact IFR operations. *The maximum height of the wind farm without affecting the W419 air route is 335.28m (1100ft) AHD.* Note: Procedures not designed by Airservices at Narrandera aerodrome were not considered in this assessment. **Grid lowest safe altitude (LSALT)** It is our view that the proposed wind farm will impact the published Grid LSALT.	Please advise the Vertical Obstacle Data (VOD) team at VOD@airservicesaustralia.com of any need to increase **Grid LSALT** heights at least two (2) weeks before construction commencing by supplying the below information: • Approved wind turbine locations • Elevations at the top of the highest point of the turbine in metres AHD • A copy of this email **Vertical Obstacle Notification** This proposed wind farm is more than 30m (99ft) AGL. Please follow the below notification process: 1. Complete the Vertical Obstacle Notification Form: ATS-FORM-0085_Vertical_Obstruction_Data_Form.pdf (airservicesaustralia.com) 2. Submit completed form to: VOD@airservicesaustralia.com as soon as the development reaches the maximum height.

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed
			The maximum height without affecting the published Grid LSALT is 365m (1199ft) AHD. **Communications/Navigation/Surveillance (CNS) Facilities** We have assessed the proposed activity to the above specified height for any impacts to Airservices Precision/Non-Precision Navigation Aids, Anemometers, HF/VHF/UHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links and have no objections to it proceeding. **Air Traffic Control (ATC) Operations** There are no additional instructions or concerns from our ATC. **Summary – W419 LSALT** It is our view that the proposed Dinawan Wind Farm impacts Airservices designed airspace procedures, CNS facilities or ATC operations. The W419 LSALT between VINOP and MAKIV will need to be increased to 2300ft. All amendments to airspace procedures are on a commercial basis. **Summary – Grid LSALT**	For further information regarding the reporting of tall structures, please contact the VOD team: • Phone - (02) 6268 5622 • Email - VOD@airservicesaustralia.com Or refer to: Civil Aviation Safety Regulation Part 175 – Airservices and You - Airservices (airservicesaustralia.com)

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed
			It is our view that the proposed Dinawan Wind Farm impacts Airservices designed Grid LSALT as currently presented. The Grid LSALT will need to increase to 2300ft.	
Department of Defence	18 April 2024		Nil response as of 28 January 2025	Response will be forwarded when received.
Goolgumbla Aerodrome	Ongoing consultation by Spark Renewables.			

6. AVIATION IMPACT STATEMENT

6.1. Overview

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

To facilitate these assessments, all wind farm proposals submitted to Airservices Australia must include an AIS.

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

- The operation of certified aerodromes within 30 nm of the wind farm
- The operation of nearby aircraft landing areas within 3 nm of the wind farm
- Grid and air route LSALTs
- Airspace protection
- Aviation navigation facilities
- ATC surveillance radar installations
- Local aircraft operations.

6.2. Nearby certified aerodromes

No Airport is certified under CASR Part 139 and within 30 nm of the Project Area. A few certified aerodromes and distances are listed below:

- Hay Airport (YHAY): Approximately 36 nm / 67.2 km northwest of the Project Area
- Deniliquin Airport (YDLQ) Approximately 38 nm / 70.6 km southwest of the Project Area
- Narrandera Airport (YNAR)Approximately 40.8 nm / 75.6 km northeast of the Project Area
- Griffith Airport (YGTH): Approximately 47 nm / 87.2 km northeast of the Project Area

The location of the Project Area relative to Hay Airport (YHAY), Griffith Airport (YGTH), Narrandera Airport (YNAR) and Deniliquin Airport (YDLQ) is shown in Figure 10 (Source: EMM, Google Earth). The orange circle around the airport represents a distance of 30 nm from the aerodrome reference point (ARP)of the airport.

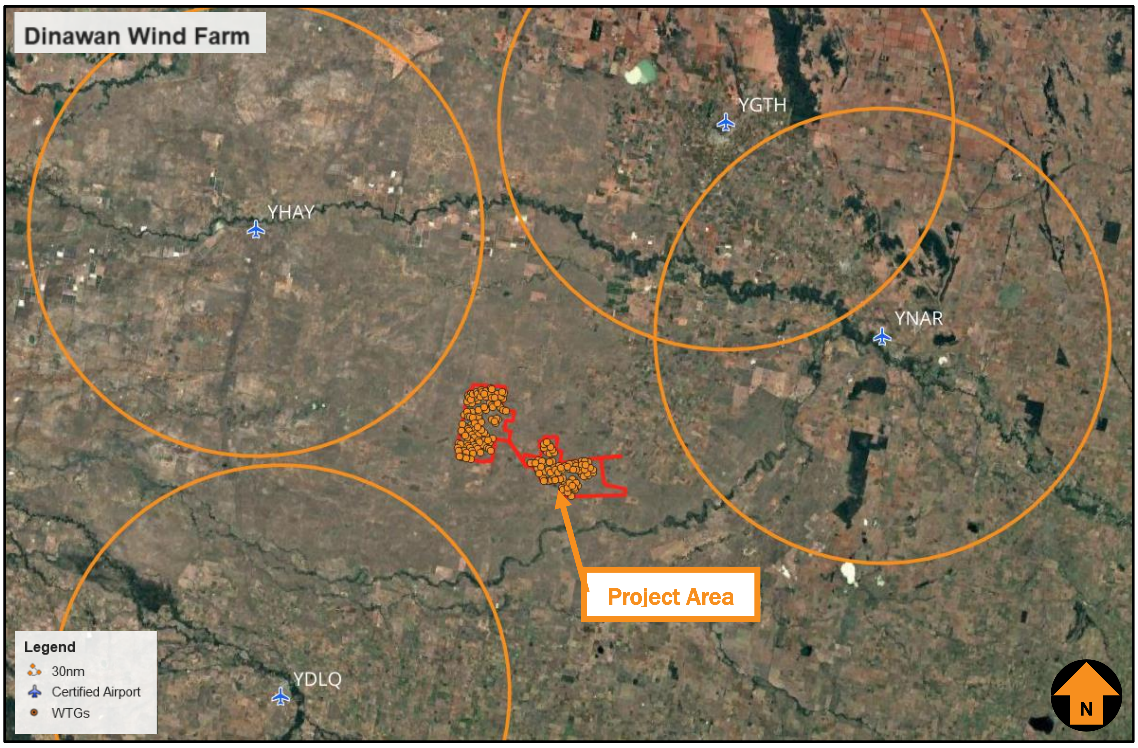

Figure 10 Location of Certified Airports in relation to Project Area

6.3. Nearby uncertified aerodromes

A search of various aviation datasets identified one uncertified aerodrome near the Project Area. Uncertified aerodromes are not subject to CASR Part 139 regulations.

The aviation datasets used for the search are:

- AIP aeronautical charts, effective 28 November 2024
- OzRunways - which sources its data from AIP. The aeronautical data provided by OzRunways is approved under CASR Part 175
- Australian Government National Map website (https://nationalmap.gov.au).

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.

Based on consultation with NSW National Parks and Wildlife Service, it is known that several aerial operations can occur in Oolambeyan National Park each year. NPWS use the old cricket pitch within the national park as an aircraft landing area. The distance between the old cricket pitch and the closest WTG is approximately 24 km. The distance between the national park boundary and the closest WTG is approximately 11 km. It beyond the 3 nm buffer from the Project Area.

Figure 11 Shows the location of nearby aerodrome relative to the Project Area and a nominal 3 nm buffer from the closer aerodromes (source: Google Earth).

Goolgumbla Aerodrome is the closest in relation to the proposed Project Area.

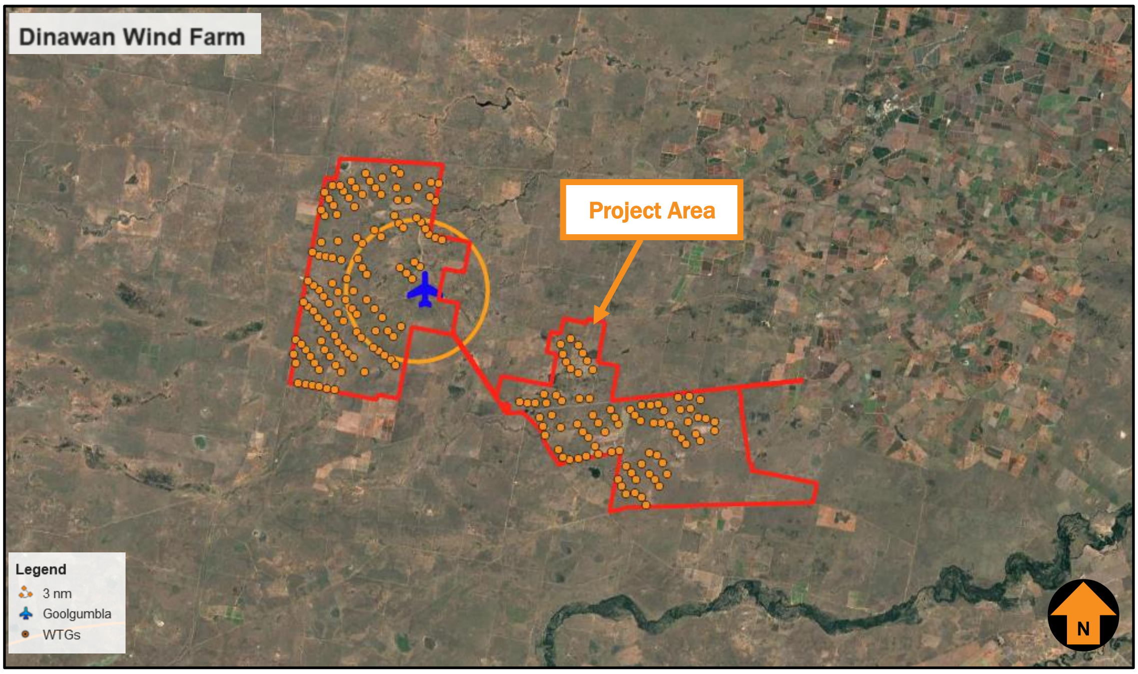

Figure 11 Aerodromes in the vicinity of the Project Area

6.3.1. Goolgumbla Aerodrome

Goolgumbla Aerodrome is located within the Project Area and is operated by a project landholder. Several WTGs are located within 3 nm of the Goolgumbla Aerodrome (Source EMM). These WTGs would be considered to create a hazard to flight safety and would restrict aircraft take-off and landing operations due to their height above the ground being approximately equivalent to the normal aircraft circuit heights (300 m AGL) (see Figure 12).

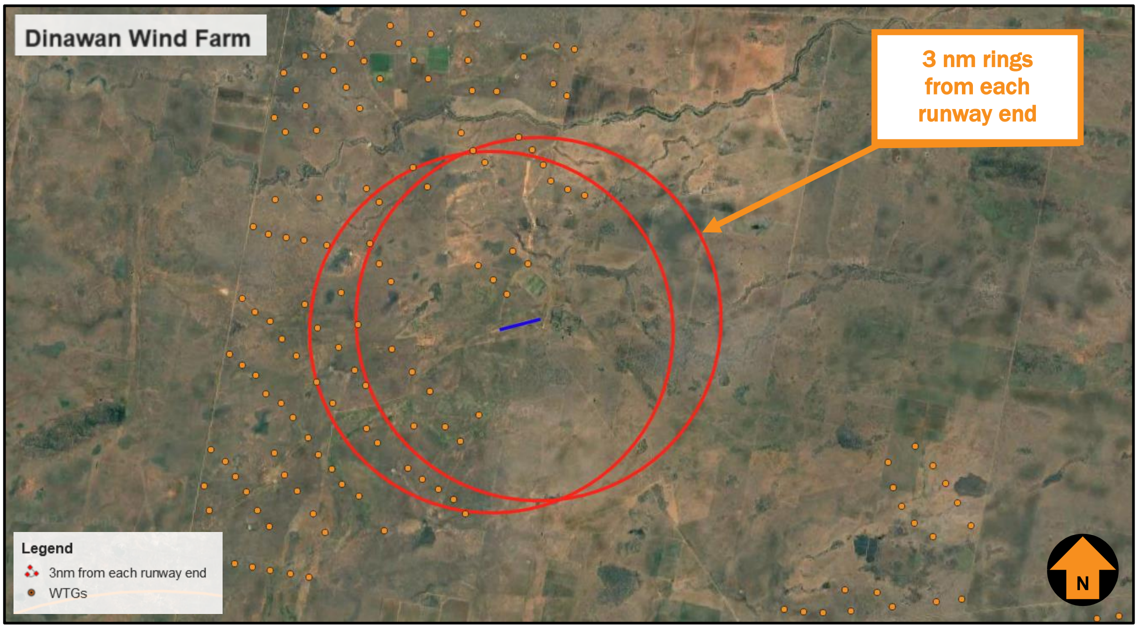

Figure 12 WTGs within 3 nm of Goolgumbla aerodrome

Three (3) of these WTGs are located within the typical 1 nm circuit area where aircraft prepare for landing at the aerodrome (see Figure 13). This has reduced from 7 WTGs to 3 WTGs as a result of the amendments to the WTG layout. These WTGs would create an adverse impact to take-off and landing operations at Goolgumbla aerodrome.

The owner of Goolgumbla aerodrome has indicated that they fly shorter circuit legs than the standard 1 nm circuit indicated in the CASA Advisory Circulars. Pilots may elect to fly shorter circuits than 1 nm but they must still comply with relevant aviation safety standards applicable to their operations.

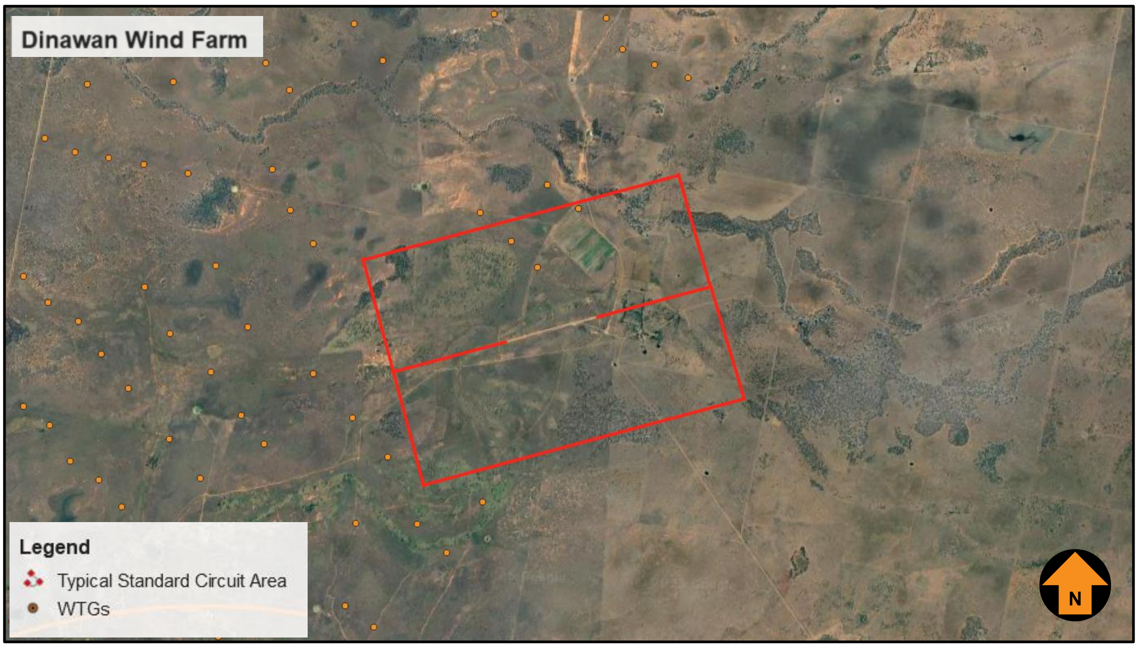

Figure 13 Goolgumbla aerodrome standard circuit area

Modern aerial application aircraft are also getting larger and require a prepared landing area, rather than a paddock of sufficient length. The locally based aerial application companies use Air Tractor AT-602 and AT-802 aircraft that have a maximum take-off weight in excess of 5500 kg, also limiting the availability of local paddocks for landing and take-off operations. Manoeuvrability of these aircraft at high take-off weights with a full load of chemicals would reduce the ability the avoid WTGs at these close distances.

6.4. Potential wake turbulence impacts

NASF Guideline D – *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers* provides guidance to State/Territory and local government decision makers, airport operators and developers of wind farms to jointly address the risk to civil aviation arising from the development, presence and use of wind farms and WMTs.

NASF Guideline D provides guidance regarding WTG wake turbulence which states:

> *Wind farm operators should be aware that wind turbines may create turbulence which noticeable up to 16 rotor diameters from the turbine. In the case of one of the larger wind turbines with a diameter of 150 metres, turbulence may be present two kilometres downstream. At this time, the effect of this level of turbulence on aircraft in the vicinity is not known with certainty. However, wind farm operators should be conscious of their duty of care to communicate this risk to aviation operators in the vicinity of the wind farm…*

The key wording in the NASF guidance is "*noticeable*" and that "*the level of turbulence in the vicinity is not known with certainty.*"

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

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

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

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

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

Assessment

A 200 m rotor diameter has been used for the wake turbulence analysis. Based on this scenario, NASF Guideline D suggests the effects of wake turbulence could be noticeable from the WTGs within 3200 m of the runway and the nominal circuit area, depending on wind direction.

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

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

Two of those studies are referred to below.

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

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

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

> *At University of Liverpool, a full CFD method [4] was used with the HMB solver to study wind turbine wakes. The CFD results showed good agreement for the blade surface pressure distributions and flow field velocities with the wind tunnel measurements. The wake was then solved on a very fine mesh*

able to capture the wake vortices up to 8 radii downstream of the blades on the MEXICO wind turbine rotor.

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

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

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

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

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

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

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

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

Table 2 Wake Turbulence Distances

1 RD (m)	*16 RD (m)*	*10 RD (m)*	*7 RD (m)*
200	3200	2000	1400

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

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

The downwind turbulence from WTGs beyond 7RD may be felt by the pilot of a light aircraft but the pilot will only need to make minor control adjustments to maintain control of the aircraft's attitude, altitude and heading. Such turbulence is likely to be classified as Light on an intensity scale published by the Australian Bureau of Meteorology shown in Figure 14.

Within the 7 RD boundary the turbulence is considered to create a medium hazard which is likely to equate to pilots experiencing "Moderate" turbulence in which the *"Pilot remains in control at all times."* (Figure 14)

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

Figure 14 Turbulence intensities[1]

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

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

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

6.4.1. Goolgumbla Aerodrome

Based on the 200 m rotor diameter the maximum extent of downwind wake turbulence referred to in the NASF guideline is 3200 m (see Figure 15).

[1] Bureau of Meteorology – Hazardous Weather Phenomena – Turbulence
[2] Bureau of Meteorology – Hazardous Weather Phenomena – Turbulence

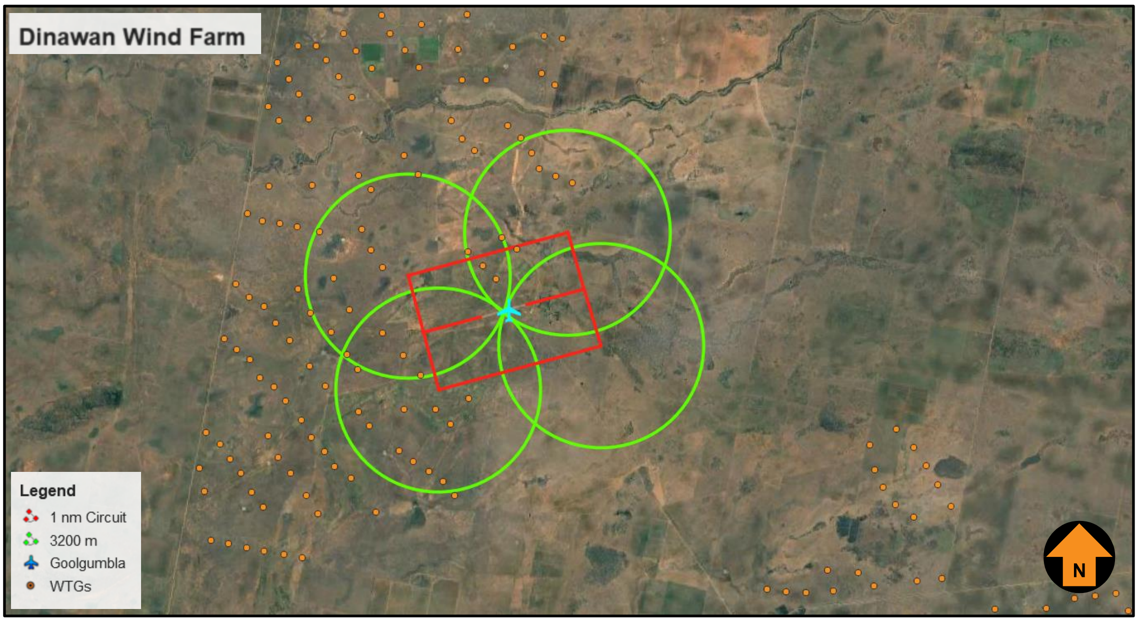

Figure 15 WTGs within 3200 m of Goolgumbla Aerodrome's standard circuit area

Aviation Projects, through detailed reviews of research, has determined that any adverse turbulence would most likely be confined to within 7 rotor diameters of a WTG, but considers that a conservative area of 10 rotor diameters is likely to be the maximum area where wake turbulence from WTGs would be felt by pilots operating downstream of a WTG.

For WTGs with a 200 m rotor diameter, this area would therefore extend to a distance of 2000 m.

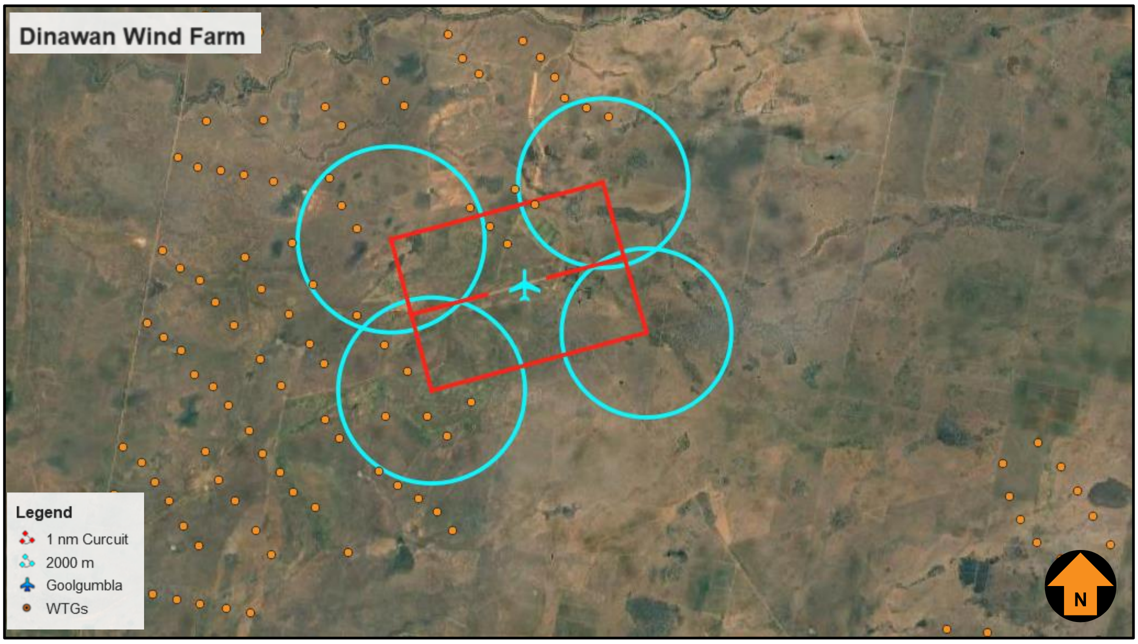

Figure 16 2000 m from the standard circuit area

Summary

Goolgumbla aerodrome and the typical circuit area is located within the area where downwind turbulence from the WTGs could occur.

Downwind turbulence from the WTGs may cause an impact to low level aircraft operations within 3200 m of a WTG, but more likely within only 2000 m.

Spark Renewables are progressing consultation with the Goolgumbla aerodrome owner (one of the wind farm landholders)to determine the best way forward in dealing with this situation. The landholder has indicated that they would prefer *"to leave 2 km either end of the runway heading 240 degrees 060 degrees by about 1 km wide for the airstrip"* (Source: email from David Richards 17 April 2024).

The owner of Goolgumbla aerodrome has indicated that they fly shorter circuit legs than the standard 1 nm circuit indicated in the CASA Advisory Circulars. Pilots may elect to fly shorter circuits than 1 nm but they must still comply with relevant aviation safety standards applicable to their operations.

6.5. Grid and Air routes LSALT

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

6.5.1. Grid LSALT

The Project Area is located within two airspace Grids, both with LSALT of 2200 ft AMSL, which provides clearance above obstacles with heights up to 1200 ft AMSL.

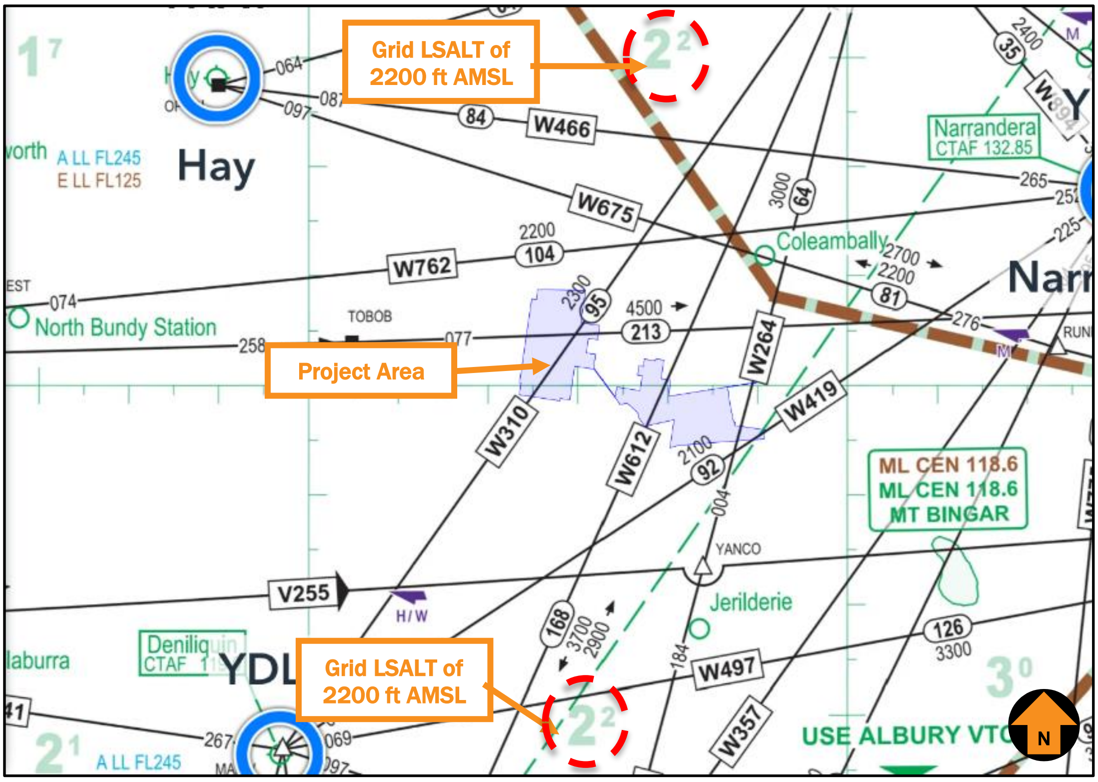

Figure 17 Grid LSALT in proximity to the Project Area

Figure 17 shows the grid LSALTs in proximity to the Project Area (source: ERC Low National, OzRunways, March 2025, Google Earth). An impact analysis of the Grid LSALT is provided in Table 3.

Table 3 Grid ISALT impact analysis

Grid ISALT	Protection Surface	Impact on airspace design	Potential solution	Impact on aircraft ops
2200 ft AMSL	1200 ft AMSL	Yes, the highest WTG (Stage 1 - WTG 125) will exceed by 26.7 m (87.7 ft)	LSALT raised by 100 ft	Minor

The highest WTG (Stage 1 - WTG 125) is 392.5 m AHD (1287.7 ft AMSL), higher than the 1200 ft obstacle height limit by 26.7 m (87.7 ft).

Therefore, the WTGs will impact the Grid LSALT. LSALTS would need to be raised in 100 ft increments, as a result both of the grid LSALTs will need to be raised by 100 ft to 2300 ft AMSL.

6.5.2. Air Route LSALTs

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

There is one air route within the protection area of the Project Area. An impact analysis of the air routes is provided in Table 4.

The highest WTG (Stage 1 T125 - East), at a maximum height of 392.5 m/1287.7 ft AMSL will infringe the W419, Q60 and Q346's LSALT requiring it to be raised to accommodate the WTGs.

The highest WTG (Stage 2 T162 - West), at a maximum height of 388.7 m/1275.1 ft AMSL will infringe the W762's LSALT requiring it to be raised to accommodate the WTGs.

Slight changes in LSALT altitudes are unlikely to cause large impact to the operators using them.

Table 4 Air route impact analysis

Air route	Waypoint pair	Route LSALT	Protection Surface	Impact on airspace design	Potential solution	Impact on aircraft ops
Q60	VG VOR to TOBOB	2200 ft AMSL	1200 ft AMSL	Yes, highest WTG (WTG 125) within the protection area will exceed by 26.7 m (87.7 ft)	LSALT raised by 100 ft	Minor
H21	NATYA to WG VOR	3200 ft AMSL	2200 ft AMSL	Nil	Nil	Nil
Q346	BORLI to UPNAP	2200 ft AMSL	1200 ft AMSL	Yes, highest WTG (WTG 125) within the protection area will exceed by 26.7 m (87.7 ft)	LSALT raised by 100 ft	Minor
H247	TOBOB to CULIN	4500 ft AMSL	3500 ft AMSL	Nil	Nil	Nil

Air route	Waypoint pair	Route LSALT	Protection Surface	Impact on airspace design	Potential solution	Impact on aircraft ops
W264	BORLI and YANCO	3000 ft AMSL	2000 ft AMSL	Nil	Nil	Nil
W310	BORLI and MAKIV	2300 ft AMSL	1300 ft AMSL	Nil	Nil	Nil
W419	MAKIV and VINOP	2100 ft AMSL	1100 ft AMSL	Yes, highest WTG (WTG 125) within the protection area will exceed by 57.2 m (187.7 ft)	LSALT raised by 200 ft	Minor
W612	CANTY and BORLI	2900 ft AMSL	1900 ft AMSL	Nil	Nil	Nil
W762	TREST and VINOP	2200 ft AMSL	1200 ft AMSL	Yes, highest WTG (WTG 162) within the protection area will exceed by 22.9 m (75.1 ft)	LSALT raised by 100 ft	Minor

6.6. Airspace Protection

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

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

6.7. Aviation facilities

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

The Project Area is located sufficient distance away from nearby certified airports and aviation facilities and will not have an impact.

6.8. ATC Surveillance Radar installations

Airservices Australia requires an assessment of the potential for the WTGs that may affect radar line of sight. The three closest radar facilities to the Project Area are:

- Mt Bobbara RSR, which is located approximately 261 km east of the Project Area
- Mt Macedon RSR, which is located approximately 275 km southeast of the Project Area.

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

Primary Surveillance Radar (PSR)

- Zone 1 0-500 m: Not permitted
- Zone 2 500 m – 15 km: Detailed assessment

- Zone 3: Further than 15 km but within maximum instrumented range and in radar line of sight: Simple assessment
- Zone 4: Anywhere within maximum instrumented range but not in radar line of sight or outside the maximum instrumented range: No assessment.

Secondary Surveillance Radar (SSR)

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

(Zone 3 is not established for secondary surveillance radar)

The Project Area is outside the line-of-sight range of Mt Babbara RSR and Mt Macedon RSR and will not impact these facilities.

6.9. AIS Summary

Based on the WTG layout and maximum blade tip height of up to 280 m AGL, the blade tip elevation of the highest WTG, which is WTG 125, will not exceed 392.5 m AHD (1287.7 ft AMSL) and;

- There is no certified airport located within 30 nm (56 km) from the Project Area
- There is one uncertified aerodrome within the Project Area – Goolgumbla Aerodrome. Spark Renewables will continue to engage with the owner of Goolgumbla Aerodrome in regard to the Project's potential impacts on the use of this facility.
- The WTGs will impact the two Grid LSALT, which need to be raised by 100 ft to 2300 ft AMSL.
- The WTGs will impact the following air route LSALTs:
    - Q60, which need to be raised by 100 ft to 2300 ft AMSL.
    - Q346, which need to be raised by 100 ft to 2300 ft AMSL.
    - W419, which need to be raised by 200 ft to 2300 ft AMSL.
    - W762, which need to be raised by 100 ft to 2300 ft AMSL.
- The Project Area is located within Class G airspace and outside all controlled airspace, Prohibited Restricted and Danger areas.
- The WTGs will not impact the aviation navigation facilities.
- The WTGs will not impact the closest ATC surveillance radar installations.

6.10. Assessment recommendations

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

1. Details of WTGs exceeding 100 m 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 139.165(1)(2)

2. 'As constructed' details of WTG coordinates and elevation should be provided to Airservices Australia, 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 above 100 m AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents. With respect to crane operations during the construction of the Project, a notification to the NOTAM office may include, for example, the following details:

   a. The planned operational timeframe and maximum height of the crane; and

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

4. Details of the Project should be provided to local and regional aircraft operators prior to construction in order for them to consider the potential impact of the Project on their operations

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

6. If this wind farm receives approval, Airservices Australia requests that the proponent advise the Vertical Obstacle team at VOD@airservicesaustralia.com of any requirement to increase Grid LSALT heights at least two (2) weeks prior to construction commencing.

Marking of WTGs and WMTs

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

8. It is not mandatory to mark the WMTs however the following markings are recommended to be implemented in consideration of potential day VFR aerial work operations in accordance with NASF Guideline D:

   a. Obstacle marking for at least the top 1/3 of the mast and be painted in alternating contrasting bands of colour

   b. Marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires; and

   c. Guy wire ground attachment points in contrasting colours to the surrounding ground/vegetation

Lighting of WTGs and WMTs

9. The recommendations for obstacle lighting on WTGs, in an aviation safety context, is outlined in the formal risk assessment process, as per NASF Guideline D guidance.

10. Consideration should be given to lighting temporary WMTs installed prior to WTG installation 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.

Micrositing

11. Providing the microsite is within 100 m of the planned WTGs, it is not likely to change the project's maximum overall blade tip height. No further assessment is likely to be required from the microsite, and the conclusions of this AIA would remain the same.

Aerial firefighting

12. 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. Access is available to the wind farm site by emergency services response for on-ground firefighting operations

    c. Wind turbines are shut down immediately during emergency operations – 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.

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

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

7. CUMULATIVE EFFECTS

The Environmental Planning and Assessment Act 1979 (EP&A Act) plays a central role in the NSW Government's statutory framework for managing cumulative impacts across NSW.

> *Cumulative impacts are a result of incremental, sustained and combined effects of human action and natural variations over time and can be both positive and negative. They can be caused by the compounding effects of a single project or multiple projects in an area, and by the accumulation of effects*

This section of the AIA addresses cumulative impacts to aviation activity in the area surrounding the Project Area.

The Project is within the South West REZ, a region selected by the NSW Government for its significant potential for renewable energy generation and regional development.

Within the REZ, many wind farms are under consideration by planning authorities.

In the area around the proposed Dinawan Wind Farm there are 2 other wind farms subject to State Significant Applications. They are:

- Yanco Delta Wind Farm located 10- 40 km north-west from Jerilderie (SSD-41743746) and adjacent to the Project Area. This Project was approved in December 2023.
- Argoon Wind Farm located off Liddles Lane (SSD-64935522) and adjacent to the Project Area. An EIS is not yet available for this wind farm.

A wind farm may create a requirement for aircraft operating at an uncertified aerodrome to limit the direction of its standard circuit patterns to one particular side of the runway. If another wind farm is to be located on that side of the runway it may cause the aerodrome to cease operations.

Wind turbines provide a prominent navigation feature for aircraft operating in accordance with the Visual Flight Rules prescribed in CASR Part 91 – General Operating and Flight Rules. They are shown on aeronautical charts and in electronic flight bag systems to enable pilots to be aware of their presence. Aircraft generally operate at a much higher altitude during the cruise phase of flight for fuel efficiency and passenger comfort.

Within an area related to the existence of downwind turbulence, aircraft operations at low altitudes may be impacted and restrict aircraft operations at aerodromes in this area.

A large number of wind farms in a particular region may impose limitations for property owners wishing to create a new aerodrome on their property.

Whilst several wind farms are being proposed in this REZ, none are constructed and not all will be approved and/or constructed.

Consultation with land owners and especially those with an aerodrome on their property, as well as local and regional emergency services will determine the extent of some cumulative impacts.

It is difficult to make a full assessment of the cumulative impacts to the aerodromes and aviation activity assessed in this AIA from the information available on NSW Planning Portal website

8. HAZARD LIGHTING AND MARKING

Based on the risk assessment set out in Section 10 it is concluded that aviation lighting is not required for WTGs and WMTs that are in close proximity to a WTG. Obstacle lighting is required for WMTs that are installed prior to WTG installation and WMTs that are not in close proximity to a WTG. For completeness, relevant lighting standards and guidelines are summarised in Annexure 3.

8.1. Wind monitoring towers (WMTs)

In terms of obstacle marking and lighting requirements, relevant requirements set out in MOS 139 and NASF are provided below.

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

> *8.109 Obstacles and hazardous obstacles*
>
> *(1) The following objects or structures at an aerodrome are obstacles and must be marked in accordance with this Division unless CASA determines otherwise under subsections (3) and (5):*
>
> > *any fixed object or structure, whether temporary or permanent in nature, extending above the obstacle limitation surfaces. Note an ILS building is an example of a fixed object;*
> >
> > *any object or structure on or above the movement area that is removable and is not immediately removed.*
>
> *8.110 Marking of hazardous obstacles*
>
> *(5) long, narrow structures like masts, poles and towers which are hazardous obstacles must be marked in contrasting colour bands so that:*
>
> > *(a) the darker colour is at the top; and*
> >
> > *(b) the bands:*
> >
> > > *i. are, as far as physically possible, marked at right angles along the length of the long, narrow structure; and*
> > >
> > > *ii. have a length ("z" in Figure 8.110 (5)) that is, approximately, the lesser of:*
> > >
> > > > *(A) 1/7 of the height of the structure; or*
> > > >
> > > > *(B) 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 be painted in alternating contrasting bands of colour. Examples of effective measures can be found in the Manual of Standards for Part 139 of the Civil Aviation Safety Regulations 1998. In areas where aerial agriculture operations take place, marker balls or high visibility flags can be used to increase the visibility of the towers;*
- *marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires;*
- *ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation;* ***or***
- *a flashing strobe light during daylight hours.*

For temporary WMTs installed prior to WTG installation and WMTs that are not in close proximity to a WTG, there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision provided obstacle lighting is fitted with medium intensity lighting at the top of the mast to ensure visibility in low light and deteriorating atmospheric conditions.

Characteristics of medium-intensity lights are specified in MOS 139 Section 9.33:

> *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.*
>
> *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.*

9. 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 considered.

9.1. 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.

9.2. ATSB occurrence taxonomy

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

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

9.3. National aviation occurrence statistics 2010-2019

The ATSB published a summary of aviation occurrence statistics for the period 2010-2019 (AR-2020-047, Final - 4 November 2020).

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

Of the 326 fatalities recorded in the 10-year period, almost two thirds (175 or 53.68%) occurred in the general aviation segment. On average, there were 1.51 fatalities per aircraft associated with a fatality in this segment. The fatalities to aircraft ratio ranges from 1.09 to 177:1. Whilst it can be inferred from the data that the majority of fatal accidents are single person fatalities, it is reasonable to assert that the worst credible effect of an aircraft accident in the general aviation category will be multiple fatalities.

A breakdown of aircraft and fatalities by general aviation sub-categories is provided in Table 5 (source: ATSB).

Table 5 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 18 refers to Fatal Accident Rate by operation type per million departures over the 6-year period (source: ATSB). Note the rates presented are not the full year range of the study (2010–2019). This was due to the availability of exposure data (departures and hours flown) which was only available between these years. According to the ATSB report, the number of fatal accidents per million departures for GA aircraft over the 6-year reporting period ranged between 6.6 in 2014 and 4.9 in 2019.

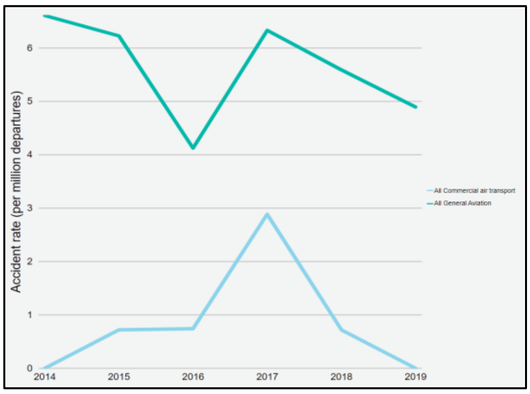

Figure 18 Fatal Accident Rate (per million departures) by Operation Type

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

In 2019, there were 1,760,000 landings, and 1,320,000 hours flown by VH-registered general aviation aircraft in Australia, with 8 fatal accidents and 17 fatalities. Based on these results, in 2019 there were 4.9 fatal accidents per million departures and 6.4 fatal accidents per million hours flown. A summary of fatal accidents from 2010-2019 by GA sub-category is provided in Table 6 (source: ATSB).

Table 6 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 10-year period and subsequently, no aircraft collided with a WTG or a WMT in Australia.

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

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

9.4. Worldwide accidents involving wind farms

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

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

Based on the Australia's Clean Energy Council statistics there were 110 wind farms in Australia 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 wind turbine generator (WTG) because the pilot believed his friend was working on the turbine. The aircraft collided with a tagline rope that was attached to a blade of the WTG and which was being held by a person working on the ground. The worker was thrown about 20 ft in the air and experienced significant non-life-threatening injuries. The aircraft sustained minor damage however the pilot landed the aircraft without further incident.
- One accident, which resulted in 2 fatalities, occurred in Palm Springs in 2001. This accident involved a wind farm but was not caused by the wind farm. The cause of the accident was the inflight separation of the majority of the right canard and all of the right elevator resulting from a failure of the builder to balance the elevators per the kit manufacturer's instructions. The accident occurred above a wind farm, and the aircraft struck a WTG on its descent and therefore the cause of the accident was not attributable to the wind farm and not applicable to this AIA.
- Two accidents involving collision with a WTG were during the day, as follows:
    - One accident occurred in Melle, Germany in 2017 as the result of a collision with a WTG mounted on a steel lattice tower at a very low altitude during the day with good visibility and no cloud. The accident resulted in one fatality. If the tower was solid and painted white, as is standard on contemporary wind farms, then it more than likely would have been more visible than if it were to be equipped with an obstacle light which in all likelihood would not have been operating during daylight with good visibility conditions.
    - One accident occurred in Plouguin, France in 2008 when the pilot decided to descend below cloud in an attempt to find the destination aerodrome. The aircraft was flying in conditions of significantly reduced horizontal visibility in fog where the top of the WTGs were obscured by cloud. The WTGs became visible too late for avoidance manoeuvring and the aircraft made contact with two WTGs. The aircraft was damaged but landed safely. No fatalities were recorded.
    - In both of the above cases, it is difficult to conclude that obstacle lighting would have prevented the accidents.
- One fatal accident, near Highmore, South Dakota in 2014 occurred at night in Instrument Meteorological Conditions (IMC).

There is one other accident mentioned in a database compiled by an anti-wind farm lobby group (wind-watch.org), which suggests a Cessna 182 collided with a WTG near Baraboo, Wisconsin, on 29 July 2000. The NTSB database records details of an accident involving a Cessna 182 that occurred on 28 July 2000 in the same area. For this particular accident, NTSB found that the probable cause of the accident was VFR flight into IMC encountered by the pilot and exceeding the design limits of the aircraft. A factor was flight to a destination alternate not performed by the pilot. No mention in the NTSB database is made of WTGs or a wind farm. Based on the statistics set out in the Global Wind Energy Council (GWEC) report 2016, there were 341,320 WTGs operating around the world at the end of 2016. In 2019, approximately 60.4 GW of wind power had been installed worldwide.

10. RISK ASSESSMENT

A risk management framework comprises 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.

10.1. Risk Identification

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

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

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

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

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

10.2. 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 7 through to Table 11.

Table 7 Aircraft collision with wind turbine generator (WTG)

<table>
<tr><td>Risk ID:</td><td colspan="2">1. Aircraft collision with wind turbine generator (WTG) (CFIT)</td></tr>
<tr><td colspan="3">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 9. These reports show a range of situations where pilots were conducting various flying operations at low level and in the vicinity of wind farms in both IMC and VMC. No reports of aircraft collisions with wind farms in Australia have been found.
In consideration of the circumstances that would lead to a collision with a WTG:
• GA VFR aircraft operators generally don't individually fly a significant number of hours in total, let alone in the area in question
• There is a very small chance that a pilot, suffering the stress of weather, will continue into poor weather conditions (contrary to the rules of flight) rather than divert away from it, is not aware of the wind farm, will not consider it or will not be able to accurately navigate around it
• If the aircraft was flown through the wind farm, there is still a very small chance that it would hit a WTG.
Refer to the discussion of worldwide accidents in Section 9.
There are no known aerial application operations conducted at night in the vicinity of the Project Area.
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 Area is clear of the OLS of any aerodrome.</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td colspan="2">Consequence</td><td>Catastrophic</td></tr>
<tr><td colspan="3">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 8). 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.</td></tr>
<tr><td colspan="2">Untreated Likelihood</td><td>Possible</td></tr>
</table>

Current Treatments (without lighting) • The Project Area is clear of the 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 will be a maximum height of 280 m (919 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 127.6 m (419 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft) • In the event that descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5,000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs • If cloud descends below the WTG hub (assumed to be approximately 200 m AGL), obstacle lighting would be obscured and therefore ineffective • At night, during visual flight, 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 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 • The 'as constructed' 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.
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. 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 Area b. 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. The level of risk with the implementation of the Recommended Treatments 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 Project WTG without obstacle lighting on the WTGs.**	
Residual Risk	7 - Tolerable

Table 8 Aircraft collision with WMT

Risk ID:	2. Aircraft collision with a WMT (CFIT)
Discussion An aircraft collision with a WMT would result in harm to people and damage to property. Any temporary and permanent WMTs will be marked and the top 1/3 of the WMTs painted in red/white/red bands of equal length. The final locations of the WMTs will be determined as part of the final construction design and the details will be reported to Airservices Australia. There are only a few instances of aircraft colliding with a WMT, but they were all during the day with good visibility, and no instance was in Australia. There are no known aerial application operations conducted at night in the vicinity of the wind farm. If a proposed object or structure is identified as likely to be an obstacle, details of the relevant proposal will be referred to CASA for CASA to determine, in writing: • Whether the object or structure will be a hazard to aircraft operations • Whether it requires an obstacle light that is essential for the safety of aircraft operations.	
Consequence If an aircraft collided with a WMT, the worst credible effect would be multiple fatalities and damage beyond repair. This would be a Catastrophic consequence.	
Consequence	Catastrophic
Untreated Likelihood There are a few occurrences of an aircraft colliding with a WMT, but all were during the day with good visibility when obstacle lighting would arguably be of no effect, and none were in Australia. It is assessed that collision with a WMT without obstacle lighting that would be effective in alerting the pilot to its presence is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.	
Untreated Likelihood	Possible
Current Treatments • CASA and Airservices Australia will be advised of the WMT locations prior to construction • Aircraft are restricted to a minimum height of 152.4 m (500 ft) AGL above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas • In the event that descending cloud forces an aircraft lower than 152.4 m (500 ft) AGL, the minimum visibility of 5,000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of the tower • Aircraft are restricted to a minimum height of 304.8 m (1,000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night)	

• Aircraft authorised to intentionally fly below 152.4 m (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities • If the WMTs will be higher than 100 m AGL, there is a statutory requirement to report them to CASA and Airservices Australia prior to construction.	
Level of Risk The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8.	
Current Level of Risk	8 - Unacceptable
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable
Recommended Treatments The following treatments which can be implemented at little cost will provide an acceptable level of safety: • Details of any WMTs when they are constructed should be advised to Airservices Australia • Consideration could be given to marking any wind monitoring towers according to the requirements set in MOS 139 Chapter 8 Division 10 Obstacle Markings (as modified by the guidance in NASF Guideline D); specifically: *8.110 (5) As illustrated in Figure 8.110 (5), long, narrow structures like masts, poles and towers which are hazardous obstacles must be marked in contrasting colour bands so that the darker colour is at the top; and the bands are, as far as physically possible, marked at right angles along the length of the long, narrow structure; and have a length ("z" in Figure 8.110 (5)) that is, approximately, the lesser of: 1/7 of the height of the structure; or 30 m.* *8.110 (7) Hazardous obstacles in the form of wires or cables must be marked using 3-dimensional coloured objects attached to the wire or cables. Note: Spheres and pyramids are examples of 3-dimensional objects. (8) The objects mentioned in subsection (7) must: be approximately equivalent in size to a cube with 600 mm sides; and be spaced 30 m apart along the length of the wire or cable.* • WMTs that are installed prior to WTG installation (Temporary WMTs) and WMTs that are not in close proximity to a WTG, should be fitted with a medium intensity steady red obstacle light at the top of the tower to ensure visibility in low light and deteriorated atmospheric conditions. Characteristics of medium-intensity lights are specified in CASR Part 139 MOS Section 9.33: *4) Medium-intensity obstacle lights must:* *c) Be visible in all directions in azimuth; and* *d) If flashing — have a flash frequency of between 20 and 60 flashes per minute.* *5) The peak effective intensity of medium-intensity obstacle lights must be 2 000 ☐ 25% cd with a vertical distribution as follows:* *d) For* ***vertical beam spread*** *— a minimum of 3 degrees;*	

e) *At -1 degree elevation — a minimum of 50% of the lower tolerance value of the peak intensity;* f) *At 0 degrees elevation — a minimum of 100% of the lower tolerance value of the peak intensity.* 6) *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* 7) *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.* • Ensure details of any additional WMTs at the Project Area have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators before, during and following construction.
Residual Risk With the additional Recommended Treatments listed above, the likelihood of an aircraft collision with a WMT resulting in multiple fatalities and damage beyond repair will be **Unlikely**, and the consequence remains **Catastrophic**, resulting in an overall risk level of **7 – Tolerable**. 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. Under these circumstances, the level of risk under the proposed treatment plan is considered **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 the Project permanent WMTs that are in close proximity to a WTG without obstacle lighting on the WMTs.** **For temporary WMTs installed prior to WTG installation and WMTs that are not in close proximity to a WTG, there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision provided obstacle lighting is fitted to ensure visibility in low light and deteriorating atmospheric conditions by aircraft operating during daylight hours.**

Residual Risk	7 - Tolerable

Table 9 Harsh manoeuvring leading to controlled flight into terrain

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

Discussion

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

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

The Project is clear of the OLS of any aerodrome.

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

The proposed WTGs will be a maximum of 280 m (919 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 127.6 m (419 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
- The 'as constructed' details of WTGs are required to be notified to Airservices Australia so that the location and height of WTGs can be noted on aeronautical maps and charts
- Since the WTGs will be higher than 100 m AGL, there is a statutory requirement to report the WTG to CASA.

Consequence

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

Consequence	Catastrophic

Untreated Likelihood

There are a few ground collision accidents resulting from manoeuvring to avoid WTGs, but none in Australia, and all were during the day (see Section 8). It is assessed that a ground collision accident following manoeuvring to avoid a WTG is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.

Untreated Likelihood	Possible

Current Treatments (without lighting)

- The Project is clear of the OLS of any aerodrome

• Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas • WTGs will be a maximum of 280 m (919 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 127.6 m (419 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft) • Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs • The WTGs and masts will be shown on aeronautical charts at the next publication cycle date available and NOTAMS prior to the publication date. This allows pilots to be aware of the existence of the wind farm at the pre-flight planning stage and during flight with reference to the aeronautical chart • If cloud descends below the WTG hub, obstacle lighting would be obscured and therefore ineffective • Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night) • Aircraft authorised to intentionally fly below 152.4 m AGL (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities • The WTGs are typically coloured white, typical of most WTGs operational in Australia, so they should be visible during the day • The 'as constructed' details of WTGs are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts • Since the WTGs will be higher than 100 m AGL, there is a statutory requirement to report the WTGs to CASA.

Level of Risk The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8.	
Current Level of Risk	8 – Unacceptable
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: • 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 Area.	
With the additional recommended treatments, the likelihood of ground collision resulting from manoeuvring to avoid a wind turbine resulting in multiple fatalities and damage beyond repair will be **Unlikely**, and the consequence remains **Catastrophic**, resulting in an overall risk level of **7 – Tolerable**. It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified. In the circumstances, the level of risk under the proposed treatment plan is considered **ALARP.** **It is assessed that there is an acceptable level of aviation safety risk associated with the potential for ground collision resulting from manoeuvring to avoid a Project WTG without obstacle lighting on the WTGs.**	
Residual Risk	7 – Tolerable

Table 10 Effect of the Project on operating crew

Risk ID:	4. 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 Area.		
Consequence The worst credible effect a wind farm could have on flight crew would be the imposition of operational limitations, and in some cases, the potential for use of emergency procedures. This would be a Minor consequence.		
	Consequence	Minor
Untreated Likelihood The imposition of operational limitations is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.		
	Untreated Likelihood	Possible
Current Treatments • The Project is clear of the OLS of any aerodrome. • Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas • The WTGs and masts will be shown on aeronautical charts at the next publication cycle date available and NOTAMS prior to the publication date. This allows pilots to be aware of the existence of the wind farm at the pre-flight planning stage and during flight with reference to the aeronautical chart • WTGs will be a maximum of 280 m (919 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 127.6 m (419 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft) • In the event that descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs • Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs • 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 • The 'as constructed' details of WTGs are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts • Since the WTGs will be higher than 100 m AGL, there is a statutory requirement to report the WTGs to CASA.	
Level of Risk The level of risk associated with a Possible likelihood of a Moderate consequence is 5.	
Current Level of Risk	5 - Tolerable
Risk Decision A risk level of 6 is classified as Tolerable: Treatment action possibly required to achieve ALARP - conduct cost/benefit analysis. Relevant manager to consider for appropriate action.	
Risk Decision	Accept, conduct cost benefit analysis
Recommended Treatments Given the current treatments and the limited scale and scope of flying operations conducted within the vicinity of the Project Area, there is likely to be little additional safety benefits to be gained by installing obstacle lighting for WTGs and Permanent WMTs which are in close proximity to WTGs. 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: • 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 Area.	
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 and Permanent WMTs in close proximity to a WTG, and with obstacle lighting for temporary WMTs installed prior to WTG installation and WMTs that are not in close proximity to a WTG.**	
Residual Risk	5 – Tolerable

Table 11 Effect of obstacle lighting on neighbours

Risk ID:	5. Effect of obstacle lighting on neighbours
Discussion This scenario discusses the consequential impact of a decision to install obstacle lighting on the wind farm. Installation and operation of obstacle lighting on WTGs 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 will be higher than 150 m (492 ft) AGL, they must be regarded as obstacles unless CASA assess otherwise. In general, objects outside an OLS and above 100 m would require obstacle lighting unless CASA, in an aeronautical study, assesses it is shielded by another lit object or it is of no operational significance.	
Level of Risk The level of risk associated with an Almost certain likelihood of a Moderate consequence is 8.	
Current Level of Risk	8 - Unacceptable
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable

Recommended Treatments As per the above safety risk assessment, the provision of lighting for the WTGs and permanent WMTs is not necessary to provide an acceptable level of safety. For temporary WMTs installed prior to WTG installation and WMTs that are not in close proximity to a WTG, obstacle lighting is recommended to ensure visibility in low light and deteriorating atmospheric conditions. If CASA or a planning authority decide that obstacle lighting is required there are impact reduction measures that can be implemented to reduce the impact of lighting on surrounding neighbours, including: • Reducing the number of WTGs with obstacle lights • Specifying an obstacle light that minimises light intensity at ground level • Specifying an obstacle light that matches light intensity to meteorological visibility • Mitigating light glare from obstacle lighting through measures such as baffling. These measures are designed to optimise the benefit of the obstacle lights to pilots while minimising the visual impact to residents within and around the Project Area. 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

11. CONCLUSIONS

The key conclusions of this AIA are summarised as follows:

11.1. Planning considerations

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

11.2. Aviation Impact Statement

Based on the WTG layout and maximum blade tip height of up to 280 m AGL, the blade tip elevation of the highest WTG, which is WTG 125, will not exceed 392.5 m AHD (1287.7 ft AMSL) and;

- There is no certified airport located within 30 nm (56 km) from the Project
- There is one uncertified aerodrome identified within 3 nm of the Project Area – Goolgumbla Aerodrome. Spark Renewables will continue to engage with the owner of Goolgumbla Aerodrome in regard to the Project's potential impacts on the use of this facility.
- The WTGs will impact the two Grid LSALT, which need to be raised by 100 ft to 2300 ft AMSL.
- The WTGs will impact the following air route LSALTs
    - Q60, which need to be raised by 100 ft to 2300 ft AMSL.
    - Q346, which need to be raised by 100 ft to 2300 ft AMSL.
    - W419, which need to be raised by 200 ft to 2300 ft AMSL.
    - W762, which need to be raised by 100 ft to 2300 ft AMSL.
- The Project Area is located within Class G airspace and outside all controlled airspace, Prohibited Restricted and Danger areas.
- The WTGs will not impact the aviation navigation facilities.
- The WTGs will not impact the closest ATC surveillance radar installations.

11.3. Aircraft operator characteristics

Aircraft will be required to navigate around the Project Area 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 only when the aircraft is within 3 nm of the aerodrome.

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

11.4. Hazard marking and lighting

The following conclusions apply to hazard marking and lighting:

- With respect to CASR Part 139 Division 139.E., the proposed WTGs must be reported to CASA

- CASA will review the proposed WTG development and make a recommendation for obstacle lighting if required.
- With respect to marking of WTGs, a white colour will provide sufficient contrast with the surrounding environment to maintain an acceptable level of safety while lowering visual impact to the neighbouring residents
- It is not mandatory to mark the WMTs, however the following markings are recommended to be implemented in consideration of potential day VFR aerial work operations in accordance with NASF Guideline D:
    a. Obstacle marking for at least the top 1/3 of the mast and be painted in alternating contrasting bands of colour
    b. Marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires; and
    c. Guy wire ground attachment points in contrasting colours to the surrounding ground/vegetation

11.5. Summary of risks

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

Table 12 Summary of Residual Risks

Identified Risk	*Consequence*	*Likelihood*	*Risk*	*Actions Required*
Aircraft collision with wind turbine generator (WTG)	Catastrophic	Unlikely	7	**Acceptable without obstacle lighting (ALARP).** Communicate details of the Project WTGs to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction.
Aircraft collision with wind monitoring tower (WMT)	Catastrophic	Unlikely	7	**Acceptable without obstacle lighting (ALARP).** Although there is no obligation to do so, consideration has been made for marking the WMTs according to the requirements set out in MOS 139 Chapter 8 Division 10 Obstacle Markings, specifically 8.110 (5), (7) and (8). Communicate details of WMTs to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes 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

Identified Risk	*Consequence*	*Likelihood*	*Risk*	*Actions Required*
				surrounding aerodromes before, during and following construction.
Effect on crew	Minor	Possible	5	**Acceptable without obstacle lighting (ALARP)** Communicate details of the Project WTGs and WMTs to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction.
Visual impact from obstacle lights	Moderate	Likely	7	**Acceptable without obstacle lighting** (zero risk of visual impact from obstacle lighting). If lights are installed, design to minimise impact.

12. RECOMMENDATIONS

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

Notification and reporting

1. Details of WTGs exceeding 100 m 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)
2. 'As constructed' details of WTG coordinates and elevation should be provided to Airservices Australia, 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 above 100 m AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents. With respect to crane operations during the construction of the Project, a notification to the NOTAM office may include, for example, the following details:
    a. The planned operational timeframe and maximum height of the crane; and
    b. Either the general area within which the crane will operate and/or the planned route with timelines that crane operations will follow.
4. Details of the Project should be provided to local and regional aircraft operators prior to construction in order for them to consider the potential impact of the Project on their operations
5. To facilitate the flight planning of aerial application operators, details of the Project, including the 'as constructed' location and height information of WTGs and overhead transmission lines should be provided to landowners so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information
6. If this wind farm receives approval, Airservices Australia requests that the proponent advise the Vertical Obstacle team at VOD@airservicesaustralia.com of any requirement to increase Grid LSALT heights at least two (2) weeks prior to construction commencing.

Marking of WTGs and WMTs

7. The rotor blades, nacelle and the supporting mast of the WTGs should be painted white, typical of most WTGs operational in Australia. No additional marking measures are required for WTGs
8. It is not mandatory to mark the WMTs however the following markings are recommended to be implemented in consideration of potential day VFR aerial work operations in accordance with NASF Guideline D:
    a. Obstacle marking for at least the top 1/3 of the mast and be painted in alternating contrasting bands of colour
    b. Marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires; and
    c. Guy wire ground attachment points in contrasting colours to the surrounding ground/vegetation.

Lighting of WTGs and WMTs

9. The recommendations for obstacle lighting on WTGs, in an aviation safety context, is outlined in the formal risk assessment process, as per NASF Guideline D guidance.
10. Consideration should be given to lighting temporary WMTs installed prior to WTG installation 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.

Micrositing

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

Aerial firefighting

12. 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. *Access is available to the wind farm site by emergency services response for on-ground firefighting operations*
    c. Wind turbines are shut down immediately during emergency operations – 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.

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.

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 20 March 2025.
    - Designated Airspace Handbook (DAH), effective 28 November 2024
- Australian Government, Department of Infrastructure, Transport, Regional Development, Communications and the Arts:
    - National Airport Safeguarding Framework, Guideline D *Managing the Risk To Aviation Safety of Wind Turbine Installation (Wind Farms)/Wind Monitoring Towers.*
- Civil Aviation Safety Authority
    - AC 139.E-01 v1.0—*Reporting of Tall Structures*, dated December 2021
    - AC 139.E-05 v1.1 *Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome* (October 2022)
    - AC 91-02 V1.2, *Guidelines for aeroplanes with MTOW not exceeding 5700 kg – suitable places to take off and land*, dated November 2022
    - AC 91-10 v1.1: *Operations in the vicinity of non-controlled aerodromes*, dated November 2021
    - Civil Aviation Regulations 1988 (CAR)
    - Civil Aviation Safety Regulations 1998 (CASR)
    - CASR Part 173 MOS– *Standards Applicable to Instrument Flight Procedure Design*, version 1.8, dated August 2022
    - CASR Part 139 MOS– *Aerodromes*, F2024C00161 registered 16/02/2024.
- International Civil Aviation Organization (ICAO):
    - Annex 14—*Aerodromes*
    - Doc 8168 *Procedures for Air Navigation Services—Aircraft Operations* (PANS-OPS).
- OzRunways, aeronautical navigation charts extracts, dated February 2025
- 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.

CASR 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*

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* <u>*at or below, an acceptable level*</u> *through a continuing process of hazard identification and safety risk management."*

Likelihood

Likelihood is defined in ISO 31000:2018 as the chance of something happening. Likelihood descriptors used in this report are as indicated in Table 1.

Table 1 Likelihood Descriptors

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

Consequence

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

Consequence descriptors used in this report are as indicated in Table 2.

Table 2 Consequence Descriptors

No	Descriptor	People Safety	Property/Equipment	Effect on Crew	Environment
1	Insignificant	Minor injury – first aid treatment	Superficial damage	Nuisance	No effects or effects below level of perception
2	Minor	Significant injury – outpatient treatment	Moderate repairable damage – property still performs intended functions	Operations limitation imposed. 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.
5-7	Tolerable Risk	Treatment action possibly required to achieve As Low As Reasonably Practicable (ALARP) - conduct cost/benefit analysis. Relevant manager to consider for appropriate action.
0-4/5	Broadly Acceptable Risk	Managed by routine procedures, and can be accepted with no action.

ANNEXURE 5 – PROJECT TURBINE COORDINATES AND HEIGHTS

Reference file: TurbineAndMetMast3D_20250114.xls

WTG ID	*Easting*	*Northing*	*Base Elevation (m AHD)*	*Tip Height (m AGL)*	*Max Height (m AHD)*	*Max Height (ft AMSL)*
Stage 1 East						
T119	385635.7216	6121581.741	112.0070038	280	392.0	1286.1
T12	373264.7578	6121957.007	108.5530014	280	388.6	1274.8
T36	375545.2347	6119498.439	108.7789993	280	388.8	1275.5
T100	382218.3312	6124231.896	111.0849991	280	391.1	1283.1
T78	379958.7703	6119232.61	109.3560028	280	389.4	1277.4
T14	373394.5352	6123787.077	109.0360031	280	389.0	1276.4
T109	383702.3614	6122071.702	111.211998	280	391.2	1283.5
T79	380071.3325	6123626.4	110.0439987	280	390.0	1279.7
T118	385357.9657	6123345.846	111.8860016	280	391.9	1285.7
T74	379389.4079	6120394.81	109.2509995	280	389.3	1277.1
T125	386743.3661	6122403.242	112.4980011	280	392.5	1287.7
T10	372970.6795	6122609.867	108.8460007	280	388.8	1275.7
T44	376158.7066	6119616.201	108.9940033	280	389.0	1276.2
T5	371942.6564	6123676.413	108.2060013	280	388.2	1273.6
T98	382342.6555	6120175.911	110.8170013	280	390.8	1282.2
T51	376837.8708	6119777.538	109.0299988	280	389.0	1276.3
T108	383753.2958	6124803.387	111.7300034	280	391.7	1285.2
T81	380114.9342	6117037.5	109.4300003	280	389.4	1277.7
T54	377152.1556	6123011.403	109.4810028	280	389.5	1277.8
T117	385476.6617	6124748.228	112.3310013	280	392.3	1287.2
T24	374655.3961	6124000.059	109.6019974	280	389.6	1278.2
T70	378772.1054	6120250.075	109.2809982	280	389.3	1277.2
T27	374600.0378	6120180.969	108.5899963	280	388.6	1274.9
T25	374633.9728	6121885.771	108.8580017	280	388.9	1275.8
T87	380873.6359	6122830.464	109.737999	280	389.7	1278.7
T56	377464.7472	6120651.062	109.1809998	280	389.2	1276.8

WTG ID	Easting	Northing	Base Elevation (m AHD)	Tip Height (m AGL)	Max Height (m AHD)	Max Height (ft AMSL)
T49	376760.0539	6124362.129	110.1119995	280	390.1	1279.9
T111	384139.6734	6121600.261	111.4769974	280	391.5	1284.4
T50	376837.6989	6121284.41	108.9160004	280	388.9	1276.0
T107	383223.7064	6118773.358	111.0400009	280	391.0	1282.9
T91	381320.8124	6116858.241	109.7129974	280	389.7	1278.6
T61	377748.5041	6119994.067	109.1119995	280	389.1	1276.6
T69	378456.4578	6123527.301	109.7890015	280	389.8	1278.8
T114	384567.9201	6124942.827	111.7529984	280	391.8	1285.3
T30	374991.1764	6119572.215	108.5179977	280	388.5	1274.7
T82	380409.3084	6118689.531	110.086998	280	390.1	1279.8
T103	382665.03	6117820.058	110.8560028	280	390.9	1282.3
T113	384535.0872	6121198.319	111.6240005	280	391.6	1284.9
T95	381581.0139	6124116.569	110.5820007	280	390.6	1281.4
T92	381695.6918	6116223.715	110.4980011	280	390.5	1281.2
T42	375918.3275	6122273.695	109.2419968	280	389.2	1277.0
T104	382620.8791	6123725.784	110.8470001	280	390.8	1282.3
T41	375986.8776	6124237.053	109.9869995	280	390.0	1279.5
T110	383912.6837	6123864.267	111.4240036	280	391.4	1284.2
T45	376435.1967	6121657.81	108.6320038	280	388.6	1275.0
T89	380922.5041	6124013.902	110.4029999	280	390.4	1280.8
T116	385299.1397	6122027.751	112.0759964	280	392.1	1286.3
T106	383204.7424	6122616.064	110.8850021	280	390.9	1282.4
T11	373191.0613	6124411.135	108.8659973	280	388.9	1275.8
T58	377597.4885	6122466.877	109.5630035	280	389.6	1278.1
T123	386654.6921	6123082.902	112.4509964	280	392.5	1287.6
T20	374152.5339	6124400.104	109.4749985	280	389.5	1277.8
T73	379378.9876	6118125.288	109.1829987	280	389.2	1276.8
T93	381702.2637	6120349.384	110.1259995	280	390.1	1279.9
T18	373931.4202	6122829.896	109.0199966	280	389.0	1276.3
T3	371344.2379	6123711.282	107.8789978	280	387.9	1272.6

WTG ID	Easting	Northing	Base Elevation (m AHD)	Tip Height (m AGL)	Max Height (m AHD)	Max Height (ft AMSL)
T15	373503.1003	6121264.894	108.6849976	280	388.7	1275.2
T64	378146.5658	6121797.101	109.6750031	280	389.7	1278.5
T101	382557.1561	6122713.036	110.6849976	280	390.7	1281.8
T72	379197.1386	6122427.814	109.7040024	280	389.7	1278.6
T105	382835.325	6119603.341	111.072998	280	391.1	1283.0
T77	379734.7975	6117631.806	109.1709976	280	389.2	1276.8
T71	378825.4895	6122973.647	109.7089996	280	389.7	1278.6
T120	386013.0286	6123353.493	112.3679962	280	392.4	1287.3
T86	380803.1695	6117131.229	109.5510025	280	389.6	1278.1
T85	380777.3625	6118177.772	110.0169983	280	390.0	1279.6
T8	372552.6525	6123685.988	108.6589966	280	388.7	1275.1
T83	380457.3652	6123209.228	109.9140015	280	389.9	1279.2
T88	381123.2462	6119464.417	110.0279999	280	390.0	1279.6
T99	382297.7845	6118303.276	110.7419968	280	390.7	1282.0
T94	381802.413	6118709.339	110.6090012	280	390.6	1281.5
T97	381895.631	6122709.627	110.3249969	280	390.3	1280.6
T28	374753.3052	6127089.508	110.2490005	280	390.2	1280.3
T33	375180.282	6126585.434	110.1159973	280	390.1	1279.9
T22	374463.1832	6127622.289	110.0009995	280	390.0	1279.5
T38	375757.5417	6126219.423	110.3320007	280	390.3	1280.6
T112	384588.1501	6122969.536	111.875	280	391.9	1285.7
T115	384742.8594	6124048.225	111.8199997	280	391.8	1285.5
T52	376909.4463	6126626.163	110.6429977	280	390.6	1281.6
T48	376457.6304	6127287.507	110.572998	280	390.6	1281.4
T37	375629.5718	6128387.827	111.3209991	280	391.3	1283.9
T43	376047.246	6127846.133	110.9039993	280	390.9	1282.5
T17	374271.241	6128401.662	110.7990036	280	390.8	1282.1
T31	375065.248	6128943.062	111.487999	280	391.5	1284.4
Stage 2 West						
T67	357485.1425	6138243.738	105.560997	280	385.6	1265.0

WTG ID	Easting	Northing	Base Elevation (m AHD)	Tip Height (m AGL)	Max Height (m AHD)	Max Height (ft AMSL)
T83	358365.9122	6133521.785	105.939003	280	385.9	1266.2
T57	357017.9346	6138864.133	105.2099991	280	385.2	1263.8
T49	356601.1539	6139353.757	104.8389969	280	384.8	1262.6
T147	362385.4991	6140110.343	108.3830032	280	388.4	1274.2
T47	356397.7667	6135430.474	105.3339996	280	385.3	1264.2
T76	358044.4889	6134143.846	105.8059998	280	385.8	1265.8
T27	355239.0582	6137382.814	104.5800018	280	384.6	1261.7
T21	354912.2071	6134235.477	105.0090027	280	385.0	1263.2
T152	362906.0611	6133817.188	107.7519989	280	387.8	1272.2
T158	363454.4599	6136372.089	107.7630005	280	387.8	1272.2
T121	360624.7404	6137695.551	106.9909973	280	387.0	1269.7
T89	358754.5225	6133007.033	106.0130005	280	386.0	1266.4
T160	363777.0872	6139009.682	108.288002	280	388.3	1273.9
T43	356186.7538	6137490.933	105.1449966	280	385.1	1263.6
T80	358244.9001	6135419.76	106.4120026	280	386.4	1267.8
T13	354431.0978	6134426.249	104.8379974	280	384.8	1262.6
T150	362813.2333	6137288.295	107.9449997	280	387.9	1272.8
T153	363171.1237	6136856.281	108.6029968	280	388.6	1274.9
T155	363336.3353	6139356.753	108.2210007	280	388.2	1273.7
T20	355049.2953	6135314.53	104.697998	280	384.7	1262.1
T29	355456.6198	6134170.888	105.1780014	280	385.2	1263.7
T41	356010.134	6134107.057	105.4160004	280	385.4	1264.5
T145	362315.0224	6132846.101	108.1350021	280	388.1	1273.4
T23	355095.7897	6139191.527	104.5279999	280	384.5	1261.6
T19	354874.4193	6137809.832	104.348999	280	384.3	1261.0
T53	356713.4316	6133999.147	105.2300034	280	385.2	1263.9
T36	355700.4322	6139749.24	104.7109985	280	384.7	1262.2
T28	355491.7369	6138694.813	104.4179993	280	384.4	1261.2
T37	355822.2123	6138235.556	104.9169998	280	384.9	1262.9
T106	359690.3511	6135969.608	106.1880035	280	386.2	1267.0

WTG ID	Easting	Northing	Base Elevation (m AHD)	Tip Height (m AGL)	Max Height (m AHD)	Max Height (ft AMSL)
T133	361368.5538	6133664.379	107.4520035	280	387.5	1271.2
T44	356265.0998	6139786.403	104.7419968	280	384.7	1262.3
T58	357090.6254	6140208.774	104.7360001	280	384.7	1262.3
T68	357522.7025	6139691.778	105.3539963	280	385.4	1264.3
T73	357837.3869	6135818.927	105.7969971	280	385.8	1265.7
T97	359201.712	6136529.265	106.4820023	280	386.5	1268.0
T149	362403.2065	6134160.27	108.0970001	280	388.1	1273.3
T142	361877.8666	6133240.514	107.5220032	280	387.5	1271.4
T82	358250.4916	6140841.252	105.4169998	280	385.4	1264.5
T75	358040.6738	6139187.008	105.9550018	280	386.0	1266.3
T102	359502.9037	6139287.884	106.5960007	280	386.6	1268.4
T129	361000.3008	6137164.176	106.6790009	280	386.7	1268.6
T134	361391.7973	6136813.167	106.3410034	280	386.3	1267.5
T148	362389.5073	6137655.96	107.6790009	280	387.7	1271.9
T88	358547.3493	6140313.852	105.7340012	280	385.7	1265.5
T101	359503.1651	6140642.765	106.4069977	280	386.4	1267.7
T122	360690.6503	6139927.396	107.7610016	280	387.8	1272.2
T127	360873.8212	6138982.295	107.2829971	280	387.3	1270.6
T94	359033.2947	6139824.789	105.9489975	280	385.9	1266.2
T119	360479.4141	6141348.57	106.75	280	386.8	1268.9
T128	360917.0085	6141049.84	107.1660004	280	387.2	1270.2
T139	361625.6268	6139025.629	107.5540009	280	387.6	1271.5
T162	363936.4043	6140456.442	108.6579971	280	388.7	1275.1
T161	363973.7666	6136159.859	107.848999	280	387.8	1272.5
T164	364514.6609	6135990.864	108.0739975	280	388.1	1273.2
T42	356148.573	6132162.467	105.9280014	280	385.9	1266.2
T51	356587.444	6131448.918	106.7929993	280	386.8	1269.0
T62	357265.368	6130888.847	106.2549973	280	386.3	1267.2
T71	357792.9678	6130235.825	105.9560013	280	386.0	1266.3
T78	358170.2705	6129795.968	105.875	280	385.9	1266.0

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WTG ID	Easting	Northing	Base Elevation (m AHD)	Tip Height (m AGL)	Max Height (m AHD)	Max Height (ft AMSL)
T61	357249.0797	6132574.029	105.6819992	280	385.7	1265.4
T26	355128.3554	6131564.117	105.9789963	280	386.0	1266.3
T113	360142.1858	6129712.821	106.6090012	280	386.6	1268.4
T103	359552.0789	6130295.657	106.2770004	280	386.3	1267.3
T90	358886.1874	6130955.747	107.2969971	280	387.3	1270.7
T15	354637.7828	6131829.948	106.1119995	280	386.1	1266.8
T33	355518.5342	6131066.013	105.0999985	280	385.1	1263.5
T39	355985.9453	6130555.621	105.836998	280	385.8	1265.9
T52	356669.2563	6129789.936	105.8980026	280	385.9	1266.1
T60	357197.9299	6129197.053	105.7699966	280	385.8	1265.6
T11	354349.7439	6130171.71	104.6159973	280	384.6	1261.9
T17	354778.6046	6129895.606	104.4400024	280	384.4	1261.3
T40	355991.21	6128666.678	105.2070007	280	385.2	1263.8
T72	357807.4315	6131632.864	106.0910034	280	386.1	1266.7
T56	356854.8944	6127591.377	104.9290009	280	384.9	1262.9
T48	356504.7248	6128089.612	105.8219986	280	385.8	1265.8
T10	354221.4468	6132224.171	104.9929962	280	385.0	1263.1
T131	361163.8272	6128260.46	106.6330032	280	386.6	1268.5
T141	361677.2916	6129096.901	107.1699982	280	387.2	1270.2
T105	359698.4132	6128632.89	106.4850006	280	386.5	1268.0
T111	360077.7413	6127017.518	105.8000031	280	385.8	1265.7
T104	359607.5459	6127323.52	105.788002	280	385.8	1265.7
T120	360570.8504	6126750.003	105.788002	280	385.8	1265.7
T130	361047.2847	6126453.807	105.7720032	280	385.8	1265.7
T137	361434.0856	6126047.474	105.7770004	280	385.8	1265.7
T81	358261.3528	6128468.284	105.1729965	280	385.2	1263.7
T87	358642.5374	6128051.808	105.6449966	280	385.6	1265.2
T63	357295.945	6127162.21	105.1969986	280	385.2	1263.8
T69	357634.4983	6126714.881	104.7870026	280	384.8	1262.4
T79	358161.4863	6126390.465	104.5899963	280	384.6	1261.8

WTG ID	Easting	Northing	Base Elevation (m AHD)	Tip Height (m AGL)	Max Height (m AHD)	Max Height (ft AMSL)
T92	359009.3692	6125382.033	104.9400024	280	384.9	1262.9
T32	355489.9961	6127540.898	104.6110001	280	384.6	1261.8
T38	355862.178	6126905.592	104.9729996	280	385.0	1263.0
T46	356267.784	6126424.814	104.7190018	280	384.7	1262.2
T55	356792.5783	6125755.734	104.8330002	280	384.8	1262.6
T7	353957.2871	6130482.018	104.4680023	280	384.5	1261.4
T64	357200.0278	6125211.292	104.8059998	280	384.8	1262.5
T3	353562.7557	6127533.171	103.8560028	280	383.9	1259.4
T12	354367.4684	6126765.265	104.1419983	280	384.1	1260.3
T18	354712.9953	6126323.3	104.2699966	280	384.3	1260.7
T24	355086.1366	6125764.908	104.0699997	280	384.1	1260.1
T45	356221.701	6123880.341	103.3590012	280	383.4	1257.7
T54	356778.0873	6123808.541	104.1839981	280	384.2	1260.4
T31	355489.9588	6125308.936	104.0500031	280	384.1	1260.0
T9	354015.893	6127202.433	104.2160034	280	384.2	1260.6
T1	353428.7178	6126419.835	103.5970001	280	383.6	1258.5
T4	353606.0441	6125688.339	103.6289978	280	383.6	1258.6
T14	354476.4726	6124105.559	103.5690002	280	383.6	1258.4
T22	355032.8567	6124033.742	103.3089981	280	383.3	1257.6
T34	355597.4701	6123960.897	103.9729996	280	384.0	1259.8
T6	353911.6399	6124178.449	103.4759979	280	383.5	1258.1
T35	355604.3259	6129081.431	105.0130005	280	385.0	1263.2
T25	355129.505	6129340.385	104.6940002	280	384.7	1262.1
T123	360664.724	6128680.35	106.0830002	280	386.1	1266.7
T156	363364.9181	6140506.611	108.6350021	280	388.6	1275.0

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