

FLOODING AND STORMWATER MANAGEMENT PLAN

APPENDIX P





Sydney Metro City & Southwest

Pitt Street North over station development:

Flooding and Stormwater Management

Applicable to:	Sydney Metro City & Southwest
Author:	Cardno
Owner	Sydney Metro
Status:	Final
Version:	#4
Date of issue:	August 2018
© Sydney Metro 2018	

Table of Contents

1.	Purpose of this report	3
1.1.	Background	3
1.2.	Overview of the Sydney Metro in its context	3
1.3.	Planning relationship between Pitt Street Station and the OSD	5
1.4.	The Site	8
1.5.	Overview of the proposed development.....	9
1.6.	Staging and framework for managing environmental impacts	12
2.	Planning Requirements	15
2.1.	Secretary’s Environmental Assessment Requirements	15
2.2.	City of Sydney Council Development Controls	15
	2.2.1. Flood Planning Requirements.....	15
3.	Flooding and Stormwater Management Strategy	17
4.	Flood Modelling and Impact Assessment	18
4.1.	Pre-Development Conditions	18
4.2.	Post-Development Conditions.....	21
4.3.	Climate Change	22
4.4.	Flood Planning Levels	24
4.5.	Flood Warning Time	25
4.6.	Evacuation and Safe Refuge	25
5.	Stormwater Drainage	27
5.1.	Existing Drainage.....	27
5.2.	Proposed Drainage.....	27
5.3.	On-Site Detention	27
6.	Conclusion	28
7.	References	29

1. Purpose of this report

1.1. Background

This report supports a concept State Significant Development application (concept SSD Application) submitted to the Department of Planning and Environment (DPE) pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The concept SSD Application is made under section 4.22 of the EP&A Act.

Sydney Metro is seeking to secure concept approval for a mixed use tower above the northern portal of Pitt Street Station, otherwise known as the over station development (OSD). The concept SSD Application seeks consent for a building envelope and its use for residential accommodation, visitor accommodation and commercial premises, maximum gross floor area (GFA), pedestrian and vehicular access, circulation arrangements and associated car parking as well as the strategies and design parameters for the future detailed design of development.

Sydney Metro proposes to construct the OSD as part of an integrated station development package, which would result in the combined delivery of the station, OSD and public domain improvements. The station and public domain elements form part of a separate planning approval for Critical State Significant Infrastructure (CSSI) approved by the Minister for Planning on 9 January 2017.

As the development is within a rail corridor, is associated with railway infrastructure and is for the purposes of residential or commercial premises with a Capital Investment Value of more than \$30 million, the project is State Significant Development (SSD) pursuant to Schedule 1, clause 19(2)(a) of the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP). The full extent of the proposed development is also State Significant Development by virtue of clause 8(2) of the SRD SEPP.

This report has been prepared to respond to the Secretary's Environmental Assessment Requirements (SEARs) issued for the concept SSD Application for Pitt Street North on 30th November 2017 which state that the Environmental Impact Statement (EIS) is to address the following requirement:

Plans & Documents: flooding assessment / stormwater management plan

1.2. Overview of the Sydney Metro in its context

The New South Wales (NSW) Government is implementing *Sydney's Rail Future*, a plan to transform and modernise Sydney's rail network so that it can grow with the city's population and meet the needs of customers in the future (Transport for NSW, 2012). Sydney Metro is a new standalone rail network identified in *Sydney's Rail Future*.

Sydney Metro is Australia's biggest public transport project, consisting of Sydney Metro Northwest, which is scheduled for completion in 2019 and Sydney Metro City & Southwest, which is scheduled for completion in 2024.

Sydney Metro West is expected to be operational in the late 2020s. (Refer to **Figure 1**).



Figure 1: Sydney Metro alignment map

Sydney Metro City & Southwest includes the construction and operation of a new metro rail line from Chatswood, under Sydney Harbour through Sydney’s CBD to Sydenham and on to Bankstown through the conversion of the existing line to metro standards.

The project also involves the delivery of seven new metro stations, including at Pitt Street. Once completed, Sydney Metro will have the ultimate capacity for 30 trains an hour (one every two minutes) through the CBD in each direction - a level of service never seen before in Sydney.

On 9 January 2017, the Minister for Planning approved the Sydney Metro City & Southwest - Chatswood to Sydenham application as a Critical State Significant Infrastructure project (reference SSI 15_7400), hereafter referred to as the CSSI Approval.

The CSSI Approval includes all physical work required to construct the CSSI, including the demolition of existing buildings and structures on each site. Importantly, the CSSI Approval also includes provision for the construction of below and above-ground structures and other components of the future ISD (including building infrastructure and space for future lift cores, plant rooms, access, parking and building services, as relevant to each site). The rationale for this delivery approach, as identified within the CSSI Application, is to enable the ISD to be more efficiently built and appropriately integrated into the metro station structure.

The EIS for the Chatswood to Sydenham component of the Sydney Metro City & Southwest project identified that the OSD would be subject to a separate assessment process.

Since the CSSI Approval was issued, Sydney Metro has lodged four modification applications to amend the CSSI Approval as outlined below:

- Modification 1- Victoria Cross and Artarmon Substation which involves relocation of the Victoria Cross northern services building from 194-196A Miller Street to 50 McLaren Street together with inclusion of a new station entrance at this location referred to as Victoria Cross North. 52 McLaren Street would also be used to support construction of these works. The modification also involves the relocation of the substation at Artarmon from Butchers Lane to 98 – 104 Reserve Road. This modification application was approved on 18 October 2017.
- Modification 2- Central Walk which involves additional works at Central Railway Station including construction of a new eastern concourse, a new eastern entry, and upgrades to suburban platforms. This modification application was approved on 21 December 2017.
- Modification 3 - Martin Place Station which involves changes to the Sydney Metro Martin Place Station to align with the Unsolicited Proposal by Macquarie Group Limited (Macquarie) for the development of the station precinct. The proposed modification involves a larger reconfigured station layout, provision of a new unpaid concourse link and retention of the existing MLC pedestrian link and works to connect into the Sydney Metro Martin Place Station. It is noted that if the Macquarie proposal does not proceed, the modification (if approved) would be surrendered. This modification application was approved on 22 March 2018.
- Modification 4 - Sydenham Station and Sydney Metro Trains Facility South which incorporated Sydenham Station and precinct works, the Sydney Metro Trains Facility South, works to Sydney Water's Sydenham Pit and Drainage Pumping Station and ancillary infrastructure and track and signalling works into the approved project. This modification application was approved on 13 December 2017. Given the modifications, the CSSI Approval is now approved to operate to Sydenham Station and also includes the upgrade of Sydenham Station.

The remainder of the City & Southwest project (Sydenham to Bankstown) proposes the conversion of the existing heavy rail line and the upgrade of the existing railway stations along this alignment to metro standards. This portion of the project, referred to as the Sydenham to Bankstown Upgrade, is the subject of a separate CSSI Application (No. SSI 17_8256) for which an Environmental Impact Statement was exhibited between September and November 2017 and a Response to Submissions and Preferred Infrastructure Report was submitted to the NSW Department of Planning & Environment (DPE) in June 2018 for further exhibition and assessment.

1.3. Planning relationship between Pitt Street Station and the OSD

While the northern portal of Pitt Street Station and the OSD will form an integrated station development, the planning pathways defined under the *Environmental Planning and Assessment Act 1979* require separate approval for each component of the development. In this regard, the approved station works (CSSI Approval) are subject to the provisions of Part

5.1 of the EP&A Act (now referred to as Division 5.2) and the OSD component is subject to the provisions of Part 4 of the EP&A Act.

For clarity, the approved station works under the CSSI Approval included the construction of below and above ground structures necessary for delivering the station and also enabling construction of the integrated OSD. This included but is not limited to:

- demolition of existing development
- excavation
- station structure including concourse and platforms
- lobbies
- retail spaces within the station building
- public domain improvements
- station portal link (between the northern and southern portals of Pitt Street Station)
- access arrangements including vertical transport such as escalators and lifts
- structural and service elements and the relevant space provisioning necessary for constructing OSD, such as columns and beams, space for lift cores, plant rooms, access, parking, retail and building services.

The vertical extent of the approved station works above ground level is defined by the 'transfer slab' level (which for Pitt Street North is defined by RL 48.00), above which would sit the OSD. This delineation is illustrated in **Figure 2** below.

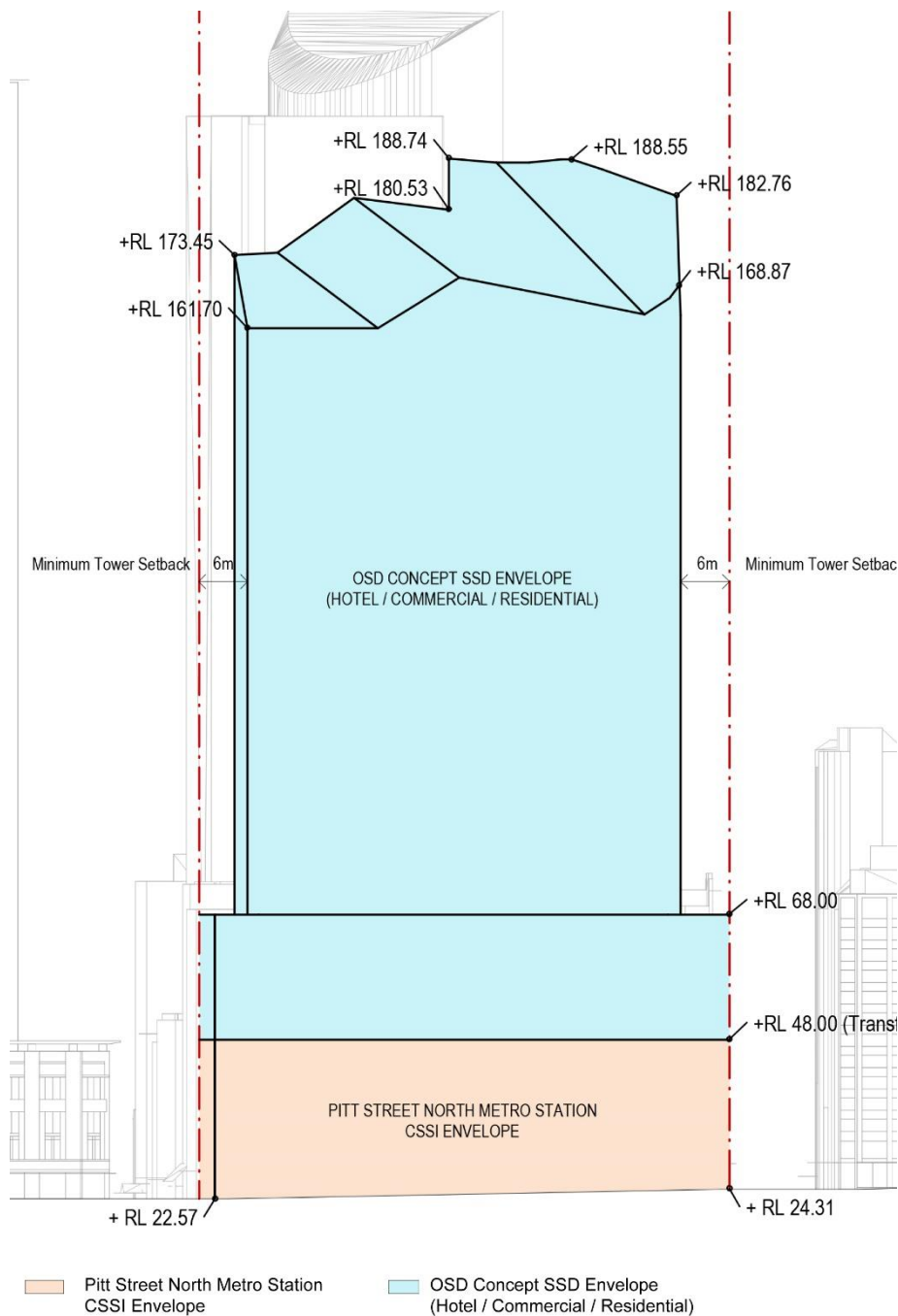


Figure 2: Delineation between station and OSD

The CSSI Approval also establishes the general concept for the ground plane of Pitt Street Station including access strategies for commuters, pedestrians and workers. In this regard, pedestrian access to the station would be from Park Street and the OSD lobbies would be accessed from Pitt Street, Park Street and Castlereagh Street.

Since the issue of the CSSI Approval, Sydney Metro has undertaken sufficient design work to determine the space planning and general layout for the station and identification of those

spaces within the station area that would be available for the OSD. In addition, design work has been undertaken to determine the technical requirements for the structural integration of the OSD with the station. This level of design work has informed the concept proposal for the OSD. It is noted that ongoing design development of the works to be delivered under the CSSI Approval would continue with a view to developing an Interchange Access Plan (IAP) and Station Design Precinct Plan (SDPP) for Pitt Street Station to satisfy Conditions E92 and E101 of the CSSI Approval.

The public domain improvement works around the site would be delivered as part of the CSSI Approval.

1.4. The Site

The Pitt Street North OSD site is located at the southern portion of the Sydney CBD block bounded by Pitt Street, Park Street and Castlereagh Street, above the northern portal of the future Pitt Street Station (refer to **Figure 3** below).

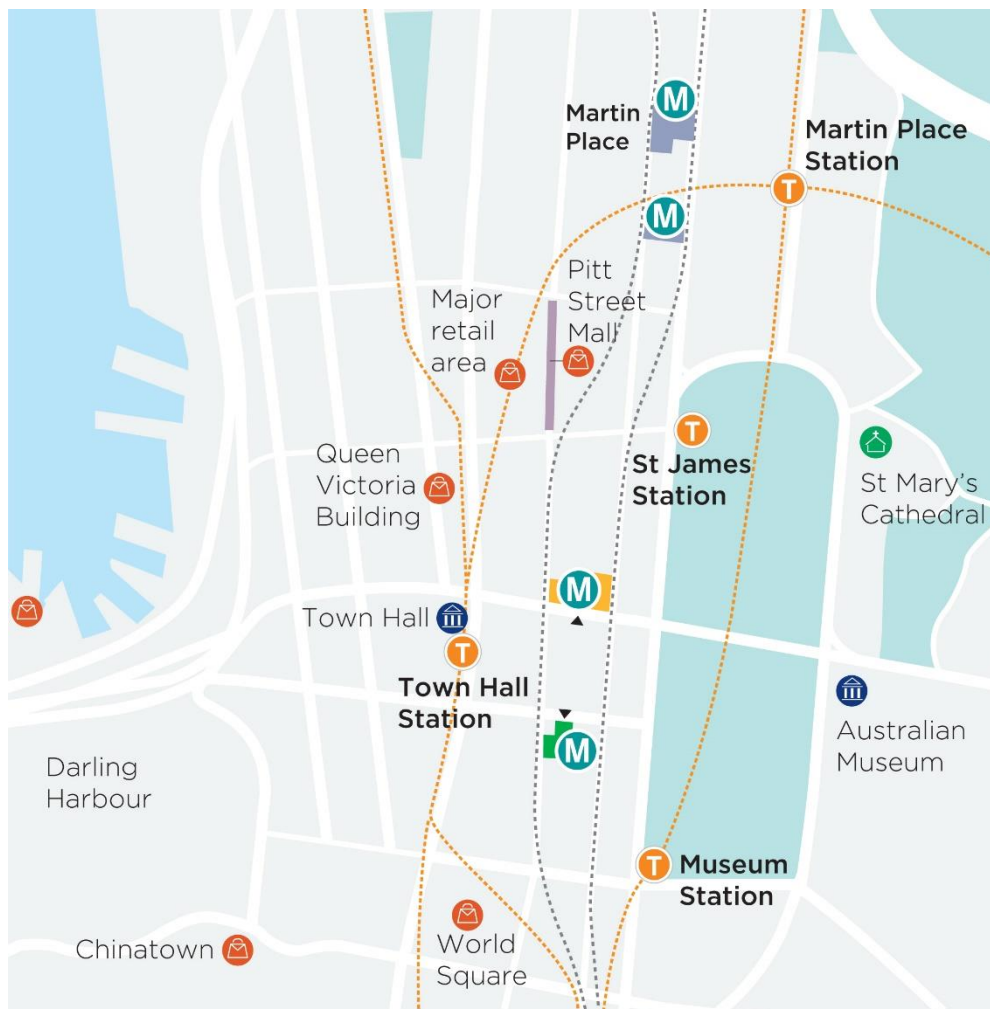
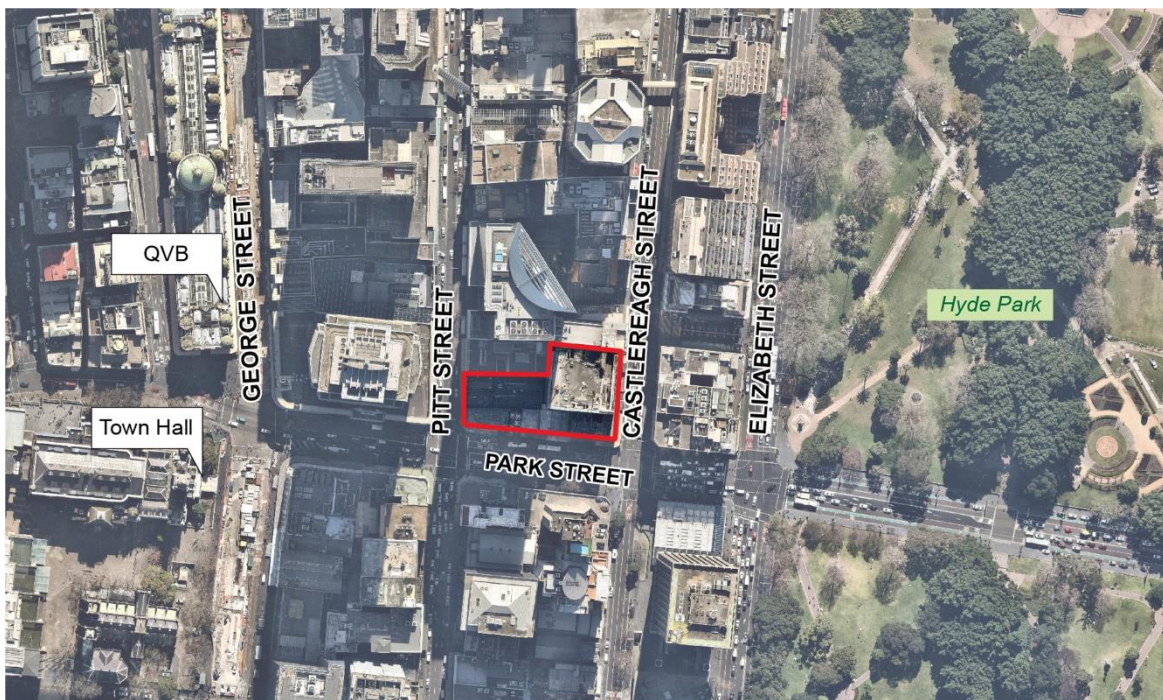


Figure 3: Pitt Street Station location plan

The site is located in the City of Sydney Local Government Area. The site (refer to **Figure 4** below) is irregular in shape, has a total area of approximately 3,150 square metres and has street frontages of approximately 28 metres to Pitt Street, 81 metres to Park Street and 48 metres to Castlereagh Street.

The site address is 175-183 Castlereagh Street, Sydney and comprises the following properties:

- Lot 3 in DP 74952
- Lot 1 in DP 229365
- Lot 2 in DP 900055
- Lot 1 in DP 596474
- Lot 17 in DP 1095869
- Lot 2 in DP 509677
- Lot 1 in DP 982663
- Lot 2 in DP 982663
- Lot 3 in DP 61187
- Lot 1 in DP 74367



 The Site

 NOT TO SCALE

Figure 4: Aerial photo of Pitt Street North

1.5. Overview of the proposed development

The concept SSD Application seeks concept approval in accordance with section 4.22 of the EP&A Act for the OSD above the approved Pitt Street Station (northern portal). This

application establishes the planning framework and strategies to inform the detailed design of the future OSD and specifically seeks planning approval for:

- a building envelope as illustrated at Figure 5
- a maximum building height of approximately Relative Level (RL) 189 which equates to approximately 43 storeys including a podium height of RL68 (approximately 45m), which equates to approximately 12 storeys above ground
- a maximum GFA of 49,120 square metres for the OSD component, which equates to a Floor Space Ratio (FSR) of 15.59:1, resulting in a total maximum GFA at the site (including station floorspace) of 50,309 square metres and a total maximum FSR of 15.97:1, including flexibility to enable a change in the composition of land uses within the maximum FSR sought
- conceptual use of the building envelope for a range of uses including commercial office space, visitor accommodation and residential accommodation
- use of the conceptual OSD space provisioning within the footprint of the CSSI Approval (both above and below ground), including the OSD lobby areas, podium car parking, storage facilities, services and back-of-house facilities
- car parking for approximately 50 spaces located across five levels of the podium
- loading and vehicular access arrangements from Pitt Street
- pedestrian access from Pitt Street, Park Street and Castlereagh Street
- strategies for utilities and service provision
- strategies for the management of stormwater and drainage
- a strategy for the achievement of ecologically sustainable development
- indicative signage zones
- a strategy for public art
- a design excellence framework
- the future subdivision of parts of the OSD footprint (if required)

As this concept SSD Application is a staged development pursuant to section 4.22 of the EP&A Act, future approval would be sought for detailed design and construction of the OSD. A concept indicative design, showing a potential building form outcome at the site, has been provided as part of this concept SSD Application at Appendix E.

Pitt Street Station is to be a key station on the future Sydney Metro network, providing access to the Sydney Central Business District (CBD). The proposal combines the metro station with a significant mixed use tower, contributing to the Sydney skyline. The OSD would assist in strengthening the role of Central Sydney as the key centre of business in Australia and would contribute to the diversity, amenity and sustainability of the CBD.

It is noted that Pitt Street Station southern portal OSD has been subject to a separate application, and does not form part of this concept SSD Application.

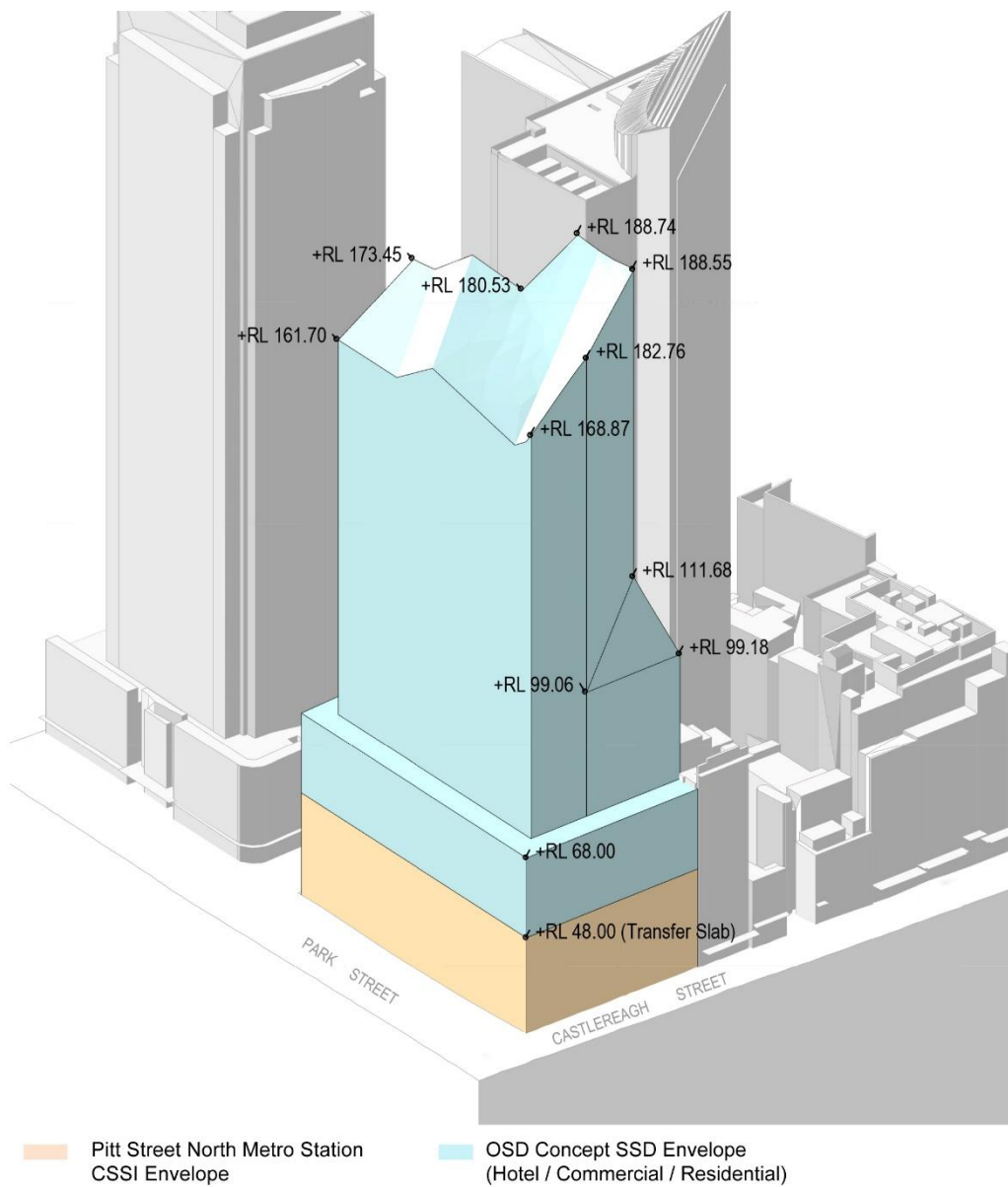


Figure 5: Pitt Street North OSD building, including OSD components (orange) and station box (grey)



Figure 6: Pitt Street North OSD indicative design, as seen from eastern, southern and western elevations

1.6. Staging and framework for managing environmental impacts

Sydney Metro proposes to procure the delivery of the Pitt Street North integrated station development in one single package, which would entail the following works:

- station structure
- station fit-out, including mechanical and electrical
- OSD structure
- OSD fit-out, including mechanical and electrical.

Separate delivery packages are also proposed by Sydney Metro to deliver the excavation of the station boxes/shafts ahead of the ISD delivery package, and line-wide systems (e.g. track, power, ventilation) and operational readiness works prior to the Sydney Metro City & Southwest metro system being able to operate.

Three possible staging scenarios have been identified for delivery of the integrated station development:

1. Scenario 1 – the station and OSD are constructed concurrently by constructing the transfer slab first and then building in both directions. Both the station and OSD would be completed in 2024.
2. Scenario 2 – the station is constructed first and ready for operation in 2024. OSD construction may still be incomplete or soon ready to commence after station construction is completed. This means that some or all OSD construction is likely to still be underway upon opening of the station in 2024.
3. Scenario 3 – the station is constructed first and ready for operation in 2024. The OSD is built at a later stage, with timing yet to be determined. This creates two distinct construction periods for the station and OSD.

Scenario 1 represents Sydney Metro's preferred option as it would provide for completion of the full integrated station development and therefore the optimum public benefit at the site at the earliest date possible (i.e. on or near 2024 when the station is operational). However, given the delivery of the OSD could be influenced by property market forces, Scenarios 2 or 3 could also occur, where there is a lag between completion of the station component of the ISD (station open and operational), and a subsequent development.

The final staging for the delivery of the OSD would be resolved as part of the detailed SSD application(s).

For the purposes of providing a high level assessment of the potential environmental impacts associated with construction, the following have been considered:

- Impacts directly associated with the OSD, the subject of this SSD application
- Cumulative impacts of the construction of the OSD at the same time as the station works (subject of the CSSI Approval).

Given the integration of the delivery of the Sydney Metro City & Southwest metro station with an OSD development, Sydney Metro proposes the framework detailed in

Figure 7 to manage the design and environmental impacts, consistent with the framework adopted for the CSSI Approval, which includes:

- project design – measures which are inherent in the design of the project to avoid and minimise impacts
- mitigation measures – additional to the project design which are identified through the environmental impact assessment
- construction environmental management framework – details the management processes and documentation for the project
- construction noise and vibration strategy – identifies measures to manage construction noise and vibration
- design guidelines – provides an assurance of end-state quality
- environmental performance outcomes – establishes intended outcomes which would be achieved by the project

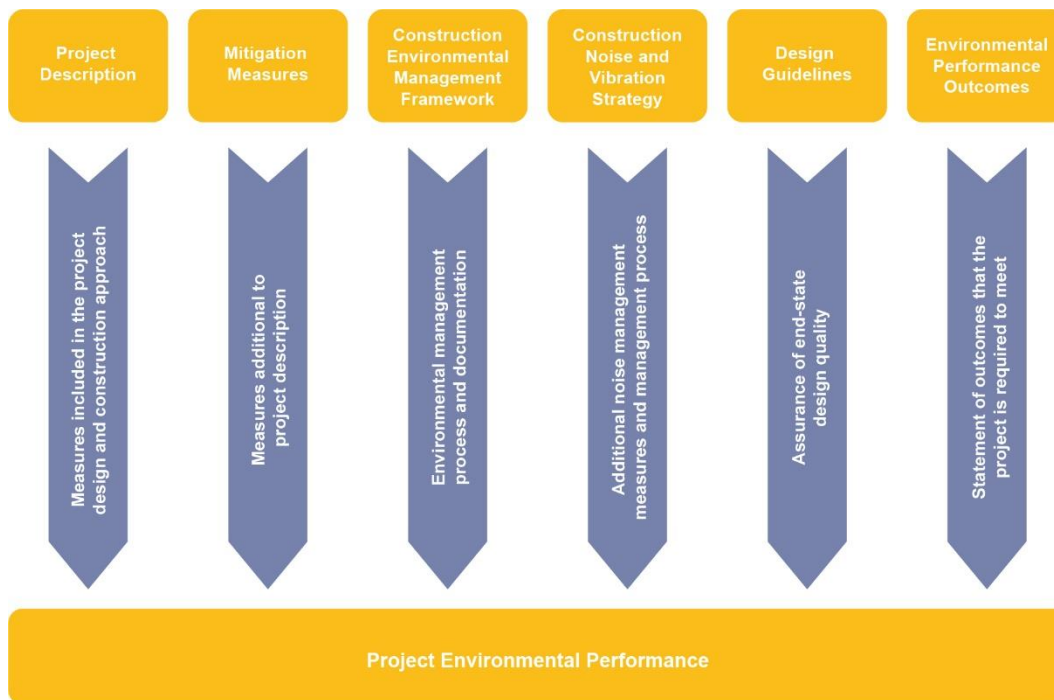


Figure 7: Project approach to environmental mitigation and management

Sydney Metro proposes to implement a similar environmental management framework where the integrated delivery of the CSSI station works and the OSD occur concurrently. This would ensure a consistent approach to management of design interface and construction-related issues.

Sydney Metro proposes this environmental management framework would apply to the OSD until completion of the station and public domain components of the integrated station development delivery contract (i.e. those works under the CSSI Approval). Should the OSD be constructed beyond the practical completion and opening of the section, standard practices for managing construction related environmental impacts would apply in accordance with the relevant guidelines and Conditions of Approval for the detailed SSD application(s).

2. Planning Requirements

2.1. Secretary's Environmental Assessment Requirements

The objective of this study is to review the flooding and stormwater management for the Pitt Street North over station development (OSD) and demonstrate that the proposed OSD will comply with the flood planning requirements based on the findings of the assessment undertaken for the metro station flooding assessment report.

This report outlines the flooding and stormwater management strategy to demonstrate that the proposed development satisfies the Secretary's Environmental Assessment Requirements (SEARs), including consideration of the City of Sydney Council planning requirements, where appropriate.

2.2. City of Sydney Council Development Controls

2.2.1. Flood Planning Requirements

The Proposed development on the site will need to comply with Council's flood planning requirements. Council's Interim Floodplain Management Policy (May 2014) lists performance criteria for development, including that it 'will not significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties'. The Policy also states specific flood planning level (FPL) requirements for development of the property.

Table 2-1 is an extract of relevant FPL criteria from the Policy (Section 5 attached).

The term “Below-Ground Garage/Car park” is defined in the Policy as “where the floor of the parking and/or access surface is more than 1 m below the surrounding natural ground”.

The term “floodplain” is defined in the Policy as “the area of land which is subject to inundation by floods up to and including the PMF event”.

The Sydney Local Environmental Plan 2012 also includes flood related clauses, such as Clause 7.15 (which may apply). This states that development consent will not be approved unless it is shown that (among other conditions): the development is compatible with the flood hazard of the land, and it will not significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties.

Table 2-1 Flood Planning Levels (extract)

Development	Type of Flooding	Flood Planning Level (FPL)	Note
Residential – habitable rooms	Inundated by mainstream / overland flooding	1% AEP flood level + 0.5m	
	Local drainage flooding	1% AEP flood level + 0.5 m or Two times the depth of flow with a minimum of 0.3 m above the surrounding surface if the depth of flow in the 1% AEP flood is less than 0.25 m	
	Outside floodplain	0.3m above surrounding ground	
Residential – non-habitable rooms	Inundated by mainstream / overland or local drainage flooding	1% AEP flood level	For areas such as a laundry, garage, lobby or stairwell.
Commercial – Retail floor levels	Inundated by mainstream / overland or local drainage flooding	Merits approach presented by the applicant with a minimum of the 1% AEP flood. The proposal must demonstrate a reasonable balance between flood protection and urban design outcomes for street level activation.	
Commercial - Business rooms	Inundated by mainstream / overland or local drainage flooding	Merits approach presented by the applicant with a minimum of the 1% AEP flood.	
Above ground car park	Enclosed car park	1% AEP flood level	
Below ground car park	Inundated by mainstream / overland or local drainage flooding	1% AEP flood level + 0.5 m or PMF (whichever is higher)	FPL applies to all openings – e.g. vehicular entrances, vents, lifts, stairwells.

3. Flooding and Stormwater Management Strategy

A flooding assessment has been undertaken based on review and assessment of existing flood information and in coordination with the flood assessment undertaken for the Pitt Street North. The following reports provides information and flood maps which includes the subject area.

- Pitt Street Station – BoD Report-CE-Pitt Street Station, sby Sydney Metro (September, 2017)
- City of Sydney - City Area Catchment Flood Study (October, 2014), by BMT WBM
- City of Sydney – City Area Catchment Flood Risk Management Study (September, 2016) by WMAwater

The flooding behaviour at the Pitt Street North is discussed in **Section 4**.

The subject development should comply with the City of Sydney Council's Interim Floodplain Management Policy and the Sydney Metro System Requirements Specification.

- All the entrances to the over station development (OSD) should be above 100 year (Average Recurrence Interval) ARI plus 0.50m freeboard for the Residential habitable floors and 0.3m above surrounding ground if the proposed development is outside the flood extents
- All basement ingress points (lifts, basement entrances, pedestrian entrances, louvres, grates etc.) should be at the 100 year ARI + 0.5m or the PMF whichever is higher.
- A merits based approach of minimum of 100 year ARI flood level to be adopted for commercial and retail entrances.

All the above requirements are to include consideration of the effect of climate change. A detailed stormwater management plan will be prepared as part of the future detailed development application.

4. Flood Modelling and Impact Assessment

4.1. Pre-Development Conditions

The Sydney City Area Catchment Flood Study (2014) and the Sydney City Area Catchment Flood Risk Management Study (2016) shows that Pitt Street acts as an overland flowpath for the majority of the City Area Catchment. The top of the Pitt Street catchment is bounded by Hyde Park to the east, Liverpool Street to the south and York Street to the west. The flows from the catchment drains along Pitt Street downstream to Circular Quay.

The Sydney City Area Catchment Flood Study (2014) and the Basis of Design document (2017) prepared by Sydney Metro identifies that flooding only occurs along Pitt Street during the 100 year ARI event. The 100 year ARI flood extent however does not reach the intersection of Pitt Street and Park Street. **Figure 8** shows the flood depths along Park Street and Castlereagh Street are shallow and less than 0.05m whereas on Pitt Street it ranges between 0.10 to 0.25m.

In a PMF flood event, the flooding extends along Pitt Street, Castlereagh Street and up Park Street. **Figure 9** shows the peak flood depths in a PMF flood event. **Appendix C** shows full catchment maps for both 100 year ARI and PMF which includes the subject site.

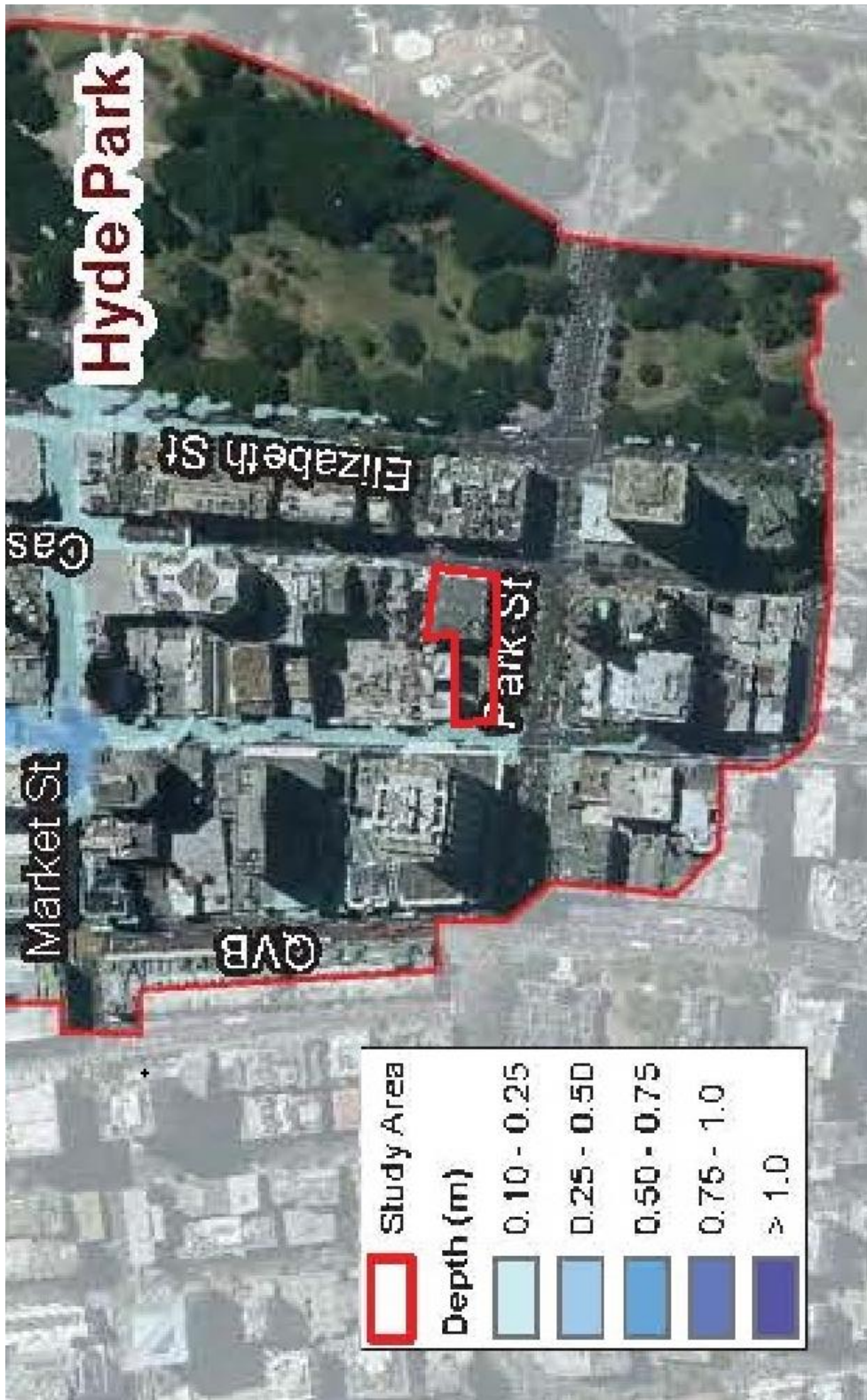


Figure 8 – 100 year ARI Flood Depth

Source: Sydney City Area Catchment Flood Study (2016)



Figure 9 – PMF Flood Depth

Source: Sydney City Area Catchment Flood Study (2016)

4.2. Post-Development Conditions

The SEARs requires that the Environmental Impact Statement (EIS) includes identification of the potential environmental impacts associated with the development. The assessment should address the following:

- Justification of impacts
- Consideration of potential cumulative impacts due to other development in the vicinity
- Measures to avoid, minimise and if necessary, offset the predicted impacts, including detailed contingency plans for managing any significant risks to the environment.

The footprint of the proposed development is located at the same location as the existing building footprint and hence it is assumed that there will be changes to flood impacts to the neighbouring properties as there is no new obstruction to flows. Since there are no impacts due to the over station development, it satisfies the Environmental Impact Statement criteria.

The proposed development is also required to meet the City of Sydney Interim Floodplain Management Policy requirements.

All the entrances to the over station development (OSD) should be above 100 year ARI plus 0.50m for the Residential habitable buildings and 0.3m above surrounding ground if the proposed development is outside the flood extents.

All the entrances to the basement should be above the 100 year ARI plus 0.50m or the PMF level whichever is higher. As the OSD only includes above ground features, there are no basement areas and hence, the development is compliant with this criteria.

4.3. Climate Change

The Climate Change assessment in the Sydney City Area Catchment Flood Study (2014) modelled peak water levels for a 10%, 20% and 30% increase to rainfall intensity for the 100 year ARI flood event.

For Sea Level Rise, design ocean boundary conditions were raised by 0.40m and 0.90m to assess the potential impact of sea level rise on the flood behaviour in the City Area catchment for the year 2050 and 2100 respectively for the 100 year ARI design modelling.

Australian Rainfall & Runoff (ARR2016) has identified that smaller magnitude increases in rainfall intensity are more likely. A 5% increase in rainfall intensity per °C increase in local warming should be adopted, consistent with ARR2016 (Book1, Chapter 6). However, the proposed development has been assessed for the 10%, 20% and 30% increase to rainfall intensity for the 100 year ARI flood event.

The impact maps in the Sydney City Area Catchment Flood Study (2014) show that the proposed development is not largely sensitive to the Climate Change impacts. It was identified that it is only sensitive to the 30% increase in rainfall intensity. The increases on Pitt Street are up to 0.10m. The flood impacts resulting from Climate Change with a 30% increase in rainfall intensity are shown in **Figure 10. Appendix C** shows full catchment map which includes the subject site.

Sea Level Rise impacts are largely seen at the downstream areas and do not have impacts at the Study Area.

The impacts of Climate Change are considered while assessing the Flood Planning Levels.

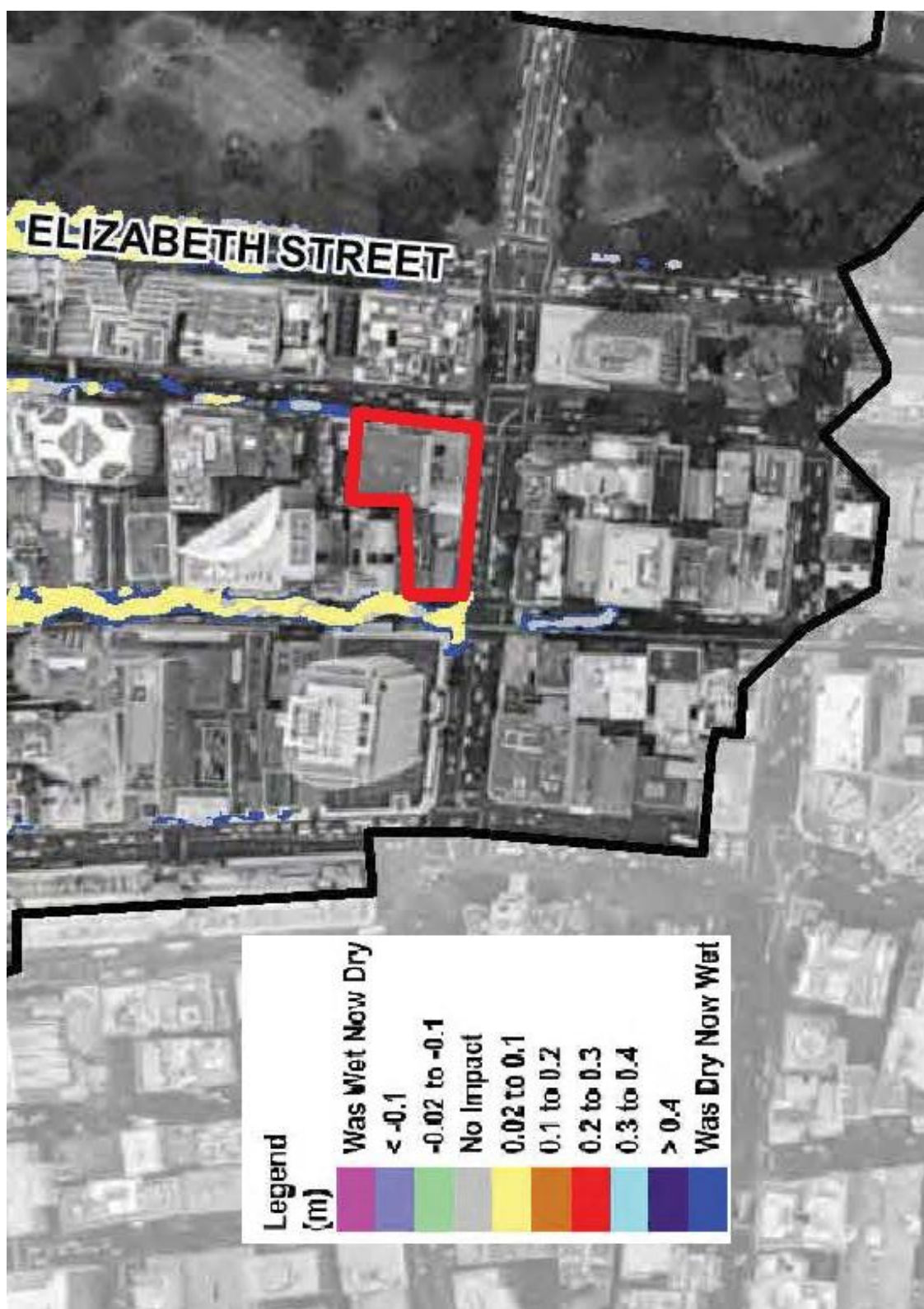


Figure 10 – Climate Change Impacts (30% Rainfall Depth Increase)

Source: Sydney City Area Catchment Flood Study (2014)

4.4. Flood Planning Levels

Based on the Flood Planning Level (FPL) requirements for development within the City of Sydney (provided in **Appendix A**), the proposed ground floor levels for the proposed Pitt Street North OSD are summarised in **Table 4-1**, and the reference locations are shown on **Figure 11**.

Peak 100 year ARI and the PMF water levels in the vicinity of the proposed development range from 22m AHD in Pitt Street to 24.50m AHD at the corner of Park and Castlereagh Street. The assessment has been undertaken by interpreting the flood maps from the City of Sydney Flood Study (2014) and City of Sydney City Area Catchment Flood Risk Management Study (September, 2016), along with the proposed design ground floor plans for the OSD prepared by Architectus on behalf of Sydney Metro (15/03/2018). The Ground Floor plan is provided in **Appendix B**.

Table 4-1 Flood Planning Levels Summary

ID	Land Use Type	100yr ARI Flood Depths	PMF Flood Depths	Flood Planning Level	Proposed Floor Level
C1	Co-Working Lobby / Metro	N/A	0.10 – 0.25	300mm Above Ground Level	24.65
C2	Residential Lobby/OSD	N/A	0.10 – 0.25	300mm Above Ground Level	24.50/24.35
C3	Shared OSD Loading Zone	N/A	0.10 – 0.25	300mm Above Ground Level	24.35
C4	Residential SRV	N/A	0.10 – 0.25	300mm Above Ground Level	24.21
C5	Hotel SRV	N/A	0.10 – 0.25	300mm Above Ground Level	24.12
PA5	Hotel Lobby	N/A	0.10 – 0.25	300mm Above Ground Level	23.31
P1	Residential Lobby	0.10 – 0.25	0.10 – 0.25	100yr ARI + 0.5 m freeboard	23.00
P2	OSD	0.10 – 0.25	0.10 – 0.25	300mm Above Ground Level	22.40
P3	OSD/Hotel Staff Entrances	0.10 – 0.25	0.10 – 0.25	300mm Above Ground Level	22.31

N/A - Reference location is outside the 100 year ARI flood extents with minor (<100mm) overland flow flooding.

Notes: For all Residential buildings, the FPL of 100yr ARI + 0.5 m freeboard is listed.

For Commercial/Retail buildings, the FPL is the 100 year ARI event as a minimum with any freeboard to be provided on a merits based approach.

Entrances to the building basement should be above the peak PMF flood level

All the above requirements have sufficient freeboard to accommodate consideration of the effect of climate change. 0.10m increases in flood levels are observed on Pitt Street with a worst case 30% increase in rainfall intensity for a 100 year ARI event. This increase is within the 0.5m freeboard adopted flood planning levels.

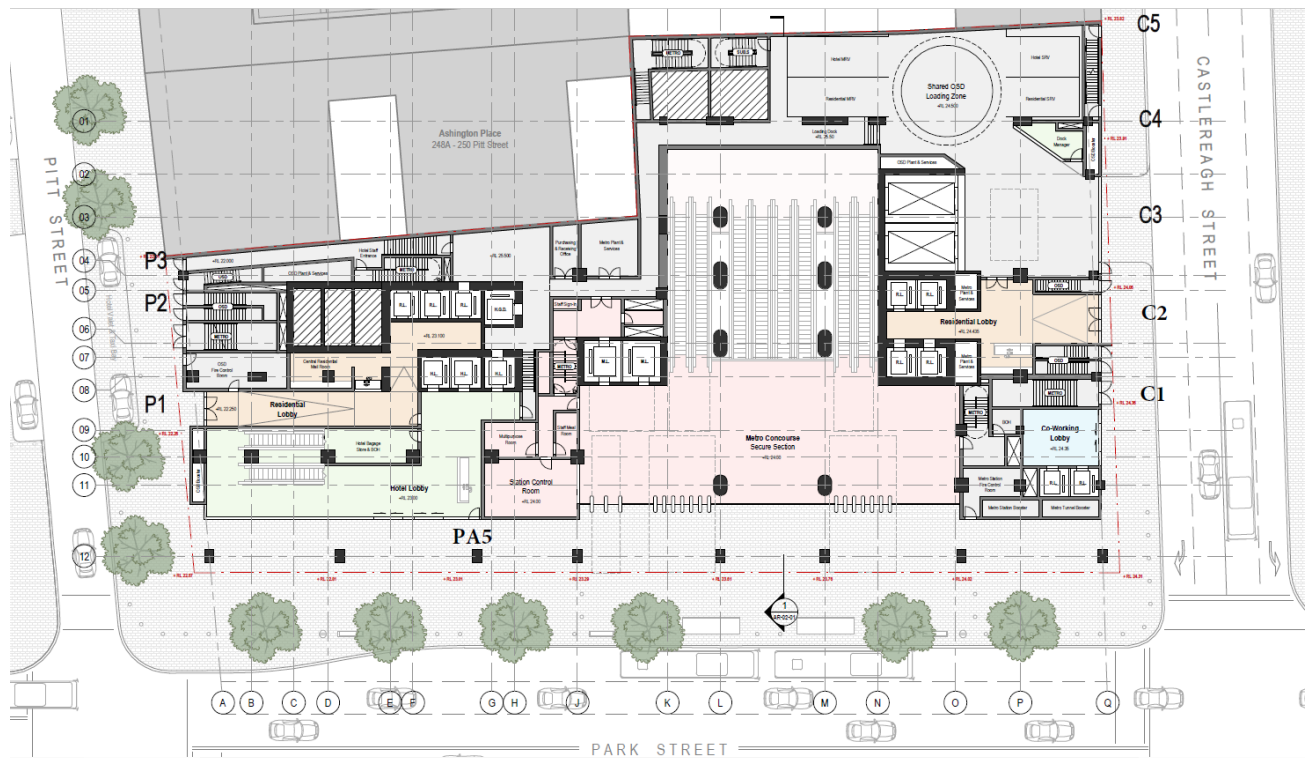


Figure 11 – Flood Planning Levels- Reference Locations

4.5. Flood Warning Time

The site remains effectively flood free on Park and Castlereagh Street in a 100 year ARI event and no flood warning would be anticipated with respect to overland flooding. The Study area is affected by flash flooding (i.e. floods where the warning time is less than 30 minutes). The short duration and response times limit the implementation of a flood warning system.

Provision of suitable shelter space on site would minimise strain on emergency services and roads during flood events where residents, guests or the public can retreat to for the short duration of the flood event.

4.6. Evacuation and Safe Refuge

During mainstream flood events greater than the 100 year ARI up to the PMF, the general strategy for evacuation would be evacuation via the road networks to high ground in Hyde Park or College Street during the early stages of the event and shelter in place for those not able to evacuate to flood free land in time. **Figure 12** shows the PMF Hazard map in the vicinity of the subject site. It shows that the area around Pitt Street North is categorised as low hazard. **Appendix C** shows full catchment map which includes the subject site.

In general, the multistorey buildings would allow residents to seek refuge within the development. People on the ground floor of the proposed building would evacuate vertically within each building and shelter in place at a level above the PMF until the flood subsided.

Based on the over station development plans, the Ground Floor is above the PMF levels.

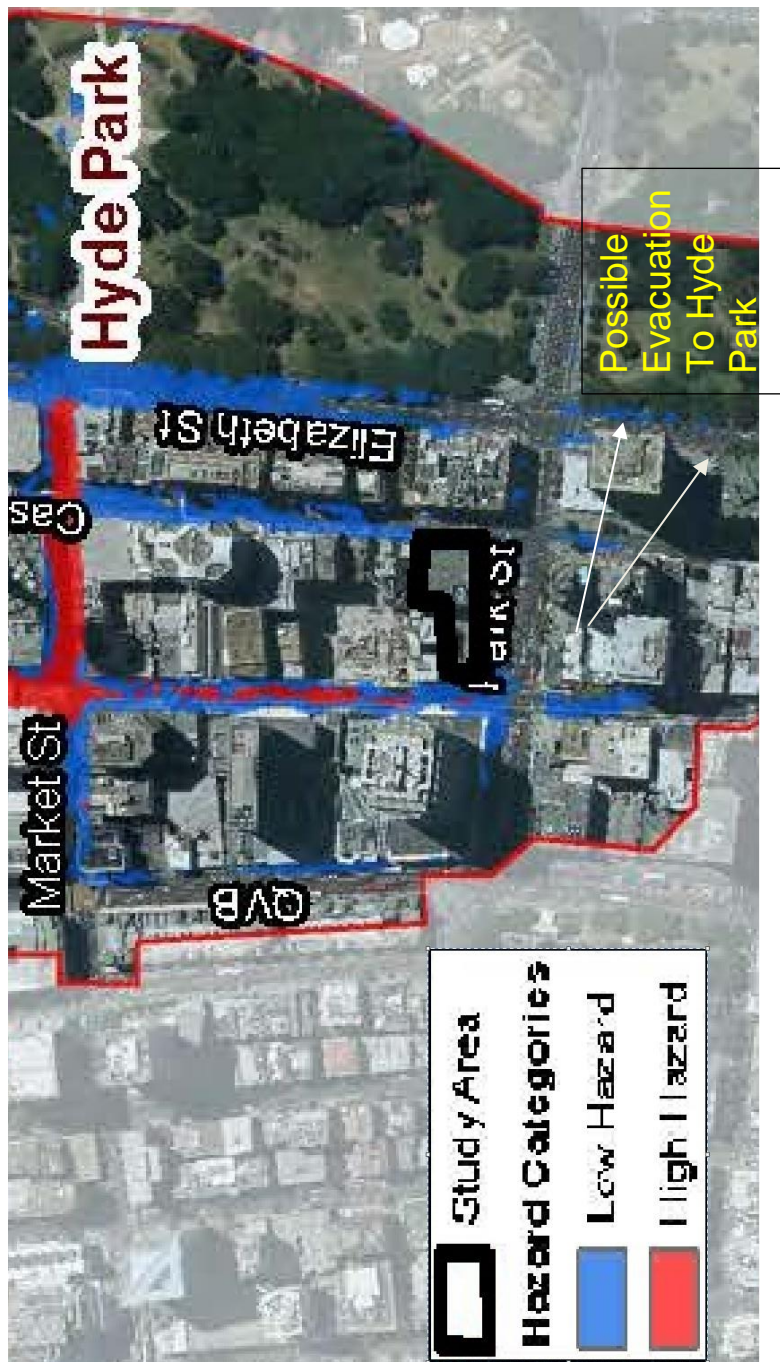


Figure 12 – PMF – Hazard Map

Source: City of Sydney (2016)

5. Stormwater Drainage

5.1. Existing Drainage

The City of Sydney Council “City Area Catchment Flood Study (2014) and the Sydney City Area Catchment Flood Risk Management Study (2016) provides details of the existing drainage within the City Area catchment. Around the Pitt Street North site, there is a pit and pipe drainage system within the road reserve.

5.2. Proposed Drainage

The proposed over station development includes On-Site Detention within the site which will seek to detain any additional runoff generated by increased impervious surfaces to ensure that flows off-site will remain at or below existing flows. As such, there will not be any additional stormwater flow into the existing drainage system and no augmentation would be required to accommodate the development.

Modification to the drainage system may be required such as adjustment to pit locations to accommodate driveways and the entrances to OSD and design of these drainage modifications shall comply with Council’s requirements as detailed in the BoD Report (2017, Sydney Metro).

5.3. On-Site Detention

The BoD Report (2017, Sydney Metro) details the requirements of Council’s and Sydney Water OSD requirements. The requirement and size of the on-site detention tanks will be determined from Sydney Water.

The proposals for the Pitt Street North Metro replace existing buildings that connect into the existing drainage system and it is assumed that there will not significant changes to the runoff from the site. Further design and investigation will need to consider any council regulations that require further on-site detention.

6. Conclusion

The over station development above Pitt Street North has been assessed with respect to flooding and stormwater management and satisfies the Secretary's Environmental Assessment Requirements (SEARs) and also satisfies the City of Sydney Council's Flood Planning requirements. The proposed development does not have any flood impacts on the neighbouring properties and the proposed development will manage stormwater on-site to not increase flows to the Council stormwater network.

7. References

Sydney Metro (2017) *BoD Report - CE – Pitt Street Station*. Prepared for Sydney Metro.

WMAwater (2016) *City Area Catchment Flood Risk Management Study*. Prepared for City of Sydney.

BMT WBM (2014) *City Area Catchment Flood Study*. Prepared for City of Sydney.

AR&R (Australian Rainfall and Runoff) (2016) *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Geoscience Australia, Canberra.

Appendix A

Flood Planning Requirements

5 Flood Planning Levels

A Flood Planning Level refers to the permissible minimum building floor levels. For below-ground parking or other forms of below-ground development, the Flood Planning Level refers to the minimum level at each access point. Where more than one flood planning level is applicable the higher of the applicable Flood Planning Levels shall prevail.

Development		Type of flooding	Flood Planning Level
Residential	Habitable rooms	Mainstream flooding	1% AEP flood level + 0.5 m
		Local drainage flooding (Refer to Note 2)	1% AEP flood level + 0.5 m or Two times the depth of flow with a minimum of 0.3 m above the surrounding surface if the depth of flow in the 1% AEP flood is less than 0.25 m
		Outside floodplain	0.3 m above surrounding ground
	Non-habitable rooms such as a laundry or garage (excluding below-ground car parks)	Mainstream or local drainage flooding	1% AEP flood level
Industrial or Commercial	Business	Mainstream or local drainage flooding	Merits approach presented by the applicant with a minimum of the 1% AEP flood level
	Schools and child care facilities	Mainstream or local drainage flooding	Merits approach presented by the applicant with a minimum of the 1% AEP flood level + 0.5m
	Residential floors within tourist establishments	Mainstream or local drainage flooding	1% AEP flood level + 0.5 m
	Housing for older people or people with disabilities	Mainstream or local drainage flooding	1% AEP flood level + 0.5 m or a the PMF, whichever is the higher
	On-site sewer management (sewer mining)	Mainstream or local drainage flooding	1% AEP flood level
	Retail Floor Levels	Mainstream or local drainage flooding	Merits approach presented by the applicant with a minimum of the 1% AEP flood. The proposal must demonstrate a reasonable balance between flood protection and urban design outcomes for street level activation.
Below-ground garage/ car park	Single property owner with not more than 2 car spaces.	Mainstream or local drainage flooding	1% AEP flood level + 0.5 m

Development	Type of flooding	Flood Planning Level	
Below-ground car parks	All other below-ground car parks	Mainstream or local drainage flooding	1% AEP flood level + 0.5 m or the PMF (whichever is the higher) See Note 1
	Below-ground car park outside floodplain	Outside floodplain	0.3 m above the surrounding surface
Above ground car park	Enclosed car parks	Mainstream or local drainage flooding	1% AEP flood level
	Open car parks	Mainstream or local drainage	5% AEP flood level
Critical Facilities	Floor level	Mainstream or local drainage flooding	1% AEP flood level + 0.5m or the PMF (whichever is higher)
	Access to and from critical facility within development site	Mainstream or local drainage flooding	1% AEP flood level

Notes

- 1) The below ground garage/car park level applies to all possible ingress points to the car park such as vehicle entrances and exits, ventilation ducts, windows, light wells, lift shaft openings, risers and stairwells.
- 2) Local drainage flooding occurs where:
 - The maximum cross sectional depth of flooding in the local overland flow path through and upstream of the site is less than 0.25m for the 1% AEP flood; and
 - The development is at least 0.5m above the 1% AEP flood level at the nearest downstream trapped low point; and
 - The development does not adjoin the nearest upstream trapped low point; and
 - Blockage of an upstream trapped low point is unlikely to increase the depth of flow past the property to greater than 0.25m in the 1% AEP flood.
- 3) Mainstream flooding occurs where the local drainage flooding criteria cannot be satisfied.
- 4) A property is considered to be outside the floodplain where it is above the mainstream and local drainage flood planning levels including freeboard.

Appendix B

Ground Floor Plan

Appendix C

Figures

FIGURE 2
PEAK FLOOD DEPTH
1% AEP DESIGN FLOOD EVENT



Figure C1 – 100 year ARI Flood Depth

Source: Sydney City Area Catchment Flood Study (2016)

FIGURE 3
PEAK FLOOD DEPTH
PMF DESIGN FLOOD EVENT



Figure C2 – PMF Flood Depth

Source: Sydney City Area Catchment Flood Study (2016)

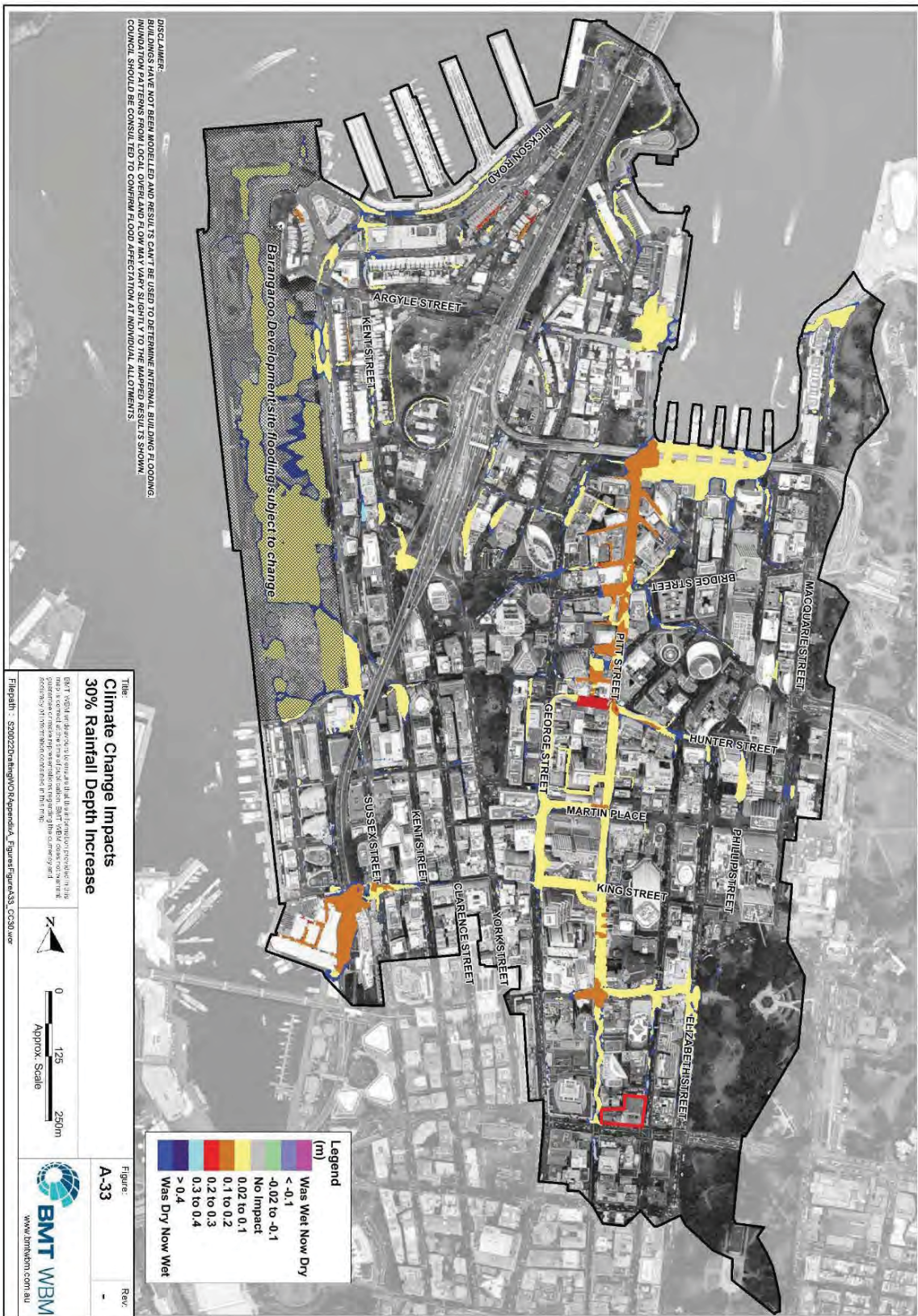


Figure C3– Climate Change Impacts (30% Rainfall Depth Increase)

Source: Sydney City Area Catchment Flood Study (2014)

**FIGURE 5
HAZARD CATEGORIES
PMF DESIGN FLOOD EVENT**

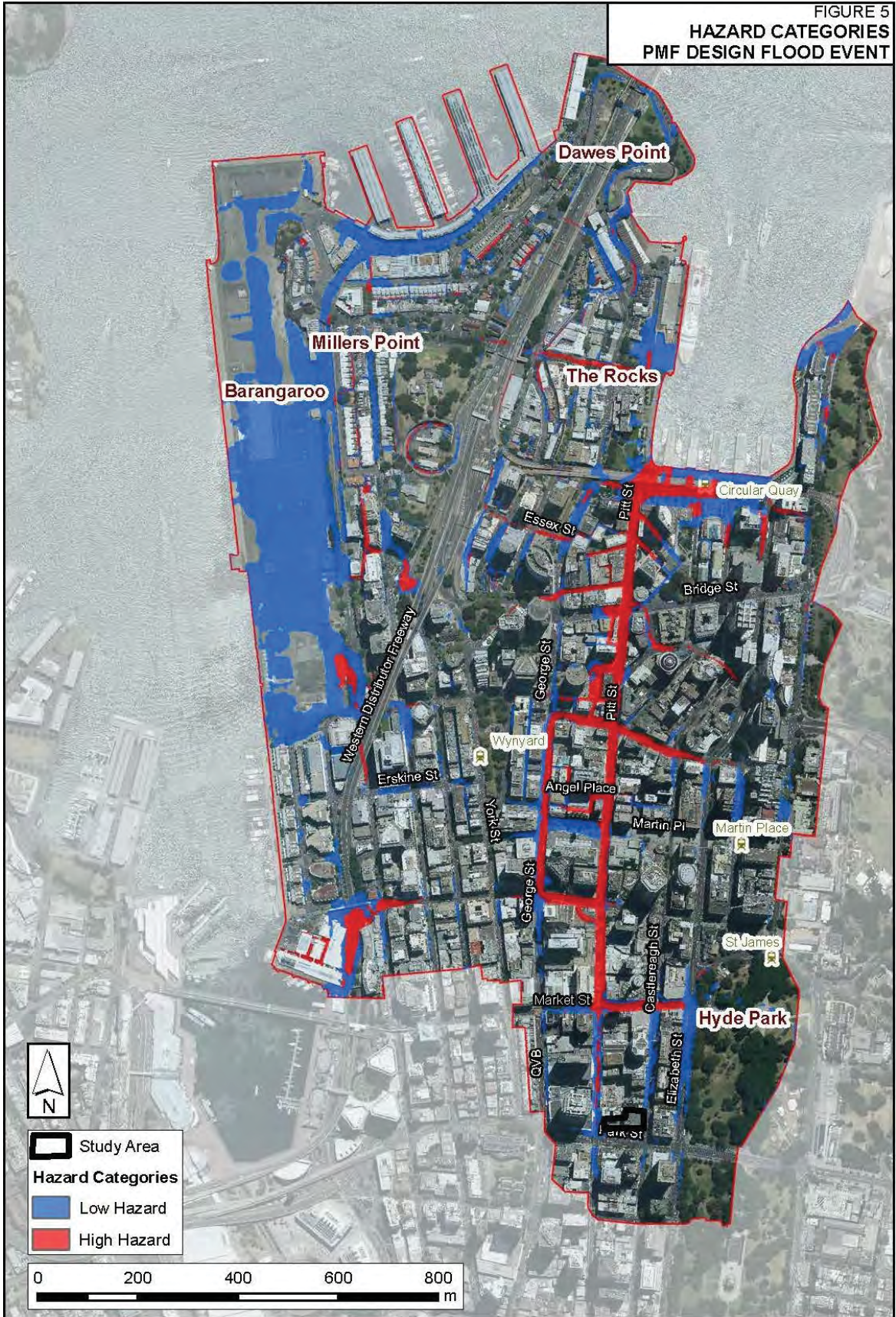


Figure C4 – PMF – Hazard Map

Source: City of Sydney (2016)