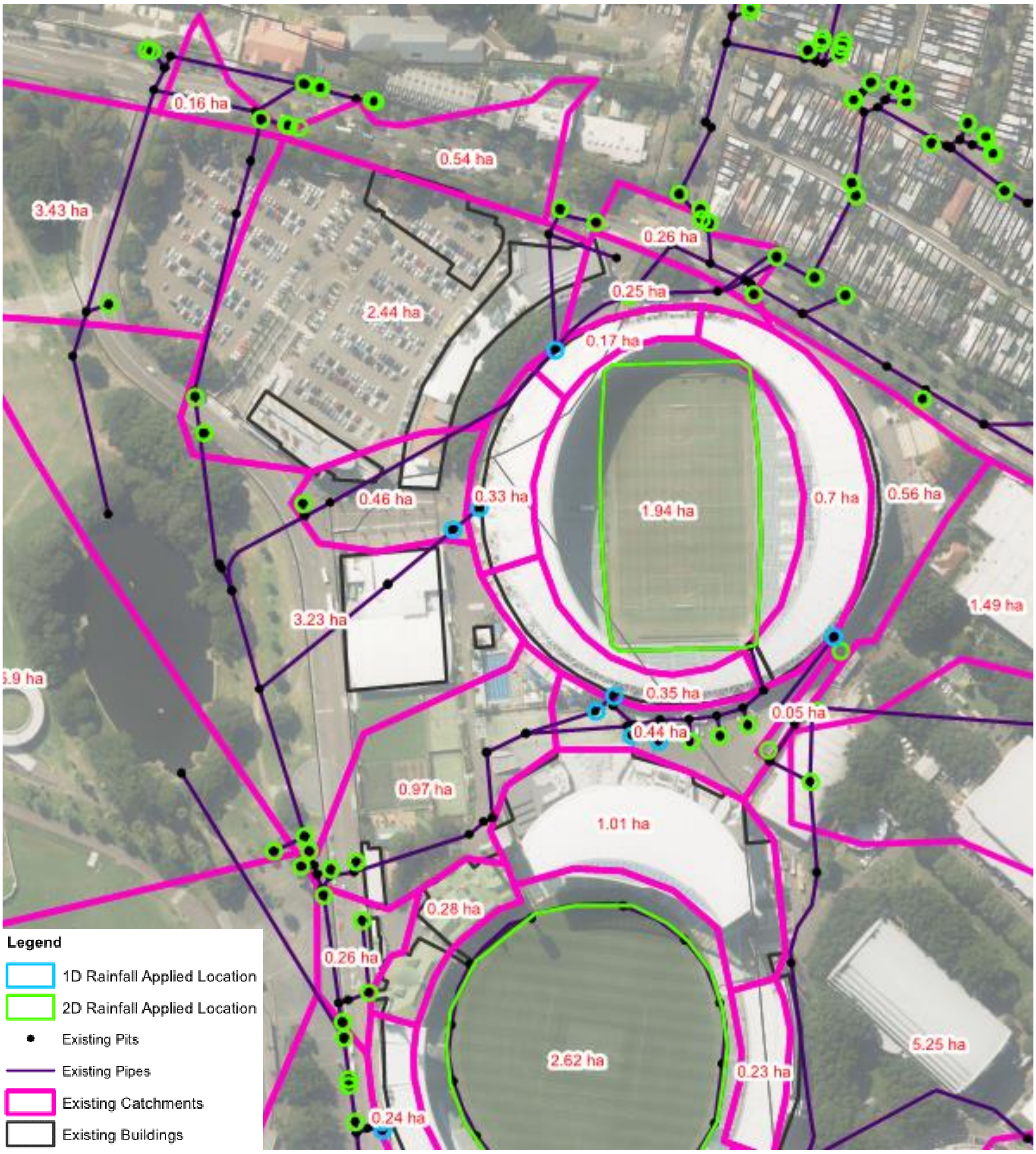

Figure 13: Existing catchments layout

Summary of changes identified in updated Arup flood model

The updated (existing conditions) 1 in 100 year ARI flood depth map is presented in Figure 1.1D in Appendix A. Notable changes in the results when compared with the original Council flood study include:

- Flooding of the field of play areas within the two existing stadia as a result of direct rainfall and surface water flows onto pitches from external areas;

- Increases in water depth on Moore Park Road due to surface features such as bunds and kerbs restricting surface flows draining from the road level onto the site;
- Changes in flooding levels and water flows around the Noble, Bradman and Messenger stands due to changes in levels and drainage infrastructure;
- Minor changes to flooding levels in the existing northern car park largely due to improved topographic information;
- Minor reduction of flooding levels and extents at trapped low point on Driver Avenue due to the changes above; and
- Minor increase in flooding depth downstream of precinct (e.g. at Lang Road) due to corrections in the existing trunk box culvert gradients.

Flood Figures are presented in Appendix A. The 1 in 100 year ARI flood depth map for the Council flood study is presented in Figure 0.1D while Figure 9.1 details the changes to the flood depths when compared with the original Council flood model for the 1 in 100 year ARI event.

The exercise of reviewing and refining the existing TUFLOW model demonstrated that the existing Sydney Water trunk drainage located within the Moore Park precinct does not have adequate capacity to manage in-ground flows during significant rainfall events. In turn, this contributes to surface water flows both upstream of and within, the precinct.

In particular, there is a significant contribution of overland flow from Moore Park Road and upstream areas located to the north of the precinct. The modelling refinements exercise also demonstrated that the movement of water onto the precinct is highly sensitive to changes in ground levels along the northern edge where it connects to Moore Park Road.

Within the precinct, water tends to drain towards Kippax Lake and the trapped low point on Driver Avenue adjacent to the SCG. From this location, water can only escape via the in-ground box culvert (which requires time for the culvert to drain downstream as its capacity is limited). Otherwise, water ponds to a sufficient depth to overflow into the SCG oval.

Owing to existing terrain and trapped low point on Driver Avenue, the existing precinct inherently provides surface storage and effectively self-attenuates the release of water to the downstream in-ground network. Downstream flooding of Lang Road which extends to its intersection with Anzac Parade is primarily a result of overland flow within the road network.

Proposed development modelling

Several aspects of the design can influence flooding. It is noted that the project is in a preliminary phase and will be subject to detailed design. For the purposes of the stage 1 DA, this report considers one possible solution to mitigate the flood impacts associated with the proposed development. The objective of this assessment is to demonstrate that compliance with the flooding objective of “no worsening” upstream or downstream of the site can be achieved. This approach is offered to allow future design stages the opportunity to develop the final design of appropriate mitigation measures.

Surface

Arup has developed a design surface for the site within the project boundary. The grading was developed based on the public domain concepts of the landscape architect, with a podium level around the northern three quarters of the stadium that roughly corresponds to the proposed internal podium level. This level then steps down approximately 4.5m to meet the existing Bradman-Noble-Messenger stand plaza.

For the surface to be self-draining, longitudinal falls have been introduced to the podiums. To preserve the intent of the public domain design, these falls have been kept to a minimum typically ~2.5%. In addition to this, to facilitate flow into drainage infrastructure, gentle crossfalls have been applied to these circulation areas. Typically, this forms a shallow 'V' profile, though in some narrower sections a one-way crossfall has been applied.

In addition to the above, the grading of Paddington Lane has generally been preserved and has been kept separate from the circulation space. However, to allow an overland flow path away from the basement entrance, this area has been regraded, and connects to the lower level circulation space near the existing SCG plaza.

The proposed grading is similar to the existing in terms of its high point and the direction of falls. The grading is generally flatter, except for the stairs between the upper and lower podiums, and from the upper podium to Driver Avenue. The eastern forecourt grows, while the westerns forecourt increases in width but decreases in distance between the stadium and Driver Avenue. At the southern side of the stadium, the Noble-Bradman Stand forecourt level continues to the new SFS – an existing lower level walkway around the SFS is not replicated.

There are several areas where the proposed grading is above or below existing ground levels at the boundary. In these areas, it has been assumed there will be a solid wall along the boundary preventing water from sheeting off the edge.

Catchments

Proposed catchments as included in flood modelling are shown in Figure 14. Delineation of the sub-catchments has been based on existing topography, the proposed surface and runoff distribution based on the property and road drainage network.

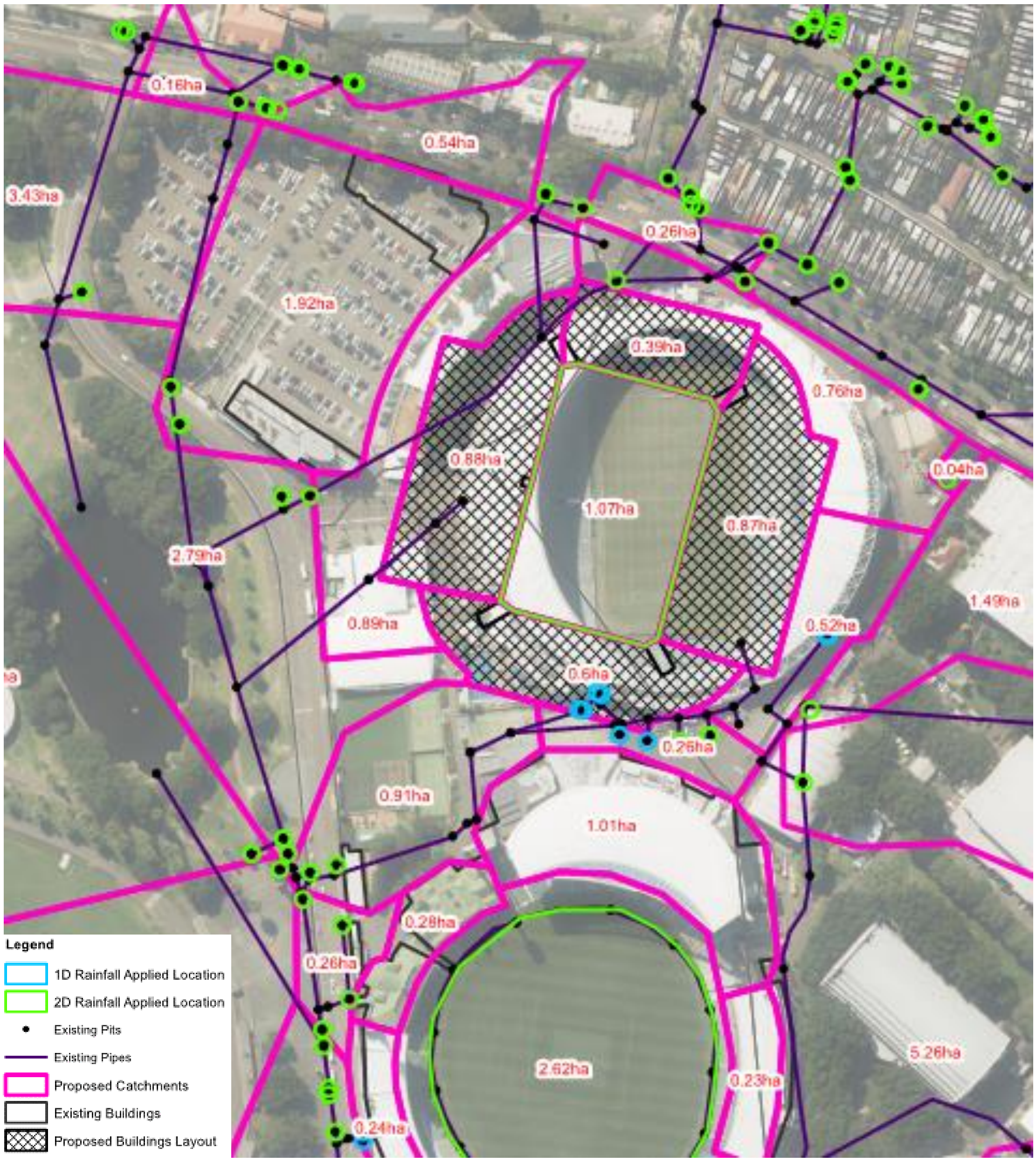

Figure 14: Proposed catchments layout

Drainage network

For initial modelling runs, the drainage network from the existing model was retained, with the changes being the proposed surface and changes to buildings.

Subsequently the proposed drainage network was added to the model to provide a more accurate assessment. The proposed drainage network based on the public domain concepts of the landscape architect is described further in Section 5.

Storage

Initial modelling runs with the proposed development showed increased flood depth downstream of the site. This was considered to result from a more direct overland flow path, with less detention of stormwater within the site.

There is a 750m^3 OSD tank that was constructed as part of the Noble-Bradman Stand works. This OSD captures drainage for the forecourt area, as well as roof drainage from the SFS and SCG and pitch/stand drainage from the SFS.

To reduce adverse downstream impacts due to the development, additional storage is will likely be required as part of the detailed stadium design within the site. This will facilitate attenuation of the flow rate to Driver Avenue and the Sydney Water network at this location.

Storage can be provided either above or below ground. Given the limited public domain space available and the desired circulation outcomes, at this stage in the design development it may be preferable to provide the required storage underground.

Stormwater Discharge

To maintain the existing downstream conditions, it is likely to be preferable as part of the proposed design to maintain the same stormwater drainage discharge points from the site. Due to changes to catchment sizes and resulting stormwater flows, as well as changes to OSD provision, outflows to receiving Sydney Water networks are likely to change. It is desirable that the peak flow rates discharged from the SFS site are restricted so they are less than the for the changes to the peak flow rates to manage the risk of downstream flooding.

Analysis

Overland flow paths

The existing major overland flow path (as shown in Figure 1.1D, Appendix A) is as follows:

1. Water flows down Moore Park Road, with water overtopping the kerb and flowing into the site at the top of Paddington Lane and the access stairs;
2. Water flows south around the eastern side of the stadium;
3. Most water is diverted across the basement entry, and flows into a walkway around the southern side of the SFS (which is lower than the Noble-Bradman Stand forecourt;
4. Water continues between the tennis courts and the pool, some water flowing into the cricket practice pitch area;
5. Water flows along the ‘Walk of Heroes’ and out onto Driver Avenue; and
6. As the water level on Driver Avenue rises, some water flows onto the SCG field, flowing between the Members’ and Ladies’ Pavilions.

Proposed major overland flows (as shown in Figure 3.1D, Appendix A) are similar to the existing, but operate differently around the southern side of the SFS:

1-2. As per existing;

3. Water is diverted across the basement entry, but flows over the Noble-Bradman Stand forecourt, as this now continues at a consistent level to the new stadium;

4. Water flows down the stairs at the western end of the Noble-Bradman Stand; and

5-6. As per existing

Flooding Assessment and Impact Mapping

The method for testing the effectiveness of the proposed flood mitigation measures is to investigate the difference between the existing and proposed case peak flood depths associated with a given design storm event. For the purposes of this stage 1 SSDA, the 1 in 100 year ARI event has been selected as the design storm event and difference maps is presented in flooding figure 2.1A (without mitigation) and 3.1A (with mitigation) in Appendix Av. An extract from flood map 3.1A is reproduced in Figure 15:

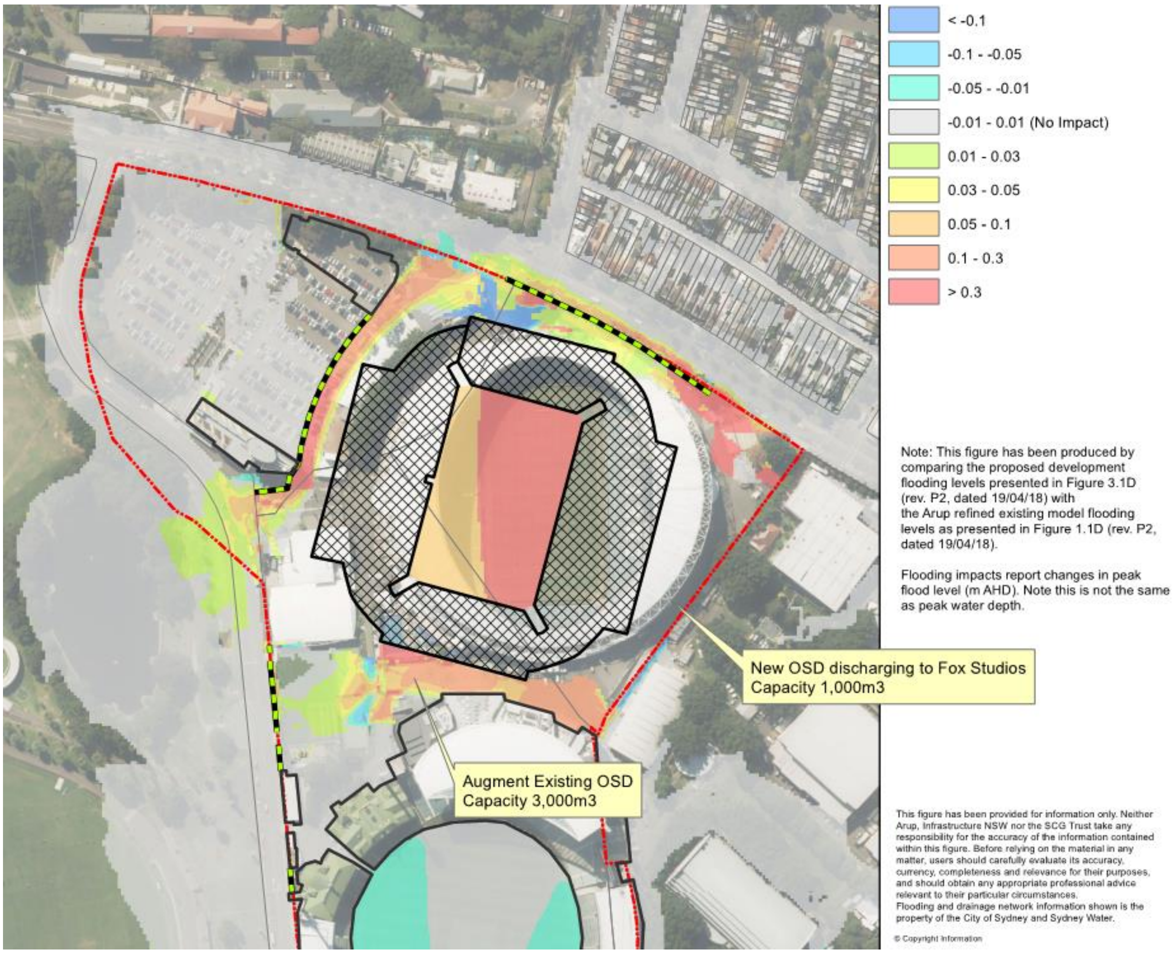

Figure 15. Flood impact map illustrating the differences between the existing and proposed case peak flood depths

The impact map illustrates that it is possible to reduce impacts upstream and downstream of the site to the range of ±1cm which is conventionally considered to be a negligible impact within the context of accuracy limitation of the modelling exercise. Arup considers this figure demonstrates it is possible to satisfy City of Sydney’s requirements for flood risk management.

Flood Hazard

Flood hazard represents the potential for harm or loss resulting from flooding. The NSW Floodplain Development Manual defines high and low hazard as follows:

- *High hazard: possible danger to personal safety; evacuation by trucks difficult; able-bodied adults would have difficulty in wading to safety; potential for significant structural damage to buildings/*
- *Low hazard: should it be necessary, truck could evacuate people and their possessions; able-bodies adults would have little difficulty in wading to safety.*

Flood hazard is assessed based on the relationship between flood depth and velocity at a location, with increase depth and/or velocity being more hazardous.

The preliminary flooding undertaken for this stage 1 application, shows that flood hazard is similar for both existing and proposed scenarios (refer Figures 1.1H and 3.1H, Appendix A). There is a high-hazard area outside the Members’ and Ladies’ Pavilions extending onto Driver Avenue outside the Ladies’ Pavilion and Brewongle Stand (see Figure 16). The area of high hazard corresponds to the trapped low point in the existing surface.

There are no high-hazard areas in the project site under either proposed or existing scenarios.

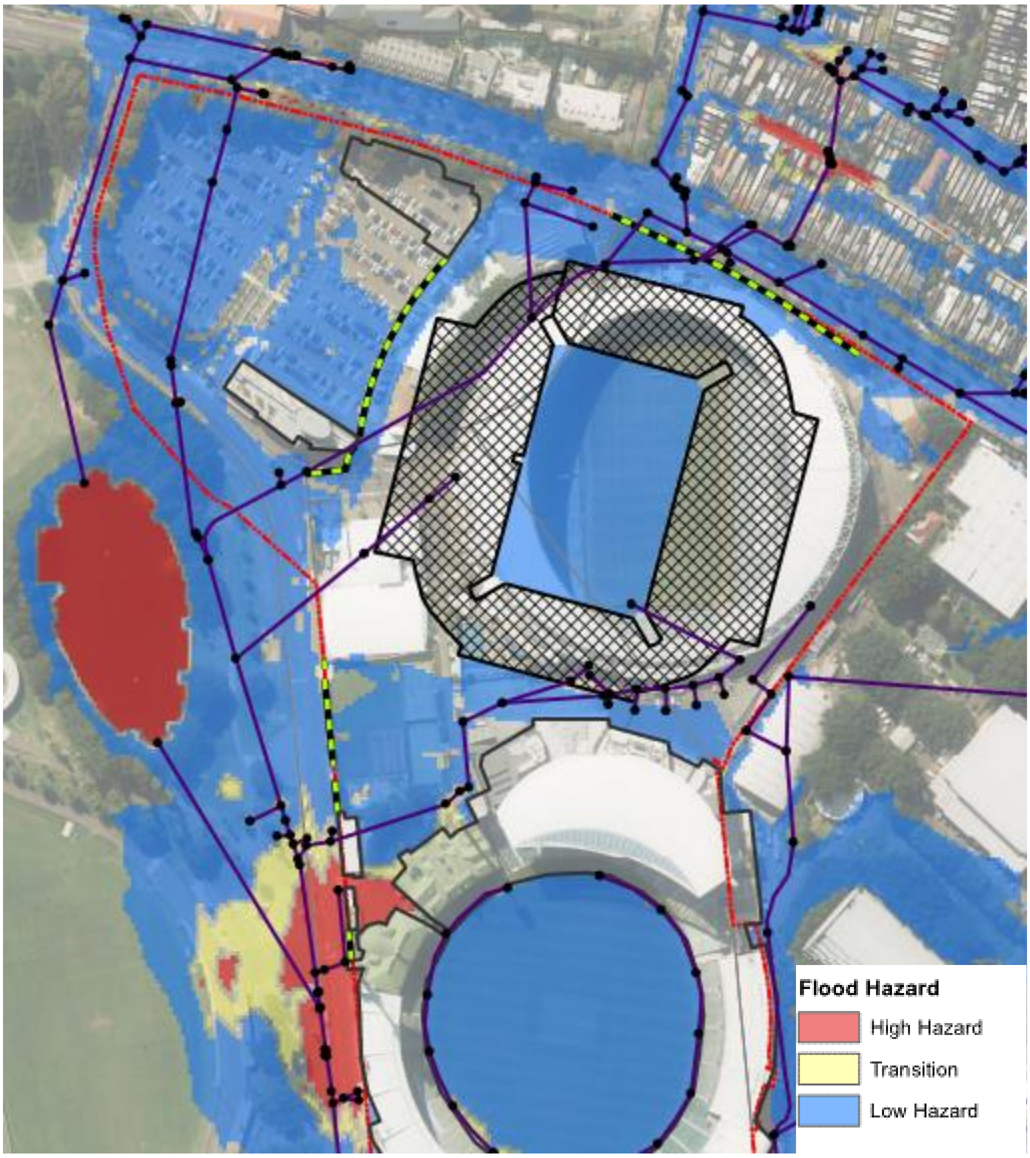

Figure 16: Flood hazard map during 1 in 100year ARI flood

Climate change

The NSW Office of Environment and Heritage has release Floodplain Risk Management Guideline, including *Practical Consideration of Climate Change* (2007).

Climate change factors impact flooding, but their degree of influence varies by site. The two main impacts on flooding are:

- Sea level rise: this is not considered to affect the site as it is not coastal and flooding is not related to any tidal waterways; and
- Increased frequency of events due to increased rainfall intensities. This may affect the site, and is typically considered in terms of sensitivity analysis.

The guideline identifies several factors that may make climate change a significant issue for a location. Given the usage of the site, and existing flooding conditions including hazard, climate change is not considered a significant issue as:

- New floodways are unlikely to result from climate change;
- Flood hazard is external to the site, and in an unoccupied area – it is primarily a result of downstream constraints beyond the scope of this project;
- Inundation does not affect the viability of the site; and
- The design will need to be resistant to flood damage, regardless of flood frequency. The proposed development will not increase the potential for damage.