Annexure P:
Flooding Assessment Report

SydneyOlympicPark

Sydney Olympic Park Master Plan 2050

Flooding Assessment Report

September 2024

Issue and Revision Record

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Executive summary

Mott MacDonald has been engaged in the preparation of a flood risk and impact assessment to support the Sydney Olympic Park Master Plan 2050 (Master Plan 2050). This report summarises the existing conditions and future development conditions based on the development of detailed hydraulic modelling, with a focus on overland flow and management of stormwater and flood risk generally.

The study utilised a hydraulic model (TUFLOW) and hydrologic model (DRAINS) pair to perform flooding assessment of the precinct covering the urbanised areas and along the watercourses and naturalised pond systems on approach to Parramatta River. The modelling incorporated the influence of various forms of flooding that affect the area, as described below.

- **Pluvial**: Local intense storms of short duration contribute to ponding through the precinct and overland flows, typically conveyed through the road reserves.
- **Fluvial**: Riverine flows from upstream catchment areas of Powells Creek, Haslams Creek and Parramatta River contribute to elevated water levels within the water course floodplains downstream of the urban stormwater systems within the precinct.
- **Coastal:** Coastal flood events don’t typically cause wider inundation of the precinct. However, along the lower foreshore areas, some areas are subject to elevated water levels from Port Jackson tidal flooding conditions which propagate up Parramatta River. These locations grow in extent and flood depth with the effects of climate change on sea levels.

The descriptions of flood behaviour focus on the 1% Annual Exceedance Probability (AEP) and the Probable Maximum Flood (PMF) magnitude events, with additional commentary on the minor storm events including the 5% AEP design storm for the local drainage network.

In existing conditions, flood hazard in urban areas is generally H1 (safe for people, vehicles and buildings) across the precinct for events up to the 1% AEP with climate change. Some exceptions to this are noted along Hill Road and Olympic Boulevard, with higher hazard categories in isolated areas. Larger events up to the PMF present unsafe conditions for some areas to which the evacuation discussion notes the appropriate design response. Non-urban zones including the watercourses and lower-lying open spaces experience high hazard conditions in frequent flood events as is to be expected for floodplain areas adjacent watercourses.

The overland flow regime is constrained in some locations, particularly during major and extreme events. Under developed conditions, flood risk is reduced through topographical changes around existing constraints. The existing constraints to movement and potential development are summarised. There is the opportunity to further optimise the urban environment to manage overland flow as development occurs, with new precinct road reserves introducing options for overland flow direction. Civil regrading works is required for access to change development, and recommended planning controls will result in improved overland flow amenity. No additional funding for capital works is required over the business as usual public domain interface works.

The major and minor system approach to flood risk has been applied through the historical development of the precinct, with road reserves delivering excess flows overland into the receiving floodplains. The design of master plan road reserves continues this approach, with mitigation of potentially elevated hazard categories through grading of precinct streets to manage overland flow. Olympic Boulevard near Sarah Durack Avenue has improved flood hazard relative to existing conditions after new precinct road reserves allow a wider spread of overland flow, relieving some of the high hazard areas under existing conditions.

Recommended planning controls have been provided to guide future proponents in the development of proposals for new/modified buildings, carparks and the associated re-grading of finished surfaces. These draft controls facilitate the sharing of flood management principles through the development application process to ensure a consistent approach to flood risk management is maintained.

The recommended flood emergency response is for evacuation. There are multiple options for a local assembly point within the precinct whereby the existing infrastructure provides the necessary shelter and provisions for large populations. This is an opportunity for consideration in future emergency response planning.

1 Introduction

1.1 Purpose of Report

This report summarises the existing conditions and future development potential of the Sydney Olympic Park in terms of hydrology, with a focus on overland flow flood risk and mitigation of flood impacts. A summary of the existing infrastructure, constraints posed by the current infrastructure, and potential for flooding across the precinct is provided to assist in identifying the development strategy that best addresses the constraints and provides a greater amenity to the community and environment alike.

This risk management and flood impact assessment provides a coordinated regional approach to design that realises benefits in terms of:

- A reduced flood risk profile under developed conditions
- Stormwater system constraints informing the future upgrades to be delivered with development
- A coordinated evacuation strategy

Section 1.4 lists the objectives of the assessment and provides links to the guiding plans and strategies that has informed the development of the objectives.

1.2 Introduction

Sydney Olympic Park is transforming into a thriving suburb strategically located in the centre of Greater Sydney. It is a suburb that benefits from a diversity of land uses, proximity to both Sydney and Parramatta central business districts, and is of national significance, all of which have played an important role in its evolution since hosting the Sydney 2000 Olympic and Paralympic Games. As the 640-hectare site continues to evolve into vibrant neighbourhoods, it will reconnect with its Wangal roots and extensive natural assets to provide a meaningful connection to Country.

The Sydney Olympic Park 2050 Vision & Strategy (the Vision) was released in June 2022 and serves as a roadmap to inform decision-making for the next three decades. Sydney Olympic Park Master Plan 2050 (Master Plan 2050) is the next stage of strategic planning for Sydney Olympic Park. Master Plan 2050 will ensure a coordinated, long term development plan is prepared for the whole precinct.

The most recent iterations of a master plan for Sydney Olympic Park were completed in 2018 and 2021, to support the delivery of Sydney Metro West. Building upon the Vision, Master Plan 2050 considers Sydney Olympic Park holistically, seeking opportunities to integrate thinking about the parklands and urban core together, enhancing its role in Greater Sydney.

The Vision articulates an aspiration to position Sydney Olympic Park as Sydney’s Green Beating Heart: a place that is energised with everyday life, is Country-first, nature positive and where Sydney comes to play.

In 2050, Sydney Olympic Park will be a complex, layered suburb offering a rich and varied range of experiences. Many will live and work here, others will visit for events, diverse attractions or for everyday retail and entertainment. Master Plan 2050 aims to balance certainty with flexibility enabling Sydney Olympic Park’s future to be resilient, dynamic and able to leverage future opportunities and technologies not yet known.

1.3 Previous Studies

Due to recent infrastructure developments in the vicinity of Sydney Olympic Park (namely, Sydney Metro West and Parramatta Light Rail Stage 2), several flood studies have been undertaken that include areas of Sydney Olympic Park.

- Parramatta River Flood Study (Draft) – Cardno (2019)

  This recent study updates the information regarding catchment flood risk, previously covered by the upper and lower Parramatta River Flood Risk Management Study and Plan
  - UPRFRMS+P (Upper Parramatta River Flood Risk Management Study and Plan)
  - LPRFRMS+P (Lower Parramatta River Flood Risk Management Study and Plan)
- Parramatta Light Rail 2 Flood Study – Mott MacDonald (2019)
- Sydney Metro West Environmental Impact Statement, Westmead to The Bays and Sydney CBD – Sydney Metro, determined 11/03/2021
- Powells Creek Flood Study – WMAwater (2022)
- Haslams Creek Floodplain Risk Management Study and Plan – Bewsher Consulting (2002)

Other studies may be available that have not been provided for this assessment. It is recommended the flood model for this study is reviewed if other flood modelling in the area becomes available.

1.4 Precinct Objectives

The strategic planning for Sydney Olympic Park include objectives and provisions relating to flooding to ensure that proposed development is targeted to avoid flood impacts and provide a net improvement in the management of flood risk. The objectives of this study are aligned with the regional plans and best practice to address these matters relating to flooding. Objectives as identified in regional plans as they relate to flooding:

- Restore and regenerate estuarine and freshwater systems
  - Build water into the built environment to clean it, purposefully design for flooding and re-establish a stronger connection to water
  - Through green infrastructure including biodiversity and waterways, local features, lot sizes, strata ownership and the transition between different built forms[1]
- Develop a town centre and parklands that is resilient to future shocks
  - including increase flooding from major rain events and sea level rises
  - manage risks to life and property from flooding[2]
- Embed the education of Wangal Country and Indigenous culture throughout Sydney Olympic Park
  - Research and application of Indigenous land management practices to manage landscapes and ecosystems that limit flood risk
- Greater Sydney's emergency response hub[3]
  - Sydney Olympic Park consolidates its role as NSW's emergency operations control centre, becoming NSW's emergency response hub
  - Future development across Sydney Olympic Park is planned so that the transport network is able to support emergency operations in future crises similar to recent roles with Western Sydney flooding

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[1] Greater Sydney Region Plan (2018) Greater Sydney Commission

[2] Greater Sydney Region Plan (2018) Greater Sydney Commission

[3] Sydney Olympic Park 2050 Place Vision and Strategy Engagement Report (2022) Sydney Olympic Park

Specific policies that will guide and facilitate the Master Plan include:

- City of Parramatta Council's City River Strategy[4]
  - Flood prone land is a valuable resource that should be managed and developed, subject to a merit approach that provides due consideration to social, economic and environmental criteria, as well as any flooding criteria, as identified in flood studies, independent assessments or strategically developed floodplain risk management studies and plans.
  - Both mainstream and overland flooding are to be considered when assessing flood risk.
  - Flood prone land should not be sterilised by unnecessarily precluding development through the application of rigid and prescriptive criteria, however inappropriate proposals should not be accepted.
  - Measures to increase resilience across the LGA should be encouraged so as to reduce the long term effects of flooding when it occurs.
- Greater Sydney Region Plan and Central City District Plan
  - manage risks to life and property from flooding
  - increase resilience through green infrastructure including biodiversity and waterways, local features, lot sizes, strata ownership and the transition between different built forms
- SOPA Policy POL13/4 Stormwater Management & Water Sensitive Urban Design[5]
  - Minimise volume and frequency of stormwater discharge from hardstand areas.
  - Maximise quality of any stormwater discharged.
  - Promote the application of innovative and sustainable stormwater management.
- NSW Statutory Floodplain Guidance and Technical Reports
  - Considering flooding in land use planning guidelines (Planning Circular 21-006), Department of Planning, Industry and Environment 2021
  - NSW Flood Risk Management Manual (2023) Department of Planning, 2023
    Includes associated guidelines and toolkit of resources, formerly the Floodplain Development Manual 2005
  - NSW Flood Prone Land Policy and associated Floodplain Risk Management Guidelines

[4] Parramatta City River Strategy Design and Activation Plan (2015) City of Parramatta Council

[5] POL 13/14, Stormwater Management and Water Sensitive Urban Design (2016) Sydney Olympic Park Authority

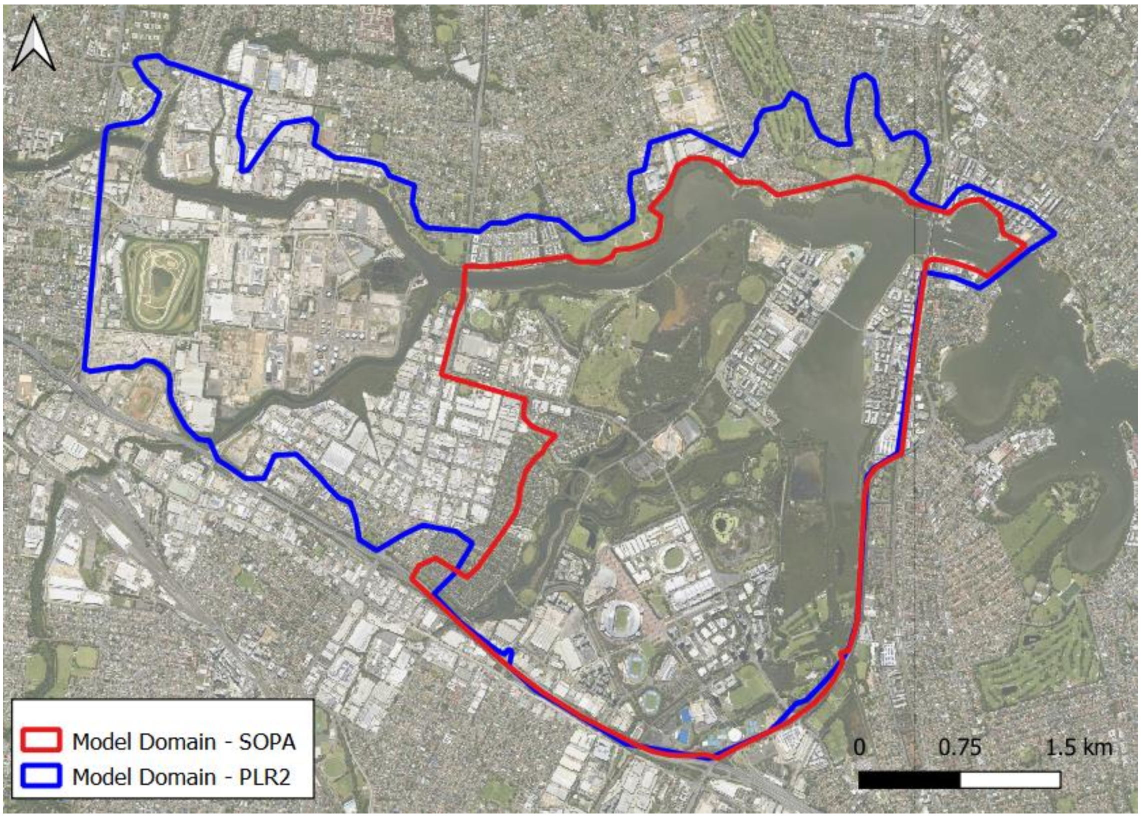
2 Model Development

The study utilised a hydraulic model (TUFLOW) to perform a flooding assessment along the watercourses and various overland flow paths. The findings and recommendations of the NSW Flood Enquiry (2022) have been incorporated in the approach to model update including selection of input data from previous studies.

2.1 Existing Flood Study and TUFLOW Model

A TUFLOW model developed by Mott MacDonald for Parramatta Light Rail Stage 2 (PLR2) was used as the basis of the Sydney Olympic Park flood model. The model domain for Sydney Olympic Park lies almost entirely within the active model domain for PLR2, shown in Figure 2.1.

Figure 2.1: Comparison of PLR2 and SOPA flood model extents



A review of the TUFLOW model and its accompanying reports was carried out to assess its validity and assumptions, to identify any limitations of the modelling and form the basis of modelling for the Sydney Olympic Park flooding assessment.

2.2 Sydney Olympic Park TUFLOW Model

A new TUFLOW model was developed for Sydney Olympic Park, using some of the PLR2 datasets as a basis. New information, outlined below, was incorporated into the model to better predict the local catchment flood extents, levels, depths, and flood hazards for Sydney Olympic Park.

2.2.1 Hydrology Update

2.2.1.1 Parramatta River

The Sydney Olympic Park flood model utilises outputs from the Parramatta River hydrological assessment undertaken for PLR2 in 2019. This assessment considered the entire catchment for Parramatta River in an XP-RAFTS model and a flood frequency analysis (FFA) was undertaken at Marston Weir.

While the overall focus of the SOPA flood assessment is the local stormwater catchments, the hydrology of Parramatta River is important as it determines tailwater levels at stormwater outlets that discharge to the river.

The critical storm duration for Parramatta River is 9hr. Based on this it is unrealistic to have a 1% AEP flow in the watercourse coincide with a 1% AEP local catchment storm, which typically have critical durations less than 2 hours. Therefore, this study has adopted 25-minute Parramatta River storm duration that for each AEP which aligns with the critical storm durations for the Town Centre and Parklands in Sydney Olympic Park. This approach to a larger adjacent receiving catchment is consistent with guiding principles of the *NSW Floodplain Risk Management Guide – Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways* (NSW OEH, 2015).

2.2.1.2 Haslams Creek and Powells Creek

Haslams Creek and Powells Creek are the two main Parramatta River tributaries that flow through Sydney Olympic Park. They provide tailwater conditions for several stormwater outlets. Recent reports for the two creeks were obtained from the SES Flood Data Portal.

Powells Creek

The draft report for the Powells Creek Flood Study (undertaken by WMAwater in 2022) was available through the SES NSW Flood Data Portal[6] and has been used as a guide for developing suitable hydrology for Haslams Creek and Powells Creek, alongside the Parramatta River hydrology model.

The Powells Creek Flood Study undertook a detailed hydrological assessment for the catchment, concluding that the critical duration for the catchment was 60 minutes for all design rainfall events, bar the 1.0EY and 20% AEP storms. The calculated critical storm durations are recreated in Table 2.1. A 60 minute storm duration is likely to create coincident peak flows in the watercourse and local stormwater networks across Sydney Olympic Park, therefore, the full storm hydrograph for Powells Creek can be adopted in the Sydney Olympic Park model.

Table 2.1: Powells Creek - Critical storm durations (WMAwater 2022)

Design Rainfall Event	Adopted Critical Storm Duration
20% AEP	45 minutes
10% AEP	60 minutes
5% AEP	60 minutes
2% AEP	60 minutes
1% AEP	60 minutes
0.5% AEP	60 minutes
0.2% AEP	60 minutes
PMF	60 minutes

[6] Powells Creek Flood Study – 3rd Draft Report, WMAwater (April 2022) https://flooddata.ses.nsw.gov.au/flood-projects/powells-creek-flood-study

Peak flows have been calculated at Homebush Bay Drive bridge which is notable as this location was chosen as the inflow location in the Sydney Olympic Park model. As a result, the peak flow calculated for the Powells Creek study can confidently be adopted for the Sydney Olympic Park model as the study has considered catchment specific hydrology rather than a more general approach used by XP-RAFTS.

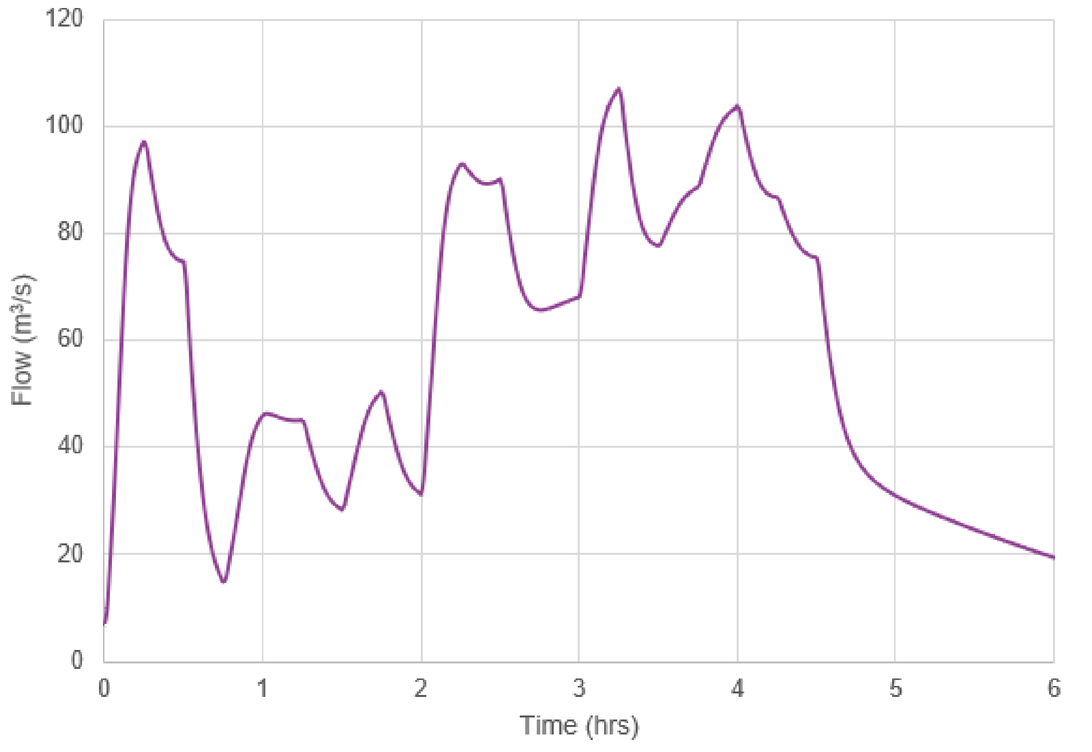
Peak flows calculated for Powells Creek are recreated in Table 2.2.

Table 2.2: Powells Creek – Peak flow (m^3/s) through Homebush Bay Drive Bridge (WMAwater 2022)

Location	1.0EY	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	0.2% AEP	PMF
Homebush Bay Drive Bridge	45	57	69	83	95	107	116	129	503

The hydrograph shape was not available from the Powells Creek Flood Study Report. Therefore, the Powells Creek hydrograph shape calculated by XP-RAFTS from the Parramatta River hydrology model has been adopted and scaled to the peak flow calculated by the Powell Creek Flood Study. A scaling factor of 1.19 was applied with the resulting 1% AEP hydrograph shown in Figure 2.2.

Figure 2.2: Powells Creek 1% AEP flow hydrograph adopted for Sydney Olympic Park



Haslams Creek

Compared to Powells Creek, less flow information was available for Haslams Creek. However, the catchment size is relatively similar to the neighbouring Powells Creek, as is the degree of urbanisation. Based on this, information derived for Powells Creek has been used to inform peak flows for Haslams Creek.

It has been assumed that the critical duration for Haslams Creek is also 60 minutes, meaning peak river flow would coincide with peak flows from the stormwater network outlets. This is based on the physical similarities of the two catchments. The XP-RAFTS model was used to calculate a 1% AEP 60 minute storm hydrograph for the Haslams Creek catchment. This peak flow was subsequently scaled using an area-weighted factor based on the comparative catchment sizes. A factor of 1.32 was applied to the Powells Creek flow to generate a suitable estimate for Haslams Creek.

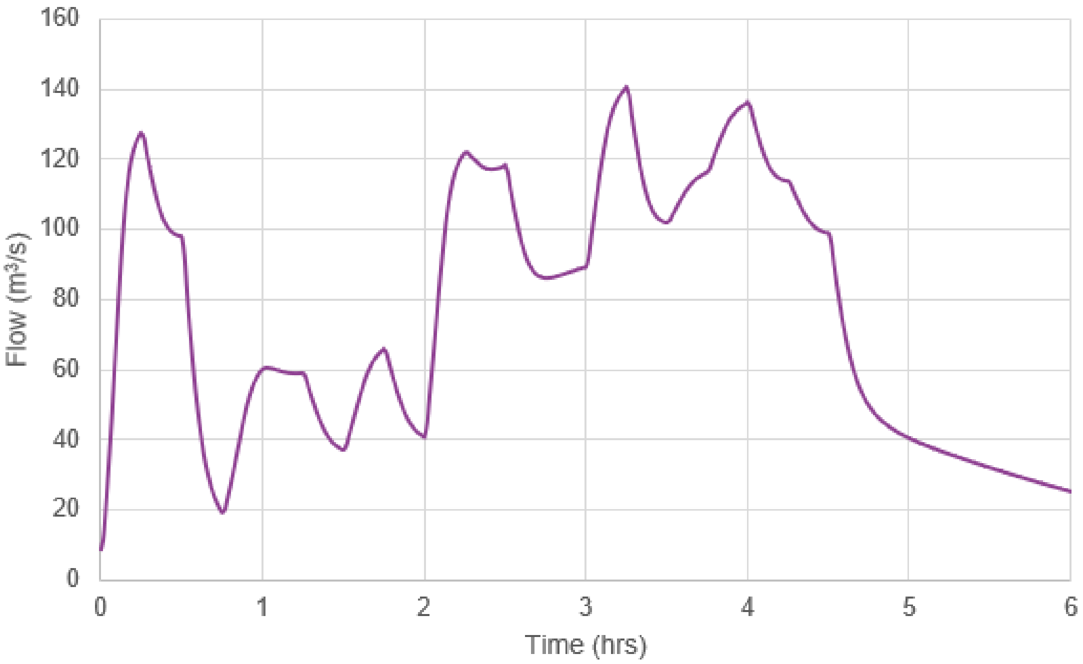
Details of the catchments are shown in Section 3.3.

Table 2.3: Comparison of hydrological parameters

Catchment	Area (ha)	Vect slope (%)	Effective impervious (%)	Peak 1% AEP Flow (2019 XP-RAFTS) (m^3/s)	Peak 1% AEP flow (existing study) (m^3/s)	Adopted 1% AEP peak flow (m^3/s)
Haslams Creek	1622	0.35	52.3	106	n/a	141
Powells Creek	1223	0.44	56.8	90	107	107

The resulting 1% AEP hydrograph for Haslams Creek shown in Figure 2.3.

Figure 2.3: Haslams Creek 1% AEP flow hydrograph adopted for Sydney Olympic Park



Stormwater Subcatchments

The model domain was divided into 113 stormwater sub catchments as shown in Figure 2.4 based on urban boundaries and topographical ridgelines identified with the ground level DEM (see Section 2.2.2). Sub catchments were grouped into three categories based on the ratio of built to vegetated surface area identified for each with aerial imagery and assigned an effective impervious area (EIA) and pervious area (PA) percentage value in DRAINS (see Table 2.4).

Figure 2.4: DRAINS sub catchments

The minor and major events were modelled in DRAINS using ARR temporal pattern data and BoM IFD data to generate local peak flows in each sub catchment for a range of 10 storm patterns and 12 durations (see Table 2.5). Outputs from the hydrological models were provided to the hydraulic flood model for critical storm selection.

Table 2.4: DRAINS sub catchment categories

Sub Catchment Category	Effective Impervious Area (EIA)	Pervious Area (PA)
Urban	90%	10%
Suburban	80%	20%
Recreational	5%	95%
	** A standard time of concentration of 5mins and 10mins was assigned to the EIA and PA respectively for sub catchments.*	

Table 2.5: DRAINS major and minor storm ensemble

Storm Patterns	Durations			
1 - 10	10min	30min	1.5hour	6hour
	15min	45min	2hour	12hour
	25min	1hour	3hour	24hour

2.2.2 Digital Elevation Models

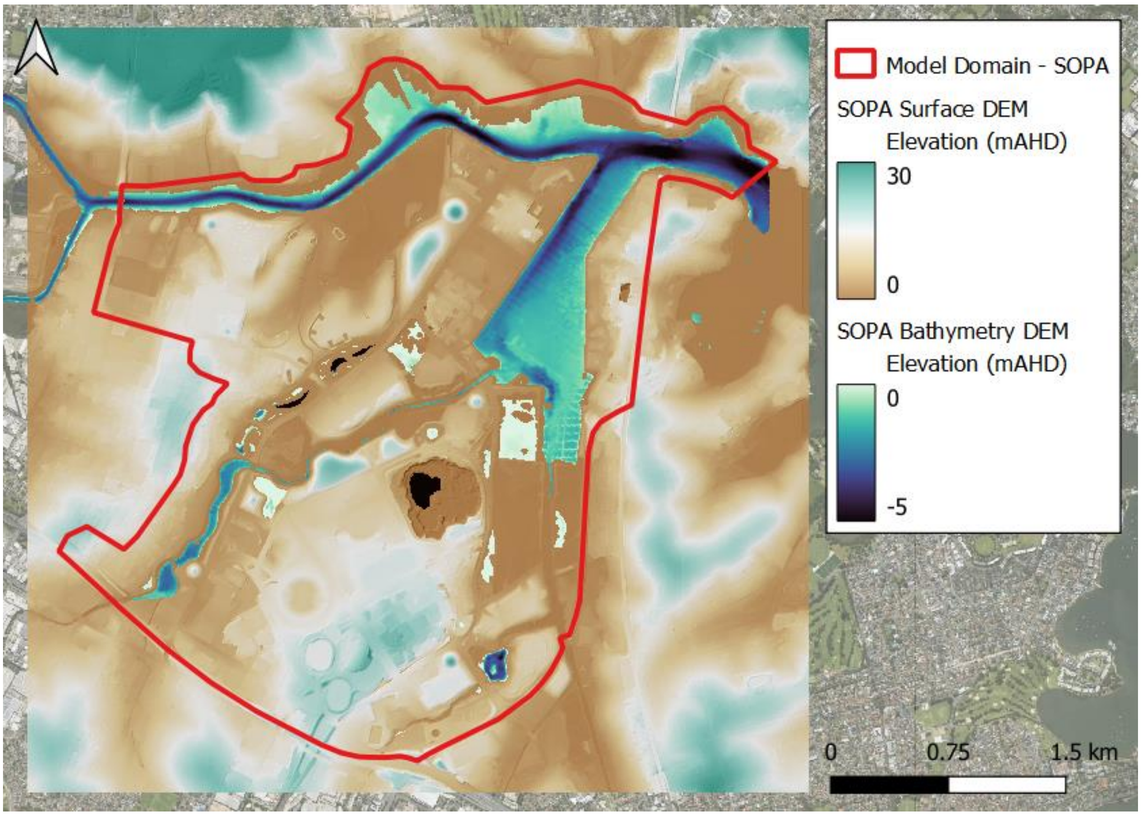
Two Digital Elevations Models (DEM) were supplied by SOPA, covering the area of Sydney Olympic Park. They represent the most recently acquired topography across Sydney Olympic Park.

- Ground level DEM
- Underwater DEM (bathymetry) for the following:
  - Parramatta River
  - Homebush Bay
  - Haslams Creek and flood storage ponds
  - Lake Belvedere
  - The Brickpit

The DEMs were input to the TUFLOW model to generate the main model grid with some minor amendments to fill erroneous holes and smooth areas of poor filtering.

The extents of the two DEM datasets are shown in Figure 2.5.

Figure 2.5: Sydney Olympic Park DEM extents



2.2.3 Stormwater Network Data

A significant update to the stormwater network data was applied to the TUFLOW model, using network plans provided by SOPA.

Stormwater Pits

Pits have been modelled as TUFLOW 'Q' type pits that allows a depth-discharge curve for known pit types to be applied. The following pit types have been modelled explicitly, along with their associated 2D connection type:

- SA1 – 1m on-grade side entry pit – SXL connection
- SA2 – 2m on-grade side entry pit – SXL connection
- SAS – sag pit – SXS connection
- SO1 – single gully pit – SXL connection
- SO2 – double gully pit – SXL connection
- 06m_G – 600mm grated pit – SXL connection
- 1m_G – 1m grated pit – SXL connection
- KIP – kerb inlet pit – SXL connection
- JP – junction pit (no flow can be applied as the pits are assumed to be sealed) – SX connection

Specific pit types were identified via the stormwater network data provided by SOPA and by using virtual site visits and aerial photography.

An SXL type connection has been adopted for the majority of pits that receive stormwater. The SXL connection provides the means to lower the adjacent ground level around the pit to aid the capture of shallow flows and is a recommended TUFLOW approach. For the SOPA model, a value of 100mm has been used. For pits not receiving flow (e.g., junction pits) an automated SX connection has been used that applies the ground elevation of the grid cell to the pit obvert.

Stormwater Pipes

Stormwater pipes have been digitised into the flood model across the SOPA catchment. Data regarding dimensions and inverts has been sourced from SOPA where available. Significant work was undertaken to correct adverse pipe gradients and missing attribute data such as pipe inverts and diameters were interpolated where necessary.

Some invert information was provided by SOPA, however, much of the key information was missing from available datasets. In these instances, engineering judgement was used to assume reasonable pipe inverts based on minimum cover requirements and constant pipe grades.

All pipes have been assumed to be concrete with a Manning's n value of 0.015 applied.

Typically, pipes smaller than 375mm have been excluded from the flood model as they add little in the way of hydraulic capacity in major storm events. Some small catchments of 300mm pipes have been included to improve the distribution of pits within some of the DRAINS subcatchments.

A series of narrow trench drains are used to drain the large, paved areas around Stadium Australia. There is no comparable unit in the TUFLOW model to represent these. To include the flow these networks contribute to the overall drainage system, a 600mm grated pit has been located on the last length of pipe, prior to the connection to the trunk drainage. This allows a portion of flow to be added accounting for these trench drains.

Stormwater Detention Tanks

Two large stormwater detention tanks were identified on the stormwater network plan provided by SOPA. These have been modelled using a stage-area relationship that calculates a volume based on vertical elevations (mAHD) and the associated area at that elevation. Elevations and areas have been based on as-built drawings provided by SOPA. Some assumptions were made regarding invert levels, based on the incoming and outgoing pipe inverts.

Modelled details for the two tanks are listed in Table 2.6.

Table 2.6: SOPA stormwater detention tank details

Tank ID	Location	Invert (mAHD)	Obvert (mAHD)	Area (m^2)	Volume (m^3)
SOPA_tank1	Edwin Flack Avenue	1.88	3.90	511	1,030
SOPA_opal	Opal Towers	4.00	8.2 (assumed obvert of tank lid)	1443 (max)	2,053

Gross Pollutant Traps

Several Gross Pollutant Traps (GPT) are located within the Sydney Olympic Park catchment. As these are typically designed to operate under low flow conditions, they have not explicitly been modelled for this stormwater assessment as they are not expected to impede high storm flows.

Roof Drainage and Rain Tanks

Large areas of roof drainage are located within the Sydney Olympic Park catchment, particularly around the stadiums. These have not explicitly been modelled for this stormwater assessment. Instead, the total flow for the individual sub-catchments has been applied to the pits, assuming that rainfall has been discharged from the roof structures into the stormwater network.

2.2.4 Climate Change

Refer to **Section 4 Climate Change** for further discussion.

2.2.5 Other Changes

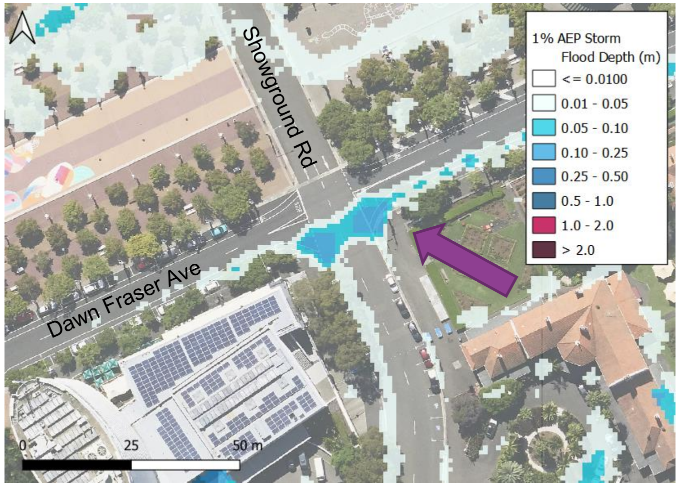
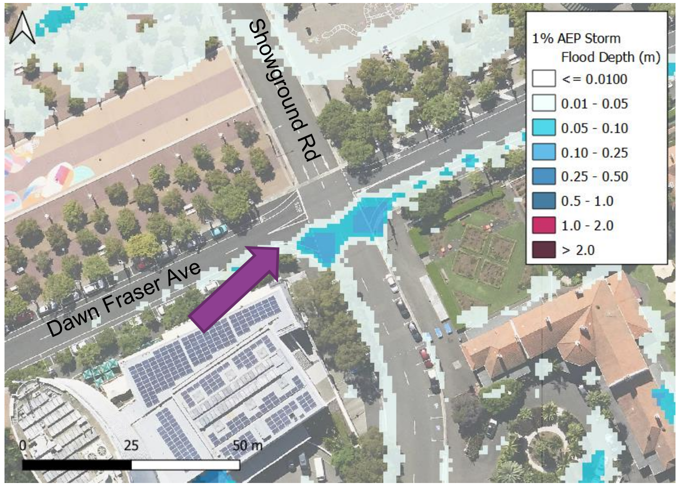
Other changes such as quadtree mesh and Heavily Parallelised Compute (HPC) were incorporated into the TUFLOW model to enhance model fidelity and result resolution to better represent overland flow paths.

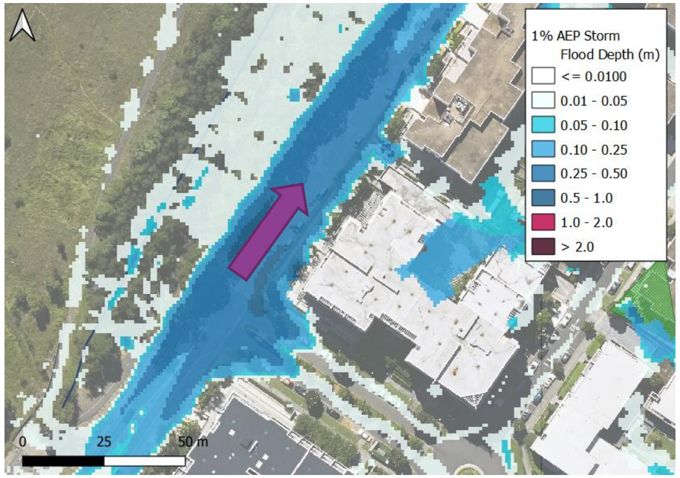
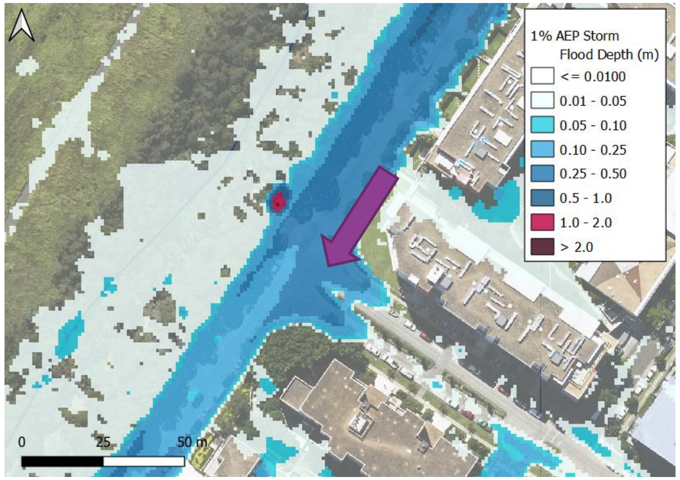
2.3 Validation of Model Outputs

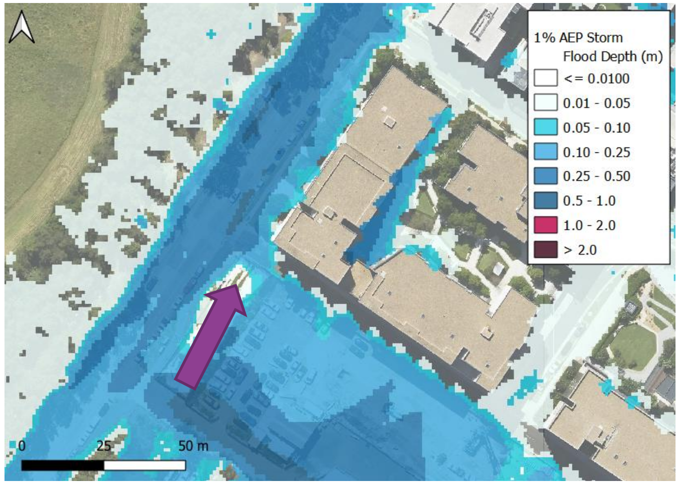
A desktop assessment was undertaken to assess the performance of flood model against known areas of flood risk across Sydney Olympic Park, correlating known or observed flooding against areas of flooding predicted by the flood model. While it is not possible to know the exact storm details (e.g., rarity, duration, or intensity) this validation provides broad evidence that the flood model geometry is performing as expected, given typical parameters and is adequately recreating known areas of flooding.

Table 2.7 cross references known flood locations against flood model extents and depths.

Table 2.7: Evidence of Flood Risk

Location	1% AEP SOPA Flood Model Output	Evidence	Source
Junction of Dawn Fraser Avenue and Showground Road, Sydney Olympic Park (arrow denotes direction of photo)			Sydney Morning Herald – October 2018 *https://bit.ly/43mMYBd*
Junction of Dawn Fraser Avenue and Showground Road, Sydney Olympic Park (arrow denotes direction of photo)			Daily Mail UK – October 2018

Location	1% AEP SOPA Flood Model Output	Evidence	Source
Hill Road, Wentworth Point (arrow denotes direction of photo)			Facebook – June 2016
Junction of Hill Road and Bayswater Drive, Wentworth Point (arrow denotes direction of photo)			Imgur – June 2016 https://imgur.com/a/w9d56

Location	1% AEP SOPA Flood Model Output	Evidence	Source
Junction of Hill Road and Verona Drive, Wentworth Point (arrow denotes direction of photo)			Facebook – February 2020 storm

3 Existing Conditions

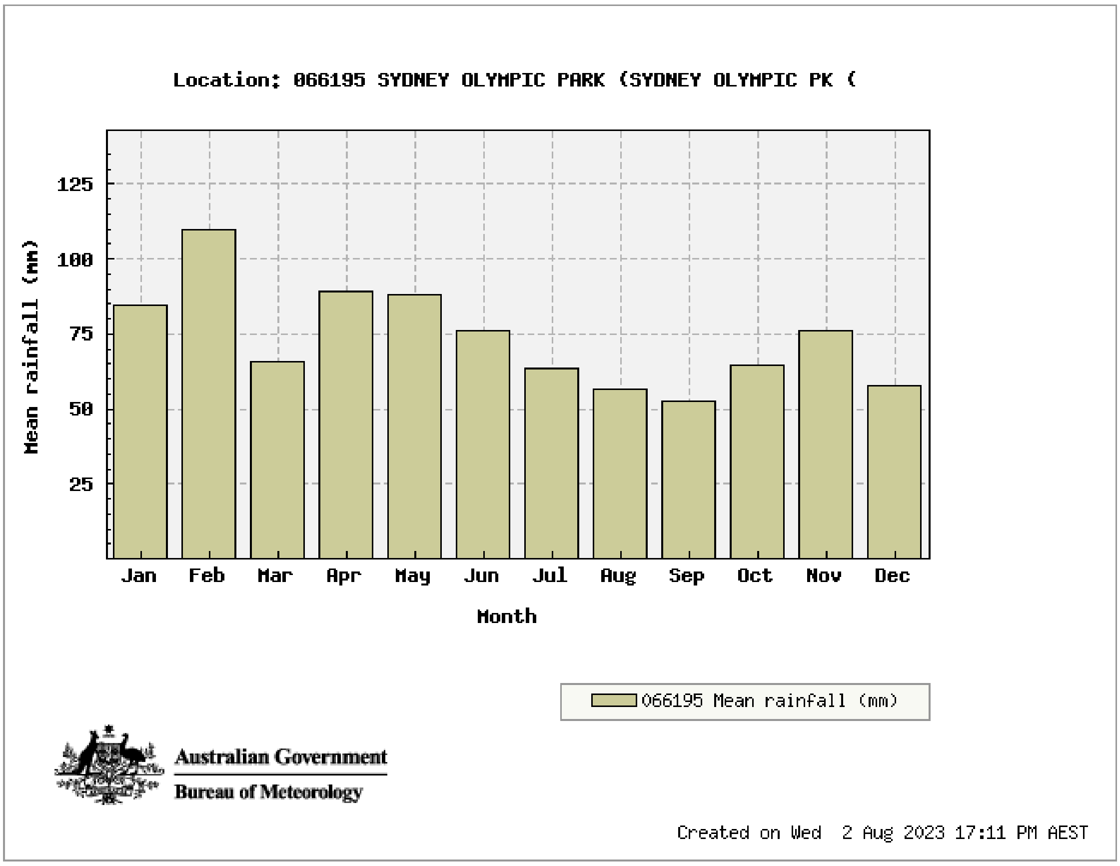
3.1 Local Climate and Topography

Monthly average rainfall statistics and temperature statistics are available, sourced from two climate stations located within Sydney Olympic Park:

- 066195 Sydney Olympic Park (adjacent Uhrig Rd) (1995 – 2011)[7]
- 066212 Sydney Olympic Park AWS (Archery Centre) (2011-present)

Mean average rainfall statistics for the two sites are presented in Figure 3.1 to Figure 3.4 below indicating the local conditions. The general trend in monthly rainfall totals is for larger rainfalls typically experienced during the first six months of the year through the Summer-Autumn period.

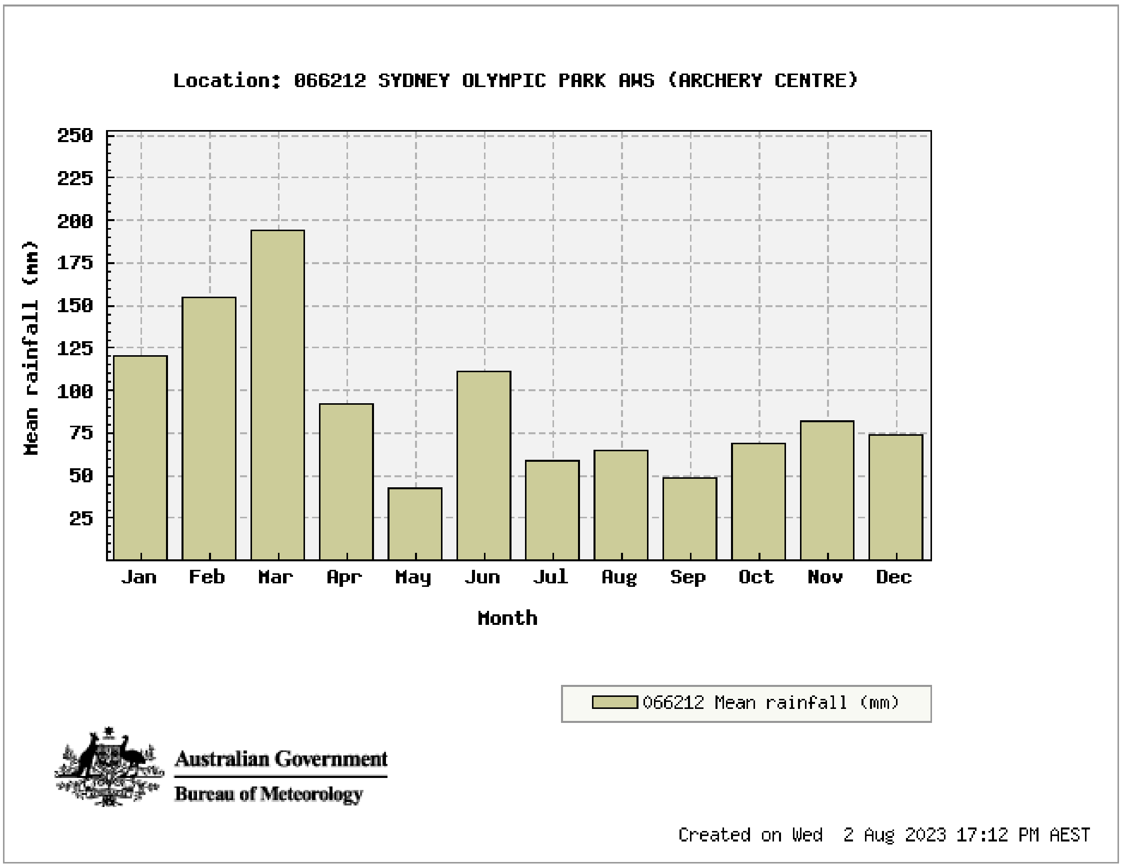
Figure 3.1: Average Monthly Rainfall – 066195 Sydney Olympic Park



Source: Australian Government, Bureau of Meteorology

[7] Relocated in 2011 to Archery Park

Figure 3.2: Average Monthly Rainfall – 066212 Sydney Olympic Park AWS (Archery Centre)



Source: Australian Government, Bureau of Meteorology

Figure 3.3: Mean Maximum Temperature – 066195 Sydney Olympic Park

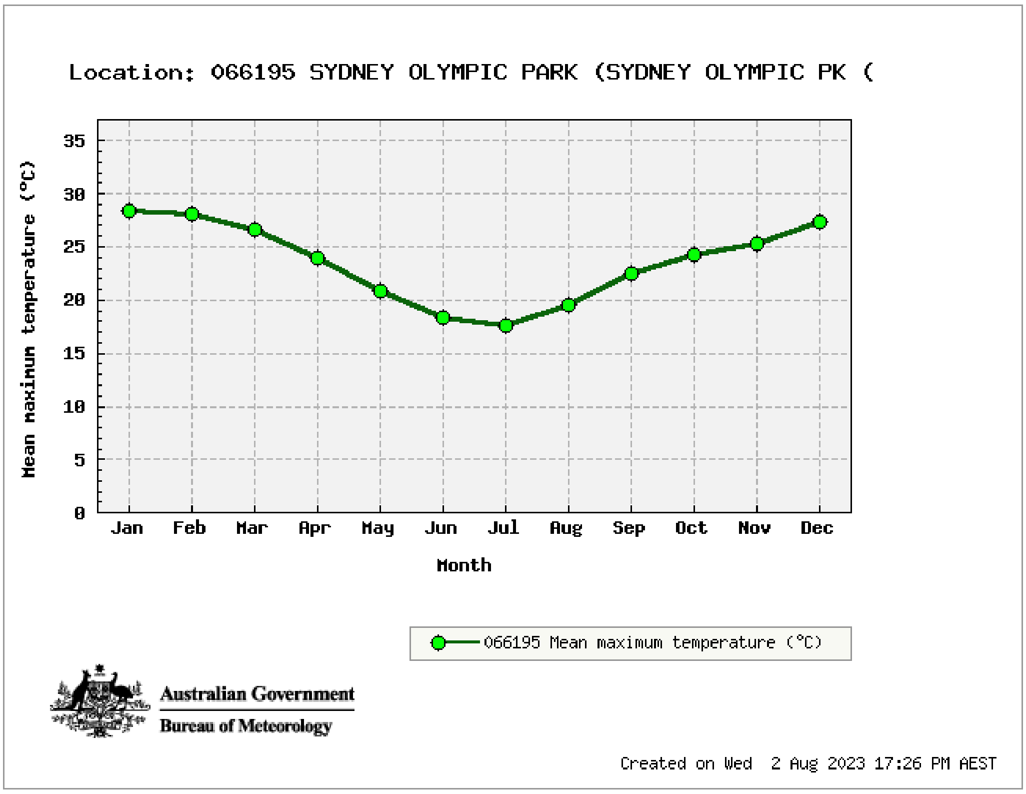
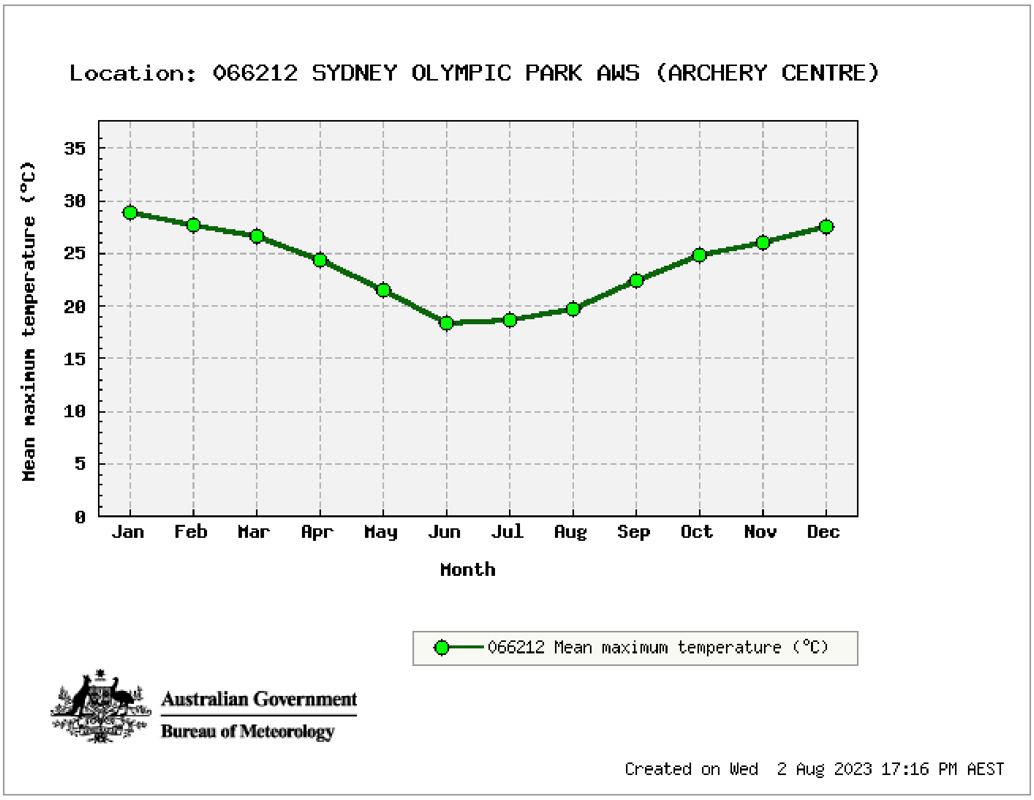


Figure 3.4: Mean Maximum Temperature – 066212 Sydney Olympic Park AWS (Archery Centre)



3.2 Sources of Flooding

Various forms of flooding affecting the area are as described in the sections below. The resultant flooding varies in magnitude depending on the intensity of the storm event, combination of flooding sources and the base climate conditions that trigger the flooding. General descriptions below focus on the 1% Annual Exceedance Probability (AEP) or the Probable Maximum Flood (PMF) magnitude events to describe the flooded conditions.

3.2.1 Overland Flow

Local rainfall in the catchment is converted to runoff after falling on:

a) Impervious surfaces, and
b) Pervious surfaces in excess of the small rainfall amount that can infiltrate the soil.

Runoff accumulates in depressions in the topography, forming overland flow paths.

3.2.2 Coastal

Coastal flood events don’t typically propagate far from the permanent extent of Homebush Bay to cause inundation of Sydney Olympic Park. However, when larger storm surge events are experienced, the lower lying areas of Sydney Olympic Park adjacent the bay may become inundated. The drainage of local storms via the pit/pipe system and overland flows are impeded as the water level in Parramatta River rises during any coincident coastal flood events.

The basis for the tidal conditions used in flood simulations are the adopted conditions within the previous floodplain management study. The design flood event scenarios for the 1% AEP flood adopts a 5% AEP ocean water level (approximately 1.34 mAHD in Parramatta River) coincidentally. The design PMF flood adopts a 1% AEP ocean water level (approximately 1.44 mAHD in Parramatta River).

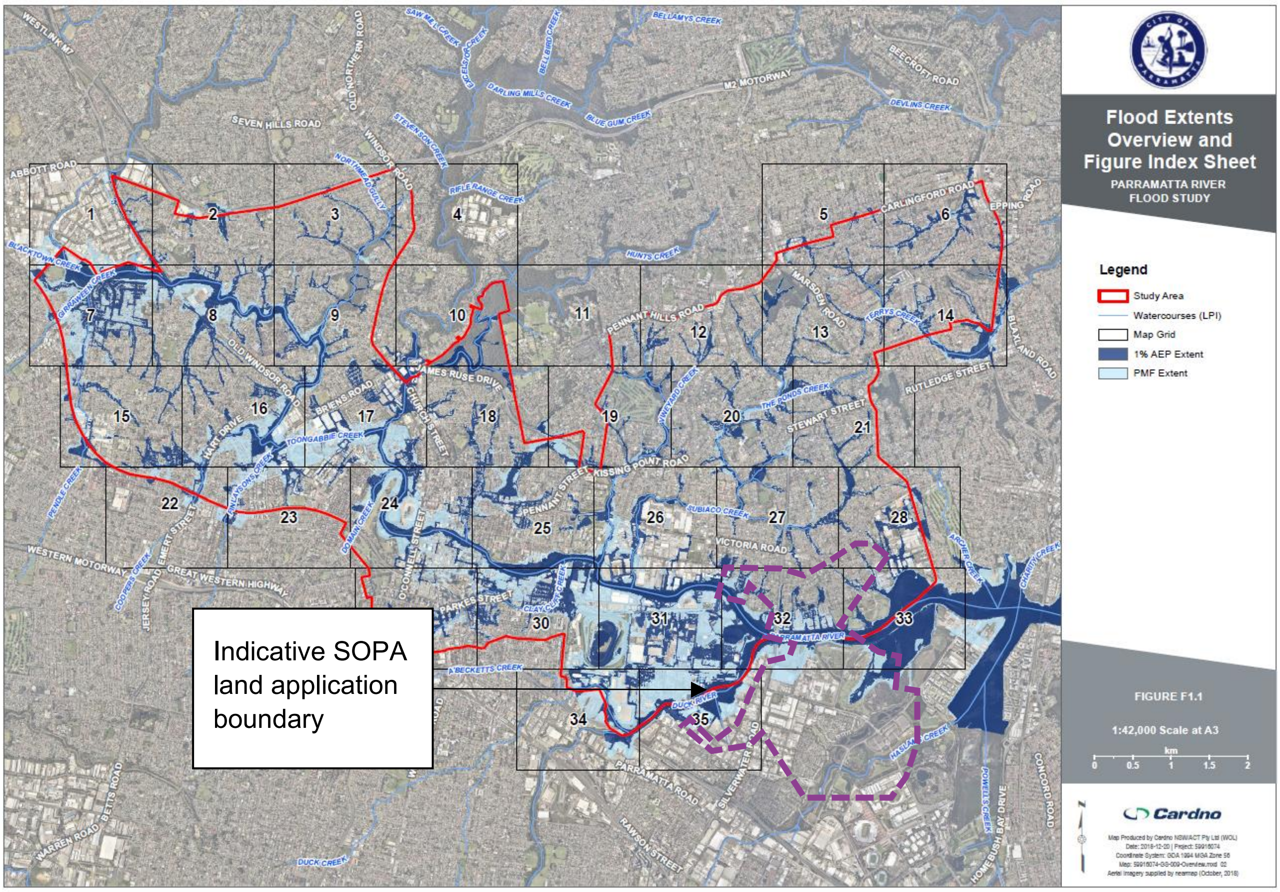
This is consistent with the *NSW Floodplain Risk Management Guide – Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways* (NSW OEH, 2015). For scenarios including climate change, the anticipated sea level rise is applied (added) to the relevant AEP harbour levels consistent with the RCP 8.5 2100 median predictions.

3.3 Regional Context

The following flood maps shows the flood impact of the 1% AEP and PMF events on the surrounding areas, as per the available flood studies.

3.3.1 Parramatta River

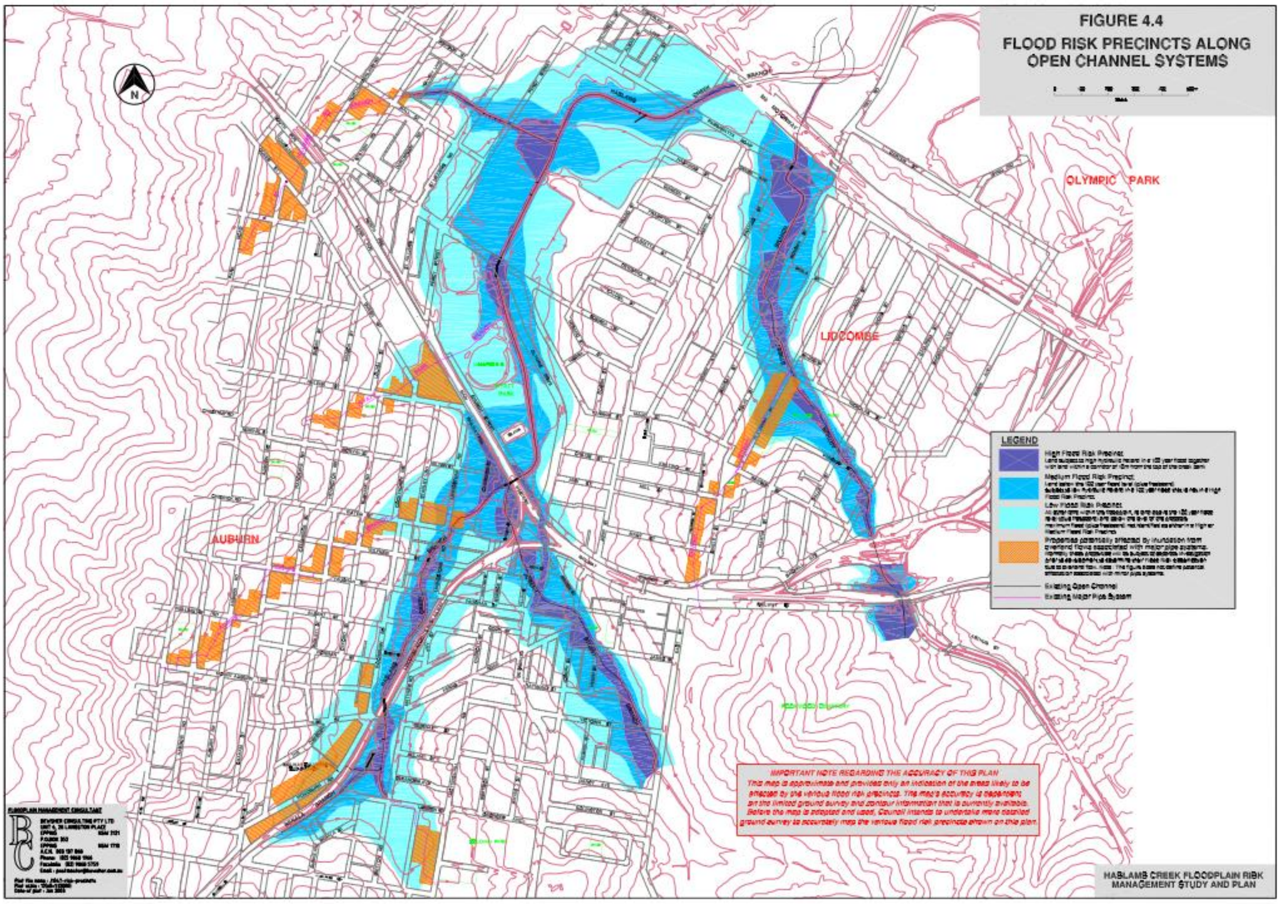
Figure 3.5: Existing Regional Flood Study – 1% AEP and PMF



Source: Parramatta River Flood Study (Cardno, 2019)

3.3.2 Haslams Creek

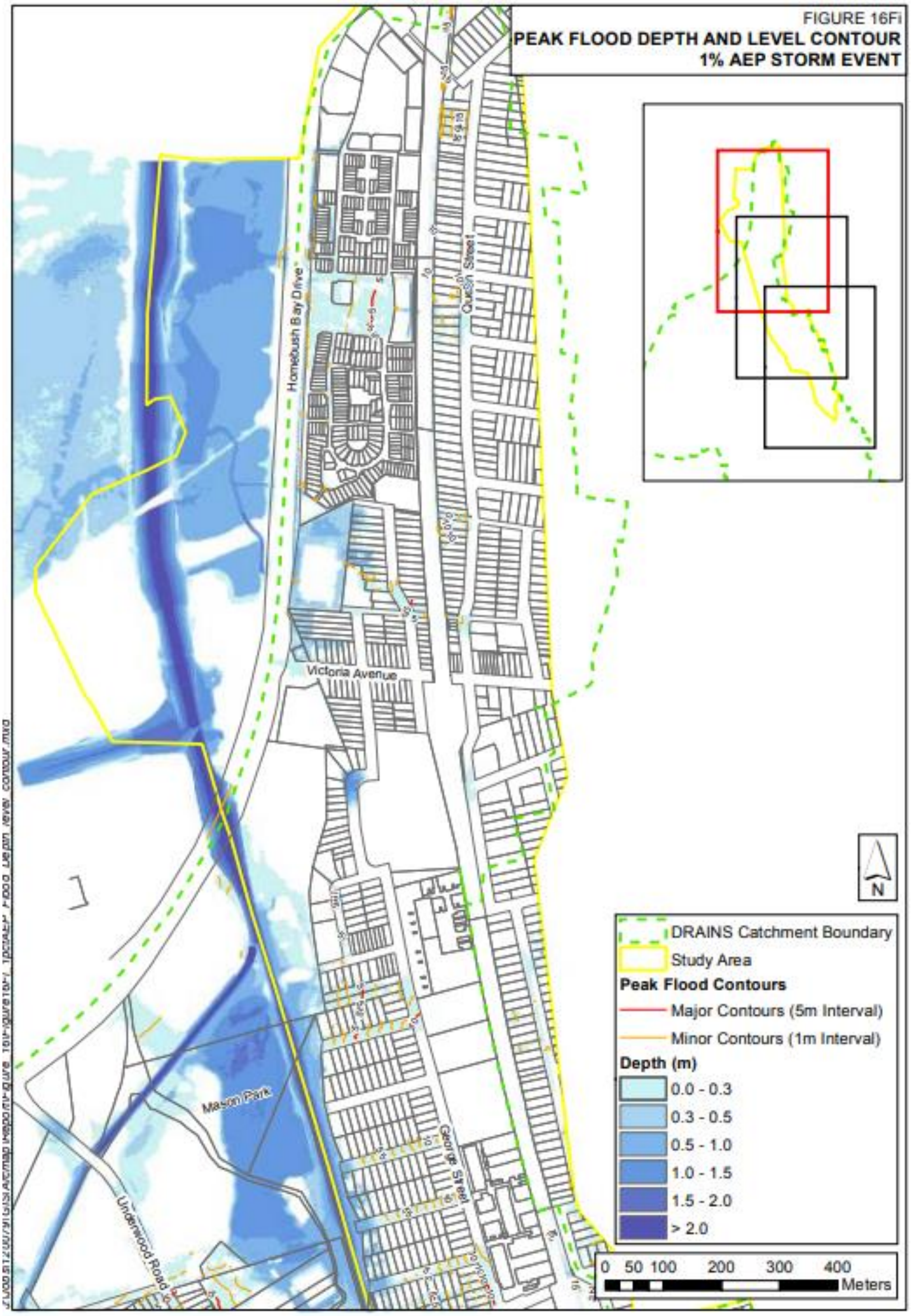
Figure 3.6: Existing Haslams Creek Regional Flood Study – 1% AEP and PMF



Source: Haslams Creek Floodplain Risk Manafment Study and Plan (Bewsher Consulting, 2003)

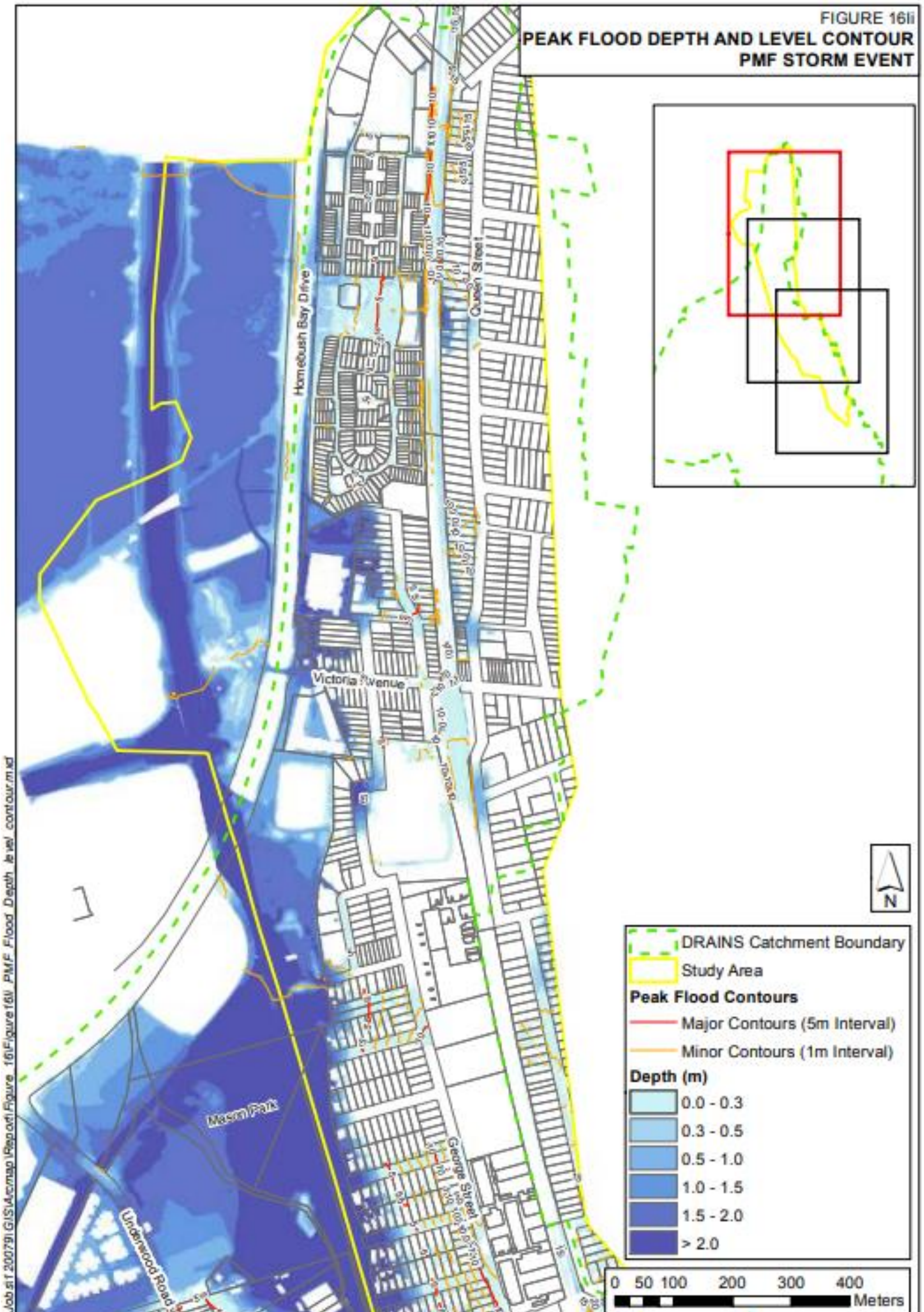
3.3.3 Powells Creek

Figure 3.7: Existing Regional Flood Study – 1% AEP



Source: Powells Creek Flood Study (WMAwater, 2022)

Figure 3.8: Existing Regional Flood Study – PMF



Source: Powells Creek Flood Study (WMAwater, 2022)

3.4 Existing Flooding Conditions

3.4.1 Critical Storm Durations and Temporal Patterns

The flooding experienced in Sydney Olympic Park Town Centre is typically overland flow resulting from short intense storms. This is indicated by the critical durations shown in Figure 3.9 and Figure 3.10. Some trapped ponding locations continue to accumulate water in longer storms; however, vast majority of the study area is subject to the worst case flooding from overland flow only. Creeks and large areas of standing water experience worst case flood depths when durations exceed a number of hours.

For the Town Centre / Parklands and Wentworth Point, the critical durations identified by the flood model are:

- 10 minutes
- 15 minutes
- 30 minutes
- 60 minutes
- 90 minutes

Figure 3.9: Existing 1% AEP Critical Flood Duration – SOPA Town Centre / Parklands

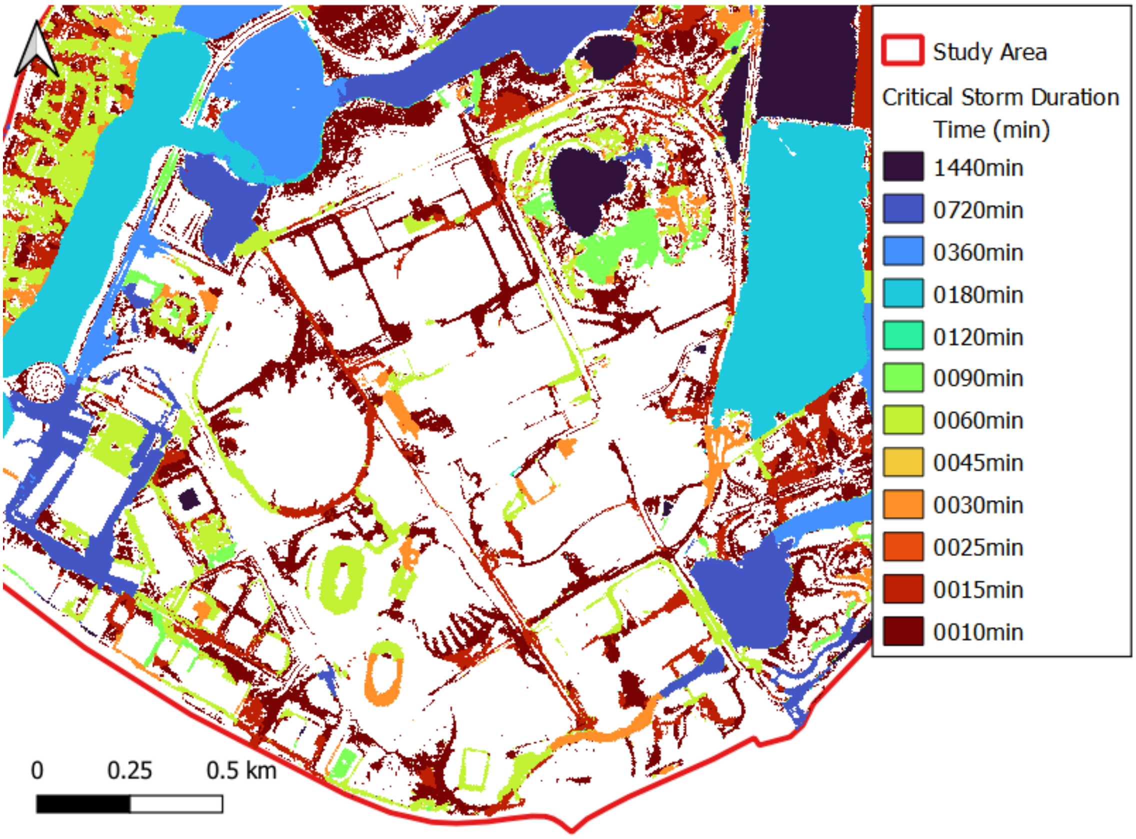
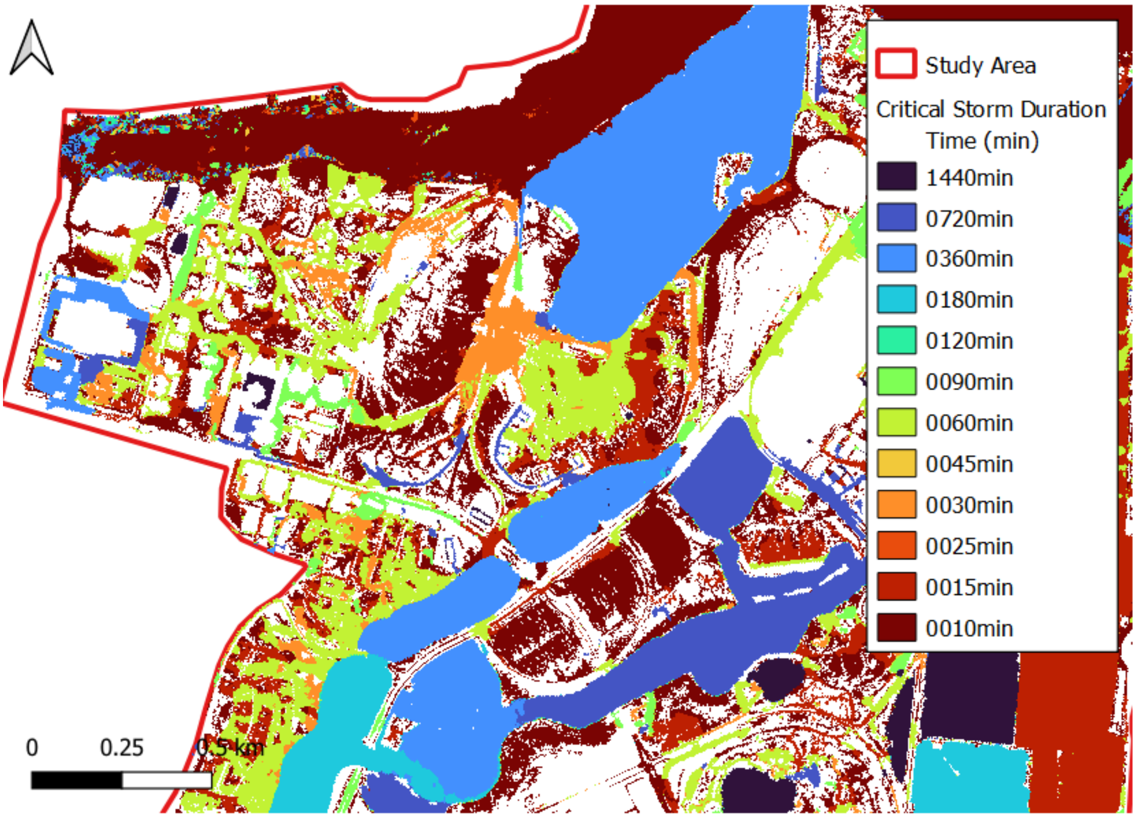


Figure 3.10: Existing 1% AEP Critical Flood Duration – Newington



The critical pattern assessment for 1% AEP storm event was performed using the storm durations ranging from 10 minutes to 90 minutes and 10 different temporal rainfall patterns. The critical pattern was assessed at SOPA town centre. All storm durations indicated a single, dominant pattern with worst-case water depth results in the Sydney Olympic Park Town Centre, however, a second pattern was also chosen to expand the analysis. Refer to Table 3.1 below for results.

Table 3.1: Critical Temporal Patterns for 1% AEP

Storm Event	Storm Duration	Dominant Critical Pattern	Secondary Critical Pattern
1% AEP	10min	9	2
1% AEP	15min	9	3
1% AEP	30min	7	10
1% AEP	60min	1	3
1% AEP	90min	6	1

3.5 Flood Depths and Extents

The following flood maps indicate the worst case flooding in the 1% AEP under existing conditions, with the mapping an envelope result of multiple simulations to capture both short flashy storms and longer events.

Refer to **Appendix A** for high resolution maps.

Figure 3.11: Existing 1% AEP Flood Depth – Town Centre / Parklands

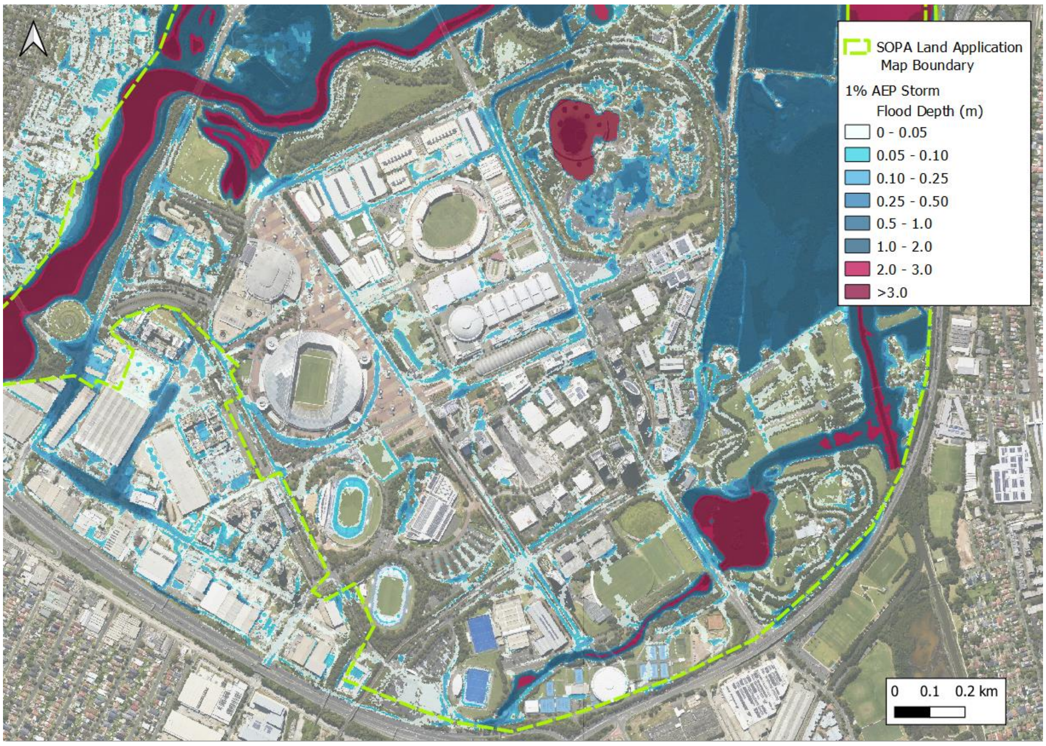
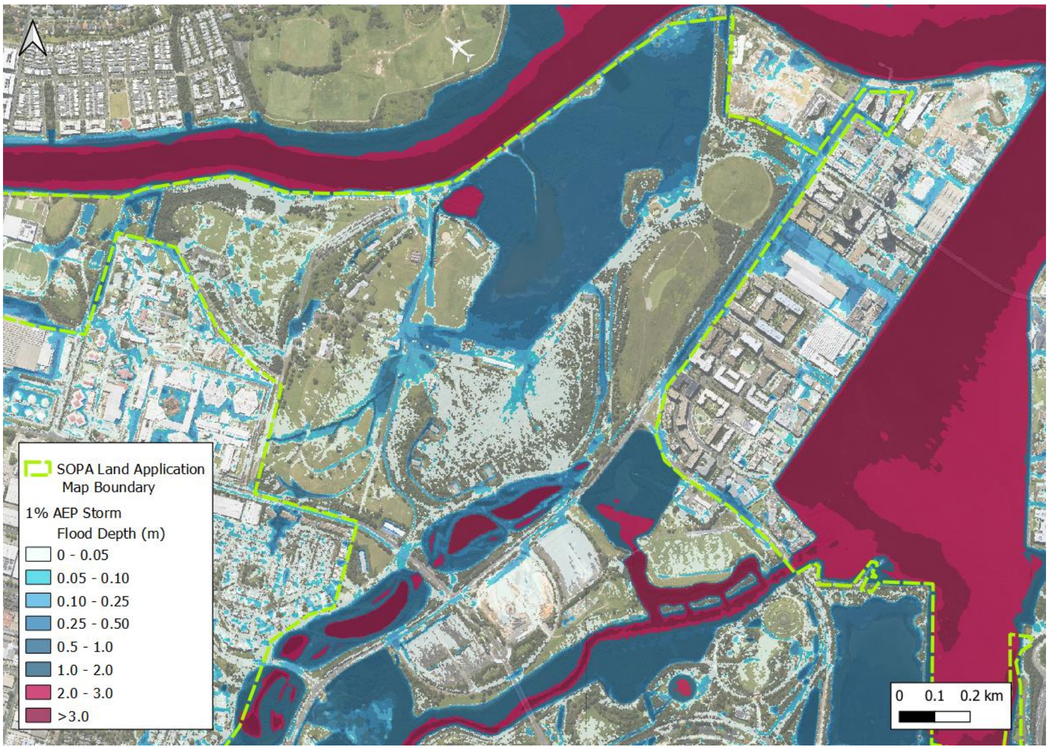


Figure 3.12: Existing 1% AEP Flood Depth – Newington



The predicted climate change conditions discussed in Section 4 have been applied to the modelling and result in a future 1% AEP flooding condition as indicated below.

Figure 3.13: Existing 1% AEP Flood Depth with Climate Change – Town Centre / Parklands

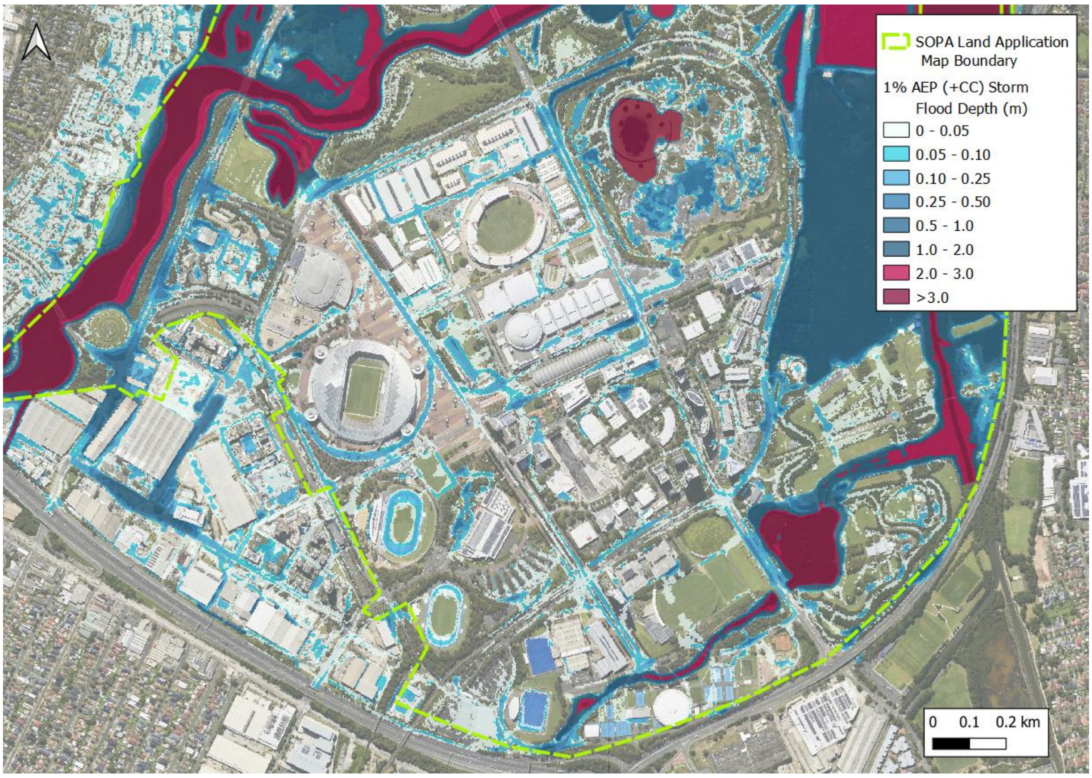
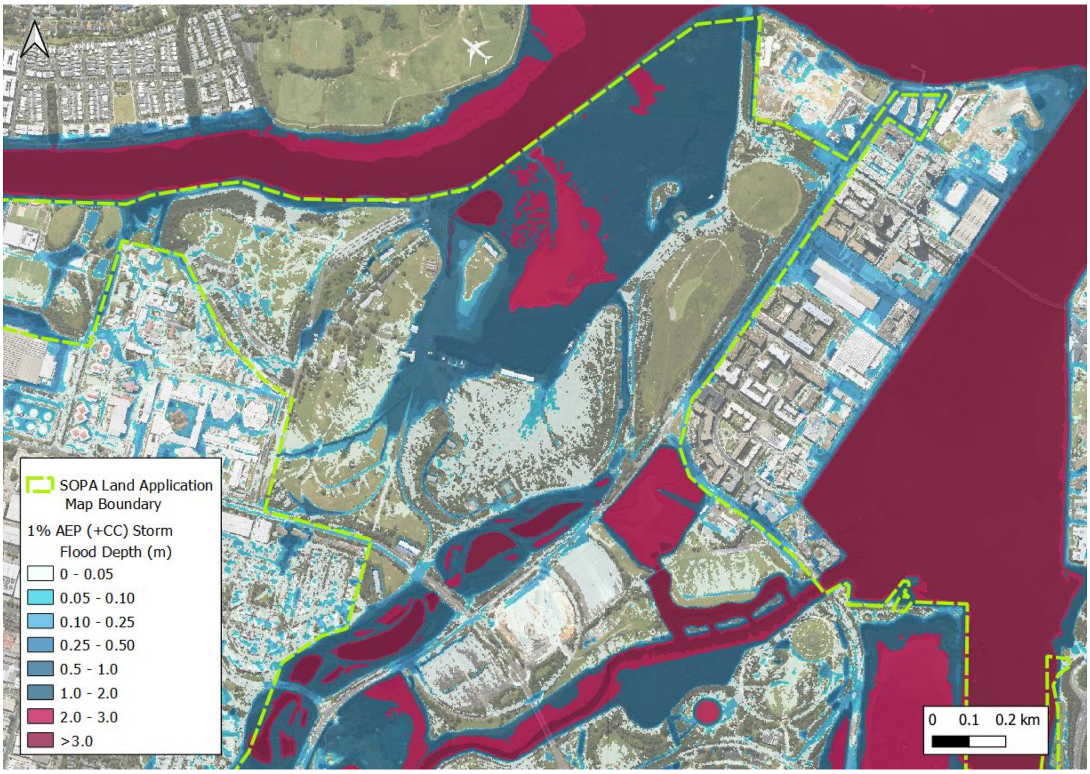


Figure 3.14: Existing 1% AEP Flood Depth with Climate Change - Newington



3.6 Constraints

3.6.1 Hydraulic Constraints

The urban drainage network in Sydney Olympic Park comprises traditional pit and pipe systems. There are large trunk drainage assets that drain to enclosed sediment basins or detention tanks.

The local pipe system owned by Sydney Olympic Park typically addresses nuisance ponding and collects local overland flow from the street network.

Figure 3.15 shows the pipe capacity across the Sydney Olympic Park Town Centre and Parklands. The figure highlights the storm event at which individual pipes reach 100% capacity, based on the outputs from the flood model. The below figure shows the capacity in terms of percentage AEP or number of occurrences each year.

Figure 3.15: Constraints in pipe system capacity – Town Centre (north)

Figure 3.16: Constraints in pipe system capacity – Town Centre (south) and Parklands

3.6.1.1 Flood Hazard

Flood hazard throughout the majority of the urban portions of the precinct is H1 hazard category, generally safe for people, vehicles and buildings in events up to the 1% AEP including climate change. Higher hazard areas within the urban zones are experienced:

- along Hill Road where hazard areas up to H3 (unsafe for vehicles, children and the elderly) are experienced in events as frequent as the 5% AEP.
- Olympic Boulevard near Sarah Durack Avenue where hazard up to H5 (Unsafe) is experienced

Areas outside of the urbanised zones comprising watercourses and the lower lying park and open space areas typically experience much high flood hazard categories.

Specific areas are discussed in more detail in Table 3.2.

3.6.1.2 Hydraulic Function

The majority of watercourse floodplains will have Flood Storage or Floodway classification.

The topography of the study area and the proximity of the urban areas to the naturalised watercourse floodplains generally provides for suitable discharge locations for floodwater into adjacent receiving watercourses. During the 1% AEP storm, the urban areas in Sydney Olympic Park generally don't comprise significant portions of Floodway or Flood Storage. Overland flow is a key consideration in the provision of safe environments during major flood events.

The most notable areas of Floodway and Flood Storage within the Sydney Olympic Park Town centre are located on Australia Avenue, New England Avenue and Hawkesbury Street in the vicinity of the Sydney Showground Stadium, shown in Figure 3.17.

Figure 3.17: 1% AEP hydraulic categorisation – Sydney Showground Stadium

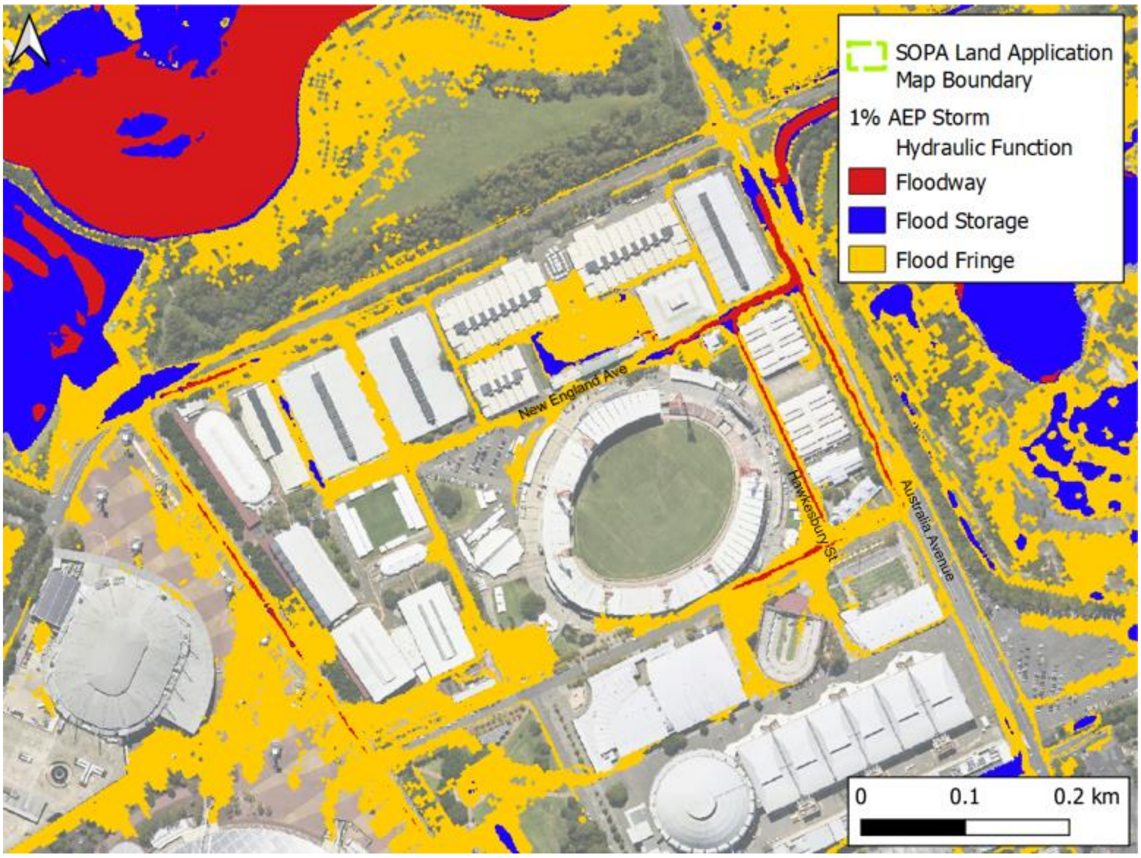


Figure 3.18 shows Hill Road in the Wentworth Point area is predominantly categorised as Flood Storage, with some areas of Floodway.

Figure 3.18: 1% AEP hydraulic categorisation – Hill Road

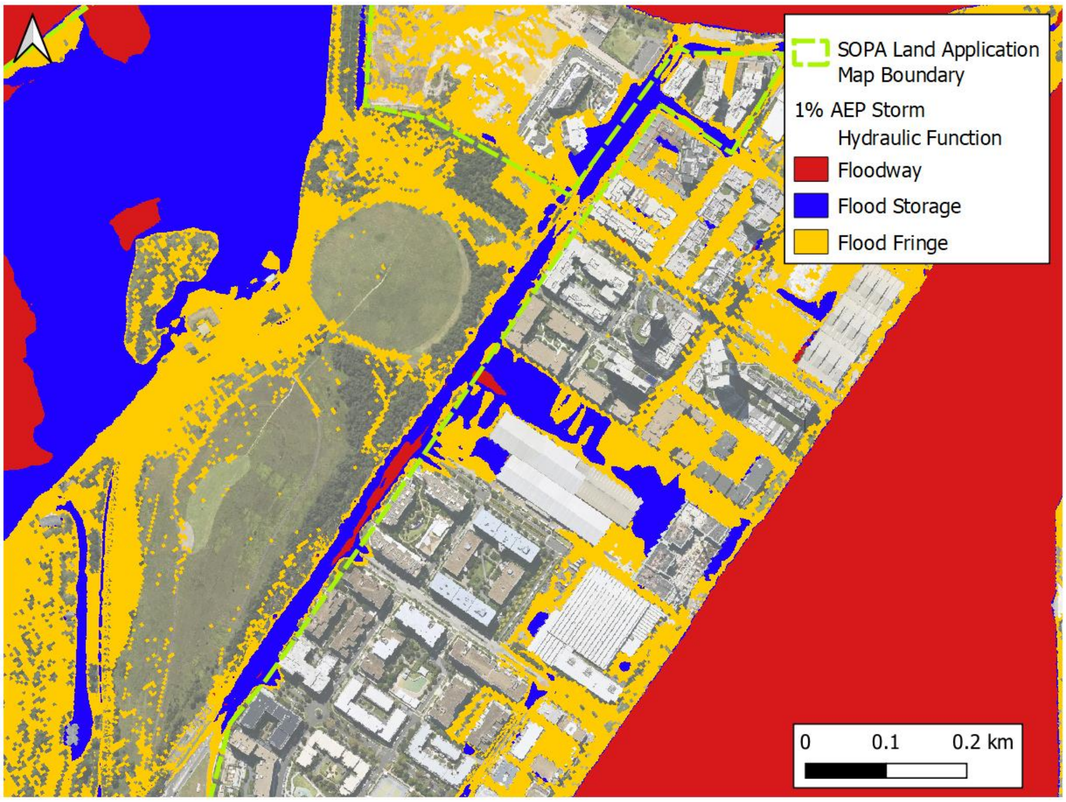


Figure 3.19: PMF hydraulic categorisation – Town Centre / Parklands

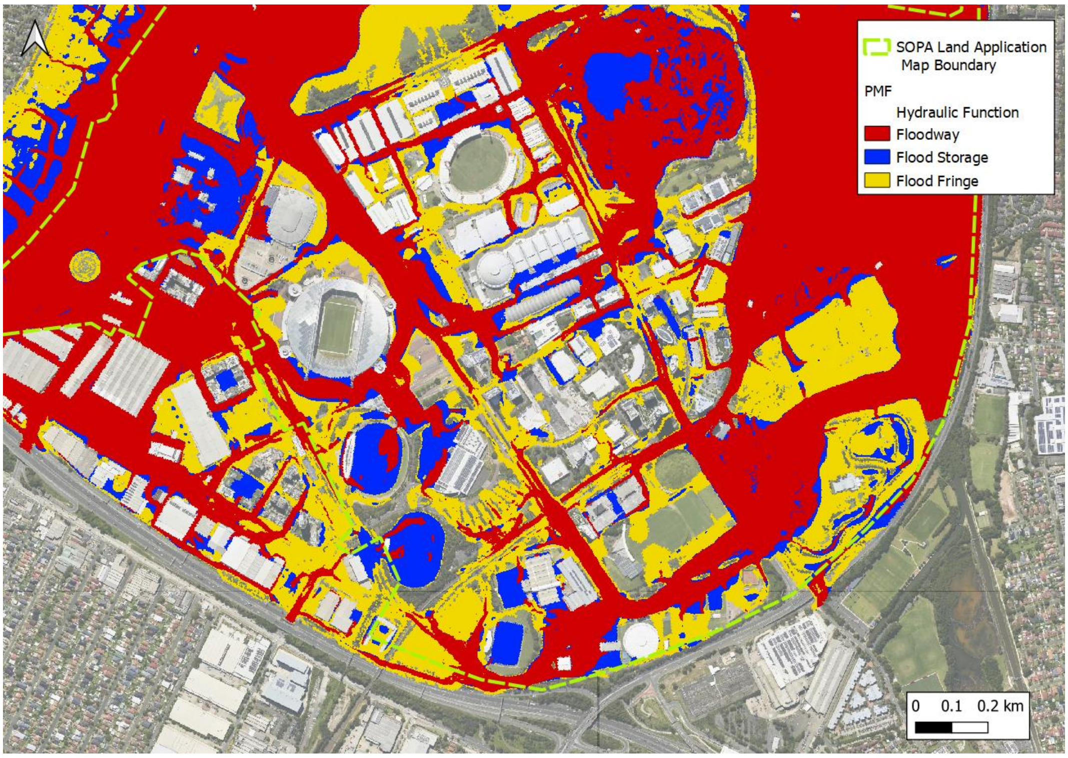
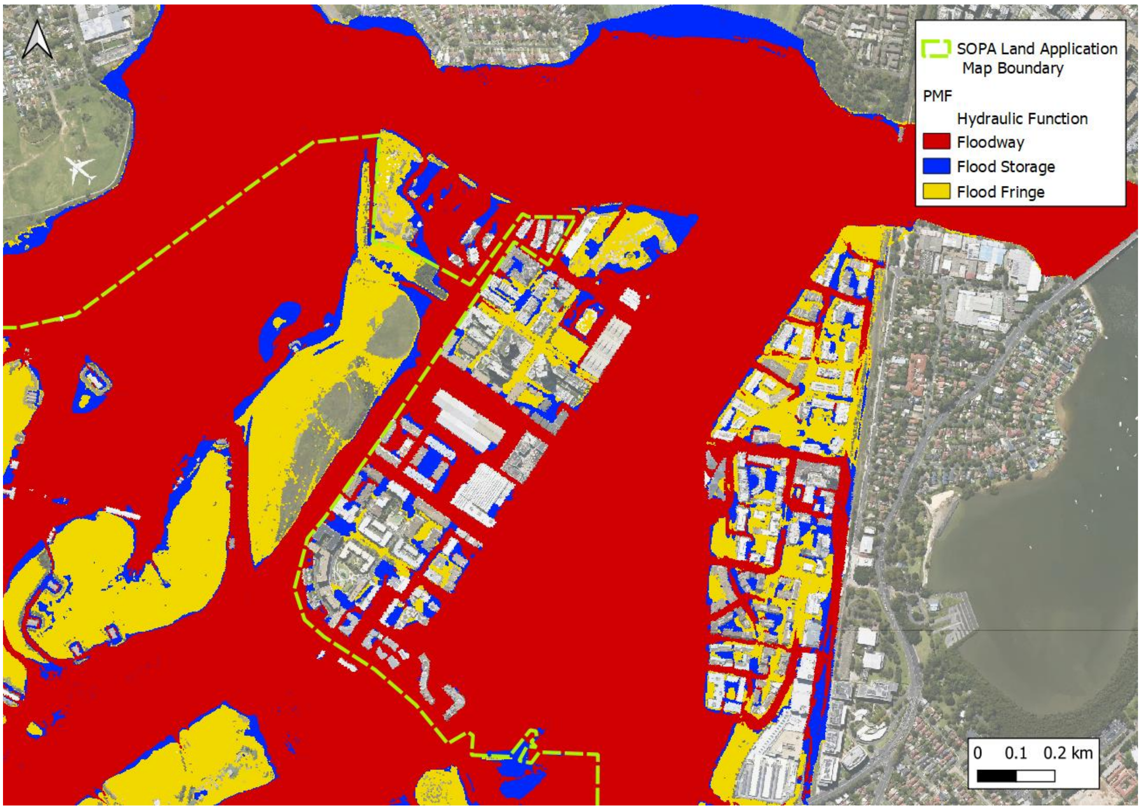


Figure 3.20: PMF hydraulic categorisation – Hill Road / Wentworth Point



The hydraulic categorisation of the land is only considered a constraint to development where it affects the rezoning in achieving the wider catchment objectives, such as;

- only developing outside high flood hazard areas,
- only developing in areas where flood impacts to adjacent properties is avoided,
- only developing in accordance with flood planning directives and;
- only rezoning where the appropriate emergency management procedures are feasible for development to achieve.

From a wider catchment perspective flood storage is preserved by the masterplan layout where it is required. This minimises the potential peak flood effects on downstream areas, and floodways are preserved such that the conveyance of flooded areas is not limited which may compromise adjacent and upstream flooded areas.

Table 3.2: Hydraulic constraints

Location	Hydraulic Constraint	Event	Precinct Consideration
Hill Road at Wentworth Point	Inundated along much its length by water depth >0.5m	1% AEP	1% AEP – internal roads within Wentworth Point remain low hazard and provide means of access Hill Road via Bennelong Parkway.
	Inundated along much its length by water depth >3.0m	PMF	PMF – precinct may become cut off by excess flood depths. Bennelong Bridge may provide a means to reach Rhodes Point, however, higher areas inside the precinct remain at lower risk
Bennelong Parkway at Wentworth Point	Inundation of road up to 0.3m	1% AEP	1% AEP – flooding prevents access along Bennelong Parkway to the south. Lower flood hazard to the west would permit access to Hill Road
	Flood depth exceed 3m caused by flooding from Homebush Bay	PMF	PMF – precinct may become cut off by excess flood depths. Bennelong Bridge may provide a means to reach Rhodes Point, however, higher areas inside the precinct remain at lower risk
Edwin Flack Avenue / Olympic Boulevard	Sag in road may flood to depth of 0.4m	1% AEP	1% AEP – low hazard on fringe of inundation would permit safe passage. Kevin Coombs Avenue provides means to access Australia Avenue and A3 Homebush Bay Drive
	Flood depths exceed 1.65m	PMF	PMF – area becomes impassable due to high hazard in most roads. Most internal roads impassable due to flood depths. Access to A3 Homebush Bay Drive cut off. Consider use of local sporting infrastructure (stadiums) as means of safe shelter.
Murray Rose Avenue / Australia Avenue	Sag in road may flood to depth of 0.5m	1% AEP	1% AEP – low hazard on adjacent internal roads means this constraint can be bypassed
	Flood depths exceed 1m	PMF	PMF – area becomes impassable due to high hazard in most roads. Most internal roads impassable due to flood depths. Access to A3 Homebush Bay Drive cut off. Consider use of local sporting infrastructure (stadiums) as means of safe shelter.
Dawn Fraser Avenue / Showground Road	Sag in road may flood to depth of 0.4m	1% AEP	1% AEP – low hazard on fringe of inundation would permit safe passage. Access Australia Avenue and A3 Homebush Bay Drive can be maintained
	Flood depths exceed 0.9m	PMF	PMF – area becomes impassable due to high hazard in most roads. Most internal roads impassable due to flood depths. Access to A3 Homebush Bay Drive cut off. Consider use of local sporting infrastructure (stadiums) as means of safe shelter.
Hill Road (Haslams Marker)* **SOPA flood model does not include recent Hill Road upgrades in this location. Updated modelling will be required if data for the upgrade becomes available*	300m length of Hill Road inundated to 1m	1% AEP	1% AEP – routes southwest cut off by inundation and high flood hazard. No access to M4 Western Motorway. Routes into Sydney Olympic Park remain low hazard with access to Australia Avenue and A3 Homebush Bay Drive
	Flooding from Haslams Creek exceeds 4m depths on Hill Road	PMF	PMF – area becomes impassable due to high hazard in most roads. Most internal roads impassable due to flood depths. Access to A3 Homebush Bay Drive cut off. Consider use of local sporting infrastructure (stadiums) as means of safe shelter.

Location	Hydraulic Constraint	Event	Precinct Consideration
Australia Avenue / Bennelong Parkway	High velocity flow creates a high hazard in northbound lane of Australia Avenue	1% AEP	1% AEP – southbound lane can remain in use to access A3 Homebush Bay Drive PMF – PMF – area becomes impassable due to high hazard in most roads. Most internal roads impassable due to flood depths. Access to A3 Homebush Bay Drive cut off. Consider use of local sporting infrastructure (stadiums) as means of safe shelter.
	Flooding from Lake Belvedere inundates Australia Avenue / Bennelong Parkway intersection	PMF	

3.6.2 Environmental Constraints

3.6.2.1 Topographical Constraints

Based on the Master Plan 2050 layout, there are areas across Sydney Olympic Park where the existing topography would need to be altered in order to facilitate urban development.

The following locations have been identified where significant level change is experienced in the existing conditions along the proposed future precinct transport corridors at this location.

- Bicentennial Marker – adjacent to Sarah Durack Avenue / Australia Avenue
- Quaycentre and Netball Centre – adjacent to Sarah Durack Avenue / Olympic Boulevard
- Suez Recycling – adjacent to Old Hill Road Link / Hill Road

3.6.2.2 Ecological Constraints

Sydney Olympic Park is home to a number of ecologically sensitive areas where access and development would be restricted. The Environmental Guidelines[8] biodiversity objectives list that Sydney Olympic Park is committed to protecting and enhancing natural ecological integrity and ensuring conservation of biological diversity is a fundamental consideration for new developments.

The following locations have been identified where the ecological sensitivity would preclude any development.

- Newington Nature Reserve and Nature Reserve Forest
- Badu Mangroves
- The Brickpit
- Waterbird Refuge
- Parklands

3.6.2.3 Ground water

There is a significant proportion of pervious area across the precinct, particularly at lower elevations, adjacent the receiving watercourses. This provides the opportunity for groundwater recharge from surface runoff. As water sensitive measures are integrated into future development to achieve Ecologically Sustainable Development (ESD) goals through development controls, this pervious area is anticipated to grow. Flooding from groundwater sources is not anticipated through urban areas of the precinct, with groundwater flows only significant in isolated areas at the fringe of the developed footprint.

[8] Environmental Guidelines, Sydney Olympic Park 2008, Sydney Olympic Park Authority (February 2008)

4 Climate Change

Climate change guidance from the Australian Rainfall and Runoff (2019) documentation refers to research undertaken in developing an interim recommendation to factor rainfall based on temperature scaling. The recommended methodology is to adopt temperature projections from the CSIRO future climates tool and refer to CoastAdapt guidance on appropriate sea level rise resources. These projections were used to derive factors, applied to specific climate change scenarios in the flood modelling, to reveal flooding responses under future climate change conditions.

4.1 Sea Level Rise

The projections for sea level rise of up to approximately 0.9m under representative concentration pathway (RCP) 8.5, for the year 2090, in the CoastAdapt guidance and available through the Climate Change in Australia marine explorer web tools have been selected for analysis of climate change effects on flooding.

Tailwater conditions

The elevated sea level has been applied at the downstream boundary conditions of the flood model to simulate the effects of the tidal behaviour under future conditions.

Backwater flooding

Backwater flooding events occur when the dominant source of flooding is downstream of the area of interest and not predominantly a function of the urban overland flows. An extreme tidal surge event is one such scenario whereby extreme sea levels produce flooding of the lower lying areas of land of Sydney Olympic Park.

4.2 Rainfall Intensity Changes

The Australian Rainfall and Runoff guidance on rainfall intensity is to use the conservative RCP 8.5 projections on climate futures and directs practitioners to the Bureau of Meteorology’s datahub tool for rainfall intensity increase projections. For this region of NSW coast, the projection for 2090 is an increase in rainfall intensity of 19.7%. The approach adopted in this study is to factor the rainfall input with climate change uplift factor across all events.

4.3 Planning Response

The design guidelines to be implemented through the Sydney Olympic Park Master Plan 2050 provide recommended Development Application requirements for new buildings. The application is:

- to be subject to a site-specific flood study prepared in accordance with;
  - the NSW Flood Risk Management Manual (2023) and supporting guidelines, formerly Floodplain Development Manual 2005,
  - the NSW Coastal Planning Guideline: Adapting to Sea Level Rise, NSW Coastal Risk Management Guide: Incorporating Sea Level Rise Benchmarks in Coastal Risk Assessments and
  - the NSW Flood Risk management Guide: Incorporating Sea Level Rise Benchmarks in Flood Risk Assessments.
- to include a flooding specific response that provides:

- a detailed topographical survey that defines flow paths, storage areas and hydraulic controls;
- flood modelling that uses appropriate hydrological and hydraulic techniques and incorporates boundary conditions
- development specific information regarding the appropriate emergency response to flooding that considers the likely population and specific routes applicable to the development
- relevant recommendations and/or mitigations from the precinct-wide Flood Assessment (this study).

5 Redevelopment Opportunity

5.1 Future Precinct Development

Planning is underway for the implementation of the precinct, to the structure plan indicated in Figure 5.1.

Figure 5.1: Sydney Olympic Park future development structure plan

Source: Sydney Olympic Park 2050: Strategic Place Framework

Key elements of the structure plan include:

1. Major playground at Blaxland Riverside Park with enhanced river experience and connection to promote sense of place and Connection to Country
2. Renovated heritage wharf and plaza welcome space with food and beverage pavilions
3. Celebrate and conserve the heritage of Newington Armory. Adaptively reuse Armory magazine buildings for arts, culture, music and temporary events
4. Recreation loops
5. Murama indigenous dance ground and Healing Space, a hub for an enhanced connection to Country, the River and adjacent ecologies
6. Introduce eco-play into Woo-la-ra designed sympathetically to conservation of native grassland habitats and site remediation constraints. Maintain access paths and regenerate buffers to Newington Nature Reserve's Coastal Saltmarsh, Sydney Turpentine Ironbark Forest and Swamp Oak Floodplain Forest
7. Community facilities such as playground and outdoor gyms along the edge of Wool-la-ra
8. River Walk
9. Future Parramatta Light Rail Stage 2 bridge
10. Surf wave park
11. Relocated BMX track
12. Walking loop
13. Potential for community facilities (picnic tables and shade structures), passive recreation and pathways on Kronos Hill and expanded habitats
14. Brickpit loop walking and running path with community facilities and pavilions around its edge
15. Brickpit retained as conservation area
16. River walk – Badu Mangroves link
17. Royal Agricultural Society Centre of Excellence with street frontage to Olympic Boulevard, providing agricultural education and food and beverage experiences including integrated native food production
18. Event coach parking
19. Olympic Boulevard Linear Park
20. Edwin Flack recreation spine
21. Cathy Freeman Park
22. Metro station and plaza
23. Central civic area
24. Active pedestrian priority streets
25. Bicentennial Park, community facilities and loop
26. Sports and publicly accessible recreation space
27. Boundary Creek
28. Upcycling, utilities and maintenance hub

5.2 Current Planning Context

Current planning controls related to flood management are specified across the following documents:

- SOPA Master Plan 2030.
- SOPA Stormwater Management and Water Sensitive Urban Design Policy No. POL13/4 (ver2.3, 2021);
- SOPA Infrastructure Engineering and Construction Manual (IECM) March 2018.
- State Environmental Planning Policy (Precincts – Central River City) 2005; and
- NSW State Government's Flood Prone Land Policy, including:
  - Standard Instrument (Local Environment Plans) Amendment (Flood Planning) Order 2021
  - Environmental Planning and Assessment Amendment (Flood Planning) Regulation 2021
  - State Environmental Planning Policy Amendment (Flood Planning) 2021

Recent revisions to the state policy regarding flood prone land includes the Planning Circular 21-006. This adds the ability for additional controls on planning proposals to consider the flood risks and to ensure they do not permit residential accommodation in high hazard areas and other land uses on flood prone land where the development cannot effectively evacuate.

5.3 Future Planning Control

Future planning controls for floor level based around the opportunity to provide an increased amenity within the precinct are under development. A preliminary Flood Planning Level (FPL) assumes a 1% AEP flood level + 0.5m freeboard. This could be varied depending on the land use based on NSW Floodplain Risk Management Manual (2023) guidance, but this initial FPL would apply to habitable floors of new structures. The reason for variation by land use is to ensure that the activation of the streetscape is consistent throughout the precinct, noting some areas are lower lying or subject to greater overland flows through the adjacent road reserve. It is recommended this principle is applied through a relevant planning control that requires proponents to provide the flood planning considerations of proposed floor levels.

Recommended Planning Control

All developments must demonstrate the following considerations have been made in design of finished floor levels and re-grading of the finished surface to interface with existing public domain levels:

a) Consistency of the re-grading of design finished surfaces with desired local overland flow behaviour,
b) Flood impacts of the design re-grading and stormwater infrastructure for events up to the 1% AEP,
c) Freeboard provided to basement and building entry threshold levels from 1% AEP flood levels, and
d) Emergency response considerations covering egress arrangements for pedestrians and vehicles in all events up to the PMF.

Figure 5.2: Floor Levels and Proposed Precinct Structures – Sarah Durack Avenue

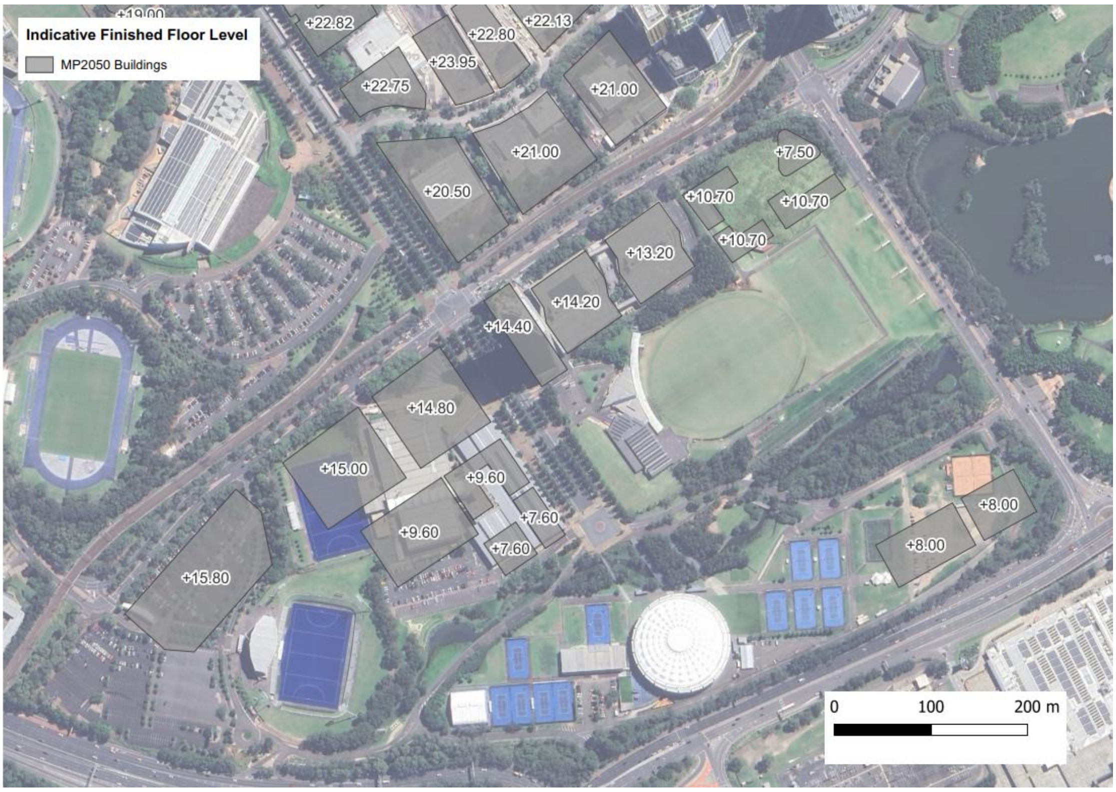


Figure 5.3: Floor Levels and Proposed Precinct Structures – Town Centre

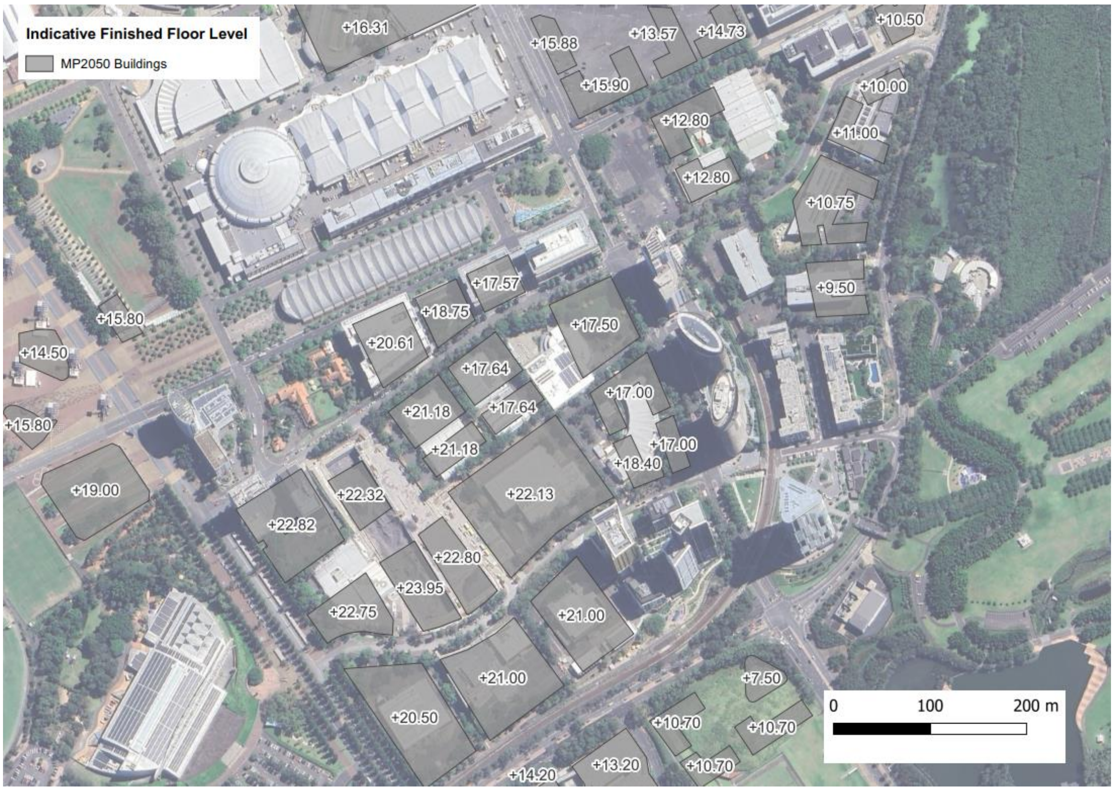


Figure 5.4: Floor Levels and Proposed Precinct Structures – Australia Avenue

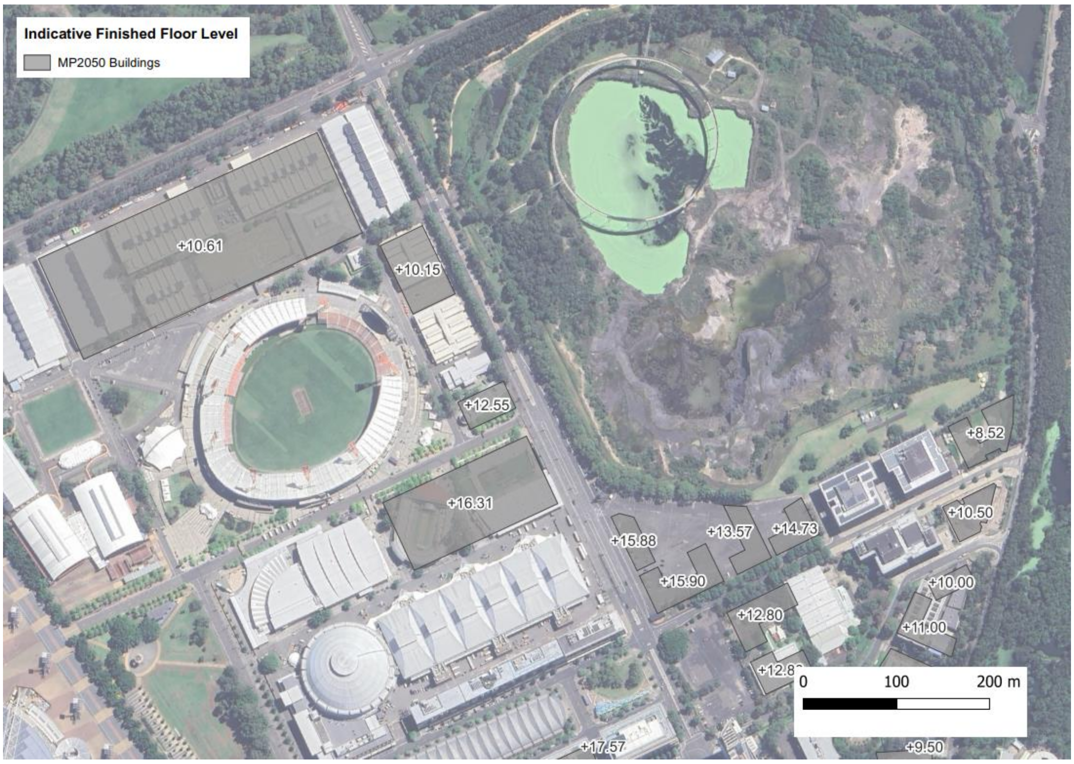
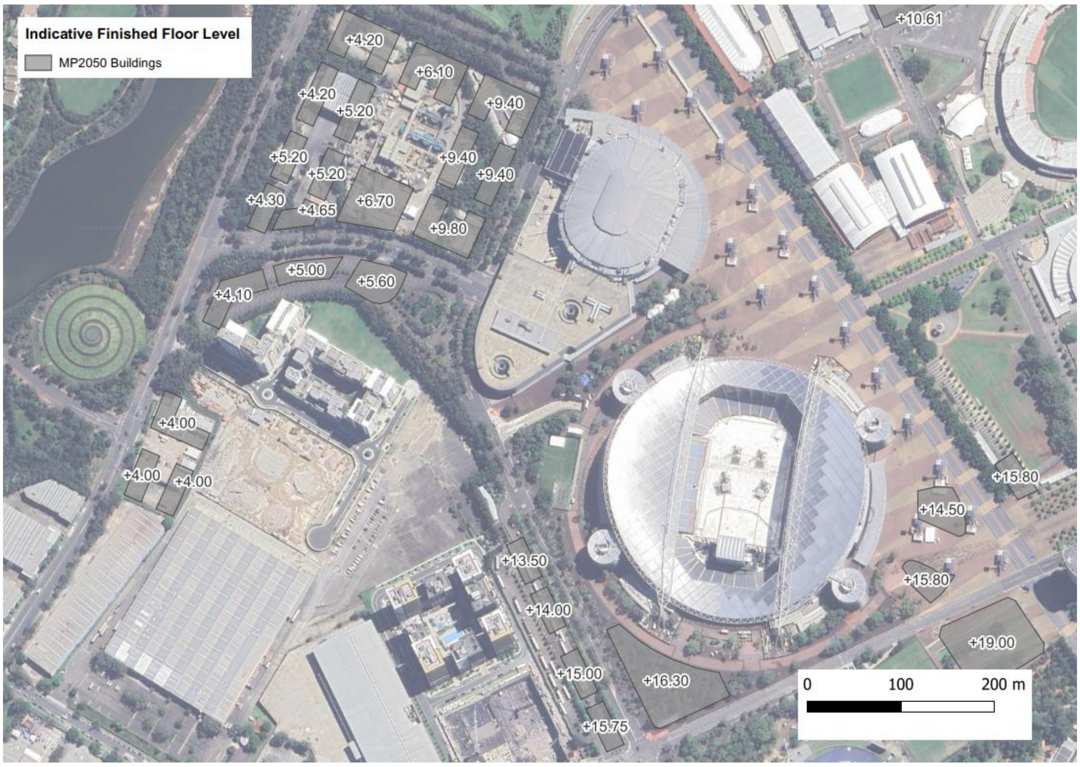


Figure 5.5: Floor Levels and Proposed Precinct Structures – Hill Road



5.3.1 DRAFT guidelines for Shelter-in-place (SIP)

The following draft guidance has been prepared by NSW Department of Planning, Housing and Infrastructure, and exhibited, but has not been adopted and doesn't reflect the preference of the SES for the emergency response strategy for flooding in new developments or rezoning. If adopted in the future it provides general principles when considering whether to apply SIP controls. Noting that evacuation off-site is always preferrable, SIP may be used where:

- The duration for flood inundation is less than six hours
- The development is not located in an area of high-risk (e.g., floodways and H5 or H6 flood hazard areas)
- Access to on-site systems to provide power, water and sewerage services during and beyond the event for the full range of flooding
- The location of storage of food, water and medical emergency for SIP purposes should be above the PMF level and available during and beyond the event for the full range of flooding
- SIP floor level is above PMF
- SIP provides a minimum floor space per person
- SIP must be structurally safe and accessible during floods up to the PMF.

Education is critical to ensuring that the community is aware of actions to be taken before, during and after SIP and the key triggers that require SIP. If SIP is proposed there needs to be ongoing community education campaigns for the areas where SIP will apply.

5.4 Water Sensitive Design Options

The practice of Water Sensitive Urban Design (WSUD) aims to improve the ability of urban environments to capture, treat and re-use stormwater before it has the chance to pollute and degrade creeks and rivers. This involves managing stormwater flows, enhancing soil moisture, promoting green spaces, and creating alternative water sources.

At present, much of the Sydney Olympic Park Town Centre is paved with little or no water sensitive design. Master Plan 2050 provides the opportunity to significantly enhance the local environment and waterways by incorporating the following water sensitive treatment options that can work alongside established wetlands:

- Swales and buffer strips
  - Swales and buffer strips provide a buffer between receiving waters (e.g. creek or wetland) and impervious areas of a catchment. Overland flows are slowly conveyed downstream, promoting an even distribution of flow. Buffer areas provide treatment through sedimentation and interaction with vegetation
- Rainwater tanks
  - Rainwater tanks collect run-off from roof areas. This water can be used where drinking quality water is not needed, like flushing toilets, washing clothes and watering gardens. By storing rainfall, rainwater tanks can reduce peak flow rates to the stormwater drainage network.
  - Diverting roof run-off to a rainwater tank and using rainwater for toilet flushing and other internal uses is one of the most effective options for achieving water quality treatment objectives.
  - Rainwater tanks are already in use across Sydney Olympic Park
- Permeable paving
  - Permeable or porous paving allows water to pass through it and infiltrate to the soil or filter back into the drainage system
- Raingardens
  - Raingardens are specially designed garden beds that filter stormwater runoff from surrounding areas or stormwater pipes. Raingardens use soil, plants and microbes to biologically treat stormwater

- Raingarden tree pits
  - Raingarden tree pits are configured to support the growth of a tree rather than the understorey plants typically seen in standard raingardens. In addition to treating stormwater runoff, they provide passive irrigation for the tree, reducing the need for manual watering.

5.5 Local Nuisance Areas

Within the urban drainage network there are locations of susceptibility to fairly regular nuisance flooding and, in larger events, pose significant hazards to the community. Typically, these locations coincide with elements of the urban drainage network where the capacity of the infrastructure are low. With developments, these nuisance areas can be minimuse with regrading or new stormwater infrastructure. However, this is limited to not impact on adjacent landuse.

- Hill Road – Wentworth Point
- Bennelong Parkway / The Piazza – Wentworth Point
- Hill Road – west of Holker Street
- Kevin Coombs Avenue / Olympic Boulevard – Town Centre
- Dawn Fraser Avenue / Showground Road – Town Centre
- Australia Avenue / Kevin Coombs Avenue – Town Centre
- Bennelong Parkway – Town Centre
- Australia Avenue - Parklands

6 Flood Modelling Results

The following flood maps are provided as outputs of this study. All flood maps are available in **Appendix A**.

Table 6.1: List of flood maps

Name	Description
Map 1	Existing Conditions – 5% AEP – Flood Depth
Map 2	Existing Conditions – 5% AEP – Flood Hazard
Map 3	Existing Conditions – 1% AEP – Flood Depth
Map 4	Existing Conditions – 1% AEP – Flood Hazard
Map 5	Existing Conditions with Climate Change – 1% AEP – Flood Depth
Map 6	Existing Conditions with Climate Change – 1% AEP – Flood Hazard
Map 7	Existing Conditions – PMF – Flood Depth
Map 8	Existing Conditions – PMF – Flood Hazard
Map 9	MP2050 Conditions – 5% AEP – Flood Depth
Map 10	MP2050 Conditions – 5% AEP – Flood Hazard
Map 11	MP2050 Conditions – 1% AEP – Flood Depth
Map 12	MP2050 Conditions – 1% AEP – Flood Hazard
Map 13	MP2050 Conditions with Climate Change – 1% AEP – Flood Depth
Map 14	MP2050 Conditions with Climate Change – 1% AEP – Flood Hazard
Map 15	MP2050 Conditions – PMF – Flood Depth
Map 16	MP2050 Conditions – PMF – Flood Hazard
Map 17	Afflux – Water Level Difference – 5% AEP
Map 18	Afflux – Water Level Difference - 1% AEP
Map 19	Afflux – Water Level Difference - 1% AEP with Climate Change
Map 20	Afflux – Water Level Difference - PMF
Map 21	MP2050 Conditions – Flood Planning Levels
Map 22	MP2050 Conditions – Opportunities and Constraints
Map 23	Existing Conditions - Evacuation Routes
Map 24	MP2050 Conditions – Evacuation Routes
Map 25	MP2050 - 1% AEP Hydraulic Categories
Map 26	MP2050 - PMF Hydraulic Categories

6.1 Design Scenario Flood Depths and Extents

The following flood maps indicate the worst-case flooding in the 1% AEP under the design condition, with the mapping an envelope result of multiple simulations to capture both short flashy storms and longer events.

Figure 6.1: Master Plan 2050 1% AEP Flood Depth –Town Centre / Parklands

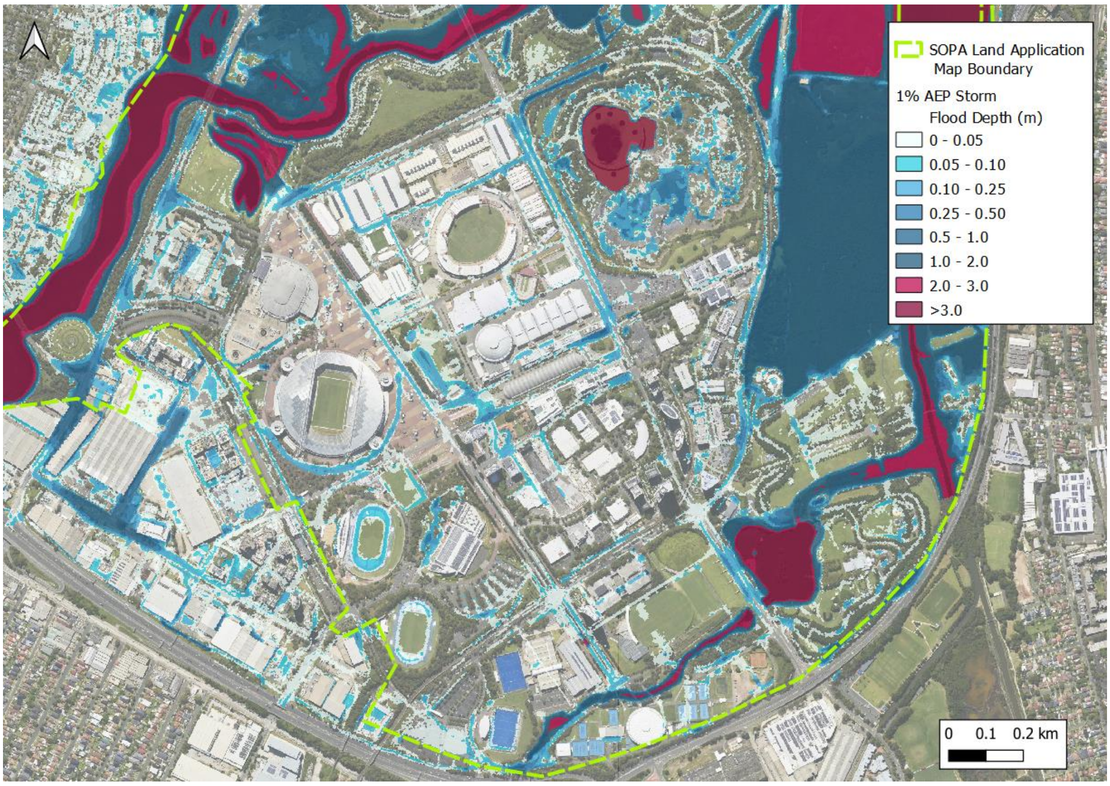
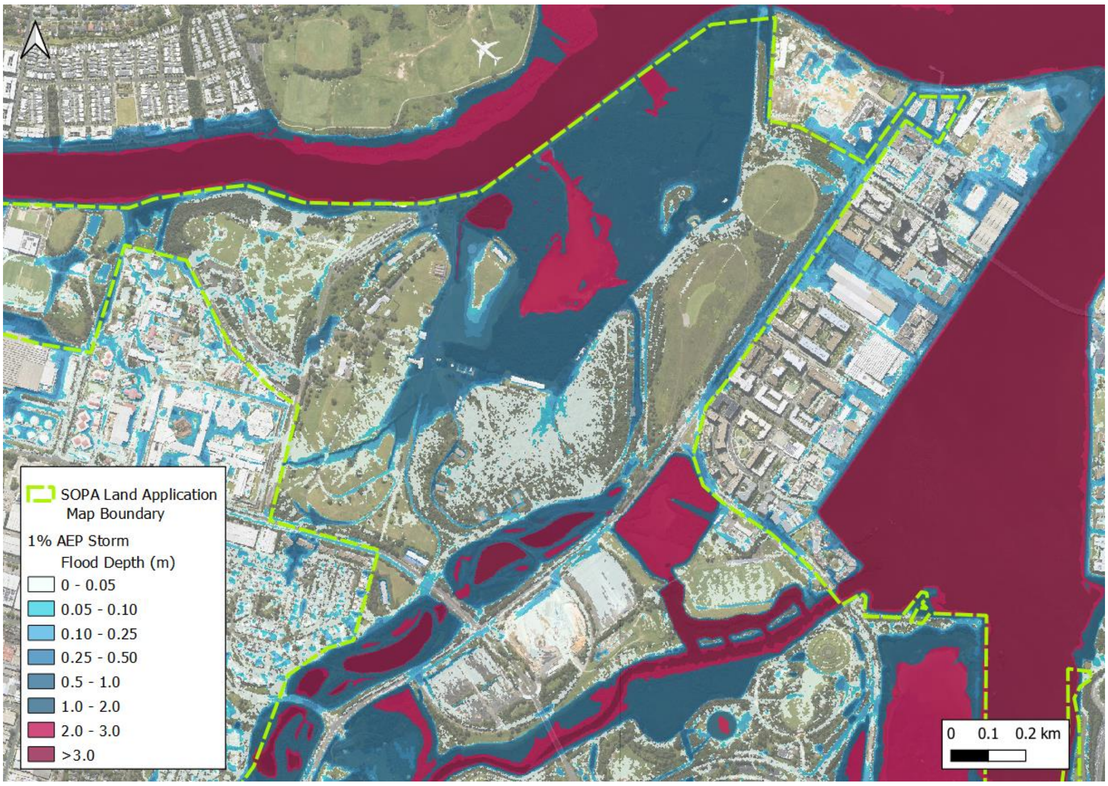


Figure 6.2: Master Plan 2050 1% AEP Flood Depth – Newington



6.2 Mitigation of Flooding

The worst-case flooding experienced across the site is due to short events, where localised storms of high intensity contribute larger runoff volumes than the stormwater system has capacity for. Therefore, the mitigation of these worst-case flood events involves the:

- Provision of overland flow paths to accommodate overland flows which are in excess of the piped system capacity;
- Increases to the piped system capacity to capture greater proportions of the runoff volume;
- One-way valves to prevent backwater flooding from high tides;
- Storage of excess storm water in the form of above ground detention basins or buried tanks.

The overland flow optimisation for mitigating flood hazard includes the provision of wider flow paths where flows can continue downstream at a shallower depth and grading generally to reduce the depth of ponded areas where they occur.

The stormwater strategy described in section 7.1 covers the pipe system capacity mitigation potential.

6.2.1 Flood Hazard

Flood hazard in the post development scenario remains largely the same as under existing conditions, with the following exceptions:

- Olympic Boulevard near Sarah Durack Avenue has improved flood hazard relative to existing conditions after new precinct road reserves allow a wider spread of overland flow, relieving some of the high hazard areas discussed in section 3.6.1.1.

The design response to flood hazard is typically through the provision of freeboard, including the ramping of basement entries to achieve dry basements. The recommended planning control of section 5.3 guides the future development to integrate flood protection for potential basement structures proposed with future development.

6.3 Evacuation Strategy

Sydney Olympic Park is bounded by a number of creeks and rivers; namely Haslams Creek, Powells Creek, Boundary Creek, Parramatta River and Homebush Bay. As such, evacuation from Sydney Olympic Park is limited to the trunk roads; A6 Silverwater Road to the west, M4 Western Motorway to the south and A3 Homebush Bay Drive to the east. Sydney Olympic Park is vulnerable to being cut-off by flooding if access to these arterial routes is prevented either through inundation of local roads or other factors. Wentworth Point is particularly at risk as Hill Road, the only public road into the peninsular, is prone to flooding from minor storm events.

Based on the outputs from the 1% AEP flood modelling, evacuation routes to A6 Silverwater Road and A3 Homebush Bay Drive can be maintained along the local roads within Sydney Olympic Park, avoiding hazardous areas of ponding flood water. It is unlikely that a safe route to the M4 Western Motorway can be maintained along Hill Road due to excessive ponding at Kronos Hill. Watercourse crossings such as Holker Busway and Bennelong Bridge may provide alternative means of evacuating Sydney Olympic Park to the surrounding suburbs.

With a PMF storm, all viable access routes to surrounding trunk roads become cut off by hazardous areas of flooding. Therefore, the safest strategy would be to evacuate to areas within Sydney Olympic Park where the risk of inundation is low. Sydney Olympic Park has a range of existing facilities appropriate for the support of large populations during the event of major and extreme flood events, including Stadium Australia and Sydney Showground Stadium. These locations comprise entertainment facilities with services that provide for shelter and sanitation/sustenance during and after major flood events.

Should evacuation to a safe place be unattainable, the majority of development within the precinct is likely to be appropriate for shelter-in-place given the reasonably low hazard flooding affectation of the development parcels and the short duration of worst-case flooding conditions (less than 6 hours through urbanised zones).

7 Storm Water Management

7.1 Stormwater Strategy

The existing stormwater infrastructure may require rehabilitation or replacement with future development, to improve sections which won't have the appropriate design life. The strategy to reduce the impacts of existing stormwater system constraints on potential development of upstream areas through constructing a new pipe system/system upgrade will require condition assessment and stormwater design during the detailed design coordination.

7.2 Stormwater Modelling

A detailed network of pipes and stormwater inlets can be introduced to the flood model to ascertain the level of amenity provided by the stormwater system and effectiveness in removing nuisance ponding. This approach is recommended in addition to the typical detailed modelling of proposed stormwater infrastructure within drainage design packages that facilitate the preparation of detailed engineering construction drawings. This serves to consider the wider network and the influence of development on existing system constraints that can be overlooked when assigning boundary conditions at the point of connection.

7.2.1 Existing System

The existing piped system in the precinct appears in a serviceable condition generally, from review of site observations/reports of previous flooding conditions. Some assumptions have been made in representing the network within the flood model, particularly in cases where modification/upgrades have occurred, resulting in redundant or duplicate connections to the downstream network.

7.2.2 Proposed System

With new development introduced to the catchment, the configuration of stormwater networks will be modified to suit the new incoming building drainage connections and local regrading of the topography.

Further amendments required to facilitate future development with adequate drainage system capacity will be documented in future revision of this report as required.

7.2.3 Results

This future stormwater system sizing is subject to the configuration and staging of individual developments, data for which is not present at this time and will be presented in a future iteration of this report as required.

8 Conclusion

This assessment provides detailed representation of the flooding regime at Sydney Olympic Park under existing and future developed conditions. The flooding mechanisms, behaviour and resulting flood risk has been described across the precinct including both urban and more natural receiving watercourses.

The Master Plan 2050 has been proposed to facilitate future development, which comprises changes to the urban environment through the precinct which will affect the flooding regime. The plans for future development have been integrated into the modelling assessment to understand future flooding conditions that allow for development coordination and planning for flood emergency response.

There are localised areas that benefit from master plan redevelopment in terms of a reduced flood hazard. This is generally a result of regrading which provides a better opportunity for overland flow management.

The modelling provides a baseline from which to assess development and stormwater management options and understand the wider impact of these works on flood risk across the precinct. The emergency management arrangements discussed in this report provide a reference for future development in preparing site specific flood emergency response plans.

Recommended planning controls have been provided to guide future proponents in the development of proposals for new/modified buildings, basements and the associated re-grading of finished surfaces. These draft controls facilitate the sharing of flood management principles through the development application process to ensure a consistent approach to flood risk management is maintained.

9 References

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