Appendix Y

Flooding Assessment

Sydney Metro West

Sydney Olympic Park Over and Adjacent Station Development Flooding Assessment

Appendix Y

July 2022

NSW GOVERNMENT

sydney METRO

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Glossary

Term	Definition
AEP	Annual Exceedance Probability is the chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. In this study AEP has been used consistently to define the probability of occurrence of flooding. The following relationships between AEP and ARI applies to this study (Ball et al, 2019). More information included in Appendix A.
AHD	Australian Height Datum is a common national surface level datum approximately corresponding to mean sea level.
ARI	Average Recurrence Interval is the long-term average number of years between the occurrences of a flood as big as or larger than the selected flood event. For example, floods with a discharge as great as or greater than the 20-year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event. Also refer to AEP, which is the industry standard terminology for definition of design flood events.
ARR	Australian Rainfall and Runoff is a national guideline document used for the estimation of design flood characteristics in Australia. Reference is made to either ARR1987 (3rd edition) or ARR2019 (4th edition) as specified.
ASD	Adjacent Station Development
Catchment	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
DPE	Department of Planning and Environment
EIS	Environmental impact statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
EY	Exceedances per year is the number of times a flood event is likely to occur or be exceeded within any given year.
Flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future and continuing risks. They are described below. Existing flood risk: the risk a community is exposed to due to its location on the floodplain. Future flood risk: the risk a community may be exposed to due to new development on the floodplain. Continuing flood risk: the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.
GFA	Gross floor area
Hydrologic modelling	Hydrologic modelling refers to the conversion of the design rainfall and runoff into flow hydrographs that are applied to the hydraulic model to

Term	Definition
	define flood depths, flood extents, velocities and hazards for a range of design storms.
Hydrology	The study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
Hydraulic modelling	Hydraulic modelling uses the rainfall, catchment and watercourse topography to predict flood behaviour including flood levels, flood extents, flood velocities and the duration of inundation in the catchment and watercourse.
OSD	Over Station Development.
PMF	Probable Maximum Flood is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. The PMF defines the extent of flood prone land, that is, the floodplain.
Rain on grid hydraulic model	In these studies, hydrological assessment has been incorporated directly into the hydraulic models, rather than employing a separate hydrological model to derive flow hydrographs. Along with topographic information and model parameters reflecting the catchment and watercourse, flood behaviour including flood levels, flood extents, flood velocities and the duration of inundation in the catchment and watercourse can be predicted.
RCP	Representative Concentration Pathways
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development.
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
TUFLOW	TUFLOW is a computer program which is used to simulate free-surface flow for flood and tidal wave propagation. It provides coupled 1D and 2D hydraulic solutions using a powerful and robust computation. The engine has seamless interfacing with GIS and is widely used across Australia. There are two schemes available for solving the two-dimensional Shallow Water Equation (SWE). Testing indicates that Classic and HPC produce results with are consistent with each other (BMT, 2019). There is no exact solution to the SWE, which is why there are several solvers available.
TUFLOW Classic	TUFLOW classic is the original TUFLOW solver which uses a 2nd order implicit finite difference solution. It uses a fixed timestep. The Classic solver's turbulence model is dependent on cell size with a fixed timestep.
TUFLOW HPC	The TUFLOW HPC (Heavily Parallelised Compute) solver uses a 2nd order explicit finite volume solution. TUFLOW HPC has increased stability with an adaptive timestep compared with Classic. The HPC model uses an updated turbulence scheme, which is cell size insensitive.

Executive summary

This Flooding Assessment 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.

This Flooding Assessment responds specifically to the Secretary's Environmental Assessment Requirements (SEARs). Flooding for the pre-development and development scenarios have been undertaken to determine hydraulic impacts and flooding immunity requirements for the proposed development. Assessments have been undertaken based on relevant Commonwealth, State and Local Government guidelines.

Hydrologic and hydraulic flood models developed for the Sydney Olympic Park site were adopted for the assessment. The baseline conditions for the assessment include the works undertaken as part of the Concept and Stage 1 Critical State Significant Infrastructure (CSSI) approval and proposed under Stage 3 CSSI application. The developed conditions modelling includes the addition of the proposed development.

The assessment has been undertaken based on information available when this report was written and will need to be updated as the design progresses.

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 in Figure 1-1.

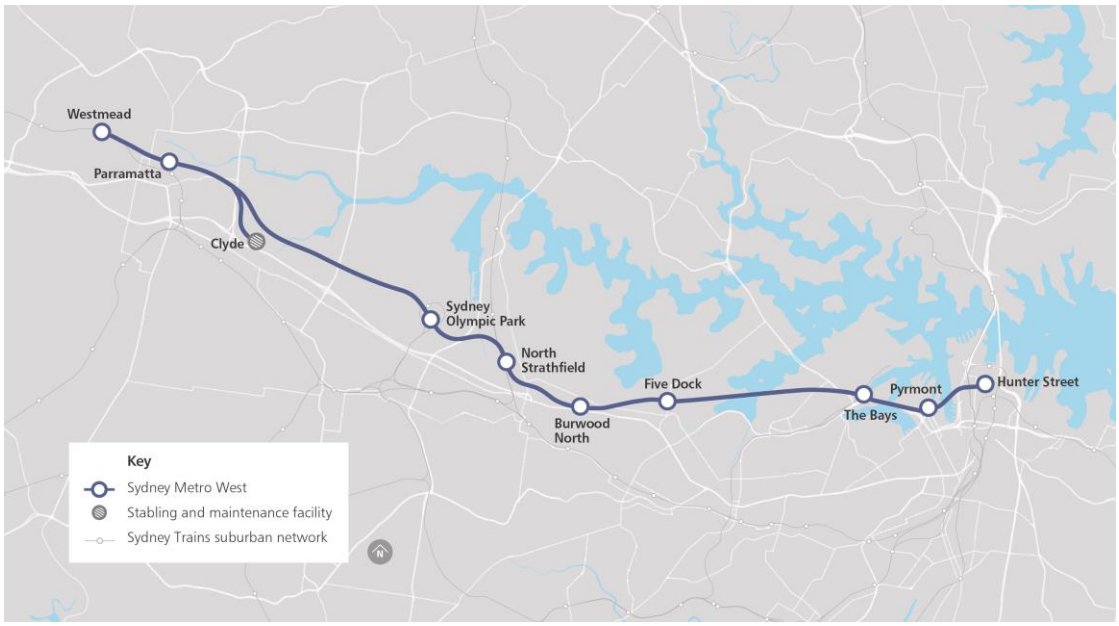


Figure 1-1 Sydney Metro West

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 the report

This Flood Assessment report 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 flooding risk requirements:

SEARs requirement	Where addressed in report
14. Flooding risk Identify any flood risk on-site having regard to adopted flood studies, the potential effects of climate change, and any relevant provisions of the NSW Floodplain Development Manual.	Section 3.3
Assess the impacts of the development, including any changes to flood risk on-site or off-site, and design solutions and operational procedures to mitigate flood risk where required.	Section 3.4.1

This flood assessment report assesses the proposal for flooding of the pre-development and development scenarios to determine hydraulic impacts and flooding immunity requirements for the proposed development.

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 Draft 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.

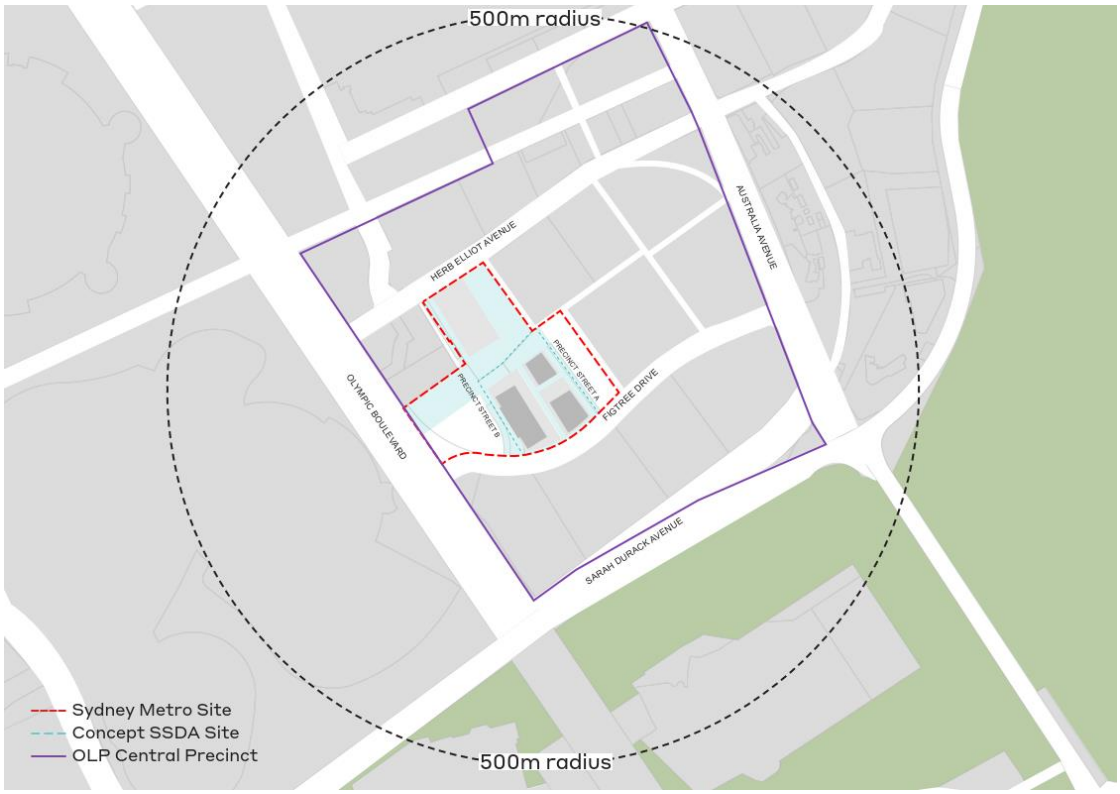


Figure 2-1 Sydney Olympic Park metro station location precinct

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

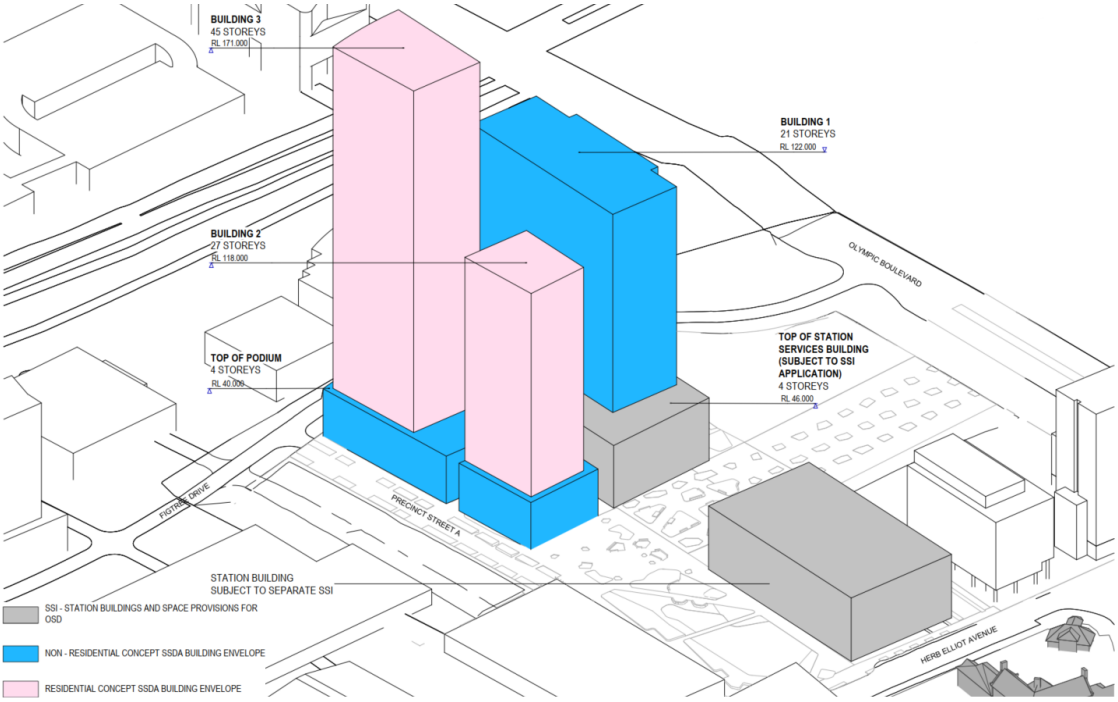


Figure 2-2 Proposed Concept SSDA development and CSSI scope

3 Scope of assessment

This Flooding Assessment has been undertaken to satisfy the planning requirements of the SEARs (received 18 February 2022), State Significant Development Guidelines (dated November 2021) and the Cumulative Impact Assessment Guidelines for State Significant Projects (November 2021). The Stated Significant Development Guidelines outline the planning pathways for Significant State Developments, including addressing the SEARs for the project. The SEARs identify information that must be provided in the EIS including the matters that require further assessment and community engagement.

Cumulative impacts are a result of incremental, sustained and combined effects of human action and natural variation over time and can be both positive and negative. They can be caused by the compounding effect of a single or multiple projects in an area. The Cumulative Impact Assessment Guidelines outline how the assessment of cumulative impacts at a strategic level and site-specific level are undertaken. To account for the cumulative effects for the station and Site 47 development, the proposed metro station works have been included in the baseline scenario. A review has also been undertaken of adjacent developments and likely cumulative impacts discussed.

The scope of this report is to summarise baseline flooding conditions and detail required upgrades, infrastructure and protection measures required to satisfy the relevant flooding standards. The results of the assessment have been used to outline the relevant flooding planning levels for the ground floor and driveway entries for Buildings 2 and Building 3. The ground floor level for Building 1 is proposed under the Stage 3 CSSI application, however, flood planning levels for the retail and commercial component have been considered in the subject Concept SSDA.

Assessment of the potential impacts of the development on flooding that consider flood events up to the Probable Maximum Flood (PMF), which focuses on:

- potential increases in flood risk and flood affectation on adjacent properties and assets as well as potential impacts to any emergency management arrangements
- land use compatibility in relation to flood hazard
- where mitigation and management measures are required.

This assessment has been undertaken in line with relevant legislation and guidelines and with reference to the SEARs. These include ARR2019, the NSW Floodplain Development Guidelines, Australian Institute for Disaster Resilience and Parramatta Development Control Plans.

The flood criteria applicable to this study area are set out below:

- Metro tunnels and other critical infrastructure would be protected by the PMF or 0.5 metres above the one per cent Annual Exceedance Probability flood level (1% AEP) whichever is greater. At locations where the flooding is described as nuisance flooding, such as the Central Precinct of Sydney Olympic Park , the freeboard required has been reduced to 300mm above the 1% AEP. This is sufficient to prevent local flash flooding entering the underground structures.
- The 1% AEP flood event and the five per cent Annual Exceedance Probability flood event (5% AEP flood event) will incorporate allowances for climate change impacts including:
    - Design for permanent infrastructure completed as part of this study would incorporate allowance for climate change consistent with Representative Concentration Pathways (RCP) 8.5 in the year 2100. The RCP8.5 refers to the upper range projection of greenhouse gases concentrations in the atmosphere

as adopted by the Intergovernmental Panel on Climate Change in 2014 for the assessment of climate change impacts.

  - Rainfall intensity uplift 21.3% in accordance with ARR2019.

- Minimise increases in flood levels due to temporary and permanent ASD infrastructure during flood events up to and including the 1% AEP climate change flood event.
- Not worsen flooding on properties or infrastructure up to the 1% AEP climate change flood event. Not worsen is defined as:
  - a maximum increase in inundation time of one hour in a 1% AEP event
  - a maximum increase of 10mm in inundation at properties where flood levels are currently exceeded in the 1% AEP flood event
  - a maximum increase of 50mm in inundation of land at properties where flood levels would not be exceeded in a 1% AEP flood event
  - no inundation of floor levels which are currently not inundated in a 1% AEP flood event.
- Dedicated evacuation routes would not be adversely impacted in flood events up to and including the PMF flood event.

The City of Parramatta guidelines require a flood planning level of 100 year ARI (1% AEP) inclusive of freeboard. For consistency with the Stage 3 CSSI Application, freeboard to be adopted is 300mm above the 1% AEP. Due to the nuisance nature of flooding at this site and owing to the location of the station within the catchment, 0.3 metres freeboard (rather than a typical freeboard of 500mm) is considered adequate and would be adopted. The Sydney Olympic Park Authority Masterplan (policy POL13/4) provides guidance on stormwater and notes that the design should minimise volume and frequency of stormwater discharge from hardstand areas. Detention basins have been designed to reduce the frequency and magnitude of stormwater discharging from the site, this is discussed further in section 4.3.2.

4 Assessment

4.1 Site description

The proposed development at Site 47 is located at the centre of the Sydney Olympic Park precinct and is bounded by Figtree Drive to the south, Olympic Boulevard to the west, and Herb Elliot Avenue to the north. The local area is a combination of mixed-use residential buildings, parkland, roads and carparks. The site is located at a local highpoint within the Sydney Olympic Park precinct with stormwater flowing towards each of the bounding roads under existing conditions. There is a comprehensive underground stormwater system that drains the local area. Olympic Boulevard and Herb Elliot drive flow to the north with a portion of flow entering the Northern Water Feature and ultimately into Haslams Creek approximately 1.1 kilometres north of the site, while Herb Elliot Drive discharges into Powells Creek approximately 1 kilometre to the east of the site. The existing site topography is elevated above the surrounding streets with much of the site being between 22.5 metres AHD and 24.5 metres AHD.

4.2 Catchment and topography

The Sydney Olympic Park precinct is located between the confluence of Haslams Creek and Powells Creek, which are tributaries of Parramatta River. The precinct is located along a ridge between the two catchments and is not inundated from these sources in flood events up to the PMF (WMA Water, 2019). The Parramatta River catchments and site location are shown on Figure 4-1. A map showing the local elevation in the area around the proposed development is presented in Figure 4-2. There are no major overland flow paths that have been identified in or around the site. However, ponding has been observed at the intersection of Showground Road and Dawn Fraser Drive. Two photos showing flooding at the intersection during intense rainfall in October 2018 are presented in Figure 4-3 and Figure 4-4.

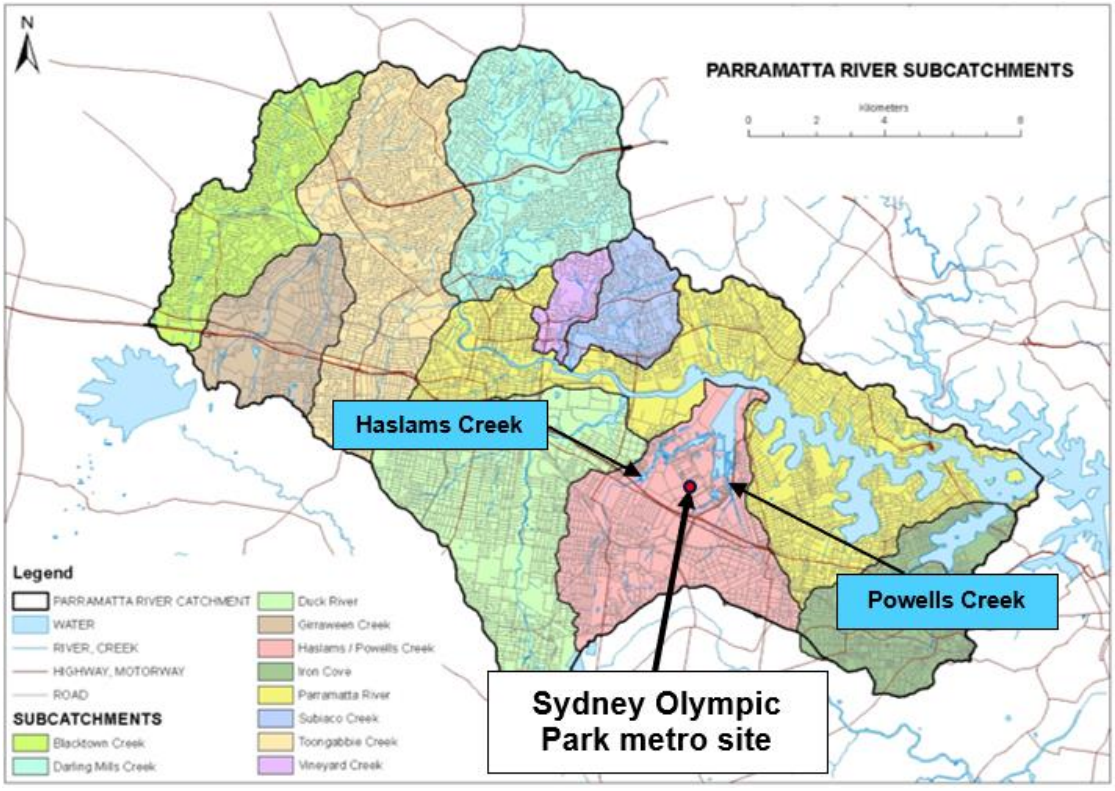


Figure 4-1 Parramatta River sub-catchments and site location

Source: Parramattariver.org.au

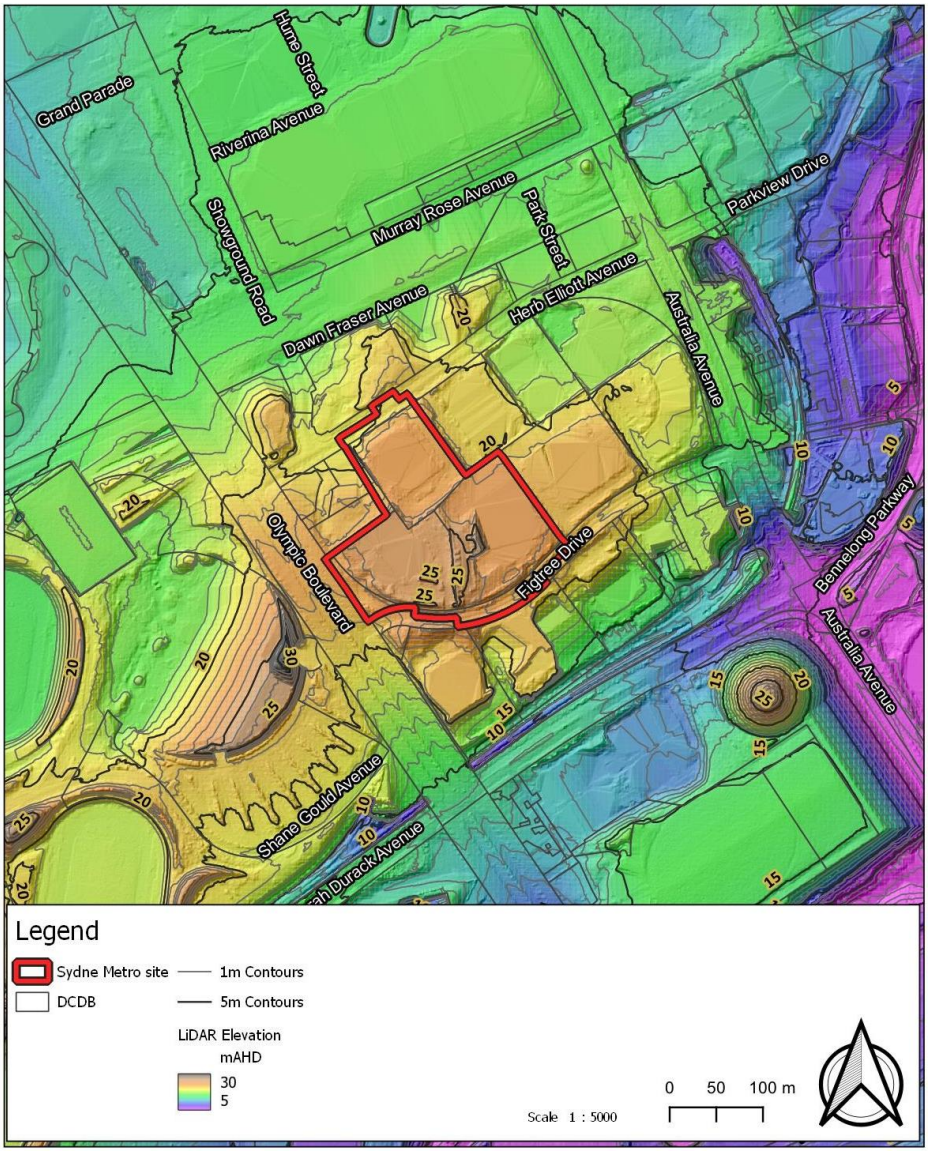


Figure 4-2 Sydney Olympic Park site local topography

Figure 4-3 Flooding at the intersection of Dawn Fraser Drive and Showground Avenue, October 18, 2018

Source: Daily Mail Online 2018

Figure 4-4 Flooding at the intersection of Dawn Fraser Drive and Showground Avenue, October 18, 2018

Source: Sydney Morning Herald Online

4.3 Flooding assessment

4.3.1 Hydraulic model background

TUFLOW models developed for the Sydney Olympic Park metro station development were adapted and adopted for assessment of the proposed developments within the Central Precinct of Sydney Olympic Park. The model adopted a 1m grid size to simulate the overland stormwater flooding in the vicinity of the site. Model inflows were developed using a DRAINS hydrology model that was used to simulate detailed catchment inflows within the hydraulic model domain for the baseline and developed conditions. The model was used to assess the 5% AEP climate change, 1% AEP climate change and PMF design flood events.

4.3.2 Hydraulic model site scenarios

The TUFLOW model was used to assess the baseline and development conditions. The baseline modelling includes the works undertaken as part of the Concept and Stage 1 CSSI approval and proposed under Stage 3 CSSI Application. The baseline modelling represents the following:

- Sydney Olympic Park metro station structures (including the basement and podium of the OSD) and associated landscaping, stormwater pit and pipe upgrades within the site.
- On-site detention basins have been adopted, the basin locations and configurations are shown in Figure 4-5 and Table 4-1, respectively.
- Proposed road works on Figtree Drive and Herb Elliot Avenue to facilitate the inclusion of the proposed bus bays.

Baseline topography and stormwater network in the site area are shown on Figure 4-6.

The developed conditions include the proposed development on Site 47. The OSD building does not affect the flooding on site, so the addition of the two ASD buildings on Site 47 are the only difference between the baseline and developed conditions hydraulic models. A map showing the developed conditions is shown on Figure 4-7. The developed site layout plan is presented in Figure 4-8.

More information regarding the stormwater quantity and quality management for the site is outlined in Sydney Olympic Park Integrated Water Management Plan report prepared to support the SSDA submission (Appendix X of the EIS).

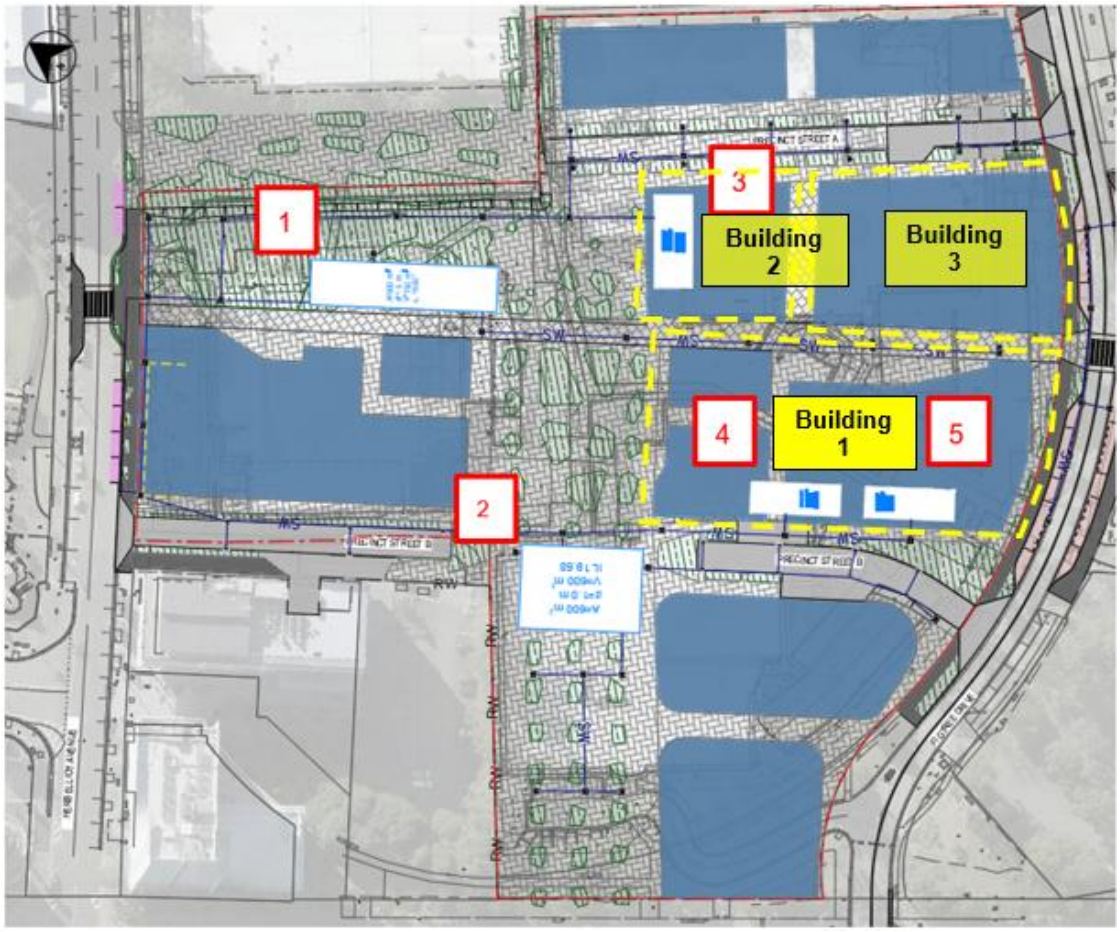


Figure 4-5 Proposed on-site detention tank locations

Table 4-1 Proposed on-site detention tank configuration 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

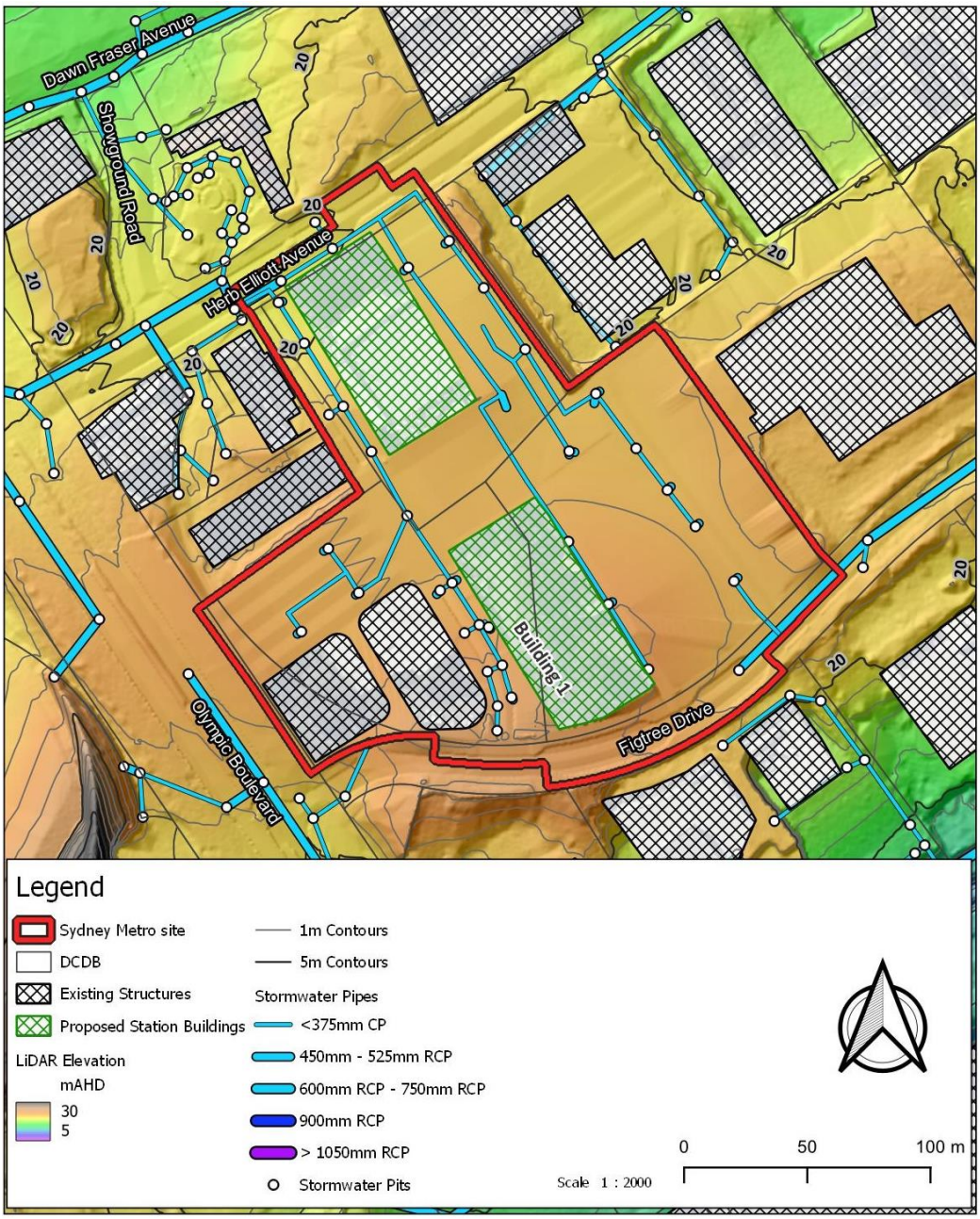


Figure 4-6 Baseline site model configuration

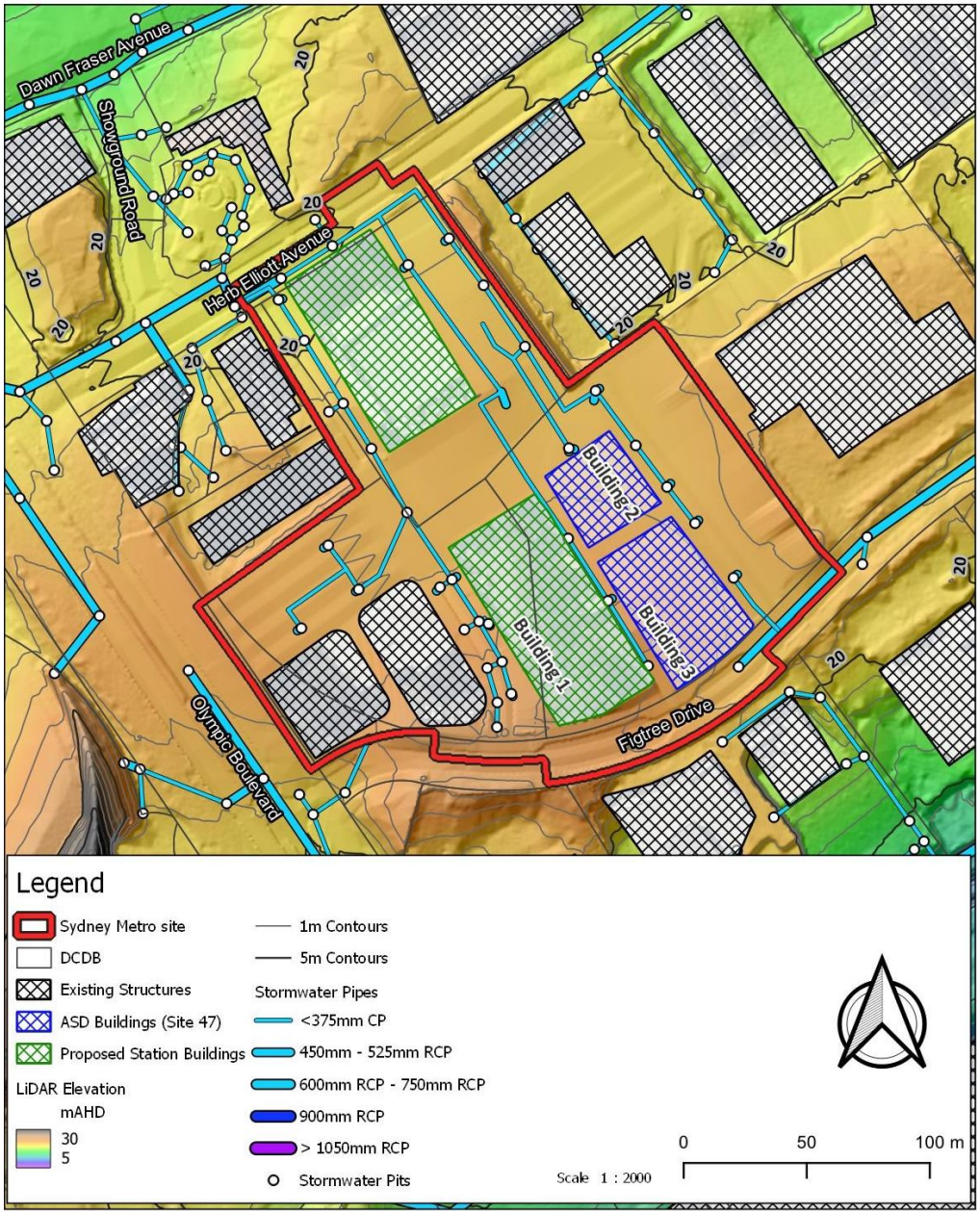


Figure 4-7 Developed SSD site model configuration

Figure 4-8 Developed site plan

4.3.3 Hydraulic model flood scenarios

For the baseline and developed scenarios, the hydraulic model was used to simulate the 5% and 1% AEP flood events with the inclusion of 21.3% climate change and the PMF flood event. The climate change allowance is based on guidance in Australian Rainfall and Runoff 2019 (ARR2019), as outlined in the Sydney Metro West Climate Change Projections memorandum (Jacobs, 2020).

The TUFLOW model was used to determine the critical duration and temporal patterns for the site based on ARR2019 guidelines. The adopted critical durations are noted in Table 4-2. As shown on the table, three durations were assessed for the 1% AEP climate change event while only one was required for the 5% AEP climate change and PMF events.

Table 4-2 Design event critical durations

Site	Critical duration(s)
5% AEP Climate Change	15-minute
1% AEP Climate Change	10-minute, 15-minute, 20minute
PMF	30-minute

4.3.4 Climate and rainfall

The site is located in Western Sydney, experiencing a temperate climate with a monthly average maximum temperature range of 17.5 to 28.6 degrees Celsius, and a monthly average minimum range of 6.2 to 17.7 degrees Celsius. Annual average rainfall total is 966 mm/year with the monthly variation as indicated in Figure 5-5 (Bureau of Meteorology, Sydney Olympic Park).

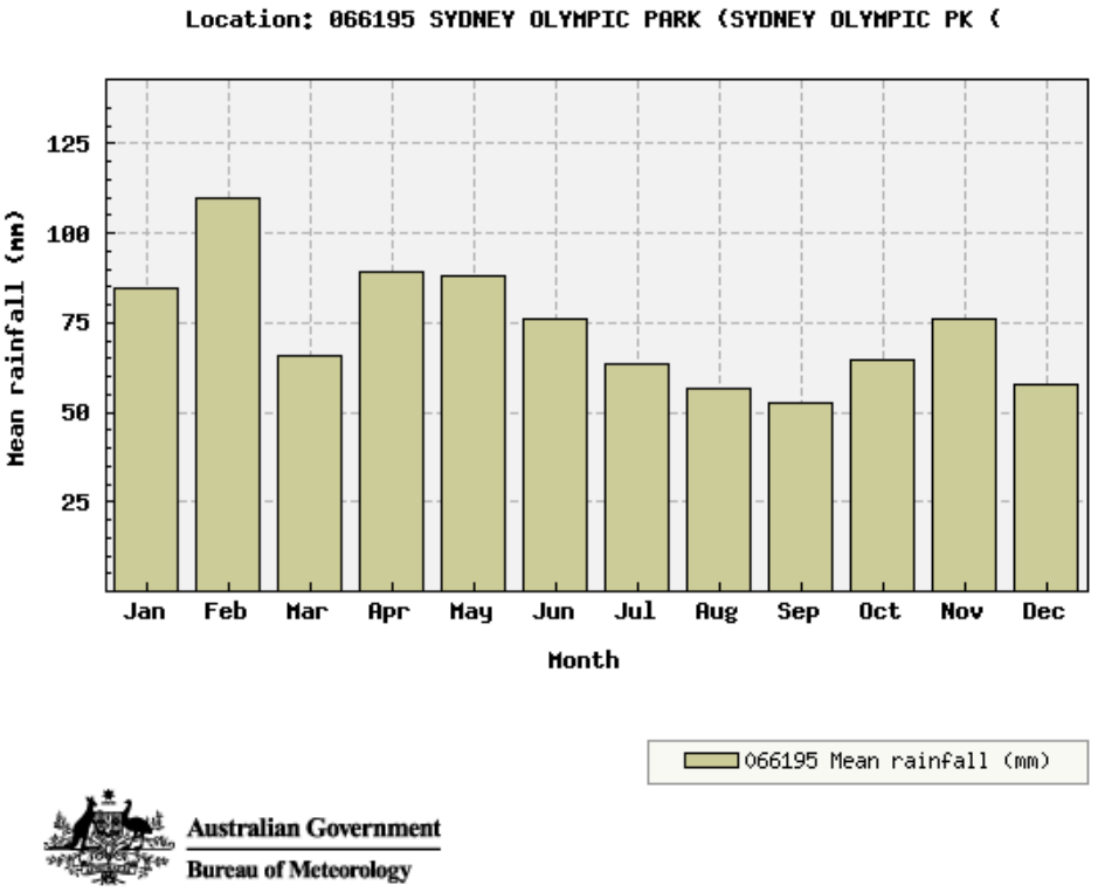


Figure 4-9 Monthly rainfall statistics at Sydney Olympic Park

Rainfall Intensity-Frequency-Duration for the TUFLOW hydraulic model was extracted from the Bureau of Meteorology website based on ARR2016 rainfall estimates for Sydney Olympic Park (latitude -33.849, longitude 151.07). The rainfall intensity-frequency-duration rainfall depths are presented in Table 4-3.

Table 4-3 Sydney Olympic Park ARR2016 rainfall intensity-frequency-duration

Duration	63% AEP	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
5 min	7.61	8.36	10.7	12.3	13.9	16.1	17.7
10 min	12	13.3	17.4	20.2	22.9	26.4	29.1
15 min	15	16.7	21.8	25.3	28.7	33.1	36.4
20 min	17.2	19.1	24.9	28.9	32.7	37.7	41.5
25 min	19	21	27.3	31.6	35.7	41.2	45.3
30 min	20.5	22.6	29.3	33.8	38.2	44	48.4
45 min	23.9	26.2	33.6	38.6	43.6	50.2	55.2
1 hour	26.4	28.9	36.8	42.2	47.6	54.8	60.4

Duration	63% AEP	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
1.5 hour	30.4	33.1	41.8	47.8	53.9	62.2	68.7
2 hour	33.5	36.5	45.9	52.6	59.3	68.6	75.9
3 hour	38.7	42.1	53.1	60.9	68.9	80.1	89
4.5 hour	45	49	62.4	72.1	82	95.8	107
6 hour	50.3	55.1	70.8	82.2	94	110	124
9 hour	59.2	65.4	85.8	101	116	137	154
12 hour	66.7	74.2	98.9	117	135	161	182

4.3.5 Baseline flood conditions

Under baseline conditions, the proposed Sydney Olympic Park metro station buildings, landscaping and stormwater network have been adopted. As noted previously, the site is located on a local high point with stormwater discharging via the stormwater and overland routes to the adjacent streets. Approximately 3.31 hectares discharges north toward herb Elliott Avenue, most of the overall precinct. Small area at the west and southern edges of the site discharge toward Olympic Boulevard and Figtree Drive, respectively. Drainage in the area is primarily confined to kerb and channel and the underground stormwater system, with some ponding occurring at the intersection of Dawn Fraser Avenue and Showground Road. Evidence of this ponding occurring was shown previously in Figure 4-3 and Figure 4-4, which was a result of intense rainfall in October 2018.

Baseline flood depth and hazard maps from the hydraulic modelling are included in Appendix B of this report. Flood hazard has been classified using the Australian Institute for disaster Resilience, 2017. The hazard classifications are based on a combination of flow velocity and flood depth as shown on the diagram in Figure 4-10.

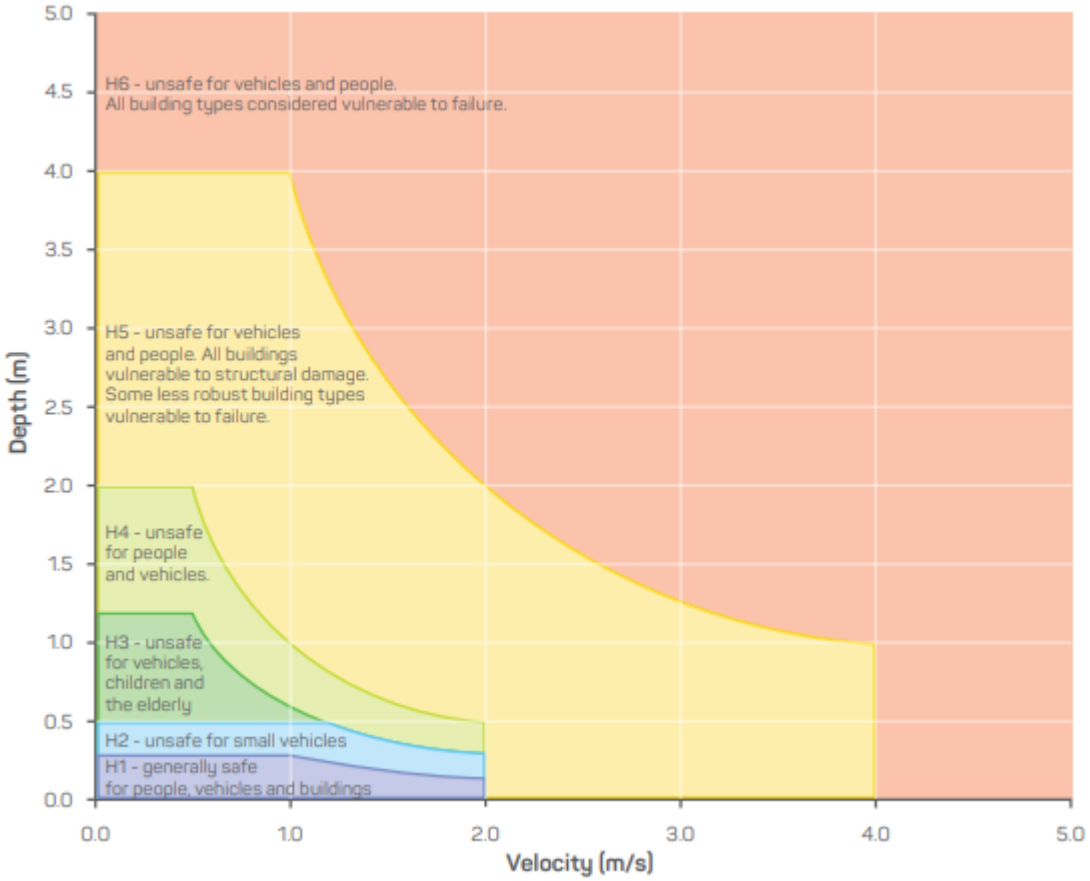


Figure 4-10 Flood hazard classifications

The hazard conditions shown in the figure are defined below.

- H1: Generally safe for vehicles, people and buildings.
- H2: Unsafe for small vehicles.
- H3: Unsafe for vehicles, children and the elderly.
- H4: Unsafe for vehicles and people.
- H5: Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6: Unsafe for vehicles and people. All building types considered vulnerable to failure.

A summary of the baseline flooding conditions for the station and surrounding area are as follows:

- Discharge from the site is primarily north towards Herb Elliot Avenue, flowing over the road formation and continuing north along Showground Road. In Herb Elliot Avenue to the north of the site there is local ponding near the intersection with Showground Road. Flood depths of up to approximately 0.26 metres and 0.30 would be experienced in the 5% AEP climate change and 1% AEP climate change flood events, respectively. In the PMF flood event, this increases to 0.45 metres.
- Discharge into Figtree Drive at the south of the site leads to flooding within the roadway, which is generally confined to the kerb and channel drainage in the 5% AEP climate change flood event. In the 1% AEP climate change flood event, the

flood increases marginally with flood depths of up to approximately 0.13 metres within the road. In the PMF flood event, the flooding overtops the Figtree Road kerbs and flows to the south. Flood depths in the PMF flood event on the road are up to 0.31 metres.

- Flood hazard in the area of the site and the adjacent streets in the 5% AEP climate change and 1% AEP climate change flood events is generally low, with the area predominantly in the H1 category. There are localised areas of H2 to H5 to the north of the site on Showground Road within the kerb, which is due to the high flow velocity in excess of 2 metres per second. In the PMF flood event, there are localised areas of high hazard with a category of H5, primarily due to high velocity. The full width of Showground Road is H5 category in the PMF flood event.
- Access and evacuation from the site are generally safe during flood events, with only localised areas with high flow velocity which would be unsafe for pedestrians and vehicles. Showground Road would not be suitable for access or evacuation during the PMF flood event due to the high hazard.

4.4 Developed flood conditions

4.4.1 Hydraulic model results summary

The developed flood conditions were modelled for the three design events noted in section 4.3.3. The flood depth with water surface levels and flood hazard for the 5% AEP climate change, 1% AEP climate change and PMF flood events are presented in Appendix C. Flood impact maps showing the difference between the baseline and developed flood conditions water surface level for three flood events are presented in Appendix D.

The addition of the new structures within Site 47 has no effect on the overland flooding within or downstream of the site up to the 1% AEP climate change flood event. This is due to the proposed building sites not being inundated in the baseline scenario. In the PMF flood event, a small portion of stormwater discharges across Building 2 within Size 47. The blocking of the overland flow will result in minor changes to stormwater flood levels within the site and will not cause any worsening of flooding to adjacent properties, infrastructure of the baseline structures, including the Sydney Olympic Park metro station. A map showing the PMF flood impacts is presented in Figure 4-11. As shown on the map, there are localised impacts to the west and north of Building 2, which are up to 0.03 metres.

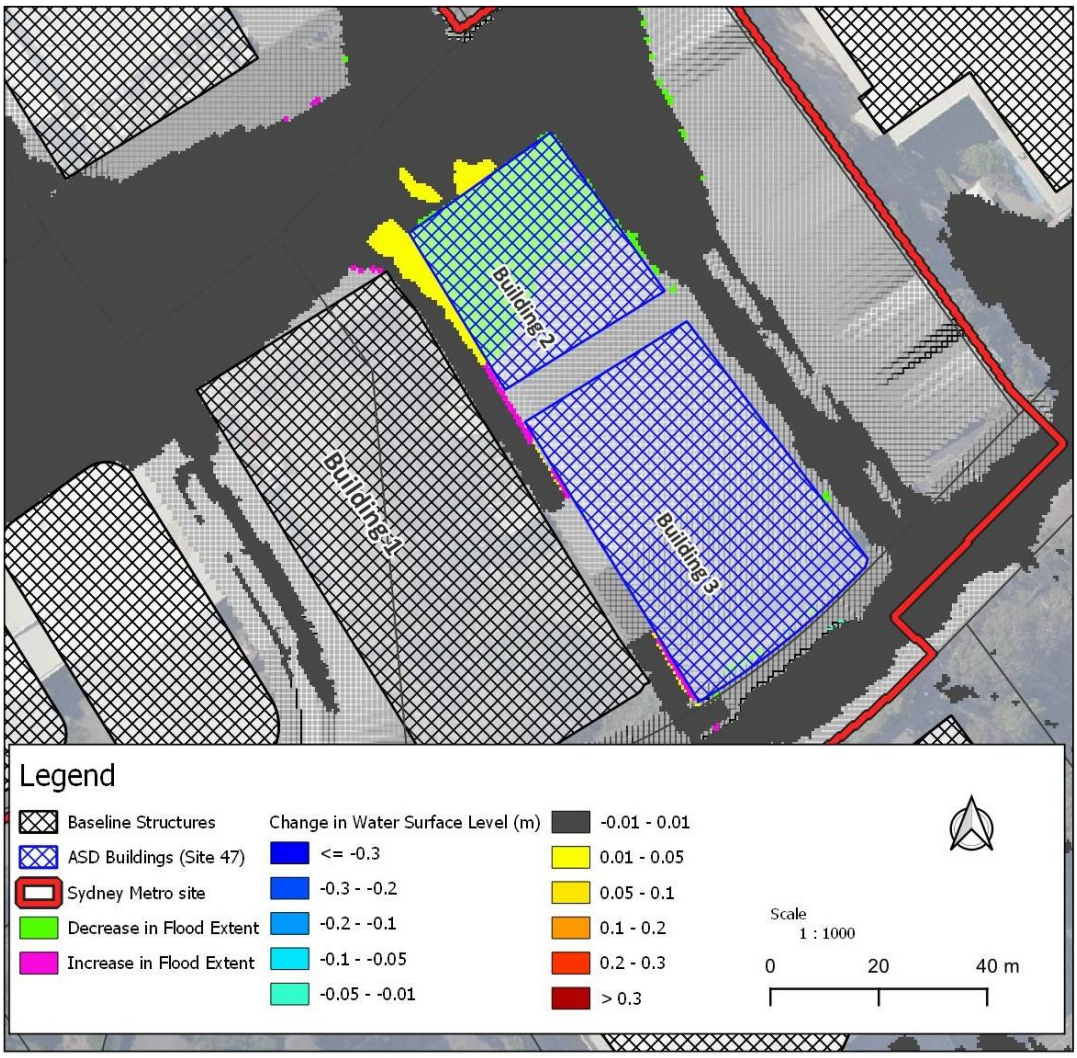


Figure 4-11 PMF flood impacts

The inclusion of the ASD buildings will not affect flood hazard or trafficability for access and evacuation in the 5% AEP climate change, 1% AEP climate change events and the PMF flood events compared to the baseline conditions as shown on the hazard maps for baseline and developed conditions in Appendix B and Appendix C of this report, respectively.

Further stormwater design and flooding analysis will be undertaken as the design progresses and as part of the Detailed SSDAs.

4.4.2 Flood planning levels

The site is affected by localised stormwater originating from the buildings and landscaping areas on the site. The stormwater is shallow nuisance type flooding, with only small, localised areas exceeding 0.1 metres in depth in the 1% AEP climate change design flood event. In the PMF event, the stormwater depth on the site is generally below 0.3 metres. The nature of flooding around the ASD buildings is shallow nuisance stormwater flooding. The ground floor levels for proposed development and basement entry will adopt the 1% AEP climate change level with the inclusion of 300mm freeboard, which exceeds the PMF flood level within the site.

The water surface levels in the 1% AEP climate change flood around the subject buildings are presented in Figure 4-12. Where no flooding is modelled, the floor level

will be located 300mm above the top of kerb adjacent to the entrances and are noted on the figure. Note, the levels on the figure are inclusive of the 300mm freeboards.

The current design includes a basement entrance to Building 3, which will include a loading dock and car parking area. The current floor levels and basement entrance level for the proposed development have not yet been set. The levels will be set during stage 1 CSSI development to comply with the stormwater requirements.

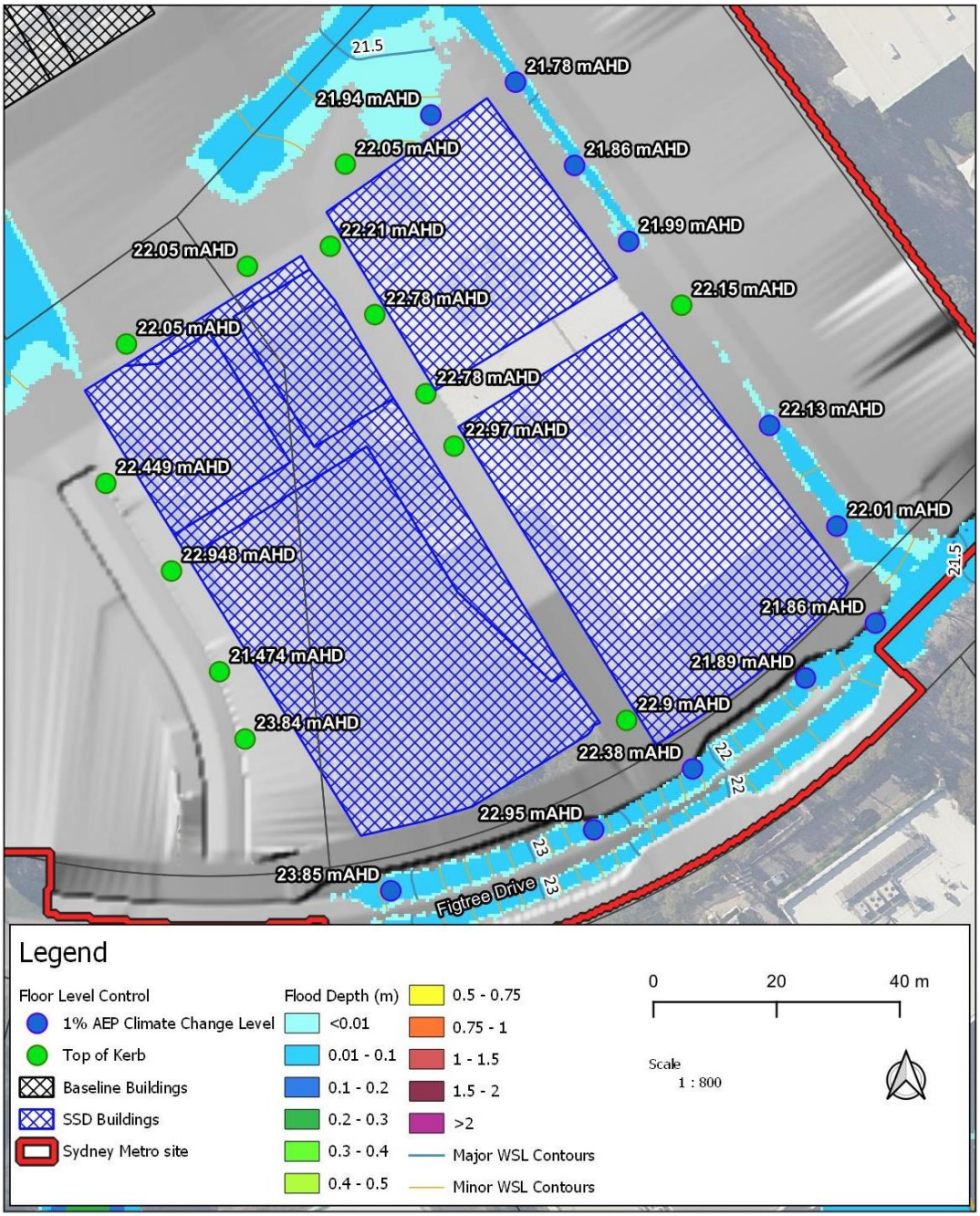


Figure 4-12 Flood planning levels

4.4.3 Emergency response

Flood hazard maps for all events assessed are included in Appendix C of this report. Flood hazard in the roads adjacent to the proposed development is generally low, being less than H2 hazard, which is considered safe for vehicle access and emergency response and evacuation purposes. In the PMF flood event there are localised areas of up to H5 flood hazard along Showground Road due the high flood velocity and should be avoided by vehicles during extreme stormwater flooding

events. The proposed development does not worsen the hazard in the adjacent streets compared to baseline conditions. Access and evacuation are readily achievable via Figtree Drive from the site up to the PMF flood event.

The flood hazard in adjacent streets is most appropriately managed by residents and retail operators with a shelter in place strategy as adjacent areas are flood free up to the PMF flood event. Flooding duration is estimated to take less than an hour, as the area is generally affected by short duration, intense rainfall events rather than extended rainfall conditions, which would affect larger riverine floodplains.

4.4.4 Cumulative impact assessment

A review of proposed developments within the Sydney Olympic Park area identified proposed development, which are outlined in Table 4-4. These two development sites are both located on Australia Avenue. A map showing the location of the developments in relation to the site are shown in Figure 4-13.

Table 4-4 Design event critical durations

Project name	Address	Description
Site 43/44 Sydney Olympic Park – Stage 1 and 2	6 Australia Avenue and 2 Herb Elliot Avenue	The project involves the staged development of two mixed-used buildings for commercial and retail spaces, associated basement car parking, landscaping and driveway access.
Site 2A and Site 2B, Sydney Olympic Park	2 Australia Avenue	The development comprises a SSDA for the site. The proposal includes the construction of two buildings including a tower (approx. 45 storeys) that provides serviced apartments, plus a podium on Site 2A and a commercial building (approx. 12 storeys) on Site 2B.

As noted previously, the addition of the new structures within Site 47 has no effect on the overland flooding within or downstream of the site up to the 1% AEP climate change flood event and only minimal on-site impacts in the PMF flood. The project is outside the area of influence of the Site 47 development and therefore cumulative impacts are not expected in up to the 1% AEP flood event.

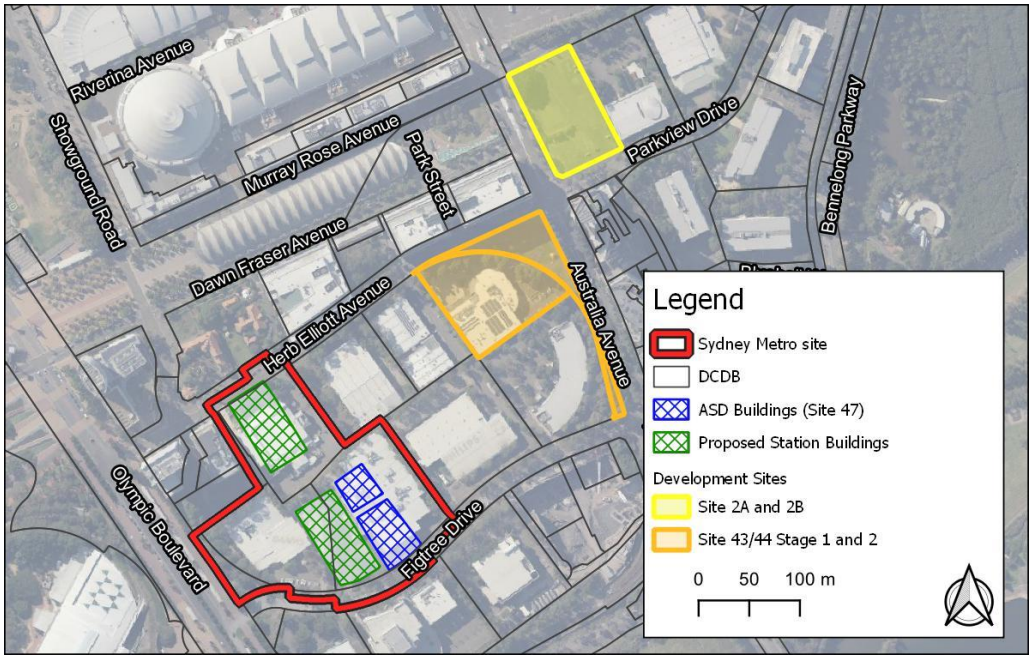


Figure 4-13 Proposed adjacent development

5 Mitigation measures

Further consultation will be undertaken where relevant with the Sydney Olympic Park Authority and the City of Parramatta Council during the Detailed SSDA preparation.

To ensure that flood associated risks are appropriately managed and mitigated at the site the ground floor of the proposed development and entrance to the underground basement 300mm freeboard above the 1% AEP flood level or top of kerb. The 1% AEP including 300mm freeboard is higher than the PMF flood level on the site.

An emergency management plan which considers high hazard in adjacent roads during very rare and extreme flood events would be prudent to manage risk to life associated with access or egress from the site. Flood hazard maps for baseline and developed conditions are included in Appendix B and Appendix C, respectively.

6 Conclusion

This Flooding Assessment report responds specifically to the SEARs. It summarises the assessment of flooding associated with the baseline and developed conditions for the proposed development at Site 47 within the Central Precinct of Sydney Olympic Park. Hydrologic and hydraulic models developed for the assessment of Sydney Olympic Park metro station were updated to model the baseline and developed conditions for the site and adopted. The models were used to assess the 5% climate change, 1% climate change and PMF flood events for baseline and developed conditions.

The results of the assessment show the site is not affected by any riverine or overland flooding mechanisms up to the PMF event and is only affected by local stormwater originating from the site itself. This flooding is described as nuisance flooding. Flood depth, water surface level and hazard have been mapped for the existing and proposed case scenarios. The development conditions flood maps have been used to inform required flood levels within the buildings on site to provide the required 300mm freeboard above the 1% AEP flood level or top of kerb where no flooding is modelled. The proposed development will not cause a worsening of flooding to third party properties for flood events up to the PMF event.

Access and evacuation are readily achievable from the site up to the PMF flood event. The proposed development will not worsen flood hazard or trafficability on adjacent roads.

Engagement with the Sydney Olympic Park Authority and the City of Paramatta Council in relation to flooding risk associated with this proposal will be undertaken during preparation of the Detailed SSDAs.

This report complies with the planning requirements, a summary of which are detailed below:

- Hydraulic modelling has been undertaken for the 5% and 1% AEP flood events with an appropriate increase in rainfall adopted to reflect climate change projections to the year 2100, based on ARR2019.
- The results of the hydraulic modelling show there will be no worsening of flooding on Site 47 and adjacent properties of infrastructure up to the 1% AEP climate change flood event as a result of the proposed development.
- Internal flood planning levels have been estimated for the proposed SSDA buildings and the basement entrances, which are to be set at the 1% AEP design flood level with the inclusion of climate change and 300mm freeboard.
- The proposed works will not affect dedicated flood evacuation routes up to and including the PMF flood event.

There are ongoing development options and changes being considered for the end state design of the Central Precinct of Sydney Olympic Park. Further stormwater and flooding analysis will be undertaken as part of the Details SSDAs.

7 References

Australian Institute of Disaster Resilience (2017a) Australian Disaster Resilience Handbook 7. Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia

NSW Government 2021, Cumulative Impact Assessment Guidelines for State Significant Projects, Department of Planning, Industry and Environment, November 2021

NSW Government 2021, State Significant Development Guidelines, Department of Planning, Industry and Environment, November 2021

Sydney Metro 2022, Sydney Olympic Park Integrated Water Management Plan, report, Appendix X prepared for Sydney Metro, February 2022.

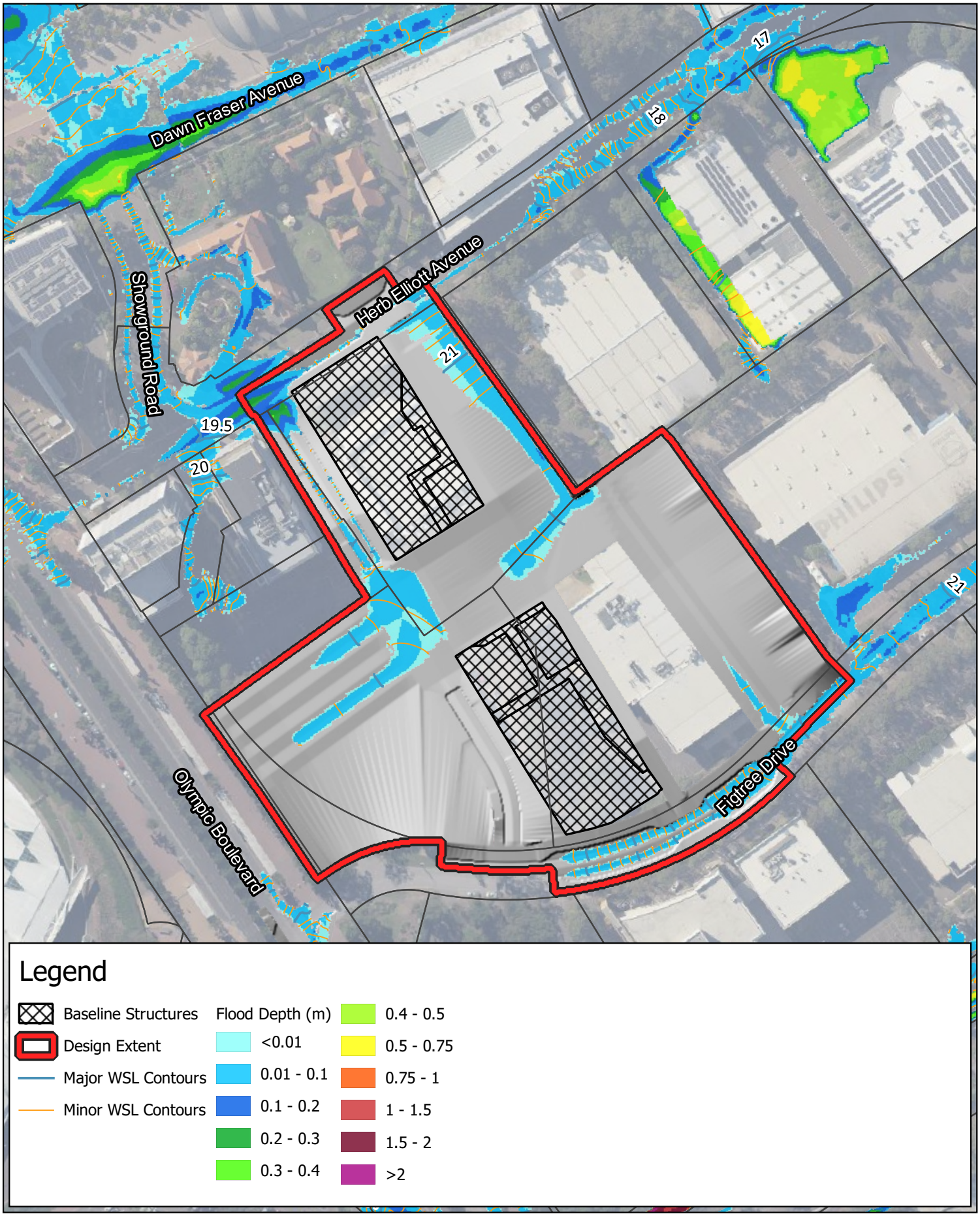
Sydney Metro 2022, Environmental Impact Statement Technical Paper 8: Hydrology, flooding and water quality, prepared for Sydney Metro, January 2022.

WMA Water 2019, Powells Creek Flood Study, Prepared for Burwood Council, October 2019

Appendix A AEP and ARI conversion table

Frequency Descriptor	EY	AEP (%)	AEP (1 in x)	ARI
Very frequent	**12**			
	6	99.75	1.002	0.17
	4	98.17	1.02	0.25
	3	95.02	1.05	0.33
	2	86.47	1.16	0.50
	1	**63.2**	1.58	1.00
Frequent	0.69	**50.00**	2	1.44
	0.5	39.35	2.54	2.00
	0.22	**20.00**	5	4.48
	0.2	18.13	5.52	5.00
	0.11	**10.00**	10.00	9.49
Infrequent	0.05	**5.00**	20	20.0
	0.02	**2.00**	50	50.0
	0.01	**1.00**	**100**	100
Rare	0.005	0.50	**200**	200
	0.002	0.20	**500**	500
	0.001	0.10	**1000**	1000
	0.0005	0.05	**2000**	2000
Extremely Rare	0.0002	0.02	5000	5000
			↓	
Extreme			PMP	

Appendix B Baseline flooding conditions



TITLE

Figure A-01
5% AEP Climate Change Baseline Flood Depth

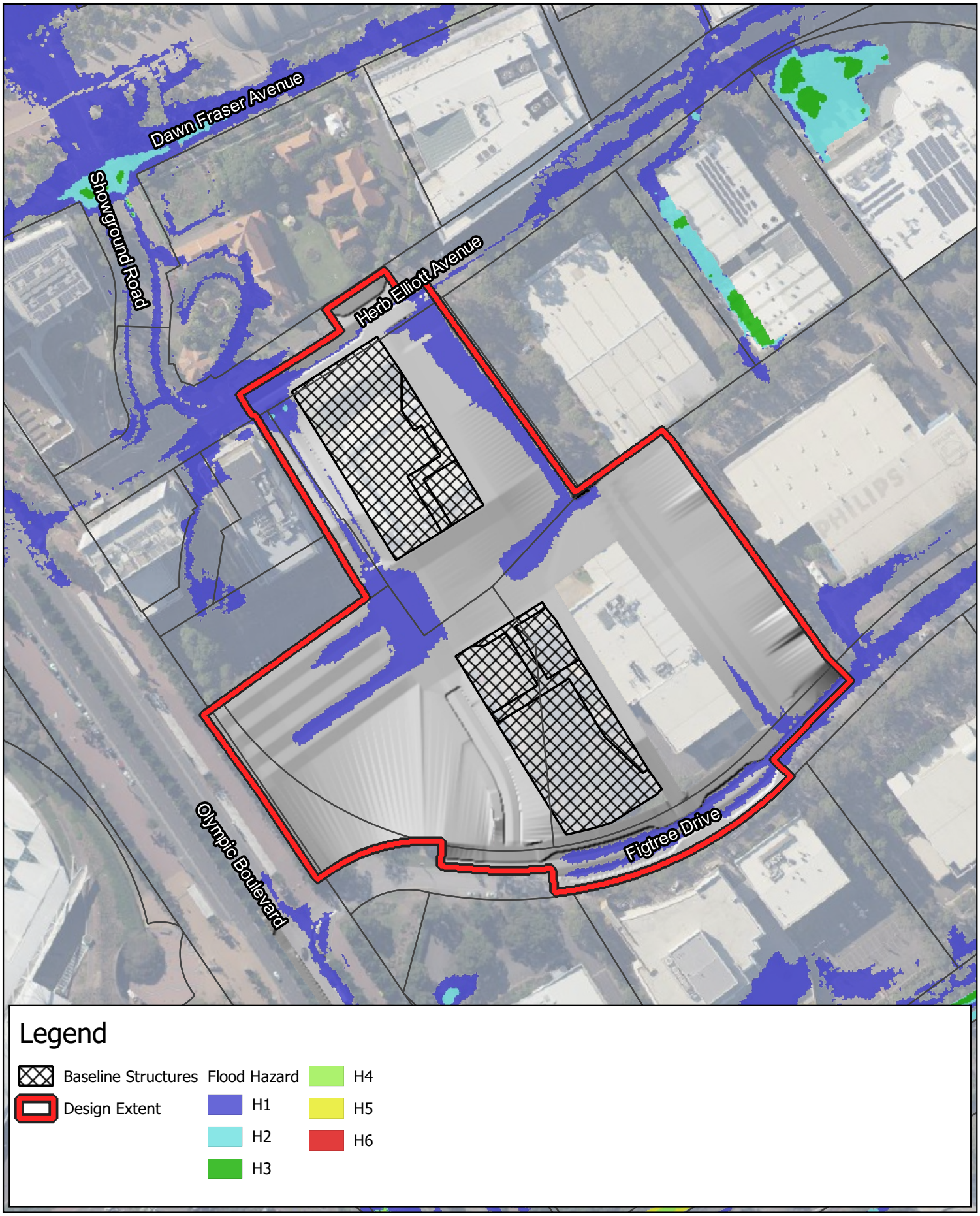
PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

Date	Drawn	Check	Approved	Scale	Rev
21/02/2022	SC	FH	SB	1 : 2000	1



TITLE

Figure A-02
5% AEP Climate Change Baseline Flood Hazard

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

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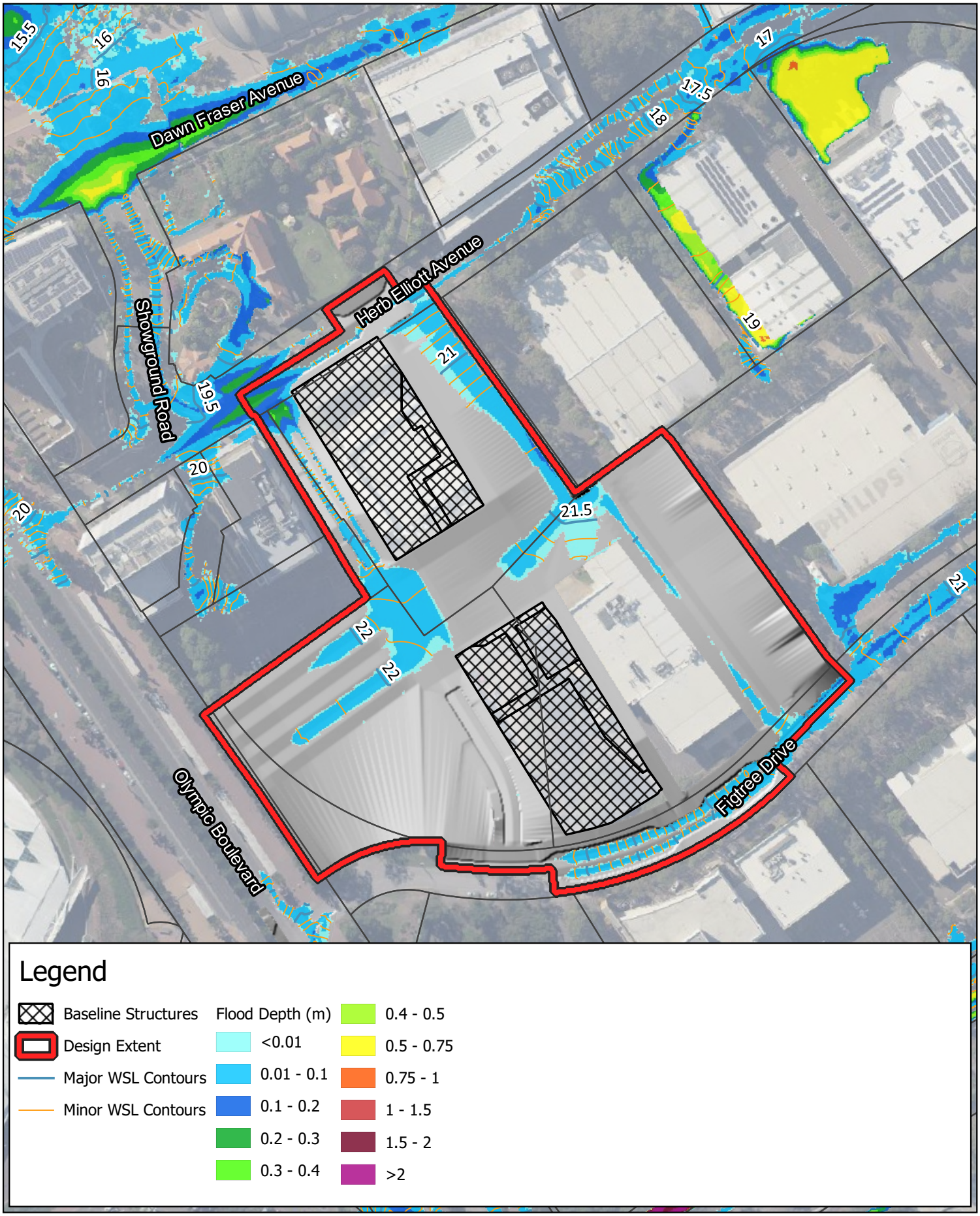

Legend

- Baseline Structures
- Design Extent
- Major WSL Contours
- Minor WSL Contours

Flood Depth (m)

- <0.01
- 0.01 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.5
- 1.5 - 2
- >2

TITLE

Figure A-03
1% AEP Climate Change Baseline Flood Depth

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

Date	Drawn	Check	Approved	Scale	Rev
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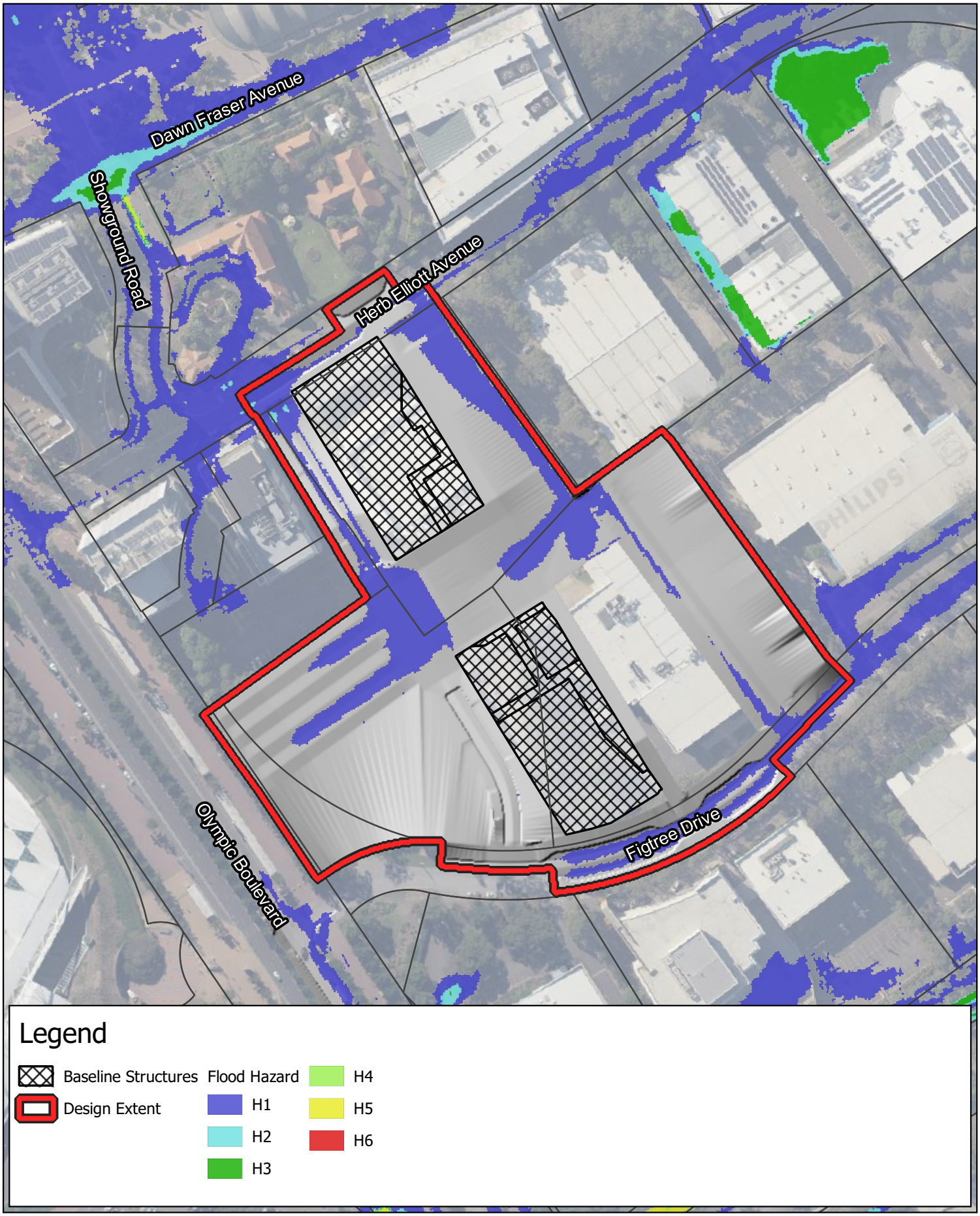

TITLE

Figure A-04
1% AEP Climate Change Baseline Flood Hazard

PROJECT

EDS - SWM - Sydney Olympic Park

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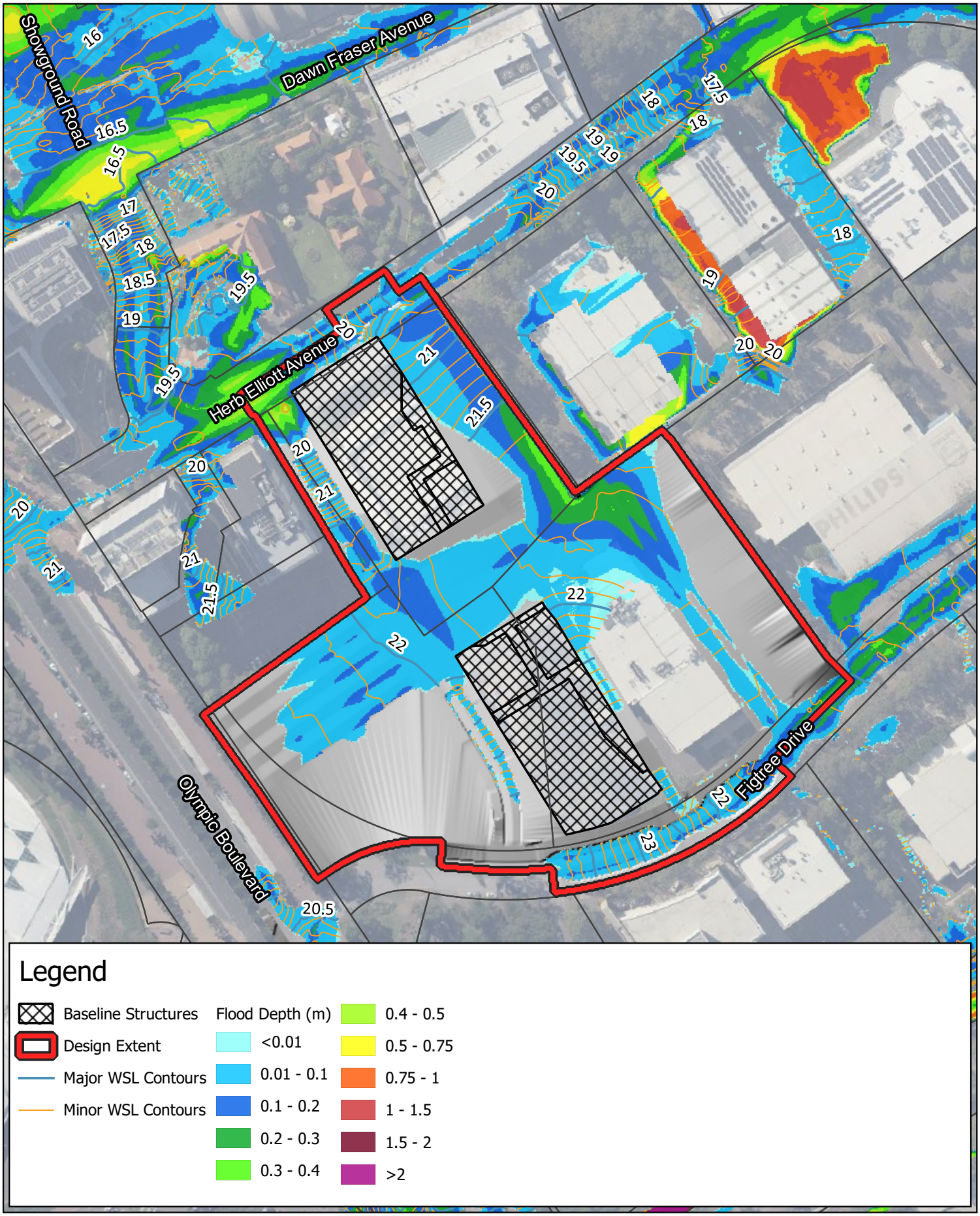

Legend

- Baseline Structures
- Design Extent
- Major WSL Contours
- Minor WSL Contours

Flood Depth (m)

- <0.01
- 0.01 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.5
- 1.5 - 2
- >2

TITLE

Figure A-05
PMF Baseline Flood Depth

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

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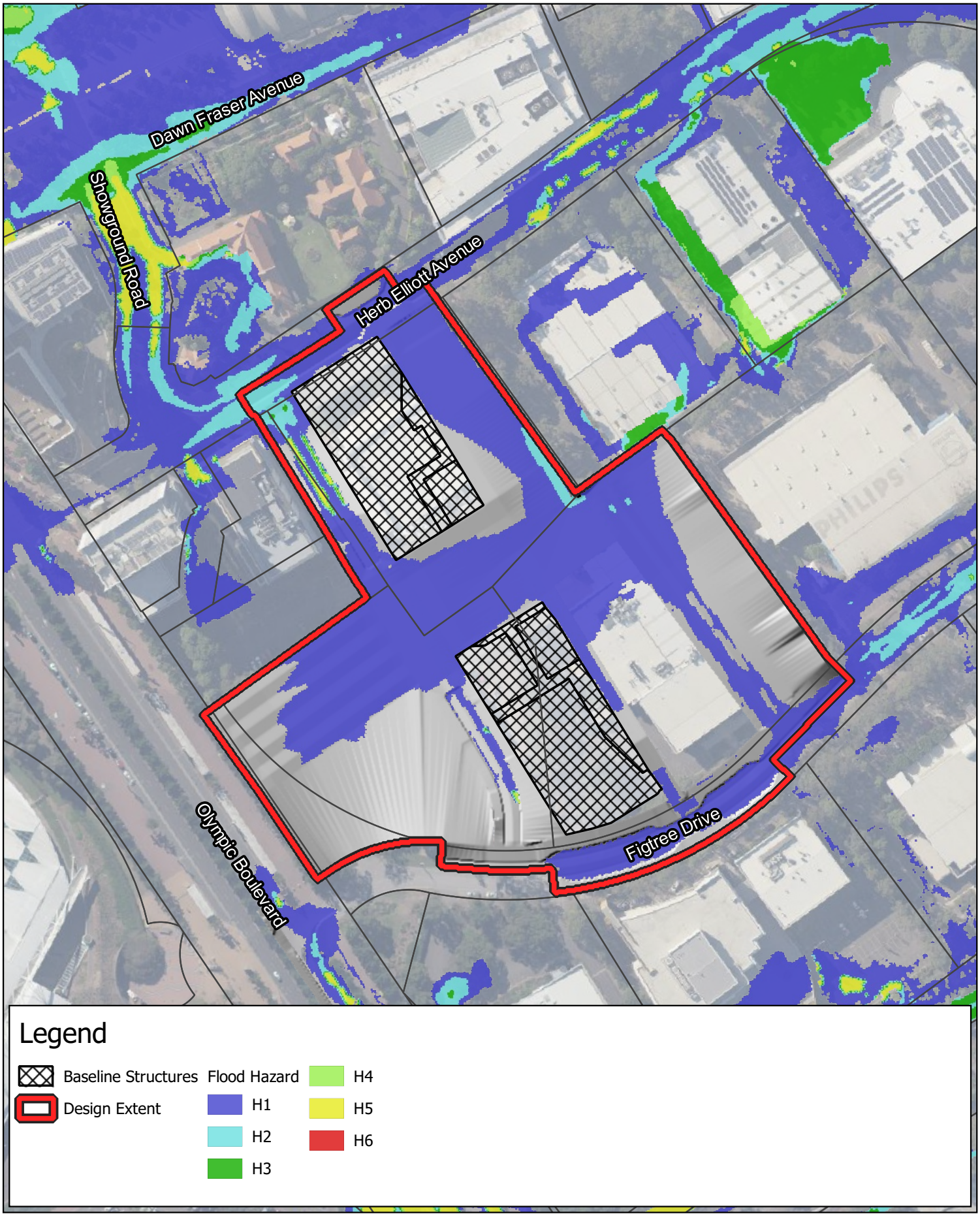

TITLE

Figure A-06
PMF Climate ange Baseline Flood Hazard

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

Date	Drawn	Check	Approved	Scale	Rev
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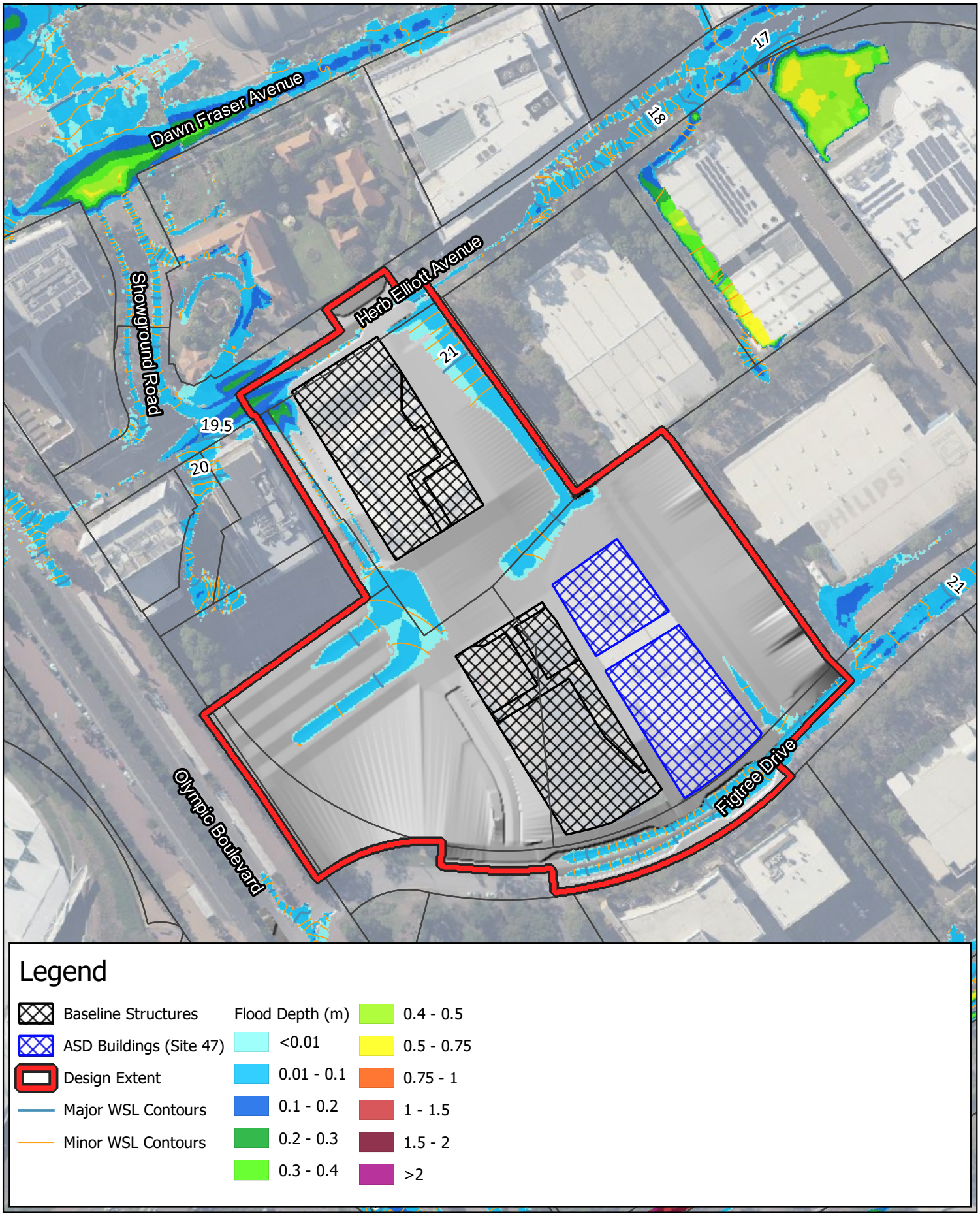
Appendix C Developed flooding conditions



TITLE

Figure B-01
5% AEP Climate Change Developed Flood Depth

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

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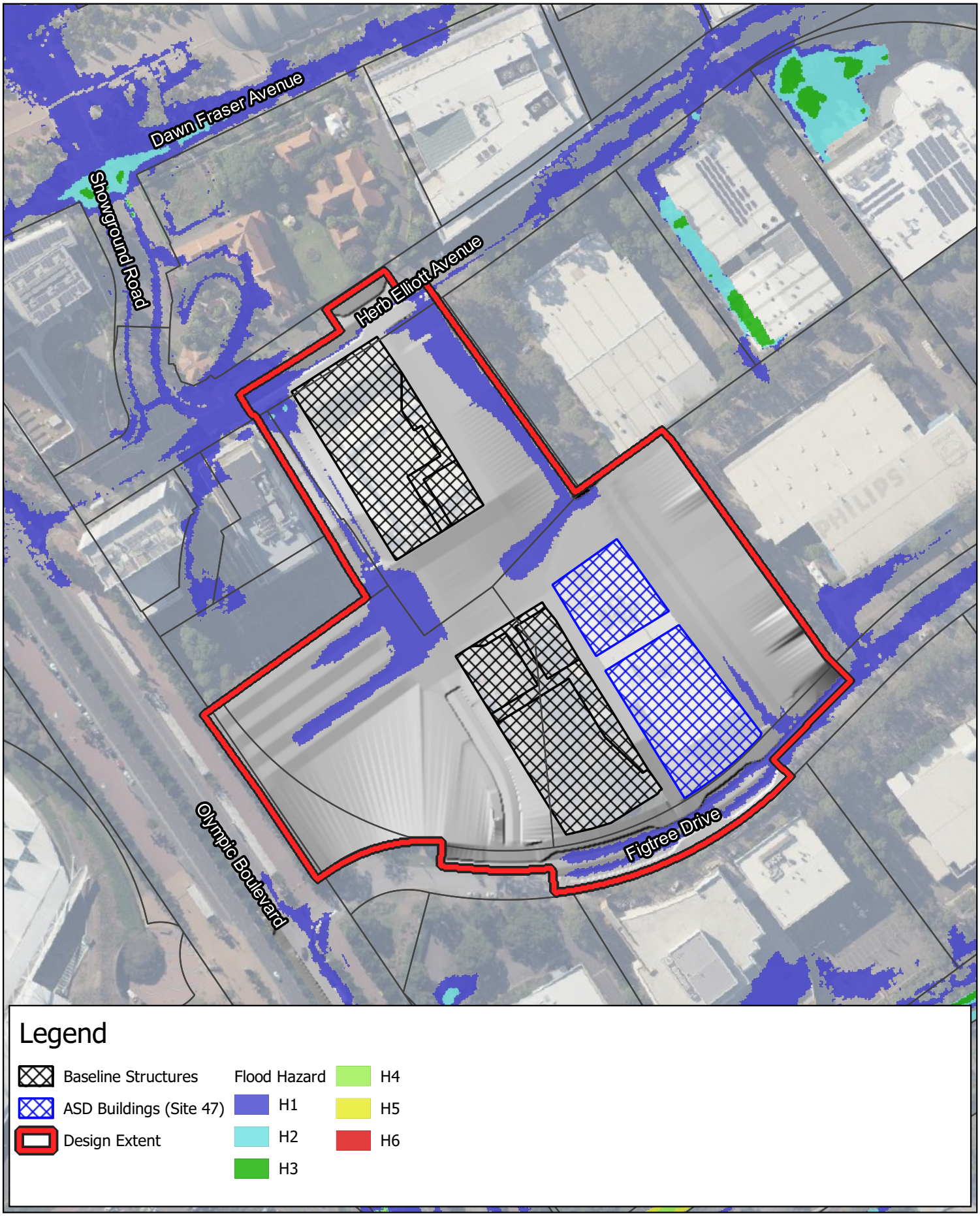

TITLE

Figure B-02
5% AEP Climate Change Developed Flood Hazard

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

Date	Drawn	Check	Approved	Scale	Rev
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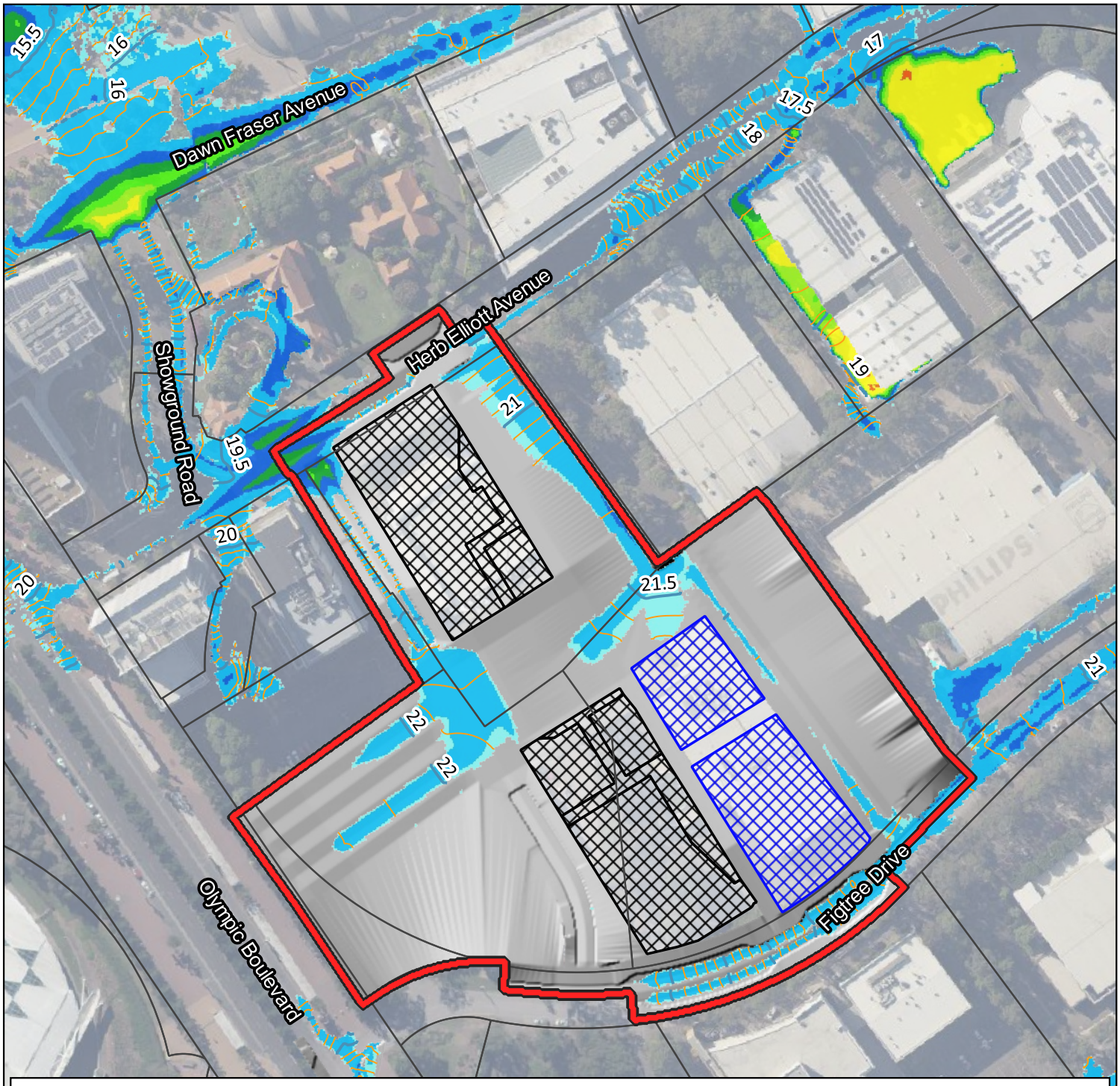

Legend

- Baseline Structures
- ASD Buildings (Site 47)
- Design Extent
- WSL Major Contours
- WSL Minor Contours

Flood Depth (m)

- <0.01
- 0.01 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.5
- 1.5 - 2
- >2

TITLE

Figure B-03
1% AEP Climate Change Developed Flood Depth

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

Date	Drawn	Check	Approved	Scale	Rev
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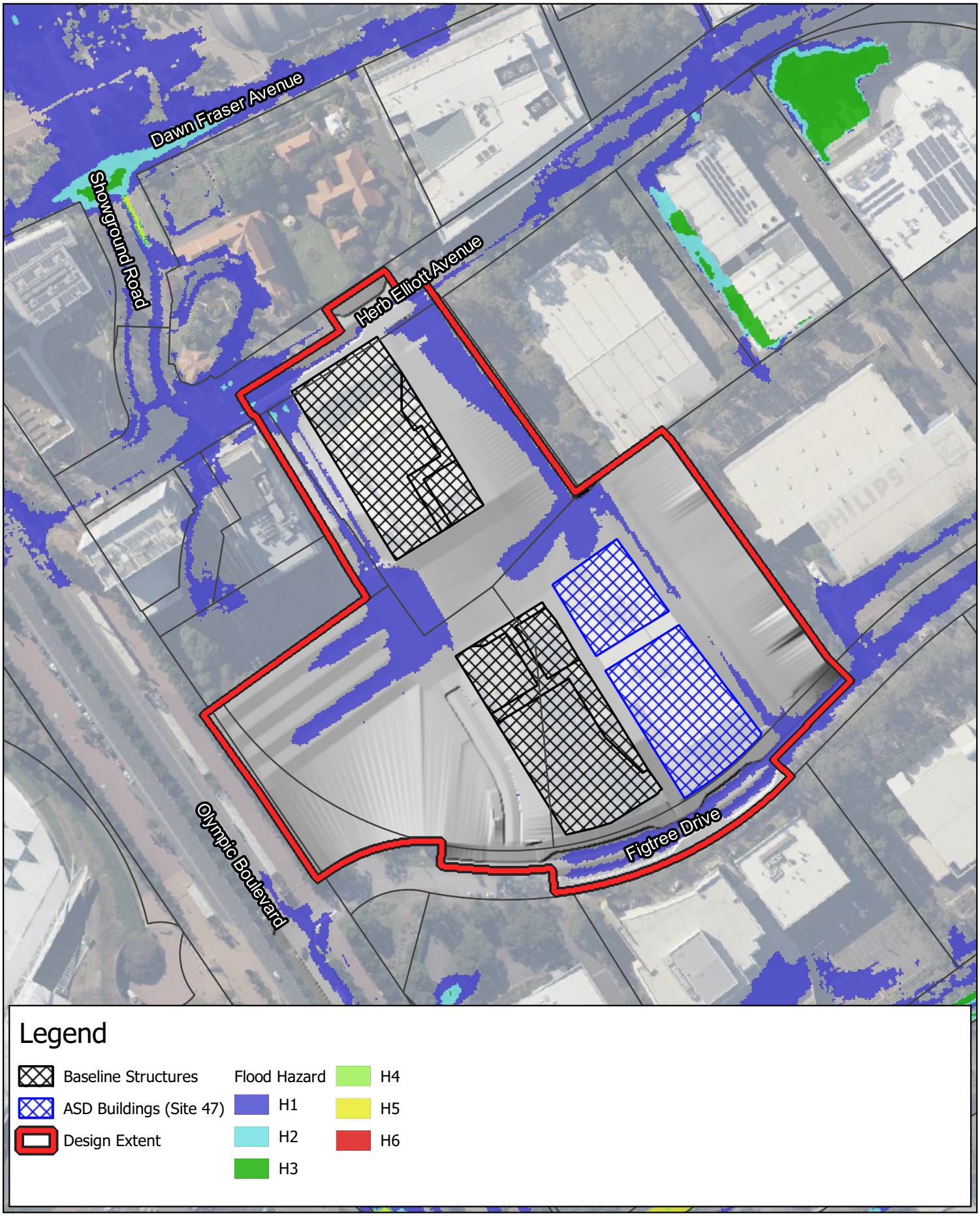

TITLE

Figure B-04
1% AEP Climate Change Developed Flood Hazard

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

Date	Drawn	Check	Approved	Scale	Rev
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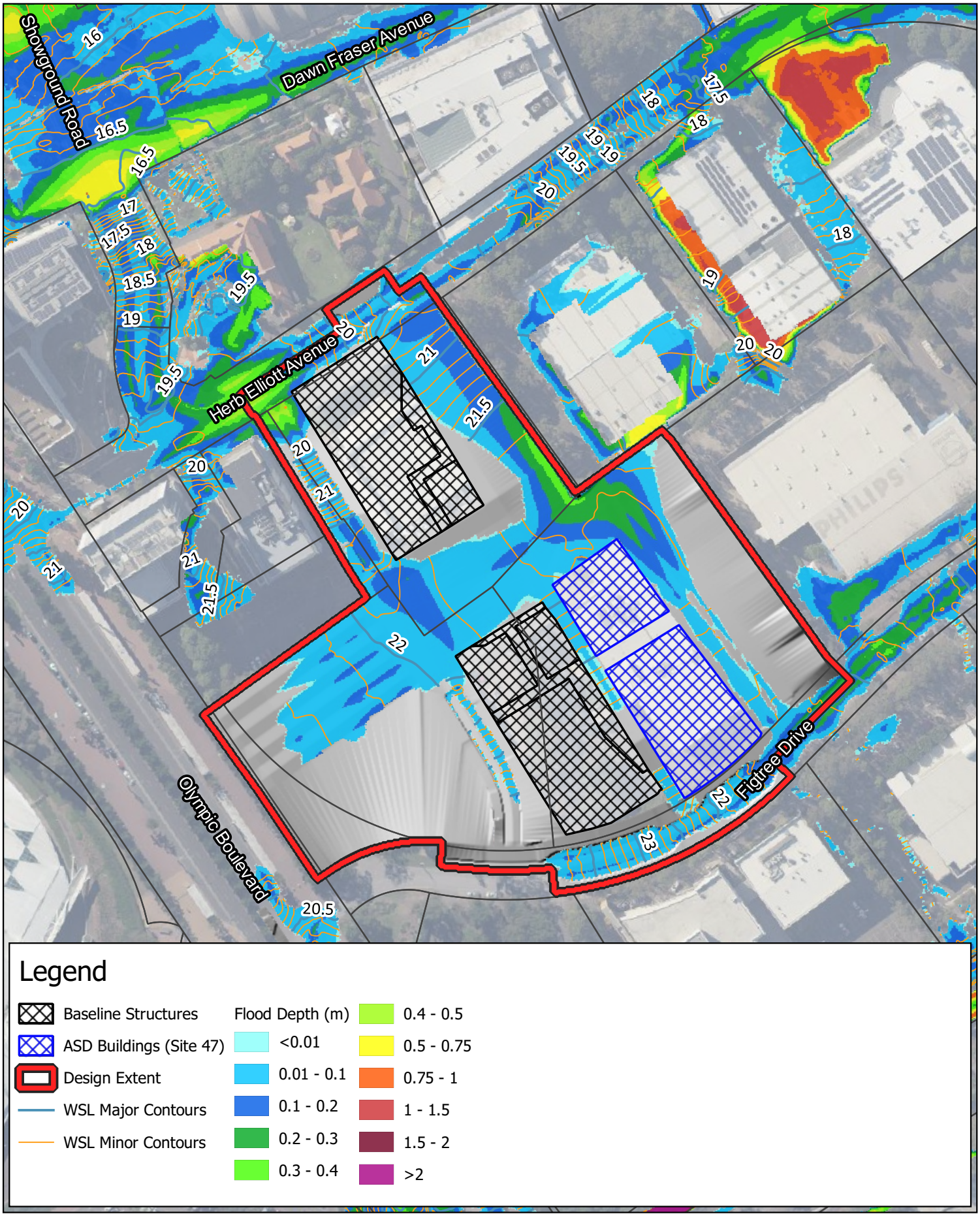

Legend

- Baseline Structures
- ASD Buildings (Site 47)
- Design Extent
- WSL Major Contours
- WSL Minor Contours

Flood Depth (m)

- <0.01
- 0.01 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.5
- 1.5 - 2
- >2

TITLE

Figure B-05
PMF Developed Flood Depth

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

Date	Drawn	Check	Approved	Scale	Rev
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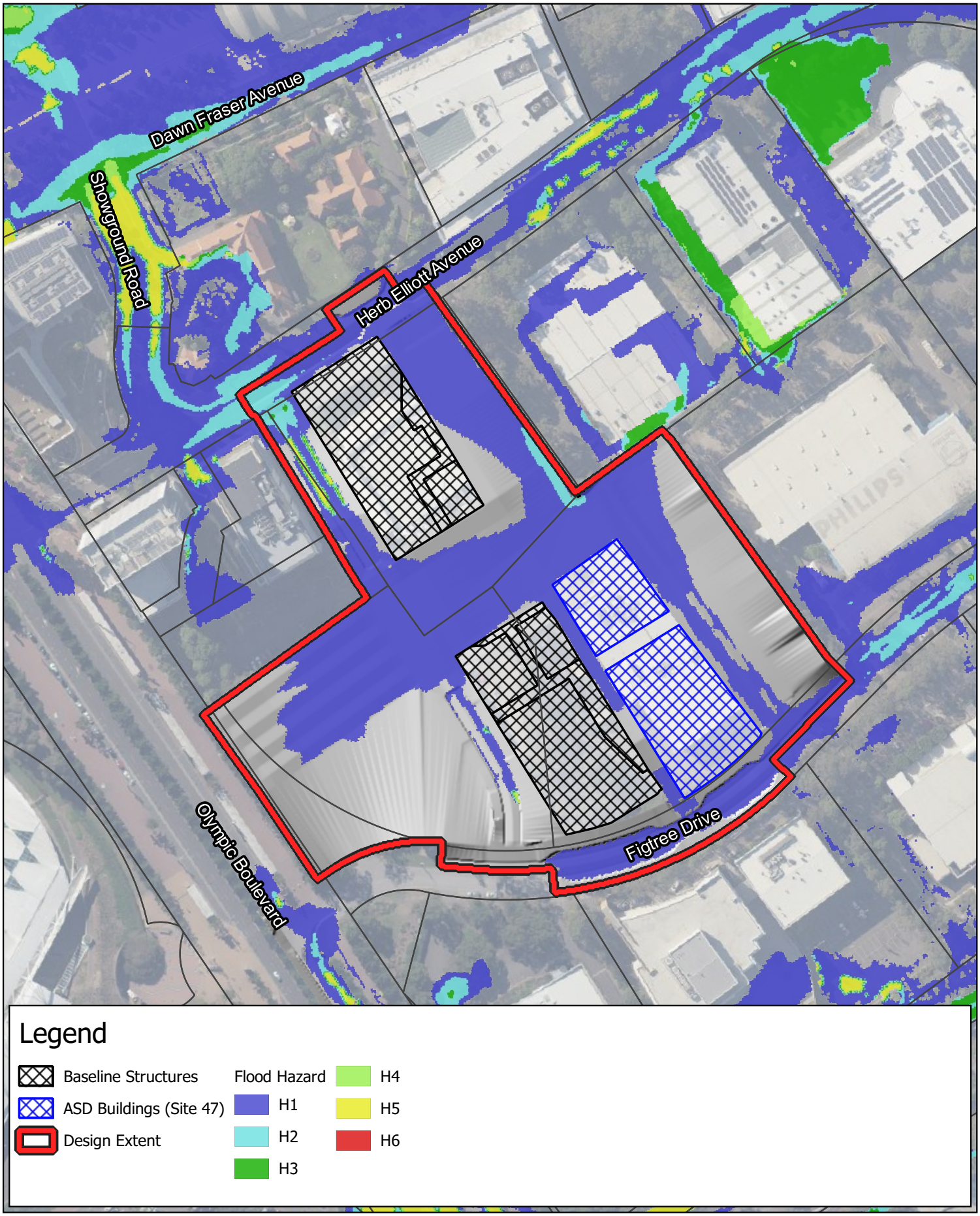

TITLE

Figure B-04
PMF Developed Flood Hazard

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

Date	Drawn	Check	Approved	Scale	Rev
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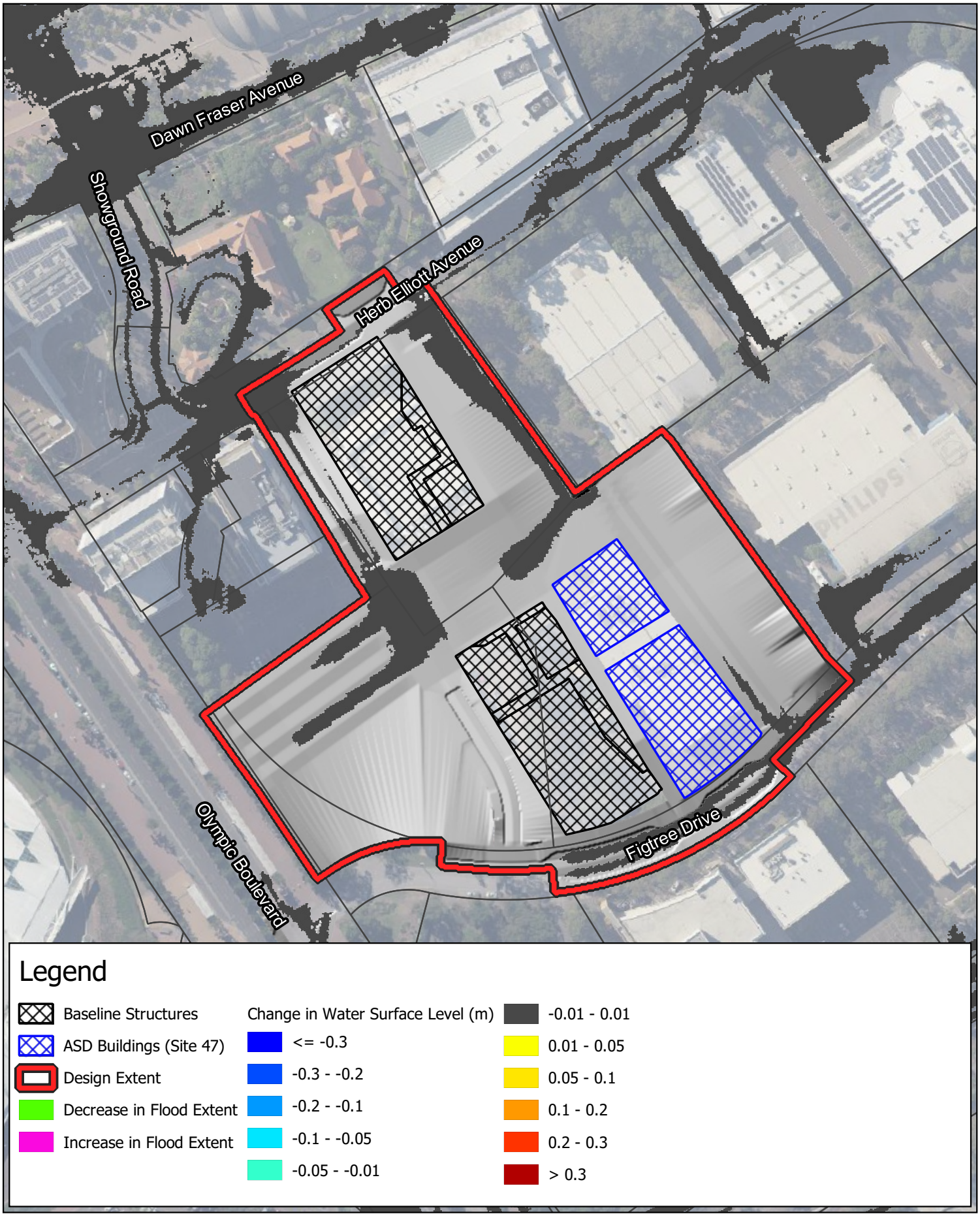
Appendix D Developed flood impacts



TITLE

Figure C-01
5% AEP Climate Change Developed Change in Water Level

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

Date	Drawn	Check	Approved	Scale	Rev
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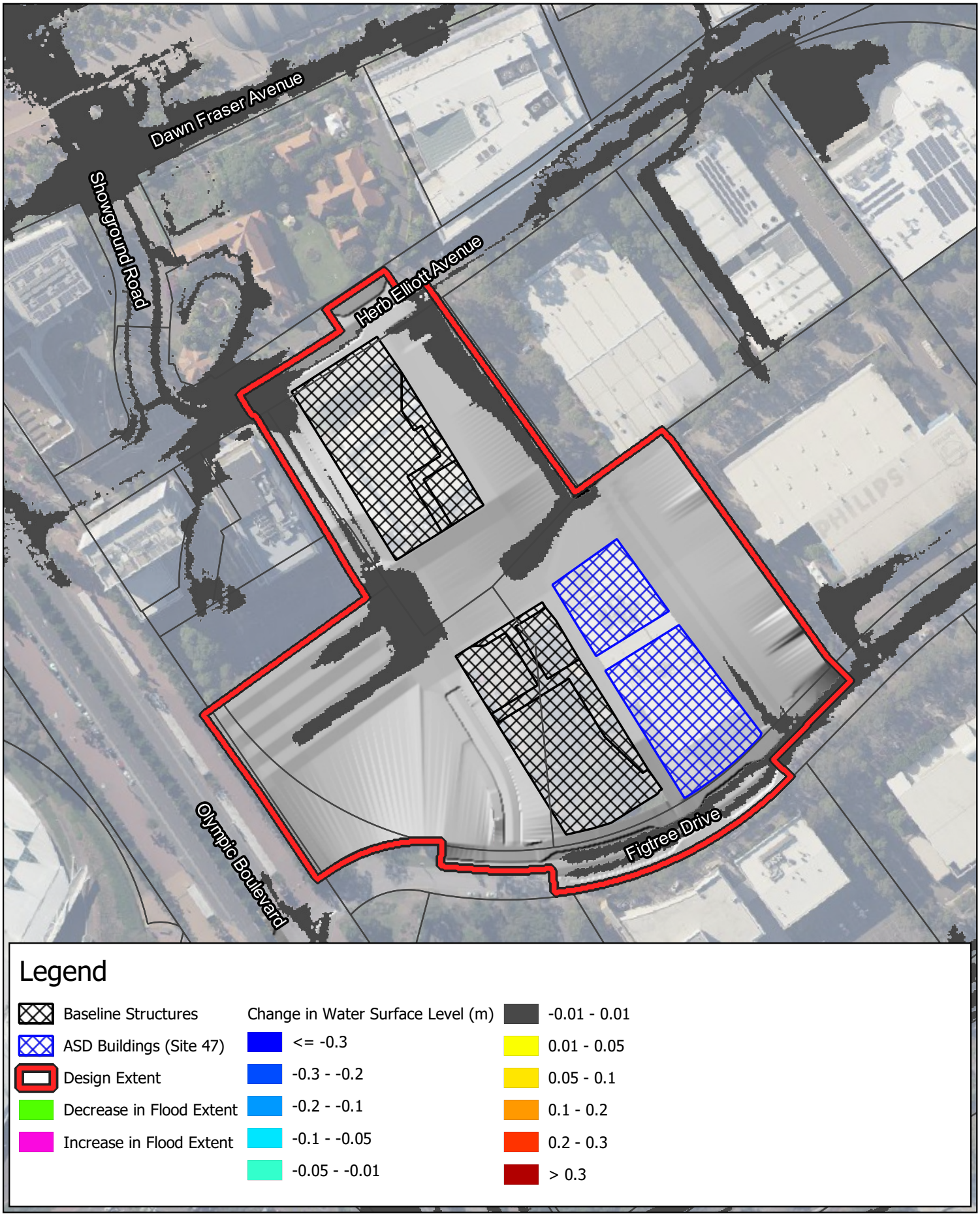

TITLE

Figure C-02
1% AEP Climate Change Developed Change in Water Level

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

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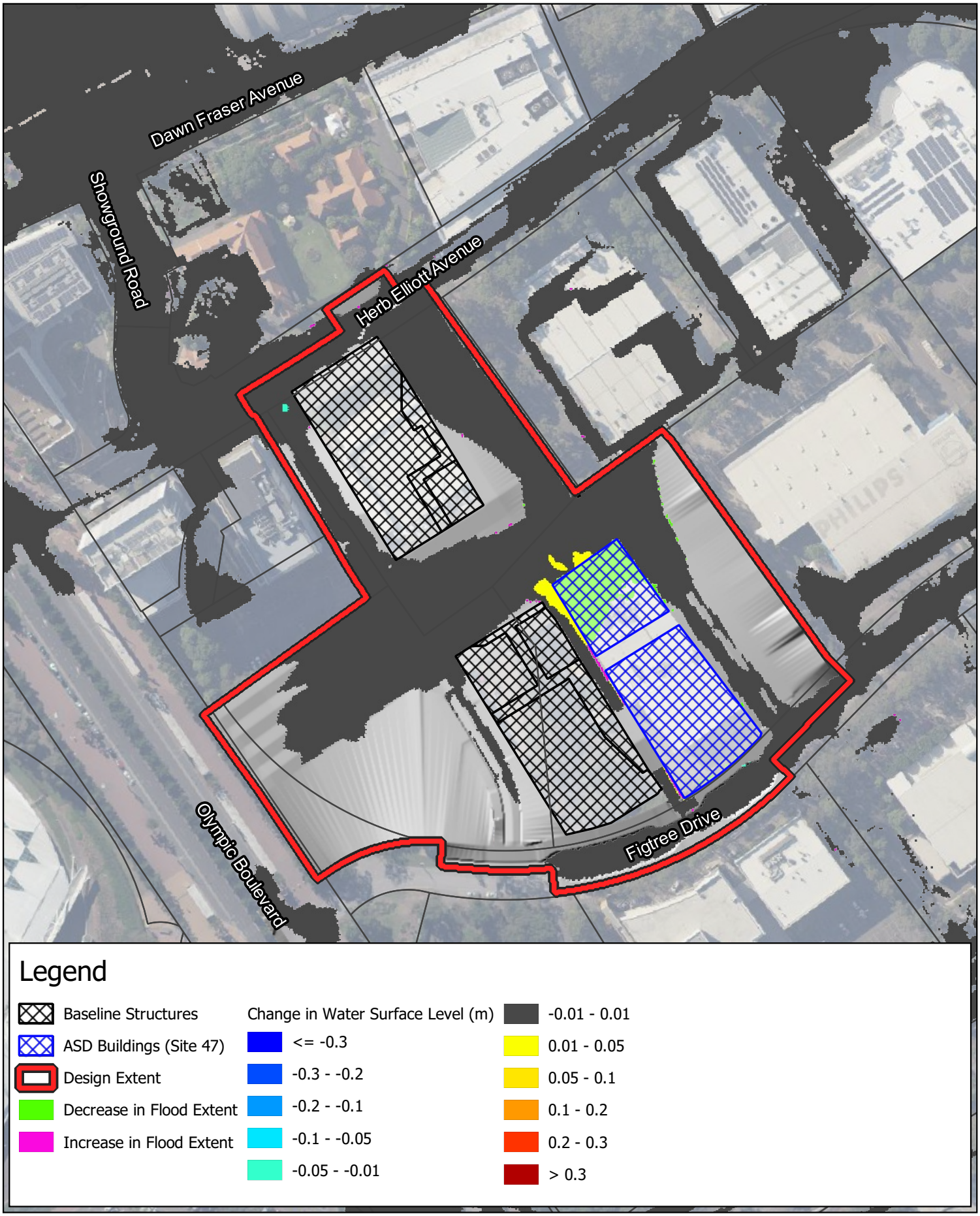

TITLE

Figure C-01
PMF Developed Change in Water Level

PROJECT

EDS - SWM - Sydney Olympic Park

0 50 100 m

NSW GOVERNMENT | sydney METRO

Date	Drawn	Check	Approved	Scale	Rev
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