



Miryvac

**Harbourside Shopping Centre,
Darling Harbour (SSD 7874) -
Assessment of Airspace
Approvability**

v1.0

11 Oct 2016

by



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Contents

Change History.....	iii
Distribution Control.....	iii
1. Introduction & Executive Summary	1
2. Context	3
2.1 Location of the Proposed Development	3
2.2 Methodology	4
2.2.1 Airspace Regulations	4
2.2.2 Prescribed Airspace.....	5
3. Analysis.....	6
3.1 OLS Analysis	6
3.2 PANS-OPS Analysis.....	7
3.3 Other Assessment Considerations	7

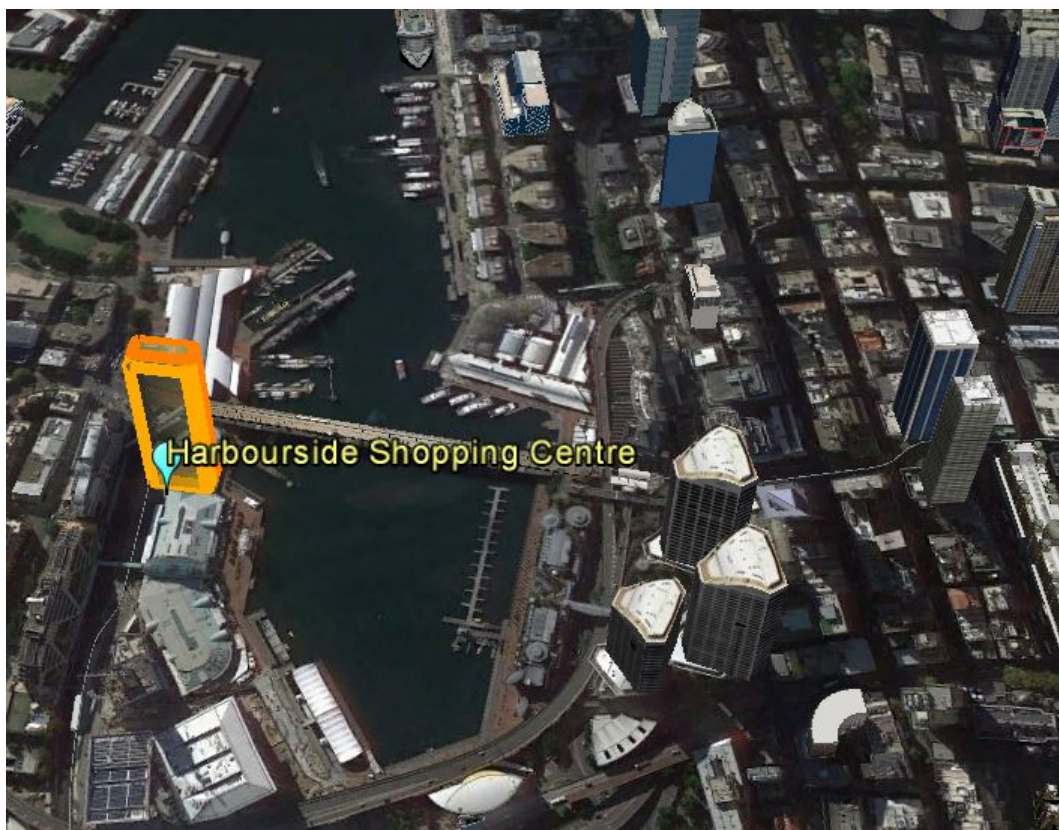
APPENDICES

Appendix 1 — Abbreviations

1. Introduction & Executive Summary

Mirvac has engaged Strategic Airspace to undertake an assessment of the height limitations imposed by airspace for the Harbourside Shopping Centre adjacent to the pedestrian bridge in Darling Harbour (see Figure 1-1 below) and to provide an opinion as to the likelihood of gaining the necessary 'airspace height' approvals from the federal Department of Infrastructure and Regional Development. This report describes the aviation-related height limitations to support ongoing planning activities and required approvals.

Figure 1-1: Project Site



The location of the proposed development is on the western side of Darling Harbour, within close proximity to the Sydney CBD. The site is approximately 2.8km from the centreline of Sydney Airport's runway 16L/34R (the eastern parallel runway) and approximately 8.5km (4.6 NM) from the 'centre' of the airport. The site is close enough to the runway centreline to be affected by some approach and departure procedures. The instrument flight procedures that could affect the maximum allowable building heights are:

- Aircraft that are departing to the north from this runway turn towards the east (away from the other parallel runway) and may fly over the proposed development site.
- Aircraft that are landing from the north on Runway (RWY) 16L are often radar vectored until they commence the final stage of the approach using either an instrument flight procedure, or landing

visually. Therefore the radar vectoring minimum altitudes contained in the Radar Terrain Clearance Chart (RTCC, part of Sydney Airport's declared airspace) have to be respected by any proposed new development near the city.

- Aircraft landing from the south on RWY 34R may be forced to execute a missed approach; this would entail turning east in which case they may fly over the project site.

Therefore, the maximum permissible height for the proposed development is determined by the airspace needed for these take-offs and landings. The proposed development's maximum height — at 166.35m Australian Height Datum (AHD) — plus the extra height needed for cranes for the construction of the building, must be contained within the height limitations imposed by these procedures to gain approval from the federal aviation authorities.

The effect of each of the relevant procedures on maximum permissible building heights is summarised in the following table.

Table 1-2: Hierarchy of Aviation-Related Height Constraints

<i>Height Limits (AHD)</i>	<i>Limit Detail</i>	<i>Comment</i>
156m	OLS Outer Horizontal Surface	THRESHOLD HEIGHT limit: Any development that would exceed this height requires a prior 'airspace height' approval from the Department of Infrastructure and Regional Development under the Airports (Protection of Airspace) Regulations.
166.35m	Proposed Maximum Building Height	Current proposed maximum building height.
<244m	Maximum Crane Height	As required to construct the building in the most efficient manner but must be below the RTCC 244m limitation.
244m	RTCC Minimum Vector Altitude (MVA) above the Darling Harbour site	This is the maximum building height (including crane height) that would be approved by the aviation authorities.
Other PANS-OPS Surface Height Constraints <i>The constraints below are higher than the RTCC MVA height limit — and so, in the particular location, most likely not considered usable by the aviation authorities.</i>		
~300m	PANS-OPS Basic ILS Missed Approach for RWY 34R.	The site is beneath the outer edge of the Basic ILS Surfaces which are one set of surfaces that protect the precision ILS approach to RWY 16L.
~315m	Departure Surfaces	From Sydney Airports Prescribed Airspace Plans

As can be seen from the above table, the proposed maximum building height off 166.35m is well below the current maximum allowable height of 244m. The margin of some 77m, between the proposed maximum building height and the constraining MVA height limit at the site, leaves considerable room for cranes that would need to be erected for the construction of the tower.

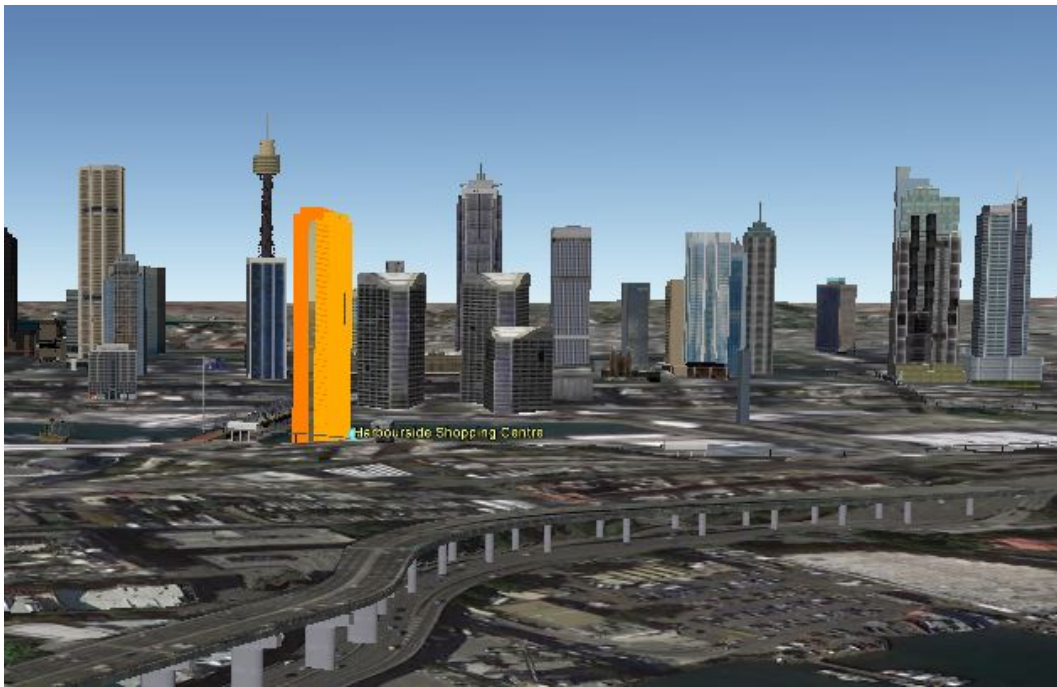
Therefore, based on the preliminary assessment, **we believe that there is no technical impediment to approval of the development as currently proposed, and that an application under the Airports (Protection of Airspace) Regulations, supported by a full aeronautical assessment and safety case would be approved by the Department of Infrastructure and Regional Development.**

2. Context

2.1 Location of the Proposed Development

The location of the proposed development is on the foreshore of Darling Harbour and adjacent to the western end of the footbridge across Darling Harbour. The proposed development is in close proximity to the central business district of the city of Sydney. The site's proximity to the city is important because the protection surfaces for landings and departures have to clear taller buildings in the centre of the city; so most of the procedures that might affect the building height are well clear of the proposed height.

Figure 2-1: Proposed Tower Development with City Skyline

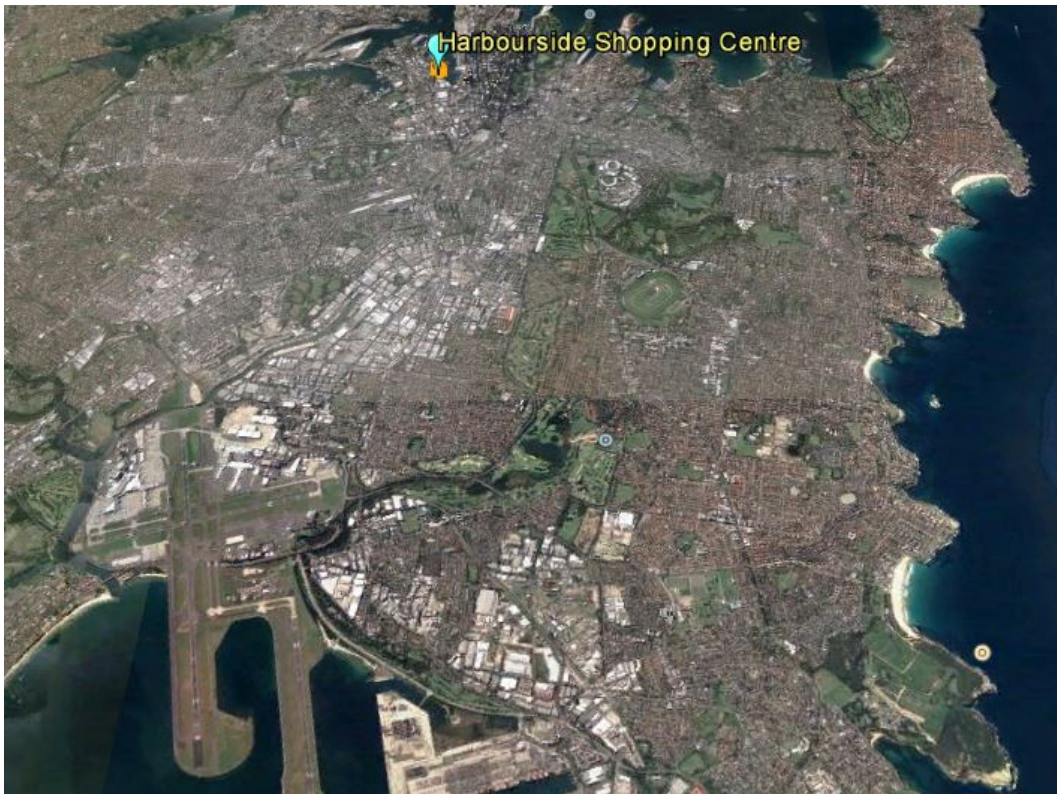


The site lies to the north-north-east of Sydney Airport, approximately 8.5km (4.6 Nautical Miles, NM) from the aerodrome reference point (ARP) — as indicated in Figure 2-2 below.

It is approximately 2.8km (1.5 NM) from the extended centreline of the eastern parallel runway, RWY 16L/34R, which in aviation terms is relatively close. Because of this, surfaces protecting landing procedures from the north and departure procedures to the north impose airspace restrictions on the proposed development.

The site is not affected by protection surfaces related to flight procedures to/from other runways at Sydney Airport.

Figure 2-2: Site in Relation to Sydney Airport



The other airports in the Sydney Basin are too distant from the proposed development to have any impact on the airspace surrounding it.

2.2 Methodology

The methodology used to determine the maximum building height (or minimum airspace height limitation) above the development site takes into consideration each of the following.

2.2.1 Airspace Regulations

The proposed development site is subject to the Airports (Protection of Airspace) Regulations (under the Commonwealth's Airports Act, 1996) because of its proximity to Sydney Airport and because of its proposed height. These regulations define both: how building height limitations due to airspace safety can be determined; and the process for gaining approval of the proposed development under the regulations.

The Prescribed Airspace Regulations, and their impact upon building height limitations, are described below.

2.2.2 Prescribed Airspace

Prescribed airspace, under these regulations, includes at minimum:

■ Obstacle Limitation Surfaces (OLS)

- The OLS surfaces are used to identify buildings and other structures that may have an impact upon the safety or regularity of aircraft operations at an airport. This impact depends upon both the type of operations at the aerodrome and which OLS surfaces are penetrated by a (proposed) building or structure.
- The OLS are flat and rising (invisible) surfaces around the airport. They are based on the geometry of the airport and its runways and therefore they rarely change.
- If a permanent building development (or temporary crane) that is proposed at a height that will penetrate (exceed) the height limit of an OLS surface, then an application must be made to the Commonwealth Department of Regional Development and Infrastructure — via the closest airport, and with copies to any other potentially affected airport — for an airspace height approval prior to construction of the permanent development &/or erection of the temporary crane obstacle. Such applications should demonstrate the proposed building development does not penetrate or adversely affect surfaces protecting: instrument flight procedures (PANS-OPS surfaces); radar vectoring; navigation infrastructure; or anything else that might affect the safety or regularity of operations at the airport.

■ PANS-OPS Surfaces

- PANS-OPS surfaces represent the protection surfaces for published instrument flight procedures to and from the airport. These surfaces comprise flat, sloping and complex surface components.
- PANS-OPS surfaces must not be penetrated by either permanent or temporary buildings or structures. However, for a variety of reasons, PANS-OPS surfaces can and do change over time.
- As flight procedures are changed from time to time (usually by Airservices), the PANS-OPS Surface Plan published by an airport may not reflect the current situation — which is why we not only reference the airport's plans but also review the published charts for current (or pending) instrument flight procedures and evaluate the associated PANS-OPS height limits. The regulations also make a provision for any factor which may be deemed to adversely affect the safety, regularity or efficiency of aircraft operations at an airport. In light of this, it is necessary to consider the following factors.

■ Other Considerations

- **Sydney Airport's Declared Airspace Plans** additionally include:
 - Radar Terrain Clearance Charts (RTCC), which depict the areas and height limits related to the Minimum Vector Altitudes (MVAs) used by Air Traffic Controllers when vectoring aircraft;
 - Lighting and visual guidance protection plans — used for approach guidance by aircraft, especially at night and in times of poor visibility; and
 - Navaid and radar evaluation / protection surface plans.
- **Other Factors**
 - Airline Engine-Out (Contingency) Take-Off Splays
These are generally assessed independently by the airlines as part of their own evaluations of any given airspace height application, but it is prudent to evaluate any potential impact in advance.
 - Other miscellaneous factors that may be considered as potential safety issues by any of the key stakeholders, and the Civil Aviation Safety Authority (CASA) in particular.

3. Analysis

The impact of the various building height limitations, from lowest to highest, is summarised in the following table.

Table 3-1: Hierarchy of Height Limitations

Height Limits (AHD)	Limit Detail	Comment
156m	OLS Outer Horizontal Surface	THRESHOLD HEIGHT limit: Any development that would exceed this height requires a prior 'airspace height' approval from the Department of Infrastructure and Regional Development under the Airports (Protection of Airspace) Regulations.
166.35m	Proposed Maximum Building Height	Current proposed maximum building height.
<244m	Maximum Crane Height	As required to construct the building in the most efficient manner but must be below the RTCC 244m limitation.
244m	RTCC Minimum Vector Altitude (MVA) above the Darling Harbour site	This is the maximum building height (including crane height) that would be approved by the aviation authorities.
Other PANS-OPS Surface Height Constraints <i>The constraints below are higher than the RTCC MVA height limit — and so, in the particular location, most likely not considered usable by the aviation authorities.</i>		
~300m	PANS-OPS Basic ILS Missed Approach for RWY 34R.	The site is beneath the outer edge of the Basic ILS Surfaces which are one set of surfaces that protect the precision ILS approach to RWY 16L.
~315m	Departure Surfaces	From Sydney Airports Prescribed Airspace Plans

3.1 OLS Analysis

The height limit of Sydney Airport's OLS at the proposed development site is **156m AHD**. The OLS surface directly above the site is called the Outer Horizontal Surface (OHS). The proposed tower would penetrate this surface by 10.35m. The cranes required to construct the tower building would probably penetrate the OHS by significantly more than 10.35m.

Similar, or greater, penetrations of the OHS are quite common and generally considered acceptable. However, because of this penetration, an application must be made for approval of the proposed development by the Department of Infrastructure and Regional Development. Failure to obtain such approval before construction commences can result in significant penalties under the Airports Act (1996).

3.2 PANS-OPS Analysis

It is only necessary to consider those procedures that use RWY 16L/34R. The effect that each of these procedures has upon the maximum allowable building height (including cranes) is shown in the table below.

Table 3-2: PANS-OPS Height Limitations

<i>Procedure</i>	<i>Height Limit (m AHD)</i>	<i>Description</i>
Circling	N/A	Outside the Circling area protection surface.
RWY 16L ILS / GLS Approach	N/A	Outside the Basic ILS surfaces.
RWY 16L RNAV GNSS Approach	N/A	Outside the RNAV GNSS protection areas.
RWY 34R ILS / GLS Approach	~ 300m	Just inside the Basic ILS Missed Approach protection area. Height limitation will vary across site.
RWY 34R RNAV GNSS Approach	~ 300m	Missed Approach Leg: This procedure has to clear higher buildings in the city which have heights up to about 330m.
RWY 34R Departure	~ 315m	This procedure has to clear higher buildings in the city which have heights up to about 330m.

3.3 Other Assessment Considerations

The following table provides a brief assessment of other considerations.

Table 3-3: Other Assessable Height Limitations

<i>Procedure</i>	<i>Height Limit (m AHD)</i>	<i>Description</i>
Radar Terrain Clearance Chart (RTCC)	244	The Lowest Safe Altitude of the sector covering the western side of Darling Harbour is 244m. This is taken from the RTCC published as part of Sydney Airports Prescribed Airspace Plans. See also Figure 3-4below.
Visual Approaches to RWY 16L	244	Aircraft flying using Visual Flight Rules (VFR) would be required to adhere to the RTCC minimum altitude until inside the appropriate circling area.
Navigation Infrastructure	N/A	The proposed development is too far from the airport to affect any navigation infrastructure.
Airlines Engine Out Procedures	N/A	Engine Out procedures (from RWY 34R, the closest take-off runway end) either turn to the east well before the city or well after the city. The Darling Harbour site is outside or below the protection areas for Engine Out Procedures. In this case, the location of the site in relation to the taller buildings in the nearby CBD and the airport means that aircraft must clear the buildings in the CBD

There are no other considerations that might limit the building height at the Darling Harbour site.

Figure 3-4: Height Limit related to RTCC/MVA for Air Traffic Control



APPENDIX 1 — ABBREVIATIONS

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

<i>Abbreviation</i>	<i>Meaning</i>
AC	Advisory Circular (document supporting CAR 1998)
ACFT	Aircraft
AD	Aerodrome
AGL	Above Ground Level (Height)
AHD	Australian Height Datum
AHT	Aircraft Height
AIP	Aeronautical Information Publication
Airports Act	Airports Act 1996, as amended
AIS	Aeronautical Information Services
ALARP	As Low As Reasonably Practicable
ALC	Airport Lease Company
Alt	Altitude
AMAC	Australian Mayoral Aviation Council
AMSL	Above Minimum Sea Level
ANEF	Australian Noise Exposure Forecast
ANSP	Airspace and Navigation Service Provider
APACL	Australia Pacific Airports Corporation Limited, owner of Melbourne and Launceston Airports
APCH	Approach
APARs, or A(PofA)R	Airports (Protection of Airspace) Regulations, 1996 as amended
ARP	Aerodrome Reference Point
AsA	Airservices Australia
ASDA	Accelerated Stop Distance Available
ATC	Air Traffic Control(ler)
ATM	Air Traffic Management
BAC	Brisbane Airport Corporation
BCC	Brisbane City Council
CAO	Civil Aviation Order
CAR	Civil Aviation Regulation
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation
Cat	Category
CBD	Central Business District
CG	Climb Gradient
CNS/ATM	Communications, Navigation, Surveillance / Air Traffic Management
CPA	Cairns Port Authority, Operators Of Cairns Airport
DA	Decision Altitude
DAH	Designated Airspace Handbook
DAP	Departure and Approach Procedures (published by AsA)
DEP	Departure
DER	Departure End (of the) Runway
DEVELMT	Development
DH	Decision Height
DIRD	Department of Infrastructure and Regional Development (sometimes also abbreviated as Infrastructure)
DME	Distance Measuring Equipment
Doc nn	ICAO Document Number nn
DoD	Department of Defence

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For: Mirvac

<i>Abbreviation</i>	<i>Meaning</i>
DODPROPS	Dependent Opposite Direction Parallel Runway Operations
EIS	Environmental Impact Study
ELEV	Elevation (above mean sea level)
ENE	East North East
ERSA	EnRoute Supplement Australia
ESE	East South East
FAF	Final Approach Fix
FAP	Final Approach Point
Ft	Feet
GBAS	Ground-Based Augmentation System, a GNSS augmentation system to provide vertical guidance and additional precision to non-precision approaches — permits GLS Approaches
GLS	GNSS Landing System – a precision landing system like ILS but based on augmented GNSS using ground and satellite systems.
GNSS	Global Navigation Satellite System
GP	Glide Path
HLS	Helicopter Landing Site
IAS	Indicated Air Speed
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IHS	Inner Horizontal Surface, an Obstacle Limitation Surface
ILS	Instrument Landing System, a precision approach landing system
IMC	Instrument Meteorological Conditions
IPA	Integrated Planning Act 1997, Queensland State Government
ISA	International Standard Atmosphere
IVA	Independent Visual Approach
Km	Kilometres
Kt	Knot (one nautical mile per hour)
LAT	Latitude
LDA	Landing Distance Available
LLZ	Localizer
LONG	Longitude
LSALT	Lowest Safe ALTitude
M	Metres
MAPt	Missed Approach Point
MDA	Minimum Descent Altitude
MDH	Minimum Descent Height
MDP	Major Development Plan
MGA94	Map Grid Australia 1994
MOC	Minimum Obstacle Clearance
MOCA	Minimum Obstacle Clearance Altitude
MOS	Manual Of Standards, published by CASA
MP	Master Plan
MVA	Minimum Vector Altitude
NASF	National Airports Safeguarding Framework
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
NNW	North North West
NOTAM	NOTice to AirMen

<i>Abbreviation</i>	<i>Meaning</i>
NPR	New Parallel Runway (Project, Brisbane Airport)
OAR	Office of Airspace Regulation
OCA	Obstacle Clearance Altitude (in this case, in AMSL)
OCH	Obstacle Clearance Height
ODPROPS	Opposite Direction Parallel Runway OPERations
OHS	Outer Horizontal Surface, an Obstacle Limitation Surface
OLS	Obstacle Limitation Surface, defined by ICAO Annex 14; refer also CASA MOS Part 139
PANS-OPS	Procedures for Air Navigation – Operations, ICAO Doc 8168; refer also CASA MOS Part 173
PBN	Performance Based Navigation
PRM	Precision Runway Monitor
RAAF	Royal Australian Air Force
RAPAC	Regional Airspace users Advisory Committee
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 (refer also MVA)
RWY	Runway
SACL	Sydney Airport Corporation Limited
SID	Standard Instrument Departure
SODPROPS	(Independent) Simultaneous Opposite Direction Parallel Runway OPERations
SPP	State Planning Policy, Queensland (specifically SPP 1/02: Development in the Vicinity of Certain Airports and Aviation Facilities)
SSR	Secondary Surveillance Radar
STAR	STandard Arrival
TAR	Terminal Approach Radar
TAS	True Airspeed
THR	THReshold (of Runway)
TMA	TerMinal Area
TNA	Turn Altitude
TODA	Take-off Distance Available
TORA	Take-Off Runway Available
VFR	Visual Flight Rules
VIS	Visual
VMC	Visual Meteorological Conditions
V _n	Aircraft critical velocity reference
VOR	Very high frequency Omni-directional Range
VSS	Visual Segment Surface
WAC	Westralia Airports Corporation, operators of Perth Airport
WAM	Wide-Area Multilateralisation
WNW	West North West
WSW	West South West
WGS84	World Geodetic System 1984
WSA	Western Sydney Airport – the proposed second international airport for the Sydney Basin