FINAL REPORT

DELBURN WIND FARM

AERONAUTICAL IMPACT ASSESSMENT

INCLUDING

AVIATION IMPACT STATEMENT,

QUALITATIVE RISK ASSESSMENT,

AND

OBSTACLE LIGHTING REVIEW

CCP14

1 November 2019

DELBURN WIND FARM PTY LTD

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EXECUTIVE SUMMARY

The proposed wind farm will comprise of 35 turbines with a tip height of 250m Above Ground Level (AGL).

There are two Registered Aerodromes within 30nm (56km) of the Delburn Wind Farm (DWF). These are LaTrobe Valley (YLTV) and Yarram (YYRM) aerodromes, both of which are equipped with lights and have published instrument approach procedures.

The Leongatha uncertified aerodrome (YLEG) is also within 30nm of the wind farm.

The Aviation Impact Statement (AIS) concluded that the DWF will not impact upon the following:

- The Lowest Safe Altitude (LSALT) of nearby published air routes;
- The Obstacle Limitation Surface (OLS) of any registered, certified or military aerodrome;
- The YLTV NDB Approach;
- The YYRM Instrument Approach Procedures; and
- The performance of civil ATC Communications, Navigation and Surveillance facilities.

The AIS concluded that the DWF will impact on the following:

- The PANS-OPS surface for the LaTrobe Valley YLTV RNAV RWY03 non-precision approach.

An amendment to this Instrument Approach Procedure will be required to overcome the PANS-OPS penetration. Airservices Australia advise that the RNAV RWY21 Overshoot decision height requires amending.

Consultation will need to be undertaken with both the aerodrome operator and the instrument approach procedure designer to have the recommended amendments made to the YLTV RNAV-Z RWY03 and RWY 21 approach procedures. Consultation will also be undertaken with the Department of Defence regarding any possible impact on Military Surveillance facilities.

The Qualitative Risk Assessment demonstrates that for the DWF: -

- By day the wind turbines are conspicuous by their size and colour;
- Night operations of aircraft do not occur below prescribed airspace;
- Aerodromes equipped for night operations are sufficiently distant; and
- It is assessed as a LOW risk to aviation and is therefore not a hazard to aircraft safety.

The Obstacle Lighting Review for the DWF finds that in accordance with the NASF Guideline D risk assessment:

- Obstacle lighting is not required as the risk to aviation is LOW and no additional mitigating strategies are necessary.

The DWF wind turbines and meteorological monitoring masts are considered to be tall structures, therefore they must be appropriately coloured to enhance visibility to aircraft and be reported to the Vertical Obstacle Database, managed by Airservices Australia.

1. INTRODUCTION

Delburn Wind Farm Pty Ltd have requested Chiron Aviation Consultants to undertake an Aeronautical Impact Assessment for the proposed Delburn Wind Farm situated in Gippsland, Eastern Victoria

1.1 Location

The Delburn Wind Farm (DWF) site is located within the plantation land centred in the Delburn area, covering the Hancock Victorian Plantations (HVP) Thorpdale Tree Farm. The site is generally bounded by Coalville and Hernes Oak to north, Thorpdale to the west, Darlimurla to the south, and Boolarra and Yinnar to the east. The township of Morwell is approximately 5km to the northeast of the development site and the township of Moe is approximately 5km to the north. Refer to Figure 1 below.

The proposed wind farm will comprise of 35 turbines with a tip height of 250m Above Ground Level (AGL).

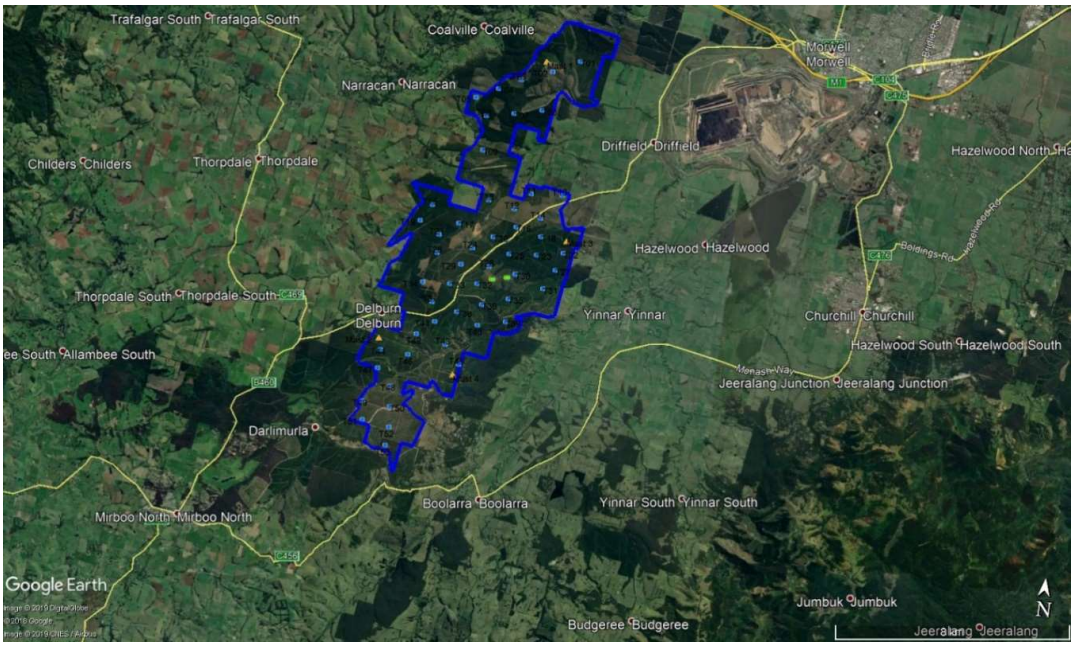


Figure 1 – Delburn Wind Farm Location

1.2 Aerodromes and Airstrips

Aerodromes fall into four categories:

- Military or Joint (combined military and civilian);
- Certified;
- Registered; and
- Uncertified or Aeroplane Landing Areas

A Military aerodrome is operated by the Department of Defence and is suitable for the operation of military aircraft. A Joint User aerodrome is a Military aerodrome used by both military and civilian aircraft, for example Darwin International and Townsville International Airports.

A Certified Aerodrome, certified under Civil Aviation Safety Regulation (CASR) 139.040, is available for Regular Public Transport and Charter operations and has a runway suitable for use by an aircraft having a maximum carrying capacity of more than 3,400kg or a passenger seating capacity of more than 30 seats, for example Melbourne Tullamarine Airport, Portland Airport and Warrnambool Airport.

A Registered Aerodrome, registered under CASR 139.260, is one to which CASR 139.040 does not apply and the operator has applied to the Civil Aviation Safety Authority (CASA) to have it registered, for example LaTrobe Valley Airport.

An Uncertified Aerodrome is any other aerodrome or airstrip and is referred to as an Aeroplane Landing Area (ALA). These range in capability and size from having a sealed runway with lighting capable of accommodating corporate jet aircraft to a grass paddock that is smooth enough to land a single engine light aircraft or a purpose built aerial agricultural aircraft.

Certified, Registered and Military aerodromes are listed in the Aeronautical Information Publication[1] (AIP) and are subject to a NOTAM[2] service that provides the aviation industry with current information on the status of the aerodrome facilities. This information is held in the public domain, is available through aeronautical publications and charts and is kept current by mandatory reporting requirements.

Uncertified aerodromes (ALA) are not required to be listed in the AIP so information about them is not held in the public domain, is not available through aeronautical publications and charts and is not required to be reported. Where ALA information is published in the AIP it is clearly annotated that it is not kept current. A local example is Leongatha Airport. Consequently, ALA can come into use and fall out of use without any formal notification to CASA or any other authority. Airstrips that appear on survey maps often no longer exist; others exist but do not feature on maps. Similarly, a grass paddock used as an ALA is not usually discernable on satellite mapping services such as Google Earth.

[1] AIP; a mandatory worldwide distribution system for the promulgation of aviation rules, procedures and information

[2] NOTAM (Notice to Airmen); a mandatory reporting service to keep aerodrome and airways information current and available to the aviation industry worldwide

Military, Joint, Certified and Registered aerodromes usually have Obstacle Limitation Surfaces (OLS) and Procedures for Air Navigation – Operations (PANS-OPS) surfaces prescribed to protect the airspace associated with published instrument approach and landing procedures. An uncertified aerodrome or ALA cannot have a published instrument approach and landing procedure so cannot have associated prescribed airspace protected by OLS or PANS-OPS. All operations into ALA, therefore, must be conducted in accordance with the Visual Flight Rules (VFR) and in Visual Meteorological Conditions (VMC).

1.3 Aerodromes in the Area

There are two Registered aerodromes within 30nm (56km) of the DWF:

- Yarram (YYRM) aerodrome is 26.40nm (48.89km) southeast of turbine T45; and
- LaTrobe Valley (YLTV) aerodrome is 8.97nm (16.62km) east northeast of turbine T06.

There is an Uncertified aerodrome (ALA) within 30nm (56km) at Leongatha (YLEG), 19nm (35.19km) southwest of turbine T49.

Other aerodromes of significance are:

- West Sale (YWSL) Registered aerodrome located 32.5nm (60.19km) east north east; and
- East Sale (YMES) Military aerodrome located 40.75nm (75.46km) east of the wind farm.

1.4 Air Routes in the Area

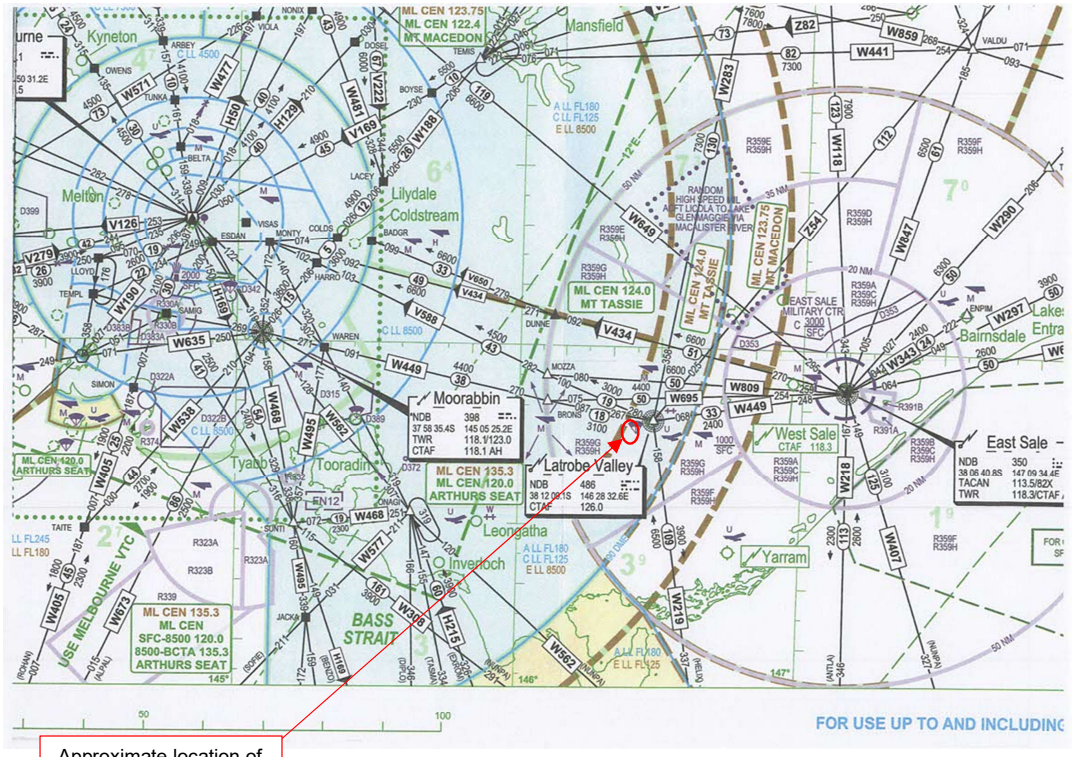


Figure 2 – Nearby Air Routes[3]

As can be seen from Figure 2 above, the DWF sits below a complex array of air routes into and out of Melbourne and below air routes associated with the East Sale RAAF Base.

1.5 Airspace in the Area

The DWF is in Class G airspace with Class E airspace above having a lower limit of 8500ft. The wind farm also sits below Restricted Area R359G, a Military Low Flying Area, activated by NOTAM, with a lower limit of 6000ft, and a conditional status of RA2.

Class G airspace is non-controlled airspace where aircraft may operate without an Air Traffic Control (ATC) clearance. Aircraft may operate in accordance with both Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) within Class G airspace.

Class E airspace is controlled airspace open to both IFR and VFR flights. IFR aircraft

[3] AIP ERC L2, dated 23 May 2019

must have an ATC clearance and communicate with the ATC Centre.

A Control Area (CTA) is defined as a "controlled airspace extending upwards from a specified limit above the earth.[4]"

A Restricted Area is defined as

> *An airspace of defined dimensions above the land areas or territorial waters of a State, within which the flight of aircraft is restricted in accordance with certain specified conditions.*[5]

Within Class G airspace an aircraft flying in accordance with the Visual Flight Rules (VFR) away from a populous area is, when flying below 3000ft, required by Civil Aviation Regulation (CAR) 157 to remain at 500ft above the highest point of the terrain **and any obstacle on it** within a radius of 600m [300m for a helicopter] from a point on the terrain directly below the aircraft. For a wind farm this equates to 500ft above the turbine tip height. For the DWF this is 820 (250m) + 500 = 1320ft Above Ground Level (AGL).

There are no published flying training areas in the vicinity of the DWF.

[4] AIP Enroute, ENR 1.4 – 3, dated 25 May 2017, available at http://www.airservicesaustralia.com/aip/current/aip/enroute.pdf last accessed 21 Feb 2018
[5] AIP GEN 2.2 – 24, Definitions, dated 28 Feb 2019.

2. SCOPE.

To meet the requirements of Osmi Australia Pty Ltd, the study required Chiron Aviation Consultants to examine the DWF development and undertake the following tasks.

2.1 Aviation Impact Statement

In August 2014, Airservices Australia (AsA) re-released a letter detailing requirements for an Aviation Impact Statement (AIS) for wind farm developments. The AsA letter requires that all developers of proposed wind farms prepare an Aviation Impact Statement and submit this to AsA for evaluation and consideration. A copy of this letter is shown at Appendix A.

The AIS required the following tasks to be undertaken: -

- Provide the coordinates and elevations of the Obstacles and associated topographical drawings;
- Specify all registered and certified aerodromes within 30nm (55.6km):
  - Nominate all instrument approach and landing procedures;
  - Confirm that the obstacles do not penetrate the Annex 14 OLS;
  - Confirm that the obstacles do not penetrate the PANS-OPS;
- Specify any published air routes over or near the obstacles
- Specify the airspace classification of the airspace surrounding the development
- Investigate any impact on aviation Communications, Navigation and Surveillance (CNS) facilities

Details of Aerodromes, OLS, PANS-OPS procedures, Lowest Safe Altitudes, Navigation and Airspace Surveillance facilities were obtained from the Australian Aeronautical Information Publications (AIP), AsA sources and CASA publications.

2.2 Qualitative Risk Assessment

The QRA required the following tasks to be undertaken: -

- The identification and assessment of potential aviation risk elements through:
  - Reference to CASA publications;
  - Reference to the AIP;
  - Reference to the National Airports Safeguarding Framework (NASF) guidelines;
  - Consultations with key relevant stakeholders;
- Assessment of the perceived impacts of the turbines on the operation of aerodromes and airstrips in the immediate vicinity of the wind farm;

- Assessment of the perceived impacts of the turbines on aviation activity including:
  - General Aviation training;
  - Recreational/Commercial flying activity;
  - Air Ambulance Operations;
  - Police Aviation Operations;
  - Aerial Fire Fighting Operations;
  - Aerial Agricultural Operations;
  - Known highly trafficked VFR routes;
  - Night flying for light aircraft;
- Assessment of any implications for the above from topographical, weather and visibility issues;
- Assessment of other issues as identified through stakeholder consultations and the assessment process;
- Conclusions on the degree of aviation risk posed by the above described issues with commensurate recommendations on any mitigating actions; and
- An assessment of the need, against the outcomes of the Qualitative Risk Assessment, for obstacle lighting of the wind farm.

2.3 Obstacle Lighting Review

The OLR reviews the outcome of the QRA to determine the need or otherwise for risk mitigation by the lighting of turbines in the wind farm with aviation obstruction lighting.

3. METHODOLOGY

The following methodology was used to complete the tasks outlined in the scope

3.1 Aviation Impact Statement

To meet Airservices Australia requirements for an Aviation Impact Statement the following methodology was used: -

- The obstacle (turbines and meteorological masts) coordinates and elevations were listed to the requisite accuracy and associated drawings and charts were obtained;
- The AIP was reviewed to determine;
  - All registered/certified and military/joint aerodromes located within 30nm (55.6km) of the wind farm
  - Any associated Instrument Departure and Approach Procedures (DAP);
  - The extent of the OLS and PANS-OPS surfaces for the identified DAP;
  - Published air routes located over or near the wind farm;
  - The classification of the airspace surrounding the wind farm;
- Ascertain the locations of CNS facilities that may be impacted and analyse the impact on;
  - Communications facilities;
  - Navigation facilities;
  - Surveillance facilities (in accordance with EUROCONTROL Guidelines); and
- Compile a report for review by Airservices Australia and Department of Defence.

3.2 Qualitative Risk Assessment

A Qualitative Risk Assessment is the analysis for risks, through facilitated interviews or meetings with stakeholders and outside experts, as to their probability of occurrence and impact expressed using non-numerical terminology; for example, low, medium and high. The basis for the QRA is ASNZS ISO 31000-2018 *Risk Management –Guidelines.*

The methodology for the Qualitative Risk Assessment was as follows:

- The Australian AIP and CASA documents were reviewed to identify relevant physical and operational aviation issues that may impact on the requirement for lighting of the wind farm;

- Current topographical maps were studied to assess the local terrain and identify any local airstrips and any other relevant features;

- Key stakeholders, including local operators, recreational aviation groups and State Government Police Air Wing, Air Ambulance and Fire Services, were identified, contacted and interviewed to ascertain the extent of local aviation activity in the vicinity of the proposed wind farm. See Appendix G for a Stakeholder List. This included any informal low flying areas and highly trafficked unpublished air routes that may exist within the vicinity of the proposed wind farm;

- Based on the above, the nature of any impacts as a consequence of the operation of the wind farm was considered and discussed in regard to;

  - General Aviation training;
  - Recreational and sport aviation activities;
  - Approved low flying activities (including aerial agricultural applications)
  - Any known highly trafficked VFR routes; and
  - Emergency Services (air ambulance, police and fire service);

- In addition, further consideration was given to the consequences (for the above elements) of the potential influence of topography and poor weather; and

Consideration of the NASF, Guideline D *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers* in relation to the QRA findings.

3.3 Obstacle Lighting Review

The Obstacle Lighting Review investigates the current Australian standards and regulatory requirements for obstacle lighting of wind farms. From this review an assessment of the need or otherwise for aviation obstruction lighting is made.

The methodology for the Obstacle Lighting Review was as follows: -

- Review the Australian regulatory requirements and standards;

- Review the NASF Guidelines for wind farms; and

From the QRA, assess the need for aviation obstruction lighting as a risk mitigator.

4. AVIATION IMPACT STATEMENT (AIS)

The Aviation Impact Statement (AIS) meets the requirements of Airservices Australia for their assessment of the DWF potential impact on the items listed in paragraph 3.1. The AIS is submitted to both Airservices Australia and the Department of Defence for assessment in relation to civil and military facilities.

4.1 Location

The Delburn Wind Farm (DWF) site is located within the plantation land centred in the Delburn area, covering the Hancock Victorian Plantations (HVP) Thorpdale Tree Farm. The site is generally bounded by Coalville and Hernes Oak to north, Thorpdale to the west, Darlimurla to the south, and Boolarra and Yinnar to the east. The township of Morwell is approximately 5km to the north east of the development site and the township of Moe is approximately 5km to the north.

Figure 1, Section 1.1, shows the location of the wind farm.

4.2 Obstacles

The DWF will comprise 35 turbines with a tip height of 250m AGL. The tallest turbine is T04 at 555m (1821ft) AHD. Adding the Minimum Obstacle Clearance (MOC) of 1000ft gives a LSALT of 2815ft.

Rounded up to the nearest hundred the LSALT over the DWF is 2900ft.

The turbine locations and elevations are shown at Appendix B.

4.3 Drawings

The DWF is located near the LaTrobe Valley Aerodrome and is below Restricted Airspace associated with East Sale RAAF Base.

Figure 3 – Location DWF in relation to Airspace Boundaries[6]

[6] AIP Charts VNC Melbourne, dated 23 May 2019

4.4 Aerodromes within 30nm

There are two Registered Aerodromes within 30nm (56km) of the proposed DWF as detailed below.

4.4.1 Yarram (YYRM)

Yarram (YYRM) Registered Aerodrome is 26.40nm (48.89km) southeast of the wind farm and is operated by the Wellington Shire Council.

YYRM has two runways, R05/23 - 756m long and R09/27 - 1090m long, both with unrated gravel surfaces. Runway 09/27 is equipped with Low Intensity Runway Lighting (LIRL) activated by Pilot Activated Lighting (PAL).

The Obstacle Limitation Surface (OLS) extends to 15km (8nm) from the runway 09 threshold. The DWF, at 47.4km from YYRM, does not penetrate the OLS.

YYRM has two published non-precision RNAV-Z Instrument Approach Procedures (IAP) associated with Runway 09/27. The Initial Approach Fix (IAF) for the RWY 09 is 15.3nm from the threshold of runway 09 and is beyond the proposed DWF.

The 25nm Minimum Sector Altitude (MSA), in the sector closest to the DWF is 3900ft. The boundary of the proposed DWF is just beyond (25.60nm) the 25nm MSA. The LSALT of 2900ft over the DWF is below the 3900ft MSA as well as the required altitude of 3900ft at the IAF waypoints for the RNAV-Z RWY09 non-precision approach.

The DWF does not impact the OLS or PANS-OPS prescribed airspace for the IAP at YYRM.

4.4.2 LaTrobe Valley (YLTV)

LaTrobe Valley (YLTV) Registered Aerodrome is 8.97nm (16.62km) east northeast of the wind farm at T06 and is operated by the LaTrobe Regional Airport Board. YLTV has two runways, R09/27 919m long with a gravel surface and R03/21 1430m long with a sealed surface. R03/21 is equipped with Pilot Activated Lighting (PAL) and a Precision Approach Path Indicator (PAPI).

The OLS extends to 15km (8nm) from the runway 03 threshold. The nearest turbine T06 is 16.18km from the runway 03 threshold,

The DWF does not penetrate the YLTV OLS.

YLTV has four published non-precision instrument approach procedures. These are:

- YLTV NDB-A;
- YLTV NDB-B;
- YLTV RNAV (GNSS) RWY 03; and
- YLTV RNAV (GNSS) RWY 21.

The 25nm MSA in the sector over the wind farm is 3000ft. The 10nm MSA is 3900ft. The wind farm is predominantly below the 25nm MSA except for six turbines below the 10nm MSA. These six turbines are in the sector 230^0 to 260^0 from the Aerodrome Reference Point (ARP).

The LSALT of 2900ft over the DWF is below the 25nm sector MSA of 3000ft and the 10nm MSA of 3900ft.

The DWF does not impact the 10nm and 25nm MSA for YLTV.

4.4.2.1 *YLTV RNAV RWY 03 Approach*

The YLTV RNAV RWY 03 non-precision approach passes over the DWF as shown in Figure 4 below.

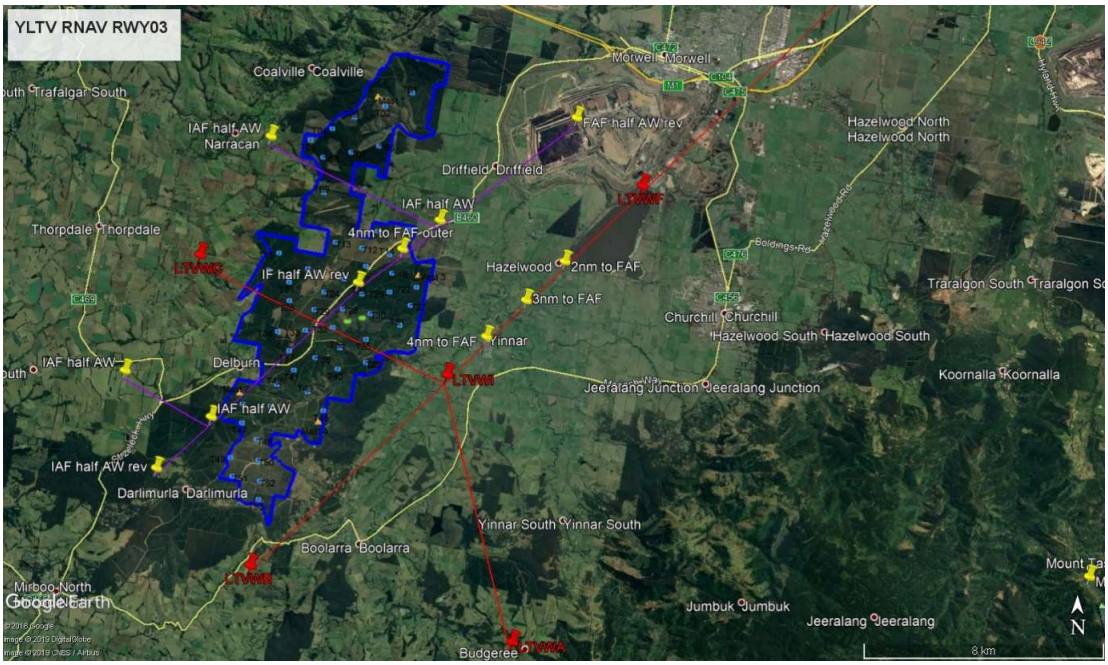


Figure 4 – YLTV RNAV RWY03 overlayed on DWF (Depicted by red line)

The DWF does impact the PANS-OPS prescribed airspace for the YLTV RNAV RWY03 instrument approach.

The instrument approach plate for YLTV RNAV RWY 03 is shown in Figure 5 below.

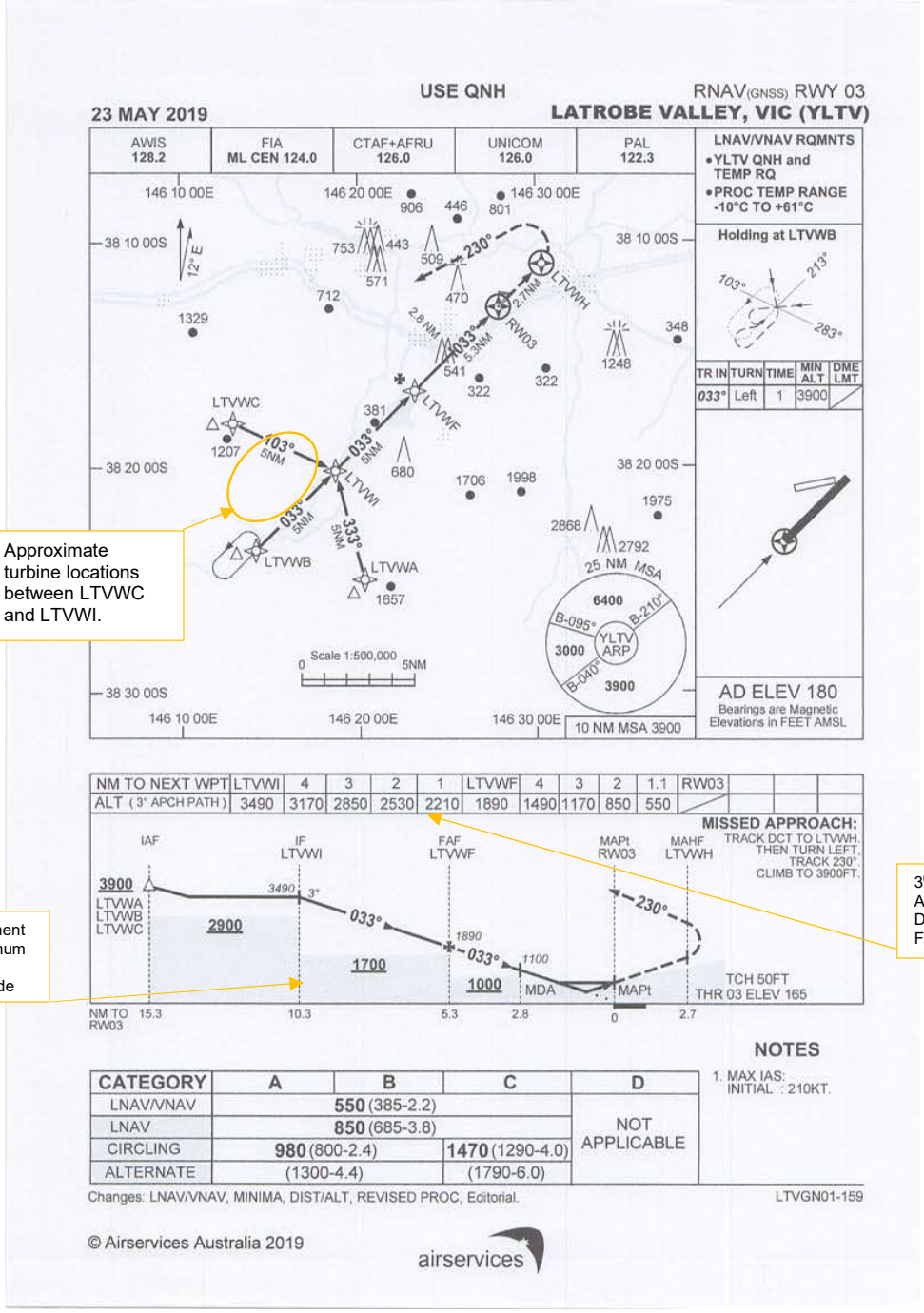


Figure 5 – YLTV RNAV RWY03 Instrument Approach Plate[7]

[7] AIP DAP LTVGN01-159, dated 23 May 2019

From the instrument approach plate the segment minimum safe altitude is 2900ft between the Initial Approach Fixes (IAF) and the Intermediate Fix (IF). The entry altitude at the IAF is 3900ft. The IF crossing altitude is 3490ft.

The tallest turbine is T04 with an LSALT of 2900ft. This turbine is outside the area considered for the segment minimum safe altitude for the IAF to IF section of the approach. The turbines situated below the IAF to IF segment have an LSALT less than 2900ft.

Between the IF and the Final Approach Fix (FAF) the segment minimum safe altitude is 1700ft. There are a number of turbines below this segment. The MOC for this segment of an instrument approach is 500ft. Applying the MOC to the tip heights of the turbines in this area shows there are five (5) turbines with an adjusted tip height greater than 1700ft.

The turbines with an adjusted tip height greater than 1700ft between LTVWI and LTVWF are shown in the table below.

Turbine	Tip Height ft. AHD	Tip height + 500ft MOC	Rounded Up	Dist. from MAPt	ATT nm subtracted	Segment MSA	3^0 App Alt	Dist. to MAPt	New Segment MSA required
T25	1446.85	1946.85	2000	9.66	8.86	1700	2850	8.3	2100
T28	1509.19	2009.19	2100	10.10	9.30	1700	3170	9.3	2100
T30	1459.97	1959.97	2000	10.18	9.38	1700	3170	9.3	2100
T32	1564.96	2064.96	2100	10.47	9.67	1700	3170	9.3	2100
T35	1420.60	1920.60	2000	10.61	9.81	1700	3170	9.3	2100

Table 1 – Turbine tip heights greater than the segment minimum safe altitude

The "rounded up" column shows the turbine tip height plus the MOC of 500ft rounded up to the nearest hundred feet above AHD. The "ATT nm" column shows the turbine distance from the MAPt RWY03 (Missed Approach Point [runway threshold]) adjusted by subtracting the Along Track Tolerance (ATT) of 0.8nm for that segment of an RNAV approach from the distance between the MAPt and the particular turbine. The ATT is subtracted to ensure the obstacle is closest to the lower portion of the 3^0 Approach Path altitude.

The 3^0 approach path altitude between 10.3nm and 9.3nm from the MAPt is 3170ft and between 9.3nm and 8.3nm it is 2850ft.

Turbines T30, T32 and T35 are situated below the 10.3nm to 9.3nm segment. The tallest turbine in this segment, T32 has an adjusted tip height of 2100ft including the MOC, therefore a segment minimum safe altitude of 2100ft provides the required safe clearance. This is below the 3^0 Approach Path Altitude of 3170ft.

Turbines T25 and T28 listed in Table 1 above are within the 9.3nm to 8.3nm segment. The tallest turbine in this segment, T28 has an adjusted tip height of 2100ft including the MOC, therefore a segment minimum safe altitude of 2100ft provides the required safe clearance. This is below the 3^0 Approach Path Altitude of 2850ft.

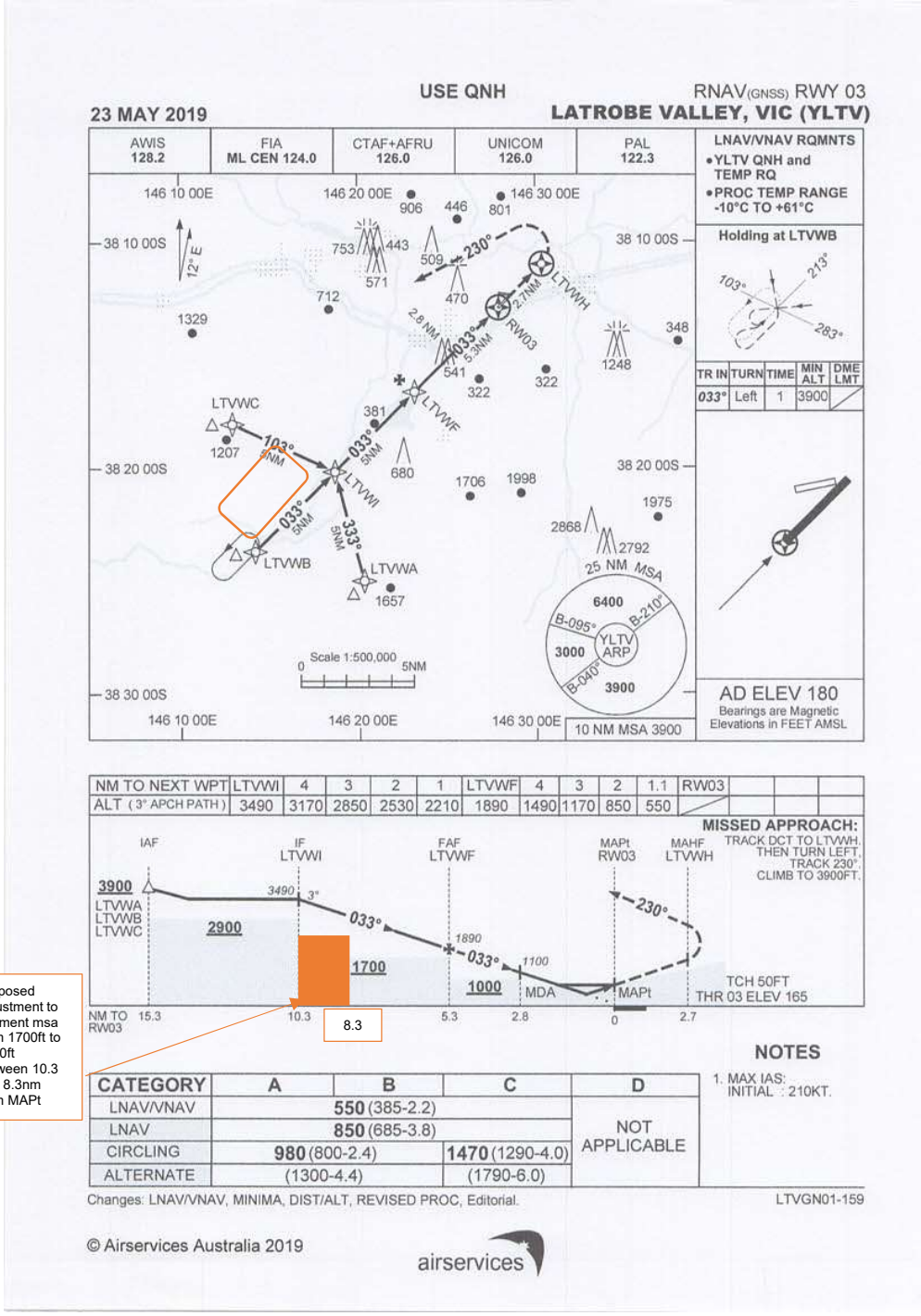
Raising the segment minimum safe altitude between LTVWI and 8.3nm from the MAPt to 2100ft will not affect the 3^0 Approach Path Altitudes. Leaving the segment minimum safe altitude at 1700ft between 8.3nm and 5.3nm (LTVWF) from the MAPt does not affect the 3^0 Approach Path Altitude crossing the FAF of 1890ft at LTVWF. This is depicted in Figure 6.

Amending this segment minimum safe altitude in conjunction with marking the location of the wind farm on the LaTrobe Valley Instrument Approach Plates will ensure pilots are aware of the obstacles below the approach path.

To ensure the DWF does not penetrate the PANS-OPS surface, the following changes to the YLTV RNAV RWY03 instrument approach are required:

- Raise the segment minimum safe altitude between the IF and 8.3nm from the MAPt LTVWM from 1700 to 2100ft.

These amendments, as shown in Figure 6 below, will ensure the Delburn Wind Farm does not penetrate the PANS-OPS surface associated with the LaTrobe Valley RNAV RWY03 instrument approach.



Proposed adjustment to segment msa from 1700ft to 2100ft between 10.3 and 8.3nm from MAPt

Figure 7 – Proposed Amendment to LaTrobe Valley RNAV RWY03 IAP

4.4.2.2 *YLTV NDB Approach*

There is a Non Directional Beacon (NDB) ground based radio navigation aid located at 38 12 09S 146 28 33E which is 0.37nm (685m) North East of the YLTV Aerodrome Reference Point (ARP).

There are 2 NDB Approaches, NDB-A and NDB-C published for YLTV. The NDB-A approach is for Category A and B aircraft utilising an airspeed of 140 knots and has a Circling Minima of 980ft. The NDB-C approach is for Category C aircraft utilising an airspeed of 180 knots and has a Circling Minima of 1470ft.

Both NDB Approaches tack the aircraft overhead the NDB at 3000ft and track outbound to the North Northeast for approximately 6nm before turning inbound on 227^0 toward the NDB. The exit from the turn is at 2000ft for Cat A&B and 2300ft for Cat C aircraft. The inbound track is 227^0 to the MAPt overhead the NDB at 980ft for Cat A&B and 1470ft for Cat C. From the MAPt the overshoot tracks 245^0 and climbs to 3000ft.

The overshoot track takes the aircraft toward turbines T03 and T06.

Turbine	Tip Height ft. AHD	Tip Height + 1000ft MOC	Rounded Up	Dist. from MAPt nm	Brg from MAPt
T03	1712.60	2712.60	2800	10.03	251
T04	1820.87	2820.87	2900	10.5	251
T06	1466.54	2466.54	2500	9.8	278

Table 2 – Turbines near NDB Approach overshoot track

The nearest turbine to the overshoot path is at 8.9nm and has a LSALT of 2600ft. From a circling height of 980ft an aircraft must climb 1620ft in 8.9nm to reach the LSALT over the turbine. There are already several tall structures and a spot height close to the NDB overshoot path between the MAPt and the turbines.

None of the turbines within 10nm of the YLTV NDB penetrate the 3000ft requirement of the overshoot procedure and all are beyond 5nm from the NDB and therefore should not affect the overshoot path of the YLTV NDB Approach.

The DWF does not impact the YLTV NDB approaches.

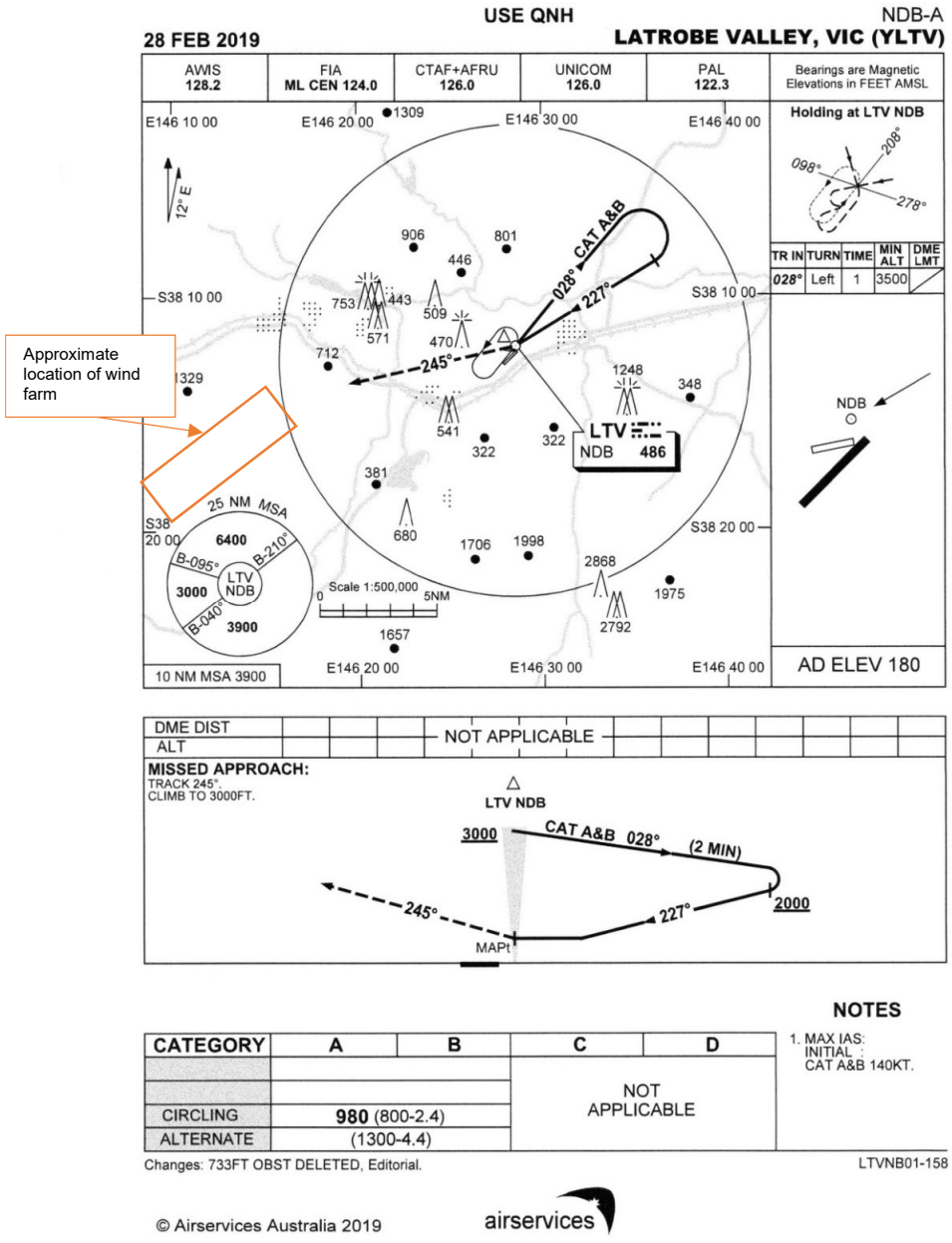


Figure 7 – YLTV NDB-A Plate with approximate Wind Farm Location[8]

[8] Modified AIP DAP, dated 23 May 2019

4.4.3 Leongatha (YLEG)

Leongatha (YLEG) is a significant uncertified aerodrome, or Aircraft Landing Area (ALA) located 19nm (35km) southwest of turbine T49. YLEG is operated by Leongatha Aerodrome Users Pty. Ltd. YLEG has two runways, R18/36 unrated gravel 625m long and R04/22 sealed 925m long. Neither runway is equipped with lights which precludes night operations. As an ALA, YLEG does not have any published instrument approach procedures and does not have an OLS. However, there are recommended obstacle clearance areas published in CAAP 92-1(1) *Guidelines for Aeroplane Landing Areas*.

The DWF, at 35km distant does not impact on these clearance areas.

4.4.4 Other Aerodromes and airstrips

Due to their significance, two aerodromes beyond the 30nm range of the DWF have been assessed.

4.4.4.1 *East Sale RAAF Base*

The East Sale Military Aerodrome (YMES) is located 40.75nm east of the wind farm. The East Sale RAAF Base caters for ab-initio and advanced pilot training, Air Traffic Controller training and is the home of the Roulettes Aerobatic Team. There are extensive Restricted Areas (airspace with restricted access) associated with the East Sale RAAF Base to provide airspace that is restricted to the use of RAAF aircraft for pilot training. East Sale also has a Military ATC Centre to control both military and civil aircraft within the East Sale Controlled Airspace (CTA) and Restricted Areas.

YMES has five instrument approach procedures, all of which are sufficiently distant from the DWF for there to be no impact on their operation or use.

4.4.4.2 *West Sale (YWSL)*

West Sale (YWSL) registered aerodrome is located 32.5nm east north east of the wind farm. YWSL has four instrument approach procedures, all of which are sufficiently distant from the DWF for there to be no impact on their operation or use.

4.5 Air Routes and Lowest Safe Altitudes

The Lowest Safe Altitudes for the air routes in the vicinity of the DWF are shown in the table below.

Route	Segment	LSALT
Grid		3900
Z54	LTV - DAVOS	3900
W219	LTV – HELIX	3900
W219	HELIX – LTV	6500
W283	LTV – CB	7300
W449	BRONS – LTV	3100
W449	LTV – ES	2400
W695	BRONS – ES	4400
W809	MOZZA – ES	6600
V588	LTV – MOZZA	3000

Table 3 – Lowest Safe Altitudes on nearby Air Routes

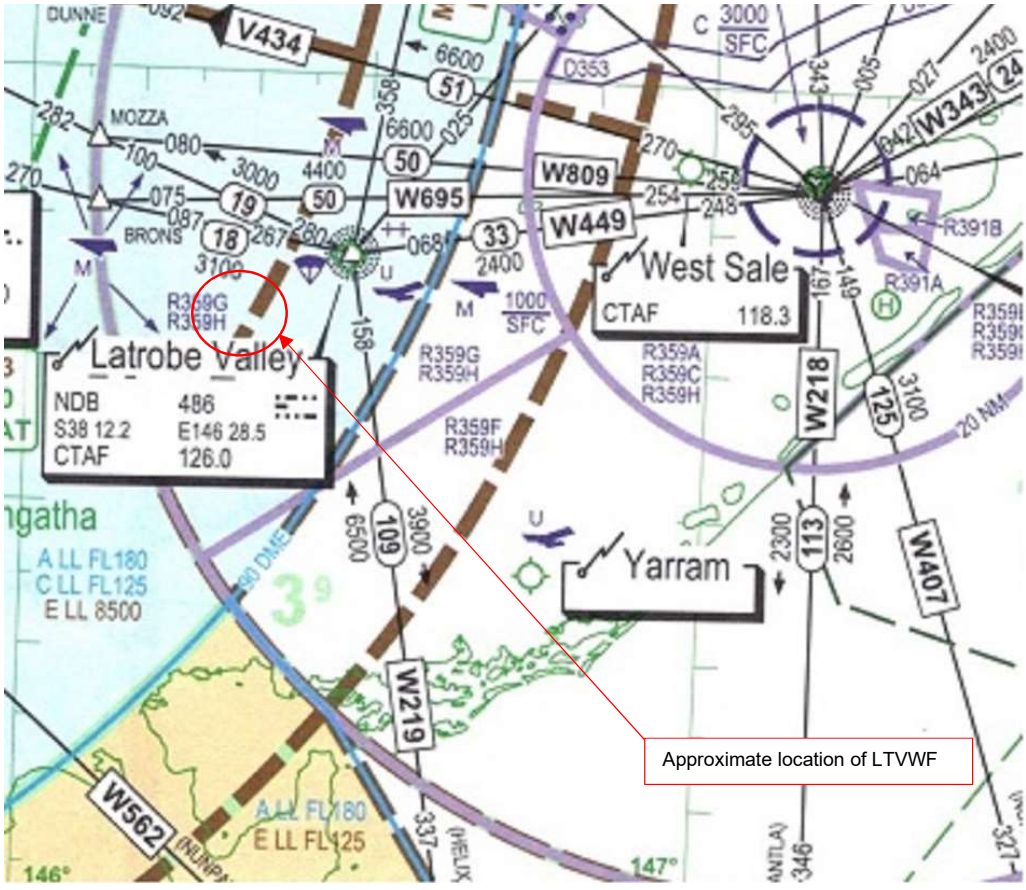


Figure 8 – Air Routes near DWF[9]

[9] AIP ERC L2, dated 8 November 2018

As can be seen from the chart above the wind farm sits below a complex array of air routes associated with arrival and departure from Melbourne.

The proposed turbines have a tip height of 250m (820ft) AGL. The tallest turbine is T04 with a tip height of 555m (1823ft) above the Australian Height Datum (AHD). Adding the required Minimum Obstacle Clearance (MOC) of 1000ft gives a Lowest Safe Altitude (LSALT) of 2823ft. When rounded up to the nearest hundred feet this becomes 2900ft AHD. Air route V588 has a published LSALT of 3000ft for the segment LTV to MOZZA which is the segment closest to the DWF. This LSALT is above that calculated for the DWF. It is noted that W449, for the segment LTV to ES, has a published LSALT of 2400ft. This air route segment is to the east of YLTV and is clear of the proposed wind farm.

The DWF does not impact on any published LSALT for the air routes in the vicinity.

4.6 Airspace

The DWF is in Class G airspace below Class E airspace with a lower limit of 8500ft.

A Military Restricted Area, R359G – Military Flying, sits above the DWF. R359G is activated by NOTAM and has a Lower Limit of 6000ft. Conditional status RA2 whereby pilots must not flight plan through the area unless on a route specified in ERSA GEN FPR or under agreement with the Department of Defence, however a clearance is not assured[10].

The DWF does not penetrate R359G.

There are no published flying training areas in the vicinity of the DWF.

4.7 Communications, Navigation and Surveillance

Wind turbines by their size and construction may cause interference to air traffic control communications, navigation and surveillance (CNS) facilities. Airservices Australia (AsA) recommends the use of the *EuroControl Guidelines on How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors*[11].

The CASR Part 139 Manual of Standards – Aerodromes, Chapter 11, sets out the general requirements for navigation aid sites and air traffic control (ATC) facilities, including the clearance planes for planned and existing facilities.

[10] AIP – DAH PRD-1, dated 8 November 2018

[11] Available at http://www.eurocontrol.int/sites/default/files/publication/files/20140909-impact-wind-turbines-sur-sensors-guid-v1.2.pdf last accessed 10 February 2019.

4.7.1 Communications

The nearest civil Air Traffic Control communications facility is at Mount Tassie, 13.4nm south east of the nearest turbine of the DWF. The Mt Tassie site is at an elevation of 740m (2428ft) AHD. The tallest turbine, T04 has a tip height of 553m (1815ft) AHD. Given the height of the communications facility the DWF should have negligible impact on ATC communications.

There are military ATC communications facilities at Est Sale RAAF Base. Again, given the distance from the DWF to East Sale there should be no impact on RAAF ATC communications. The Department of Defence will make an assessment regarding ATC and other military communications facilities.

4.7.2 Navigation

There are Non-Directional Beacon (NDB) radio navigation aids at YLTV and YMES. There is a TACAN (Tactical Air Navigation system) at YMES.

The NDB at YLTV is 8.9nm (16.5km) from the nearest DWF turbine and is considered sufficiently distant to be unaffected by the wind farm. The Manual of Standards (MOS) Part 139, section 11.1.3 requires that the immediate surroundings to a 150m radius of the antenna be should be kept free of buildings above 2.5m in height[12].

The YMES navigation aids are respectively: - NDB - 41.66nm (77.15km) and TACAN – 41.51nm (76.87km) from the nearest DWF turbine. These navigation aids are considered to be sufficiently distant to be unaffected by the wind farm.

4.7.3 Surveillance (Radar)

The nearest civil ATC radar facility is the Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR) at Gellibrand Hill (Melbourne Airport), 75nm (139km) from the DWF.

The applicable document, as referred to in the Airservices letter, is the Eurocontrol Guidelines *"How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors"* edition 1.2, September 2014 (EUROCONTROL-GUID-130).

This guideline nominates the following four zones and the associated level of assessment for PSR installations.

Zone	Zone 1	Zone 2	Zone 3	Zone 4
Description	0 – 500m	500m 0 15km and in radar line of sight	Further than 15km but within maximum instrumented range and in line of sight	Anywhere within maximum instrumented range but not in line of sight or outside the maximum instrumented range
Assessment Requirements	Safeguarding	Detailed assessment	Simple assessment	No assessment

[12] CASA Manual of Standards Part 139 – Aerodromes version 1.14 January 2017.

The guideline nominates the following three zones for the assessment of SSR.

Zone	Zone 1	Zone 2	Zone 4
Description	0 – 500m	500m – 16km but within maximum instrumented range and in radar line of sight	Further than 16km or not in radar line of sight
Assessment Requirements	Safeguarding	Detailed Assessment	No assessment

Note: There is no Zone 3 for SSR

The Gellibrand Hill PSR and SSR are located well beyond the distance which would require any further assessment and the wind farm will not impact on the performance of the radar systems.

It is assumed that there is an ATC radar facility at YMES. Details of this facility are not known to the author. The Department of Defence will make an assessment regarding their ATC radar and other surveillance facilities.

4.8 AIS Conclusions

The AIS concluded that the DWF will not impact upon the following:

- The OLS of any registered, certified or military aerodrome;
- The LSALT for air routes in the vicinity;
- The YLTV NDB Approach;
- The YYRM Instrument Approach Procedures
- The performance of civil ATC Communications and Navigation Aids;
- The performance of civil surveillance radars.

The DWF will impact on the YLTV RNAV RWY03 and RWY21 Instrument Approach Procedures.

The changes to the RWY03 approach procedure recommended above combined with the raising of RWY21 overshoot LNAV/VNAV minima to 600ft as recommended by Airservices, will ensure the DWF does not penetrate any associated PANS-OPS surfaces.

The Department of Defence has advised that the DWF will not impact upon any of their facilities including at RAAF Base East Sale.

4.9 Airservices Australia Response

The response from Airservices Australia is shown at Appendix C.

The need to amend the RNAV GNSS RWY21 overshoot is noted. The preferred option, as recommended by Airservices Australia is to raise the LNAV/VNAV minima by 50ft to 600ft.

Consultation with LaTrobe Valley Regional Airport will continue. Initial consultation indicated that the Airport Board of Management were willing to consider the changes to the Instrument Approach Procedures. Once consultation is complete the RNAV Non-precision Approach Procedures will be amended to ensure the DWF does not penetrate PANS-OPS surfaces.

4.10 Department of Defence Response

The response from the Department of Defence is shown at Appendix D.

The Department of Defence has no issues or concerns with the proposal as it is some distance from any Defence establishments and 75km from the East Sale RAAF Base.

5. QUALITATIVE RISK ASSESSMENT

The expression “in the vicinity of the aerodrome” is considered by CASA to mean within the boundaries of either the OLS or the PANS-OPS surfaces for a certified or registered aerodrome.

The NASF Guideline D considers 30km (16.2nm) from a certified or registered aerodrome to be “in the vicinity.”

Within Victoria, the Planning Authority refers to aerodromes within 15km (8nm) of a wind farm for consideration.

More generally the impact on any certified or registered aerodrome within 56km (30nm) of a wind farm is considered.

5.1 Certified and Registered Aerodromes

As noted in Section 4.4, there are two registered aerodromes, Yarram (YYRM) and LaTrobe Valley (YLTV), within 30nm (56km) of the proposed DWF.

The DWF does not affect the OLS or PANS-OPS prescribed airspace for Yarram (YYRM) aerodrome.

The DWF does not affect the OLS for YLTV, however minor changes will be required to the non-precision RNAV (GNSS) Instrument Approach Procedures PANS-OPS surfaces as detailed in Section 4.4.2.

Two aerodromes of significance, but beyond 30nm from the DWF are East Sale RAAF Base and West Sale Registered aerodrome. These are referred to in section 4.4.4.

5.2 Uncertified Aerodromes

Leongatha (YLEG) is a significant Uncertified aerodrome (ALA) located 19nm (35km) southwest of the DWF. The DWF, at 35km distant does not affect the operation of YLEG.

5.3 Airspace

The DWF is in Class G airspace below Class E airspace with a lower limit of 8500ft. Above and adjacent to the DWF is Restricted Airspace associated with military flying activity from East Sale RAAF Base. Restricted Area R359G, with a lower limit of 6000ft is above the DWF. The DWF does not penetrate R359G.

There are no published flying training areas in the vicinity of the DWF.

5.4 Relevant Air Routes

Section 4.5 details the published air routes and LSALT in the area of the DWF.

The DWF does not impact the published LSALT for the air routes in the vicinity.

5.5 Night Flying

Aircraft flying at night under either IFR or VFR are protected by published or calculated LSALT. Descent below the LSALT for a VFR at Night flight is restricted to within 3nm (5.4km) of the aerodrome and with it in sight. Where an IFR aircraft is using a published instrument approach it is protected by PANS-OPS surfaces.

Both YLTV and YYRM are equipped with Pilot Activated Lighting (PAL) and non-precision RNAV (GNSS) Instrument Approach Procedures and therefore are available for night operations by aircraft in accordance with both IFR and VFR at Night flights.

Night operations into YYRM are not affected by the DWF.

When the amendments listed in Section 4.4.2 for YLTV have occurred, night operations at YLTV will not be affected by the DWF.

5.6 General Aviation Flying Training

Wind turbines, by their size and colour are considered to be highly conspicuous and therefore not an issue for VFR flight by day. Flying training is conducted in accordance with VFR for the major part of the course. In the latter stages of training student airline pilots progress to night flying in accordance with VFR at Night procedures and then to IFR training. Flying training is usually conducted in light General Aviation (GA) aircraft such as Cessna C182 or Diamond DA40 aircraft. As discussed previously night flying is undertaken at or above the LSALT and therefore is above the DWF.

A flying training organisation at YLTV uses areas to the south and east of the aerodrome with occasional sorties to the north for their student pilot training in both Recreational Aviation Australia (RA-Aus) and GA aircraft. This organisation advised that in times of marginal VMC approaches toward the aerodrome would be from the low terrain to the south and east, not over the hills where the DWF is located.

5.7 Recreational and Sport Aviation

Recreational and Sport aircraft, particularly ultra-lights registered with Recreational Aviation Australia (RA-Aus) are limited to daytime flight in accordance with the Visual Flight Rules (VFR). This requires the aircraft to remain clear of cloud and a minimum of 500ft above the highest obstacle on the ground. Ultra-light aircraft have a Maximum Take-Off Weight (MTOW) of 600kgs or less. A small General Aviation aircraft such as a Cessna C172 has a MTOW of 1110kg. *The photo shows an Australian built Lightwing ultra-light aircraft.*

As noted in Section 5.6 flying training in RA-Aus aircraft is conducted in the same area as GA training, i.e. to the south through east to occasionally the north of the LaTrobe Valley Aerodrome.

5.8 Approved Low Flying Activities

There are no published low level flying training areas nearby to the DWF.

5.9 Aerial Applications Activity

The Aerial Application Association of Australia opposes wind farm developments unless the developer has (inter alia):

- Consulted in detail with local operators;
- Received independent expert advice on safety and economic impacts; and
- Considered the impacts on the aerial application industry.[13]

An aerial application operator made the comment that *"the decision to host wind turbines is one made by the landholder who must accept that there will most probably be limitations to any aerial applications on the property[14]."*

There is some aerial applications activity in the general area, dependent on seasons, crops and pests, however, there is minimal activity in the immediate area of the DWF.

[13] https://aaaa.org.au/policies/
[14] Expert opinion obtained by the author during previous QRA work

Another operator made the comment that *"wind farms are becoming common, they're a fact of life, we know more about them and can operate safely in their vicinity."*[15]

The operators interviewed all consider meteorological monitoring masts to be "killers" because they are very difficult to see. The agreement amongst them was that as a minimum they should be marked in accordance with the NASF Guideline D and that the base around the outer guy wires should be marked in a contrasting colour to the ground.

5.10 Known Highly Trafficked Areas

There are no known highly trafficked areas in the immediate vicinity of the DWF. As noted earlier flying training occurs to the south around to the east of YLTV.

5.11 Emergency Services Flying

All Emergency Services flying is subject to ongoing dynamic risk assessment throughout the flight. The safety of the aircraft and its crew is paramount.

5.11.1 Police Air Wing

The Police Air Wing helicopters are capable of IFR flight and flown by suitably IFR rated pilots who are also qualified for low level flight, for example, search and rescue operations.

From previous work done by the author for other wind farms in Victoria the Police Air Wing utilise dynamic risk assessment for all operations and the pilot in command has the final say as to whether the operation is aborted because of the risk to the aircraft and crew. For low level night operations, the aircraft are equipped with Night Vision Goggles (NVG) enabling the pilot "to see" in reduced light conditions. For the final descent and landing the "night sun" searchlight is used to illuminate the landing area.

5.11.2 Helicopter Emergency Medical Services

The Helicopter Emergency Medical Service (HEMS) utilise helicopters capable of IFR flight. For low level night operations, the aircraft are equipped with NVG enabling the pilot "to see" in reduced light conditions. For the final descent and landing the "night sun" searchlight is used to illuminate the landing area. All HEMS operations are subject to a dynamic risk assessment and the pilot in command has the final say as to whether the operation is aborted due to the risk to the aircraft and crew. *"There are lots of them*

[15] Stakeholder interview with aerial agricultural applications operator for Border Air.

(wind farms) around and we are conscious of their locations. The presence of a wind farm will not stop our operations, we know they are there and fly accordingly."[16] The presence of tall obstacles influences the cruising level of the helicopters in known aircraft icing conditions due to the capabilities of the aircraft anti-icing equipment.

5.11.3 Fixed Wing Air Ambulance

Fixed wing Air Ambulance operations in Victoria are undertaken in twin engine turbo-prop aircraft in accordance with IFR. The aircraft are usually Beechcraft Super Kingair (BE200) which have a MTOW of 5700kg and use suitable aerodromes. The primary use of these aircraft is for patient transfer from regional to major city hospitals. The DWF will not affect fixed wing Air Ambulance operations due to the nature of the operations and the aircraft size. *"The wind farm does not need lights. In solid IMC (Instrument Meteorological Conditions) you can't see them (the lights)."*[17]

5.12 Fire Fighting

Firefighting is a multi-faceted operation utilising multiple resources and equipment appropriate to the circumstances. A fire ground is a dynamic place where resources are continually being reassigned to have the best effect. Aerial firefighting is just one of the resources available and its use may or may not be appropriate to the current fire ground situation. There will be times when aerial firefighting is not possible due to turbulence, smoke, strong wind or erratic fire behaviour.

5.12.1 Aerial Firefighting

At all times the pilot in command has the ultimate responsibility for the safety of the aircraft.[18]

Aerial firefighting flying is conducted at low level using specialist aircraft flown by appropriately rated pilots in accordance with the Visual Flight Rules. The pilot is required to maintain forward visibility with the ground, therefore they will remain clear of smoke so that they can accurately and safely drop the fire retardant.

"It is important to remember that aircraft alone do not extinguish fires."[19]

[16] Stakeholder interview Senior Base Pilot, HEMS Victoria.

[17] Stakeholder interview Senior Base Pilot, Pelair, Fixed Wing Air Ambulance Victoria

[18] A point reiterated in an interview by the author with a Victorian Forest Fire Management Fire Ground Manager, 6 August 2019. This is part of the Civil Aviation Regulations 1988.

[19] NSW Rural Fire Service submission to the Senate Select Committee on Wind Turbines, 6 March 2015, page 2

From previous work undertaken by the author regarding firefighting within wind farms it is noted that the rural firefighting agencies in Victoria, New South Wales, South Australia and Western Australia all view wind turbines and wind farms to be 'just another hazard' that has to be considered in the risk management process associated with aerial firefighting.

The State rural firefighting agencies made submissions to the Senate Select Committee on Wind Turbines. These submissions attached the Australian Fire and Emergency Service Authorities Council (AFAC) *Wind Farms and Bushfire Operations Position Paper 30 October 2014* document. See Appendix E for a copy of this paper.

The AFAC paper states:

> *"Aerial firefighting operations will treat the 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."*[20]

All these agencies make the point that firefighting aircraft operate to the Visual Flight Rules so can only operate during daylight hours and must remain clear of smoke in order to maintain the required visibility of the ground and obstacles such as trees, power lines, radio masts, houses and ground based fire fighters. The Victorian Country Fire Authority (CFA) recommends:

> *"… … a minimum distance between turbines of 300 metres. This provides adequate distance for aircraft to operate around a wind energy facility given the appropriate weather and terrain conditions. Fire suppression aircraft operate under the 'Visual Flight Rules'. As such, fire suppression aircraft only operate in areas where there is no smoke and can operate during the day or night."*[21]

There have been trials of night flying for aerial firefighting conducted in Victoria. At present there only two organisations authorised by CASA to conduct aerial firefighting at night. Both organisations utilise specific helicopters equipped for night flight that are flown as a two-pilot operation who are both appropriately rated. Night aerial firefighting is not currently undertaken by fixed wing aircraft.

The South Australian Country Fire Service has published a fact sheet titled *Aerial Firefighting* which explains the use and limitations of aircraft in firefighting. The major

[20] AFAC *Wind Farms and Bushfire Operations Position version 2.0 30 October 2014, page 2*
[21] CFA Guidelines for Renewable Energy Facilities, February 2019 section 5.1.2

point made is that:

> *"Although aircraft are often the most visible part of the response to fire, and therefore believed to be the most important, almost all fires are still extinguished by ground crews.[22]"*

A further point made by the CFS is that firefighting aircraft

> *"… may not be able to fly if wind speeds are too high, dust or smoke covers the fire, or when daylight is fading.* and
>
> *Firefighting aircraft will be grounded if Remotely Piloted Aircraft (drones) are flown without permission over the fireground."*

See Appendix F for a copy of the fact sheet.

5.12.2 Ground Based Firefighting

The Delburn Wind Farm is located within HVP's Thorpdale Tree Farm, a large forest plantation.

Ground based firefighting is comprehensively covered in the Bushfire Risk Assessment.

5.13 Topographical and Marginal Weather Conditions

The LaTrobe Valley region of Victoria is known for having morning fog, low cloud and reduced visibility during the winter. This creates marginal to Non-Visual Meteorological Conditions (Non-VMC). VMC are the weather conditions required for VFR flight at or below either 3000ft AMSL or 1000ft AGL, namely: -

- Clear of cloud;
- In sight of the ground or water; and
- With a forward visibility of 5000m[23].

The rules governing VFR flight require that pilots remain clear of cloud and not get into such situations by turning away from the low cloud and terminating the flight at the nearest suitable aerodrome.

Aircraft operating under Instrument Flight Rules (IFR) can operate in poor weather conditions and in cloud which precludes visual acquisition of obstacles and terrain. These operations are protected by PANS OPS surfaces and LSALT's that are designed to keep the aircraft clear of obstacles and terrain.

Otherwise CAR 157 states (in part) that an aircraft operating under VFR must not fly lower than 152m/500ft over a non-populated area being terrain or obstacles on that

[22] SA CFS Fact Sheet *Aerial Firefighting,* July 2019

[23] AIP ENROUTE, page ENR 1.2 – 4 date 9 NOV 2017. http://www.airservicesaustralia.com/aip/current/aip/enroute.pdf last accessed 25 January 2018

terrain and within, for an aircraft other than a helicopter, 600m horizontally and, in the case of a helicopter, 300m horizontally to the same, unless:

- Due stress of weather or any other unavoidable cause it is essential that a lower height be maintained; or
- It is engaged in approved low flying private or aerial work; or
- It is engaged in flying training and flies over part of a flying training area in respect of which low flying is authorised by CASA under sub regulation 141(1); or
- It is undertaking a baulked approach; or
- It is flying in the course of actually taking-off or landing at an aerodrome.

In regard to the first bullet point above it is possible that due to lowering cloud base, and if through poor airmanship the aircraft had pressed on to the point that it was unable to execute a turn and fly away from the weather, an aircraft could find itself lower than 152m/500ft above the terrain or obstacles. The operative word is unavoidable. Flying into marginal or non VMC weather is entirely avoidable. It should be noted that a non-instrument rated pilot endeavouring to fly in cloud almost always has a fatal outcome[24].

Marginal VMC in the LaTrobe Valley, with low cloud and fog during winter, is an issue that local operators are very aware of. As noted earlier approach into YLTV is conducted over the low ground to the south and east of the aerodrome.

5.14 NASF Guidelines

The National Airports Safeguarding Framework – Guideline D *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers* provides guidance for the siting and marking of the turbines and meteorological monitoring towers associated with wind farms.

5.14.1 Notification to Authorities

Paragraph 20 of Guideline D advises that:

> *When wind turbines over 150m above ground level are to be built within 30km (16.2nm) of a certified or registered aerodrome, the proponent should notify the Civil Aviation Safety Authority and Airservices. If the wind farm is within 30km of a military aerodrome, Defence should be notified.*

The turbines are greater than 150m and are not within 30km of a military, certified or registered aerodromes.

[24] Accidents involving Visual Flight Rules pilots in Instrument Meteorological Conditions, Australian Transport Safety Bureau, 22 August 2019, available at http://www.atsb.gov.au/publications/2019/avoidable-accidents-4-vfr-into-imc/ last accessed 30 Sep 2019

The turbines and meteorological monitoring towers used in the DWF must be reported to Airservices Australia and the RAAF in accordance with AC 139-08(1) *Reporting of Tall Structures* to ensure their position is marked on aeronautical charts.

5.14.2 Risk Assessment

The NASF Guideline has the following requirements for a risk assessment.

> *26. Following preliminary assessment by an aviation consultant of potential issues, proponents should expect to commission a formal assessment of any risks to aviation safety posed by the proposed development. This assessment should address any issues identified during stakeholder consultation.*

The risk assessment for the DWF indicates that the overall risk to aviation is LOW. A risk assessment of LOW indicates that the wind farm is *'not a hazard to aircraft safety'.*

> *27. The risk assessment should address the merits of installing obstacle marking or lighting. The risk assessment should determine whether or not a proposed structure will be a hazardous object. CASA may determine, and subsequently advise a proponent and relevant planning authorities that the structures have been determined as:*
>
> *(a) Hazardous but that the risks to aircraft safety would be reduced by the provision of approved lighting and/or marking; or*
>
> *(b) Hazardous and should not be built, either in the location and/or to the height proposed as an unacceptable risk to aircraft safety will be created; or*
>
> *(c) Not a hazard to aircraft safety.*

By day the DWF turbines are conspicuous by their size and colour. The DWF does not impact on any LSALT in the area. Night operations for aircraft do not occur below the LSALT for IFR and VFR at night. IFR aircraft are protected by the LSALT and PANS-OPS prescribed airspace at each aerodrome. Where an approach to land is undertaken operating to VFR at night, descent below the LSALT does not occur until within 3nm of the airport and in VMC.

Given the above, the DWF does not require obstacle lighting as the risk to aviation is LOW and no additional mitigating strategies are required.

Overall the risk assessment demonstrates that the DWF is a LOW risk to aviation and is therefore *not a hazard to aircraft safety.*

> *28 If CASA advice is that the proposal is hazardous and should not be built, planning authorities should not approve the proposal. If a wind turbine will penetrate a PANS-OPS surface, CASA will object*

> *to the proposal. Planning decision makers should not approve a wind turbine to which CASA has objected.*

The DWF does not penetrate any OLS or PANS-OPS surfaces either civil or military, therefore CASA has no reason to determine that it is hazardous.

> *29 In the case of military aerodromes, Defence will conduct a similar assessment to the process described above if required. Airservices, or in the case of a military aerodrome, Defence, may object to a proposal if it will adversely impact on Communications, Navigation or Surveillance (CNS) infrastructure. Airservices/ Defence will provide detailed advice to proponents on request regarding the requirements that a risk assessment process must meet from the CNS perspective.*

There is no civil or known military CNS infrastructure that will be impacted by the DWF.

> *30 During the day, large wind turbines are sufficiently conspicuous due to their shape and size, provided the colour of the turbine is of a contrasting colour to the background. 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. Other colours are also acceptable, unless the colour of the turbine is likely to blend in with the background.*

The DWF turbines will be appropriately coloured to ensure they are conspicuous by day.

5.14.3 Lighting of Wind Turbines

> *33 Where a wind turbine 150m or taller in height is proposed away from aerodromes, the proponent should conduct an aeronautical risk assessment.*
>
> *34. The risk assessment, to be conducted by a suitably qualified person(s), should examine the effect of the proposed wind turbines on the operation of aircraft. The study must be submitted to CASA to enable an assessment of any potential risk to aviation safety. CASA may determine that the proposal is:*
>
> > *(a) hazardous, but that the risks to aircraft safety would be reduced by the provision of approved lighting and/or marking; or*
> >
> > *(b) not a hazard to aircraft safety.*

As noted earlier, pilots flying IFR consider that obstacle lights on the DWF are not required because:

- In “solid IMC” they cannot be seen; and

- In light cloud or light fog, they "flare" and distract the pilot.[25]

The DWF does not penetrate any OLS or PANS-OPS airspace, once the changes are made to the YLTV RNAV-Z non-precision approach; therefore, it is assessed as a LOW risk to aviation and is therefore *not a hazard to aircraft safety.*

[25] Stakeholder interviews with experienced IFR pilots.

5.15 QRA Findings

Risk Element	Assessed Level of Risk	Comment
Airport Operations	LOW	
Aircraft Landing Area Operations	LOW	Suitability for use is a pilot responsibility.
Known Highly Trafficked Routes	LOW	None identified
Published Air Routes	LOW	Nil impact
Restricted Airspace	LOW	Below and clear of R265D
Promulgated Flying Training Areas	LOW	Nil exist in the area
GA Flying	LOW	
Night Flying	LOW	
Emergency Services Flying	LOW	
Commercial Flying	LOW	
Recreational and Sport Aviation	LOW	
Recreational Pilot Training (RA-AUS)	LOW	
GA Pilot Training	LOW	
Weather and Topographical Issues	LOW	

Table 2 – Risk Assessment Summary

6. OBSTACLE LIGHTING REVIEW

6.1 Australian regulatory Framework for Obstacle Lighting of Wind Farms

The Civil Aviation Safety Authority (CASA) has limited regulatory authority to require the lighting of obstacles (tall structures) away from an aerodrome. This is particularly applicable to wind farms, which are generally beyond the Obstacle Limitation Surface (OLS) of certified or registered aerodromes. It must be noted that Civil Aviation Safety Regulations (CASR) Part 139 – Aerodromes are applicable to certified and registered aerodromes only [Military and Joint User apply the same general form].

CASA can only make recommendations regarding the lighting of wind farms, and not determinations/directions mandating lighting of wind farms that are not in the vicinity [beyond the OLS] of a certified or registered aerodrome. It is noted that in the Senate Select Committee on Wind Turbines (2015) CASA provided evidence to the Committee about the limited role it plays in regulating airspace around wind farms.

> *We know our responsibilities and the power of our legislation, which is very limited. For the most part, wind turbines are built away from aerodromes and certainly away from federally leased aerodromes. So the only power we have is to make a recommendation to the planning authority about whether the turbine is going to be an obstacle and, if we decide it is an obstacle, we can*

make a recommendation as to whether it should be lighted and marked. This is the extent of our power.[26]

In my experience, CASA has emphasised the view that "*it is a matter for the appropriate Land Use Planning Authority to consider the implementation of our recommendations"* regarding aviation obstacle lighting of wind farms.

6.1.1 Civil Aviation Safety Regulations

The Civil Aviation Safety Regulations (CASR) Part 139 – Aerodromes, Section E contains the regulations governing obstacles. These regulations are applicable to the protection of airspace and aircraft operations in the vicinity of certified or registered aerodromes. They are not applicable to obstacles that are beyond the vicinity of aerodromes; that is, beyond the OLS.

6.1.2 Manual of Standards Part 139 – Aerodromes

The Manual of Standards (MOS) Part 139 provides amplification and methods of compliance to the CASR Part 139 Aerodromes. As the Delburn Wind Farm is beyond the vicinity of any military, certified or registered aerodrome MOS 139 does not apply.

6.1.3 National Airports Safeguarding Framework

The Australian National Airports Safeguarding Advisory Group (NASAG) produced a set of guidelines called the National Airports Safeguarding Framework (NASF) in 2012.

The purpose of the National Airports Safeguarding Framework (the Safeguarding Framework) is to enhance the current and future safety, viability and growth of aviation operations at Australian airports, by supporting and enabling:

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

Guideline D *Managing the Risk to Aviation Safety of Wind Turbine Installations [Wind Farms] / Wind Monitoring Towers* provides information regarding wind farms. This guideline provides the following information: -

> *20 When wind turbines over 150m above ground level are to be built within 30km (16.2nm) of a certified or registered aerodrome, the*

[26] Senate Select Committee on Wind Turbines, Final Report, August 2015, paragraph 5.38

proponent should notify the Civil Aviation Safety Authority and Airservices. If the wind farm is within 30km of a military aerodrome, Defence should be notified.

33 Where a wind turbine 150m or taller in height is proposed away from aerodromes, the proponent should conduct an aeronautical risk assessment.

34. The risk assessment, to be conducted by a suitably qualified person(s), should examine the effect of the proposed wind turbines on the operation of aircraft. The study must be submitted to CASA to enable an assessment of any potential risk to aviation safety. CASA may determine that the proposal is:

(a) hazardous, but that the risks to aircraft safety would be reduced by the provision of approved lighting and/or marking; or

(b) not a hazard to aircraft safety.

The DWF does not penetrate any OLS or PANS-OPS, once the changes are made to the YLTV RNAV-Z non-precision approach airspace; and is assessed as a LOW risk to aviation and is therefore *not a hazard to aircraft safety.*

Given the above, the DWF does not require obstacle lighting as the risk to aviation is LOW and no additional mitigating strategies are required.

6.2 Obstacle Lighting Summary

The DWF does not penetrate any OLS or PANS-OPS, once the changes are made to the YLTV RNAV-Z non-precision approach airspace; and is assessed as a LOW risk to aviation and is therefore *not a hazard to aircraft safety.*

This Risk Assessment finds that the overall risk to aviation in the area of the DWF is LOW; therefore, the DWF is *not a hazard to aircraft safety* and no further mitigation is required.

The DWF does not require obstacle lighting as the risk to aviation is LOW and no additional mitigating strategies are required.

7. WIND MONITORING TOWERS

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.

The photograph in Fig 7 shows a Meteorological Monitoring Mast as seen from the ground.

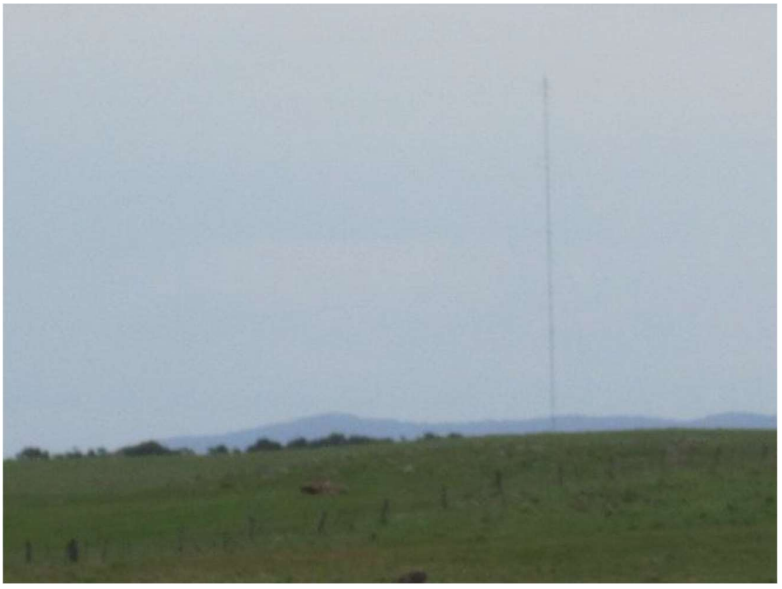


Figure 7 – A Meteorological Monitoring Mast photographed from the ground

The aerial application operators and the emergency services pilots all note the danger of meteorological monitoring masts to low flying aircraft. All these pilots made comment that "met masts are extremely dangerous." Each of these stakeholders requested 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.

The aerial application pilots all requested that the outer guy wire ground anchor points be painted a contrasting colour to enhance their visibility. When low flying, particularly when spraying, the pilot is looking at the ground as their reference point. The contrasting ground anchor point is the most valuable visual cue in this situation.

It is generally considered by aerial agricultural pilots that a flashing strobe light is ineffective and as such should not be used.

All the markings used to make the masts more visible must be maintained in a serviceable condition. This is particularly important for balls, flaps and sleeves that deteriorate due to wind and sun damage.

7.1 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.*

The aerial applications and emergency services pilots interviewed by the author all make the point that the flashing strobe light does little to make the mast more visible and therefore is unnecessary.

7.2 Federal Aviation Administration – Marking of Met Towers

It is noted that the Federal Aviation Administration (FAA) has issued guidance material for the marking of Meteorological Evaluation Towers (METS) of less than 200ft (61m) in height to enhance visibility to low flying aircraft. The FAA recommends that the entire tower be painted in alternating contrasting bands of colour, the guy wires have high visibility balls or sleeves and that the markings are replaced when faded or otherwise deteriorated.

7.3 Reporting of Tall Structures

The turbines proposed for the DWF have a tip height of 250m (820ft) AGL; therefore, they must be reported as per CASR 175.480.

CASR Part 175E requires that obstacles having a height of 100m AGL (turbines and meteorological monitoring masts) be reported as tall structures for inclusion in the vertical obstacle database and on appropriate aeronautical charts.

The procedure for reporting tall structures is contained in Advisory Circular AC 139-08 *Reporting of Tall Structures*[27].

Meteorological Monitoring Masts for the DWF must also be reported as per AC 139-08 and to the Aerial Agricultural Association of Australia (admin@aaaa.org.au).

Consideration should be given to ensuring a NOTAM that provides the height and location of the structure is issued. This is due to the current lead time between reporting tall structures and the information appearing on aeronautical charts.

[27] Advisory Circular AC 139-08 v2.0 March 2018 available at https://www.casa.gov.au/files/139c08pdf

The DWF presently has one appropriately marked met mast erected. The location of this mast is notified by NOTAM. The location of this mast has been notified to Airservices Australia, the LaTrobe Valley Aerodrome Operator, the Aerial Agricultural Association of Australia and the Leongatha Aerodrome Operator.

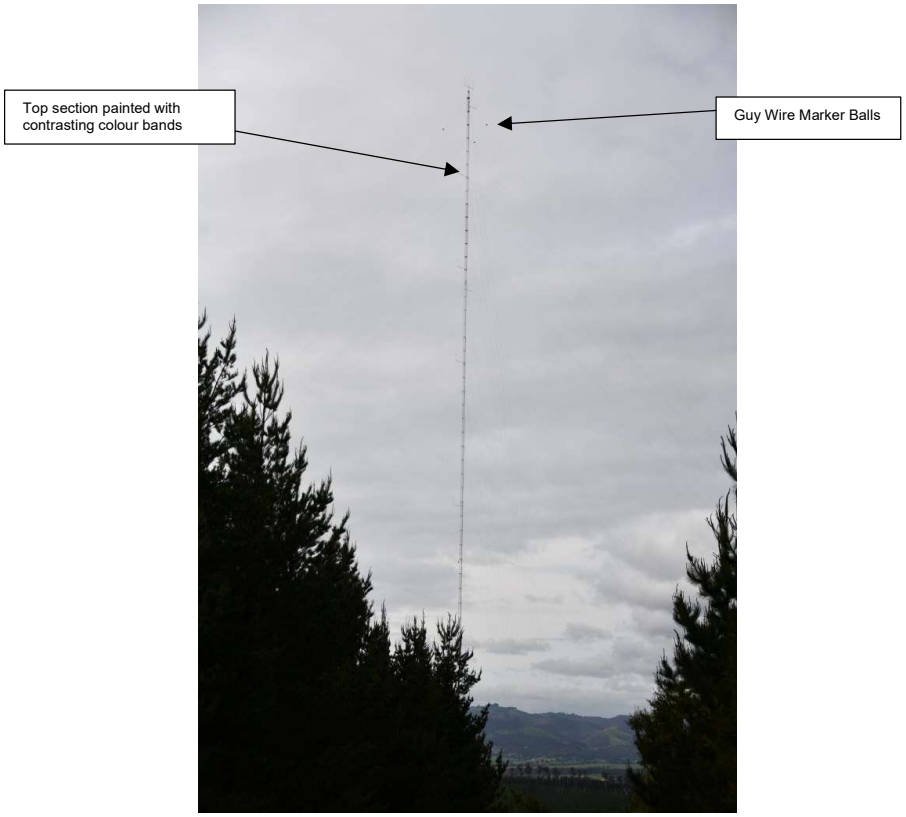


Figure 8 – A Meteorological Monitoring Mast in the DWF

7.4 Recommendations

It is recommended that Delburn Wind Farm Pty Ltd ensure that future wind monitoring towers used in the DWF are:

- Appropriately marked as per guidelines above except for strobe light;
- Reported as tall structures in accordance with AC139-08;
- Notified to the Aerial Application Association of Australia;
- Subject to a NOTAM specifying their location and height.

8. CONCLUSIONS – AERONAUTICAL IMPACT ASSESSMENT

8.1 Aviation Impact Statement

The AIS concluded that the DWF will not impact upon the following:

- The OLS of any registered, certified or military aerodrome;
- The LSALT for air routes in the vicinity;
- The YLTV NDB Approach;
- The YYRM Instrument Approach Procedures;
- The performance of civil ATC Communications, Navigation and Surveillance facilities.

The DWF will impact on the YLTV RNAV RWY03 and RWY 21 Instrument Approach procedures.

However, the changes to the approaches recommended above will ensure the DWF does not penetrate any PANS-OPS surfaces associated with this instrument approach. Consultation with the LaTrobe Valley Regional Airport Operator is ongoing.

The Department of Defence has advised that the DWF will not impact on any of their facilities including RAAF Base East Sale.

8.1.1 Airservices Response to AIS

The response from Airservices Australia is shown at Appendix C.

The RNAV GNSS Approaches for both RWY 03 and RWY 21 need minor amendment. The RWY 03 Approach requires the Segment Minimum Altitude between LTVWI and 2nm after LTVWI to be raised to 2000ft. Thence the minimum altitude will be 1700ft. The RNAV GNSS RWY 21 overshoot will need the preferred option of raising the LNAV/VNAV minima by 50ft to 600ft.

Consultation with LaTrobe Valley Regional Airport will continue. Initial consultation indicated that the Airport Board of Management were willing to consider the changes to the Instrument Approach Procedures. Once consultation is complete the RNAV Non-precision Approach Procedures will be amended to ensure the DWF does not penetrate PANS-OPS surfaces.

8.1.2 Department of Defence Response to AIS

The response from the Department of Defence is shown at Appendix D. The Department of Defence has no issues or concerns with the proposal as it is some distance from any Defence establishments and 75km from the East Sale RAAF Base.

8.2 Risk Assessment

The QRA demonstrates that the DWF will *"not be a hazard to aircraft safety"* and therefore *"not of operational significance"* to aircraft operations.

8.3 Obstacle Lighting

The DWF turbines have a tip height of 250m AGL and therefore can be regarded as an obstacle and be subject to a Risk Assessment to ascertain whether they constitute a hazard to aviation safety.

The Risk Assessment finds that the overall risk to aviation in the area of the DWF is LOW. On this basis no further mitigation is required.

Obstacle lighting is not required.

8.4 Met Masts

Meteorological Monitoring Masts used on the DWF s have the:

- Top one third painted in alternating contrasting colour bands;
- Outer guy wires fitted with marker balls, high visibility flags or sleeves; and
- Outer guy wire ground attach points painted in contrasting colour.

8.5 Reporting Tall Structures

The DWF wind turbines and meteorological monitoring masts are considered to be tall structures, therefore they must be reported to the Vertical Obstacle Database, managed by Airservices Australia. The procedure for reporting tall structures is contained in Advisory Circular AC 139-08 V2.0.

Consideration should be given to ensuring a NOTAM that provides the height and location of the structures is issued.

The installed DWF wind monitoring tower has been reported to the Vertical Obstacle Database and is the subject of a NOTAM.

.

APPENDIX A

Airservices Australia

Aviation Assessments for Wind Farm Developments

October 2019

APPENDIX A

airservices

To Whom It May Concern

Airservices Aviation Assessments for Wind Farm Developments

Guidelines to manage the risk to aviation safety from wind turbine installations (Wind Farms/Wind Monitoring Towers) have been developed 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.

The wind farm guidelines provide information to proponents and planning authorities to help identify any potential safety risks posed by wind turbine and wind monitoring installations from an aviation perspective.

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

To facilitate these assessments all wind farm proposals submitted to Airservices must include an Aviation Impact Statement (AIS) prepared by an aeronautical consultant in accordance with the AIS criteria set out below.

AIS must be undertaken by an aeronautical consultant with suitable knowledge and capabilities to provide a reliable and comprehensive report. All data is to be supplied in electronic form. If you are not familiar with any aeronautical consultants, you may wish to view the member directory on the Australian Airports Association (AAA) website:

https://www.airports.asn.au/public/member-directory

AIS Criteria

The AIS must provide a detailed analysis covering, as a minimum:

Airspace Procedures:

1. Obstacles
   - Co-ordinates in WGS 84 (to 0.1 second of arc or better)
   - Elevations in metres (m) Australia Height Datum (AHD) (to 0.3m)
2. Drawings
   - Overlayed on topographical base not less than 1:250,000. Details of datum and level of charting accuracy to be noted.
   - Electronic format compatible with Microstation version V8i.
3. Aerodromes
   - Specify all registered/certified aerodromes that are located within 30NM (55.56km) from any obstacle referred to in (1) above.
   - Nominate all instrument approach and landing procedures at these aerodromes.

connecting australian aviation

- Confirmation that the obstacles do not penetrate Annex 14 or Obstacle Limitation Surface (OLS) for any aerodrome. If an obstacle does penetrate, specify the extent.

4. Air Routes
   - Nominate air routes published in ERC-L & ERC-H which are located near/over any obstacle referred to in (1) above.
   - Specify two waypoint names located on the routes which are located before and after the obstacles.
5. Airspace
   - Airspace classification – A, B, C, D, E, G etc where the obstacles are located.

Navigation/Radar:

1. Detect the presence of dead zones
2. False target analysis
3. Target positional accuracy
4. Probability of detection
5. Radar coverage implications
6. We would expect the analysis to follow the guidelines outlined in the latest version of the EUROCONTROL Guidelines on How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors:

   https://www.eurocontrol.int/tags/guidelines

NOTE: Within the Eurocontrol Guidelines there are specific assumptions about the type of wind turbine for which the Guidelines are applicable (i.e. 3 blades, 30-200 m height, and horizontal rotation axis). For any deviations to the wind turbine characteristics listed within the Eurocontrol Guidelines, the proponent should justify to Airservices why these Guidelines are still applicable.

Airservices Review of AIS

Airservices will review the quality and completeness of an AIS and will undertake limited modelling and analysis to confirm the findings and recommendations of the report.

Provided the AIS is of sound quality and is complete in accordance with the above criteria, there is currently no charge for the review or limited modelling and analysis.

If the AIS is not of sound quality or is not complete in accordance with the above criteria, no modelling or analysis will be undertaken. Airservices will advise the proponent that the AIS does not meet the requirements and that the proposal cannot be assessed by Airservices.

If Airservices review of an AIS confirms impacts identified in the report (or identifies additional impacts), Airservices will advise the proponent of the impacts and the required mitigating actions (where mitigation is feasible). The proponent will also be advised that there will be charges for any mitigation actions to be undertaken by Airservices.

These charges may be advised at the time but it is likely that a detailed quote will be needed and this will only be provided on request from the proponent.

Please contact the Airport Developments Team on 03 9339 2182 or airport.developments@airservicesaustralia.com if you have any questions.

Current as at October 2019

APPENDIX B

Turbine Locations and Heights

APPENDIX B

ID	Easting	Northing	Latitude	Longitude	Base Elev	Tip Height	Tip Height (ft)	Add MOC	LSALT	Tip plus 500ft	Rounded
T03	436525	5765561	-38.25573679	146.274506	272	522	1712.60	2712.60	2800	2212.60	2300
T04	435750	5765156	-38.25933146	146.265612	305	555	1820.87	2820.87	2900	2320.87	2400
T05	435296	5764592	-38.26438149	146.2603716	299	549	1801.18	2801.18	2900	2301.18	2400
T06	437495	5764699	-38.26357297	146.2855158	197	447	1466.54	2466.54	2500	1966.54	2000
T07	436473	5764438	-38.26585333	146.273811	237	487	1597.77	2597.77	2600	2097.77	2100
T08	435544	5763978	-38.26993253	146.2631503	238	488	1601.05	2601.05	2700	2101.05	2200
T09	435470	5762948	-38.2792093	146.2622105	222	472	1548.56	2548.56	2600	2048.56	2100
T12	436508	5761045	-38.29643265	146.2739065	178	428	1404.20	2404.20	2500	1904.20	2000
T14	437790	5761008	-38.29685591	146.2885632	177	427	1400.92	2400.92	2500	1900.92	2000
T15	433800	5760517	-38.30099504	146.2428909	243	493	1617.45	2617.45	2700	2117.45	2200
T16	437282	5760458	-38.30177698	146.2827053	177	427	1400.92	2400.92	2500	1900.92	2000
T17	434760	5760476	-38.30143487	146.2538655	203	453	1486.22	2486.22	2500	1986.22	2000
T20	436493	5760073	-38.30519097	146.2736477	217	467	1532.15	2532.15	2600	2032.15	2100
T21	434216	5759907	-38.30652276	146.2475914	205	455	1492.78	2492.78	2500	1992.78	2000
T24	435788	5759640	-38.30904283	146.2655456	218	468	1535.43	2535.43	2600	2035.43	2100
T25	437408	5759641	-38.30914837	146.2840738	191	441	1446.85	2446.85	2500	1946.85	2000
T28	436532	5759218	-38.31289873	146.2740169	210	460	1509.19	2509.19	2600	2009.19	2100
T29	435389	5759043	-38.31439413	146.2609276	235	485	1591.21	2591.21	2600	2091.21	2100
T30	437040	5758715	-38.31746744	146.2797824	195	445	1459.97	2459.97	2500	1959.97	2000
T32	435954	5758492	-38.3194001	146.26734	227	477	1564.96	2564.96	2600	2064.96	2100
T33	434976	5758338	-38.32071748	146.2561388	239	489	1604.33	2604.33	2700	2104.33	2200
T34	434051	5758153	-38.32231705	146.2455406	208	458	1502.62	2502.62	2600	2002.62	2100
T35	437056	5758069	-38.32329012	146.2799078	183	433	1420.60	2420.60	2500	1920.60	2000
T36	436134	5757873	-38.32499117	146.269343	207	457	1499.34	2499.34	2500	1999.34	2000

ID	Easting	Northing	Latitude	Longitude	Base Elev	Tip Height	Tip Height (ft)	Add MOC	LSALT	Tip plus 500ft	Rounded
T37	434704	5757718	-38.32628492	146.2529701	242	492	1614.17	2614.17	2700	2114.17	2200
T38	435544	5757416	-38.32906725	146.2625519	224	474	1555.12	2555.12	2600	2055.12	2100
T39	436935	5757281	-38.33038281	146.2784533	189	439	1440.29	2440.29	2500	1940.29	2000
T41	434751	5757067	-38.33215491	146.2534476	258	508	1666.67	2666.67	2700	2166.67	2200
T42	434253	5756519	-38.33705687	146.2476991	258	508	1666.67	2666.67	2700	2166.67	2200
T43	435616	5756655	-38.33593029	146.2633062	176	426	1397.64	2397.64	2400	1897.64	1900
T45	435767	5755772	-38.3438984	146.2649534	182	432	1417.32	2417.32	2500	1917.32	2000
T46	433871	5755768	-38.34379645	146.243258	242	492	1614.17	2614.17	2700	2114.17	2200
T47	433005	5755169	-38.34913001	146.2332919	216	466	1528.87	2528.87	2600	2028.87	2100
T48	433276	5754264	-38.3573057	146.2363074	188	438	1437.01	2437.01	2500	1937.01	2000
T49	432573	5753672	-38.36258784	146.2282052	187	437	1433.73	2433.73	2500	1933.73	2000

Ident and Location of DWF turbines
T04 is the tallest turbine – denoted by yellow
Note: Turbine ID numbers are not consecutive

APPENDIX C

Airservices Australia

AIS

Response

APPENDIX C

ian_jennings@netspace.net.au

From: Airport Developments <Airport.Developments@AirservicesAustralia.com>
Sent: Tuesday, 4 June 2019 11:52 AM
To: 'Ian Jennings'
Cc: 'airspace.protection@casa.gov.au'; 'latrobe@latrobe.vic.gov.au'
Subject: AIRSERVICES RESPONSE: VIC-WF-042 - Delburn Wind Farm [SEC=UNCLASSIFIED]

Hi Ian,

I refer to your request for an Airservices assessment of the Delburn Wind Farm.

Airspace Procedures
With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at the heights and locations specified in the consultants' report, the windfarm **will affect** the RNAV GNSS RWY 03 and the RNAV GNSS RWY 21 instrument procedures at Latrobe Valley Airport.

The RNAV GNSS RWY 03 procedure will need to be **amended** to accommodate the windfarm. The intermediate segment minimum altitude will need to be raised to at least 2000ft from LTVWI to 2nm after LTVWI. Thence the minimum altitude will be 1700ft until LTVWF.

The RNAV GNSS RWY 21 procedure will need to be **amended** to accommodate the windfarm. The LNAV/VNAV minima will need to be raised by 50ft from 550ft to 600ft. Alternatively, the procedure could maintain the existing LNAV/VNAV minima, requiring instead the missed approach tracking to be amended. This alternative option will require additional design work by Airservices and will require further consultation.

Note that procedures not designed by Airservices at Latrobe Valley Airport were not considered in this assessment.

Communications/Navigation/Surveillance (CNS) Facilities
This wind farm, to a maximum height of 1815m (5955ft) AHD, will not adversely impact the performance of Precision/Non-Precision Navigational Aids, HF/VHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.

Summary
At this stage, Airservices cannot support this proposal. Airservices requires that the operator of Latrobe Valley Airport (included in this email response) to be consulted and confirm that the proposed permanent change to RNAV GNSS RWY 03 and the RNAV GNSS RWY 21 instrument procedures at Latrobe Valley will not adversely impact on their operations before any change (temporary or permanent) can be supported by Airservices. Furthermore, any Airservices work associated with amending the flight procedures will be undertaken on a commercial basis and require further consultation with Airservices.

Vertical Obstacle Notification
If the wind farm receives approval, as soon as construction commences, the proponent must complete the Vertical Obstacle Notification Form for tall structures and submit the completed form to VOD@airservicesaustralia.com. For further information regarding the reporting of tall structures, please contact (02) 6268 5622, email VOD@airservicesaustralia.com or refer to the web link below:
http://www.airservicesaustralia.com/services/aeronautical-information-and-management-services/part-175/

Kind regards,

William Zhao
Advisor Airport Development
Tower Road, Melbourne Airport, Tullamarine VIC 3043
t 03 9339 2504
e airport.developments@airservicesaustralia.com

1

APPENDIX D

Department of Defence

AIS

Response

APPENDIX D

ian_jennings@netspace.net.au

From: Hogan, Timothy MR 2 <timothy.hogan2@defence.gov.au>
Sent: Friday, 23 August 2019 12:16 PM
To: E&IG Infrastructure EP Exec Support; 'Ian Jennings'
Cc: Mangion, Charles MR; Williams, Matt MR 7
Subject: RE: Delburn Wind Farm AIS [SEC=UNCLASSIFIED]

UNCLASSIFIED

Hi Ian,

In regards to your request below, I would like to provide the following comments.

The proposed 250m wind turbines (Delburn, Victoria) is some distance from any Defence establishments and 75km from RAAF Base East Sale and therefore Defence has no issues or concerns with the proposal.

However, there is an ongoing need to obtain and maintain accurate information about tall structures so that this information can be marked on aeronautical charts.
Marking tall structures on aeronautical charts assists pilot navigation and enhances flight safety.
Air Services Australia (ASA) is responsible for recording the location and height of tall structures.
The information is held in a central database managed by ASA and relates to the erection, extension or dismantling of tall structures, RAAF requirements are:

a. 30 metres AGL, that are within 30 kilometres of an aerodrome, and
b. 45 metres AGL elsewhere.

As the structure meets the requirement for reporting of tall structures, Defence requests that the applicant provide ASA 'as constructed' details.
Please find attached Obstacle Notification Form. The details can be emailed to ASA at vod@airservicesaustralia.com.

Sorry for the delay in the response on this one.

Regards

Tim

Tim Hogan

Assistant Director, Estate Planning Land Planning and Regulation Infrastructure Division, Dept of Defence.
Ph: 02 6266 8193
Fax: 02 6266 8192
email: timothy.hogan2@defence.gov.au

APPENDIX E

Australian Fire and Emergency Services Authorities Council
Wind Farms and Bushfire Operations

afac
Australasian Fire and Emergency Service Authorities Council

Wind Farms and Bushfire Operations

Version Control

Version	Author	Edits	Date
0.1	Gary Featherston	First draft requested by the Rural and Land Management Group at its meeting of 7 May 2013	28 August 2013
0.2	Gary Featherston	Updated wind farm numbers and included comments from earlier reviewers.	30 August 2013
0.3	Gary Featherston	Approved by the RLM group before edits to include EMR and Total fire ban legislation.	9 September 2013
0.4	Gary Featherston	Added comments provided by the Clean Energy Council.	19 September 2013
1.0	Gary Featherston	Approved by Council	24 October 2013
1.1	Gary Featherston	Minor revision to add monitoring towers.	15 September 2014
2.0	Gary Featherston	Approved by Council, published.	30 October 2014

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Email: afac@afac.com.au
Internet: http://www.afac.com.au

Disclaimer:

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Table of Contents

1 Introduction

Wind power is a rapidly expanding mode of renewable energy production in Australia with installed capacity doubling in the past five years. As of September 2013, Australia has 64 wind farms with an installed capacity of 3058 megawatts (MW), with another ten wind farms under construction.

The increasing number of wind farms makes it important for AFAC member agencies to clarify their position and to identify those issues important for their operations in and around these facilities.

2 Purpose

This is a position to state AFAC member agencies attitude towards wind farms and their development. It aims to clarify the risks in order to inform stakeholders including regulators, members of the community and the wind farm industry.

3 Scope

The scope of this paper is limited to the issues relating to planning for bushfire prevention, preparedness, response and to recovery operations in and around existing and planned wind farms.

It excludes the environmental, social and economic issues associated with wind farms. It does not provide any judgments on the values or otherwise of wind farms.

4 Position

Bushfire management issues are best treated at the planning stage of a wind farm project. This includes the impact of bushfires on the wind farm and the potential for fires to start within the development boundaries. Local planning controls are in place to regulate these issues with respect to any infrastructure development and some local planning controls refer specifically to wind farms.

Wind monitoring towers associated with wind farm investigations and planning can be very much taller than the planned turbines and can be less visible. The location and height of monitoring towers should be noted during aerial firefighting operations.

Wind farms can interfere with local and regional radio transmissions by physical obstruction and radio frequency electromagnetic radiation. Any interference can be minimised or eliminated though appropriate turbine siting at the planning stage and by moving away from the tower if experiencing local interference during operations.

Wind farms are an infrastructure development that must be considered in the preparation of Incident Action Plans for the suppression of bushfires in their vicinity. These considerations are routine and wind farms are not expected to present elevated risks to operations compared to other electrical infrastructure.

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Aerial fire fighting operations will treat the 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.

Wind farms are not expected to adversely affect fire behaviour in their vicinity. Local wind speeds and direction are already highly variable across landscapes affected by turbulence from ridge lines, tall trees and buildings.

Turbine towers are not expected to start fires by attracting lightning.

Turbines can malfunction and start fires within the unit. Automatic shutdown and isolation procedures are installed within the system. Although such fires may start a grass fire within the wind farm, planning for access and fire breaks can reduce the likelihood of the fire leaving the property. This risk from such fires is less than that of many other activities expected in these rural environments.

Wind farms may operate on days of Total Fire Ban subject to relevant national, state and territory legislation.

Liaison with wind farm operators and energy industry representatives during and after bushfires should aim to ensure minimal disruption to generation capacity and rapid resumption of essential services to the community.

5 Supporting Documentation

There's power in the wind: national snapshot.
Clean Energy Council, April 2012

There's power in the wind: fact sheet.
Clean Energy Council, June 2011

Both sourced from
http://www.cleanenergycouncil.org.au/resourcecentre/factsheets.html
on 29 August 2013

Emergency Management Guidelines for Wind Farms
Country Fire Authority, April 2007

Fact Sheet 10. Wind Farming, Electromagnetic Radiation & Interference.
Australian Wind Energy Association.
Sourced from
http://www.synergy-wind.com/documents/10Electromagnetic.pdf
9 September 2013

APPENDIX F

South Australian Country Fire Service
Aerial Firefighting Fact Sheet

APPENDIX F

CFS FACT SHEET

Aerial firefighting

Although aircraft are often the most visible part of the response to a fire, and therefore believed to be the most important, almost all fires are still extinguished by ground crews.

The Country Fire Service (CFS) currently has a base fleet of 26 aircraft which can be relocated across several airstrips across the state to offer aerial firefighting support to ground crews.

Aircraft are particularly valuable for fires in difficult terrain or fast moving fires that are too dangerous for ground crews to be placed in front of.

They may not be able to fly if wind speeds are too high, dust or smoke covers the fire, or when daylight is fading.

Firefighting aircraft will also be grounded if Remotely Piloted Aircraft (drones) are flown without permission over a fire ground.

Although other places in the world may be experimenting with night aerial firefighting, the Country Fire Service can only legally and safely operate during daylight hours.

Single Engine Air Tanker (SEAT)

The CFS currently contracts 14 SEATs, or fire bombers, throughout South Australia.

The SEATs can fly at almost 300kph and carry 3,200 litres of water and firefighting chemicals.

Tactical Coordination aircraft

Four helicopters and one airplane make up the CFS tactical coordination fleet.

These aircraft help to coordinate SEATs to specifically support firefighters at problematic parts of the fire ground where ground crews may not be able to access the fire, or where people, homes and buildings may be in danger.

Government of South Australia

South Australian Country Fire Service
cfs.sa.gov.au

Contact the Bushfire Information Hotline
1800 362 361 (TTY 133 677)
@Countryfireservice
@CFSalerts

CFS

Aerial firefighting

Crews can also help to advise bomber crews of the type of fire retardants best suited to the fire's behaviour and fuels.

Tactical and Strategic Overview aircraft

Four helicopters and two airplanes make up the CFS tactical and strategic overview fleet.

These aircraft are used to observe, collect information to help predict the path of the fire, gather and relay information, and map the perimeter of the fire.

Erickson Aircrane (S-64E)

The Erickson Aircrane can carry 7,500 litres of water and firefighting chemicals and can use its pump to refill from open water sources in just 45 seconds.

The Erickson is based in the Mount Lofty Ranges, where it is close to multiple open water supplies.

Large Air Tankers (LATs)

As part of a national firefighting agreement LATs may be requested from interstate.

LATs are currently operated by the New South Wales and Victorian firefighting organisations, and may carry up to 20,000 litres of water and firefighting chemicals.

CFS air support teams work with the support of the Royal Australian Air Force at Edinburgh to refill LATs at the airbase if multiple drops are required.

Cleaning up if firefighting chemicals are used on your property

The concentrations of chemicals used in drops are not harmful to animals or humans and are biodegradable.

It is recommended that you wash in cold water with a mild soap as a precaution to avoid possible skin irritation if you come in contact with the products.

If your house is doused and your gutters run off to a rainwater tank, you should drain and flush the gutters and tank, then refill with fresh water.

The concentrations of chemicals used by the CFS do not pose health risks but may change the taste and potability of drinking water.

Water mixed with aerial drops in rainwater tanks can still be used for cleaning and firefighting.

Animals, cars or buildings that are doused in firefighting drops can also be washed with water and appropriate shampoos or soaps to remove residue.

If fruit trees or vegetables are doused it is recommended they are washed thoroughly before consuming to remove any possible residue taste.

Government of South Australia

South Australian Country Fire Service
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CFS

APPENDIX G

Stakeholder List

APPENDIX G

The following organisations were consulted.

Stakeholder	Contact
LaTrobe Valley Regional Airport	Airport Manager
LaTrobe Valley Aero Club	Chief Instructor
Bandicoot Adventure Flights	Chief Pilot
Aerial Extras	Chief Pilot
Leongatha Aerodrome	Airport Manager
Wooryal Air Services	Chief Pilot
Forest Fire Management Gippsland	Regional Manager
Country Fire Authority Morwell	Regional Manager
Police Air Wing	Senior Base Pilot
Fixed Wing Ambulance (Pelair)	Senior Base Pilot
Helicopter Emergency Medical Service	Senior Base Pilot

APPENDIX H

Glossary of Terms and Abbreviations

APPENDIX H

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.*

IFR (Instrument Flight Rules) are rules applicable to the conduct of flight under IMC. IFR is established to govern flight under conditions in which flight by outside visual reference is not safe. IFR flight depends upon flying by reference to instruments in the flight deck, and navigation is accomplished by reference to electronic signals. It is also referred to as, “a term used by pilots and controllers to indicate the type of flight plan an aircraft is flying,” such as an IFR or VFR flight plan.

IMC (Instrument Meteorological Conditions) are meteorological conditions expressed in terms of visibility, distance from cloud and ceiling, less than the minimum specified for visual meteorological conditions.

LSALT (Lowest Safe Altitudes) are published for each low level air route segment. Their purpose is to allow pilots of aircraft that suffer a system failure to descend to the LSALT to ensure terrain or obstacle clearance in IMC where the pilot cannot see the terrain or obstacles due to cloud or poor visibility conditions. It is an altitude that is at least 1,000 feet above any obstacle or terrain within a defined safety buffer region around a particular route that a pilot might fly.

MOS (Manual of Standards) comprises specifications *(Standards)* prescribed by CASA, of uniform application, determined to be necessary for the safety of air navigation.

NASAG (National Airports Safeguarding Advisory Group) set up in May 2010 to implement the Australian Government’s National Aviation Policy White Paper, *Flight Path to the Future* initiatives relating to safeguarding airports and surrounding communities from inappropriate development. NASAG comprises representatives from state and territory planning and transport departments, the Civil Aviation Safety Authority (CASA), Airservices Australia, the Department of Defence and the Australian Local Government Association (ALGA) and is chaired by the Department of Infrastructure and Regional Development (DIRD).

NASF (National Airports Safeguarding Framework) is the set of guidelines, adopted in July 2012, developed by NASAG to safeguard airports and surrounding communities.

NOTAMs (Notices to Airmen) are notices issued by the NOTAM office containing information or instruction concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to persons concerned with flight operations.

Obstacles - All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.

OLS (Obstacle Limitation Surfaces) are a series of planes associated with each runway at an aerodrome that defines the desirable limits to which objects may project into the airspace around the aerodrome so that aircraft operations may be conducted safely.

PANS-OPS (Procedures for Air Navigation Services - Aircraft Operations) is an Air Traffic Control term denominating rules for designing instrument approach and departure procedures. Such procedures are used to allow aircraft to land and take off under Instrument Meteorological Conditions (IMC) or Instrument Flight Rules (IFR). ICAO document 8168-OPS/611 (volumes 1 and 2) outlines the principles for airspace protection and procedure design which all ICAO signatory states must adhere to. The regulatory material surrounding PANS-OPS may vary from country to country.

PANS-OPS Surfaces - Similar to an Obstacle Limitation Surface, the PANS-OPS protection surfaces are imaginary surfaces in space which guarantee the aircraft a certain minimum obstacle clearance. These surfaces may be used as a tool for local governments in assessing building development. Where buildings may (under certain circumstances) be permitted to penetrate the OLS, they cannot be permitted to penetrate any PANS-OPS surface, because the purpose of these surfaces is to guarantee pilots operating under IMC an obstacle free descent path for a given approach.

Prescribed airspace is an airspace specified in, or ascertained in accordance with, the Regulations, where it is in the interests of the safety, efficiency or regularity of existing or future air transport operations into or out of an airport for the airspace to be protected. The prescribed airspace for an airport is the airspace above any part of either an OLS or a PANS OPS surface for the airport and airspace declared in a declaration relating to the airport.

Regulations (Civil Aviation Safety Regulations)

VFR (Visual Flight Rules) are rules applicable to the conduct of flight under VMC. VFR allow a pilot to operate an aircraft in weather conditions generally clear enough to allow the pilot to maintain visual contact with the terrain and to see where the aircraft is going. Specifically, the weather must be better than basic VFR weather minima. If the weather is worse than VFR minima, pilots are required to use instrument flight rules.

VMC (Visual Meteorological Conditions) are meteorological conditions expressed in terms of visibility, distance from cloud and ceiling, equal or better than specified minima

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
AC	Advisory Circular (document support CASR 1998)
ACFT	Aircraft
AD	Aerodrome
AHD	Australian Height Datum
AHT	Aircraft height
AIP	Aeronautical Information Publication
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
IAP	Instrument Approach Procedure
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IHS	Inner Horizontal Surface, an Obstacle Limitation Surface
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
ISA	International Standard Atmosphere
km	kilometres
kt	Knot (one nautical mile per hour)
LAT	Latitude
LIRL	Low Intensity Runway Lighting
LLZ	Localizer
LONG	Longitude
LSALT	Lowest Safe Altitude
m	metres
MAPt	Missed Approach Point
MDA	Minimum Descent Altitude
MGA94	Map Grid Australia 1994
MOC	Minimum Obstacle Clearance
MOS	Manual of Standards, published by CASA
MSA	Minimum Sector Altitude
SSR	Monopulse Secondary Surveillance Radar
MVA	Minimum Vector Altitude
PAL	Pilot Activated Lighting
PAPI	Precision Approach Path Indicator
NASAG	National Airports Safeguarding Advisory Group
NASF	National Airports Safeguarding Framework
NDB	Non Directional Beacon
NE	North East
NM or nm	Nautical Mile (= 1.852 km)
nnDME	Distance from the DME (in nautical miles)
NNE	North East
NOTAM	NOtice To AirMen
OAS	Obstacle Assessment Surface
OCA	Obstacle Clearance Altitude
OCH	Obstacle Clearance Height
OHS	Outer Horizontal Surface
OIS	Obstacle Identification Surface

Abbreviation	Meaning
OLS	Obstacle Limitation Surface
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations, ICAO Doc 8168
PRM	Precision Runway Monitor
PROC	Procedure
PSR	Primary Surveillance Radar
QNH	An altimeter setting relative to height above mean sea level
Rnnn	Restricted Airspace – promulgated in AIP as R with 3 numbers
RA-Aus	Recreational Aviation Australia – regulates specific category of aircraft.
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
VMC	Visual Meteorological Conditons
V_n	aircraft critical Velocity reference
VOR	Very high frequency Omni directional Range