

# **FLOOD ASSESSMENT AND STORMWATER MANAGEMENT REPORT**

APPENDIX T





# Sydney Metro City & Southwest Victoria Cross Over Station Development:

Flood assessment and stormwater management report

<b>Applicable to:</b>	Sydney Metro City & Southwest
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<b>Owner</b>	Transport for NSW
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## 1.0 Introduction

### 1.1 Purpose of this report

This report supports a concept State Significant Development Application (concept SSD Application) submitted to the Department of Planning and Environment (DP&E) 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.

Transport for NSW (TfNSW) is seeking to secure concept approval for a commercial office tower above the Victoria Cross Station, otherwise known as the over station development (OSD). The concept SSD Application seeks consent for a building envelope and its use as a commercial premises (office, business and retail), maximum building height, maximum gross floor area, pedestrian and vehicular access, circulation arrangements and associated car parking, future subdivision (if required) and the strategies and design parameters for the future detailed design of development.

TfNSW proposes to procure the construction of 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 DP&E on 9 January 2017.

As the development is within a rail corridor, is associated with railway infrastructure and is for commercial premises with a Capital Investment Value of more than \$30 million, the project is identified as State Significant Development (SSD) pursuant to Schedule 1, 19(2)(a) of the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP).

This report has been prepared to outline the flood and stormwater management strategy for the OSD and to specifically respond to the Secretary's Environmental Assessment Requirements (SEARs) issued for the concept SSD Application on 30 November 2017 which states that the Environmental Impact Statement (EIS) is to include a flood 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 (Stage 1), which is due for completion in 2019 and Sydney Metro City & Southwest (Stage 2), which is due for completion in 2024 (Refer to **Figure 1**).



**Figure 1:** Sydney Metro alignment map

Stage 2 of Sydney Metro 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 (7) new metro stations, including at North Sydney. 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 lodged by TfNSW 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 OSD (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 OSD to be more efficiently built and appropriately integrated into the metro station structure.

The EIS for the Chatswood to Sydenham component of the 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 original station design remains approved. This modification application was approved on 22 March 2018.
- Modification 4 - Sydenham Station and Sydney Metro Trains Facility South which incorporates 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 Stage 2 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 part of the project, referred to as the Sydenham to Bankstown Upgrade, is the subject of a separate CSSI Application (Application No. SSI 17\_8256) which is currently being assessed by the DP&E.

### 1.3 Planning relationship between Victoria Cross Station and the OSD

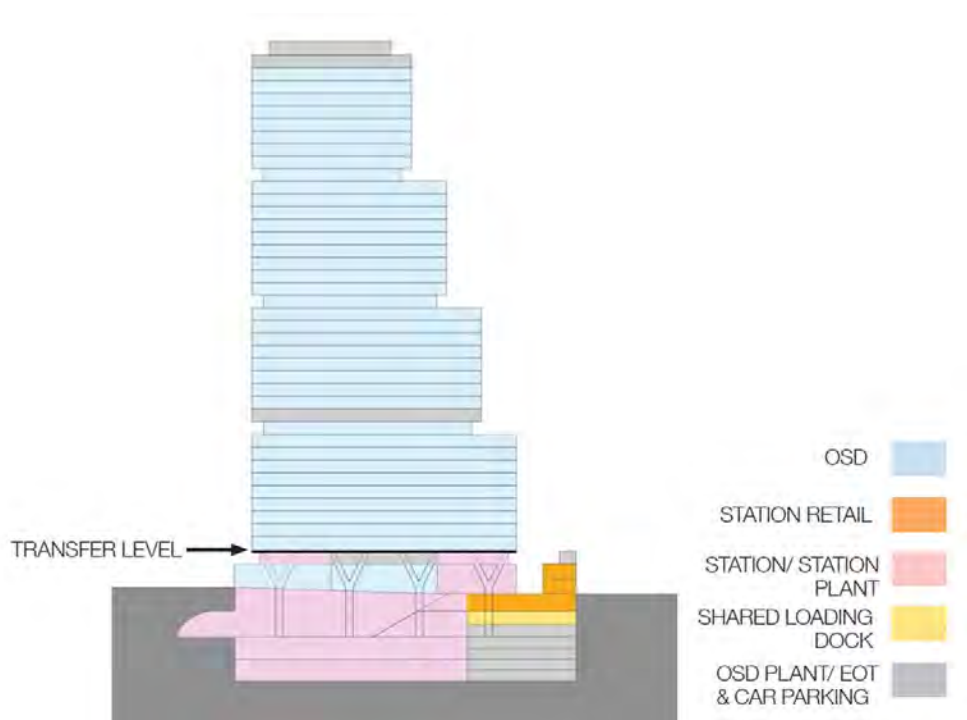
While the Victoria Cross Station and OSD will form an Integrated Station Development, the planning pathways defined under the *Environmental Planning & Assessment Act 1979* require separate approval for each component of the development. In this regard, the approved station works (CSSI Approval) are 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 include the construction of below and above ground structures necessary for delivering the station and also enabling construction of the integrated OSD. This includes 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
- Pedestrian through-site link
- 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 Victoria Cross is defined by RL 82), above which would sit the OSD. This delineation is illustrated in **Figure 2**.





**Figure 2:** Delineation between the Metro station and OSD

The CSSI Approval also establishes the general concept for the ground plane of Victoria Cross Station including access strategies for commuters, pedestrians and workers. In this regard, pedestrian access to the station would be from Miller and Denison Streets and the commercial lobby would be accessed from Miller Street. Retail uses (approved under the CSSI Approval) would be located on the ground floor of the development at both the Miller Street and Denison Street levels activating the through-site link. Separate consent would be sought in the future for the fit-out and specific use of this retail space.

Since the issue of the CSSI Approval, TfNSW 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 Victoria Cross 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.

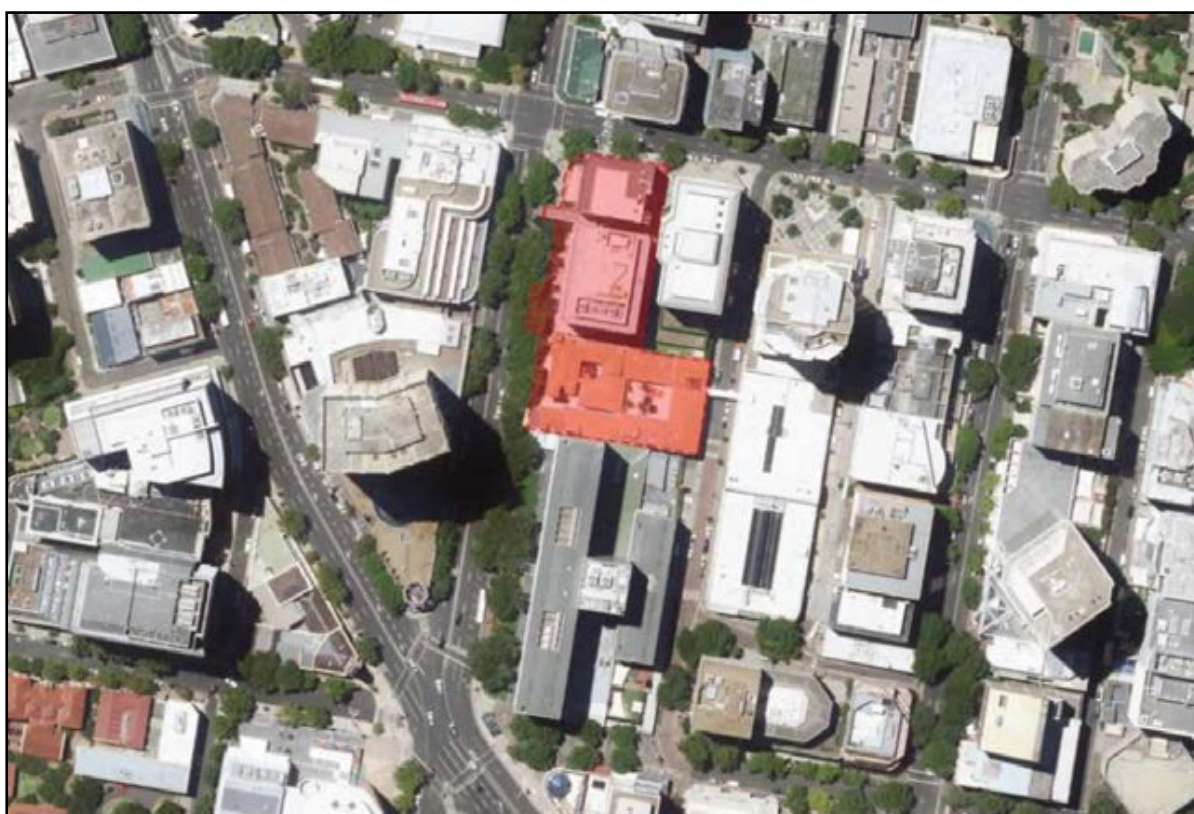
## 1.4 The Site

The Victoria Cross OSD site is located at the southeast corner of the intersection of Miller and Berry Streets, North Sydney, above the southern portal of the future Victoria Cross Station (refer to **Figure 3w**). The site is located in North Sydney Centre which is identified as a “strategic centre” under *A Plan for Growing Sydney*. It is the third largest office market in Sydney and is a key component of Sydney’s Global Economic Corridor.



**Figure 3:** Victoria Cross Station location plan

The site is located in the North Sydney Local Government Area approximately 3km north of Sydney CBD, 5km southeast of Chatswood and 2km southeast of St Leonards. The site (refer to **Figure 4**) is irregular in shape, has a total area of approximately 4,815 square metres and has street frontages of approximately 37 metres to Berry Street, 34 metres to Denison Street and 102 metres to Miller Street.



**Figure 4:** The site

The site comprises the following properties:

- 155–167 Miller Street SP 35644 (formerly Tower Square)
- 181 Miller Street Lot 15 in DP 69345, Lot 1 & Lot 2 DP 123056 and Lot 10 in DP 70667
- 187 Miller Street Lot A in DP 160018
- 189 Miller Street Lot 1 in DP 633088
- Formerly part 65 Berry Street Lot 1 in DP 1230458

## 1.5 Overview of the proposed development

This concept SSD Application comprises the first stage of the Victoria Cross OSD project. It will be followed by a detailed SSD Application for the design and construction of the OSD to be lodged by the successful contractor who is awarded the contract to deliver the Integrated Station Development.

This concept SSD Application seeks approval for the planning and development framework and strategies to inform the future detailed design of the OSD. It specifically seeks approval for the following:

- A building envelope as illustrated in **Figure 5**

- A maximum building height of RL 230 or 168 metres (approximately 42 storeys, comprising 40 commercial storeys and 2 additional storeys for the roof top plant) for the high rise portion of building envelope and RL 118 or 55 metres (approximately 13 storeys) for the lower rise eastern portion of the building envelope
- A maximum gross floor area (GFA) of 60,000 square metres for the OSD component, which is equivalent to a floor space ratio of 12.46:1
- Use of the building envelope area for commercial premises including commercial office, retail and business premises
- Use of the conceptual OSD space provisioning within the footprint of the CSSI Approval (both above and below ground), including the OSD lobby and associated retail space, basement parking, end-of-trip facilities, services and back-of-house facilities
- Car parking for a maximum of 150 parking spaces over four basement levels with an additional 11 parking spaces allocated to the station retail approved under the terms of the CSSI Approval
- Loading, vehicle and pedestrian access arrangements from Denison Street
- Strategies for utility and services 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).

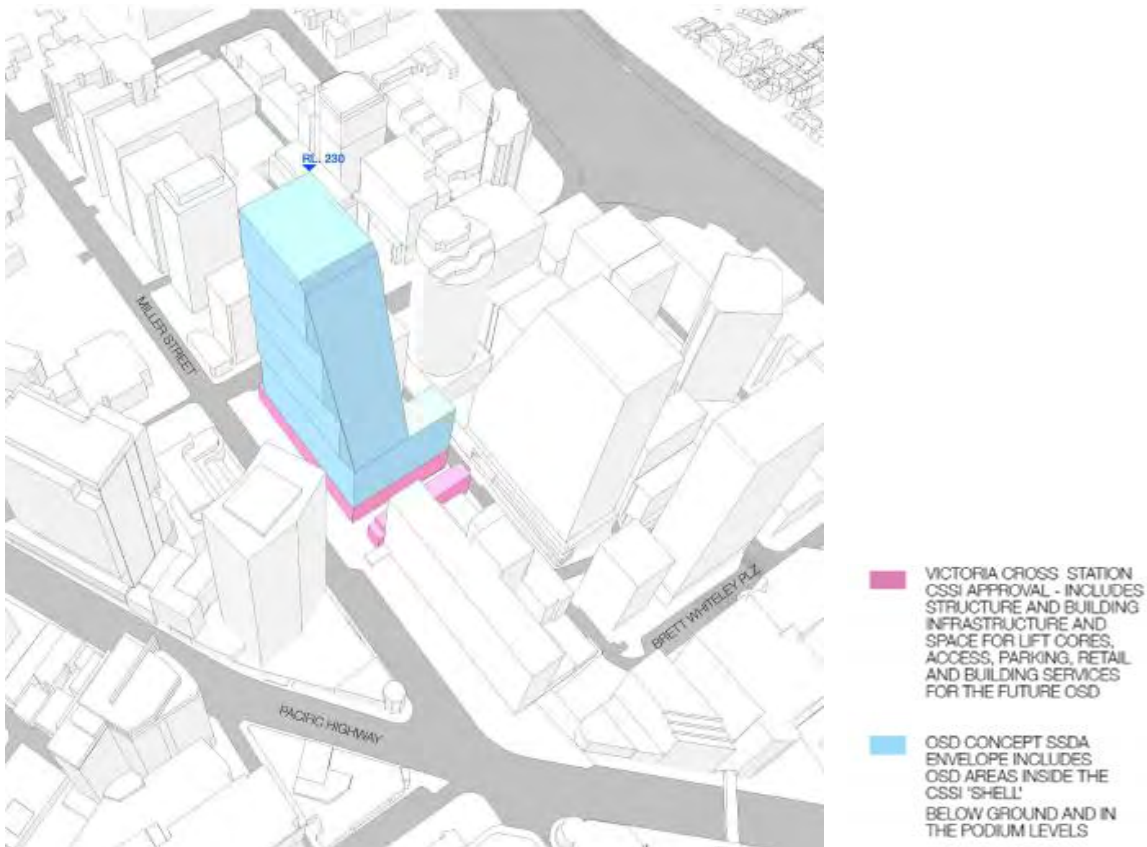
The total GFA for the Integrated Station Development including the station GFA (i.e. retail, station circulation and associated facilities) and the OSD GFA is 67,000 square metres and is equivalent to a FSR of 13.9:1.

A drawing illustrating the proposed building envelope is provided in **Figure 5**. The concept SSD Application includes an indicative design for the OSD to demonstrate one potential design solution within the proposed building envelope (refer to **Figure 6**).

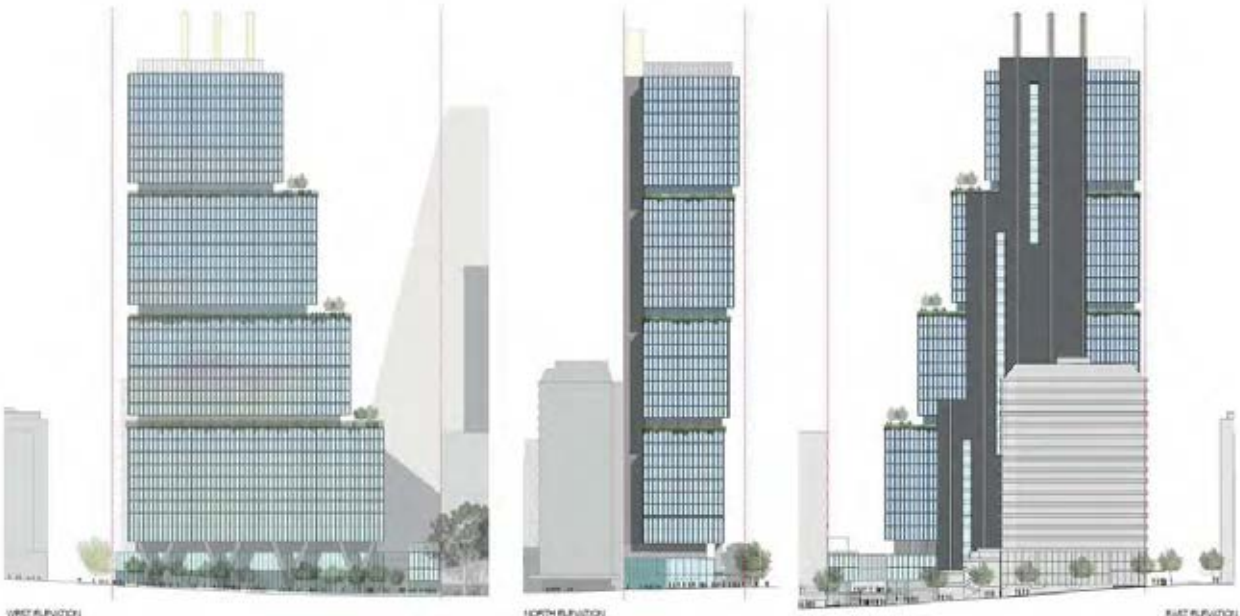
Victoria Cross Station is to be a key station on the future Sydney Metro network, providing access to the growing North Sydney Central Business District (CBD). The proposal combines the Metro station with a significant commercial office tower, contributing to the North Sydney skyline. The OSD would assist in strengthening the role of North Sydney as a key component of Sydney's global economic arc and would contribute to the diversity, amenity and commercial sustainability of the CBD.

It is noted that Victoria Cross services building and new station entrance at Victoria Cross do not form part of the concept SSD Application.





**Figure 5:** Proposed Victoria Cross OSD building envelope



**Figure 6:** Victoria Cross indicative OSD design

## 2.0 Scope of assessment

This report is based on the OSD concept design drawings provided by TfNSW (hereafter referred to as the indicative OSD design). This report documents the flood assessment and stormwater management plan that has been undertaken for the OSD in support of the concept SSD Application.

The following tasks were undertaken as part of this report:

- Review of relevant legislation, policies and guidelines associated with stormwater management;
- Consultation with TfNSW's station design team in relation to flood modelling and mitigation and station stormwater design and management;
- Identification of preliminary OSD stormwater management strategy; and
- Estimation of preliminary OSD on-site detention volumes and configurations.

A series of collaboration workshops have been undertaken with TfNSW's Underground Station Design & Technical Services Team (METRON) to coordinate the designs, identify challenges and propose solutions. This occurred as METRON advanced towards their Stage 1 design deliverable (approximately a 40% level of definition).

It is important to note that the stormwater management and flood mitigation measures within the proposed Victoria Cross station leads the context for the assessment of flood impacts and stormwater management plans for the OSD. **Table 1** provides a summary of interfaces and responsibilities between the CSSI Approval and the concept SSD Application. Relevant references are made throughout this report to the preliminary design undertaken by TfNSW's station design team to provide context for the concept proposal and the indicative OSD design.

**Table 1** Victoria Cross concept SSD & CSSI design development Interface.

Item	Responsibility	Interface Details
Flood Modelling	TfNSW are responsible for undertaking a flood assessment for the new station and public domain, under the terms of the CSSI Approval.	Preliminary flood modelling has been undertaken by TfNSW in accordance with the CSSI Approval to assess the flooding impacts of the proposed ISD. Outcomes and features of the preliminary flood modelling assessment are broadly discussed within this report.
Stormwater Management	TfNSW are responsible for providing a stormwater management plan for the station, station retail and public domain areas within the site area including in-ground stormwater asset modification/ installation under the CSSI Approval. The concept SSD Application is responsible for stormwater management of the proposed OSD including rainwater collection, storage, treatment and discharge to in-ground infrastructure.	A Stormwater management plan for the station design has been undertaken in accordance with the CSSI Approval and broadly discussed in this report. A Stormwater Management plan for the OSD is detailed within this report adopting the design criteria identified through preliminary authority liaison as part of the CSSI Approval.
Authority Liaison	TfNSW are responsible for undertaking authority liaison (Sydney Water & North Sydney Council) for the development (station & OSD).	Preliminary authority liaison with Sydney Water and Council has been undertaken by TfNSW with the principles and outcomes of the liaison discussed within this report.

## 3.0 Existing flood studies

A desktop study of North Sydney Council's existing flood information has been undertaken to provide a flooding context for the site.

### 3.1 North Sydney LGA Flood Study (2017)

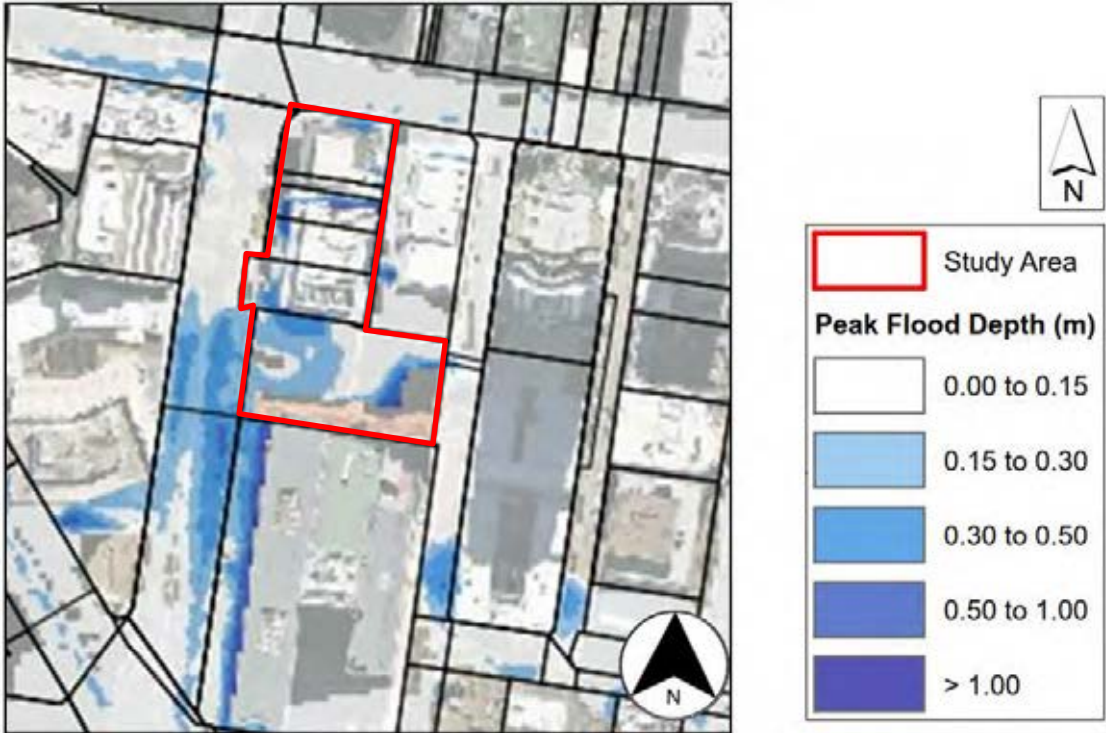
In February 2017, North Sydney Council released the North Sydney LGA Flood Study, which was undertaken by WMAwater. The aim of the study is to assist Council in satisfying their responsibilities for managing flood risk within the LGA. The flood study was prepared to define existing flood behaviour in the North Sydney LGA 10.9 km<sup>2</sup> catchment area and to establish the basis for subsequent floodplain management activities. The study incorporates key elements specific to the Victoria Cross OSD site including:

- Compilation and review of existing information;
- Review of previous flooding history; and
- Define the flood behaviour for a range of design events including the 20%, 10% and 1% AEP, and the Probable Maximum Flood (PMF) event.

**Figure 7** presents the 100yr ARI flood mapping in the site area. This study notes that the OSD site area is flood prone with depths in excess of 0.3m for events up to the 5yr ARI event and in excess of 1m for the 100yr ARI event.

It should be noted that the Council Flood Study has been undertaken over the entire North Sydney LGA region and does not consider any pipe elements smaller than 450mm. As such, the results of the study may not provide a definitive flood level for the site area.





**Figure 7:** 100 year ARI flood  
 Source: North Sydney LGA Flood Study (2017)

### 3.2 Victoria Cross Station preliminary flood assessment

A preliminary flood assessment has been undertaken by TfNSW which has been based on the 2017 Council Flood Model.

The assessment has confirmed that the site is located in a flood affected area, noting that the previous building courtyard at Tower Square (now demolished under the terms of the CSSI Approval) provided informal flood storage during major storms greater than the 5yr ARI event.

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## 4.0 Flood planning requirements

The following sections describe the flooding principles for the broader site area. It should be noted that flood assessment and stormwater management for the site has been undertaken as part of the CSSI Approval. The following sections will highlight the relevant features of the flood management strategy developed by TfNSW following the issue of the CSSI approval, to provide context for the broader site development.

### 4.1 Proposed flood planning requirements

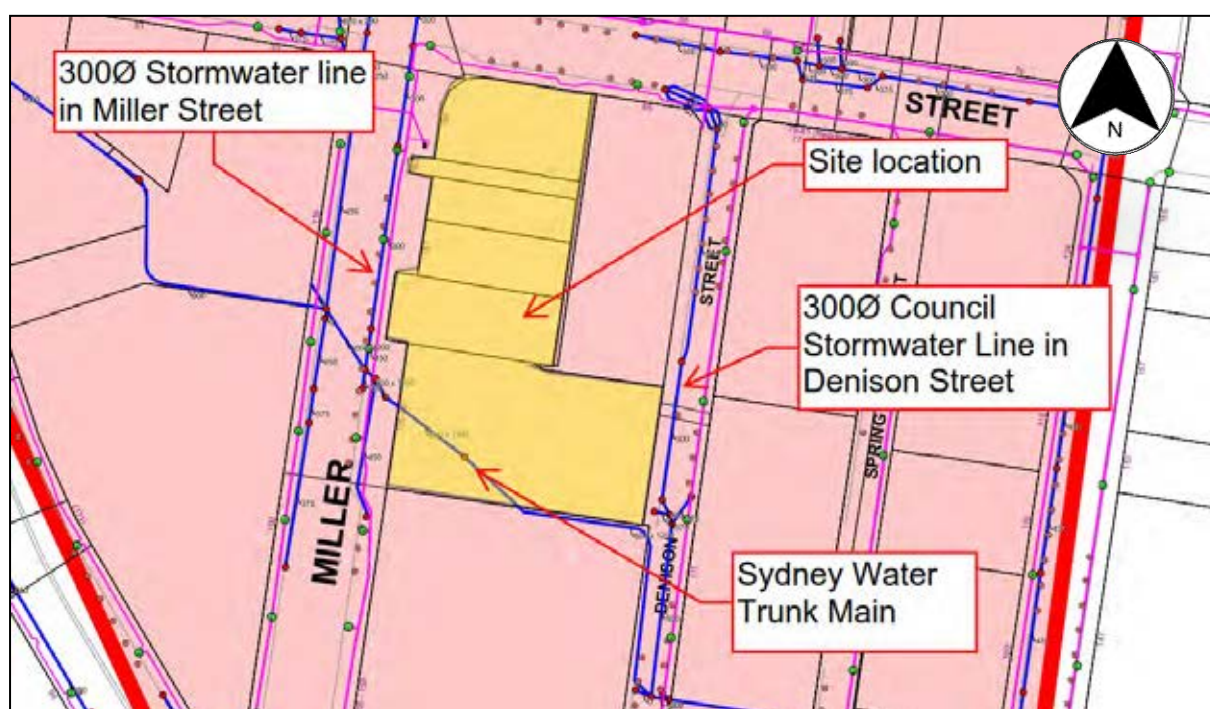
The proposed criteria as nominated by TfNSW in their CSSI flood assessment have been noted as follows:

- Station entry levels and basement ramp thresholds are to be set to PMF flood level;
- Retail areas located within the Miller Street – Denison Street through-site link overland flow path area are to be protected to 100yr ARI flood Level;
- Lift shafts located within the Miller Street – Denison Street through-site-link overland flow path to be protected to events greater than 100yr ARI event using automatic flood barriers; and
- All other entrances are proposed to be set to the 100yr ARI flood level +500mm freeboard.



## 5.2 Existing council drainage infrastructure

North Sydney Council operate and maintain the local street drainage infrastructure around the site. The site is understood to be serviced by the local drainage infrastructure in Miller Street and Denison Street as shown below in **Figure 9**. The DBYD information suggests that the council system discharges directly to the Sydney Water trunk drainage line.



**Figure 9:** North Sydney Council local drainage infrastructure  
Source: DBYD, 2017.

### 5.2.1 Existing catchment

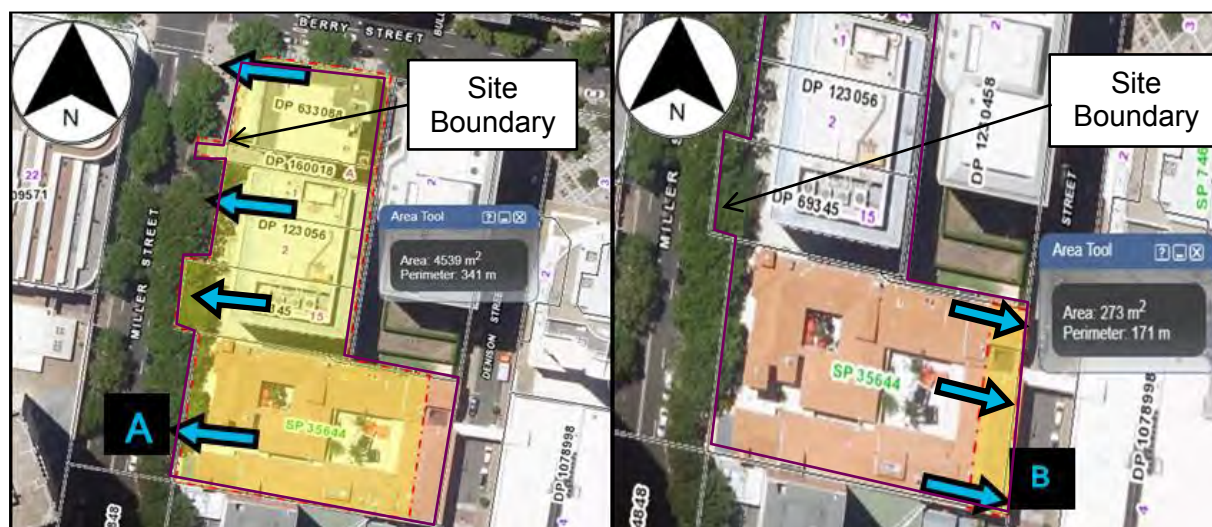
The previously existing (now demolished under the CSSI approval) development lots were almost 100% impervious with the majority of the runoff originating from building roofs (discharged via gutter and downpipes) and surrounding pavement surfaces. There were some minor bypass areas between buildings and along public footpath areas. The previously existing (now demolished) development lot SP35644 (refer to **Figure 10**) was understood to be graded towards Miller Street with a portion of the eastern roof area discharging to Denison Street via a downpipe to the southern corner of the development lot.

Given Council's Stormwater DCP does not explicitly stipulate on-site detention to be employed in the area, it is assumed that the previous developments did not have any formalised on-site detention or rainwater reuse tanks.

The previously existing stormwater discharge from the site has been calculated using the DRAINS software program. **Figure 8** demonstrates existing roof catchment distribution and



peak discharge values can be found in **Table 2**. These values are based on the AR&R '87 ILSAX method for 100% impervious areas for a 5 minute time of concentration.



**Figure 10:** Existing catchment distribution - Victoria Cross South.  
Source: SIX Maps

**Table 2:** Preliminary existing stormwater discharge – Victoria Cross South

Location1	Site area (m2)	5Yr ARI Peak Discharge Qp5yr (L/s)	10Yr ARI Peak Discharge Qp10yr (L/s)	20Yr ARI Peak Discharge Qp20yr (L/s)	100Yr ARI Peak Discharge Qp100yr (L/s)	Comments
Vic Cross South: A	4537	203	232	269	324	Discharge to Miller Street drainage system
Vic Cross South: B	278	12	14	16	20	Discharge to Denison Street drainage system
Total	4815	215	246	285	344	Ultimately site discharges to Sydney Water culvert

**Table 2 Notes:**

1. Refer to **Figure 10** for discharge locations A & B.

## 6.0 Victoria Cross station – preliminary flood mitigation strategy

Preliminary flood modelling has been undertaken as part of the post CSSI approval design development works. Based on preliminary discussions with TfNSW, the following features form part of the flood mitigation strategy in conjunction with the proposed flood planning requirements noted in **Section 4.1**.

### 6.1 Overland flow path between Miller Street and Denison Street

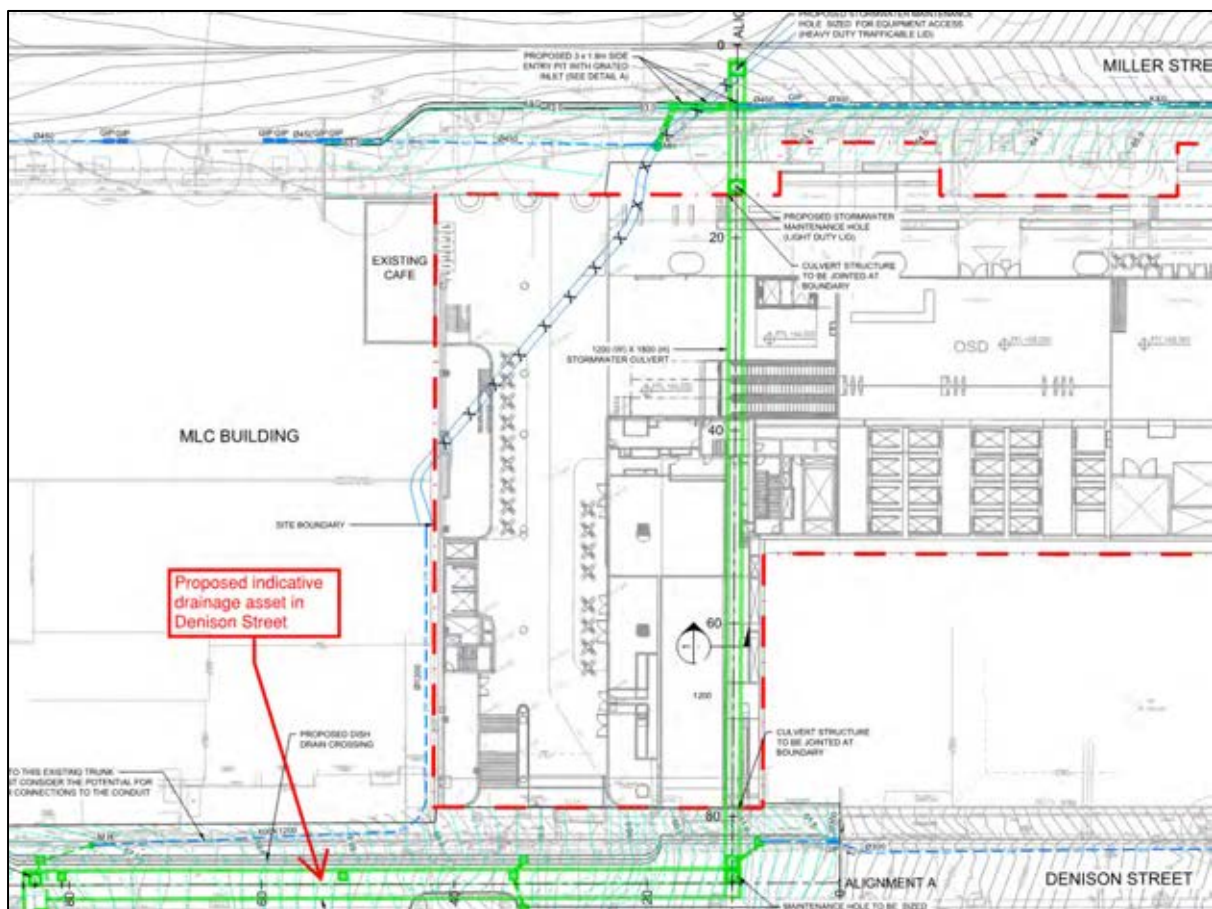
The intent is to provide safe conveyance of flow currently discharged along the existing overland flow path during major storm events along the proposed Through-site link which adjoins Miller Street and Denison Street. Flood protection for the proposed retail tenancies and station entrances will be provided through surface grading and elevated floor levels. The surface grading will need to consider DDA accessibility. It is proposed that the station entrances and basement areas will be protected up to the PMF flood level with protection of the retail entrances up to the 100yr ARI flood level as noted in **Figure 11** below.



**Figure 11:** Flood Protection Principles

## 6.2 Compensatory flood storage in Denison Street

The preliminary flood analysis undertaken by TfNSW indicates that additional flood storage would be required to achieve the flood protection requirements as noted in **Section 4.1**. The preliminary location for the compensatory flood storage is proposed below ground in Denison Street as shown in **Figure 12** below. It is noted that the proposed location is indicative only and subject to further design development in consultation with Sydney Water and Council.

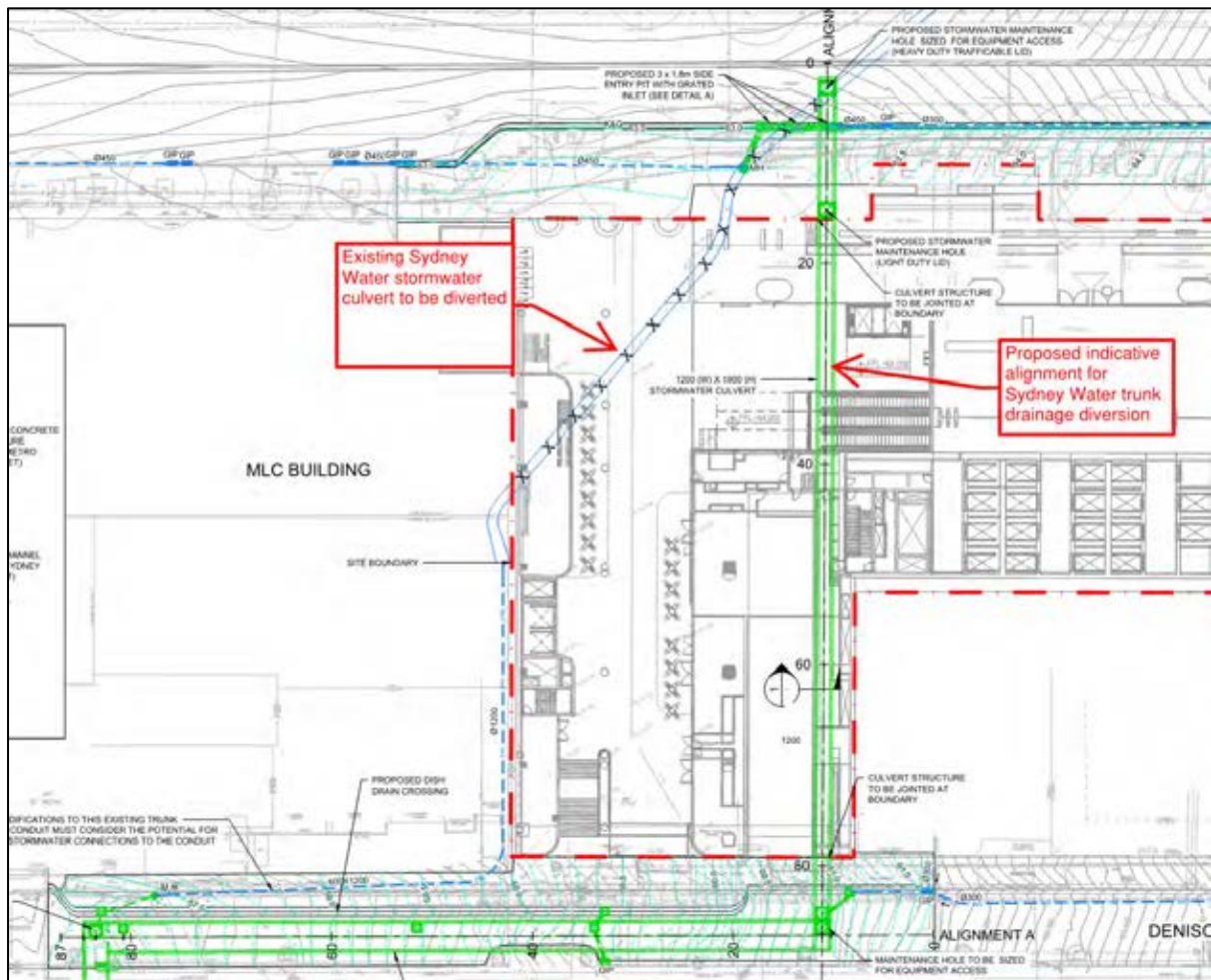


**Figure 12:** Indicative compensatory flood storage  
Source: METRON



### 6.3 Realignment of existing trunk drainage

To facilitate the new development, the existing Sydney Water trunk drainage line that traverses the site will need to be relocated. The preliminary TFNSW design intent proposes that a new sealed pipeline will connect the existing trunk drainage line in Miller Street to the proposed compensatory flood storage in Denison Street as shown indicatively in **Figure 13** below.



**Figure 13:** Indicative trunk drainage diversion.  
Source: METRON



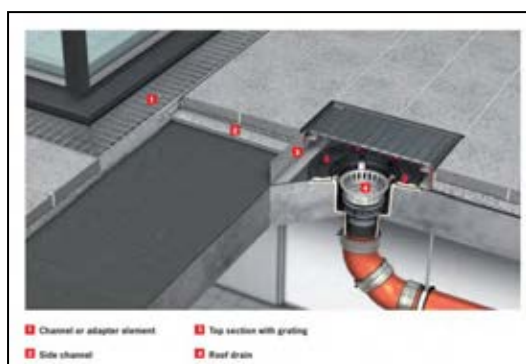
## 7.0 OSD Stormwater Management Plan

The following sections describe the proposed features of the stormwater management plan as applicable to the concept SSD Application for the proposed OSD.

### 7.1 Proposed stormwater management strategy

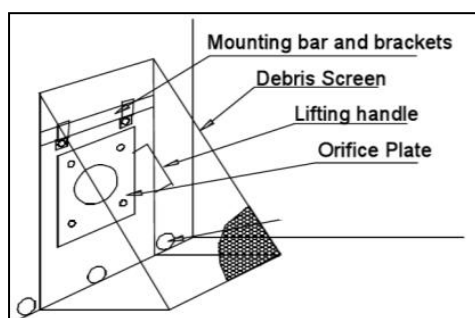
The proposed OSD is to be constructed over the Victoria Cross station. As requested by TfNSW, a separate stormwater system will be installed within the future OSD which will discharge directly to the Council/Sydney Water system in Denison Street.

Refer to **Appendix A** for a schematic layout for the stormwater management system. Stormwater run-off from the tower roof will be collected using a gutter and downpipe system. Run-off from the roof will be directed to the building's on-site detention and stormwater treatment system. Stormwater run-off from the building terrace areas will be graded to a series of proprietary drainage inlet systems (including rain water outlets and grated trench drains) and discharged to the buildings on-site detention and water treatment devices. **Figure 14** below demonstrates a typical terraced drainage system.



**Figure 14:** Typical Terrace drainage collection systems  
Source: ACO Drain

The peak discharge from the site will be restricted to comply with Council and Sydney Water on-site detention and permissible site discharge requirements (refer to **Section 7.4** for further details). A suitably sized orifice plate will be used to control the peak discharge from the on-site detention tank. A debris screen or trash screen will be used to prevent the orifice/outlet pipe from potential blocking. **Figure 15** shows a typical debris screen and orifice plate detail.



**Figure 15:** Typical debris screen and orifice plate detail

The on-site detention system will provide an overflow device to cater for any peak discharge in excess of the design capacity (100yr ARI storm event) with consideration for the building's vertical catchments. The overflow system will discharge via a series of separate downpipes to Denison Street to allow for visual inspection.

## 7.2 Water Sensitive Urban Design (WSUD)

The OSD will aim to achieve, where practical, the pollution reduction targets identified in Section 3.5.6 of the North Sydney Council DCP, as summarised below:

- a. Litter and vegetation larger than 5mm: 90% reduction on the Baseline Annual Pollutant Load;
- b. Total Suspended Solids: 85% reduction on the Baseline Annual Pollutant Load;
- c. Total Phosphorous: 65% reduction on the Baseline Annual Pollutant Load;
- d. Total Nitrogen: 45% reduction on the Baseline Annual Pollutant Load.

## 7.3 Stormwater treatment

To achieve Green Star rating points and Council's Water quality targets, the OSD development will need to achieve pollution reduction targets. Requirements for specific water quality targets are expected to be further refined in future design phases, however the following provides an outline of typical water treatment devices that could be used:

- First flush diversion of the captured roof water, prior to connection to water harvesting and OSD tank system; and
- Trash screens installed over the stormwater outlets on the OSD tank.

Gross Pollutant Trap is to screen all stormwater discharging from the site before entering the Council stormwater system.

The rainwater harvesting systems for the buildings shall collect rainwater from the tower roof level only and gravitate to the rainwater harvesting tank/s.

Reused treated rainwater may be re-used for toilet flushing, landscape irrigation and wash down.

Further information on ESD requirements can be found within the separate ESD report at Appendix Q within this EIS.

## 7.4 On-site detention requirements

Preliminary correspondence between TfNSW and Council suggests that Council may seek to enforce on-site detention requirements to restrict the proposed site peak discharge of all events up to the 100 year ARI event to that of the pre-development peak discharge for the 5 year ARI event. It is envisaged that this requirement will be further discussed with Council during future design stages, however for the purposes of the concept SSD Application, the existing site 5 year ARI event has been adopted as the permissible site discharge to demonstrate compliance should Council enforce this requirement.

A preliminary schedule of permissible site discharge (PSD) has been developed for the site (i.e. integrated development – OSD & Station areas) on the basis that all site discharge must be restricted to that of a 5yr ARI pre-development peak discharge. Noting that the pre-development site currently discharges to the Sydney Water trunk line (via Council’s drainage system) maintaining distribution of flows between Denison Street and Miller Street has not been considered in the preliminary analysis.

**Table 3:** Preliminary PSD requirements (assuming upper limit of 5yr ARI Pre-development peak discharge)

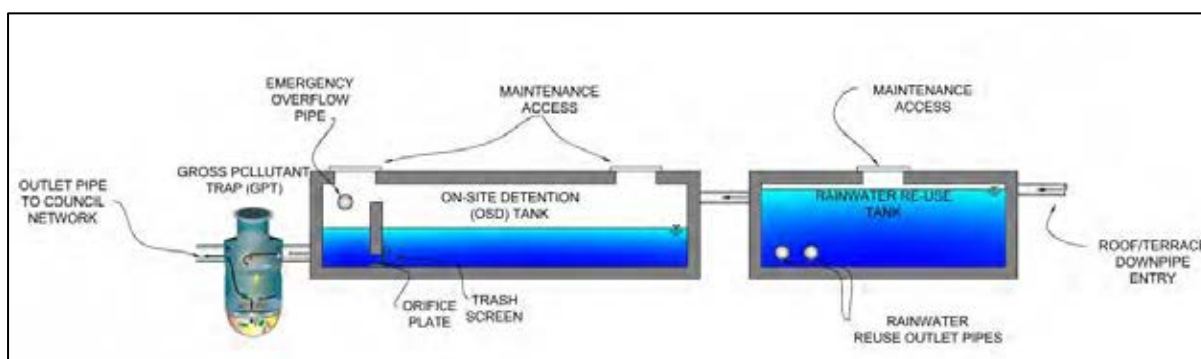
Location	Total Site area (m <sup>2</sup> )	5Yr ARI Peak Discharge Qp <sub>5yr</sub> (L/s)	PSD (L/s/m <sup>2</sup> )	Comments
Vic Cross South Over Station Development	4815	215	0.045	PSD rates to be confirmed with Sydney Water & Council during future design phases.

## 7.5 On-site detention options

There are several possible mechanisms to provide on-site detention and water quality enhancement for the OSD within the site. Two options are presented below which may be considered further in future design stages. For the purpose of preliminary spatial allocation of stormwater management infrastructure in the indicative OSD design, it is assumed that Option 1, an on-site detention and storage tank with separate rainwater tanks will be adopted.

### Option 1

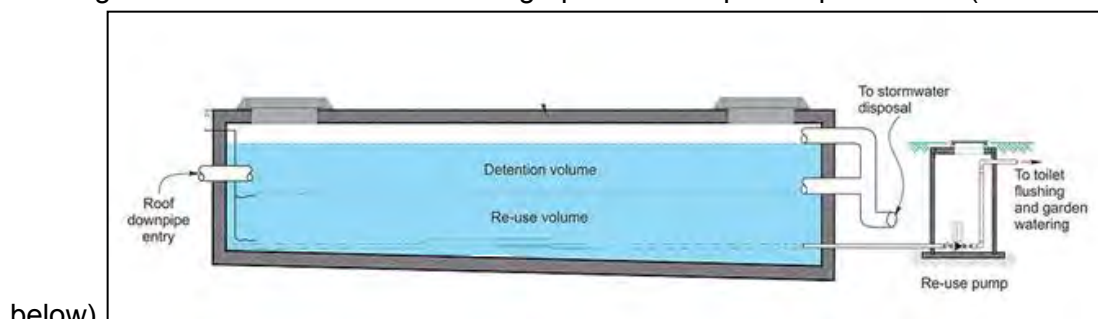
On-Site Detention Storage via segregated storage and reuse tanks to regulate the peak discharge (refer to **Figure 16** below);



**Figure 16:** OSD storage tank option (refer to Appendix A for further details)

### Option 2

Combined On-Site Stormwater Detention and rainwater re-use via storage tanks within the building to be considered in future design phases for spatial optimisation (refer to **Figure 17**



below).

**Figure 17:** Typical combined on-site detention & rainwater re-use storage tank

## 7.6 Preliminary on-site detention storage requirements

A DRAINS ILSAX hydrology model was used to determine the minimum detention storage requirements for the OSD roof and terrace areas. It has been assumed that two detention tanks will be provided, with lower portions of the site bypassing the detention storage (upper areas being sufficiently restricted to compensate for bypass flows). The preliminary locations of the detention tanks have been shown indicatively in **Appendix A**. The outlet for each detention tank consists of an orifice and primary outlet with an emergency overflow pipe for larger magnitude storms.

The indicative OSD tanks have been sized to cater for the 100yr ARI event with no additional allowance for vertical catchments for the primary outlet and detention storage volume. Consideration for the contribution of vertical catchments has been provided within the overflow pipe. This approach will need to be confirmed with Council through consultation in future design phases. In estimating the detention storage requirements, it has been assumed that any rainwater tanks are at full capacity with no additional storage allowance.

The detention requirements for the over station development have been assessed with consideration for bypass run-off within the station areas to ensure a holistic approach to achieving Council's PSD requirements for the entire site area.

A summary of the preliminary discharge arrangements are shown below in **Table 4**.

**Table 4:** Preliminary discharge arrangements

Plan Catchment Area (m <sup>2</sup> )	Peak Storm Duration	100yr ARI Catchment Peak Discharge Qp <sub>100yr</sub> (L/s)
L43 – Rooftop to L22 Mid Mid Rise Terrace OSD Tank 1 (2169 m <sup>2</sup> )	1.5 Hr Storm	<i>See Figure 18</i> Inflow: 135 L/s Outflow: 50 L/s
L13 – Lower Terrace OSD Tank 2 (793 m <sup>2</sup> )	1.5 Hr Storm	<i>See Figure 19</i> Inflow: 77 L/s Outflow: 22 L/s
Bypass to Denison Street: (1016 m <sup>2</sup> )	1.5Hr Storm	73 L/s
Bypass to Miller Street (837 m <sup>2</sup> )	Varies	59 L/s
Total Site: 4815 m <sup>2</sup>	Varies	Net combined discharge off site: 196 L/s

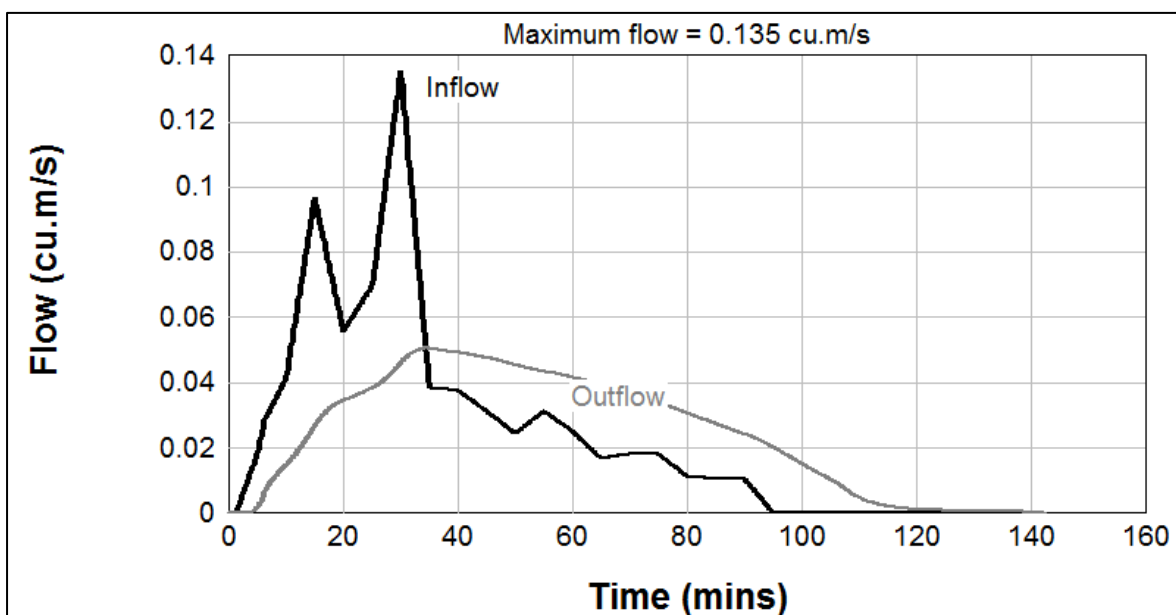


Figure 18: 100yr ARI Peak Inflow/Outflow Hydrograph (1.5Hr Storm) for the Indicative OSD Design Tank 1.

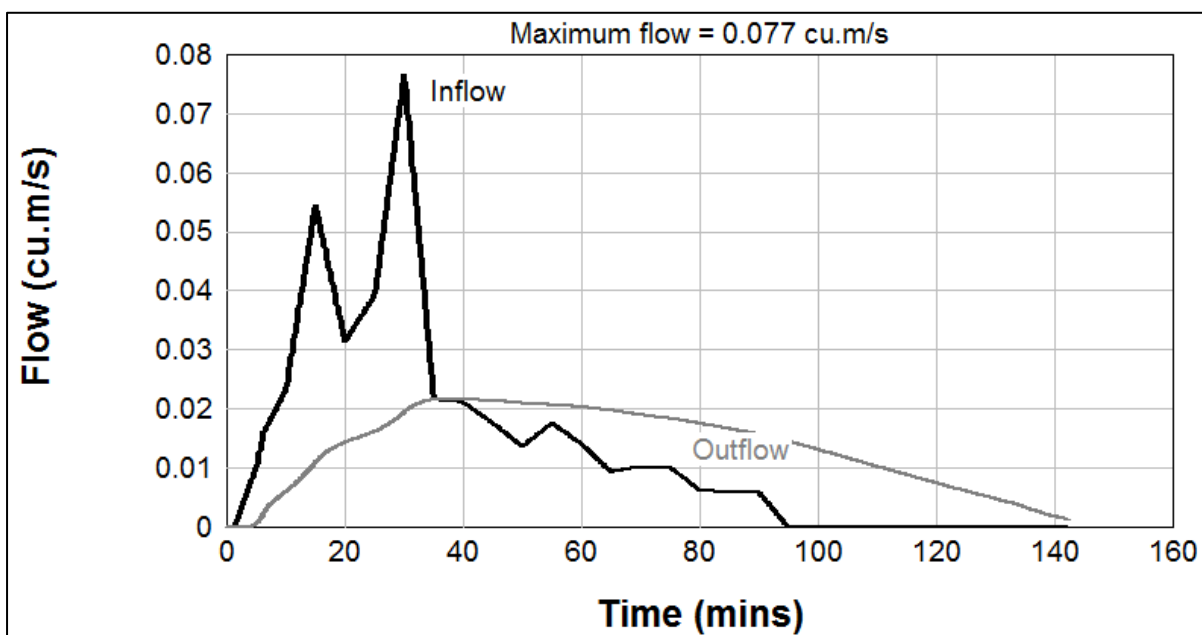


Figure 19: 100yr ARI Peak Inflow/Outflow Hydrograph (1.5Hr Storm) for the Indicative OSD Design Tank 2

## 7.7 Preliminary results discussion

The preliminary site discharge arrangement sketches are provided in **Appendix A** with preliminary spatial allowances presented in **Table 5**. From the preliminary hydraulic modelling results above, it is noted that post-development 100yr ARI peak discharge is compliant with a 5yr ARI pre-development permissible site discharge. Provision for on-site detention could effectively reduce the entire site discharge from 344L/s (existing condition) to 196 L/s in the 100yr ARI event.

**Table 5:** Preliminary OSD tank storage and spatial requirements

Indicative OSD Design Tank	Min 100yr Effective Storage Detention Volume <sup>1</sup> (m3)	Min Tank Volume (m3) <sup>2</sup>	Outlet Arrangements <sup>3</sup>	Preliminary Spatial Dimensions <sup>4</sup> (m)
OSD Tank 1	85 m <sup>3</sup>	105 m <sup>3</sup>	<b>Primary:</b> 130mm Orifice <b>Overflow:</b> 300mm Pipe	<b>Spatial allowance:</b> 8m x 8m x 2.2m
OSD Tank 2	45 m <sup>3</sup>	55m <sup>3</sup>	<b>Primary:</b> 90mm Orifice <b>Overflow:</b> 300mm Pipe	<b>Spatial allowance:</b> 5.5m x 5.5m x 2.2m

**Table 5 Notes:**

1. No allowance for rainwater tank.
2. Minimum tank volume based on effective storage volume with an additional 25% for freeboard & overflow
3. Outlet arrangements subject to detailed design
4. Preliminary external tank dimensions assuming maximum height of 2m, 0.25m wall thickness. Additional allowance to be considered for maintenance access.

## 7.8 Downpipe coordination

Discharge from the proposed on-site detention tanks will be separate to the Victoria Cross station drainage reticulation arrangements, as requested by TfNSW. A preliminary coordination exercise has been undertaken for downpipes located within the station building to avoid the station. Future design phases will need to ensure full coordination can be demonstrated.

## 8.0 Conclusion

This report identifies that the site is located within a currently flood affected area. Future designs will need to consider Council and Sydney Water requirements for management of stormwater and flooding. Preliminary modelling undertaken by TfNSW has demonstrated that a solution to the flooding issues could be achieved by providing safe major storm event overland flow paths and providing flood storage in Denison Street. These works are subject to further design development and consultation with Council and Sydney Water.

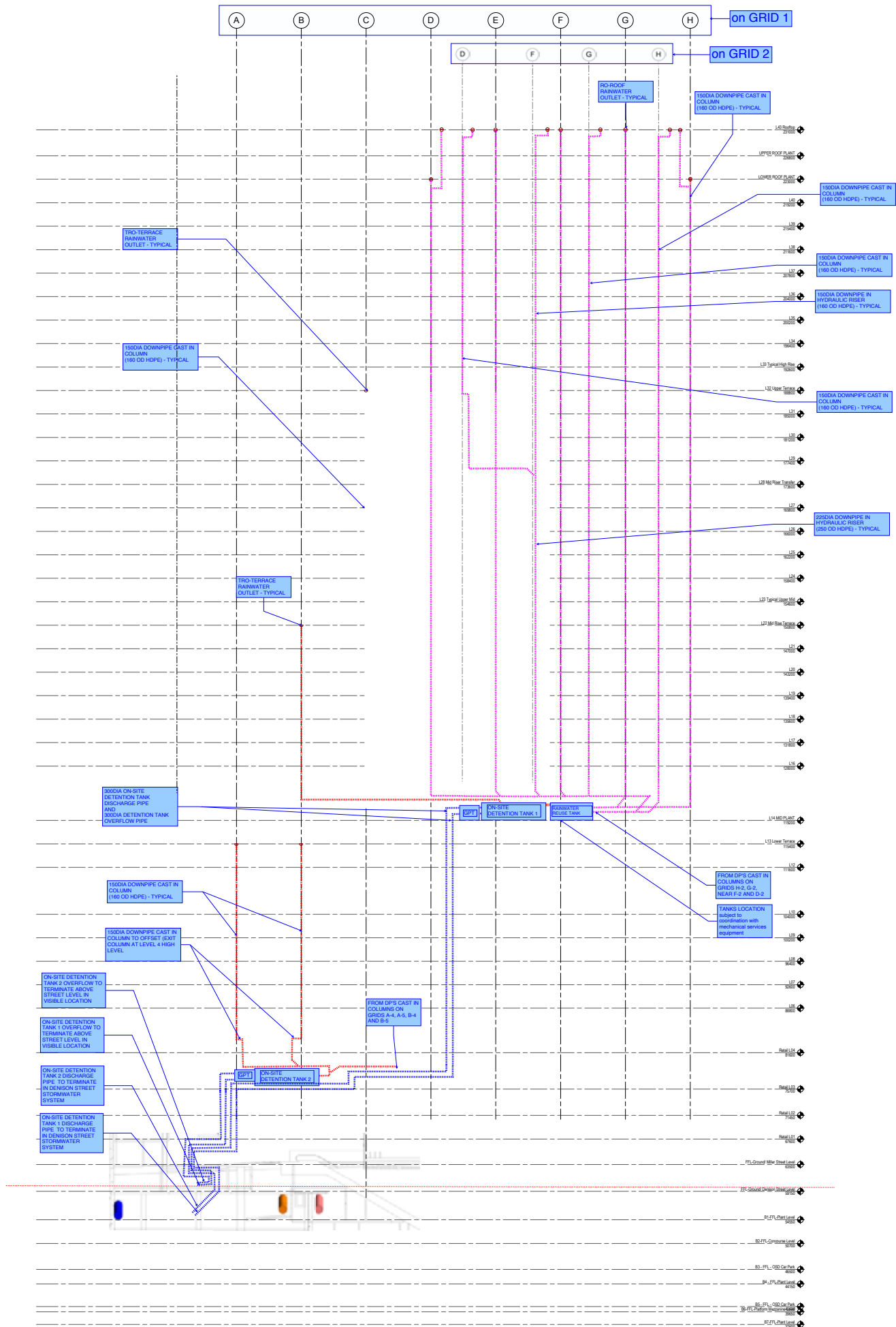
On-site detention requirements discussed in this report have been derived from preliminary discussions between TfNSW and Council – i.e. the permissible site discharge for events up to and including the 100yr ARI event are to be restricted to the pre-development 5yr ARI peak discharge.

Prior to lodgement of the future detailed SSD Application, further consultation with Council and Sydney Water will be required to resolve management of site stormwater.



## Appendix A

### Proposed site discharge schematic layout



<b>VICTORIA CROSS - STORMWATER SCHEMATIC</b>		
Date: 13.02.2018	Rev: AC	Drawings No: SKH - SW 00015
<b>AECOM</b>		Rev. 2