GoldenPlains WIND FARM MANAGEMENT PTY LTD

Golden Plains Wind Farm

Appendix C.1: Aviation Impact Assessment

FINAL REPORT

GOLDEN PLAINS WIND FARM

AVIATION ADVICE

AMENDMENT OF PLANNING PERMIT

215 TURBINE LAYOUT

AND

INCREASED ROTOR DIAMETER

TO 165M

CCP02(09)

Report to:

GoldenPlains
WIND FARM MANAGEMENT PTY LTD

19 November 2020
V3.0

Chiron Aviation Consultants
Essendon Vic 3040
Australia

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EXECUTIVE SUMMARY

Golden Plains Wind Farm Management Pty Ltd is seeking to amend the Victorian Planning Permit #PA1700266 for the Golden Plains Wind Farm. The amendments include a revised turbine layout accommodating 215 turbines within the same boundary and increasing the maximum turbine rotor diameter from 150 to 165m.

The aviation related information used in the EES and as the basis for the planning permit conditions is provided by the Aeronautical Impact Assessment (AIA) undertaken by Chiron Aviation Consultants. The AIA report is titled *Final Report, Golden Plains Wind Farm Aviation Impact Statement, Qualitative Risk Assessment and Obstacle Lighting Review, Chiron Aviation Consultants, 20 April 2018.*

The conclusions of an AIA are valid for a particular volume of airspace, derived from the maximum turbine tip height and the distance of the boundary from regulated aerodromes. If the boundary or the tip height do not increase, then the volume of airspace occupied does not increase, consequently the conclusions of the AIA remain valid.

The proposed 215 turbine layout and turbine specifications retain the maximum permitted turbine tip height of 230m Above Ground Level (AGL) (condition 1 b i) and remains within the permitted boundary, therefore the volume of airspace occupied is within that assessed in the AIA. The conclusions of the AIA (228 turbine) remain valid for the 215 turbine Golden Plains Wind Farm layout.

Aviation obstacle lighting is not required.

Revising the turbine layout and increasing the maximum turbine rotor diameter has no impact on the existing operations of the airstrip at 1944 Wingeel Road, Barunah Park since the turbine rotor disk remains beyond the suggest maximum obstacle free area outlined in Civil Aviation Advisory Publication 139-1(1) *Guidelines for Aeroplane Landing Areas.*

The proposed changes to the Golden Plains Wind Farm layout and turbine specifications have no impact on the Aeronautical Impact Assessment or the continued operation of the airstrip at 1944 Wingeel Road.

1. INTRODUCTION

Golden Plains Wind Farm Management Pty Ltd has requested Chiron Aviation Consultants undertake an assessment of a revised Golden Plains Wind Farm (GPWF) layout comprising 215 wind turbine generators (WTG) with a 165m rotor diameter. This assessment of the revised layout is a comparison of the proposed 215 WTG layout and 165m rotor diameter with the impacts assessed under the Environmental Effects Statement (EES) with reference to the relevant conditions in the Victorian Planning Permit #PA1700266.

Chiron Aviation Consultants have provided various expert advice on the Golden Plains Wind Farm project, including:

- Peer review of Aviation report presented as part of the EES
- Aviation Safety Assessment of the airstrip at 1944 Wingeel Road, Barunah Park
- Assessment of the WTG layout presented in the Development Plans.

1.1 Planning Permit

The Golden Plains Wind Farm is approved by the Victorian Planning Permit #PA1700266 dated 29 April 2019. This permit requires several aviation related conditions to be met.

1.1.1 Permit Condition 1 b

A maximum of up to 228 turbines (reduced as required to comply with condition 1 (c)) with the following specifications

I. Maximum blade tip height of 230 metres above ground level

II. Minimum blade tip clearance from ground level of no less than 40m

III. Maximum rotor diameter of up to 150 metres

1.1.2 Permit Condition 1i

No aviation safety lighting on any turbine.

1.1.3 Permit Condition 75

Prior to turbines GP 227, 231 and GP 229 being constructed, an aircraft safety assessment prepared by a suitably qualified person must be submitted which demonstrates that the existing operations from the airstrip at 1944 Wingeel Road, Barunah Park will be able to continue safely without significant impact from the turbines, to the satisfaction of

the responsible authority, unless an alternative arrangement is agreed between the parties to the satisfaction of the responsible authority.

1.1.4 Permit Condition 76

Copies of the development plans, endorsed under condition 1 to be provided to the following entities within 30 days after being endorsed:

a. *CASA*

b. *The Department of Defence (RAAF Aeronautical Information Service)*

c. *Airservices Australia*

d. *Any aerodrome operator within 30km of the external property boundaries of the site*

e. *Flying training organisations at Ballarat, Bacchus Marsh, Point Cook and Lethbridge aerodromes*

f. *The Aerial Agricultural Association of Australasia*

g. *Any organisation responsible for providing aerial firefighting, air ambulance and search and rescue in the area (e.g. Victoria Police Air Wing, Country Fire Authority, Rural Ambulance Victoria)*

h. *Local aerial agricultural applications operators*

1.1.5 Permit Condition 77

The notification required under condition 76(a) to (c) must utilise the procedures and forms referred to in Civil Aviation Safety Authority Advisory Circular AC 139-08 (v2) Reporting of tall structures and hazardous plume sources dated March 2018

1.1.6 Permit Condition 78

Obstacle marking on meteorological masts is to be provided in accordance with Section 39 of the (NASF) Guideline D

1.1.7 Permit Condition 79

Before development starts an Aviation Impact Statement based upon the approved detailed design is to be provided to Airservices Australia and the Department of Defence (RAAF Aeronautical Information Service).

2. QUALIFICATIONS

The author's area of expertise is airspace and air traffic management. He holds a Diploma of Aviation – Air Traffic Control and has expertise in aircraft performance as well as in aircraft maintenance planning. Through these activities the author has an extensive knowledge of aviation regulations.

The author has undertaken Aeronautical Impact and Qualitative Risk Assessments and Obstacle Lighting Reviews for Wind Farm projects in Victoria, New South Wales, South Australia and Western Australia. These have included investigations into the impact of wind farms on the operation of Aeroplane Landing Areas and the use of aerial agricultural applications activity. Additionally, the author has undertaken performance assessments of aircraft types suitable for operations at large airports, including the Dili International Airport in Timor Leste. A common requirement of all these activities is a thorough knowledge of aviation legislation and regulations and the ability to apply them to the task at hand. As an Air Traffic Services Senior Instructor, the author has taught "air legislation" (rules and regulations) and "basic aero knowledge" (how aeroplanes fly) as well as other subjects common to both pilot and air traffic controller training.

3. CONTEXT

Golden Plains Wind Farm Management Pty Ltd is seeking an amendment to the current planning permit for an amended turbine layout as well as an increased rotor diameter.

The Golden Plains Wind Farm is approved by the Victorian Planning Permit #PA1700266 dated 29 April 2019. The aviation related conditions are informed by the information provided in the Environmental Effects Statement (EES). The aviation related information in the EES is provided by the Aeronautical Impact Assessment (AIA) undertaken by Chiron Aviation Consultants. The AIA report is titled *Final Report, Golden Plains Wind Farm Aviation Impact Statement, Qualitative Risk Assessment and Obstacle Lighting Review, Chiron Aviation Consultants, 20 April 2018.* This report will be referred to as the AIA.

The AIA comprises an *Aviation Impact Statement (AIS),* a *Qualitative Risk Assessment (QRA)* and an *Obstacle Lighting Review (OLR).*

The AIS section is submitted to Airservices Australia and the Department of Defence, Estate and Infrastructure Group, for their assessment of any likely impact the wind farm may have on:

- Certified and Registered Aerodromes (now known as Regulated Aerodromes[1]) and Military Aerodromes within 30nm (56km) of the development boundary
  - Published instrument approach procedures
  - Obstacle Limitation Surfaces (OLS) airspace
  - Procedures for Air Navigation – Aircraft Operations (PANS-OPS) airspace

[1] Civil Aviation Safety Regulations Part 139 *Aerodromes* were amended 13 August 2020

- Published Air Routes over or near the wind farm
- Airspace classification of the airspace surrounding the development – for example published Prohibited, Restricted or Danger Area (PRD) airspace
- Aviation Communications, Navigation and Surveillance (CNS) facilities.

The QRA identified and assessed potential aviation risk elements, including

- On the operation of aerodromes within the immediate vicinity
- Perceived impacts on aviation activity including flying training, emergency services operations, aerial applications, and aerial firefighting
- Assessment of other issues as identified through stakeholder consultations.

From this, conclusions were drawn as to the degree of aviation risk posed by the development and any commensurate recommendations for mitigating actions.

The OLR reviews the outcomes of the AIS and QRA to determine the need or otherwise for risk mitigation by lighting of turbines in the wind farm with aviation obstacle lighting.

The AIA considers the Golden Plains Wind Farm as a volume of airspace defined by the area within the lateral boundary of the project and the height, above the Australian Height Datum (AHD), of the tip of the tallest turbine.

3.1 AIA Conclusions – 228 WTG

The AIA, as submitted concluded that the GPWF

- Is not a hazard to aircraft safety
- Aviation obstacle lighting is not required

Additionally, the AIA concluded that the GPWF will not impact upon the following

- The OLS and PANS-OPS surfaces of Ballarat and Avalon aerodromes
- The LSALT for published air routes in the vicinity
- The performance of Navigation Aids and Communications facilities
- The performance of any surveillance radar facilities.

The permit conditions were derived from this AIA.

4. AVIATION ANALYSIS OF 215 TURBINE LAYOUT

The conclusions of the AIA will remain valid if the volume of airspace occupied by the GPWF does not increase. The airspace volume will only increase if the area defined by the lateral boundary increases and/or the height of the tallest turbine increases. In the case of the 215 WTG GPWF, which is contained within the project boundary, a decrease in the volume of airspace occupied will have no impact on the conclusions of the AIA.

The 215 WTG layout turbine numbering system is different to that used in the EES and AIA.

The turbine locations remain contained within the same area of the site.

4.1 Increased Rotor Diameter

It is proposed to amend Permit Condition 1 b iii "*Maximum rotor diameter of up to 150 metres.*" The amendment seeks to increase the turbine rotor diameter to a maximum of 165m.

Permit conditions 1 b i and ii will be met, therefore

- the maximum turbine tip height will remain at a maximum of 230m AGL and
- the minimum blade tip clearance will remain at no less than 40m from ground level.

The increased rotor diameter does not increase the turbine tip height of 230m AGL.

4.2 GPWF Height

The proposed 215 WTG layout will meet Permit Condition 1 b (1) in that the maximum blade tip height of 230m AGL will be retained.

The tallest turbine is WTG041 with a tip height of 436.7m above the Australian height Datum (AHD). This equates to a tip height of 1432.74ft AHD. To obtain the Lowest Safe Altitude (LSALT) over the GPWF, a Minimum Obstacle Clearance (MOC) of 1000ft is added to give 2432.74ft AHD. This is rounded up to the nearest hundred feet and gives a LSALT of 2500ft.

The tallest turbine tip in the 228 WTG layout was GP020 at 434.1m AHD. As detailed in section 4.3 of the AIA the maximum tip height was 1424.21ft, giving a LSALT of 2500ft.

Therefore, the permitted maximum tip height does not change the LSALT, which is the height used to calculate the volume of the GPWF.

4.3 GPWF Area

The turbines of the 215 WTG layout occupy an area that is within the area of the AIA as used in the EES. The 215 WTG layout remains within the area defined by the lateral boundary of that permitted in the Victorian Planning Permit #PA1700266.

Therefore, the permitted area has not increased.

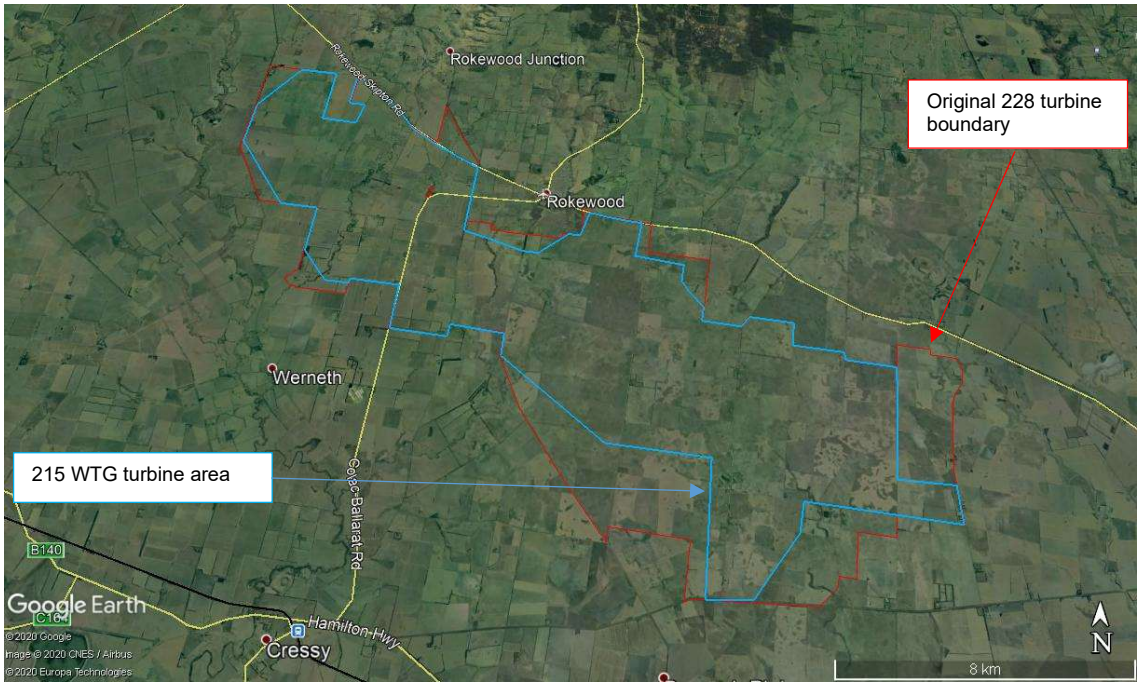

Figure 1 – Original vs 215 turbine project area

4.4 GPWF Volume

Given that the area of the 215 WTG layout is within the area permitted and the maximum tip height remains at 230m AGL, the volume of airspace occupied by the proposed 215 turbine GPWF is within that assessed in the AIA.

Therefore, the permitted volume has not increased.

4.5 AIA Conclusions - 215 WTG

As demonstrated above, the permitted volume of the GPWF has not increased, consequently the conclusions of the AIA remain valid.

Therefore, the 215 WTG layout GPWF:

- Is not a hazard to aircraft safety, and
- Aviation obstacle lighting is not required.

Additionally, the 215 WTG layout GPWF will not impact upon the following:

- The OLS and PANS-OPS surfaces of Ballarat and Avalon aerodromes,
- The LSALT for published air routes in the vicinity,
- The performance of Navigation Aids and Communications facilities, and
- The performance of any surveillance radar facilities.

Since the AIA conclusions remain valid for the 215 WTG GPWF layout, that is, aviation obstacle lighting is not required, Permit Condition 1(i) *No aviation safety lighting on any turbine* is met.

5. PERMIT CONDITION 79

This condition states:

> *Before development starts an Aviation Impact Statement based upon the approved detailed design is to be provided to Airservices Australia and the Department of Defence (RAAF Aeronautical Information Service).*

An Aviation Impact Statement (AIS) has been submitted and assessed by Airservices Australia and the Department of Defence, Estate and Infrastructure Group.

It must be understood that the Department of Defence, Estate and Infrastructure Group, not the RAAF Aeronautical Information Service is the authority responsible for assessing AIS.

Given that the volume of airspace occupied by the proposed 215 turbine GPWF is within that assessed in the AIA, which includes the AIS, then the conclusions of the AIS remain valid.

The assessment from Airservices Australia found that the GPWF did not affect:

- Any sector or circling altitude
- Any instrument approach or departures procedure at any airport in the vicinity
- Any overlying air routes
- The performance of any precision/non precision navaids, HF/VHF Comms, A_SMGCS, Radar, PRM, ADS-B or Satellite links. (CNS)

The Department of Defence, Estate and Infrastructure Group assessment raised no objections to the GPWF.

There is no requirement to submit another AIS unless the *approved detailed design* increases the volume of airspace occupied by the GPWF.

It should be noted that Airservices Australia and the Department of Defence, Estate and Infrastructure Group are the appropriate authorities to receive and assess an Aviation Impact Statement. Therefore, submission of the original AIS to Airservices Australia and the Department of Defence, Estate and Infrastructure Group meets the requirements of Permit Condition 79.

Notification for the purposes of inclusion on the Vertical Obstacle Database, including notification to RAAF Aeronautical Information Service is achieved by permit condition 77.

6. INCREASED ROTOR DIAMETER

Permit Condition 1 b iii stipulates a "*Maximum rotor diameter of up to 150 metres."*

It is proposed to amend this condition to a maximum rotor diameter of 165 metres.

The increased rotor diameter will remain within the constraints of permit conditions

- 1 b i the maximum turbine tip height will remain at a maximum of 230m AGL and
- 1 b ii the minimum blade tip clearance will remain at no less than 40m from ground level.

As noted above, amending the rotor diameter from 150m to 165m has no impact on the AIA conclusions.

7. AIRSTRIP 1944 WINGEEL ROAD

The airstrip at 1944 Wingeel Road, Barunah Park is located at 37 59 36S 143 52 01E. This airstrip is now listed[2] in the Aeronautical Information Publication (AIP) Designated Airspace Handbook (DAH) as an "Aircraft Landing Area without ERSA FAC[3] - Verified[4]." The airstrip is named Barunah Park/Craigwood and has the aeronautical location designator YCGW. It is also depicted on the Visual Navigation Chart (VNC) – Melbourne and the En Route Chart (ERC) L2.

Permit Condition 75 states:

> *Prior to turbines GP 227, 231 and GP 229 being constructed, an aircraft safety assessment prepared by a suitably qualified person must be*

[2] It was not listed prior to the 7 November 2019 AIRAC chart amendment date

[3] AIP DAH Section 20, UNLC ALA-4, Dated 5 November 2020 available at https://www.airservicesaustralia.com/aip/pending/dah/DAH_05NOV2020.pdf

[4] Verified Aircraft Landing Areas are those that Airservices has a responsible person registered for the location and the associated information confirmed. ibid

> *submitted which demonstrates that the existing operations from the airstrip at 1944 Wingeel Road, Barunah Park will be able to continue safely without significant impact from the turbines, to the satisfaction of the responsible authority, unless an alternative arrangement is agreed between the parties to the satisfaction of the responsible authority.*

The turbine numbers referred to in the planning permit cross reference to the 215 WTG turbine numbering system as shown below.

Permit Numbering	New Numbering
GP227	WTG215
GP231	WTG216
GP229	WTG217

Table 1 – Turbine Number Cross Reference

7.1 Aeroplane Landing Areas

Aeroplane Landing Areas (ALA), including airstrips, are referred to as Unregulated Aerodromes[5]. The Civil Aviation Safety Authority (CASA) has no jurisdiction over ALA. An ALA has no regulated runway length, width, or clearway (obstacle free) areas.

An ALA listed in the AIP as verified simply means that Airservices Australia has registered the name of a responsible person for the location and the associated information is confirmed. It does not prescribe any regulatory status to the ALA.

The only data published regarding dimensions for an ALA is in Civil Aviation Advisory Publication (CAAP), No 92-1(1) *Guidelines for Aeroplane Landing Areas*, dated July 1992[6].

As noted in the opening paragraph of this CAAP: -

> *The information in this publication is advisory only. There is no legal requirement to observe the details set out in this publication.*

The only Civil Aviation Regulation pertaining to the use of an ALA is Civil Aviation Regulation (CAR 1988) 92.

[5] CASR Part 139 Aerodromes was amended on 13 August 2020. Certified and Registered Aerodromes are now Regulated Aerodromes as per CASR 139.030. Anything else is Unregulated.
[6] CAAP 92-1(1) available at https://www.casa.gov.au/files/921pdf

92 Use of aerodromes[7]

(1) A person must not land an aircraft on, or engage in conduct that causes an aircraft to take off from, a place that does not satisfy one or more of the following requirements:

(a) the place is an aerodrome established under the Air Navigation Regulations;

(b) the use of the place as an aerodrome is authorised by a certificate granted, or registration, under Part 139 of CASR;

(c) the place is an aerodrome for which an arrangement under section 20 of the Act is in force and the use of the aerodrome by aircraft engaged in civil air navigation is authorised by CASA under that section;

(d) the place (not being a place referred to in paragraph (a), (b) or (c)) is suitable for use as an aerodrome for the purposes of the landing and taking-off of aircraft;

and, having regard to all the circumstances of the proposed landing or take-off (including the prevailing weather conditions), the aircraft can land at, or take-off from, the place in safety.

Penalty: 25 penalty units.

(2) CASA may, in relation to an aerodrome, issue directions relating to the safety of air navigation.

(3) A person must not contravene a direction.

Penalty: 25 penalty units.

(4) An offence against subregulation (1) or (3) is an offence of strict liability.

The pilot in command is responsible for ensuring that the ALA is suitable for the intended aeroplane operation.

7.2 Barunah Park/Craigwood ALA (YCGW) Information

The airstrip is approximately 760m in length and is oriented east/west to give a runway direction of 09/27.

Note: an aircraft taking off to the west is using R27 (the direction shown on the aircraft compass), with the take-off beginning at the R27 Threshold, i.e. the eastern end of the runway.

The airstrip referred to in Permit Condition 75 is used for aerial applications operations by three Aerial Agricultural Applications Operators. Depending on seasonal requirements it is used approximately 10 to 14 days per year, to service ten neighbouring

[7] CAR 92 - https://www.legislation.gov.au/Details/F2017C00094/Html/Volume_3#_Toc473724736

properties.[8] It is understood that one operator has used the airstrip for twenty years. The airstrip is not used for night operations.

Aerial applications aircraft, by design, are highly manoeuvrable, rugged aircraft that operate at very low level, in tight confines and from unprepared runways. They are flown by highly trained, appropriately rated and endorsed pilots who also hold appropriate endorsements for the handling and use of agricultural chemicals.

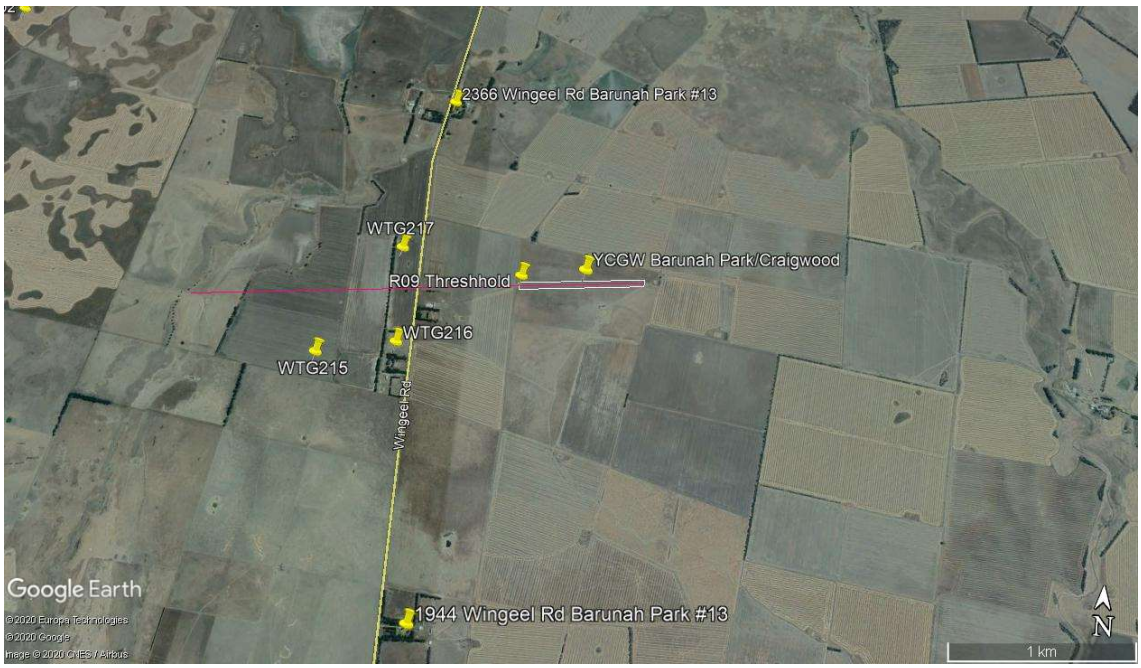

Figure 2 – Location of Barunah Park/Craigwood ALA

[8] Stakeholder interviews by the author.

Figure 3 – YCGW Airstrip – Google Earth view

The runway elevation is approximately 157m (520ft) above the Australian Height Datum (AHD). The runway surface appears to be the same as the farm roads leading from the sheds, silos, and stockpile adjacent to Wingeel Road, i.e. compacted natural surface with minimal grass coverage.

There is a Single Wire Earth Return (SWER) powerline located 464m from the Runway 09 Threshold, i.e. the western end of the runway. There are no safety markers apparent on this wire to enhance its visibility to aircraft operating at the ALA. These powerlines are typically supported on slender poles 12m above the ground. The ground level at the pole nearest to the runway centreline is approximately 156m AHD. This puts the unmarked wire obstacle 11m (36ft) above the runway level.

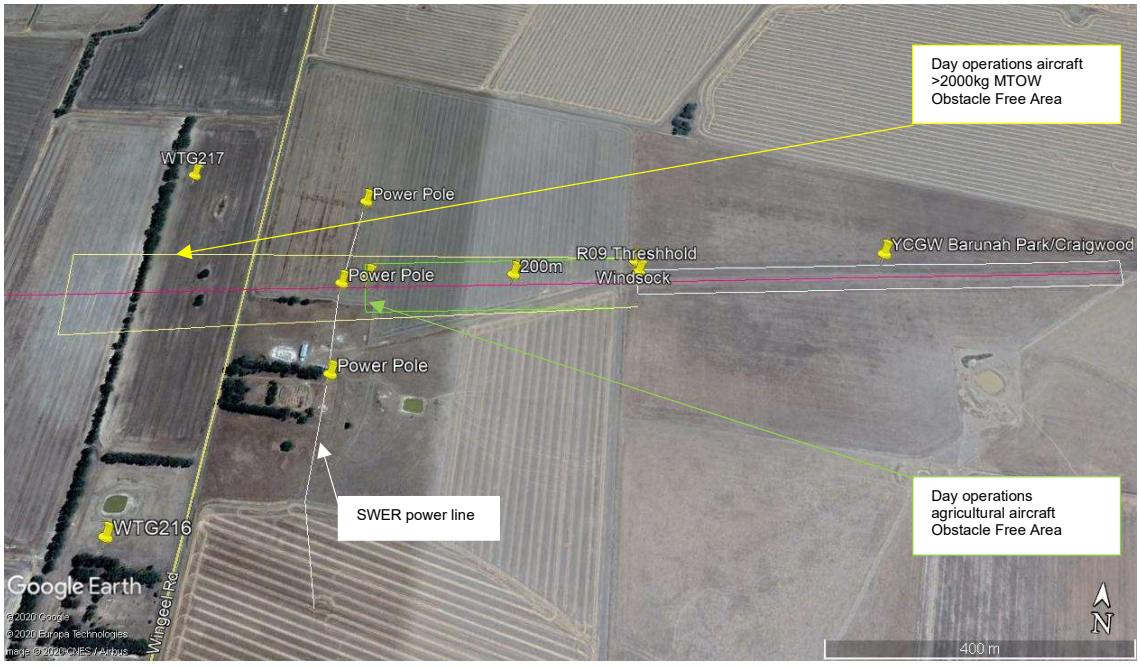

Figure 4 – YCGW RWY 27 Obstacle Free Areas

CAAP 92-1(1), suggests, at figure 2B page 3, an obstacle free area (OFA) for aeroplanes with a MTOW greater than 2000kg. It also suggests, at figure 4 page 4, a smaller obstacle free area for daytime agricultural operations of any MTOW.

The airstrip is used by aerial applications aircraft, therefore the smaller OFA is the more relevant. The largest OFA is shown to demonstrate that turbines WTG 215, WTG 216 and WTG 217 are clear of the operational area of the airstrip.

The SWER is below the obstacle gradient of 5% and beyond the obstacle free area that is suggested for daytime aerial agricultural operations.

The third turbine WTG 215 is 1320m west southwest of the RWY 09 threshold which puts it 514m south west of the southern extremity of the larger OFA.

Figure 5 – Turbine distance to suggested obstacle free area

The base of turbine WTG 216 is 412m south of the extended runway centreline and 348m south of the OFA. The base of turbine WTG 217 is 212m north of the runway centreline and 142m north of the OFA. A line connecting the two turbines intersects the RWY 27 centreline at 742m from the western end of the runway (RWY09 threshold). An aircraft taking off on RWY 27 will be airborne before this point or will be aborting the take off.

Wind turbines, due to their shape, size and colour are considered conspicuous by day[9].

This demonstrates, given that the turbines are conspicuous, well clear of the runway centreline, and outside the larger obstacle free area:

> *"… … that the existing operations from the airstrip at 1944 Wingeel Road, Barunah Park will be able to continue safely without significant impact from the turbines, … …"*

7.3 Increased Rotor Diameter and YCGW Operations

An increase in rotor diameter from 150m to 165m gives a radius increase of 7.5m, i.e. from 75m to 82.5m, that is, the vertical tangential edge of the rotor disk is 7.5m further from the turbine base.

[9] NSAF Guideline D, paragraph 30.

An increase in rotor diameter from 150m to 165m changes the distance from the tangential edge of the rotor disk to the runway centreline from:

Turbine #	Distance from Turbine Base to RWY 27 Centreline	Turbine Disk to RCL 150m Rotor	Turbine Disk to RCL 165m Rotor
WTG 216	412	412 - 75 = 337	412 – 82.5 = 329.5
WTG 217	212	212-75 = 137	212 – 82.5 = 129.5

Table 2 – Distance from Rotor Disk to Runway 27 Centreline

The distance from the boundary of the largest OFA to the tangential edge of the rotor disk changes from:

Turbine #	Distance from Turbine Base to Obstacle Free Boundary	Turbine Disk to OFA 150m Rotor	Turbine Disk to OFA 165m Rotor
WTG 216	348	348 - 75 = 273	348 – 82.5 = 265.5
WTG 217	142	142-75 = 67	142 – 82.5 = 59.5

Table 3 – Rotor Disk distance beyond CAAP 29-1 obstacle free area

The runway centreline and the largest suggested CAAP 92-1(1) obstacle free area remain sufficiently distant from the increased turbine rotor diameter disk tangential edge.

An aircraft taking off to the west has adequate clearance from the turbines, WTG 216 and WTG 217. The third turbine WTG 215 is 1320m west southwest of the RWY 09 threshold which puts it well beyond the largest OFA.

Again, this demonstrates, given that the turbines are outside the obstacle free area, well clear of the runway centreline, and conspicuous that:

> *"… … the existing operations from the airstrip at 1944 Wingeel Road, Barunah Park will be able to continue safely without significant impact from the turbines, … …"*

Increasing the rotor diameter from 150 to 165m will have no impact on the continued safe operations at YCGW. Permit condition 75 is met.

8. PERMIT CONDITIONS 76, 77, 78 AND 79

These permit conditions remain unchanged since they apply to notifications and actions that are not directly related to the turbine layout or specification.

9. CONCLUSIONS

The 215 turbine Golden Plains Wind Farm layout remains within the boundary assessed in the Aeronautical Impact Assessment (AIA) of the 228 turbine layout. The turbine tip height of 230m AGL also remains. Therefore, the volume of airspace occupied by the Golden Plains Wind Farm remains unchanged from that assessed in the Aeronautical Impact Assessment. As a result, the AIA conclusions remain valid for the 215 WTG GPWF layout, that is, aviation obstacle lighting is not required,

Permit Condition 1(i) *No aviation safety lighting on any turbine* is met.

Changing the maximum rotor diameter in condition 1 b iii from 150 metres to 165 metres, within the constrains of conditions 1 b i and 1 b ii does not increase the maximum tip height, therefore amending the rotor diameter from 150m to 165m has no impact on the AIA conclusions.

Permit Condition 1 b iii can be amended to "*Maximum rotor diameter of up to 165 metres"*

Permit Condition 79 could be clarified to show that the appropriate authorities to receive and assess an Aviation Impact Statement are Airservices Australia and the Department of Defence, Estate and Infrastructure Group. An AIS, as per condition 79, has been submitted and assessed, therefore, unless there is an increase in the wind farm volume another AIS is not required.

Permit condition 77 covers notification to the RAAF Aeronautical Information Service.

Permit Conditions 76, 77 and 78 remain unchanged since they apply to notifications and actions that will occur when construction of the GPWF commences.

An increase in rotor diameter from 150m to165m will have no impact on the continued safe operation of the airstrip at 1944 Wingeel Road, Barunah Park. Permit condition 75 is met.

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APPENDIX A

Glossary of Terms and Abbreviations

APPENDIX A

AERONAUTICAL STUDY GLOSSARY

To facilitate the understanding of aviation terminology used in this report, the following is a glossary of terms and acronyms that are commonly used in aeronautical impact assessments and similar aeronautical studies. A full list of terms and abbreviations used in this report is included in this Appendix. It should be noted that, within aviation, the International standard unit for altitude is feet (ft.) and distance is nautical mile (nm).

AC (Advisory Circulars) are issued by CASA and are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means, of complying with the *Regulations*.

Aeronautical study is a tool used to review aerodrome and airspace processes and procedures to ensure that safety criteria are appropriate.

AHD (Australian Height Datum) is the datum to which all vertical control for mapping is to be referred. The datum surface is that which passes through mean sea level at the 30 tide gauges and through points at zero AHD height vertically below the other basic junction points.

AIP (Aeronautical Information Publication) is a publication promulgated to provide operators with aeronautical information of a lasting character essential to air navigation. It contains details of regulations, procedures and other information pertinent to flying and operation of aircraft. In Australia, the AIP may be issued by CASA or Airservices Australia.

Air routes exist between navigation aid equipped aerodromes or waypoints to facilitate the regular and safe flow of aircraft operating under Instrument Flight Rules (IFR).

Airservices Australia is the Australian government-owned corporation providing safe and environmentally sound air traffic management and related airside services to the aviation industry.

Altitude is the vertical distance of a level, a point or an object, considered as a point, measured from mean sea level.

AMSL (Above Mean Sea Level) is the elevation (on the ground) or altitude (in the air) of any object, relative to the average sea level datum. In aviation, the ellipsoid known as World Geodetic System 84 (WGS 84) is the datum used to define mean sea level.

ATC (Air Traffic Control) service is a service provided for the purpose of:

a. preventing collisions:

   1. between aircraft; and

   2. on the manoeuvring area between aircraft, vehicles and obstructions; and

b. expediting and maintaining an orderly flow of air traffic.

CASA (Civil Aviation Safety Authority) is the Australian government authority responsible under the *Civil Aviation Act 1988* for developing and promulgating appropriate, clear and concise aviation safety standards. As Australia is a signatory to the ICAO *Chicago Convention,* CASA adopts the standards and recommended practices established by ICAO, except where a difference has been notified.

CASR (Civil Aviation Safety Regulations) are promulgated by CASA and establish the regulatory framework *(Regulations)* within which all service providers must operate.

Civil Aviation Act 1988 (the Act) establishes the CASA with functions relating to civil aviation, in particular the safety of civil aviation and for related purposes.

ICAO (International Civil Aviation Organization) is an agency of the United Nations which codifies the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth. The ICAO Council adopts standards and recommended practices concerning air navigation, its infrastructure, flight inspection, prevention of unlawful interference, and facilitation of border-crossing procedures for international civil aviation. In addition, the ICAO defines the protocols for air accident investigation followed by transport safety authorities in countries signatory to the Convention on International Civil Aviation, commonly known as the *Chicago Convention*. Australia is a signatory to the *Chicago Convention.*

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ABBREVIATIONS

Abbreviations used in this report, and the meanings assigned to them for the purposes of this report are detailed in the following table:

Abbreviation	Meaning
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AHT	Aircraft height
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Airports Act	Airports Act 1996, as amended
AIS	Aeronautical Information Service
ALA	Aircraft Landing Area
Alt	Altitude
AMSL	Above Minimum Sea Level
A(PofA)R	Airports (Protection of Airspace) Regulations, 1996 as amended
APARs	Airports (Protection of Airspace) Regulations, 1996 as amended
ARP	Aerodrome Reference Point
AsA	Airservices Australia
ATC	Air Traffic Control(ler)
ATM	Air Traffic Management
CAO	Civil Aviation Order
CAR	Civil Aviation Regulation
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation
Cat	Category
DAP	Departure and Approach Procedures (charts published by AsA)
DER	Departure End of (the) Runway
DEVELMT	Development
DME	Distance Measuring Equipment
Doc nn	ICAO Document Number nn
DIRD	Department of Infrastructure and Regional Development. (Formerly Department of Infrastructure and Transport)
DoIT	Department of Infrastructure and Transport. Also called “Infrastructure”. (Formerly Department of Infrastructure, Transport, Regional Development and Local Government (DITRDLG) and previously the Department of Transport and Regional Services (DoTARS))
DITRDLG	See DoIT above
DOTARS	See DITRDLG above
ELEV	Elevation (above mean sea level)
ENE	East North East
ERSA	Enroute Supplement Australia
FAF	Final Approach Fix
FAP	Final Approach Point

Abbreviation	Meaning
ft	feet
GA	General Aviation
GNSS	Global Navigation Satellite System
GP	Glide Path
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
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ILS	Instrument Landing System
ISA	International Standard Atmosphere
km	kilometres
kt	Knot (one nautical mile per hour)
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LLZ	Localizer
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m	metres
MAPt	Missed Approach Point
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nnDME	Distance from the DME (in nautical miles)
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OCA	Obstacle Clearance Altitude
OCH	Obstacle Clearance Height
OHS	Outer Horizontal Surface
OIS	Obstacle Identification Surface
OLS	Obstacle Limitation Surface
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations, ICAO Doc 8168
PRM	Precision Runway Monitor
PROC	Procedure

Abbreviation	Meaning
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QNH	An altimeter setting relative to height above mean sea level
Rnnn	Restricted Airspace – promulgated in AIP as R with 3 numbers
REF	Reference
RL	Relative Level
RNAV	aRea NAVigation
RNP	Required Navigation Performance
RPA	Rules and Practices for Aerodromes — replaced by the MOS Part 139 — Aerodromes
RPT	Regular Public Transport
RWY	Runway
SFC	Surface
SID	Standard Instrument Departure
SOC	Start Of Climb
SSR	Secondary Surveillance Radar
STAR	Standard ARrival
TAR	Terminal Area Radar
TAS	True Air Speed
THR	Threshold (Runway)
TNA	Turn Altitude
TODA	Take-Off Distance Available
VFR	Visual Flight Rules
V_n	aircraft critical Velocity reference
VOR	Very high frequency Omni directional Range

FINAL REPORT

AVIATION ADVICE

METEOROLOGICAL MONITORING MASTS

FOR

GOLDEN PLAINS WIND FARM

CCP02(10)

Report to:

GoldenPlains
WIND FARM MANAGEMENT PTY LTD

17 March 2021

Chiron Aviation Consultants
Essendon Vic 3040
Australia

DOCUMENT RELEASE APPROVAL

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EXECUTIVE SUMMARY

Golden Plains Wind Farm Management Pty Ltd has requested Chiron Aviation Consultants undertake an aviation assessment of the Golden Plains Wind Farm Meteorological Monitoring Masts associated with the Golden Plains Wind Farm as approved by Victorian Planning Permit #PA1700266.

Golden Plains Wind Farm Management Pty Ltd proposes to erect 11 meteorological monitoring masts (met masts) across the Golden Plains Wind Farm (GPWF) site. The mast will be a guyed lattice tower 155m tall. The masts will be erected prior to the construction of the wind turbines.

The proposed met masts will not impact upon the following: -

- The Obstacle Limitation Surface (OLS) and Procedures for Air Navigation Services ï Aircraft Operation (PANS-OPS) surfaces of Ballarat and Avalon aerodromes:
- The LSALT for air routes in the vicinity:
- The performance of Navigation Aids and Communication Facilities: and
- The performance of any surveillance facilities (radars).

The met masts must be marked in accordance with the NASF Guidelines and have additional marking on the lower third of the outer guy wires, as well as the guy wire ground anchor points marked in a contrasting colour the ground.

The location and height of the masts must be reported to Airservices Australia Vertical Obstacles Database in accordance with CASA Advisory Circular AC 139-08 v2.0 March 2018 *Reporting Tall Structures and Hazardous Plume Sources,* for inclusion on aeronautical charts.

Additionally, a NOTAM detailing the location and height of the met masts must be issued when construction commences.

1. INTRODUCTION

Golden Plains Wind Farm Management Pty Ltd has requested Chiron Aviation Consultants undertake an aviation assessment of the Golden Plains Wind Farm Meteorological Monitoring Masts associated with the Golden Plains Wind Farm as approved by Victorian Planning Permit #PA1700266.

Chiron Aviation Consultants have provided various expert aviation advice on the Project, including: -

- Peer review of Aviation report presented as part of the EES
- Aviation Safety Assessment of the airstrip at 1944 Wingeel Road, Barunah Park
- Assessment of the WTG layout presented in the Development Plans.

2. CONTEXT

Golden Plains Wind Farm Management Pty Ltd proposes to erect 11 meteorological monitoring masts (Met Masts) across the Golden Plains Wind Farm (GPWF) site. The mast will be a guyed lattice tower 155m tall. The three guy wire anchor points will be 103m from the base of the tower. The masts will be erected prior to the construction of the wind turbines.

2.1 Golden Plains Wind Farm Aeronautical Impact Assessment

The Aeronautical Impact Assessment (AIA)[1] undertaken for the EES (using 230m turbine tip height) concluded that the GPWF: -

- Is not a hazard to aircraft safety;
- Aviation obstacle lighting is not required.

Additionally, the AIA confirmed that the GPWF will NOT impact upon the following: -

- The Obstacle Limitation Surface (OLS) and Procedures for Air Navigation Services ï Aircraft Operation (PANS-OPS) surfaces of Ballarat and Avalon aerodromes:
- The LSALT for air routes in the vicinity:
- The performance of Navigation Aids and Communication Facilities: and
- The performance of any surveillance facilities (radars).

[1] *Final Report, Golden Plains Wind Farm Aviation Impact Statement, Qualitative Risk Assessment & Obstacle Lighting Review*, Chiron Aviation Consultants dated 20 April 2018.

2.2 Met Mast Locations

The met mast locations are all within the permitted area of the GPWF.

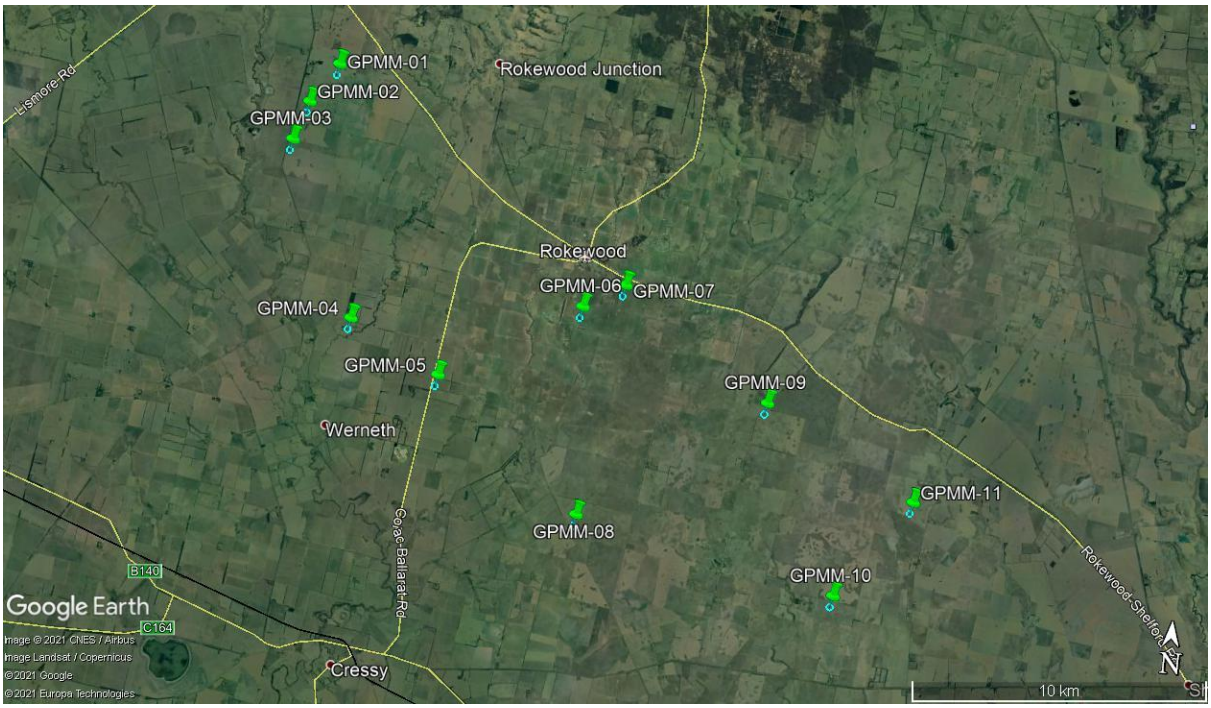

Figure 1 – Proposed Met Mast Locations.

The proposed met masts are up to 155m tall, slender guyed towers. The guy wire ground anchor points will be approximately 103m from the base of the tower.

At 155m AGL, the met mast tops are below the tip height of 230m AGL assessed for the turbines, therefore the met masts will not impact upon the following: -

- The Obstacle Limitation Surface (OLS) and Procedures for Air Navigation Services ï Aircraft Operation (PANS-OPS) surfaces of Ballarat and Avalon aerodromes:
- The LSALT for air routes in the vicinity:
- The performance of Navigation Aids and Communication Facilities: and
- The performance of any surveillance facilities (radars).

3. OBSTACLE MARKING OF MET MASTS

Meteorological Monitoring Masts are very difficult to see due to their slender construction and thin guy wires. The masts are often a grey (galvanised steel) colour that readily blends with the background.

Aerial agricultural applications operators and the emergency services pilots all note the danger of meteorological monitoring masts to low flying aircraft. All these pilots made comment that ñmet masts are extremely dangerous.ò Each of these stakeholders request that the NASF Guidelines, except for the strobe light, be used to make the masts more visible and that the markings be maintained in a serviceable condition.

3.1 NASF Guidelines – Marking of Meteorological Monitoring Masts

The NASF guideline also refers to the marking and lighting of wind monitoring towers. The relevant points are summarised as:

> *Wind monitoring towers are very difficult to see from the air due to their slender construction and guy wires. This is a particular problem for low flying aircraft, particularly aerial agricultural and emergency services operations.*
>
> *Measures to be considered to improve visibility include:*
>
> - *The top one third of wind monitoring towers be painted in alternating contrasting bands of colour. Examples can be found in the CASA MOS 139 sections 8 and 9;*
> - *Marker balls, high visibility flags or high visibility sleeves placed on the outer guy wires;*
> - *Ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground and vegetation; or*
> - *A flashing strobe light during daylight hours.*

Aerial applications and emergency services pilots interviewed by the author[2] all make the point that a flashing strobe light does little to make the mast more visible and therefore is unnecessary.

3.2 Additional Marking

To maximise the visibility of the met mast for approved low flying operations such as aerial applications it is recommended that:

- The guy wires be fitted with a combination of ball and flap type high visibility markers,
- Markers be placed in the top and bottom thirds of the guy wire length
- The area around the guy wire bases of approximately 3m radius should be a contrasting colour to the surrounding ground
- A routine maintenance program is instituted to ensure its visibility is maintained.

[2] Stakeholder interviews for wind farms conducted by the author over the last decade

4. REPORTING TALL STRUCTURES

There is an ongoing requirement to report the location and height of tall structures to ensure aviation safety and to maintain an accurate database so that this information can be marked on aeronautical charts.

An immediate form of notification to the aviation community is via a NOTAM[3] that promulgates the proposed height and location of the met masts. This will ensure pilots, including aerial applications, emergency services, and other commercial pilots, will be aware of the mast locations.

A NOTAM can be raised through the Vertical Obstacles Database at Airservices Australia or the CASA Regional Office in Melbourne (phone 131 757).

CASA Advisory Circular AC 139-08 v2.0 March 2018 *Reporting Tall Structures and Hazardous Plume Sources*[4] provides the information and processes for the reporting of tall structures.

The form used for reporting tall structures to the Airservices Australia Vertical Obstacle Databa base is available at http://www.airservicesaustralia.com/wp-content/uploads/ATS-FORM-0085_ObstacleNotificationForm.pdf

The Vertical Obstacle Database group can be contacted at (02) 6268 5596 and at e-mail vod@airservicesaustralia.com

The reporting of tall structures needs to occur at the commencement of erection of the met masts.

5. RECOMMENDATIONS

It is recommended that the masts be marked in accordance with: -

- NASF guidelines, except for the strobe light,
- Additional ball and flap markers on the top and bottom thirds of the outer guy wires.
- The area around the guy wire ground anchor points to be marked in a contrasting colour

A routine maintenance program will be required to ensure the markings are maintained in optimum condition.

A NOTAM detailing the location and height of the met masts must be issued when construction commences. This NOTAM can detail all the met masts or only those to be

[3] NOTAM is a Notice To Air Men ï an International process for quickly promulgating safety information to the aviation community.
[4] AC 139-08 available at https://www.casa.gov.au/files/139c08pdf

erected in a particular group. A separate NOTAM would be issued for each subsequent group.

When construction commences the following organisations should be notified: -

- Local aerial agricultural applications organisations, such as Air Apply, Western Aerial and Field Air
- Flying schools at Ballarat and Melton
- CFA Division 15 Office, Wendouree

.

APPENDIX A

Glossary of Terms and Abbreviations

APPENDIX A

AERONAUTICAL STUDY GLOSSARY

To facilitate the understanding of aviation terminology used in this report, the following is a glossary of terms and acronyms that are commonly used in aeronautical impact assessments and similar aeronautical studies. A full list of terms and abbreviations used in this report is included in this Appendix. It should be noted that, within aviation, the International standard unit for altitude is feet (ft.) and distance is nautical mile (nm).

AC (Advisory Circulars) are issued by CASA and are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means, of complying with the *Regulations*.

Aeronautical study is a tool used to review aerodrome and airspace processes and procedures to ensure that safety criteria are appropriate.

AHD (Australian Height Datum) is the datum to which all vertical control for mapping is to be referred. The datum surface is that which passes through mean sea level at the 30 tide gauges and through points at zero AHD height vertically below the other basic junction points.

AIP (Aeronautical Information Publication) is a publication promulgated to provide operators with aeronautical information of a lasting character essential to air navigation. It contains details of regulations, procedures and other information pertinent to flying and operation of aircraft. In Australia, the AIP may be issued by CASA or Airservices Australia.

Air routes exist between navigation aid equipped aerodromes or waypoints to facilitate the regular and safe flow of aircraft operating under Instrument Flight Rules (IFR).

Airservices Australia is the Australian government-owned corporation providing safe and environmentally sound air traffic management and related airside services to the aviation industry.

Altitude is the vertical distance of a level, a point or an object, considered as a point, measured from mean sea level.

AMSL (Above Mean Sea Level) is the elevation (on the ground) or altitude (in the air) of any object, relative to the average sea level datum. In aviation, the ellipsoid known as World Geodetic System 84 (WGS 84) is the datum used to define mean sea level.

ATC (Air Traffic Control) service is a service provided for the purpose of:

a. preventing collisions:

   1. between aircraft; and

   2. on the manoeuvring area between aircraft, vehicles and obstructions; and

b. expediting and maintaining an orderly flow of air traffic.

CASA (Civil Aviation Safety Authority) is the Australian government authority responsible under the *Civil Aviation Act 1988* for developing and promulgating appropriate, clear and concise aviation safety standards. As Australia is a signatory to

the ICAO *Chicago Convention,* CASA adopts the standards and recommended practices established by ICAO, except where a difference has been notified.

CASR (Civil Aviation Safety Regulations) are promulgated by CASA and establish the regulatory framework *(Regulations)* within which all service providers must operate.

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Abbreviation	Meaning
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