Aviation Assessment

Wind Monitoring Tower
Ferguson Wind Farm
Princetown, Victoria

Client

BayWa r.e. Projects Pty Ltd

LB00387

Final V3

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1 Introduction

1.1 The Development

BayWa r.e. Projects Pty Ltd (the client) has tasked Landrum and Brown to prepare an aviation assessment for the Ferguson Wind Farm - Wind Monitoring Tower installed north of Princetown in Victoria.

The study will assess the impact of the anemometer on local aircraft activity, aviation safety and reference:

- CFA Guidelines for Renewable Energy Installations;
- AFAC Doctrine – Wind Farms and Bushfire Operations;
- Impacts on local known aerodromes and aviation activity;
- CASA standards; and
- NASF D Guidelines – Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farm/Wind Monitoring Towers).

A 40 m AGL wind monitoring tower is in place at present but needs to be upgraded to be 100m AGL. The terrain height at the location is approximately 193 m, giving the tower a maximum elevation of approximately 293 m AHD.

The location of the 100m tower is approximately 1.2 km north of the intersection of Princetown Road and Boorook Road, Princetown, and approximately 10 km north of the Princetown Post office.

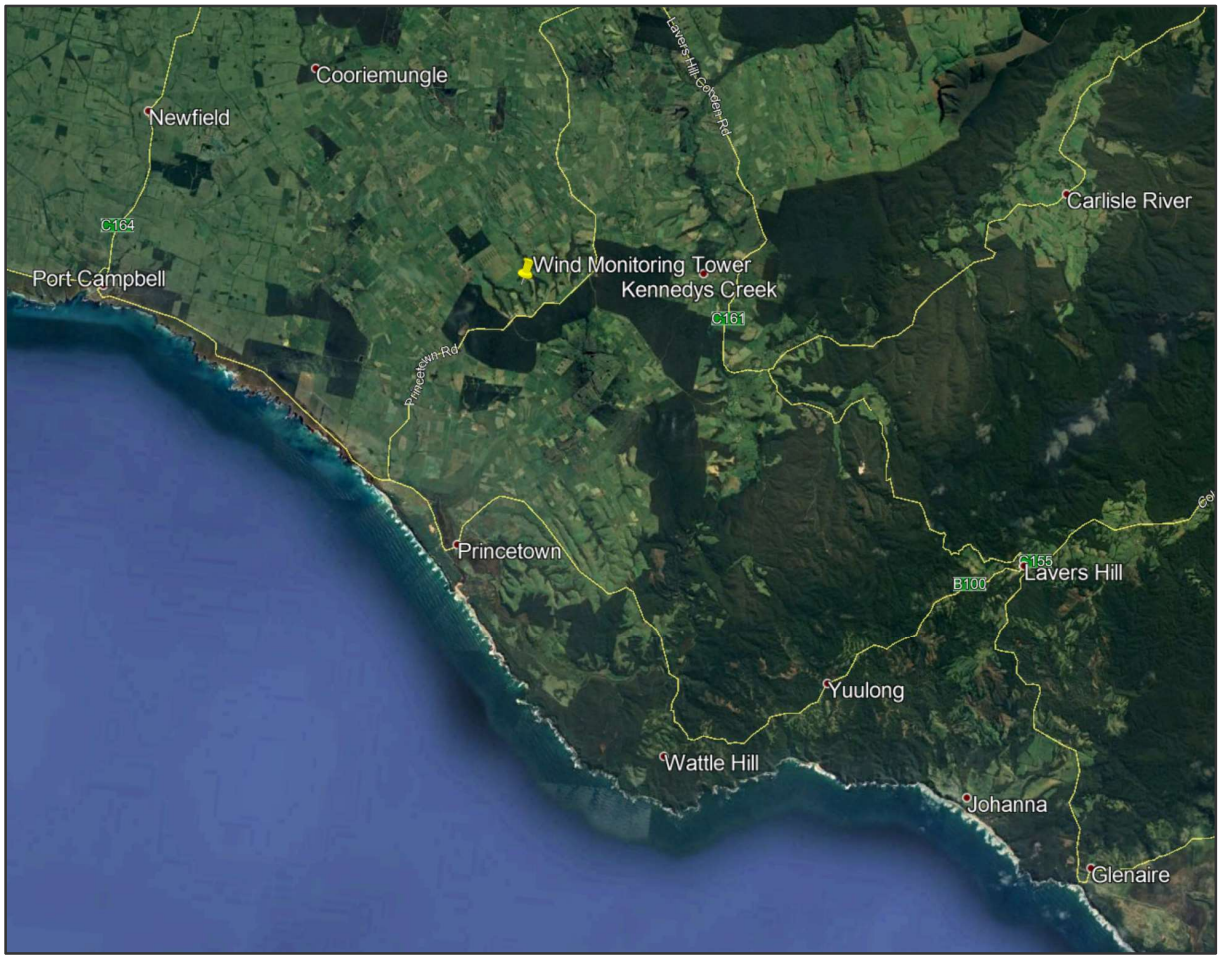

Figure 1: Location of Wind Monitoring Tower (Google Earth)

A Glossary of Aeronautical terms and Abbreviations is shown at Annex B.

2 Nearby Aerodromes

The nearest aerodrome that is published in the Australian Aeronautical Information Publication (AIP) and shown on aeronautical charts is an uncertified aerodrome at Peterborough, approximately 22 km west of the wind monitoring tower.

An uncertified aerodrome at Cobden is approximately 32 km north of the wind monitoring tower.

Helicopter Landing Sites (HLS) are located at Port Campbell, 11 km south west and at Glenample, 8 km south west.

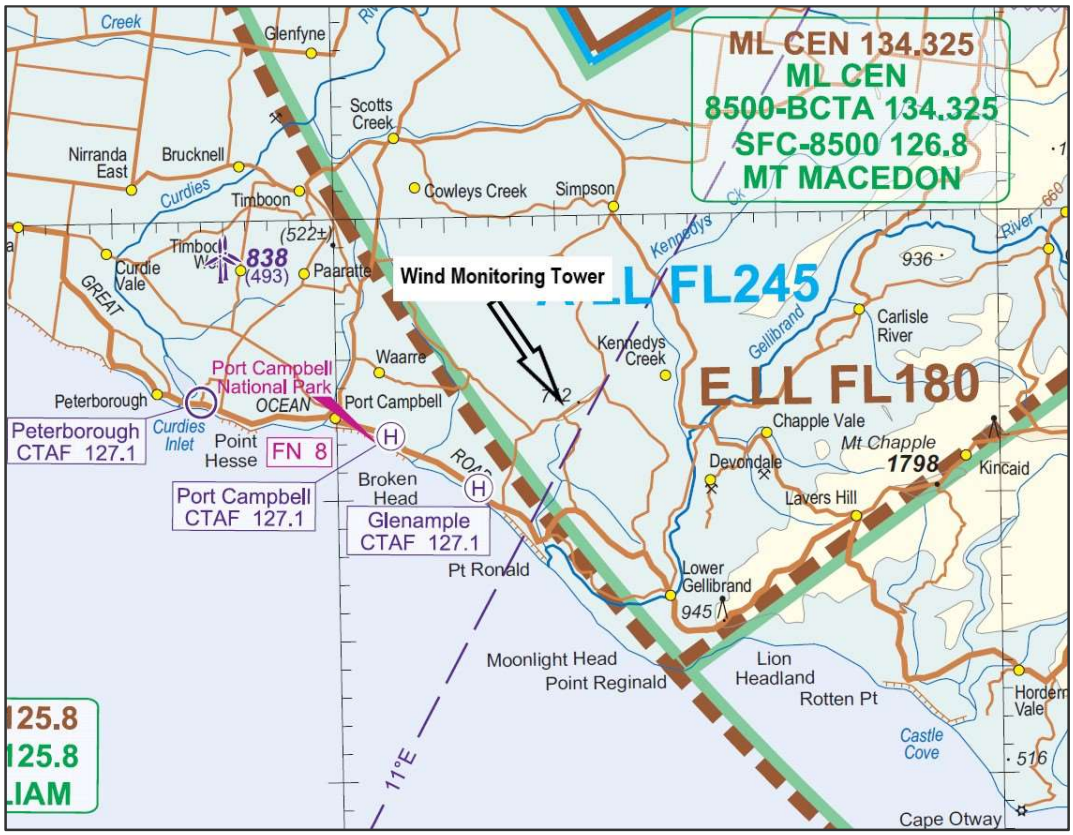

Figure 2: Visual Navigation Chart (Airservices Australia)

Flight operations at these aerodromes and HLS will not be affected by the wind monitoring tower due to its location outside the areas that aircraft would operate during take-off and landings.

There may be private airstrips in the region that are not shown on aeronautical charts.

2.1 Aerodromes with Obstacle Limitation Surfaces (OLS)

The aerodromes discussed could have an OLS with a radius of 4 km from each but as the aerodromes are further away, the OLS are not affected.

2.2 PANS OPS Surfaces

PANS OPS surfaces are associated with published instrument approach and departure procedures. They can exist up to 54 km from an aerodrome. The nearest aerodrome with published instrument approach procedures is at Warrnambool, 74 km west of the wind monitoring tower and outside of the PANS OPS surfaces.

The wind monitoring tower will not infringe any PANS OPS surface.

3 Aviation Activity in the Area

It is difficult to determine the amount of aviation activity in the area surrounding the wind monitoring mast as the airspace is uncontrolled (Class G) and records of movements are not kept.

Scenic flights by light aircraft and helicopters takes place in the region of the 12 Apostles and Cape Otway with a high period during the warmer months.

Light aircraft flown by pilots who are only qualified to fly in good weather conditions, known as VMC – Visual Meteorological Conditions, regularly fly in this area. They must not fly any lower than 152 m (500 ft) above ground or obstacles within 600 m of their flight path. As the wind monitoring tower has a maximum height of 100m (328 ft) AGL it will not have an adverse impact on these flights.

Due to populations being spread out over the area, and not having a military aerodrome in the region, it is unlikely that regular low-level military flight operations are conducted in the area surrounding the wind monitoring tower.

Agricultural spraying operations are likely to be conducted in the area but a thorough briefing about all local obstacles, provided by the land owner to those pilots would make them aware of the wind monitoring tower and its anchor lines to allow them to take account of the tower when planning and flying such low level operations.

Aircraft and pilots capable of flying in poor weather conditions, where it is not necessary to see the ground or water for navigation or situational awareness must comply with a set of minimum altitudes published on aeronautical charts or determined by specific calculations by the pilot if not following a published air route for such flights. The Lowest Safe Altitude (LSALT) is determined by adding 300 m (1000 ft) to the highest terrain or obstacle within the navigation tolerance of the air route being flown

There are no air route navigation tolerance areas existing above the wind monitoring tower.

The Grid LSALT for the area surrounding the wind monitoring tower is 3700 ft, with a protection surface of 2700 ft, 823 m AHD. The wind monitoring tower at a maximum height of 293 m AHD will not impact upon the Grid LSALT in the area.

Result: The wind monitoring tower is unlikely to have an adverse impact upon flight operations in the area.

4 ATC Communications, Navigation and Surveillance (CNS) Systems

Airservices Australia provides ATC communications, navigation and surveillance to aircraft operating with the Australian Flight Information Region (FIR).

The nearest known communications and surveillance are located at Mt Macedon, 183 km north east of the wind monitoring tower and at Mt William, in the Grampian Mountain Range, 150 km north west of the wind monitoring tower.

The nearest navigation aid is located in the Melbourne area, approximately 170 km north west of the wind monitoring tower.

Result: The wind monitoring tower will not have any impact upon any ATC CNS System.

5 Guidelines for Renewable Energy Installations

There are several regulatory and guideline documents describing ways to mitigate and reduce the hazard that wind monitoring towers may present to aviation activity.

Each is similar but uses slightly different standards to produce the same outcome.

5.1 CASA Requirements

The Civil Aviation Safety Authority (CASA) Regulation Part 139, Section 8, Division 10 prescribes that any obstacle that extends above the OLS of aerodrome must be marked in accordance with the Division unless CASA determines otherwise.

CASA requires that obstacles higher than 150 m AGL must be notified to them for an assessment of the impact to aviation safety.

Result: As the wind monitoring tower is lower than 150 m AGL it does not need to be notified to CASA and as it does not extend into the OLS of any aerodrome it does not need to be marked or lit.

5.2 CFA Guidelines for Renewable Energy Installations (Feb 2019)

Victoria's Country Fire Authority (CFA) publishes the *CFA Guidelines for Renewable Energy Installations (*February 2019*)* to provide concise guidance to organisations developing and managing wind farm and other such power resources about standard measures and processes in relation to fire safety, risk and emergency management that should be considered when designing, constructing and operating new renewable energy facilities, and upgrading existing facilities.

This section relates to the guideline related to CFA fire-fighting aircraft hazard minimization.

The CFA recognises that *"installed weather monitoring stations can be high and difficult to see and are hazardous to CFA flight operations during fires." (*para 5.1.3*)*

The CFA requires that monitoring towers higher than 100 ft (30 m) must be clearly marked and guy wires fitted with markers. The installation must also be notified to CFA and Geoscience Australia (for inclusion in the Vertical Obstruction Database).

Result: As the wind monitoring tower will be higher than 30 m, the CFA will be required to be notified of the proposal to construct the tower.

The painting of the wind monitoring tower in a single colour conspicuous to the background vegetation combined with the provision of marker balls on the guy wires of the wind monitoring tower will make the tower conspicuous against the background from a pilot's perspective and therefore meet the requirements of the CFA's guidelines.

5.3 Australian Fire and Emergency Services Authorities Council (AFAC)

The AFAC Wind Farms and Bushfire Operations Guideline, Version 3.0 dated 25 October 2018 states the AFAC member agencies approach towards wind farms, their development and operations in relation to bushfire prevention, preparedness, response and recovery. It is also intended for wind farm developers and operators and land use planners and relevant regulators.

This section relates to the aviation component of the document.

"Windfarm developers should also be aware that meteorological monitoring towers, which are associated with pre-construction investigative activities as well as operating wind farms, are generally more likely to pose a risk to pilots as they are not easily visible structures. For these structures, developers should record these towers in the Tall Structures Database maintained by Air Services Australia (Civil Aviation Safety Authority 2018) and install warning lights or visible markers (such as orange balls) on all masts to minimise risks during aerial firefighting operations." (AFAC Wind Farm and Bushfire Operations Guideline V3.0 25 October 2018)

These recommendations are aligned with the CFA guidelines and with CASA requirements, but shutdown procedures detailed below will also need to be taken into consideration.

"The developer or operator should ensure that:

- *liaison with the relevant fire and land management agencies is ongoing and effective;*

- *access is available to the wind farm site by emergency services response for on-ground firefighting operations;*
- *wind turbines are shut down immediately during emergency operations – where possible, blades should be stopped in the 'Y' or 'rabbit ear' position, as this positioning allows for the maximum airspace for aircraft to manoeuvre underneath the blades and removes one of the blades as a potential obstacle.*

Aerial personnel should assess risks posed by aerial obstacles, wake turbulence and moving blades in accordance with routine procedures." (AFAC Wind Farms and Bushfire Operations Guideline V3.0 25 October 2018)

5.4 National Airports Safeguarding Framework (NASF) – Guideline D

NASF Guideline D provides guidance to State/Territory and local government decision makers, airport operators and developers of wind farms to jointly address the risk to civil aviation arising from the development, presence and use of wind farms and wind monitoring towers.

These guidelines also provide specific advice on measures to reduce hazards to aviation, and how to implement them.

Consultation with aviation stakeholders is strongly encouraged in the early stages of planning for wind turbine developments. This should include:

- early identification of any nearby certified or registered aerodromes;
- immediate consultation with any nearby aerodrome owners;
- preliminary assessment by an aviation consultant of potential issues;
- confirmation of the extent of the OLS for any nearby aerodromes;
- registration of all wind monitoring towers on the RAAF AIS database;
- consultation with local agricultural pilots and nearby unlicensed airstrip owners; and
- consultation with CASA and Airservices.

There is no requirement for CASA to be notified if a wind turbine or wind monitoring tower is less than 150m in height and does not infringe the OLS of an aerodrome. However, they should still be reported for inclusion in the national database of tall structures.

Marking and Lighting of Wind Monitoring Towers

These structures 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 including aerial agricultural operations. Wind farm proponents should take appropriate steps to minimise such hazards, particularly in areas where aerial agricultural operations occur.

Measures to be considered should include:

- the top 1/3 of wind monitoring towers to painted in alternating contrasting bands of colour. In areas where aerial agriculture operations take place, marker balls or high visibility flags can be used to increase the visibility of the towers;
- marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires;
- ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation; or
- a flashing strobe light during daylight hours.

The NASF Guideline D provides suitable guidance to enable wind monitoring tower operators to take appropriate measures to minimise the hazard that they may create to aviation safety. Combined with the requirement to provide details of the tower to the aeronautical obstruction database will ensure that the requirements of the CFA and AFAC are met and exceeded.

Result: The provision of marker balls on the guy wires of the wind monitoring tower will make the tower conspicuous against the background from a pilot's perspective and therefore meet the requirements of each agency's guidelines.

5.5 Visibility of Hazards to Aviation

The various guidelines presented in this report have been developed in recognition that slender towers and supporting guy wires are difficult to see from the cockpit of a moving aircraft. By marking the tower with colours that contrast with the surrounding background the tower becomes more conspicuous, thereby enabling the pilot to identify whether the tower presents a hazard to their operation in sufficient time to enable them to avoid the hazard by a safe margin.

Tall and thin towers are generally supported by guy wires to ensure the integrity of the structure. Such guy wires are anchored up to 100 m from the base of the tower that they support. A pilot that recognises the tower may not necessarily recognise that guy wires supporting the tower exist. The provision of markers on the guys wires such as balls or flags makes the entire structure recognizable and allows pilots to make appropriate alterations to flight paths to avoid the entire structure by a safe margin.

6 Conclusion

This study indicates that the wind monitoring tower installed north of Princetown in western Victoria:

- Is unlikely to have an adverse impact on aviation safety in the area;
- Will not impact on take off and landing operations at known aerodromes in the region;
- Will not infringe any OLS or PANS OPS surface;
- Will not infringe any Air Route or Grid LSALT;
- Will not have an adverse impact on ATC CNS Systems;
- Should be painted in a single colour that is conspicuous to the background terrain and the guy wires equipped with marker balls to make them more visible to nearby pilots and to meet the CFA guidelines; and
- Should be notified to Airservices Australia for inclusion in obstacle databases and publication on aeronautical charts.

Appendix A – Assessment Methodology

In preparing aeronautical impact assessments associated with airport safeguarding and protection, it is necessary to observe the requirements of the relevant aviation authorities including:

- The Department of Infrastructure, Regional Development and Cities (DIRDC);
- The Civil Aviation Safety Authority of Australia (CASA);
- Airservices Australia (ASA);
- Airport Operators; and
- Department of Defence where appropriate.

The major relevant documents include:

- The Airports Act 1996, Airports (Protection of Airspace) Regulations 1996;
- Civil Aviation Safety Regulation (CASR) Part 139 Manual of Standards – Aerodromes;
- Aeronautical Information Publication (AIP);
- Airservices Australia's Airways Engineering Instruction – Navigation Aid Building Restricted Areas and Siting Guidance (BRA);
- National Airspace Safeguarding Framework (NASF) Guidelines;
- International Civil Aviation Organisation (ICAO) DOC 8168 Procedures for Air Navigation – Aircraft Operations (PANS OPS).

Annex B – Glossary of Aeronautical Terms and Abbreviations

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.

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.

AIPs (Aeronautical Information Publications) are publications promulgated to provide operators with aeronautical information of a lasting character essential to air navigation. They contain details of regulations, procedures and other information pertinent to flying and operation of aircraft. In Australia, AIP is issued by Airservices Australia on behalf of CASA.

Air routes exist between navigation aid equipped aerodromes or waypoints to facilitate the regular and safe flow of aircraft operating under 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.

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 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 are 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. Pilots must hold IFR qualifications and aircraft must be suitably equipped with appropriate instruments and navigation aids to enable flight in IMC.

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.

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 infringe the OLS, they cannot be permitted to infringe 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. Pilots must be specifically qualified and aircraft specifically equipped to enable flight in IMC,

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 CAR 1998)
ACFT	Aircraft
AD	Aerodrome
ADS-B	Automatic Dependent Surveillance - Broadcast
AHD	Australian Height Datum
AIP	Aeronautical Information Publication
Airports Act	Airports Act 1996, as amended
AIS	Aeronautical Information Service
ALT	Altitude
AMSL	Above Mean Sea Level
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
BRA	Building Restricted Area
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
DME	Distance Measuring Equipment
Doc nn	ICAO Document Number nn
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
GBAS	Ground Based Augmentation System (satellite precision landing system)
GNSS	Global Navigation Satellite System
GP	Glide Path
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
IHS	Inner Horizontal Surface, an Obstacle Limitation Surface
ILS	Instrument Landing System
ISA	International Standard Atmosphere
km	kilometres
kt	Knot (one nautical mile per hour)
LAT	Latitude
LLZ	Localizer
LONG	Longitude
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
MVA	Minimum Vector Altitude
NASAG	National Airports Safeguarding Advisory Group
NDB	Non Directional Beacon
NE	North East
NM	Nautical Mile (= 1.852 km)
nnDME	Distance from the DME (in nautical miles)
NNE	North 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
PBN	Performance Based Navigation
PRM	Precision Runway Monitor
QNH	An altimeter setting relative to height above mean sea level
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
RTCC	Radar Terrain Clearance Chart
RWY	Runway
SFC	Surface
SID	Standard Instrument Departure
SOC	Start Of Climb
STAR	STandard ARrival
SGHAT	Solar Glare Hazard Analysis Tool
TAR	Terminal Approach Radar
TAS	True Air Speed
THR	Threshold (Runway)
TNA	Turn Altitude
TODA	Take-Off Distance Available
V_n	aircraft critical Velocity reference
VOR	Very high frequency Omni directional Range
WAC	World Aeronautical Chart