SYDNEY FOOTBALL STADIUM REDEVELOPMENT

STATE SIGNIFICANT DEVELOPMENT APPLICATION

Concept Proposal and Stage 1 Demolition

SSDA 9249

APPENDIX P:

Stormwater and Flooding Report

NSW GOVERNMENT

Infrastructure NSW

Sydney Football Stadium Redevelopment

Stormwater and Flooding Assessment

260159-CIV-REP-0001

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Executive Summary

This stormwater and flooding assessment is provided in support of the concept proposals for the redevelopment of Sydney Football Stadium (SFS). This report considers the Stage 1 SSDA which includes concept proposal for the stadium envelope and supporting retail and functional uses as well as demolition and modification of the public domain, existing facilities and associated structures.

This report provides an overview of the existing stormwater and flooding conditions, the changes likely to be associated with the proposed redevelopment and provides information about the proposed design principles for managing risks.

Flooding

As a function of its location within an overland flow path for surface water flowing from Moore Park Road to the north and Driver Avenue to the South West, the SFS site is subject to flooding. Flood modelling indicates that there is a risk overland flows will occur during both minor storms and major storms in the existing and future developed conditions.

Changes to the topography under the proposed scenario will impact the opportunities for surface storage and likely increase the speed at which any overland flows drain towards Driver Avenue relative to existing conditions. As such, additional on site detention (OSD) is recommended as part of the development to control flows such that flooding does not worsen downstream conditions. The required OSD can be implemented in a number of different ways to mitigate any changes in overland flow and is subject to detailed design.

Stormwater

The existing site has a Ø900mm / Ø1350mm Sydney Water stormwater drainage asset situated to the north and west of the existing stadium, and crossing through the site. This drain carries stormwater from the suburb of Paddington and surface water from Moore Park Road to the Sydney Water main drain below Driver Avenue. The Sydney Water infrastructure on the site will be impacted by the proposed stadium footprint and will require a diversion of approximately 220m in length. This diversion and the sequencing of these works will require further consideration as part of the Stage 2 SSDA application.

The internal stormwater network for the site will likely need to be removed and replaced due to the changes associated with the proposed stadium footprint and public domain. This will likely consist of a new pit and pipe network surrounding the proposed stadium to direct water into the existing Sydney Water network in a manner that closely matches the existing arrangement.

New stormwater quality improvement devices (SQIDs) will also be required to meet modern stormwater pollution reduction targets.

1 Introduction

This report supports a State Significant Development (SSD) Development Application (DA) for the redevelopment of the Sydney Football Stadium which is submitted to the Minister for Planning pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). A staged approach to the planning applications is proposed which includes:

- **Stage 1** – Concept Proposal for the stadium envelope and supporting retail and functional uses as well as development consent for the carrying out of early works, including demolition of the existing facility and associated structures.
- **Stage 2** – detailed design, construction and operation of the stadium and supporting business, retail and functional uses.

This report relates to the Stage 1 Concept DA and detailed Early Works package.

Infrastructure NSW is the Proponent for the Stage 1 planning application.

1.1 Background

The Sydney Football Stadium (SFS) is a significant component of the sports facilities that comprise the Sydney Cricket and Sports Ground (SC&SG). Completed in 1988, the SFS has hosted numerous sporting events in its 30 years of operation for a number of sporting codes including football (soccer), rugby league and rugby union as well as occasional music concerts.

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 included development of master plans for Tier 1 stadia and their precincts covering transport, integrated ticketing, spectator experience, facilities for players, media, corporate and restaurant and entertainment provision. The SFS is one of three Tier 1 stadia within NSW, the others being Stadium Australia (Olympic Park) and the Sydney Cricket Ground (SCG).

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

- Have 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.

Following release of the NSW Stadia Strategy, the Sydney Cricket and Sports Ground Trust (SCSGT) undertook master planning culminating in the 2015 Preliminary SCG Master Plan. This master plan defines the context for future redevelopment of the SCG, SFS and related sports infrastructure to ensure that the

precinct continues to meet the needs and expectations of visitors and tenants into the future.

In a competitive rectangular stadium landscape nationally, the existing SFS is now facing serious commercial and operational challenges in remaining relevant and competitive for existing and future hirers and patrons. Owing to the age of SFS, there are a number of deficiencies in the provision of facilities that are required to function as a modern and competitive Tier 1 stadium. The stadium has aged poorly and fails to meet modern expectations of a Tier 1 stadium in terms of patron experience, crowd management, safety/security, accessibility, facilities for core tenants, operational efficiency, premium hospitality and food/beverage offerings and media requirements.

On 24 November 2017, the NSW Premier announced the SFS Redevelopment. The redevelopment will include demolition of the existing facility and replacement with a modern, globally competitive stadium that achieves the requirements for a Tier 1 stadium now and into the future. Redevelopment of the SFS will assist in supporting the realisation of the Master Plan principles to:

- Create a flexible venue suitable for sports, e-sports and major events alike;
- Include technology for the future;
- Create a venue for the growth of men's and women's elite sport, as well as the ability to adapt to new sports and the rise of e-sports;
- Create a publicly accessible entertainment and recreational facility;
- Create a stadium integrated with its surrounds including Centennial and Moore Parks and the surrounding residential and business areas; and
- Create a sustainable future.

1.2 Site Description

The site is located at 40-44 Driver Avenue, Moore Park within the Sydney Cricket Ground Precinct. It is bound by Moore Park Road to the north, Paddington Lane to the east, the existing SCG stadium to the south and Driver Avenue to the west. The site is located within the City of Sydney local government area.

The site is legally described as Lots 1528 and 1530 in Deposited Plan 752011 and Lot 1 in Deposited Plan 205794. The site is Crown Land, with the SCSGT designated as the sole trustee under the *Sydney Cricket and Sports Ground Act 1978*. The site is wholly contained within designated land controlled by the Sydney SCSGT under Schedule 2A of the *Sydney Cricket and Sports Ground Act 1978*.

In a broader context, the site is largely surrounded by Centennial and Moore Parks, the Fox Studios and Entertainment Quarter precincts and the residential suburb of Paddington. Located approximately 3km from the Sydney CBD and approximately 2km from Central Station, the site is connected to Sydney's transport network through existing bus routes and will benefit from a dedicated stop on the soon to be completed Sydney CBD and South East Light Rail.

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

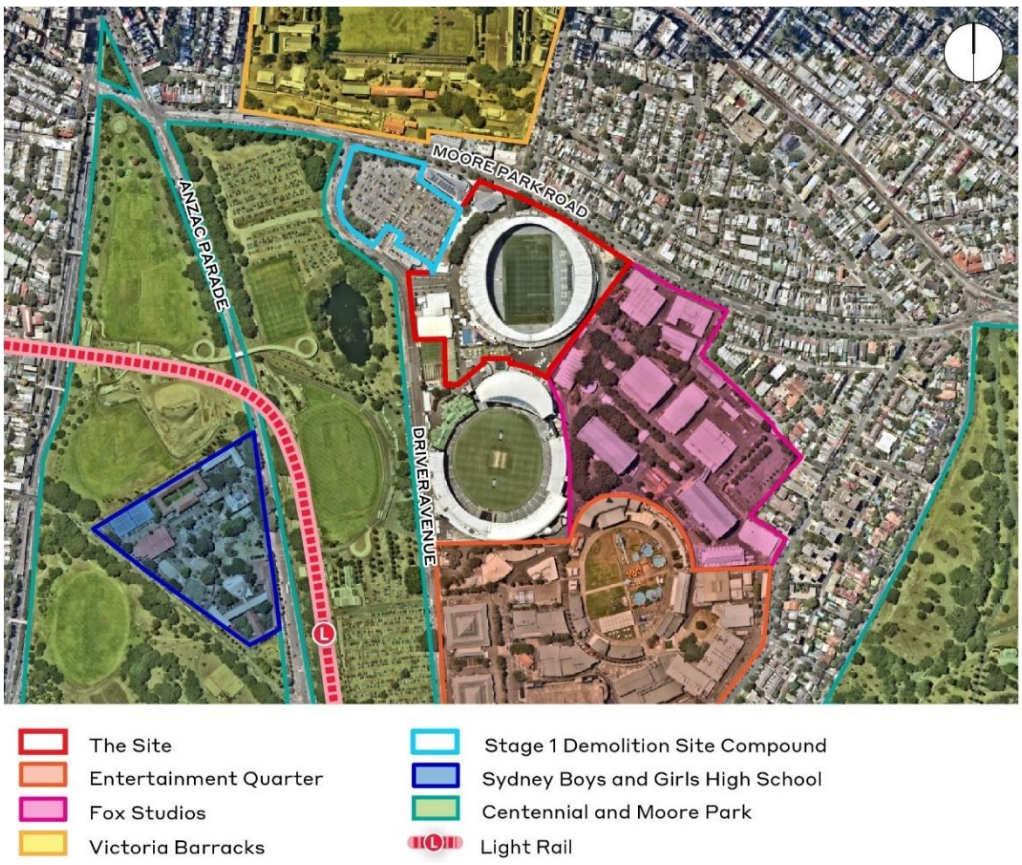


Figure 2: Site area and local context

1.3 Overview of Proposed Development

The SFS Redevelopment Stage 1 application includes a Concept Proposal and Early Works package.

The Concept Proposal comprises:

- A new stadium with up to 45,000 seats on the site of the existing stadium including:
  - New facilities for general admission;
  - New playing pitch;
  - Hospitality facilities; and
  - Ancillary food and beverage and entertainment facilities;
- New basement with service vehicular access for servicing and bump-in/bump-out;
- New public domain works surrounding the stadium, building on the venue's unique parkland setting;
- Urban Design and Public Domain Guidelines; and
- Signage strategy.

Indicative concept building envelope plans outlining the extent of the proposed stadium building envelope and surrounding public domain to be included in the Stage 1 planning application are included within the Environmental Impact Statement for the project.

From a capacity, operational and mix of uses perspective, the new stadium will be consistent with the existing SFS.

The Stage 1 Early Works comprises:

- Site establishment, including erection of site protection fencing and temporary relocation of facilities;
- Decommissioning and demolition of the existing stadium and associated structures including the existing Sheridan, Roosters and Waratahs buildings and the administration building of Cricket NSW to ground level and 'make safe' of the site;
- Use of the existing Moore Park 1 (MP1) car park for construction staging; and
- Make good of the site suitable for construction of the new stadium (subject to separate Stage 2 application).

The SFS Redevelopment will create a new stadium with up to 45,000 seats through a range of seating styles and corporate facilities. The stadium will include state of the art technology with digital screens throughout to improve the fan experience. Sightlines will be improved and facilities including catering, amenities and accessibility will be designed to service future needs, creating a world-class customer experience befitting a global city such as Sydney.

1.4 Civil Engineering Scope of Works

For the Stage 1 application the scope of civil engineering works, as documented in this report, is a stormwater and flooding assessment. This scope covers:

- Stormwater concept plan detailing how water quality and quantity impacts on drainage systems would be managed; and
- Flooding: assessment of flood risks on the site and the flood impacts of the development on the surrounding area.

1.5 Planning Objectives

The Secretary's Environmental Assessment Requirements (SEARs) for Stage 1 are:

15. Drainage

Provide preliminary detail of drainage associated with the proposal, including stormwater and drainage infrastructure and rainwater harvesting and storage for on-site reuse.

Relevant Policies and Guidelines:

- *Guidelines for development adjoining land and water managed by DECCW (OEH, 2013)*

16. Flooding

Identify flood risk on-site (detailing the most recent flood studies for the project area) and consideration of any relevant provisions of the NSW Floodplain Development Manual (2005), including the potential effects of climate change, sea level rise and an increase in rainfall intensity. If there is a material flood risk, include design solutions for mitigation.

In terms of flooding and stormwater, the proposed stadium will aim to meet the objectives of:

- City of Sydney’s LEP; and
- Sydney Water for discharge to its infrastructure.

1.6 Purpose of Report

This report explains the existing flooding mechanisms for the SFS site and discusses the opportunity to mitigate flooding impacts associated with the proposed redevelopment.

It is noted that the project is in a preliminary phase and will be subject to detailed design and a stage 2 SSDA application. The aim of this report is not to prescriptively document mitigation measures, but to outline one possible solution to maintain the status quo and avoid any downstream or surrounding impacts due to the proposed redevelopment and thus demonstrate that the proposed redevelopment can meet the planning objectives as outlined above.

2 Existing Site Conditions

2.1 Existing Conditions

The Sydney Cricket & Sports Ground Trust (SC&SGT) site is in Moore Park, south of Sydney CBD. The Trust land is home to the 48,000 seat Sydney Cricket Ground (SCG) oval, the 45,000 seat Sydney Football Stadium (SFS) rectangular pitch, numerous sporting administration buildings and related facilities. These include the NRL Headquarters, Australian Rugby Development Centre (ARDC), AFL, Sydney FC, Cricket NSW, Roosters, Waratahs, Sheridan Building (which contains AFL NSW/ACT, Sydney FC, Trust offices, Stadium Sports Medicine Clinic etc.) and Fanatics Headquarters, members' services building and members' car park (MP1), tennis courts, training wickets, swimming pool, gym and public amenities.

2.2 Boundaries

The project site falls wholly within SC&SGT land. The site is bounded by:

- Moore Park Road to the north. This boundary provides the primary access from the north and east, near Regent Street. There is a level difference between the footpath and circulation space around the stadium, with retaining walls and batters separating the two. This difference decreases moving west, and levels are similar at Oatley Road.
- Fox Studios to the east. The eastern side of the site is occupied by Paddington Lane, which serves as service vehicle access for the SFS and SCG. The site is separated from Fox Studios by a high wall for the full length of this boundary.
- The SCG (Noble-Bradman Stand) to the south. The project site encompasses the forecourt constructed when these stands were upgraded in 2013, as well as the basement beneath, though there is a desire to minimise impacts on these.
- Driver Avenue to the west. This provides the primary access from the south and west, with a plaza area linking the road and stadium. There are also existing cricket facilities on this frontage.
- To the west of the stadium site are MP1 car park, the Rugby League Central building and Australian Rugby Development Centre (ARDC) building as illustrated in Figure 3. These two recently constructed buildings will not be altered by stadium redevelopment but the MP1 car park will be temporarily used as construction staging areas to facilitate site works. The existing Sheridan and adjoining buildings are within the project site and are to be demolished.

The project site, boundaries and surrounds are shown in Figure 3.

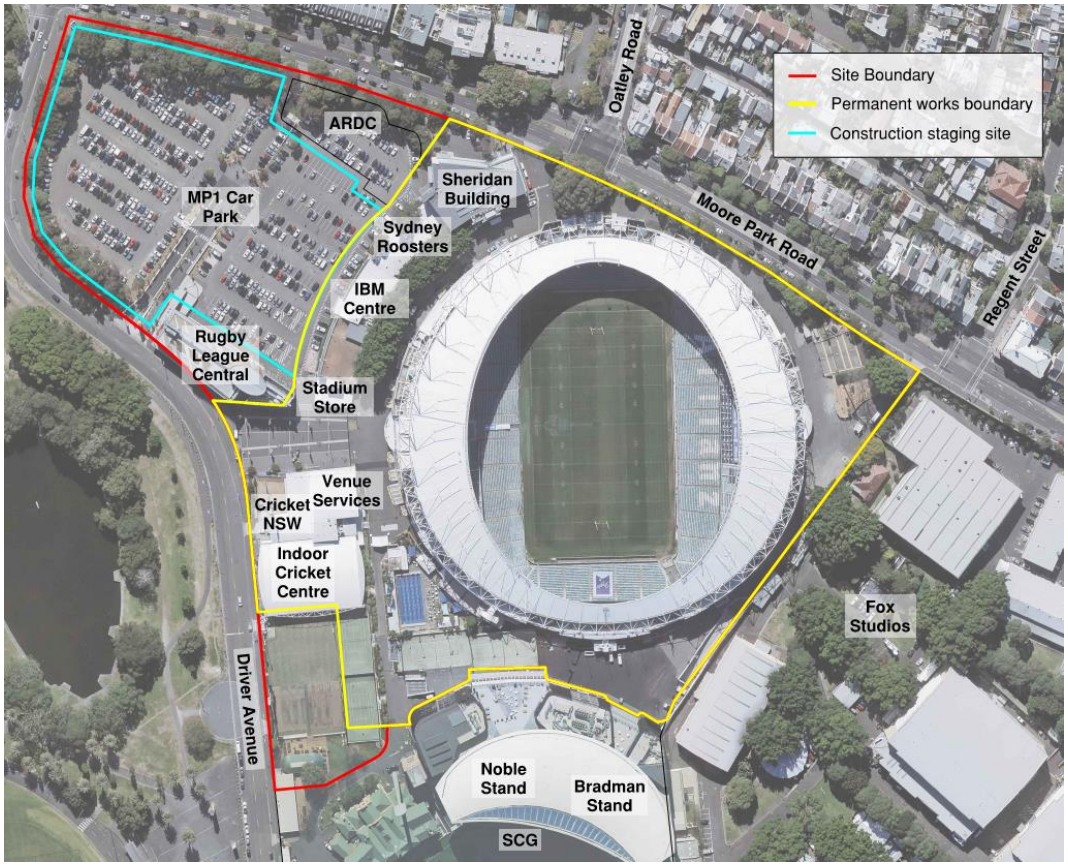


Figure 3: Project site and surrounds

2.3 Topography and surface

There are significant level differences across the site, with a general fall from north-east to south-west. The level difference between frontages is approximately 13m, falling from Moore Park Road to Driver Avenue.

On the Moore Park Road frontage, there is a retaining wall, dropping from street level to a plaza level similar to the stadium concourse level. From Driver Avenue, the ground ramps up towards the stadium, with stairs included at stadium entrances to reach concourse level.

There are level differences between the existing SFS and surrounding concourse compared to the SCG Noble-Bradman forecourt, as well as the Sheridan and connected buildings.

The site surface is almost exclusively paved (generally asphalt) outside the stadium. There are a number of trees around the northern side of the stadium, and small landscaped areas either side of the Moore Park Road entrance.

There are several retaining walls around the stadium plaza, separating it from Moore Park Road and the Noble-Bradman Stand forecourt at a higher level, and the Sheridan and associated buildings at a lower level.

2.4 Flooding

The site is currently subject to flooding from overland stormwater flows. It is situated on a major overland flow path which permits stormwater flowing along Moore Park Road to drain towards a trapped low point on Driver Avenue. Water is ultimately conveyed off the site via an in-ground Sydney Water drain located below Driver Avenue southwards towards Centennial Park.

The most significant overland flows path in the vicinity of the existing SFS permit water to drain around the eastern and southern sides of the stadium. Further detail on existing flooding is contained in Section 4.

2.5 Stormwater

There are existing Sydney Water trunk stormwater mains, surrounding the site, mirroring the overland flow path. These include major culverts along Driver Avenue and Fox Studios, as well as a large pipe crossing the site from Moore Park Road to Driver Avenue.

There is an existing site network of pits and pipes, draining both the public domain and stadium roof. This internal network discharges to several external points to the south and west.

Further detail on existing stormwater infrastructure is contained in Section 5.

2.6 Surrounding Sites and Infrastructure

The SC&SGT land is bounded by Driver Avenue and Moore Park to the west, the Entertainment Quarter to the south and Fox Studios to the east and Moore Park Road to the north.

Moore Park Road is classified as a state road and is operated by the Roads and Maritime Service (Roads and Maritime). Driver Avenue is a private road operated by the Centennial Park and Moore Park Trust (CPMPT).

The City of Sydney is progressing the design of a new cycleway link along Moore Park Road. Design information for this link is not publicly available and the implications of the possible modifications to the design proposals has not yet been considered.

2.6.1 Moore Park

Located to the west of the SC&SGT ground is Moore Park, an open parkland linking Centennial Park with Paddington, Darlinghurst and Surry Hills. This ground is managed by Centennial Park and Moore Park Trust (CPMPT), a governmental body that falls within the Office of Environment and Heritage.

A portion of Moore Park enclosed by Anzac Parade, Moore Park Road and Lang Road immediately adjoins the SC&SGT site. This ground incorporates Kippax Lake, a 7,000m^2 man-made water feature which is fed by rainfall runoff from the surrounding ground and road runoff piped from Moore Park Road.

The SC&SGT site and Moore Park are inter-connected by Driver Avenue, the main access road to the site and stadia. Driver Avenue is aligned north-south through the site and has intersections with Lang Road and Moore Park Road. The Albert 'Tibby' Cotter Bridge allows pedestrian and cyclist movements over Anzac Parade and the adjoining bus lane, linking the eastern and western parts of Moore Park.

Both SC&SCT site and this section of Moore Park are located within the City of Sydney local government area (LGA) jurisdiction. Randwick Council's LGA begins at Lang Road to the south.

2.6.2 Entertainment Quarter & Fox Studios

To the south of the SC&SGT site is the Entertainment Quarter (EQ). This expansive facility includes shops, bars, cafes, restaurants, cinemas, live entertainment venues, children's playground, parklands and entertainment sporting facilities.

To the North of the EQ, and east of the SC&SGT site is Fox Studios which consists of a number of large buildings for film and theatre production as well as roads and landscaping. Fox Studios is separated from the SFS by high masonry walls running along the boundary.

2.7 Utilities

There are numerous existing utilities in the precinct including a number of trunk mains that provide service to Sydney's Eastern Suburbs. The utilities include assets which would be deemed "Core Infrastructure" due to the large areas they service. Impacts to these utilities should be carefully managed and mitigated as a consideration of any development proposal within the precinct. Existing utilities other than stormwater are addressed by the services engineer's report.

2.7.1 Busby's Bore – Heritage Infrastructure

Busby's Bore is a heritage listed water supply tunnel located between Centennial Park and Sydney's CBD. Built by convict labour between 1827 and 1837, this tunnel was excavated through solid sandstone. The bore is owned by Sydney Water. Further information about Busby's Bore is provided in the Archaeological report.

The alignment is approximately understood from a combination of record drawings (such as Figure 4) which have been reviewed against SC&SGT information that confirms the positions of some of access shafts.

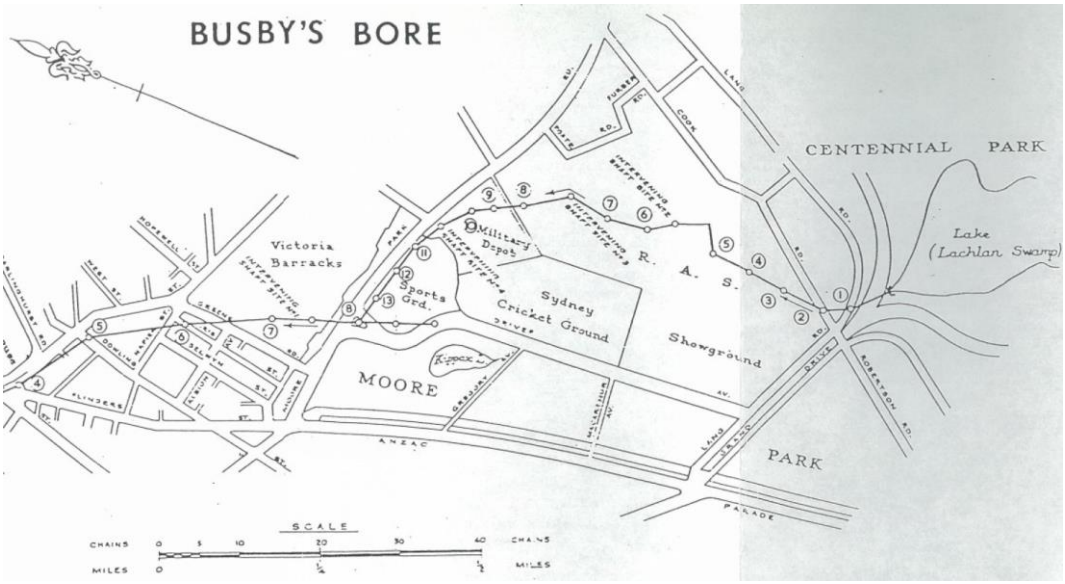


Figure 4: Historical drawing of Busby's Bore

Near the SFS the tunnel is understood to run north through Fox Studios, skirting the north-eastern edge of the existing SFS, then follow the southern edge of Moore Park Road before turning north approximately at the location of the Driver Avenue and Moore Park Road intersection.

Due to the location of the bore relative to the stadium, it may not be possible to confirm the bore's location until after demolition of the stadium, and during ground preparation. It is important to have an understanding of the plan position and depth of this infrastructure in planning associated in-ground infrastructure modifications.

2.8 Ground Conditions

The development precinct falls from north-east to south-west ranging from approx. RL: 52.0m at the current entrance from Moore Park Road (near Regent Street) to approx. RL: 39.0m at the Driver Avenue frontage. The steepest grades are located at the interface between the SC&SGT site and Moore Park Road where there is a mixture of retaining walls and engineered batter slopes. Much of the remainder of the site falls at shallow grades with a trapped low point at RL: 36.0m located on Driver Avenue immediately west of the SCG. This low point is at risk of flooding as illustrated in the flood maps in Appendix A.

Four separate geotechnical reports from previous development projects within the site were made available for review. Ground conditions generally consist of fill over fine to medium sands over interbedded clayey sand over a weathered sandstone bedrock.

Groundwater has been recorded on site at a range of levels, from RL: 31.3m to RL: 37.3m within the footprint of the proposed stadium. Existing groundwater records and documentation are sufficient to make educated engineering judgement for concept design but more detailed investigation is recommended for the subsequent design phases.

Further detail concerning the ground conditions and groundwater levels is provided in the groundwater report.

2.9 Anzac Parade Bus Lane

Alongside Anzac Parade, adjoining the west edge of the Moore Park ground is a dedicated bus lane. This is primarily used during peak commuting hours and during sporting/concert events at both stadia as well as the EQ.

There is also a bus loop outside the SCG serving event buses that shuttle between Central Station and the stadia. The bus lane is an important patron arrival point for the SFS, SCG and other facilities. This is discussed in detail in the transport consultant's report.

2.10 Light Rail Corridor

Alongside the exiting bus lane and currently under construction is the CBD and South East Light Rail (CSELR). This new transport infrastructure enters the precinct from the west crossing below Anzac Parade in a tunnel. From here the rail alignment swings south, emerging from a tunnel portal to the south west of the SFS. There will be a light rail stop west of the SCG, which will be a new and significant patron arrival/departure point. The rail alignment continues southwards alongside the bus lane to the east of Anzac Parade crossing Lang Road and towards Randwick and Kingsford. CSELR is due to open in March 2020, and will be operational before the new stadium is constructed.

3 Proposed Works

The proposed works include the demolition of the existing stadium and some surrounding buildings and the construction of a new stadium and associated public domain on the site.

3.1 Demolition

The proposed works include demolition of the following structures:

- Sydney Football Stadium;
- Cricket NSW, venue services and indoor cricket centre building, located between the stadium and Driver Avenue; and
- Sheridan Building, Sydney Roosters building and Stadium Store, located between the stadium and MP1 car park (refer Figure 3).

The structures to be demolished are shown in Figure 5.

3.2 New Stadium – Concept Proposal

A new stadium will be constructed on the site. It will have similar seating capacity to the existing stadium, but expanded hospitality and ancillary facilities. It will also include a basement beneath the concourse (roughly level with the playing field).

Relative to the existing stadium, the proposed stadium:

- is larger;
- has shifted to the west; and
- has greater roof coverage (and hence greater roof area).

The proposed stadium footprint is shown in Figure 5.

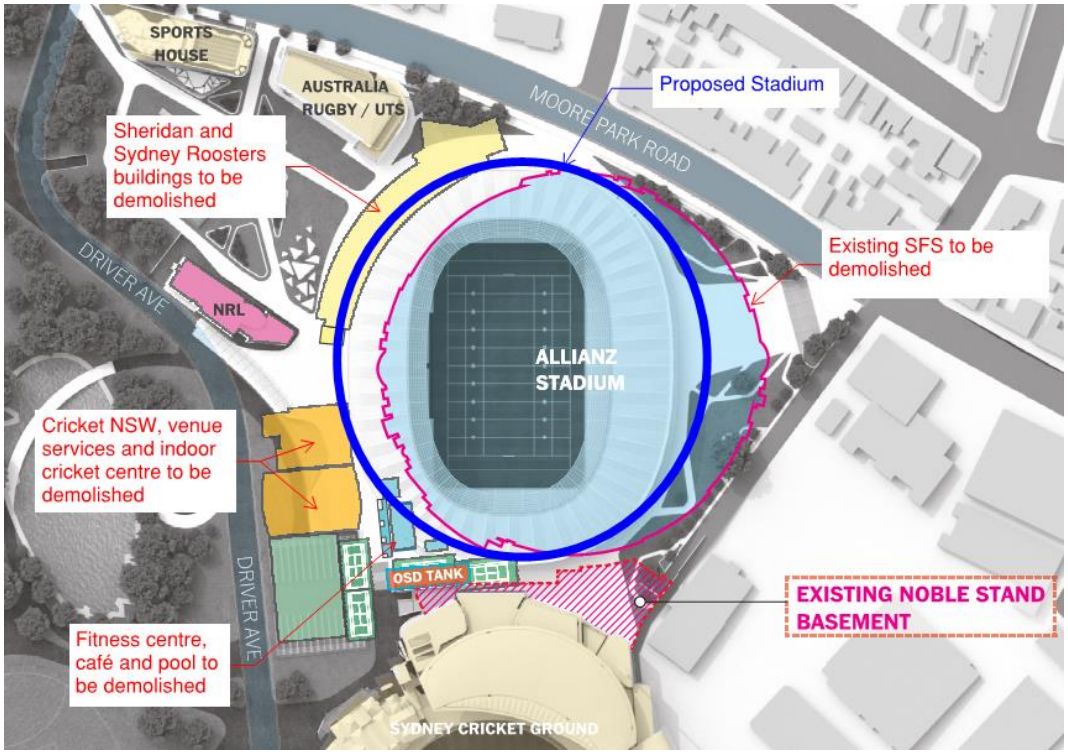


Figure 5: Proposed works

The detailed design of the new stadium will be separate to a separate State Significant Development Application. This application will include detailed assessment of water quality, stormwater storage/discharge and flood mitigation.

3.3 Public Domain

The public domain for the new stadium is designed to improve circulation, allowing 360-degree circulation and improving access to and from multiple entry/egress points, for both the SFS and SCG.

The desire is for an external plaza that is at grade with the internal concourse, though the topography of the site means this is likely only achievable around the northern section of the stadium, with a step down to the south and the existing Noble-Bradman forecourt level.

The proposed public domain includes stairs from both Moore Park Road and Driver Avenue frontages to the external plaza level, as well as stairs from the upper plaza to the lower southern plaza.

Improving accessibility is a key focus of the design, so ramps will be used where possible, and accessible alternatives to stairs provided.

The public domain concept is shown in Figure 6.

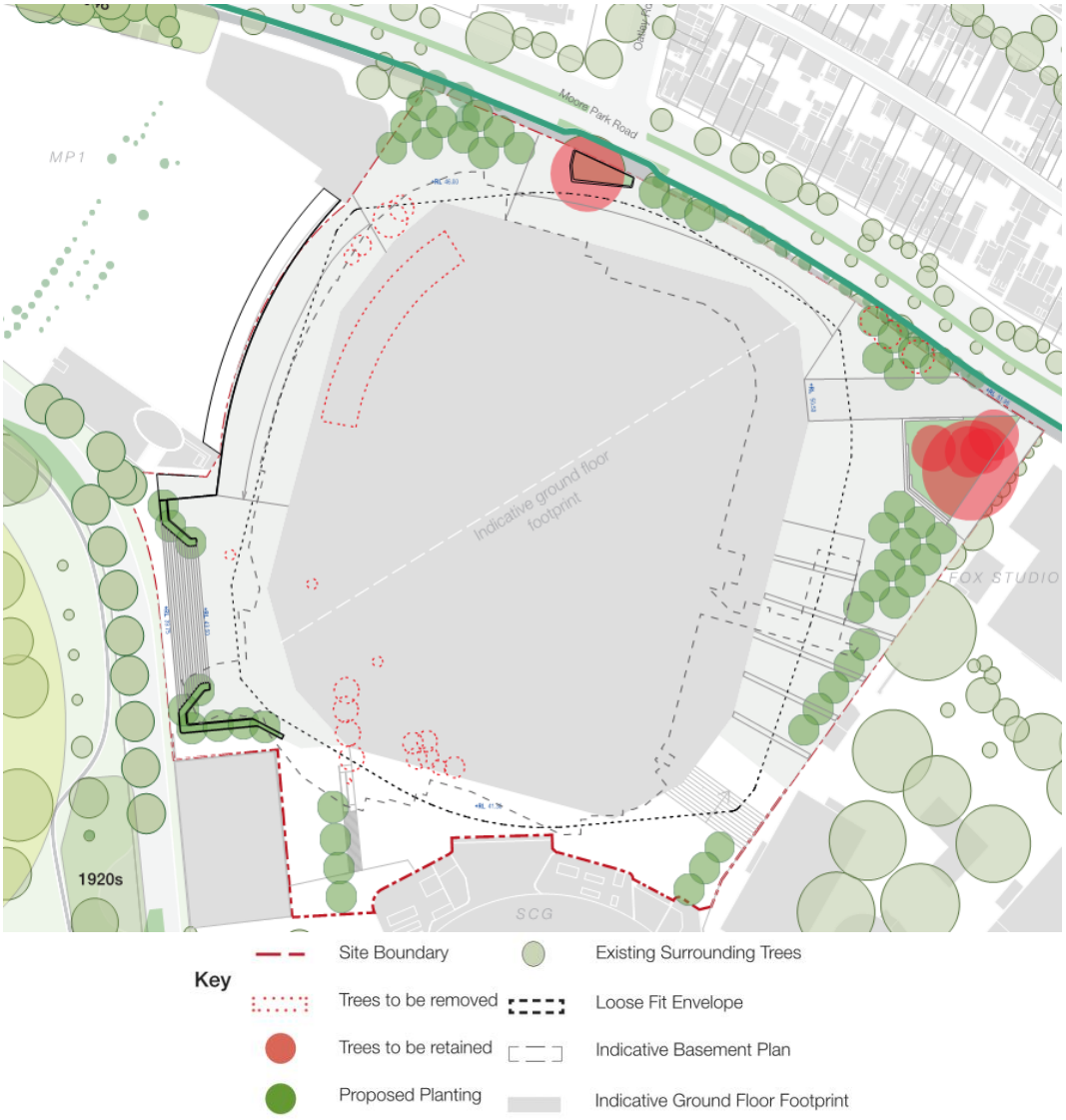


Figure 6: Public domain concept plan prepared by SJB Urban Designers

The detailed design of the public domain will be the subject of the future detailed State Significant Development Application, which will include detailed assessment of water quality, stormwater storage/discharge and flood mitigation.

4 Flooding

4.1 Flood Risk Management Approach

Arup has a good understanding of the existing drainage systems, topography and flooding issues associated with the Sydney Football Stadium precinct as a result of ongoing involvement with projects over several decades. Arup has also reviewed the City of Sydney Council Centennial Park flood study report (dated 2016 by WMA Water) which is informed by a 2D hydraulic model built using software package TUFLOW.

With this information and knowledge, Arup is aware that the existing SFS site is prone to flood affectation during relatively minor storm events from the 1 in 2 year annual recurrence interval (ARI) up to more significant events including the 1 in 100 year ARI. This is illustrated in Figure 7 which illustrates the maximum flood water depths during a 1 in 2 year storm event.

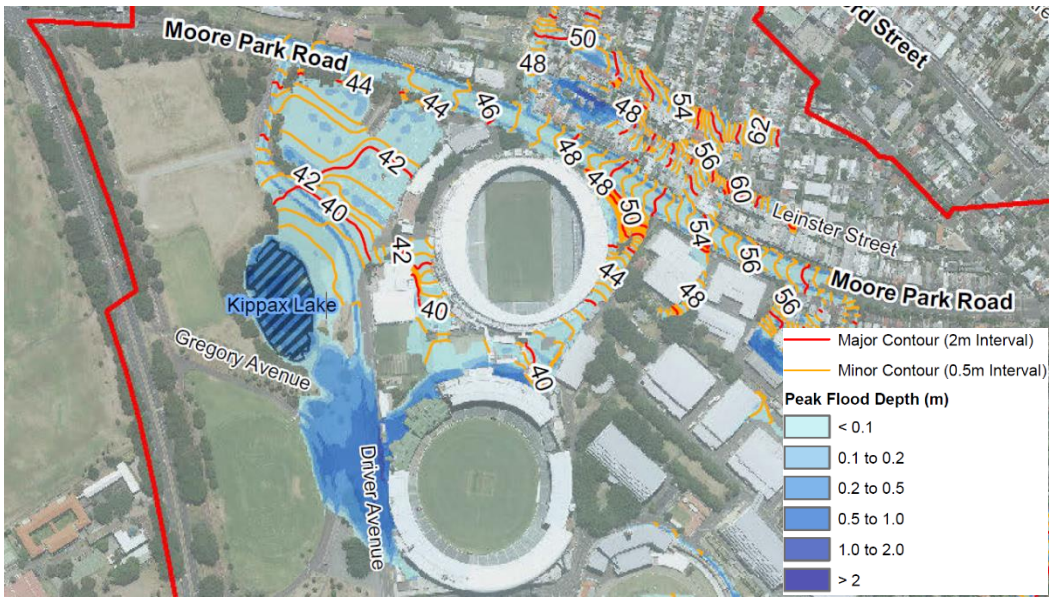


Figure 7. City of Sydney Centennial Park flood study figure illustrating the peak flooding depths during a 1 in 2 year storm ARI

From our detailed understanding of both the existing site conditions and our knowledge of the TUFLOW flood model, Arup consider the existing City of Sydney model is insufficiently detailed for the purposes of assessing the behaviour of floodwater in the SFS site. This is because it does not include existing pit and pipe infrastructure and is based on course topographical information which is outdated. This is common for flood models built for purposes of analysing wider catchment areas and which are often built using relatively limited data and course assumptions.

For this reason and owing to the nature of flooding in the SFS site, Arup has undertaken some more detailed flood modelling and assessment for the site. The purpose of this is twofold: firstly, to better understand the detailed behaviour of

flooding on the site and secondly, to develop a strategy for managing flooding risks for the proposed development.

The flood risk management approach undertaken as part of the stage 1 DA has been based on industry best practice following the recommendations of the NSW Floodplain Development Manual (2005). It also seeks to comply with City of Sydney's requirements for water and flood management as outlined in the Sydney DCP 2012 and the Interim Floodplain Management Policy (May 2014).

The primary aim of managing the flood risks is to prevent adverse impacts on adjoining developments or properties in the form of peak flood level increase or worsening flood hazards when compared to the existing conditions. Any changes to flooding and overland flow behaviour as a result of the SFS redevelopment must therefore be managed by mitigation works within the development site as far as reasonably practical.

This Stage 1 SSDA flood assessment is intended to establish the in-principle approach to flood risk management for the site. This will be developed in greater detail as part of a separate Stage 2 SSDA application.

4.2 Summary of Flood Risk Modelling

The flood risk modelling work undertaken by Arup in support of this Stage 1 SSDA can be summarised as follows:

1. Review of existing published flood study and City of Sydney TUFLOW model;
2. Implement and test Arup modifications and refinements to the existing TUFLOW model;
3. Review and analyse results of the enhanced model to better understand the existing flooding conditions;
4. Use this information to consider various approaches to managing flood risk within the proposed development site;
5. Use the enhanced TUFLOW model to test the effectiveness of the preferred flood risk management approach; and
6. Review results and present recommendations to manage flood risks within the site.

Commentary on the items outlined above are presented in expanded detail in Appendix C. Flood maps and figures illustrating the findings of this work are presented in Appendix A. Conclusions of the work done together with Arup's recommendations for flood risk management for this Stage 1 SSDA are presented in Section 4.3.

4.3 Flood Risk Management Recommendations

Figure 8 below summarises the existing behaviour of overland flow and flooding in and around the existing stadium based on Arup's refined flood model. It illustrates the behaviour during a 1 in 100year ARI storm however, modelling results suggest this behaviour is similar in all storm events.

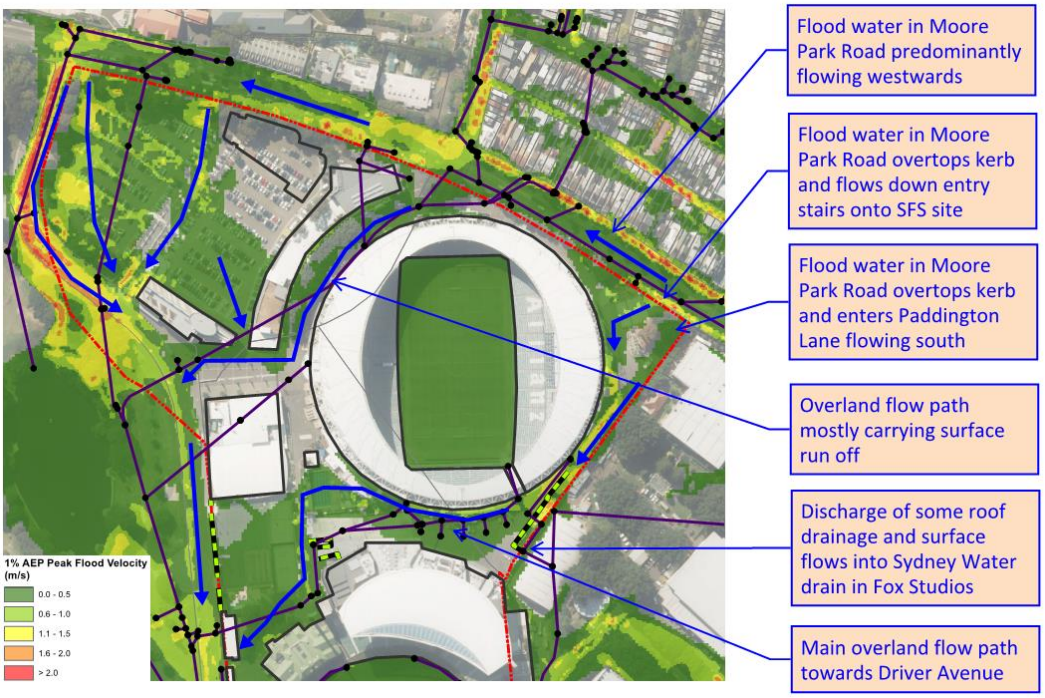


Figure 8. Summary of behaviour of existing overland flow and flooding behaviour within and surrounding the SFS site during a 1 in 100 year ARI storm

The existing flooding and overland flows within the SFS site are a function of several factors as follows:

- Stormwater drainage pits and pipes servicing Moore Park Road and the upstream catchment do not have adequate capacity to manage significant flows. This results in water flowing overland and with a tendency for flow concentrations in the gutters of Moore Park Road.
- When the water flow depth in the southern gutter of Moore Park Road is sufficiently elevated, stormwater will overtop the kerb and tend to flow onto the SFS site. Significant flows onto the SFS site are observed at Paddington Lane and the steps leading into the site.
- Rainfall and runoff within the SFS site tend to flow around the perimeter of the stadium either in dedicated drainage systems or as overland flows where in-ground systems have insufficient capacity.
- Overland flows drain away from the SFS site in three main locations: to the Fox Studio's Sydney Water drain in the south east, to Driver Avenue via the western plaza and to Driver Avenue via the "Walk of Heroes" and the SCG heritage stand plaza to the south west. For more details refer to Section 5.1.
- Of these three discharge locations, the south west is the most significant.

Armed with this understanding of the existing behaviour, various different approaches to flood risk management have been tested. Based on this work, Arup's Stage 1 SSDA recommendations for flood risk management can be summarised as follows:

- As far as reasonably practical, attempt to maintain existing flows on Moore Park Road. Whilst it is considered unreasonable that overflows from the road can discharge onto the SFS site, it is equally recognised that prohibiting these flows with barriers such as walls and the like is likely to be unacceptable to City of Sydney Council. This would also undermine the principle of not worsening upstream conditions as set out in the Floodplain Development Manual.
- As far as reasonably practical, maintain or reduce the existing peak flow rates discharged from the site into downstream areas. This will help to achieve the objective of no worsening of downstream conditions and will also mean the Fox Studios area or the Driver Avenue area are treated consistently.
- Introduce deliberate overland flow paths such that they direct surface drainage in a way that poses as low a risk as possible to people or vehicles in the SFS site. This includes the route of overland flow paths in relation to areas where people may be walking or congregating.
- Provide sufficient stormwater storage within the SFS site to contain direct rainfall and runoff and attenuate peak downstream discharge rates.
- Consider the separation of flows from upstream areas from direct rainfall and runoff within the site for ease of management and opportunities for rainwater reuse.
- Manage the risk of flood damage to buildings or similar assets within the SFS site and the wider precinct. This should include the newly constructed pitch.
- As far as possible, seek to reduce overflows from Moore Park Road into Paddington Lane which under the development proposals is likely to become an overland flow path to the existing SCG basement with limited opportunities for overflow. This means that there is a risk that overflow from Moore Park Road would drain directly into the basement rather than towards Driver Avenue as it does in the existing condition. This is a key flooding risk associated with the development proposals.
- Consider and manage the risk of backflows through pit and pipe infrastructure from the Driver Avenue Sydney Water system into the SFS site during a significant storm which could exacerbate flooding conditions associated with the proposed development.

The principles of these recommendations have been implemented into some preliminary flood modelling which is described in greater detail in Appendix C. This modelling demonstrates it is possible to manage the identified flood risks within the SFS site boundary in a manner that does not exacerbate downstream flooding conditions.

Appendix A contains flood maps illustrating the results of this assessment, both with and without on site storage (refer to flood map 2.1D and 3.1D) and which has

been found to be highly effective at reducing downstream risks (refer flood map (3.1A). Figure 9 provides a high level summary of how these recommendations could be implemented which is the basis of the flood maps presented in this report. It is noted that this represents just one possible solution that shall be developed in further detail as part of a future Stage 2 SSDA.

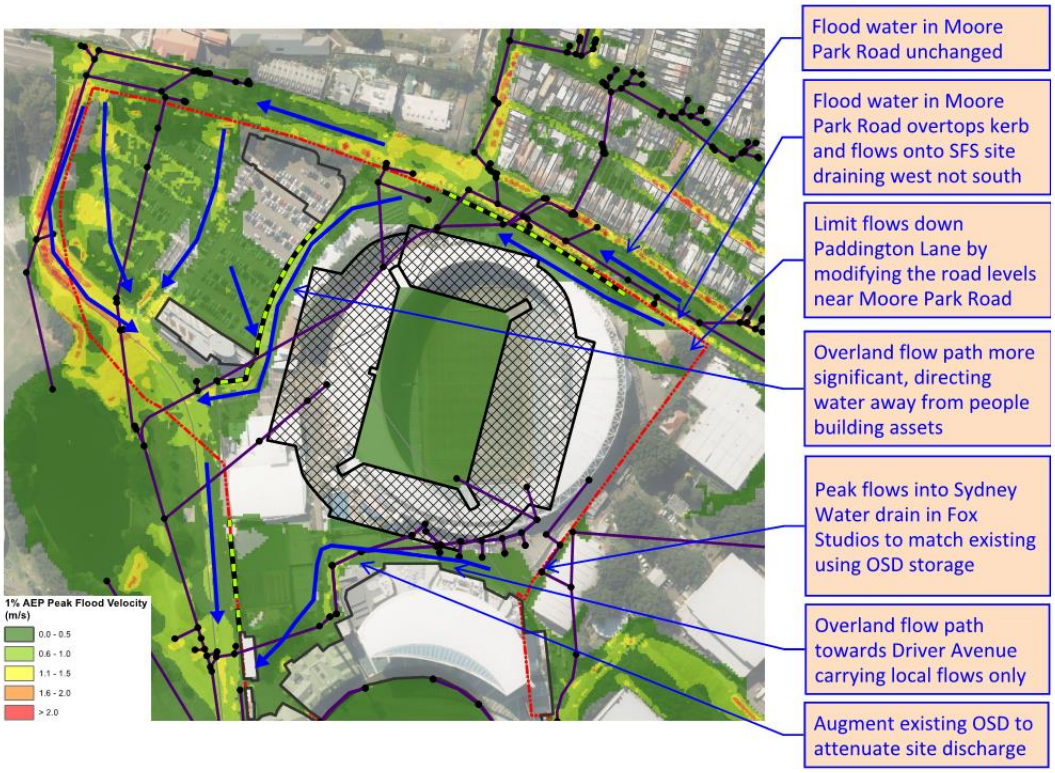


Figure 9. Summarising the approach to managing overland flows in the SFS site during the 1 in 100year ARI event by implementing the recommendations

By adopting these principles, Arup considers it practical to satisfy City of Sydney Council's requirements for water and flood management as outlined in the Sydney DCP 2012 and the Interim Floodplain Management Policy (May 2014).

4.4 Further work

As the design progresses, many aspects of the design will be further refined, and there will be opportunity to test alternative options. Further work to be undertaken as part of the stage 2 application should include (as a minimum):

- Assessment using Australian Rainfall and Runoff 2016 as per the latest industry best practice, refer to Section 4.4.1;
- Investigation of alternative flood storage locations, including potential for above ground storage;
- Testing of various combinations of on site detention (OSD) and permissible site discharge (PSD), confirm the Sydney Water requirements for this site; and
- Refinement of surface grading – potential for some water to be directed on longer flow paths.

4.4.1 Australian Rainfall and Runoff 2016 (ARR 2016)

As previously discussed all flood modelling undertaken to support the Stage 1 application is based on the previous CoS flood study. This study was developed using ARR1987, which has since been superseded by ARR 2016. Arup undertook an initial sensitivity study to understand what the likely impacts of changing to using ARR 2016 would be on the results and the recommendations of this report.

Key changes to the model in respect of implementing ARR 2016 include:

- Initial and continuing losses;
- Impervious surface fraction;
- Ensemble temporal patterns;
- Updated rainfall IFD data; and
- Application of pre-burst depth.

The outcomes of this high level sensitivity assessment indicate that generally, a reduction in peak flows and surface flooding volume for the 1 in 100 year ARI event is likely to occur. This results in lower peak flood levels across the site and particularly for the trapped low point on Driver Avenue. The results of the sensitivity test can be seen in Figures 11.1D in Appendix A.

As part of the next stages of the development application, it is recommended City of Sydney Council are consulted about the hydraulic modelling approach to identify which version of ARR should be used for the assessment of this development.

5 Stormwater

5.1 Existing stormwater network

5.1.1 Sydney Water assets

There are several existing Sydney Water stormwater assets in and around the site, and there is a trunk drainage network mirroring the existing overland flow path from north-east to south-west.

Figure 10 shows a number of pipes enter the site along its northern edge, near the intersection of Moore Park Road and Oatley Road, crossing the site to Driver Avenue:

- Parallel ∅600 and ∅400 pipes run into a ∅900 just inside the site boundary, east of Oatley Road, running to the south-west;
- A ∅600 enters the site from the Oatley Road intersection and joins the ∅900 approximately 30m inside the boundary;
- A ∅450 runs south under the Sheridan building and joins the ∅900 which has increased to ∅1350;
- The ∅1350 continues across the site, around the NRL headquarters and under Driver Avenue;
- The ∅1350 joins a 1275x1050 culvert which runs south along Driver Avenue to Lang Road; and
- An additional ∅900 runs from the western side of the SFS to the box culvert west of Driver Avenue.

In addition to this network, there is a separate culvert that runs from the south-east corner of the site, through Fox Studios and the EQ to Centennial Park, discharging in Busby's Pond:

- 1425x1200 culvert exiting the site east of the SCG basement access at the bottom of Paddington Lane. This culvert used to extend further into the site, but was truncated at a pit near the boundary when the Bradman-Noble stand and associated basement were constructed.
- ∅1050 from within Fox studios joins the culvert above, and the size increases to 2400x1200.

Currently the site discharges to both the Driver Avenue and Fox Studios trunk mains, though the area discharging to Fox Studios was reduced when the Noble-Bradman Stand upgrade was complete.

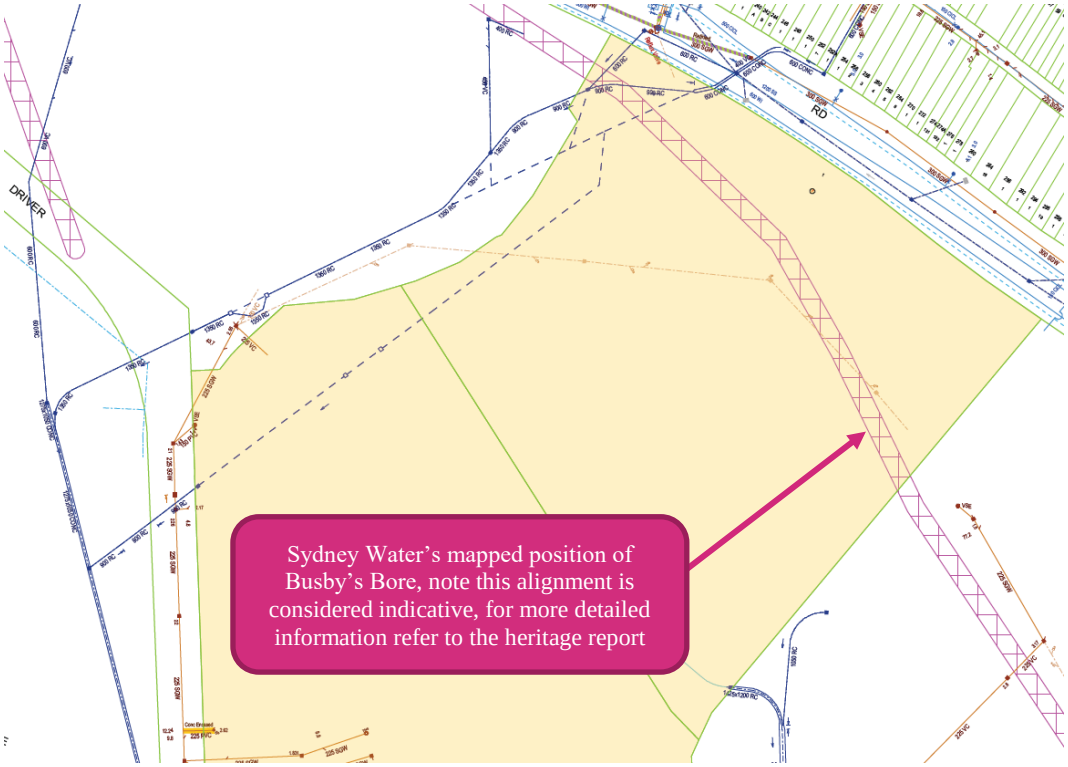


Figure 10: Existing Sydney Water network map in the vicinity of the site

5.1.2 Private stormwater assets

There is an existing pit and pipe network that serves the site, draining public domain areas, and collecting stadium roof drainage. It is understood that most of the network is as constructed with the existing SFS in the late 80s, although some modifications were made when the Bradman-Noble Stand upgrade was completed.

The site stormwater infrastructure consists of pits and pipes which encircle the existing stadium, with grated inlets for capturing surface water. Downpipes from the stadium roof also connect to these pits. The pipes draining the roof and public domain areas are roughly divided into four sectors which discharge to the Sydney Water network in different locations.

Originally, the northern and western segments discharged to the Driver Avenue culvert, while the eastern and southern segments discharged to the Fox Studios culver. However, during the Bradman-Noble Stand upgrade, the southern segment was redirected to the Driver Avenue culvert, via a new on site detention (OSD) tank, to allow additional downstream capacity for the Fox Studios culvert.

In addition to the roof and external drainage, there are also pipes draining the pitch and stands. This network also discharges to the Driver Avenue culvert.

The existing site stormwater network is shown in Figure 11.

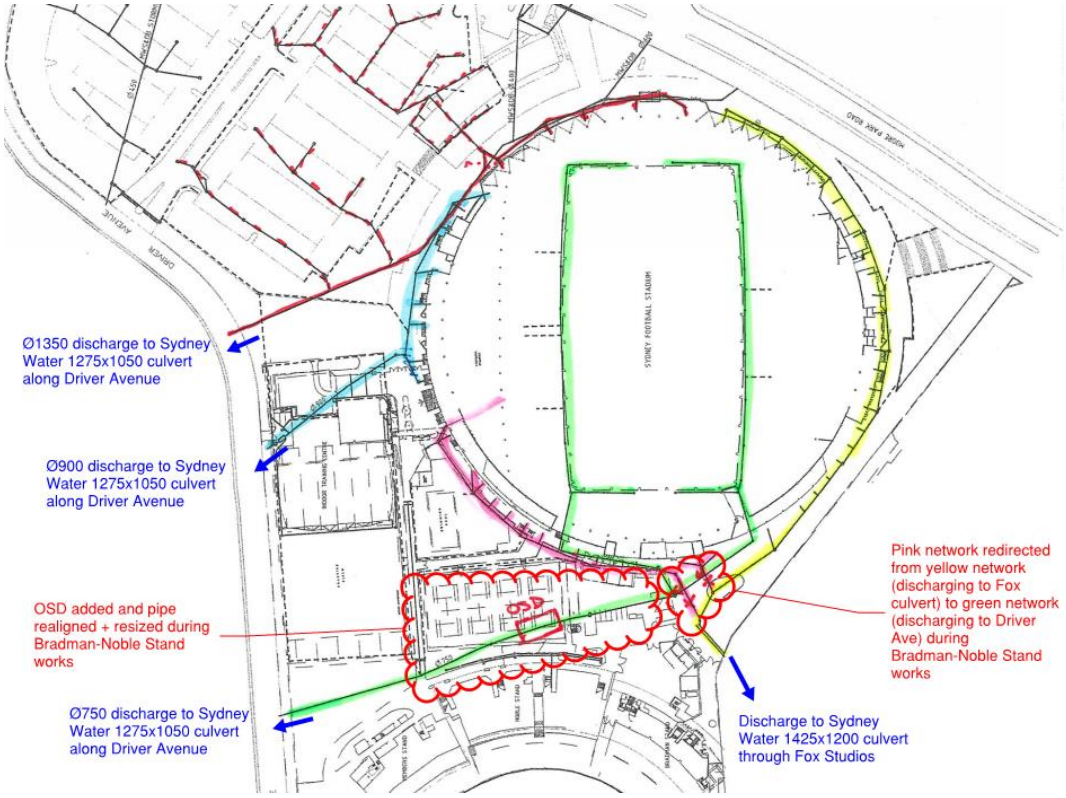


Figure 11: Existing site drainage network

5.2 Impacts of proposed development on existing stormwater network

This section discusses the likely impacts of the proposed development as described in Section 3 of this report and based on the public domain concepts. It is noted that the project is in a preliminary phase and will be subject to detailed design. This section will demonstrate one possible solution for diverting and connecting to the existing stormwater assets, whilst allowing future detailed design stages to develop the final design of appropriate mitigation measures.

5.2.1 Sydney Water trunk main

The proposed stadium footprint extends over the current alignment of the Sydney Water ∅900/∅1350 trunk main. The invert of the pipe ranges from approximately RL43.3 at the northern side of the site, to RL37.7 at Driver Avenue. The proposed pitch level is RL39.5, and while the concourse level is RL46, the design intent is for a basement beneath the concourse at a similar level to the pitch. As such, the proposed stadium clashes with this main and diversion is required.

As part of the detailed design of the stadium, which will be the subject of a future development application, the Sydney Water main will be diverted around the northern and western sides of the stadium, beneath the external circulation area. The diversion would be from its entry point to the site at Moore Park Road to the Rugby League Central building, as shown in Figure 12. The length of the diversion would be approximately 220m. This would also require adjustment to

Sydney Water ∅600 and ∅450 stormwater mains that feed this pipe, as well as numerous direct connections from site drainage.

The construction of the diversion would need to be constructed prior to the removal of the existing pipe. As such the sequencing of these works will most likely occur before the construction of the new stadium. Given the new alignment though, this would need to occur after the demolition of the Sheridan and connected buildings.

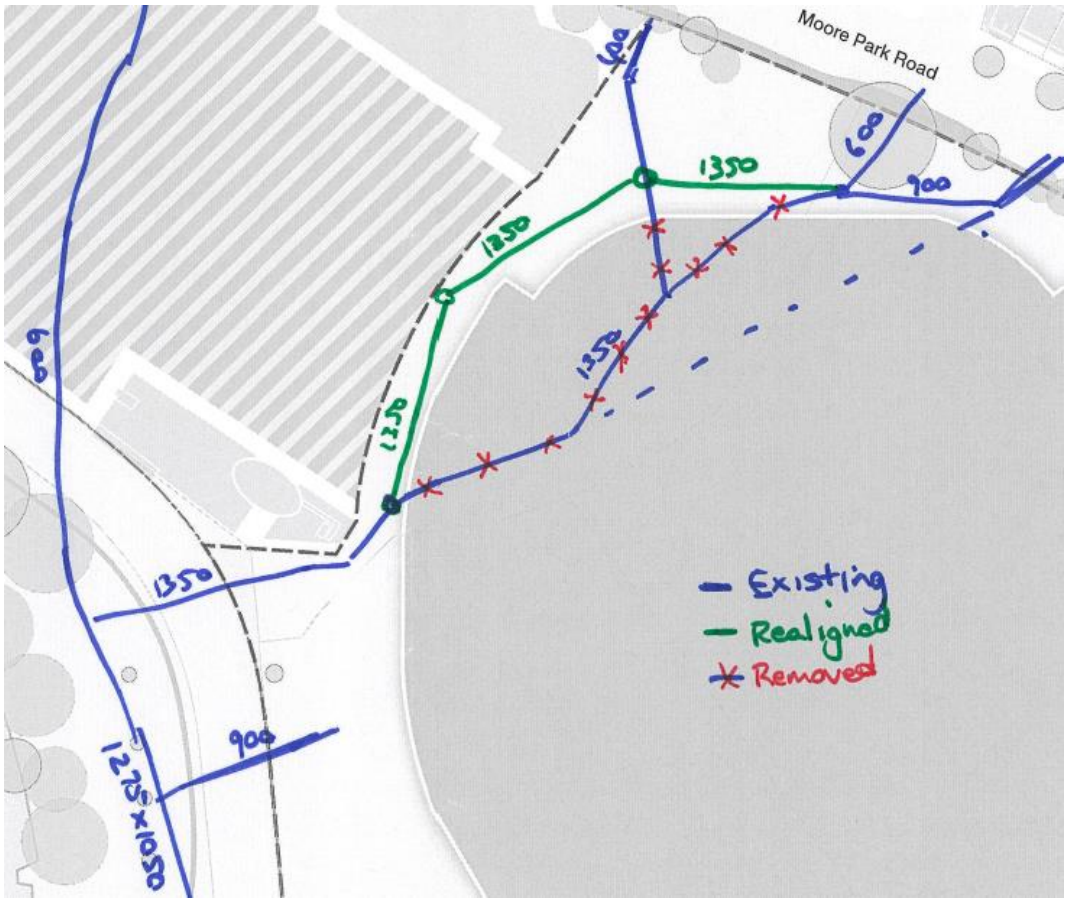


Figure 12: Indicative route of trunk stormwater main diversion

5.2.2 Modifications to existing on site detention (OSD)

The existing 750m^3 OSD was built as part of the Noble-Bradman Stand upgrade, capturing water from the new stands' roof and forecourt area, in addition to part of the roof and pitch drainage from the existing SFS. The OSD tank, along with the pipes that feed it, were built outside the northern edge of the SCG basement.

The OSD tank has a downstream invert of approximately RL37, and a top of roof slab level of approximately RL39.6. As part of the future Stage 2 SSDA application consideration should be given to how the stormwater runoff from the plaza area between the SFS and SCG can be drained into this OSD tank. This is likely to require attention in the context of any expansion of the existing SCG basement which has the potential to disrupt existing drainage systems.

The existing network also includes a stormwater quality improvement device (SQID) which may also require relocation. SQIDs are generally provided upstream of OSD tanks to prevent pollutants entering the tanks and compromising its effectiveness.

5.2.3 Modifications to site drainage network

As the stadium footprint will move and public domain levels will change (significantly in places), it is assumed that the entirety of the drainage network service the existing SFS will be removed and replace by a new system serving the new stadium. The exceptions to this is the SCG drainage in the Noble-Bradman stand forecourt.

Drainage from MP1 car park that connects to the Sydney Water main crossing the site will be modified as needed because of the change in site boundary and demolition of the buildings, and the relocation of the Sydney Water main.

5.3 Stormwater Performance Requirements

5.3.1 Sydney Water

The site discharges into Sydney Water assets to the east and west of the site, specifically:

- A 1275 x 1050 concrete main running down Driver Avenue; and
- A 1425 x 1200 reinforced concrete main at the south-east corner of the site that increases to 2400 x 1200 inside the Fox Studios site.

As such, the development must comply with Sydney Water requirements for discharge to these assets. To manage the capacity of their network, Sydney Water set requirements for on site detention (OSD) and permissible site discharge (PSD) for the site, based on the area of the site and its perviousness.

The project site has the following characteristics:

- Area: 67,878 m^2 (approximately);
- Pervious area: 10,660 m^2 (approximately 16%); and
- Impervious area: 57,218 m^2 (approximately 84%).

Based on this information and projects of a similar size and scale, it is likely Sydney Water will establish requirements for the proposed development:

- On site detention (OSD): 1,320 m^3; and
- Permissible site discharge (PSD): 2,110 l/s.

These values have been adopted for the Stage 1 SSDA report as assumed parameters to inform preliminary design proposals and it appears likely these requirements can be satisfied. This will be re-assessed and calculated as part of the future detailed development application in consultation with Sydney Water.

5.3.2 City of Sydney

Section 3.7 of the Sydney DCP 2012 set out City of Sydney's requirements for water and flood management.

The DCP includes requirements for how a drainage network is designed and documented. Key criteria can be applied at a high level, and during preliminary design phases, are outlined below.

Flooding:

The DCP requires site-specific flood studies to be undertaken to demonstrate compliance with the Sydney LEP 2012. According to Clause 7.15(3) of the LEP:

(3) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:

(a) is compatible with the flood hazard of the land, and

(b) is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and

(c) incorporates appropriate measures to manage risk to life from flood, and

(d)is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and

(e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.

Site drainage network capacity:

Drainage systems are to be designed so that on a site with an area greater than 1,000sqm:

- *stormwater flows up to the 5% annual exceedance probability event are conveyed by a minor drainage system; and*
- *stormwater flows above the 5% annual exceedance probability event are conveyed by a major drainage system.*

Site discharge:

Post-development stormwater volumes during an average rainfall year are to be:

(a) 70% of the volume if no measures were applied to reduce stormwater volume; or

(b) the equivalent volume generated if the site were 50% pervious, whichever results in the greater volume of detention required.

Based on the preliminary design and flood modelling undertaken to date, it is considered likely that these requirements can be addressed to the satisfaction of City of Sydney. This shall be explored further as the design develops.

5.3.3 Environmentally Sustainable Design

The ESD report outlines the targets for the project. The following provides an overview of how the stormwater management strategy and design could contribute to achieving such targets:

Green Star

Stormwater is covered by Credit 26 under Green Star Design and As Built v1.2. There are two points available, and a further two innovation points possible. Points are awarded for each of two criteria.

Criterion 26.1 – Stormwater Peak Discharge

One point is awarded where the post-development peak discharge from the site does not exceed the pre-development peak discharge, for either the 1 year ARI event (where there is a low risk of increased flooding due to climate change) or 5 year ARI (where there is a medium or high risk of increased flooding due to climate change).

Criterion 26.2 – Stormwater Pollution Targets

Where criterion 26.1 has been achieved, one additional point will be awarded where the stormwater pollution reduction targets from column A of Table 1 are achieved.

Additional innovation points are awarded where the project meets the targets from column B (one point) or column C (two points).

Table 1: Green Star Stormwater Pollution Reduction Targets

Pollutant	Reduction Target (% of the typical urban annual load)		
	A	B	C
Total Suspended Solids (TSS)	80%	80%	90%
Gross Pollutants	85%	90%	95%
Total Nitrogen (TN)	30%	45%	60%
Total Phosphorus (TP)	30%	60%	70%
Total Petroleum Hydrocarbons	60%	90%	90%
Free Oils	90%	90%	98%

LEED

As per the ESD report, the LEED pathway and the potential to achieve a specific LEED rating has been contemplated for the stadium redevelopment. In order to understand what requirements this pathway may place on the design of the stormwater systems will be, further detailed design will be required and this will be explored as part of a detailed development application. Nevertheless, it is considered likely that the LEED requirements for stormwater will be similar to that of the Green Star requirements.

5.4 Proposed Stormwater Network

5.4.1 Adjustments to existing assets

The proposed network includes adjustment to parts of the existing network, including the major Sydney Water stormwater pipe crossing the site, and the Noble-Bradman Stand OSD tank. These adjustments are discussed in Section 5.2. The proposed stormwater network will be subject to further design development and assessment as part of the Stage 2 Development Application.

5.4.2 Proposed pit and pipe network

The proposed site network will mirror the form of the existing network:

- A 'ring' of pipes around the stadium, with grated inlet pits capturing water from public domain areas:
  - Indicative spacing of pits is one 900x900mm grated inlet per 2,000m^2 or public domain space;
- Roof drainage flowing into this 'ring' network, either at pits or direct connections;
- Pitch drainage connecting to this network; and
- Discharge to the external network at four locations:
  - ∅1350 pipe connecting to the Driver Avenue culvert just south of Rugby League Central;
  - ∅900 pipe connecting to the Driver Avenue culvert under the existing Cricket NSW building;
  - ∅750 pipe connecting to the Driver Avenue culvert west of the Noble-Bradman Stand (incorporating existing OSD); and
  - ∅675 pipe connecting to the Fox Studios culvert east of the existing SCG basement access.

The split of catchments between discharge points will be similar to existing, though will depend on final OSD locations. Given the roof catchment will increase, and the eastern forecourt will grow, it is likely that the length of the existing eastern catchment will decrease to limit flows to the Fox Studios culvert.

5.4.3 Proposed on site detention (OSD)

To mitigate adverse downstream flooding impacts, additional OSD is required. This may be provided in one or more new tanks, above ground, or some combination of the two. The size/s and location/s of OSD will be confirmed as design progresses, Section 4 discusses one possible solution for this provision.

In general, it is desirable for OSD to be placed as far downstream as possible. This means that a greater portion of the catchment can be fed to it, providing better control of discharge to the external network. Further, as SQIDs are typically

placed upstream of OSDs to help reduce maintenance requirements, this also reduces untreated discharge.

The site currently discharges to the Sydney Water network at four different points, only one of which (a ∅750 pipe discharging to the Driver Avenue culvert) currently incorporates any OSD. As such potential locations for OSD prior to other discharge point could be:

- Under the Driver Avenue forecourt area, prior to connecting into either the existing ∅1350 or ∅900 mains that discharge to the Driver Avenue culvert; and
- North of the basement access at the end of Paddington Lane, prior to discharging into the Fox Studios culvert. There is an existing pipe running down the eastern side of the basement access to this culvert. OSD here may allow this culvert to have a larger catchment without increasing discharge rates.

In addition to the above, there are other areas that of the site where available space and lack of constraints may mean they are suitable for OSD:

- The eastern forecourt has a larger open space area, and the area between the edge of the existing and proposed stadiums is likely to be relatively free of other existing services.

While this area is at the upstream end of the site, an OSD here could serve part of the roof, which is a significant catchment. This will be confirmed as part of the Stage 2 SSDA.

5.4.4 Roof drainage

Roof drainage will be designed by the building hydraulic engineer. However, the stadium drainage system will discharge to the proposed stormwater systems described in Section 5.4.2. The design of the roof system and these connections will be explored in more detail as part of the stage 2 SSDA.

5.4.5 Pitch drainage

Drainage for the pitch will be designed by a specialist pitch consultant. However, the pitch drainage system will discharge to the Sydney Water network via the site drainage network, noting that some drainage will also occur by infiltration.

It may be possible to provide some OSD beneath the pitch to further improve downstream flooding conditions.

5.4.6 Water quality

Water quality is to be a central consideration of the design of all new stormwater systems. It is likely that these systems may consist of gross pollutant traps, sediment capture systems, rainwater harvesting, swales, bio-retention and/or rain gardens, ionic exchange filter cartridges and hydrocarbon interceptors.

These water sensitive urban design (WSUD) management systems are required to achieve the targets described in Section 5.3.3. The design of these features will be explored in more detail as part of the stage 2 SSDA.

5.5 Sediment and Erosion Control

During construction, there is a risk of site clearance, earthworks cut and fill operations as well as other site activities resulting in bare soil and existing fill materials exposed to the elements. In this scenario rainfall, and particularly heavy rainfall threatens to scour this material dislodging and transporting fill downstream.

To mitigate the risk of scouring and associated deposition and sedimentation of downstream areas and/or in-ground drainage systems, consideration of sediment and erosion control measures is required. Best practice principles and site management techniques are described in Landcom's *Managing Urban Stormwater* series, commonly referred to as the Blue Book.

Appendix B contains Arup's preliminary sediment and erosion control plan for the SFS project site and the surrounding areas. It is noted this is at a preliminary stage and will need to be developed by the contractor at a later stage of design so as to be coordinated with the sequencing of works.

The proposed sediment and erosion control plan considers the risk of significant storm flows arriving onto the site from Moore Park Road as described in Section 4. During construction, it is considered impractical to accommodate these flows through the site as they pose a very high scour risk as well as a risk to site staff, construction equipment and materials on the site. For this reason, it is recommended that flows from Moore Park Road be temporarily excluded by means of barrier or bund constructed on the northern boundary of the site.

This approach shall be developed in further detail as part of a future Stage 2 SSDA. This is likely to involve consultation with City of Sydney Council who should be aware of the temporary modification and associated flood risk implications to Moore Park Road.

6 Conclusion

The report has assessed the flooding and stormwater impacts and requirements of the proposed Stage 1 SSDA application associated with the Sydney Football Stadium redevelopment. It shows that with works limited to the project site, it is possible to construct the new stadium to meet planning objectives and whilst managing any potential adverse impacts on the surrounding area.

6.1 Flooding

The proposed SFS redevelopment includes a larger stadium footprint than the existing. Whilst several existing buildings on site are to be demolished, given the size and position of the proposed stadium there is likely to be an overall decrease in the space available for overland flow and surface water storage.

This change, along with changes of the grading of public domain areas are likely to reduce the available surface storage within the development site and may increase the speed with which overland flows are directed through the site and in particular towards Driver Avenue. The implications of this could be minor adverse impacts on the local trapped areas downstream of the site, affecting Driver Avenue and Moore Park east, as well as the SCG.

To offset the increased flow speed, additional on site detention (OSD) is proposed as one appropriate means of mitigating downstream impacts. OSD storage will capture direct rainfall and runoff from within the site, and allow its release into the downstream stormwater system to be attenuated in order to manage peak flows and resulting flooding. Analysis shows and OSD volume of 1,320m^3, with a permissible site discharge (PSD) of 2,100L/s should mitigate any adverse downstream impacts such that they are no worse than the existing conditions.

For these reasons, Arup recommends the use of OSD storage as part of the redevelopment whether in the form of below ground technologies (e.g. tanks) or above ground measures (e.g. surface grading). Flooding analysis suggests that with the provision of OSD, the proposed SFS redevelopment can be constructed in such a way to minimise adverse stormwater impacts on surrounding private properties and/or roads, both upstream or downstream of the site, thereby satisfying City of Sydney Council’s planning requirements.

6.2 Stormwater

There is an existing Sydney Water stormwater main crossing the site from Moore Park Road to Driver Avenue (size: Ø900/ Ø 1350). This main clashes with the footprint of the proposed stadium and will need to be realigned around the northern and western sides of the stadium. Existing drains that flow into this main will also require modifications to maintain these existing connections and the sequencing of this work will also require further consideration.

The existing private network draining the current stadium and surrounding public domain areas will likely need to be completely replaced. The design of any new

private stormwater networks will need to respond to the design of the new stadium as well as the extents, levels and grades of public domain areas.

The proposed stormwater network is anticipated to be feature grated inlet pits connected to a pipe network around the stadium that ultimately discharge into the existing Sydney Water infrastructure.

Water quality devices can be provided to limit pollutant loads in accordance with City of Sydney requirements. In meeting City of Sydney requirements, the design would also meet Green Star Pollution Reduction Target B.

6.3 Limitations and risks

Given the preliminary stage of the design of the stadium and the public domain surrounding it, there are limitations and risks associated with the analysis and design work described in this report. As the project progresses, the design will need to be reviewed along with the factors below to ensure objectives continue to be met and to provide confidence in costing and constructability. Key limitations and risks to be addressed in the Stage 2 SSDA may include:

- The final stadium footprint within the site envelope may impact flow paths.
- Public domain levels may be modified as the design develops. This may not have significant impact if the same overland flow paths are retained, but consideration must be given to surface storage and overland flow paths.

6.4 Further work

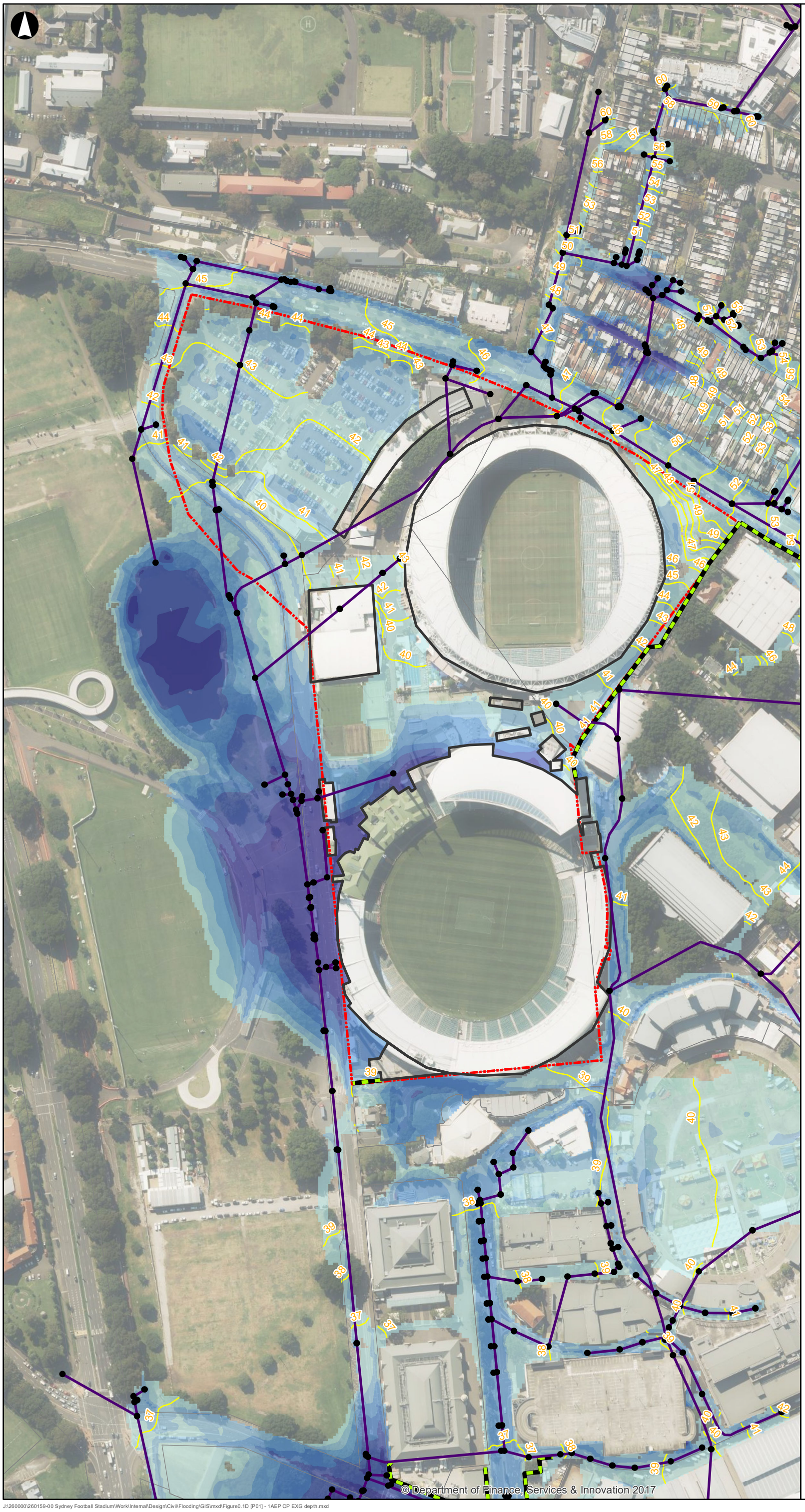
As the design progresses during the stage 2 SSDA, a number of design elements can be progressed to provide more detail and more confidence in the performance of the site in terms of stormwater and flooding. Items that warrant further investigation as the project progresses may include:

- Consideration on the applicability of AR&R 2016, compared to ARR 1987, in flood analysis. AR&R 2016 supersedes AR&R 1987 and was designed to reflect modern best practice. It is considered to provide a better representation of Australian rainfall conditions based on a more complete rainfall dataset and contemporary analytical techniques. However, City of Sydney Council's existing flood model has been calibrated to the AR&R1987 and may need to be refined further before changes can be explored.
- Investigation of the potential for provision of above-ground storage to reduce the necessary OSD volume. Reductions in OSD sizing would reduce spatial requirements and capital cost.
- Exploration of different methods of water quality treatment. While proprietary devices and "hard" engineering can be effective in providing water quality treatment, there are associated costs and maintenance requirements. Alternative "soft" treatments, such as tree pits or rain gardens, can be incorporated into the landscape/public domain design. These may be able to be used instead of/in concert with proprietary devices, and would have different capital cost implications and maintenance requirements.

Appendix A

Flood Modelling Figures

A3



Legend

- Existing Pits
- Existing Pipes
- Existing Buildings
- Walls
- SCGT Boundary
- 1% AEP Peak Flood Level Contours (mAHD)

1% AEP Peak Flood Depths (m)

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

Issue	Date	By	Chkd	Appd
P1	04-04-18	CM	NC	DC

Metres
0 40 80 160

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Client

SYDNEY CRICKET & SPORTS GROUND TRUST

insw Infrastructure New South Wales

Job Title

Sydney Football Stadium

Peak Flood Depth and Level
Existing Conditions
(Council Original Flood Study)
1% AEP Event

Scale at A3

1:3000

Job No	Figure Status	Revision
260159	**Preliminary**	
Figure No **0.1D**		**P1**

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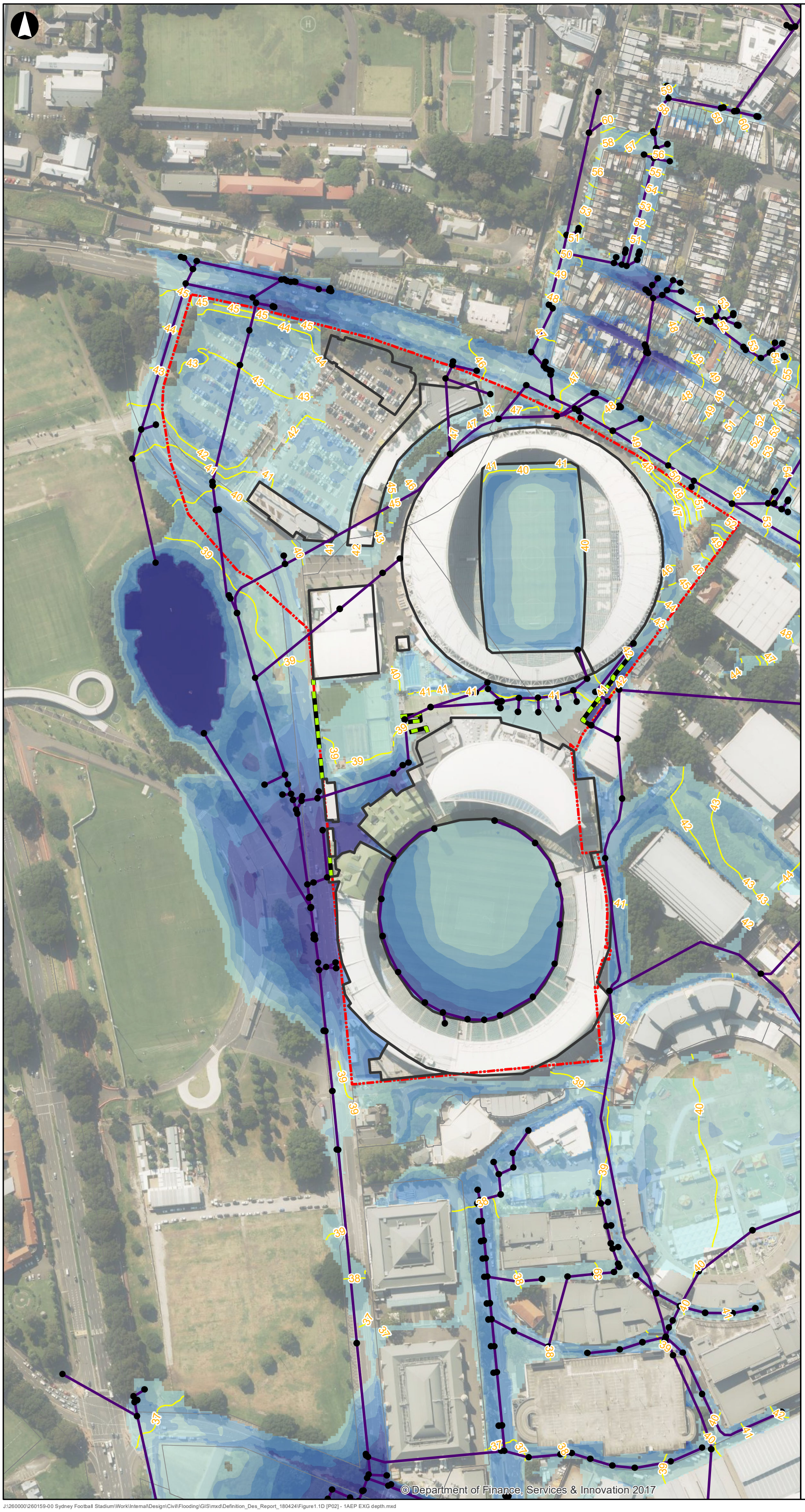
A3



Legend

- Existing Pits
- Existing Pipes
- Existing Buildings
- Retaining Walls/Fences
- SCGT Boundary
- 1% AEP Peak Flood Level Contours (mAHD)

1% AEP Peak Flood Depths (m)

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

Issue	Date	By	Chkd	Appd
P2	19-04-18	NC	CG	DC

Metres
0 40 80 160

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Client

SYDNEY CRICKET & SPORTS GROUND TRUST

insw Infrastructure New South Wales

Job Title

Sydney Football Stadium

Peak Flood Depth and Level
Existing Conditions
1% AEP Event

Scale at A3

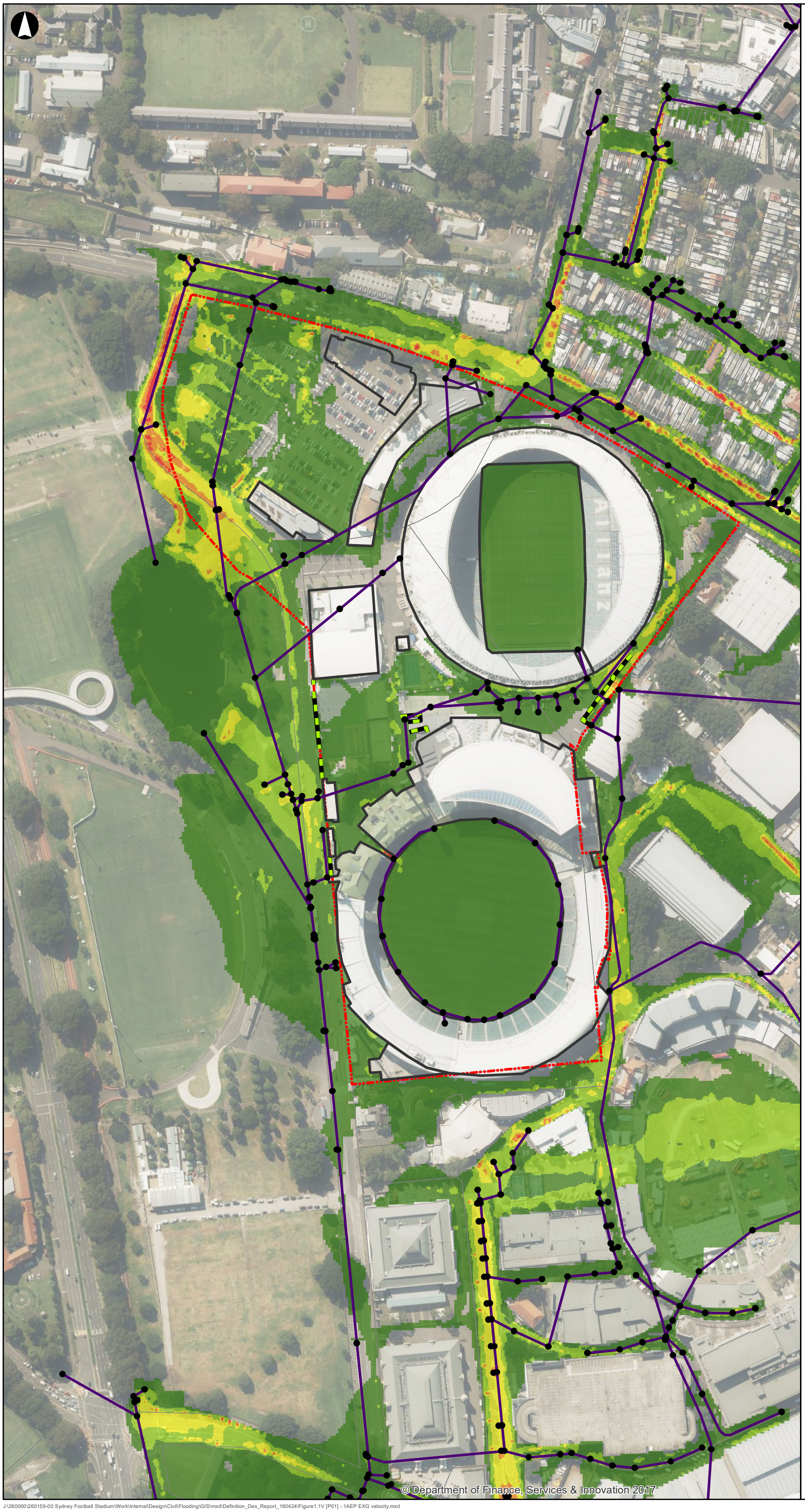
1:3000

Job No	Figure Status	Revision
260159	**Preliminary**	**P2**

Figure No
1.1D

J:\260000\260159-00 Sydney Football Stadium\Work\Internal\Design\Civil\Flooding\GIS\mxd\Definition_Des_Report_180424\Figure1.1D [P02] - 1AEP EXG depth.mxd

A3



Legend

- Existing Pits
- Existing Pipes
- Existing Buildings
- Retaining Walls/Fences
- SCGT Boundary

1% AEP Peak Flood Velocity (m/s)

- 0.0 - 0.5
- 0.6 - 1.0
- 1.1 - 1.5
- 1.6 - 2.0
- > 2.0

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Flooding and drainage network information shown is the property of the City of Sydney and Sydney Water.

Issue	Date	By	Chkd	Appd
P1	19-04-18	NC	CG	DC

Metres
0 40 80 160

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Client

SYDNEY & CRICKET SPORTS GROUND TRUST

insw Infrastructure New South Wales

Job Title

Sydney Football Stadium

Peak Flood Velocities
Existing Conditions
1% AEP Event

Scale at A3

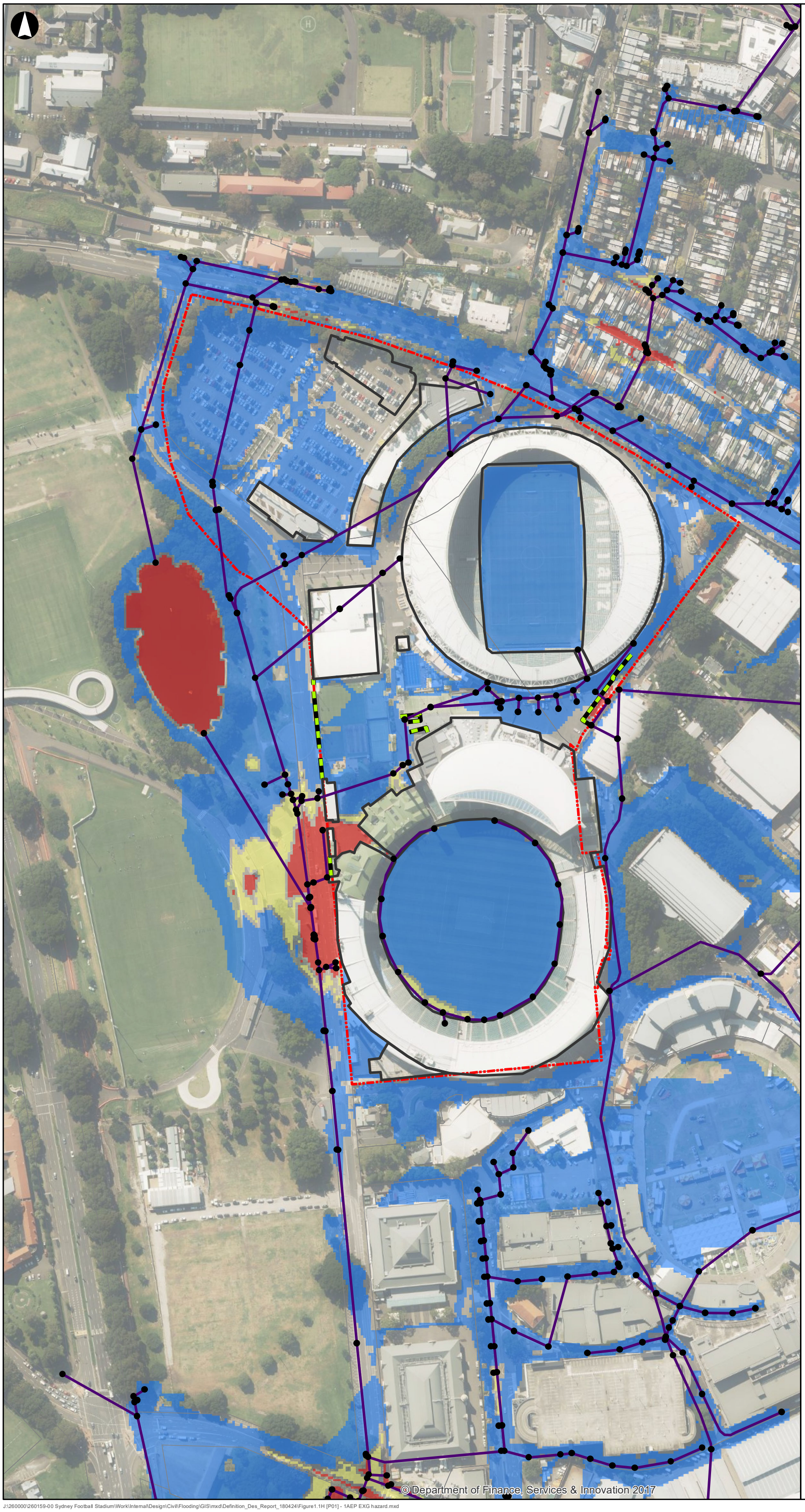
1:3000

Job No	Figure Status	Revision
260159	**Preliminary**	**P1**

Figure No
1.1V

J:\260000\260159-00 Sydney Football Stadium\Work\Internal\Design\Civil\Flooding\GIS\mxd\Definition_Des_Report_180424\Figure1.1V [P01] - 1AEP EXG velocity.mxd

A3



Legend

- Existing Pits
- Existing Pipes
- Existing Buildings
- Retaining Walls/Fences
- SCGT Boundary

Flood Hazard

- High Hazard
- Transition
- Low Hazard

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Job Title

Sydney Football Stadium

Peak Flood Hazard
Existing Conditions
1% AEP Event

Scale at A3

1:3000

Job No	Figure Status
260159	**Preliminary**

Figure No	Revision
1.1H	**P1**

J:\260000\260159-00 Sydney Football Stadium\Work\Internal\Design\Civil\Flooding\GIS\mxd\Definition_Des_Report_180424\Figure1.1H [P01] - 1AEP EXG hazard.mxd