ERM

APPENDIX L AVIATION IMPACT ASSESSMENT

February 2024

AVIATION IMPACT ASSESSMENT

KERI KERI WIND FARM

Prepared for Environmental Resources Australia Pty Ltd

AVIATION PROJECTS

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1.0	Final	29 February 2024		

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ACRONYMS

AAAA	Aerial Agricultural 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

Acciona Energy Australia Global Pty Ltd (The Applicant) is proposing to develop the Keri Keri Wind Farm (the Project), located approximately 31 kilometres (km) southeast of Balranald, and 75 km southwest of Hay, NSW, within the Murray River Local Government Area (LGA).

Environmental Resources Australia Pty Ltd (ERM) has engaged Aviation Projects to prepare an Aviation Impact Assessment (AIA) for the Project to support the proposed application and formally consult with aviation agencies.

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

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

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

Project description

The Project involves the construction, operation, maintenance and decommissioning of the Keri Keri Wind Farm, as generally illustrated on Figure 2, including:

- *Up to 155 Wind Turbine Generators (WTG) with a hub height of 200 metres (m) and maximum height tip height of 291.5 m (vertical tip);*
- *Battery energy storage system (BESS) with capacity of approximately 200 megawatt (MW) / 800 MW hours (MWh);*
- *Electrical reticulation, on-site substations and switchyard; and*
- *Other ancillary infrastructure including (but not limited to) internal access tracks, road upgrades, meteorological masts, and operation and maintenance (O&M) buildings.*

Planning considerations

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

The Balranald Shire Council Local Environmental Plan does not incorporate any reference to the protection of aeronautical infrastructure.

Aviation Impact Assessment

Based on the Project WTG layout and maximum blade tip height of up to 291.5 m AGL, the blade tip elevation of the highest WTG, which is WTG4, will not exceed 361.9 m AHD (1187.6 ft AMSL) and:

- would not infringe any OLS surfaces
- would not infringe any PANS-OPS surfaces
- would have an impact on two grid LSALTs. The overlying 1700 ft Grid LSALT will need to be increased to 2200 ft AMSL. The overlying 1800 ft grid LSALT will need to be increased t to 2200 ft AMSL
- would have an impact on nearby designated air routes. W762 LSALT will need to be increased to 2200 ft AMSL. The LSALT for air route H247 will need to be increased to 2200 ft AMSL
- wake turbulence effects are unlikely to cause an adverse impact upon aircraft arriving at and operating within the standard circuit area at Jeraly Station ALA and Keri-Keri ALA. Consultation with the owners is underway
- would not have an impact on operational airspace
- would be wholly contained within Class G airspace
- would be outside the clearance zones associated with civil aviation navigation aids and communication facilities.

Obstacle lighting risk assessment

Aviation Projects has undertaken a safety risk assessment of the Project and concludes that WTGs and temporary/permanent WMTs that are installed in close proximity to a WTG will not require obstacle lighting to maintain an acceptable level of safety to aircraft.

Temporary WMTs that are installed prior to WTG installation, and WMTs that are not in close proximity to a WTG, will require obstacle lighting to maintain an acceptable level of safety.

Consultation

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

Summary of key recommendations

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

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

1. 'As constructed' details of WTG and WMT coordinates and elevations should be provided to Airservices Australia, using the following email address: vod@airservicesaustralia.com.
2. Department of Defence should be consulted if there is any subsequent modification in the wind turbine height or scale of development, using the following email address: land.planning@defence.gov.au;
3. To facilitate the flight planning of aerial application operators, the location and height of WTGs and WMTs should be provided to landowners so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information.
4. The Proponent should consider engaging with local aerial agricultural operators and aerial firefighting operators in developing procedures for such aircraft operations on the Project's neighbouring properties, noting that there is no statutory requirement to do so.
5. The rotor blades, nacelles and towers of the WTGs should be painted in white, typical of most wind turbines operational in Australia.
6. Consideration should be given to marking the temporary and permanent wind monitoring towers according to the requirements set out in Manual of Standards (MOS) 139 Section 8.10 (as modified by the guidance in NASF Guideline D). Aviation marker balls and painting the top 1/3 of WMTs structures in red and white bands is considered to be an acceptable mitigation strategy.
7. Consideration should be given to lighting WMTs installed prior to WTG installation and WMTs that are not in close proximity to a WTG, 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.

1. INTRODUCTION

1.1. Situation

Acciona Energy Australia Global Pty Ltd (The Proponent) is proposing to develop the Keri Keri Wind Farm (the Project), located approximately 31 kilometres (km) southeast of Balranald, NSW, within the Murray River Local Government Area (LGA).

Aviation Projects was engaged to prepare an Aviation Impact Assessment (AIA) for the Project to support the proposed application and formally consult with aviation agencies.

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

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

1.2. Purpose and Scope

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

The assessment specifically responds to the:

- Draft Murray River Local Environment Plan (LEP) 2021
- Wakool LEP 2013
- NSW Government, Department of Planning Housing and Infrastructure (DPHI) SEARS, April 2022
- Civil Aviation Safety Authority, *Civil Aviation Safety Regulations 1998* (CASR)
- Civil Aviation Safety Authority, Advisory Circular (AC) 139.E-05 v1.0 *Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome*
- NASF Guideline D: *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers*
- Other specific requirements as advised by Airservices Australia.

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

1.3. Methodology

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

1. Confirm the scope and deliverables with the Proponent (or representative)
2. Review client material
3. Review relevant regulatory requirements and information sources
4. Prepare a draft AIA and supporting technical data that provides evidence and analysis for the planning application to demonstrate that appropriate risk mitigation strategies have been identified
5. Prepare an AIS and a qualitative risk assessment to determine need for obstacle lighting and marking
6. Identify risk mitigation strategies that provide an acceptable alternative to night lighting. The risk assessment was completed following the guidelines in *ISO 31000:2018 Risk Management – Guidelines*
7. Consult with relevant Councils, Part 173 procedure designers (Airservices Australia) and aerodrome operators of the nearest aerodrome/s to seek endorsement of the proposal to change instrument procedures (if applicable)
8. Consult/engage with stakeholders to negotiate acceptable outcomes (if required)
9. Finalise the AIA report for client acceptance when responses received from stakeholders for client review and acceptance.

1.4. Aviation Impact Statement (AIS)

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

Aerodromes:

- Specify all certified aerodromes that are located within 30 nm (55.6 km) of the project site
- Nominate all instrument approach and landing procedures at these aerodromes
- Review the potential effect of the Project operations on the operational airspace of the aerodrome(s)

Air Routes:

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

Airspace:

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

Navigation/Radar:

- Nominate radar navigation systems with coverage overlapping the site.

1.5. Material reviewed

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

- Attachment 1 KK_LAY_001_0018 – KK layout map.pdf
- Wind Combined Agency Advice.pdf
- Wind Issued SEARS_14042022_120011.pdf
- Geodetic data package dated 220824
- Geodetic data package dated 220831
- 20230104_PCV.shp
- IPAUSNSWXXKER20230704.shp
- KKWF_WTG and WMT Data_20240227.xlsx.

2. BACKGROUND

2.1. Site overview

The Project site is located 31 km southeast of Balranald in New South Wales.

An overview of the Project site relative to Balranald NSW is provided in Figure 1 (source: ERM, Google Earth).

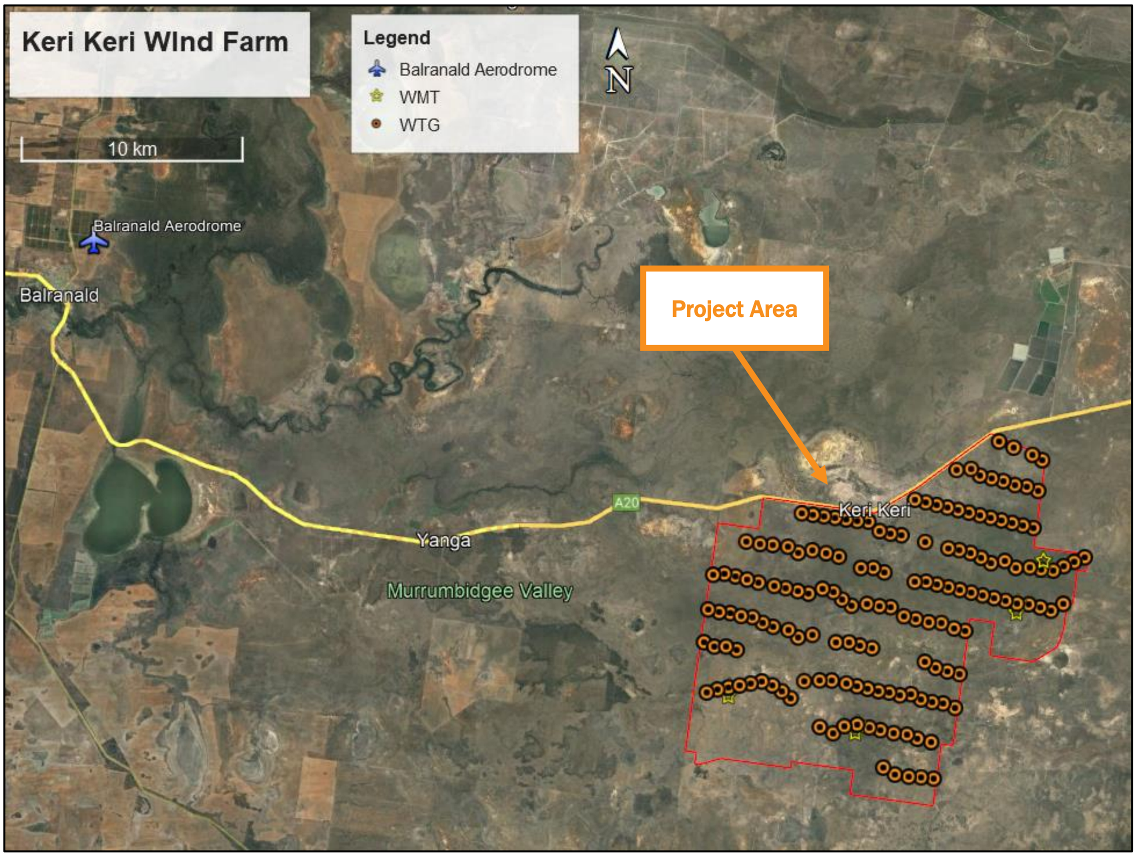


Figure 1 Project site overview

2.2. Project Description

The Project involves the construction, operation, maintenance, and decommissioning of a wind farm, with up to 155 wind turbine generators (WTGs), together with associated and ancillary infrastructure.

The Project consists of the following key components:

- *Up to 155 WTGs, each comprising:*
    - *Three blades mounted to a rotor hub (hub height of 200 m) on a nacelle above a tubular steel tower, with a blade tip height (blade length plus hub height) of up to 291.5 m AGL;*
    - *A gearbox and generator assembly housed in the nacelle; and*
    - *Adjacent hardstands for use as crane pads, assembly and laydown areas;*

- *Electrical infrastructure comprising:*
    - *One 33/330 kV electrical substation and two 132 kV collector substations, including control room, communications tower, transformers, circuit breakers, switches, lighting protection and other ancillary equipment;*
    - *A battery energy storage system (BESS) of up to 200 MW/800 MWh (approximately four hours of storage);*
    - *71.8 km of overhead 33 kV and 259.6 km of underground 33 kV electrical reticulation connecting the WTGs to the onsite substations (where practicable, these are generally following site access tracks);*
    - *23.1 km of 330 kV overhead transmission line connecting the three substations to a new electrical switchyard (including circuit breakers, switches and other ancillary equipment) to provide connection to the planned NSW-SA interconnector, Project EnergyConnect currently under construction;*
- *Ancillary infrastructure*:
    - Four site access points with one along Sturt Highway and three along Keri Keri Road;
    - *Three operations and maintenance (O&M) facilities and four security huts;*
    - *Four biosecurity wash bays;*
    - *Internal access tracks connecting the WTGs and associated Project infrastructure with the public road network;*
    - *Decommissioning of four temporary meteorological monitoring masts and installation of up to four permanent meteorological monitoring masts for power testing. The permanent monitoring masts will be located close to a WTG location and will have a maximum height of approximately 159 m AGL; and*
- *Upgrades to public roads and intersections required for the delivery of oversize and overmass (OSOM) WTG components, transformers and associated construction-phase materials and vehicular movements.*
- *The following temporary elements will be required during the construction phase of the Project:*
    - *Two temporary construction site compounds, comprising site buildings and facilities for construction contractors / equipment, site offices, car parking and amenities for the construction workforce;*
    - *Mobile concrete batching plants to supply concrete for WTG footings and substation construction works;*
    - *Earthworks for access tracks, WTG platforms and foundations;*
    - *Borrow pit and rock crushing facilities for the generation of suitable aggregate for concrete batching and/or for access track and hardstand construction;*
    - *One workers' accommodation compound and carpark;*
    - *Hardstand laydown areas for the storage of construction materials, plant, and equipment;*
    - *Up to four temporary meteorological monitoring masts. The temporary monitoring masts will be located close to a WTG location with a maximum height of approximately 159 m AGL;*

- *External water supply and storage for concrete batching and construction activities;*
- *The transport, storage and handling of fuels, oils and other hazardous materials for construction and operation of wind farm infrastructure; and*
- *Beneficial reuse of materials won from within the Disturbance Footprint during cut and fill and WTG foundation excavation works for use in access track, hardstands and foundation material.*

Ultimately the project will be decommissioned and the Project Area will be rehabilitated.

Project Component	*Description*	*Quantity*
Project footprint		
Project Area	Total area to which the Application applies	18,012 ha
Disturbance Footprint	The area of land that is directly impacted by the Project including: all temporary and permanent disturbance areas; and all areas where vegetation may be removed during project construction and operation.	Up to 1,152 ha
Permanent Disturbance Footprint	The area of land that will be subject to permanent alteration as a result of the Project's infrastructure until decommissioning.	Up to 585 ha
WTGs		
Rotor diameter	183 m	155 WTGs
Blade length	91.5 m	
Uppermost blade tip	291.5 m	
Tower (hub) height	200 m	
WTG hardstand	Approx. 701 m^2 per WTG required for construction. Approx. 374 m^2 per WTG during operation after rehabilitation.	
Ancillary Infrastructure		
New 330 kV transmission line	Towers up to 70 m high, spaced approx. 500 m (subject to terrain), with 60 m easement	23.1 km
Underground 33 kV lines	Trenching for underground electrical lines will be approx. 0.6 m wide per circuit by 1.0 m deep.	259.6 km
Overhead 33 kV lines	Where ground conditions are not suitable for open cut trench installation, overhead single circuit electricity lines will be installed using concrete poles, with 30 m easement	71.8 km
33/330 kV Substation	200 m x 300 m + 35 m APZ all sides	1
132 kV Collector Substation	200 m x 300 m + 35 m APZ all sides	2

Project Component	Description	Quantity
Switchyard	200 m x 300 m + 35 m APZ all sides	1
200 MW/800 MWh BESS	400 m x 300 m + 35 m APZ all sides	1
O&M Facility including carpark	100 m x 100 m + 35 m APZ all aides	3
Security hut	20 m x 20 m at site access point	4
Biosecurity wash bays	70 m x 110 m at site access point	4
New internal access tracks and drainage	Approximately 15 m wide formation including 5.5 m roadway plus shoulders and drainage as required.	151.4 km
Transport route and site access	Site access off Keri Keri Road and Sturt Highway. Upgrades will be required at several locations along the route.	N/A
Permanent meteorological masts (with concrete footings for mast and guy wires)	Sensor height at 159 m on approximately 3 m x 3 m concrete foundation.	4
Temporary Facilities		
Concrete batching plants	150 m x 100 m + 15 m batters	2
Laydown Areas	200 m x 150 m + 15 m batters	3
Borrow pit	200 m x 200 m + 15 m batters	1
Construction compound (site office, car parking and storage areas)	100 m x 100 m + 15 m batters	2
Temporary meteorological masts (with concrete footings for mast and guy wires)	Sensor height at 159 m on approximately 3 m x 3 m concrete foundation.	4
APZ requirements	Min. 20 m per meteorological mast Min. 20 m all sides of buildings	N/A
Other Project elements		
Duration and start of construction phase	Commencing late 2027 for approximately 24 months Peak construction activities to occur over approximately 12 months Mechanical completion: Late 2029 Testing/commissioning completion: Late 2029	
Construction hours	Monday to Friday: 7.00 am to 6.00 pm; Saturday: 8.00 am to 6.00 pm; and No works on Sunday or public holidays.	
Construction workforce	Up to 400 FTE	
Duration of operation phase	30 years	

Project Component	Description	Quantity
Operational workforce	Approximately 12 long-term service and maintenance jobs will be created during Project operation.	
Decommissioning	2055 or later subject to approval	
Capital investment	$2.8 billion AUD	
Net reduction in greenhouse gas emissions	2.6 million tonnes CO² equivalent per annum	

The project layout is depicted in Figure 2.

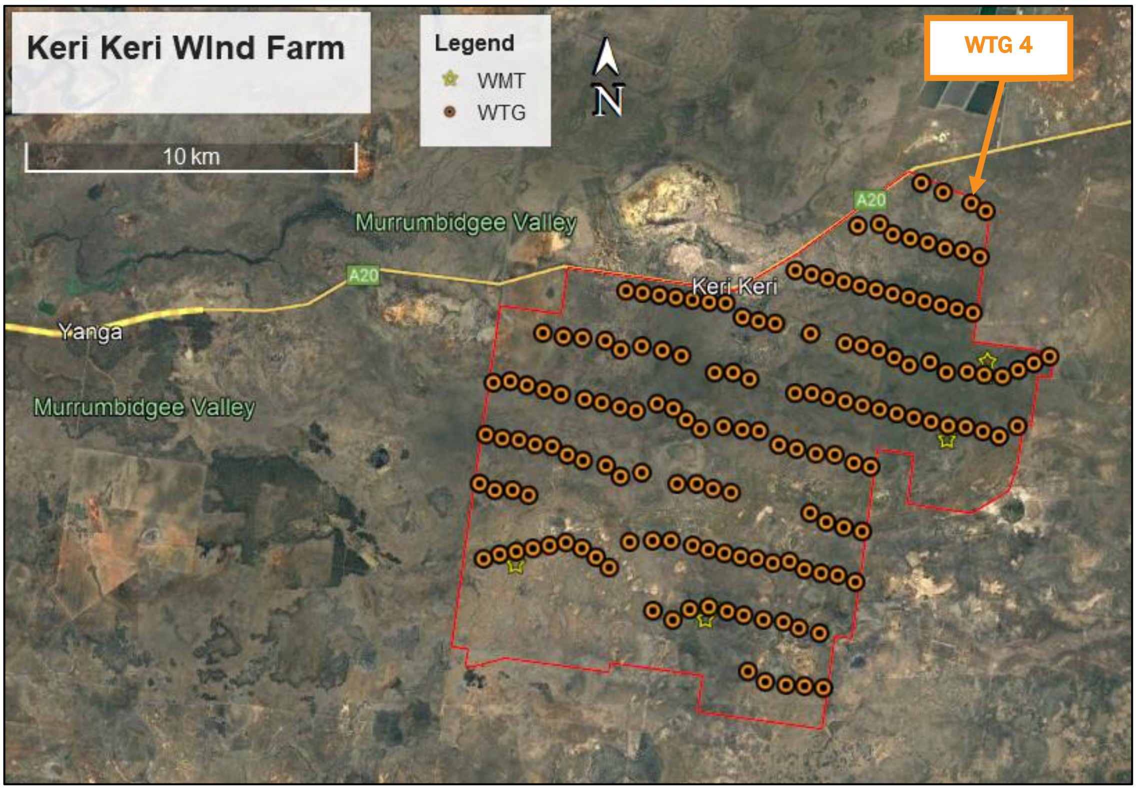


Figure 2 Project layout

3. EXTERNAL CONTEXT

3.1. Planning context

Acciona seeks to construct and operate the Keri Keri Wind Farm while protecting individuals, communities, and the environment from adverse impacts.

The role of the NSW DPHI is to coordinate the planning process according to the applicable regulations, and in partnership with individual people, community groups, businesses and industry groups, other organisations, local councils, and State and Commonwealth Government agencies. The legal framework includes the *Environmental Planning and Assessment Act 1979* and *Environmental Planning and Assessment Regulation 2000*. Development projects such as wind farms in NSW must submit a development application for approval by the Minister for Planning and Public Spaces.

The Secretary's Environmental Assessment Requirements (SEARS) for the project relevant to this study include:

> *Hazards and Risks – the EIS must include an assessment of the following:*
>
> - *Aviation Safety:*
>
> *- assess the impact of the development under the National Airports Safeguarding Framework Guideline D: Managing Wind Turbine Risk to Aircraft;*
>
> *- provide associated height and co-ordinates for each turbine assessed;*
>
> *- assess potential impacts on aviation safety, including cumulative effects of wind farms in the vicinity, potential wake / turbulence issues, the need for aviation hazard lighting, considering, defined air traffic routes, aircraft operating heights, approach / departure procedures, radar interference, communication systems, navigation aids;*
>
> *- identify aerodromes within 30 km of the turbines and consider the impact to nearby aerodromes and aircraft landing areas;*
>
> *- address impacts on obstacle limitation surfaces; and*
>
> *- assess the impact of the turbines on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the turbines and transmission line;*
>
> - *Bushfire - identify potential hazards and risks associated with bushfires / use of bushfire prone land, including the risks that a wind farm would cause bush fire and any potential impacts on the aerial fighting of bush fires and demonstrate compliance with Planning for Bush Fire Protection 2019;*

3.2. National Airports Safeguarding Framework

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

- the implementation of best practice in relation to land use assessment and decision making in the vicinity of airports
- assurance of community safety and amenity near airports

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

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

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

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

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

3.3. Murray River Council

The Draft Murray River Council Local Environment Plan (LEP) 2021, which encompasses the Project area does not include any airspace provisions relevant to the project.

The Wakool Local Environment Plan 2013 within the Murray River LGA does not include any airspace provisions relevant to the project.

3.4. Balranald Shire Council

The Balranald Shire Council LEP 2010 does not include any airspace provisions relevant to the project

3.5. Aircraft operations at non-controlled aerodromes

There are several uncontrolled aerodromes in the vicinity of the Project Area. 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. Advisory Circular (AC) 91-10 v1.1 *Operations in the vicinity of non-controlled aerodromes* provides guidance for pilots flying at or in the vicinity of non-controlled aerodromes, with respect to CASR 91.

A conventional circuit pattern and heights are provided in AC 91-10 v1.1. The standard circuit consists of a series of flight paths known as *legs* when departing, arrival or when conducting circuit practice. Illustrations of the standard aerodrome traffic circuit procedures provided in AC 91-10 v1.1. are shown in Figure 3 and Figure 4.

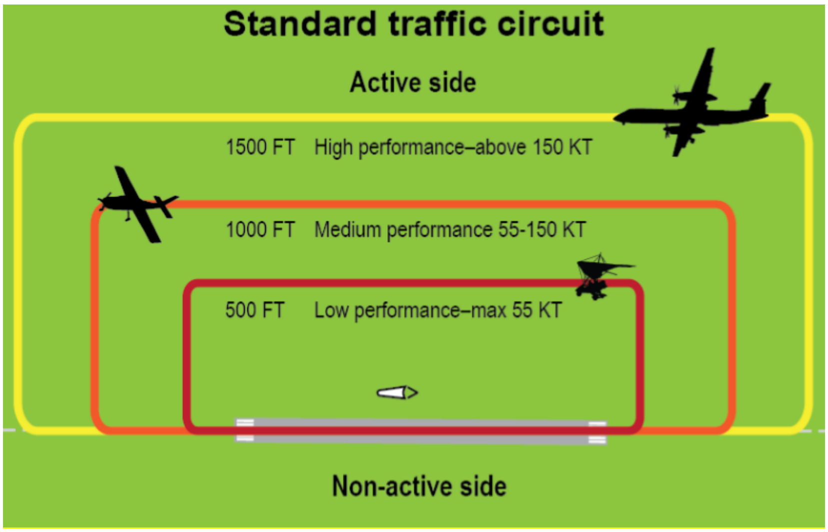


Figure 3 Lateral and vertical separation in the standard aerodrome traffic circuit

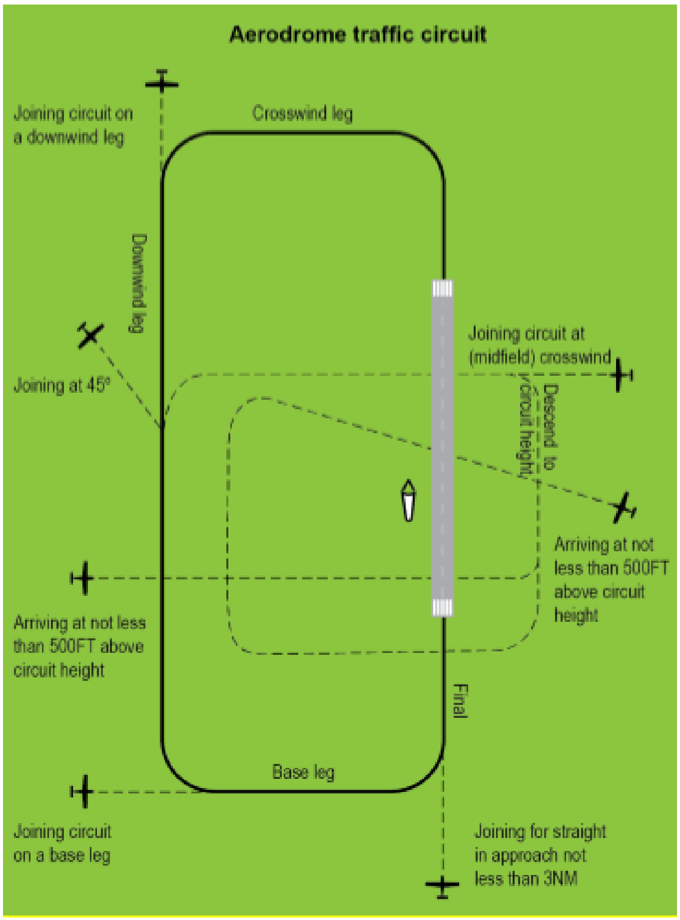


Figure 4 Aerodrome standard traffic circuit, showing arrival and joining procedures

AC 91-10 v1.1. paragraph 7.10 makes reference to a distance that is "normally" well outside the circuit area and where no traffic conflict exists, which is at least 3 nm (5556 m). The paragraph is copied below:

> *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 (VFR)

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

Civil Aviation Safety Regulation (1998) 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).

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

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

3.6.2. Night VFR

With respect to flight under the VFR at night, Civil Aviation Safety Regulations (1998) 91.277 requires that the pilot in command of an aircraft flying VFR at night must not fly below the following heights (unless during take-off and landing operations, within 3 nm of an aerodrome, or with an air traffic control clearance):

a) *the published lowest safe altitude for the route or route segment (if any);*

b) *the minimum sector altitude published in the authorised aeronautical information for the flight (if any);*

c) *the lowest safe altitude for the route or route segment;*

d) *1,000 ft above the highest obstacle on the ground or water within 10 nautical miles ahead of, and to either side of, the aircraft at that point on the route or route segment;*

e) *the lowest altitude for the route or route segment calculated in accordance with a method prescribed by the Part 91 Manual of Standards for the purposes of this paragraph.*

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

According to CASR 91, flight under the instrument flight rules (IFR) requires an aircraft to be operated at a height clear of obstacles that is calculated according to an approved method. Obstacle lights on structures not within the vicinity of an aerodrome are effectively redundant to an aircraft being operated under the IFR.

3.7. Aircraft operator characteristics

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

Operations conducted under VFR are required to remain in visual meteorological conditions (VMC) (at least 5,000 m horizontal visibility at a similar height of the WTGs) and clear of the highest point of the terrain by 500 ft vertical distance and 600 m horizontal distance. In VMC, the WTGs will likely be sufficiently conspicuous to allow adequate time for pilots to avoid the obstacles. VFR operators will most likely avoid the Project Area once WTGs are erected.

Flight under day VFR is conducted above 500 ft (152.4 m) 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 WTGs will be sufficiently visually conspicuous to pilots conducting VFR operations within the vicinity of the Project to enable appropriate obstacle avoidance manoeuvring.

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

3.8. Passenger transport operations

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

3.9. Private operations

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

3.10. Military operations

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

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 (2 m) and 100 ft (30.5 m) AGL.

Aerial application operations are conducted in the area.

Due to the nature of the operations conducted, aerial application 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 Project site was assessed.

3.12. Aerial Application 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:

> *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.*

The AAAA's National Wind Farm Operating 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.

This AIA has been prepared in consideration of the National Windfarm Operating Protocols.

3.13. Local aerial application operators

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

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

Based on previous studies for other wind farm projects undertaken by Aviation Projects, and the results of consultation with AAAA and local aerial application operators, it is reasonable to conclude that safe aerial application operations would be possible on properties within the Project site and on neighbouring properties, subject to final WTG locations and by implementing recommendations provided in this report at Section 11.

To facilitate the flight planning of aerial application operators, details of the Project, including location and height information of WTGs, wind 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.

3.14. Aeromedical services

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.

Refer to Section 5 for detailed responses from emergency service stakeholders.

3.15. 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 verbatim 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.*

Acciona intends to consult with fire services (aerial and ground) before making any commitment to operational procedures.

3.16. Yanga State Conservation Area

Yanga National Park, Yanga State Conservation Area and Yanga Nature Reserve are collectively referred to as the 'Yanga parks' or 'the parks' in this plan. The parks are located on the floodplain of the Lower Murrumbidgee River (the 'Lowbidgee') at the western edge of the Riverina agricultural region, about eight kilometres outside of Balranald.

The Yanga Parks' eastern boundary abuts the Project boundary along Keri Keri Road as shown in Figure 5.

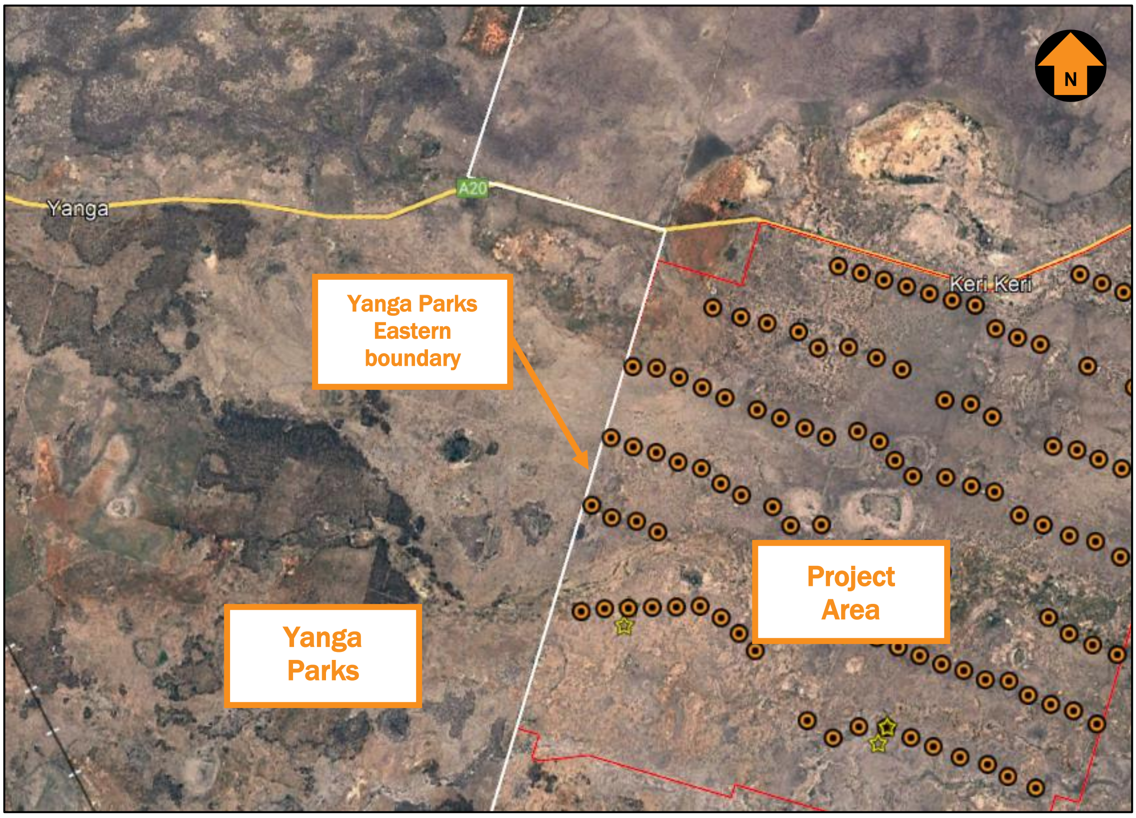


Figure 5 Yanga Parks depiction

The control of pest animals by the use aircraft and aerial shooting by NSW Parks and Wildlife Service (NPWS) is occasionally conducted within the Yanga Parks.

It is likely that such flight operations would involve flight at or below the tops of the WTGs and in benign wind conditions to assist in stable flight.

Consultation by the wind farm operator/developer with NPWS is required to ensure that they can include the Project in their conservation planning within the Yanga Parks.

4. INTERNAL CONTEXT

4.1. Wind farm site description

The Keri Keri Wind Farm is an 18,001 hectare site located approximately 31 km southeast of Balranald NSW, adjacent to and south of the Sturt Highway. The topography is primarily flat and featureless scrubland.

A site visit was conducted by aircraft on 10 October 2022

Figure 6 and Figure 7 show typical landscape for the Project site. (Source: Google Earth)

Figure 6 Typical landscape for the project site

Figure 7 Typical landscape for the project site

4.2. Wind turbine generator (WTG) description

The Project site is to comprise of up to 155 WTGs. The maximum blade tip height of the proposed WTGs will be 291.5 m above ground level (AGL).

The ground elevation for the highest WTG (WTG4) is 70.49 m above mean seal level (AMSL) which, with a 291.5 m WTG height, results in a maximum overall height of 361.9 m AMSL (1187.6 ft AMSL).

Figure 2 illustrates the Project layout identifying the highest WTG.

The coordinates and ground elevations of the proposed WTGs analysed are listed in Annexure 5.

'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 during the construction process. The potential micrositing of the WTGs has been considered in the assessment with the estimate of the overall maximum height being based on the highest ground level is within 100 m of the nominal WTG position. The micrositing of the WTGs is not likely to result in a change in the maximum overall blade tip height of the Project. This AIA assumes that a maximum blade tip height of 291.5 m AGL is implemented at all WTG locations.

4.3. Wind monitoring tower description

The Project site is to comprise of 4 temporary and 4 permanent wind monitoring towers (WMTs). The maximum height of the WMTs will be 159 m AGL.

The ground elevation for the highest WMT location is 69.49 m above mean seal level (AMSL) which, with a 159 m WMT height, results in a maximum overall height of 228.49 m AMSL (749.6 ft AMSL).

WMTs constructed prior to the WTGs, should be appropriately lit and marked in accordance with NASF Guideline D and MOS 139 Section 8.110 / 9.30. The details of the WMTs will be reported to Airservices Australia for entry into Vertical Obstruction Database when the construction is completed.

Figure 8 illustrates the Project's WMT layout (source: ERM, Google Earth).

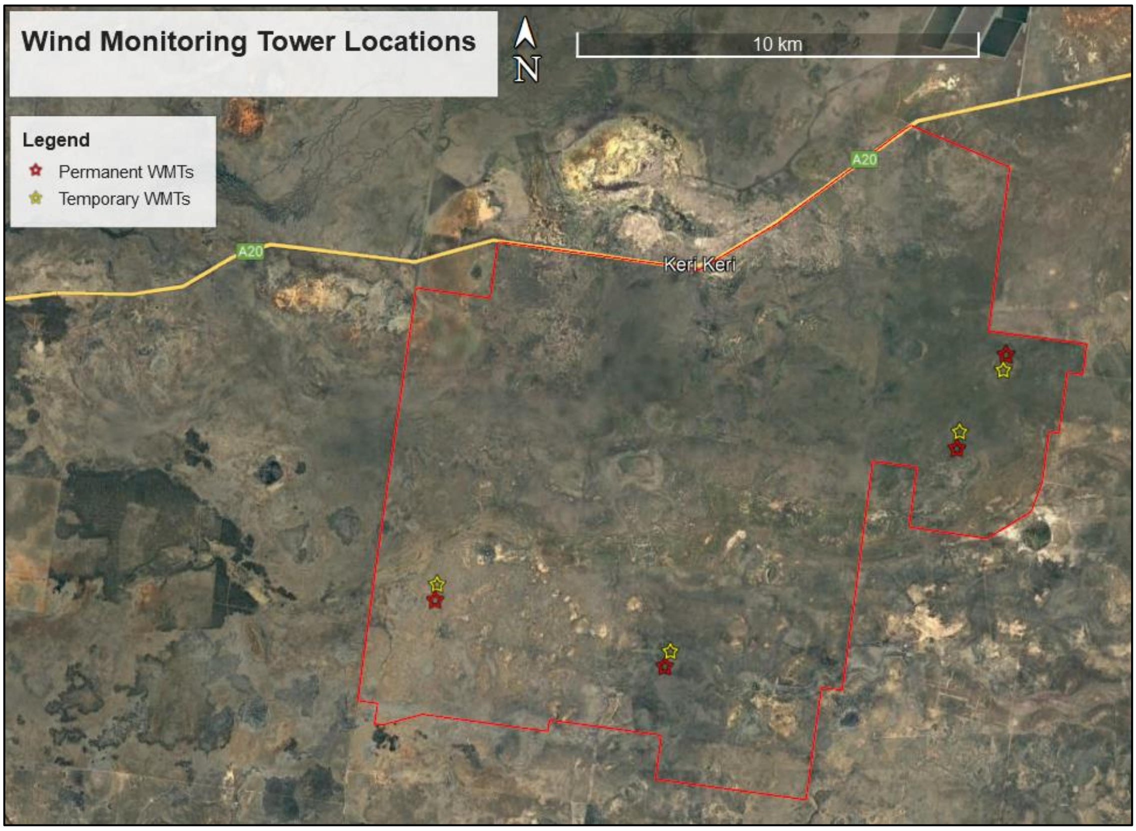


Figure 8 WMT locations

The known details including coordinates and ground elevations of the permanent WMTs are provided in Annexure 6.

'Micrositing' of WMTs means an alteration to the siting of WMTs by not more than 100 m and any consequential changes to access tracks and internal power cable routes. The potential micrositing of the WMTs has been considered in the assessment with the estimate of the overall maximum height being based on the highest ground level is within 100 m of the nominal WMT position. The micrositing of the WMTs is not likely to result in a change in the maximum overall mast height. This AIA assumes that a maximum mast height of 159 m AGL is implemented at all WMT locations.

4.4. Grid transmission

Electrical infrastructure is contained within the Project site and will consist of:

- one (1) 33/330 kV electrical substation and two (2) 132 kV collector substations, including control room, transformers, circuit breakers, switches and other ancillary equipment;
- a battery energy storage system (BESS) of up to 200 MW/800MWh (four hours of storage);
- overhead and underground 33 kV electrical reticulation connecting the WTGs to the onsite substations (generally following site access tracks);
- a 330 kV overhead transmission line of approximately 10.7 km, connecting the three substations to a new electrical switchyard (including circuit breakers, switches and other ancillary equipment) to

provide connection to the planned NSW-SA interconnector, Project EnergyConnect currently under construction.

Figure 9 shows the extent of overhead and underground electrical reticulation and transmission lines within the Project site.

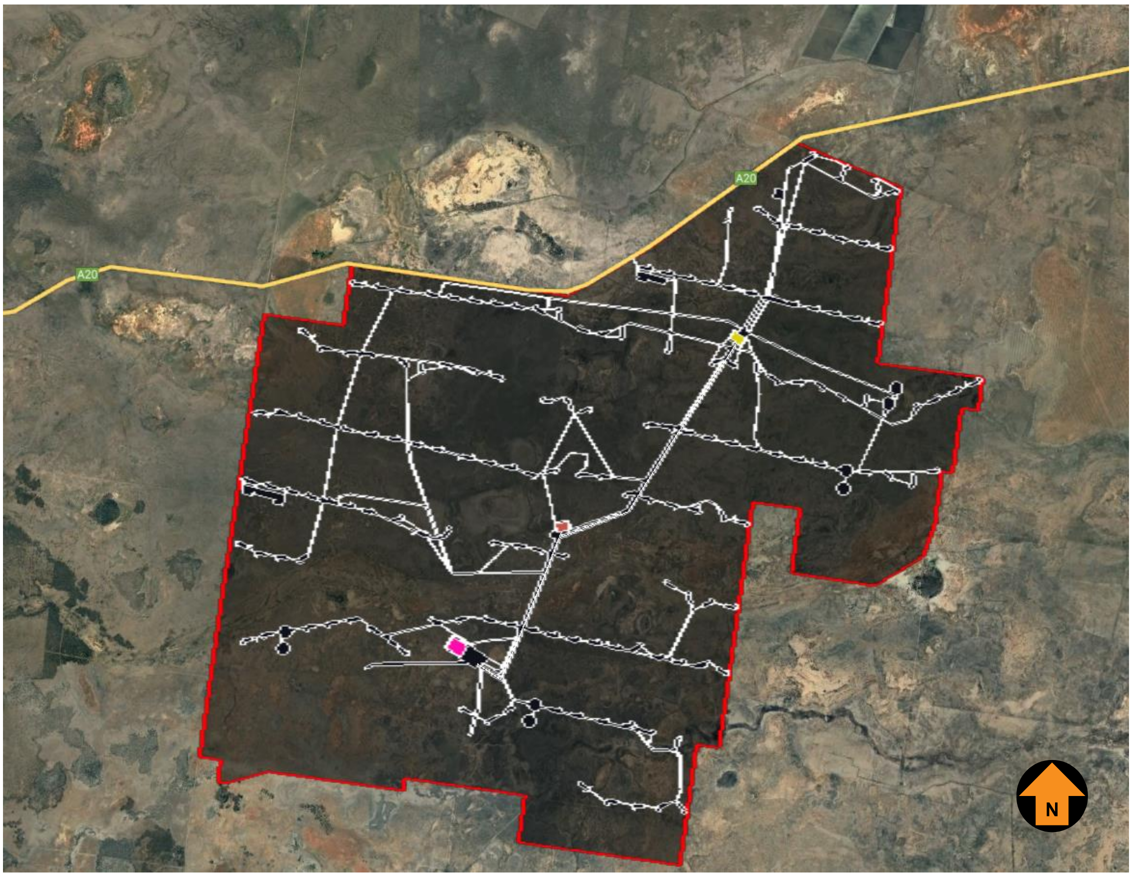


Figure 9 electrical reticulation and transmission lines within the Project site

5. CONSULTATION

The following list of stakeholders were identified as requiring consultation:

- Airservices Australia
- Department of Defence
- Balranald Shire Council

Consultation by the wind farm developer/operator should be carried out with NPWS in order for each party to understand the other's operational requirements.

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

Whilst there have been no responses to two of our consultation requests, it is not unusual. Relevant matters can be provided at planning authority meetings.

Table 1 Stakeholder consultation details (TBC)

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Action Proposed*
Airservices Australia	3 March 2023	8 June 2023	Nil Impact to Instrument Approach Procedures LSALTs for air route W762 need to be increased.	I refer to your request for an Airservices assessment of a wind farm at Keri Keri Wind Farm, Southern NSW. Airspace Procedures With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at the height of the highest wind turbine of 367 m (1205 ft) AHD, the wind farm will not affect any sector or circling altitude, nor any instrument approach or departure procedure at any aerodromes. The wind farm turbines 172, 173, 174 and 175 at a maximum height of 364.98 m (1198 ft) AHD will affect air route segment W762 NATYA - TREST. The route LSALT for this segment will need to be raised to 2200 ft. The maximum height of the wind farm turbines 172, 173, 174 and 175 without affecting air route W762 is 335.2m 1100ft AHD. Note: Procedures not designed by Airservices were not considered in this assessment. Communications/Navigation/Surveillance (CNS) Facilities We have assessed the proposal to a maximum height of 367 m (1205 ft) AHD for any impacts to Airservices Precision/Non-Precision Navigation Aids, Anemometers, HF/VHF/UHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links and have no objections to it proceeding. Air Traffic Control (ATC) Operations There are no additional instructions or concerns from our ATC.

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed
				Summary Based on the above assessment, our view is that the proposed Keri Keri Wind Farm would have an impact on Airservices designed instrument procedures, CNS facilities or ATC operations at any aerodromes. We request that you consult with any airports, along with aviation operators there to ensure that all stakeholders fully understand the proposed changes that are required to accommodate the Wind Farm. We will require comments from the airport stating they are comfortable for the project to proceed as is currently presented. Note: All work we conduct to amend the route LSALT will be undertaken on a commercial basis and require further consultation.
Department of Defence	3 March 2023		Nil received - 26 February 2024	Generally rely on wind farm data entered in obstacle database and shown on aeronautical charts.
Balranald Shire Council	3 March 2023		Nil received - 26 February 2024	Nil impact to Balranald Airport may limit response priority.

6. AVIATION IMPACT STATEMENT

6.1. Overview

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

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 Aviation Impact Statement (AIS).

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

- The operation of nearby certified aerodromes
- The operation of nearby aircraft landing areas (uncertified aerodromes)
- Grid and air route LSALTS
- Airspace protection
- Aviation facilities
- Radar installations
- Local aircraft operations.

6.2. Nearby certified aerodromes

The area of 30 nm (56 km) from an airport's aerodrome reference point (ARP) is used to identify possible constraints from the Project.

The only certified airport within 30 nm of the Project site is Balranald Airport (YBRN) located approximately 17 nm to the northwest.

The location of Balranald Airport and the Project site is shown in Figure 10 (source: ERM, OzRunways, 250K Topographic map).

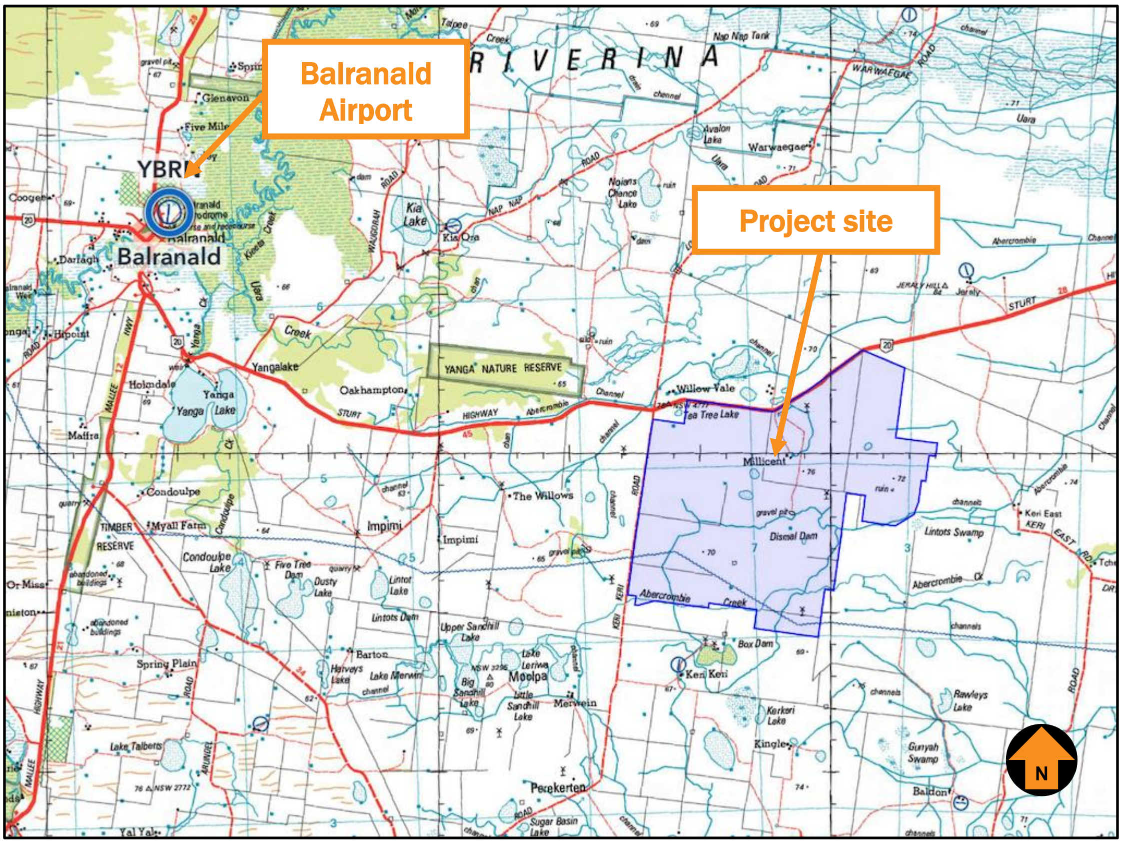


Figure 10 Balranald airport within 30 nm of the Project site

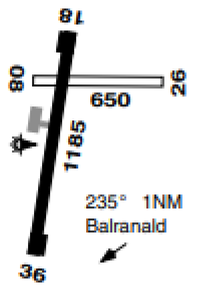
Balranald Airport (YBRN) is a Code 1, non-instrument certified aerodrome, which is operated by the Balranald Shire Council.

Figure 11 shows the Balranald Airport aerodrome information (source: AsA, FAC, dated 08 September 2022).

AIP Australia 30 NOV 2023 FAC YBRN - 1

BALRANALD **ELEV 210**

AVFAX CODE 2233



NSW UTC +10 YBRN
343725S 1433442E VAR 10 DEG E CERT
AD OPR Balranald Shire Council, PO Box 120, Balranald, NSW, 2715. PH 03 5020 1300. ARO 0418 322 902 H24.

AERODROME OBSTACLES

TWR 466FT AMSL BRG 205 DEG MAG 1.2NM FM ARP. Lit.

PHYSICAL CHARACTERISTICS

08/26	078	21c	5700/350 (51PSI) Grass	WID 30	RWS 90
18/36	176	39a	PCN 9 /F /B /450 (65PSI) /U	WID 18	RWS 90

AERODROME AND APPROACH LIGHTING

RWY 08/26	PTBL(1)		BY PRIOR ARRANGEMENT
RWY 18/36	LIRL	PAL 123.9	
RWY 18/36	PTBL(1)		BY PRIOR ARRANGEMENT

(1) EMERG only. 60MIN PN.

ATS AND AERODROME COMMUNICATION FACILITIES

FIA MELBOURNE CENTRE 118.6 7000FT

CTAF 126.7

ADDITIONAL INFORMATION

Wildlife hazard exists. Australian magpie flying in flocks up to 30 transiting across RWY 18 THR BTW 50 – 150FT AGL HJ. CTC ARO via PH or CTAF for harassment.

CHARTS RELATED TO THE AERODROME

WAC 3458.

Figure 11 Balranald Airport information

Balranald Airport is not serviced by any instrument approach procedures.

6.2.1. Balranald OLS

OLS are established for each aerodrome runway. For the Code 1 non-instrument runway at Balranald the maximum lateral extent of the OLS is up to 2.7 km for the conical surface and 1.6 km for the take-off and approach surfaces.

The Project site is located beyond the horizontal extent of the OLS. Therefore, the Project site will not impact the Balranald Airport OLS.

6.3. Nearby aircraft landing areas (uncertified aerodromes)

An area of 3 nm (5.6 km) radius of an aircraft landing areas (ALA) is used to assess potential impacts of proposed developments on aircraft operations at or within the vicinity of the ALA.

A search on OzRunways, which sources its data from Airservices Australia (AIP) and Aircraft Owners and Pilots Association (AOPA) Australia Airfield Directory, did not identify any ALAs within 3nm from the Project site. The aeronautical data provided by OzRunways is approved under CASA CASR Part 175.

A search of the National Map database identified two landing grounds located within 3 nm of the closest Project site WTG.

Jeraly ALA is located northeast of the Project. Consultation with the owner is underway.

Keri-Keri ALA is located south of the Project. Consultation with the owner indicates that this ALA is seldom used and likely only *"about once a year over the past 5 years."*[1]

ALAS in the vicinity of the Project site are shown in Figure 12 (source: OzRunways, National Map, ERM, Google Earth)

Figure 12 ALAs in the vicinity of the Project site

6.4. Potential wake turbulence impacts

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

[1] Email from Raymond Andrew Dowling dated 12 April 2023

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 rotor diameter for each WTG is 183 m. Based on this scenario, the effects of wake turbulence detailed in the NASF could be noticeable at 2928 m from the WTGs.

Aviation Projects, through evaluation of research conducted by suitable organisations, considers that any adverse turbulence would most likely be confined to within 7 rotor diameters of a WTG.

Aviation Projects applies a conservative area within 10 rotor diameters when assessing downwind turbulence from WTGs. It would be the maximum area where wake turbulence from WTGs would be felt by pilots operating in the circuit area of an aerodrome. This turbulence would not be considered to create an adverse impact to the aircraft. This area would therefore have a maximum radius of 1830 m from a WTG.

Figure 13 shows 1830 m rings (associated with potential maximum horizontal extent of wake turbulence) around the relevant WTGs closest to Jeraly Station ALA.

It can be seen the effects of wake turbulence could extend slightly into the 3nm area surrounding Jeraly Station ALA. Aircraft departing or arriving at the Jeraly ALA in the 3nm area, and outside the standard circuit area, would be expected to above the WTGs. The area within 1 nm of the runway is considered to be the area in which aircraft conduct standard circuit operations immediately after take-off and prior to landing. There is a limited possibility of wake turbulence affecting operations of aircraft arriving and departing at the Jeraly ALA from the southwest, but highly unlikely in the circuit area. The landowner is being consulted to determine any impacts.

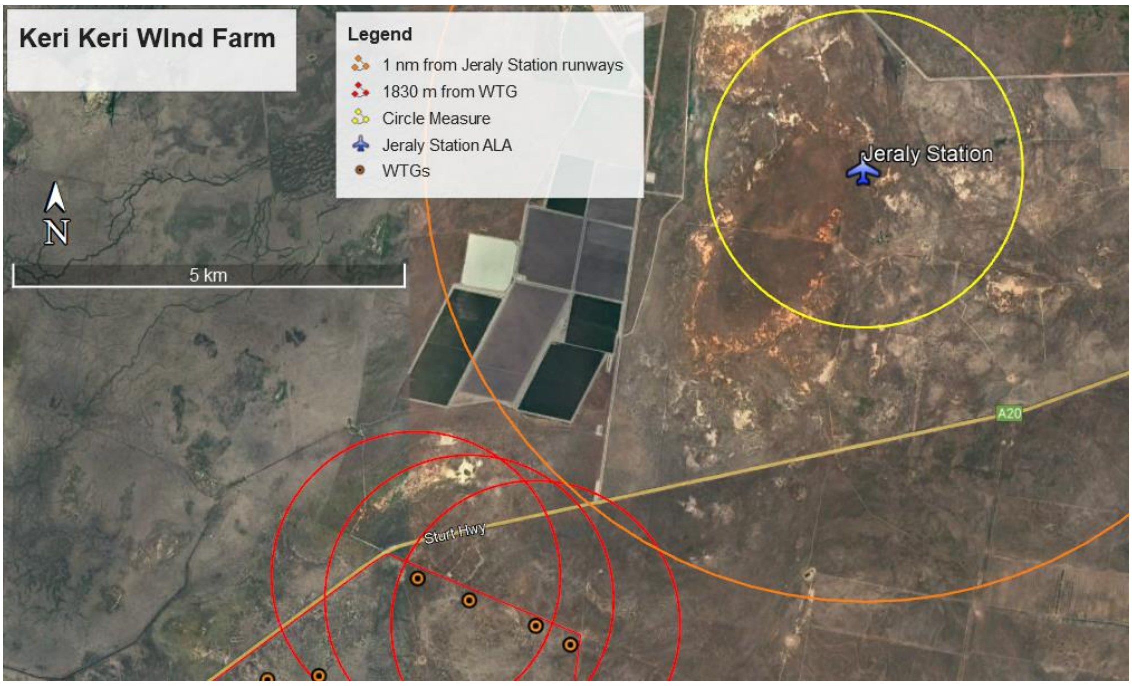


Figure 13 Possible extent of Wake Turbulence from WTGs – Jeraly Station ALA

It can be seen the effects of wake turbulence could extend slightly into the 3nm area north of the Keri-Keri ALA. Aircraft departing or arriving at the Keri-Keri ALA in the 3nm area, and outside the standard circuit area, would be expected to above the WTGs. The area within 1 nm of the runway is considered to be the area in which aircraft conduct standard circuit operations immediately after take-off and prior to landing. There is a limited possibility of wake turbulence affecting operations of aircraft arriving and departing at the Keri-Keri ALA from the north or northeast, but highly unlikely in the circuit area. The landowner has advised that this ALA is rarely used. Figure 14 shows the applicable distances.

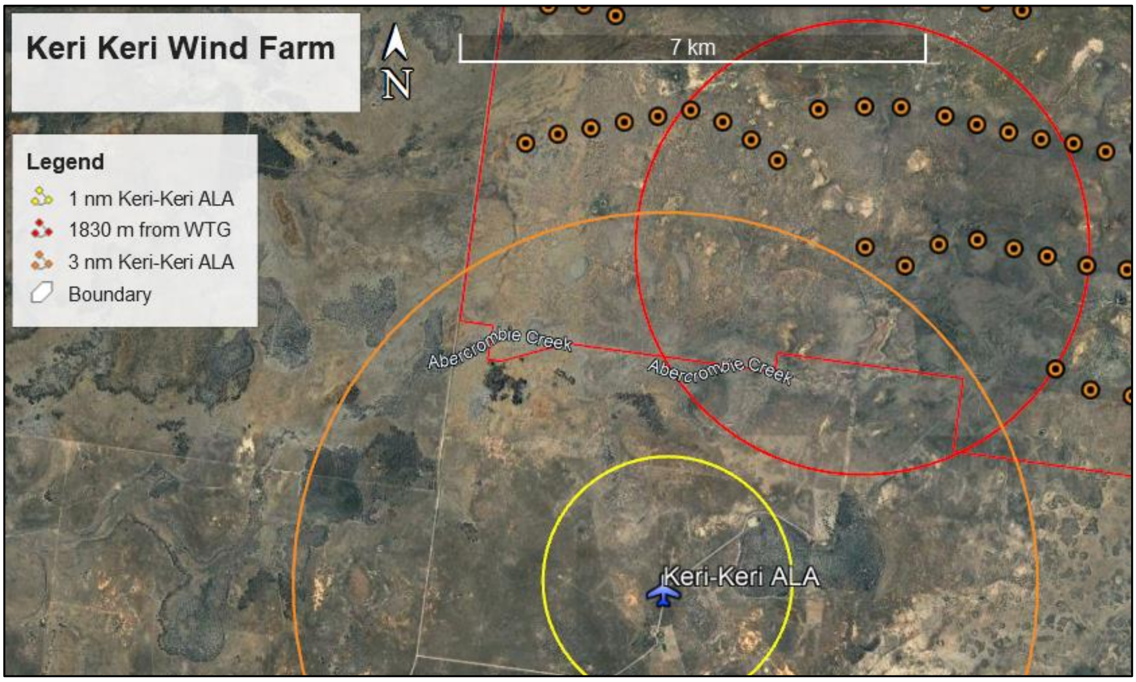


Figure 14 Keri-Keri ALA

6.5. Grid and Air routes LSALT

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

6.5.1. Grid LSALT

The Project site located within two airspace grids with LSALTs of 1700 ft AMSL and 1800 ft AMSL which provide clearance above obstacles with heights up to 700 ft AMSL and 800 ft AMSL, respectively.

Figure 15 shows the grid LSALTs in proximity to the Project site (source: ERC Low National, OzRunways, 30 November 2023).

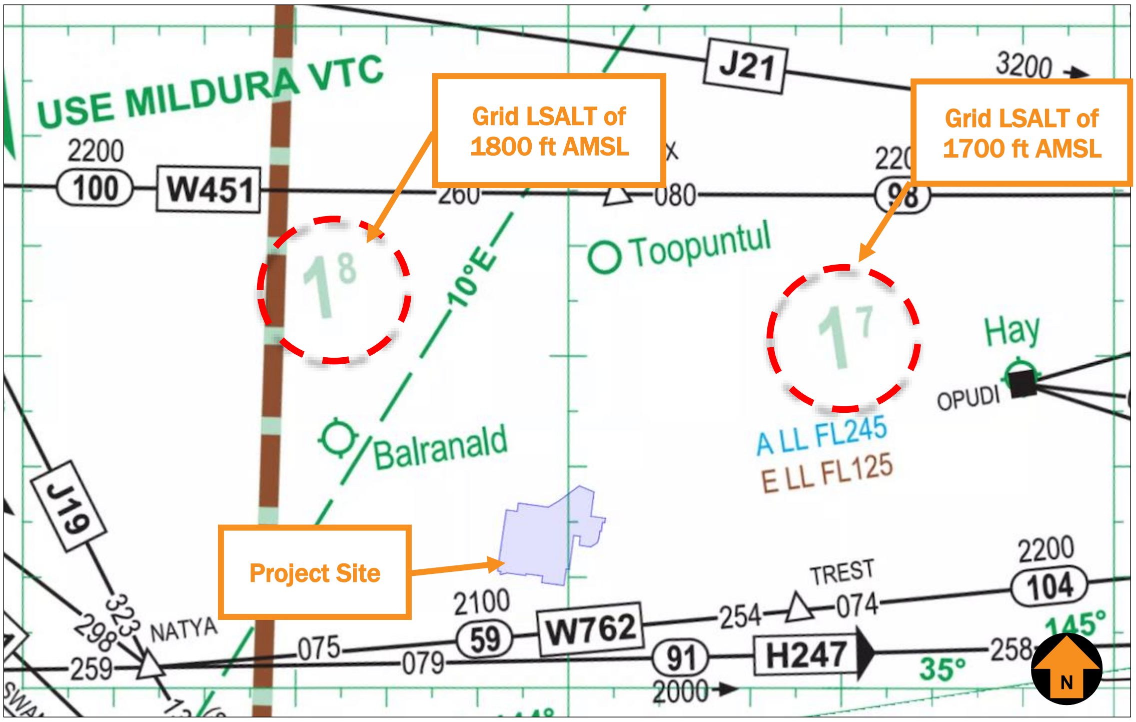


Figure 15 Grid LSALTs in proximity to the Project site

The WTGs in the 1700 ft Grid LSALT sector, with heights in the order of 1186 ft, are approximately 486 ft higher than the 700 ft obstacle height limit. The 1700 ft Grid LSALT will need to be increased by 500 ft to 2200 ft AMSL.

WTG 4 is the highest WTG in the 1800 ft Grid LSALT sector. With a maximum height of 1187.6 ft, WTG 4 is 387.6 ft higher than the 800 ft obstacle height limit. The 1800 ft Grid LSALT will need to be increased by 400 ft to 2200 ft AMSL to accommodate this proposed wind farm.

6.5.2. Air Route LSALTs

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

There are two air routes within 7 nm of the Project Site shown in Figure 16 below (source: ERC Low National, OzRunways, 30 November 2023).

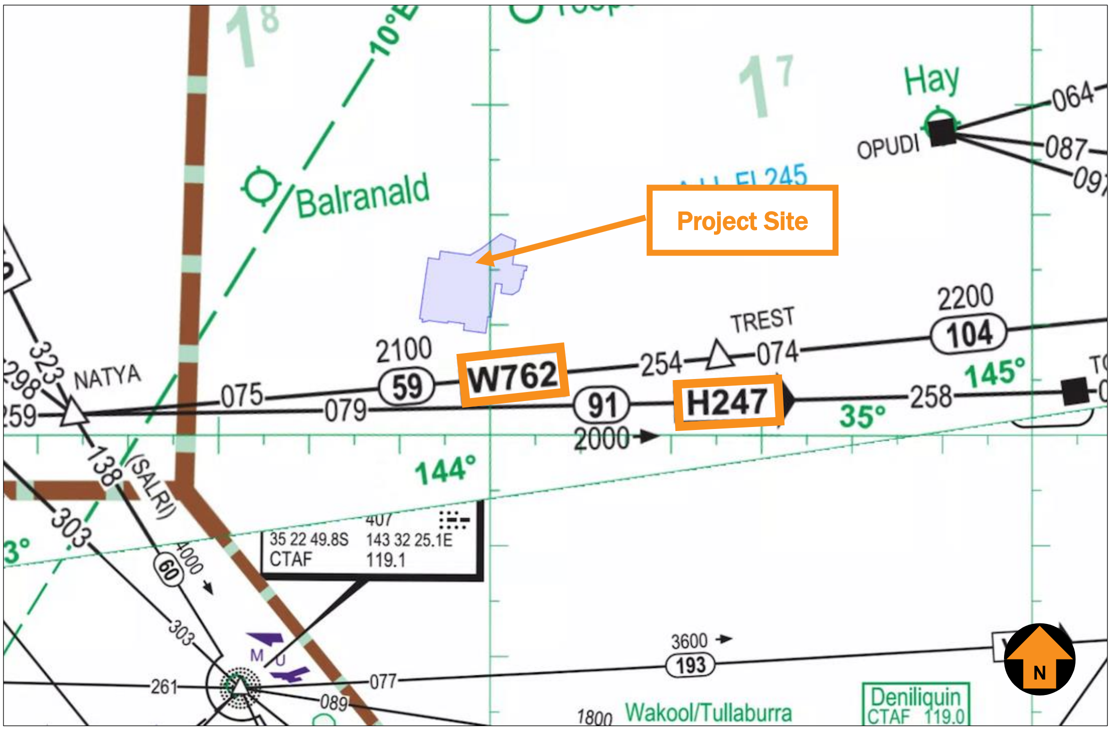


Figure 16 Air routes in proximity to the Project

An impact analysis of the surrounding air routes is provided in Table 2.

Table 2 Air route impact analysis

Air route	*Waypoint pair*	*Route LSALT*	*Obstacle Height Limit*	*Impact on airspace design*	*Potential solution*	*Impact on aircraft ops*
W762	NATYA to TREST	2100 ft AMSL	1100 ft AMSL	WTGs exceed obstacle limit by 87.6 ft	Raise LSALT by 100 ft to 2200 ft AMSL	Nil
H247	NATYA to TOBOB	2000 ft AMSL	1000 ft AMSL	WTGs exceed obstacle limit by 187.6 ft	Raise LSALT by 200 ft to 2200 ft AMSL	Nil

Aviation Projects considers that the amendments to the Grid and Air Route LSALTs is of a minor nature and will not create an adverse impact to aviation safety.

6.5.3. Airspace Protection

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

Therefore, the Project area will not have an impact on controlled or designated airspace.

6.6. Aviation facilities

The Project area is located sufficient distance away from nearby certified airports and will not have an impact on the aviation facilities of those airports.

6.7. Radar installations

Airservices Australia requires an assessment of the potential for the WTGs to affect radar line of sight. The closest radar facility to the Project site is the Mt Macedon Secondary Surveillance Radar (SSR), which is located approximately 296 km to the south.

The Project site are outside the range of the Mt Macedon radar and will not impact this facility.

6.8. AIS Summary

Based on the Project WTG layout and maximum blade tip height of up to 291.5 m AGL, the blade tip elevation of the highest WTG, which is WTG4, will not exceed 361.9 m AHD (1187.6 ft AMSL) and:

- would not infringe any OLS surfaces
- would not infringe any PANS-OPS surfaces
- would have an impact on two grid LSALTs. The overlying 1700 ft Grid LSALT will need to be increased to 2200 ft AMSL. The overlying 1800 ft grid LSALT will need to be increased t to 2200 ft AMSL
- would have an impact on nearby designated air routes. W762 LSALT will need to be increased to 2200 ft AMSL. The LSALT for air route H247 will need to be increased to 2200 ft AMSL
- wake turbulence effects would be unlikely to cause an adverse impact upon aircraft arriving at and operating within the standard circuit area at Jeraly Station ALA or at Keri-Keri ALA. Consultation with the owners is underway
- would not have an impact on operational airspace
- would be wholly contained within Class G airspace
- would be outside the clearance zones associated with civil aviation navigation aids and communication facilities.

The list of WTGs and WMTs are provided in Annexure 5.

6.9. Assessment recommendations

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

- As constructed details of the Project must be provided to Airservices Australia to adjust the Grid and air route impacts to accommodate the Project.

7. HAZARD LIGHTING AND MARKING

Based on the risk assessment set out in Section 9 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.**

7.1. Wind monitoring towers (WMTs)

Given that aerial operators might use the airspace within the Project site and that it is expected that WMTs will be constructed prior to WTGs, the WMTs may be free-standing and not surrounded by any other obstacles. Therefore, the proposed temporary and permanent WMTs should be marked with red/white/red bands as per the NASF Guideline D.

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.*

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 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.*
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.*

7.2. Overhead transmission line

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

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

Most agricultural land in Australia is crisscrossed with powerlines and aerial application companies and pilots put enormous effort into managing these hazards safely, generally using a risk identification, assessment and management process in line with Australian Standard AS4360/ISO 3[1]000.

The agricultural pilot curriculum mandated by CASA includes training for the safe management of powerlines and AAAA has been active in providing ongoing professional development for application pilots that includes a focus on planning, risk management and a knowledge of human factors relevant to managing powerlines in a low-level aviation environment.

AAAA runs a specific training course for aerial application pilots entitled 'Wire Risk Management' to address these issues.

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

8.110 Marking of hazardous obstacles

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

(8) The objects mentioned in subsection (7) must:
(a) be approximately equivalent in size to a cube with 600 mm sides; and
(b) be spaced 30 m apart along the length of the wire or cable.

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

8. ACCIDENT STATISTICS

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

8.1. General aviation operations

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

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

8.2. ATSB occurrence taxonomy

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

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

8.3. National aviation occurrence statistics 2010-2019

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

According to the report, there were no fatalities in high or low capacity RPT operations during the period 2010-2019. In 2019, 220 aircraft were involved in accidents in Australia, 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 3 (source: ATSB).

Table 3 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 17 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.

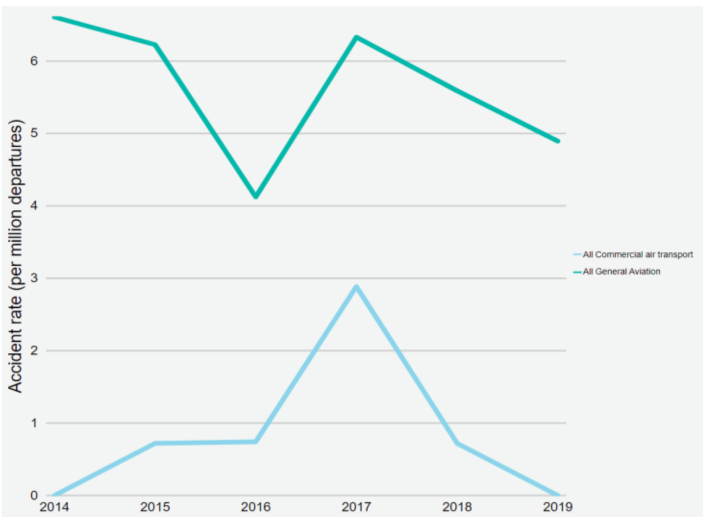


Figure 17 Fatal Accident Rate (per million departures) by Operation Type

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 4 (source: ATSB).

Table 4 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, 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.

8.4. Worldwide accidents involving wind farms

Worldwide since aviation accident statistics have been recorded, there have been a total of 4 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 4 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 2016, there were 341,320 WTGs operating around the world at the end of 2016.

Based on the Australia's Clean Energy Council statistics there were 102 wind farms in Australia at the end of 2019. Aviation Projects has researched public sources of information, 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 4 recorded aviation accidents involving a wind farm are summarised as follows:

- 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.

A summary of the 4 accidents is provided in Table 5.

Table 5 Summary of accidents involving collision with a WTG

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

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

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

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

9. RISK ASSESSMENT

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

The risk assessment framework used by Aviation Projects and risk event description is provided in **Annexure 4.**

9.1. Risk Identification

The primary risk being assessed is that of aviation safety associated with the 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 and Regional Development, 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.

9.2. Risk Analysis, Evaluation and Treatment

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

A summary of the level of risk associated with the Project, under the proposed treatment regime, with specific consideration of the effect of obstacle lighting, is provided in Table 6 through to Table 10.

Table 6 Aircraft collision with wind turbine generator (WTG)

Risk ID:	**1. Aircraft collision with wind turbine generator (WTG) (CFIT)**

Discussion

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

There have been 4 reported occurrences worldwide of aircraft collisions with a component of a WTG structure since the year 2000 as discussed in Section 1. 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 1.

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

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

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

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

The Project site is clear of the obstacle limitation surfaces (OLS) of any aerodrome.

Consequence

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

Consequence	Catastrophic

Untreated Likelihood

There have been 4 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.

Untreated Likelihood	Possible

Current Treatments (without lighting)

• The Project site is clear of the obstacle limitation surfaces (OLS) of any aerodrome. • Aircraft are restricted to a minimum height of 500 ft (152.4 m) AGL above the highest point of the terrain and any object on it within a radius of 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 291.5 m (957 ft) AGL at the top of the blade tip. The rotor blade at its maximum height will be approximately 139 m (457 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. • Aircraft are restricted to a minimum height of 304.8 m (1,000 ft) above obstacles (including terrain) which are within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night). • Aircraft authorised to intentionally fly below 152.4 m (500 ft) AGL (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities undertaken specifically for and prior to undertaking such authorised flights. Any obstacle including WTGs in the path of the authorised flight would be specifically risk assessed during that process. • The WTGs are typically coloured white so they should be visible to pilots during the day. • 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 (refer to Section 5) prior to construction to heighten their awareness of its location and so that they can plan their operations accordingly. Specifically:

○ Engage with local aerial agricultural and aerial firefighting operators to develop procedures, which may include, for example, stopping the rotation of the WTG blades prior to the commencement of the subject aircraft operations within the Project site. ○ Arrangements should be made to publish details of the Project in ERSA for surrounding aerodromes, which would involve notification to Airservices Australia.	
Residual Risk With the implementation of the Recommended Treatments listed above, the likelihood of an aircraft collision with a WTG resulting in multiple fatalities and damage beyond repair will be **Unlikely**, and the consequence remains **Catastrophic**, resulting in an overall risk level of **7 - Tolerable**. It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified. 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 7 Aircraft collision with wind monitoring tower (WMT)

Risk ID:	2. Aircraft collision with a wind monitoring tower (WMT) (CFIT)

Discussion

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

There are 4 temporary and 4 permanent WMTs as part of the Project.

The WMTs will be free standing at a maximum height of 159 m (522 ft) AGL in height.

The proposed 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 location of the proposed temporary and permanent WMT locations and other applicable details will be provided to Airservices Australia prior to construction.

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

There is a relatively low rate of aircraft activity in the vicinity of the Project site.

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 must 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

- The temporary and permanent WMT locations will be advised to CASA and Airservices Australia 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. The highest permanent WMT will be at a maximum height of 159 m (522 ft) AGL, which will be 22 ft (7 m) above the minimum height of 500 ft AGL for an aircraft flying at this height.

• In the event that descending cloud forces an aircraft lower than 152.4 m (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) AGL (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities. • Since 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 to enable publication of the details in aeronautical documents and charts. • 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 MOS 139 Section 9.33: *5) Medium-intensity obstacle lights must:*	

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c) *be visible in all directions in azimuth; and* d) *if flashing — have a flash frequency of between 20 and 60 flashes per minute.* 6) *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.* 7) *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.* 8) *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 site 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.**

Residual Risk	7 - Tolerable

Table 8 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 291.5 m (957 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 139 m (457 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.

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 (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 291.5 m (957 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 139 m (457 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft). • Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs. • If cloud descends below the WTG hub, obstacle lighting would be obscured and therefore ineffective. • Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night). • Aircraft authorised to intentionally fly below 152.4 m AGL (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities. • The WTGs are typically coloured white, 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 site.
Residual Risk

With the additional Recommended Treatments listed above, the likelihood of ground collision resulting from manoeuvring to avoid a WTG resulting in multiple fatalities and damage beyond repair will be Unlikely, and the consequence remains Catastrophic, resulting in an overall risk level of 7 – Tolerable. It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified. In the circumstances, the level of risk under the proposed treatment plan is considered ALARP. **It is 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 9 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 site.	
Consequence The worst credible effect a wind farm could have on flight crew would be the imposition of operational limitations, and in some cases, the potential for use of emergency procedures. This would be a Minor consequence.	
Consequence	Minor
Untreated Likelihood The imposition of operational limitations is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.	
Untreated Likelihood	Possible
Current Treatments • The Project is clear of the OLS of any aerodrome. • Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas. • WTGs will be a maximum of 291.5 m (957 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 139 m (457 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 Minor consequence is 5.	
Current Level of Risk	5 - Tolerable
Risk Decision A risk level of 5 is classified as Tolerable: Treatment action possibly required to achieve ALARP - conduct cost/benefit analysis. Relevant manager to consider for appropriate action.	
Risk Decision	Accept, conduct cost benefit analysis
Recommended Treatments Given the current treatments and the limited scale and scope of flying operations conducted within the vicinity of the Project site, 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 site.	
Residual Risk Notwithstanding the current level of risk is considered **Tolerable,** the additional Recommended Treatments listed above will enhance aviation safety. The likelihood remains **Possible**, and consequence remains **Minor**. In the circumstances, the risk level of 5 is considered **ALARP.** **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 10 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 or WMT can have an effect on neighbours' visual amenity and enjoyment, specifically at night and in good visibility conditions.

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

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

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

In general, objects outside an OLS and above 100 m would require obstacle lighting unless CASA, in an aeronautical study, assesses it is shielded by another lit object or it is of no operational significance.

Consequence

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

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

This would be a Moderate consequence.

Consequence	Moderate

Untreated Likelihood

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

Untreated Likelihood	Almost certain

Current Treatments

If the WTGs or WMTs will be higher than 150 m (492 ft) AGL, they must be regarded as obstacles unless CASA assess otherwise. In general, objects outside an OLS and above 100 m would require obstacle lighting unless CASA, in an aeronautical study, assesses it is shielded by another lit object or it is of no operational significance.

Level of Risk

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

Current Level of Risk	8 - Unacceptable

Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable
Recommended Treatments Not installing obstacle lighting would completely remove the source of the impact. As per the above safety risk assessment, the provision of lighting for the WTGs and permanent WMTs is not necessary to provide an acceptable level of safety. For temporary WMTs installed prior to WTG installation and WMTs that are not in close proximity to a WTG, obstacle lighting is recommended to ensure visibility in low light and deteriorating atmospheric conditions. If CASA or a planning authority decide that obstacle lighting is required there are impact reduction measures that can be implemented to reduce the impact of lighting on surrounding neighbours, including: • reducing the number of WTGs with obstacle lights • specifying an obstacle light that minimises light intensity at ground level • specifying an obstacle light that matches light intensity to meteorological visibility • mitigating light glare from obstacle lighting through measures such as baffling. These measures are designed to optimise the benefit of the obstacle lights to pilots while minimising the visual impact to residents within and around the Project site. Consideration may be given to activating the obstacle lighting via a pilot activated lighting system. An option is to consider using Aircraft Detection Lighting Systems (referred in the United States Federal Aviation Administration Advisory Circular AC70/7460-1L CHG1 – *Obstruction Marking and Lighting*). Such a system would only activate the lights when an aircraft is detected in the near vicinity and deactivate the lighting once the aircraft has passed. This technology reduces the impact of night lighting on nearby communities and migratory birds and extends the life expectancy of obstruction lights.	
Residual Risk Not installing obstacle lights would clearly be an acceptable outcome to those potentially affected by visual impact. If lighting is required, consideration of visual impact in the lighting design should enable installation of lighting that reduces the impact to neighbours. The likelihood of a **Moderate** consequence remains **Likely**, with a resulting risk level of **7 – Tolerable**. **It is our assessment that visual impact from obstacle lights can be negated if they are not installed.** If obstacle lights are to be installed, they can be designed so that there is an acceptable risk of visual impact to neighbours.	
Residual Risk	7 - Tolerable

10. CONCLUSIONS

The key conclusions of this AIA are summarised as follows:

10.1. Planning considerations

The Draft Murray River Council Local Environment Plan (LEP) 2021, which encompasses the Project area does not include any airspace provisions relevant to the project.

The Wakool Local Environment Plan 2013 within the Murray River LGA does not include any airspace provisions relevant to the project.

The Balranald Shire Council LEP 2010 does not include any airspace provisions relevant to the project.

10.2. Aviation Impact Statement

Based on the Project WTG layout and maximum blade tip height of up to 291.5 m AGL, the blade tip elevation of the highest WTG, which is WTG4, will not exceed 361.9 m AHD (1187.6 ft AMSL) and:

- would not infringe any OLS surfaces
- would not infringe any PANS-OPS surfaces
- would have an impact on two grid LSALTs. The overlying 1700 ft Grid LSALT will need to be increased to 2200 ft AMSL. The overlying 1800 ft grid LSALT will need to be increased t to 2200 ft AMSL
- would have an impact on nearby designated air routes. W762 LSALT will need to be increased to 2200 ft AMSL. The LSALT for air route H247 will need to be increased to 2200 ft AMSL
- wake turbulence effects would be unlikely to cause an adverse impact upon aircraft arriving at and operating within the standard circuit area at Jeraly Station ALA and at the Keri-Keri ALA. Consultation with the owners is underway
- would not have an impact on operational airspace
- would be wholly contained within Class G airspace
- would be outside the clearance zones associated with civil aviation navigation aids and communication facilities.

10.3. Aircraft operator characteristics

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

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

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

10.4. Hazard marking and lighting

The following conclusions apply to hazard marking and lighting:

- With respect to CASR Part 139 Division 139.E.1 Notifying potential hazards 139.165, the proposed WTGs and WMTs must be reported to CASA. WTGs and WMTs must be marked in accordance with Part 139 MOS 2019 Chapter 8 Division 10 section 8.110.
- WTGs must be lit in accordance with Part 139 MOS 2019 Chapter 9 Division 4 9.30 and 9.31, unless an aeronautical study assesses they are of no operational significance, which this AIA does.
- 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.
- Temporary and permanent WMTs should be marked according to the requirements set out in Manual of Standards (MOS) 139 Section 8.10 (as modified by the guidance in NASF Guideline D). Aviation marker balls and painting the top 1/3 of WMTs structures in red and white bands is considered to be an acceptable mitigation strategy.
- WTGs and permanent WMTs that are installed in close proximity to a WTG will not require obstacle lighting to maintain an acceptable level of safety to aircraft.
- Temporary WMTs that are installed prior to WTG installation, and WMTs that are not in close proximity to a WTG, will require obstacle lighting to maintain an acceptable level of safety. These WMTs should be lit with medium intensity steady red obstacle lighting at the top of the WMT mast. Characteristics of medium intensity obstacle lighting in MOS 139, Section 9.33.

10.5. Summary of risks

A summary of the level of residual risk associated with the Project with the Recommended Treatments implemented, is provided in Table 11.

Table 11 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

Identified Risk	Consequence	Likelihood	Risk	Actions Required
				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 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.

11. RECOMMENDATIONS

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

Notification and reporting

1. 'As constructed' details of WGT and WMT 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 WGT and WMT coordinates and elevation should be provided to Airservices Australia, using 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 wind farm should be provided to local and regional aircraft operators prior to construction in order for them to consider the potential impact of the wind farm on their operations.
5. To facilitate the flight planning of aerial application operators, details of the Project, including the 'as constructed' location and height information of WTGs, WMTs and overhead transmission lines should be provided to landowners so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information.

Operation

6. Whilst not a statutory requirement, the Proponent should consider engaging with any local aerial agricultural operators and aerial firefighting operators in developing procedures for such aircraft operations in the vicinity of the Project.
7. The proponent should notify landowners of the identified landing ground within 3nm south of the Project Site to determine any impacts from the WTG proximity and potential wake turbulence effects, and with the owner of Jeraly Station ALA to determine any impacts from WTG wake turbulence effects.

Marking of WTGs

8. 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.

Lighting of WTGs

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

Marking of wind monitoring towers

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

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

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

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

Lighting of wind monitoring towers

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

Micrositing

12. The potential micrositing of the WTGs and WMTs has been considered in the assessment with the estimate of the overall maximum height being based on the highest ground level within 100 m of the nominal WTG and WMT positions. Providing the micrositing is within 100 m of the WTGs and WMTs is likely to not result in a change in the maximum overall blade tip height of the Project. No further assessment is likely to be required from micrositing and the conclusions of this AIA would remain the same.

Overhead transmission line

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

Triggers for review

14. Triggers for review of this risk assessment are provided for consideration:

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

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

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

ANNEXURES

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

ANNEXURE 1 – REFERENCES

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

- Airservices Australia, Aeronautical Information Package; including AIP Book, Departure and Approach Procedures, Designated Airspace Handbook and En Route Supplement Australia dated 30 November 2023
- Draft Murray River Council Local Environmental Plan 2021
- Wakool Local Environment Plan 2013
- Balranald Shire Council Local Environmental Plan 2010
- Civil Aviation Safety Authority, Civil Aviation Regulations 1988 (CAR)
- Civil Aviation Safety Authority, Civil Aviation Safety Regulations 1998 (CASR)
- Civil Aviation Safety Authority, Advisory Circular (AC) 91-10 v1.1: *Operations in the vicinity of non-controlled aerodromes*, dated November 2021
- Civil Aviation Safety Authority, Manual of Standards Part 173 – Standards Applicable to Instrument Flight Procedure Design, version 1.5, dated March 2016
- Civil Aviation Safety Authority, *Part 139 (Aerodromes) Manual of Standards 2019*, dated 5 September 2019
- Civil Aviation Safety Authority, Advisory Circular 139.E-01 v1.0—Reporting of Tall Structures , dated December 2021
- Civil Aviation Safety Authority, Advisory Circular (AC) 139.E-05 v1.0 Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome
- Department of Infrastructure and Regional Development, Australian Government, National Airport Safeguarding Framework, Guideline D *Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation*, dated June 2013
- International Civil Aviation Organization (ICAO) Doc 8168 Procedures for Air Navigation Services—Aircraft Operations (PANS-OPS)
- ICAO Standards and Recommended Practices, Annex 14—Aerodromes
- OzRunways, aeronautical navigation charts extracts, dated 28 February 2024
- Standards Australia, ISO 31000:2018 *Risk management – Guidelines*

ANNEXURE 2 – DEFINITIONS

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

Term	*Definition*
Runway	A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.
Runway strip	A defined area including the runway and stopway, if provided, intended: a. to reduce the risk of damage to aircraft running off a runway; and b. to protect aircraft flying over it during take-off or landing operations.
Safety Management System	A systematic approach to managing safety, including organisational structures, accountabilities, policies and procedures.

ANNEXURE 3 – CASA REGULATORY REQUIREMENTS – LIGHTING AND MARKING

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

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

Civil Aviation Safety Regulations 1998, Part 139—Aerodromes

CASR 139.165 requires the owner of a structure (or proponents of a structure) that will be 100 m or more above ground level to inform CASA. This must be given in written notice and contain information on the proposal, the height and location(s) of the object(s) and the proposed timeframe for construction. This is to allow CASA to assess the effect of the structure on aircraft operations and determine whether the structure will be hazardous to aircraft operations.

Manual of Standards Part 139—Aerodromes

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

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

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

    Note CASA recommends the use of flashing red medium-intensity obstacle lights.
4. *Medium-intensity obstacle lights must be used if:*
    a. *the object or structure is an extensive one; or*

b. *the top of the object or structure is at least 45 m but not more than 150 m above the surrounding ground; or*

c. *CASA determines in writing that early warning to pilots of the presence of the object or structure is desirable in the interests of aviation safety.*

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

5. *For subsection (4), low-intensity and medium-intensity obstacle lights may be used in combination.*

6. *High-intensity obstacle lights:*

    a. *must be used on objects or structures whose height exceeds 150 m; and*

    b. *must be flashing white lights.*

7. *Despite paragraph (6) (b), a medium-intensity flashing red light may be used if necessary, to avoid an adverse environmental impact on the local community.*

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

8. *Subject to subsection (9), for wind turbines in a wind farm, medium-intensity obstacle lights must:*

    a. *mark the highest point reached by the rotating blades; and*

    b. *be provided on a sufficient number of individual wind turbines to indicate the general definition and extent of the wind farm, but such that intervals between lit turbines do not exceed 900 m; and*

    c. *all be synchronised to flash simultaneously; and*

    d. *be seen from every angle in azimuth.*

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

9. *If it is physically impossible to light the rotating blades of a wind turbine:*

    a. *the obstacle lights must be placed on top of the generator housing; and*

    b. *a note must be published in the AIP-ERSA indicating that the obstacle lights are not at the highest position on the wind turbines.*

10. *If the top of an object or structure is more than 45 m above:*

    a. *the surrounding ground (ground level); or*

    b. *the top of the tallest nearby building (building level); then the top lights must be medium-intensity lights, and additional low-intensity lights must be:*

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

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

Advisory Circular 139.E-01 v1.0—Reporting of Tall Structures

In Advisory Circular (AC) 139.E-01 v1.0—Reporting of Tall Structures, CASA provides guidance to those authorities and persons involved in the planning, approval, erection, extension or dismantling of tall structures so that they may understand the vital nature of the information they provide.

Airservices Australia has been assigned the task of maintaining a database of tall structures. RAAF and Airservices Australia require information on structures which are:

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

b) 45 metres or more above ground level elsewhere for the RAAF, or

c) 30 m or more above ground level elsewhere for Airservices Australia.

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

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

International Civil Aviation Organisation

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

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

6.2.4 Wind turbines

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

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

Note 2. — See 4.3.1 and 4.3.2

Markings

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

Lighting

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

a) to identify the perimeter of the wind farm;

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

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

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

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

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

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

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

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

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

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

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

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

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

6.2.3.15 Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and

a) low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45 m; and

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

Section 4.3 Objects outside the OLS states the following:

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

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

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

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

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

Light characteristics

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

The characteristics of the obstacle lights should be in accordance with the applicable standards in Part 139 MOS 2019.

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

Part 139 MOS 2019 Chapter 9 Division 4 – Obstacle Lighting section 9.32 outlines Characteristics of Low Intensity Obstacle Lights.

1. *Low-intensity obstacle lights must have the following:*
   a. *fixed lights showing red;*
   b. *a horizontal beam spread that results in 360-degree coverage around the obstacle;*
   c. *a minimum intensity of 100 candela (cd);*
   d. *a vertical beam spread (to 50% of peak intensity) of 10 degrees;*
   e. *a vertical distribution with 50 cd minimum at +6 degrees and +10 degrees above the horizontal;*
   f. *not less than 10 cd at all elevation angles between –3 degrees and +90 degrees above the horizontal.*

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

2. *To indicate the following:*
   a. *taxiway obstacles;*
   b. *unserviceable areas of the movement area; low-intensity obstacle lights must have a peak intensity of at least 10 cd.*

Part 139 MOS 2019 Chapter 9 Division 4 – Obstacle Lighting section 9.33 outlines Characteristics of Medium Intensity Obstacle Lights.

1. *Medium-intensity obstacle lights must:*

a. be visible in all directions in azimuth; and

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

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

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

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

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

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

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

The details of the WMT were introduced in **Section 4** of this report.

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

> *8.110 Marking of Hazardous Obstacles*
>
> *(5) As illustrated in Figure 8.110 (5), long, narrow structures like masts, poles and towers which are hazardous obstacles must be marked in contrasting colour bands so that the darker colour is at the top; and the bands are, as far as physically possible, marked at right angles along the length of the long, narrow structure; and have a length ("z" in Figure 8.110 (5)) that is, approximately, the lesser of: 1/7 of the height of the structure; or 30 m.*
>
> *(7) Hazardous obstacles in the form of wires or cables must be marked using 3-dimensional coloured objects attached to the wire or cables. Note: Spheres and pyramids are examples of 3-dimensional objects.*
>
> *(8) The objects mentioned in subsection (7) must:*
> *(a) be approximately equivalent in size to a cube with 600 mm sides; and*
> *(b) be spaced 30 m apart along the length of the wire or cable.*

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

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

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

Overhead transmission lines

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

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

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

(a) be approximately equivalent in size to a cube with 600 mm sides; and

(b) be spaced 30 m apart along the length of the wire or cable.

ANNEXURE 4 – RISK FRAMEWORK

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

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

Section 2.1 of the ICAO Doc 9589 *The concept of safety* defines safety as follows [author's underlining]:

> *2.1.1 Within the context of aviation, safety is "the state in which the possibility of harm to persons or of property damage is reduced to, and maintained <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: KKWF_WTG and WMT Data_20240227.xlsx

WTG ID	X (GDA 1994 Zone 54)	Y (GDA 1994 Zone 54)	Terrain Elevation (m AHD)	WTG Tip Height (m AGL)	WTG Max Height (m AMSL)	WTG Max Height (ft AMSL)
1	777091	6156229	70.13	291.5	361.63	1186.5
3	777736	6155933	70.37	291.5	361.87	1187.2
4	778571	6155585	70.49	291.5	361.99	1187.6
5	779003	6155334	70.43	291.5	361.93	1187.4
6	775145	6155005	69.6	291.5	361.1	1184.7
7	775799	6155035	69.56	291.5	361.06	1184.6
8	776190	6154725	69.61	291.5	361.11	1184.7
9	776712	6154585	69.75	291.5	361.25	1185.2
10	777235	6154445	69.81	291.5	361.31	1185.4
11	777750	6154255	70	291.5	361.5	1186.0
12	778280	6154165	70.24	291.5	361.74	1186.8
13	778783	6153963	70.08	291.5	361.58	1186.3
14	773233	6153726	68.89	291.5	360.39	1182.4
15	773719	6153596	69.02	291.5	360.52	1182.8
16	774200	6153466	69.3	291.5	360.8	1183.7
17	774681	6153338	69.38	291.5	360.88	1184.0
18	775162	6153209	69.24	291.5	360.74	1183.5
19	775644	6153080	69.16	291.5	360.66	1183.3
20	776137	6152948	69.23	291.5	360.73	1183.5
21	776616	6152819	69.17	291.5	360.67	1183.3
22	777094	6152691	69.09	291.5	360.59	1183.0
23	777573	6152563	69.23	291.5	360.73	1183.5
24	778052	6152434	69.41	291.5	360.91	1184.1
25	778525	6152307	69.78	291.5	361.28	1185.3
26	768627	6153184	68.28	291.5	359.78	1180.4
27	769125	6153101	68.09	291.5	359.59	1179.8

WTG ID	X (GDA 1994 Zone 54)	Y (GDA 1994 Zone 54)	Terrain Elevation (m AHD)	WTG Tip Height (m AGL)	WTG Max Height (m AMSL)	WTG Max Height (ft AMSL)
28	769621	6153020	68.13	291.5	359.63	1179.9
29	770117	6152934	67.97	291.5	359.47	1179.4
30	770614	6152854	68.03	291.5	359.53	1179.6
31	771113	6152808	67.77	291.5	359.27	1178.7
32	771605	6152370	67.76	291.5	359.26	1178.7
33	772086	6152240	68.02	291.5	359.52	1179.5
34	772583	6152157	67.57	291.5	359.07	1178.1
36	773638	6151825	67.93	291.5	359.43	1179.2
38	774670	6151506	68.63	291.5	360.13	1181.5
39	775162	6151417	68.68	291.5	360.18	1181.7
40	775663	6151273	68.89	291.5	360.39	1182.4
41	776130	6151040	68.96	291.5	360.46	1182.6
42	776568	6150790	68.79	291.5	360.29	1182.1
43	777195	6150872	69.57	291.5	361.07	1184.6
44	777679	6150547	69.68	291.5	361.18	1185.0
45	778308	6150548	69.19	291.5	360.69	1183.4
46	778816	6150442	68.89	291.5	360.39	1182.4
47	779358	6150374	69.84	291.5	361.34	1185.5
48	779836	6150560	69.72	291.5	361.22	1185.1
49	780315	6150745	69.73	291.5	361.23	1185.1
50	780792	6150930	69.44	291.5	360.94	1184.2
51	767466	6151792	67.78	291.5	359.28	1178.7
52	767920	6151502	67.81	291.5	359.31	1178.8
53	768557	6151599	67.93	291.5	359.43	1179.2
54	769172	6151448	67.56	291.5	359.06	1178.0
55	769740	6151276	67.49	291.5	358.99	1177.8
57	770722	6150741	67.85	291.5	359.35	1179.0
58	771275	6150728	68.56	291.5	360.06	1181.3
59	771763	6150516	68.2	291.5	359.7	1180.1
62	773118	6150059	68.77	291.5	360.27	1182.0

WTG ID	X (GDA 1994 Zone 54)	Y (GDA 1994 Zone 54)	Terrain Elevation (m AHD)	WTG Tip Height (m AGL)	WTG Max Height (m AMSL)	WTG Max Height (ft AMSL)
63	773629	6150043	68.63	291.5	360.13	1181.5
64	774111	6149907	68.6	291.5	360.1	1181.4
65	774622	6149770	68.61	291.5	360.11	1181.5
66	775132	6149633	68.74	291.5	360.24	1181.9
67	775643	6149496	68.83	291.5	360.33	1182.2
68	776154	6149359	68.89	291.5	360.39	1182.4
69	776665	6149222	69.33	291.5	360.83	1183.8
70	777176	6149085	69.62	291.5	361.12	1184.8
71	777687	6148949	69.49	291.5	360.99	1184.4
72	778214	6148899	69.45	291.5	360.95	1184.2
73	778725	6148748	69.35	291.5	360.85	1183.9
74	779208	6148587	69.91	291.5	361.41	1185.7
75	779767	6148878	70.24	291.5	361.74	1186.8
76	764068	6150632	67.04	291.5	358.54	1176.3
77	764572	6150664	67.16	291.5	358.66	1176.7
78	765070	6150528	66.84	291.5	358.34	1175.7
79	765585	6150374	66.98	291.5	358.48	1176.1
80	766090	6150220	67.24	291.5	358.74	1177.0
81	766797	6150053	67.16	291.5	358.66	1176.7
82	767309	6149937	67.16	291.5	358.66	1176.7
83	767849	6149793	67.16	291.5	358.66	1176.7
84	768327	6149663	67.23	291.5	358.73	1176.9
85	768966	6149862	67.5	291.5	359	1177.8
86	769450	6149705	68.02	291.5	359.52	1179.5
87	769830	6149354	67.68	291.5	359.18	1178.4
88	770249	6149066	67.59	291.5	359.09	1178.1
89	770943	6149126	68.24	291.5	359.74	1180.2
90	771504	6149011	68.83	291.5	360.33	1182.2
91	772006	6148952	68.53	291.5	360.03	1181.2
92	772591	6148526	68.2	291.5	359.7	1180.1

WTG ID	X (GDA 1994 Zone 54)	Y (GDA 1994 Zone 54)	Terrain Elevation (m AHD)	WTG Tip Height (m AGL)	WTG Max Height (m AMSL)	WTG Max Height (ft AMSL)
94	773116	6148384	68.46	291.5	359.96	1181.0
95	773693	6148229	68.45	291.5	359.95	1180.9
96	774260	6148177	68.5	291.5	360	1181.1
97	774825	6147916	68.49	291.5	359.99	1181.1
98	775323	6147790	68.32	291.5	359.82	1180.5
105	763796	6149087	66.7	291.5	358.2	1175.2
106	764289	6148955	66.98	291.5	358.48	1176.1
107	764786	6148896	66.96	291.5	358.46	1176.0
108	765271	6148750	67.27	291.5	358.77	1177.1
109	765779	6148680	67.52	291.5	359.02	1177.9
110	766228	6148412	67.47	291.5	358.97	1177.7
111	766692	6148225	67.61	291.5	359.11	1178.2
112	767380	6148061	67.4	291.5	358.9	1177.5
113	767804	6147716	67.05	291.5	358.55	1176.3
114	768450	6147814	67.11	291.5	358.61	1176.5
116	769498	6147446	67.79	291.5	359.29	1178.8
117	770086	6147428	67.96	291.5	359.46	1179.3
118	770573	6147271	68.15	291.5	359.65	1180.0
119	771112	6147140	68.31	291.5	359.81	1180.5
124	773470	6146462	68.2	291.5	359.7	1180.1
125	773944	6146176	68.28	291.5	359.78	1180.4
126	774470	6146003	68.49	291.5	359.99	1181.1
127	775013	6145866	68.62	291.5	360.12	1181.5
128	763567	6147626	66.65	291.5	358.15	1175.0
129	764021	6147416	67.03	291.5	358.53	1176.3
130	764552	6147404	67.25	291.5	358.75	1177.0
131	765026	6147235	67.39	291.5	358.89	1177.5
137	768023	6145750	67.41	291.5	358.91	1177.5
139	768714	6145769	67.51	291.5	359.01	1177.9
140	769261	6145745	67.62	291.5	359.12	1178.2

WTG ID	X (GDA 1994 Zone 54)	Y (GDA 1994 Zone 54)	Terrain Elevation (m AHD)	WTG Tip Height (m AGL)	WTG Max Height (m AMSL)	WTG Max Height (ft AMSL)
141	769914	6145594	67.66	291.5	359.16	1178.3
142	770385	6145455	67.81	291.5	359.31	1178.8
143	770860	6145328	67.83	291.5	359.33	1178.9
144	771343	6145208	67.77	291.5	359.27	1178.7
145	771826	6145132	67.81	291.5	359.31	1178.8
146	772304	6144996	67.79	291.5	359.29	1178.8
147	772804	6145031	67.63	291.5	359.13	1178.2
148	773246	6144780	68.17	291.5	359.67	1180.0
149	773745	6144650	68.13	291.5	359.63	1179.9
150	774240	6144574	68.35	291.5	359.85	1180.6
151	774766	6144359	68.47	291.5	359.97	1181.0
153	763624	6145372	67.22	291.5	358.72	1176.9
154	764109	6145493	67.43	291.5	358.93	1177.6
155	765109	6145643	67.36	291.5	358.86	1177.4
156	765613	6145715	67.46	291.5	358.96	1177.7
157	767003	6145324	67.33	291.5	358.83	1177.3
158	767387	6145004	67.17	291.5	358.67	1176.7
162	769767	6143683	67.01	291.5	358.51	1176.2
163	770346	6143737	67.27	291.5	358.77	1177.1
164	770890	6143591	67.15	291.5	358.65	1176.7
165	771384	6143461	67.32	291.5	358.82	1177.2
166	771974	6143306	67.53	291.5	359.03	1177.9
167	772573	6143227	67.58	291.5	359.08	1178.1
168	773031	6143027	68.12	291.5	359.62	1179.9
170	773648	6142859	68.09	291.5	359.59	1179.8
171	771462	6141780	67.54	291.5	359.04	1178.0
172	771976	6141453	67.77	291.5	359.27	1178.7
173	772597	6141343	68.43	291.5	359.93	1180.9
174	773151	6141292	68.47	291.5	359.97	1181.0
175	773714	6141220	68.45	291.5	359.95	1180.9

WTG ID	X (GDA 1994 Zone 54)	Y (GDA 1994 Zone 54)	Terrain Elevation (m AHD)	WTG Tip Height (m AGL)	WTG Max Height (m AMSL)	WTG Max Height (ft AMSL)
176	766110	6145793	67.54	291.5	359.04	1178.0
177	768130	6153268	68.18	291.5	359.68	1180.1
178	766783	6151888	67.71	291.5	359.21	1178.5
179	764607	6145565	67.32	291.5	358.82	1177.2
180	766585	6145604	67.49	291.5	358.99	1177.8
181	768663	6143676	67.23	291.5	358.73	1176.9
182	769253	6143379	66.9	291.5	358.4	1175.9
183	766212	6151946	67.63	291.5	359.13	1178.2
184	765598	6152074	67.52	291.5	359.02	1177.9

ANNEXURE 6 – WIND MONITORING TOWERS - COORDINATES AND HEIGHTS

Reference file: KKWF_WTG and WMT Data_20240227.xlsx

WMT ID	X (GDA 1994 Zone 54)	Y (GDA 1994 Zone 54)	Type	Terrain Elevation (m AHD)	WMT Height (m AGL)	WMT Elevation (m AMSL)	WMT Elevation (ft AMSL)
P1	778894	6150818	Permanent	69.2	159	228.2	748.7
P2	777607	6148538	Permanent	69.14	159	228.14	748.5
P3	770197	6143372	Permanent	67.08	159	226.08	741.7
P4	764545	6145181	Permanent	67.32	159	226.32	742.5
T5	778816	6150442	Temporary	68.89	159	227.89	747.7
T6	770346	6143737	Temporary	67.28	159	226.28	742.4
T7	764607	6145565	Temporary	67.29	159	226.29	742.4
T8	777687	6148949	Temporary	69.49	159	228.49	749.6

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