Appendix X

Integrated Water Management and Water Quality Plan

Sydney Metro West

Sydney Olympic Park Over and Adjacent Station Development Preliminary Integrated Water Management Plan

Appendix X

July 2022

NSW GOVERNMENT

sydney METRO

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Glossary

Term	Definition
AEP	Annual Exceedance Probability
ARI	Average recurrence interval
ARR	Australian Rainfall and Runoff
AS	Australian Standard
ASD	Adjacent Station Development
Catchments	The land area draining through the mainstream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
CBD	Central business district
Concept and Stage 1 CSSI Approval	Application SSI-10038, including all major civil construction works between Westmead and The Bays, including station excavation and tunnelling, associated with the Sydney Metro West line
Concept SSD Application	A concept development application as defined in section 4.22 the EP&A Act, as a development application that sets out concept proposals for the development of a site, and for which detailed proposals for the site or for separate parts of the site are to be the subject of a subsequent development application or applications.
Council	City of Parramatta Council
CSSI	Critical State Significant Infrastructure
DPE	Department of Planning and Environment
EIS	Environmental impact statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
ESD	Ecologically Sustainable Design
EY	Exceedances per year
GFA	Gross floor area
GPT	Gross pollutant trap
IECM	Infrastructure Engineering and Construction Manual
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
OSD	Over Station Development
SEARs	Secretary's Environmental Assessment Requirements
SOPA	Sydney Olympic Park Authority
SSDA	State Significant Development Application
SSI	State Significant Infrastructure
Stage 2 CSSI Application	Application SSI-19238057, including major civil construction works between The Bays and Hunter Street Station
Stage 3 CSSI Application	Application SSI-22765520, including rail infrastructure, stations, precincts and operation of the Sydney Metro West line
Sydney Metro West	Construction and operation of a metro rail line and associated stations between Westmead and the Sydney CBD as described in section 1.1

Term	Definition
TfNSW	Transport for New South Wales
WRAMS	Water Reclamation and Management Scheme
WSUD	Water Sensitive Urban Design

Executive summary

This Integrated Water Management Plan supports a Concept State Significant Development Application (Concept SSDA) 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 SSDA is made under section 4.22 of the EP&A Act.

Sydney Metro is seeking to secure concept approval for an over station development (OSD) and adjacent station development (ASD) on an area defined as Site 47 within the Central Precinct of Sydney Olympic Park (referred collectively as the 'proposed development'). The proposed development will comprise of one new commercial and retail building (Building 1) above the Sydney Olympic Park metro station and two residential accommodation buildings (Buildings 2 and 3) with retail and commercial space, adjacent to the Sydney Olympic Park metro station.

The Concept SSDA seeks consent for a building envelope and mixed-use purposes, maximum building height, a maximum gross floor area (GFA), pedestrian and vehicular access, circulation arrangements and associated car parking and the strategies and design parameters for the future detailed design of development.

The Integrated Water Management Plan involved the analysis of the existing stormwater quantity and quality conditions for the Concept SSDA site. The report aims to provide a hydraulic and water quality analysis as well as design of on-site detention systems and water quality treatment measures to demonstrate the feasibility of the proposed development from a stormwater and water quality perspective at a conceptual level and responds specifically to the Secretary's Environmental Assessment Requirements (SEARs).

The report provides analysis of the site under existing conditions as well as post development conditions including sensitivity analysis for climate change. The baseline investigations involved analysing the existing drainage network, catchment and topography, and the existing stormwater performance. This analysis was supported by the site flood modelling (Appendix Y Flood Risk Assessment within the environmental impact statement). The requirements for site storage and permissible site discharge were determined by the City of Parramatta Council conditions within the Sydney Olympic Park Authority (SOPA) Stormwater Management and Water Sensitive Urban Design (WSUD) Manual.

The size of stormwater detention tanks has been calculated using the SOPA Stormwater Management and WSUD Manual calculation sheets. The arrangement and location of the tanks within the proposed development will be dependent on coordination with the architectural design.

WSUD elements are proposed as part of the treatment train that will provide an adequate level of detention and treatment to achieve the stormwater quality targets.

The report evaluates the potential for adoption of an integrated water cycle management approach at the proposed development which includes rainwater harvesting, reuse and recycled water to achieve the best possible outcomes for a Green Star accreditation.

1 Introduction

1.1 Sydney Metro West

Sydney Metro West will double rail capacity between Greater Parramatta and the Sydney Central Business District (CBD), transforming Sydney for generations to come. The once in a century infrastructure investment will have a target travel time of about 20 minutes between Parramatta and the Sydney CBD, link new communities to rail services and support employment growth and housing supply.

Stations have been confirmed at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock, The Bays, Pyrmont and Hunter Street (Sydney CBD).

Sydney Metro West station locations are shown Figure 1-1.

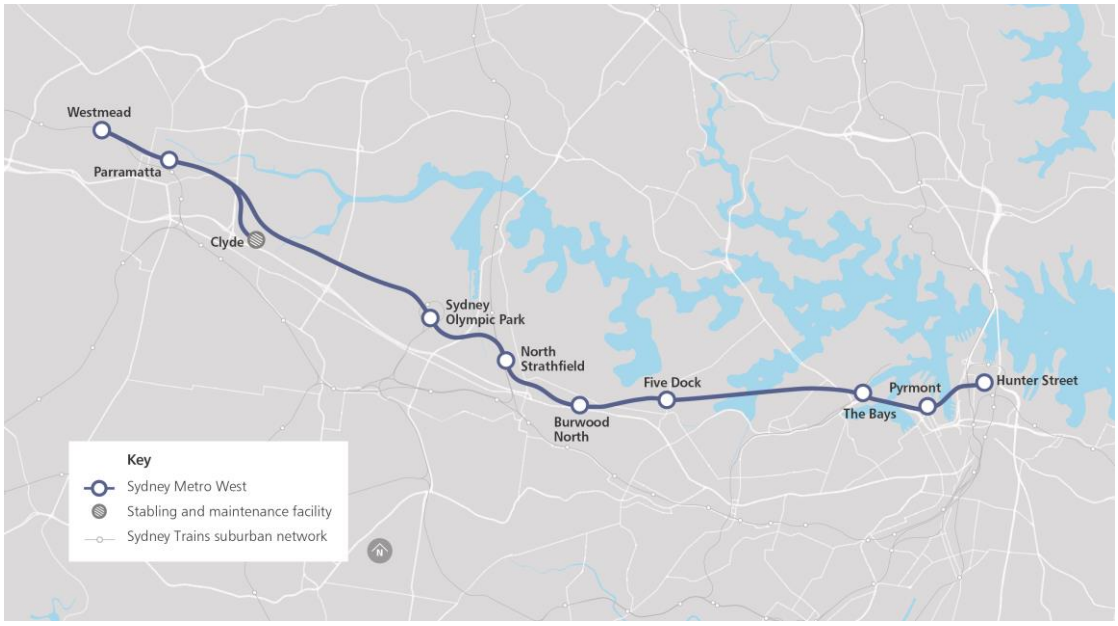

Figure 1-1 Sydney Metro West

1.2 Background and planning context

Sydney Metro is seeking to deliver Sydney Olympic Park metro station under a two-part planning approval process. The station fit-out infrastructure is to be delivered under a Critical State Significant Infrastructure (CSSI) application subject to provisions under division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), while the over and adjacent station developments are to be delivered under a State Significant Development (SSD) subject to the provisions of part 4 of the EP&A Act.

1.2.1 Critical State Significant Infrastructure

The State Significant Infrastructure (SSI) planning approval process for the Sydney Metro West metro line, including delivery of station infrastructure, has been broken down into a number of planning application stages, comprising the following:

- Concept and Stage 1 CSSI Approval (SSI-10038) – All major civil construction works between Westmead and The Bays including station excavation, tunnelling and demolition of existing buildings (approved 11 March 2021).

- Stage 2 CSSI Application (SSI-19238057) – All major civil construction works between The Bays and Hunter Street Station (under assessment).
- Stage 3 CSSI Application (SSI-22765520) – Tunnel fit-out, construction of stations, ancillary facilities and station precincts between Westmead and Hunter Street Station, and operation and maintenance of the Sydney Metro West line (under assessment).

1.2.2 State Significant Development Application

The SSD will be undertaken as a staged development with the subject Concept State Significant Development Application (Concept SSDA) being consistent with the meaning under section 4.22 of the EP&A Act and seeking conceptual approval for a building envelope, land uses, maximum building heights, a maximum gross floor area, pedestrian and vehicle access, vertical circulation arrangements and associated car parking. A subsequent Detailed SSD/s is to be prepared by a future development partner which will seek consent for detailed design and construction of the development.

1.3 Purpose of this report

This Integrated Water Management Plan supports a Concept SSDA submitted to the Department of Planning and Environment (DPE) pursuant to part 4 of the EP&A Act. The Concept SSDA is made under section 4.22 of the EP&A Act.

This report has been prepared to specifically respond to the Secretary's Environmental Assessment Requirements (SEARs) issued for the Concept SSDA on 18 February 2022 which states that the environmental impact statement (EIS) is to address the following requirements:

Table 1-1 SEARs and where they are addressed in this report

SEARs requirement	Where addressed in report
13. Stormwater and wastewater Provide an Integrated Water Management Plan for the development that: • is prepared in consultation with the local council and any other relevant drainage or water authority • details the proposed drainage design for the site including any on-site treatment, reuse and detention facilities, water quality management measures, and the nominated discharge points • demonstrates compliance with the local council or other drainage or water authority requirements and avoids adverse impacts on any downstream properties. Where drainage infrastructure works are required that would be handed over to the local council, or other authority, provide full hydraulic details and detailed plans and specification of proposed works that have been prepared in consultation with, and comply with the relevant standards, the local council or other drainage or water authority.	Sections 3 and 4

The purpose of this report is to summarise the design approach, key assumptions, relevant references and standards applied to the development of the concept stormwater design documentation for the proposed development.

These concept stormwater works are for the permanent works for the proposed development. Enabling and temporary works have not been included within this concept design report and package.

This report has been developed to:

- describe how input data has been obtained, collected and interpreted
- discuss the key design standards used for the design
- present the stormwater strategies that have been developed within the station precinct
- show key interfaces with other disciplines and stakeholders, including details on any external coordination meetings
- detail required next steps and further civil engineering work required to develop the design in subsequent stages.

2 The site and proposal

2.1 Site location and description

The site is located within Sydney Olympic Park and is situated within the City of Parramatta Local Government Area. The site is in the Central Precinct of Sydney Olympic Park and defined as Site 47 in the Proposed SOP Master Plan (Interim Metro Review). The broader metro site is bound by Herb Elliot Avenue to the north, Olympic Boulevard to the west and Figtree Drive to the south as shown in Figure 2-1.

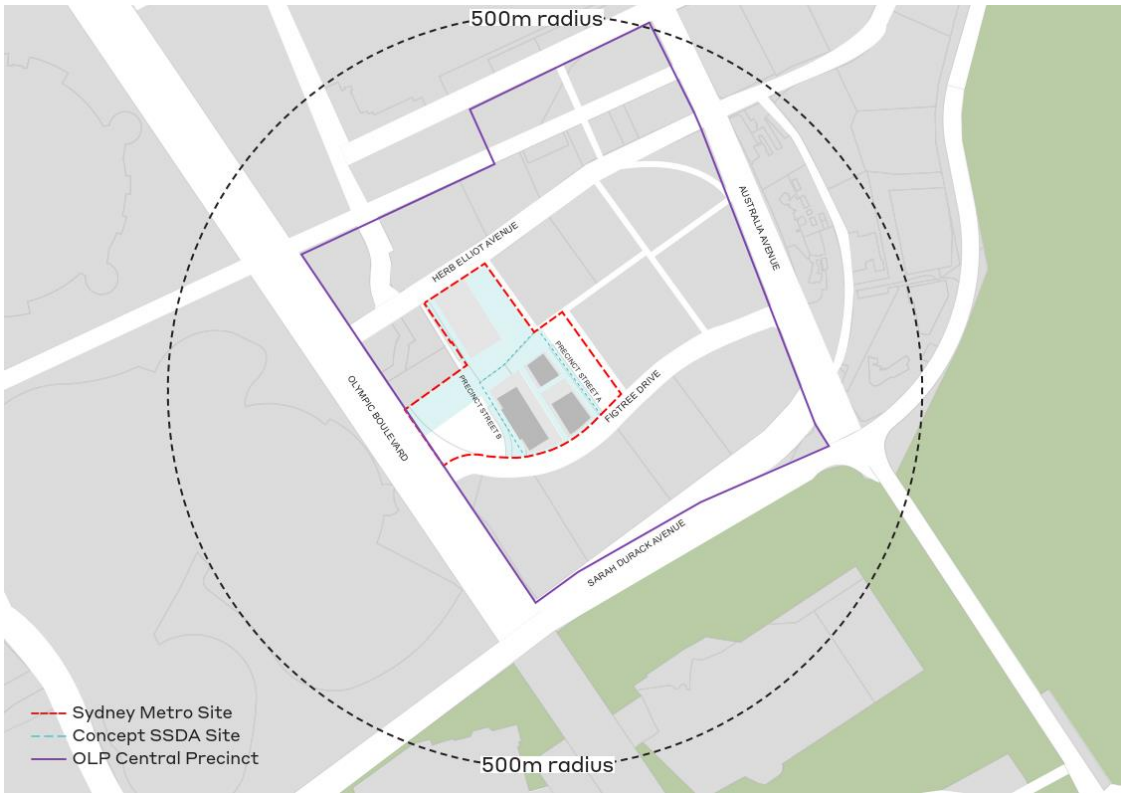

Figure 2-1 Sydney Olympic Park metro station location precinct

As described in Table 2-1, the site comprises part of Lot 59 in DP 786296 and Lot 58 in DP 786296, and comprises approximately 11,407m^2 of land.

Table 2-1 Site legal description

Street address	Legal description
5 Figtree Drive, Sydney Olympic Park	Lot 58 in DP 786296
7 Figtree Drive, Sydney Olympic Park	Lot 59 in DP 786296

2.2 Overview of this proposal

The Concept SSDA will seek consent for three building envelopes and the delivery of Precinct Street A as detailed in Table 1-2 and Figure 1-3.

Table 2-2 Sydney Olympic Park proposed development overview

Item	Description
Land use	**Building 1:** Commercial and retail **Building 2:** Commercial, retail and residential **Building 3:** Commercial, retail and residential
Building height (RL) / Number of storeys	**Building 1:** 120.20 / 21 storeys **Building 2**: 116.90 / 27 storeys **Building 3:** 171.50 / 45 storeys
Gross floor area (m^2)	**Building 1:** 28,517 **Building 2:** 12,089 **Building 3:** 27,384 **TOTAL: 68,000**
Car parking spaces	358

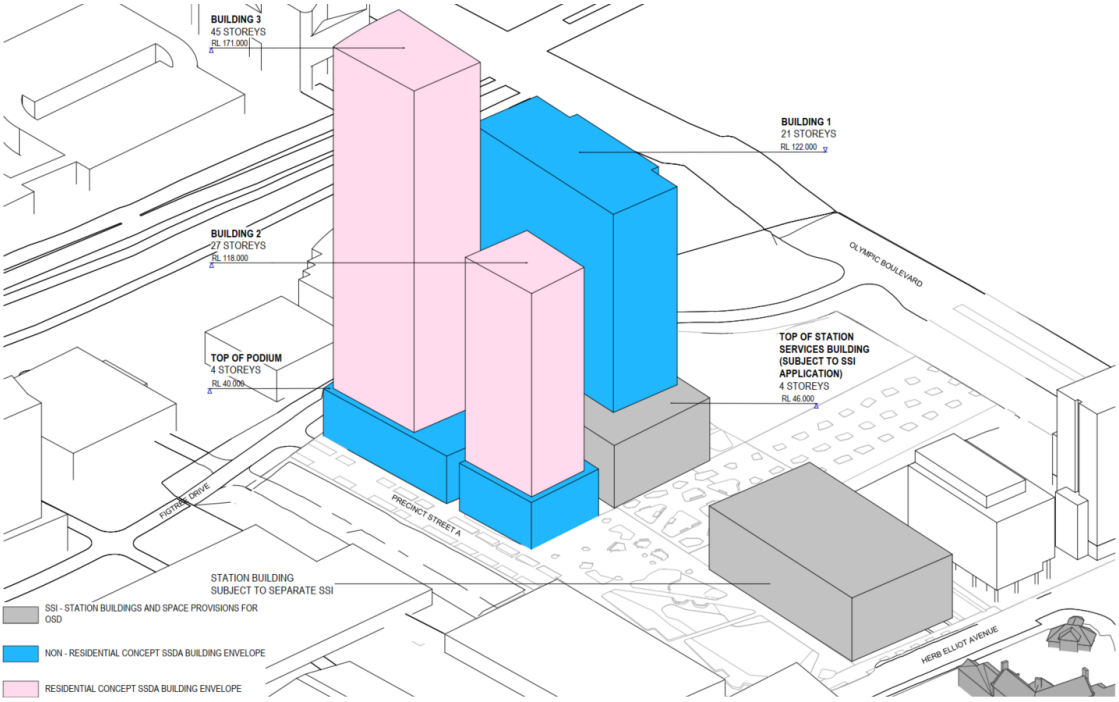

Figure 2-2 Proposed Concept SSDA development and CSSI scope

3 Scope of assessment

The scope of this report is to summarise existing stormwater and water quality conditions and detail required upgrades, infrastructure and protection measures required to satisfy the SEARs, Sydney Olympic Park Authority's (SOPA's) stormwater and water quality standards such as Policy for Stormwater Management POL13/4 and Infrastructure Engineering and Construction Manual, and the relevant design standards listed in section 4.1.1.

The stormwater and water quality requirements and the location where they have been addressed within this report are summarised below:

- Stormwater discharge from development site shall have no adverse impacts on upstream and downstream drainage system as per SOPA's Stormwater Management and Water Sensitive Urban Design (WSUD). Further details outlined in section 4.3.2.
- Provision of on-site detention tanks as required by SOPA as summarised in section 4.3.2.
- Development site stormwater quality to meet SOPA targets as outlined in section 4.4.2.

It is noted that this assessment relates to the works required for the proposed development, works associated with the Sydney Metro West project including the Sydney Olympic Park metro station is not included within this report except where utility coordination is required. Additionally, this report identifies preliminary development staging and stormwater consultation, the final staging and delivery of stormwater and water quality infrastructure will form part of subsequent design stages.

The stormwater water quality assessment involved:

- undertaking a desktop review of publicly available data to characterise existing surface water (baseline) conditions at the proposed development site including climate, catchment history, topography, hydrology, the soil landscape and environmental values
- reviewing relevant legislation, plans, policies and guidelines for water management within NSW including the SOPA and the City of Parramatta
- identifying the types of surface water impacts which may occur due to the proposed development
- identifying mitigation measures to address potential surface water impacts.

A separate preliminary flooding report has been developed for this proposed development site, refer to the Sydney Olympic Park Flooding Assessment (Appendix Y of the EIS).

4 Assessment

4.1 Standards and basis of design

4.1.1 Design standards

The design has been undertaken in compliance with the Asset Standards Authority, relevant Australian standards and local government guidelines. SOPA standards have generally been adopted for the development. Key documents used as guidance for the design are summarised below in Table 4-1.

Table 4-1 Summary of design standards

	Document number	Document name	Version or date
SOPA	POL13/4	Stormwater Management and WSUD Manual	October 2016
	N/A	Infrastructure Engineering and Construction Manual (IECM)	March 2018
Australian Standards (AS)	AS 3500.3	Plumbing and Drainage Code - Stormwater Drainage (2003)	2021
Austroads Guidelines	AGRD05-13	Guide to Road Design part 5: Drainage – General and Hydrology Considerations	February 2021
	AGRD05A-13	Guide to Road Design part 5A: Drainage – Road and Surface, Networks, Basins and Subsurface	May 2013
	AGRD05B-13	Guide to Road Design part 5B: Drainage – Open Channels, Culverts and Floodways	May 2013
Supplement to Austroads	RMS 17.055	Austroads Guide to Road Design part 5 Supplement	2013
	RMS 17.053	Austroads Guide to Road Design part 5A Supplement	2013
	RMS 17.054	Austroads Guide to Road Design part 5B Supplement	2013
General	N/A	Australian Rainfall and Runoff: A Guide to Flood Estimation	2019

4.1.2 Basis of design

In developing the civil concept design, information from a variety of sources has been used. A summary of this information is contained below in Table 4-2.

Table 4-2 Stormwater basis of design

	Document number	Document name	Version or date
SOPA	POL13/4	Stormwater Management and WSUD Manual	October 2016
	N/A	IECM	March 2018

4.1.3 Assumptions, dependencies and constraints

The assumptions for proposed development are as follows:

- Several assumptions have been made in relation to the location of the existing drainage system when building the existing drainage model where survey does not cover a particular area or where survey is not clear/contradictory.
- SOPA existing drainage system is in a satisfactory condition and suitable to be connected into.
- All proposed drainage systems outside of the station box (i.e. in plaza areas, new roads and footpaths etc.) will be owned and maintained by SOPA and the new drainage system will be designed to their standards.
- Survey CAD files from RPS (received as part of the utility survey undertaken on 24/07/2020) will be considered more accurate than pit cards where contradictory information is present.
- It is assumed that the drawings and associated attachments of this report will form part of the Concept SSDA. No separate development application is assumed to be necessary due to the proposed development's SSI status, noting that a development application is stated as needed in SOPA's stormwater management policy.
- It is assumed that all private developments have on-site detention systems to ensure pre-development flows were maintained when constructed. It is assumed that the pre-development condition was an entirely grassed area, and all private property roof area will be modelled as pervious to ensure a conservative assessment of the proposed development can be obtained and mitigate risk of inadvertently increasing peak flow rates by assuming no existing on-site detention. Private roads and car park areas are assumed to not generate flows to the proposed development site and will be modelled as impervious area.
- The station contractor shall manage any groundwater and stormwater that flows into the station box.

The dependencies for Sydney Olympic Park are as follows:

- The existing and future upgrade SOPA recycled water treatment plant and system have the capacity to treat the surface runoff from the proposed development site for reuse purpose.

The constraints for Sydney Olympic Park are as follows:

- The existing recycled water treatment plant and system is under capacity and can provide recycled water usage to new developments in Sydney Olympic Park. SOPA have planned to upgrade the existing system to accommodate future growth however the timing of the upgrade works is not clear.

These have been used in developing the stormwater and water quality design, additionally they have been used in detailing future design work that is required in future stages.

4.1.4 Consultation

The concept design documentation integrates comments and feedback on the preliminary documentation from the following authorities and stakeholders:

- SOPA

In correspondence with SOPA the preference for the metro site is to drain to both the Northern Water Feature Catchment and Southern Pond catchment. This drainage will be facilitated by to draining the site to Herb Elliot Avenue.

Throughout the correspondence SOPA expressed that it is imperative this matter is well executed in the design by Sydney Metro given the natural slope of the land in metro site is towards Herb Elliot Avenue.

Within the consultation SOPA wished to note:

- Due to some loss of impervious area, we may get a minor increase in stormwater flow velocity. Numerical value of this increase is rather unimportant and unnecessary.
- There could be some consequence of the peak and design stormwater flows on the existing drainage network. This needs to be investigated with further studies.
- The net increase in stormwater volume discharged to our drainage network may be negligible in the context of the whole catchment area.
- There is no envisaged consequence or negative impact on WRAMS stormwater harvesting ability.
- Sydney Olympic Park's stormwater drainage network was designed to accommodate 5%AEP stormwater event. Stormwater infrastructure services have been designed using AS, applicable at that time Australian
- Rainfall and Runoff peak flows and volumes estimates, which together with the hydraulic modelling resulted in drainage system design. Flow rates and volume parameters vary across the site
- considerably, depending on the catchment area, topography, coefficient of runoff, etc and SOPA doesn't have preferred values.
- For verification purposes I would recommend, that drainage design calculations shall be undertaken in accordance with the current version of Australian Rainfall and Runoff.

A sketch illustrating the anticipated changes to the drainage network are provided in Appendix A

Following this, a further SOPA consultation with further developed documentation will be conducted to ensure compliance with SEARs and ensure a coordinated approach to design.

4.1.5 Design criteria

The design criteria applied to the stormwater works are summarised in Table 4-3 below:

Table 4-3 Summary of design criteria

Works	Item	Standard	Adopted
Pit and pipe network	Minor design storm	SOPA – POL 13/4 – Attachment 1: 3(a)	20yr Average Recurrence Interval (ARI) (5% Annual exceedance probability (AEP))
	Major design storm	SOPA – POL 13/4 – Attachment 1: 3(c)	100yr Average Recurrence Interval (1% AEP)
	Minimum pipe size	Transport for NSW (TfNSW) - Austroads Guide to Road Design part 5A Supplement	375mm for longitudinal drainage 450mm for transverse drainage

Works	Item	Standard	Adopted
		clause 6.5.2	
	Maximum pit spacing	IECM section 4.2.1.3	30m
	Minimum pit sizes	AS3500.3:2018	Refer table 7.5.2.1 in AS3500 for further details
	Pit blockage factors	IECM section 4.2.1.1	Major storm: Sag pit = 0.5
	Overland flow safety criteria	SOPA POL13/4 - Attachment 1: 3(c)	Max depth x velocity = 0.4m^2/s
	Spread width	IECM section 4.2.1.3	1m in gutters (measured from kerb line)
	Sheet flow at median breaks, super elevation and at end of traffic islands	AGRD05A-13: table 5.1	Less than 5L/s (using an intensity which is lesser of 50mm/h or the 1EY, 5-miunute intensity)
	Minimum pipe depth	AGRD05A-13: table 6.1	Footpaths - 450mm for rigid pipes 600mm for flexible pipes Road carriageways - 600mm for rigid pipes 750mm for flexible pipes Cover that is less than the above will be subject to pipe class or structural calculations
	Minimum pipe grade	TfNSW Austroads Guide to Road Design part 5A Supplement clause 6.5.4	0.5%
	Stormwater detention	SOPA POL13/4: Attachment 1 3(e)	1 in 1-year ARI pre-development flows to be equivalent to post-development 1in 100-year ARI pre-development flows to be equivalent to post-development
Water quality	Baseline pollution reduction targets for all developments	SOPA POL13/4: Attachment 1	Total nitrogen - 45% Total phosphorous - 65% Total suspended solids - 85% Hydrocarbons - 90% Gross pollutants - 95%
Hydraulic and hydrologic modelling	Hydrological model	SOPA POL 13/4 – Attachment 1: 4	DRAINS model Time and area method - ILSAX
	Design rainfall	AR&R Data Hub	AR&R
	Urban rainfall losses	N/A	Impervious area depression storage - 5mm Pervious area depression storage - 1mm Soil type - C: Slow infiltration antecedent moisture condition - 3

Works	Item	Standard	Adopted
	Pit losses	N/A	Missouri charts
	Storm durations	N/A	10-120 minutes

4.2 Baseline investigations

4.2.1 Existing drainage network

To understand the existing drainage network within the proposed development site boundary, the existing system has been modelled in 12D and results have been used to form the basis of the proposed detention system and requirements. BIM modelling of the existing drainage network also allows co-ordination with other disciplines assets and assists in identifying clashes.

4.2.2 Catchment and topography

A combination of feature survey, SOPA GIS data and utility survey has been used to develop an understanding of the existing drainage network, which includes identifying locations of existing pits and pipes and also understanding discharge locations. To enable design progression, numerous assumptions have been made to build the existing drainage model.

The existing drainage network surrounding the proposed development site has been split into the following catchment areas:

- Figtree Drive
- Olympic Boulevarde North
- Olympic Boulevarde South
- Herb Elliot Avenue
- Dawn Fraser Avenue.

These catchment areas are represented in Figure 4-1. It should be noted that the catchment areas only represent the areas that have been modelled and are not intended to represent the entire catchment area.

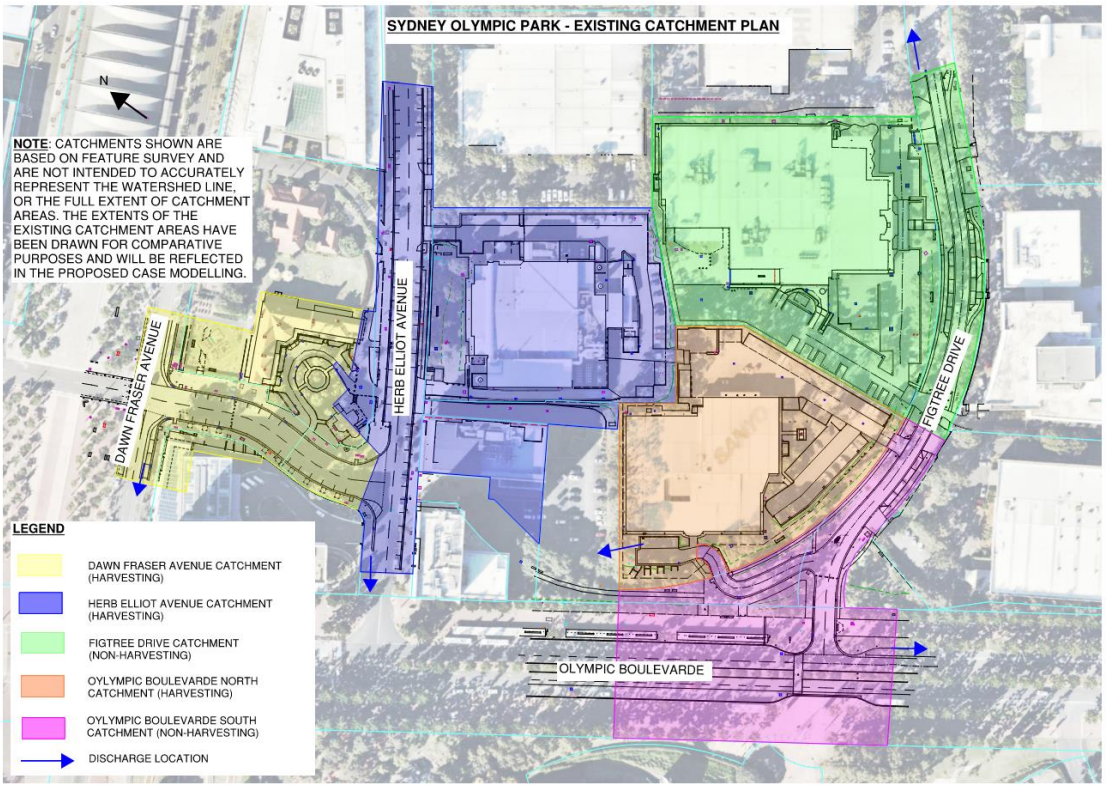

Figure 4-1 Sydney Olympic Park metro station catchment areas

Figure 4-2 Site number within station precinct

A short description of each catchment is provided below.

Figtree Drive

Figtree Drive provides a traffic connection point between Olympic Boulevard to the west and Australia Avenue to the east. There is an existing crest in Figtree Drive roughly at the location of the proposed development boundary between Site 47 and Site 48. East of the crest stormwater runoff drains towards Australia Avenue, whilst runoff to the west of the crest drains towards Olympic Boulevard; this portion of Figtree Drive is considered to be part of the Olympic Boulevard South catchment. Within the proposed development boundary, only Site 47 contributes to the Figtree Drive catchment.

It is noted that the Figtree Drive catchment does not contribute to the Water Reclamation and Management Scheme (WRAMS) and is believed to drain to the southern pond catchment as advised by SOPA. The existing WRAMS system is discussed in more detail in section 4.4.1.

Olympic Boulevard North

Olympic Boulevard is located to the west of the proposed development site and has a wide road reserve which contains the current bus interchanges which serve the Sydney Olympic Park area. There is a crest in the road approximately 100m north of Figtree Drive. The area south of this crest contributes to the Olympic Boulevard South catchment, whilst the area to the north discharges to a drainage network which runs north along Olympic Boulevard and supplies the WRAMS network.

Within the proposed development area, contribution to the Olympic Boulevard North catchment is restricted to runoff from Site 48. Interrogation of the survey shows that runoff from Site 48 is graded to the south-west of the property which drains into a DN450 pipe connected from a grated pit located within Site 48, this discharges stormwater to the north of the site. Although it is unclear where exactly this DN450 pipe connects to as the survey stops at this pit, it is assumed the pipe discharges to the stormwater network running north along Olympic Boulevard and forms part of the WRAMS network. This assumption is based on Map 1 in SOPA's Stormwater Management and Water Sensitive Design policy which indicates that Site 48 is within the WRAMS stormwater harvesting catchments.

Olympic Boulevard South

The Olympic Boulevard South catchment consists of runoff from Olympic Boulevard (the area south of the crest discussed in the section above) and a portion of Figtree Drive.

The Figtree Drive portion of the catchment discharges to a pit and pipe network just prior to the intersection with Olympic Boulevard, which then connects into the Olympic Boulevard pit and pipe system just south of the Figtree Drive/Olympic Boulevard intersection which then conveys water to the south.

The Olympic Boulevard South catchment is not part of the WRAMS scheme and is believed to drain to the creek just south of Shirley Strickland Avenue.

Herb Elliot Avenue

Similar to Figtree Drive, Herb Elliot Avenue provides a traffic connection between Olympic Boulevard to the west and Australia Avenue to the east. There is a crest in Herb Elliot Avenue approximately halfway between Olympic Boulevard and Australia Avenue. Stormwater runoff to the west of the crest is collected in a pit and pipe system which grades west and connects into the Olympic Boulevarde drainage network and ultimately drains north to supply the WRAMS network.

The runoff from Site 40 discharges into the Herb Elliot drainage system and contributes to the Herb Elliot Avenue catchment. Figure 4-3 shows the pre-development discharge points of each site.

Dawn Fraser Avenue

The Dawn Fraser Avenue catchment consists of runoff from Showground Road and Dawn Fraser Avenue itself. Showground Road is graded steeply (up to 7%) from Herb Elliot Avenue down to Dawn Fraser Avenue, and runoff is collected in a pit and pipe system. The pit and pipe system within Showground Road connects into a DN750 pipe running east to west along Dawn Fraser Avenue.

The large pit and piped network in Dawn Fraser Avenue continue to grade west before connecting into the drainage network running north along Olympic Boulevarde and ultimately supplies the WRAMS network.

4.2.3 Existing stormwater performance

SOPA has advised that the stormwater pipe network within its boundary was designed to cater for the 5% Annual Exceedance Probability (AEP) storm event. The existing drainage network has been modelled using the ILSAX hydrological model for numerous storm events and temporal patterns. A study undertaken by Jacobs to identify appropriate climate change projections identified a +21.3% increase in rainfall intensities by the year 2090 for the RCP 8.5 global warming scenario. The values given in Table 4-4 include allowance for climate change.

The one Exceedances per Year (EY) is equivalent to 1 in 1.58 year or 63.2% AEP. Storm events more frequent than 50% AEP is typically expressed as EY in the Australian Rainfall and Runoff (ARR) adopted probability terminology.

Table 4-4 Existing peak flow rates within the station precinct

Discharge location	1EY Peak flow rate (L/s) + 21.3% climate change	1% AEP Peak flow rate (L/s) + 21.3% climate change*
Herb Elliot Avenue	151	487

*Note: The above values do not necessarily represent the true peak flow values at the identified locations. They are values calculated based on catchment areas which lie within or near the project area and as such may not contain the entire catchments contributing to the discharge locations. The values are calculated to provide a benchmark for the post-development scenario.

Figure 4-3 Existing catchment plan (station precinct)

The model created for the analysis has assumed that the existing private properties within the proposed development boundary currently have on-site detention systems in line with current SOPA standards. Analysis of the survey suggests the internal road and car parking networks are not connected to any on-site detention system, and therefore it assumed only the roof areas are connected to on-site detention system.

To replicate historical pre-development conditions, all roof areas have been modelled as pervious area. This approach has been taken at early concept stage to ensure that a conservative value for on-site detention requirements is calculated and ensure no adverse impacts are caused by inadvertently increasing flows through the downstream system. SOPA have been approached to confirm whether the existing properties have on-site detention systems; feedback is still outstanding at the time of writing this report.

In order to account for the tail water influence at the discharge or existing connection pit, the tail water level is estimated using the flood depths at the connection point obtained from the flood maps.

Table 4-5 Herb Elliot Avenue tail water level

Catchment	Location of connection point	5% AEP flood depth (m)	5% AEP tail water level (m AHD)	1% AEP flood depth (m)	1% AEP tail water level (m AHD)
Herb Elliot Avenue	Existing kerb inlet pit	≈ 0.13	19.50	≈ 0.13	19.50

4.3 Stormwater quantity

4.3.1 Stormwater strategy

The proposed stormwater drainage and runoff system for the proposed development will comply with the design requirements as identified in section 4.1.5 with the main design considerations summarised below:

- post development stormwater runoff connections into existing drainage infrastructure will match predevelopment case where feasible
- on-site detention is to be situated above the 100 year ARI flood levels to facilitate discharge into potentially fully charged stormwater pipes
- management of water quantity to ensure no increase in stormwater discharge rate from the sites for the 1EY and 100 year ARI storms.

A DRAINS model was developed to assess the existing hydrological and hydraulic conditions for the proposed development site and revised to estimate the stormwater discharge from the proposed development site under the proposed future conditions.

4.3.2 Proposed stormwater design

As per SOPA's Stormwater Management and Water Sensitive Design Policy, on-site detention is required for developments to ensure that the 1EY and 1% AEP post-development peak discharge rates do not exceed the 1EY and 1% AEP pre-development discharge rates. As noted previously, it is currently unknown if the existing developments incorporate on-site detention. It has been assumed that the existing developments do not have on-site detention systems for the preliminary calculations.

The proposed development site generally grades to the north and towards Herb Elliot Avenue except for a small length of Precinct Street A which grades to the South and towards Figtree Drive. The proposed development site levels in between the station buildings will generally be higher that the road levels along Herb Elliot Avenue.

Proposed road upgrades along Figtree Drive and Herb Elliot Avenue will typically follow the existing road grading. Several new stormwater pits will be constructed/re-constructed as part of the roadworks and should connect to the existing downstream stormwater pits without a significant increase in their existing catchment areas.

The proposed stormwater strategy is to provide on-site detention systems for the proposed development. Due to the significant area increase to the Herb Elliot catchment, two external on-site detention tanks, sized at 750 and 600m^3, were proposed to intercept the runoff from the external areas and the northern station building. Additional on-site detention tanks were also proposed for the southern station buildings (station and OSD) and within Site 47.

These on-site detention tanks will be connected to the proposed piped system within the site boundaries before collectively discharges into an existing kerb inlet pit along Herb Elliot Avenue. This existing kerb inlet pit is connected and drains towards the SOPA stormwater system, as part of the WRAMS strategy.

All proposed on-site detention tanks were modelled in DRAINS to analyse the stormwater flows post-development. As per SOPA requirement, post development flows are to be managed and stormwater management design is to ensure flows do not exceed the pre-development conditions.

The catchment flow results for the 1EY and 1% AEP storm events are summarised in Table 4-6 below.

Table 4-6 Sydney Olympic Park proposed catchment flow rates

Catchment	1EY pre-flow (L/s)	1EY post-flow (L/s)	1% AEP pre-flow (L/s)	1% AEP post-flow (L/s)
Herb Elliot Avenue	151	151	487	355

*All Peak flow rate includes a 21.3% climate change factor

The proposed drainage piped system is to be sized to convey the 5% AEP storm event, with climate change factor, in accordance with Australian Rainfall & Runoff and council requirements as outlined in section 4.1.5.

The DRAINS model result for 5% AEP is shown in Figure 4-4.

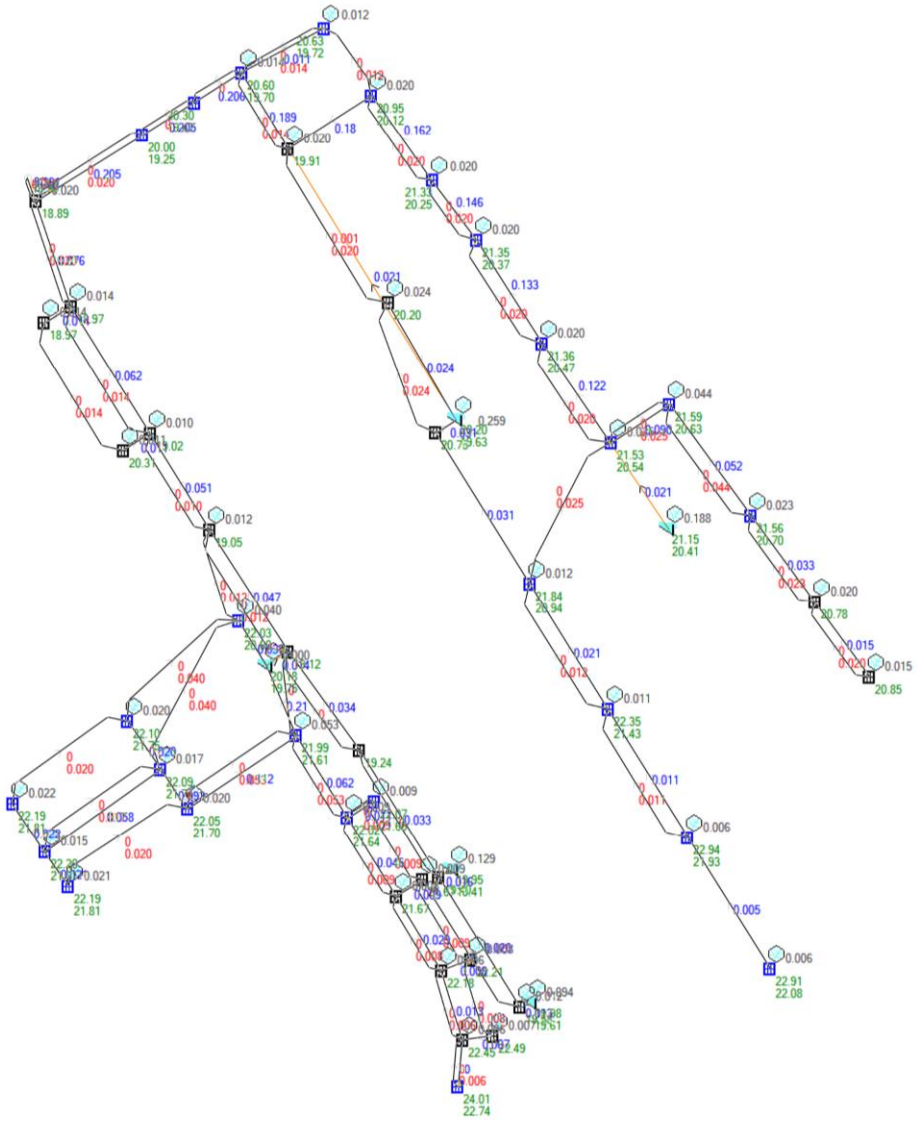

Figure 4-4 DRAINS model result for 5% AEP storm event

A summary of the proposed development's concept for on-site detention design is provided in Table 4-7 and their locations are shown in Figure 4-5.

Table 4-7 Sydney Olympic Park metro station proposed on-site detention tank summary

On-site detention tank	Volume (m^3)	Orifice diameter (mm)	Outlet pipe diameter (mm)	Weir width (m)
1	750	100	375	2
2	600	100	375	2
3	240	100	375	2
4	160	100	375	2
5	160	100	375	2

*Volume based on DRAINS calculations

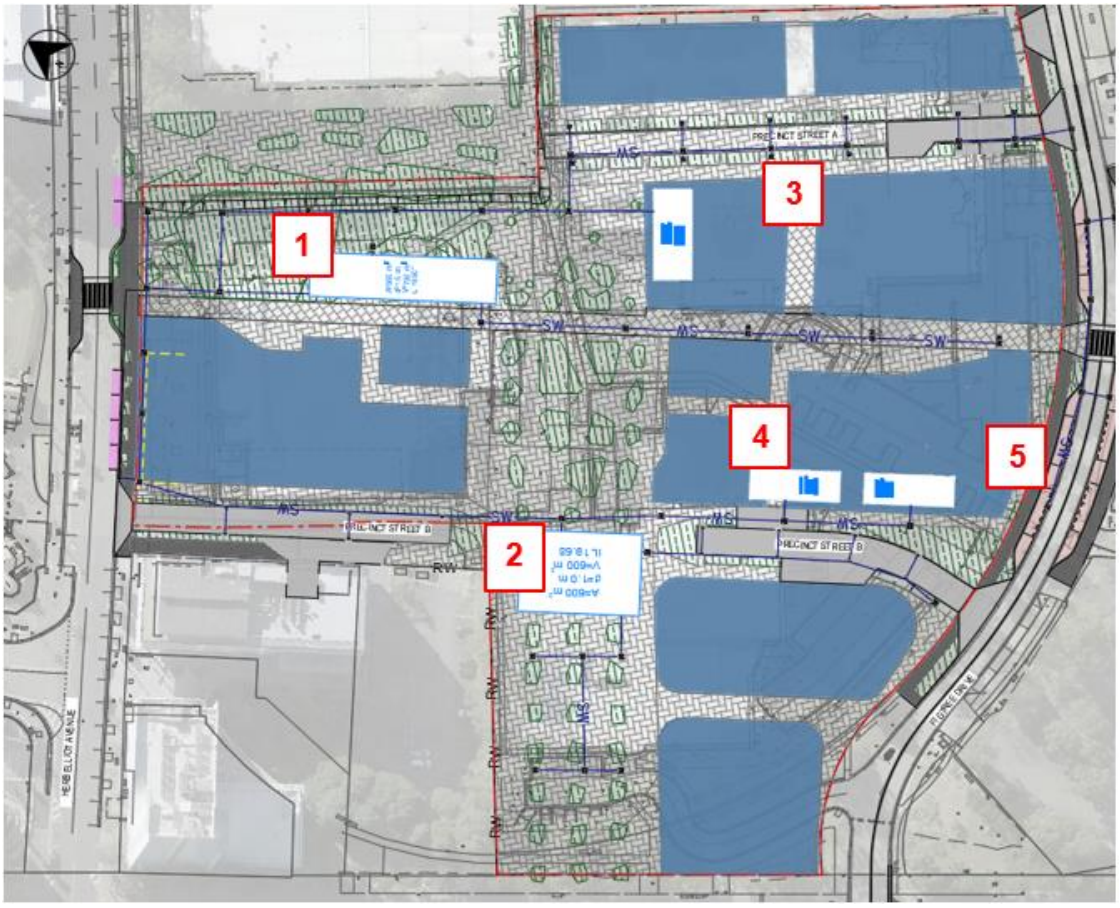

Figure 4-5 Proposed on-site detention tank locations

The post development flows at Herb Elliot Avenue show no adverse impact on the existing stormwater system. The post flow for 1EY is the same as its pre-flows considering climate change factor while the post flow for 1% AEP is less than its pre flow.

The provision of on-site detention system also provides opportunity to implement stormwater quality control devices as discussed further in section 4.4.2.

Due to the proposed site topography, the external on-site detention tanks should be able to have their orifice outlets above the tail water level tabulated in Table 4-5. The outlet levels for both external on-site detention tanks were set to be higher than the 5% and 1% AEP flood levels at the connection pit along Herb Elliot Avenue. This satisfies the tail water requirement with consideration to submerged outlets.

4.3.3 Proposed stormwater works

A summary of the proposed stormwater works on-site are summarised below and shown in Figure 4-6:

- construction of stormwater pipe network and associated storage and rainwater tanks (hydraulics) within the proposed development
- decommission of existing stormwater connections within the proposed development site boundary
- protection of existing stormwater assets to be retained for construction activities.

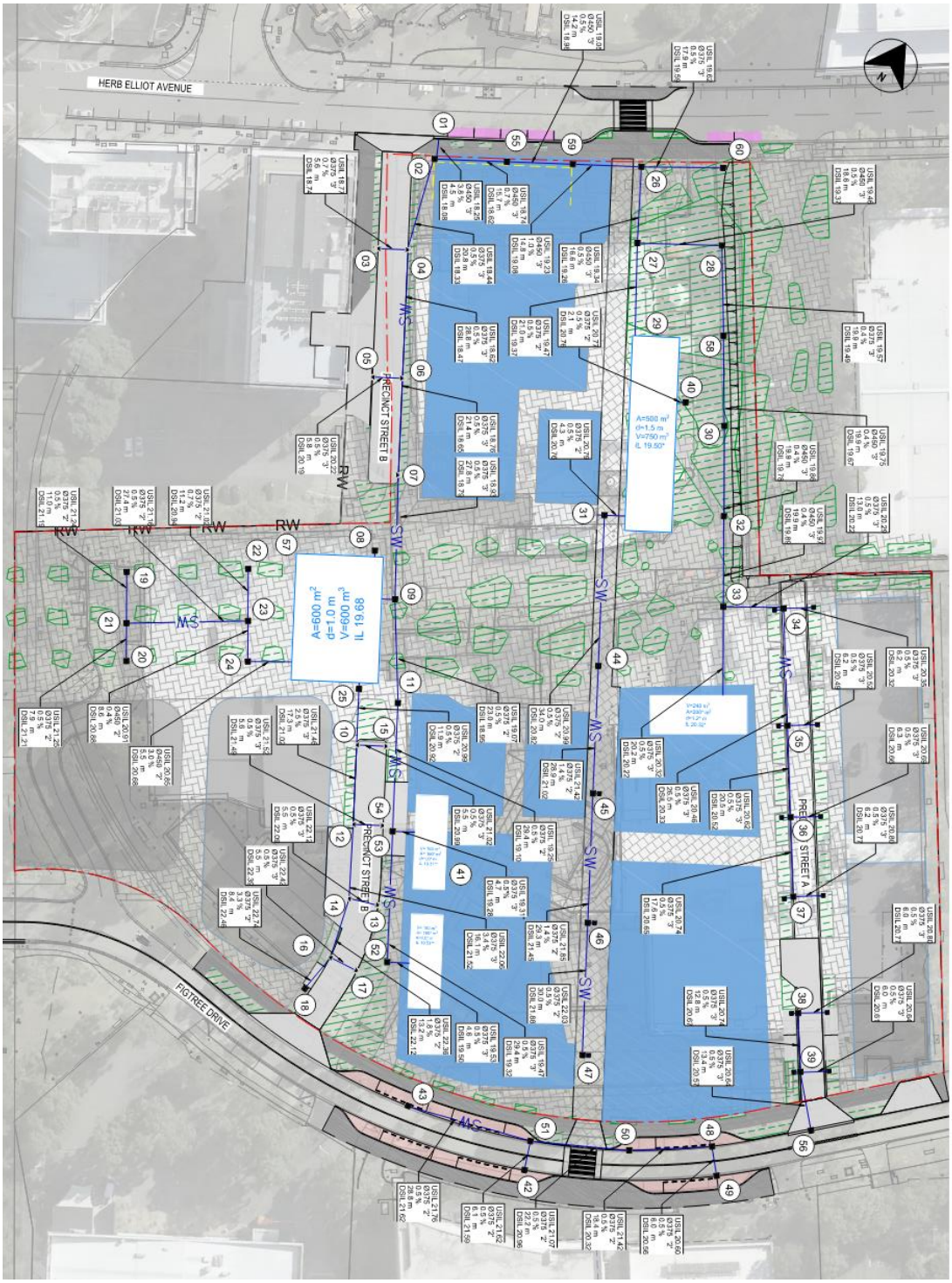

Figure 4-6 Proposed stormwater system within the station precinct

The proposed drainage works associated with on-site detention tanks 5 and 3 will fall under SSD approval and works as they are facilitating the building envelope, land uses, pedestrian and vehicle access, and associated car parking. Whilst the remaining on-site detention tanks (1, 2 and 4) and associated drainage works will fall under CSSI approval, see Figure 4-7. Should any stormwater drainage work be proposed to be dedicated to Council or SOPA, full hydraulic details and detailed plans of the works would be prepared as part of the Detailed SSDA.

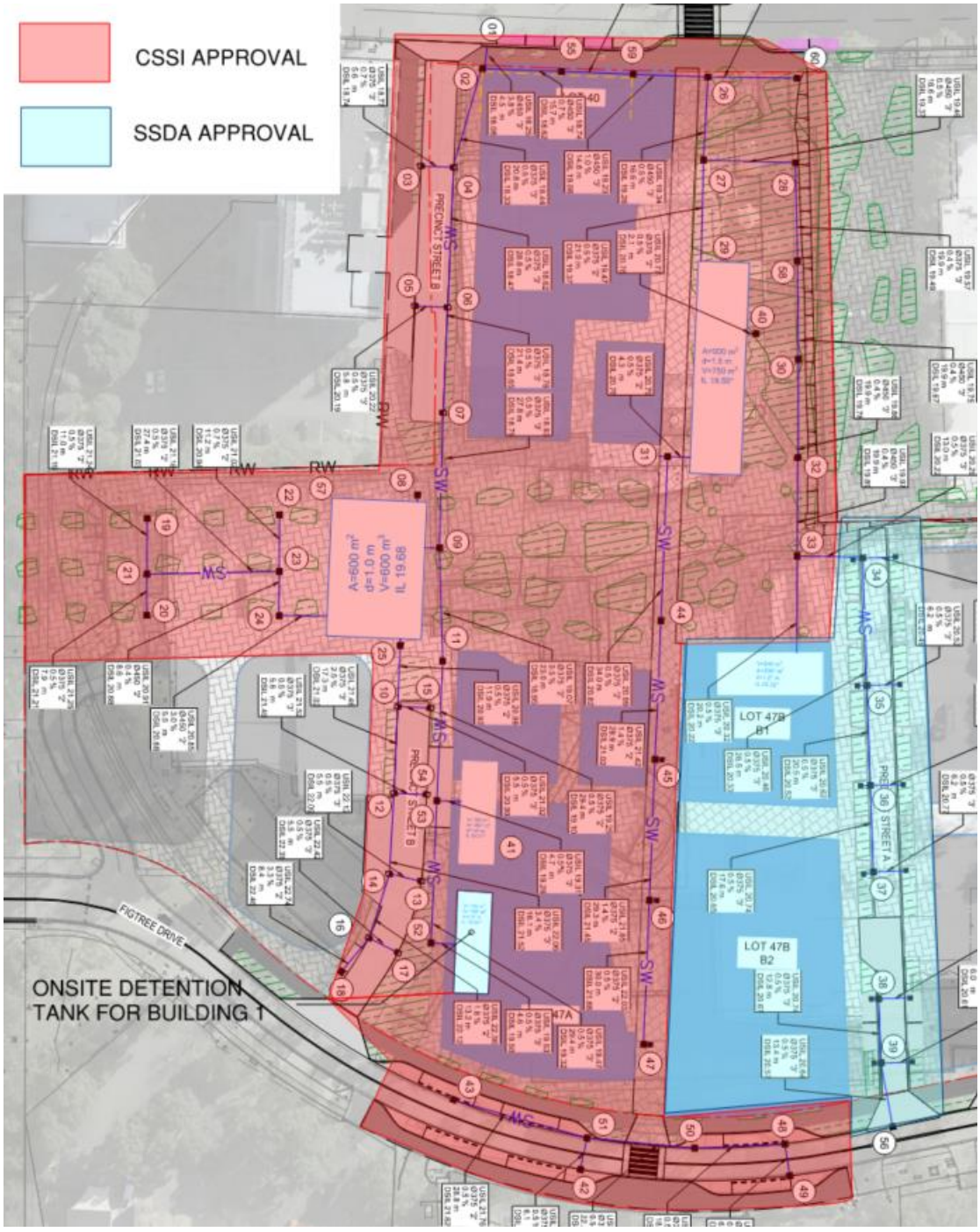

Figure 4-7 Proposed stormwater system and planning context

4.4 Stormwater quality

4.4.1 Existing stormwater quality measures

The catchments within the proposed development area are predominantly impervious roof and road areas, with small amounts of verge or green area. No treatment measures such as biofiltration systems, basins or wetlands have been sighted within the proposed development area.

It is possible that the private developments within the proposed development area do incorporate rainwater harvesting tanks, particularly Site 47 which is not connected to the WRAMS recycled non-potable water network. Any provision of rainwater tanks will increase the sustainability of the existing developments and contribute to WSUD principles by conserving water and limiting the amount of untreated runoff entering the drainage system.

Given the largely impervious area, existing runoff is likely to be of moderate quality containing litter, sediments and nutrients. Downstream water quality treatment measures implemented by SOPA are unknown.

An integrated approach to water management is taken by SOPA for the Sydney Olympic Park area. The approach has allowed SOPA to realise significant environmental benefit in terms of water conservation, waste minimisation and pollution control.

An integral part of the water management system is the WRAMS, which commenced operation at Sydney Olympic Park in the year 2000. The core principle of WRAMS system is to capture both stormwater and sewage, treat the runoff to acceptable standards and supply the local community with recycled water suitable for non-drinking uses such as irrigation, toilet flushing and car washing. The scheme currently supplies recycled water to approximately 20,000 people.

Figure 4-8 below is taken from SOPA's Stormwater Management and Water Sensitive Design Policy. It highlights the areas which are not connected to the WRAMS system (red) and the areas that are (blue). The proposed development site has been drawn on the figure in pink, which shows that most of the proposed development area is connected to the WRAMS irrigation system, with Site 47 being the only property not currently connected to the system. SOPA have highlighted that there is future intent to divert runoff from Site 47 (amongst other sites) to the WRAMS system.

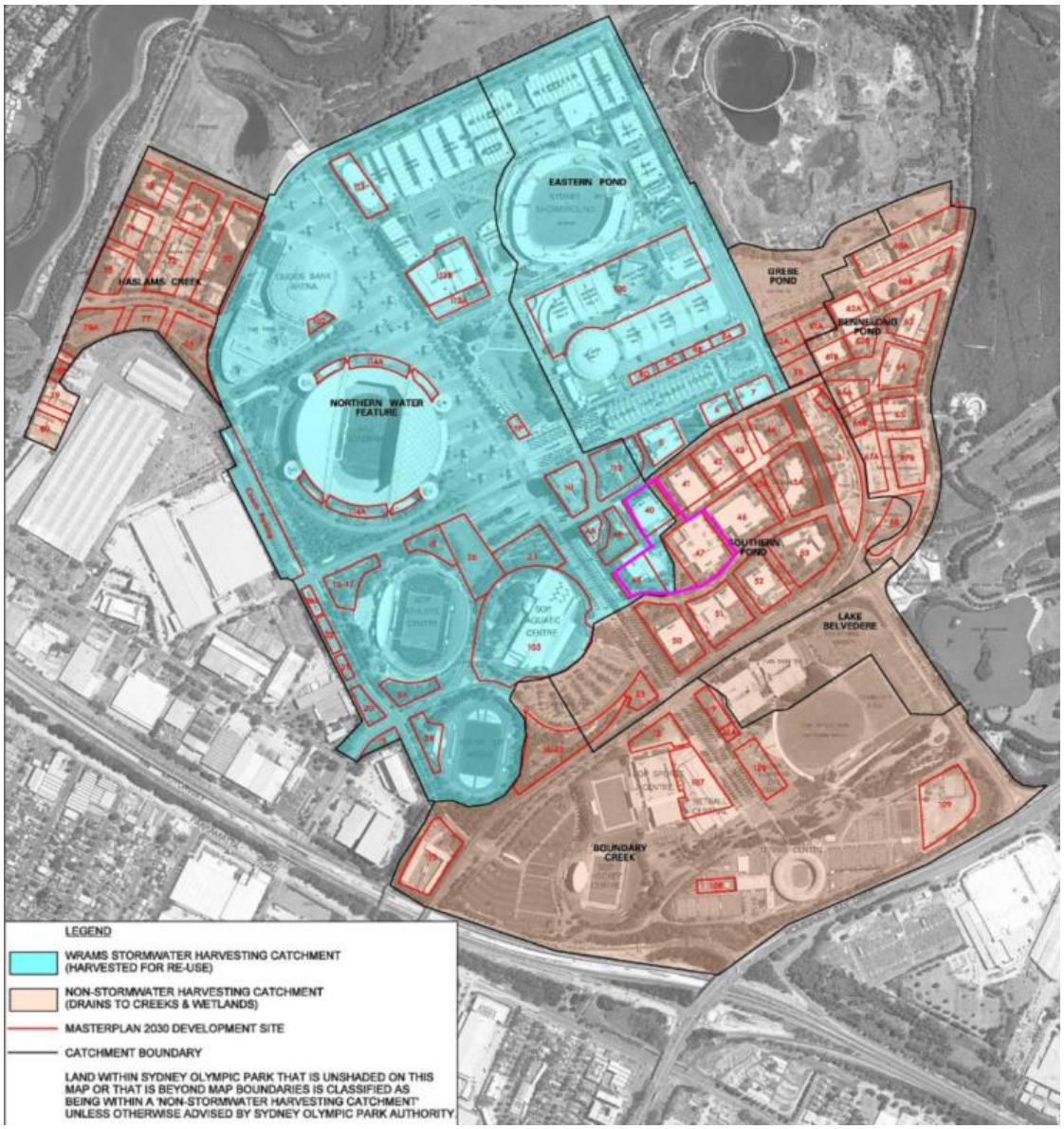

Figure 4-8 SOPA's stormwater catchment areas within Sydney Olympic Park

4.4.2 Proposed stormwater quality strategy

The design has looked to promote WSUD has been developed in accordance with the requirement of SOPA standards to the fullest extent possible.

Modelling of the proposed development was undertaken using Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software. The software was utilised to simulate urban stormwater systems operating at a range of temporal and spatial scales.

MUSIC models the total amounts of gross pollutants and nutrients produced within various types of catchments. It allows the user to simulate the removal rates expected when implementing removal filters to reduce the increased gross pollutant and nutrient levels created by the proposed development.

Using the latest architectural and landscape sketchbooks as a baseline layout, WSUD treatment trains have been identified. The following treatments are proposed to be implemented within the proposed development site:

- rainwater tank
- stormwater filter cartridge
- gross pollutant trap
- bio-retention basin (raingardens/tree pits).

The SOPA water quality targets are:

- 95% reduction in post-development loads for gross pollutants
- 85% reduction in post-development loads for total suspended solids
- 65% reduction in post-development loads for total phosphorus
- 45% reduction in post-development loads for total nitrogen.

The following methodology and parameters were incorporated into the MUSIC modelling for the proposed development site. For the purposes of this MUSIC assessment specific products have been referenced to ensure an accurate depiction of water quality reductions and targets. This does not recommend the use of these specific products as equivalent products are considered as suitable on the condition that these products are modelled to verify compliance.

Stormwater filter cartridge

The stormwater filter cartridge is an underground cartridge treatment system which is used to remove suspended solids and other water pollutants from stormwater runoff. Each filtration cartridge provides a membrane surface area which allows runoff to travel through the membrane while removing the pollutants. The MUSIC node from Ocean Protect was used with the input data as summarised below.

Table 4-8 Stormwater filter cartridge – MUSIC input parameters

Pollutant	Input	Output	Adopted rate
Suspended solid (mg/L)	1000	66	93.4%
Phosphorus (mg/L)	10	1.39	86.1%
Nitrogen (mg/L)	100	44.1	55.9%
Gross pollutant (kg/ML)	14.9	0	100%

These calculations are based upon Ocean Protect StormFilter® reduction rates but equivalent products to be proposed in the future.

Gross pollutant trap

For primary treatment of the stormwater runoff within station areas where the use of green infrastructure treatment is limited, a Gross Pollutant Trap (GPT) is to be provided. The GPT is proposed and is a gully pit inset or basked designed to remove gross pollutants, total suspended solids and attached pollutants in residential and commercial developments. Each GPT is able to treat up to 20L/s and multiple traps can be installed within the same structure to treat higher flows. The MUSIC node from Ocean Protect was used with the input data as summarised below.

Table 4-9 Gross pollutant trap – MUSIC input parameters

Pollutant	Input	Output	Adopted rate
Suspended solid (mg/L)	100	27	73%
Phosphorus (mg/L)	10	7	30%
Nitrogen (mg/L)	50	39.5	21%
Gross pollutant (kg/ML)	14.9	0	100%

These calculations are based upon Ocean Protect OceanGuard® reduction rates but equivalent products to be proposed in the future.

It is noted that this product has been chosen for analysis of the system at this stage, an approved equivalent may be adopted as long as the water quality targets are being met.

Bio-retention basin

Pollutant removal rates for treatment basins are not fixed within the MUSIC model, rather they are based on a set of input parameters which determine the effectiveness. In developing the MUSIC model for the site, the following input parameter assumptions were made for the proposed bioretention system:

Table 4-10 Bio-retention basin – MUSIC input parameter

Parameter	Values
Extended detention depth	0.15m
Filter depth	0.53m
Saturated hydraulic conductivity	3550 mm/hr
Total nitrogen content of filter media	500 mg/kg
Orthophosphate content of filter media	1 mg/kg

Development treatment train

The working treatment train satisfies SOPA baseline pollution reduction targets for stormwater harvesting catchment. A huge fraction of the treatment trains is made up of rain gardens hence alternative water quality treatments will be considered if green spaces will be reduced as design progresses.

The water quality treatment train has been modelled in MUSIC as shown in Figure 4-9 with the treatment nodes' catchment areas shown in Figure 4-10.

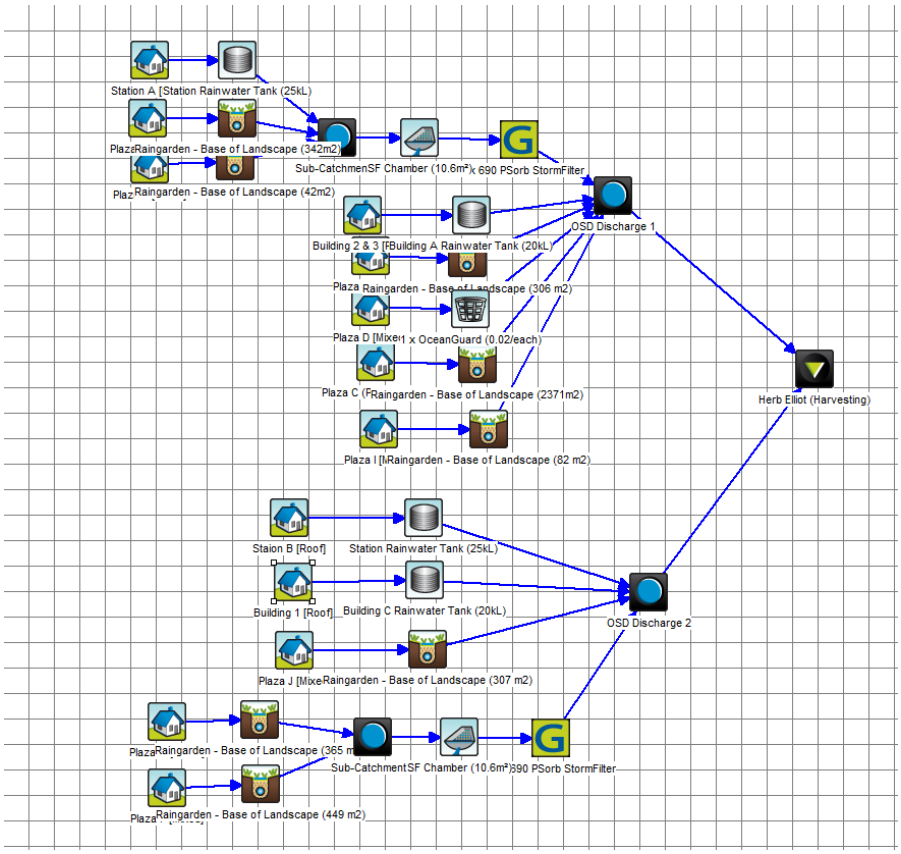

Figure 4-9 Herb Elliot Avenue MUSIC model

Figure 4-10 Treatment nodes' catchment areas

A summary of the treatment nodes' catchment areas is tabulated in Table 4-11.

Table 4-11 Summary of treatment nodes' catchment areas

Catchment area	% Impervious	% Pervious	Area (ha)
Station A (North)	100	0	0.442
Station B (South)	100	0	0.314
Building 1	100	0	0.178
Building 2 & 3	100	0	0.355
Plaza A	90	10	0.373
Plaza B	67	33	0.103
Plaza C (Park)	0	100	0.237
Plaza D	100	0	0.120
Plaza E	92	8	0.050
Plaza F (Precinct St B)	68	32	0.141
Plaza G (Precinct St A)	83	17	0.176
Plaza I	69	31	0.026
Plaza J	77	23	0.131

With the on-site detention tanks taking up majority of the external space, there is limited space left to provide treatment for the impervious area on this portion of the proposed development site. Further analysis will be undertaken at the next design stage to understand what treatment measures can still be implemented and whether they would be feasible. Measures taken could be to:

- increase the length of bio-retention system from Precinct Street A/B
- provide more green space around Precinct Street A/B
- increase number of cartridges collecting runoff from the roof of the new building.

Given the stage of design, it is likely there are more opportunities to implement WSUD treatments throughout the site and the MUSIC model and WSUD designs will be refined as design progresses.

Table 4-12 MUSIC results for site

Pollutant	SOPA reduction targets (%)	Results (%)
Total suspended solids (kg/year)	85	88.5
Total phosphorus (kg/year)	65	69.8
Total nitrogen (kg/year)	45	50.6
Gross pollutants (kg/year)	95	100

4.5 Cumulative impacts

In providing a high-level assessment of the potential environmental impacts directly associated with the Concept SSDA development were considered, the subject of this SSD Application, in addition to the cumulative impacts associated with the CSSI (Sydney Olympic Park metro station) and the following developments:

- Site 2A and 2B, Australia Avenue, Sydney Olympic Park

- Site 43/44 Sydney Olympic Park – Stage 1 and 2 (6 Australia Avenue and 2 Herb Elliott Avenue).

It should be noted that the construction program for the above listed developments is not available. Therefore, a high-level cumulative assessment was undertaken in consistency with what was undertaken for Stage 3 of the EIS of the CSSI under the assumption that those developments would be constructed at the same time with this proposal as a worst-case scenario.

A review of the publicly available construction information indicates that:

- Site 2A and 2B, Australia Avenue stormwater strategy includes an independent on-site detention system discharging onto Murray Rose Avenue with pre to post flow conditions met.
- Similarly, Site 43/44 Sydney Olympic Park – Stage 1 and 2 stormwater strategy includes an independent on-site detention system discharging onto Figtree Drive with pre to post flow conditions met.

Both of these sites are downstream from the proposed site thus in the event of a stormwater system failure in either of the sites, this will not adversely impact the metro site.

No additional mitigation measures will be required for the site.

5 Conclusion

This Integrated Water Management Plan responds specifically to the SEARs. It has concluded that adequate water quality and stormwater designs are suitable for the proposed development site.

The stormwater quantity design has been developed in accordance with SOPA guidelines, providing storage within the building developments and connection to the existing City of Parramatta Council buried pipe network.

The stormwater quality design has been developed in accordance with SOPA guidelines to have achieved the required mitigation targets.

Future work that is required to finalise the stormwater and water quality design includes:

- design of connection to existing council drainage system
- final on-site detention requirements based on the finalised architectural scheme
- further authority coordination as required.

The building design is subject to further design development and future developer(s) will need to prepare Detailed SSDAs. The Detailed SSDAs would need to assess the following:

- final on-site detention requirements based on the finalised architectural scheme
- design of Ecologically Sustainable Design initiatives and coordination with stormwater strategy
- further authority coordination as required.

Appendix A SOPA drainage master plan

to Northern Water Feature

to Eastern Water Quality Control Pond

THE DOME
HALL 1
ROSS PAVILION
HALL 2
BINNIE PAVILION
HALL 3
BURING PAVILION
HALL 4
R.A.S. ADMINISTRATION
GATE 15
GATE 13
MURRAY ROSE LANE
No 11
No 9
No 7
No 8
MURRAY ROSE AVENUE
SHOWGROUND ROAD
YULANG
STATION SQUARE
OLYMPIC PARK RAILWAY STATION
PARK STREET
JACARANDA SQUARE
No 1
DAWN FRASER AVENUE
NOVOTEL No 11
HOTEL
IBIS
No 10
No 8
No 4
No 2
STOCKROUTE PARK
HERB ELLIOTT AVENUE
PULLMAN HOTEL No 9
No.10
No.8
No.6
No 4
No 2
No.7
No.5
No.3
No.1
FIGTREE DRIVE
OLYMPIC BOULEVARD
AUSTRALIA AVENUE
No 9-11
No 1-7
No.2
No.8
No.6
No.4
DEVELOPMENT SITE (Under Construction)
to Boundary Creek Catchment
RAILWAY
SARAH DURACK AVENUE
CAR PARK P3
No 3-5

LEGEND
- Existing Drainage Network
- Existing Network to be Upgraded
- Existing Network to be Removed
- New Network
- New Lot Drainage Connection

PRODUCT OF SOPA SPATIAL INFORMATION SERVICES UNIT

MGA

0 10 20 30 40 50 60 70 80 90 100m

SYDNEY OLYMPIC PARK AUTHORITY
8 AUSTRALIA AVENUE SYDNEY OLYMPIC PARK NSW 2127
PH. (02) 9714 7300 FAX. (02) 9714 7818

SYDNEY OLYMPIC PARK

MASTER PLAN 2030
CENTRAL PRECINCT
DRAINAGE NETWORK

NSW GOVERNMENT | SydneyOlympicPark

DRG. NO. : 001-P-P-4808 REV. A

SCALE : AS PER SCALE BAR

PLOT DATE: 5/02/2019