Aeronautical Impact Assessment

Lot 4 158-164 Hawkesbury Rd & 2a Darcy Rd Westmead, NSW

12 September 2017

Combined Projects (Westmead) Pty Ltd

Project	**Client**	**Project No.**	**Version No.**	**Author**
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1. Introduction

Landrum & Brown Worldwide (Australia) Pty Ltd has been tasked by Combined Projects (Westmead) to prepare an Aeronautical Impact Assessment (AIA) for the proposed building development at Lot 4, 158-164 Hawkesbury Rd & 2a Darcy Rd Westmead, NSW.

The maximum proposed building height is 101.3 m AHD.

Lot 4 is adjacent to Lot 5 at the same address. On 21July 2017, the consultants delivered the "Westmead Lot 5 HLS AIA" report to Combined Projects (Westmead) which identified that the proposed helicopter flight paths associated with the proposed Central Acute Services Building (CASB) Helicopter Landing Site (HLS) would pass over the Lot 5 site, and limit the building height.

A revised flight path which avoided passing over Lot 5 was identified and the report "Westmead Lot 5 Obstacle Assessment V0.3 01 AUG 17" was delivered, showing that the proposed revised flight path was clear of obstacles within the CASA prescribed tolerances for HLS.

This revised flight path is also clear of Lot 4, and this will be shown in this Lot 4 report.

The following items were considered in the preparation of the AIA:

- Consideration of relevant Acts and Regulations applicable to developments in the vicinity of airports and air traffic routes. The major relevant documents include: The *Airports Act 1996, Airports (Protection of Airspace) Regulations 1996* and *CASR Part 139 Manual of Standards - Aerodromes.*
- Analysis of Obstacle Limitation Surfaces (OLS);
- Analysis of Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS);
- Impacts on Navigation Aids, communications and Airspace Surveillance facilities; and
- Roof Top Exhaust Plumes.

Note that the proposed Western Sydney Airport is 24 km from the development site, and OLS and PANS-OPS surfaces for this airport were not considered for this report as these surfaces are not expected to extend as far as the site. The RAAF Base Richmond is 30 km from the site and was also not considered in the report.

The following documents were examined or referred to for the preparation of this AIA:

- Drawings of the Lot 4 building coordinates and proposed heights, shown at Appendix A and Appendix B respectively;
- The Rehbein report "Westmead redevelopment development planning –Central Acute Services Building helicopter operations assessment";
- The Parramatta City Council report on "The Impact on Helicopter Emergency Medical Services" in relation to the Lot 5 proposed development;
- CASA CAAP 92-2 (2) "guidelines for the establishment and operation of onshore Helicopter Landing Sites;
- ICAO Annex 14 Vol II Heliports;
- ICAO Doc 8168 PANS-OPS; and
- The Australian AIP DAP.

A Glossary of Aeronautical Terms and Abbreviations is shown at Appendix C.

2. The Proposed Lot 4 Development and the CASB HLS

Figure 2.1 shows an extract from the Rehbein report of the helicopter operations assessment, and the diagram shows the proposed CASB HLS flight path in relation to other Hospital HLS flight paths. The CASB flight path is aligned 220°/040°(T). Please note that the True North and Magnetic North directions shown on this diagram have been found to be incorrect by about 20°.

The Rehbein report did not specify the CASB HLS MGA coordinates, however these were calculated by the developer's surveyor as E 313942.0 N 6257912.0. These were plotted on Google Earth to show the CASB HLS site relative to the hospital and local surroundings, as shown in Figure 2.2. This Figure also shows the proposed CASB Flight Path in relation to Lot 4 with the maximum building height of 101.3 m AHD also shown.

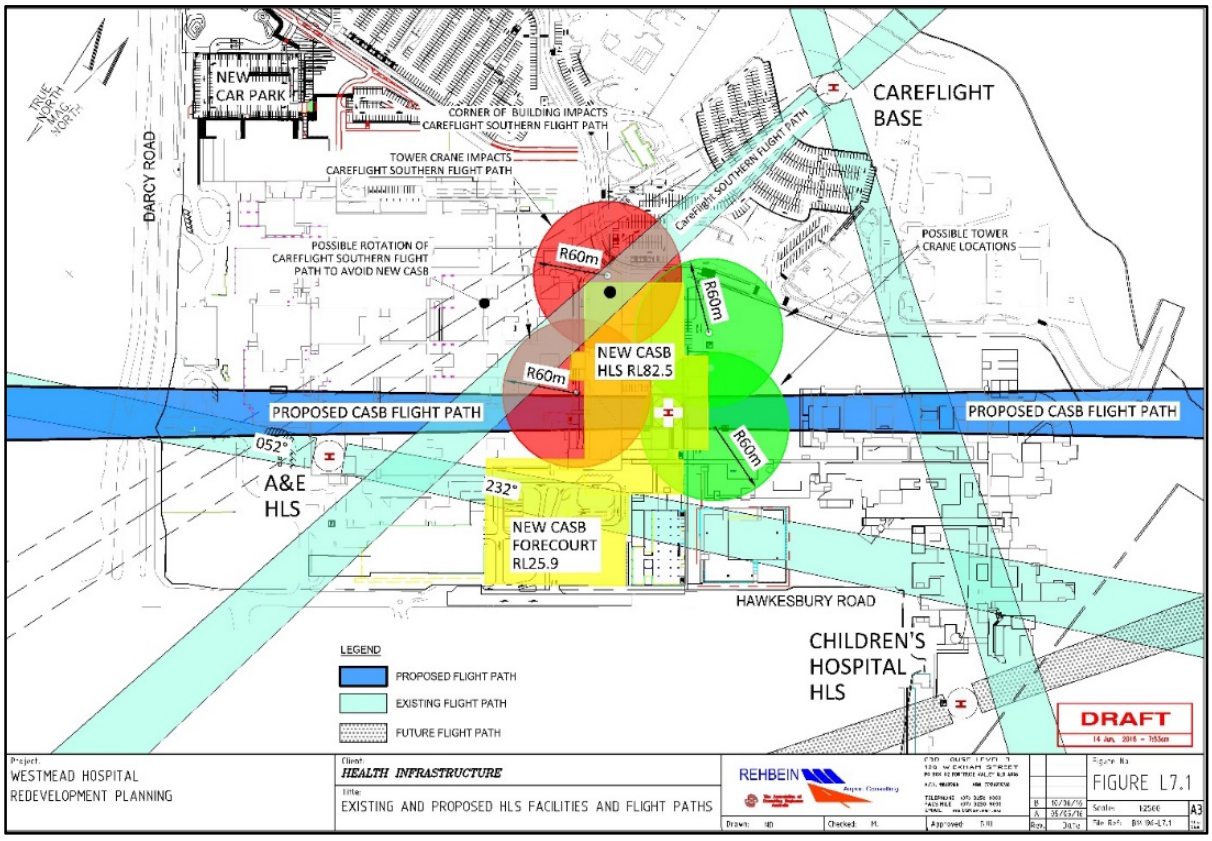


Figure 2.1 Rehbein Report Proposed CASB HLS Flight Path

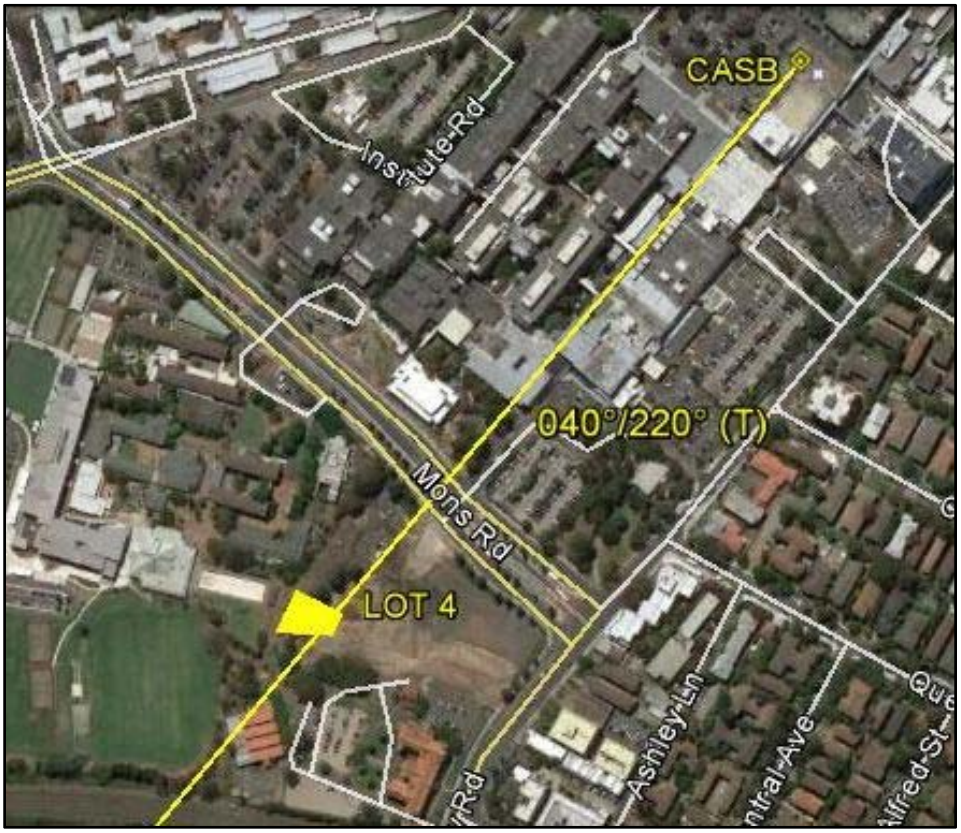


Figure 2.2 Rehbein Report Proposed CASB HLS Flight Path and Lot 4

As can be seen in Figure 2.2, the Rehbein Report Proposed CASB HLS Flight Path passes almost directly over the Lot 4 development.

The CASB HLS height is 76.2 m AHD from the NSW Health documents.

The Final Approach and Take-off Area (FATO) and safety area have not been provided by NSW Health, so the standard 25 m FATO and 8 m Safety area for a NSW health Augusta AW 139 helicopter have been used, making a total of 33 m from the centre of the HLS.

The obstacle slope of 4.5% or 2.5° starts at 16.5 m from the HLS centre.

Table 2.1 shows the calculations for the heights of the 4.5% slope at coordinate P of the Lot 4 development:

LOT 4 Coordinate Point	Dist from FATO + Safety	Slope Height @ 4.5%	CASB HLS AHD	Slope Height at Point P	Proposed Point P Height AHD
P 101.3	535.5	24.10	76.20	**100.30**	101.3

Table 2.1 Calculations for the slope height at the Lot 4 coordinate point P

As can be seen in Table 2.1, the slope is below the proposed maximum building height, which will not be approved by Council and NSW Health. It is therefore necessary to identify alternative flight paths that avoid the Lot 4 development site. This is examined in the next section.

3. Alternative Flight Paths

The design of any alternative flight path must be made in accordance with the criteria of CASA CAAP 92-2 (2) and ICAO Annex 14 Vol II Heliports. The area for Take-off Climb and Approach surface width is shown in Figure 3.1, which has been extracted from both referenced documents.

The design criteria used in identifying alternative flight paths are 15% night divergence, and the Augusta AW 139 helicopter rotor diameter of 13.8 m was used to determine the 10 times rotor diameter overall width/night of 138 m.

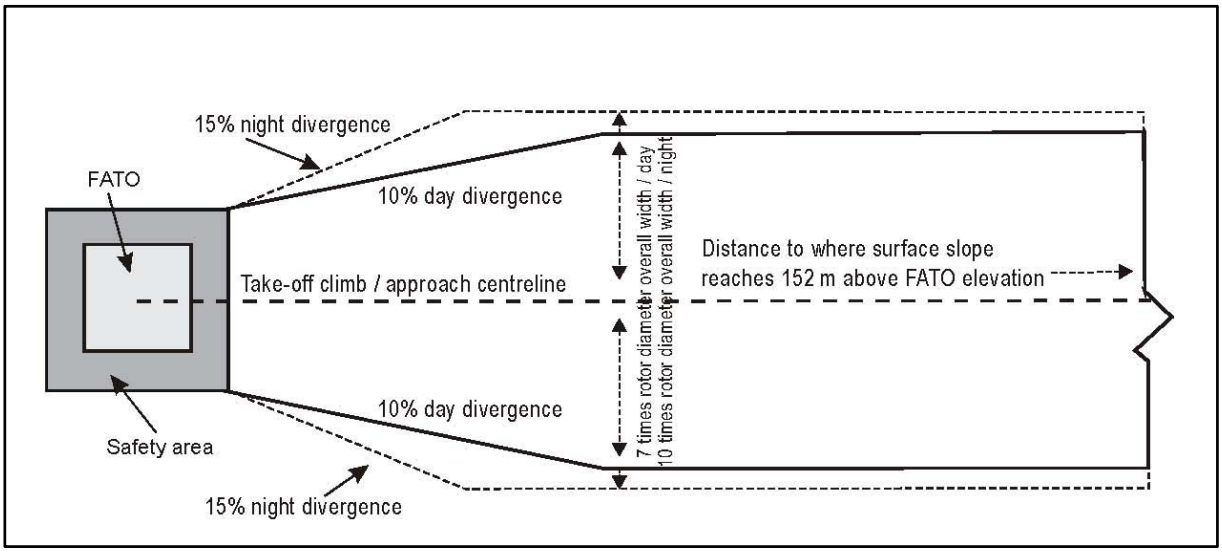


Figure 3.1 Flight Path design criteria

In addition, transitional surfaces with a slope of 50% are required for Helicopter Instrument Flight procedures, for a FATO with a Point in Space (PinS) approach procedure with a VSS. These procedures are designed by Airservices Australia and the actual area will be determined when further assessment of alternative flight paths is made.

Figure 3.2 shows the transitional surfaces area in general.

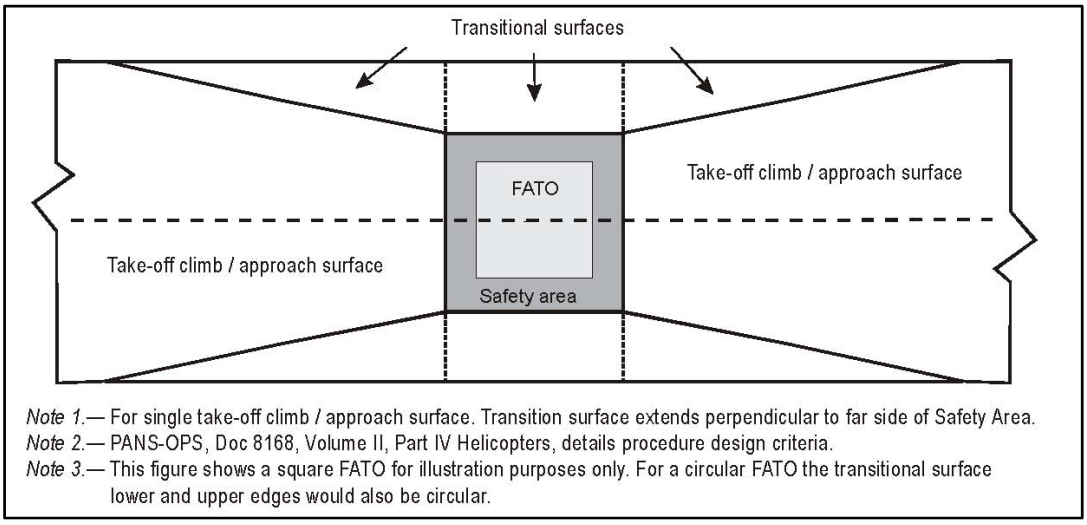


Figure 3.2 Transitional Surfaces

One alternative flight path has been identified for assessment. This is aligned 052°/232° and the FATO and flight path alignment (yellow), and the protection areas of 15% night divergence (green) and typical Transitional Surface boundary (Magenta) are shown in Figure 3.3.

The image shows the details to the south west of CASB, near the hospital and Lot 4. The green lines extend to 3377 m from the FATO safety area boundary.

The flight path to the north west of the FATO has not been shown. This can remain on a bearing of 040°/220°as per the Rehbein Report flight path, and no further assessment would be required in this direction. The CASA and ICAO criteria allow for a change in track at the FATO centre of a maximum of 30°, and the change from the alternative south west flight path to the north west flight path is 12°.

If it is preferred that the alternative flight path of 052°/232°is continued to the northwest, then a full assessment would be required for this direction.

Figure 3.3 Alternative Flight Path and Protection Areas

An obstacle assessment was conducted to show that the alternative flight path protection areas were not penetrated by obstacles. This is shown in Section 4.

4. Obstacle Assessment

Figure 4.1 (on following page) shows the obstacle assessment area (between the green lines) and potential obstacles.

As can be seen significant obstacles within the OLS area are:

- 14 storey building roof height 68 m AHD
- 6 storey building roof height 54 m AHD
- 7 storey building roof height 55 m AHD.

The height of the OLS area starts at the HLS Final Approach and Take Off (FATO) boundary at 76.2 m AHD, and then slopes up at 4.5%. As the obstacles are below the HLS height, these will not penetrate the OLS slope.

Additionally, Table 4.1 shows the slope height at the obstacle locations:

Obstacle	Dist from FATO	Slope Height	CASB HLS AHD	Slope Height at Obstacle	Obstacle Height AHD
14 Storey Bldg	869.5	39.13	76.20	**115.33**	**68**
6 Storey Bldg	2138	96.21	76.20	**172.41**	**54**
7 storey Blbg	2449	110.21	76.20	**186.41**	**55**

Table 4.1 Obstacle and OLS Slope Heights

As can be seen in Table 4.1 the obstacles are well below the OLS Slope Heights.

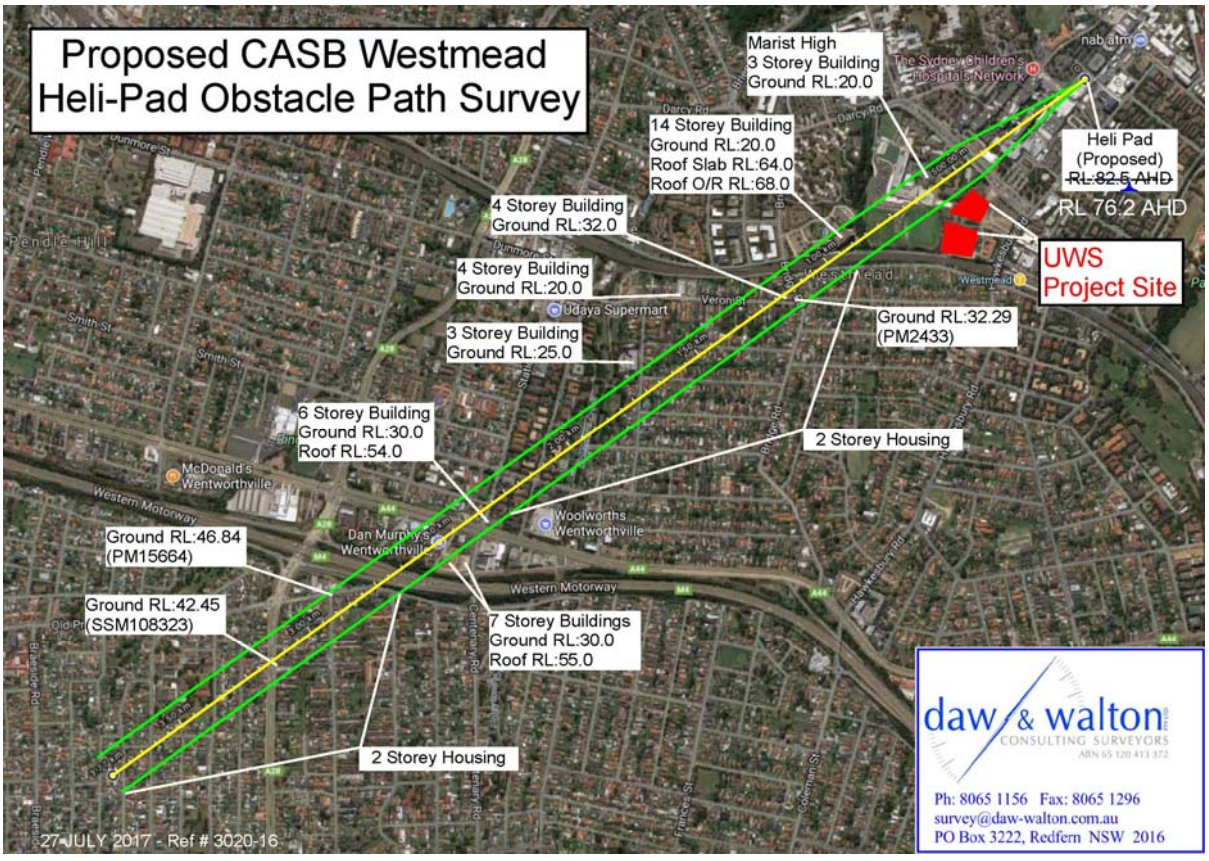


Figure 4.1 Flight Path OAS Area and obstacles, and Lots 4 and 5 shown in red.

5. Obstacle Limitation Surfaces (OLS)

As well as the Westmead HLS procedures, the OLS for Sydney and Bankstown airports need to be examined to confirm the OLS surfaces are not penetrated.

SYDNEY AIRPORT OLS

The OLS for this airport extend to 15 km from the Airport Reference Point (ARP) in the direction of Lot 4. As the development site is located 24 km from the Sydney ARP**, the Sydney Airport OLS will not be penetrated.**

BANKSTOWN AIRPORT OLS

Figure 6.1 is an extract from the Bankstown airport OLS as published in the Airport Mater Plan.

The Lot 4 site is in the outer Horizontal Surface (OHS) of the OLS, where the surface height is 156 m AHD.

As the maximum building height at Lot 4 is 101.3 m AHD, the Bankstown Airport OLS of 156 m AHD will not be penetrated.

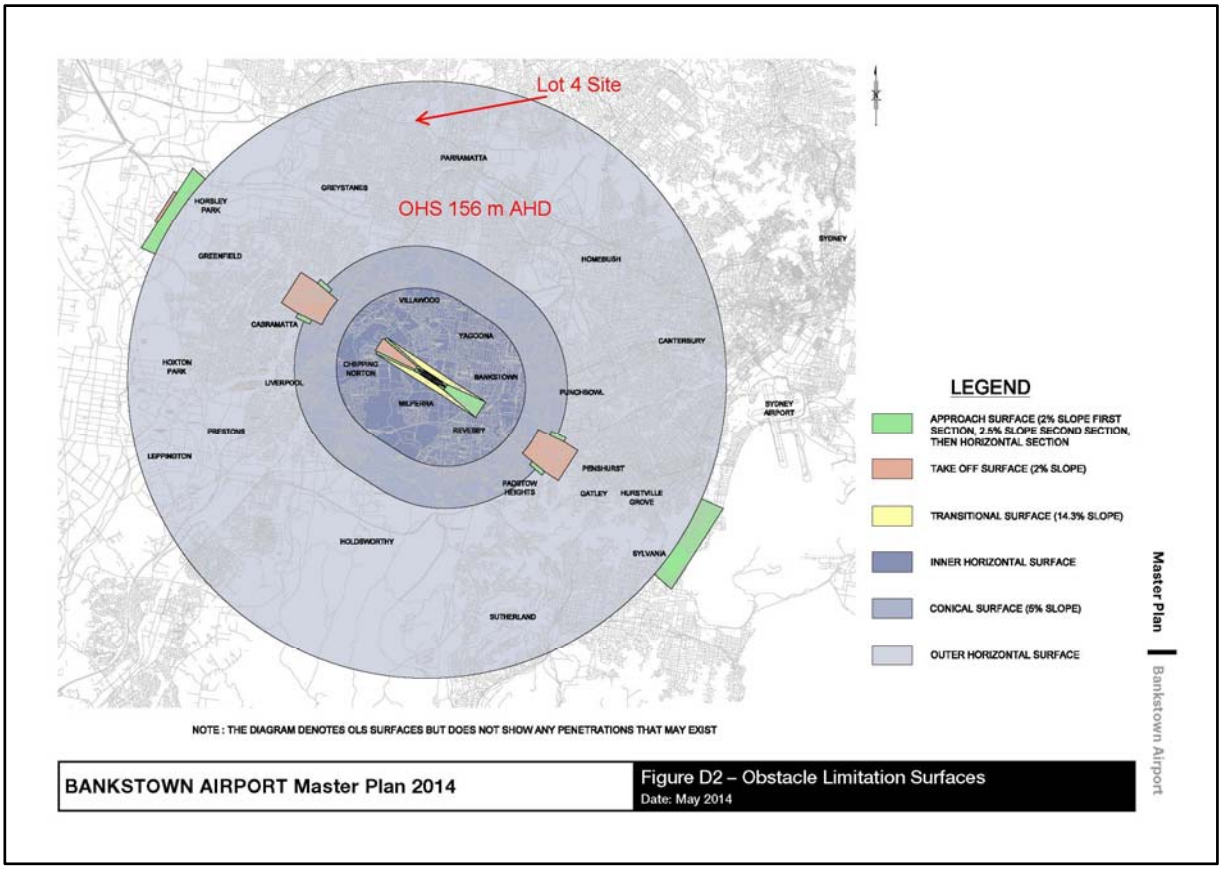


Figure 5.1 Bankstown Airport OLS

6. PANS-OPS Surfaces

SYDNEY AIRPORT PANS-OPS

Figure 6.1 is an extract from the Sydney Airport PANS-OPS chart as published by Sydney Airport Corporation Limited (SACL).

As can be seen in Figure 6.1, the PANS-OPS surface height at the Lot 4 site is 335.2 m AHD.

As the maximum building height at Lot 4 is 101.3 m AHD, the Sydney Airport PANS-OPS surface of 335.2 m AHD will not be penetrated.

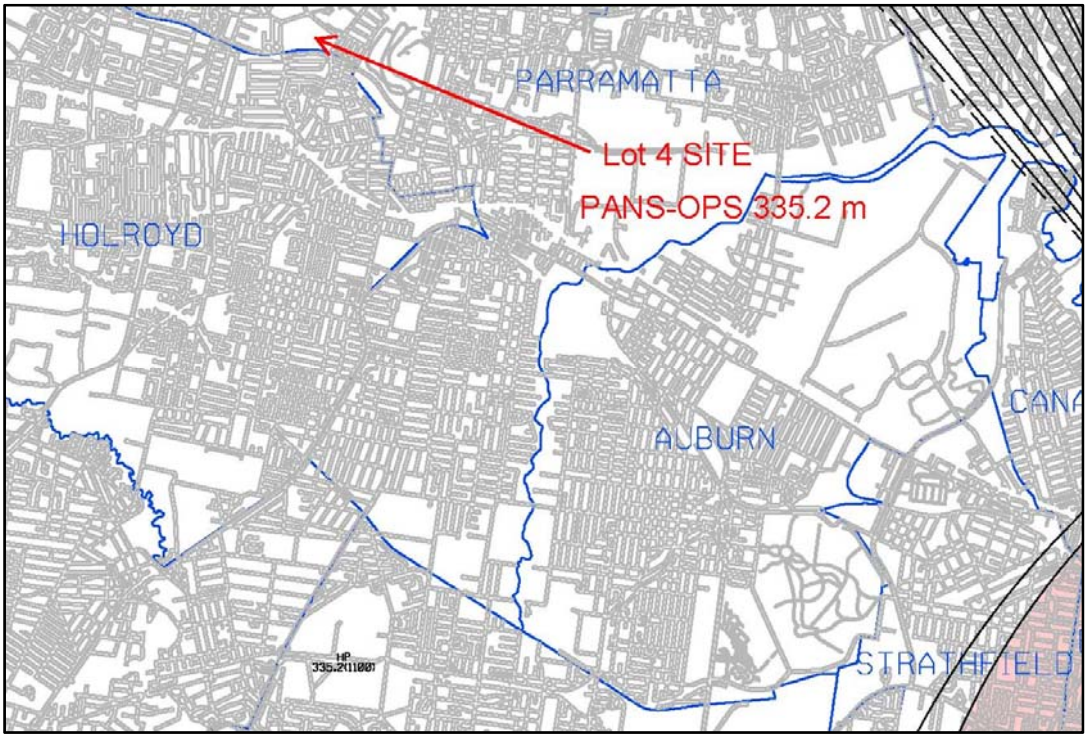


Figure 6.1 Sydney Airport PANS-OPS Surface

BANKSTOWN AIRPORT PANS-OPS SURFACE

Figure 6.2 is an extract from the Bankstown Airport PANS-OPS chart as published in the Airport Master Plan.

As can be seen in Figure 6.2, the PANS-OPS surface height at the Lot 4 site has been interpolated as 320 m AHD.

As the maximum building height at Lot 4 is 101.3 m AHD, the Bankstown Airport PANS-OPS surface of 320 m AHD will not be penetrated.

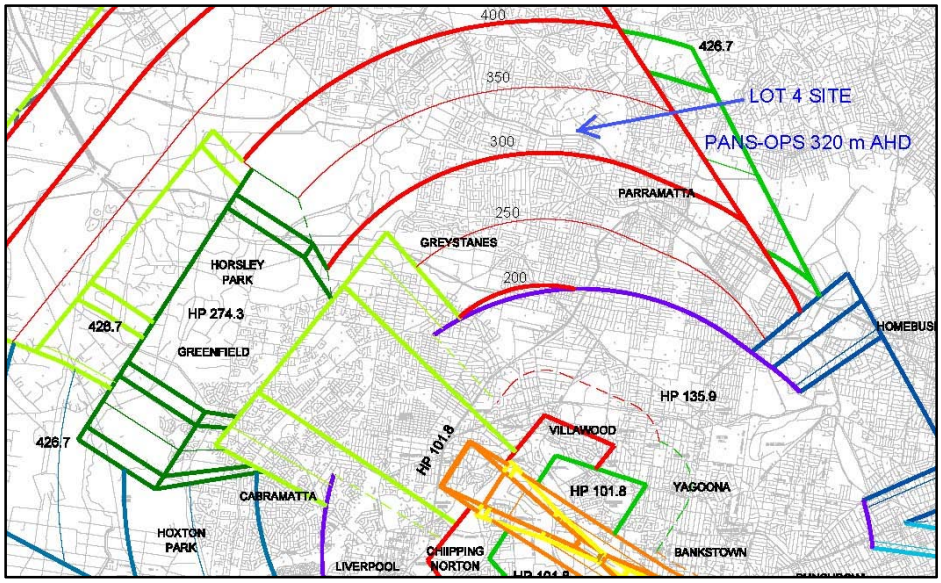


Figure 6.2 Bankstown Airport PANS-OPS Surfaces

7. Westmead Hospital Instrument Approach Procedures

There are three instrument approach procedures published in the Australian AIP DAP for the existing Westmead Hospital HLS (YWST). These are:

- RNAV- Z (GNSS) 052 from the south east, Minimum Altitude 700 ft
- RNAV-Z (GNSS) 127 from the north west, Minimum Altitude 800 ft
- NDB 127 from the north west, Minimum altitude 830 ft

The maximum building height for Lot 4 is 101.3 m or 332.3 ft, and when the Minimum Obstacle Clearance of 246 ft is applied the result is 578.3 ft, which is below the lowest Approach Minimum Altitude of 700 ft. Construction cranes will require separate approval and may be limited maximum height below 587.3 ft (176 m) AHD.

However, the above procedures will most likely be redesigned for the new CASB HLS, and any obstacles such as the Lot 4 development (if approved) will need to be considered.

8. Radar Performance Impact

The Sydney Airport Terminal Area Radar (TAR), comprising of Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR) is located on the airport 24.06 km south east of the building site, at an antenna elevation of 34.5 m AHD

There is another TAR located at Cecil Park, 16.16 km to the south west of the building site, at an antenna elevation of 200.51 m AHD.

CLEARANCE REQUIREMENTS FOR RADARS

CASA Manual of Standards (MOS) Part 139 Aerodromes publishes the clearance requirements for radars. The section of the MOS that applies to the site is:

> *11.1.14.4*
>
> *"The following clearance requirements are to be maintained:*
>
> *(a) No intrusion within 1 km of the radar into a height surface 5 m below the bottom of the antenna. No intrusion between the radar and the possible location of any desired targets, i.e. roughly speaking above 0.5 degrees elevation at any distance.*
>
> *(b) No metallic or other electrical reflective surfaces anywhere which subtend an angle of more than 0.5 degrees when viewed from the radar, e.g. fences, power lines, tanks as well as many buildings. All overhead power lines within 1 km must be aligned radially from the radar or be located at least 10 degrees below horizontal from the antenna."*

CLEARANCE REQUIREMENTS FOR THE SYDNEY AIRPORT TAR

The elevation of the Sydney airport TAR antenna is 38.2 m AHD, and the distance to the building site is 24060 m. The elevation of a 0.5° plane from the antenna at the site is:

> 24060 x Tan 0.5° = 210 m + TAR elevation of 38.2 m = 248 m (rounded down).

As the maximum building height is 101.3 m AHD, the building will not penetrate the Sydney TAR clearance plane.

CLEARANCE REQUIREMENTS FOR THE CECIL PARK TAR

The elevation of the Cecil Park TAR antenna is 200.51 m AHD, and the distance to the building site is 16160 m. The elevation of a 0.5° plane from the antenna at the site is:

> 16160 x Tan 0.5° = 141 m + antenna elevation of 200.51 m = 341.5 m AHD (rounded down).

As the maximum building height is 101.3 m AHD, the building will not penetrate the Cecil Park TAR clearance plane.

9. Navigation Aids Performance Impact

There are a number of navigation aids installed at Sydney Airport, including ILS, GBAS and DME.

The Building Restricted Areas (BRA) specified in the Air Services Australia document Navigation Aid Building Restricted Areas and Siting Guidance AEI-7.1613 Issue 2 contain building development limitations.

The BRA for the GBAS installation is within 3000 m of this installation, all other BRAs are less than 3000 m.

As the site is 21510 m from the nearest airport boundary, the BRAs for all the Sydney airport Navigation Aids will not be impacted.

There is only an NDB installed at Bankstown Airport, however an ILS installation is planned for RWY 11C/29C. As the site is 12260 m from the nearest airport boundary, the BRAs for all present and future Bankstown Navigation Aids will not be impacted.

The performance of the navigation aids at Sydney and Bankstown Airports will not be impacted by the Lot 4 Westmead building development.

10. Roof Top Exhaust Plumes

Roof top exhaust plume rises in excess of 4.3 m/s must be referred to CASA for their assessment of risk to aircraft operations. The developer has advised that exhaust plume rises will not exceed 4.3 m/s and therefore these need not be referred to CASA.

11. High Density Traffic Airspace

The development site is situated in the lane of entry D539A, and the nearby Parramatta CBD is a tracking point for aircraft departing Bankstown to the north. An extract from the Sydney Visual Terminal Chart (VTC) as published by Airservices Australia is shown in Figure 11.1.

Figure 11.1 Location of Lot 4 adjacent to the Westmead Hospital and the airspace shown in the Sydney VTC

In addition to traffic using the lane of entry for departures from Bankstown, there are a number of helicopter flight paths in the vicinity of Lot 4:

- to/from the Westmead and Cumberland hospitals to the north west; and
- Choppers North and Choppers West tracking points for helicopters arriving and departing Bankstown.

Traffic operating in this airspace can fly up to 2000 ft AHD, which is the upper limit of D539A and lower limit of the CTA C protecting arrivals and departures for Sydney Airport.

Apart from IFR helicopters operating to and from the Westmead Hospital HLS, all other traffic is restricted to the Visual Flight Rules (VFR) in Visual Meteorological Conditions (VMC) by day, and therefore are required to see and avoid any obstacles.

CASA may require the buildings and construction cranes to be equipped with obstruction lighting to enhance sighting.

12. Conclusions

This AIA concludes that:

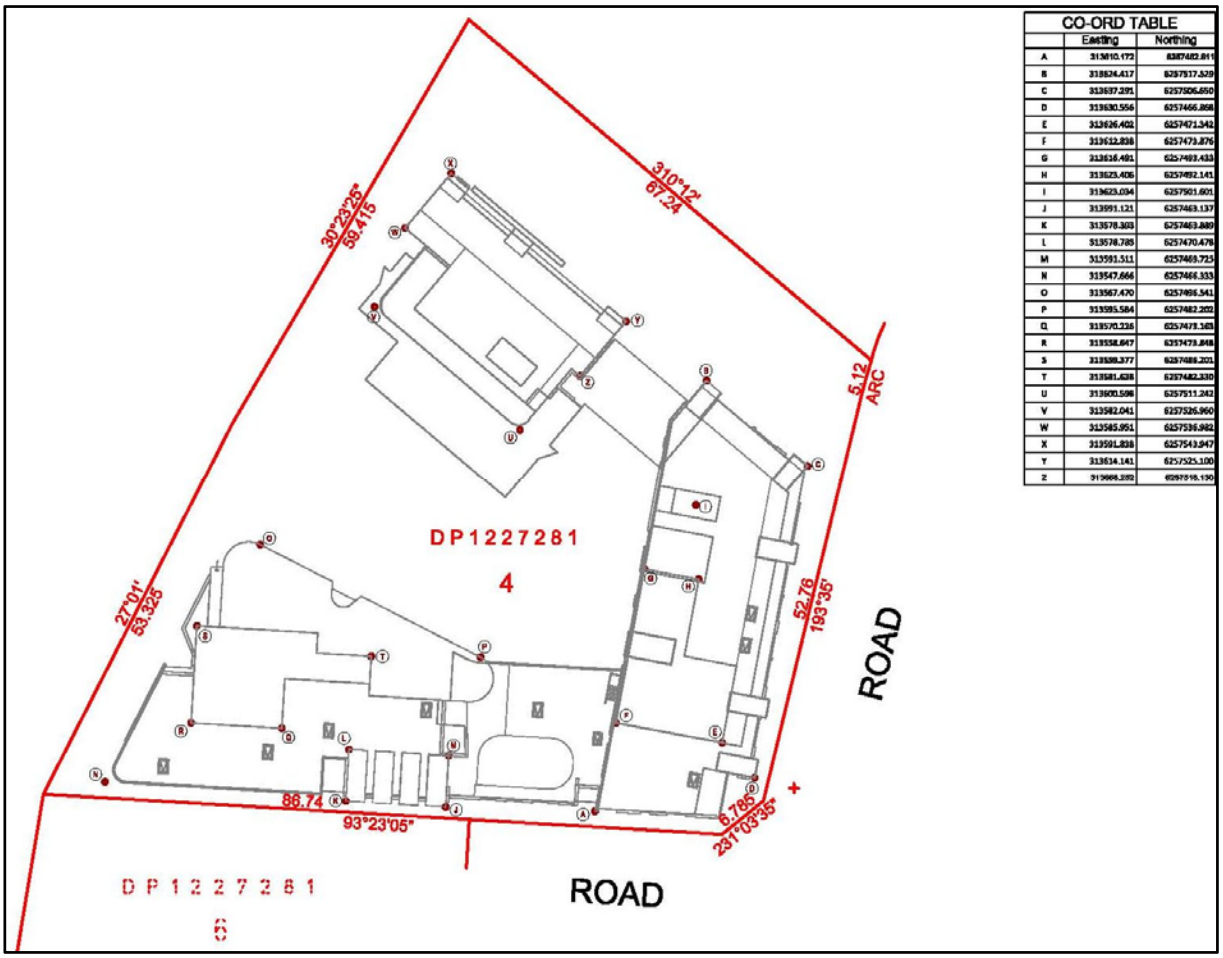
- The proposed alternative flight path for the CASB HLS to avoid overflying Lot 4 will meet CASA obstacle clearance requirements;
- The OLS and PANS-OPS surfaces for Sydney and Bankstown will not be penetrated;

  The PANS OPS surfaces for the Westmead Hospital Helipad RNAV-Z (GNSS) 052 and NDB 127 approach procedures will not be penetrated by the maximum building height of 101.3 m AHD. Construction cranes will require separate approval and may be limited to a maximum height below 587.3 ft (176 m) AHD. However, these procedures will need to be modified when the new CASB HLS is implemented, and the building and crane heights will be taken into account by Airservices Australia.
- The building height of 101.3 m AHD will not penetrate the clearance planes of the Sydney TAR at 228.4 m AHD, and Cecil Park TAR at 354.1 m AHD;
- The performance of the navigation aids and communication facilities in the Sydney region will not be impacted;
- Roof top exhaust Plume rises will be less than 4.3 m/s, and therefore will not need notification to CASA;
- The development site is located in a busy air area for Bankstown Airport traffic departing to the north, and for helicopter traffic crossing the area. Most of this traffic will operate in Visual Meteorological Conditions by day and can see and avoid obstacles. CASA will most likely require the installation of obstruction lighting to facilitate visibility of the building and crane.

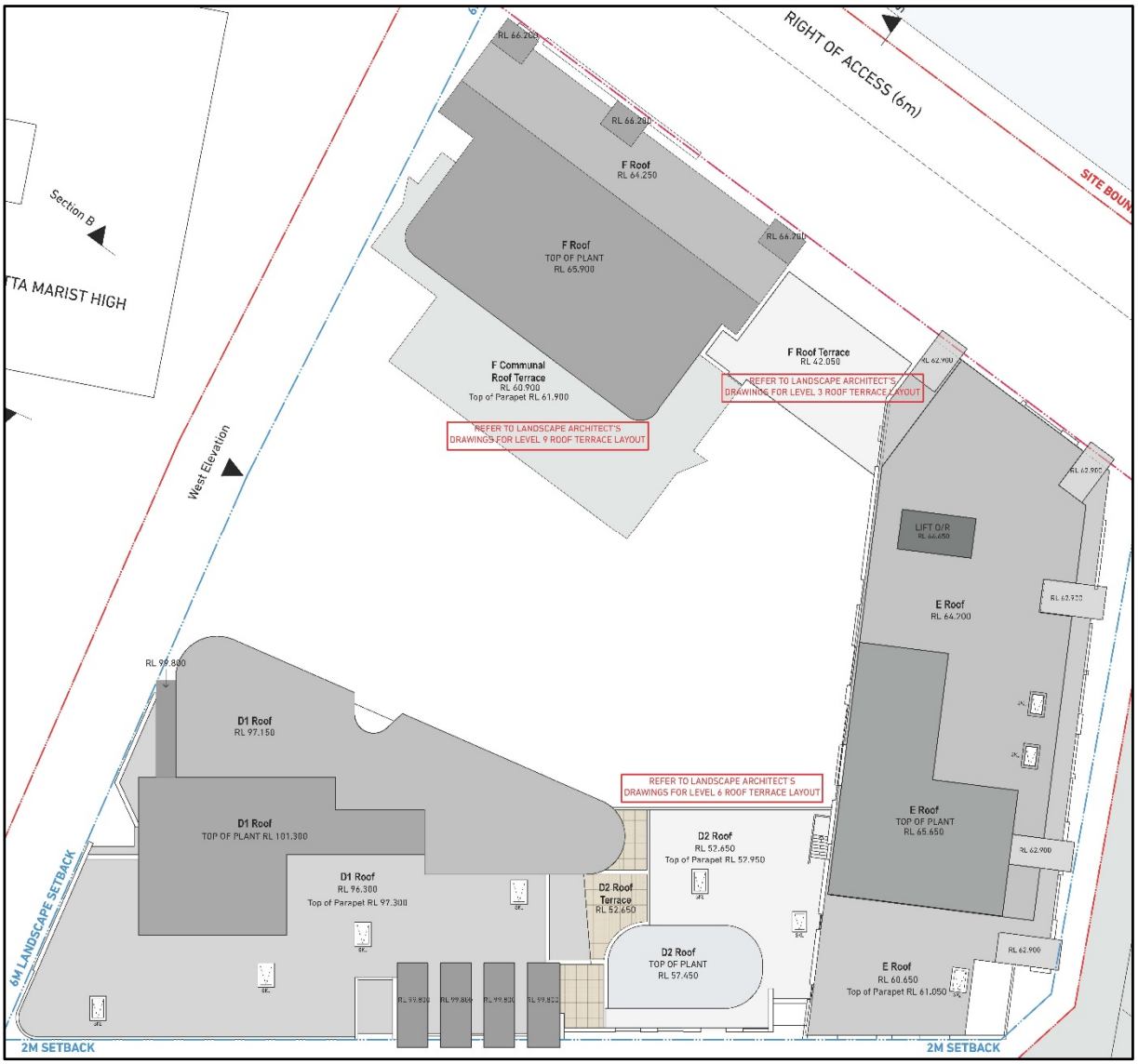
This AIA will need to be submitted to Bankstown Airport Management and to Westmead Hospital HLS operators, and will be referred to CASA and AsA for comment.

APPENDICES

APPENDIX A LOT 4 BUILDING ROOF COORDINATES



APPENDIX B LOT 4 BUILDING HEIGHTS



APPENDIX C

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, AIPs 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 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.

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 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 CAR 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
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 (for GP)
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
DIT	Department of Infrastructure and Transport. (Formerly Dept. of Infrastructure, Transport, Regional Development and Local Government and Department of Transport and Regional Services (DoTARS))
DOTARS	See DIT above
ELEV	Elevation (above mean sea level)
ENE	East North East
ERSA	Enroute Supplement Australia
FAF	Final Approach Fix
FAP	Final Approach Point
FATO	Final Approach and Take-Off area (for helicopter HLS)
ft	feet
GBAS	Ground Based Augmentation System (satellite precision landing system)
GNSS	Global Navigation Satellite System
GP	Glide Path

Abbreviation	Meaning
IAS	Indicated Airspeed
HLS	Helicopter Landing Site
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
LOC	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
OLS	Obstacle Limitation Surface
PANS-OPS	Procedures for Air Navigation Services – 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

Abbreviation	Meaning
SID	Standard Instrument Departure
SOC	Start Of Climb
STAR	Standard ARrival
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