UrbanGrowth NSW Development Corporation

Waterloo Metro Quarter SSP: Aeronautical Impact Assessment

Version 1.5 FINAL

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strategic airspace

Prepared by Consultants:

Strategic Airspace Pty Limited
ABN: 60 097 857 415

PO Box 253, Bondi Junction NSW 1355
Australia

Tel: +61 2 **9211.0085**

Email - Attn: Cathy.PakPoy@StrategicAirspace.com

Client:

UrbanGrowth NSW Development Corporation

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Document Title: **Waterloo Metro Quarter SSP: Aeronautical Impact Assessment**

Purpose / Abstract: *This report has been commissioned by UrbanGrowth NSW to inform the Waterloo Metro Quarter (WMQ) SSP, a separate but interrelated part of the overall planning process for the Waterloo Precinct which also includes the adjacent Waterloo Estate Precinct. Investigation of the Precinct is being undertaken by UrbanGrowth NSW Development Corporation (UrbanGrowth NSW), in partnership with the Land and Housing Corporation (LAHC). The outcome of the State Significant Precinct process will be new planning controls that will enable future development applications for the renewal of the Waterloo Precinct.*

This report assesses the current and forecast regulated airspace height constraints over the Waterloo Metro Quarter Precinct. A key objective is to provide an aeronautical solution/study that can be submitted for rezoning, consistent with the overall objectives sought for the Waterloo Metro Quarter (WMQ) and that supports the Precinct Proposal. The current airspace constraints are examined in relation to the maximum building envelopes proposed potential crane requirements.

Based on current airspace constraints, the maximum permissible height (Australian Height Datum, AHD) for the entire precinct would be 126.4m AHD. This constraint would apply to both buildings and cranes required for construction. Applications under the Airports (Protection of Airspace) Regulations would be required in advance, for any building or crane that would exceed the relevant Obstacle Limitation Surfaces (OLS) constraint, from the Commonwealth Department of Infrastructure, Regional Development & Cities (DIRD).

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Contents

Change History iv
Distribution Control iv

1. Executive Summary 1
1.1 Assessment Conclusions 1
1.2 Planning Approach 3

2. Introduction 4
2.1 Overall Precinct Objectives 4
2.2 Waterloo State Significant Precinct 5
2.3 The Metro Quarter 6
2.3.1 Approved Metro Rail Infrastructure 7
2.4 Purpose 7
2.5 Site Description & Local Context 7
2.6 Planned Building Heights 9

3. Study Requirements 10

4. Aeronautical Impact Context & Analysis 11
4.1 Location of the Proposed Development 11
4.2 Methodology 13
4.2.1 Airspace Regulations 13
4.2.2 Prescribed Airspace 13
4.2.3 Note about Heights: Australian Height Datum (AHD) vs Above Ground Level (AGL) 14
4.2.4 The Application Pathway for Airspace Height Approvals 14
A Applications for Buildings 15
B Applications for Cranes 15
4.3 Airport Plans & Aeronautical Data References for the Study 16
4.3.1 Sydney Airport Master Plan 2033 16
A Effects of Recent Changes 16
B Trends that May Affect the Airspace over WMQ 16
4.3.2 Other Information Sources 17
A Sydney Airport Prescribed Airspace Plans 17
B Procedure & Airspace Charts published by Airservices Australia 17
4.4 Analysis Summary 18
4.5 OLS Analysis 19
4.6 PANS-OPS Analysis 20
4.6.1 “Area” Procedures 22
A Minimum Sector Altitudes (MSAs) 22
B Circling Minima 22
4.6.2 Instrument Approaches & Missed Approaches 23
A Approach Procedures to RWY 16L and RWY 25 24
B Missed Approach Segments of Approach Procedures for RWY 07 and RWY 34R 24
4.6.3 Departures 24
4.7 Other Assessment Considerations 25
4.7.1 Radar Terrain Clearance Chart (RTCC) / Minimum Vector Altitude (MVA) Surface 25

4.7.2 Proximity to Emergency Helicopter Landing Site & Flight Paths 26
4.8 Other Approvability Measures in relation to Sydney Airport Operations 27

5. Proposal 28
5.1 Proposed Planning Framework 28
5.2 Indicative Concept Proposal 28

6. Planning Assessment 30
6.1 Final Strategy 30
6.2 Implementation 30
6.3 Assessment 31
6.4 Proposed Development: Building Height Clearances & Cranes 31

7. Conclusion 33

Tables

Table 1 — Proposed Building Heights 9
Table 2 — Study Requirements Index 10
Table 3 — Analysis Summary — Airspace Height Constraints for the WMQ 18
Table 4 — Proposed Building Heights, OLS Impact & Relevance to Building Height Application 20
Table 5 — PANS-OPS Height Limit Summary 21
Table 6 — Other Assessable Height Limitations — including the RTCC MVA Limit 25
Table 7 — Analysis Summary: Proposed Building Heights & Airspace Height Clearances 31
Table 8 — All PANS OPS Instrument Flight Procedure Charts for Sydney Airport (AIP Amendment 155 – Effective 24-May-2018 to 15-Aug-2018) 2

Figures

Figure 1 — Aerial Photograph of Waterloo Precinct, & Waterloo Metro Quarter (WMQ) SSP in relation to Sydney Airport 1
Figure 2 — Maximum Height Constraints across the Waterloo Precinct (as per Figure 10, p22) 3
Figure 3 — Location and Site Plan of the Precinct 5
Figure 4 — Aerial Photograph 6
Figure 5 — Aerial View of the Proposed WMQ in relation to the nearby Development Precincts 8
Figure 6 — Three-dimensional drawing of the Indicative Concept Proposal, viewed from the West 8
Figure 7 — Proposed Massing Schedule & Building Heights (View from the West) 9
Figure 8 — Waterloo Metro Quarter (WMQ) SSP in relation to Sydney Airport (Large Format) 12
Figure 9 — Waterloo Precinct in relation to Sydney Airport's OLS 19

Figure 10 — PANS-OPS & RTCC/MVA Height Constraints across the Waterloo Precinct 22

Figure 11 — Waterloo Metre Quarter in relation to the nearest Emergency HLS (at Royal Prince Alfred Hospital) 26

Figure 12 — Three-dimensional drawing of the Indicative Concept Proposal, viewed from the East 29

Figure 13 — Building A Crane Clearance 32

Appendices

Appendix 1 — Abbreviations

Appendix 2 — PANS-OPS Procedures

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1. Executive Summary

This study report provides an aeronautical solution/study that can be submitted for rezoning, consistent with the overall objectives sought for the Waterloo Metro Quarter (WMQ), which together with the Waterloo Estate comprises the Waterloo State Significant Precinct (SSP), and that supports the Precinct Proposal. It is also intended to provide a robust, defensible evidence base to inform the Precinct Proposal, and promote solutions that can be readily implemented and supported by key stakeholders.

While this report takes into consideration the comprehensive investigation, vision and strategy for the entire Precinct, it only assesses the Planning Framework (SSP) proposed for the Metro Quarter in relation to aeronautical impact.

Specifically, this study addresses the aviation-related airspace overhead the WMQ which is subject to the Airports (Protection of Airspace) Regulations (APARs) and responds to the Study Requirements (section 3) issued by the Minister for Planning in May 2017.

Figure 1 — Aerial Photograph of Waterloo Precinct, & Waterloo Metro Quarter (WMQ) SSP in relation to Sydney Airport

1.1 Assessment Conclusions

The Report determined the following:

- The study area is located approximately 5.5km (3NM) from the airport midway between the straight-in flight paths to the closest runways. It is less than 200m from the existing Turanga and Matavai towers in the neighbouring Waterloo Estate SSP, which are approximately the same height as the tallest of the proposed WMQ buildings, Building A the northern-most tower, and taller than all other buildings proposed in the WMQ SSP.

- The WMQ is subject to Obstacle Limitation Surface (OLS) height limits which step up from almost 63m Australian Height Datum (AHD) at the southern-most corner to around 73m AHD at the north-east corner of the Waterloo Metro Quarter SSP.
- The tower buildings of the Waterloo Metro Quarter will require approval under the Commonwealth Airports (Protection of Airspace) Regulations (APARs). This is because these proposed buildings would exceed the heights of the Obstacle Limitation Surfaces (OLS) for Sydney Airport. Exceeding the OLS heights does not, in itself, limit the height of the proposed buildings; for the WMQ it merely triggers the need for approval by the Commonwealth. Buildings other than the three tower buildings may or may not require approval, depending on their final location and height relative to the OLS (Table 4).

  OLS heights can be considered threshold heights; any building or crane which would exceed the relevant height would need to gain airspace height approvals from the Commonwealth Department of Infrastructure, Regional Development & Cities (DIRD), under the Airports (Protection of Airspace) Regulations (APAR) prior to construction or erection.
- The PANS-OPS (and other surfaces) overhead the WMQ impose the maximum height limits for the towers. This restriction is not a major impediment to the current Planning Proposal as the highest of the maximum proposed building heights across the WMQ is below the current lowest airspace height constraint.
- The limiting PANS-OPS height restriction is that imposed by the Category A & B Circling Area. The surface representing this restriction is a horizontal plane, at 126.4m AHD, covering the whole of WMQ site. The next highest limiting surface is part of the Radar Terrain Clearance Chart (which is not a PANS-OPS surface but is considered important to protect air traffic control operations) at 152.4m AHD.

  PANS-OPS surface heights are based on the heights related to the protection requirements of the various PANS-OPS Instrument Flight Procedures for Sydney Airport. These define the maximum permissible heights for buildings (including all overruns) under the APAR, except where another aviation safety-related airspace constraint is lower.
- The WMQ development is located between the Green Square Town Centre (GSTC), which is 1 km to the south and closer to the airport, and the CBD to the north, but within sufficiently proximity to each in aviation terms. Logically this form a virtual airspace corridor which contains buildings of equivalent heights in the GSTC to the south and in the adjacent Waterloo Estate, and far taller buildings in the CBD. The WMQ Concept Plan will not challenge any of the airspace protection surfaces that already cater for existing buildings in this virtual corridor, and thus the proposed development will have nil impact on the air transport operations of Sydney Airport.
- Advance planning by the architects has taken into account constructability and crane issues: all buildings at their maximum proposed heights could be constructed using cranes that will be able to operate at heights below the PANS-OPS height constraint.

Figure 2 — Maximum Height Constraints across the Waterloo Precinct (as per Figure 10, p22)

1.2 Planning Approach

- *Final Strategy*: The final strategy for the Metro Quarter is to adopt the current airspace height limitations, including allowances for cranes.
- *Implementation*: Early implementation of WMQ airspace strategy is possible. An application for the entire Metro Quarter at the current maximum allowable height (126.4m AHD) can be made for the Planning Proposal. This site envelope would accommodate all tower buildings plus cranes. The airspace height application under APAR may require additional documentation to demonstrate the feasibility of constructing Tower A using a crane that would not infringe the PANS-OPS height limit, sufficient to give the aviation stakeholders and the Department of Infrastructure, Regional Development & Cities (the approving authority) confidence in that aspect of the proposal. Once the final location and height of all buildings and cranes are known an amended application can be made if necessary.
- *Assessment*: The current Concept Plan for the WMQ does not 'challenge' the airspace height restrictions.

Taking the above factors into consideration, as well as the location of the site in relation to the airport, **there is no technical impediment to approval of the development of the Waterloo Metro Quarter** providing the maximum heights of buildings and cranes do not exceed the PANS-OPS Height Constraints documented herein**, and we consider 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, Regional Development & Cities (DIRD)**.

2. Introduction

The Minister for Planning has determined that parts of Waterloo are of State planning significance which should be investigated for rezoning through the State Significant Precinct (SSP) process. Study Requirements for such investigations were issued by the Minister on 19 May 2017.

Investigation of the Precinct is being undertaken by UrbanGrowth NSW Development Corporation (UrbanGrowth NSW), in partnership with the Land and Housing Corporation (LAHC). The outcome of the State Significant Precinct process will be new planning controls that will enable future development applications for renewal of the Precinct.

The Precinct includes two separate but contiguous and inter-related parts:

- The Waterloo Metro Quarter (the Metro Quarter)
- The Waterloo Estate (the Estate)

While the study requirements for the Precinct were provided as separate requirements for the Metro Quarter and for the Estate, UrbanGrowth NSW and LAHC have prepared comprehensive baseline investigations for the entire Precinct. However, lodgement of a separate SSP study for the Metro Quarter in advance of the SSP Study for the Estate is proposed to allow construction of Over Station Development (OSD) within the Metro Quarter to be delivered concurrently with the Metro Station, as an Integrated Station Development (ISD).

While this report therefore provides comprehensive baseline investigations for the entire Precinct, it only assesses the proposed Planning Framework amendments and Indicative Concept Proposal for the Metro Quarter.

2.1 Overall Precinct Objectives

The following are UrbanGrowth NSW and LAHC's objectives for renewal of the Precinct:

Housing: A fully integrated urban village of social, private and affordable housing
A place that meets the housing needs of people with different background, ages, incomes, abilities and lifestyles – a place where everyone belongs. New homes for social, affordable and private residents that are not distinguishable and are modern, comfortable, efficient, sustainable and adaptable.
Services and Amenities: New and improved services, facilities and amenities to support a diverse community
A place that provides suitable and essential services and facilities so that all residents have easy access to health, wellbeing, community support, retail and government services.
Culture & Design: A safe and welcoming place to live and visit
A place where there is activity day and night, where people feel safe, at ease and part of a cohesive and proud community. A place that respects the land and Aboriginal people by showcasing and celebrating Waterloo's culture, history and heritage

Open Space & Environment: High quality public spaces and a sustainable urban environment
A place that promotes a walkable, comfortable and healthy lifestyle with high quality, well designed and sustainable buildings, natural features and safe open spaces for everyone to enjoy, regardless of age, culture or ability
Transport and Connectivity: A well connected inner city location
Integrate the new metro station and other modes of transport in such a way that anyone who lives, works or visits Waterloo can get around easily, safely and efficiently

2.2 Waterloo State Significant Precinct

The Waterloo SSP study area is located approximately 3.3km south-south-west of the Sydney CBD in the suburb of Waterloo (refer Figure 3). It is located entirely within the City of Sydney local government area (LGA).

It is bordered by Phillip Street to the north, Pitt Street to the east, McEvoy Street to the south and Botany Road to the west. It also includes one block east of Pitt Street bordered by Wellington, Gibson and Kellick Streets. The Precinct has an approximate gross site area of 20.03 hectares (ha) (including road reserves). The Precinct is comprised of two separate but contiguous parts:

1. The Waterloo Estate; and
2. The Waterloo Metro Quarter (the Metro Quarter).

A map of the Precinct and relevant boundaries is at Figure 4 below.

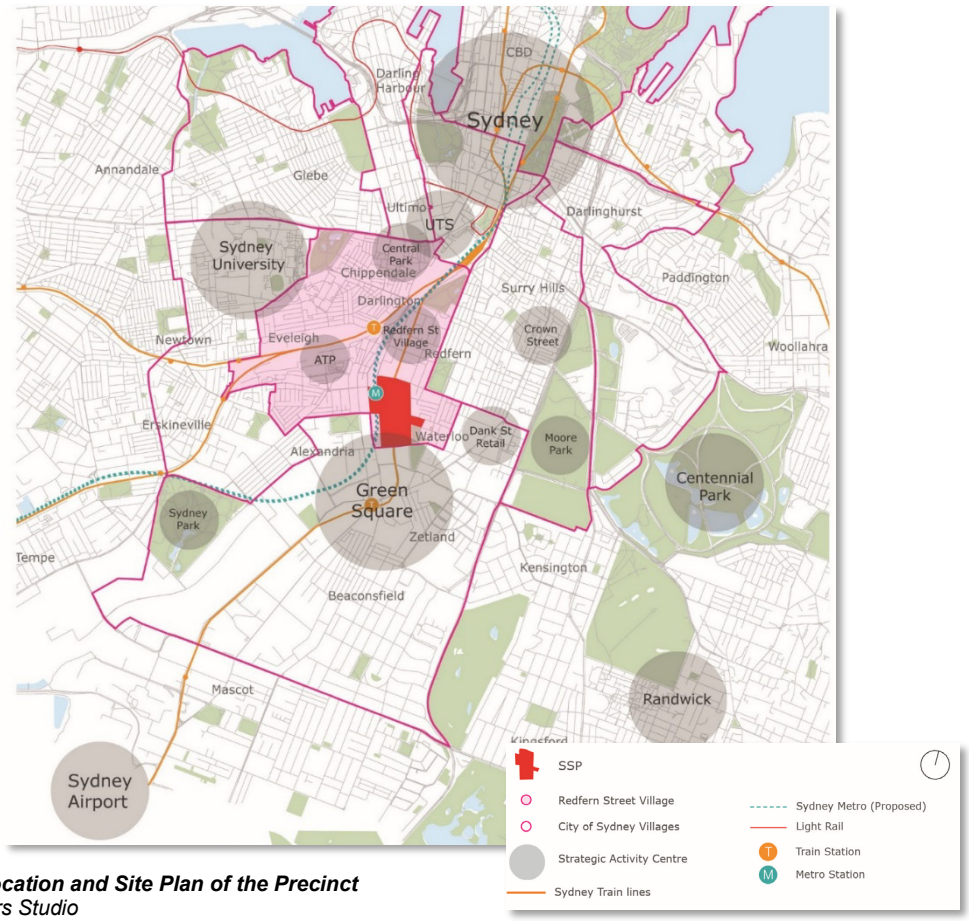

Figure 3 — Location and Site Plan of the Precinct
Source: Turners Studio

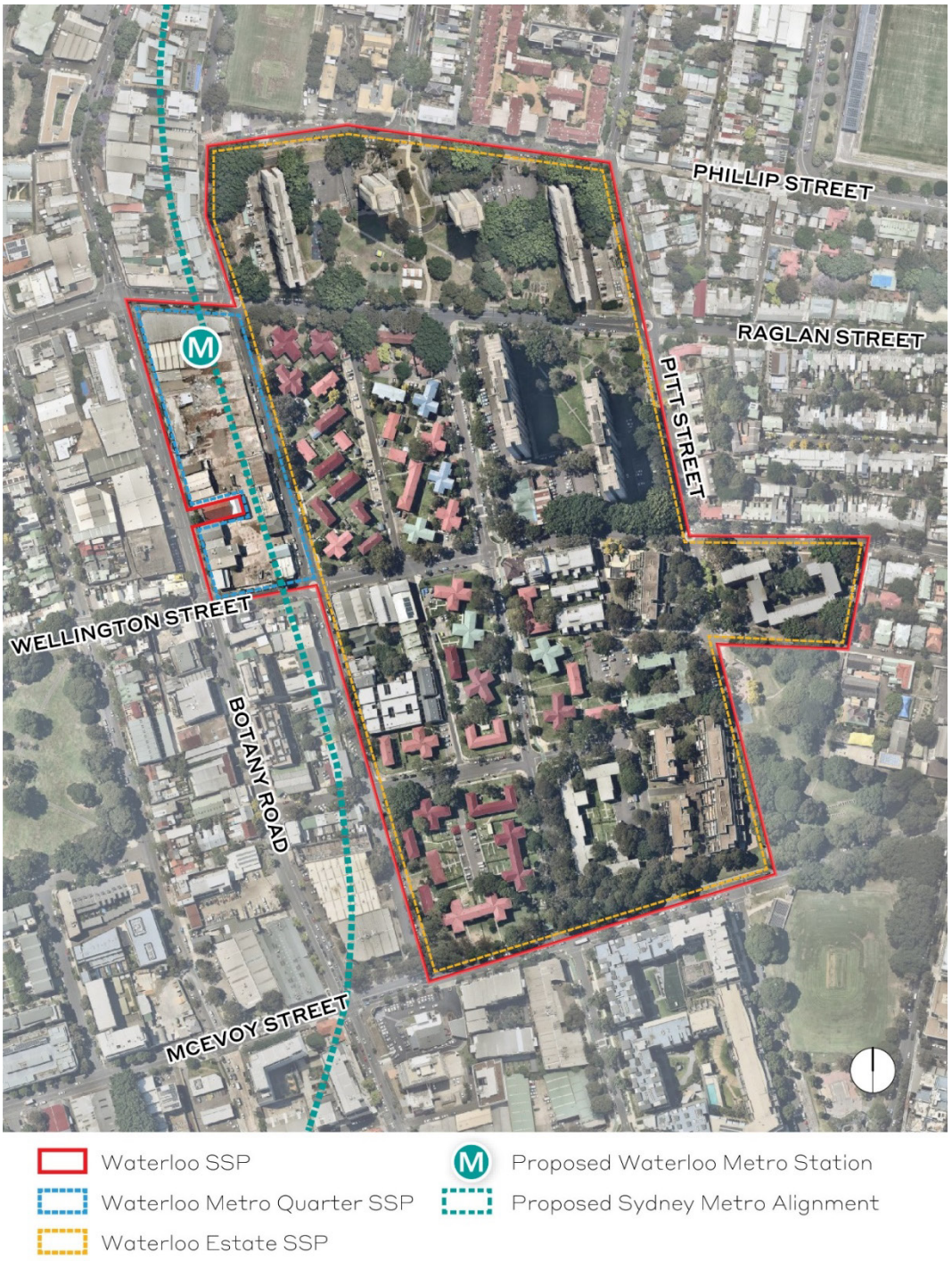

Figure 4 — Aerial Photograph
Source: Ethos Urban & Nearmap

2.3 The Metro Quarter

The Metro Quarter comprises land to the west of Cope Street, east of Botany Road, south of Raglan Street and north of Wellington Street. It has an approximate gross site area of 1.91ha and a developable area of 1.28ha. The heritage listed Waterloo Congregational Church located at 103–105 Botany Road is located in the same street block but is not part of the Precinct. Formerly privately owned, all land in the Metro Quarter was purchased by Sydney Metro to facilitate construction of the Waterloo Metro Station, with the rights for over-station development subsequently acquired by UrbanGrowth NSW.

2.3.1 Approved Metro Rail Infrastructure

The Waterloo Metro station will be constructed within the eastern side of the Metro Quarter as part of the Sydney Metro City & Southwest - Chatswood to Sydenham. This section of the Sydney Metro project received planning approval in January 2017 (SSI 15_7400), with construction led by Sydney Metro. While most of the Metro Station will be located beneath finished ground level, two substantial entry/plant structures, with heights equivalent to a 5-storey residential building (up to 20 metres), will protrude above finished ground level; one along the northern end of Cope Street, the other along the southern end of Cope Street.

Demolition of existing buildings has been completed and excavation of the Waterloo Metro Station is underway.

2.4 Purpose

The purpose of this report is to:

- Provide an aeronautical solution/study that can be submitted for rezoning, consistent with the overall objectives sought for the Precinct and that supports the Precinct Proposal.

  Specifically, this report has been prepared having regard to Prescribed Airspace for Sydney Airport. **It examines the current and forecast regulated airspace height limits constraints overhead the site that are related to aviation airspace protection requirements** and which would

  a) Trigger the requirement to apply for an airspace height approval;
  b) Constrain the maximum permissible building envelope heights; and
  c) Constrain the maximum permissible heights for cranes that would be required to enable construction of the proposed development.

- Provide a robust, defensible evidence base to inform the Precinct Proposal.
- Promote solutions that can be readily implemented and supported by key stakeholders.

The specific Study Requirements which this report responds to are outlined in section 3 (see Table 2, p10).

2.5 Site Description & Local Context

The Waterloo Precinct, 1.6km from the southern end of the Sydney Central Business District (CBD). lies amidst a local region which has already undergone significant urban renewal.

Figure 5 depicts the proposed Over Station Development (OSD) development in the WMQ SSP in relation to the site area and existing buildings in the Waterloo Estate area, as well as those in the Redfern Precinct. The tallest of the towers, the 29-storey building proposed at the northern end of the WMQ SSP, was designed to be consistent in height with the existing Turanga (111.8m AHD) and Matavai (113.2m AHD) towers, which are located some 150-200 metres to the north-east and east-north-east in the Waterloo Estate precinct. These two towers are also shown in Figure 5 below.

Figure 5 — Aerial View of the Proposed WMQ in relation to the nearby Development Precincts
Source: UGDC, Strategic Airspace

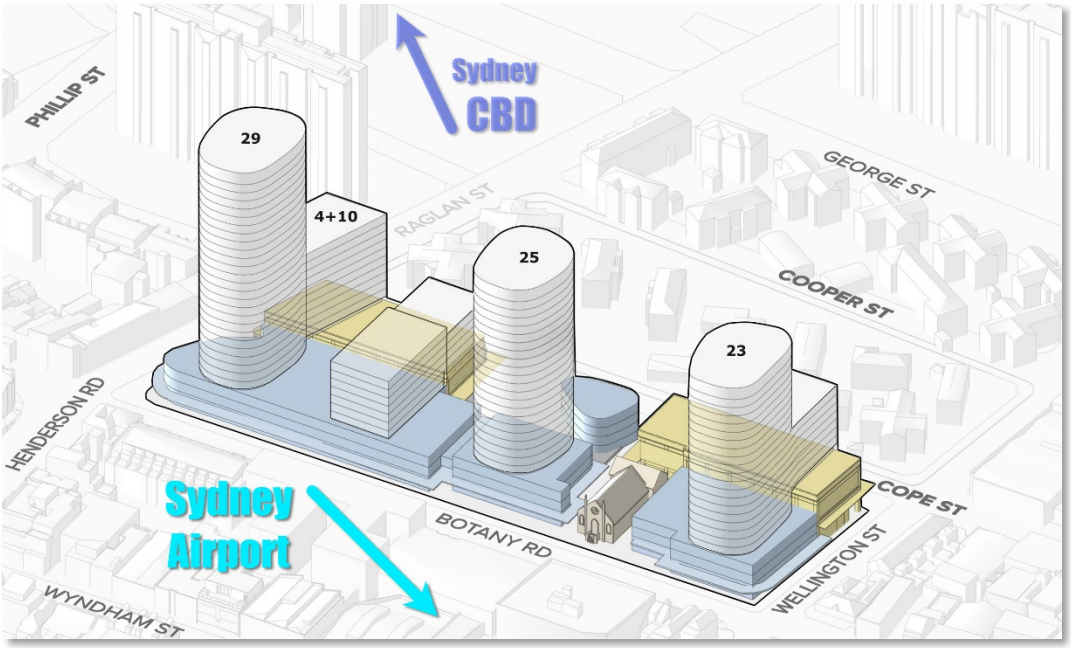

Figure 6 — Three-dimensional drawing of the Indicative Concept Proposal, viewed from the West
Source: UGDC, Turner

The three towers proposed as part of the WMQ SSP are shown schematically, in 3D, in Figure 6 above.

2.6 Planned Building Heights

Figure 7 shows the proposed maximum building heights in relation to the PANS-OPS height constraints applicable across the WMQ.

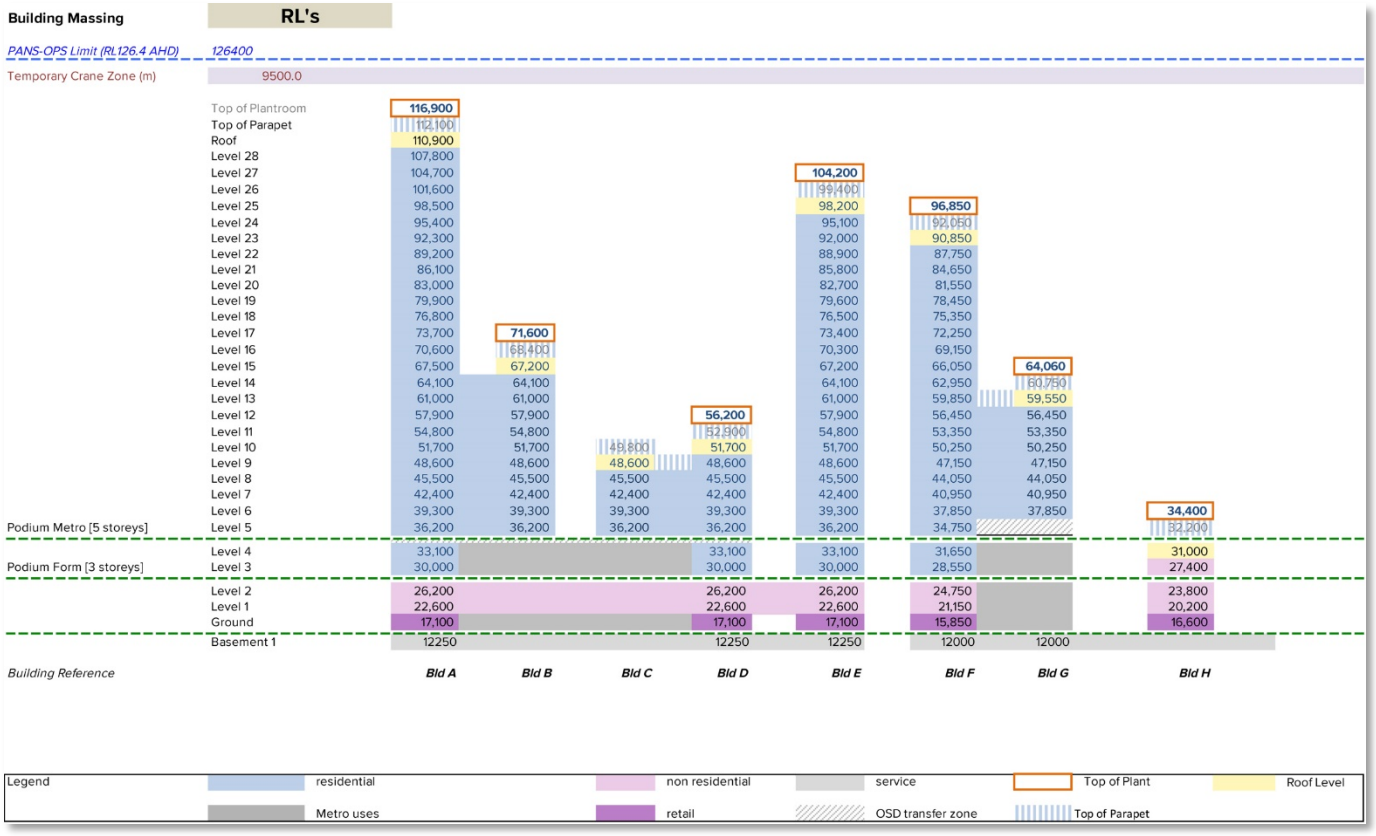

Figure 7 — Proposed Massing Schedule & Building Heights (View from the West)
Source: UGDC, Turner

Table 1 — Proposed Building Heights

Building	*Assessment Height m AHD*	*Maximum Height Proposed m AHD*	*Comment*
A – Northern Tower	**116.9**	**116.9**	Top of Lift Overrun
B	71.6	71.6	Top of Plantroom
C	49.8	49.8	Top of Roof / Parapet
D	56.2	56.2	Top of Plantroom
E – Central Tower	**104.2**	**104.2**	Top of Plantroom
F – Southern Tower	**96.9**	**96.85**	Top of Plantroom
G	64.1	64.06	Top of Plantroom
H	34.4	34.4	Podium, Top of Roof / Parapet

3. Study Requirements

On 19 May 2017 the Minister issued Study Requirements for the nominated Precinct. Of relevance to this study are the following requirements:

Table 2 — Study Requirements Index

Study Requirement	*Report Cross-Reference*
20. Aeronautical	
20.1. Review relevant background information, including the 'Sydney Airport Master Plan 2033' to understand the current and proposed future operations of Sydney Airport, as relevant to the precinct.	Section 4.3 (p16)
20.2. Identify and clearly map the OLS, PANS OPS and any other relevant Sydney Airport height limitation layers, including consideration of Navigation Aid Surfaces.	Sections 4.4 (p18), 4.5 (p19), 4.6 (p20) & 4.7 (p25)
20.3. Translate these layers into a maximum height for permanent (e.g. buildings) and temporary (e.g. cranes) structures include a building methodology specialist to translate this information into maximum building envelope height planes.	As above, plus Section 6.4 (p31)
20.4. Advise on other measures, if necessary, to ensure the precinct does not have an adverse impact on the operations of Sydney airport, e.g. lighting, reflective surfaces etc).	Section 4.8 (p27)
20.5. Advise on the pathway required to secure approval from relevant bodies, e.g. Air Services Australia, as part of subsequent development application processes, including for temporary structures such as cranes.	Section 4.2 (p13), and specifically 4.2.4 (p14)
20.6. Certify that subject to any recommended measures, the precinct proposal will not have an adverse impact on the operations of Sydney Airport.	Section 7 (p33)

These study requirements have been considered together with the proposed Concept Plan and this report wholly satisfies these requirements.

4. Aeronautical Impact Context & Analysis

The aeronautical assessment at this stage of planning references the closest points of the Waterloo Metro Quarter SSP study area, rather than the location of specific buildings, in relation to the airport. This approach to the technical assessment during the planning assessment and approval phases generally provides more conservative results in terms of height clearances.

4.1 Location of the Proposed Development

The site lies to the north of Sydney Airport, approximately 5.65km (3.1 Nautical Miles, NM) from the aerodrome reference point (ARP) at a bearing of 009° Magnetic (M) or 022° True (T) — as indicated in Figure 5 below..

The primary measurement point used is the south-western corner of WMQ, at the corner of Botany Road and Wellington Street, Waterloo. The south-eastern boundary point is at the corner of Cope Street intersection with Wellington Street.

Other key measurement references are:

- In relation to Runway (RWY) 07/25, the cross-runway
  - ~4.45km (2.4NM) at 001°M (013°T) from the threshold of RWY 25
  - ~3.89km (2.1NM) from the extended runway centreline
- In relation to Runway (RWY) 16L/34R, the eastern parallel runway
  - ~5.96km (3.2 NM) at 357°M (010°T) from the threshold of Runway (RWY)16L
  - ~2.25km (1.2NM) from the extended runway centreline

In addition, it is noted that the precinct, at its southern border, is approximately 465m (0.25NM) to the north of the most significant development in the local region, the Green Square Town Centre, which is partly developed, and which has a maximum airspace height approval (for buildings and/or cranes) up to 125m AHD. In essence, this development will have the potential to provide a 'shielding effect' to tall buildings proposed for the Waterloo Precinct, thereby possibly facilitating the airspace-related height assessment and approval path for developments in the Waterloo Metro Quarter SSP.

It is also noted that the maximum heights of the WMQ tower buildings took into consideration the heights of the nearby Turanga and Matavai social housing towers in the Waterloo Estate, located some 150-200 metres to the north-east and east-north-east. WMQ's Building A would be no more than 1.9m taller than the existing Matavai tower, and all other WMQ buildings would be lower than both of the existing Waterloo Estate towers.

The other airports in the Sydney Basin are too distant from the study area to have any impact on the airspace overhead the precinct.

Figure 8 — Waterloo Metro Quarter (WMQ) SSP in relation to Sydney Airport (Large Format)

4.2 Methodology

The methodology used to determine the maximum permissible building heights is based on an orderly assessment of the potential impact against the various elements described in this section.

4.2.1 Airspace Regulations

The proposed development site is subject to the Airports (Protection of Airspace) Regulations (APAR), 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.

4.2.2 Prescribed Airspace

Prescribed Airspace, as defined under the APAR, 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 Infrastructure, Regional Development & Cities (DIRD) — 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**
    - Protection for other Instrument Flight Procedure surfaces, where the procedures are not classified as PANS-OPS and/or have been omitted from Sydney Airport's declared PANS-OPS surfaces charts. These may include a variety of Required Navigation Procedures (RNP).
    - Airline Engine-Out (Contingency) Take-Off Splays
      (as per Civil Aviation Order 20.7 1b)
      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.
      This may also include protection of critical airspace for visual flight procedures used for emergency service helicopter landing sites.
  - Note: Airspace that is approved by the Department of Infrastructure, Regional Development & Cities as Declared Airspace is considered part of an airport's Prescribed Airspace.

4.2.3 Note about Heights: Australian Height Datum (AHD) vs Above Ground Level (AGL)

All "heights" provided in this document are elevations expressed in metres in the Australian Height Datum (AHD) and thus they are true elevations, and not heights above ground level (AGL).

For estimating maximum development heights AGL, the ground elevation^{AHD} should be subtracted from the airspace height limits^{AHD}.

Note also for aviation-related airspace height limits, any building height approval under the Airports (Protection of Airspace) Regulations is regarded as inclusive of the building itself plus all rooftop furniture and overruns (plant buildings, lift risers, etc).

4.2.4 The Application Pathway for Airspace Height Approvals

All applications under the Airports (Protection of Airspace) Regulations — for permanent structures (called *controlled activities*) and temporary (*short-term controlled activities*) — must be submitted to DIRD, at the appropriate time, through the closest relevant airport, in this case Sydney Airport.

Applications should include aeronautical impact assessment reports that are based on the most current plans for the proposed development available at the time. For major developments, such reports should include consideration of cranes that will be required for construction: this information will be used for assessment of the feasibility of constructing the buildings if approved at the maximum heights sought. Separate applications for cranes will also be required at the appropriate times during the construction period, prior to their erection.

There are a number of factors and considerations that would influence a decision on when to make an APAR application for a building. Common decision criteria are outlined below.

- The need for early certainty of approval, versus the effort entailed in preparing documentation and supporting details required to prepare and justify an APAR application that can be approved.
- Application assessment lead time: under the APAR, the minimum processing time for evaluation is 49 days, but it may be substantially longer before a determination is made if additional information and/or clarifications are required.
- Approvals are sometimes not required prior to submitting a Development Application (DA) but in other cases planning assessment requires a level of certainty that an APAR application would be approved in the event that the planning proposal or DA is approved.
  - Some DAs are granted with the requirement to secure an airspace height approval as a consent condition.
  - Sydney Airport, CASA and DIRD prefer to process applications that already have DA approval for several reasons:
    - Because applications based on advanced development plans and designs (eg, to DA level or beyond) will have enough associated information — eg, a Construction Management Plan which includes preliminary crane plans — that will help to support and justify the feasibility of construction in the event of an APAR approval; and
    - To reduce the likelihood that they will have to re-evaluate the sites for amended applications in the future due to changed designs (for example, following DA resolution).
- In the event that changes to a design or construction events are likely to exceed an approval already granted for the site, an application for an amendment to the pre-existing approval would need to be made. The documentation requirements and assessment periods for amendments are usually the same as for an initial application.

A Applications for Buildings

For proposed developments that would penetrate the OLS, such as the taller buildings within the WMQ, Sydney Airport will seek consultation from Airservices Australia, CASA and other key stakeholders (such as major airlines), and then within 3 weeks from the date of receipt forward the application to DIRD. Upon final receipt of technical calculations and opinions from the agency and other stakeholders, DIRD will make a determination and advise the airport and the applicant. Whilst the Regulations provide a 4-week response timeframe for the DIRD response, there are provisions whereby this timeframe can be extended, and extensions are a common occurrence: applications typically take at least 3 months from date of application to date of the determination. Complex cases can take longer.

A successful application would be given approval under Regulation 14 of the APAR as a controlled activity.

B Applications for Cranes

For proposed cranes and temporary structures that would penetrate the OLS but not infringe the PANS-OPS constraint overhead, Sydney Airport may grant approval of applications under delegation. Where an application seeks approval for cranes that would penetrate the PANS-OPS height constraint, permission may be granted subject to operational and safety assessments,

as well as the agreement of Sydney Airport. In such cases, a crane which infringes the PANS-OPS would be approved for a maximum duration of 3 contiguous months as a short-term controlled activity under Regulation 14(5) of the APAR.

4.3 Airport Plans & Aeronautical Data References for the Study

4.3.1 Sydney Airport Master Plan 2033

Sydney Airport's Master Plan for 2033 does not address many of the changes affecting operations and airspace that have taken place over the past few years. The current master plan does not reflect many of the changes to navigation and airspace that have occurred over recent years. This is because of changes in some standards and changes in operational requirements that are beyond the control of Sydney Airport. Additionally, it is because they were not forecast by the Airservices Australia who were the major contributors to the predicted airspace usage content of that master plan.

Sydney Airport is currently revising the Master Plan with a vision for the airport in 2039. The preliminary draft released in September 2018 for public consultation indicates no changes to the airport infrastructure which would affect the existing OLS, nor does it forecast any changes to the flight paths of the PANS-OPS procedures that are currently in place. Based on the current timeline, Sydney Airport has advised that they would anticipate that the final Master Plan 2039 would be approved (by the Commonwealth Department of Infrastructure) around April-May 2019.

A Effects of Recent Changes

There have been significant changes to Sydney Airport airspace in recent years. These changes have been caused by new types of operations, new navigation technology and changed safety criteria and standards which are developed and maintained by the *International Civil Aviation Organisation* (ICAO) and used by Airservices and CASA. Most of these changes have not affected the critical airspace directly above the WMQ site.

These changes have been identified from Airservices and ICAO documents and have been taken into consideration in this report.

B Trends that May Affect the Airspace over WMQ

The 2033 Master Plan does identify several trends, mostly in terms of aircraft types and number, that may affect the environmental (noise) impact and airspace limitations over the WMQ. These trends are:

- A slowly decreasing number of General Aviation and Corporate Aviation operations: these types of airport users are the most likely to use the most restrictive PANS-OPS operation (the Category A and B Circling Area) affecting the WMQ site.
  As the number of potential users of this type of landing procedure diminishes, the relevance of this most restrictive surface diminishes. This strengthens any argument for changing or removing the restriction.
- Increasing use of newer navigation technologies: this will decrease the need for the Category A and B Circling Area and may eventually

reduce the current reliance on 'radar vectoring' which is the cause of the second most restrictive surface (the Radar Terrain Clearance Charts (RTCC)) above the WMQ site. No other changes to flight paths that would impact the WMQ are anticipated.

- The increasing number of new technology larger passenger transport aircraft, which are more efficient and have significantly lower noise emissions. This aspect is not anticipated to change the impact of flight paths in any way that will affect height constraints overhead the WMQ.

4.3.2 Other Information Sources

A Sydney Airport Prescribed Airspace Plans

The currently available plans — including OLS, PANS-OPS, airspace related to the protection of radar and ground-based navigation aids, and the RTCC surfaces — were published in March 2015. However, these did not include airspace changes caused by the removal of one of the primary navigation aids at Sydney Airport. They also did not anticipate changes in the ICAO criteria that underly the PANS-OPS procedures (which became effective in November 2015). They are yet to include the introduction of Baro-VNAV procedures that were implemented at Sydney Airport in August 2017.

B Procedure & Airspace Charts published by Airservices Australia

These charts are regularly updated every 3 months and the updates are published on Airservices web site 6 weeks prior to implementation. These charts reflect changes in ICAO criteria, changes in navigation infrastructure used and other changes implemented as a result of air traffic management demands and practices.

The PANS-OPS instrument flight procedures published in these charts are the procedures pilots are obliged to follow. Hence, they are the best source of information in deriving current airspace restrictions. The height limitations identified in this report are based on these charts.

4.4 Analysis Summary

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

Table 3 — Analysis Summary — Airspace Height Constraints for the WMQ

Height Limits (AHD)	*Height Limit Detail*	*Comment*
63m – 73m	OLS Conical Surface	THRESHOLD HEIGHT limits applicable to the WMQ site (depicted in Figure 9, p19) Any development that would exceed the relevant limiting heights across the site would require a prior 'airspace height' approval from the Department of Infrastructure, Regional Development & Cities under the Airports (Protection of Airspace) Regulations (or APAR). An application can be made for each building separately, or the WMQ SSP as a single site.
126.4m	**PANS-OPS CIRCLING Surface for Category A & B Aircraft** — Entire WMQ SSP study area	**This constraint is the maximum permissible building height (including heights for long term crane usage) that would be approved by the aviation authorities in the relevant areas** (see Figure 10, p22) The vertical space available between the top of all buildings (and for Building A, the top of roof rather than the top of the overrun) and this PANS-OPS height constraint leaves ample room for cranes. Consideration may need to be given to the construction technologies and types of cranes used for any buildings where the maximum heights sought are close to this PANS-OPS height constraint.
152.4m	Radar Terrain Clearance Chart (RTCC) / Minimum Vector Altitude (MVA)	This constraint, which sits above the PANS-OPS Circling height limit across the entire WMQ SSP, is the absolute maximum permissible building height (including crane heights) that would be approved by the aviation authorities in the event that a temporary approval was granted for a crane that would infringe the PANS-OPS Circling Surface Height.
N/A or >152.4m	PANS-OPS Approaches & Departures Surfaces	The study area is outside the extent of the protection areas of PANS-OPS Approach Surfaces for Sydney Airport. Where PANS-OPS Missed Approach and Departure Procedure Surfaces do overlay the study area, the limiting heights are higher than that of the RTCC MVA constraint.
NA	Other Surfaces	The study area is outside any airspace protection requirements related to Sydney Airport's Navigation and Airport Lighting and Visual Guidance facilities, as well as those related to Airline Engine Inoperative contingency take-off procedures.

4.5 OLS Analysis

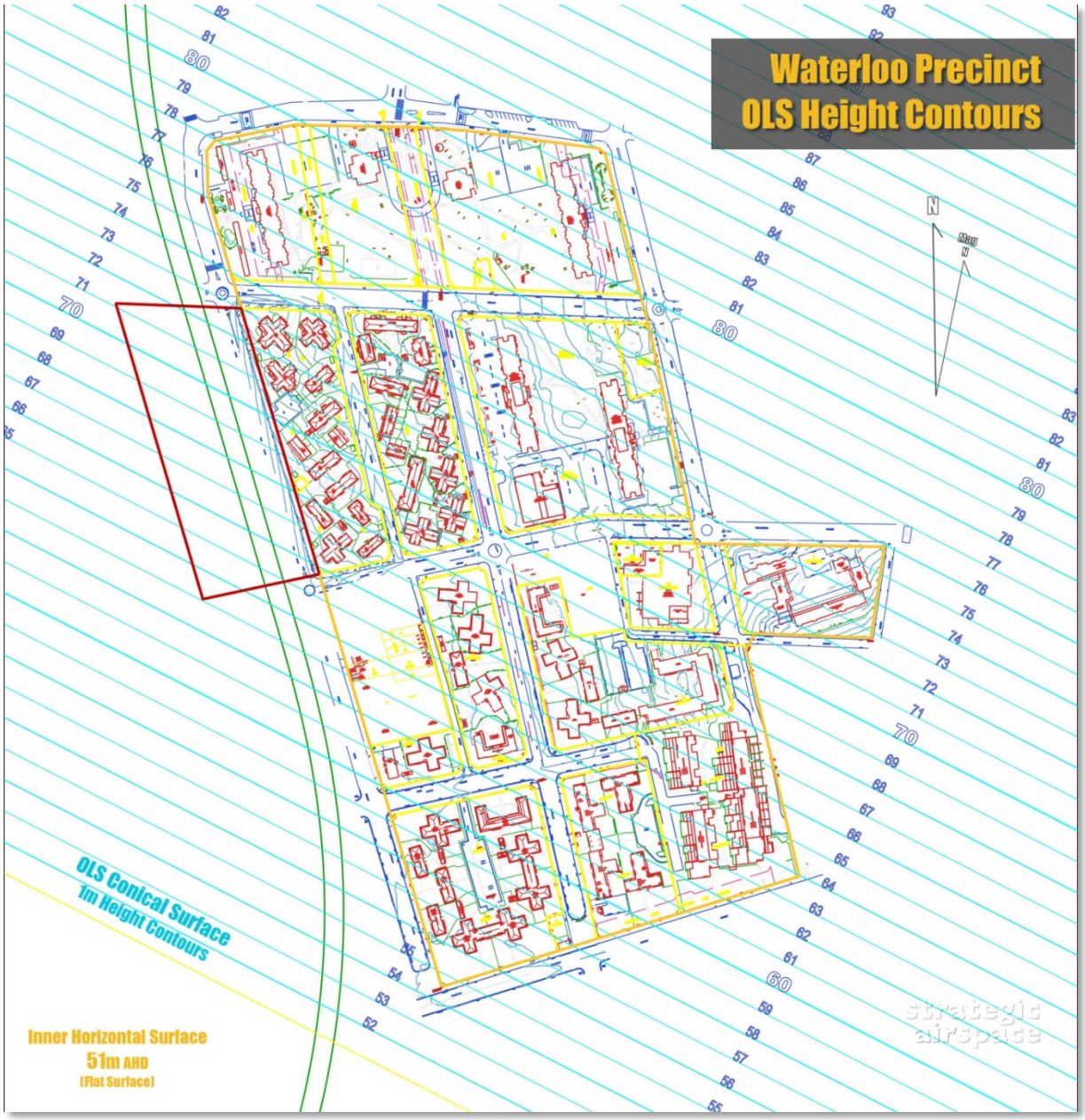

Figure 9 — Waterloo Precinct in relation to Sydney Airport's OLS

The height limit of Sydney Airport's OLS overhead the precinct is defined by the Conical Surface, which rises at a gradient of 5 per cent from the south-west to the north-east, as depicted in Figure 9 above.

Table 4 — Proposed Building Heights, OLS Impact & Relevance to Building Height Application

Building	*Proposed Max Height (m AHD)*	*Probable OLS Impact Clearance / Penetration (m AHD)*	*Height Approval Implication*
A – Northern Tower	**116.9**	**~ –47**	Will penetrate the OLS; prior airspace height approval will be required
B	71.6	**~ –3**	*May* penetrate the OLS, subject to final design location. Need for prior height approval subject to OLS impact.
C	49.8	~ 18	No OLS impact; prior height approval for this building N/A
D	56.2	~ 12	No OLS impact; prior height approval for this building N/A
E – Central Tower	**104.2**	**~ –37**	Will penetrate the OLS; prior airspace height approval will be required
F – Southern Tower	**96.9**	**~ –32**	Will penetrate the OLS; prior airspace height approval will be required
G	64.1	~ 0 TBA	*May* penetrate the OLS, subject to final design location of the footprint of tower. Need for prior height approval of the tower subject to OLS impact.
H	34.4	~ 30	No OLS impact; prior height approval for this building N/A

In summary, the three tower buildings A, E and F would penetrate the OLS and would thus require airspace approvals prior to construction. Subject to final designs, the mid-rise buildings B and G may infringe the OLS. The other buildings would below the OLS.

4.6 PANS-OPS Analysis

In addition to reviewing the PANS-OPS Surfaces chart of Sydney Airport's Prescribed Airspace (as declared and approved by DIRD in 2015), assessment was conducted of the following instrument (non-visual) procedure types for Sydney Airport, as published by Airservices Australia in the Australian Aeronautical Information Publication (AIP) Departure and Approach Procedures (DAP), up to Amendment 155 (effective 24-May-2018 to 15-Aug-2018).

- The Circling Minima and Minimum Sector Altitudes (MSAs) for existing PANS-OPS procedures
  "Area" procedures, which provide protection for aircraft manoeuvring or circling within defined areas above the airport and surrounds
- The discrete minima for the Instrument Approach Procedures.
- Missed Approaches — as part of the evaluation of Approach Procedures
- The existing Standard Instrument Departure Procedures (SIDs)

Of the approach and departure procedures, only procedures that might be relevant to the Waterloo Metro Quarter SSP are included in this report. Principally these are procedures

for the eastern north-south runway (RWY 16L/34R) and the east-west runway (RWY 07/25), as well as the "area" procedures.
The western north-south parallel runway (RWY 16R/34L) is not mentioned because of the location of the site in relation to the airport, and because aircraft using that runway are prohibited from operation to the east of the runway centreline (so as not to cause conflicts with aircraft on the other parallel runway).

At the time of the preparation of this report the building design is still not final. Hence, the overall site envelope is used for assessment of the impact of PANS-OPS surfaces on building heights. This means that the closest corner of the site to the relevant runway end of each procedure is used to determine the height limitation. Height limitations will be slightly higher, than these 'closest corner' heights, at other locations within the Metro Precinct.

The Sydney Airport Master Plan to 2033 was also reviewed for potential future impact (refer also 4.3.1 above, p16). The Master Plan does not forecast any changes to procedures that would, to our best knowledge, make the airspace above the WMQ SSP any more constraining than that resulting from analysis of the current PANS-OPS procedures.

Analysis determined that the precinct is not constrained by protection surfaces related to approach flight procedures to runways at Sydney Airport, and although the precinct is under the protection surfaces for some missed approach and departure procedures, the effective height limit imposed on the site is by the surface related to the Circling Procedure for Category A and B Aircraft. See the following sections for more details.

Table 5 — PANS-OPS Height Limit Summary

Procedure	*Height Limit (m AHD)*	*Description*
Circling	**126.4**	**Category A & B Circling** — out to the extent of 3DME (a measurement from an on-aerodrome navaid, expressed in Nautical Miles; 3DME is approximately 5.6km), after which Circling is not permitted. This limit applies to the vast majority of the site area, only the north-eastern corner of the Waterloo Estate being outside.
Approaches and Missed Approaches to all Runways	N/A or >220+	Outside the lateral protection areas of approach procedures for the closest runways - RWY 16L, 07 and 25. The missed approach surfaces for RWY 34R missed approach procedures are all higher than 220m at the SE corner of the site.
Departures	~198.6+	The most restrictive departure surface is that for the RWY 34R departure. This surface has an elevation of 198.6m at the SW corner of the site and is higher over the rest of the site.
Minimum Sector Altitude (MSA)	335.2	10NM Inner MSA of 2100ft.

Figure 10 — PANS-OPS & RTCC/MVA Height Constraints across the Waterloo Precinct

Further details are provided in the following sections.

4.6.1 "Area" Procedures

A Minimum Sector Altitudes (MSAs)

The height restrictions imposed by Minimum Sector Altitudes are higher than the limits imposed by other procedures.

B Circling Minima

These are areas that define where and how low aircraft are allowed to circle the airport before landing. They are only applicable to some of the approach procedures.

The Waterloo Metro Quarter site is entirely covered by the circling restriction applicable to Category A and B aircraft. It extends from the airport, across the site, until a location 3DME (a measurement from an on-aerodrome

navaid, expressed in Nautical Miles; 3DME is approximately 5.6km) from the airport, beyond which Circling is not permitted.

In the area not covered by the circling restriction (the northern portion of the adjacent Waterloo Estate SSP), the surface heights associated with other the instrument approach and departure procedures are applicable — except where other surfaces are more restrictive (see 4.3 Other Assessment Considerations (p25).

Procedure	*Feature and / or Restriction*	*Description*
Cat A & B Circling	Horizontal Surface: • Covers most of the Waterloo Precinct: **126.4m**	See Figure 10 above. Covers most of the site, with the exception of the north-eastern top of the Waterloo Estate. Category A & B Circling — out to the extent of 3DME (a measurement from an on-aerodrome navaid, expressed in Nautical Miles; 3DME is approximately 5.6km), after which Circling is not permitted

The above limit cannot be changed according to the regulations.

B-I Potential Option to Propose Removal of No Circling Distance & Circling-related Constraint

It is also noted that the implementation of the No Circling Area after 3DME applicable only in the north-east quadrant between the eastern parallel runway RWY16L/34R and the cross runway RWY 07/25 does not comply with the international PANS-OPS standard. Therefore, any future height application for the WMQ SSP could potentially include a proposal, supported by a technical argument and safety case, for the removal of the circling area within that specific quadrant (which overlays the WMQ SSP). In such as case, the next highest height constraint would apply — ie, most limiting of the next PANS-OPS surface height limit or the RTCC surface height limit.

4.6.2 Instrument Approaches & Missed Approaches

The impact of each of the relevant PANS-OPS protection surfaces for current approach and departure procedures for Sydney Airport are provided in the tables below. The lateral extent of restrictions is shown in the diagrams (where appropriate).

Note also that where specific guideline height limits are provided, they are relevant only to the specific procedure. Other procedures mentioned in this report may impose more restrictive height limits over the same location.

The height restrictions due to the instrument approach procedures vary across the site, but for the most part are irrelevant because the PANS-OPS surface height of 126.4m, associated with the circling minima, is more restrictive.

A Approach Procedures to RWY 16L and RWY 25

The WMQ Precinct is laterally clear of the protection surfaces of the following procedures:

- RWY 16L RNAV(GNSS) Approach
- RWY 16L ILS and GLS Approaches – outside the lateral extent of the Basic ILS surfaces
- Runway 25 RNAV(GNSS) Approach
- RWY25 ILS and GLS Approaches – outside the lateral extent of the Basic ILS surfaces.

B Missed Approach Segments of Approach Procedures for RWY 07 and RWY 34R

The following procedures do not impose any height limit on the site, either because the limiting heights are so high (higher than other more restrictive surfaces) or the site is laterally outside the protection surfaces. The lowest of the height limits from any of the following procedures is higher than 185m AHD at the southern-most point of Waterloo Estate. The limiting heights related to departures increase across the precinct.

- RWY 07 RNAV(GNSS) Missed Approach – outside the lateral extent of the missed approach
- RWY 07 ILS and GLS Missed Approaches – outside the lateral extent of the Basic ILS surfaces
- RWY 34R RNAV(GNSS) Missed Approach 264.6m above the SE corner of the site
- RWY 34R ILS and GLS Missed Approaches
  - 2.5% Missed Approach is 248.4m above SE corner of the site
  - 4.0% Missed Approach is 221.6m above SE corner of the site

4.6.3 Departures

Height limitations are imposed by departure procedures from both RWY34R and RWY07. The height constraints from these procedures are:

- RWY 34R – 198.6m at the SW corner of the site;
- RWY 07 – 234m at the SE corner of the site

4.7 Other Assessment Considerations

The following table provides a brief assessment of other considerations.

Table 6 — Other Assessable Height Limitations — including the RTCC MVA Limit

Procedure	*Height Limit (m AHD)*	*Description*
Radar Terrain Clearance Chart (RTCC) / Minimum Vector Altitude (MVA)	**152.4**	This height constraint is applicable over the north-eastern portion of the Waterloo Estate area, outside the area where the Circling surface constraint is more restrictive. This is the limit related to the Minimum Vectoring Altitude (MVA), which is used by air traffic controllers. This information is sourced from the RTCC published as part of Sydney Airport's Prescribed Airspace Plans.
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 most relevant take-off runway end) are designed and maintained by each of the passenger transport aircraft operators in accordance with the relevant regulations. All such procedures necessarily take into account Sydney Tower Eye, which is closer to the airport and taller than the proposed development. As such this proposal will not adversely affect any contingency procedures.
Strategic Helicopter Landing Sites	N/A	The precinct is sufficiently distant from the nearest Strategic Helicopter Landing Site (SHLS), which is located at the Royal Prince Alfred Hospital, and is laterally clear of the preferred flight paths and their associated protection areas.

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

4.7.1 Radar Terrain Clearance Chart (RTCC) / Minimum Vector Altitude (MVA) Surface

The surface depicted in Sydney Airport's Radar Terrain Clearance Chart (RTCC) overhead the Waterloo Precinct protects the airspace used by air traffic controllers as the lowest Minimum Vector Altitude (MVA) they can use for vectoring aircraft.

The RTCC / MVA height limit overhead the entire study area is 152.4m AHD. This surface constraint becomes the effective limit where it is lower than surface heights related to PANS-OPS procedures. In this case, it comes into effect over the north-east portion of the neighbouring Waterloo Estate SSP, outside the area where the Circling Surface limit is more constraining. This is depicted in Figure 10 above (p22).

NOTE (refer also 4.6.1B-I, p23):
If the PANS-OPS Circling Area surface height which currently constraints development in the WMQ SSP was to be removed, this RTCC surface height would become the constraining height applicable across the entire WMQ precinct.

4.7.2 Proximity to Emergency Helicopter Landing Site & Flight Paths

The Waterloo Metro Quarter, at the closest point of the site, is approximately 1.7km from the Strategic Helicopter Landing Site (SHLS) at the nearby Royal Prince Alfred Hospital. The helicopter emergency management services (HEMS) to this facility are provided by the NSW Ambulance helicopter service. Whilst not formally part of the Prescribed Airspace of Sydney Airport, the requirement that new developments not interfere with such facilities and their associated HEMS flight paths was added, as Guideline H, to the National Airports Safeguarding Framework (NASF) in 2018. As such, the potential impact of new developments in this now included as part of the key factors to be considered when evaluating approvability under the APAR.

In this instance, the Waterloo Metro Quarter is laterally clear of the HEMS flight paths to and from this SHLS (as illustrated in the Figure 11), and their associated flight path protection areas (not shown). Thus, the Concept Plan would have no adverse impact in this regard.

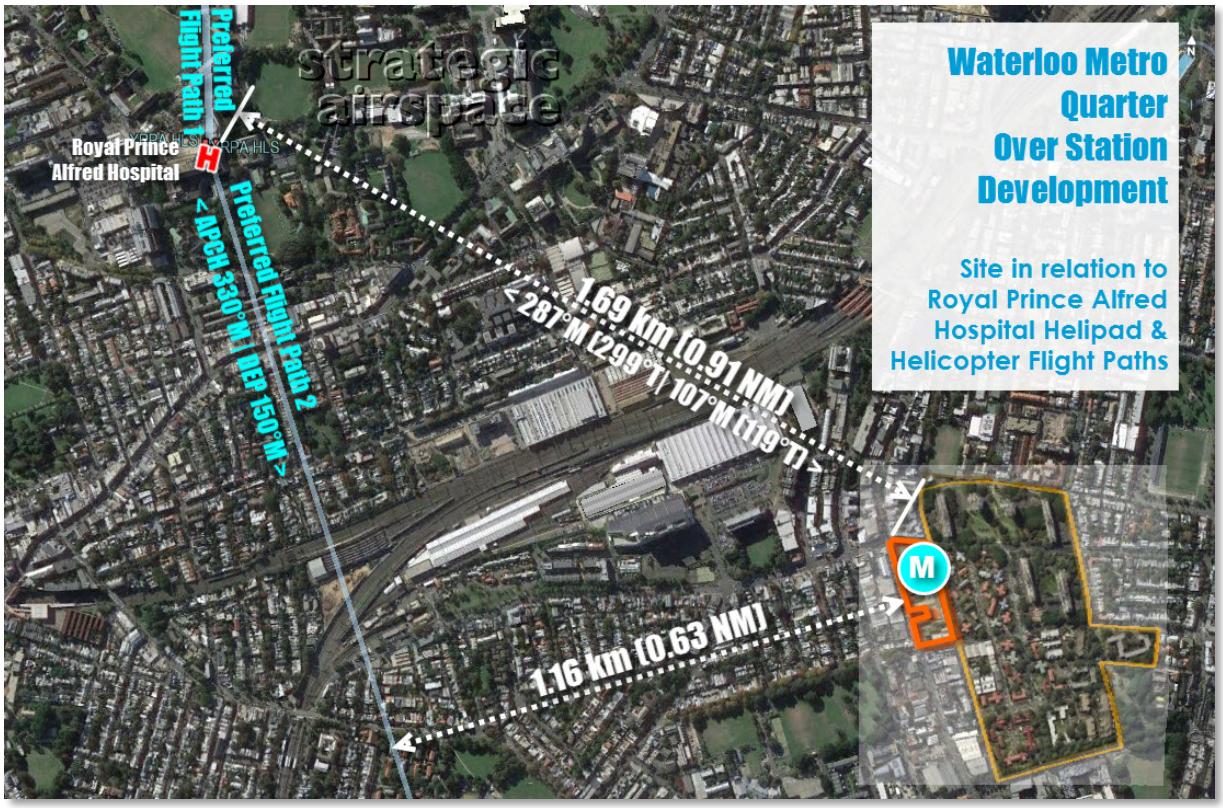

Figure 11 — Waterloo Metre Quarter in relation to the nearest Emergency HLS (at Royal Prince Alfred Hospital)

4.8 Other Approvability Measures in relation to Sydney Airport Operations

Other short-term (ie, during construction) and long-term factors to consider that could potentially impact on aviation operations, and therefore ultimately approvability from the aviation point of view, include the nature of the materials used externally (eg, reflectivity), lighting and contribution to wind turbulence. The approvability in relation to environmental impact due to aircraft noise overhead the site is excluded from this assessment.

Based on the location of the site in relation to the airport, the aspect of the taller buildings in relation to runway alignments, the maximum proposed heights, the configuration of the buildings within the site and the nature of the development as a mixed-use development:

- We note that the entire WMQ study area is outside the zones defined in the Civil Aviation Safety Regulations (CASR MOS Part 139) as requiring special extern lighting constraints — thus no adverse impact from this point of view; and
- We consider that the proposed development will not contribute any negative impact on aviation operations in terms of reflectivity.

Finally, based on the relatively low height of the buildings and their configuration within the site, taken together with the location of the site in relation to the runway, no wind turbulence that is measurable to a level where it would provide an adverse impact on aviation operations is anticipated.

5. Proposal

This report relates to:

- An SSP Study to create a new suite of planning controls; and
- an Indicative Concept Proposal

for the Waterloo Metro Quarter ISD.

5.1 Proposed Planning Framework

The existing and proposed planning controls for the Metro Quarter are:

	Existing	Proposed
Zoning	B4 Mixed Use	B4 Mixed Use
Height of Buildings	Part 12, Part 15 metres	- Part RL 116.9 (AHD) – North - Part RL 104.2 (AHD) – Central - Part RL 96.9 (AHD) - South
Floor Space Ratio	1.75:1	6.1:1 (including Metro Station)

5.2 Indicative Concept Proposal

The Indicative Concept Proposal for the Metro Quarter ISD comprises:

- Approximately 69,000 sqm of gross floor area (GFA), comprising:
  - Approximately 56,500 sqm GFA of residential accommodation, providing for approximately 700 dwellings, including 5 to 10% affordable housing and 70 social housing dwellings;
  - Approximately 4,000 sqm of GFA for retail premises and entertainment facilities
  - Approximately 8,500 sqm GFA for business and commercial premises and community and recreation facilities (indoor).
- Publicly accessible plazas fronting Cope Street (approximately 1,400 sqm) and Raglan Street (580sqm).
- A three-storey mixed-use, non-residential podium, including a free standing building within the Cope Street Plaza.
- Three taller residential buildings of 23, 25 and 29 storeys, and four mid-rise buildings of four to ten storeys above the podium and/or the approved metro station infrastructure.
- Parking for approximately 65 cars, 700 residential bicycles and 520 public bicycles.
- Two east-west, through-block pedestrian connections

Approval has already been separately granted for a Sydney Metro station on the site, which will comprise approximately 8,415 sqm of GFA. The total GFA for the ISD,

including the metro station GFA is approximately 77,500 sqm. Transport interchange facilities including bus stops on Botany Road and kiss and ride facilities on Cope Street will be provided under the existing CSSI Approval.

The above figures are deliberately approximate to accommodate detailed design resolution.

While the existing heritage listed Waterloo Congregational Church is within the SSP Study Area, there are no proposals for physical works or changes to the planning framework applicable to the church.

Three-dimensional drawings of the Concept Proposal are included at Figure 6 (p8) and Figure 12 below.

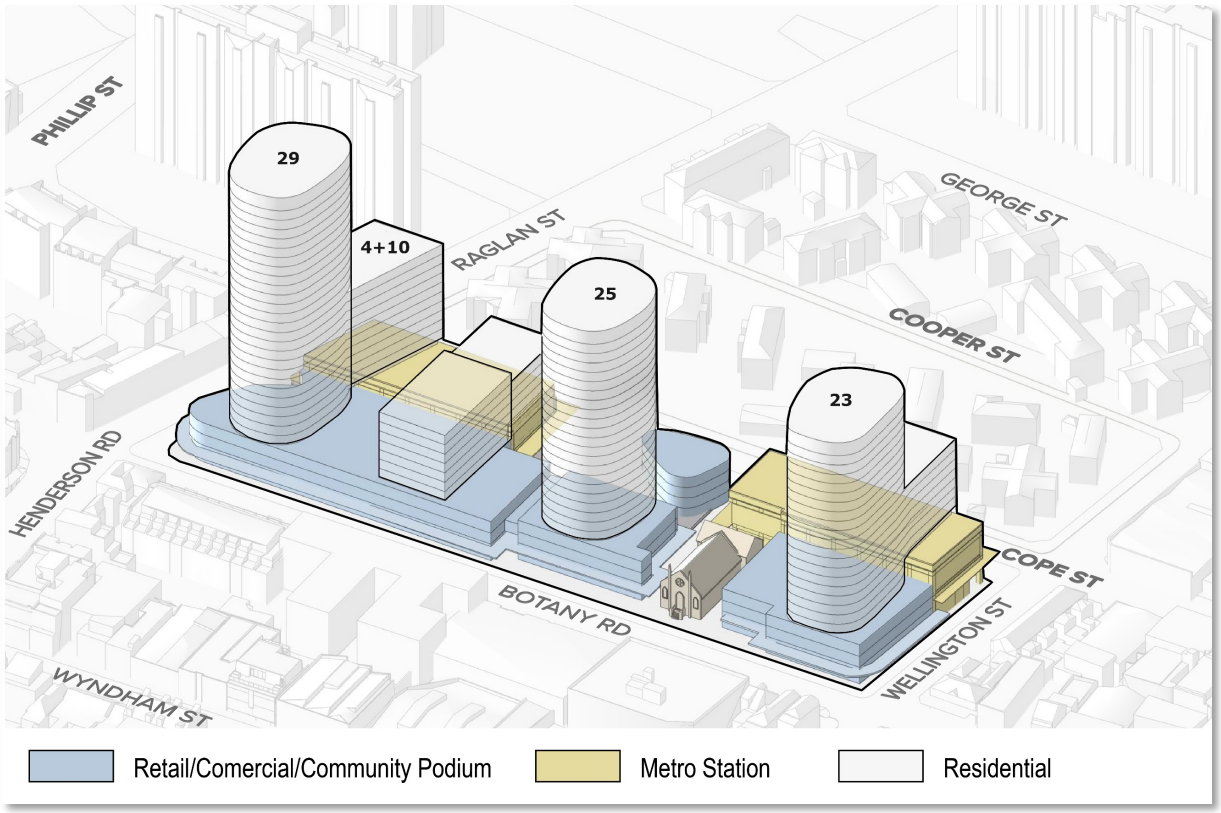

Figure 12 — Three-dimensional drawing of the Indicative Concept Proposal, viewed from the East
Source: UGDC, Turner

6. Planning Assessment

6.1 Final Strategy

The 'Final' strategy for the WMQ is to adopt the current airspace height restrictions as maximum heights for both buildings and cranes. This provides certainty for the WMQ development so as to minimise both risk and application processing timelines associated with gaining airspace height approvals.

The final strategy for the development of the Waterloo Estate is still being resolved in concert with consideration of current and potential future airspace height restrictions.

6.2 Implementation

If timing is important to the WMQ project, it is recommended that an application be made to the aviation authorities at the earliest possible time.

Given that the PANS-OPS height constraint is a flat surface, the simplest option may be to make an application for a maximum height across the entire WMQ study area, whilst at the same time indicating:

- That the Concept Proposal development plans are based on three towers only that would penetrate the OLS; but
- That an application for the entire study area would provide flexibility for the final design parameters (eg, to allow for minor relocation of building footprints) without necessitating potential future amendments of any height approval granted.
- The WMQ will not contribute any adverse effect to the safety, regularity or efficiency of air transport operations at Sydney Airport because of the combination of the maximum building heights and the site location. The WMQ is situated in a virtual corridor between the Green Square Town Centre (GSTC), which is 1km closer to the airport and has buildings of equivalent heights, and the taller buildings of the CBD. Although technically not shielded (as defined by the kind of "straight line shadowing effect defined in the MOS Part 139 Regulations) by the mass and height of buildings in the GSTC, the location of the WMQ to the north (away from the airport) means that flight procedures and operational practices already require aircraft to vertically clear the GSTC buildings in the event of departures or circling or being vectored (directed by air traffic controllers) overhead. The same applies to the buildings in the CBD for departing aircraft. Both are clear for aircraft approaching the airport. In addition, the WMQ development does not have a concentration of tall buildings within the development that could be perceived as increasing risk to aviation safety. Thus, the WMQ development being located between the GSTC and the CBD, but within sufficiently proximity to each in aviation terms, means that the proposed towers of the WMQ will be logically protected and will have nil impact on the air transport operations of Sydney Airport.

That said, DIRD has advised that consultation in advance with Sydney Airport and the aviation agencies would be beneficial to the future of the project. Some issues to be

resolved include whether any future APAR applications would be based on specific developments alone, the Waterloo Metro Quarter as a whole using a single cap height for the site (rather than on a building-by-building basis, especially given that the massing plans are still at a conceptual stage). It is recommended that to facilitate technical coordination and the timely processing of the approval processes, any future applications are made via Strategic Airspace on behalf of the relevant proponent(s).

6.3 Assessment

The Indicative Concept Proposal for the WMQ does not 'challenge' the airspace height restrictions.

6.4 Proposed Development: Building Height Clearances & Cranes

The maximum heights of all proposed buildings in the Waterloo Metro SSP are below the limiting surface height: that of the Cat A & B Circling Area protection surface which is 126.4m AHD. The gap between tops of these buildings and the Circling protection surface can accommodate cranes for the construction of the buildings using conventional construction materials, techniques and crane technologies. This requirement has been taken into account in the concept designs and advance construction planning.

The proposed height of each building and its clearance from the Cat A & B surface is summarised in Table 7 below.

Table 7 — Analysis Summary: Proposed Building Heights & Airspace Height Clearances

Building	*Proposed Max Height (m AHD)*	*Clearance (m) from Restrictive Height: PANS-OPS Cat A & B Circling Surface Height 126.4m AHD*	*Constructability Comment*
A – Northern Tower	**116.9** **110.9 Top of Roof**	**9.5** **15.5**	No crane impact anticipated. Architectural plans have made allowance for construction techniques that will allow this building to be constructed using cranes that would not penetrate the PANS-OPS Circling Height. See also Figure 13 below
B	71.6	54.8	OK
C	49.8	76.6	OK
D	56.2	70.2	OK
E – Central Tower	**104.2**	**22.2**	No crane impact anticipated. May be constructed with cranes below PANS-OPS Circling Height
F – Southern Tower	**96.9**	**29.5**	No crane impact anticipated. May be constructed with cranes below PANS-OPS Circling Height

Building	*Proposed Max Height (m AHD)*	*Clearance (m) from Restrictive Height: PANS-OPS Cat A & B Circling Surface Height 126.4m AHD*	*Constructability Comment*
G	64.1	62.3	OK
H	34.4	92.0	OK

Only Building A, the northern-most tower, has a maximum planned height that could potentially be considered as requiring a crane which may need to infringe the PANS-OPS circling height constraint. The crane clearance between the top of the roof slab and the PANS-OPS height constraint is in fact sufficient for construction of the building and of the rooftop overruns for the lift tower and plant. Contingency plans are also in place to ensure that they could also employ construction materials and techniques for the top of the building if necessary to ensure that the PANS-OPS constraint would not be infringed overhead this building.

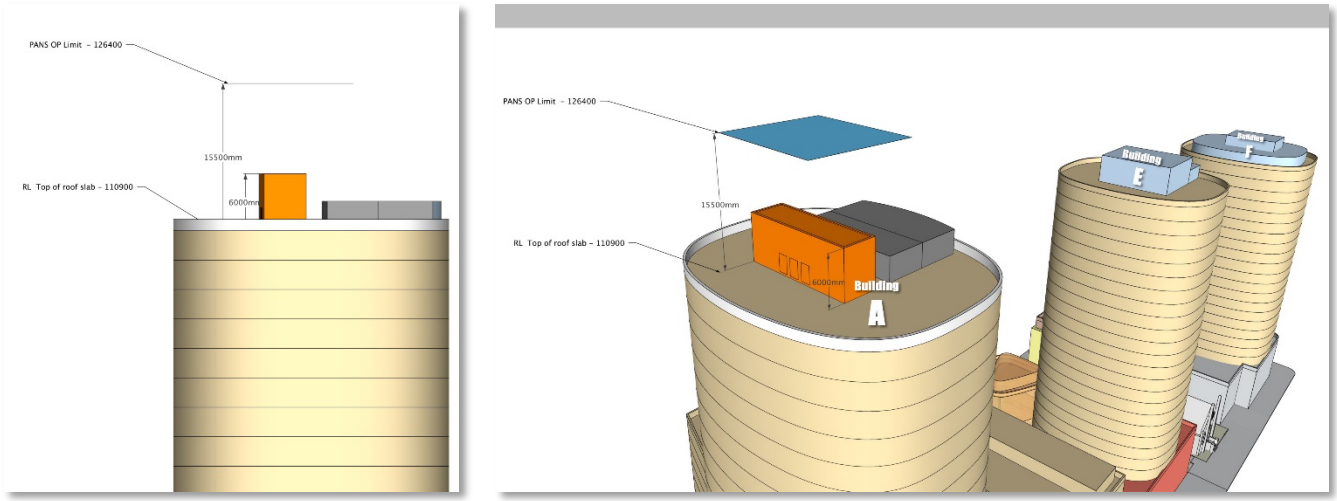

Figure 13 — Building A Crane Clearance
Source: Turner

7. Conclusion

The Waterloo Metro Quarter (WMQ) is located in the small virtual corridor, commencing from the quadrant between the extended centrelines of the two nearest runways of Sydney Airport (RWY 7/25 and RWY 16L/34R) through to the Sydney Central Business District, which has been and continues to be the focus of urban redevelopment. It has also been confirmed that the precinct location is clear of the published helicopter flight paths to and from the Royal Prince Alfred Hospital, and thus is not prejudicial to those emergency helicopter services. The precinct is situated under an Obstacle Limitation Surface (OLS) which slopes up across the site and which will determine which of the proposed buildings would ultimately require prior airspace height approvals. At the same time the site, in this location, is relatively unaffected by height constraints of the PANS-OPS surfaces that protect the approach, missed approach and departure procedures for Sydney Airport. The constraining PANS-OPS surface overhead the site is a horizontal (flat) flat surface at an elevation of 126.4m AHD. This defines the maximum allowable height for proposed buildings.

The final strategy for the Metro Quarter is to adopt this current airspace height limit for all buildings, including allowances for cranes. This strategy also allows for the early airspace height approvals necessary for the proposed development.

Based on the WMQ Concept Plan, the three taller buildings (and possibly two other buildings) would infringe the OLS and would thus require prior airspace approvals. Early implementation could be achieved by applying for an airspace height approval for the entire site. Such an application may require additional documentation to demonstrate the feasibility of constructing Tower A (because of its maximum proposed height) using a crane that would not infringe the PANS-OPS height limit. All other buildings have clearly sufficient allowances for crane operations.

To summarise, the combination of the location of the Waterloo Metro Quarter in relation to the airport, and the nature, massing and maximum heights of the Concept Plan, mean that the proposed development would not contribute any measurable adverse effect to the safety, regularity or efficiency of air traffic.

As such, **there is no technical impediment to approval of the development of the Waterloo Metro Quarter SSP** as the maximum heights of buildings and cranes do not exceed the PANS-OPS Height Constraint documented herein**, and we consider 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**.

APPENDICES

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:

Abbreviation	*Meaning*
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
BA (Planning)	Building Application or Building Approval (Planning)
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 (Aviation)	Decision Altitude (Aviation)
DA (Planning)	Development Application or Development Approval (Planning)
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, Regional Development & Cities (sometimes also abbreviated as Infrastructure)
DME	Distance Measuring Equipment
Doc nn	ICAO Document Number nn
DoD	Department of Defence
DODPROPS	Dependent Opposite Direction Parallel Runway OPerations
EIS	Environmental Impact Study
ELEV	Elevation (above mean sea level)

Abbreviation	*Meaning*
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
HIAL	High Intensity Approach Light
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
LEP	Local Environment Plan (Planning
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
MSA	Minimum Sector Altitude
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
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

Abbreviation	*Meaning*
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
PAPI	Precision Approach Path Indicator (a form of VGSI)
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)
SSDA	State Significant Development Application
SSP	State Significant Precinct
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 Multilateration
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

APPENDIX 2 — PANS-OPS PROCEDURES

The latest versions of the IFPs consulted were from the current AIP Amendment 155 (effective from 24-May-2018 to 15-Aug-2018) — as indicated in Table 5 below.

The procedures identified as potentially having an impact on the site are indicated with the ➢ symbol in the table below.

Table 8 — All PANS OPS Instrument Flight Procedure Charts for Sydney Airport (AIP Amendment 155 – Effective 24-May-2018 to 15-Aug-2018)

SYDNEY (YSSY)

Name of Chart	*Effective Date (Amendment No)*
AERODROME CHART PAGE 1	2-Mar-2017 (Am 150)
AERODROME CHART PAGE 2	10-Nov-2016 (Am 149)
APRON CHART - INTERNATIONAL PAGE 1	13-Nov-2014 (Am 141)
APRON CHART - INTERNATIONAL PAGE 2	24-May-2018 (Am 155)
APRON CHART - DOMESTIC PAGE 1	26-May-2016 (Am 147)
APRON CHART - DOMESTIC PAGE 2	24-May-2018 (Am 155)
APRON CHART - DOMESTIC PAGE 3	24-May-2018 (Am 155)
STANDARD DOMESTIC TAXI ROUTES - ARRIVALS	21-Aug-2014 (Am 140)
STANDARD DOMESTIC TAXI ROUTES - DEPARTURES	6-Mar-2014 (Am 138)
NOISE ABATEMENT PROCEDURE PAGE 1	17-Nov-2011 (Am 129)
NOISE ABATEMENT PROCEDURE PAGE 2	17-Aug-2017 (Am 152)
NOISE ABATEMENT PROCEDURE PAGE 3	3-Mar-2016 (Am 146)
NOISE ABATEMENT PROCEDURE PAGE 4	3-Mar-2016 (Am 146)
NOISE ABATEMENT PROCEDURE PAGE 5	2-Mar-2017 (Am 150)
NOISE ABATEMENT PROCEDURE PAGE 6	24-May-2018 (Am 155)
NOISE ABATEMENT PROCEDURE PAGE 7	3-Mar-2016 (Am 146)
NOISE ABATEMENT PROCEDURE PAGE 8	3-Mar-2016 (Am 146)
NOISE ABATEMENT PROCEDURE PAGE 9	3-Mar-2016 (Am 146)
NOISE ABATEMENT PROCEDURE PAGE 10	3-Mar-2016 (Am 146)
AIRPORT EFFICIENCY PROCEDURES	1-Mar-2018 (Am 154)
IVA USER GUIDE PAGE 1	1-Mar-2018 (Am 154)
IVA USER GUIDE PAGE 2	1-Mar-2018 (Am 154)
SID SYDNEY ONE DEP (RADAR) - ALL RWYS	17-Aug-2017 (Am 152)
SID RWY 34L SOUTH WEST DEP (JET)	10-Nov-2016 (Am 149)
SID RWY 16R & 34L SOUTH DEP (NON-JET) (RNAV)	24-May-2018 (Am 155)
SID RWY 16R DEENA SEVEN (JET) (RNAV)	24-May-2018 (Am 155)
SID RWY 34R ENTRA FIVE (JET) (RNAV)	10-Nov-2016 (Am 149)
SID RWY 07 FISHA EIGHT (JET) (RNAV)	17-Aug-2017 (Am 152)
SID KAMBA DEP RWYS 07 & 16L (NON-JET) (RNAV)	1-Mar-2018 (Am 154)
SID RWY 16R KAMPI FIVE (JET) (RNAV)	24-May-2018 (Am 155)
SID RWY 16L KEVIN SIX (JET) (RNAV)	9-Nov-2017 (Am 153)
SID RWY 16L ABBEY THREE (JET) (RNAV)	24-May-2018 (Am 155)
SID RWY 34R MARUB SIX (JET) (RNAV)	24-May-2018 (Am 155)
SID RWY 34L RICHMOND FIVE DEP (JET)	17-Aug-2017 (Am 152)

Name of Chart	*Effective Date (Amendment No)*
STAR BOREE EIGHT A ARRIVAL (RNAV)	24-May-2018 (Am 155)
STAR BOREE EIGHT P ARRIVAL (RNAV)	24-May-2018 (Am 155)
STAR MEPIL THREE ARRIVAL (RNAV)	24-May-2018 (Am 155)
STAR MARLN THREE ARRIVAL (RNAV)	24-May-2018 (Am 155)
STAR ODALE SEVEN ARRIVAL (RNAV)	24-May-2018 (Am 155)
STAR RIVET THREE ARRIVAL (RNAV)	24-May-2018 (Am 155)
ILS OR LOC RWY 07	9-Nov-2017 (Am 153)
ILS OR LOC RWY 16L PAGE 1	24-May-2018 (Am 155)
ILS RWY 16L PAGE 2	24-May-2018 (Am 155)
ILS OR LOC RWY 16R PAGE 1	24-May-2018 (Am 155)
ILS RWY 16R PAGE 2	24-May-2018 (Am 155)
ILS OR LOC RWY 25	9-Nov-2017 (Am 153)
ILS OR LOC RWY 34L PAGE 1	24-May-2018 (Am 155)
ILS RWY 34L PAGE 2	24-May-2018 (Am 155)
ILS OR LOC RWY 34R PAGE 1	24-May-2018 (Am 155)
ILS RWY 34R PAGE 2	24-May-2018 (Am 155)
RNAV-Z (GNSS) RWY 07	17-Aug-2017 (Am 152)
RNAV-Z (GNSS) RWY 16L	9-Nov-2017 (Am 153)
RNAV-Z (GNSS) RWY 16R	9-Nov-2017 (Am 153)
RNAV-Z (GNSS) RWY 25	17-Aug-2017 (Am 152)
RNAV-Z (GNSS) RWY 34L	9-Nov-2017 (Am 153)
RNAV-Z (GNSS) RWY 34R	9-Nov-2017 (Am 153)
GLS RWY 07	9-Nov-2017 (Am 153)
GLS RWY 16L	9-Nov-2017 (Am 153)
GLS RWY 16R	9-Nov-2017 (Am 153)
GLS RWY 25	9-Nov-2017 (Am 153)
GLS RWY 34L	9-Nov-2017 (Am 153)
GLS RWY 34R	9-Nov-2017 (Am 153)
ILS PRM USER INSTRUCTIONS PAGE 1	10-Nov-2016 (Am 149)
ILS PRM USER INSTRUCTIONS PAGE 2	20-Aug-2015 (Am 144)
ILS PRM RWY 16L	9-Nov-2017 (Am 153)
ILS PRM RWY 16R	24-May-2018 (Am 155)
ILS PRM RWY 34L	24-May-2018 (Am 155)
ILS PRM RWY 34R	24-May-2018 (Am 155)

Source: AIP Book (24-May-2018) via http://www.airservicesaustralia.com/aip/aip.asp?pg=10