MT FYANS
WIND FARM

APPENDIX Q

AVIATION SAFETY ASSESSMENT

AVIATION PROJECTS

AUGUST 2022

MT FYANS WIND FARM

AVIATION SAFETY ASSESSMENT

Prepared for Hydro Tasmania Pty Ltd

AVIATION PROJECTS

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1.4	Revised Figure 2	09 August 2022		

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AVIATION PROJECTS

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ACRONYMS

AAAA	Aerial Application Association of Australia
AC	Advisory Circular
AFAC	Australasian Fire and Emergency Services Council
AGL	above ground level
AHD	Australian Height Datum
AIA	Aviation Impact Assessment
AIP	Aeronautical Information Package
AIS	Aviation Impact Statement
ALA	aircraft landing area
ALARP	as low as reasonably practicable
AMSL	above mean sea level
ARP	Aerodrome Reference Point
AS	Australian Standards
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	(1ft = 0.3048 m)
km	kilometres	(1 km = 0.5399 nm)
m	metres	(1 m = 3.281 ft)
nm	nautical miles	(1 nm = 1.852 km)

DEFINITIONS

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

NOTES

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

EXECUTIVE SUMMARY

Introduction

Hydro Tasmania Pty Ltd (Hydro Tasmania) acting on behalf of Woolnorth Wind Farms Holdings Pty Ltd (Woolnorth) seeks to develop a wind farm known as the Mt Fyans Wind Farm Project (MFWF Project). Hydro Tasmania is currently preparing a proposal to obtain planning approval from the Minister for Planning for the MFWF site, located in south west Victoria.

The proposed MFWF Project is located:

- approximately 140 km west of Geelong in a region that stretches from western Melbourne to Hamilton, referred to as the Western Volcanic Plains;
- approximately 190 km west of Melbourne;
- 11 km east of Darlington town;
- 8 km north of Woorndoo town;
- 6 km west of Hexham town; and
- on the northern outskirts of the town of Mortlake (population approximately 1350) in Moyne Shire.

Hydro Tasmania is proposing up to 81 Class II/III wind turbine generators (WTGs) with a proposed maximum tip height of 200 m (656 ft) above ground level (AGL) within a number of corridors with underground cable connecting the turbine clusters. The MFWF Project site includes internal site access tracks, an on-site substation and approximately 19 km of overhead electrical transmission line connecting to Mortlake Power Station.

The MFWF site will need an aviation safety assessment undertaken in accordance with the:

- Victorian Government's *Wind Farm Planning Guidelines*;
- 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.

Hydro Tasmania has requested Aviation Projects provide an Aviation Safety Assessment and supporting technical data that provides evidence and analysis for the planning application to demonstrate that appropriate risk mitigation strategies have been identified.

Conclusions

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

Certified airports

1. The proposed Project is almost completely within the 25 nm MSA of Warrnambool Airport (YWBL).
2. The 25 nm MSA 3300 ft AMSL protection surface elevation is 2300 ft AMSL (701 m AHD). The highest WTG85 is 1227 ft AMSL. This is lower than the 25 nm MSA by 1073 ft (327 m). The Project will not impact the 25 nm PANS-OPS surface of YWBL.
3. All WTGs are located beyond the horizontal extent of category A, category B and category C circling areas at Warrnambool Airport.
4. The proposed Project site is located outside the horizontal extent and will not impact the OLS of Warrnambool Airport.

Aircraft Landing Areas (ALAs)

5. All ALAs are free from impact of their approach and take-off surfaces

Obstacle Limitation Surfaces

6. The proposed Project site is located outside the horizontal extent and will not impact the OLS of Warrnambool Airport.

Air Routes and Lowest Safe Altitude

7. The Project will not impact the LSALT of any air route.
8. The Project will not impact the local grid LSALT.

Aviation Facilities

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

Radar

10. The Project site will not interfere with the serviceability of any radar facilities.

Aviation Impact Statement (AIS)

11. Based on the Project WTG layout and maximum blade tip height of up to 200 m AGL, the blade tip elevation of the highest WTG, which is WTG85, will not exceed 374 m AHD (1227 ft AMSL).

12. This AIS concludes the Project:

    a) will not penetrate any OLS surfaces

    b) will not penetrate any PANS-OPS surfaces

    c) will not have an impact on nearby aircraft landing areas

    d) will not have an impact on nearby designated air routes

    e) will not have an impact on the grid LSALT

    f) will not have an impact on operational airspace

    g) is wholly contained within Class G airspace

    h) is outside the clearance zones associated with civil aviation navigation aids and communication facilities.

Obstacle lighting risk assessment

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

Consultation

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

Cumulative impacts

15. Since the proposed wind farm has no impact on aviation activities other than on or within close proximity to the site, it is assessed that there is no significant cumulative impact arising from nearby existing or approved wind farms.

16. None of the wind farms in relatively close proximity to the proposed MFWF with turbines greater than 110 m AGL blade tip height are planned to have obstacle lighting. Waubra is the only wind farm in the region which previously operated obstacle lighting. In 2012 the Minister for Planning issued consent for the obstacle lighting to be switched off at the Waubra Wind Farm. This consent followed the advice of an aviation risk assessment prepared on behalf of the proponent, which determined that:

    the wind farm did not require aviation obstacle lighting and switching the lights off would not pose an unacceptable risk to aircraft.

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. To facilitate the flight planning of aerial application operators, the location and height of 'as constructed' WTGs and the 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.
2. Overhead transmission lines and/or supporting poles associated with the Project 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 Manual of Standards (MOS) Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8) where applicable.
3. '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).
4. 'As constructed' details of WTG and WMT coordinates and elevations should be provided to Airservices Australia, using the following email address: vod@airservicesaustralia.com.
5. The Proponent should consider engaging with local aerial agricultural operators and aerial firefighting operators in developing procedures for such aircraft operations in the vicinity of the Project, noting that there is no statutory requirement to do so.
6. Details of the final wind farm layout should be provided to local and regional aircraft operators prior to construction in order for them to consider the wind farm for their operations.
7. The rotor blades, nacelles and towers of the WTGs should be painted in white, providing sufficient contrast with the surrounding environment and to maintain an acceptable level of safety.
8. Consideration should be made to marking the temporary and permanent WMTs according to the requirements set out in Manual of Standards (MOS) Part 139 Chapter 8 Division 10 (as modified by the guidance in NASF Guideline D).

1. INTRODUCTION

1.1. Situation

Hydro Tasmania Pty Ltd (Hydro Tasmania) acting on behalf of Woolnorth Wind Farms Holdings Pty Ltd (Woolnorth) seeks to develop a wind farm known as the Mt Fyans Wind Farm Project (MFWF Project). Hydro Tasmania is currently preparing a proposal to obtain planning approval from the Minister for Planning for the MFWF site, located in south west Victoria.

The Aeronautical Impact Assessment will review potential impacts of the proposed MFWF Project maximum wind turbine heights on aviation safety in respect of relevant requirements of air safety regulations and procedures and in respect of consultation with relevant regulators.

1.2. Background

The proposed MFWF Project is located:

- approximately 140 km west of Geelong in a region that stretches from western Melbourne to Hamilton, referred to as the Western Volcanic Plains, south west Victoria;
- approximately 190 km west of Melbourne;
- 11 km east of Darlington town;
- 8 km north of Woorndoo town;
- 6 km west of Hexham town; and
- on the northern outskirts of the town of Mortlake (population approximately 1350) in Moyne Shire.

The region is characterised by a vast flat to undulating cleared agricultural plain, scattered with volcanic features in the forms of cones and stony rises. Mt Shadwell, which forms the backdrop to Mortlake, is located between the MFWF Project and Mortlake.

The Hamilton Highway, which runs between Geelong and Hamilton, forms part of the southern boundary of the MFWF Project location. The 500 kV South Australia/Victoria transmission line runs through the MFWF Project Site. Mortlake Gas Power Station connects to this transmission line 8 km to the south west of the MFWF Project site.

The MFWF Project is one of a number of wind farms at various stages of planning, approval, construction or operation in the region.

1.3. Scope of works

The scope of works of this report is to address the following task items:

1. confirmed the scope and deliverables;
2. reviewed client material;
3. conducted a site visit to properly investigate aviation safety aspects of the proposed MFWF site;

4. reviewed relevant regulatory requirements and information sources;
5. prepared a Draft Aviation Safety Assessment Report and supporting technical data that provides evidence and analysis for the planning application to demonstrate that appropriate risk mitigation strategies have been identified. The Draft Aviation Safety Assessment Report (Aviation Impact Statement (AIS), qualitative risk assessment to determine need for obstacle lighting) of applicable aspects for client review and acceptance before submission to external stakeholders;
6. identified risk mitigation strategies that provide an acceptable alternative to night lighting. The risk assessment will be completed following the guidelines of ISO 31000:2018 Risk Management – Guidelines;
7. ensured Hydro Tasmania develop constructive relationship with stakeholders involved in consultation. Consult with relevant stakeholders in consultation with Hydro Tasmania, including CASA, Airservices Australia, Department of Defence, state and local government authorities, Royal Flying Doctor Service, aerodrome operators, aircraft operators, Aerial Application Association of Australia and land owners/leaseholders. Includes preparation of correspondence, telephone consultation as applicable, and consolidation of responses for client review and acceptance; and
8. Upon receipt of stakeholder feedback, produced a Final Report for client review/acceptance.

1.4. Report Structure

This report is structured around the following areas of consideration:

- Introduction;
- Background;
- Planning context;
- Consultation;
- Aviation Impact Statement;
- Aircraft operator characteristics;
- Hazard lighting and marking;
- Accident statistics;
- Risk assessment;
- Conclusions; and
- Recommendations.

1.5. Stakeholders

Stakeholders considered and/or consulted in the preparation of this report include:

- Aerial Application Association of Australia;
- Air service operators at Ararat, Ballarat, Cobden and Warrnambool aerodromes, and specifically Western Aerial;
- Airservices Australia;
- Civil Aviation Safety Authority;
- Department of Defence;
- Operators of non-regulated aerodromes within the vicinity of the Project, including Mortlake ALA (YA1263); and
- TAG173 (The Airport Group).

1.6. Client material

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

- Department of Environment, Land, Water and Planning, Victoria State Government, Environmental Assessment, *Environment Effects Statement Referral for Mt Fyans Wind Farm*, received 14 August 2017;
- Hydro Tasmania, *MFWF Regional Location*, *Mt Fyans Wind Farm Environment Effects Referral*, drawing No. E306828-P513278-GIS01-07, dated 11 September 2018;
- Hydro Tasmania, *Planning Zones & Overlays*, drawing No E306828-P513278-GIS01-05 - MFWF Planning Zones, dated 03 June 2022
- Hydro Tasmania, *Figure 2: Development Plan, Mt Fyans Wind Farm Environment Effects Referral,* received 1 August 2017;
- Hydro Tasmania, *Mt Fyans Wind Farm Aviation Safety Assessment scope of works,* received 1 August 2017;
- Hydro Tasmania, arc map geodata base with wind farm spatial information, received 14 August 2017;
- Hydro Tasmania, information on *Mt Fyans transmission agreement, wind agreements, proposed layout, residents involved, residents non-involved, total site area, trans line indicative and vicmap contour 10m*, received 12 September 2017;
- Hydro Tasmania, turbine layout, WMT locations *MFWF_WTG_Locations_20220603*; and
- Hydro Tasmania, *CFA Emergency Management Guidelines for Wind Farm Facilities*, May 2015, References.

2. BACKGROUND

2.1. Project description

The proposed MFWF Project is located approximately 140 km west of Geelong in a region that stretches from western Melbourne to Hamilton, referred to as the Western Volcanic Plains, south west Victoria located within Moyne Shire Council local government area.

The Hamilton Highway, which runs between Geelong and Hamilton, forms part of the southern boundary of the MFWF Project location. The 500 kV South Australia/Victoria transmission line runs through the MFWF Project Site. Mortlake Gas Power Station connects to this transmission line 8 km to the south west of the MFWF Project site.

Figure 1 provides the Mt Fyans Wind Farm Locality Plan (source: Hydro Tasmania).

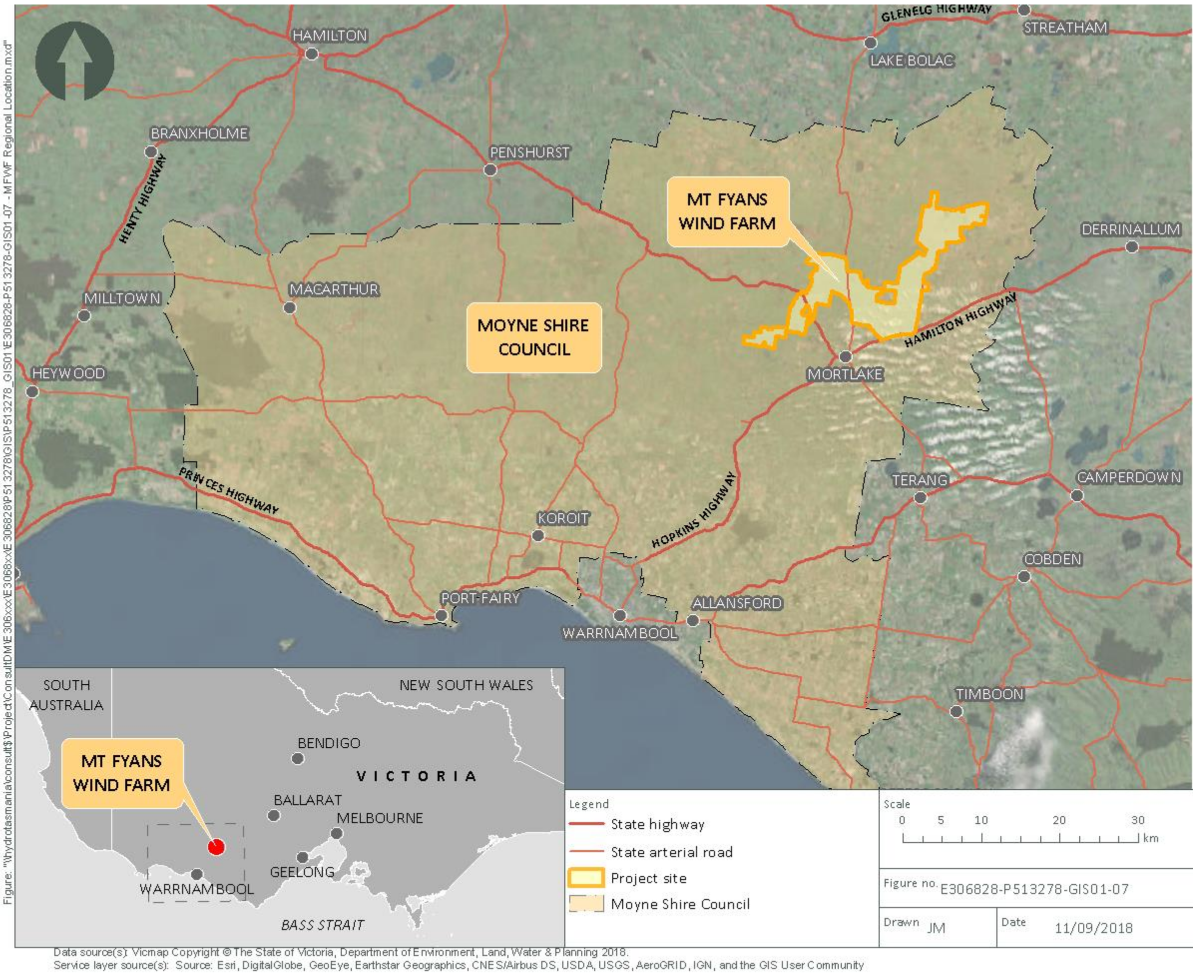

Figure 1 Mt Fyans Wind Farm Locality Plan

3. EXTERNAL CONTEXT

3.1. National Airports Safeguarding Framework

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

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

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

3.2. Victorian Government

Hydro Tasmania seeks to increase wind power production while protecting individuals, communities and the environment from adverse impacts from wind farms, through the Victorian Government's Policy and planning guidelines for development of wind energy facilities in Victoria.

Section 4.3.5 of the Victorian Government's guidelines sets out aircraft safety requirements as follows:

> *The height of wind energy turbines can be substantial, resulting in potential impacts upon nearby airfields and air safety navigation.*
>
> *Applicants should address aircraft safety issues by considering the proximity of the site to airports, aerodromes, or landing strips. Applicants should consult with the Civil Aviation Safety Authority (CASA) for wind energy facility proposals that:*
>
> *• are within 30 kilometres of a declared aerodrome or airfield*
>
> *• infringe the obstacle limitation surface around a declared aerodrome*
>
> *• include a building or structure the top of which will be 110 metres or more above natural ground level (height of a wind turbine is that reached by the tip of the turbine blade when vertical above ground level).*

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

In relation to lighting of wind turbines, the guidelines require the visual impact of the proposed wind farm should have regard to relevant state and local government planning policy, including:

- *limiting night lighting so that required for safe operation of a wind energy facility and for aviation safety;*
- *reducing the number of wind turbines with obstacle lights while not compromising aviation safety;*

Section 5.1.5 of the Victorian Government's guidelines sets out further aircraft safety requirements as follows:

The height of wind energy turbines can be substantial, resulting in potential impacts upon nearby airfields and air safety navigation.

A responsible authority should consider the proximity of the site to airports, aerodromes or landing strips, and ensure that any aircraft safety issues are identified and addressed appropriately.

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

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

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

A responsible authority should ensure that the proponent has consulted appropriately with CASA in relation to aircraft safety and navigation issues.

It is recommended that the proponent consults and receives approval from CASA prior to lodging their application for ease of process. Refer to Section 4.3.6 of these guidelines for more detail.

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

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

- *reducing the number of wind turbines with obstacle lights*
- *specifying an obstacle light that minimises light intensity at ground level*

- *specifying an obstacle light that matches light intensity to meteorological visibility*
- *mitigating light glare from obstacle lighting through measures such as baffling.*

3.3. Moyne Shire Council

Moyne Planning Scheme includes section 18.02-7S Airports and airfields. The objective for airports and airfields is:

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

Strategies relevant to the proposed MFWF Project include:

> *Plan for areas around airports and airfields so that land use or development does not prejudice future airport or airfield operations or expansions in accordance with an approved strategy or master plan for that airport or airfield.*
>
> *Ensure that in the planning of airports and airfields, land use decisions are integrated, appropriate land use buffers are in place and provision is made for associated businesses that service airports.*
>
> *Plan the location of airports and airfields, nearby existing and potential development, and the land-based transport system required to serve them, as an integrated operation.*
>
> *Plan the visual amenity and impact of any land use or development on the approaches to an airport or airfield to be consistent with the status of the airport or airfield.*

Hydro Tasmania provided the planning zones and overlays for the MFWF site and surrounding area. The wind farm site and transmission development envelope is zoned farming zone. Figure 2 shows the zoning of the MFWF site (source: Hydro Tasmania, Mt Fyans Wind Farm Environment Effects Referral).

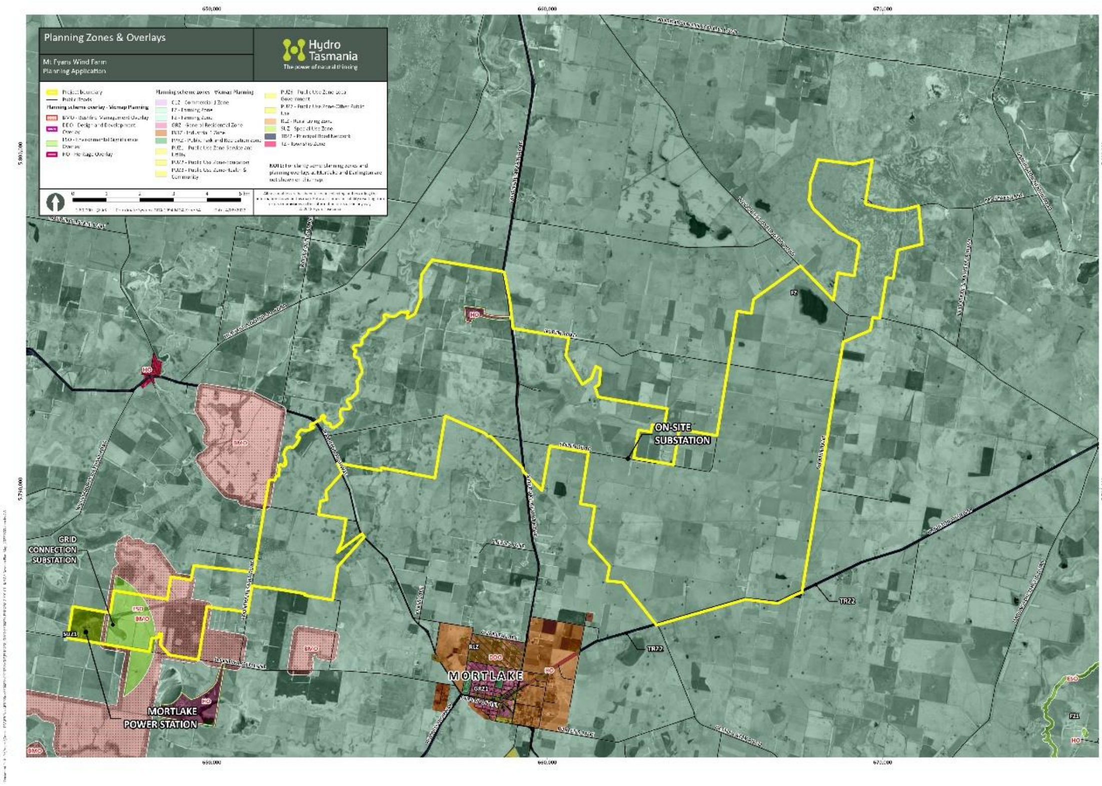

Figure 2 Mt Fyans Wind Farm planning zones and overlays

3.4. Aircraft operations at non-controlled aerodromes

There are several non-controlled 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.

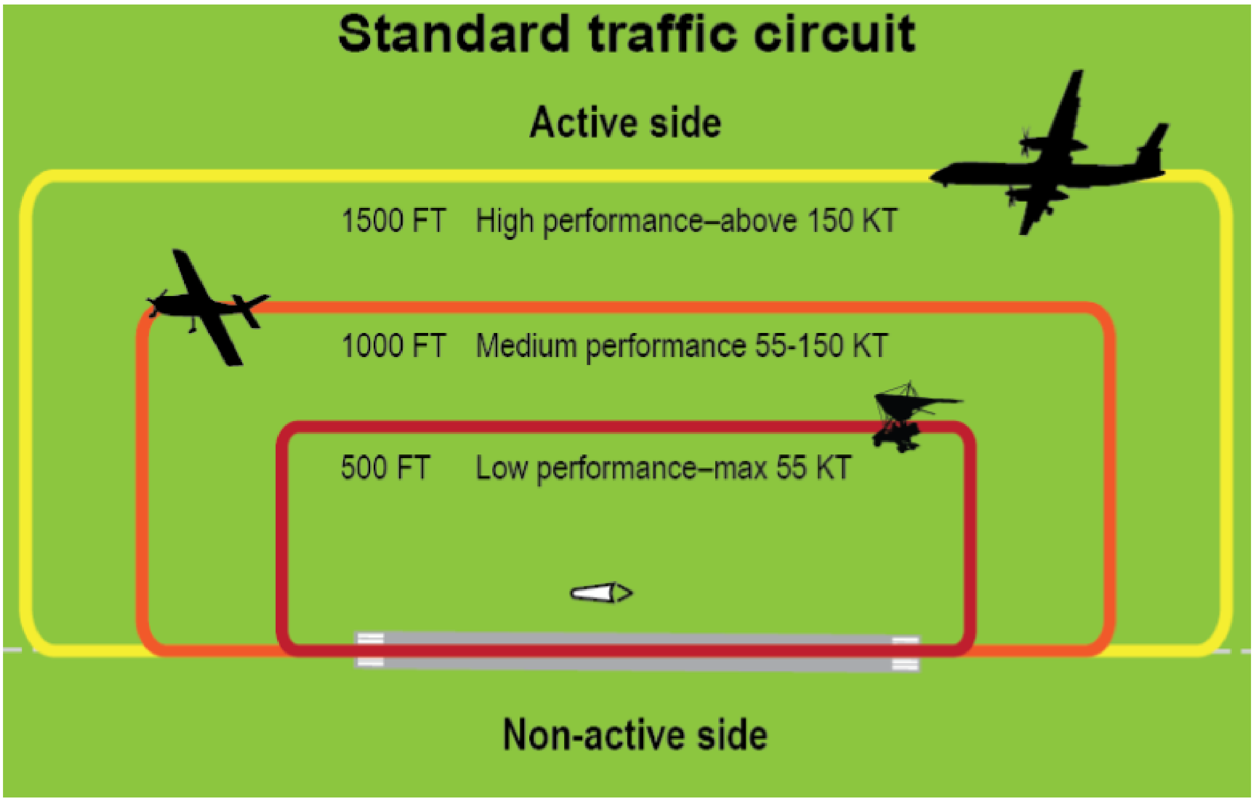

Figure 3 Lateral and vertical separation in the standard aerodrome traffic circuit

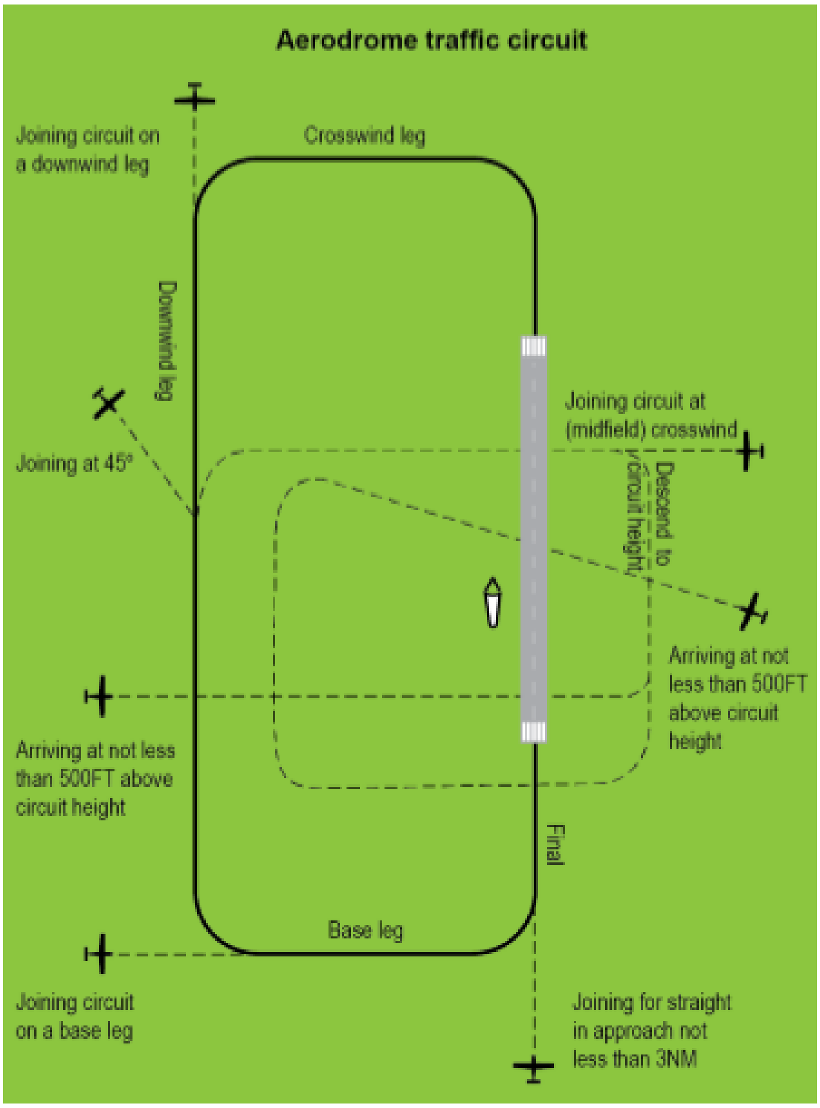

Figure 4 Aerodrome standard traffic circuit, showing arrival and joining procedures

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.*

3.5. Rules of flight

3.5.1. 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.

3.5.2. 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.*

3.5.3. 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.

3.6. 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 3.

3.7. Passenger transport operations

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

3.8. 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.

3.9. 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.

3.10. 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.

3.11. 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:

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

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

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

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

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

3.12. 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.

3.13. 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.

3.14. 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.*

AVIATION PROJECTS

4. INTERNAL CONTEXT

Hydro Tasmania's proposed MFWF Project will comprise of:

- up to maximum of 81 Class II/III WTGs, which will be higher than 150 m AGL;
- maximum overall height (tip height) of the wind turbines of not greater than 200 m (656 ft) AGL;
- highest wind turbine is WTG 85 with a ground elevation of 174 m AHD (571 ft AMSL);
- up to three proposed permanent wind monitoring (anemometry) towers at MFWF with heights of up to 120 m (394 ft) AGL for a class III WTG model and when constructed will be reported to Airservices Australia;
- ancillary infrastructure includes an on-site substation, an off-site substation located immediate to the east of the existing Mortlake Substation, and underground cable connecting the turbine clusters; and
- approximately 19 km of overhead electrical line connecting to Mortlake Power Station.

The proposed maximum overall tip height of the highest wind turbine, WTG 85 is 374 m AHD (1227 ft AMSL).

Aviation Projects conducted a site visit of the proposed MFWF on 11 October 2017 and prepared the following section with photos taken in various directions of the site from Six Mile Lane, Mortlake Ararat Road and Darlington Woorndoo Road. The MFWF site is farmland with cattle, sheep and crop production. Hydro Tasmania advised the height of the existing overhead transmission line is approximately 50 m.

Figure 5 shows the MFWF site with wind turbines located nearby to the existing overhead transmission line onsite looking north west from Six Mile Lane. Figure 6 is the MFWF site looking west from Six Mile Lane.

Figure 5 Mt Fyans Wind Farm site looking north west from Six Mile Lane, with existing transmission line

Figure 6 Mt Fyans Wind Farm site looking west from Six Mile Lane

Figure 7 shows Mt Fyans Wind Farm site looking north east from Mortlake Ararat Road with the existing overhead powerline onsite.

Figure 7 Mt Fyans Wind Farm looking north east from Mortlake Ararat Road

The site of the MFWF is generally flat land located around Mt Shadwell. Figure 8 shows the existing antennae on top of Mt Shadwell and includes an insert showing a closer photo of Mt Shadwell, taken looking west from Six Mile Lane. The proposed MFWF wind turbines are located to the north and east around Mt Shadwell.

Figure 8 Mt Fyans Wind Farm site looking west from Six Mile Lane with Mt Shadwell and existing antennae.

Figure 9 shows the MFWF site looking north from Darlington Woorndoo Road

Figure 9 Mt Fyans Wind Farm site looking north from Darlington Woorndoo Road

Figure 10 shows the MFWF site looking north west from Mortlake Ararat Road north from Mt Shardwell.

Figure 10 Mt Fyans site looking north west from Mortlake Ararat Road

Hydro Tasmania provided data on the MFWF proposed wind farm layout and project site envelopes. Further details provided by Hydro Tasmania:

> *The Project has been designed using development envelopes. A wind turbine development envelope delineates the area in which turbines maybe developed. No wind turbines will be located outside a wind turbine development envelope. Three wind turbine development envelopes are proposed, each with the following maximum number of turbines:*
>
> - *TDE A: western area – maximum 27 turbines*
> - *TDE B: central/southern area – maximum 45 turbines*
> - *TDE C: northern area – maximum 9 turbines*

The proposed wind farm layout highlighting the wind turbine with the greatest overall height (in red colour) is shown in Figure 11 (source: Hydro Tasmania, Google Earth).

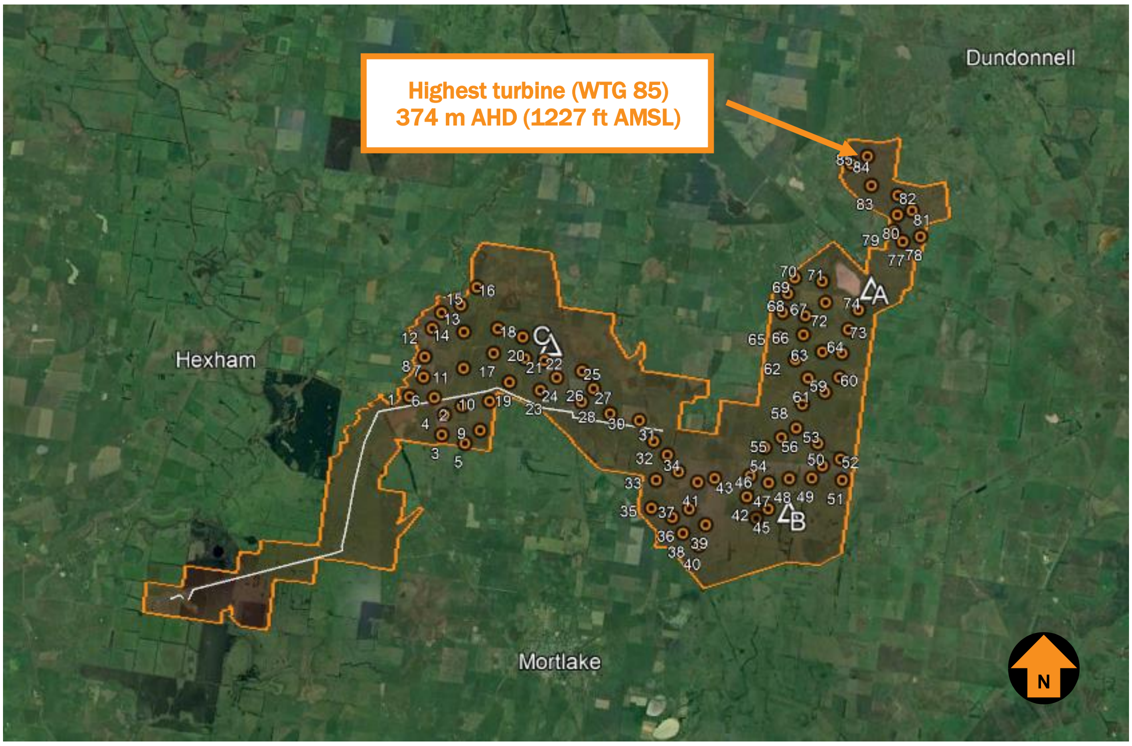

Figure 11 Mt Fyans Wind Farm Layout - highest turbine WTG 85

The coordinates and ground elevations of the proposed MFWF wind turbines are listed at Annexure 5.

4.1. Description of wind monitoring towers

The term 'wind monitoring towers' (WMTs) is used in this aeronautical impact assessment in lieu of 'wind monitoring masts' for consistency with aviation-related regulations, standards and guidance.

According to Hydro Tasmania, the MFWF Project commenced development in 2009 and a key activity was the collection of wind data through the use of an 80 m WMT and relocatable Sodar units. Hydro Tasmania stated:

> *Three to four WMTs will be established within the Project Site over the construction and commissioning stage of the Project. One or two of the WMTs will be maintained on site to provide a permanent wind record.*

Hydro Tasmania provided the coordinates and elevations for up to three proposed permanent WMTs for the MFWF site. The proposed permanent WMTs when constructed will be reported to Airservices Australia.

The details of the proposed permanent WMTs are provide in Table 1.

Table 1 Proposed permanent and temporary wind monitoring tower description

Detail	*WMT1 (A) (permanent)*	*WMT2 (B) (permanent)*	*WMT3 (C) (Temporary)*
Location (MGA54) (Easting, Northing)	668696.1659 5795175.815	665981.417 5788304.799	658649.8202 5793625.387
Ground elevation at site (m AHD)	163.57	150.41	150
Height of WMT AGL	Up to 120 m	Up to 120 m	Up to 120 m
Overall height of WMT	Up to 283 m AHD Up to 928 ft AMSL	Up to 267 m AHD Up to 876 ft AMSL	Up to 272 m Up to 892 ft AMSL
Lighting/Marking	Not proposed	Not proposed	Not proposed
Design	Triangular lattice tower with guy wires	Triangular lattice tower with guy wires	Triangular lattice tower with guy wires
Permanent tower	To be confirmed	To be confirmed	To be confirmed
Construction date	To be confirmed	To be confirmed	To be confirmed
Reported to Airservices Australia?	Once constructed Yes	Once constructed Yes	Once constructed Yes

The locations of the proposed WMTs are indicated in Figure 11.

5. STAKEHOLDER CONSULTATION

The following stakeholders were identified as requiring consultation:

- Aerial Application Association of Australia;
- Air service operators at Ararat, Ballarat, Cobden and Warrnambool aerodromes, and specifically Western Aerial;
- Airservices Australia;
- Civil Aviation Safety Authority;
- Department of Defence;
- Operators of non-regulated aerodromes within the vicinity of the Project, including Mortlake ALA (YA1263); and
- TAG173, The Airport Group.

Details and results of formal consultation activities are provided in Table 2.

Table 2 Stakeholder consultation feedback

Agency/Contact	Activity/Date	Response/Date	Issues Raised During Consultation	Action Proposed
Airservices Australia	22 February 2018 Email to Airport Developments	23 March 2018 Email from William Zhao, Advisor Airport Development, Operations Standards and Assurance	**Airspace Procedures** With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at a maximum height of 377m (1237ft) AHD the wind farm will not affect any sector or circling altitude, nor any instrument approach or departure procedure at Warrnambool Airport. The wind farm will also not affect any air route LSALT. Note that procedures not designed by Airservices at Warrnambool Airport were not considered in this assessment. **Communications/Navigation/Surveillance (CNS) Facilities** This wind farm to a maximum height of 377m (1237ft) AHD will not adversely impact the performance of Precision/Non-Precision Nav Aids, HF/VHF Comms, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.	Notify Airservices Australia of existing WMT - complete. Notify Airservices Australia of 'as-constructed' details. Prepare an aeronautical risk assessment and submit to Airservices Australia – complete.

Agency/Contact	*Activity/Date*	*Response/Date*	*Issues Raised During Consultation*	*Action Proposed*
The Airport Group	22 February 2018 Email to general enquiries email	22 February 2018 Email from Ray Romano, Chief Designer – Instrument Flight Procedures, Airspace Specialist, The Airport Group	The wind farm falls partially within the boundaries of the Warrnambool 25nm Minimum Safe Altitude area. The critical altitude for this area is 2316ft AHD [705m]. At a maximum height of 377m AHD, the wind turbines will not affect any Instrument Flight Procedure promulgated by The Airport Group.	No further actions required
Commonwealth Department of Defence	22 February 2018 Email to Estate Planning Land Planning and Regulation Infrastructure Division DSRGIDEP.ExecutiveSupport@defence.gov.au	22 June 2018 Letter from Sonya Dare, Director Land Planning and Regulation, Estate Planning Branch, Department of Defence,	Defence has conducted an assessment of the proposed wind farm for potential impacts on the safety of military flying operations as well as possible interference to Defence communications and radar. The proposed 200 metre AGL turbines and 120 metre meteorological towers meet the requirements for reporting of tall structures. There is an ongoing need to obtain and maintain accurate information about tall structures so that this information can be marked on aeronautical charts. Marking tall structures on aeronautical charts assists pilot navigation and enhances flight safety. Airservices Australia (ASA) is responsible for recording the location and height of tall structures. The information is held in a central database managed by ASA and relates to the erection, extension, or dismantling of tall structures, the top of which is above: a. 30 metres AGL, that are within 30 kilometres of an aerodrome; and b. 45 metres AGL elsewhere. The proposed structures will meet the above definition of a tall structure. Defence therefore requests that the applicant provide ASA with "as constructed" details. The details can be emailed to ASA at vod@airservicesaustralia.com.	Notify Airservices Australia of 'as-constructed' details. Submit an aeronautical risk assessment to CASA. Refer to CASA and Airservices requirements to marking and lighting of wind turbines.

Agency/Contact	*Activity/Date*	*Response/Date*	*Issues Raised During Consultation*	*Action Proposed*
			Defence notes that the National Airports Safeguarding Framework Guideline D – Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers recommends that where a wind turbine 150 metres or taller in height is proposed away from aerodromes, the proponent should conduct an aeronautical risk assessment. It also recommends that the risk assessment be submitted to the Civil Aviation Safety Authority (CASA) to determine whether the proposal is a hazard to aircraft safety and requires approved lighting or marking. Defence supports this requirement and believes that in this instance, it would be prudent for the risk assessment of this proposal to be sent to CASA for consideration. If CASA determines that obstacle lighting is to be provided, it should be compatible with persons using night vision devices. If LED lighting is proposed, the frequency range of the LED light emitted should be within the range of wavelengths 665 to 930 nanometres. If wind monitoring towers are constructed as part of the proposal, Defence notes that the National Airports Safeguarding Framework Guideline D – Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers - Paragraph 39 recommends the top 1/3 of wind monitoring towers are painted in alternating contrasting bands of colour in accordance with the Manual of Standards for Part 139 of the Civil Aviation Safety Regulations 1998. Defence has no objection to the proposed wind farm.	
Civil Aviation Safety Authority	22 February 2018 Email to anna.corro@casa.gov.au	16 March 2018 Email from Matthew Windebank, Aerodrome Engineer – Air Navigation,	CASA has advised that it will only review assessments referred to it by a planning authority or agency.	Submit aviation impact assessment to Victoria's Department of Environment,

Agency/Contact	*Activity/Date*	*Response/Date*	*Issues Raised During Consultation*	*Action Proposed*
		Airspace & Aerodromes Branch, CASA		Land, Water and Planning.
Air service operators				
Western Aerial (Derrinallum)	09 October 2017 Phone/Email to Todd Miller	11 October 2017 Email from Todd Miller	We currently operate in and adjacent to the proposed area that you supplied. The impact would be that in some cases we would not be able to conduct operations there any more. Certainly anywhere within the area marked would be a "no-go" zone. Additionally some areas beside the towers would no longer be able to be treated due to inability to avoid flying through the wind farm. In some instances this can be avoided by changing the direction of application but is operationally less efficient and therefore creates an increase cost for the client. The above reasons also apply for the areas along the transmission line corridor. As mentioned the height of these lines while not as high as lattice masts can, in my experience, be more of a restriction themselves than the towers as they are not contained within the farm and can stretch over many properties. I have yet to see any recommendations to flying and applying chemicals within close proximity to a wind farm but obviously anything that restricts our ability to safely operate and release chemicals in a designated area would have an impact. I imagine off target placement would be less of an issue if the turbines were stopped during application. I have heard of controls limiting flying to 500 metres parallel and three kilometres towards the turbines whilst they are operating. As a member of the Aerial Agricultural Association of Australia our position is in line with this policy. http://www.aerialag.com.au/Portals/0/Users/005/05/5/AAAA%20Windfarm%20Policy.pdf	Refer to obstacle marking and lighting section.

Agency/Contact	*Activity/Date*	*Response/Date*	*Issues Raised During Consultation*	*Action Proposed*
Mortlake ALA	9 October 2017 Phone/Email to Peter Allen, South Boorook (Mortlake ALA)	3 November 2018 Email from Peter Allen, South Boorook Pty. Ltd. Mortlake	Thank you for your email. I am very concerned about the negative impact the Mt Fyans Wind Farm will have on the community. Therefore I strongly object to the Wind farm going ahead. It will be a hazard for aircraft in the area. **Response**: Thanks for your email. Mortlake ALA is a significant distance from the Mt Fyans Wind Farm (MFWF) site (i.e. further than the nominal planning distance of 3 nm). Please provide further detail on how the proposed MFWF project would present a hazard to your aviation activities from Mortlake ALA. Hydro Tasmania will be engaging with the community prior to submitting an application for planning assessment and is committed to understanding and involving the community in the development/planning process to ensure the project contributes positively to the sustainable development of the Mortlake and District community. Any concerns you have from a community member perspective, please direct these concerns to Carmen Whiteley, Project Officer – Stakeholders and Renewable Asset Development, Hydro Tasmania, on phone (03) 6230 5487.	Provide further explanation of the project – complete.

Agency/Contact	*Activity/Date*	*Response/Date*	*Issues Raised During Consultation*	*Action Proposed*
Air Apply Aerial Spraying	9 October 2017 Phone/Email to Troy Bentley, Air Apply Aerial Spraying	23 November 2017 Email from Troy Bentley, Air Apply Aerial Spraying	Thank for the opportunity to provide feedback on the proposed Mt Fyans wind farm. We do occasionally work throughout the area of the proposed site and for adjoining farms so our operations in proximity to them will be affected. As you would be aware our industry association (Aerial Application Association of Australia) have developed policies in relation to wind farm development and their associated infrastructure and as members of the AAAA's we support these policies. Aside from aerial application operators in the the area, you may wish to contact organisations conducting aerial fire fighting operations. The area of the proposed Mt Fyans wind farm being rocky grasslands would be an area that is conducive to the use of fixed wing water bombing aircraft, A fire amongst wind towers could prove difficult to fight due to reduced visibility with and obviously the increased obstacles of wind towers, Subsequently fire control agencies would possibly have to wait for free to burn the wind farm to fight them safe and effectively. I would suggest contacting the 2 companies that hold the fixed wing fire fighting contracts for western Victoria for comment. Field Air Ballarat (admin@fieldair.com.au) - Stephen Holding AGA Services (rob@agair.com.au) - Rob Boschen Our other concern in the development stage is the correct marking of wind monitoring towers, we ask that these are marked in accordance with the NASAG guideline D (attached), in particular the guy wires and the fencing around where the guy wires meet the ground (preferably painting the top rail of the fence white). Please find Attached, AAAA Windfarm policy (inducing powrline policy) AAAA National Windfarm operating protocols (including NASAG guideline D) If you require further more specific information please do not hesitate to call.	To mark WMTs in accordance with NASA G Guideline-D.

Agency/Contact	*Activity/Date*	*Response/Date*	*Issues Raised During Consultation*	*Action Proposed*
			Response: Thanks for your email. Aviation Projects is preparing the aviation impact assessment for the Mt Fyans Wind Farm and is recommending consideration be given to marking the wind monitoring towers according to the requirements of NASF Guideline D. If the wind monitoring towers exceed a height of 150 m above ground level, the wind monitoring towers should be lit with a high intensity white flashing obstacle light during the day and a low intensity steady red light at night, until such time as a wind turbine is constructed within close proximity to the wind monitoring tower. In relation to overhead transmission lines and poles, Aviation Projects has recommended that the potential for them to adversely affect aerial application operations should be identified in consultation with local aerial application operators, and they should marked in accordance with MOS 139 Section 8.10.2.8. Hydro Tasmania is engaging with the Country Fire Association in Mortlake and will engage with the community prior to submitting an application for planning assessment. Hydro Tasmania is committed to understanding and involving the community in the development/planning process to ensure the project contributes positively to the sustainable development of the Mortlake and District community. Any concerns you have from a community member perspective, please direct these concerns to Carmen Whiteley, Project Officer – Stakeholders and Renewable Asset Development, Hydro Tasmania, on phone (03) 6230 5487.	
Warrnambool Aero Club (Warrnambool Airport)	09 October 2017 Phone to the club on 0429 938 600 and (03) 5567 1101	Phone lines were disconnected.	Issues planned to raise during consultation: a. Private pilots; and b. Recreational flying. The phone numbers are engaged, no record of an email address. Do not operate at the lower level – no impact (according to Border Air Services)	Nil.
Warrnambool Aviation	09 October 2017 Email to Janel	No response has been received.	Email to Warrnambool Aviation Thanks for your time on the phone.	Nil.

Agency/Contact	Activity/Date	Response/Date	Issues Raised During Consultation	Action Proposed
			I work for Aviation Projects on behalf of Hydro Tasmania and would like consultation feedback from Warrnambool Aviation regarding a proposed Mt Fyans Wind Farm. Please find attached the proposed layout of Mt Fyans Wind Farm. I have placed marked the location of Warrnambool Airport to place the airport in context of the proposed Mt Fyans Wind Farm. I am interested in finding out if your aviation activity (e.g. flight training, scenic flights, aerial photography) occurs at or nearby proposed Mt Fyans Wind Farm, and if so, your feedback would be greatly appreciated.	
Border Air Services (Camperdown)	09 October 2017 Phone/Email to Brett Hislop, member of Aerial Application Association of Australia	09 October 2017 Phone response, Brett Hislop	Brett Hislop (operates Border Air Services) Has operated previously near wind farms and understands the AAAA National Windfarm Operating Protocols.	Nil.
Warrnambool City Council	N/A	N/A	The Warrnambool Economic and Development plan and Investment Strategy 2015 - 2020 includes: support of the Warrnambool Regional Airport's construction of a lengthened and strengthened main runway. • Securing the helicopter operations at Warrnambool regional Airport to commute to gas fields remains a high priority. • The Airport serves as a major emergency services hub in south west Victoria. • The airport has a new HEMS rescue helicopter and facility.	Nil.

6. AVIATION IMPACT STATEMENT

The Aviation Impact Statement (AIS) was prepared in accordance with Airservices Australia requirements.

6.1. Nearby certified/registered aerodromes

There is one registered/certified aerodrome with Instrument Approach Procedures (IAPs) or Obstacle Limitation Surfaces (OLS) within 30 nm (55.6 km) of the boundary of the proposed MFWF.

Figure 12 shows the proposed MFWF and surrounding aerodromes (source: Hydro Tasmania, OzRunways, VFR Chart, dated 25 March 2020).

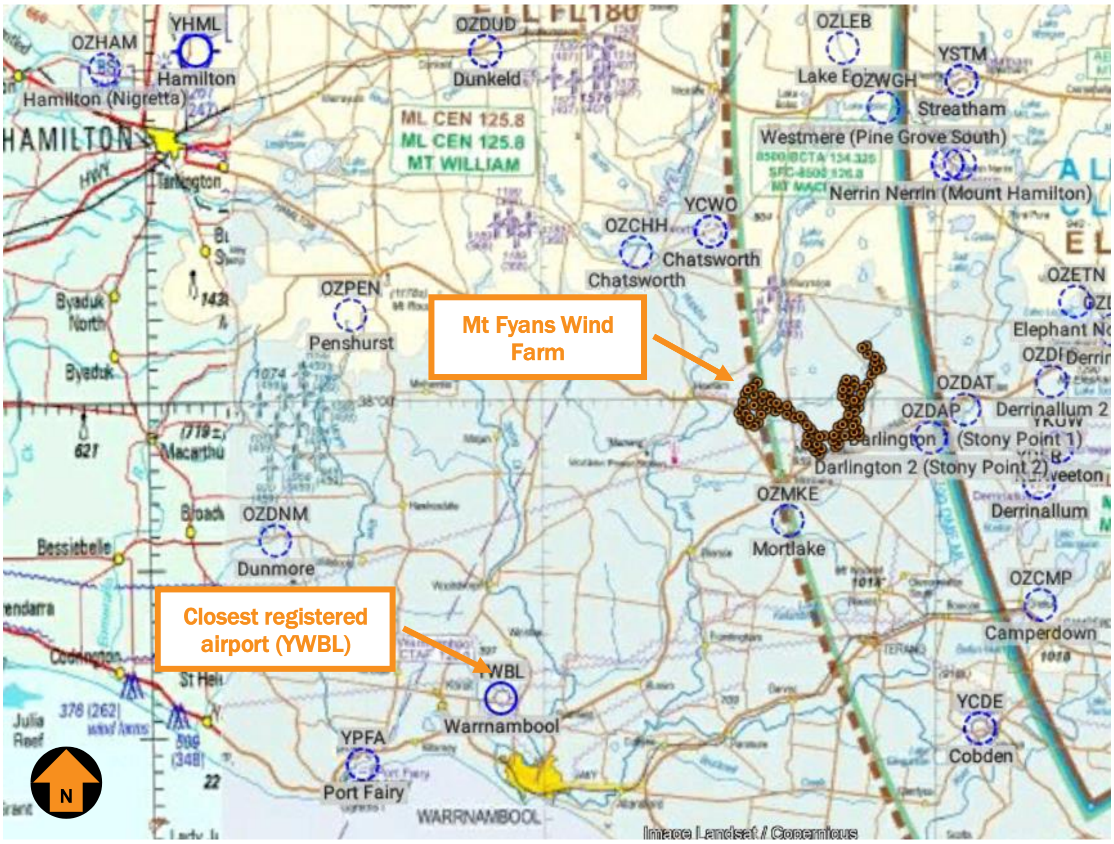

Figure 12 Mt Fyans Wind Farm and surrounding aerodromes

The nearby registered/certified aerodromes are listed in Table 3.

Table 3 Nearby registered/certified aerodromes

Aerodrome	*Operator*	*Location from the Project*
Ararat Airport (YARA) – registered	Ararat Rural City Council	North of proposed Project. Closest proposed turbine is WTG 85 located approximately 71 km (38 nm) from Ararat Airport.
Ballarat Airport (YBLT) – registered	City of Ballarat	North east of proposed Project. Closest proposed turbine is WTG 85 located approximately 100 km (50 nm) from Ararat Airport.
Warrnambool (YWBL) – registered	Warrnambool City Council	South west of proposed Project. Closest proposed turbine is WTG 3 located approximately 42 km (23 nm) from Warrnambool ARP.

The majority of the proposed MFWF is located within the 30 nm from the Warrnambool Airport's aerodrome reference point (ARP).

Ararat Airport and Ballarat Airport are located outside of the 30 nm radius and will not be impacted by the proposed MFWF.

Figure 14 shows locations of the proposed MFWF relative to Ararat Airport, Ballarat Airport and Warrnambool Airport (source: Hydro Tasmania, Google Earth).

Figure 13 Nearby aerodromes and 30 nm range rings and Mt Fyans Wind Farm

6.2. Nearby aircraft landing areas

As a guide, an area of interest within a 3 nm radius of an aircraft landing area (ALA) is used to assess potential impacts of proposed developments on aircraft operations at or within the vicinity of the ALA.

A search on OzRunways, which sources it data from Airservices Australia (AIP), returned a number of nearby non-regulated aerodromes, which are Mortlake and Cobden ALAs. The aeronautical data provided by OzRunways is approved under CASA CASR Part 175.

Mortlake ALA is the closest ALA to the proposed MFWF, which is located approximately 8 km (4.4 nm) from WTG 2 and outside the nominal 3 nm buffer area.

Figure 14 shows the location of nearby ALAs relative to the proposed MFWF and a nominal 3 nm buffer from the ALAs (source: Hydro Tasmania, Google Earth).

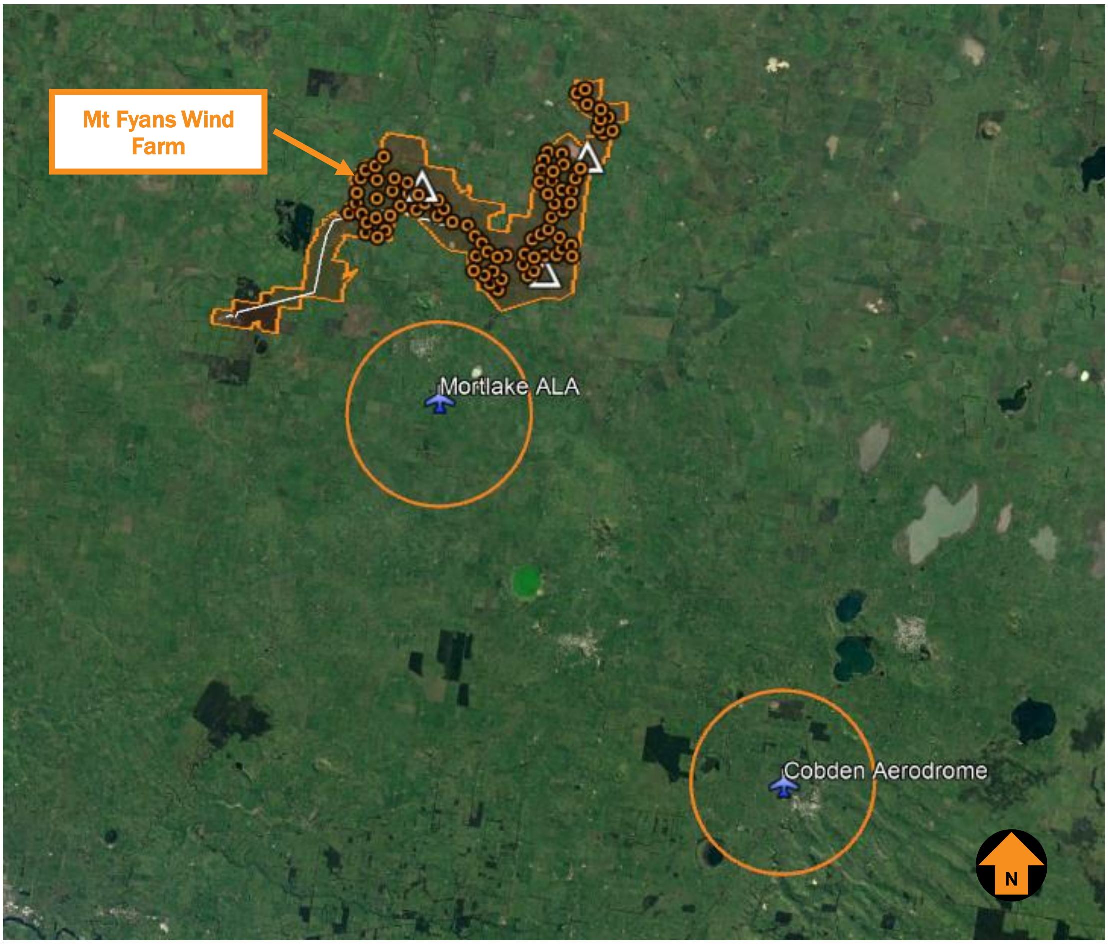

Figure 14 Nearby ALAs and 3 nm buffer areas

There are no other ALAs that have a wind turbine within 3 nm. Therefore, the proposed MFWF will not impact nearby ALAs.

6.3. Warrnambool Airport description and scope of operation

The closest aerodrome to the proposed MFWF site is Warrnambool Airport, which is owned and operated by the Warrnambool City Council. Warrnambool Airport is located north west of Warrnambool City by approximately 7 km.

The proposed MFWF is located approximately 41 km (22 nm) to the north east of Warrnambool Airport.

A check of Airservices Australia's Aeronautical Information Package shows that Warrnambool Airport (YMBL) has a main sealed runway 13/31 that is 1372 m in length and a cross grass runway 04/22 that is 1069 m in length. The elevation for Warrnambool Airport's aerodrome elevation is 74 m AHD (242 ft AMSL).

Warrnambool Airport has a Code 3 instrument non-precision runway 13/31.

Warrnambool Airport ARP coordinates published in Airservices Australia's Designated Airspace Handbook are Latitude S38°17'43" and Longitude E142°26'48".

Most of the wind turbines of the proposed MFWF are located within the 30 nm radius of Warrnambool Airport except WTGs 77-85.

Refer to Figure 15 (source: Hydro Tasmania and Google Earth).

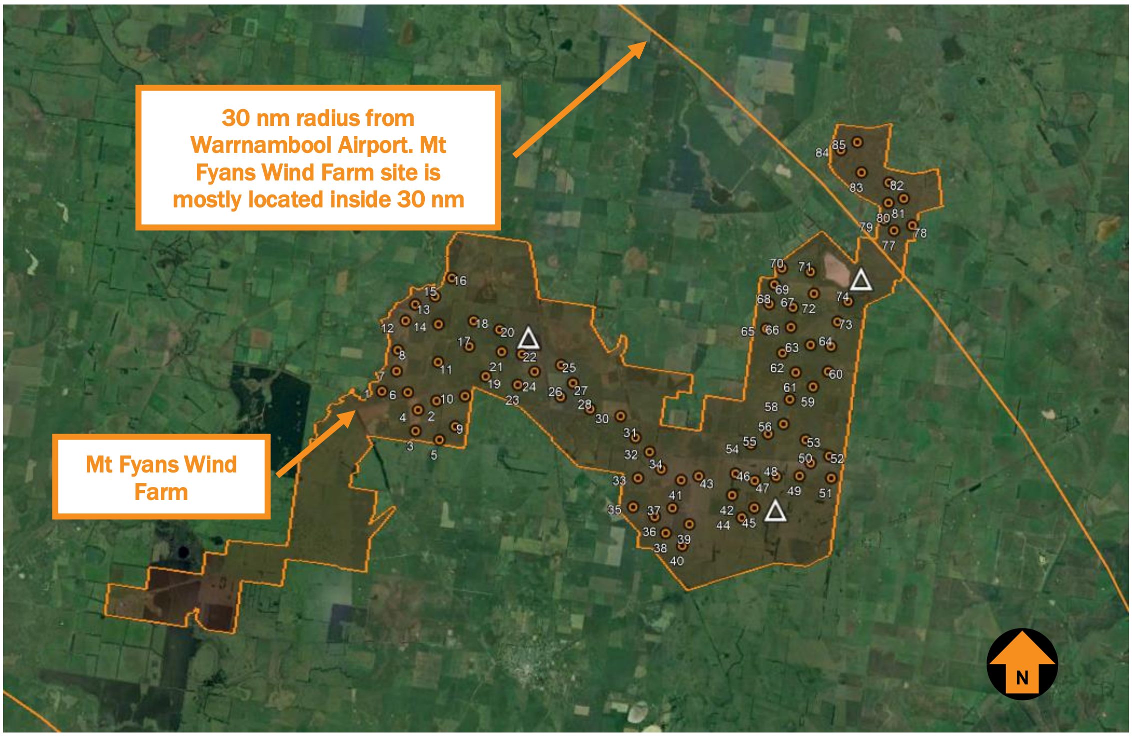

Figure 15 Warrnambool 30 nm and Mt Fyans Wind Farm

6.4. Instrument procedures

A check of Aeronautical Information Package (AIP) via the Airservices Australia website showed that Warrnambool Airport (YWBL) is served by non-precision terminal instrument flight procedures, as per Table 4 (source: Airservices Australia).

The aerodrome procedures designer is Airservices Australia (AsA). The Airport Group previously designed the RNAV-Z(GNSS) approach to runway 31. Consultation was conducted with Airservices and The Airport Group.

Table 4 Warrnambool Airport (YMBL) aerodrome and procedures charts

Chart name (Procedure designer)	*Effective date*
FACILITIES CHART (AsA)	16 June 2022 (FAC YWBL - 1)
RUNWAY DISTANCE SUPPLEMENT	16 June 2022 (RDS YWBL - 1)
AERODROME CHART (AsA)	02 December 2021 (WBLAD01-169)
RNAV-Z (GNSS) RWY 13 (AsA)	25 March 2021 (WBLGN02-166)
RNAV-Z (GNSS) RWY 31 (ASA (previously TAG173)	25 March 2021 (WBLGN01-166)

6.5. PANS-OPS surfaces

The minimum safe altitude (MSA) is applicable for each instrument approach procedure at Warrnambool Airport. An image of the MSA published for the aerodrome is shown in Figure 16 (source: Airservices Australia).

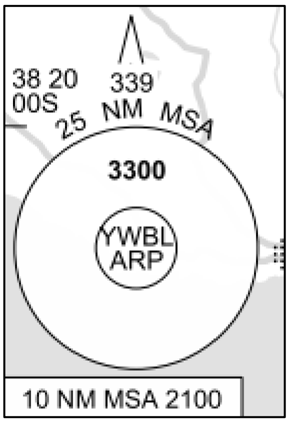

Figure 16 MSA at Warrnambool Airport

The Manual of Standards 173 *Standards Applicable to Instrument Flight Procedure Design* (MOS 173), requires that a minimum obstacle clearance (MOC) of 1000 ft below the published MSA is maintained.

Obstacles within 15 nm (10 nm MSA + 5 nm buffer) and within 30 nm (25 nm MSA + 5 nm buffer) of Warrnambool Airport's ARP define the height at which an aircraft can fly when within 10 nm and 25 nm.

The proposed MFWF is located outside the 10 nm MSA of Warrnambool Airport but within the 25 nm MSA of Warrnambool Airport. Refer to Figure 17 (source: Hydro Tasmania, Google Earth).

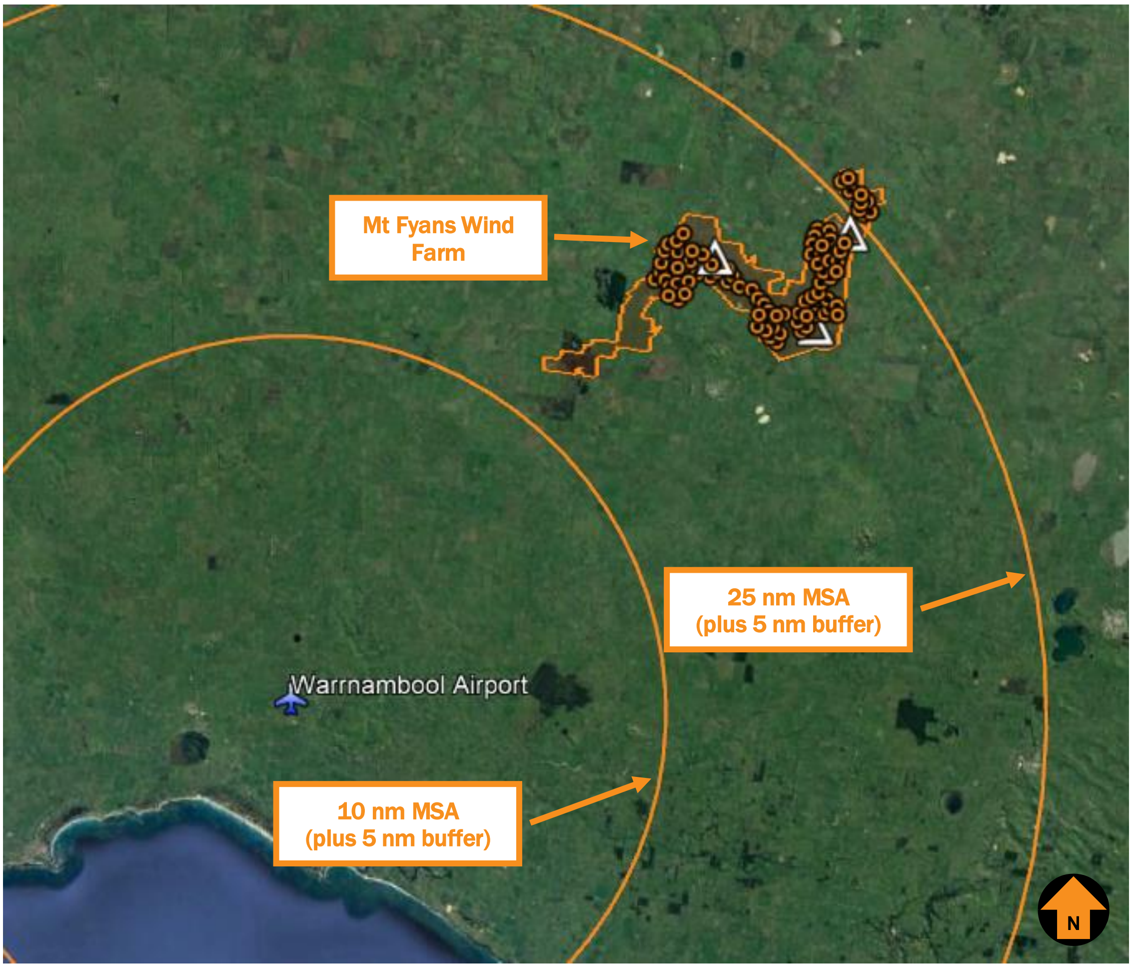

Figure 17 Warrnambool Airport's 10 nm and 25 nm MSAs

The highest WTG located within the 25 nm MSA (plus 5 nm buffer) of Warrnambool Airport are WTGs 63 and 74, at a maximum overall height of approximately 361 m AHD (1184 ft AMSL). As a result, WTGs 63 and 74 will be approximately 340 m (1116 ft) below the 2300 ft MOC. Therefore, the 25 MSA of 3300 ft AMSL will not be impacted.

6.6. Warrnambool Airport - circling areas

All turbines are located beyond the horizontal extent of all circling areas at Warrnambool Airport.

6.7. Obstacle limitation surfaces

The maximum horizontal distance that an obstacle limitation surface (OLS) may extend for an aerodrome in Australia is 15 km (8.1 nm) from the edge of a runway strip.

The closest proposed turbine is WTG 3 which is located approximately 42 km (23 nm) from Warrnambool ARP. The Project site is located outside the horizontal extent of the OLS of Warrnambool Airport.

6.8. Air routes and LSALT

MOS 173 requires that a minimum obstacle clearance of 1000 ft below the published lowest safe altitude (LSALT) is maintained along each air route.

For the 200 m (656 ft) AGL wind turbine, turbine WTG 85 is the tallest proposed turbine at 374 m AHD (1227 ft AMSL).

The proposed MFWF is partially located within a grid LSALT of 5200 ft AMSL and 2500 ft AMSL. The respective protection surfaces at 4200 ft AMSL and 1500 ft AMSL will not be impacted by the proposed MFWF.

The proposed MFWF is located within the vicinity of the air routes are shown in Figure 18 (source: Hydro Tasmania, OzRunways, ERC Low National, 25 March 2020).

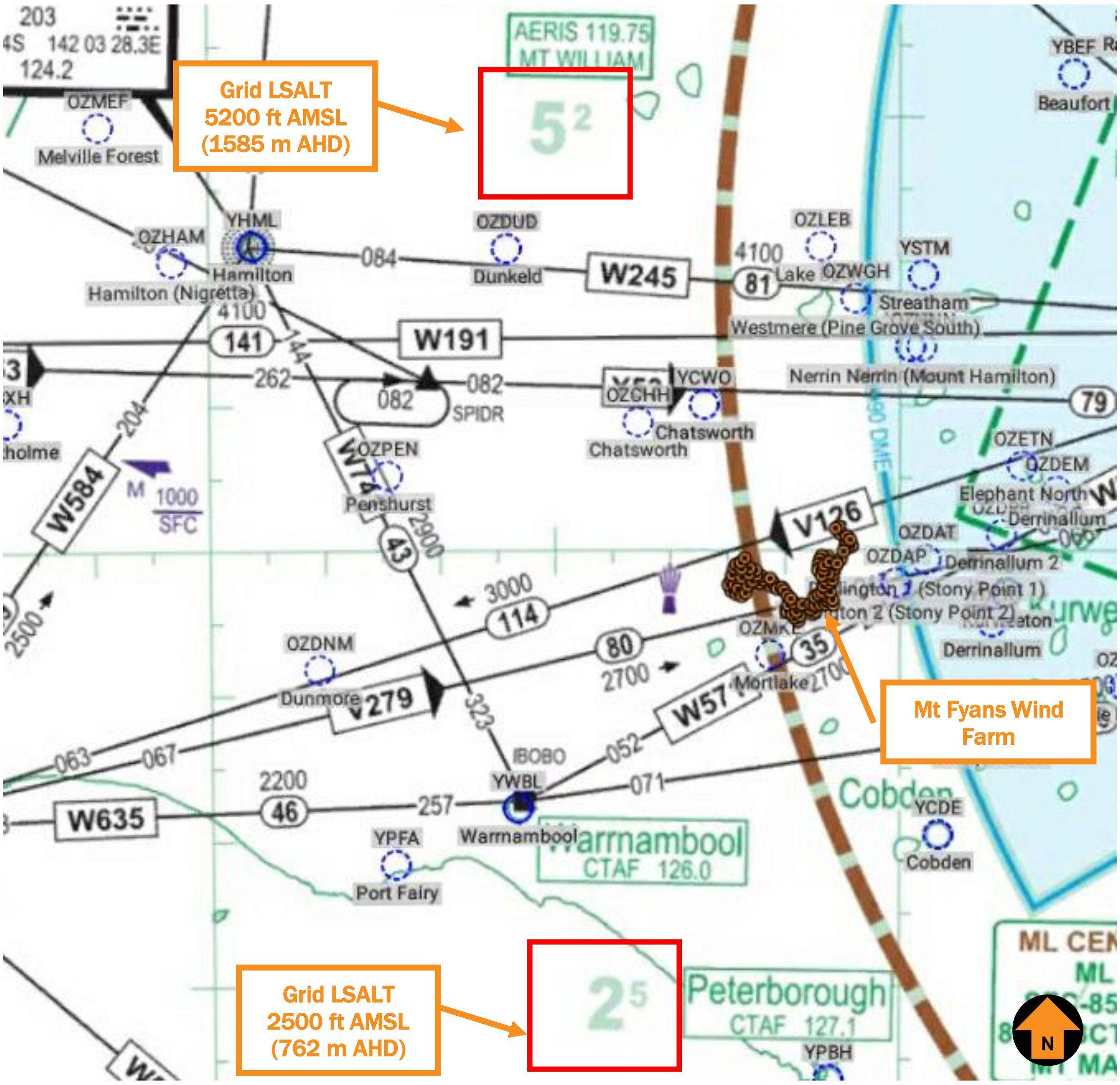

Figure 18 Air routes and grid LSALT and Mt Fyans Wind Farm

An impact analysis of the surrounding air routes is provided in Table 5.

Table 5 Air route impact analysis

Air route	Waypoint pair	Route LSALT	MOC	Impact on airspace design
V126	ESDIG and Portland	3000 ft AMSL	2000 ft AMSL 610 m AHD	Minimum obstacle clearance of 1000 ft is maintained. No impact
V279	NOGIP, LANUN and WENDY	2700 ft AMSL	1700 ft AMSL 518 m AHD	Minimum obstacle clearance of 1000 ft is maintained No impact
W571	IBOBO (Warrnambool Airport) and LANUN	2700 ft AMSL	1700 ft AMSL 518 m AHD	Minimum obstacle clearance of 1000 ft is maintained. No impact

Note: Minimum obstacle clearance (MOC) is the height above which obstacles would impact on LSALTS or air routes.

For the maximum tip height of 374 m AHD (1227 ft AMSL), the requirement for an MOC of 1000 ft below the published MSA will be satisfied.

Therefore, subject to final heights and locations of the proposed wind turbines, proposed MFWF is located outside controlled airspace and will not impact on air routes MOC.

6.9. Airspace

The proposed MFWF is located outside controlled airspace (wholly within Class G airspace), and is not located in any Prohibited, Restricted and Danger areas. Therefore, the proposed MFWF at the height of 200 m (656 ft) AGL will not have an impact on controlled or designated airspace. Refer to Figure 18 (source: OzRunways, ERC Low National, 25 March 2020).

6.10. Aviation facilities

The Mt Fyans Wind Farm Project site is outside aviation facilities of nearby airports.

6.11. Radar

With respect to aviation radar facilities, the closest wind turbine is WTG 81 of the Project site and is located approximately 158.3 km (85.5 nm) from the Mt Macedon Primary Surveillance Radar (PSR).

According to the EUROCONTROL Guidelines for Assessing the Potential Impact of Wind Turbines on Surveillance Sensors, the recommended ranges for PSR, the proposed MFWF Project site is located in Zone 4 and outside the radar line of sight.

The EUROCONTROL guidelines state:

> *When outside the radar line of sight of a PSR, the impact of the wind turbine (3-blades), 30-200 m height, and horizontal rotation axis) is considered to be tolerable.*

The proposed MFWF Project is unlikely to impact on radar facilities in the vicinity of the wind farm.

6.12. Airservices Australia

With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at a maximum height of 374m (1227ft) AHD the wind farm:

- will not affect any sector or circling altitude, nor any instrument approach or departure procedure at any airport;
- will not impact any air route lowest safe altitude (LSALT); and
- will not adversely impact the performance of Precision/Non-Precision Nav Aids, HF/VHF Comms, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.

6.13. TAG173

At a maximum height of 377m AHD, the wind turbines will not affect any Instrument Flight Procedure previously promulgated by The Airport Group (now Airservices Australia).

A list of wind turbines and their coordinates and elevation data that are applicable to this Aviation Impact Statement (AIS) are provided in **Annexure 5**.

6.14. Summary

An Aviation Impact Statement (AIS) was prepared in accordance with Airservices Australia requirements. As a result of that activity, it was determined that based on the proposed wind farm layout and overall turbine blade tip height limit of 200 m (656 ft) AGL, the blade tip elevation of the highest turbine, which is WTG 85 will not exceed 374 m AHD (1227 ft AMSL), and:

- will not penetrate any OLS surfaces;
- will not penetrate any PANS-OPS surfaces;
- will not have an impact on nearby aircraft landing areas;
- will not have an impact on nearby designated air routes;
- will not have an impact on prescribed airspace;
- is wholly contained within Class G airspace; and
- is outside the clearance zones associated with aviation navigation aids and communication facilities.

7. HAZARD MARKING AND LIGHTING

Based on the risk assessment set out in Section 9 it is concluded that aviation lighting is not required for WTGs and WMTs. For completeness, relevant lighting standards and guidelines are summarised in **Annexure 3.**

This section therefore assesses the need for aviation marking for the proposed permanent WMTs and overhead transmission lines.

7.1. Wind monitoring towers (WMTs)

Given that aerial operators might frequently use the airspace within the Project site and that it is expected the proposed permanent WMTs will be constructed prior WTGs, the WMTs will be free-standing and not surrounded by any other obstacles. Therefore, the proposed 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 could 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 WMTs, without obstacle lighting on the WMTs.

7.2. Overhead transmission lines

Hydro Tasmania provided details of the electrical reticulation within a transmission development envelope established to delineate the area within which an overhead transmission line may be developed. According to Hydro Tasmania:

The Project site has an excellent wind resource whilst being close to the Mortlake Substation allowing connection to the 500 kV Victoria – South Australia interconnector and the national electricity market.

Using the development envelope approach allows flexibility to microsite infrastructure within the boundaries during detailed design. Micrositing is required to respond to location specific topographical and land use characteristics, as well as technical/operational requirements whilst avoiding adverse impacts to significant values. This approach is critical for the design of the wind turbine layout given the wide range of turbine models and Classes that may be used for the Project.

To ensure the overall density/distribution of the turbines within each wind turbine development envelope does not alter significantly during detailed design, the final distribution of turbines will ensure that there will be no more than 10 turbines within a 2 km diameter circle.

Underground cables

Groups of six to 10 turbines will be connected to an on-site substation via a 22/33 kV underground cable. Cables will be general buried to a depth of at least 800 mm.

Overhead cable

A double circuit 132 kV or single/double circuit 220 kV overhead electrical line is proposed to transmit the electricity from the on-site substation to the grid connection at Mortlake Substation. The *total length of the proposed overhead line is 19 km. The spacing between the poles will generally be around 200 m.*

The overhead line will use a compact pole design which will reduce both the visual impact of the structure and their physical footprint. Poles will generally be between 25 m to 30 m above ground level. The asset will include an overhead communication line which will run along the top of the poles. Depending on the final design and voltage of the transmission line the maximum height may be 35 m high in specific locations.

The detailed design of the electrical reticulation will be finalised prior to construction of the proposed MFWF Project. The route of the electrical reticulation will follow the infrastructure corridors in Figure 19 (source: Hydro Tasmania, Google Earth).

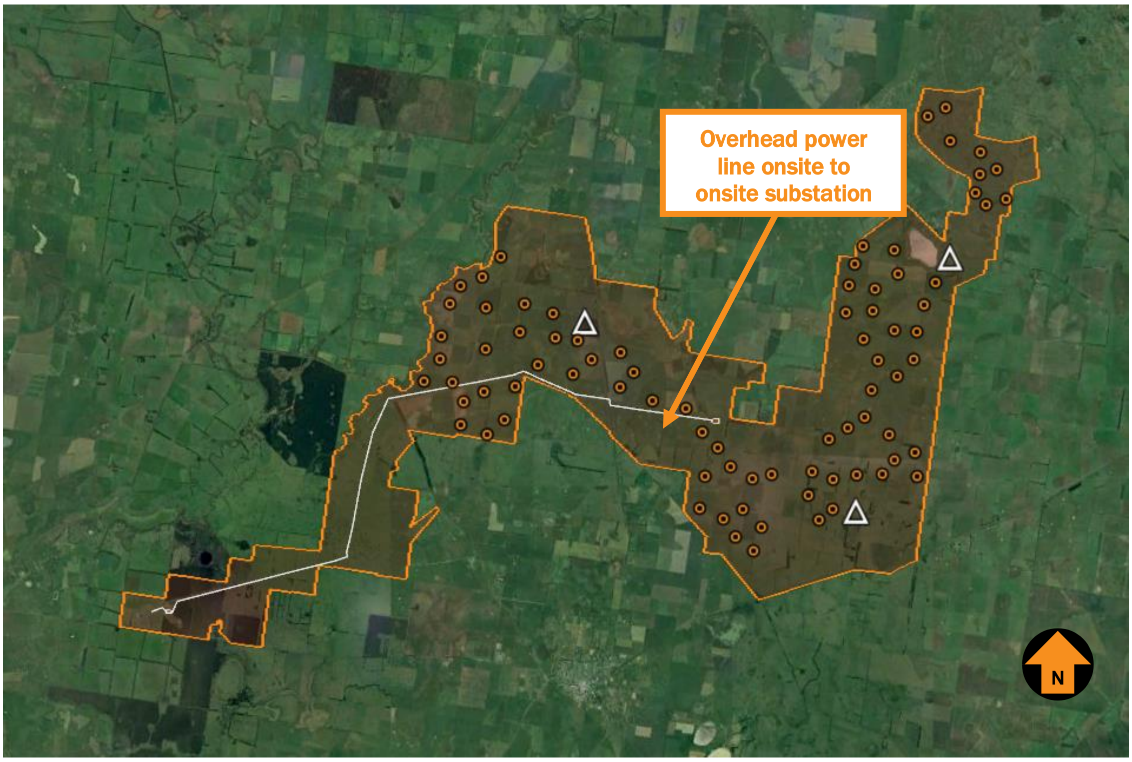

Figure 19 Electrical reticulation

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 6 (source: ATSB).

Table 6 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 20 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.

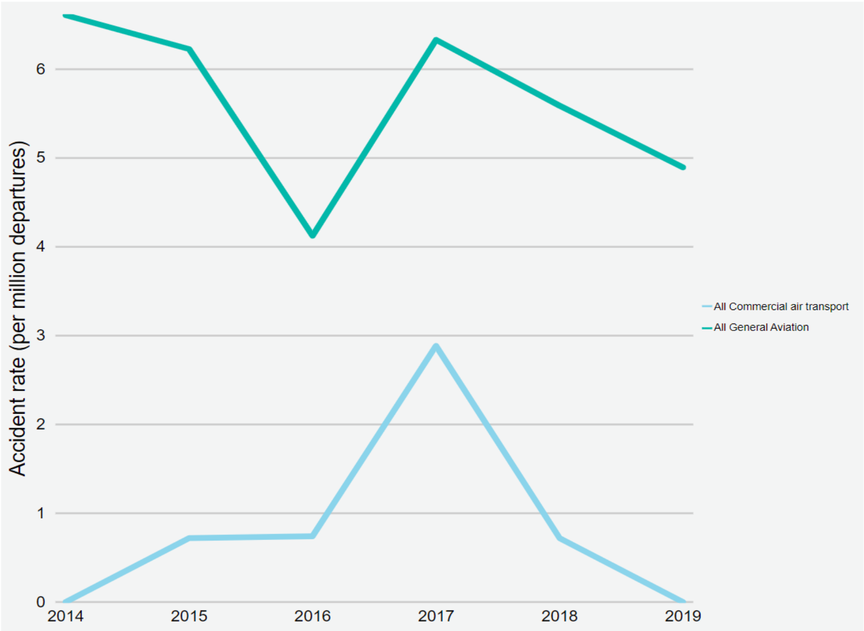

Figure 20 Fatal Accident Rate (per million departures) by Operation Type

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 7 (source: ATSB).

Table 7 Fatal accidents by GA sub-category – 2010 -2019

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

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

Over the 10-year period, no aircraft collided with a 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. In 2019, approximately 60.4 GW of wind power had been installed worldwide.

Based on the Australia's Clean Energy Council statistics there were 102 wind farms in Australia at the end of 2019. Aviation Projects has researched public sources of information, accessible via the world wide web, regarding aviation safety occurrences associated with wind farms. Occurrence information published by Australia, Canada, Europe (Belgium, Denmark, France, Germany, Norway, Sweden and The Netherlands), New Zealand, the United Kingdom and the United States of America was reviewed.

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 four accidents is provided in Table 8.

Table 8 Summary of accidents involving collision with a wind turbine

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

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

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

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

9. RISK ASSESSMENT

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

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

9.1. Risk Identification

The primary risk being assessed is that of aviation safety associated with the 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 level of risk to an acceptable level.

Each of the five risk events are considered in separate tables in the following pages.

Risk ID:	1. Aircraft collision with wind turbine

Discussion

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

There have been four reported occurrences worldwide of aircraft collisions with a component of a wind turbine structure since the year 2000. These reports show a range of situations where pilots were conducting various flying operations at low level and in the vicinity of wind farms in both IMC and VMC. No reports of aircraft collisions with wind farms in Australia have been found.

In consideration of the circumstances that would lead to a collision with a wind turbine:

- GA VFR aircraft operators generally 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; and
- If the aircraft was flown through the wind farm, there is still a very small chance that it would hit a wind turbine.

Refer to the discussion of worldwide accidents at Section 0.

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

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

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

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

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

Consequence

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

Consequence	Catastrophic

Untreated Likelihood

There have been four reports of aircraft collisions with wind turbines worldwide, which have resulted in a range of consequences, where aircraft occupants sustained minor injury in some cases and fatal injuries in others. Similarly, aircraft damage sustained ranged from minor to catastrophic. One of these accidents resulted from structural failure of the aircraft before the collision. Only two relevant accidents occurred during the day, and only one resulted in a single fatality. It is assessed that collision with a wind turbine resulting in multiple fatalities and damage beyond repair is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.

Untreated Likelihood	Possible

Current Treatments (without lighting) • The Project is clear of the obstacle limitation surfaces 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 250 m (820 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 98 m (322 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft). • In the event that descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines. • If cloud descends below the turbine hub, obstacle lighting would be obscured and therefore ineffective. • Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night). • Aircraft authorised to intentionally fly below 152.4 m AGL (500 ft) AGL (day) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities. • The wind turbines are typically coloured white so they should be visible during the day. • The as constructed details of wind turbines are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts. • Because the 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.

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

Proposed 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: a) Engage with local aerial agricultural and aerial firefighting operators to develop procedures, which may include, for example, stopping the rotation of the WTG blades prior to the commencement of the subject aircraft operations within the Project site.

b) Arrangements should be made to publish details of the Project in ERSA for surrounding aerodromes, which would involve notification to Airservices Australia.	
Residual Risk With the additional recommended treatments, the likelihood of an aircraft collision with a wind turbine resulting in multiple fatalities and damage beyond repair will be Unlikely, and the consequence remains Catastrophic, resulting in an overall risk level of 7 - Tolerable. It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified. In the circumstances, the level of risk under the proposed treatment plan is considered as low as reasonably practicable (ALARP). It is our assessment that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a wind turbine, without obstacle lighting on the turbines of the Project.	
Residual Risk	7 - Tolerable

Risk ID:	2. Aircraft collision with a wind monitoring tower

Discussion

An aircraft collision with a wind monitoring tower (WMT) would result in harm to people and damage to property.

After construction of MFWF, there will be one or two permanent WMTs and one or two temporary WMTs of up to up to 120 m AGL. The towers will be installed at or below the wind turbine hub height at different locations on the site.

The WMTs will have high visibility aviation marker balls up on the top level guy wires.

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

There is a relatively low rate of aircraft activity in the vicinity of the wind farm.

There are no known aerial application operations conducted at night in the vicinity of the wind farm.

For objects at a height of 100 m AGL or more and outside the OLS of an aerodrome, CASA must be notified. Obstacle lighting may be required unless CASA, in an aeronautical study, assesses it as being shielded by another lit object or that it is of no obstacle significance.

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 wind monitoring tower, 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 wind monitoring tower, but all were during the day with good visibility when obstacle lighting would arguably be of no effect, and none was in Australia. It is assessed that collision with a wind monitoring tower without obstacle lighting that would be effective in alerting the pilot to its presence may only occur in exceptional circumstances, which is classified as Rare.

Untreated Likelihood	Rare

Current Treatments (without lighting)

- The WMTs at MFWF with a height of approximate 80 m or 120 m (262 ft or 394 ft) AGL, depending on class of WMT model selected, will not require lighting.
- The MFWF proposed overall wind turbine tip height will be of no greater than 200 m (656 ft) AGL.
- Aircraft are restricted to a minimum height of 152.4 m (500 ft) AGL above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas. The WMTs will likely be at a maximum height of 120 m (394 ft) AGL, depending on class of WTG selected, which is below the minimum height of 500 ft AGL for an aircraft flying at this height.

- In the event that descending cloud forces an aircraft lower than 152.4 m AGL (500 ft), the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of the tower.
- Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).
- Aircraft authorised to intentionally fly below 152.4 m (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities.
- The towers are constructed from grey steel.
- Since the 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

Proposed Treatments

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

- Details of any wind monitoring towers when they are constructed should be advised to Airservices Australia.

- Consideration could be given to marking any wind monitoring towers according to the requirements set in MOS 139 Chapter 8 Division 10 Obstacle Markings (as modified by the guidance in NASF Guideline D); specifically:

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

- Ensure details of any additional wind monitoring towers on 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, the likelihood of an aircraft collision with a wind monitoring tower resulting in multiple fatalities and damage beyond repair will be Unlikely, and the consequence remains Catastrophic, resulting in an overall risk level of 7 – Tolerable. It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified. In the circumstances, the level of risk under the proposed treatment plan is considered as low as reasonably practicable (ALARP). It is our assessment that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with the wind monitoring towers, without obstacle lighting on the turbines of the Project.	
Residual Risk	7 - Tolerable

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

Discussion

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

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

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 wind farms, but none in Australia, and all were during the day. It is assessed that a ground collision accident following manoeuvring to avoid a wind turbine is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.

Untreated Likelihood	Possible

Current Treatments (without lighting)

- The Project is clear of the obstacle limitation surfaces 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.
- Wind turbines will be a maximum of 200 m (656 ft) at the top of the blade tip, so the rotor blade at its maximum height will be approximately 48 m (156 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft).
- Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines.
- If cloud descends below the turbine hub, obstacle lighting would be obscured and therefore ineffective.
- Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).

• Aircraft authorised to intentionally fly below 152.4 m AGL (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities. • The wind turbines are typically coloured white so they should be visible during the day. • The 'as constructed' details of wind turbines are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts. • Since the turbines will be higher than 100 m AGL, there is a statutory requirement to report the turbines to CASA.	
Level of Risk The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8.	
Current Level of Risk	8 – Unacceptable
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable
Proposed Treatments The following treatments which can be implemented at little cost will provide an acceptable level of safety: • Ensure details of the Project have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators before, during and following construction. • Although there is no requirement to do so, the Proponent may consider engaging with local aerial application and aerial firefighting operators to develop procedures, which may include, for example, stopping the rotation of the wind turbine rotor blades prior to the commencement of the subject aircraft operations within the Project area.	
Residual Risk With the additional recommended treatments, the likelihood of ground collision resulting from manoeuvring to avoid a wind turbine resulting in multiple fatalities and damage beyond repair will be Unlikely, and the consequence remains Catastrophic, resulting in an overall risk level of 7 – Tolerable. It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified. In the circumstances, the level of risk under the proposed treatment plan is considered as low as reasonably practicable (ALARP). It is our assessment that there is an acceptable level of aviation safety risk associated with the potential for ground collision resulting from manoeuvring to avoid a wind turbine, without obstacle lighting on the turbines of the Project.	
Residual Risk	7 - Tolerable

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.

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 (without lighting)

- The Project is clear of the obstacle limitation surfaces 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.
- Wind turbines will be a maximum of 200 m (656 ft) at the top of the blade tip, so the rotor blade at its maximum height will be approximately 48 m (156 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft).
- In the event that descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines.
- Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines.
- If cloud descends below the turbine hub, obstacle lighting would be obscured and therefore ineffective.
- Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).
- Aircraft authorised to intentionally fly below 152.4 m AGL (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities.
- The wind turbines are typically coloured white so they should be visible during the day.
- The 'as constructed' details of wind turbines are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts.

• Since the turbines will be higher than 100 m AGL, there is a statutory requirement to report the turbines to CASA.	
Level of Risk The level of risk associated with a Possible likelihood of a 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
Proposed Treatments Given the current treatments and the limited scale and scope of flying operations conducted within the vicinity of the Project, there is likely to be little additional safety benefit to be gained by installing obstacle lighting, other than if a WMT exceeds 150 m AGL in height and is not in relatively close proximity to a wind turbine. However, the following treatments, which can be implemented at little cost, will provide an additional margin of safety: • Ensure details of the Project have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators before, during and following construction. • Although there is no requirement to do so, the Proponent may consider engaging with local aerial application and aerial firefighting operators to develop procedures, which may include, for example, stopping the rotation of the wind turbine rotor blades prior to the commencement of the subject aircraft operations within the Project area.	
Residual Risk Notwithstanding the current level of risk is considered tolerable, the additional recommended treatments will enhance aviation safety. The likelihood remains Possible, and consequence remains Moderate. In the circumstances, the risk level of 5 is considered as low as reasonably practicable (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 turbines of the Project.	
Residual Risk	5 - Tolerable

Risk ID:	5. Effect of obstacle lighting on neighbours

Discussion

This scenario discusses the consequential impact of a decision to install obstacle lighting on the wind farm.

Installation and operation of obstacle lighting on wind turbines or WMT can have an effect on neighbours' visual amenity and enjoyment, specifically at night and in good visibility conditions.

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

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

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

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

Consequence

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

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

Consequence	Moderate

Untreated Likelihood

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

Untreated Likelihood	Almost certain

Current Treatments

If the wind turbines or WMT will be higher than 150 m AGL (492 ft), they must be regarded as obstacles unless CASA assess otherwise. In general, objects outside an OLS and above 110 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 a Likely 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
Proposed 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. However, if CASA or 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 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. Consideration of visual impact in the lighting design should enable installation of lighting that produces an acceptable impact to neighbours. The likelihood of a Moderate consequence remains Likely, with a resulting 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

9.3. Summary of risks

A summary of the level of risk associated with the proposed MFWF Project, under the proposed treatment regime, is provided in Table 9.

Table 9 Summary of Risks

Risk Element	*Consequence*	*Likelihood*	*Risk*	*Actions Required*
Aircraft collision with wind turbine	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Communicate details of the Project to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction.
Aircraft collision with wind monitoring tower	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Although there is no obligation to do so, consider marking the wind monitoring towers according to the requirements set out in MOS 139 Section 8.10 Obstacle Markings, specifically 8.10.2.6 and 8.10.2.8. Any wind monitoring towers that exceed a height of 150 m AGL should be lit with a high intensity white flashing obstacle light during the day and a low intensity steady red light at night, until such time as a wind turbine is constructed within close proximity to the WMT (nominally 900 m). Communicate details of wind monitoring towers to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes following construction.
Avoidance manoeuvring leads to ground collision	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Communicate details of the Project 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 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.

10. CONCLUSIONS

The results of this aeronautical impact assessment are summarised as follows:

10.1. Planning considerations

If all the recommendations contained herein are implemented, the proposed MFWF, with a WTG maximum tip height of 200 m (656 ft) AGL, will not adversely affect the safety, operational integrity and efficiency of air services as:

1. The Project will comply with Victorian Government's Policy and planning guidelines for development of wind energy facilities in Victoria;
2. The Project will comply with the Clean Energy Council Best Practice Guidelines for Implementation of Wind Energy Projects in Australia;
3. The Project will comply with the Moyne Planning Scheme;

The proposed MFWF will comply with *NASF Guideline D*, as there will be an acceptable level of aviation safety without obstacle lighting on the wind turbines.

10.2. Aviation Impact Statement

Based on the proposed MFWF comprising of up to 81 WTGs, with an overall turbine blade tip height limit of 200 m (656 ft) AGL, the blade tip elevation of the highest turbine, which is WTG 85, will not exceed 374 m AHD (1227 ft AMSL) and:

- will not penetrate any OLS surfaces;
- will not penetrate any PANS-OPS surfaces;
- will not impact on nearby aircraft landing areas;
- will not have an impact on nearby designated air routes;
- will not have an impact on prescribed airspace;
- is wholly contained within Class G airspace; and
- is outside the clearance zones associated with aviation navigation aids and communication facilities.

With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at a maximum height of 374m (1227ft) AHD the wind farm will not affect any sector or circling altitude, nor any instrument approach or departure procedure at any airport, any air route lowest safe altitude (LSALT) and will not adversely impact the performance of Precision/Non-Precision Nav Aids, HF/VHF Comms, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.

At a maximum height of 377m AHD, the wind turbines will not affect any Instrument Flight Procedure previously promulgated by The Airport Group (now Airservices Australia).

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.

The Proponent will engage with aerial firefighting operators as part of its consultation with Fire Services 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.

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

10.5. Cumulative impacts

- Since the proposed wind farm has no impact on aviation activities other than on or within close proximity to the site, it is assessed that there is no significant cumulative impact arising from nearby existing or approved wind farms.
- None of the wind farms in relatively close proximity to the proposed MFWF with turbines greater than 110 m AGL blade tip height are planned to have obstacle lighting. Waubra is the only wind farm in the region which previously operated obstacle lighting. In 2012 the Minister for Planning issued consent for the obstacle lighting to be switched off at the Waubra Wind Farm. This consent followed the advice of an aviation risk assessment prepared on behalf of the proponent, which determined that:

  the wind farm did not require aviation obstacle lighting and switching the lights off would not pose an unacceptable risk to aircraft.

10.6. Risk assessment

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

Table 10 Risk assessment summary

Risk Element	Consequence	Likelihood	Risk	Actions Required
Aircraft collision with wind turbine	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Communicate details of the Project to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction.
Aircraft collision with wind monitoring tower	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Although there is no obligation to do so, consider marking the wind monitoring towers according to the requirements set out in MOS 139 Section 8.10 Obstacle Markings, specifically 8.10.2.6 and 8.10.2.8. Any wind monitoring towers that exceed a height of 150 m AGL should be lit with a high intensity white flashing obstacle light during the day and a low intensity steady red light at night, until such time as a wind turbine is constructed within close proximity to the WMT (nominally 900 m). Communicate details of wind monitoring towers to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes following construction.
Avoidance manoeuvring leads to ground collision	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Communicate details of the Project 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 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

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. Although not a mandatory requirement, the Proponent should consider engaging with local aerial application operators and aerial firefighting operators in developing procedures for such aircraft operations in the vicinity of the proposed MFWF project.

Marking of turbines

7. The rotor blades, nacelle and the supporting mast of the wind turbines should be painted a white colour, typical of most wind turbines operational in Australia.

Lighting of turbines

8. **Aviation Projects has assessed that the Project will not require obstacle lighting to maintain an acceptable level of safety to aircraft.**
9. The Proponent may consider other factors in its decision as to whether obstacle lights should be installed.

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.

Marking of overhead transmission lines and poles

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

Micrositing – turbine movements

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.

    According to Hydro Tasmania, the micrositing of the WTG and associated infrastructure within the development envelopes will be determined by the class and model of the wind turbine selected and by any conditions imposed through the development approval.

Triggers for review

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

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

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

    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:

- Aerial Agricultural Association of Australia, *National Windfarm Operating Protocols*, May 2014
- Aerial Agricultural Association of Australia, *Powerlines Policy*, dated March 2011
- Aerial Agricultural Association of Australia, *Windfarm Policy*, dated March 2011
- Airservices Australia, Aeronautical Information Package; including AIP Book, Departure and Approach Procedures, and En Route Supplement Australia dated 16 June 2022
- Airservices Australia, *Designated Airspace Handbook*, effective 16 June 2022
- Aircraft Owners and Pilots Association of Australia (AOPA), *National Airfield Directory 2012*, 15th ed
- Civil Aviation Safety Authority, *Civil Aviation Regulations 1998 (CAR)*, as amended;
- Civil Aviation Safety Authority, *Civil Aviation Safety Regulations 1998* (CASR)
- Civil Aviation Safety Authority, *Civil Aviation Advisory Publication (CAAP) 92-1(1): Guidelines for aeroplane landing areas*, dated July 1992
- Civil Aviation Safety Authority, Advisory Circular (AC) 91-10 v1.1: *Operations in the vicinity of non-controlled aerodromes*, dated November 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
- 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
- Department of Environment, Land, Water and Planning, Victoria State Government, *Planning Maps Online* and Planning Schemes Online, *Moyne Planning Scheme*, last updated 14 July 2022;
- 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*;
- Eurocontrol, *Eurocontrol Guidelines: How to Assess the Potential Impact of Wind Turbines Surveillance Sensors*, Edition 1.2, dated September 2014, reference EUROCONTROL-GUID-130;
- 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 (WAC and ERC) extracts, dated 19 July 2022;

- Standards Australia, ISO 31000:2018 *Risk management - Guidelines*; and
- Victoria State Government, the Department on Environment, Land, Water and Planning (DELWP), Policy and planning guidelines – Development of Wind Energy Facilities in Victoria, November 2021.

ANNEXURE 2 – DEFINITIONS

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

Term	*Definition*
Obstacles	All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.
Runway	A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.
Runway strip	A defined area including the runway and stopway, if provided, intended: 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.

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
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 COORD / HEIGHTS

Source: Hydro Tasmania, excel spreadsheet file: *MFWF_WTG_Locations_20220603*, excel spreadsheet.

The maximum blade tip height proposed is 200 m (656 ft) AGL.

Envelope	*WTG No*	*WTG ID*	*Latitude (WGS 84)*	*Longitude (WGS 84)*	*Base Elevation (m AHD)*	*Turbine Ht (m AGL)*	*Maximum Blade Tip (m AHD)*	*Maximum Blade Tip (Ft AMSL)*
A	1	A01	-38.0055165	142.7566099	137	200	337	1105.6
A	2	A02	-38.0125946	142.7605719	138	200	338	1108.9
A	3	A03	-38.0162484	142.7681091	140	200	340	1115.5
A	4	A04	-38.0103727	142.7705079	146	200	346	1135.2
A	5	A05	-38.0186454	142.7763231	139	200	339	1112.2
A	6	A06	-38.005798	142.765489	144	200	344	1128.6
A	7	A07	-38.0000884	142.761628	140	200	340	1115.5
A	8	A08	-37.9944314	142.762062	141	200	341	1118.8
A	9	A09	-38.0150139	142.7817619	139	200	339	1112.2
A	10	A10	-38.0068414	142.7851224	142	200	342	1122.0
A	11	A11	-37.9976299	142.7758841	149	200	349	1145.0
A	12	A12	-37.9864606	142.7647521	149	200	349	1145.0
A	13	A13	-37.9820578	142.7680851	151	200	351	1151.6
A	14	A14	-37.9874352	142.7760368	151	200	351	1151.6
A	15	A15	-37.9798916	142.7748871	155	200	355	1164.7
A	16	A16	-37.9749198	142.7806646	159	200	359	1177.8
A	17	A17	-37.9934216	142.7865779	144	200	344	1128.6
A	18	A18	-37.9865315	142.788096	151	200	351	1151.6
A	19	A19	-38.0015187	142.7922069	144	200	344	1128.6
A	20	A20	-37.9888745	142.7969663	149	200	349	1145.0
A	21	A21	-37.9948653	142.7976932	146	200	346	1135.2
A	22	A22	-37.9955363	142.8046284	150	200	350	1148.3
A	23	A23	-38.0038067	142.8031863	149	200	349	1145.0
A	24	A24	-38.0002266	142.8089873	145	200	345	1131.9
A	25	A25	-37.998454	142.8180747	145	200	345	1131.9

Envelope	WTG No	WTG ID	Latitude (WGS 84)	Longitude (WGS 84)	Base Elevation (m AHD)	Turbine Ht (m AGL)	Maximum Blade Tip (m AHD)	Maximum Blade Tip (Ft AMSL)
A	26	A26	-38.0070257	142.8178595	147	200	347	1138.5
A	27	A27	-38.0033476	142.8221361	146	200	346	1135.2
B	28	B28	-38.010358	142.8279934	147	200	347	1138.5
B	30	B30	-38.0122628	142.8384517	147	200	347	1138.5
B	31	B31	-38.0180814	142.843552	152	200	352	1154.9
B	32	B32	-38.0219346	142.8483876	151	200	351	1151.6
B	33	B33	-38.0289572	142.8444	151	200	351	1151.6
B	34	B34	-38.0266029	142.8523784	153	200	353	1158.1
B	35	B35	-38.0368206	142.8427343	149	200	349	1145.0
B	36	B36	-38.0394335	142.8501386	149	200	349	1145.0
B	37	B37	-38.0370819	142.8562168	154	200	354	1161.4
B	38	B38	-38.043872	142.8539189	152	200	352	1154.9
B	39	B39	-38.0414817	142.8620401	149	200	349	1145.0
B	40	B40	-38.0472885	142.8595548	152	200	352	1154.9
B	41	B41	-38.02955	142.8592087	149	200	349	1145.0
B	42	B42	-38.0351941	142.8681246	149	200	349	1145.0
B	43	B43	-38.0285054	142.8652244	150	200	350	1148.3
B	44	B44	-38.0396825	142.8800332	149	200	349	1145.0
B	45	B45	-38.0370633	142.8843123	147	200	347	1138.5
B	46	B46	-38.0278024	142.8778713	150	200	350	1148.3
B	47	B47	-38.029707	142.8844367	150	200	350	1148.3
B	48	B48	-38.0285975	142.8917908	148	200	348	1141.7
B	49	B49	-38.0284207	142.8998256	152	200	352	1154.9
B	50	B50	-38.0249375	142.9035901	151	200	351	1151.6
B	51	B51	-38.0289861	142.9106673	153	200	353	1158.1
B	52	B52	-38.0230581	142.9100121	152	200	352	1154.9
B	53	B53	-38.0187012	142.9019365	150	200	350	1148.3
B	54	B54	-38.0198171	142.8831239	152	200	352	1154.9

Envelope	WTG No	WTG ID	Latitude (WGS 84)	Longitude (WGS 84)	Base Elevation (m AHD)	Turbine Ht (m AGL)	Maximum Blade Tip (m AHD)	Maximum Blade Tip (Ft AMSL)
B	55	B55	-38.0170444	142.888999	152	200	352	1154.9
B	56	B56	-38.014398	142.8942838	153	200	353	1158.1
B	58	B58	-38.0077236	142.8964477	154	200	354	1161.4
B	59	B59	-38.0043416	142.9044126	158	200	358	1174.5
B	60	B60	-38.0001935	142.9095781	156	200	356	1168.0
B	61	B61	-38.0004457	142.8984582	156	200	356	1168.0
B	62	B62	-37.99522	142.89392	160	200	360	1181.1
B	63	B63	-37.9930369	142.9035508	161	200	361	1184.4
B	64	B64	-37.9933912	142.9105445	158	200	358	1174.5
B	65	B65	-37.9886671	142.8884076	157	200	357	1171.3
B	66	B66	-37.9882434	142.8968114	159	200	359	1177.8
B	67	B67	-37.9828925	142.8975061	158	200	358	1174.5
B	68	B68	-37.981974	142.8893632	156	200	356	1168.0
B	69	B69	-37.9767275	142.8911526	159	200	359	1177.8
B	70	B70	-37.972306	142.8937486	156	200	356	1168.0
B	71	B71	-37.9732747	142.9035183	159	200	359	1177.8
B	72	B72	-37.9791925	142.904694	157	200	357	1171.3
B	73	B73	-37.9867774	142.9128	160	200	360	1181.1
B	74	B74	-37.9812761	142.9163837	161	200	361	1184.4
C	77	C77	-37.9621332	142.9321252	169	200	369	1210.6
C	78	C78	-37.9607466	142.9383887	170	200	370	1213.9
C	79	C79	-37.9592088	142.9288389	167	200	367	1204.1
C	80	C80	-37.9546584	142.9292876	170	200	370	1213.9
C	81	C81	-37.9534693	142.9354279	173	200	373	1223.8
C	82	C82	-37.9491946	142.9303726	170	200	370	1213.9
C	83	C83	-37.9464605	142.9209659	170	200	370	1213.9
C	84	C84	-37.9397189	142.9119582	171	200	371	1217.2
C	85	C85	-37.9382712	142.919514	174	200	374	1227.0

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