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Mr Tom Hu
Project Director
Kapau Holdings Pty Ltd
Level 6, 200 George Street
SYDNEY NSW 2000

12th December 2013

Dear Tom,

**66A DONCASTER AVENUE, RANDWICK
FLOOD CONSTRAINTS ASSOCIATED WITH POTENTIAL USE OF SITE AS A LIGHT RAIL
STABLING FACILITY**

I refer to your recent request for us to provide some commentary on the potential flood related constraints that could impact on the Transport for New South Wales (TfNSW) proposal to develop the Anson City Developments 1 Pty Ltd site at 66A Doncaster Avenue, Randwick, as a light rail stabling facility.

The following is a summary of the findings of our investigations which has included a review of the following documents:

- '66A Doncaster Ave, Randwick – Flood Impact Assessment' (WorleyParsons, 2010)
- 'Kensington – Centennial Park Flood Study' (WMAwater, 2013)
- 'CBD and South East Light Rail Project – Environmental Impact Statement', (Parsons Brinckerhoff, November 2013)
- 'CBD and South East Light Rail Project – State Significant Infrastructure Application', Supporting Document (TfNSW, June 2013)
- 'CBD and South East Light Rail Project – Information Boards, Alison Road to Randwick' (TfNSW, September 2013)
- 'Submission from Randwick City Council on CSLER EIS' (Randwick City Council, December 2013)

1. BACKGROUND

In 2010, WorleyParsons prepared a Flood Impact Assessment (FIA) Report for the proposed residential and community centre development at 66A Doncaster Avenue, Randwick. This included flood modelling investigations to assess existing flooding constraints at the site and to determine options for mitigating those constraints and optimising the development potential of the site.

The model that was developed for the FIA relied upon a series of draft modelling results provided by Randwick City Council (Council). The results were extracted from investigations then underway for the 'South Sydney – Centennial Park Flood Study'. The model developed for the FIA was used to assess the potential impact of the proposed development on flood characteristics and to guide the design of elements of the development so that its impacts were minimised.

Figures identifying existing flood behaviour for the 100 year Average Recurrence Interval (ARI) event have been extracted from the FIA Report and are provided in **Attachment A**.



In 2012, WorleyParsons undertook further investigations to establish any changes to the predicted flood impacts as a result of a refinement to the development proposal. These further investigations established that the modified development proposal did not materially alter the predicted flood impacts. Hence, the original FIA Report (*WorleyParsons, 2010*) established the potential flood impacts that would arise as a consequence of the proposed development of the site.

Earlier this year, the Randwick City Council commissioned flood modelling was finalised and are documented in a report titled, '*Kensington – Centennial Park Flood Study*' (KCPFS) (2013). That report was published after our most recent advice on flooding constraints for the proposed development. In recognition of this, we have reviewed the final KCPFS. Unfortunately, it is not clear from the KCPFS whether any modifications have occurred to the draft modelling results that were relied upon for the WorleyParsons' FIA Report.

2. PROPOSED LIGHT RAIL STABLING FACILITY

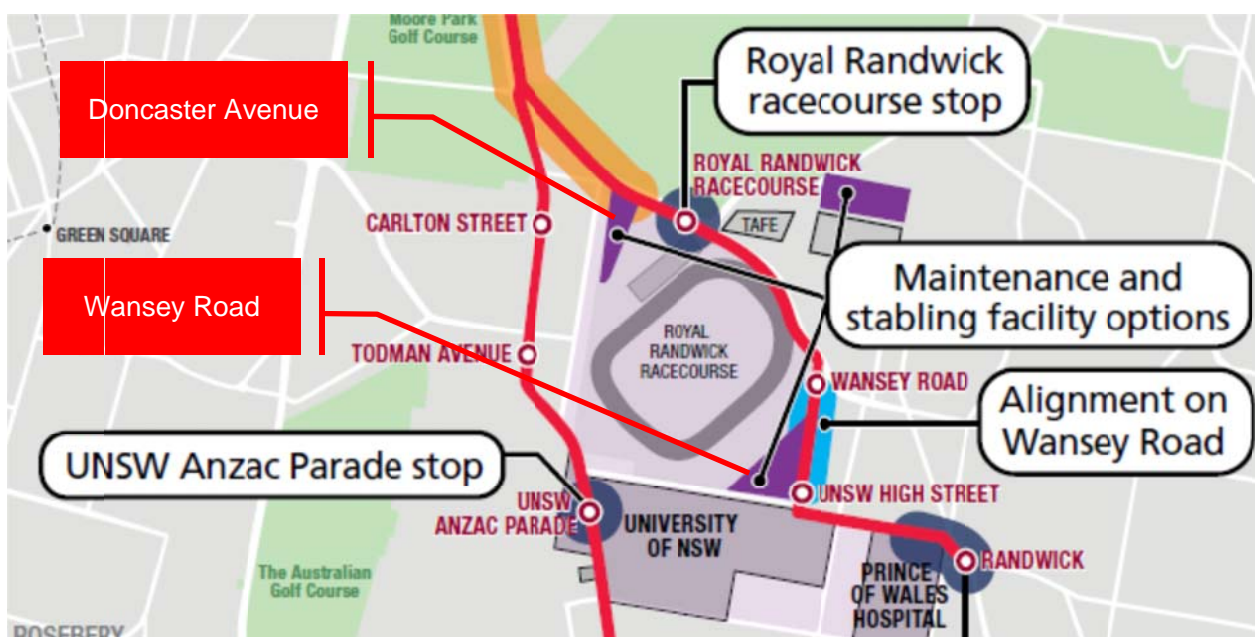
The proposal for a light rail stabling facility is a component of the CBD and South East Light Rail Project (CSELR). A State Significant Infrastructure Application (SSI_6042) was prepared for the CSELR by Transport for NSW (TfNSW) and was submitted to the Department of Planning and Infrastructure (DP&I) in June 2013. The Director General of the DP&I subsequently issued environmental assessment requirements (DGR's) in August 2013. An Environmental Impact Statement (EIS) has subsequently been prepared and aims to address the DGR's. The EIS is on public exhibition from 14th November 2013 to 16th December 2013.

The EIS provides background information on the site selection process for the stabling facility and preliminary details of the proposed stabling facility function and development. These items are discussed further in the following sections.

2.1 Site Selection

Two main options have been considered in the EIS for the location of the light rail stabling facility as highlighted in **Figure 1**. These are:

- (i) Doncaster Avenue, Randwick
- (ii) Wansey Road, Randwick



Source: CSELR EIS (Figure 4.3), Parsons Brinckerhoff, November 2013

Figure 1 Options for Light Rail Stabling Facility Location



A number of opportunities and constraints were identified for both sites. However the “key differentiator” which led to the selection of the Doncaster Avenue site as the preferred option was that the Wansey Road site is currently occupied by a number of horse stables which would require relocation. This was determined to incur additional costs and would require a greater extent of property acquisition relative to the Doncaster Avenue site.

No mention is made in the site selection summary (*Section 4.5.1 of the EIS*) of any of the following:

- flooding issues experienced at the Doncaster Avenue site
- potential impacts existing flood behaviour would have on operations at the site
- costs associated with works required to improve the Doncaster Avenue site to provide acceptable flood risk for operations at the site
- costs associated with upgrading both the local and downstream trunk drainage systems to ensure no negative impact on flood behaviour to surrounding developments.

It is not known whether the above issues were considered as part of the site selection process at all or were thought to be insignificant.

It appears that the Wansey Road site is predominantly, if not completely, outside the flood extents for all events up to and including the Probable Maximum Flood (PMF). Hence, the development of the Wansey Road site as a stabling facility would not require expenditure to address flooding or flood management issues.

2.2 Doncaster Avenue Site Development

Design details of the proposed stabling facility at Doncaster Avenue are limited due to the project being in the early planning stages. The concept plan shown in **Figure 2** provides the greatest level of design detail that has been found to be available.

The boundary of the property owned by Anson City Developments 1 Pty Ltd and referred to as 66A Doncaster Avenue, has been added to this figure. This shows that the light rail facility extends beyond the boundary of this site to include additional lands to the north and to the west.

No information has been located which provides proposed finished surface levels for the stabling facility. However, it is noted in the EIS (*Section 10.2.2*) that the proposed stabling facility will likely be raised above existing levels such that it is “*closer to the existing road levels in Alison Road*”.

3. REVIEW OF FLOODING INFORMATION

A comparison of the 100 year ARI flood extents and velocities provided in the KCPFS (*refer Attachment B*) with those documented in the WorleyParsons' FIA Report (*refer Attachment A*) indicates that the separate modelling undertaken for these reports has generated only minor differences in flood characteristics. Therefore, we have based our commentary on the data available in the KCPFS as this is a publicly available document that has been adopted by Council (*11th June 2013*) for flood planning purposes in this area.

3.1 Existing Flood Behaviour

The findings of the KCPFS indicate that the capacity of the existing stormwater pipe system under Alison Road to the north of the site can be exceeded during periods of heavy rainfall across the Centennial Park catchment. This results in stormwater flows from Centennial Park travelling overland across Alison Road towards the proposed light rail stabling facility site. As a result, there is potential for the site proposed for the light rail stabling facility to be inundated during flood producing storms that occur across the Centennial Park catchment.



Flood modelling undertaken for the KCPFS included design event analysis for a range of design storm events ranging from the 5 year ARI flood to the Probable Maximum Flood (PMF). The results of this modelling show that the site would be inundated to depths of up to 0.5 to 1.0 metres during the 5 year ARI event. Peak overland flow velocities of 0.2 to 0.5 m/s are predicted towards the north western corner of the site.

These results suggest that the site would be exposed to flooding in events less rare than the 5 year ARI storm. Although modelling has not been undertaken to determine the design storm frequency that would trigger inundation of the site, it is suggested that this is likely to be in the order of the 2 year ARI event.

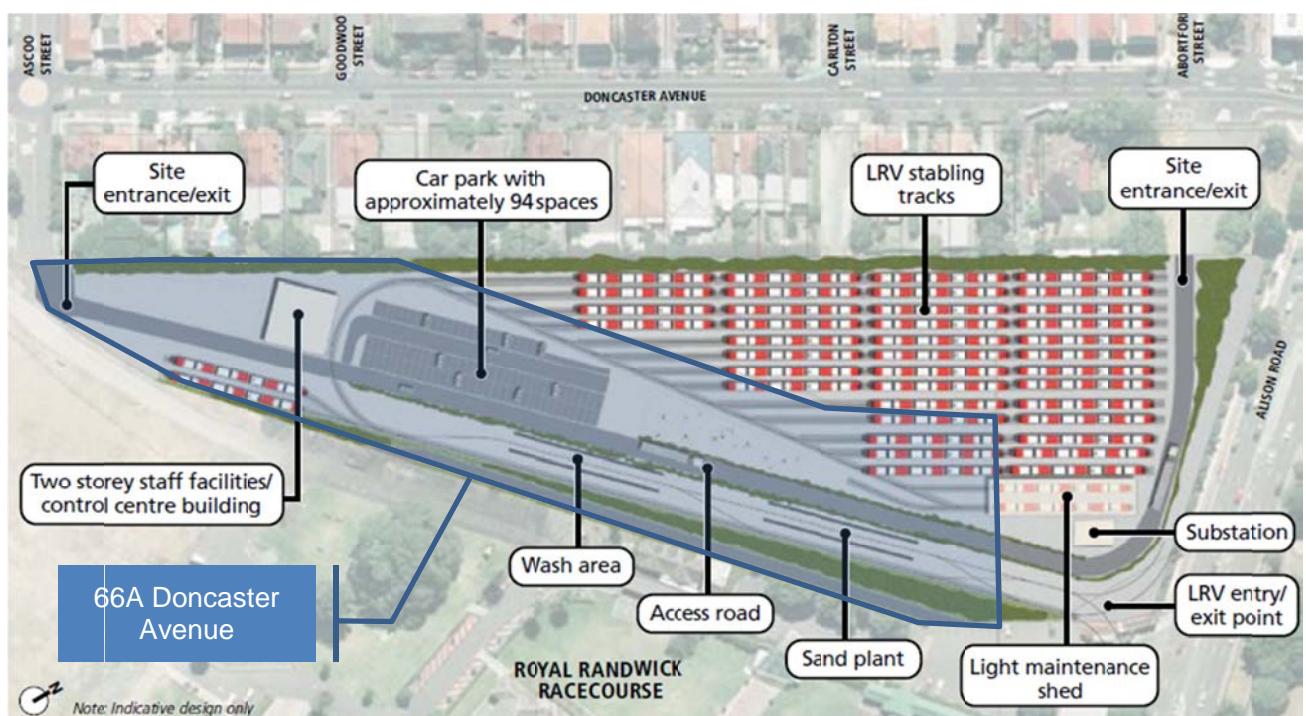
Although concept design levels are not currently available for the light rail stabling facility, it is unlikely that frequent flooding of the stabling facility would be an acceptable scenario.

During the 100 year ARI event the peak flood depths increase to 1.0 to 1.5 metres. Peak overland flow velocities are predicted to range between 0.5 and 1.0 m/s and flow paths through the north western portion of the site have been provisionally categorised as being 'high hazard' (refer **Attachment B**).

Hence, the use of the site without modification to the landform will be compromised by its potential flood affectation.

3.2 Potential Flood Impacts

Should the stabling facility require greater flood immunity than the site currently provides, this would likely require the filling of some or all of the site to elevate the facility above existing flood levels. Without any mitigation measures, this would likely lead to overland flows being diverted towards the Doncaster Avenue/Alison Road intersection where the resultant increase in flood levels would likely be significant.



Source: CSEL R EIS (Figure 5.50), Parsons Brinckerhoff, November 2013

Figure 2 Conceptual Layout for Doncaster Avenue Light Rail Stabling Facility



If the proposed facility were to be constructed largely at existing surface levels (*i.e., accepting that relatively frequent flooding of the facility may occur*) and did not contain any significant buildings in existing flood affected areas then the flood impacts on surrounding properties may be within an acceptable range.

However, it is noted in **Figure 2** that a substation and light maintenance shed are proposed near the northern boundary, which is currently a flood affected area. The substation would likely require a high level of flood protection and need to be located above the 100 year ARI flood level, therefore requiring significant filling at this location. The light maintenance shed could also be an obstruction to overland flows which could alter local flood behaviour. The unmitigated impacts of these items would likely be increased flood levels on surrounding properties.

4. FLOOD MITIGATION OPTIONS

The EIS states that during the detailed design and pre-construction phase the CSELR would be designed to ensure compliance with the *NSW Floodplain Development Manual*. This includes a requirement to **not** increase flood levels above existing levels.

For the proposed stabling facility, there would be limited options available to mitigate potential impacts due to the scale of existing flooding issues. Three general flood mitigation measures are identified for consideration in the EIS. These are provided below with further commentary on their applicability to the stabling facility:

(i) Increasing downstream drainage capacity

The trunk drainage system downstream of the site, as shown in the KCPFS and included in **Attachment B**, consists of approximately 2.5 km of box culverts and large diameter pipes (1500 – 2000 mm diameter) that ultimately discharge downstream of Gardeners Road, adjacent to Eastlake Golf Club. While the KCPFS does not comment on the capacity of this system, it appears to be almost entirely under capacity as flooding can be found along the entire length of the system for the 5 year ARI event. Given the size of the existing infrastructure and the length of the system to the discharge location, upgrading this system would be **logistically very difficult and extremely expensive**. Utilising surcharge pits could limit the extent of the required upgrades, however finding a suitable site where flows could be safely surcharged would be very difficult.

(ii) Diverting upstream flows around or under the track formation

It is not considered feasible to divert flows around the site without impacting on flood levels on surrounding properties. As noted previously, development that results in off-site increases in peak flood levels is not consistent with the tenets of the NSW Flood Prone Land Policy and is unacceptable. Constructing the stabling facility on an elevated platform, supported by an open structure to allow flow beneath the facility, is also highly unlikely to be unfeasible due to physical constraints, work safety issues and the relatively high cost.

(iii) Providing stormwater detention under or adjacent to the track formation

Potential flood impacts are considered unlikely to be mitigated by any limited detention capacity that could be provided on the site itself. The only significant open space in the upstream catchment is that located within Centennial Park where expansion of existing detention facilities would be unlikely to receive public support as public amenity could be adversely affected. Land acquisition would therefore be the only option available to provide detention facilities. This is an option that is likely to have a very high cost due to the large area that would be required and high property values in the area.



Further to the commentary provided above, Randwick City Council, in its draft submission on the CSELR EIS to DP&I, has also identified that there is *“high potential for flooding on the proposed LRV stabling area, and does not agree to the implication that the levels of the proposed Randwick stabling area can be raised to reduce flood impacts.”*

In addition, Council has identified that a loss of flood storage on the site and the construction of noise walls and/or buildings which divert overland flows could also result in flood impacts.

5. CLIMATE CHANGE RISK ISSUES

As part of the preparation of the EIS, a Climate Change Risk Assessment was undertaken. A total of 27 key climate change risks were identified in relation to the CSELR proposal. In the Conclusions to that Assessment, the only item that was identified as being of ‘*high risk*’ was in relation to flooding of infrastructure, with particular mention given to the stabling facility at Doncaster Avenue.

Other points of note in the Risk Assessment include:

- The existing drainage network in some locations will not meet the CSELR design criteria
- The downstream piped network capacity in some locations will be insufficient to accept an enhanced level of stormwater collection along the CSELR route.

It is recommended in the EIS that future drainage design include sufficient capacity to allow for increased flows under climate change scenarios. A 15% increase in rainfall intensity, in accordance with Sydney Metropolitan Catchment Management Authority (SMCMA) recommendations, is identified as the appropriate standard. However, it is not considered feasible to retrofit the existing drainage system to cater for the additional flows that would be generated by a 15% increase in rainfall intensity without upgrading the entire downstream drainage system.

In addition to the mitigation measures discussed previously, it is suggested that reduced drainage design criteria could be applied to areas with existing flooding issues. However, it is concluded in the Climate Change Risk Assessment that allowing reduced design criteria in combination with a potential 15% increase in rainfall intensities due to climate change would **significantly increase both the likelihood and consequence of flooding**. With the option available of locating the stabling facility at Wansey Road, which has minimal if any flood risk, it is unlikely that this approach would be able to demonstrate that Railcorp’s standard of ‘*acceptable risk*’ had been achieved.

6. CONCLUSIONS

The following summarises the conclusions arising from our assessment of the EIS for the CBD and South East Light Rail Project (CSELR).

- If the site were to remain predominantly at existing surface levels, thereby limiting potential flood impacts on surrounding properties, it would likely experience nuisance flooding in relatively frequent events in the order of the 2 to 5 year ARI storm, and more damaging impacts during larger, but less frequent events.
- The conclusions within the Climate Change Risk Assessment for the CSELR Project indicate that potential climate change scenarios, which include 15% increases in rainfall intensities, would lead to a significantly greater flood risk due to increased likelihood and consequence of flooding.
- If the proposal is to involve raising of the landform to provide greater flood immunity, this would lead to unacceptable impacts on surrounding properties or require significant upgrades to existing drainage infrastructure to reduce potential flood impacts to acceptable levels.



- Potential options for mitigating flood impacts include upgrading downstream drainage capacity or providing detention. However, both of these options would come at considerable cost that could well be greater than the cost of relocating the horse stabling facilities at Wansey Road.

Therefore, based on the assumed requirements for a light rail stabling facility (*i.e., relatively flat land at similar levels to the adjoining road infrastructure*), it is our opinion that for the reasons set out above, that the flood constraints at the site are likely to mean that the Doncaster Road Site is not an appropriate location for the proposed stabling facility. Further investigation into potential flood impacts and mitigation options at the Doncaster Avenue site is required to justify its selection.

I trust that the above response suitably addresses your requirements. Should you have any questions please do not hesitate to contact me on 8456 7230.

Yours faithfully

WORLEYPARSONS

Chris Thomas
Manager, Water & Environment
NSW Location



WorleyParsons

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ATTACHMENT A

FLOOD MAPPING EXTRACTED FROM THE 2010 WORLEYPARSONS FLOOD IMPACT ASSESSMENT REPORT

FIGURE 3



FIGURE 4

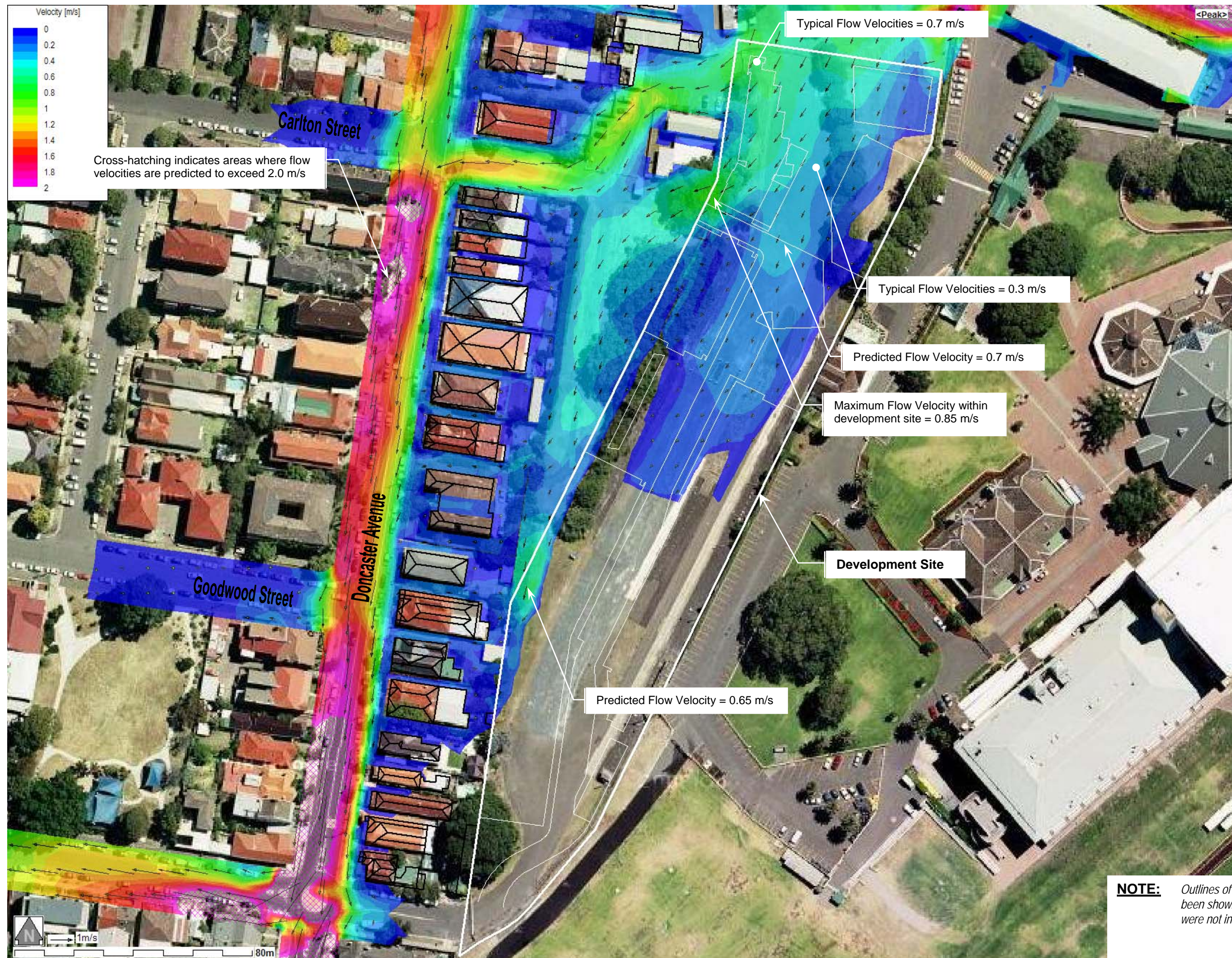
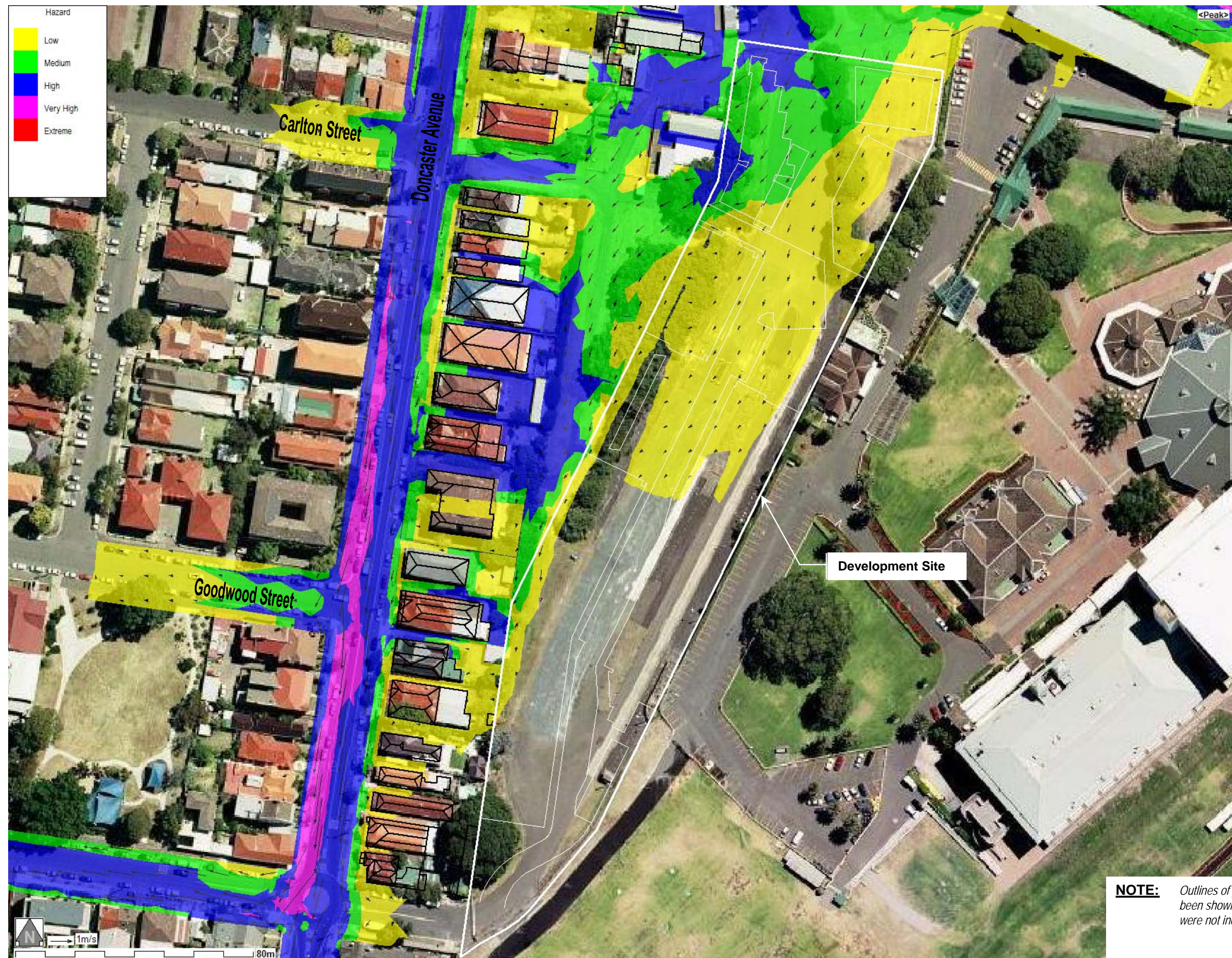


FIGURE 5



NOTE: Outlines of proposed buildings and roads have only been shown for indicative purposes. Proposed works were not included in this modelling simulation.



ATTACHMENT B

FLOOD MAPPING EXTRACTED FROM KENSINGTON-CENTENNIAL PARK FLOOD STUDY

FIGURE 7
DRAINAGE NETWORK LAYOUT

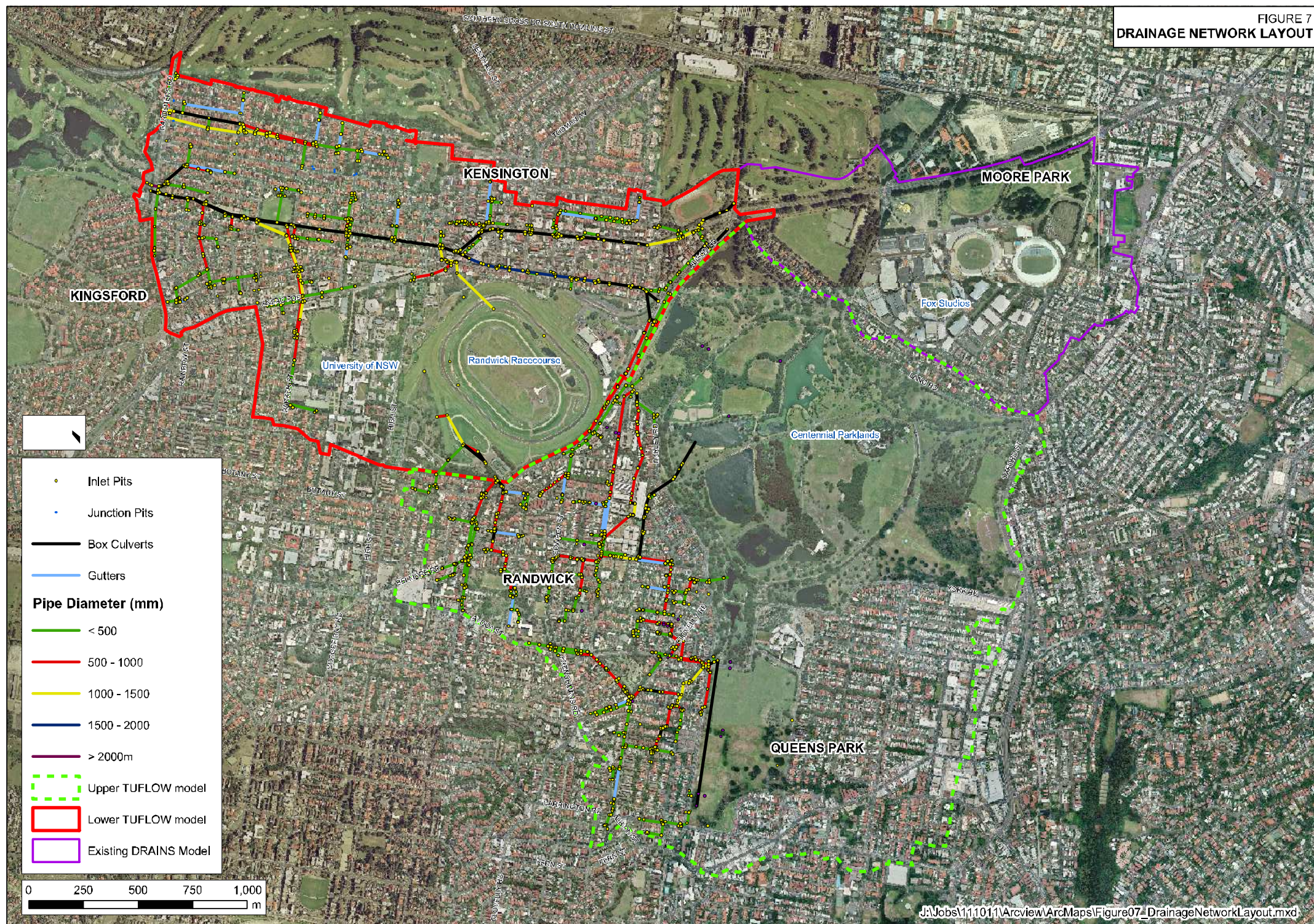


FIGURE 11A
PEAK FLOOD LEVELS AND DEPTHS
20% AEP EVENT

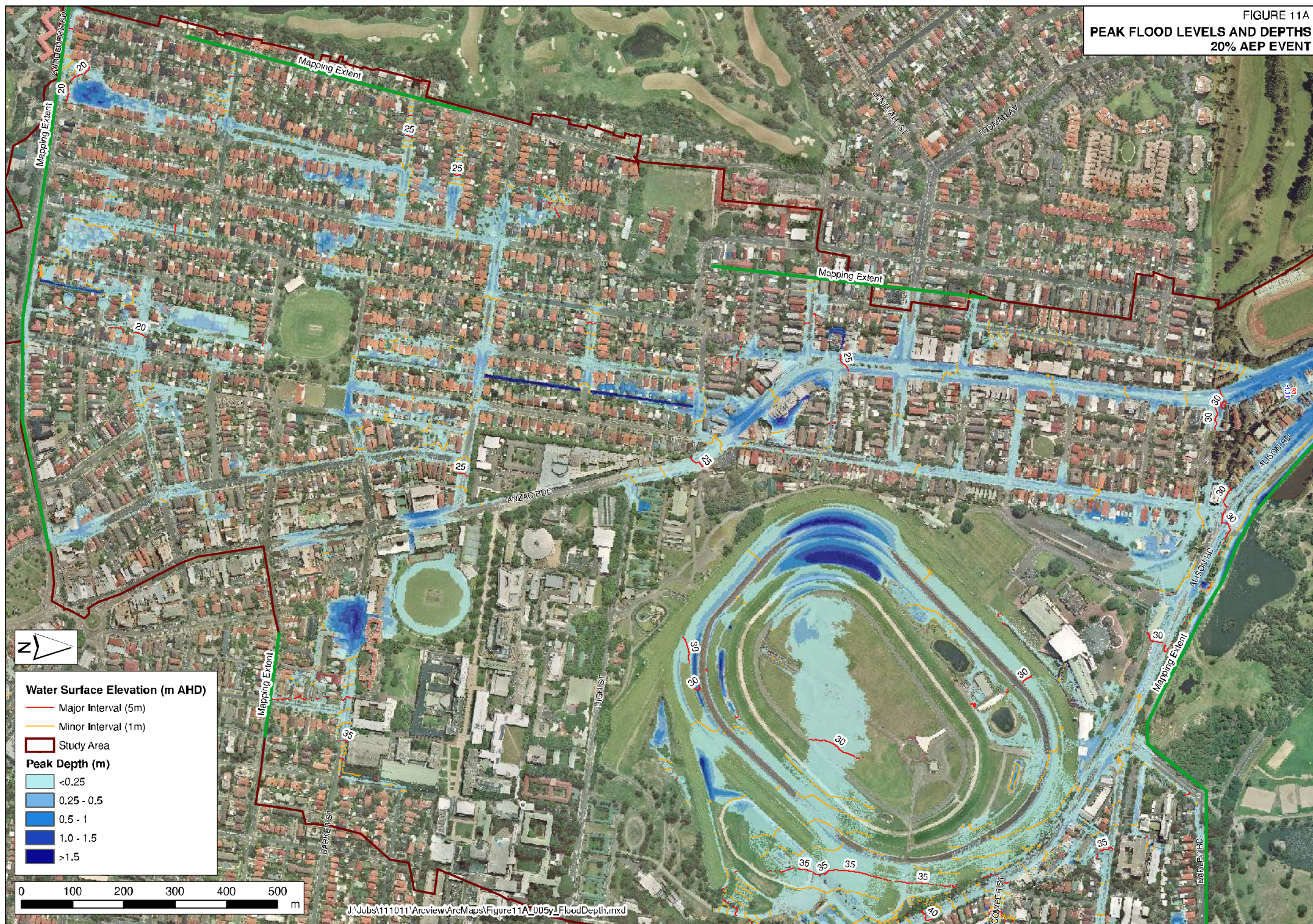


FIGURE 12A
PEAK FLOW VELOCITIES
20% AEP EVENT

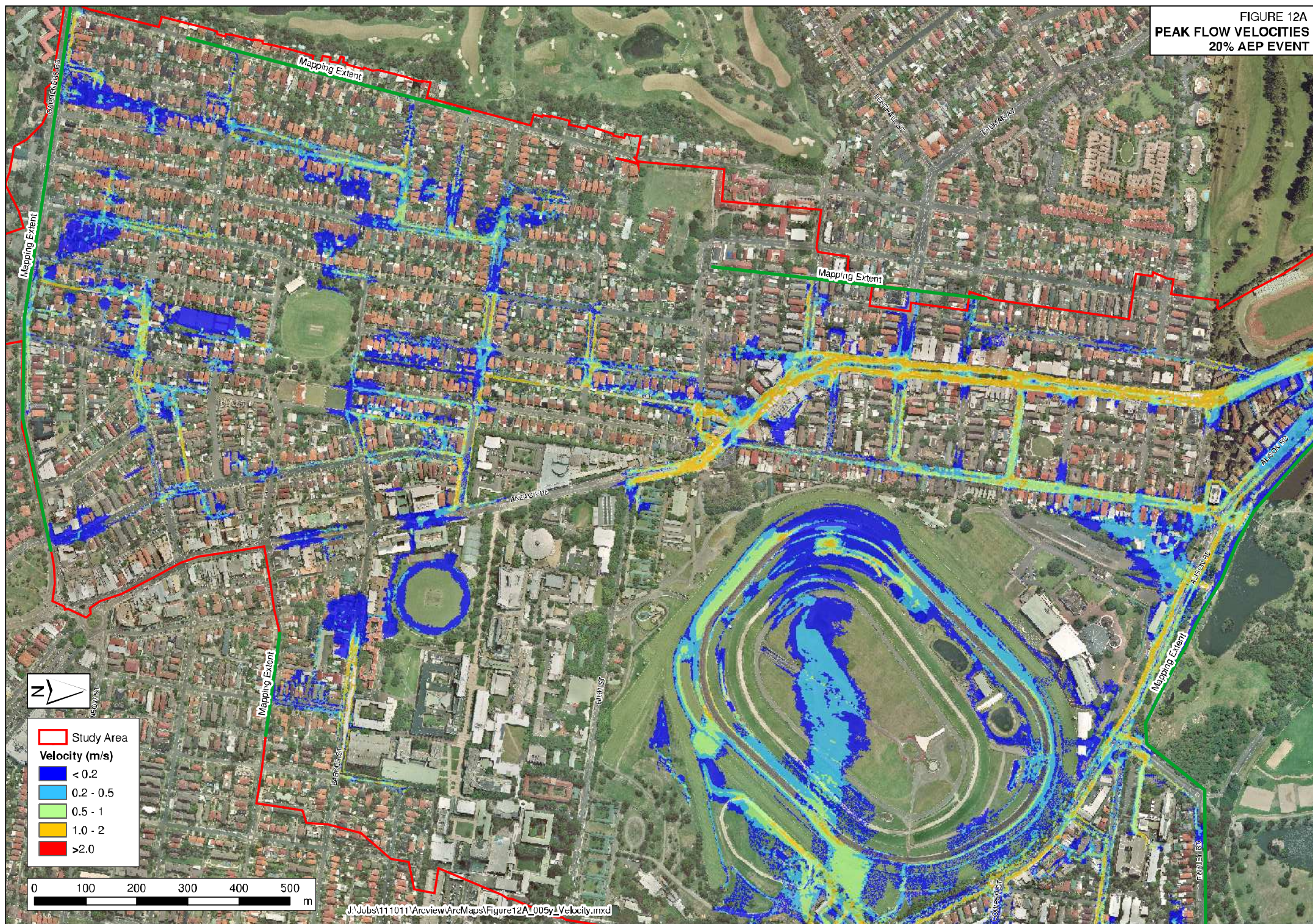


FIGURE 19A
PEAK FLOOD LEVELS AND DEPTHS
1% AEP EVENT

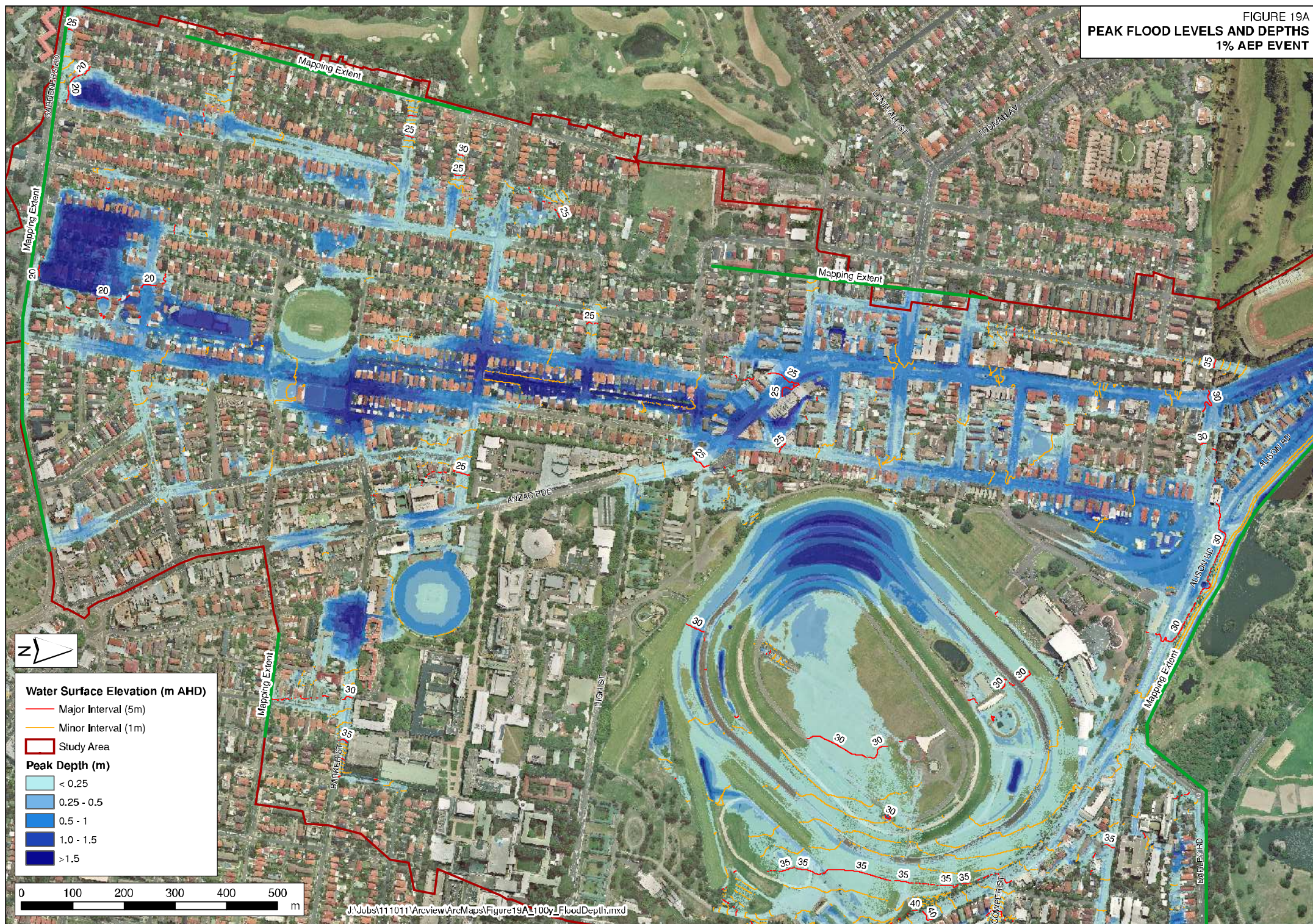


FIGURE 20A
PEAK FLOW VELOCITIES
1% AEP EVENT

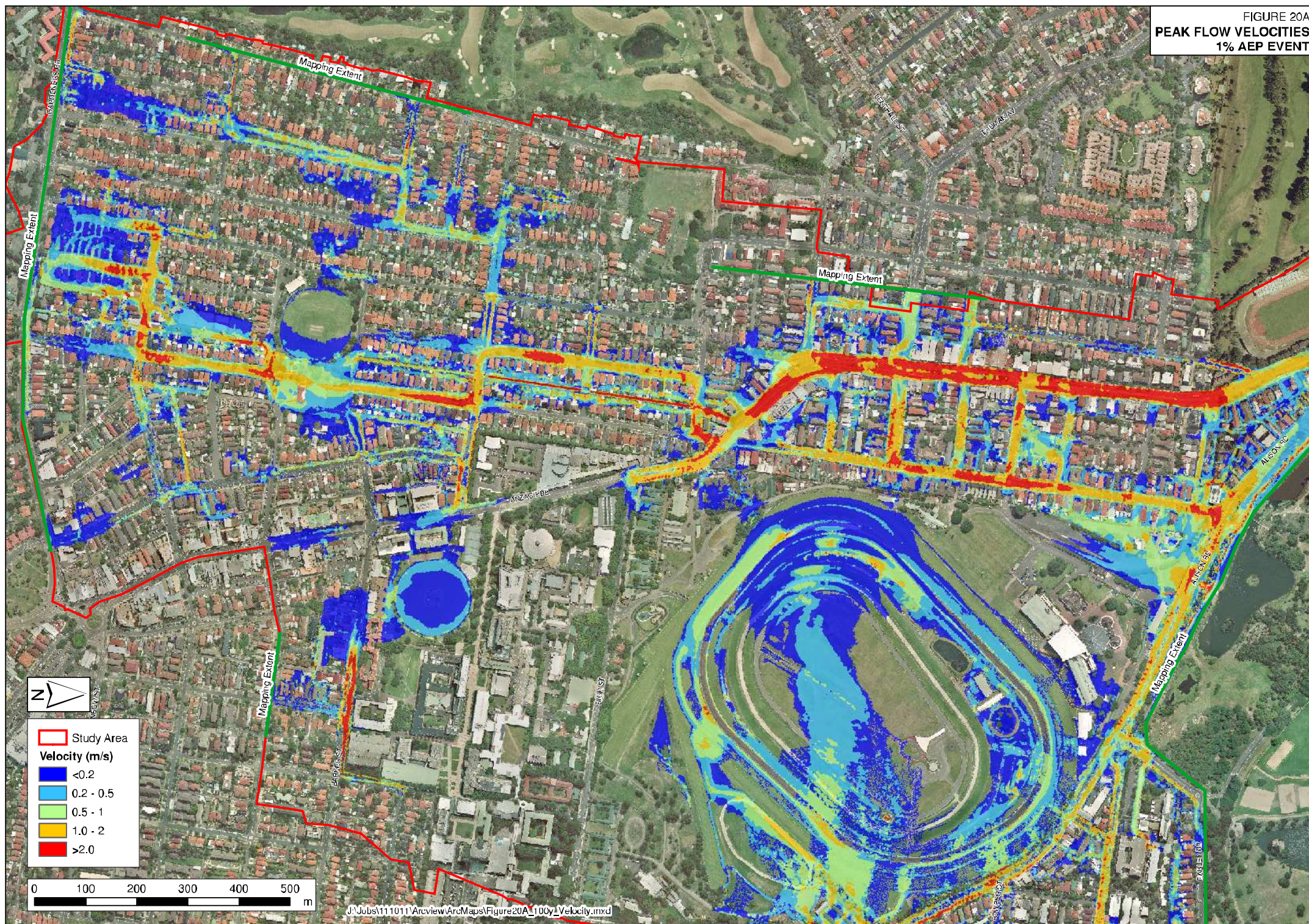


FIGURE 29A
HYDRAULIC CATEGORISATION

