Stadium Australia Redevelopment

Stormwater Management Plan

Infrastructure NSW

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1 Introduction

This report supports a State Significant Development (SSD) Development Application (DA) for the refurbishment of Stadium Australia, which is submitted to the Minister for Planning pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Infrastructure NSW is the proponent of the SSD DA.

1.1 Background

Stadium Australia opened in 1999 for the 2000 Sydney Olympic and Paralympic Games and is currently the second largest stadium in Australia. In March 2018, the NSW Premier announced plans to refurbish Stadium Australia to address deficiencies with the existing infrastructure and ensure that the stadium retains its status as a premier venue within a network of stadia and events infrastructure in NSW.

The NSW Stadia Strategy 2012 provides a vision for the future of stadia within NSW, prioritising investment to achieve the optimal mix of venues to meet community needs and to ensure a vibrant sports and event environment in NSW. A key action of the strategy includes developing Tier 1 stadia and their precincts covering transport, integrated ticketing, spectator experience, facilities for players, media, corporate and restaurant and entertainment provision. Stadium Australia is one of three Tier 1 stadia within NSW, the others being Sydney Football Stadium and the Sydney Cricket Ground.

In order to qualify for Tier 1 status, a stadium is required to include:

- seating capacity greater than 40,000;
- regularly host international sporting events;
- offer extensive corporate facilities, including suites, open-air corporate boxes and other function/dining facilities; and
- be the home ground for sporting teams playing in national competitions.

The refurbishment of Stadium Australia will address deficiencies in the existing infrastructure and improve facilities to be in line with contemporary Australian venue standards. The works ensure the stadium remains a modern, globally competitive venue that achieves the requirements for a Tier 1 stadium. The refurbishment of Stadium Australia addresses the following project objectives:

- transform the stadium into a ‘fan favourite’ destination for experiencing and enjoying sports and entertainment events;
- maximise the direct and indirect economic, social and cultural benefits to NSW from the project, including securing major, economically beneficial events within NSW to ensure the economic sustainability of the stadium into the future;
- deliver a multi-use contemporary rectangular venue that meets the needs of patrons, hirers and other users for rugby, football, concerts and other new forms of entertainment, and reaffirms the status of the stadium as Australia’s largest purpose-built rectangular venue in Australia;
- improve the facility’s sensitivity to the environmental conditions of the site by providing a roof which provides cover to 100% of seats (to the drip line);
- provide new and refurbished corporate areas, members areas and general admission areas to enhance the patron experience;
- promote universal accessibility, safety and security such that the stadium is welcoming, inclusive and safe for all stadium users, including persons requiring universal access;
- promote environmental sustainability and embrace a whole of life approach to operations and maintenance; and

- achieve a high standard of design and reinforce the Stadium's status and identity within the NSW stadia network, and more broadly, nationally and internationally.

1.2 Site Description

The site is located at 15 Edwin Flack Avenue within the Sydney Olympic Park. It is bound by Edwin Flack Avenue to the west, Dawn Fraser Avenue to the south, Olympic Boulevard to the east and Qudos Bank Arena to the north. The site is located within the City of Parramatta Local Government Area.

The site is legally described as Lot 4000 in DP 1004512 and part of Lot 4001 in DP 1004512. In 2017, the Minister for Sport assigned Venues NSW as the trustee of Stadium Australia under the Sporting Venues Authorities Act 2008.

In a broader context, the site forms part of Sydney Olympic Park complex which is a sporting and economic centre in metropolitan Sydney that covers 663 hectares. Sydney Olympic Park comprises a range of sports and entertainment venues, parklands, and commercial, retail and residential developments. It benefits from convenient access to Homebush Bay Drive, Parramatta Road and the M4 Western Motorway, as well as Olympic Park railway station. The Parramatta Light Rail Stage 2 and Sydney Metro West will also significantly increase accessibility.

The locational context of the Site is shown in Figure 1, whilst the site boundaries and existing site features are shown in Figure 2.

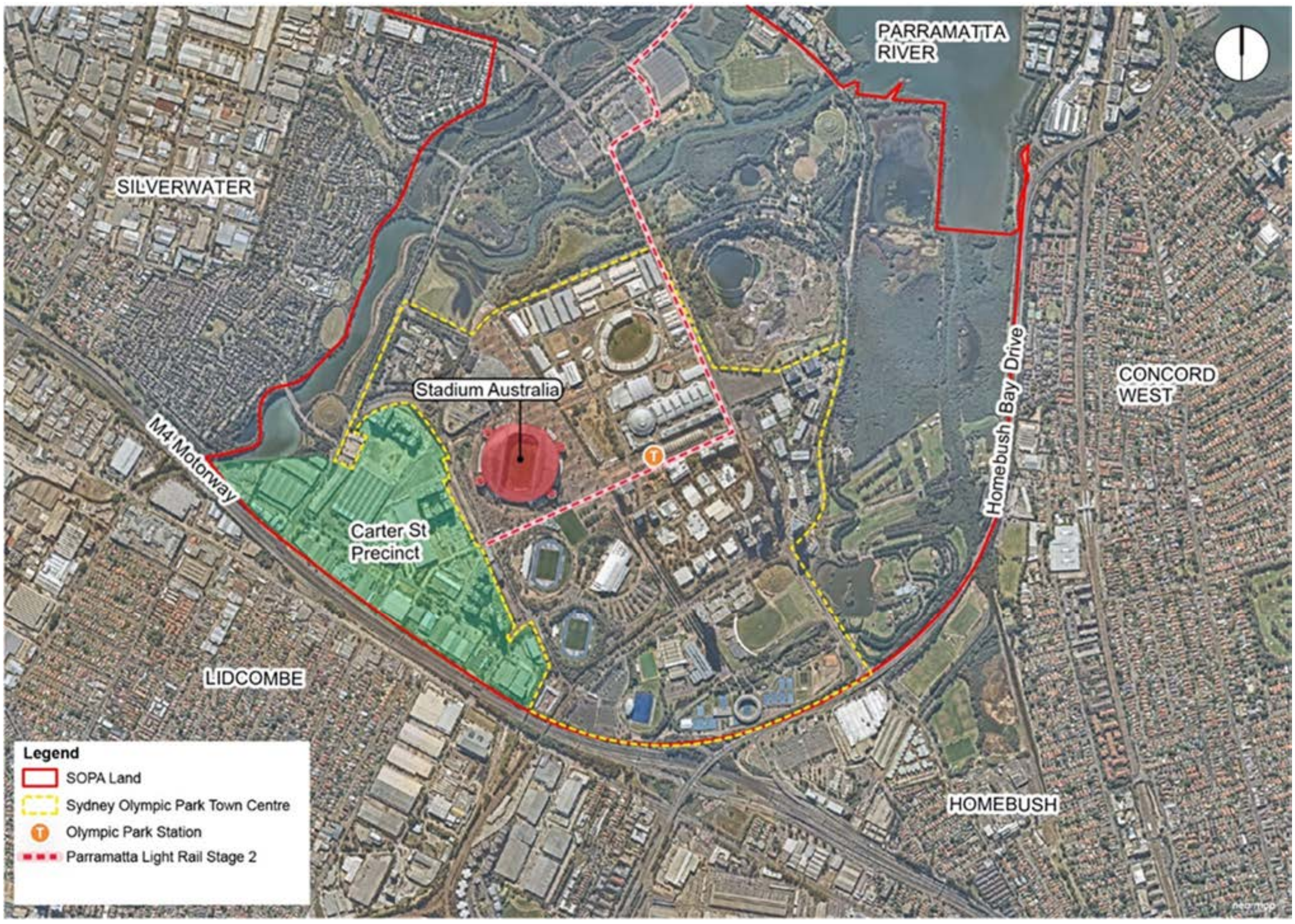

Figure 1 Regional Site Context

Figure 2 Site Area and Local Context (Boundary to be Confirmed)

1.3 Overview of Proposed Development

In March 2018 the NSW Government announced its commitment to refurbish the existing Stadium Australia and retain its status as a premier venue within a network of stadia and events infrastructure in NSW. This comprises the following:

- Reconfiguring the field of play to a permanent rectangular configuration.
- Redeveloping the lower and middle seating bowl to locate seating closer to the field and increase the pitch (steepness) of the seating bowl, which has the effect of reducing the capacity to approximately 70,000 seats (plus up to 20,000 persons on the field during concerts).
- Providing 100% drip-line roof coverage to all permanent seats by replacing the northern and southern sections of the roof and extending the existing eastern and western sections of the roof.
- Providing a new northern and southern public stadium entrance, including a new stadium facade and double-height concourse
- Renewing the food and beverage concessions, bathrooms, team facilities including new gender neutral changerooms, members and corporate facilities, press and broadcast facilities, and back of house areas.
- Providing new signage, high-definition video replay screens, LED lighting, and other functional improvements.
- Retaining the public domain areas surrounding the stadium that deliver a range of publicly accessible, event and operational areas, with minor works for tree removal.

Part of the existing stadium forecourt will be used as a construction compound during the construction phase and reinstated following the completion of works and prior to commencement of stadium operations.

Figure 3 Indicative Photomontage of Proposed Stadium

1.4 Secretary's Environmental Assessment Requirements

The Department of Planning, Industry and Environment (DPIE) has issued Secretary's Environmental Assessment Requirements (SEARs) to the applicant for the preparation of an Environmental Impact Statement for the proposed development. This report has been prepared having regard to the relevant SEARs as follows:

SEARs	Comment/Reference
Key Issues Address the relevant provisions, goals and objectives in the following: ■ Sydney Olympic Park Stormwater and Water Sensitive Urban Design Policy 2016	Refer to Section 2.2.3 and 2.2.4
14. Water and Drainage The EIS shall identify: ■ any water licensing requirements or other approvals required under the Water Act 1912 or Water Management Act 2000	The development not located within 40m of creek, river, lake or estuary. No water licensing requirements or other approvals are required under the *Water Act 1912* or *Water Management Act 2000*.
■ any geotechnical issues (including contamination and acid sulphate soils) associated with the construction of the development	Refer to section 2.1.3 regarding soil/groundwater aggressivity. Also Refer to Geotechnical Report and Preliminary Site Investigation both prepared by WSP.
■ detail drainage associated with the proposed works, including stormwater and drainage infrastructure	Refer to section 3.1.
■ detail measures to minimise operational water quality impacts on surface waters and groundwater	Refer to section 3.2.

SEARs	Comment/Reference
■ detail how drainage associated with the proposed works, including stormwater and drainage infrastructure will be managed to ensure the run-off levels for the stadium remain at existing levels and water quality either remains as existing or improves upon the existing.	Refer to section 3.
18. Sediment, Erosion and Dust Controls ■ The EIS shall identify measures and procedures to minimise and manage the generation and off-site transmission of sediment, dust and particles.	Sediment and erosion control measures are detailed in section 4. Refer to Air Quality report prepared by Wilkinson Murray regarding dust.

Table 1 SEARs Reference

2 Existing Site Condition

2.1 Geotechnical

2.1.1 Groundwater

Previous investigations of site groundwater had been undertaken from 1990 to 1996 prior to the stadium construction and groundwater levels had been provided by Coffey in the Geotechnical Investigation Report (Ref. S10530/1-AR) dated April 1996. Based on the previous groundwater levels provided by Coffey, a desktop mapping analysis has been performed to understand the existing groundwater levels within the site, see Figure 5 below.

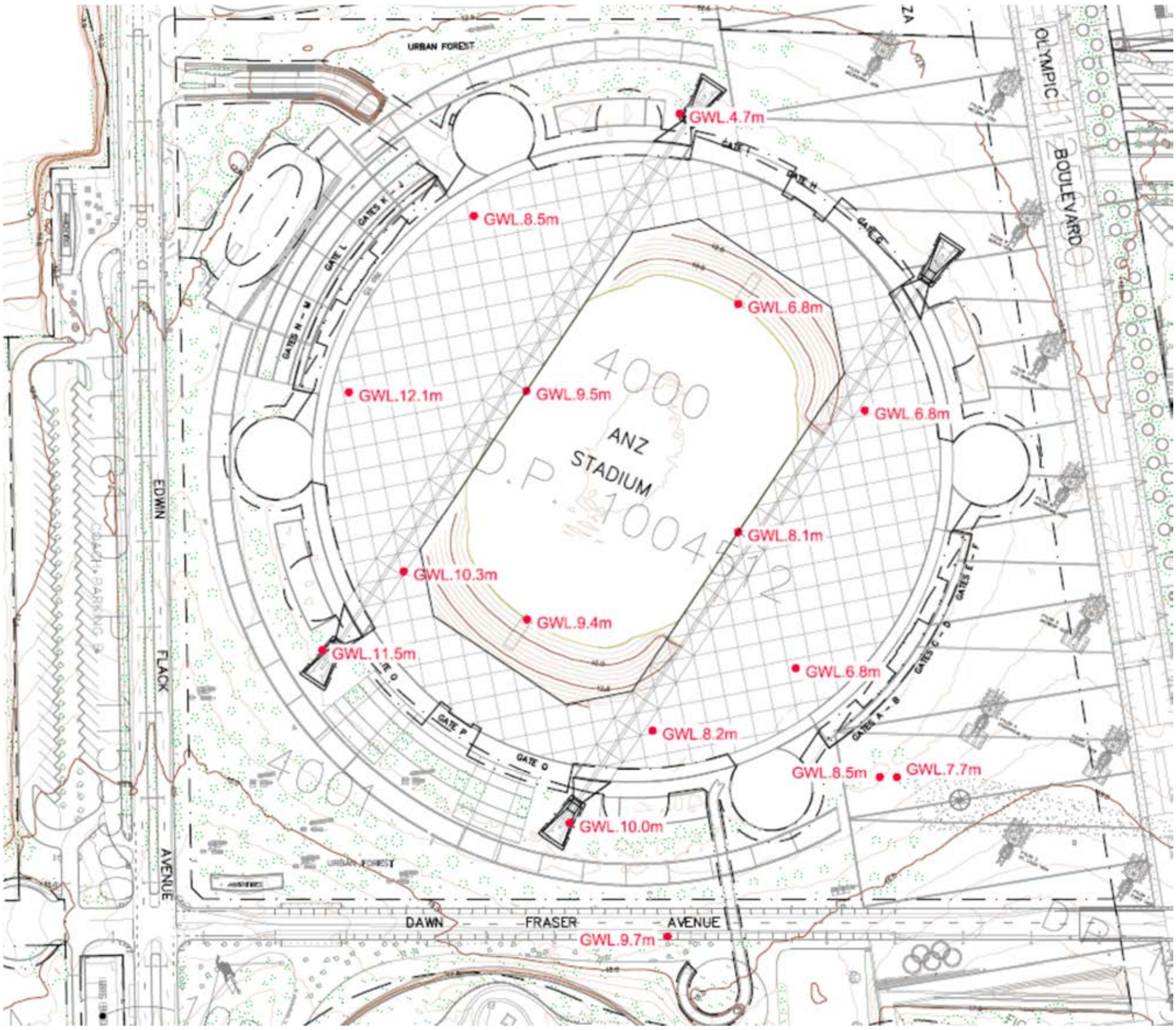

Figure 4 Groundwater Level Mapping Source: Coffey Geotechnical Investigation S10530/03-AB 1996 RL = AHD

The site investigation reports have indicated that the presence of isolated perched groundwater will be encountered in the overburden clays and fills, particularly in the lower, wetter portions of the site. It is likely that during the redevelopment, should overburden clays be removed, groundwater seepage out of the shale strata can be expected. Some seepage from the semi-confined aquifer could be anticipated. Control of groundwater in excavations may be satisfactorily maintained using sump pumps.

2.1.2 Artesian Flow Directions

Previous groundwater investigations and monitoring from bore hole data appear to vary with climate influences and groundwork activity (source: Coffey GI S10530/1-AF). The artesian flow direction flows from the south to the north generally in parallel with the current stadium orientation.

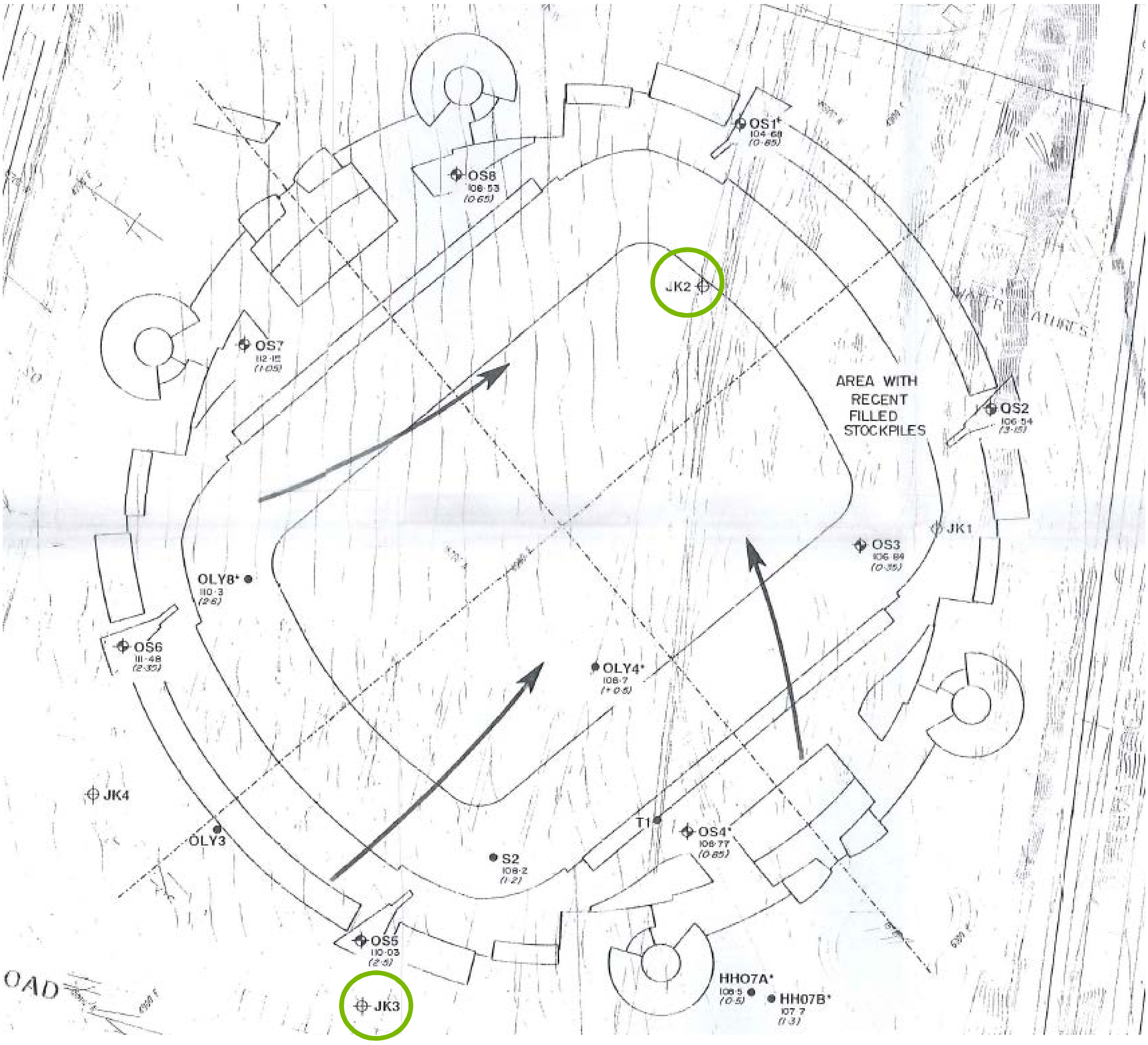

Figure 5 Artesian Flow Direction Source: Coffey Geotechnical Investigation S10530/03-AB 1996

2.1.3 Soil/Groundwater Aggressivity

Limited chemical testing information is available for the stadium site. J&K Geotechnical analysed soil samples from boreholes JK2 and JK3 for pH and sulphate content. The soils contained levels of 17.9mg/kg sulphate and a pH = 7.8 (JK3 0.8 to 1.0m) and 52.5mg/kg sulphate and pH 8.2 (JK2 0.8 to 1.0m). These results indicate that soil is slightly to moderately alkaline with a low risk of sulphate attack (source S10530/1-AF 1996). Refer to figure 6 for the JK borehole locations.

Groundwater samples obtained by Coffey Geotechnical from the neighbouring Aquatic Centre site gave the following concentrations.

Water Test	Range
pH	8.3 to 8.5
Electrical Conductivity	12500 to 13000 µSc/m
Dissolved CO_2	4 to 6 mg/L

Table 2 Past Water Test Result – Aquatic Centre

These concentrations were analysed by consulting analytical chemists and groundwater was considered to have minimal aggressivity towards concrete yet high conductivity (assess to be elevated chloride levels). For these sulphate levels AS3600 exposure classification B1 requires 40mm cover (32MPa concrete) and for saline soils 50mm cover with an additional 20mm for on-ground members.
At the bottom you say more tests are needed, so rather not specify a cover thickness. It should be noted that testing of groundwater by others at the Aquatic Centre have found elevated levels of sulphate (i.e. 1000 to 2100mg/L SO_4) which could be attributed to local leachate from landfills. These high levels pose a considerable risk to concrete from sulphate attack (source S10530/1-AF 1996).

Given the variability of soil and groundwater salinity and sulphate levels in the ground at Sydney Olympic Park area, it is recommended that further work be carried out in the stadium site to address aggressivity risks to future buried structural elements.

2.2 Existing Stadium Drainage

2.2.1 Existing Stadium Roof Discharge

The existing stadium roof consist of four individual fixed domed roofs. The two bigger roofs are fitted with siphonic inlets on a grid patter with syphonic discharge to break-pits and four rainwater tanks located under each spiral staircase.

The two smaller side roofs (short end) use box gutters on the outer edge with 2no x 3 x ø100mm downpipes each discharging to the site stormwater reticulation directly. It is reasonably assumed that this system is siphonic also.

Rainfall peak runoff flows were calculated in accordance with AS3500.3 (2018) for the 100-year ARI, 5-minute rainfall intensity. Q100 = 236 L/s for each roof. (Q20=184, Q500=354 L/s)). If the current system operates as intended; at peak design flow each downpipe will discharge 118L/s to the existing inground stormwater reticulation.

2.2.2 Existing Stadium Inground Drainage Network

The existing stadium internal drainage is designed as a gravity ring system on different levels and discharging to downstream through a rising main via a pumping system. There is also an existing weir system to divert the captured roof water through the stormwater line under the pitch, see Figure 9.9 for details.

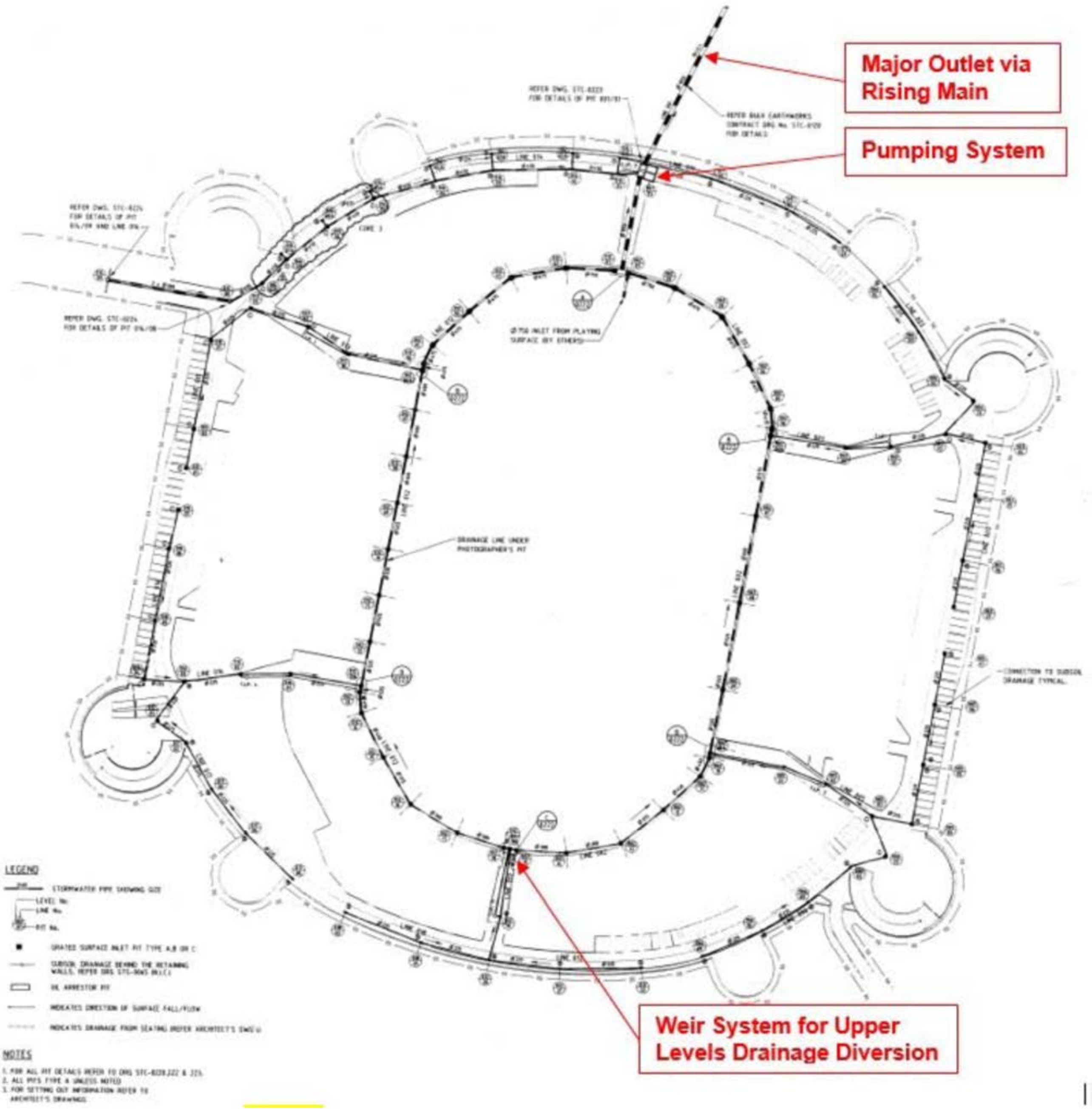

Figure 6 Existing Internal Stormwater Drainage Layout Plan

The external stormwater drainage is also designed as a gravity collector pipe grid discharging to an outer outfall ring drain and major outlet is discharging towards the northeast to the stadium with connections for the branch drainage outside the stadium.

The capacity of the existing stormwater network is deemed sufficient for an 20-yeat ARI storm event.

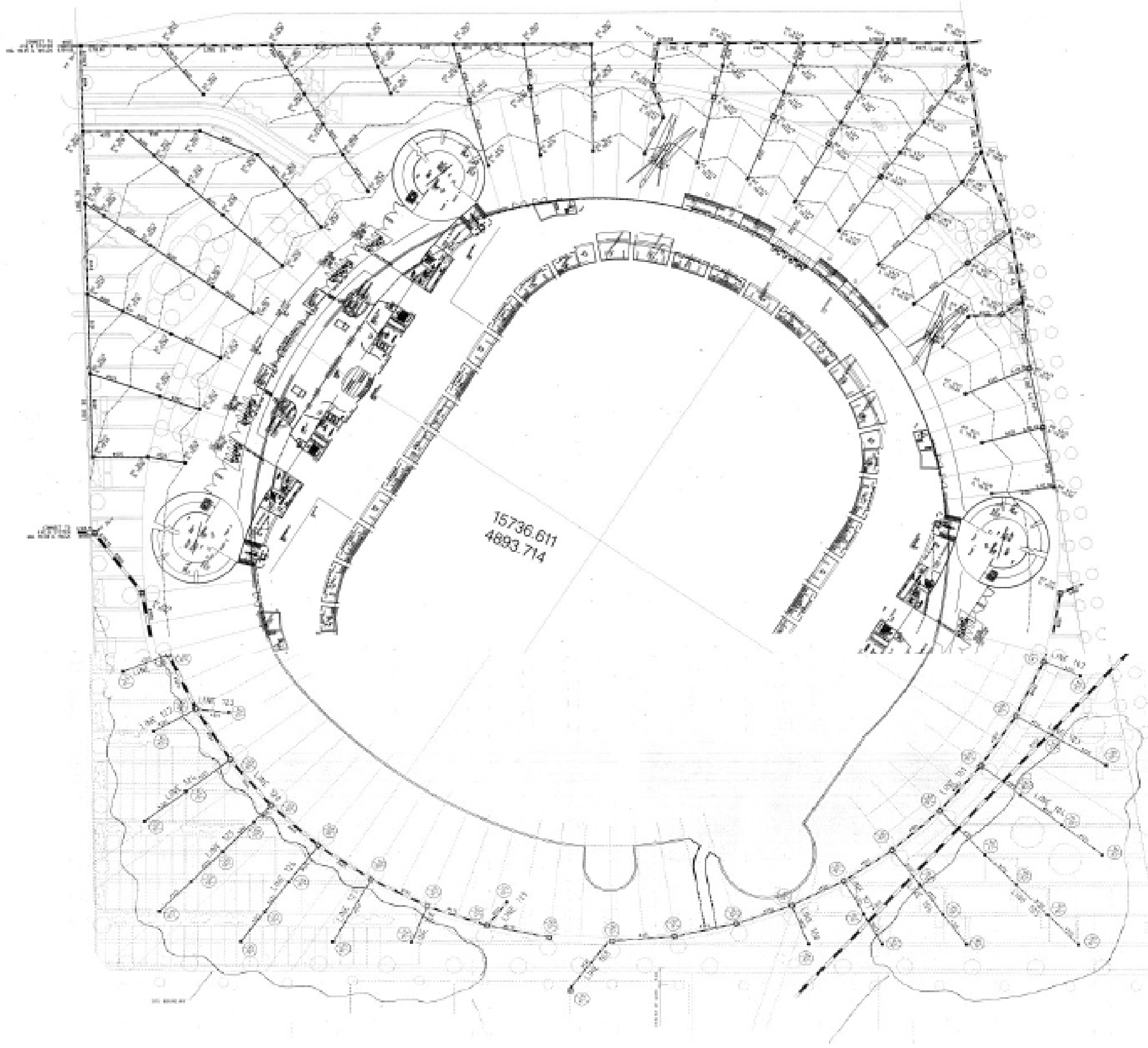

Figure 7 Existing External Stormwater Drainage Layout Plan

2.2.3 Existing Water Quality Treatment Policy

The Sydney Olympic Park has a large wastewater recycling system comprising of a dual water reticulation network made up of separate potable water, reclaimed water mains and stormwater. The SOPA policy for stormwater management and water sensitive urban design sets out strict guidelines for development design, planning and construction. The authority is committed to best practice in holistic stormwater management, with emphasis on mitigating the detrimental local and downstream impacts on the environment from poor quality and/or excessive volume of stormwater discharging from sites.

The Authority's **policy aims** to achieve this by:

- Promoting appropriate water sensitive urban design in development;
- Optimising local harvesting and on-site utilisation of stormwater;
- • Requiring proper management of stormwater from construction sites;
- • Requiring appropriate management of discharge of stormwater from and within development sites post-construction.

Policy Position

Development within Sydney Olympic Park must:

- • Comply with best practice water sensitive urban design practices;

- • Comply with best practice stormwater quality and quantity targets;
- • Manage stormwater from construction sites to best practice standards;

For further policy requirements, refer to the SPOA Policy POL13/4 2016.

2.2.4 Existing Water Quality Treatment Train

Following a desktop study of the available information attained to date, the stadium site does not have any WSUD or SQID devices within the stadium precinct. Apart from the rainwater storage and re-use tanks there does not appear to be any treatment of the stormwater run-off leaving the site until such time it enters an existing gross pollutant trap (GPT) along Edwin Flack Avenue prior to entering into the wetland adjacent to the same road.

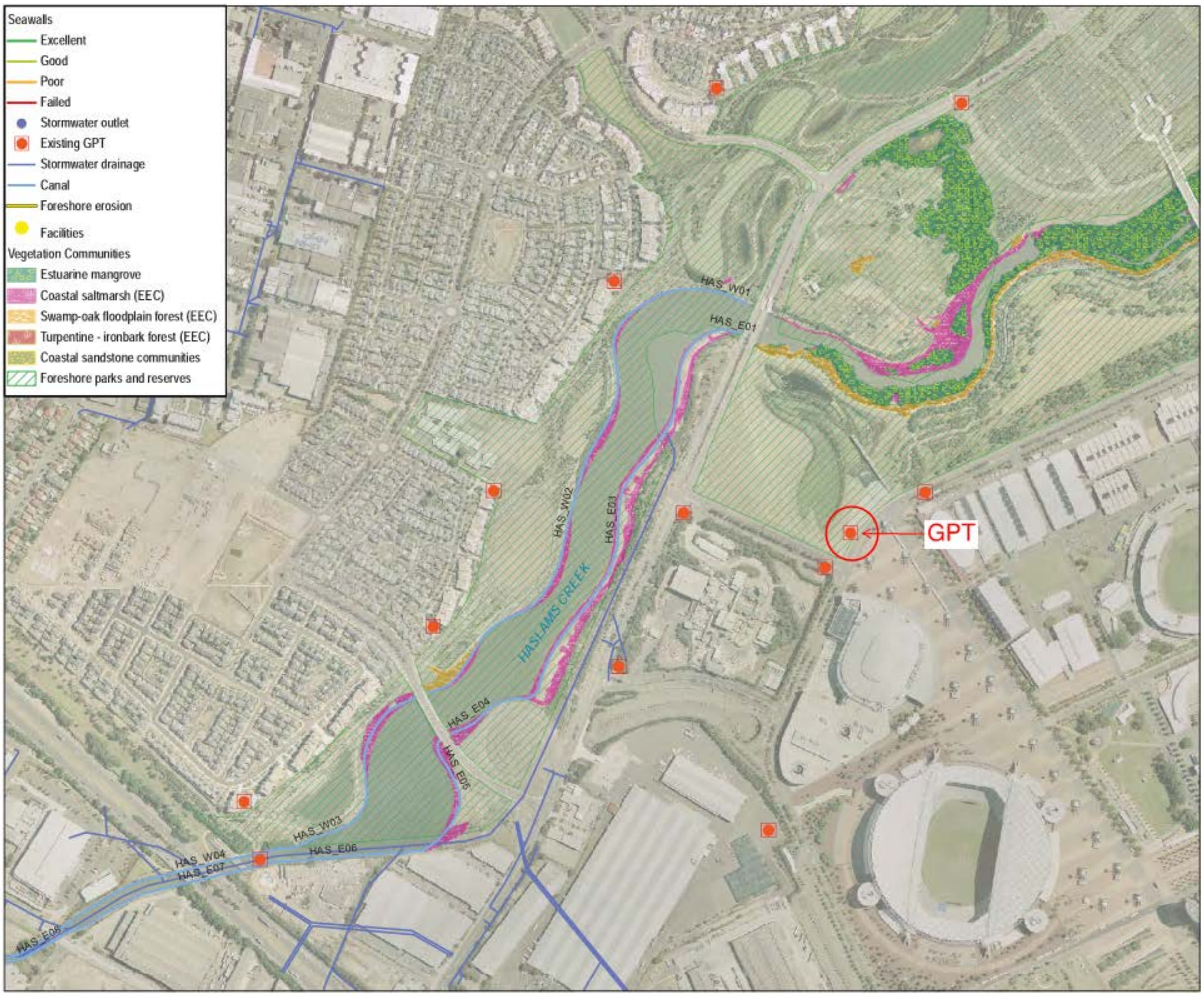

Figure 8 Existing Stormwater Run-Off Treatment Train

The stormwater run-off leaving the stadium enters a non-typical treatment train. The stadium catchment and other upstream catchments predominately enter the large diameter stormwater drain running down Olympic Boulevard. The flow from this large diameter pipe then passes through an in-line GPT prior to discharging into the wetland adjacent to Edwin Flack Avenue.

When taken in isolation and disregarding catchments other than that of the stadium, the water quality treatment achieved is shown on table 4.

Pollutant	Performance Target Reduction Loads	Existing Achieved Target Reduction Loads	Compliance with SOPA SWMP Policy
Gross Pollutants (GP)	95% reduction in the mean annual load of gross pollutants	100%	Compliant
Total Suspended Solids (TSS)	85% reduction in the mean annual load of Total Suspended Solids	95.4%	Compliant
Total Phosphorus (TP)	65% reduction in the mean annual load of Total Phosphorus	79.5%	Compliant
Total Nitrogen (TN)	45% reduction in the mean annual load of Total Nitrogen	58.7%	Compliant
Hydrocarbons	90% reduction in the mean annual load of hydrocarbons	Deemed Compliant	Compliant

Table 3 Stormwater Quality Treatment for Existing Development (Inclusive of Wetland)

Pollutant	Performance Target Reduction Loads	Existing Achieved Target Reduction Loads	Compliance with SOPA SWMP Policy
Gross Pollutants (GP)	95% reduction in the mean annual load of gross pollutants	94.4%	Non-Compliant
Total Suspended Solids (TSS)	85% reduction in the mean annual load of Total Suspended Solids	52.8%	Non-Compliant
Total Phosphorus (TP)	65% reduction in the mean annual load of Total Phosphorus	25.1%	Non-Compliant
Total Nitrogen (TN)	45% reduction in the mean annual load of Total Nitrogen	13.1%	Non-Compliant
Hydrocarbons	90% reduction in the mean annual load of hydrocarbons	Unknown	Non-Compliant

Table 4 Stormwater Quality Treatment for Existing Development (Prior to Entering the Wetland)

It's evident that the wetland is a key node for the treatment train effectiveness to reduce pollutants and improvement of the discharged water quality.

The current system does not specifically target the removal of hydrocarbons at the source and although a GPT with an oil baffle can retain some free oils it is limited in its capacity. Wetlands are a natural purification system and has been shown to be very good at treating wastewater with hydrocarbons and other compounds.

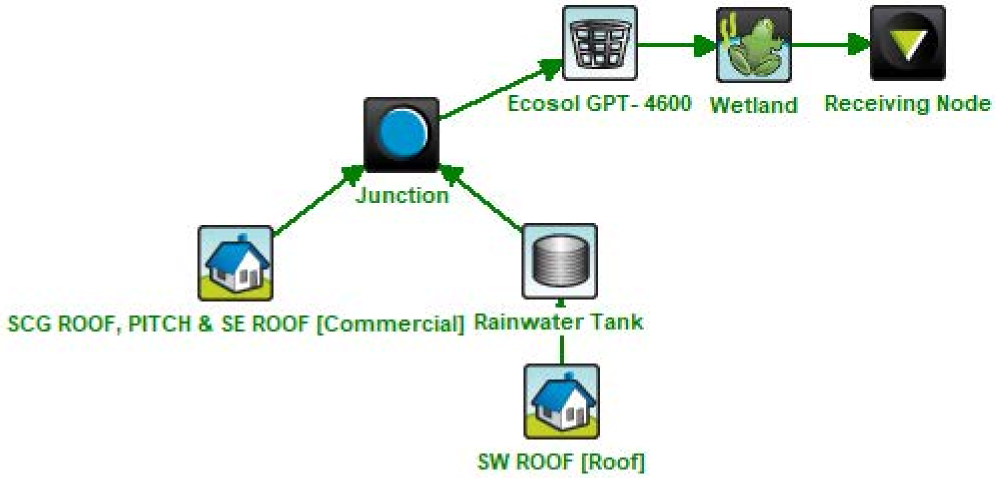

Figure 9 Existing MUSIC Treatment Train

3 Post-Development Site Condition

3.1 Post-Redevelopment Stadium Drainage

The proposed redevelopment does not increase in plan area and hence the overall stadium catchment does not change. The proposed modification of the north/south stands and roof structures has a zero-net gain in catchment. However, the proposed increased coverage of the northern and southern roofs will impact the existing roof hydraulics and the ground level stormwater drainage systems.

Figure 11 shows the possible augmentation of the stadium's stormwater drainage under the northern and southern stands where it is envisaged that the existing under-stand drainage system will be removed and replaces with a new in-ground network in front of seating to drain runoff from the stands and playing field.

The increase of roof area will result in amplified discharge from the modified roof and reduced run-off from the ground surface (pitch level) catchment. Existing ø375mm stormwater pipes at roof drainage discharge points will been upgraded to ø450mm RCPs to accommodate peak flows.

On-site detention will no longer be provided under the stands for major storm event but would rather temporary overflow on to the field before draining out. One consideration for the detailed design of the augmented drainage is to oversize the inground stormwater pipework to allow for additional storage en lieu of dedicated on-site detention (OSD) structures.

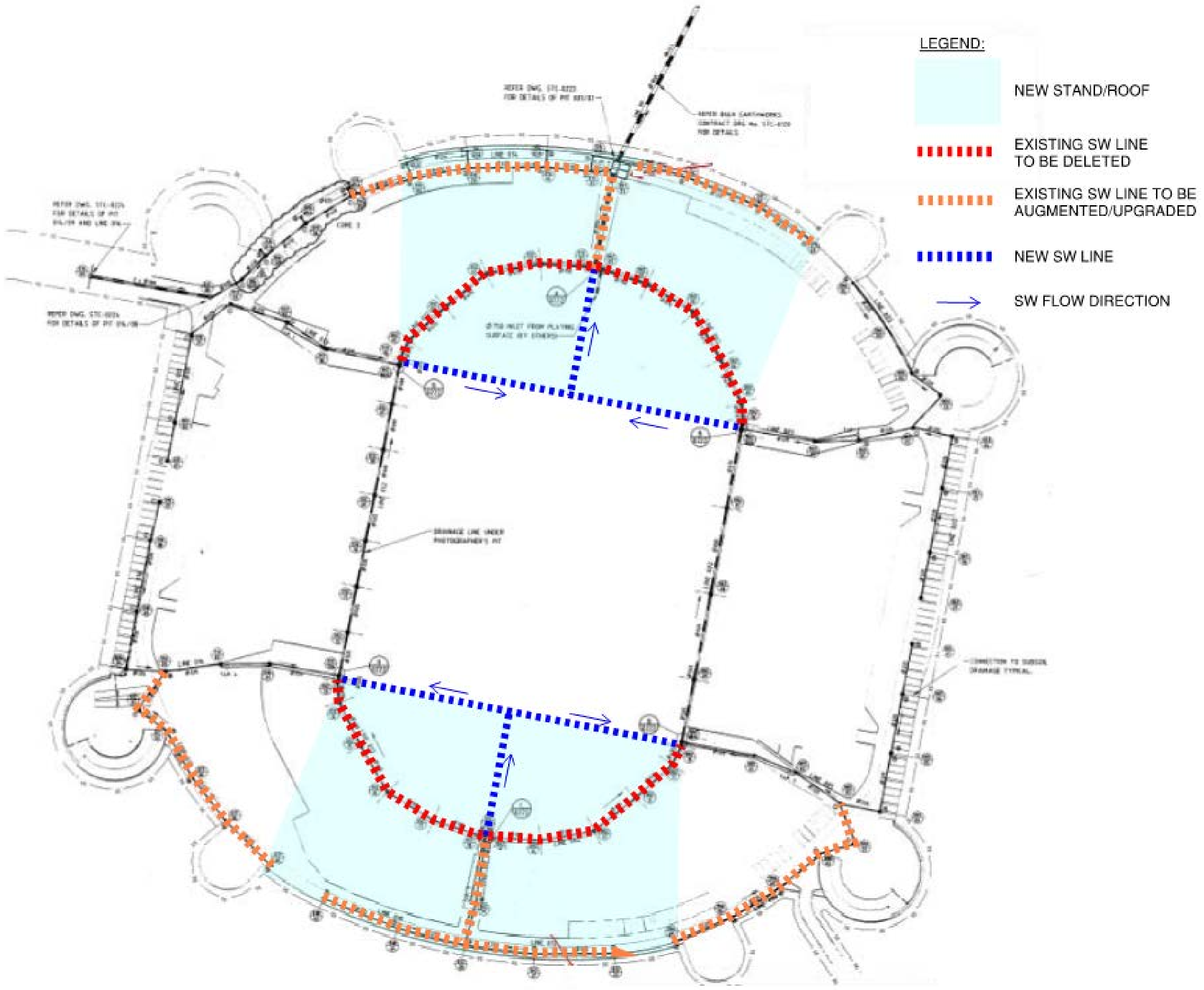

Figure 10 Proposed Post-Development Stadium Drainage Layout

3.2 Operational Water Quality Impacts on Surface & Groundwater

Post-development stormwater runoff's water quality of surface and groundwater is not anticipated to change from existing levels as there is zero-net gain in overall catchment size and stadium footprint is unaffected. Permeable and impermeable areas also remain largely as is.

There is no proposed works to the exterior of the stadium superstructure, hence no change to the existing pavement and run-off coefficients for stormwater.

Existing sub-soil drainage network and drainage points will be maintained with expected localised amendments required to suit the new northern and southern stands works.

Proposed changes to the in-ground stormwater drainage system is shown by figure 11 and discussed in section 3.1 above.

3.3 Roof Discharge Changes

As addressed previously in this report, the increased roof coverage will generate additional run-off from the structure. The rate of discharge will be managed by modifying the hydraulic conveyance infrastructure such as gutters and downpipes.

Figure 11 Proposed Post-Development Stadium Roof Profile (Source: COX Architects)

This infrastructure is likely to be siphonic and will collect rain in box gutters located between the roof arches. The existing downpipes do not have enough capacity to accommodate the proposed larger roof area and the downpipes will need to be upgraded (enlarged or more added). Roof drainage system will be design for the worst case 100-year ARI storm event in accordance with AS3500.3.

The new siphonic drainage will discharge at ground level and enter the underground pipe system from where it joins the stormwater network

4 Erosion and Sediment Control

The site is bordered by Qudos Bank Arena to the North, the Olympic Boulevard to the West, the Dawn Fraser Avenue to the South and Edwin Flank Avenue to the East. The site gently slopes from Dawn Fraser Avenue (15m AHD) in the general direction of the Qudos Bank Arena onto Olympic Boulevard (10m AHD) to the North East.

The erosion and sediment controls will provide prevention and mitigation measures to minimise and manage the possible impacts on water quality during construction. The objectives of these controls are, but not limited to, the following:

- To avoid erosion, contamination and sedimentation occurring, resulting from construction or demolition activities with a concentration on controls to minimise dust and vehicular mud-tracking;
- To control the quality of stormwater leaving the construction site, so that no unacceptable impact will intrude upon the natural watercourses and/or existing stormwater drains;
- Erosion and sediment controls to be effective and properly maintained during the construction phase;
- Water management for collected /retained stormwater to achieve acceptable water quality criteria;
- To monitor the effects of activities and the effectiveness of mitigation measures.

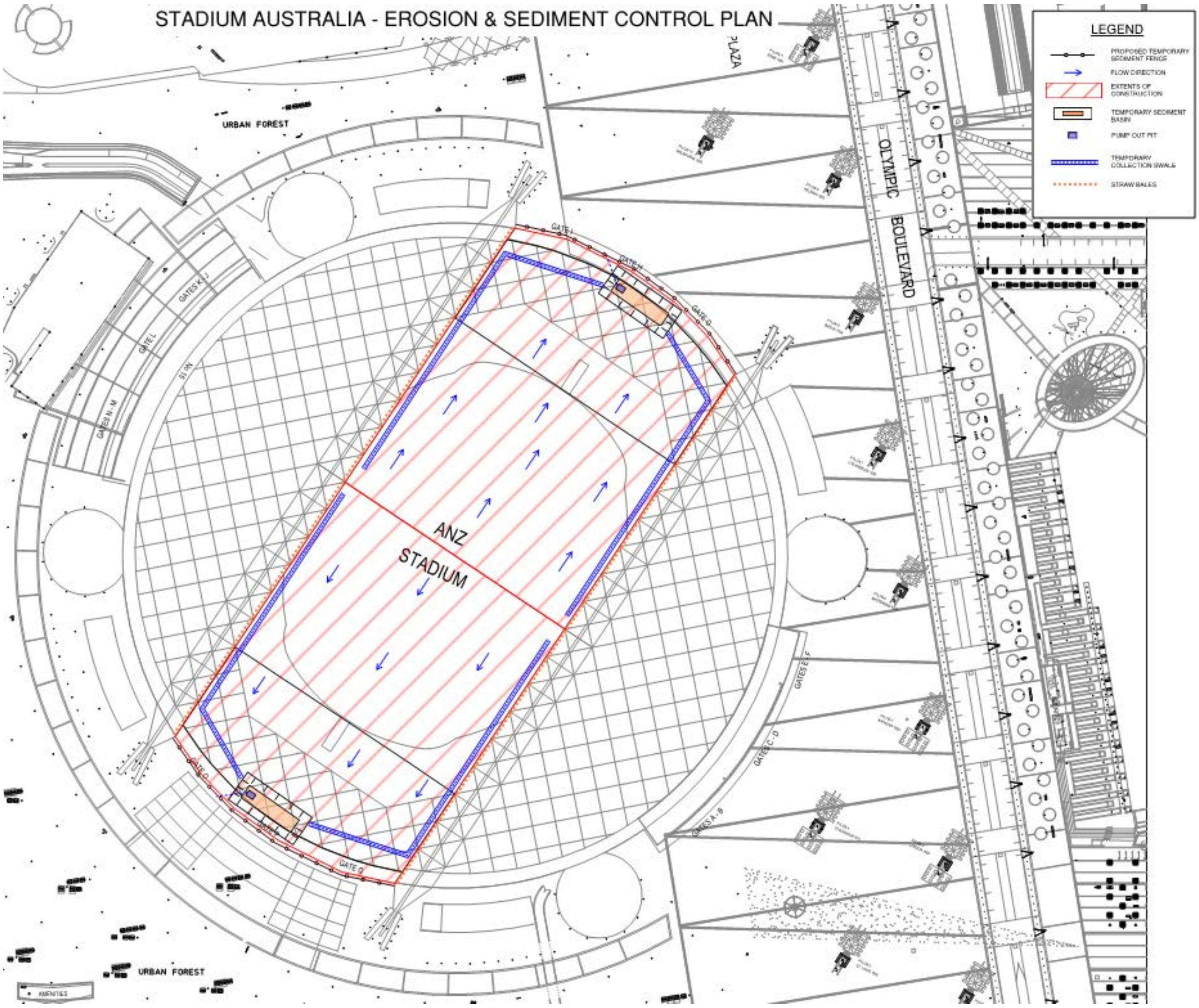

Figure 12 Erosion and Sediment Control Plan

4.1 Overland Flows from Site

On-site overland flows during the construction phase will be directed into one of two (minimum number of sediment ponds) located at either end of the site via temporary swales and localised gradients. Each detention pond will double as a settling pond and will be periodically desilted. The frequency of desilting will be related to rainfall volumes and time of year.

Detained stormwater run-off will be allowed to settle over a period or settle more rapidly with the addition of a flocculant. Controlled decanting to the existing stormwater infrastructure in Olympic Boulevard will be via a pump-out pit at the low point of the detention/settling pond. The level of the detention pond will be monitored so that capacity of the pond is maximised. The location of the pump-out pit and rising main is located on the figure 13.

4.2 Dust Suppression and Water Monitoring

To minimise dust emissions from the site during the construction phase, the contractor will re-use water stored in the detention/sedimentation ponds throughout the demolition and bulk earthworks stages of the project for dust suppression and soil compaction. This will help manage the spread of fine particles entrained in stormwater and will reduce the need to use potable water sources during this construction phase.

Dust monitoring stations will be utilised to manage fine particles within the site.

The contractor will regularly monitor run-off stormwater within the detention/sedimentation ponds and check for toxic impurities so as not to discharge these impurities in the SOPA drainage system or groundwater aquifer. If the run-off stored in the ponds is deemed unsafe (e.g. oily water), the contractor will dispose of the water to a facility capable of treating the water.

4.3 Erosion & Sediment Control Assumptions

The ESC strategy assumes that:

- No works, such as the commencement of earthworks or removal of vegetation, will be performed until all appropriate erosion and sediment controls have been installed;
- ESC controls will be inspected periodically to ensure adequate performance and prompt maintenance and repair of any issues.

5 Conclusion

Proposed changes to Stadium Australia's stormwater system during and post redevelopment have only minor impact on roof drainage, inground drainage and OSD, and no impact on overall water quality. All changes and modifications to the stormwater network will be designed in accordance with SOPA Guidelines and Policies.

Based on the findings and recommendations of this report, the following measures are suggested to mitigate the identified impacts of the proposed works.

Mitigation Measures	Indicative Timing
Install erosion and sediment control measures as outlined in section 4 of this report.	Prior to commencement of works.
Roof drainage to be designed for 100-year ARI in accordance with AS3500.3	Prior to the commencement of the relevant works
Ensure pipe network drainage is designed for 20-year ARI in accordance with AR&S 2019 that is capable of receiving 100-year ARI roof drainage.	Prior to the commencement of the relevant works.
Undertake further investigations in regard to soil salinity and sulphate levels.	Prior to the commencement of the relevant works.

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