Aeronautical Impact Assessment

Building Development
167 Northumberland Street,
Liverpool, NSW.

Client

Meriton Group

LB00360

Final V2

3 February 2021

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Draft v001	Draft report for submission to Client	PWW	2 December 2019
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Draft v003	Inclusion of Liverpool Hospital HLS	PWW	3 February 2021
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Contents

1 Introduction

1.1 The Development

The Meriton Group has tasked Landrum & Brown Worldwide (Australia) Pty Ltd to prepare an Aeronautical Impact Assessment (AIA) for the development of a commercial building at 167 Northumberland Street, Liverpool.

The development comprises a building up to a maximum height of 129.887 m AHD.

The site is located between Northumberland Street and Laurantus Serviceway, Liverpool.

Figure 1: Site Location in relation to Bankstown Airport

Figure 2: Proposed development location (Google Earth)

Construction, for the purpose of this report, is anticipated to commence in January 2021 and be completed by the end of August 2022.

This report considers the likely impact of the development upon aviation activities in the area, especially Bankstown Airport and outlines the steps necessary to gain approval from The Department of Infrastructure, Transport, Regional Development and Cities for any infringement of Prescribed Airspace at airports in the vicinity of the site.

The report also assesses whether the building may have an impact upon the emergency services helicopters' flight paths to/from Liverpool Hospital's Helicopter Landing Sites.

2 Prescribed Airspace

2.1 Overview

The Airports (Protection of Airspace) Regulations 1996 specifies volumes of Prescribed Airspace related to Federally leased airports such as Sydney Airport and Bankstown Airport that protect them from uncontrolled obstacle growth that may have an adverse impact upon flight safety or the regularity of flight operations at those airports.

Prescribed Airspace for an airport is the airspace above any facet of the Obstacle Limitation Surfaces (OLS) or the PANS OPS (Procedures for Air Navigation Services – Aircraft Operations) surfaces for an airport, or the Radar Terrain Clearance Chart (RTCC) protection surfaces.

The OLS are conceptual surfaces associated with runways that are designed to protect aircraft operations from unrestricted obstacles

The OLS comprises:

- outer horizontal surface (OHS);
- conical surface;
- inner horizontal surface (IHS);
- approach surface for each runway;
- inner approach surface for each runway;
- transitional surface for each runway;
- inner transitional surface;
- baulked landing surface; and
- take-off climb surface.

The outer segments of the OLS for airports with Type B, 3D instrument approaches, such as Sydney Airport, extend to 15 km from the airport's Aerodrome Reference Point (ARP). Airports such as Bankstown have OLS extending to 4 km from the ARP, however Bankstown has designated an OLS that extends to 15 km for future Master Planning purposes. The future surfaces have been considered.

The PANS OPS surfaces are designed beneath instrument approach and departure flight paths with a prescribed minimum obstacle clearance above the obstacles or terrain. They provide an obstacle free flight path to enable safe and efficient aircraft operations in Instrument Meteorological Conditions (IMC) during which flight crews cannot necessarily see the ground or obstacles and they must rely upon aircraft instrumentation to determine their position in relation to navigation aids and runways.

The RTCC provides Air Traffic Control (ATC) with a minimum safe altitude above terrain and obstacles, above which they can provide surveillance services to aircraft in the area around major airports. A protection surface below the useable heights restricts obstacle growth.

Permanent infringement of PANS OPS or RTCC protection surfaces are not supported by the aviation authorities, however, temporary "controlled activities" up to a duration of 3 months can be approved subject to support from the airport, Airservices Australia and CASA being provided to DITRDC. If the infringement is shown to impact on aviation safety or regularity of aircraft operations, it is unlikely to be approved.

2.2 PANS OPS Surfaces

Bankstown and Sydney Airports' PANS OPS surfaces were assessed in detail for this proposed development.

Other airports including RAAF Richmond and Camden Airport have PANS OPS surfaces related to a 25 nm Minimum Safe Altitude (MSA) over the development site but they are in excess of 300 m AHD so are not relevant to the content of this report.

Western Sydney Airport, which is not planned to be operational until approximately 2027 will also have 25 nm MSA PANS OPS surfaces over the development site that are anticipated to be higher than 300 m AHD.

2.2.1 Bankstown Airport

The detailed assessment of Bankstown Airport's PANS OPS surfaces showed that the lowest PANS OPS surface above the building site is related to the Standard Instrument Departure for RWY 29C, with a PANS OPS surface height of 130.0 m AHD.

The development site is also located within the IFR Circling Area for Category C aircraft, with a PANS OPS surface of 135.9 m AHD.

The proposed building at a maximum height of 129.88 m AHD will not infringe the PANS OPS surfaces at Bankstown Airport.

2.2.2 Sydney Airport

A detailed assessment of Sydney Airport's PANS OPS surfaces showed that the lowest PANS OPS surface above the building site is related to the 25 nm MSA with a minimum altitude of 340 m AHD.

The proposed building will not infringe the PANS OPS surfaces at Sydney Airport.

2.3 Obstacle Limitation Surfaces

Obstacle limitation surfaces extend to a maximum distance of 15 km from the Aerodrome Reference Point (ARP) of relevant airports.

The development site is located outside Sydney Airport's OLS but within Bankstown Airport's OLS.

2.3.1 Bankstown Airport

The development site is located within the Conical Surface of the Bankstown Airport OLS.

The Conical Surface is at a height of approximately 128 m AHD at the eastern edge of the development site rising to approximately 130 m AHD at the western edge of the site.

The Conical Surface rises from 51 m at the edge of the Inner Horizontal Surface to approximately 128 m AHD at Northumberland St. (see Figure 3)

The proposed building at a maximum height of 129.887 m AHD will infringe the OLS Conical Surface.

An application to Bankstown Airport must be made in order to gain approval from DITRDC for this building project.

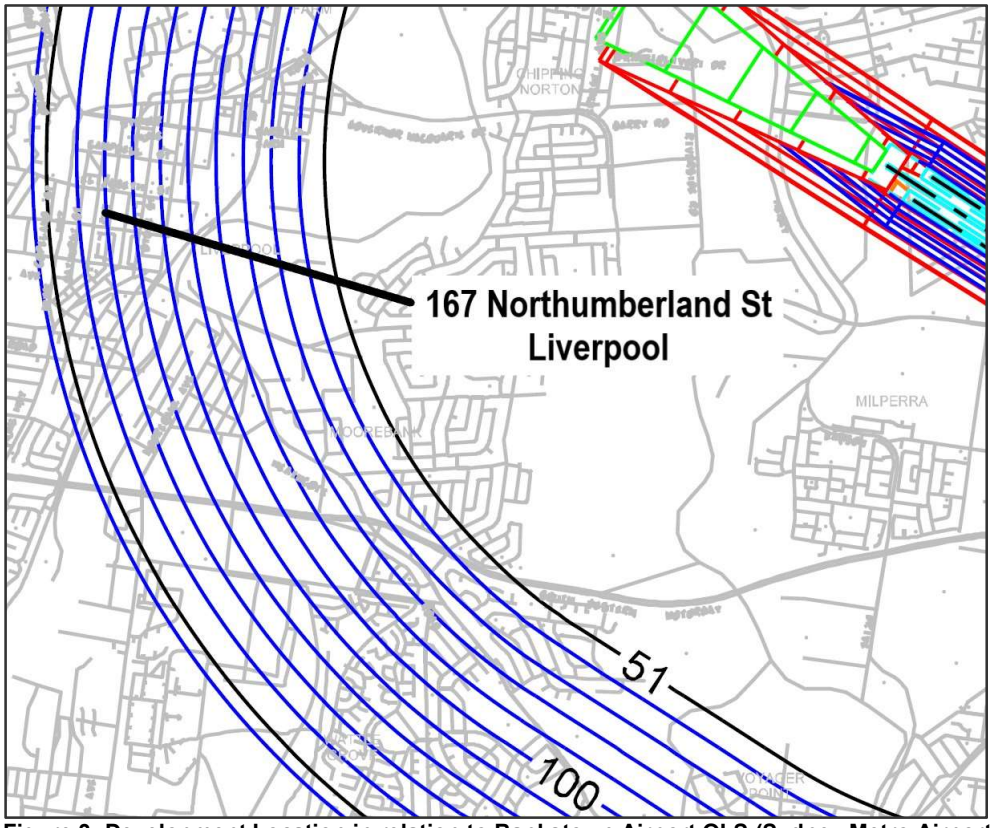


Figure 3: Development Location in relation to Bankstown Airport OLS (Sydney Metro Airports Master Plan 2014)

2.4 Aeronautical Study and Safety Case for OLS Infringement

As part of this assessment, an aeronautical study has been conducted to demonstrate that the proposed building to a maximum height of 129.887 m AHD would not adversely affect safety or significantly affect the regularity of operations of aircraft as per ICAO Annex 14, Aerodrome Design and Operations requirements.

As noted above, the proposed building will infringe the Bankstown Airport Conical Surface of approximately 128 m AHD by 1.9m.

The purpose of the Inner Horizontal Surface and the Conical Surface, as described in ICAO standards, is to protect aircraft circling the airport from obstacles in less than visual flight conditions prior to landing.

When the OLS surfaces were initially established, instrument approaches were generally only provided to one runway at the relevant airport and aircraft were not equipped for straight-in approaches with vertical guidance other than via the Instrument Landing System (ILS). A circling approach to a runway other than to the runway to which an instrument approach was designed was usually conducted when local weather conditions, such as wind direction, velocity or flight visibility, made a landing on the instrument approach runway unsuitable.

A study by the Flight Safety Foundation[1] Approach-and-Landing-Accident Reduction (ALAR) Taskforce found that circling approaches were a major causation factor in a majority of aircraft accidents in the vicinity of airports. The ICAO Assembly Resolution A33-16 Global Aviation Safety Plan (GASP) recognised the need to prevent Controlled Flight Into Terrain (CFIT) accidents by implementing a worldwide program whereby National Aviation Authorities provided a straight-in instrument approach with vertical guidance to each runway used by airline aircraft. In Australia, this program is almost complete with the introduction of Baro-

[1] Flight Safety Foundation ALAR Briefing Note 5.1

VNAV approaches at all certified and registered airports at which regular passenger transport aircraft operate.

The promulgation of straight-in instrument approaches has reduced the requirement to restrict obstacle growth in areas where aircraft now do not operate due to the reduction in the frequency of circling approaches. ICAO has acknowledged the limitations imposed by the current OLS layout and has formed the OLS Task Force (OLSTF) [2] to review, update and align the OLS surfaces with the PANS OPS surfaces. In completing this work, ICAO recognises the economic balance required between terrestrial infrastructure requirements of growing cities and efficiency and safety of flight operations.

At Bankstown Airport, only Runway 11C is provided with a straight-in approach with vertical guidance, due to the presence of Sydney Airport, so in a strong north wind IFR aircraft arriving in IMC would need to conduct a circling approach to Runway 29C.

See section 2.4.1 for a detailed assessment that shows that the IFR Circling areas are not infringed.

The development site is located outside of the protection area for the CAT A/B aircraft but within the protection area for CAT C aircraft. The aircraft category (CAT) depends on aircraft performance parameters and is published in the ICAO PANS OPS document.

With the building height proposed at a maximum elevation of 129.887 m AHD, the IFR Circling areas are not infringed.

2.4.1 Examination of Circling Approaches

The proposed building, at the maximum height of 129.887 m AHD, was examined to confirm that there would be no changes required to the published circling minimum altitudes for the permanent building.

The circling area limits from the runway thresholds, and Minimum Obstacle Clearance (MOC) for circling approaches are published in the ICAO PANS OPS document, as follows:

- CAT A and B: Area radius 4.9 kilometres, MOC 295 feet (90 metres), and
- CAT C: Area radius 7.85 kilometres, MOC 394 feet (120 metres).

The Minimum Descent Altitudes (MDA) published for circling approaches at Bankstown Airport, when an accurate QNH is available are:

- CAT A and B aircraft: 650 feet (198.1 m) AMSL. PANS OPS surface height 355 ft/**108.2 m** AHD, and
- CAT C aircraft: 840 feet (256 metres) AMSL. PANS OPS surface height 446 ft/**135.9 m** AHD.

The MOC is the prescribed margin above obstacles or terrain in the PANS OPS segment of an instrument approach procedure that determines the Minimum Descent Altitude (MDA) for the procedure.

Note: The Aeronautical Information Publication (AIP) publishes all distances in nautical miles, and altitudes in feet for instrument flight procedures. Displays to pilots are in the same format. The MDA box is shaded which allows pilots to reduce the shown MDA by 100ft if they are in receipt of an accurate QNH, this usually occurs when ATC are on duty.

Table 2 depicts the applicable circling area protection surface height and the clearance (in green) or infringement (in red) of the building on each surface.

Aircraft Category (CAT)	Height of PANS OPS Surface	Result for building height of 129.887 m AHD
A and B	108.2 m	Beyond lateral limit of PANS OPS Surface
C	135.9 m	**6.013 m Clearance**

Table 1: Circling Area PANS OPS heights

[2] https://www.icao.int/SAM/Documents/2016-SUPLIM/RPEAGA7_NI_04_Apéndice%20B_Obstacle%20Surfaces-%20the%20Concept-%20draft-%20OLSTF-5%20Final%20with%20comments.pdf

2.4.2 Aeronautical Study Conclusion

It is unlikely that the proposed building development will have a significant impact upon flight operations at Bankstown Airport as its maximum height does not infringe the IFR Circling Area MDA.

This aeronautical study will need to be included in any application to the aviation authorities for approval of the activity.

2.5 Radar Terrain Clearance Chart

The protection surface height for the RTCC above the development site is 152 m AHD.

At a maximum height of 129.887 m the proposed building will not infringe the RTCC protection surface.

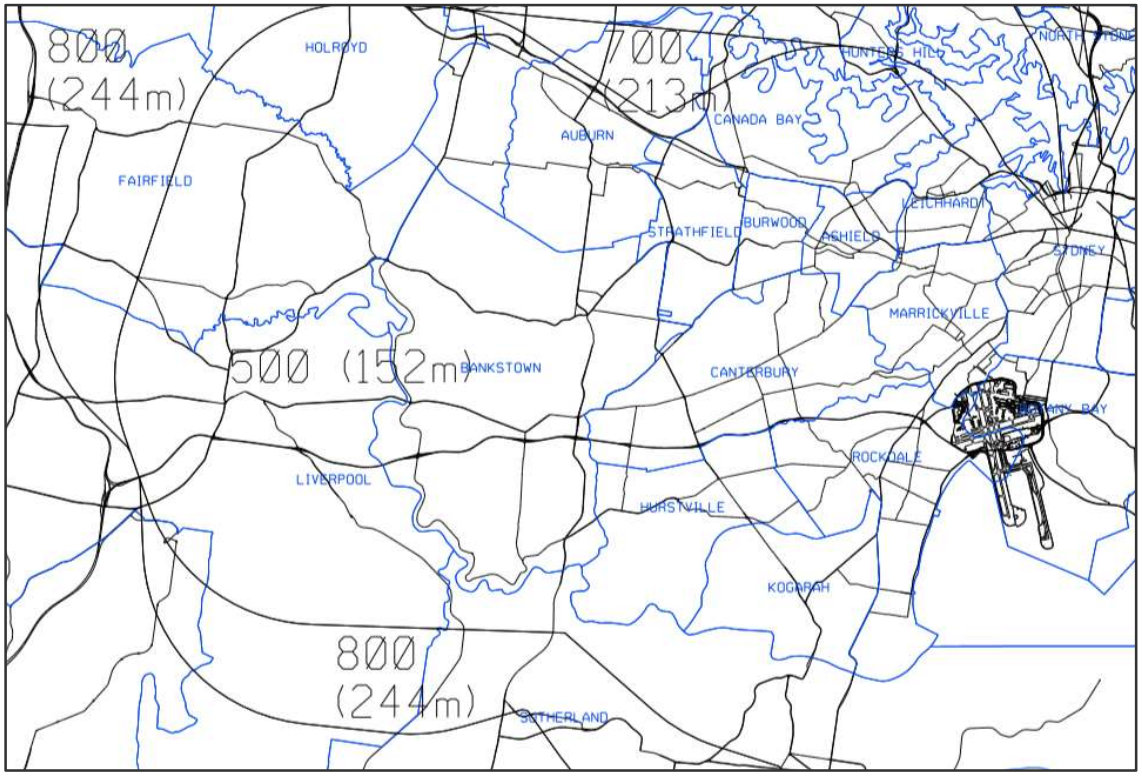


Figure 4: Sydney RTCC (SACL Airspace Protection web site)

3 Liverpool Hospital Helicopter Landing Sites

Liverpool Hospital is located approximately 700 m east of the proposed development site and has two Helicopter Landing Sites (HLS) provided for emergency services helicopters by day and night.

Liverpool Hospital is the major health service provider for south-western Sydney, providing services to the local government area of Liverpool City Council as well as district services to residents and visitors in the area. It also provides a range of statewide services in areas such as critical care and trauma, neonatal intensive care and brain injury rehabilitation.

The hospital has a very high trauma load and accepts referrals from outside its immediate area.

Toll Air Ambulance provides helicopter aeromedical operations in partnership with NSW Ambulance on a 24-hour, 7 day a week basis, delivering critical care to local communities. They regularly operate to and from the Liverpool Hospital HLS during the day and at night when the pilots are able to conduct the flight in accordance with the Visual Flight Rules (VFR).

Other authorised emergency services helicopters are also able to use the HLS.

The HLS does not have any instrument approach procedures published for it, therefore restricting operations to good weather conditions as appropriate to the Visual Flight Rules.

The HLS is considered to be a strategically important HLS due to the hospital's aero-medical retrieval and ambulance requirements. It is capable of supporting operations by AW139 helicopters, currently the largest helicopter operated by NSW Ambulance Service.

Figure 5 shows the HLS at the hospital.

The primary Eastern Pad is located in the centre of the hospital and is in regular use. The secondary Western Pad is not in use at present but is likely to be brought back into commission during 2021. Both HLS have been considered in this report.

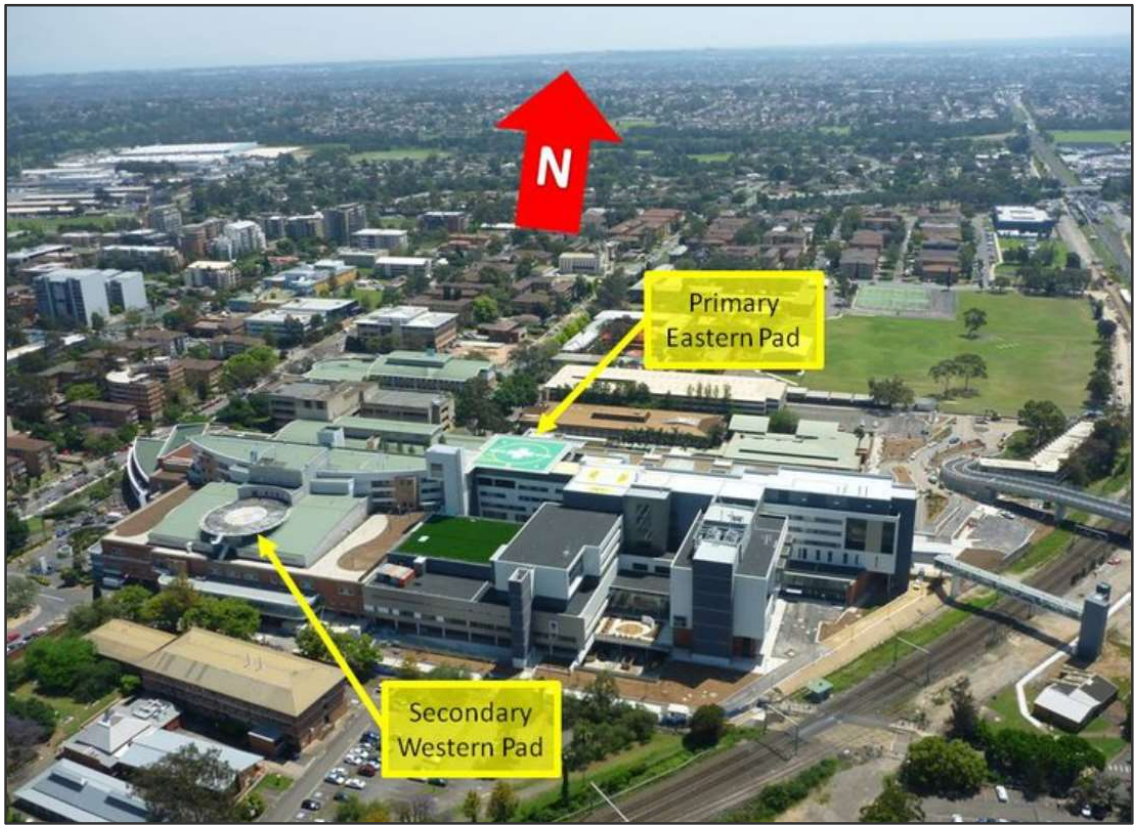


Figure 5: Liverpool Hospital Helicopter Landing Sites. (Ozrunways.com)

The Liverpool Hospital Eastern HLS has a reported elevation of 130 ft/ 39.64 m AHD whilst the Western HLS has an elevation of 110 ft/33.53 m AHD.

3.1 Flight Path Protection

The flight paths are protected by Take-Off Climb and Approach Surfaces promulgated by:

- The International Civil Aviation Organisation (ICAO), of which Australia is a signatory;
- The Civil Aviation Safety Authority (CASA),
- The Commonwealth Department of Infrastructure, Transport, Regional Development and Communications (DITRDC); and
- NSW Health.

DITRDC publishes guidelines under the National Airports Safeguarding Framework that protects these strategically important HLS. (NASF Guideline H)

NASF Guideline H provides guidance to State/Territory and local government planning authorities as well as the owners and operators of these HLS to ensure:

- The ongoing operation of the HLS;
- The use of the HLS is not compromised by any proposed development encroaching into flight paths; new developments do not present a hazard to helicopters arriving or departing at these HLS; and

- Any new HLS is appropriately located.

The guideline is also designed to address the following:

- Lighting that could cause a distraction or that could interfere with night operations;
- Mitigating noise relating to helicopter operations;
- Wildlife or bird strikes;
- Remotely piloted aircraft system operation or collisions; and
- Building induced wind shear or air turbulence that could affect the normal flight of helicopters operating to the HLS.

The guideline specifies that within land use planning controls, the maximum height limit specified should not extend into any flight path for one of these HLS. If a development is planned to exceed the heights of any of the protection surfaces it must be referred to the HLS owner and CASA.

NSW Health Guidelines for Hospital Helicopter Landing Sites in NSW also provides "…international experience and best practice in the establishment of HLS."

The NSW Health guideline refers to the ICAO and CASA documents along with USA Federal Aviation Administration (FAA) Advisory Circular 150/5390-2C Heliport Design which contains information regarding flight path protection that is essentially similar to the Australian documents and guidelines. An additional Transitional Surface for visual helicopter approach/departure operations is specified and required by NSW Health.

CASA publishes Civil Aviation Advisory Circular (CAAP) 92-2(2) – *Guidelines for the Establishment and Operation of Onshore Helicopter Landing Sites.* It provides guidance on a set of recommended standards for HLS operations acceptable to CASA.

The area that protects the authorised departure and approach flight paths, as described in CAAP 92-2(2) is shown in **Figure 6**. The night divergence angle was used in this assessment as nighttime helicopter operation occur regularly.

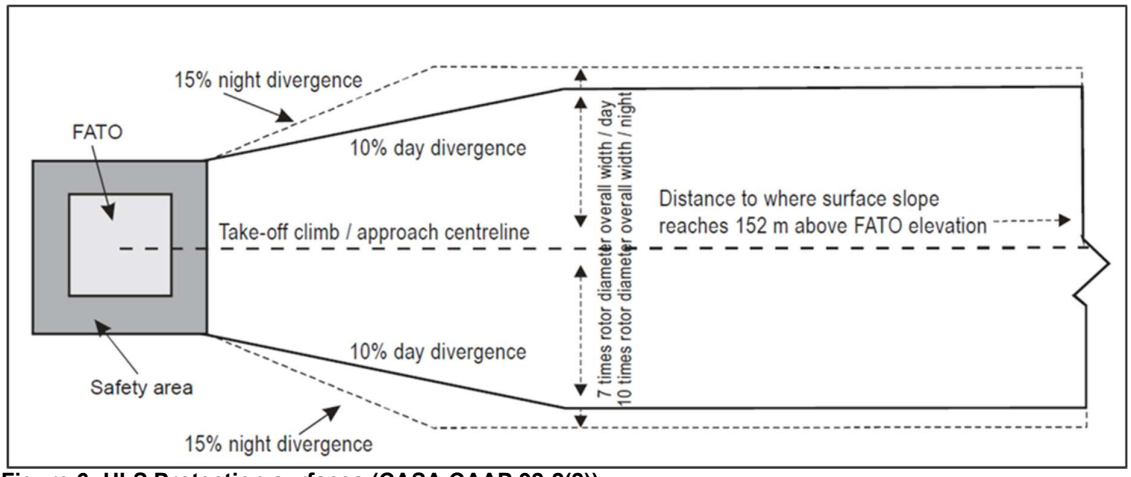


Figure 6: HLS Protection surfaces (CASA CAAP 92-2(2))

The surface commences at the edge of the Safety Area and at the elevation of the HLS. It rises at a gradient of 4.5% until it reaches 152 m above the FATO.

Figure 7 shows the NSW Health VFR HLS Approach/Departure Transitional Surfaces. This surface is less onerous than the CASA recommendations. The assessment used the NSW Health Transitional added to the CASA Take-Off Climb/Approach Surface to determine the most conservative values that provide the best protection for the helicopters operating to/from the St George Hospital HLS.

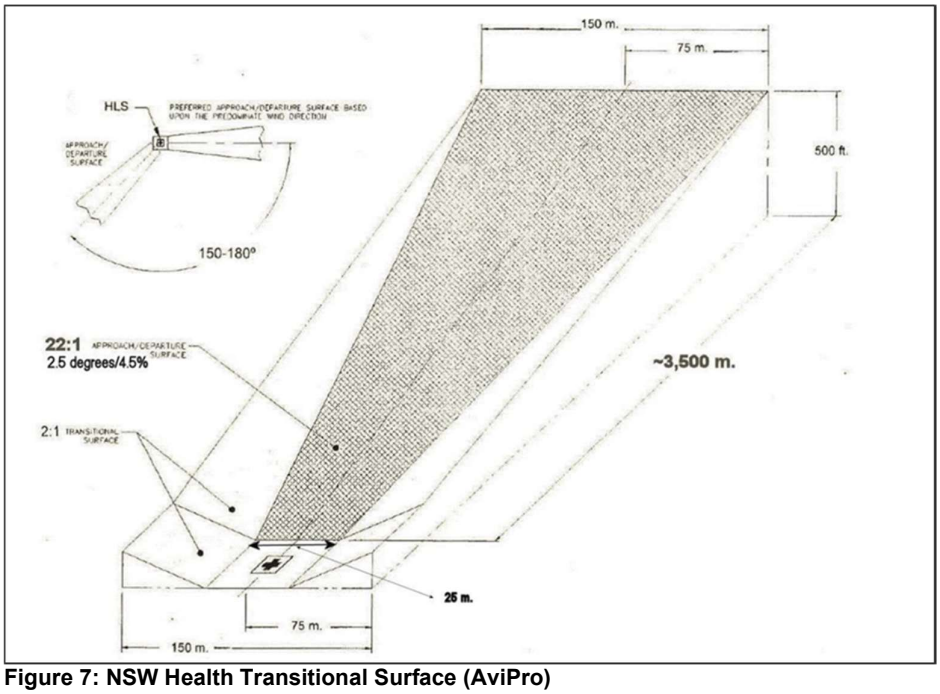


Figure 7: NSW Health Transitional Surface (AviPro)

3.2 Assessment

The proposed building development is located approximately 131 m south of the nearest point of the boundary of the Take-Off Climb and Approach Surface and therefore does not infringe that protection associated with the St George Hospital HLS.

The elevation of the Take-Off Climb/ Approach Surface at the nearest point of the building is 64.625 m AHD.

Figure 8 shows the location of the development site in relation to the Liverpool Hospital HLS and the protection surfaces associated with the two HLS.

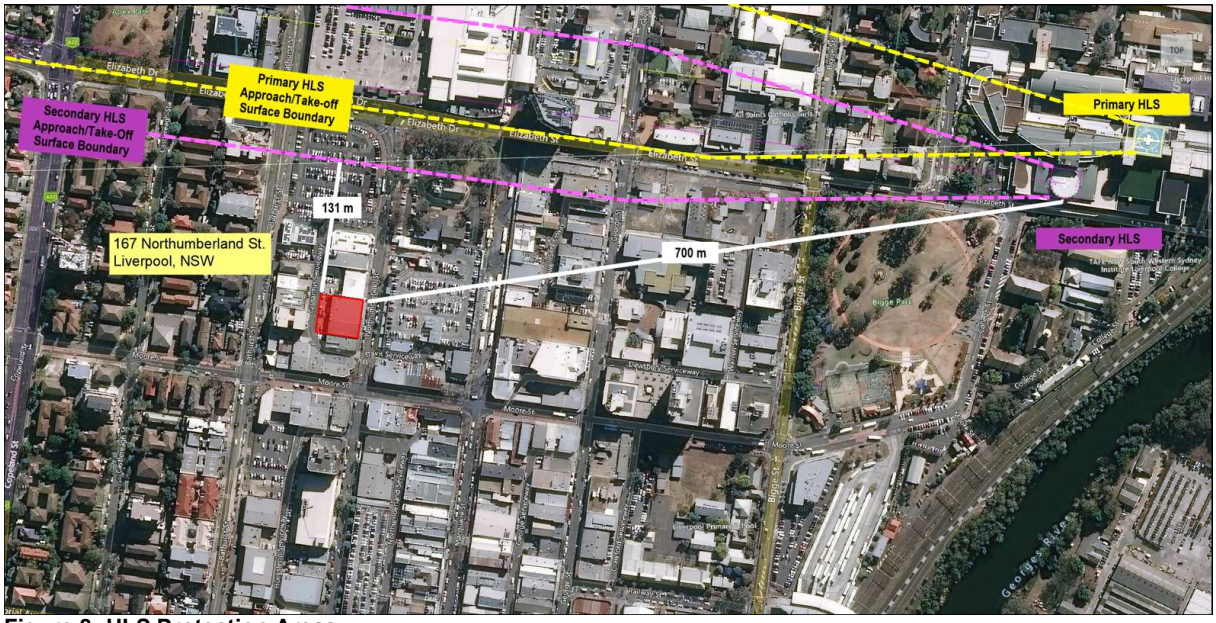


Figure 8: HLS Protection Areas

The proposed building is located outside of the approach/take-off surfaces for both HLS.

The proposed building development at 167 Northumberland St, Liverpool, does not have an adverse impact upon emergency service helicopter operating to/from the Liverpool Hospital HLS.

4 ATC Surveillance System Performance

ATC rely on surveillance systems to safely and efficiently control aircraft operations in the vicinity of Sydney Airport and the other airports in the Sydney Basin.

Buildings and/or terrain that infringe radar clearance planes have the potential to cause signal shadows in areas where ATC need to provide a surveillance service or advisory service to aircraft.

This assessment identified two radars in relative proximity to the development site: the Sydney Airport Terminal Area Radar (TAR), and the Cecil Park TAR.

The presence of multiple surveillance systems that support each other will reduce the potential of shadow effects.

The proposed development, at a height of 107.08 m AHD, will not infringe the Sydney Airport TAR clearance plane or the Cecil Park TAR clearance plane.

Airservices Australia will assess any likely impact that the proposed development may have on the Sydney Airport TAR, or other surveillance systems such as ADS-B, along with any mitigating effect of the other installations.

Surveillance System	Distance from development	Antenna Elevation (AHD)	Clearance Plane Elevation at development site Distance x Tan 0.5° + TAR elevation	Result for development height of 129.887 m AHD
Sydney Airport TAR	25400 m	38.2 m	221.6 m	91.713 m Clearance
Cecil Park TAR	9200 m	200.5 m	280.787 m	150.9 m Clearance

Table 2: Impact of development on ATC Surveillance System Performance

5 Navigation Aid Performance

There are navigation aids installed at Bankstown Airport and Sydney Airport, including ILS, GBAS, NDB and DME.

The Building Restricted Areas (BRA) describes a sensitive zone that exists to a radius of 3000 m from the navigation aid antenna sites. The building development limitations within the BRA is specified in the Airservices Australia document Navigation Aid Building Restricted Areas and Siting Guidance AEI-7.1613 Issue 2.

The development site is located more than 3 km from any navigation aid and is therefore outside of all BRA for all navigation aids in the Sydney area and therefore should not have an impact upon their operation.

6 Roof Top Exhaust Plumes

Exhaust plumes in excess of 4.3 m/s which exist in either OLS or PANS OPS surfaces can create sufficient turbulence to upset the stability of aircraft during take-off and landing operations.

Part 139 of the Civil Aviation Safety Regulations 1988 (CASR 1988) provides that CASA may determine that a gaseous efflux having a velocity in excess of 4.3 m/s is, or will be, a hazard to aircraft operations because of the velocity of the efflux.

Should any roof top exhaust plume rise in excess of 4.3 m/s infringe any of the above mentioned OLS or PANS OPS surfaces, they must be referred to CASA for their assessment of risk to aircraft operations.

7 Conclusion

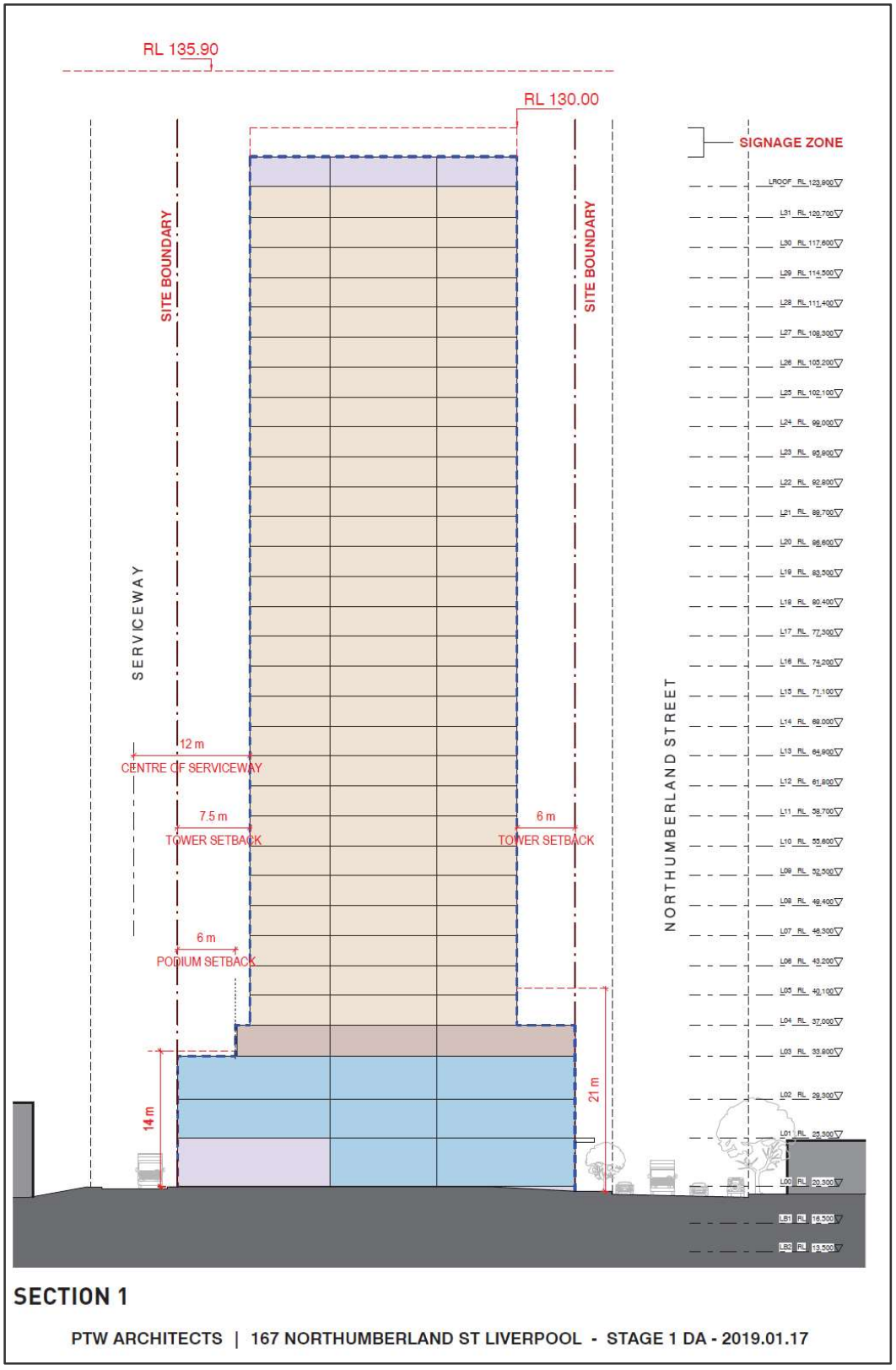
The development proposal for 167 Northumberland Street, Liverpool, with a building to a maximum height of 129.887 m AHD:

- will infringe the Conical Surface of the OLS for Bankstown Airport (128 m AHD);
- will not infringe the PANS OPS surfaces for Bankstown Airport (130 m AHD);
- will not infringe Sydney Airport's OLS or PANS OPS surfaces;
- will not infringe the Approach/Take-off Surfaces for the Liverpool Hospital HLS';
- will not infringe the PANS OPS surfaces for any other airport in the vicinity;
- will not infringe any BRA for navigation aids at Sydney Airport;
- will not infringe the Sydney TAR or the Cecil Park TAR clearance planes; and
- will not infringe the RTCC protection surface above the site (152m AHD).

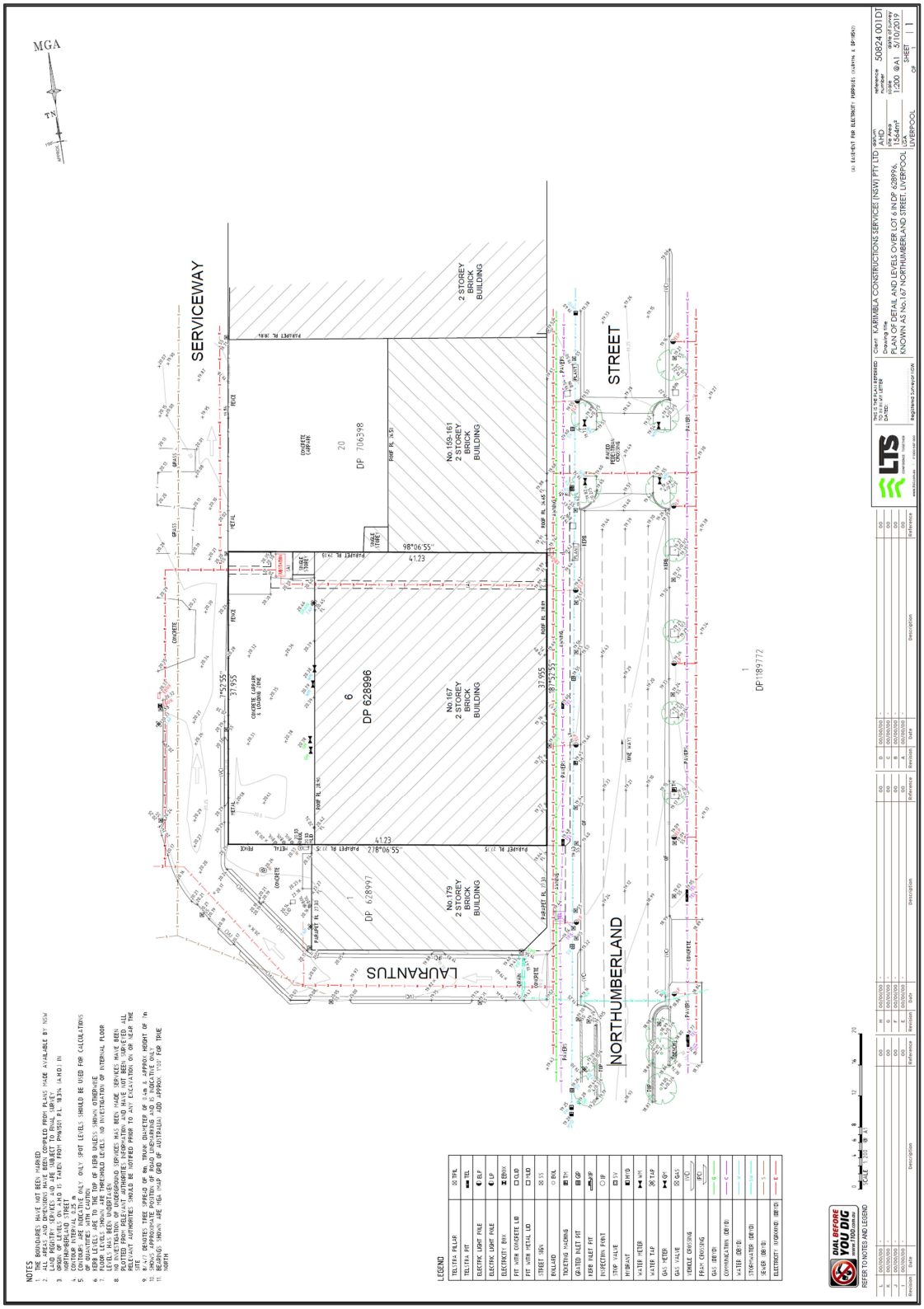
Based on the information provided throughout this report, the permanent infringement to the Bankstown Airport OLS by the building is unlikely to be considered to adversely affect aviation safety or regularity of flight operations and approval for the building is likely to be achieved.

It will be necessary to gain approval for the infringement of the Bankstown OLS and PANS OPS surfaces via an application to Bankstown Airport.

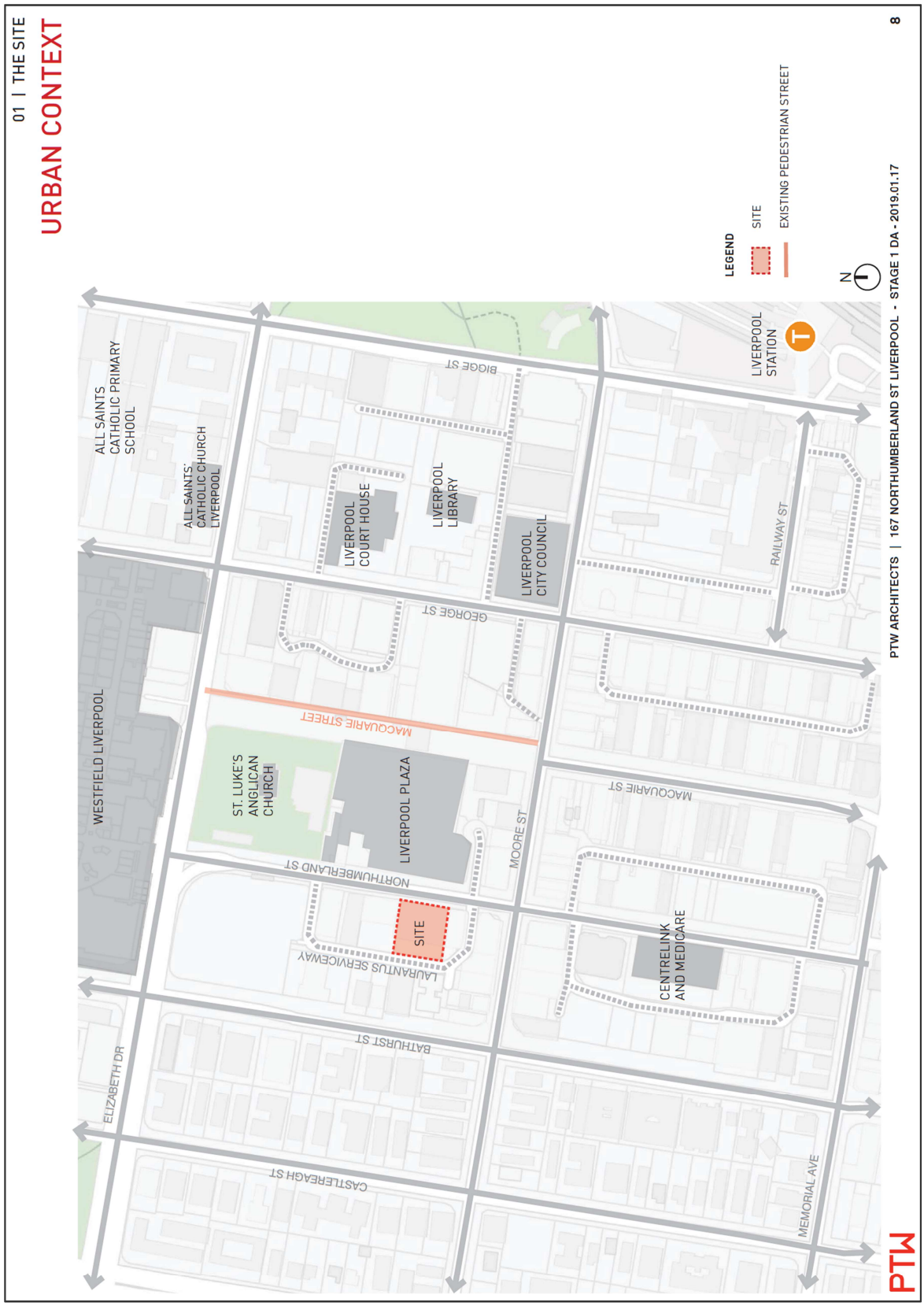
Appendix A – Building Height and Site Layout Diagrams



East-West Section Elevation
Source: Meriton Group/PTW



Site Layout
Source: Meriton Group/PTW



Site Location
Source: Meriton Group/PTW

Appendix B – 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;
- NSW Health; and
- Department of Defence where appropriate.

The *Airports Act 1996* and *Airports (Protection of Airspace) Regulations 1996* prescribes the volumes of airspace surrounding Federally Leased Airports that protect aircraft operations into those airports, in order to ensure the safety and regularity of airline and other flight operations.

Sydney Airport and Bankstown Airport Prescribed Airspace comprises:

- Obstacle Limitation Surfaces (OLS) that restrict obstacle growth in the vicinity of takeoff and landing paths; and
- PANS OPS surfaces that provide a buffer between flight paths and terrain or obstacles.

Relevant Acts and Regulations applicable to developments near airports and air traffic routes were referenced during this assessment.

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);
- International Civil Aviation Organisation (ICAO) DOC 8168 Procedures for Air Navigation – Aircraft Operations (PANS OPS); and
- NSW Health's Guidelines for Hospital HLS in NSW.

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

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, 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.

MDA (Minimum Descent Altitude) is the lowest altitude that can be used during a non-precision approach in IMC. Flight below the MDA reduces the clearance above obstacles and is not permitted in IMC.

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.

Radar Terrain Clearance Chart (RTCC) is a chart that provides air traffic controllers with the lowest usable altitude that they can vector an aircraft using prescribed surveillance procedures within controlled airspace. There is a protection surface below this usable altitude which is shown in airport master plans.

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 (documents that 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
BARO-VNAV	Barometric Vertical Navigation
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
DITRDC	Department of Infrastructure, Transport, Regional Development and Cities
ELEV	Elevation (above mean sea level)
ENE	East North East
ERSA	Enroute Supplement Australia
FAF	Final Approach Fix
FAP	Final Approach Point
FAS	Final Approach Surface of a BARO-VNAV approach

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
LOC	Localizer
LONG	Longitude
LNAV	Lateral Navigation criteria
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 – Aircraft Operations, ICAO Doc 8168

Abbreviation	Meaning
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
VNAV	Vertical Navigation criteria
V_n	aircraft critical Velocity reference
VOR	Very high frequency Omni directional Range
WAC	World Aeronautical Chart