SEPTEMBER 2017

AVIATION SAFETY ASSESSMENT

COPPABELLA WIND FARM

Prepared for Goldwind Australia Pty Ltd

AVIATION PROJECTS

AVIATION PROJECTS

DOCUMENT CONTROL

Document Title: Aviation Safety Assessment – Coppabella Wind Farm

Reference: 100306-01

Release Date: XX XXX 2017

Prepared by: L Hodgson

Reviewed by: K Tonkin

Released by:

Revision History: Not for Release

Revision History

Version	*Description*	*Transmitted*	*Reviewed by*	*Date*
0.1	First Draft	26 August 2016	GWA (JB)	24 January 2017
0.2	Revised First Draft	08 February 2017	GWA (JB)	16 May 2017
0.3	Final Draft	15 June 2016	GWA (TN)	31 August 2017
0.4	Revised Final Draft	1 September 2017		

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ACRONYMS

AAAA	Aerial Agriculture Association of Australia
AGL	above ground level
AHD	Australian Height Datum
AIS	Aviation Impact Statement
ALA	aeroplane landing area
ALARP	as low as reasonably practicable
ATC	air traffic control
CAR	Civil Aviation Regulation(s) (1988)
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation(s) (1998)
CFIT	controlled flight into terrain
ERSA	En Route Supplement Australia
ICAO	International Civil Aviation Organization
IFR	instrument flight rules
IMC	instrument meteorological conditions
LSALST	lowest safe altitude
MOS	Manual of Standards
NASAG	National Airport Safeguarding Advisory Group
OLS	obstacle limitation surface
PANS-OPS	Procedures for Air Navigation Services - Aircraft Operations
PDC	Project Development Consent
PSR	primary surveillance radar
RPT	regular public transport
SSR	secondary surveillance radar
VFR	visual flight rules
VMC	visual meteorological conditions
WMT	wind monitoring tower (aviation term interchangeable with wind monitoring mast)
WTG	wind turbine generator

UNITS OF MEASUREMENT

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

EXECUTIVE SUMMARY

Introduction

Goldwind Australia (the Client) is planning for the development of the Coppabella Wind Farm (the Project) and requires a range of planning and environmental services.

The Project Development Consent (PDC) allows for up to 79 turbines with a 132kV connection to the north of the Project site as shown in the figure in the PDC document.

The wind turbines to be used at the Project site will involve the Goldwind turbine listed in Table E 1.

Table E 1 Wind turbine model under consideration

Model	*Approx Rotor diameter (m)*	*Approx Hub height (m AGL)*	*Overall tip height (m AGL)*	*Notes*
Goldwind GW140	140	Up to 100	171 (approximately)	Requires PDC modification to allow a WTG overall tip height >150 m AGL.

The Client wishes to be in a position to progress construction of the project in the latter half of 2017. Geotechnical and environmental studies are being undertaken in 2016 Q3 – 2017 and the project layout is being fine-tuned in parallel with the environmental and planning work so a degree of iteration may be associated with required assessment or allowance made for micro-siting of turbines. Adjustments to the layout (micro-siting) may still occur beyond this assessment and in some cases may need further review if changes have potential to increase aviation risks. At this point in time, micrositing of seven turbines has been considered.

There are a number of requirements of the PDC relating to air safety that need to be addressed prior to commencement of construction. To ensure compliance with the PDC Conditions is achieved in a timely fashion, the Client seeks specialist services to undertake a specific scope of work and, as necessary, make submissions to regulatory authorities for gaining approvals of the assessments or acceptance of information provided prior to construction. The specialist advisory services will review potential impacts of the proposed wind farm development on aviation safety in respect of relevant requirements of the PDC SSD-6698 and in parallel with project engineering planning and proposed implementation arrangements.

An approach that allows a sensitivity analysis in respect of variations to risk to aircraft from micro-siting of turbines reduces the need to revisit risk assessments for revised layouts that involve micro-siting of less than 100 m.

The Project site is shown in Figure E 1. The Client engaged Aviation Projects to provide the specialist advisory service.

Methodology

In undertaking this task, the following activities were conducted:

- the scope and deliverables were discussed with and agreed by the Client;
- a site visit was conducted on 15 August 2016;
- a desktop review of supplied data was conducted;
- relevant regulatory requirements and sources of information were reviewed;
- a qualitative risk assessment and Aviation Impact Statement (excluding considerations of radar interference) was prepared;
- stakeholders were consulted in writing and/or by telephone interview as applicable;
- a draft report was prepared, finalised and forwarded to relevant stakeholders for their review; and
- this final report was delivered.

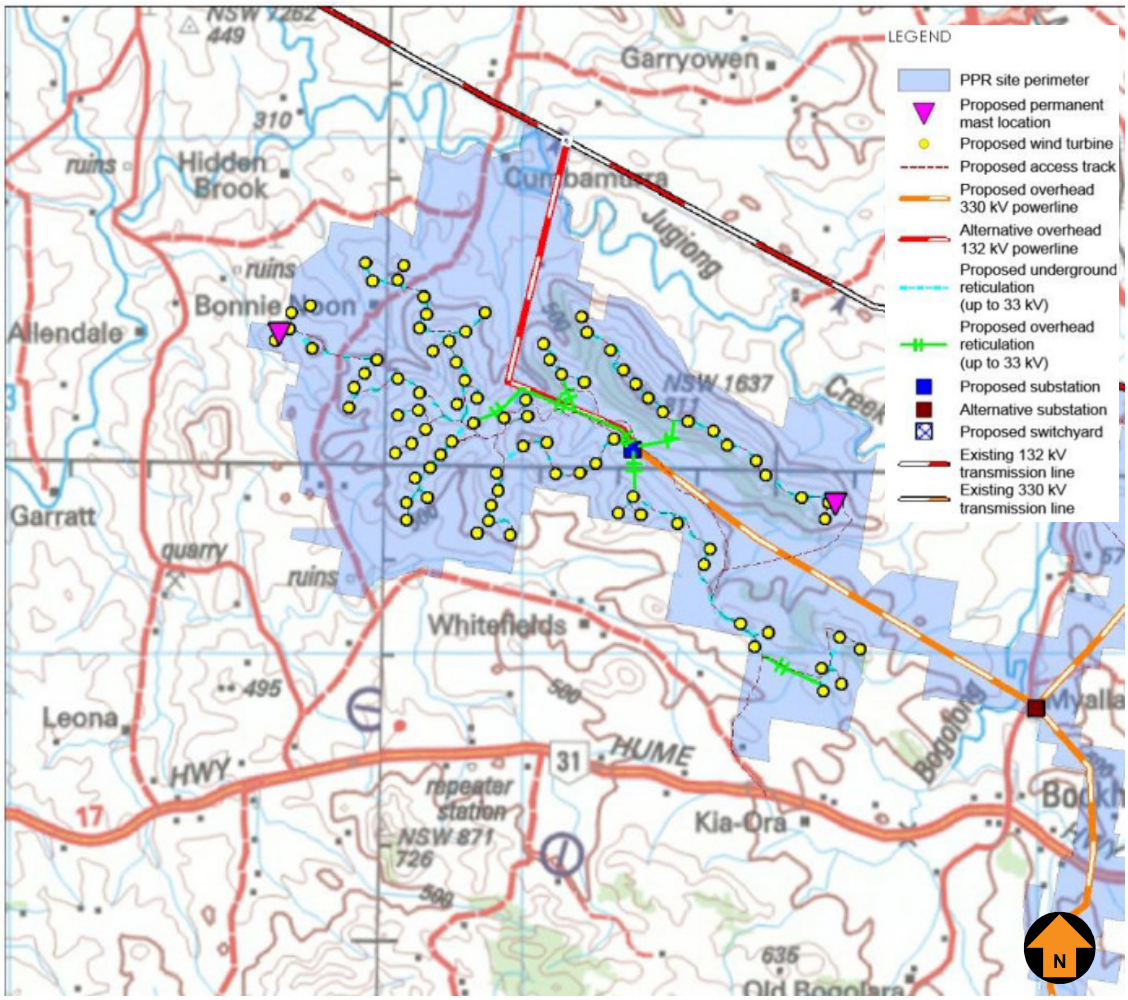

Figure E 1 Project site

Conclusions

The following conclusions were made as a result of this assessment:

Consultation

- An appropriate and justified level of consultation is being undertaken with relevant parties.

Aircraft operator characteristics

- Aircraft operate under the IFR and VFR in the vicinity of the Project site. Operations conducted in the vicinity include private, aerial application, firefighting and emergency operations.
- [insert RFS response to this report]
- [insert RFDS response to this report]
- [insert aerial agricultural response to this report]

Aviation Impact Statement

- At a maximum height with the GW140 model at 171 m AGL and WTG9 at 980 m AHD (3216 ft AMSL), only one impact was found, which is that WTG9 will infringe the 1000 ft minimum obstacle clearance (MOC) for the 25 nm minimum safe altitude (MSA) of (4200 ft AMSL) at Cootamundra Airport by 4.6 m (16 ft). This impact may be mitigated through micrositing or detailed design of the site levels.

Hazard lighting and marking

- With respect to MOS 139 7.1.5.1, the proposed wind turbines must be reported to CASA if they will be higher 110 m AGL. With respect to MOS 139 7.1.5.2, the wind turbines must be regarded as an obstacles if they are higher than 150 m AGL, unless CASA assesses otherwise.
- There are no existing wind monitoring towers on the Project site. At least two proposed wind monitoring towers ('Coppabella 1' and 'Coppabella 2') will have tip heights of 100 m AGL and are proposed to not have obstacle lighting or marking.
- With respect to MOS 139 9.4.1.2 (b), the wind turbines will need to be lit if they are higher than 110 m AGL, unless an aeronautical study assesses they are of no operational significance.
- **Aviation Projects assesses 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.**
- [Insert CASA response to this report]
- If required to be installed, obstacle lights should be designed according to the criteria set out in the applicable regulatory material. A summary of design characteristics for obstacle lighting, if obstacle lighting is required, is provided below:
    - Planning Permit condition 4(b) states that the Applicant shall ensure that any aviation hazard lighting complies with CASA's requirements;

  - ICAO Annex 14 Volume 1 paragraph 6.2.4.3 provides a recommendation, MOS 139 section 9.4.3.4A provides a standard, and NASF Guideline D provides guidance for a wind turbine of a wind farm, if lighting is required, to be fitted with medium intensity obstacle lighting;
  - two obstacle lights should be provided on those turbines that require obstacle lighting;
  - the light fixtures should be mounted sufficiently above the surface of the nacelle so that the lights are not obscured by the rotor hub, and at a horizontal separation to ensure an unobstructed view of at least one of the lights by a pilot approaching from any direction;
  - if flashing obstacle lighting is provided, both lights should flash simultaneously; and
  - the characteristics of the obstacle lights should be in accordance with the applicable standards in MOS 139 (note that MOS 139 Section 9.4.3.4A addresses obstacle lighting for wind turbines); and
- To ensure the ongoing availability of obstacle lights (if required), and in support of satisfying Planning Permit condition 34(b), a monitoring, reporting and maintenance program will need to be established in accordance with the guidance in MOS 139 Section 9.4.10.
- With respect to marking of turbines, it is generally accepted that 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.
- The location, height and other applicable details of the proposed wind monitoring tower have not yet been advised to RAAF AIS. They are not proposed to be obstacle marked or lit.
- There is no regulatory requirement to mark or light power poles or overhead transmission lines. Power poles may have a height of up to 35 m AGL. Project overhead transmission lines (if constructed), may impact on aerial application operations. However, the proposed power line is expected not to adversely impact on aircraft operations as it will be contained within the Project site boundary and will only connect the substation to the existing 132 kV power line.
- With respect to the Department of Defence, response to a request for consideration of potential aviation impacts is yet to be received at the time of finalising this report. However, it is worth noting that, in previous responses by Department of Defence during consultation for other proposed developments, Department of Defence has requested that, if lighting is required and light emitting diode (LED) obstruction lighting is applied, the frequency range of LED lighting fall within the wavelength range of 655 to 930 nanometres, which will enable the lighting to be visible to persons using night vision devices. Subsequent correspondence received following the finalising of this report will be considered by Aviation Projects and addressed as necessary.
- [Insert Department of Defence response to this report]

Risk assessment

A summary of risks associated with the Project, under the proposed treatment regime, is provided in Table E 2.

Table E 2 Summary of risk assessment

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 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.

Recommendations

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

Notification and reporting

1. Final (approved) wind turbine coordinates and elevations (after micrositing) should be provided to RAAF AIS in accordance with AC 139-08(0) *Reporting of Tall Structures*.

2. Any obstacles above 110 m AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents.

3. The location of wind turbines, monitoring towers and powerlines should be made available to RFS, RFDS, aerial agriculture operators and land owners so they are able to provide this information to aerial application pilots when requested for flight planning purposes.

Marking of turbines

4. The rotor blades, nacelle and the supporting mast of the wind turbines should be painted white.

Lighting of turbines

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

6. The Client should limit the overall blade tip height to a maximum of 975.4 m AHD so that the PANS-OPS surface associated with the 25 nm MSA at Cootamundra Airport is not infringed.

7. Aviation Projects has assessed that obstacle lighting will not be required to maintain an acceptable level of aviation safety. However:

    a. If obstacle lighting was required (for example, as a requirement of the responsible authority), the lighting should have the following characteristics:

        1. obstacle lighting should be designed in accordance with the characteristics specified in ICAO Annex 14 Vol 1 Chapter 6 (note that Section 6.2.4 addresses obstacle marking and lighting of wind turbines) and MOS 139 Chapter 9 (note that Section 9.4.3.4A addresses obstacle lighting for a wind farm), while minimising visual impact;

        2. [Insert Department of Defence response to this report]; and

        3. the Client may consider other factors in its decision as to whether obstacle lights should be installed.

    b. To ensure the ongoing operation and availability of obstacle lights (if required) at night and during times of reduced visibility, a monitoring, reporting and maintenance program should be established in accordance with the guidance in MOS 139 Section 9.4.10.

Marking of wind monitoring towers

8. Consideration should be given to marking any wind monitoring towers according to the requirements set out in MOS 139 Section 8.10 (as modified by the guidance in NASF Guideline D).

Marking of overhead transmission lines and poles

9. 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 agriculture operators and marked in accordance with MOS 139 Section 8.10.2.8. Note that the new transmission lines that are proposed will not adversely affect aircraft operations.

Triggers for review

10. Triggers for review of this risk assessment and obstacle lighting design are provided for consideration:

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

    b. following any significant changes to the context in which the assessment was prepared, which are not expected to occur within the next 12 months, including the regulatory framework; and

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

1. INTRODUCTION

1.1. Situation

Goldwind Australia (the Client) is planning for the development of the Coppabella Wind Farm (the Project) and requires a range of planning and environmental services.

The Project Development Consent (PDC) allows for up to 79 turbines with a 132kV connection to the north of the Project site as shown in Figure 1 (source: Goldwind Australia).

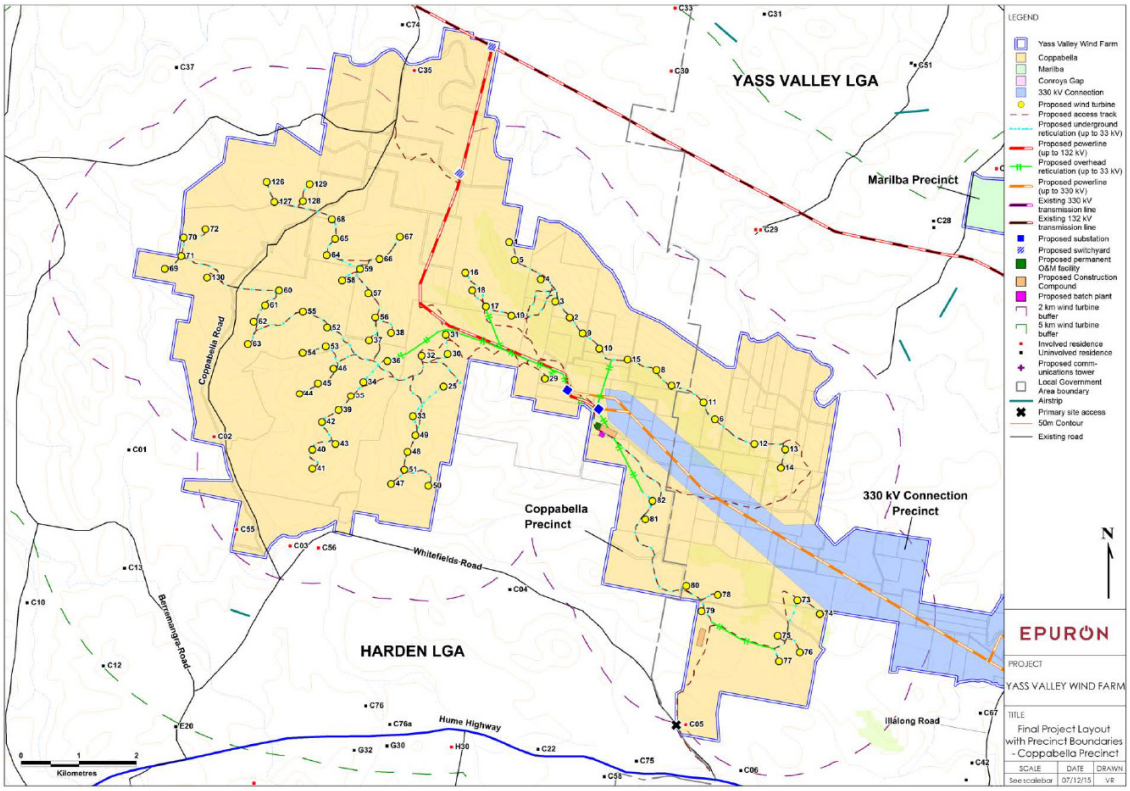

Figure 1 Final Project Layout with Precinct Boundaries - Coppabella Precinct

The first stage of the Project development is likely to involve about 62 turbines consistent with the available grid connection capacity. The required services will recognise the full project implementation (79 turbines).

The wind turbines to be used at the Project site will involve one of the Goldwind turbines listed in Table 1.

Table 1 Wind turbine models under consideration

Model	*Approx Rotor diameter (m)*	*Approx Hub height (m AGL)*	*Overall tip height (m AGL)*	*Notes*
Goldwind GW140	140	Up to 100	171 (approximately)	Requires PDC modification to allow a WTG overall tip height >150 m AGL.

The Client wishes to be in a position to progress construction of the project in the latter half of 2017. Geotechnical and environmental studies are being undertaken in 2016 Q3 – 2017 and the project layout is being fine-tuned in parallel with the environmental and planning work so a degree of iteration may be associated with required assessment or allowance made for micro-siting of turbines. Adjustments to the layout (micro-siting) may still occur beyond this assessment and in some cases may need further review if changes have potential to increase aviation risks. At this point in time, micrositing of seven turbines has been considered.

There are a number of requirements of the PDC relating to air safety that need to be addressed prior to commencement of construction. To ensure compliance with the PDC Conditions is achieved in a timely fashion, the Client seeks specialist services to undertake a specific scope of work and, as necessary, make submissions to regulatory authorities for gaining approvals of the assessments or acceptance of information provided prior to construction. The specialist advisory services will review potential impacts of the proposed wind farm development on aviation safety in respect of relevant requirements of the PDC SSD-6698 and in parallel with project engineering planning and proposed implementation arrangements.

An approach that allows a sensitivity analysis in respect of variations to risk to aircraft from micro-siting of turbines reduces the need to revisit risk assessments for revised layouts that involve micro-siting of less than 100 m.

The Client engaged Aviation Projects to provide the specialist advisory service.

1.2. Purpose of task

Aviation obstacle lighting specifications.

The scope of the services required relates to PDC Schedule 3 Condition 4 – Lighting (specifically item (b)), which is copied below:

> *Lighting*
>
> *4. The Applicant shall:*
>
> *(a) implement all reasonable and feasible measures to minimise the off-site lighting impacts of the development;*
>
> ***(b) ensure that any aviation hazard lighting complies with CASA's requirements;***

(c) ensure that all external lighting associated with the development (apart from any aviation hazard lighting):

- *is installed as low intensity lighting (except where required for safety or emergency purposes);*
- *does not shine above the horizontal;*
- *uses best management practice for bat deterrence; and*
- *complies with Australian Standard AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting, or its latest version.*

The Client seeks a risk assessment for the proposed turbines and layout that will assess whether aviation safety lighting is required for the Project. The report will make a recommendation as to whether lighting is or, is not required. The report would be subsequently submitted to Civil Aviation Safety Authority (CASA) for its review and consideration and should meet CASA required standards for a risk assessment for the purpose.

In addition, in accordance with Schedule 3, Condition 38, notifications are required to Aviation Authorities prior to commencing construction of the development.

Specific tasks that are required by Client include delivery of the following:

Item 1 – Risk assessment for the Project

- Preparation of Risk Assessments to address the risk from the wind turbine structures (GW140) and any need for aircraft safety lighting. The completed assessments (separate assessment for wind farms based on each of the two turbine models) will need to be submitted to CASA and, CASA concurrence sought for the recommendation of the report.

Item 2 – Notifications to Aviation Authorities

- As required by Condition 38 of the Development Consent, "Prior to commencement of construction of the development, the Applicant must provide specified information to CASA, Airservices Australia and the RAAF (together the authorities).

Consultation with Regulators

- The proposal should allow for consultation with regulators (Office of Environment and Heritage (OEH) and Stakeholders).

1.3. Structure

This report is structured as followed:

- Introduction;
- Background;
- Planning context;
- Consultation;
- Aviation Impact Statement;

- Aircraft operator characteristics;
- Hazard lighting and marking;
- Obstacle lighting risk assessment;
- Conclusions; and
- Recommendations.

1.4. Stakeholders

An appropriate and justified level of consultation is being undertaken with the following parties and considered in the preparation of this report:

- Aerial Agricultural Association of Australia;
- Airservices Australia;
- Civil Aviation Safety Authority;
- Department of Defence;
- local aircraft operators;
- operators of regulated and non-regulated aerodromes;
- Royal Flying Doctor Service;
- Rural Fire Service; and
- other stakeholders where noted.

The report is being circulated for comment, and if not received at time of lodgement, then it is ongoing.

1.5. Client material

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

- Goldwind Australia, Aeronautical Impact Assessment, Obstacle Lighting Review & Qualitative Risk Assessment – Proposed Wind Farm Development at Yass Valley Wind Farm New South Wales (J0334), v0.3 (preliminary draft report), dated 25 November 2010;
- Goldwind Australia, email titled *RE: 100306-01 YVWF Aviation Impact Assessment - RFI - 1 - GWA Response*, dated 8 August 2016, with the following attachments:
    - *Excel with Coordinates of Turbines – Ground level, Tip height for 150 (slightly below 150m) and 170m;*
    - *2m contour data;*
    - *Appendix 2 – 79 Turbine approved layout; and*
    - *Yass Layout – 62 WTG;*

- Goldwind Australia, email titled *RE: 100306-01 YVWF Aviation Impact Assessment - RFI - 1 - GWA Response 2*, dated 8-18 August 2016, with the following attachments:
  - *Zip file with Dev envelope etc.; and*
  - *Attachments 11 and 12 – Air Safety items – Note these addressed the wider wind farm (not just the approved western part)*;
- Goldwind Australia, document titled Yass Valley Wind Farm (YVWF) Request for Proposal (RFP) – Aviation Hazard Assessment, date received 27 June 2016;
- Goldwind Australia, NSW Planning Assessment Commission Determination Report: Appendix 3 Development Consent Conditions, Application Number: SSD-6698, dated 30 March 2016; and
- Goldwind Australia, Yass Valley Wind Farm (YVWF) Request for Proposal (RFP) – Aviation Hazard Assessment, date received 27 June 2016.
- Goldwind Australia, email titled *Review of CWF Aviation Safety Assessment*, dated 31 August 2017, with following attachment:
  - *Excel file 09062017_WTGElevations_0024.xlsx*, updated WTG elevations from the latest contour survey.

1.6. 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* 17 August 2017;
- Airservices Australia, *Designated Airspace Handbook*, effective 25 May 2017;
- Airservices Australia, letter: *Airservices Aviation Assessments for Wind Farm Developments*, dated 13 February 2014;
- Aircraft Owners and Pilots Association of Australia (AOPA), *National Airfield Directory 2012*, 15th ed;
- AS/NZS ISO 31000:2009 *Risk management—Principles and guidelines*, Standards Australia;
- Civil Aviation Safety Authority, Advisory Circular (AC) 139-8(0): Reporting of Tall Structures, dated April 2005;
- Civil Aviation Safety Authority, *Civil Aviation Regulations 1988 (CAR)*, as amended;
- Civil Aviation Safety Authority, *Civil Aviation Safety Regulations 1998* (CASR), No. 237, registered 06 October 2016;

- Civil Aviation Safety Authority, *Manual of Standards Part 139 – Aerodromes*, version 1.14, dated January 2017;
- Civil Aviation Safety Authority, *Manual of Standards Part 173 – Aerodromes*, version 1.5, dated March 2016;
- Department of Infrastructure and Regional Development, Australian Government, *The National Airports Safeguarding Framework: Guideline D Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation,* dated June 2013;
- Environment Protection and Heritage Council, *National Wind Farm Development Guidelines DRAFT*, dated July 2010;
- International Civil Aviation Organization, Doc 8168 *Procedures for Air Navigation Services—Aircraft Operations* (PANS-OPS);
- International Civil Aviation Organization, Standards and Recommended Practices, *Annex 14—Aerodromes;* and
- NSW Government Planning Assessment Commission, *NSW Planning Assessment Commission Determination Report*, Application Number: *SSD-6698*, dated 30 March 2016.

2. BACKGROUND

2.1. Project description

The Project is located approximately 16 km west of Yass, in the Yass Valley and Harden local government areas.

Figure 2 shows the Project general area (source: OzRunways, extracted 08 August 2016).

Figure 2 Coppabella Wind Farm general area

PDC Conditions providing the description of the Project are copied below:

> ***LIMITS ON CONSENT***
>
> ***Approved Precincts***
>
> *5. Consent is granted only for the development in the Coppabella precinct and the access track traversing the 330 kV Connection precinct.*
>
> *Note: To avoid any doubt, this consent does not allow the development of any wind turbines or ancillary infrastructure in the Marilba precinct, Conroy's Gap Extension precinct and 330 kV Connection precinct, (except for the access track connecting wind turbine number 82 to wind turbine number 13). The approved wind turbines in the Coppabella precinct are those numbered 1 to 19, 25, 29 to 82, and 126 to 130.*
>
> ***Wind Turbines***
>
> *6. The Applicant may construct, operate and replace or upgrade as necessary up to 79 wind turbines.*

Note: To avoid any doubt, the Applicant does not require additional approval to replace or upgrade wind turbines over time, as long as the replacement or upgrade is carried out in accordance with the conditions of this consent.

7. The Applicant shall not use the Vestas V90 3MW wind turbine model, unless the Applicant demonstrates to the satisfaction of the Secretary that it would be able to comply with the operational noise criteria in this consent without relying upon sector management.

Note: Use of the Vestas V90 3MW model is predicted to result in exceedances of the operational noise criteria in this consent.

Wind Turbine Height

8. No wind turbines may be greater than 150 metres in height (measured from above ground level to the blade tip).

Micro-siting Restrictions

9. The Applicant may micro-site the wind turbines and ancillary infrastructure without further approval provided:

(a) they remain within the development corridor shown in the figure in Appendix 3;

(b) no wind turbine is moved more than 100 metres from the location shown in the figures in Appendix 2; and

(c) the revised location of the wind turbine and/or ancillary infrastructure would not result in any non-compliance with the conditions of this consent.

Final Layout Plans

10. Prior to the commencement of construction, the Applicant shall submit detailed plans of the final layout of the development to the Secretary, including:

(a) details on the micro-siting of any wind turbines and/or ancillary infrastructure; and

(b) the GIS coordinates of the wind turbines.

Note: If the construction of the development is to be staged, then the provision of these plans may be staged.

The Project may be constructed in stages. The first stage of the Project development may only involve 45 turbines limited by the available grid connection capacity. A map of the final layout is provided in Figure 3.

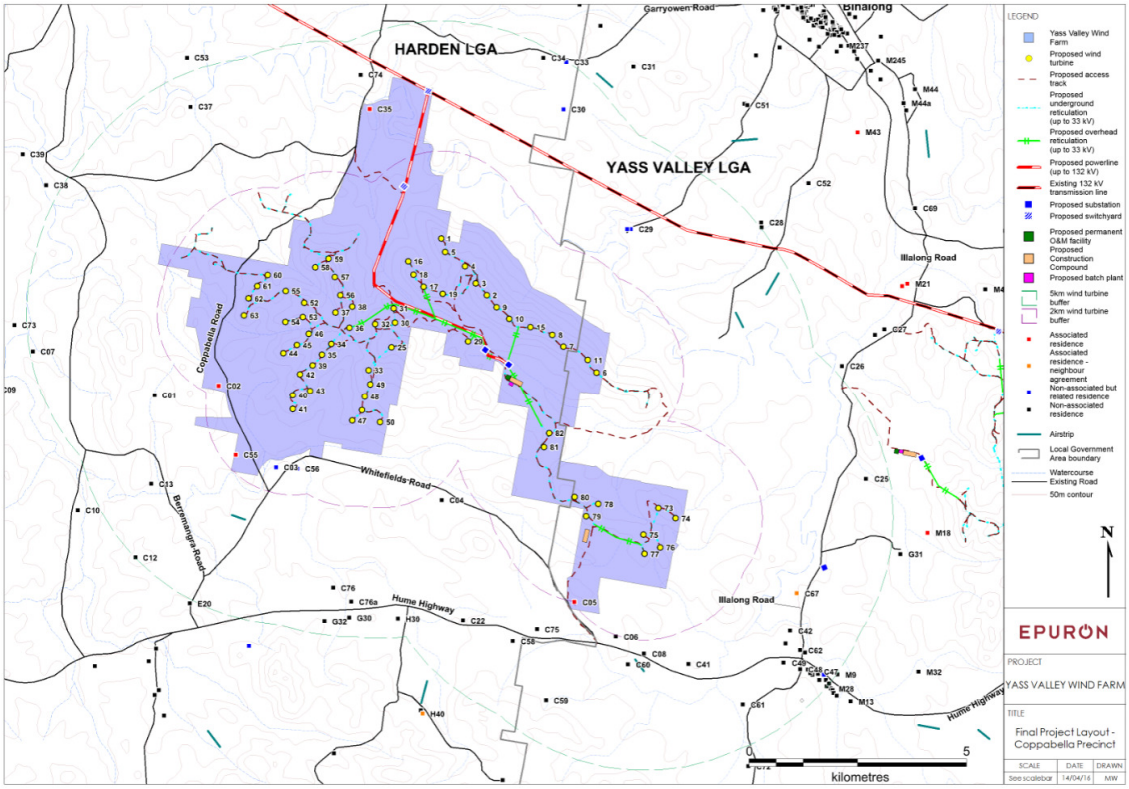

Figure 3 Final project layout

The Client is considering wind turbines (model GW140) with a height of up to 171 m (561 ft) above ground level (AGL) on a maximum ground elevation of 809 m AHD (2655 ft above mean sea level (AMSL)) located at wind turbine 9.

For a 171 m AGL tall wind turbine (wind turbine GW140), the maximum overall tip height will be 980 m AHD (3216 ft AMSL). Constructing GW140 model turbines will require modification of the PDC.

The coordinates and ground elevations of the Project wind turbines are listed at **Annexure 1**.

2.2. Description of wind monitoring towers

The term 'wind monitoring towers' is used in this report in lieu of 'wind monitoring masts' for consistency with aviation-related regulations, standards and guidance. There are no existing wind monitoring towers on the Project site.

At least 2 permanent wind monitoring towers are proposed to be on the Project site and in this report these are named: 'Coppabella 1' and 'Coppabella 2'. Goldwind advised there will be the installation of a number of temporary wind monitoring towers prior to construction.

The approximate details of the proposed permanent wind monitoring towers are provided in Table 2.

Table 2 Proposed permanent wind monitoring towers description

Detail	*Coppabella 1*	*Coppabella 2*
Indicative location (WGS84 zone 55 south)	Version 1 Eastings: 646 052 Northings: 6 153 011 Version 2 Eastings: 642 156 Northings: 6 155 339	Version 1 Eastings: 635 248 Northings: 6 156 310 Version 2 Eastings: 638 563 Northings: 6 154 175
Ground elevation at site	TBA	TBA
Height of tower AGL	100 m AGL	100 m AGL
Height of tower AHD	TBA	TBA
Lighting/Marking existing/proposed	None proposed	None proposed
Design	Lattice	Lattice
Permanent tower	Yes	Yes
Construction date	Not yet constructed	Not yet constructed
Reported to RAAF AIS?	No	No

3. PLANNING CONTEXT

3.1. Department of Planning and Environment

The NSW Government Department of Planning and Environment's Planning Assessment Commission released a report titled *NSW Planning Assessment Commission Determination Report – Yass Valley Wind Farm Project (SSD 6698) – Yass Valley and Harden Shire LGA*, dated 30 March 2016. Extracts of this report are provided below:

> *6.1 Impact on Aviation Services*
>
> *Of particular concern to the Commission was the potential impact on aviation services including impacts on the radar systems and local airstrips. The Commission notes that Airservices Australia is now satisfied that its concern could be managed with the recommended conditions of approval, which requires a detailed independent report to be prepared on all potential impacts of the project and implementation of all recommended mitigation measures to the satisfaction of Airservices Australia.*
>
> *Although the Commission finds this issue has been addressed for this proposal, it considers that there is a need for the Department to see that further research is carried out on the potential impact of turbulence arising from the operations of wind turbines.*
>
> *6.8 Conclusion*
>
> *On the evidence, the Commission finds most of its concerns have been addressed in the Revised Assessment Report (2016) and the updated conditions of approval.*
>
> *...*
>
> *The Commission is satisfied that other issues including aviation, biodiversity, voluntary contributions, noise, health, traffic & transport, heritage, telecommunication, and water have been adequately addressed and residual issues could be managed with the recommended conditions of approval.*
>
> *7. Commission's Determination*
>
> *The Commission has considered the information available including the Assessment Report 2016 and associated documents, agencies and public submissions, information provided by the applicant, issues raised at meetings with stakeholders including landowners during the site visit.*
>
> *The Commission is satisfied that the Department has considered and addressed all relevant issues and the recommendation to approve only the Coppabella Precinct is reasonable. The application is approved as recommended subject to conditions in Appendix 3 of this report.*

3.2. Planning Permit

The applicable Conditions within the referred *'Appendix 3'* in the *NSW Planning Assessment Commission Determination Report,* in addition to the Conditions noted 2.1 of this Aviation Impact Assessment, are copied below:

> ***VISUAL***
>
> ***Lighting***
>
> *4. The Applicant shall:*
>
> *...*
>
> *(b) ensure that any aviation hazard lighting complies with CASA's requirements;*
>
> *...*
>
> ***AVIATION***
>
> ***Mitigation of Aviation-Related Impacts***
>
> *34. Prior to the construction of any wind turbines, the Applicant shall:*
>
> *(a) prepare a detailed report to the satisfaction of Airservices Australia on all the potential aviation-related impacts of the development, including any potential impacts on the operation of the Mt Majura PSR/SSR Air Traffic Control radar, Mt Bobbara SSR Air Traffic Control radar, and any other Airservices Australia infrastructure or facilities. This report must:*
>
> - *be prepared by a suitably independent, qualified and experienced person acceptable to Airservices Australia;*
> - *be prepared in accordance with EUROCONTROL Guidelines on how to assess the potential impact of Wind Turbines on Surveillance Sensors, September 2014, or its latest version* [this item is not within the scope of this Aviation Impact Assessment]*;*
> - *include a review of the findings of previous assessments in respect of the development; and*
> - *include recommendations for reasonable and feasible measures to mitigate or manage the potential impacts, that are acceptable to Airservices Australia;*
>
> *(b) prepare, an Aviation Impact Management Plan to the satisfaction of Airservices Australia. This plan must:*
>
> - *describe the measures that would be implemented to mitigate and/or manage the aviation-related impacts of the development, having regard to the recommendations in the detailed report required in (a) above; and*
> - *include a program for the implementation of these measures, having regard to any regulatory approvals that may need to be obtained, Airservices Australia's statutory and operational priorities and the proposed construction program for the development; and*
>
> *(c) enter into a legally binding agreement with Airservices Australia articulating further details to give effect to the implementation of the Aviation Impact Management Plan, including the provision*

of adequate security for implementation of the measures in the plan and any associated costs (see condition 36 below).

35. Following approval, the Applicant shall implement the Aviation Impact Management Plan.

36. If following approval of the Aviation Impact Management Plan changes are proposed to the location and/or dimensions of any wind turbines, then the Applicant shall assess the aviation-related impacts of the proposed changes and update the Aviation Impact Management Plan to the satisfaction of Airservices Australia prior to constructing the wind turbines in the revised location.

Liability for Costs

37. The Applicant shall be liable for all costs associated with the implementation of the Aviation Impact Management Plan, including the reimbursement of all of Airservices Australia's costs, including (but not limited to):

(a) Airservices Australia's internal time and materials costs;

(b) the costs of Airservices Australia's project management and subcontracting arrangements (including any procurement costs);

(c) project and equipment costs;

(d) public and stakeholder engagement and consultation costs;

(e) alternative site licensing or leasing costs;

(f) the costs associated with obtaining regulatory approvals or complying with any regulatory requirements (including any environmental impact studies and community consultation costs); and

(g) any other associated costs identified by Airservices Australia.

Notification of Aviation Authorities

38. Prior to the commencement of construction of the development, the Applicant must provide the following information to CASA, Airservices Australia, and the RAAF (together the authorities):

(a) coordinates in latitude and longitude of each wind turbine and wind monitoring mast;

(b) final height of each wind turbine and wind monitoring mast in Australian Height Datum;

(c) ground level at the base of each wind turbine and wind monitoring mast in Australian Height Datum;

(d) confirmation of compliance with any OLS; and

(e) details of aviation hazard lighting.

39. Within 30 days of the practical completion of any turbine or mast, the Applicant shall:

(a) provide confirmation to the authorities and local aviation users that the information that was previously provided remains accurate; or

(b) update the information previously provided.

3.3. Airservices Australia

Further to the specified scope of work, the Client seeks the preparation of an Aviation Impact Statement (AIS) for submission to Airservices Australia.

Airservices Australia issued a letter document, with the subject **Airservices Aviation Assessments for Wind Farm Developments**, dated 13 February 2014. The document sets out the criteria (not copied herein) that must be satisfied in an AIS. An AIS must be submitted to Airservices Australia to facilitate its assessment of a wind farm proposal.

The document also refers to guidelines to manage the risk to aviation safety from wind turbine installations (Wind Farms/Wind Monitoring Towers) under development by the National Airports Safeguarding Advisory Group (NASAG). NASAG is comprised of high-level Commonwealth, State and Territory transport and planning officials and has been formed to develop a national land use planning regime to apply near airports and under flight paths.

AIS must be undertaken by an aeronautical consultant with suitable knowledge and capabilities to provide a reliable and comprehensive report. Aviation Projects satisfies this requirement.

Note that it is not intended to investigate or report upon potential impacts to navigation or radar facilities as part of the AIS, as this is being separately investigated by others and not within the scope of work.

3.4. Review of previous reports

The Ambidji Group Pty Ltd (Ambidji) prepared preliminary draft report, titled *Aeronautical Impact Assessment, Obstacle Lighting Review & Qualitative Risk Assessment, Proposed Wind Farm Development at Yass Valley Wind Farm, New South Wales*, dated 25 November 2010.

The conclusions and recommendations of this report are copied below:

> *6. CONCLUSIONS*
>
> *6.1 Aeronautical Impact Assessment*
>
> *From the data provided, the proposed Yass Valley Wind Farm does not infringe any:*
>
> - *PANS OPS surfaces of aerodromes;*
> - *OLS for aerodromes;*
> - *Air Route protection surfaces;*
> - *Clearance Planes for Navigation Aids. or*
> - *The ATC radar clearance plane for the MT Majura radar.*
>
> *The proposed wind farm also does not have an impact on engine inoperative flight paths from aerodromes in the region.*
>
> *However, there are a number of turbines in the proposed Yass Valley Wind Farm that infringe upon the ATC radar clearance plane for the MT Bobbara radar.*

It is likely that further consideration of the affects of the infringement of the MT Bobbara radar clearance plane will be required by Airservices Australia prior to any decision being made to approve the construction of the Yass Valley Wind Farm.

Consultations with AsA may lead to options for mitigation of the impacts.

6.2 Obstacle Lighting Review

In regard to those structures that are outside obstacle limitation surfaces of an aerodrome, and are more than 110m above ground level, CASA's Manual of Standards Part 139 - Aerodromes, states that in general an obstacle would require obstacle lighting unless, an aeronautical study assesses it as being shielded by another object or that it is of no operational significance.

The proposed Yass Valley Wind Farm proposes wind turbines greater than the CASA 110m and up to the ICAO recommended 150m obstacle height threshold where ICAO deems these to be obstacles that require consideration for lighting. However, the ICAO recommendation on wind turbines of 150m or higher states that they should be regarded as obstacles unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes.

The Qualitative Risk Assessment in this report represents such a special aeronautical study as allowed by CASA and ICAO. It assessed the degree of risk (hazard) posed by the Yass Valley Wind Farm and made recommendations regarding the requirement or otherwise for aviation obstacle lighting.

3 Qualitative Risk Assessment

The Qualitative Risk Assessment has determined that there is minimal probability of an aircraft impacting with a turbine day or night or in poor weather is very low.

The risk from the qualitative assessment has been determined as low to low/medium.

The low/medium risk applies to approved low flying operations for aerial applications, emergency service activity and fire fighting activity. These operations are not unsafe provided pre-planning is undertaken in respect of aerial applications and the pilots are experienced operators and the location of the wind farm is depicted in the Aeronautical Publications in respect of all three low level operations.

All other aviation operations have been assessed as low risk.

It is concluded that the level of assessed risk does not support the requirement for installing obstacle lighting at the proposed Yass Valley Wind Farm.

6.4 Duty of Care Disclaimer

The obstacle lighting review has determined that there are no regulatory requirements which would impact upon the decision to not install aviation lighting for the proposed Yass Valley Wind Farm. In addition, the Qualitative Risk Assessment has determined the assessed level of risk to aviation operations associated with the presence of the wind farm in general or the farm not being lit as low to low/medium.

Notwithstanding this outcome, as a function of corporate responsibility and duty of care, it is appropriate to formally advise all relevant stakeholders of the location and heights of the turbines and meteorological monitoring masts and when they would be constructed or decommissioned.

Acciona Energy's attention is also drawn to the following determination of the New South Wales Court of Appeal, in the case of Sheather vs Country Energy, where inter-alia the court determined the following [Sheather v Country Energy [2007] NSWCA 179].

> *"Mr Sheather, the owner of the helicopter which crashed into a Country Energy owned spur line while flying well below the mandatory height regulations for aircraft, appealed an earlier decision on the grounds that Country Energy had failed to provide sufficient warning of the spur line. Despite Country Energy observing all legal compliance requirements, the NSW Court of Appeal held that Country Energy owed a duty of care to pilots and aircraft owners and had breached its duty of care".*

Due cognisance of this decision should be taken by Origin Energy and its legal and insurance advisors in considering this Qualitative Risk Report.

7. RECOMMENDATIONS

On the basis of a review of international and national aviation documentation, CASA's current position for marking and lighting of obstacles for wind farms, a review of the approach to lighting at other Australian wind farm developments, an OLS and PANS OPS aeronautical impact review and a qualitative risk assessment, Ambidji's makes the following recommendations:

- *That aviation obstacle lighting for the proposed Yass Valley Wind Farm site is not required;*
- *That Origin engages with Airservices Australia to pursue mitigation and approval of the Mount Bobbara radar clearance plane penetrations;*
- *That Origin engages with its legal, insurance and other relevant advisors in regard to its own corporate assessment of risk and duty of care responsibilities in regard to the requirement for aviation obstacle lighting;*
- *That Origin make contact with the relevant aviation stakeholders as listed in Appendix H, prior to the construction of turbines and notifies operators in the region of the location and height of the existing and any planned meteorological monitoring masts in the area; and*
- *That any meteorological monitoring masts in the Yass Valley Wind Farm area be fitted with swing flap reflector markers. Discussion with a power industry reflective flag manufacturing company (Power Engineers) suggested the mast guy stays be marked as follows:*
    - *Fitting 3 x 30cm flags per guy stay;*
    - *In alternating colours yellow, white and orange; to each mast guy ;*
    - *Spaced equidistant along each guy wire; and*
    - *In addition to using the snap clamp supplied with each marker a proprietary brand construction adhesive such as Sika Flex (http://www.sika.com.au/) be used in conjunction with the clamp.*

Since the release of the preliminary draft assessment by Ambidji, various internal and external contexts – on which the assessment was based – have changed, including but not limited to the proposed Project layout and height as well as terminal instrument procedures at nearby aerodromes. This Aviation Safety Assessment considers the current internal and external contexts.

The Planning Assessment Commission (delegate of the NSW Minister for Planning) released a report titled *NSW Planning Assessment Commission Determination Report Yass Valley Wind Farm Project (SSD 6698), Yass Valley and Harden Shire LGA*, dated 30 March 2016. The sections of the report applicable to this Aviation Safety Assessment are copied below:

> *6.1 Impact on Aviation Services*
>
> *Of particular concern to the Commission was the potential impact on aviation services including impacts on the radar systems and local airstrips. The Commission notes that Airservices Australia is now satisfied that its concern could be managed with the recommended conditions of approval, which requires a detailed independent report to be prepared on all potential impacts of the project and implementation of all recommended mitigation measures to the satisfaction of Airservices Australia.*
>
> *Although the Commission finds this issue has been addressed for this proposal, it considers that there is a need for the Department to see that further research is carried out on the potential impact of turbulence arising from the operations of wind turbines.*
>
> *7. COMMISSION'S DETERMINATION*
>
> *The Commission has considered the information available including the Assessment Report 2016 and associated documents, agencies and public submissions, information provided by the applicant, issues raised at meetings with stakeholders including landowners during the site visit.*
>
> *The Commission is satisfied that the Department has considered and addressed all relevant issues and the recommendation to approve only the Coppabella Precinct is reasonable. The application is approved as recommended subject to conditions in Appendix 3 of this report.*

The applicable conditions are noted in Section 0.

3.5. Nearby aerodromes

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

Table 3 Nearby certified / registered aerodromes

Aerodrome	*Operator*	*Type*	*Location from the Project*
Cootamundra	Cootamundra-Gundagai Regional Council	Registered, Code 2 Instrument non-precision	175° magnetic (M) (187° True) 40.1 km (21.6 nm)
Young	Young Shire Council	Registered, Code 2 Instrument non-precision	323° magnetic (M) (335° True) 57.0 km (31 nm)

Section 5 of this report addresses aviation impacts, including impacts on terminal instrument procedures at the abovementioned aerodromes.

A search on OzRunways, which sources its data from Airservices Australia (AIP) and AOPA National Airfield Directory datasets, returned a number of nearby non-regulated aerodromes. The aeronautical data provided by this application is approved by CASA under Civil Aviation Regulation 233(1)(h).

A map showing nearby aerodromes is provided in Figure 4 (source: Goldwind).

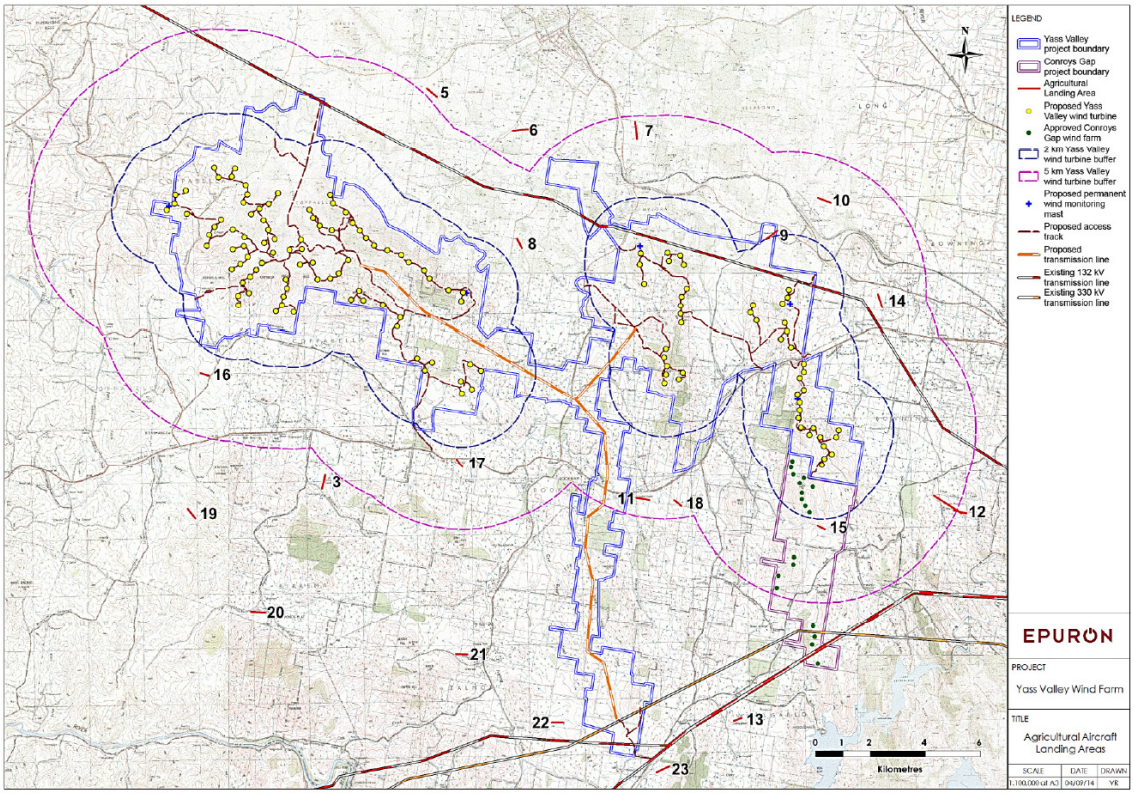

Figure 4 Nearby aerodromes

A map of ALAs identified from the OzRunways database and ALAs identified in the Client material is shown in Figure 5. Note that the ALA ID numbers do not correspond with the ALA IDs shown in Figure 4.

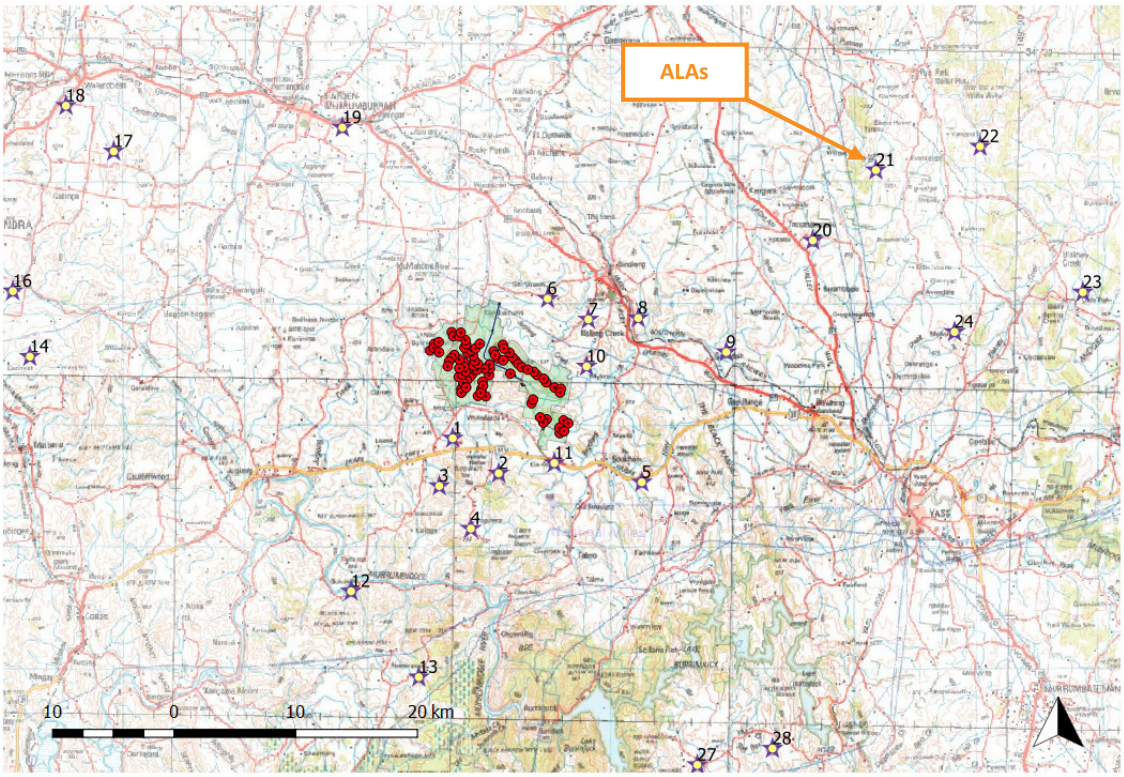

Figure 5 Nearby ALAs

These ALAs are shown in Table 4, ordered by the ALA distance from the nearest proposed wind turbine.

Table 4 List of nearby ALAs

ID	Eastings	Northings	Distance (m) from closest turbine
11	645372	6146886	2500
10	648030	6154843	2696
1	637014	6148926	3817
9	659518	6156020	3976
8	652271	6158818	4221
6	644817	6160414	5290
2	640794	6146045	5558
7	648177	6158703	5879

ID	Eastings	Northings	Distance (m) from closest turbine
5	652569	6145310	6571
3	635910	6144997	7891
16	600923	6161033	9263
4	638506	6141494	10563
18	605290	6176285	13175
14	602318	6155642	14486
17	609217	6172532	14932
15	596826	6152979	15252
20	666637	6165202	15524
12	628654	6136339	18686
19	627940	6174492	19085
24	678297	6157674	21138
13	634227	6129272	23178
21	671823	6170983	23249
28	663316	6123401	26096
27	657137	6122051	26921
22	680397	6172933	30500
23	688850	6160942	32177

Aircraft landing areas (ALA) generally have associated airspace in accordance with the dimensions set out in Civil Aviation Advisory Publication (CAAP) 92-1(1) *Guidelines for Aeroplane Landing Areas*, dated July 1992. The two types of impacts of the Project on ALAs that have been considered in this assessment are intrusions of wind turbines in the ALA airspace and wind turbine wake turbulence existing inside the ALA airspace.

The maximum horizontal extent of the airspace as described in CAAP 92-1(1) is 900 m. The closest ALA (ALA ID 11) will be 1.34 nm (2.5 km) of the Project site, which is sufficiently distant to have no impact on the take-off and landing at the ALA.

The Department of Infrastructure and Regional Development (C'th) has released guidance regarding provision of wind turbine wake turbulence in paragraph 43 of NASF Guideline D, which states:

> *Wind farm operators should be aware that wind turbines may create turbulence which noticeable up to 16 rotor diameters from the turbine. In the case of one of the larger wind turbines with a diameter of 125 metres, turbulence may be present two kilometres downstream. At this time, the effect of this*

> *level of turbulence on aircraft in the vicinity is not known with certainty. However, wind farm operators should be conscious of their duty of care to communicate this risk to aviation operators in the vicinity of the wind farm…*

Given that the maximum rotor diameter of the WTG models under consideration is 140 m, the distance at 16 diameters (16D) is 2240 m (1.2 nm) downstream from the wind turbine. ALA ID 11 has the minimum distance from the closest wind turbine (2500 m, 1.4 nm) which is greater than a distance of 16D associated with a wind turbine rotor diameter of 140 m. Therefore, based on the guidelines provided in NASF Guideline D, the Project will not likely impact on nearby ALAs due to wake turbulence.

In addition, Civil Aviation Regulation (CAR) 157 refers to distances that aircraft must maintain from an object. The applicable distances are 500 ft of vertical distance and 600 m (300 m for helicopters) of horizontal distance from an object, unless the conditions outlined in CAR 157 3A and 4 are satisfied.

4. CONSULTATION

The stakeholders identified and consulted are listed below:

- Aerial Agricultural Association of Australia;
- Airservices Australia;
- Civil Aviation Safety Authority;
- Department of Defence;
- Local aircraft operators;
- Operators of regulated and non-regulated aerodromes;
- Royal Flying Doctor Service;
- Rural Fire Service; and
- Other stakeholders where noted.

Details of consultation undertaken are provided in Table 5.

Table 5 Stakeholder consultation details

Agency/Contact	*Activity/Date*	*Response/Date*	*Issues Raised During Consultation*	*Action Proposed*
Aerial Agricultural Association of Australia **Chief Executive Officer** **Phil Hurst**	TBA	TBA	TBA	TBA
Airservices Australia **Airport Developments**	TBA	TBA	TBA	See Section 5 for a discussion on Aviation Impacts.
Civil Aviation Safety Authority **Dilip Mathew** **Manager Aerodromes**	TBA	TBA	TBA	TBA
Department of Defence **Estate Planning QVT**	TBA	TBA	TBA	TBA
Royal Flying Doctor Service **Mascot Senior Base Pilot** **Andrew Duma**	23 August 2016 1415 - Called 02 6269 5500 – Mellissa – providing phone number 02 8374 2400 Mascot Base. 1420 – Called 02 8374 2400 – left message.	TBA	TBA	TBA

Agency/Contact	Activity/Date	Response/Date	Issues Raised During Consultation	Action Proposed
Cootamundra Shire Council	23 August 2016	TBA	TBA	TBA
Delta Agribusiness	24 August 2016 1348 – Called 02 6226 2622 – Sam Bucknell	TBA	Mr Bucknell has been delivering Urea (Nitrogen) the last few days due to the ground being so wet. He advised that aerial agricultural application is the only option when the ground is wet. John Stokes Blaney Air Farms who've I've been delivering fertiliser to.	TBA
Hillstops Council **(operator of Young Airport)**	23 August 2016 Called – expect a call back. 11:20 – Received call back – Dirk Wymer (Director Infrastructure Services).	TBA	Mr Wymer advised Hilltops Council's procedure for tall structures outside of the aerodrome's OLS is refer people to CASA's document titled AC139-08, April 2005.	TBA
John Stokes **Blayney Air Farms (aerial agricultural pilot)**	24 August 2016 0429435403 1410 - 1425	NA	Mr Stokes provided comment, which may be summarised as follows: • the wind turbines are highly visible and are therefore not a significant issue, whereas the WMTs are arguably the most dangerous things to agricultural pilots;	Refer to discussion on obstacle lighting and marking in this report.

Agency/Contact	Activity/Date	Response/Date	Issues Raised During Consultation	Action Proposed
			• Turbulence from wind turbines with approximately five knots winds is manageable; • A lot of hard work goes into planning for 'jobs' around wind farms, requiring hazard advice from customers (farmers), who often 'forget' to advise the pilot of a new hazard (e.g. a WMT); and • A WMT in close proximity to a wind turbine may help to reduce the risk associated with the inability to judge where the WMT is located in order to avoid it, thus improve productivity.	
NSW Rural Fire Service **Development Assessment and Planning Officers, NSW – Peter Eccleston, Matthew Apps** **02 8741 5555** **csc@rfs.nsw.gov.au** **Keith Mackay - 0287415243**	Telecon, 23 August 2016 Called 02 8741 5243 – left message.	TBA	TBA	TBA

AVIATION PROJECTS

Agency/Contact	*Activity/Date*	*Response/Date*	*Issues Raised During Consultation*	*Action Proposed*
Yass Aerial Services **02 6227 6007**	24 August 2016 1500 – left message	TBA	TBA	TBA
Fred Fahey Aerial Services **Fred Fahey** **(02) 6342 9256** **0428 637 253**	24 August 2016 1512	TBA	When asked if Mr Fahey has time to talk about the Project, he expressed that he does not, he has gone through this process many times and providing comment would be a waste of time.	TBA
Yass Valley Council **02 6226 9234**	24 August 2016 1519 – Sue – Liz Makin – back in the office tomorrow.	TBA	TBA	TBA

5. AVIATION IMPACT STATEMENT

5.1. Obstacles

The list of wind turbines and wind monitoring towers (obstacles), showing coordinates and elevation data that are applicable to this Aviation Impact Statement (AIS) are provided in **Annexure 1**.

The wind turbine with the maximum height is turbine number 9, with a base elevation of 809 m AHD (2655 ft AMSL) and overall blade tip of 959 m AHD (2805 ft AMSL) (for 150 m AGL turbines) or 980 m AHD (3216 ft AMSL) (for 171 m AGL turbines).

A map of the Project layout, showing turbine 9, is provided at Figure 6.

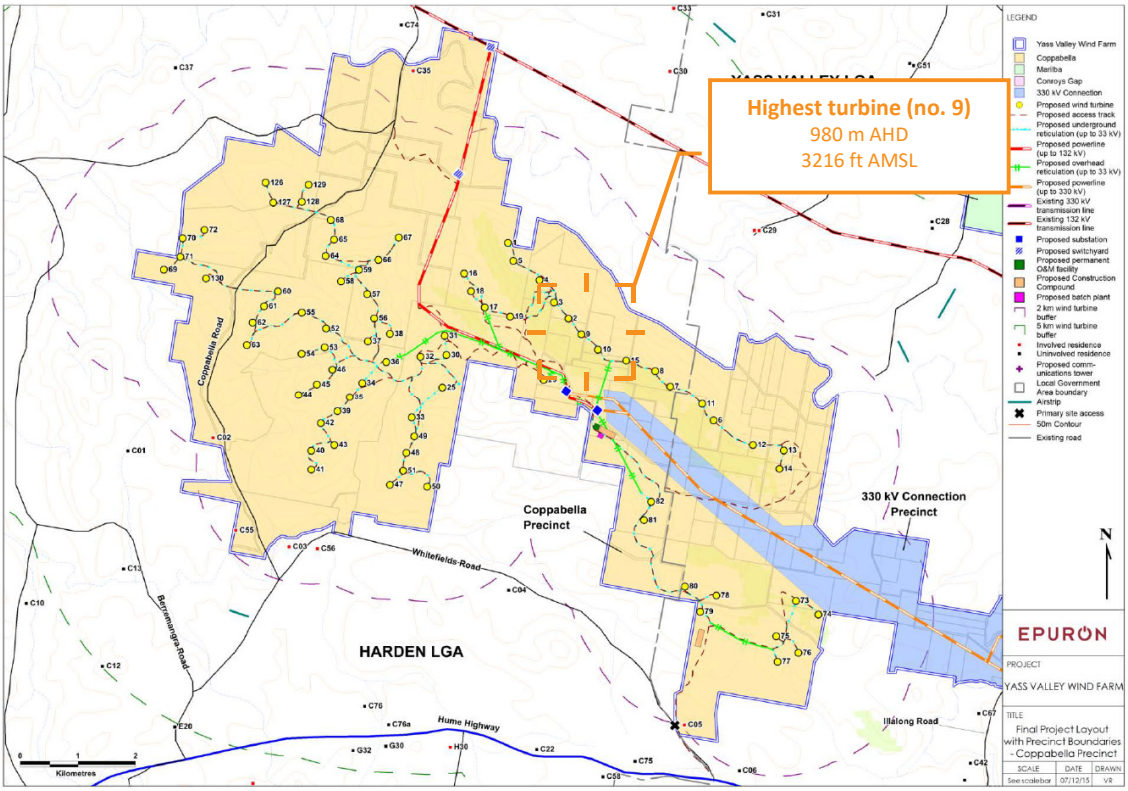

Figure 6 Project layout

5.2. Drawings

The 79 approved wind turbines overlayed on a 1:250 000 scale topographical base, extracted from OzRunways on 09 August 2016, is provided in Figure 7.

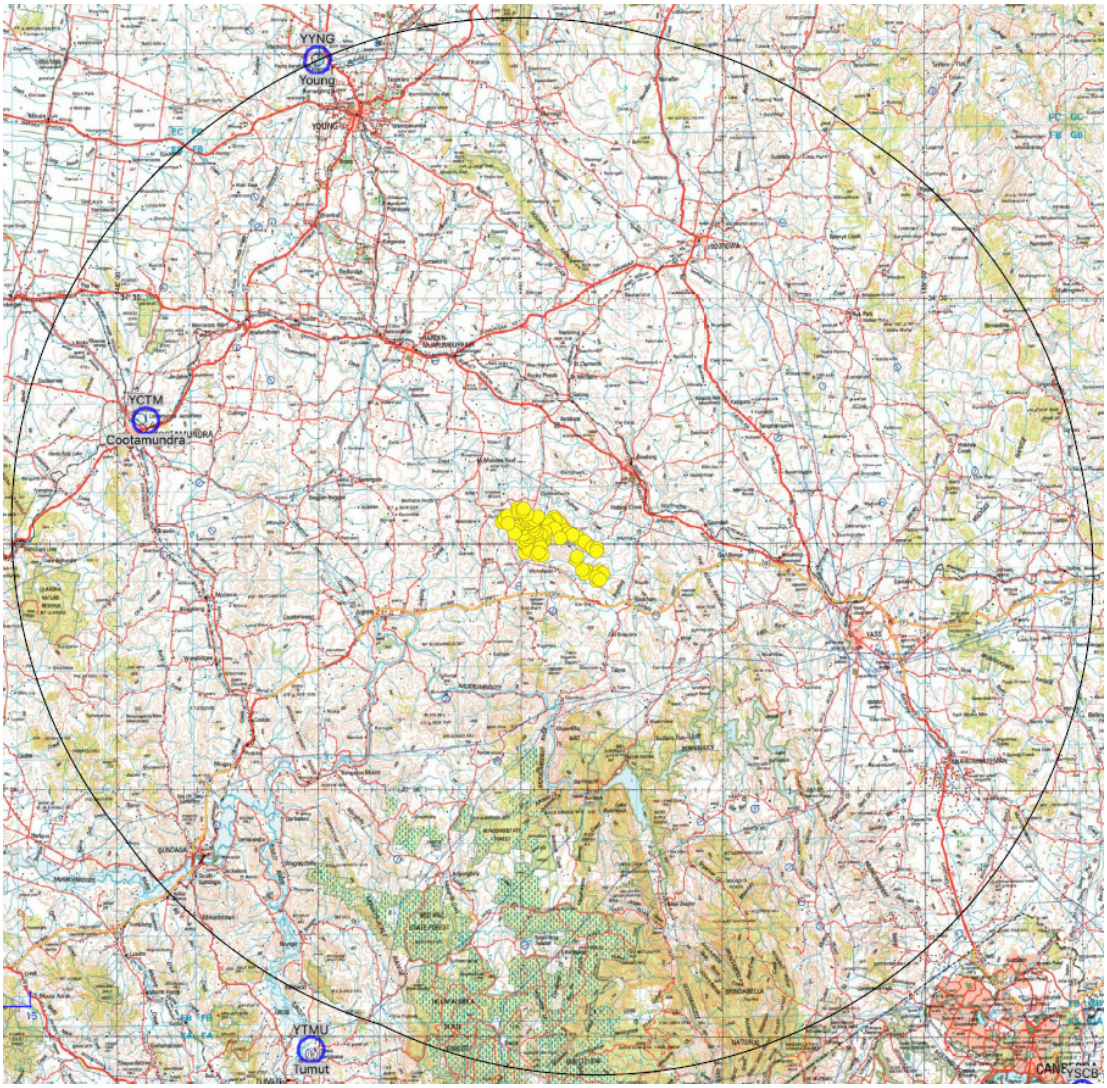

Figure 7 Topographical base 1:250 000 showing 30 nm buffer around approved turbines

5.3. Aerodromes

The aerodromes within 30 nm of the approved wind turbines are listed in Table 6. This table also provides the analysis of impacts on the aerodromes obstacle limitation surfaces (OLS) and procedures for air navigation services – air operations (PANS-OPS) surfaces, in the right-most column. The analysis is based on the standards provided in CASA's documents titled *Manual of Standards (MOS) Part 139 – Aerodromes* and *MOS Part 173 – Standards Applicable to Instrument Flight Procedure Design*.

The only impact found by this analysis is the Cootamundra 25 nm minimum safe altitude (MSA) surface 1000 ft minimum obstacle clearance (MOC), which is encroached by turbine number 9 by 4.6 m (16 ft). To address this encroachment, wind turbine 9 should be limited to a maximum overall blade tip height below 3200 ft AMSL (975.4 m AHD) or the 25 nm MSA at Cootamundra should be raised by 100 ft to 4300 ft AMSL (subject to consultation with Airservices Australia).

Table 6 Nearby aerodromes

Aerodrome	*Type*	*DAPs*	*ARP*	*Location from airport*	*OLS / PANS-OPS*
Cootamundra YCTM Operator: Cootamundra-Gundagai Regional Council	Registered Code 2 Instrument non-precision	RNAV-Z (GNSS) RWY 16 RNAV-Z (GNSS) RWY 34	**WGS84** 34°37'28" 148°02'09" **UTM zone 55** E 594953.18 N 6168115.53	**Closest turbine** No. 69 099° Magnetic 111° True 41.8 km 22.6 nm	**150 m AGL turbine** Not penetrated **171 m AGL turbine (No. 9 only)** Penetrates 25 nm MSA 1000 ft protection surface by 4.6 m (16 ft).
Young YYNG Operator: Young Shire Council	Registered Code 2 Instrument non-precision	RNAV-Z (GNSS) RWY 01 RNAV-Z (GNSS) RWY 19	**WGS84** 34°15'20" 148°14'53" **UTM zone 55** E 614912.29 N 6208803.32	**Closest turbine** No. 126 154° Magnetic 166° True 56.0 km 30.1 nm	Not penetrated by any turbine.

5.4. Radar and navigation facilities

Note that the potential impacts to navigation or radar facilities were not assessed, as they are being separately investigated and not within the scope of work.

5.5. Air routes and grid LSALT

Lowest Safe Altitudes (LSALTs) published in AIP must be clear of obstacles by 1000 ft. The Project is entirely located within a grid with a grid LSALT of 4600 ft AMSL. This grid LSALT will not be impacted by the Project.

The Project is located within the vicinity of the air routes listed in Table 7 and shown in Figure 8.

The Project will not have an impact on published air routes or grid LSALTs.

Table 7 Nearby air routes

Air route	*Sector*	*LSALT*	*Remark*
W497	ISNOL - WG VOR	4600	No impact
W569	ISNOL - UGVER	4600	No impact
W113	HAPPI – WG VOR	5500	No impact
H247	TOBOB - CULIN	7700	No impact
W332	ASUMU – CB VOR	5700	No impact

5.6. Airspace

The Project will be situated entirely inside uncontrolled, G class airspace. The lower limit of E class controlled airspace is 8500 ft AMSL (2590.8 m AHD) and will not be impacted. The Project is not located inside designated (danger, restricted or prohibited) airspace. Figure 8 shows airspace in the vicinity of the Project.

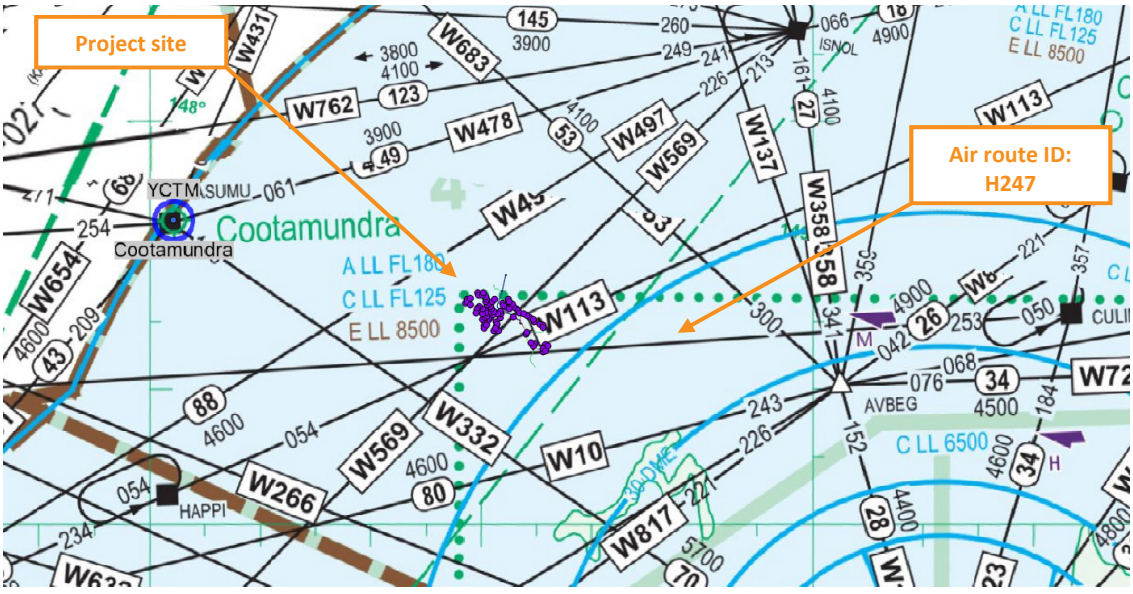

Figure 8 Air routes and airspace

6. AIRCRAFT OPERATOR CHARACTERISTICS

6.1. Passenger transport operations

Regular public transport (RPT) operations are only conducted at certified aerodromes. There are no certified aerodromes within 30 nm of the Project.

RPT and passenger carrying charter operations are generally operated under the Instrument Flight Rules (IFR). The Aviation Impact Statement provided in Section 5 addresses the matters associated with IFR aircraft operations.

6.2. Private operations

Private operations are generally conducted during day light hours or Visual Flight Rules (VFR) at night, and some under IFR. Flight under day VFR is conducted above 500 ft (152.4 m) above the highest point of the terrain within a 600 m radius (300 m for helicopters). It is expected that the wind turbines will be sufficiently visually conspicuous to pilots conducting VFR operations to enable appropriate obstacle avoidance manoeuvring if transiting the area of the Project.

Night VFR aircraft operations are required to conform to IFR applicable altitude requirements, which are addressed in Section 5.

6.3. Aerial application

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

6.3.1. Aerial Agriculture Association of Australia

In previous consultation with the Aerial Agriculture Association of Australia (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 also the operational stage, for pilots/aircraft operators during aircraft operations and discusses economic compensation. NASF Guideline D is included as Appendix 1, and AAAA Aerial Application Pilots Manual – excerpts on planning are provided as Appendix II.

6.3.2. Local aerial application operators

Local aerial application operators consulted in previous studies 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.

Consultation with local aerial application operators has been undertaken during preparation of the impact assessment. On 24 August 2016, Mr Stokes was contacted for consultation.

Mr Stokes stated that, he does not mind the wind turbines as they are highly visible and easy to judge how to avoid the towers. However, as an agricultural pilot, the wind monitoring towers are the most dangerous aspect of a wind farm.

Mr Stokes provides anecdotal advice that turbulence with approximately five knots winds is manageable.

Mr Stokes advised that he has to work hard to get the best spray coverage amongst wind farms, which includes flight planning and, prior to spraying, conducting 'reconnaissance' inspection flights. The planning stage includes asking the customer questions regarding potential hazards, such as powerlines, towers and other hazards. Sometimes the customer "forgets" to inform the pilot of a wind monitoring tower or powerline. In one incident, the customer forgot to mention a wind monitoring tower and, upon approaching to land in a paddock to refill the aircraft with fertiliser, a wind monitoring tower suddenly appeared in front of him.

As an example, a 40 ha area, with two WMTs with three WTGs next to them, about 30% of the area is planned to not be covered by aerial agriculture operations due to the uncertainty that results from the inability to judge the positioning of WMTs.

When asked if the proximity of a WMT to a wind turbine would make a difference to the hazard associated with WMT visibility, Mr Stokes suggested it may help to improve productivity because the

uncertainty in judging the location of WMT reduces and therefore more ground could be planned to be covered.

Mr Stokes stated that, with only four little red balls on the top of a WMT, little difference to visibility results.

[insert local aerial agricultural operators' response to this report].

Based on previous studies, and subject to 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 neighbouring the Project site, subject to final turbine locations, and subject to a case-by-case assessment and by following recommendations provided in this report.

For the flight planning of aerial application operators, details of the Project, including location and height information of wind turbines, wind monitoring towers and overhead powerlines should be provided to land owners so that, when asked for hazard information on their property, the land owner 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.

6.4. Aerial fire fighting

The Australasian Fire and Emergency Services Council (AFAC) developed a national position on wind turbines: *Wind Farms and Bush Fires Operations*, version 2.0, dated 30 October 2014.

Of specific interest in this document is the paragraph copied below:

> *Aerial fire fighting operations will treat turbine towers similar to other tall obstacles. Pilots and Air Operations Managers will assess these risks as part of routine procedures. Risks due to wake turbulence and the moving blades should also be considered. Wind turbines are not expected to pose unacceptable risks.*

6.5. Emergency services

6.5.1. Air Ambulance

[insert Air Ambulance response to this report]

6.5.2. Royal Flying Doctor Service

[insert RFDS response to this report]

7. HAZARD LIGHTING AND MARKING

7.1. Civil Aviation Safety Authority

In considering the need for aviation hazard lighting, the applicable regulatory context was determined and direct consultation with the Civil Aviation Safety Authority was undertaken.

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 Manuals of Standards (MOS) and other guidance material. Relevant provisions are outlined in further detail in the following section.

7.1.1. Civil Aviation Safety Regulations 1998, Part 139—*Aerodromes*

In areas remote from an aerodrome, CASR 139.365 requires the owner of a structure (or proponents of a structure) that will be 110 m or more above ground level to inform CASA. This is to allow CASA to assess the effect of the structure on aircraft operations and determine whether or not the structure will be hazardous to aircraft operations.

7.1.2. Manual of Standards Part 139—Aerodromes

Chapter 7 of MOS 139 sets out the standards applicable to Obstacle Restriction and Limitation. Section 7.1.5 deals with Objects Outside the OLS:

> *7.1.5.1 Under CASR Part 139 any object which extends to a height of 110 m or more above local ground level must be notified to CASA.*
>
> *Note: For instrument runways, obstacle monitoring includes the PANS-OPS surface which extends beyond the OLS of the aerodrome. See MOS 139 paragraph 7.1.1.*
>
> *7.1.5.2 Any object that extends to a height of 150 m or more above local ground level must be regarded as an obstacle unless it is assessed by CASA to be otherwise.*

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

Section 9.4.1 provides some general guidance on obstacle lighting:

> *9.4.1.2 In general, an object in the following situations would require to be provided with obstacle lighting unless CASA, in an aeronautical study, assesses it as being shielded by another lit object or that it is of no operational significance:*
>
> *(b) outside the obstacle limitation surfaces of an aerodrome, if the object is or will be more than 110 m above ground level.*

Section 9.4.2 provides guidance on Types of Obstacle Lighting and Their Use:

> *9.4.2.1 Three types of lights are used for lighting obstacles. These are low intensity, medium intensity and high intensity lights, or a combination of such lights.*
>
> *9.4.2.2 Low intensity obstacle lights are steady red lights and are to be used on non-extensive objects whose height above the surrounding ground is less than 45 m.*

Note: A group of trees or buildings is regarded as an extensive object.

9.4.2.3 Medium intensity obstacle lights are to be used either alone or in combination with low intensity lights, where:

(a) the object is an extensive one;

(b) the top of the object is 45 m or more above the surrounding ground; or

(c) CASA determines that early warning to pilots of the presence of the object is desirable.

9.4.2.4 There are three types of medium intensity obstacle lights:

(a) Flashing white light. Likely to be unsuitable for use in environmentally sensitive locations, and near built-up areas. May be used in lieu of obstacle markings during the day to indicate temporary obstacles in the vicinity of an aerodrome, for example construction cranes, etc. and are not to be used in other applications without specific CASA agreement.

(b) Flashing red light, also known as a hazard beacon. Is suitable for all applications, and is extensively used to mark terrain obstacles such as high ground.

(c) Steady red light. May be used where there is opposition to the use of a flashing red light, for example in environmentally sensitive locations.

9.4.2.5 High intensity obstacle lights are flashing white lights used on obstacles that are in excess of 150 m in height...

Section 9.4.3.4A provides guidance on obstacle lighting specific to wind farms:

9.4.3.4A In the case of a wind farm whose wind turbines must have obstacle lighting, medium intensity lights are to be installed as follows:

(a) if any part of the wind turbine, including the rotating blades, penetrates the obstacle limitation surface (OLS) of an aerodrome, top lights must mark the highest point reached by the rotating blades;

Note: Because it is not practicable to install obstacle lights at the tip of the blades, these lights may be located on a separate structure, adjacent to the wind turbine, at a height that corresponds to the highest point of the rotating blade of the turbine.

(b) if the rotating blades do not penetrate the OLS, the top lights must be placed on top of the generator housing;

(c) obstacle lights must be provided on a sufficient number of individual wind turbines to indicate the general definition and extent of the wind farm, with intervals between lit turbines not exceeding 900 m;

(d) all of the obstacle lights on a wind farm must be synchronised to flash simultaneously;

(e) the downward component of obstacle lighting may be shielded to the extent mentioned in either or both of the following sub-subparagraphs:

(i) so that no more than 5% of the nominal light intensity is emitted at or below 5° below horizontal;

(ii) so that no light is emitted at or below 10° below horizontal;

(f) to prevent obstacle light shielding by the rotating blades, 2 lights must be provided on top of the generator housing in a way that allows at least 1 of the lights to be seen from every angle in azimuth.

[Insert CASA response to this report]

7.1.3. Advisory Circular 139-08(0)—Reporting of Tall Structures

In Advisory Circular (AC) 139-08(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.

The RAAF Aeronautical Information Service (AIS) (recently changed to Airservices Australia) has been assigned the task of maintaining a database of tall structures, the top measurement of which is:

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

b) 45 metres or more above ground level elsewhere.

The purpose of notifying RAAF AIS (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.

As the proposed turbines will be located within 30 km of an aerodrome and will be higher than 30 m AGL, they must be reported to RAAF AIS (Airservices Australia). This action should occur once the final layout after micrositing is confirmed and prior to construction.

7.2. International Civil Aviation Organization

Australia, as a contracting State to the International Civil Aviation Organization (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 wind turbines, 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 obstacle limitation surfaces 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.*

7.3. Light characteristics

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

CASA recommended that low intensity obstacle lighting is installed on the wind turbines of the Project. However, In the absence of formal correspondence from CASA with respect to this risk assessment for providing the Project with obstacle lighting, a summary of generally accepted design characteristics (which reflects the provisions in the regulatory framework) is provided below:

- two flashing red medium intensity obstacle lights should be provided;
- the light fixtures should be mounted sufficiently above the surface of the nacelle so that the lights are not obscured by the rotor hub, and at a horizontal separation to ensure an unobstructed view of at least one of the lights by a pilot approaching from any direction; and
- the characteristics of the obstacle lights should be in accordance with the applicable standards in MOS 139.

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

- MOS 139 section 9.4.6 outlines Characteristics of Low Intensity Obstacle Lights.

9.4.6.1 Low intensity obstacle lights, for general applications, are to have the following characteristics:

(a) fixed lights showing red;

(b) a horizontal beam spread that results in 360° coverage around obstacle;

(c) a peak intensity of 100 cd minimum;

(d) a vertical beam spread (to 50% of peak intensity) of 10°;

(e) a vertical distribution with 100 cd minimum at +6° and +10° above the horizontal; and

(f) not less than 10 cd at all elevation angles between –3° and +90° above the horizontal.

Notes:

1. The intensity level is higher than ICAO standards because in Australia only obstacles assessed as significant to aircraft operations are required to be provided with obstacle lighting.

2. Currently the intensity requirement is normally met by a double-bodied light fitting which also provides a degree of redundancy.

3. Double-bodied light fittings should be orientated so that they show the maximum illuminated surface towards the predominant, or more critical, direction of aircraft approach.

4. For objects that do not infringe the obstacle limitation surfaces, and where CASA has not determined that obstacle lights are required, if the object owner wishes, of their own volition, to provide obstacle lights, it is sufficient for these low intensity obstacle lights to have the following intensity distribution: peak intensity 32 cd minimum, vertical beam spread of 10°, and 32 cd minimum at +6° and +10° elevation.

9.4.6.2 Low intensity obstacle lights, used to indicate taxiway obstacles or unserviceable areas of the movement area, are to have a peak intensity of 10 cd minimum.

MOS 139 section 9.4.7 outlines Characteristics of Medium Intensity Obstacle Lights.

9.4.7.1 Medium intensity obstacle lights are to be flashing or steady red lights or flashing white lights, visible in all directions in azimuth.

9.4.7.2 The frequency of flashes is to be between 20 and 60 flashes per minute.

9.4.7.3 The peak effective intensity is to be 2,000 ± 25% cd with a vertical distribution as follows:

(a) vertical beam spread is to be 3° minimum (beam spread is defined as the angle between two directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the peak intensity);

(b) at -1° elevation, the intensity is to be 50% minimum and 75% maximum of lower tolerance value of the peak intensity; and

(c) at 0° elevation, the intensity is to be 100% minimum of the lower tolerance value of the peak intensity.

9.4.7.4 Where the flashing white light is used in lieu of obstacle marking during the day to indicate temporary obstacles in the vicinity of an aerodrome, in accordance with Paragraph 9.4.2.4(a), the peak effective intensity is to be increased to 20,000 ± 25% cd when the background luminance is 50 cd/m² or greater.

MOS 139 Section 9.4.10 sets out the requirements for ongoing availability of obstacle lights:

9.4.10.4 For obstacles located outside the obstacle limitation surface area of an aerodrome, the owners of the lights need to establish a program to monitor the lights and report light failures. The reporting point for obstacle light failure is normally the nearest CASA office. When an obstacle light is unserviceable, the matter needs to be reported immediately to the relevant CASA office so that a NOTAM warning pilots of the light outage can be initiated.

To ensure the ongoing availability of obstacle lights (if required), a monitoring, reporting and maintenance program will need to be established in accordance with this guidance.

[insert Department of Defence response to this report]

With respect to the Department of Defence, consideration of potential aviation impacts is yet to be requested at the time of finalising this report. However, it is worth noting that, in previous responses by Defence during consultation for other proposed developments, it has requested that, if lighting is required and light emitting diode (LED) obstruction lighting is applied, the frequency range of LED lighting fall within the wavelength range of 655 to 930 nanometres, which will enable the lighting to be visible to persons using night vision devices.

Any subsequent correspondence received following preparation of this report will be considered by Aviation Projects and incorporated as applicable.

7.4. Visual impact of night lighting

Annex 14 Section 6.2.4 and MOS 139 9.4.3.4A are specifically intended for wind turbines 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;

- Where two lights are mounted on a nacelle, dynamic shielding or light extinction of one light at a time, for the period that a blade is passing in front of the light, is permissible, providing that at all times at least one light can be seen, without interruption, from every angle of azimuth;
- 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 conspicuity of the overall turbine.

Notwithstanding the general provisions for obstacle lighting applicable to wind farms that have been noted in ICAO Annex 14 and MOS 139, [insert CASA response to this report].

7.5. Marking of turbines

ICAO Annex 14 Vol 1 Section 6.4.2 recommends that the rotor blades, nacelle and upper 2/3 of the supporting mast of the wind turbines should be painted white, unless otherwise indicated by an aeronautical study.

It is generally accepted that 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.

7.6. Wind monitoring towers

There are no existing permanent wind monitoring towers at the Project site. There are at least two proposed wind monitoring towers with heights of up to 100 m AGL and a maximum height of 909 m AHD (based on the ground elevation of turbine 9 at a ground elevation of 809 m AHD. No obstacle lighting or marking is proposed for the towers.

Consideration could be given to marking any wind monitoring towers according to the requirements set out in MOS 139 Section 8.10 Obstacle Markings; specifically:

> *8.10.2.1 A structure must be marked when more than 150 m higher than the surrounding terrain. Surrounding terrain means the area within 400 m of the structure. Structures above 90 m may need to be marked, and inconspicuous structures 75 m above ground level should also be marked. Fixed objects on the aerodrome movement area, such as ILS buildings, must be marked as obstacles.*
>
> *8.10.2.6 Masts, poles and towers must be marked in contrasting bands with the darker colour at the top, as shown in Figure 8.10-3. The bands must be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less.*
>
> *8.10.2.8 Wires or cable obstacles must be marked using three-dimensional coloured objects such as spheres and pyramids, etc; of a size equivalent to a cube with 600 mm sides, spaced 30 m apart.*

NASF Guideline D suggests consideration of the following measures specific to the marking and lighting of wind monitoring towers:

- *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 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.*

7.7. Overhead power lines

The Project will be connected to an existing high voltage (132 kV) overhead powerline with proposed 132 kV powerlines as shown in Figure 9.

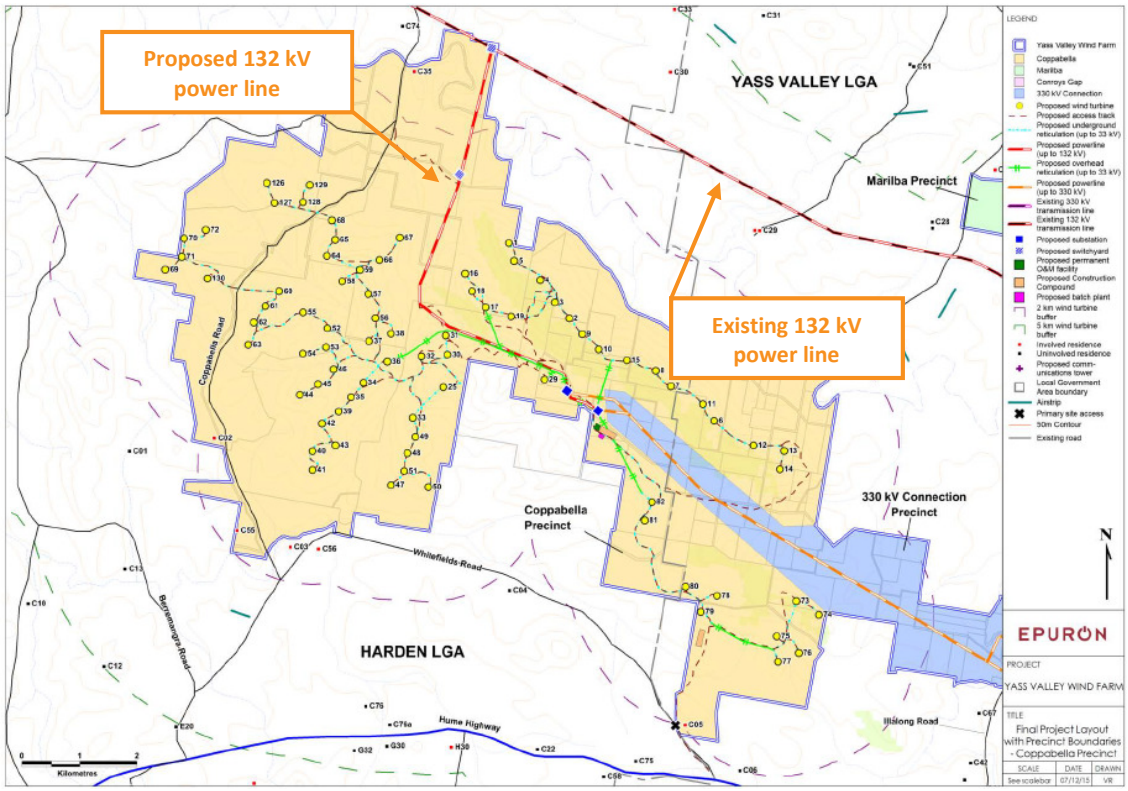

Figure 9 Proposed and existing 132 kV power lines

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.

Once the overhead power line route is determined (as per the Development Consent and in the infrastructure envelope in PDC Appendix 3), it is prudent to consider potential adverse impacts on aerial application operations. 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 agriculture operators and marked in accordance with MOS 139 Section 8.10 Obstacle Markings; specifically:

8.10.2.8 Wires or cable obstacles must be marked using three-dimensional coloured objects such as spheres and pyramids, etc; of a size equivalent to a cube with 600 mm sides, spaced 30 m apart.

7.8. Future regulatory requirements and guidance

The National Airports Safeguarding Advisory Group (NASAG), comprising of Commonwealth, State and Territory Government planning and transport officials, the Australian Government Department of Defence, the Civil Aviation Safety Authority (CASA), Airservices Australia and the Australian Local Government Association (ALGA), has developed the National Airports Safeguarding Framework (the Framework).

The National Airports Safeguarding Framework is a national land use planning framework that aims to:

- improve community amenity by minimising aircraft noise-sensitive developments near airports; and
- improve safety outcomes by ensuring aviation safety requirements are recognised in land use planning decisions through guidelines being adopted by jurisdictions on various safety-related issues.

Guideline D of the Framework deals with wind farm developments: *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms) / Wind Monitoring Towers.*

The Framework and any future development or amendment of regulations or guidance could potentially affect the requirement for lighting and/or applicable design specifications.

Consideration of the need for obstacle lighting and the final layout and design specification is therefore subject to confirmation of applicable regulatory requirements and guidance. This consideration, in the form of an updated aeronautical study (a detailed and thorough risk assessment using internationally recognised standards) as previously described, should occur once the final layout is known and prior to installation of the lights during construction.

8. ACCIDENT STATISTICS

8.1. General aviation operations

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

- Aerial work. This includes flying for the purposes of agriculture (spraying and spreading), mustering, search and rescue, fire control, or survey and photography;
- Flying training; and
- Private, business and sports aviation. Sports aviation includes gliding, parachute operations, ballooning, warbird operations, and acrobatics.

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 2006-2015

The Australian Transport Safety Bureau recently published a summary of aviation occurrence statistics for the period 2006 to 2015 (AR-2016-122) Final, 11 January 2017.

According to the report, there were no fatalities in high capacity RPT operations, two in low capacity RPT operations and 17 in charter operations during the period 2006-2015.

Of the 360 fatalities recorded in the 10-year period, almost two thirds (231 or 64.17%) occurred in the general aviation segment. On average, there were 1.5 fatalities per aircraft associated with a fatality in this segment. Other than aerial survey and photography (2:1) and private/business (1.725:1), the fatalities to aircraft ratio ranges from 1:1 to 1.5:1. 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 8 (source: ATSB).

Table 8 Number of fatalities by GA sub-category 2006 to 2016

Sub-category	*Aircraft assoc. with fatality*	*Fatalities*	*Fatalities to aircraft ratio*
Agriculture	16	16	1:1
Mustering	13	14	1.08:1
Search and rescue	2	2	1:1
Fire control	3	3	1:1
Survey and photography	8	16	2:1
Other aerial work	6	9	1.5:1
Flying training	8	11	1.375:1
Private/business	80	138	1.725:1
Sport aviation (excluding gliding)	5	5	1:1
Gliding	12	16	1.33:1
Totals	153	230	1.5:1

According to the ATSB report, the number of fatal accidents per million departures for GA aircraft over the 10-year reporting period ranged between 11.3 in 2012 and 5.9 in 2014. Refer to Figure 10 (source: ATSB).

Figure 15: General aviation accident and fatal accident rate (per million departures, VH-registered aircraft only), 2006 to 2014

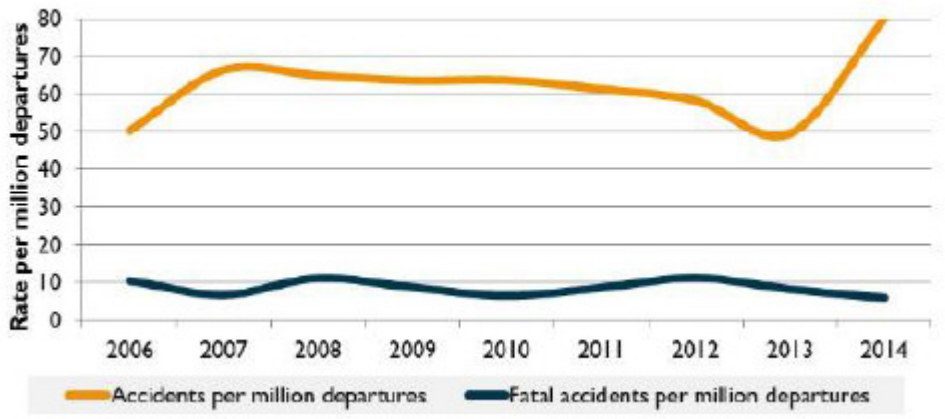

Figure 10 GA accident and fatal accident rate per million departures

In 2014, there were 11 fatal accidents and 19 fatalities involving GA aircraft, resulting in a rate of 5.9 fatal accidents per million departures and 9.3 fatal accidents per million hours flown.

In 2015, there were 1,849,000 departures, and 1,295,000 hours flown by VH-registered general aviation aircraft in Australia, with 13 fatal accidents and 15 fatalities. Based on these results, in 2015 there were 7.0 fatal accidents per million departures and 10.0 fatal accidents per million hours flown. A summary of fatal accidents in 2015 by GA sub-category is provided in Table 9 (source: ATSB).

Table 9 Fatal accidents by GA sub-category - 2015

Sub-category	*Fatal accidents*	*Fatalities*
Aerial work	3	3
Aerial agriculture	1	1
Aerial mustering	2	2
Search and rescue	0	0
Fire control	0	0
Survey and photography	0	0
Flying training	1	1
Private/business	5	7
Sports	1	1
Foreign registered	0	0
Totals	13	15

Over the 10-year period, there were 16,689,000 general aviation departures in Australia, during which time no aircraft collided with a wind turbine or a wind monitoring tower.

Of the 3,761 incidents and accidents in GA operations in the 10-year period, 994 (26.4%) were terrain collisions.

There is an underlying fatality rate for GA operations that is considered tolerable within Australia's regulatory and social context.

8.4. Worldwide accidents involving wind farms

To provide some perspective on the likelihood of a VFR aircraft colliding with a wind turbine, a summary of the four accidents that involved an aircraft colliding with a wind turbine, and the relevant factors applicable to this assessment, is incorporated in this section.

Global Wind Energy Council reports on its website there were 314,000 wind turbines operating around the world at the end of 2015.

Australia's Clean Energy Council reports on its website there were 2062 wind turbines in Australia at the end of 2015.

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.

Of the four known accidents, one was caused by 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 overhead a wind farm, and the aircraft struck a wind turbine on its descent. This accident is not applicable to the circumstances under consideration.

There have been two accidents involving collision with a wind turbine during the day.

Only one of these (Melle, Germany 2017) resulted in a single fatality, as the result of a collision with a wind turbine steel lattice mast at a very low altitude during the day with good visibility and no cloud. If the mast was solid and painted white, then it more than likely would have been more visible than if it was equipped with an obstacle light.

In the other case (Plouguin, France, 2008), the pilot decided to descend below cloud in an attempt to find the destination aerodrome. The aircraft was in conditions of significantly reduced horizontal visibility in fog where the top of the turbine was obscured by cloud. The turbines became visible too late for avoidance manoeuvring and the aircraft made contact with two turbines. The aircraft was damaged but landed safely.

In both cases, is difficult to conclude that obstacle lighting would have prevented the accident.

The other fatal accident occurred at night in IMC and is not applicable to the circumstances under consideration.

There is one other accident mentioned in a database compiled by an anti-wind farm lobby group, which suggests a Cessna 182 collided with a wind turbine 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, but suggests that the accident was caused by IFR 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 is made of wind turbines or a wind farm.

A summary of the four accidents is provided in Table 10.

Table 10 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 Day VFR?
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.
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 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	Not specified	No

ID	Description	Date	Location	Fatalities	Flight rules	Turbine height	Obstacle lighting	Cause of accident	Relevant to obstacle lighting Day VFR?
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.	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 Day VFR?
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	No

9. RISK ASSESSMENT

9.1. Risk criteria

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

The risk assessment framework used by Aviation Projects has been developed in consideration of AS/NZS ISO 31000:2009 *Risk management—Principles and guidelines* and the guidance provided by CASA in its 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 Standards and Recommended Practices (SARPs), and is therefore adopted as the primary reference for aviation safety risk management in the context of the subject assessment.

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

2.1.1 Within the context of aviation, safety is "the state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management."

9.2. Likelihood

Likelihood is defined in AS/NZS ISO 31 000:2009 as the chance of something happening. Likelihood descriptors used in this report are as indicated in Table 11.

Table 11 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)

9.3. 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 12.

Table 12 Consequence Descriptors

No	Descriptor	People Safety	Property	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.

9.4. Risk matrix

The risk matrix, which correlates likelihood and consequence to determine a level of risk, used in this report is shown in Table 13.

Table 13 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

9.5. Actions required

Actions required according to the derived level of risk are shown in Table 14.

Table 14 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.

9.6. Risk Identification

The primary risk being assessed is that of aviation safety. Based on an extensive review of occurrence data and input from stakeholders, the significant risks that are manifested by the Project have been identified for further assessment:

- there is potential for an aircraft to collide with a wind turbine (CFIT);
- there is potential for an aircraft to collide with a wind monitoring tower (CFIT);
- there is potential for a pilot to initiate manoeuvring in order to avoid colliding with a wind turbine or monitoring tower resulting in collision with terrain; and
- there is potential for the hazards associated with the Project to invoke operational limitations or procedures on operating crew.

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. 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 secondary risk being assessed is the visual impact that obstacle lights (if fitted) will have on the surrounding residents.

9.7. 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 a 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 wordwide accidents at Section 8.4.

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

Any object that extends to a height of 150 m or more above local ground level must be regarded as an obstacle unless it is assessed by CASA to be otherwise.

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 152.4 m (500 ft) 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 proposed turbines will be a maximum of 171 m AGL

(561 ft) at the top of the blade tip, so the rotor blade at its maximum height will be 18.6 m (61 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 RAAF AIS (Airservices Australia) so that the location and height of wind farms can be noted on aeronautical maps and charts.
- Because the turbines are above 110 m AGL, there is a statutory requirement to report the towers 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:

- Details of the Project should be communicated to local and regional aircraft operators prior to, during and following construction to heighten their awareness of its location and so that they can plan their operations accordingly. Specifically:
    - Engage with local aerial agricultural and aerial firefighting operators to develop procedures, which may include, for example, stopping the rotation of the wind turbine rotor blades prior to the commencement of the subject aircraft operations within the Project area
    - Arrangements should be made to publish details of the wind farm in ERSA for surrounding aerodromes

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. However, the Proponent may consider other factors in its decision as to whether obstacle lighting should be installed.	
Residual Risk	7 - Tolerable

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

Discussion

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

The Client advises there are at least two proposed wind monitoring towers at the Project site. The height of the wind monitoring towers will be 100 m AGL.

The WMT is on a maximum base elevation of 809 m AHD (overall tower height of 909 m AHD (2982 ft AMSL).

The WMT location and other applicable details of the proposed towers have not dbeen advised to RAAF AIS (Airservices Australia).

The WMTs are intended to be permanent.

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 agriculture operations conducted at night in the vicinity of the wind farm.

For objects at a height of 110 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.

Any object that extends to a height of 150 m or more above local ground level must be regarded as an obstacle unless it is assessed by CASA to be otherwise.

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 is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.

Untreated Likelihood	Possible

Current Treatments (without lighting)

- The proposed wind monitoring towers at the Project site will be up to 100 m AGL and do not require lighting. The locations and other applicable details have not been advised to RAAF AIS (Airservices Australia).
- The WMTs are intended to be permanent.
- 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 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas. The highest wind monitoring tower after construction may be

at a maximum height of 100 m (328 ft) AGL, so there will be at least 52.4 m (172 ft) vertical separation from 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 WMTs will be constructed from grey steel.

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.
- Although there is no obligation to do so, consideration could be given to marking any wind monitoring towers according to the requirements set out in MOS 139 Section 8.10 Obstacle Markings (as modified by the guidance in NASF Guideline D); specifically:
  8.10.2.6 Masts, poles and towers must be marked in contrasting bands with the darker colour at the top, as shown in Figure 8.10-3. The bands must be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less.
  8.10.2.8 Wires or cable obstacles must be marked using three-dimensional coloured objects such as spheres and pyramids, etc; of a size equivalent to a cube with 600 mm sides, spaced 30 m apart.
- 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.
- It should also be noted that, when the wind turbines are constructed, the existing wind monitoring tower and any proposed tower(s)) will be surrounded by wind turbines or within close proximity or wind turbines which are significantly more visible, and pilots should therefore be deterred from flying near the wind monitoring tower which will further reduce the likelihood of a collision.

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 6 – Manageable. 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, other than if the WMT exceeds 150 m AGL in height and is not in relatively close proximity to a wind turbine. 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 harsh 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.

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 AGL (500 ft) 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 proposed turbines will be a maximum of 171 m (561 ft) at the top of the blade tip, so the rotor blade at its maximum height will be 18.6 m (61 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 RAAF AIS (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 110 m ALG, 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 agricultural 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 on crew of limitations imposed by the wind farm

Discussion

Introduction or imposition of additional operating procedures or limitations can affect an aircraft's operating crew.

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

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

Consequence

The worst credible effect a wind farm could have on flight crew would be the imposition of operational limitations. 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 AGL (500 ft) 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 proposed turbines will be a maximum of 171 m (561 ft) at the top of the blade tip, so the rotor blade at its maximum height will be 18.6 m (61 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 RAAF AIS (Airservices Australia) so that the location and height of turbines can be noted on aeronautical maps and charts.

• Since the turbines will be higher than 110 m ALG, 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	Tolerable, 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 agricultural 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 surrounding residents

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 the wind turbines or WMT will be higher than 150 m AGL (492 ft), the wind turbines 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.

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.

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

If 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 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; and
- mitigating light glare from obstacle lighting through measures such as baffling.

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. If lighting is required, there are impact reduction measures that can be implemented to reduce the impact of lighting on surrounding neighbours. These measures are designed to optimise the benefit of the obstacle lights to pilots while minimising the visual impact to those on the ground.	
Residual Risk Not installing obstacle lights would clearly be an acceptable outcome to those affected by visual impact. Consideration of visual impact in the lighting design should enable installation of lighting that produces an acceptable impact to neighbours, which reduces the likelihood of a Moderate consequence to Possible – the event might occur at some time in the future, resulting in a risk level of 7 - Tolerable– Manageable. It is our assessment that visual impact from obstacle lights can be negated if they are not installed, but 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

9.8. Summary of risks

A summary of the level of risk associated with the proposed Kiata Wind Farm, under the proposed treatment regime, is provided in Table 15.

Table 15 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 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 following conclusions were made as a result of this assessment:

10.1. Consultation

An appropriate and justified level of consultation is being undertaken with relevant parties.

10.2. Aircraft operator characteristics

- Aircraft operate under the IFR and VFR in the vicinity of the Project site. Operations conducted in the vicinity include private, aerial application, firefighting and emergency operations.
- [insert RFS response to this report]
- [insert RFDS response to this report]
- [insert aerial agricultural response to this report]

10.3. Aviation Impact Statement

- At a maximum height with the GW140 model at 171 m AGL and wind turbine no. 9 at 980 m AHD (3216 ft AMSL), only one impact was found, which is that wind turbine 9 will infringe the 1000 ft minimum obstacle clearance (MOC) for the 25 nm minimum safe altitude (MSA) of (4200 ft AMSL) at Cootamundra Airport by 4.6 m (16 ft). This impact may be mitigated through micrositing or detailed design of the site levels.

10.4. Hazard lighting and marking

- With respect to MOS 139 7.1.5.1, the proposed wind turbines must be reported to CASA if they will be higher 110 m AGL. With respect to MOS 139 7.1.5.2, the wind turbines must be regarded as an obstacles if they are higher than 150 m AGL, unless CASA assesses otherwise.
- There are no existing wind monitoring towers on the Project site. At least two proposed wind monitoring towers ('Coppabella 1' and 'Coppabella 2') will have tip heights of up to 100 m AGL and are proposed to not have obstacle lighting or marking.
- With respect to MOS 139 9.4.1.2 (b), the wind turbines will need to be lit if they are higher than 110 m AGL, unless an aeronautical study assesses they are of no operational significance.
- **Aviation Projects assesses 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.**
- [Insert CASA response to this report]
- If required to be installed, obstacle lights should be designed according to the criteria set out in the applicable regulatory material. A summary of design characteristics for obstacle lighting, if obstacle lighting is required, is provided below:

  - Development Consent, Schedule 3 condition 4(b) states that the Applicant shall ensure that any aviation hazard lighting complies with CASA's requirements;
  - ICAO Annex 14 Volume 1 paragraph 6.2.4.3 provides a recommendation, MOS 139 section 9.4.3.4A provides a standard, and NASF Guideline D provides guidance for a wind turbine of a wind farm, if lighting is required, to be fitted with medium intensity obstacle lighting;
  - two obstacle lights should be provided;
  - the light fixtures should be mounted sufficiently above the surface of the nacelle so that the lights are not obscured by the rotor hub, and at a horizontal separation to ensure an unobstructed view of at least one of the lights by a pilot approaching from any direction;
  - if flashing obstacle lighting is provided, both lights should flash simultaneously; and
  - the characteristics of the obstacle lights should be in accordance with the applicable standards in MOS 139 (note that MOS 139 Section 9.4.3.4A addresses obstacle lighting for wind turbines); and

- To ensure the ongoing availability of obstacle lights (if required), and in support of satisfying Development Consent, Schedule 3 condition 34(b), a monitoring, reporting and maintenance program will need to be established in accordance with the guidance in MOS 139 Section 9.4.10.
- With respect to marking of turbines, it is generally accepted that 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.
- The location, height and other applicable details of the proposed wind monitoring towers have not yet been advised to RAAF AIS. It is not proposed that the wind monitoring towers be lit but it is proposed that markings may be applied.
- There is no regulatory requirement to mark or light power poles or overhead transmission lines. The power poles will have a height of approximately 35 m AGL. Project overhead transmission lines may impact on aerial application operations. However, the proposed power line is expected not to adversely impact on aircraft operations as it will be contained within the Project site boundary and will only connect the wind farm substation to the 132 kV power line.
- With respect to the Department of Defence, response to a request for consideration of potential aviation impacts is yet to be received at the time of finalising this report. However, it is worth noting that, in previous responses by Department of Defence during consultation for other proposed developments, Department of Defence has requested that, if lighting is required and light emitting diode (LED) obstruction lighting is applied, the frequency range of LED lighting fall within the wavelength range of 655 to 930 nanometres, which will enable the lighting to be visible to persons using night vision devices. Subsequent correspondence received following the finalising of this report will be considered by Aviation Projects and addressed as necessary.
- Insert Department of Defence response to this report]

10.5. Risk assessment

A summary of risks associated with the Project, under the proposed treatment regime, is provided in Table 16.

Table 16 Summary of risk assessment

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 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

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

Notification and reporting

1. Final (approved) wind turbine coordinates and elevations (after micrositing) should be provided to RAAF AIS in accordance with AC 139-08(0) *Reporting of Tall Structures*.
2. Any obstacles above 110 m AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents.
3. The location of wind turbines, monitoring towers and powerlines should be made available to RFS, RFDS, aerial agriculture operators and land owners so they are able to provide this information to aerial application pilots when requested for flight planning purposes.

Marking of turbines

4. The rotor blades, nacelle and the supporting mast of the wind turbines should be painted white.

Lighting of turbines

5. Aviation Projects has assessed that the Project will not require obstacle lighting to maintain an acceptable level of aviation safety.
6. The Client should limit the overall blade tip height to a maximum of 975.4 m AHD so that the PANS-OPS surface associated with the 25 nm MSA at Cootamundra Airport is not infringed.
7. Aviation Projects has assessed that obstacle lighting will not be required to maintain an acceptable level of aviation safety. However:
    a. If obstacle lighting was required (for example, as a requirement of the responsible authority), the lighting should have the following characteristics:
        1. obstacle lighting should be designed in accordance with the characteristics specified in ICAO Annex 14 Vol 1 Chapter 6 (note that Section 6.2.4 addresses obstacle marking and lighting of wind turbines) and MOS 139 Chapter 9 (note that Section 9.4.3.4A addresses obstacle lighting for a wind farm), while minimising visual impact;
        2. [Insert Department of Defence response to this report]; and
        3. the Client may consider other factors in its decision as to whether obstacle lights should be installed.
    b. To ensure the ongoing operation and availability of obstacle lights (if required) at night and during times of reduced visibility, a monitoring, reporting and maintenance program should be established in accordance with the guidance in MOS 139 Section 9.4.10.

Marking of wind monitoring towers

8. Consideration should be given to marking any wind monitoring towers according to the requirements set out in MOS 139 Section 8.10 (as modified by the guidance in NASF Guideline D).

Marking of overhead transmission lines and poles

9. 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 agriculture operators and marked in accordance with MOS 139 Section 8.10.2.8. Note that the new transmission lines that are proposed will not adversely affect aircraft operations.

Triggers for review

10. Triggers for review of this risk assessment and obstacle lighting design are provided for consideration:

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

    b. following any significant changes to the context in which the assessment was prepared, which are not expected to occur within the next 12 months, including the regulatory framework; and

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

ANNEXURES

1. Turbine and WMT Coordinates and ground elevations

ANNEXURE 1 – TURBINE AND WMT COORDINATES AND GROUND ELEVATIONS

Source: *Excel file 09062017_WTGElevations_0024.xlsx*, updated WTG elevations from the latest contour survey, received 31 August 2017.

Turbine ID	*Eastings (m) WGS84 zone 55s*	*Northings (m) WGS84 zone 55s*	*Ground elevation m AHD*	*Tip height m AHD (GW140 171 m AGL)*	*Comments*
1	641,135	6,156,615	657.3	828.3	
2	642,183	6,155,309	793.7	964.7	
3	641,934	6,155,584	760.9	931.9	
4	641,683	6,155,973	677.8	848.8	
5	641,228	6,156,306	657.6	828.6	
6	644,704	6,153,528	698.3	869.3	
7	643,949	6,154,128	727	898.0	
8	643,690	6,154,400	695.7	866.7	
9	642,410	6,155,033	809.1	980.1	
10	642,697	6,154,767	762.9	933.9	
11	644,507	6,153,820	700.3	871.3	
12	645,386	6,153,102	623.4	794.4	
13	645,920	6,153,005	608	779.0	
14	645,844	6,152,689	613.9	784.9	
15	643,186	6,154,579	761.7	932.7	
16	640,374	6,156,085	594	765.0	
17	640,731	6,155,502	632.7	803.7	
18	640,494	6,155,780	635.2	806.2	
19	641,174	6,155,340	649.8	820.8	
25	639,997	6,154,114	777.1	948.1	
29	641,753	6,154,245	654	825.0	
30	640,070	6,154,676	674.7	845.7	
31	640,038	6,155,010	632.4	803.4	
32	639,618	6,154,648	670.4	841.4	

Turbine ID	Eastings (m) WGS84 zone 55s	Northings (m) WGS84 zone 55s	Ground elevation m AHD	Tip height m AHD (GW140 171 m AGL)	Comments
33	639,464	6,153,582	688.2	859.2	
34	638,607	6,154,188	708.1	879.1	
35	638,391	6,153,940	706	877.0	
36	639,022	6,154,556	663.9	834.9	
37	638,704	6,154,914	642	813.0	
38	639,088	6,155,044	704	875.0	
39	638,176	6,153,691	658.9	829.9	
40	637,724	6,153,002	597.2	768.2	
41	637,724	6,152,676	552.2	723.2	
42	637,890	6,153,483	635.8	806.8	
43	638,123	6,153,103	575.4	746.4	
44	637,501	6,153,978	594.3	765.3	
45	637,821	6,154,164	566.3	737.3	
46	638,091	6,154,423	586.7	757.7	
47	639,088	6,152,412	559.6	730.6	
48	639,374	6,152,965	557.8	728.8	
49	639,508	6,153,251	606.5	777.5	
50	639,733	6,152,377	666.1	837.1	
51	639,315	6,152,655	698.1	869.1	
52	637,982	6,155,133	678.3	849.3	
53	637,955	6,154,807	544	715.0	
54	637,553	6,154,697	604.5	775.5	
55	637,558	6,155,411	659.8	830.8	
56	638,814	6,155,310	579.8	750.8	Location Error in Consent
57	638,692	6,155,728	577.3	748.3	
58	638,239	6,155,953	631.5	802.5	
59	638,546	6,156,147	685	856.0	

Turbine ID	Eastings (m) WGS84 zone 55s	Northings (m) WGS84 zone 55s	Ground elevation m AHD	Tip height m AHD (GW140 171 m AGL)	Comments
60	637,143	6,155,777	648.8	819.8	
61	636,904	6,155,521	576.4	747.4	
62	636,707	6,155,235	650.1	821.1	
63	636,604	6,154,848	700.6	871.6	
64	637,973	6,156,390	665.9	836.9	
65	638,118	6,156,671	666.3	837.3	
66	638,884	6,156,320	526.1	697.1	
67	639,241	6,156,706	582.5	753.5	
68	638,060	6,157,008	597.6	768.6	
69	635,163	6,156,152	586.5	757.5	
70	635,491	6,156,697	595.9	766.9	
71	635,449	6,156,374	556.6	727.6	
72	635,867	6,156,842	596.1	767.1	
73	646,131	6,150,401	504.3	675.3	
74	646,521	6,150,162	506.7	677.7	
75	645,789	6,149,787	466.4	637.4	
76	646,174	6,149,496	453.7	624.7	
77	645,814	6,149,346	469.8	640.8	
78	644,751	6,150,491	452	623.0	
79	644,471	6,150,212	644.8	815.8	
80	644,204	6,150,650	653.2	824.2	
81	643,496	6,151,799	583.5	754.5	
82	643,622	6,152,119	592.3	763.3	
126	636,929	6,157,657	464.5	635.5	
127	637,065	6,157,311	482.9	653.9	
128	637,560	6,157,324	451.6	622.6	
129	637,674	6,157,619	468.1	639.1	
130	635,896	6,156,000	564	735.0	

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