

Sydney Metro

**PITT STREET NORTH OVER STATION
DEVELOPMENT (PSN OSD)**

Appendix R. Fire Engineering Review

**State Significant Development,
Development Application (SSD DA)**

Prepared for **Pitt Street Developer North Pty Ltd**


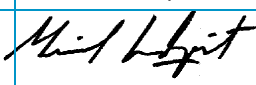
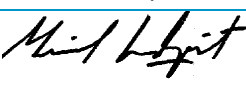


9 July 2020

Revision C

Issue for DPIE

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Quality management

Version	Date	Information relating to report			
R1.0	14/02/2020	Reason for issue	Draft report issued to Pitt Street Developer North Pty Ltd for distribution to design team for review and comment.		
			Prepared by	Reviewed by	Approved by
		Name	Micael Lundqvist	Victor Tung	Greg Leach
		Signature			
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			Prepared by	Reviewed by	Approved by
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		Signature			

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Updates since previous submission

This section of the report describes the changes that have been made to this report since Round 1 Submission to Sydney Metro, due to the following reasons:

Type of Change	Description of Change	Section Reference (this report)
Updated information	Update to Sydney Metro description including Figure 2 – Sydney Metro Alignment Map to latest map.	Section 2.2 – Page 7 to 11
Updated information	Section 2.3 removed.	N/A
Updated information	Revised details of performance solution 1 in Table 5 for consistency with station and OSD South reports.	Section 3.2 – Page 13
Updated information	Revised EWIS strategy following consultation with Pitt Street North Over Station Developer.	Appendix C – Page 53
Updated information	Included FRNSW stage 3 meeting minutes.	Appendix B.3 – Page 49

Table 1 Updates since previous submission

1. Introduction

This report has been prepared to accompany a detailed State Significant Development (SSD) development application (DA) for a commercial mixed-use Over Station Development (OSD) above the new Sydney Metro Pitt Street North Station. The detailed SSD DA is consistent with the Concept Approval (SSD 17_8875) granted for the maximum building envelope on the site, as proposed to be modified. The Minister for Planning, or their delegate, is the consent authority for the SSD DA and this application is lodged with the NSW Department of Planning, Industry and Environment (NSW DPIE) for assessment.

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 25 October 2019.

The detailed SSD DA seeks development consent for:

- Construction of new commercial tower of approximately 38 storeys
- The tower includes maximum GFA, excluding floor space approved in the CSSI.
- Integration with the approved CSSI proposal including though not limited to:
 - Structures, mechanical and electronic systems, and services; and
 - Vertical transfers.
- Use of spaces within the CSSI 'metro box' building envelope for the purposes of:
 - Retail tenancies;
 - Commercial lobby and commercial amenities;
 - Car parking spaces within the podium for the purposes of the commercial premises; and
 - Loading and services access.
- Utilities and services provision.
- Stratum subdivision (staged).

Table 2 Concept approval of Conditions of Consent

Item	Description of requirement	Section reference (this report)
B14 - Fire and Rescue Assessment	Draft Fire and Rescue Assessment / Engineering Brief prepared in consultation with Fire and Rescue NSW providing relevant details of:	Initial engineering briefing with Fire and Rescue NSW (FRNSW) was undertaken on 10/12/2019 and 5/2/2020. Future documentation and consultation with FRNSW for the OSD tower will be undertaken in the form of a Fire Engineering Brief Questionnaire. This submission can be made to FRNSW on receipt of a DA number.
	(a) The various sectors within the Pitt Street North Metro site served by independent fire systems (such as the OSD, the underground and aboveground metro sector, etc)	Sections 4 and 5.1.
	(b) Fire engineering analysis of the pedestrian connection interfaces between the sectors and the sectors themselves, having regard to emergency occupant egress, fire and smoke compartmentation, smoke hazard management and fire fighting intervention	Section 5.2.

Item	Description of requirement	Section reference (this report)
	(c) Adequacy of fire and life safety systems within the Pitt Street North Metro site in relation to the fire hazards of the Sydney Metro	Sections 4 and 5.3.
	(d) Design of fire hydrant systems for OSD elements that exceed 135m	Section 5.4.
	(e) Future consultation to be undertaken with Fire and Rescue NSW in respect of the final design and construction of the OSD and operational compatibility of the Pitt Street North Metro site's proposed fire and life safety systems.	Section 5.5.

2. Project overview

2.1 The site

The site is located within the Sydney CBD. It has three separate street frontages, Pitt Street to the west, Park Street to the south and Castlereagh Street to the east. The area surrounding the site consists of predominantly commercial high-density buildings and some residential buildings, with finer grain and heritage buildings dispersed throughout.

The site has an approximate area of 3,150m² and is legally described as follows:

- 252 Pitt Street (Lot 20 in DP1255509)

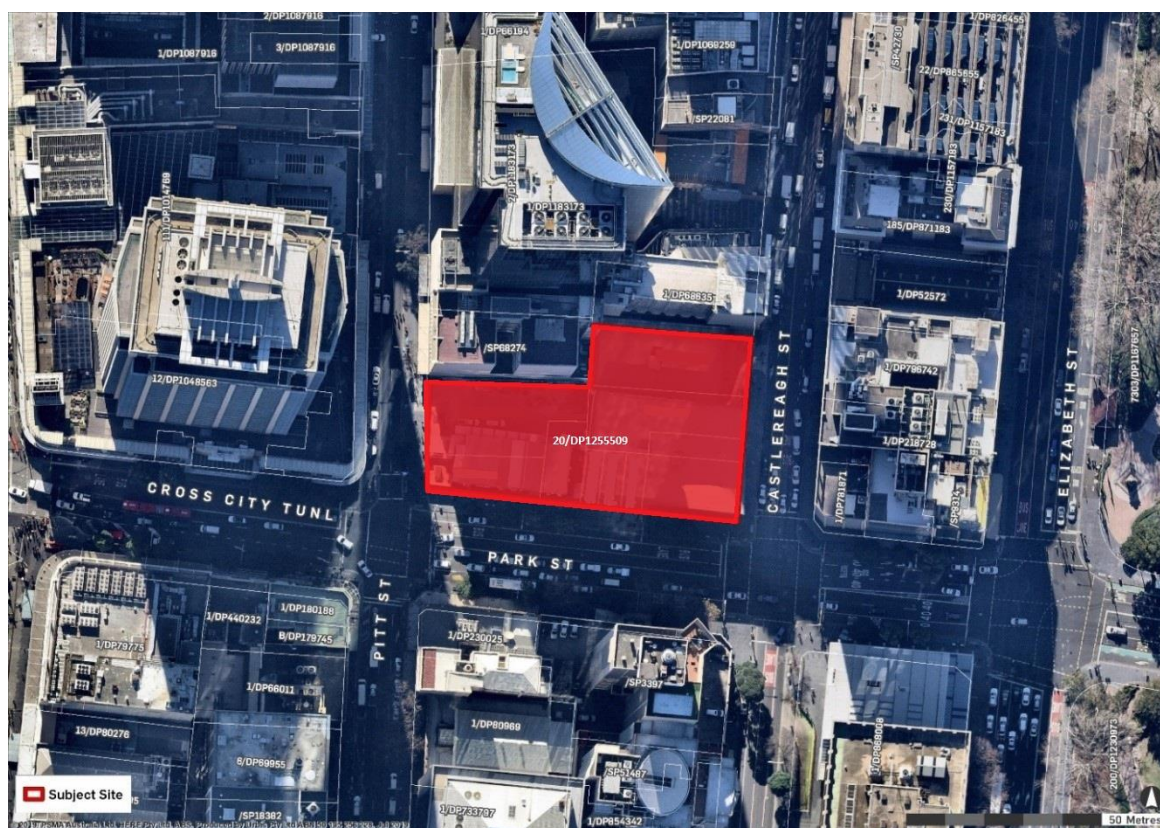


Figure 1 Location plan [Source: Urbis]

2.2 Sydney Metro description

Sydney Metro is Australia's biggest public transport project. A new standalone railway, this 21st century network will revolutionise the way Sydney travels.

There are four core components:

1. Sydney Metro Northwest (formerly the 36km North West Rail Link)

This project is now complete and passenger services commenced in May 2019 between Rouse Hill and Chatswood, with a metro train every four minutes in the peak. The project was delivered on time and \$1 billion under budget.

2. Sydney Metro City & Southwest

Sydney Metro City & Southwest project includes a new 30km metro line extending metro rail from the end of Metro Northwest at Chatswood, under Sydney Harbour, through new CBD stations and southwest to Bankstown. It is due to open in 2024 with the ultimate capacity to run a metro train every two minutes each way through the centre of Sydney.

Sydney Metro City & Southwest will deliver new metro stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street, Waterloo and new underground metro platforms at Central Station. In addition it will upgrade and convert all 11 stations between Sydenham and Bankstown to metro standards.

In 2024, customers will benefit from a new fully-air conditioned Sydney Metro train every four minutes in the peak in each direction with lifts, level platforms and platform screen doors for safety, accessibility and increased security.

3. Sydney Metro West

Sydney Metro West is a new underground railway connecting Greater Parramatta and the Sydney CBD. This once-in-a-century infrastructure investment will transform Sydney for generations to come, doubling rail capacity between these two areas, linking new communities to rail services and supporting employment growth and housing supply between the two CBDs.

The locations of seven proposed metro stations have been confirmed at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock and The Bays.

The NSW Government is assessing an optional station at Pyrmont and further planning is underway to determine the location of a new metro station in the Sydney CBD.

4. Sydney Metro – Western Sydney Airport

Metro rail will also service Greater Western Sydney and the new Western Sydney International (Nancy Bird Walton) Airport. The new railway line will become the transport spine for the Western Parkland City's growth for generations to come, connecting communities and travellers with the rest of Sydney's public transport system with a fast, safe and easy metro service. The Australian and NSW governments are equal partners in the delivery of this new railway.

The Sydney Metro Project is illustrated in Figure 2 below.

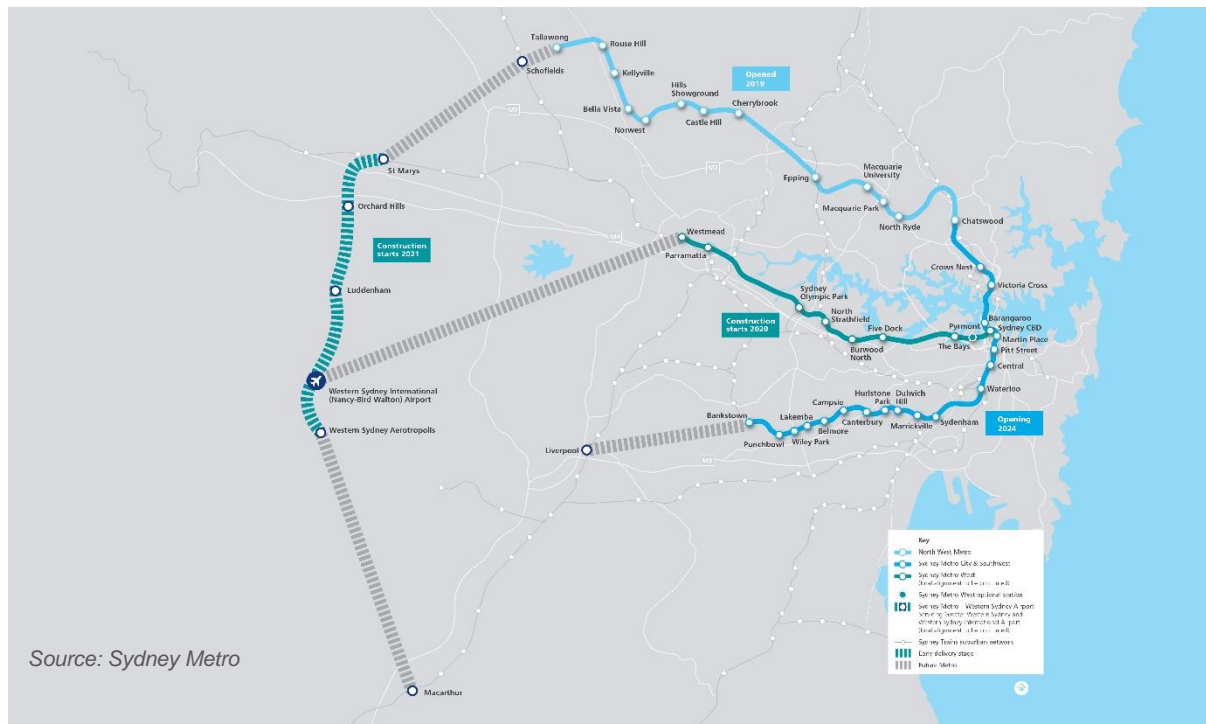


Figure 2 Sydney Metro Alignment Map

On 9 January 2017, the Minister for Planning approved the Sydney Metro City & Southwest - Chatswood to Sydenham project as a Critical State Significant Infrastructure project (reference SSI 15_7400) (CSSI Approval). The terms of the CSSI Approval includes all works required to construct the Sydney Metro Pitt Street Station, including the demolition of existing buildings and structures on both sites (north and south). The CSSI Approval also includes construction of below and above ground works within the metro station structure for appropriate integration with over station developments.

The CSSI Approval included Indicative Interface Drawings for the below and above ground works at Pitt Street North Metro Station site. The delineation between the approved Sydney Metro works, generally described as within the “metro box”, and the Over Station Development (OSD) elements are illustrated below. The delineation line between the CSSI Approved works and the OSD envelope is generally described below or above the transfer slab level respectively.

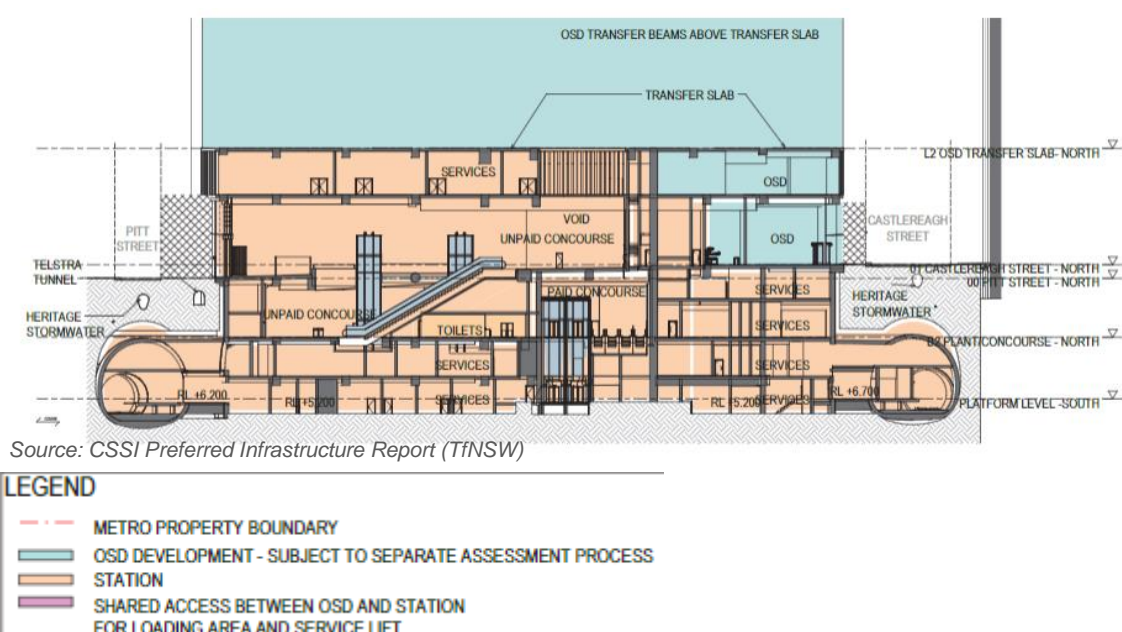
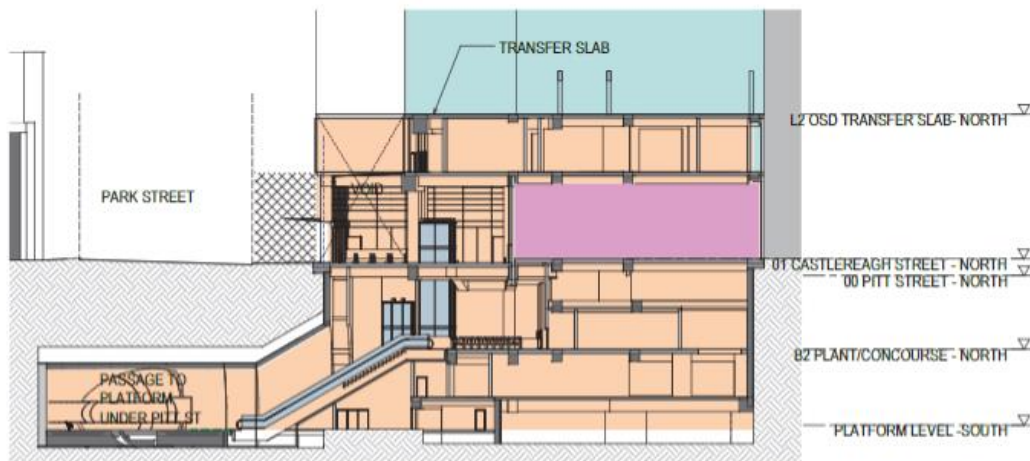


Figure 3 Pitt Street Station – North (East-West Section)



Source: CSSI Preferred Infrastructure Report (TfNSW)

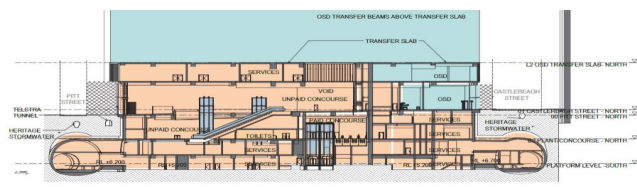


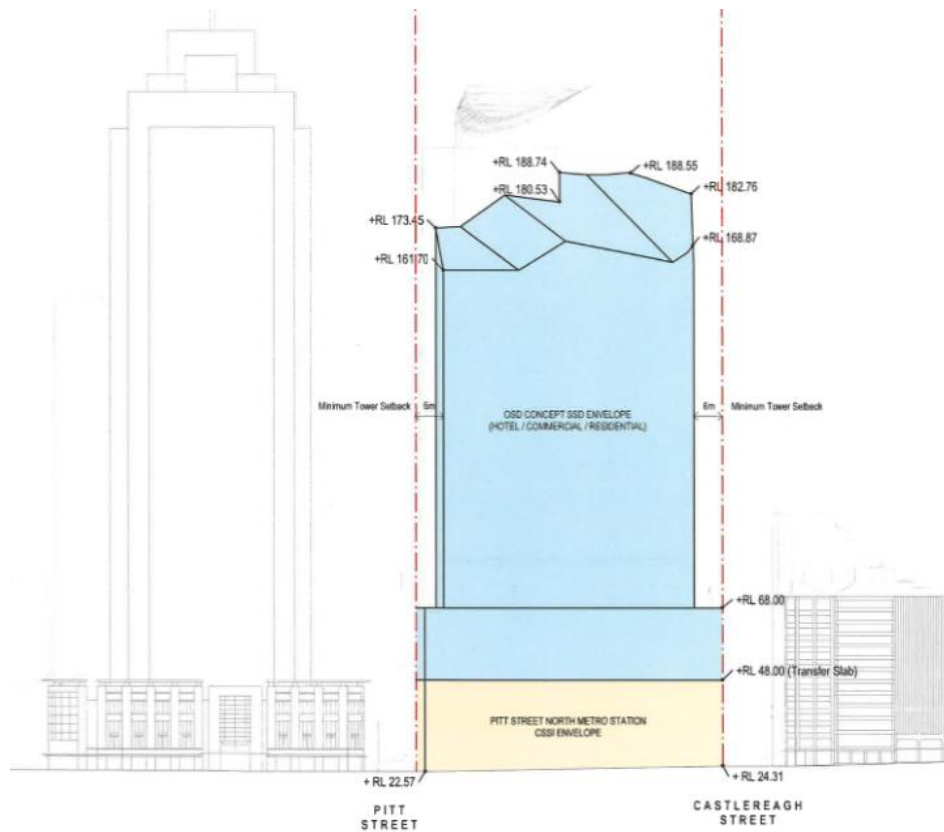
Figure 4 Pitt Street Station – North (North-South Section)

The Preferred Infrastructure Report (PIR) noted that the integration of the OSD elements and the metro station elements would be subject to the design resolution process, noting that the detailed design of the “metro box” may vary from the concept design assessed within the planning approval.

As such in summary:

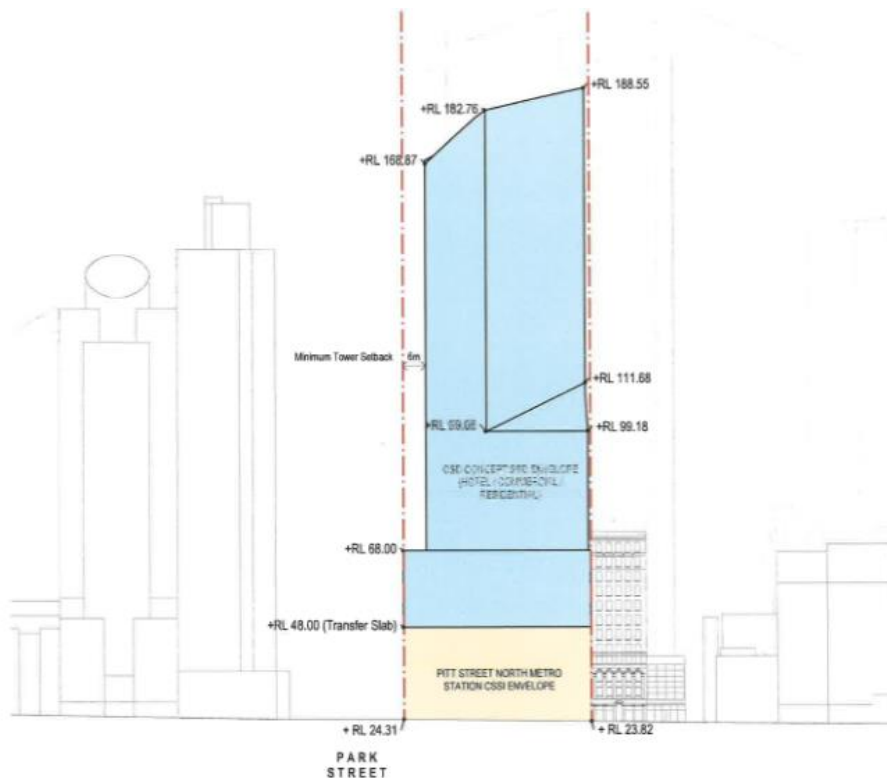
- The CSSI Approval provides consent for the construction of all structures within the approved “metro box” envelope for Pitt Street North.
- The CSSI Approval provides consent for the fit out and use of all areas within the approved “metro box” envelope that relate to the ongoing use and operation of the Sydney Metro.
- The CSSI Approval provides consent for the embellishment of the public domain, and the architectural design of the “metro box” envelope as it relates to the approved Sydney Metro and the approved Pitt Street North Station Design & Precinct Plan.
- Separate development consent however is required to be issued by the NSW DPIE for the use and fit-out of space within the “metro box” envelope for areas related to the OSD, and notably the construction and use of the OSD itself.

As per the requirements of clause 7.20 of the *Sydney Local Environmental Plan 2012*, as the OSD exceeds a height of 55 metres above ground level (among other triggers), development consent is first required to be issued in a Concept (formerly known as Stage 1) DA. This is described below.



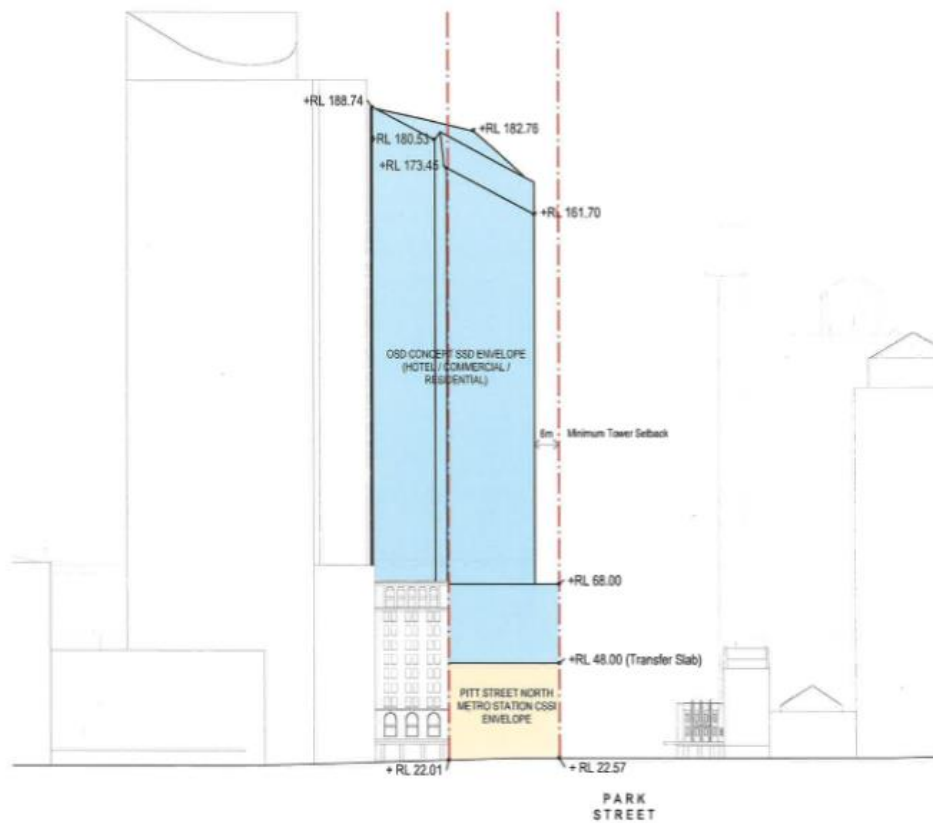
Source: SSD 8875 Concept Stamped Plans

Figure 5 Pitt Street North Concept SSD DA – Envelope – South Elevation



Source: SSD 8875 Concept Stamped Plans

Figure 6 Pitt Street North Concept SSD DA – Envelope – East Elevation



Source: SSD 8875 Concept Stamped Plans

Figure 7 Pitt Street North Concept SSD DA – Envelope – West Elevation

3. Description of the building and performance solutions

3.1 Building description

Table 3¹ shows the main characteristics of the building for determining compliance with the NCC. Table 4 shows the proposed use and classification of the building or part in accordance with part A6 of the NCC.

Table 3 Main building characteristics

Characteristic	NCC provision	Description
Effective height	Schedule 3	Approx. 142m
Type of construction required	C1.1	Type A
Rise in storeys	C1.2	38
Levels contained	-	40 (excl station)

Table 4 Use and classification

Part of building	Use	Classification (A6)
Basement 01	OSD plant Substation	Class 5 ancillary Class 8
Ground level	Loading dock Retail tenancies Entry lobbies	Class 7b Class 6 Class 6 ancillary
Ground floor mezzanine	OSD fire pump room and plant	Class 5 ancillary
Level 01	End of trip facilities OSD plant	Class 5 ancillary Class 5 ancillary
Level 02	Commercial/retail and associated BOH areas and plant Car stacker	Class 6 Class 7a
Level 03	Commercial lobby Car stacker	Class 5 Class 7a
Level 04	Station plant	Class 9b ancillary
Level 05-08 (podium)	Office	Class 5
Level 09	OSD plant	Class 5 ancillary
Level 10-20 (low rise)	Office	Class 5
Level 21 (transfer)	Office	Class 5
Level 22-34 (high rise)	Office	Class 5
Level 35	Office OSD plant	Class 5 Class 5 ancillary
Level 36-38	OSD plant	Class 5 ancillary

¹ Philip Chun Building Code Consulting, 20 March 2020, BCA assessment report, SMCSWSPS-PCH-OSN-PL-REP-000001, revision A.

3.2 Performance solutions

The design of the building includes areas that do not comply with the DTS provisions of the NCC². We intend to use a performance solution to meet relevant performance requirements of the NCC. Table 5 shows the NCC requirements associated with the performance solutions.

Note: Performance solutions relating to the station design and OSD enabling shell will be documented within the station fire engineering report. Separate reports are proposed to facilitate future fitout changes to the OSD without impacting on the station and vice versa.

Table 5 NCC requirements associated with the performance solutions

No	Description of performance solutions	DTS provision	Performance requirements	Proposed fire safety measures and performance solution
1.	<p>The OSD North Tower will be separated from the station building by a combination of vertical and horizontal fire and smoke rated construction instead of vertical fire walls. The station and OSD towers will be treated as separate buildings for the purposes of approvals.</p> <p>OSD North Tower is considered to be a separate building form the station. This performance solution focuses on the fire services system and ancillary areas affected by the separation however various elements of fire services infrastructure will be shared on common floors.</p>	<p>C2.7</p> <p>E1.3, E1.5, E2.2, E3.4 and E4.9</p>	<p>CP2, EP1.3, EP1.4, EP2.2, EP3.2 and EP4.3</p>	<p>A performance solution for the building design and treatment as separate buildings is considered reasonable on the basis of providing fire separation between the 'buildings' and an integrated fire systems design and system response matrix.</p>
2.	<p>Protection of openings within 3m of the north site boundary but located more than 15m above the highest roof on the adjoining properties is not proposed at the north façade, adjacent to the Masonic Club and Ashington Place.</p>	<p>C3.2 and C3.4</p>	<p>CP2</p>	<p>A performance solution for the unprotected openings above the nominated height is considered reasonable on the basis of sprinkler protection of this building and as the adjoining sites are heritage listed and have sold their rights of any future development. This results in external protection in accordance with NCC clause C3.2 and specification C1.1 when considering the highest points of the existing buildings as the fire source features.</p>
3.	<p>The following areas will be served by a single exit instead of two as required in a building in excess of 25m:</p> <ul style="list-style-type: none"> ground level retail units level 1 BOH areas. <p>The level 1 COMMS rooms also have up to 30m to the single exit instead of 20m. HV switch room has access to alternative exit via AS 1657 ladder in the goods lift lobby.</p>	<p>D1.2 and D1.4</p>	<p>DP4 and EP2.2</p>	<p>A performance solution for single exits and travel distance is considered reasonable based on sprinkler protection, smoke detection and occupant warning systems including AS 1670.1 detection. The relevant areas are also located near ground level of the building, ie not affected by the high-rise portions of the building.</p>

² Philip Chun Building Code Consulting, 20 March 2020, BCA assessment report, SMCSWSPS-PCH-OSN-PL-REP-000001, revision A.

No	Description of performance solutions	DTS provision	Performance requirements	Proposed fire safety measures and performance solution
4.	The travel distance to a point of choice, closest exit and between alternative exits may be up to 30m, 60m and 100m instead of 20m, 40m and 60m in retail areas on level 2.	D1.4 and D1.5	DP4 and EP2.2	A performance solution for increased travel distances is considered reasonable based on sprinkler protection, smoke detection and occupant warning systems including AS 1670.1 detection. The ground – level 2 retail areas are also proposed to be provided with smoke exhaust.
5.	The travel distance to a point of choice, closest exit and between alternative exits may be up to 30m, 60m and 100m instead of 20m, 40m and 60m in BOH and plant areas on levels ground mezzanine, 1, 2, 3 and 9. Note: Level 4 station plant is assessed in a separate report.			
6.	The travel distance to a point of choice, closest exit and between alternative exits may be up to 30m, 60m and 100m instead of 20m, 40m and 60m on commercial lobby level 3 and typical office levels 5-8 and 10-35.			
7.	The egress path between a structural column and the adjacent sprinkler tank will be 950mm clear width instead of 1m.	D1.6	DP4 and DP6	A performance solution for reduced width is considered reasonable based on the nature of the areas being BOH staff areas consistent with uses granted concessions to be served by AS 1657 ladders and walkway.

No	Description of performance solutions	DTS provision	Performance requirements	Proposed fire safety measures and performance solution
8.	The fire stairs serving the OSD development as well as the fire stairs serving the station will converge and share the same fire isolated passageway. The OSD is technically considered a separate building therefore independent egress from the separate buildings is not achieved.	D1.7	DP2, DP4, DP5 and DP6	A performance solution is considered reasonable for the convergence of station plant area exits with the OSD fire stair at ground level as the station plant areas have a low occupant load. The discharge of BOH stairs is considered reasonable due to the low occupant load and as alternative exits are available within reasonable distance.
9.	The ladder egress from level 01 good lift lobby will not provide independent egress to a road or open space as it will discharge on ground mezzanine level.			
10.	The fire stair serving the car stacker and fire sprinkler tank will not provide independent egress to a road or open space as it will discharge on level 3 into the building.			
11.	The ladder egress from plant levels 36-37 will not provide independent egress to a road or open space as it will discharge on level 35 where access to an alternative fire-isolated stair is available via an external path of travel.			
12.	The level 36-37 plant areas will each be in excess of 200m ² and will be served by one fire-isolated stair and one AS 1657 ladder.	D1.16		A performance solution for the ladder egress from the plant rooms is considered reasonable based on the low number of occupants expected in these areas. Fire brigade access is facilitated via one fire stair.
13.	Doors leading to the fire-isolated stair and discharge from the ladders at ground level serving the substation and the HV switch room at basement level 01 swing against the direction of egress as an electrical supply authority requirement.	D2.20	DP2	A performance solution for the direction of door swing is considered reasonable based on the low number of occupants expected in these areas.
14.	The door providing entry to the stair serving the car stacker will swing against the direction of egress.			

No	Description of performance solutions	DTS provision	Performance requirements	Proposed fire safety measures and performance solution
15.	<p>The pumproom is located on ground mezzanine level with access via a fire separated corridor leading to a pressurised fire-isolated stair.</p> <p>The OSD North booster assembly is not located within 20m of the main pedestrian entrance of the OSD North Tower.</p> <p>The fire hydrant system for the OSD North Tower will be designed to AS 2419.1:2017 instead of AS 2419.1-2005.</p>	E1.3 and AS 2419.1	EP1.3	<p>A performance solution for the access to the fire pump room is considered reasonable based on access via a fire stair and separated corridor.</p> <p>The location of the booster is considered appropriate as it is adjacent to the FCR and near the main entrance.</p> <p>Adaptation of the latest fire hydrant standard is supported by FRNSW.</p>
16.	The fire control room serving the OSD Tower is not located at the main OSD entrance and will be designed to only have a single entrance directly from the street instead of two paths of access.	E1.8 and specification E1.8	EP1.6	<p>A performance solution for the access to the fire control room is considered reasonable based on access being directly from outside.</p> <p>Alternative access to main office entry is available within reasonable distance along the footpath outside the building.</p>
17.	A rationalised smoke control system is proposed to be provided to the retail fire compartment in the OSD development on ground floor level – level 3.	E2.2	EP2.2	A performance solution for the smoke hazard management in the retail areas is considered reasonable based on sprinklers, smoke detection and occupant warning systems.
18.	Zone smoke control is not proposed to the station, retail and commercial lobby areas of the OSD enabling levels.	E2.2	EP2.2	A performance solution for the omission of zone smoke control from the station and OSD enabling levels is considered reasonable based on the provision of sprinklers and pressurisation of the OSD Tower high-rise commercial levels.
19.	The basement stair serving basement level 01 is not proposed to be provided with stair pressurisation.	E2.2	EP2.2	A performance solution for the omission of stair pressurisation from the basement stair flight is considered reasonable based on the low occupant numbers and that only a single basement level is served.
20.	Performance based design of automated vehicle parking system (AVPS) / car stacker.	E1.5, E1.10 and E2.3	CP1, CP2, EP1.1, EP1.2, EP1.3, EP1.4, EP1.6 and EP2.2.	A performance solution for the car stacker is proposed as recommended by the Australasian Fire and Emergency Service Authorities Council (AFAC) guideline 3007.

4. Fire safety measures – OSD North

The following fire safety measures are proposed for the OSD North as a starting point for the fire safety engineering assessment to achieve compliance with the relevant performance requirements of NCC 2019.

4.1 General

1. The design must comply with the current DTS provisions of the NCC relating to fire safety unless specifically stated. This section does not provide a comprehensive list of fire safety measures required by the DTS provisions of the NCC. The fire safety measures listed here only relate to the performance solutions and must be read together with the DTS provisions.
2. This report and the requirements listed in this section must be implemented into the design and identified on the fire safety schedule for the building. They must be maintained and certified in accordance with the Environmental Planning and Assessment Regulations 2000 and relevant Australian standards.
3. We recommend periodic inspection, testing and maintenance of all fire safety measures be undertaken in accordance with AS 1851:2012.

4.2 Structural fire resistance and compartmentation

4. The FRLs of the building elements must be designed in accordance with the requirements of specification C1.1 of the NCC for a building of type A construction except where otherwise specified.
5. The design of the loadbearing structure of the building must ensure that failure of the non-fire rated AVPS or its supporting frame – and potential subsequent impact on the surrounding structures – does not cause progressive collapse of the building.
6. The OSD must be fire separated from Pitt Street station by construction achieving an FRL of not less than 120/120/120 or higher if required by specification C1.1 of the NCC, eg the retail fire compartment requires FRL 180/180/180 and the loading dock requires FRL 240/240/240.

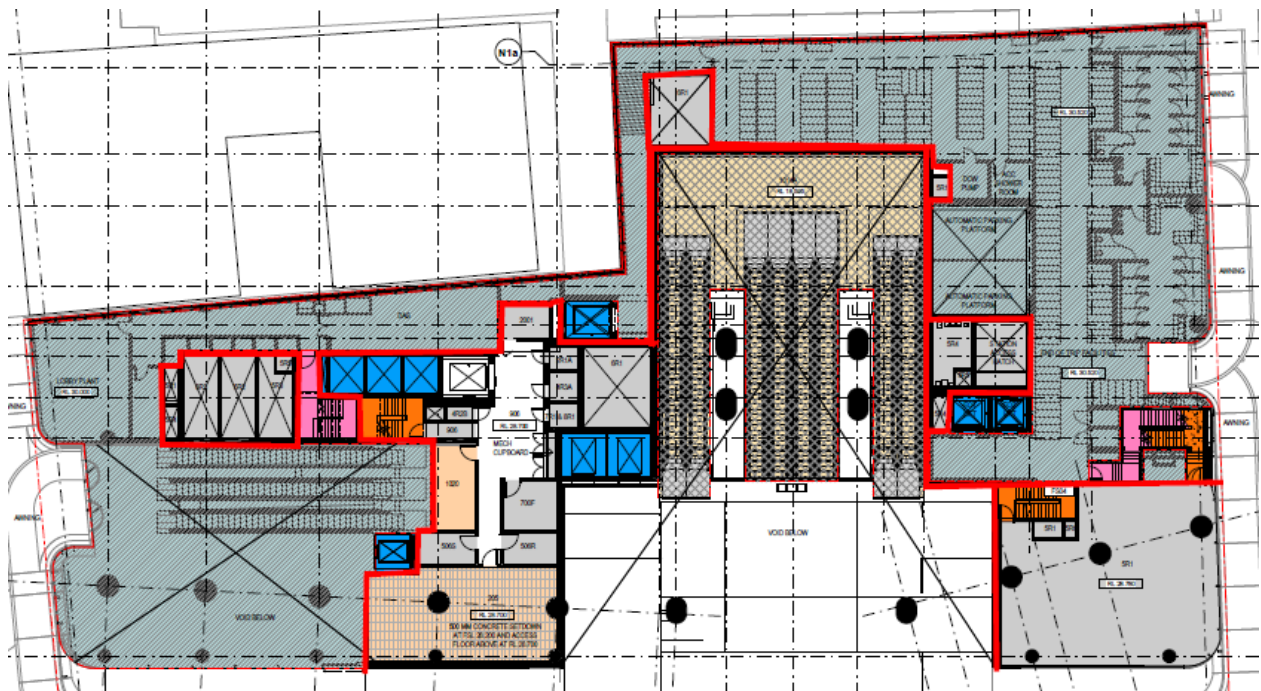


Figure 8 Indicative fire separation between OSD North and Pitt Street station at level 1

7. The car stacker and substation must form individual fire compartments which are fire separated from the remainder of the building with construction achieving an FRL of not less than 240/240/240. The substation fire separation shall also comply with the relevant utility authority requirements.
8. Emergency equipment required to operate during a fire and equipment having a high fire hazard or potential for explosion must be enclosed in construction which achieves an FRL of not less than 120/120/120 as required by clauses C2.12 and C2.13 of the NCC, or as directed by the utility authority who may have additional requirements.
9. The external walls and all attachments are understood to be non-combustible and fire rated where required by the deemed-to-satisfy provisions of the NCC.
10. The openings within the external walls located less than 3m from the side or rear boundaries of the allotment and less than 15m above the highest point of the buildings on the adjacent allotments (RL +88 and RL +92 respectively) must be protected in accordance with clause C3.4 of the NCC. If wall-wetting sprinklers are used, they must comply with AS 2118.2-2010 and located externally with windows that are automatically closing or permanently fixed in the closed position. Refer to Figure 10 to Figure 14.
11. A formal legal instrument must be completed with the owners of the adjacent allotments to the north limiting any future development on those sites to equal or less of the height of the existing buildings excluding chimneys and the like (RL +73 and RL +77 or less respectively). Refer to Figure 9.

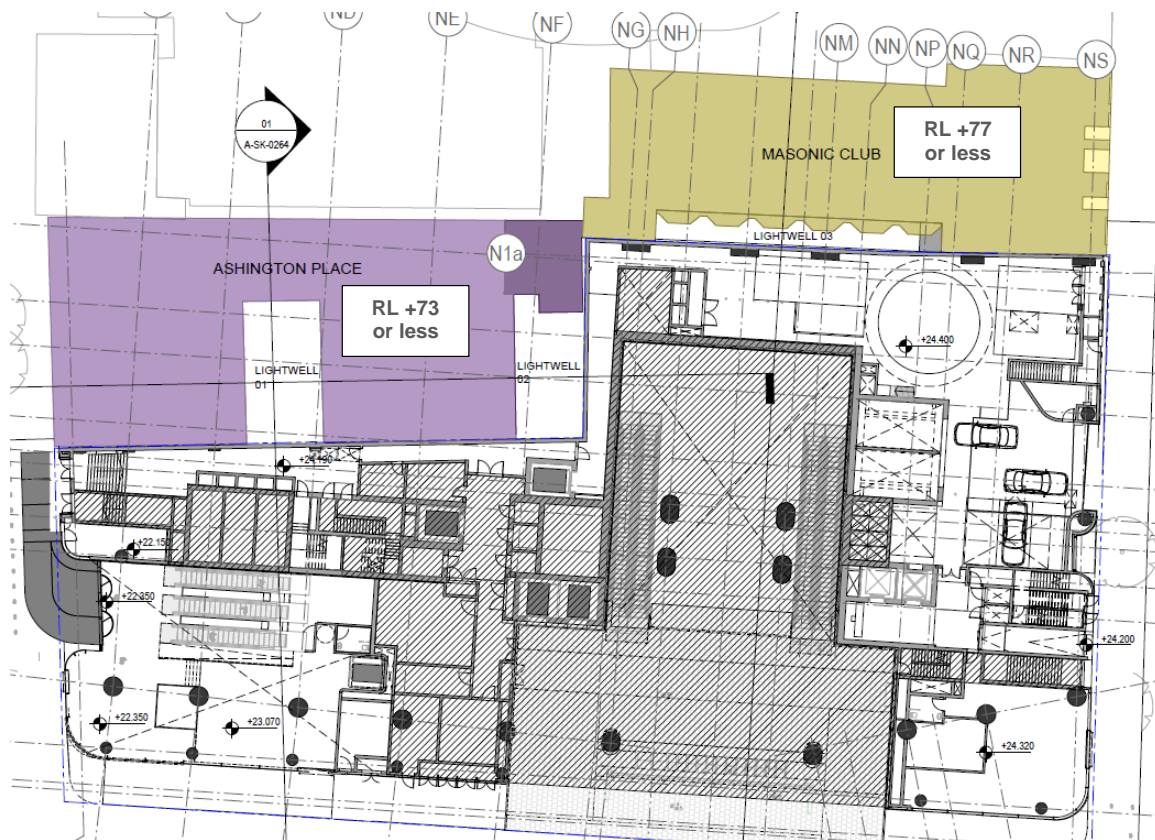


Figure 9 Height limits of adjoining properties

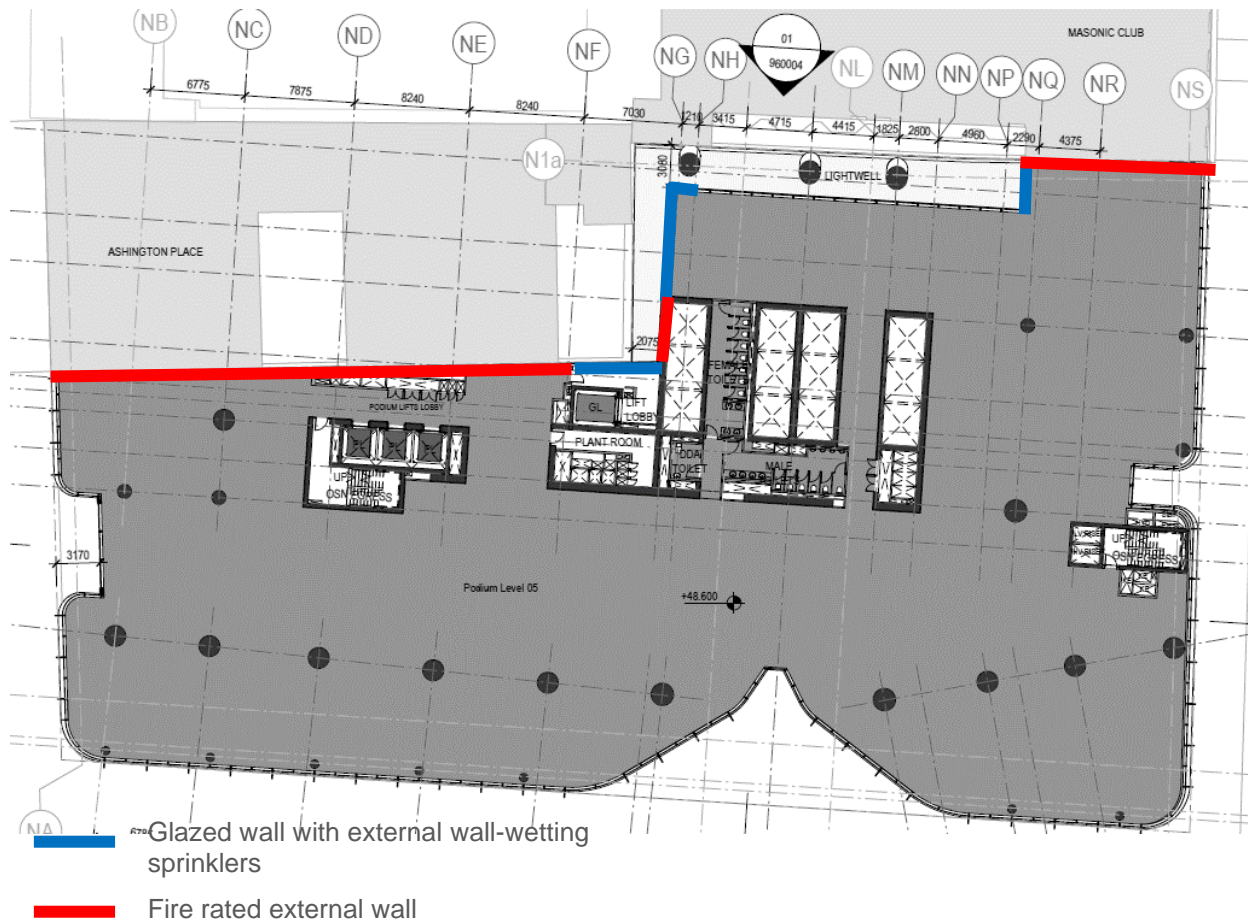


Figure 10 Indicative protection of external walls of OSD podium levels 05-08

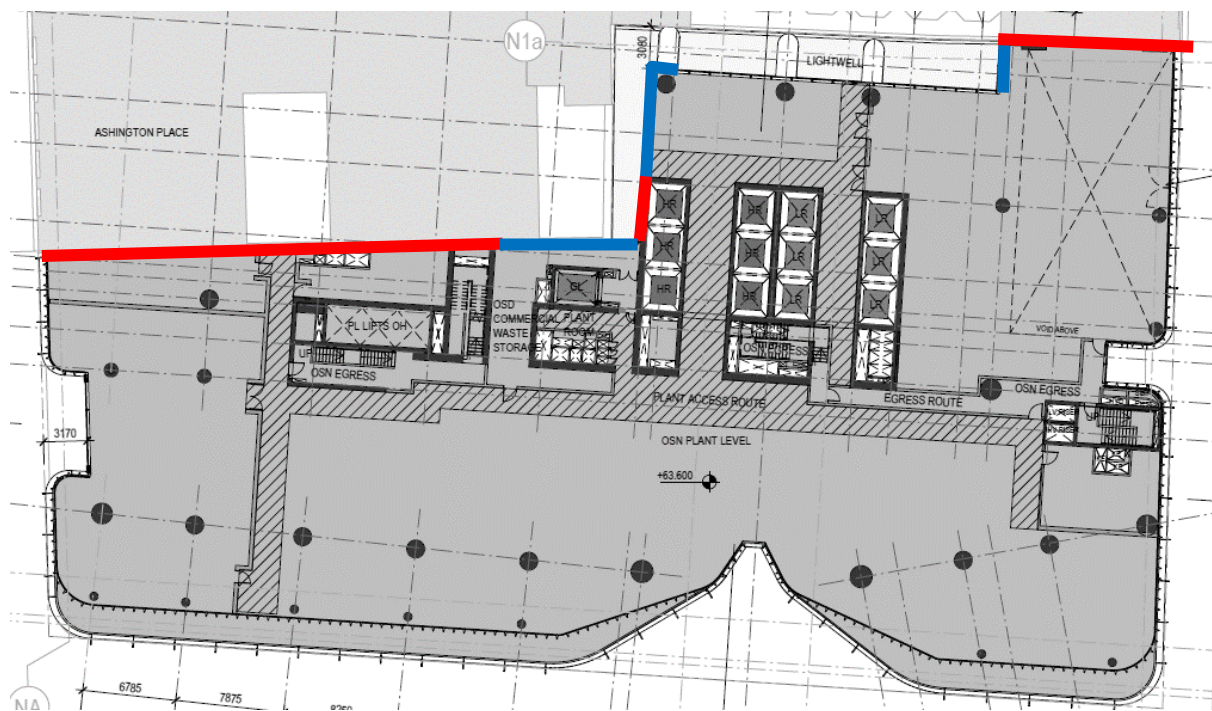


Figure 11 Indicative protection of external walls of OSD plant level 09



Figure 12 Indicative protection of external walls of OSD low-rise level 10

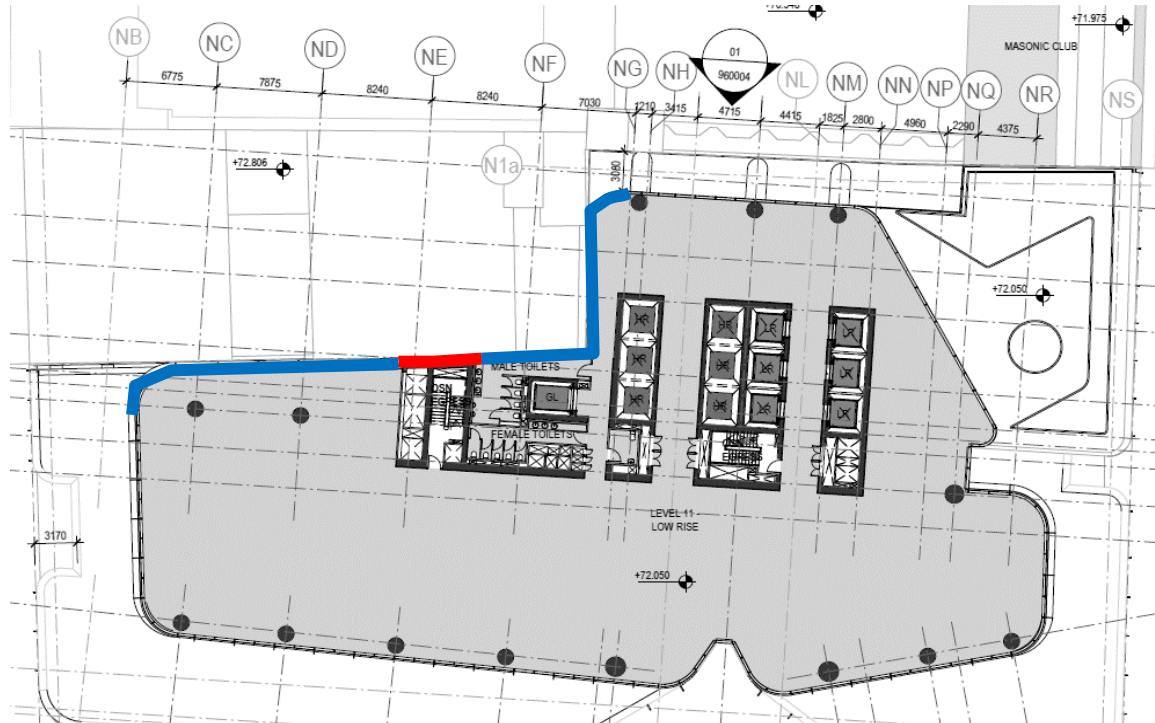


Figure 13 Indicative protection of external walls of OSD low rise level 11

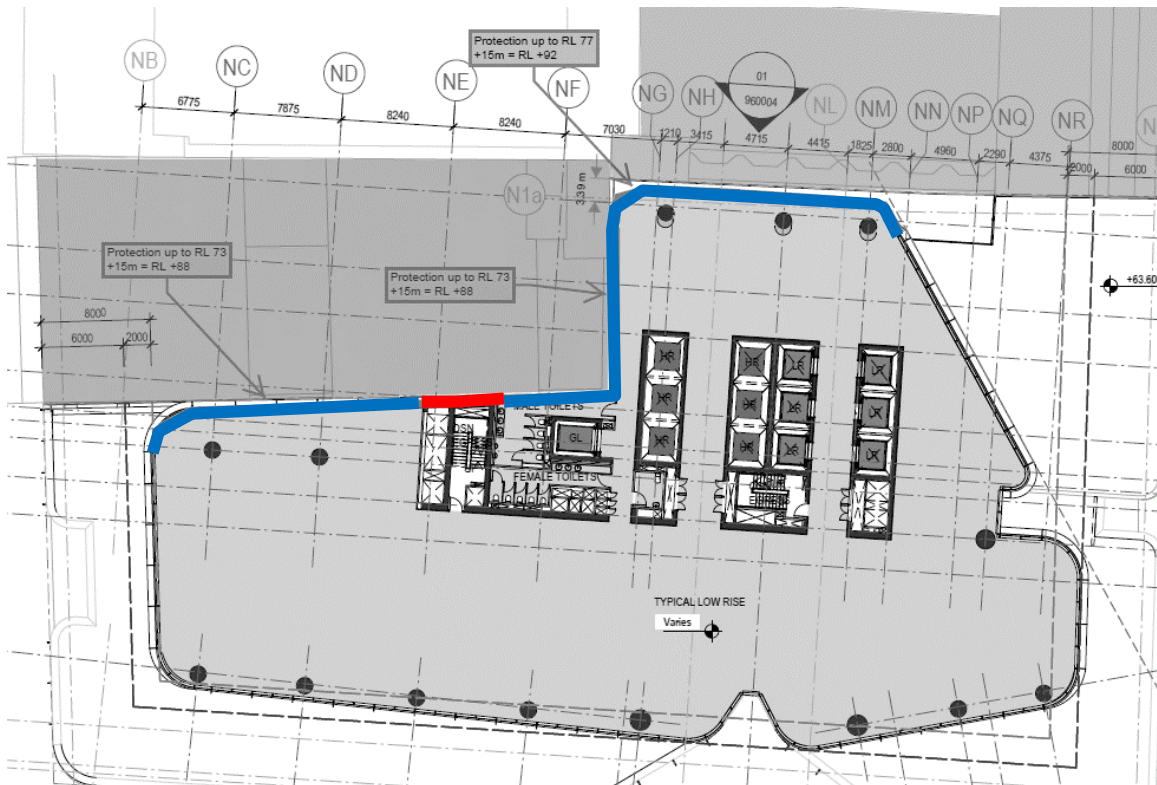


Figure 14 Indicative protection of external walls of OSD low rise levels 12-15

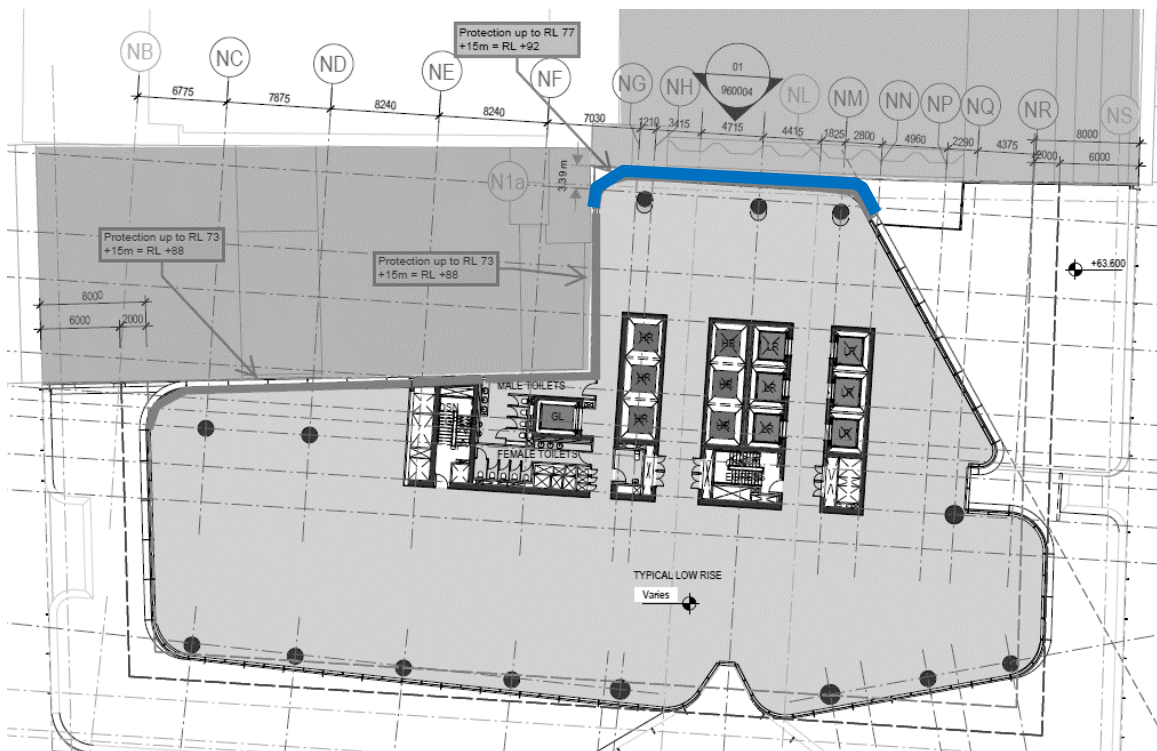


Figure 15 Indicative protection of external walls of OSD low rise level 16

4.3 Access and egress

12. Fire-isolated exits are required to be provided as illustrated in Figure 19 to Figure 26. Based on the available aggregate exit width the following maximum population limits apply in accordance with clause D1.6 of the NCC:
 - a. 320 persons on level 2 which is required to have 3 x 1m exit width
 - b. 200 persons on level 3 and 5-8 which is required to have 2 x 1m exit width
 - c. 200 persons on level 10-35 which is required to have 2 x 1m exit width.

If additional exit width is required via the escalators, then additional requirements apply as per the Stage 2 station FEB.

Note 1: Levels 1, 4 and 36-37 are plant areas with the expected maximum population limited to less than 10 persons per level.

Note 2: If fire stairs serving OSD areas on levels 5-8 and below increase to 1.25m clear width each the number of occupants per level under clause D1.6 of the BCA increase to 260 persons.
13. The provision for escape within the building is to have access to not less than two fire-isolated exits on each storey with the exception of:
 - a. ground level retail units
 - b. level 1 BOH plant areas.
14. All paths of travel to and within exits must be not less than 1m in clear width in accordance with clause D1.6 of the NCC with the exception of:
 - a. low population back-of-house plant areas on basement level 1, level 01 goods lift lobby and levels 36-37 plant rooms which may have one exit being via AS 1657:2018 compliant ladders located within a fire rated shaft
 - b. 950mm clearance is allowed around the level 2 sprinkler tank
 - c. 800mm clear width is allowed within the car stacker.
15. Aggregate exit width must be provided in accordance with clauses D1.6 and D1.13 of the NCC.
16. The following maximum travel distances apply to the office levels and associated plant areas of the building on levels ground mezzanine and 1-35:
 - a. 30m to a single exit or point of choice instead of 20m
 - b. 60m to the closest of two or more alternative exits
 - c. 100m between alternative exits.
17. All doorways which form part of a required exit within the building must be made to swing in the direction of travel to the fire-isolated exit and from the exit to the discharge point from the building in accordance with clause D2.20 of the NCC with the exception of:
 - a. basement level 01 substation and HV switch room exits
 - b. connecting door from basement level 01 rising stair flight to OSD high-rise stair discharge
 - c. level 2 car stacker to egress stair up to level 3.
18. Doors in required exits, forming part of required exits or in the paths of travel to required exits must be readily openable without a key from the side that faces a person seeking egress in accordance with clause D2.21 of the NCC.

19. Re-entry provisions to the OSD areas within fire-isolated exits serving any storey above an effective height of 25m must comply with clause D2.22, ie either the doors to the exit must not be locked from the inside of the exit or alternatively the doors must be provide a fail-safe device that automatically unlocks the door upon the activation of a fire alarm. Doors that are proposed to automatically unlock must also comply with the following requirements:
 - a. on at least every fourth storey, the doors are not able to be locked and a sign is fixed on such doors stating that re-entry is available, or
 - b. an intercommunication system, or an audible or visual alarm system, operated from within the enclosure is provided near the doors and a sign is fixed adjacent to such doors explaining its purpose and method of operation.
 - c. Battery backups must be provided to facilitate a minimum 2-hour operating time of the intercom system in the event of power outage.

Note: Re-entry to station plant areas from within shared exits is not required.
20. The western fire-isolated stair serving the OSD requires occupants to travel within a fire-isolated passageway that is shared with Pitt Street Station before discharging to road and open space – see Figure 16.
21. Not less than two points of firefighter access and egress must be provided to the car stacker fire compartment as illustrated in Figure 19. Walkways with a minimum clear envelop of not less than 800mm wide and 2m high must be provided within the car stacker on level 2 to provide firefighter access such that all car spaces are within 10m and no more than 3 cars from the walkways.
22. The BOH corridor on ground mezzanine and good lift lobby on level 1 must be fire separated as illustrated in Figure 17 and Figure 18 with construction achieving an FRL of not less than -/120/120.
23. The goods lift lobby on level 1 must be provided with an AS 1657 compliant egress ladder to the ground mezzanine level below as illustrated in Figure 18.

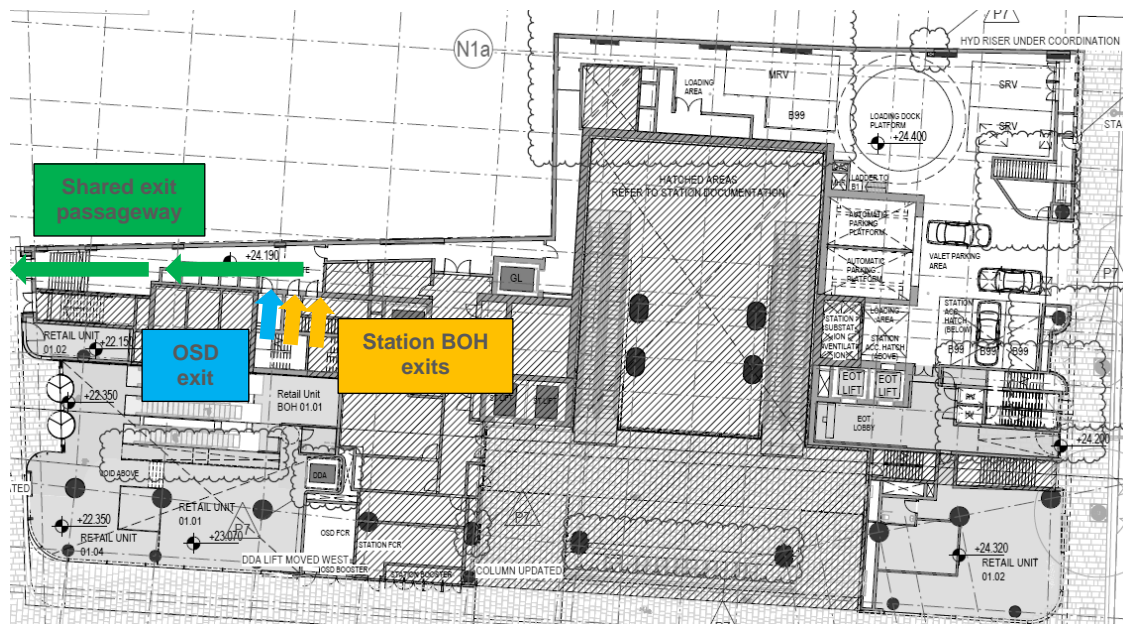


Figure 16 Shared passageway exit discharge at ground level

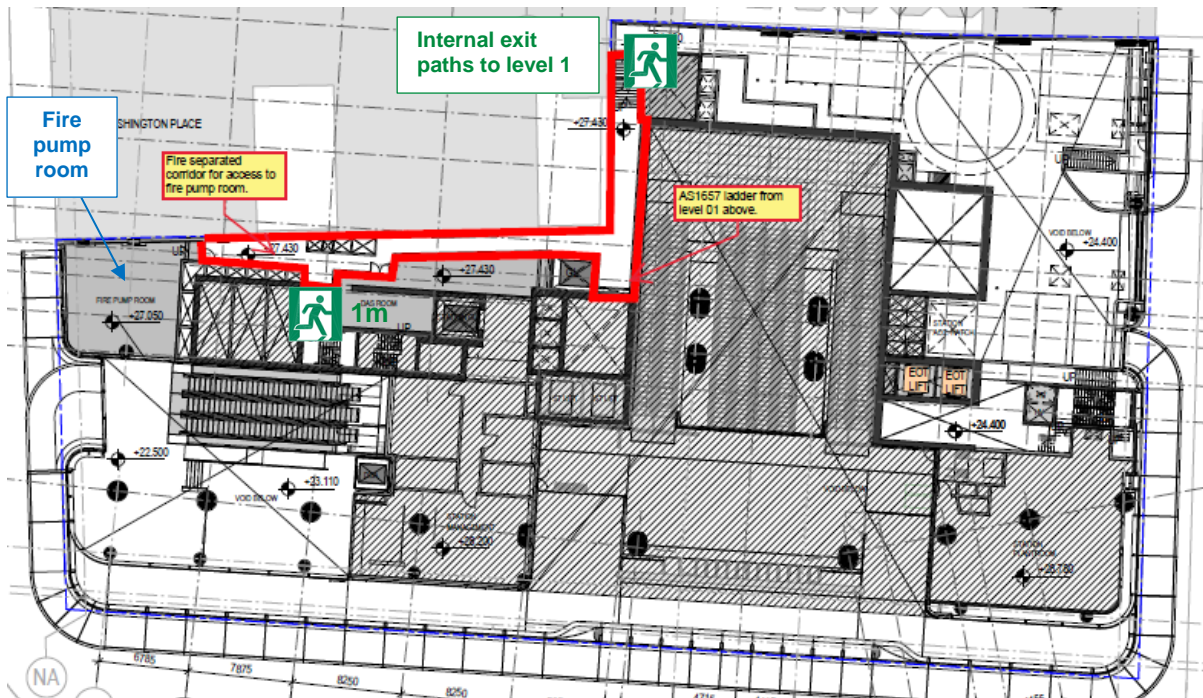


Figure 17 Exits from ground mezzanine including fire separated pump room access

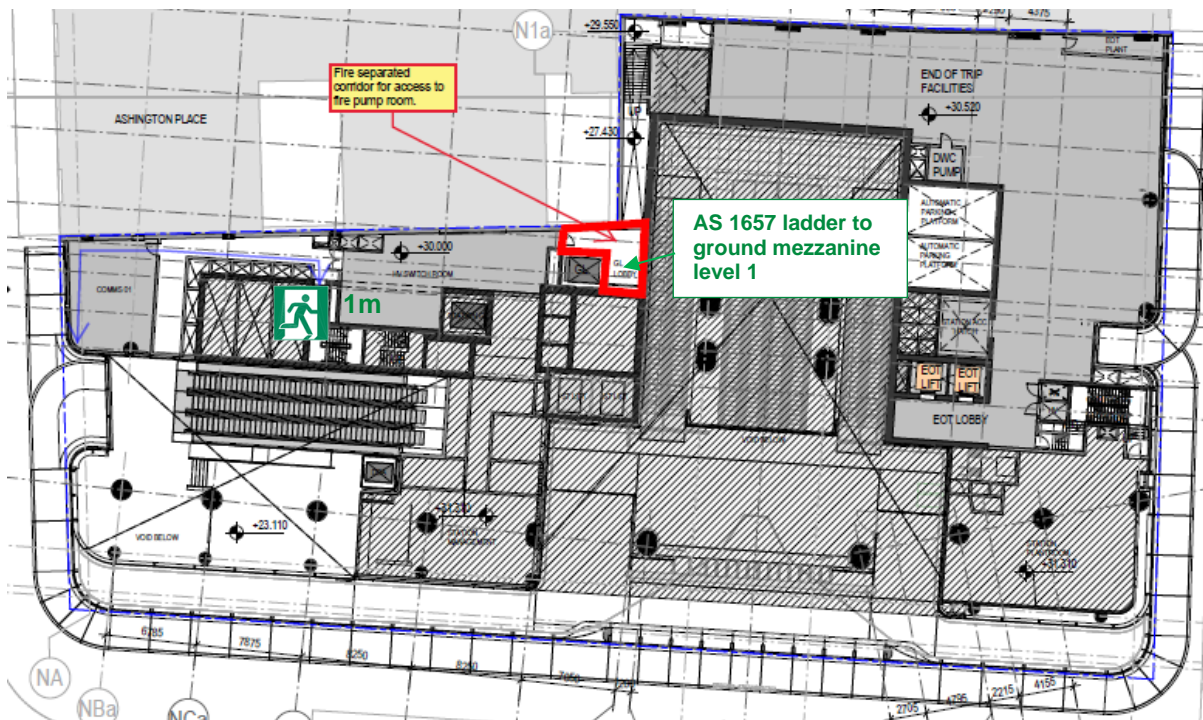


Figure 18 Exits from level 1 plantrooms

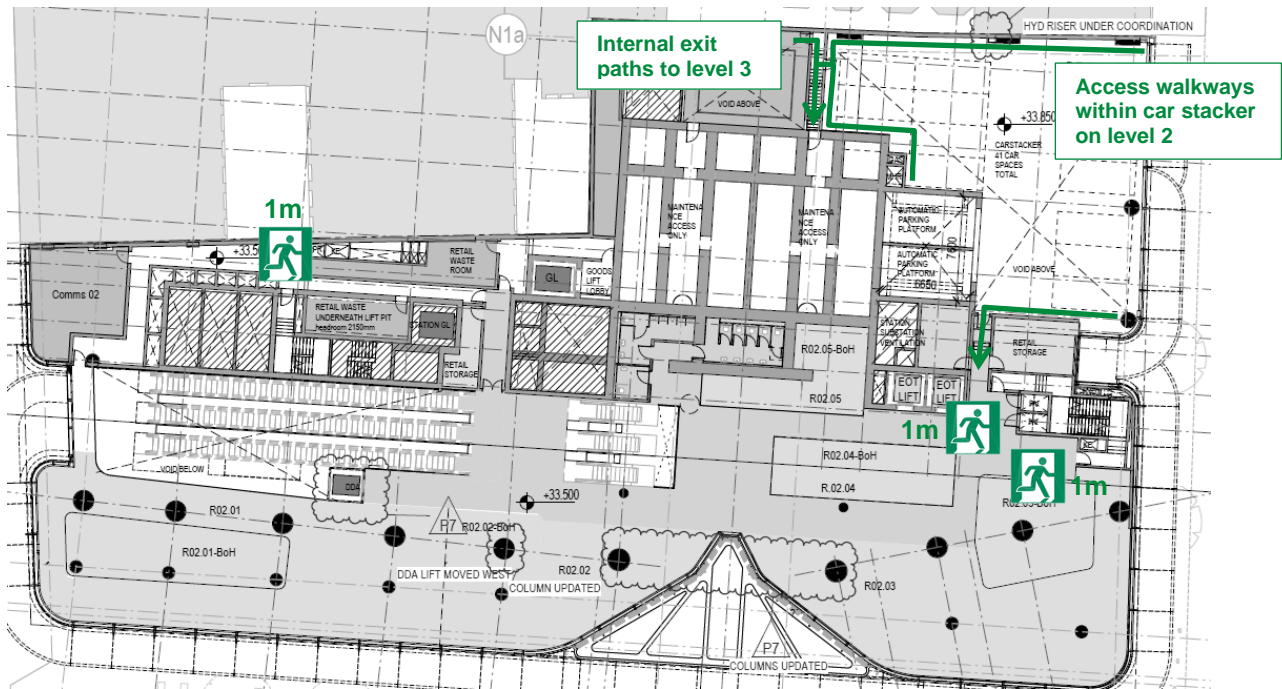


Figure 19 Exits from level 2 retail level including car stacker access

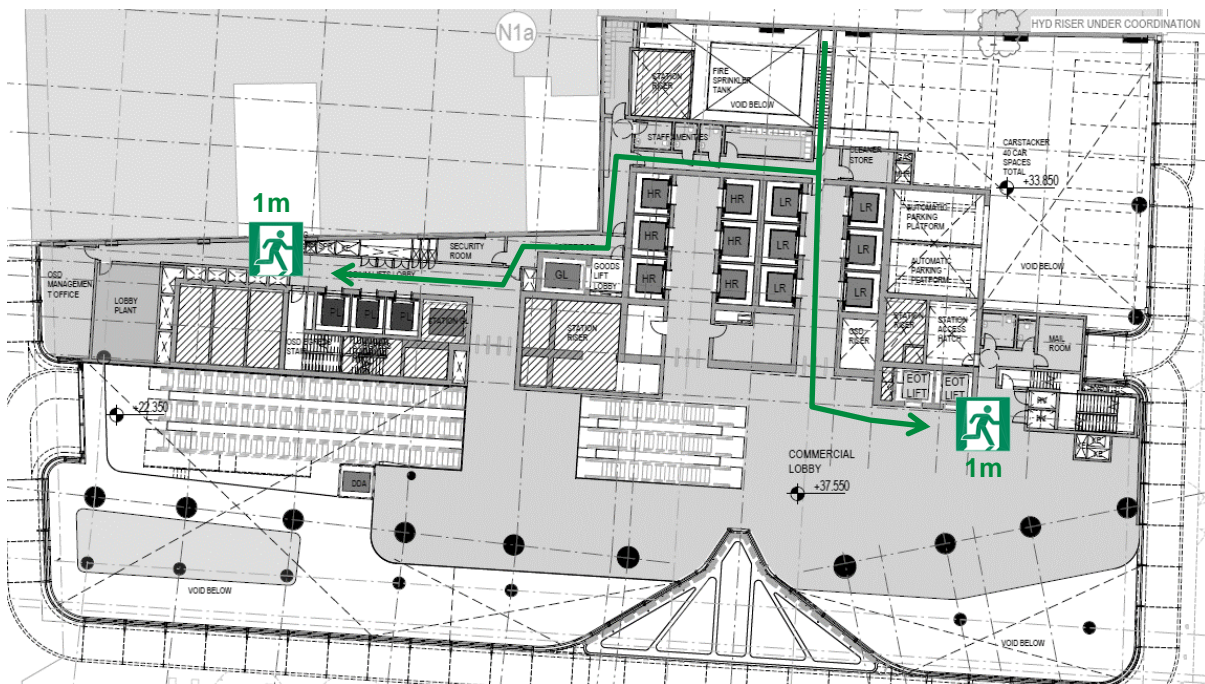


Figure 20 Level 3 discharge of egress stair

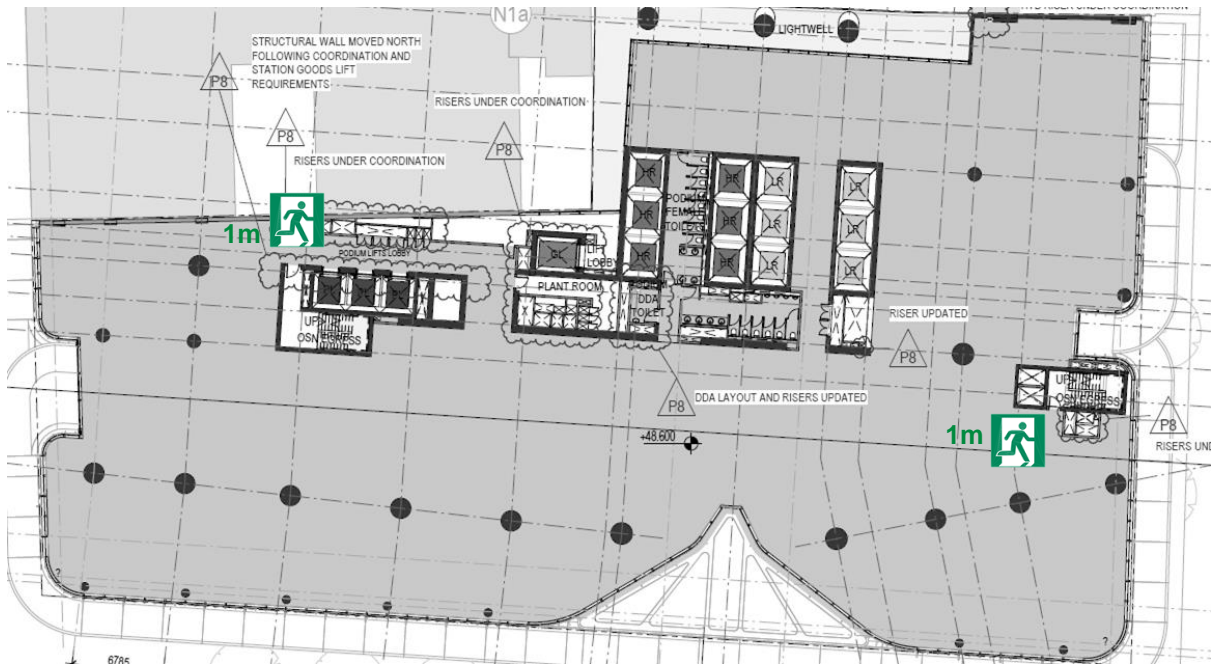


Figure 21 Exits from typical podium level 5-8



Figure 22 Exits from OSD plant level 9

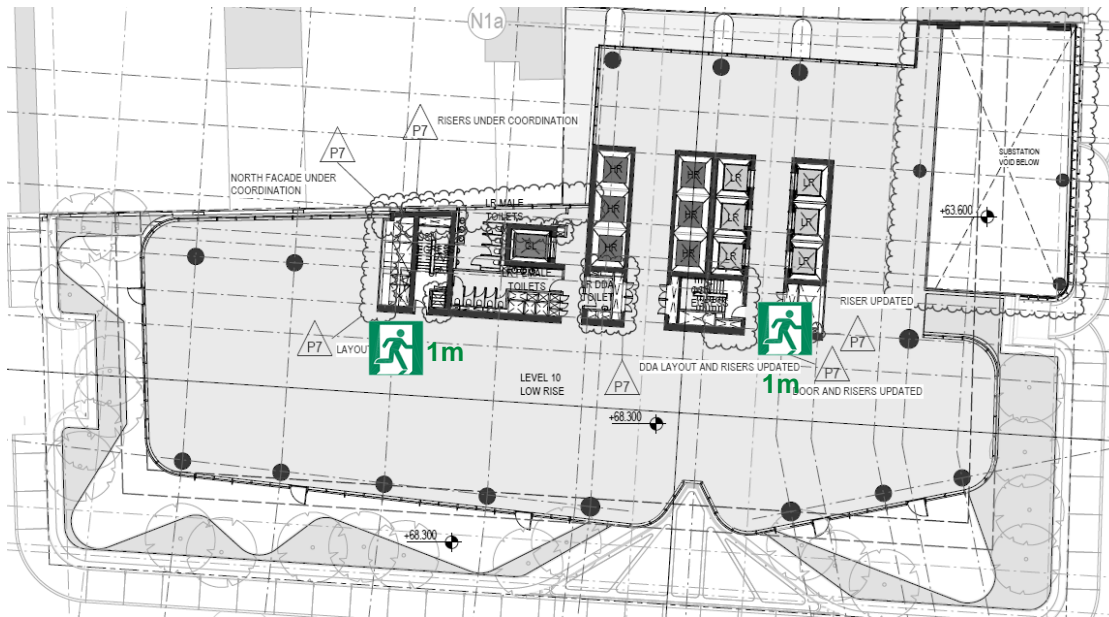


Figure 23 Exits from typical low-rise level



Figure 24 Exits from typical high-rise level

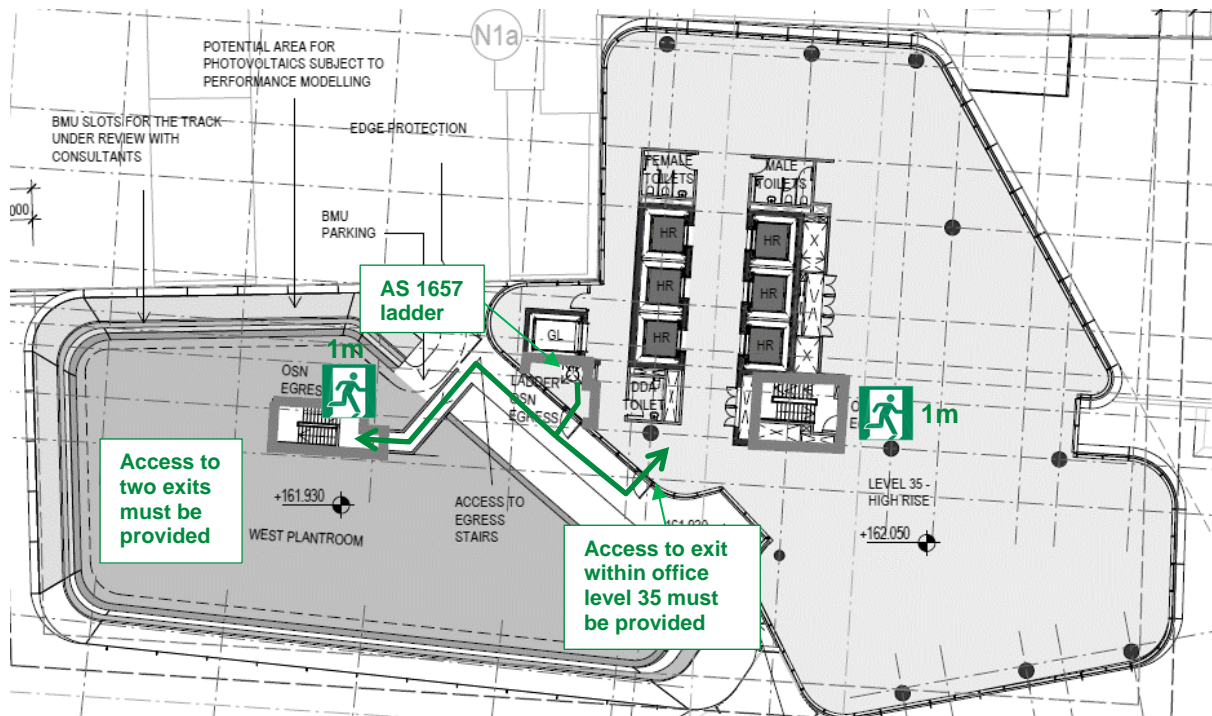


Figure 25 Level 35 discharge of egress ladder

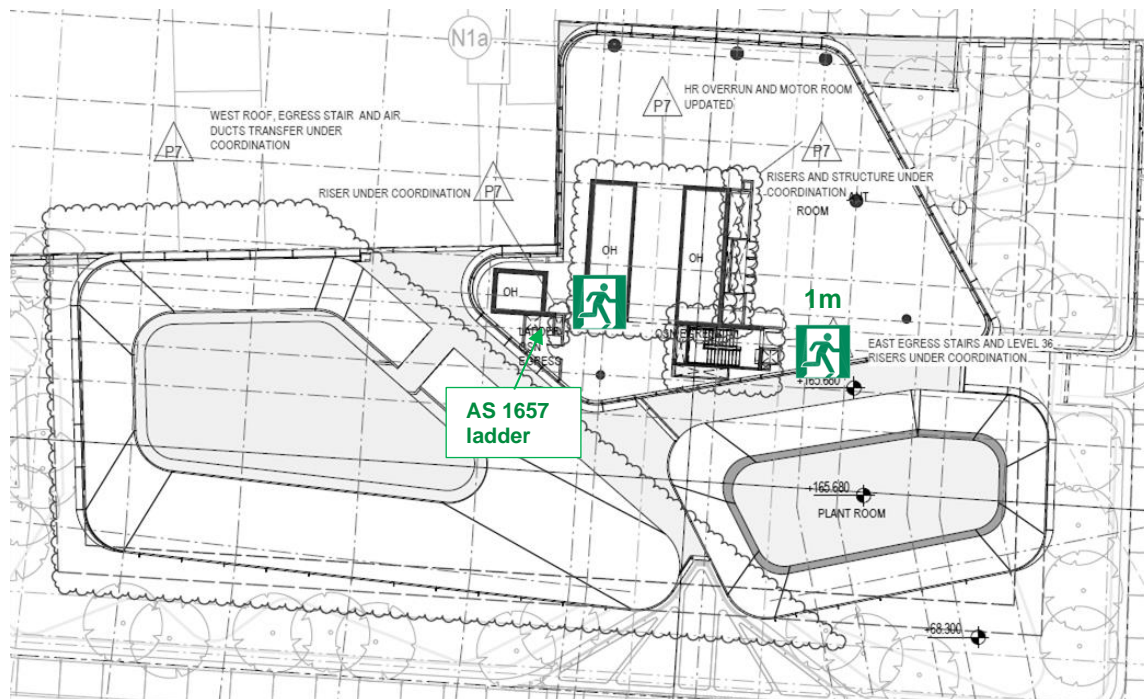


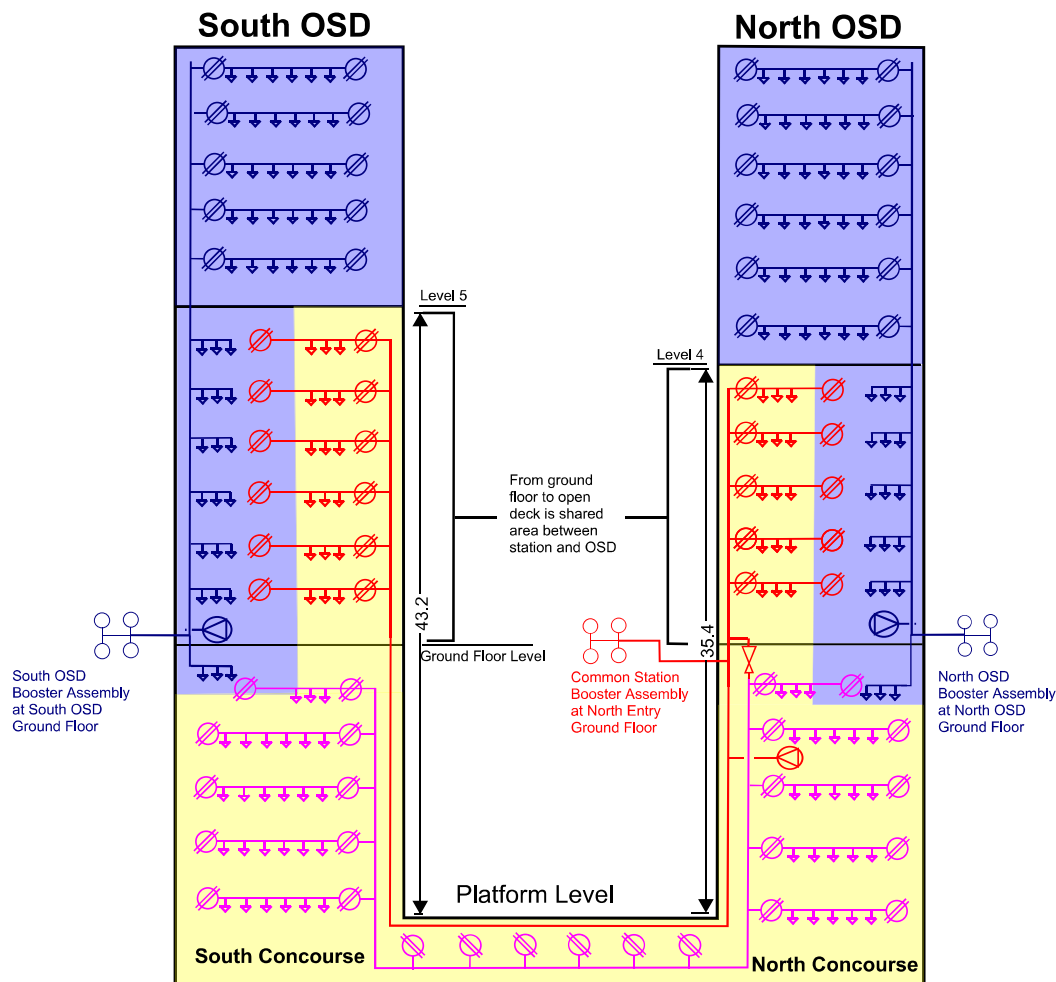
Figure 26 Exits from plan levels 36-37

4.4 Services and equipment

4.4.1 Firefighting systems

24. The wet fire services serving the OSD must be separated from the station systems as shown in Figure 27.

Note: The sprinkler systems for the station and OSD areas are fed from the respective fire systems water supply and boosters, whilst the hydrant system serving the OSD enabling levels B1-L4 is fed from the station fire systems water supply and booster.



Proposed Wet System Demarcation:

Fire Hydrants on podium levels at North and South to be boosted by station boosters. Sprinklers to be fed of OSD ring main and Station ring main independently.

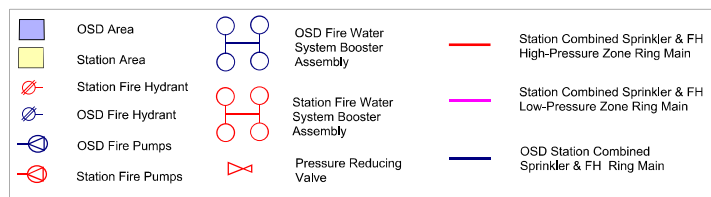


Figure 27 Wet fire services delineation

25. The combined sprinkler and hydrant system must comply with the requirements of AS 2118.1:2017 and AS 2419.1:2017, except where modified by AS 2118.6:2012 or otherwise stated within this report.
26. A fire hydrant system must be installed throughout the building in accordance with clause E1.3 of the NCC and AS 2419.1:2017 including a ring main and the following requirements to meet FRNSW operational requirements for buildings exceeding 135m in height:
 - a. high-rise tank located at or near the top of the uppermost pressure zone
 - b. maximum pressure in the supply pipework is not to exceed 2400kPa.
27. The following requirements are applicable for intermediate on-floor hydrants:
 - a. On-floor fire hydrants must be provided to ensure full coverage of the building including the car stacker based on 30m hose length and 10m spray from the access walkways within the car stacker.
 - b. When working from an internal hydrant, the next additional hydrant should be located not more than 25m from that hydrant. **Note:** To be confirmed. 25m is based on past project requirements from FRNSW.
 - c. Where additional hydrants are provided, floor specific block plans – minimum A3 in size – must be installed adjacent to the internal fire hydrants located within the fire stairs. The purpose of these floor specific block plans is to assist fire-fighters to locate the additional internal hydrants on that level. The floor specific block plans must be permanently mounted and oriented in such a manner so as to reflect the aspect of the installation as it is presented to the reader and be incorporated into the fire safety schedule.
28. The OSD North booster assembly and fire control room locations are illustrated in Figure 28.
29. The fire pump room is proposed to be located on the ground level mezzanine and accessed via a fire separated corridor as shown in Figure 29.

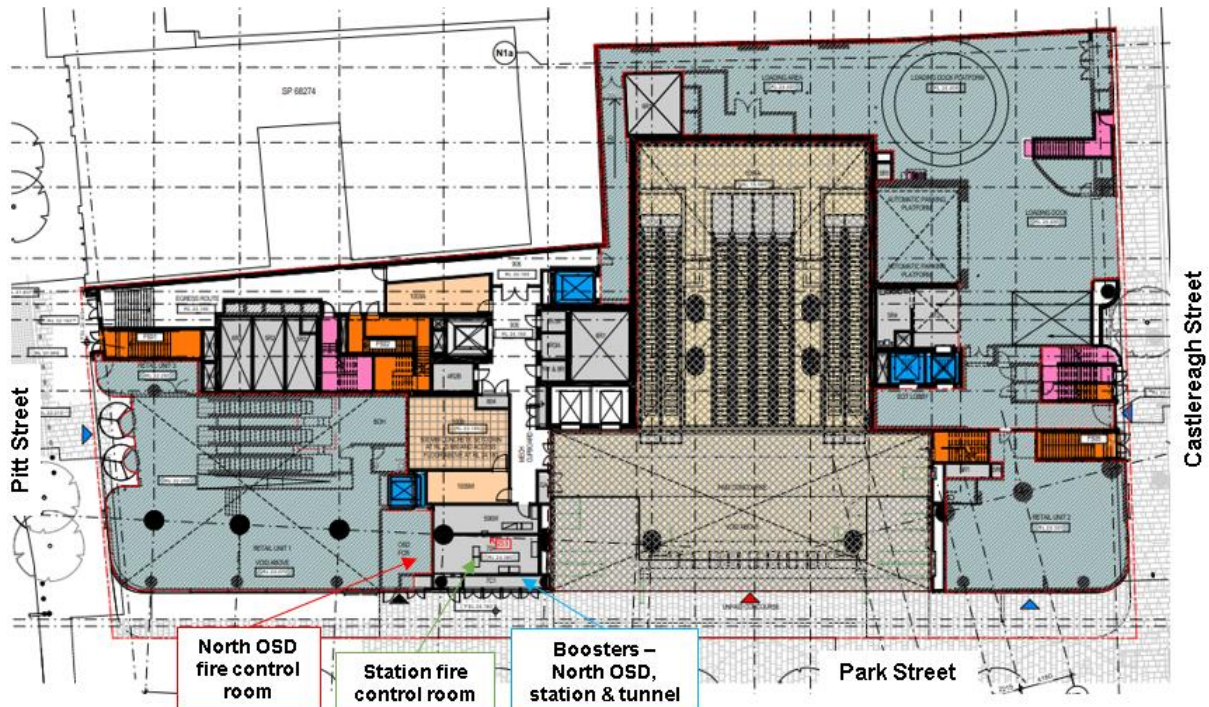


Figure 28 Booster and fire control room locations

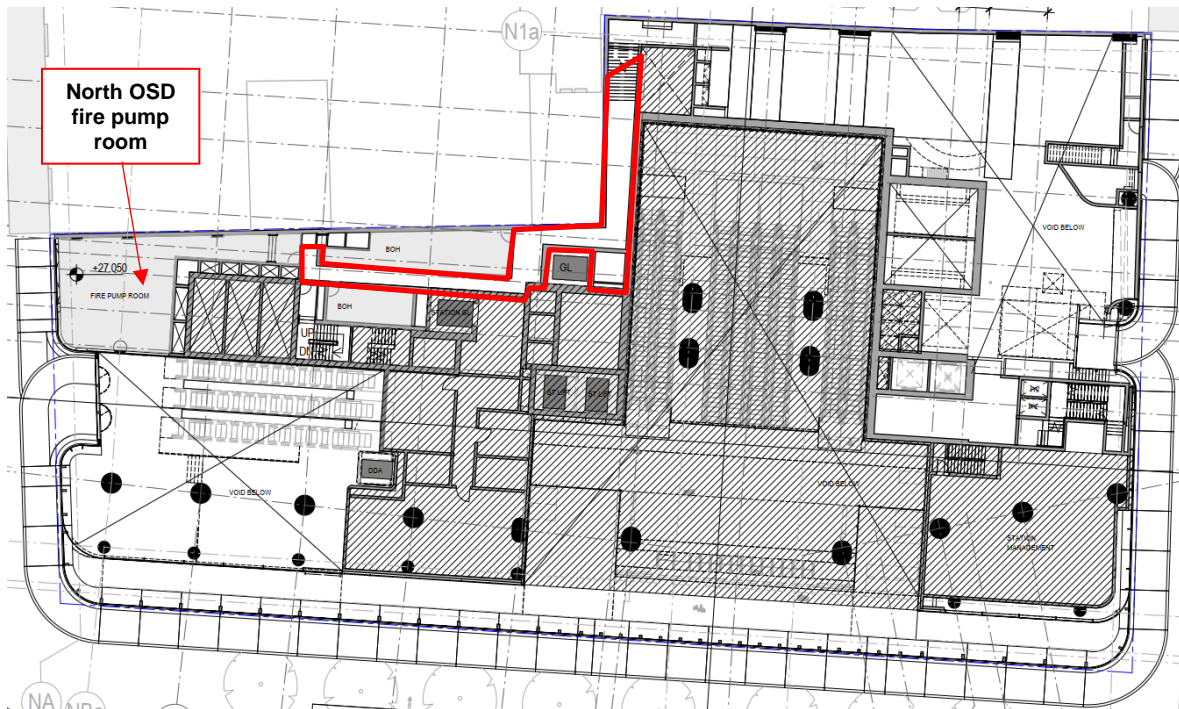


Figure 29 North OSD fire pump room location – ground level mezzanine

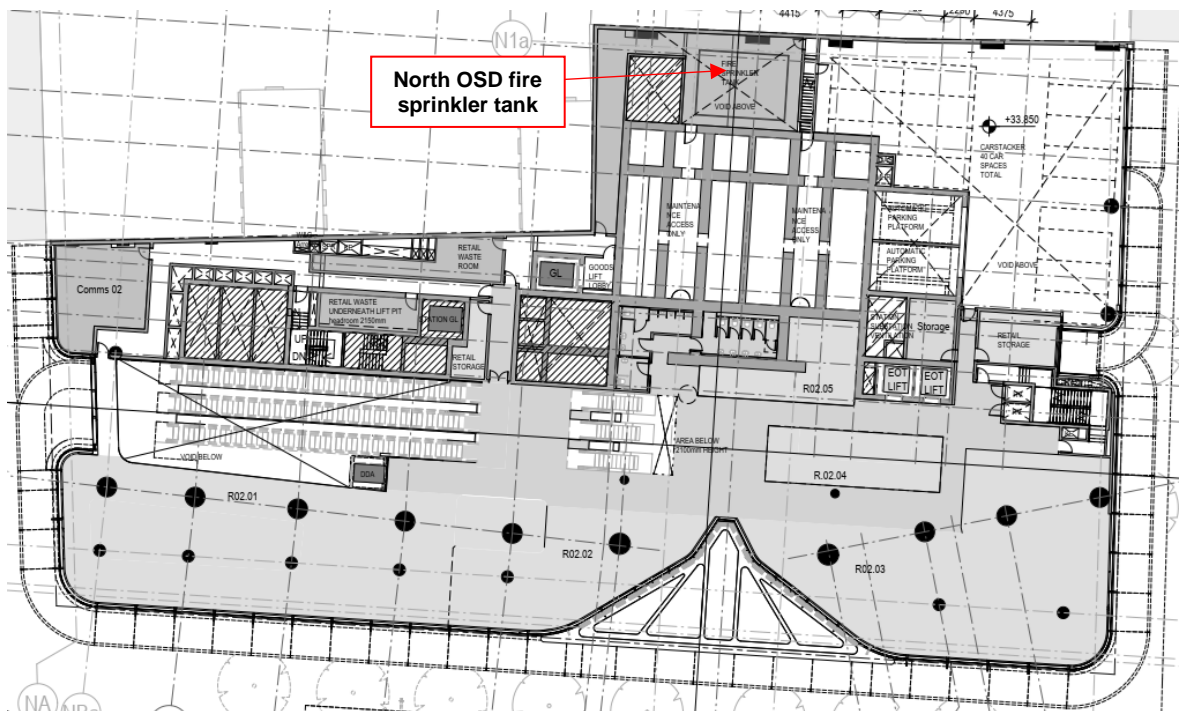


Figure 30 North OSD fire water storage tank location – level 2

30. A fire hose reel system must be installed throughout the building in accordance with clause E1.4 of the NCC and AS 2441:2005. Fire hose reels are not required within car stacker, substation and the commercial office (class 5) areas. Areas without fire hose reels will have portable extinguishers in accordance with the NCC.
31. A sprinkler system must be installed throughout the OSD in accordance with specification E1.5 of the NCC and AS 2118.1:2017 and AS 2118.6-2012. It is noted that the:
 - a. the substation is not sprinkler protected
 - b. station system is designed to AS 2118.1-1999
 - c. station plant areas provided with gas suppression are not provided with sprinklers
 - d. tunnel ventilation plenums are not provided with sprinklers as these are used for smoke exhaust.
32. The sprinkler system must have the following additional characteristics:
 - a. All sprinkler heads must be fast response with an RTI of $50(\text{ms})^{1/2}$ or less except where otherwise required by AS 2118.1:2017.
 - b. Concealed, recessed or flush-mounted sprinkler heads must not be used except where specifically noted in this report as it may delay sprinkler activation. Semi-recessed sprinkler heads are considered acceptable provided they achieve a fast response rating.

Note: Concealed, recessed or flush-mounted fast response sprinkler heads are acceptable in areas with limited / low fire load such as lift lobbies, toilets, change rooms and similar. Subject to review by an appropriately qualified fire safety engineer, the use of flush-mounted heads is also acceptable within other areas of office fitouts – eg circulation corridors / spaces, client floors, areas with feature ceilings etc. A statement of approval from the fire engineer must be included in the as-installed fire services operations and maintenance instruction manuals and referenced on the as-installed fire services drawings.
 - c. Activation temperature of 68°C except where otherwise required by AS 2118.1:2017.
 - d. Activation of the sprinkler system must operate the smoke hazard management systems of that area and activate the emergency warning and intercom systems as appropriate.
 - e. The sprinkler system must be zoned to match the zoning of the smoke hazard management systems.
 - f. Sprinkler valves must be provided to permit each floor to be isolated separately. The intent of this requirement is to prevent large areas of the building being unprotected at any one time.
 - g. The sprinkler system is to be provided with a dual water supply as set-out in specification E1.5 of the NCC and AS 2118.1:2017.
33. Portable fire extinguishers must be provided as listed in table E1.6 of the NCC and within the commercial office (class 5) areas. The extinguishers must be selected, located and distributed in accordance with sections 1, 2, 3 and 4 of AS 2444:2001.

34. A fire control room dedicated to the OSD North tower must be provided at ground level as shown in Figure 28. The fire control room must comply with specification E1.8 of the NCC except that:
 - a. access to the fire control room can be via a single door directly from outside
 - b. access to the fire control room is not required to be adjacent to the main entry to the OSD Tower.
35. In addition to compliance with specification E1.8 of the NCC, the OSD fire control room must contain:
 - a. a slave mimic panel for the Pitt Street station
 - b. visual signals indicating the status of the AVPS system
 - c. signage indicating power isolation procedures and isolation locations for the AVPS
 - d. tactical fire plans showing access to the different parts of the building and key firefighting provisions.
36. Emergency lifts must be provided in accordance with clause E3.4 of the NCC for a building with an effective height of more than 25m.

4.4.2 Smoke hazard management

37. The dry fire services serving the OSD must be separate from the station systems.
38. An addressable fire and smoke detection system in accordance with specification E2.2a of the NCC and section 7 of AS 1670.1:2018 must be provided on the OSD enabling levels and throughout the OSD North. In addition, the following shall be provided:
 - a. At least one detector shall be provided in every room, except smoke detectors are not required in kitchens and other areas where the use of the area is likely to result in smoke detectors causing spurious signals
 - b. Smoke detectors located below ceiling level must be arranged as follows:
 - The distance from any point of the soffit of the protected area to the nearest detector does not exceed 7m. Ceiling pockets created by beams and other ceiling geometry such as ducts, bulkheads and the like need not be considered.
 - The distance from any detector and the nearest detector to it shall not exceed 10m.
 - The distance from the nearest row of detectors to any wall or partition shall not exceed 5m or be less than 300mm
 - c. Activation of the detection within the car stacker shall automatically initiate a controlled shutdown of the AVPS. The AVPS shall not automatically restart when the fire panel is reset. Reactivation of the AVPS must only be via manual operation from the control panel by a trained authorised person.
 - d. If safe to do so, the vehicle lift shall return to the level of firefighter access on level 2 to serve as void fall protection for firefighters.
 - e. Visual signals shall be provided at the designated firefighter access points to the car stacker and within the FCR. These visual signals should indicate the status of the system, eg 'vehicle parking system operating' / 'vehicle parking system isolated' and 'electrical system live' / 'electrical system isolated'.

Note: Station system is designed to 2015 version and OSD systems 2018 as referenced by the respective applicable NCC edition.

39. Smoke detectors required to activate air pressurisation systems for fire-isolated exits and zone smoke control systems must:
 - a. be installed in accordance with AS 1670.1:2018, and
 - b. have additional smoke detectors installed adjacent to each bank of lift landing doors set back horizontally from the door openings by a distance of not more than 3m.
40. All air-handling systems capable of recycling air between the fire compartments must be provided with smoke dampers where the air handling ducts penetrate any elements separating the fire compartments served in accordance with clause E2.2 of the NCC. The system must be arranged such that the air-handling system is automatically shut down and the smoke dampers close by smoke detectors complying with clause 7.5 of AS 1670.1:2018.
41. The following preliminary smoke exhaust strategy is proposed for OSD North:
 - a. Ground floor
 - (i) Smoke baffle / smoke curtain between the ground floor retail tenancy and the escalator void to level 2 down to 3m above lowest floor level.
 - (ii) 20m³/s high level smoke exhaust within the ground floor retail tenancy discharging directly to the outside beyond the external façade.
 - (iii) 12m² passive make-up air via entry doors.
 - (iv) Management procedures to ensure the use of the ground floor retail tenancy is restricted to a café / restaurant with kitchen areas located in a smoke separated room underneath the escalators.
 - (v) Management procedures to ensure no fuel load is located in front of the escalators.
 - b. Level 2
 - (i) Level 2 ceiling void smoke sealed below the level 3 slab edge to create a reservoir ~750-800mm deep with a >50% perforated ceiling.
 - (ii) 27m² passive make-up air via openable louvres on the west, south and east façades evenly distributed on level 2 between 1.51-3m AFFL.
 - c. Level 3
 - (i) Full height smoke separation at the level 3 slab edge to the underside of the level 4 slab, eg 6mm toughened glazing.
 - (ii) Concertina smoke curtain around the level 3 escalator void down to the level 2 slab.
 - (iii) 2 x 15-20m³/s high level smoke exhaust within the level 2 double height space – ie below the level 4 slab.

Note: Smoke hazard management requirements will be confirmed following detailed modelling and assessment in the fire engineering report.

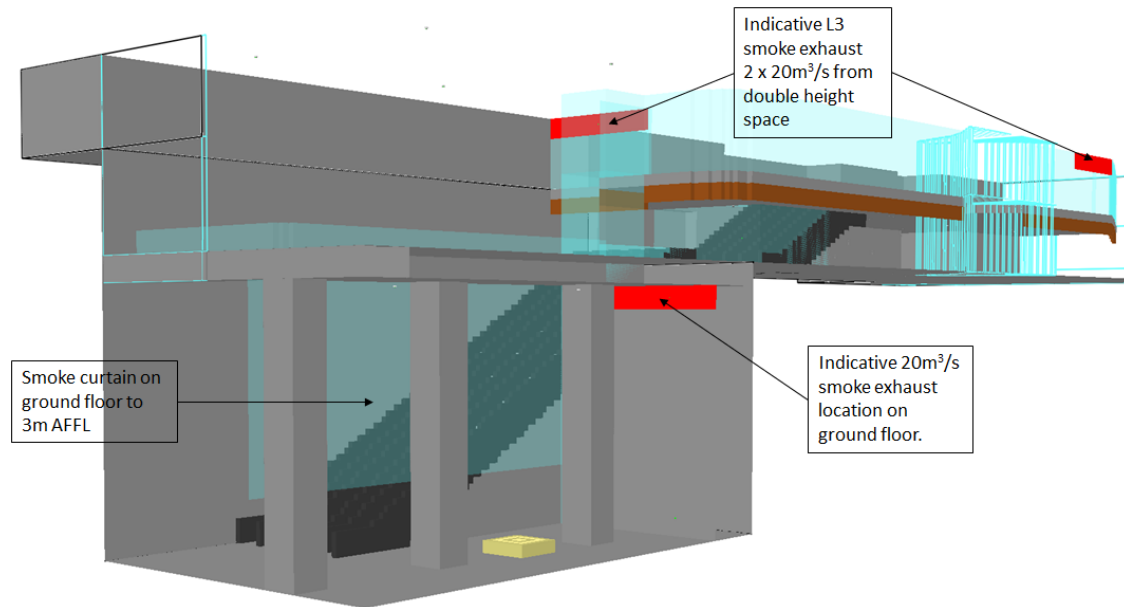


Figure 31 Indicative location of smoke control measures – ground floor view

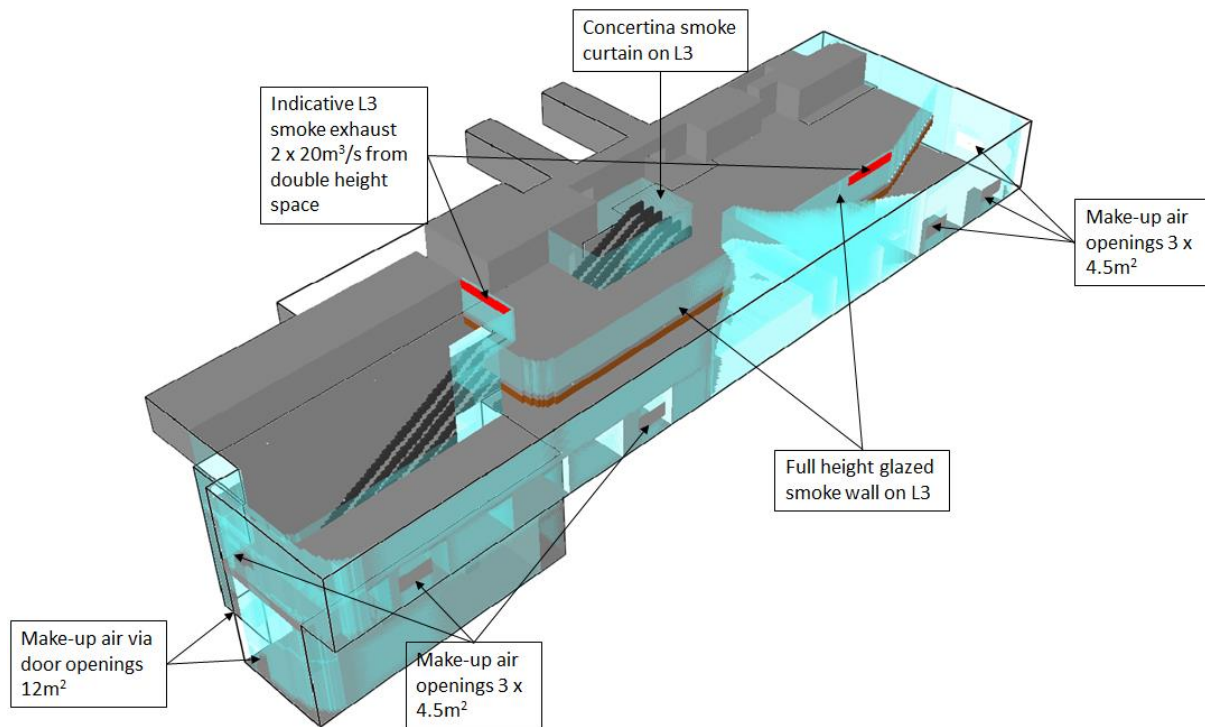


Figure 32 Indicative location of smoke control measures – level 2-3 view

42. All fire-isolated stairs, passages and lobbies must be provided with a stair pressurisation system where required by table E2.2a of the NCC and in accordance with AS 1668.1:2015 except for the stair flight serving basement level 01 which connects to the OSD Tower stair at ground level.
43. Zone smoke control is proposed to be omitted on the station areas and OSD enabling levels basement level 1 to level 4. Levels 5-35 above the OSD enabling levels are required to be provided with a zone smoke control system in accordance with clause E2.2 of the NCC and AS 1668.1:2015. The pressurisation system must achieve a positive pressure differential of not less than 20Pa compared to the OSD enabling levels in the event of a fire on any level below level 5.
44. Smoke lobbies must be provided between high fire load areas and lift shafts which connect to the OSD towers in areas where zone smoke control is being omitted and a 20Pa pressure cannot be provided from non-fire affected areas.

Note: It is understood that the North tower can achieve a positive pressure differential of not less than 20Pa compared to the OSD enabling podium levels and hence not require smoke lobbies.

4.4.3 Emergency lighting, exit signs and warning systems

45. An emergency lighting system must be installed throughout the building in accordance with clauses E4.2 and E4.4 of the NCC and AS 2293.1:2018.
46. Exit signs and directional signs must be installed throughout the building in accordance with clauses E4.5, E4.6 and E4.8 of the NCC and AS 2293.1:2018.
47. An emergency warning and intercom system (EWIS) complying with clause E4.9 of the NCC and AS 1670.4-2018 must be installed throughout the building.
 - a. The emergency warning system must be audible through all occupied areas of the building including external areas where evacuation back into the building is required.
 - b. Additional visual signals must be provided to augment the audible emergency evacuation signal if the background noise exceeds the limit under the standard – eg in plant rooms.

Note: Station system is designed to 2015 version and OSD systems 2018 as referenced by the respective applicable NCC edition.

48. The zoning and cascading of the station and OSD North EWIS systems will be developed in consultation with Sydney Metro to mitigate adverse impact on the train operations in the event of a fire alarm in the OSD North tower. A draft EWIS cascading strategy is provided in Appendix C.

4.5 Fire safety during construction

49. During construction after the building has reached an effective height of 12m, the required fire hydrants and fire hose reels must be operational in at least every storey that is covered by the roof or the floor structure above except the two uppermost storeys, and any required booster connections must be installed – in accordance with clause E1.9 of the NCC.

4.6 Commissioning of fire safety strategy

50. The building work and fire safety measures relating to the performance solution report must be inspected by an appropriately qualified fire safety engineer prior to occupation to confirm that the holistic performance is consistent with these requirements. Detailed inspections and commissioning tests for the building fire safety systems will need to be undertaken separately by the relevant consultants and/or installers.

5. Review of conditions of consent

5.1 Separation of fire systems

The OSD tower and Pitt Street station are to be treated as separate buildings and will not share the same facilities and plant rooms. Fire services to the OSD tower and Pitt Street station will generally be separated including:

- a. Water storage tanks
- b. Fire pump rooms
- c. Fire hydrant booster assemblies
- d. Fire control rooms
- e. Fire detection and occupant warning systems – common occupant warning throughout the floors will utilise both systems.
- f. Sprinkler suppression systems
- g. Fire hydrant systems – OSD enabling levels up to and including level 4 in the OSD North tower are proposed to form part of the station fire hydrant system and boosted from the northern station entry.

Note: The separation of the fire services was discussed with FRNSW on 10/12/2019 and is currently under development and subject to further consultation as requested by FRNSW.

5.2 Pedestrian connection interfaces

The OSD tower has no direct connection with the station and will be fire separated from the station to mitigate the impact of fire in either building.

Egress stairs serving the public areas of the station will be separate from the OSD tower stairs. Station areas which share egress stairs with the OSD tower are limited to back-of-house plant areas which have low fire risk and low occupant load to ensure minimal impact on the OSD tower evacuation capacity.

Smoke hazard management systems are generally separate between the station and OSD tower with the shared stairs served by the OSD stair pressurisation systems.

5.3 Fire and life safety systems

As detailed in section 4, a concept fire and life safety (FLS) strategy has been developed for the station OSD enabling levels and the OSD tower to confirm the adequacy of the fire and life safety systems within the Pitt Street Metro site in relation to the fire hazards of the Sydney Metro.

5.4 Design of fire hydrant system for OSD

The fire hydrant designer LCI have confirmed that the fire hydrant system for the OSD North tower will be provided with a high-rise level water tank with three above-ground pressure zones and the supply pressures do not exceed 2400kPa. Refer to schematic in Appendix C.

5.5 FRNSW consultation

Consultation has been undertaken with FRNSW in relation to the interface between the Pitt Street Station and the OSD North and South was undertaken on 10/12/2019 and 5/2/2020 – refer to minutes in Appendix B.2.

Additional consultation with FRNSW is ongoing and will be incorporated as part of the construction issue documentation. This includes finalisation of the separation of fire services between the station and OSD tower.

6. Conclusion

As detailed in this report, the development of the OSD tower concept design has considered the specific nature and fire hazards associated with the Sydney Metro integrated development site and it is possible to develop performance solutions for the issues identified to demonstrate compliance with the relevant performance requirements of the NCC without major changes to the proposed OSD tower design.

The details of the proposed performance solutions are subject to the outcome of the fire engineering brief and analysis which will be carried out generally in accordance with the International Fire Engineering Guidelines (IFEG).

The performance solutions for the building will be developed as part of the ongoing design and development process and documented in a format suitable for submission to the relevant approval authorities. It is noted that additional performance solutions may be identified during the ongoing design development process in consultation with the design team.

Appendix A Drawings and information

Drawing title	Dwg no	Date	Drawn by
General arrangement plan - Ground level	SMCSWSPS-FOS-OSN-AT-DWG-930013	19/3/2020	Foster + Partners
General arrangement plan - Ground level mezzanine	SMCSWSPS-FOS-OSN-AT-DWG-930014	19/3/2020	Foster + Partners
General arrangement plan - Level 01	SMCSWSPS-FOS-OSN-AT-DWG-930113	19/3/2020	Foster + Partners
General arrangement plan - Level 02	SMCSWSPS-FOS-OSN-AT-DWG-930213	19/3/2020	Foster + Partners
General arrangement plan - Level 03	SMCSWSPS-FOS-OSN-AT-DWG-930313	19/3/2020	Foster + Partners
General arrangement plan - Level 04	SMCSWSPS-FOS-OSN-AT-DWG-930413	19/3/2020	Foster + Partners
General arrangement plan - Level 05	SMCSWSPS-FOS-OSN-AT-DWG-930513	19/3/2020	Foster + Partners
General arrangement plan - Level 06	SMCSWSPS-FOS-OSN-AT-DWG-930613	19/3/2020	Foster + Partners
General arrangement plan - Level 07-08	SMCSWSPS-FOS-OSN-AT-DWG-930713	19/3/2020	Foster + Partners
General arrangement plan - Level 09	SMCSWSPS-FOS-OSN-AT-DWG-930913	19/3/2020	Foster + Partners
General arrangement plan - Level 10	SMCSWSPS-FOS-OSN-AT-DWG-931013	19/3/2020	Foster + Partners
General arrangement plan - Level 11	SMCSWSPS-FOS-OSN-AT-DWG-930113	19/3/2020	Foster + Partners
General arrangement plan - Level 12	SMCSWSPS-FOS-OSN-AT-DWG-930213	19/3/2020	Foster + Partners
General arrangement plan - Level 13-20	SMCSWSPS-FOS-OSN-AT-DWG-931313	19/3/2020	Foster + Partners
General arrangement plan - Level 21	SMCSWSPS-FOS-OSN-AT-DWG-931313	19/3/2020	Foster + Partners
General arrangement plan - Level 22	SMCSWSPS-FOS-OSN-AT-DWG-932313	19/3/2020	Foster + Partners
General arrangement plan - Level 23 - 33	SMCSWSPS-FOS-OSN-AT-DWG-932313	19/3/2020	Foster + Partners
General arrangement plan - Level 34	SMCSWSPS-FOS-OSN-AT-DWG-933413	19/3/2020	Foster + Partners
General arrangement plan - Level 35	SMCSWSPS-FOS-OSN-AT-DWG-933513	19/3/2020	Foster + Partners
General arrangement plan - Level 36	SMCSWSPS-FOS-OSN-AT-DWG-933613	19/3/2020	Foster + Partners
General arrangement plan - Level 37	SMCSWSPS-FOS-OSN-AT-DWG-933713	19/3/2020	Foster + Partners
General arrangement plan - Level 38	SMCSWSPS-FOS-OSN-AT-DWG-933813	19/3/2020	Foster + Partners
General arrangement plan – Basement 01 level	SMCSWSPS-FOS-OSN-AT-DWG-939513	19/3/2020	Foster + Partners

Report title	Report reference	Date	Prepared by
Building Code of Australia 2019 report for SSDA submission – Proposed commercial development – Pitt Street metro over station development north	SMCSWSPS-PCH-OSN-PL-REP-000001 - Revision A	20/3/2020	Philip Chun Building Code Consulting

Appendix B FRNSW consultation

B.1 Stage 1 – 20/9/2017

The following meeting minutes have been extracted from the Design stage 1 FEB report prepared by Metron³ and are provided for background information.

6.2 Summary of Consultation Undertaken and any Agreements Achieved

6.2.1 Stations and Services - Meeting Minutes for Fire Brigade Consultation

Strategy

The strategy for fire brigade consultation involves consultations performed by METRON, TSOM, the unsolicited proposal organisation and CSM (Central). Joint consultations will facilitate a streamlined and cohesive consultation process and will achieve effective fire brigade response and engagement. Separate consultations have been also performed by each organisation.

The appended minutes are in reference to the meeting with FRNSW to present the METRON FLS strategy.

Date

The meeting was held at Fire Rescue NSW headquarters on Wednesday 20th September 2017.

Attendance:

³ Metron, Fire Engineering Brief – Stage 1 design Underground Stations Design & Technical Services, NWRLSRT-MET-SRT-FL-REP-000003 rev P10 dated 20 July 2018

- Mark Castelli – FRNSW
- Matthew Rowley – FRNSW
- Andy Tam – MTR
- David Sweetman – METRON
- Elliott Vercoe – METRON
- Roger Blackwell – TfNSW
- Shaohua Xia – FRNSW
- Patrick NG – MTR
- Will Marshall – METRON
- Geoff Pearce – METRON

Minutes:

1. TfNSW explained intent of meeting was to introduce METRON and the basis of fire safety design of their stations and service buildings.
2. TfNSW presented 4 copies of the tunnel alignment drawings, from Chatswood to Sydenham for reference throughout the project briefings and discussions.
3. METRON explained the limitation of areas associated with their works and interface needed to both linewise, as well as Martin Place and Central stations
4. METRON identified –
 - a. Each station to have Fire Control Room, generally at surface
 - b. Sprinkler booster, station hydrant booster and tunnel hydrant booster at each station
 - c. all travel distances and egress times will be demonstrated by Fire Engineering, with ASET/RSET calcs and modelling.
 - d. All escalators will be on essential supplies with those running in direction of egress to be maintained, those travelling towards the incident will slow to stop.
 - e. All lifts are stretcher lifts and also on essential supplies, with UPS for homing.
 - f. All plant rooms are fire separated.
 - g. Over Station Development will be designed by Others, but all OSD areas will be fully fire separated. All OSD areas will be fitted-out separately as a part of that development. No services will be shared, separate fire water supplies and boosters, separate FCR, egress and other provisions.
5. METRON presented stations as being of 2 types, –
 - a. Cut and Cover – Crows Nest; Barangaroo; Waterloo - all with Island platforms and having an enclosed, pressurised scissor stair at each end
 - b. Cavern – Victoria Cross; Pitt Street (also includes Martin Place, but that station is designed by Others.) – all with separate caverns per platform and interconnecting adits to centralised egress routes having escalators and an enclosed, pressurised scissor stair at each end.
6. Barangaroo Station was discussed –
 - a. Unusual escape stair arrangements in Pods at street level, with ground level egress facilities still under development.
 - b. Underground connection to future shopping centre – to be separated by a fire shutter.
7. Victoria Cross Station was discussed –

- a. Deep station, with lifts and stairs at one end, escalators lifts and stairs at other.
 - b. Ground level to form a breezeway, allow natural smoke venting – FRNSW noted the detailed design at Chatswood demonstrated the need for smoke modelling to be undertaken with wind analysis.
8. Pitt Street Station was discussed –
- a. Cavern station with 2 separate OSD towers, ground level wraps around Edingburgh Castle Hotel.
 - b. Separate FCR and FIP for towers and station, with interlink for information
 - c. Shared egress stairs from above ground areas shared, i.e. car park and service rooms. FRNSW queried the clarity of direction and separation between areas especially if their access opposes direction of general population's egress.
9. METRON presented an outline of their FEB, which included Over Station Development Transfer levels, but excludes the OSD as such. METRON confirmed:
- a. clarified that Metro boosters would comprise separate Tunnel and Station systems, with the Tunnel boosters to be separate for tunnels each side of the station. OSD boosters are to be completely separated from Metroboosters.
 - b. clarified that the NFPA standards and ASA standards are considered reference documents only and are not mandated.
 - c. identified that platform/train evacuation scenarios were based on a single missed headway to both up and down track for both design and high challenge events, using AW4 loadings, SFAIRP principles will be adopted for Extreme cases.
 - d. confirmed 10MW train fires are assessed for structural integrity, but smoke control and egress assessments are limited to 3MW as fire growth beyond this would be after evacuation completed.
 - e. Concourse smoke exhaust is generally provided with a dedicated exhaust system (with the exception of Pitt Street). Station entrances are provided with natural ventilation.
 - f. Egress provisions are generally based around 2 x 2m wide fire separated paths at each end of the platforms, with a total of 8 wheelchair refuges within the stairwell.
 - g. Pedestrian modelling has been performed to demonstrate maximum of 8 minutes queue time, with ASET/RSET calcs to support this
10. FRNSW queried the assessments performed for bomb threat evacuation. It was discussed that this is currently not included, but given the increased terrorist threat, could be included within the next design phase if instructed by TfNSW.
11. FRNSW queried the inclusion of fare gate opening and Opal card instructions during evacuation, as recent example at Wynyard station demonstrated delays as passengers attempted to "tap-off" despite the Opal system being shut down during the evacuation. TfNSW to review arrangements and potential for messages with the Operator – currently represented by MTR.
12. FRNSW queried Stabling areas and how doors would be opened during an incident at the stabling. TfNSW to review arrangements and potential for messages with the Operator – currently represented by MTR.
13. FRNSW advised that from the broad overview of the preliminary station designs presented there didn't appear to be any issues of major concern at this stage of the design phase. Notwithstanding, FRNSW advised that further assessment of the submitted drawings may identify issues that may be of concern and need resolution.

14. Post meeting comment: FRNSW advised that once the station designs progress to the final detailed stages and further consultations are undertaken, there is potential for design issues to arise that may be of concern to FRNSW with regard to fire and life safety or detrimentally impact FRNSW firefighting operations. As per previous infrastructure stakeholder engagement and protocol, FRNSW will welcome engagement with the project's design team to work through any issues of concern to achieve safe and satisfactory resolutions.

6.2.2 RCD - Meeting Minutes for Fire Brigade Consultation

Strategy

The strategy for fire brigade consultation involves presenting FRNSW with the concept of the RCD and outlining the preliminary FLS strategy, and key considerations involving the development.

The appended minutes are in reference to the meeting with FRNSW to present the METRON FLS strategy.

Date

The meeting was held at Fire Rescue NSW headquarters on Tuesday 9th January, 2018.

Attendance:

- Mark Castelli – FRNSW
- Ben Hamilton - FRNSW
- Elliott Vercoe – METRON
- Roger Blackwell – TfNSW
- Will Marshall – METRON

Minutes:

1. WM Introduced the concept of the RCD, and outlined the FLS scope in relation to the undercover deck.
2. MC queried whether vehicle access would be provided above the deck. RB explained that above the deck is still concept design and is to undergo development.
3. RB mentioned that a precinct wide water storage system will introduce delineation concerns due to sharing of services between an infrastructure project and private development. BH mentioned that maintenance will require coordination. RB confirmed this strategy has not yet been resolved but will need to be considered in future development.
4. WM outlined the fire safety strategy as shown in the attached presentation.
5. MC queried the exclusion of sprinklers to the trackways beneath the deck. WM and RB mentioned the occupants were at risk of electrocution, the height of the space, and the train body providing protection from sprinkler suppression.
6. RB noted the difficulty of implementing egress paths. The egress cannot be like Tallawong Road Stabling Facility, as there are no drop down egress paths running beneath the tracks.
7. Upon conclusion of the presentation, MC was asked if there were any immediately concerning items. MC responded that the main thing to comment on would be the exclusion of sprinklers. MC also noted the potential for sharing the water tanks with the above RCD

development will be problematic; RB and WM noted this will need to be considered as part of the over deck works

8. BH asked about the water pump arrangement. WM explained that we have a combined system, and showed the location of the pumps and water tanks.
9. MC asked whether a concrete is readily available which achieves the FLS requirements for the linewide tunnels. WM confirmed it is being used on Westconnex, and that it is available.
10. MC mentioned he is more concerned regarding vehicle access for the oversite development, however understands this has not yet been developed.
11. Re: fire rated slab. RB mentioned that there is not significant support to reduce the 240/240/240 fire curve. WM explained we have currently allowed for a 240 minute fire rating against the RABT fire curve, but are considering a reduction to 240 minutes against the 'standard' cellulosic fire curve as the RCD space isn't of such an enclosed nature for the RABT fire curve to be considered realistic. RB mentioned this could be explored.
12. MC asked regarding the hydrant 60 m hose spacing with 1 m into the train. WM confirmed these will be available as in the regular stabling yard. RB confirmed stabling hydrants are above ground twin-outlet hydrants.

B.2 Stage 2 – 5/2/2020

Warringtonfire Suite 802 Lvl 8, 383 Kent St
ABN: 81 050 241 524 Sydney NSW
P: 02 9211 4333 2000 Australia

Time 8am – 9.30am

Date 05/02/2020

Job no SY180170

Issued 07/02/2020

Project Pitt Street Station

Meeting minutes

Attendees	Role	Organisation
Michael Gleeson	Fire authority	FRNSW
David Absalom	Fire authority	FRNSW
Yael Bornstein	Proponent	TfNSW / Sydney Metro
Emily Ball	Proponent	TfNSW / Sydney Metro
Andrew Addinsell	SMCSW FLS SME	TfNSW / Sydney Metro
Carlo Laba	OSD developer representative	TSA Management
John Mills	D&C contractor	CPB
Boris Petrovic	Services engineer	Aurecon
Lieselot Baert	Architect	Foster + Partners
Tony Tang	Architect	Cox Architecture
Peter Murphy	Certifying authority / BCA consultant	Philip Chun
Micael Lundqvist (ML)	Fire safety engineer	Warringtonfire
Genevieve Stanistreet	Fire safety engineer	Warringtonfire

Table 1 Stakeholders present at meeting

Purpose

The purpose of the meeting was to discuss the work documented in the fire engineering brief report, specifically the following:

- Fire engineering process / deliverables
- Trial concept design
- Preliminary station ASET / RSET analysis
- Proposed performance solutions

Key points discussed

1. Scope / fire engineering process & deliverables
 - ML provided an overview of the project and fire engineering deliverables. It was noted that comments on the FEB will be addressed in the FER.
 - CPB confirmed that the FEB will be issued to FRNSW and TfNSW / Sydney Metro on Friday 7th February 2020.

20200207-SY180170 FEB workshop 2 meeting minutes.docx



2. Trial concept design

- ML provided an overview of the trial concept design – refer to presentation slides attached.
- Fire rating for OTE structure – ML noted that current strategy is to protect OTE structure from a train fire for 2 hours with ISO fire exposure from below and smoke temperature exposure from within duct. FRNSW queried whether trackside temperature modelling would be undertaken. ML confirmed that the fire and smoke modelling include this. **Note:** This modelling is for trackside below the OTE duct, not inside the OTE duct.
- FRNSW noted that a summary of the OTE fire safety requirements across the different Metro stations would be beneficial to identify differences between stations. ML noted that this would need to be requested from TfNSW / Sydney Metro.
- ML also noted that platform side there are unprotected steel elements designed to withstand 450°C to mitigate risk of failure when occupants / FRNSW may be located in that area. FRNSW queried what would happen if this temperature was exceeded. ML clarified that structural design is such that potential failure is to be localised. ML also noted failure is not expected to have a big impact on the smoke exhaust as a locally enlarged opening to the OTE is expected to increase the volume exhaust in that area as the OTE is a plenum.
- South OSD level 2 restaurant fire separation – ML detailed the proposed -/60/- fire rated glazing. It was noted that this is not documented in the FEB Rev A as this is a recent design development.
- Escalators for evacuation from the station – FRNSW queried whether a possible preference by occupants to use escalators over fire-isolated stairs is accounted for in the occupant evacuation modelling undertaken. ML confirmed that in the Pathfinder occupant evacuation modelling undertaken, a significant portion of the occupants evacuate via the escalators. FRNSW queried whether a scenario has been assessed where all escalators stop. ML confirmed that this scenario has not been assessed, but can be if required.
- Operator intervention for misaligned train scenario to reduce air pressure on EEDs and EWDs – ML noted that operator intervention will be required to reduce air pressure on EEDs and EWDs in the unlikely event of a misaligned train fire scenario. The alternative option would be to reduce the station exhaust, however it is considered more appropriate to run the station exhaust at full capacity and rely on operator intervention in the unlikely case of a train misaligned to the platform and the auto-sliding doors (ASDs).
- North OSD level 2 retail egress – ML detailed the proposed egress strategy incorporating the use of a station fire stair instead of reliance on escalators for evacuation. **Note:** TfNSW / Sydney Metro recommended confirming this with TSOM.
- Station manual fire suppression – FRNSW support the provision of fire extinguishers in FOH areas and no fire hose reels in FOH areas. CPB confirmed allowance has been made for fire extinguishers in FOH areas in locked cabinets as per SWTC requirements. **Note:** CPB to send an RFI to TfNSW / Sydney Metro to seek advice on consistency with other Metro stations.
- North B5 plant level – ML noted that it is understood there is currently a provision for sprinklers and smoke detection on this level. As the area is a restricted access area for cable reticulation, this may cause issues in the event of a detector going off and the operator needing to access the areas to check the cause of alarm. FRNSW noted they will not access HV areas until power has been verified as isolated and requested confirmation of what systems would be affected in the event of such a shutdown. **Note:** Strategy to be resolved with design team and TSOM and documented in FER.

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- FIP provisions – ML noted that SMCSW FLS SME requested for station and OSD towers to have FIP + 2 x mimics in all FCR in previous meeting. In OSD FCR it is proposed to provide relevant OSD FIP + station mimic only, ie no mimic for other OSD due to required cable route through station and no clear operational benefit in providing this additional mimic. FRNSW agreed that a mimic for the other OSD would not be that beneficial. FRNSW noted that in the event of an alarm, typically two fire trucks would respond. Note: CPB to send an RFI to TfNSW / Sydney Metro to seek formal advice from FRNSW and Sydney Metro in relation to this requirement.
 - EWIS matrix – ML detailed the proposed EWIS strategy, noting that it is a work in progress. In the event of a fire in the station, FRNSW noted that their preference is for the EWIS to start to cascade into the OSD tower. TfNSW / Sydney Metro noted that this strategy may be different to other Metro stations, eg Martin Place. Note: Further TWG workshop to be held with Metro, TSOM and OSD developer to confirm requirements.
 - Water supply – FRNSW queried the station hydrant water supply. Aurecon confirmed that the feed hydrant as part of the booster will draw from the main, whilst on site pumps draw from tanks.
 - Wet systems split – ML presented the proposed wet systems split. Fire hydrants on podium levels at north and south are to be boosted by station boosters at north site. Sprinklers are to be fed off OSD ring mains and station ring main independently. No objection to the proposed system split was raised in the meeting.
3. Preliminary station ASET / RSET analysis
- ASET / RSET analysis – ML presented the preliminary ASET / RSET modelling results – refer to presentation slides attached. It was noted that a 10MW extreme event fire scenario has been modelled to inform the SFAIRP review of station smoke hazard management provisions.
 - FRNSW queried where the 10MW fire size originated. ML explained that the 10MW fire size is based on the estimated peak HRR for one train carriage. This was calculated by the train provider Alstom as part of the SMNW project. Sydney Metro confirm this Alstom report has been provided to FRNSW previously.
- Post meeting note: Section 6.3 of the FEB details that part of the rolling stock specification requires a maximum fire heat release rate per car of 10MW as defined by the Duggan method.
4. Proposed performance solutions
- ML provided a brief overview of the key proposed performance solutions. Due to time restrictions all performance solutions were not discussed – refer to presentation slides attached.
 - Egress from South OSD enabling levels 4 / 5 was discussed. FRNSW noted that they would like two exits to be provided from TVS/TES plenums and fan rooms.

B.3 Stage 3 – 7/4/2020

Warringtonfire Suite 802 Lvl 8, 383 Kent St
ABN: 81 050 241 524 Sydney NSW
P: 02 9211 4333 2000 Australia

Time	8.30am – 9.30am	Date	07/04/2020
Job no	SY180170	Issued	08/04/2020
Project	Pitt Street Station		

Meeting minutes

Attendees	Role	Organisation
Michael Gleeson	Fire authority	FRNSW
David Absalom	Fire authority	FRNSW
Shaohua Xia	Fire authority	FRNSW
Yael Bornstein	Proponent	TfNSW / Sydney Metro
Emily Ball	Proponent	TfNSW / Sydney Metro
Andrew Addinsell	SMCSW FLS SME	TfNSW / Sydney Metro
Carlo Laba	OSD developer representative	TSA Management
John Mills	D&C contractor	CPB
Josh Bhalla	Architect	Cox Architecture
Michael Grave	Architect	Cox Architecture
Peter Murphy	Certifying authority / BCA consultant	Philip Chun
Micael Lundqvist (ML)	Fire safety engineer	Warringtonfire
Genevieve Stanistreet	Fire safety engineer	Warringtonfire

Table 1 Stakeholders present at meeting**Purpose**

The purpose of the meeting was to seek feedback from FRNSW / Sydney Metro regarding the design and FLS strategy development for the Stage 3 Station FER following completion of the Stage 2 FEB and present OSD North and South performance solutions. The agenda comprised:

- Stage 2 Station FEB status
- Stage 3 Station design development
- OSD North – proposed performance solutions
- OSD South – proposed performance solutions

The meeting was held via Microsoft Teams.

20200408-SY180170 FER workshop 1 meeting minutes.docx



Key points discussed

1. Stage 2 Station FEB status
 - Sydney Metro confirmed they have reviewed the Stage 2 Station FEB. Comments have been issued to CPB.
Action: CPB to forward Sydney Metro comments to Warringtonfire so they can be addressed in the Stage 3 FER.
Post-meeting note: Informal comments received from CPB 7/4/2020. Sydney Metro confirmed comments have been formally issued via SMCSWSPU-SMD-TX-000217 on 8/4/2020.
 - Sydney Metro confirmed that FEB submissions to FRNSW for the station and OSDs are to be submitted to Sydney Metro who will forward the submissions to FRNSW. ML noted that the South OSD FEBQ is ready to be issued to FRNSW, whilst the North OSD FEBQ will be finalised for submission this week.
Action: TSA to issue the OSD FEBQs to Sydney Metro for submission to FRNSW when completed.
 - Sydney Metro confirmed that the station FEB has not been issued to FRNSW. It is acknowledged that it is unlikely that comments from FRNSW will be received prior to the Stage 3 FER submission date in late April.
Action: CPB to issue outstanding paperwork to Sydney Metro for the submission of the Stage 2 Station FEB to FRNSW for review.
2. Stage 3 Station design development
 - ML provided an overview of the revision to the EWIS cascade strategy. The EWIS cascade has been revised to not automatically cascade into the North OSD (commercial tower) from the station FOH and BOH. The automatic cascade into the South OSD (residential tower) from the station is proposed to be retained. ML noted the maximum delay of 10 minutes between ALERT and EVAC is to be adopted. Refer to presentation slides for the proposed EWIS cascade strategy.
 - ML queried the mode of activation of OTE/TVS for station smoke exhaust in the event of a train fire alarm. Sydney Metro confirmed that it is an automatic ventilation response.
 - ML queried the network wide strategy to reduce the pressure across the EEDs and EWDs in the event of a misaligned train. Sydney Metro agreed a consistent approach is required but noted this needs to be discussed by the station designers with Linewide and TSOM.
Action: Warringtonfire to review existing RFIs and discuss the strategy to reduce the pressure across the EEDs and EWDs in the event of a misaligned train with Linewide and TSOM.
 - ML discussed the use of wall linings within the station which are not deemed non-combustible under BCA2016, eg laminated glass which is used for blast requirements where the combustible interlayer laminate exceeds the BCA2016 allowance. This serves to minute that Sydney Metro have previously confirmed that all wall linings allowed under the SWTC can be considered to meet the requirement of the overarching SMCSW FLS strategy for 'non-combustible linings' (SMCSWSPU-CPB-SPU-CPB-GEN-000041).
 - ML detailed changes to the fixed fire suppression provided. No sprinklers are proposed to be provided to the thoroughfare areas where there is a low fire load, which is consistent with the Stage 1 design. It was noted that the B5 north cable basement will not be provided with smoke detection or sprinklers as per RFI issued to Sydney Metro (SMCSWSPU-CPB-DRFI-000124). No objections were raised.

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- ML noted that fire hose reels are not proposed to be provided in the platforms, adits and escalator voids (FOH areas) to promote evacuation over firefighting by customers and to mitigate risk of hose reels obstructing main egress paths. Sydney Metro have confirmed the SMCSW FLS strategy supports this approach (SMCSWSPU-CPB-DRFI-000119).
- Portable fire extinguishers are to be provided next to fire hydrants in the FOH areas (SMCSWSPU-CPB-DRFI-000119). FRNSW queried whether if they are located in locked cabinets, will they be unlocked on fire trip. ML noted that it is not yet confirmed if they will be in monitored or locked cabinets, if in locked cabinets they will likely be accessible with a 003 key but a network wide solution should be agreed with Sydney Metro.
- ML noted that subject to a SWTC concession being granted by Sydney Metro the hydraulic pipes below ground are proposed to be HDPE pipes, not low smoke zero halogen (LSZH). Electrical wiring and conduits are to be LSZH. Sydney Metro confirmed this is the preferred solution, no PVC pipes are used on other stations.

Action: CPB to submit request for SWTC concession. It is understood a network wide approach will be agreed.

- ML noted that OSD enabling requirements in the Station FER will be reduced to what is required for the station opening only. Fire safety measures for the fitout or OSD completion will be documented in the OSD FERs.

Action: Warringtonfire to document above changes in Stage 3 Station FER.

3. OSD North - proposed performance solutions

- ML provided a brief overview of the key proposed performance solutions – refer to presentation slides attached.
- FRNSW noted that they will likely request that firefighter tenability in the car stacker will need to be addressed – tenability criteria as per Society of Fire Safety Guideline extract below.

For the purpose of assessing the safety of the fire brigade personnel, the criteria set out by Australasian Fire Authorities Council (AFAC)^[21] may be used. These are summarised in Table 1.

Table 1: Exposure limits for fire fighters under various condition

	Routine Condition	Hazardous Condition	Extreme Condition	Critical Condition
Maximum Time	25 minutes	10 minutes	1 minute	< 1 minute
Maximum Air Temperature	100°C	120°C	160°C	> 235°C
Maximum Radiation	1kW/m ²	3kW/m ²	4 - 4.5kW/m ²	> 10kW/m ²

Figure 10 shows the AFAC criteria for fire fighters for exposure of up to 10 minutes.

Action: Warringtonfire to document in OSD North FEBQ.



4. OSD South - proposed performance solutions
 - ML provided a brief overview of the key proposed performance solutions – refer to presentation slides attached.
 - Sydney Metro queried the fire separation proposed between the restaurant and station entry. ML confirmed that the fire separation will comprise non-fire rated glass protected with Tyco wall-wetting sprinklers to provide a pseudo 2-hour fire separation as per the SMCSW FLs strategy. Fire rated glazing was investigated but did not meet blast resistance requirements.
5. Additional discussions
 - ML detailed that the next workshop will likely be when the Stage 3 Station FER is submitted to stakeholders. The Stage 3 Station FER will address Sydney Metro comments on the Stage 2 Station FEB, however as comments are unlikely to be received from FRNSW on the FEB by the FER submission date in late April, it is unlikely that the FER will address FRNSW comments not raised during workshops.
 - Sydney Metro queried whether the fire curtains in the OSD North were in the station or OSD. ML confirmed that the fire curtains are within the OSD part of the building, the station FLS strategy does not incorporate any operable fire curtains.
 - ML queried how to address the third party stakeholder involvement requirements. Sydney Metro confirmed that engagement with third party stakeholders could be via a standalone fire engineering consultation or as part of another existing stakeholder process required for the project. A certificate of no object is not required from these stakeholders but they must be given an opportunity to be brief and make comment.
Action: CPB to organise third party stakeholder involvement with Warringtonfire.
 - FRNSW questioned how the use of escalators will be analysed in the evacuation modelling of the station, as the escalators are not fire rated and not connected to an emergency power supply. ML noted that if a fire is in an area that will affect the escalators, it is assumed that this area is not tenable and not be used in the evacuation modelling. Sydney Metro confirmed that the escalators are powered by two incoming supplies, thereby a redundancy is provided.
Action: Warringtonfire to document requirement for dual power supply to include escalators in Stage 3 Station FER.
 - FRNSW queried the process for evacuation of mobility impaired occupants, particularly if the lifts need to be fire rated and provided with an emergency power supply. ML noted that evacuation of mobility impaired occupants is in the first instance for occupants to move to refuge areas with CCTV and audio help points within the fire-isolated stairs and passageways. However, if safety to do so lifts may be used during emergency intervention activities by the fire brigade. Sydney Metro confirmed that the lifts are powered by two incoming power supplies, thereby a redundancy is provided.
Action: Warringtonfire to document requirement for dual power supply to include lifts in Stage 3 Station FER.

Appendix C Draft EWIS cascading strategy

OSD Tower South (residential)				OSD Tower North (commercial)						
	OSD Tower			OSD Tower						
	OSD Tower			OSD Tower						
L06-	OSD plant	Station BOH		OSD plant	Station BOH		L05-			
Crash deck L05	OSD plant	Station BOH		OSD plant	Station BOH		L04 Crash deck			
L04	OSD plant/storage	Station BOH		OSD plant	Station BOH		L03			
L03	OSD communal areas / restaurant			OSD sky lobby	Carstacker		L02			
L02				OSD sky lobby	Carstacker		L01			
L01	OSD plant	Station BOH	Station FOH	OSD sky lobby	Station BOH	EOTF etc	L01			
Ground L00	Lobby / Dock	Station BOH	Station FOH	OSD sky lobby	Station BOH	Lobby / Dock etc	Ground L00			
B1 / B1 Mezz	OSD plant	Station BOH (voids)	Station FOH	Station FOH	Station BOH	OSD plant	B1 / B1 Mezz			
B2	Station BOH	Station FOH		Station FOH	Station BOH		B2			
B3	Station BOH	Station FOH		Station FOH	Station BOH		B3			
B4	Station BOH	Station FOH		Station FOH	Station BOH		B4			
B5	Sumps, pits and cable trenches			Station FOH	Station BOH		B5			
Notes:										
No cascade of EWIS from 'red, orange, yellow' into 'blue, green'.										
No cascade of EWIS from Station 'blue, green' into OSD North.										
Station FOH split into three zones - South, Platform and North. Single EWIS zone but different cascade matrix.										
MTS have confirmed station BOH and FOH are to be split into aseparate zones.										
Allow zoning for split of all levels and uses for future flexibility.										
PSS B01-L01 and PSN B01-L03 merged to simplify cascade matrix.										
PSS L03-L05 merged to ensure first cascade from station FOH includes these levels as they contain station smoke exhaust serving FOH.										
2 up / 1 down means all zones on those levels, eg PSN L04 cascades to L05-06 and EOFT, Carstacker etc + Sky lobby.										
Matrix examples:										
1. Fire in Station FOH North (green)				4. Fire in OSD Sky lobby / residential communal areas or restaurant (red)						
a. ALERT in station FOH incl platform and South entry (green)				a. ALERT in fire affected compartment (red) + carstacker (due to egress via Sky lobby)						
b1. EVAC in station FOH after up to 10min or 2nd alarm (MTS to confirm delay)				b1. EVAC in fire affected compartment after up to 10min or 2nd alarm (ECO to confirm delay)						
b2. ALERT in station BOH				b2. ALERT in adjacent OSD and station BOH (2 up / 1 down = orange, yellow and OSD Tower)						
c1. EVAC in station BOH				c. EVAC in adjacent OSD (2 up / 1 down) after another 10min						
				d. Normal cascade in OSD Tower beyond crash deck at same intervals (ECO to confirm cascade 10min & 2 up / 1 down)						
				e. No cascade into station FOH/BOH (green and blue) and no cascade to non-fire affected OSD Tower.						
2. Fire in Station BOH South (blue)				5. Fire in first OSD Tower level (white)						
a. ALERT in station BOH (blue)				a. ALERT in fire affected compartment (minimum that storey)						
b1. EVAC in station BOH after up to 10min or 2nd alarm (MTS to confirm delay)				b1. EVAC in fire affected compartment after up to 10min or 2nd alarm (ECO to confirm delay)						
b2. ALERT in station FOH and adjacent OSD South (3 up / 1 down = green, orange, red and yellow) - Note proposed 3 up cascade.				b2. ALERT in adjacent OSD and station BOH (2 up / 1 down = yellow and OSD Tower)						
c1. EVAC in station FOH and adjacent OSD South (3 up / 1 down) after another 10min				c1. EVAC in adjacent OSD and station BOH after another 10min						
c2. ALERT in next OSD South (2 up / 1 down = OSD Tower)				c2. ALERT in next OSD and station BOH (2 up / 1 down = red, orange and OSD Tower)						
d. Normal cascade in OSD South Tower beyond crash deck at same intervals (ECO to confirm cascade 10min & 2 up / 1 down)				d. Normal cascade in OSD Tower beyond crash deck at same intervals (ECO to confirm cascade 10min & 2 up / 1 down)						
				e. No cascade into station FOH/BOH (green and blue) and no cascade to non-fire affected OSD Tower.						
3. Fire in above ground OSD or station BOH plant (eg yellow)										
a. ALERT in fire affected compartment (minimum that storey)										
b1. EVAC in fire affected compartment after up to 10min or 2nd alarm (MTS/ECO to confirm delay)										
b2. ALERT in adjacent OSD (2 up / 1 down = red and OSD Tower)										
c1. EVAC in adjacent OSD after another 10min										
c2. ALERT in next OSD enabling (2 up / 1 down = orange and OSD Tower)										
d. Normal cascade in OSD Tower beyond crash deck at same intervals (ECO to confirm cascade 10min & 2 up / 1 down)										
e. No cascade into station FOH/BOH (green and blue) and no cascade to non-fire affected OSD Tower.										

Appendix D Fire hydrant schematic

