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STRUCTURAL - CIVIL - STORMWATER - REMEDIAL

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Flood Risk Management Report

2a Ruskin Rowe, Avalon Beach

Issue C

8 August 2019

Prepared for: Sven and Amber Almenning

Prepared by: Christian Ferry

Overland Flow Assessment Report

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Issue: C

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Client: Sven and Amber Almenning

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Document History

Issue	Engineer	Checked	Description	Date
A	C. Ferry	M.Wachjo	Overland Flow Assessment Report	15.05.2019
B	C. Ferry	M.Wachjo	Revised Floor Levels	15.07.2019
C	C. Ferry	M.Wachjo	Revised Report	08.08.2019

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Executive Summary

A 2D hydraulic analysis was undertaken to determine the effects of the proposed development on the existing overland flow regime through 2a Ruskin Rowe in Avalon Beach. To effectively assess the anticipated flooding effects, a 2D hydrodynamic flood model was constructed using the software HEC-RAS version 5.0.7 to simulate the overland flow path through the subject site based on computed flows for the 1% peak AEP and PMF storm events. The peak hydrograph arising from the 1% peak AEP event was obtained in DRAINS. A HEC-RAS analysis was carried out for both the pre and post development cases. The results from the HEC-RAS analysis indicated that the proposed development does not have any significant impact of the existing overland flow path regime and is therefore not expected to cause adverse flooding effects to neighbouring properties. Further, the results revealed that the finished floor levels of the main dwelling achieve the minimum freeboard requirements outlined in the Northern Beaches Council DCP. However, the proposed garage must be constructed as an open carport as this structure is expected to have more than 300mm of ponding during 1% AEP storm event. Further, vehicular barriers and/or restraints must be constructed in order to prevent vehicles floating away during flooding events. Consequently, no adverse flooding effects are envisaged to occur within neighbouring properties due to the proposed development should the recommendations herein be adopted. The results from the analysis are detailed in the report below.

1. Introduction

Northern Beaches Consulting Engineers were engaged by Sandberg Schoffel Architects on behalf of Sven and Amber Almenning to undertake a hydrologic and hydraulic investigation into the effects of a proposed residential development at 2a Ruskin Rowe in Avalon. The assessment involved analysing localised flooding behaviour for heavy rainfall events that result in overland flow.

Michael Wachjo of Northern Beaches Consulting Engineers (NBCE) conducted a site inspection at the above address on 7 December 2018. The site inspection was carried out to observe the existing drainage regime and measure the relevant dimensions of the existing drainage channel through the property. The premises have been assessed in accordance with the requirements of *Pittwater Council 21 DCP* and *Pittwater Council LEP (2014)*, Council supplied flood information and the *NSW Government Floodplain Management Manual 2005*.

1.1 Aim

The purpose of this report is to determine the hydraulic profile through the subject site and the anticipated effects of overland flows from the proposed development during heavy rainfall events. An analysis was undertaken to assess the extent of flooding envisaged to occur through the subject site and examine strategies to mitigate any impacts from flood waters during heavy rainfall events. The analysis involved evaluating the flow behaviour within the subject catchment and assessing the potential effects of the proposed development on the existing overland flow conditions. The anticipated flood behaviour within the contributing catchment was considered for the 1% Average Exceedance Probability (AEP) and Probable Maximum Flood (PMF) storm event. The corresponding water surface and velocity profile was calculated through hydrologic and hydraulic modelling. Note, the analysis utilised the results of AEP storm event modelling using IFD (Intensity Frequency Duration) design rainfall data based on AR&R 2016 (Australian Rainfall & Runoff) methodology.

The calculations and recommendations presented in this report have been prepared in general accordance with the following policies:

- *Australian Rainfall and Runoff 2016*
- *NSW Government Floodplain Management Manual 2005*

1.2 Site Characteristics

The 2536m^2 site is located on Ruskin Rowe in Avalon within the Northern Beaches Council (Pittwater) LGA and is bounded by residential properties along the north-western and south-western boundaries of the site.

There is an existing stormwater drainage network consisting of pits, pipes and open channel structures beyond the south-western boundary of the subject site in Ruskin Rowe, which caters for the upstream runoff within the contributing sub-catchment. The subject site is situated within the lower portion of the Careel Creek catchment and is subject to high flows during heavy rainfall events. The Council owned stormwater drainage infrastructure upstream of the subject site converges beyond the site boundary of 6 Ruskin Rowe, discharging into a creek channel which meanders through 6 Ruskin Rowe and continue through the subject site. The creek dimensions vary throughout the site, reaching depths up to approximately 2m deep and flow widths of up to approximately 10m wide. The creek channel terminates at the north-western corner of the site, discharging through three box culverts via a headwall which extends below Avalon Parade and continues through to the discharge point at Careel Bay at the bottom of the catchment via Careel Creek.

2. Flooding

2.1 Methodology

Flood extents were modelled using the computer program HEC-RAS 5.0.6. A combination of LiDAR (Light Detection and Ranging) survey data, survey levels prepared by SCS Engineering Surveyors and SIX Maps (NSW) government website information was used in the modelling process to define the existing creek channel and surrounding terrain. The peak stormwater runoff flow rate within the upstream catchment of the subject site was modelled in the computer program DRAINS for the 1% AEP and PMF storm events. The overland flow regime was modelled in HEC-RAS for these storm events using the peak runoff rates obtained in DRAINS. The stormwater drainage system was modelled with a 50% blockage factor applied to all pits, pipes upstream of the subject site and a 75% blockage factor for the three culverts at the lower north-eastern end of the creek channel the through the subject site. Note that the 75% blockage factor applied to the three culverts is a highly conservative measure. This measure is beyond flood control criteria typically adopted by Council for blockages.

Figure 1 - Subject Site Location and Surroundings. Source: SIX Maps (NSW)

2.2 Catchment Analysis

The subject site is located within the Careel Creek catchment which conveys stormwater runoff to the Careel Bay via Careel Creek. The total contributing catchment affecting the subject site was measured in the computer program QGIS 2.18.8 using LiDAR data and is approximately 70.044Ha.

The sub-catchment affecting the subject site predominately drains to the existing creek channel which runs through the subject site. The pit and pipe drainage network conveys collected runoff within the sub-catchment through a series of pipelines which eventually discharge to this channel.

Further, the contributing catchment consists predominately of low-medium residential development with a significant portion of the catchment being densely vegetated bushland within the upper half of the catchment. The catchment extends approximately 128m upstream and reaches an elevation of approximately 141m AHD. QGIS 2.18.8 was also used to measure the average catchment slope. The manning's roughness 'n' values used for the analysis have been approximated based on observed site conditions (refer Table 1 below). Modelled results from a DRAINS analysis have been used to estimate the peak flow hydrographs for the 1% AEP storm event. This flow hydrograph was used to estimate the estimate flood levels in the computer program HEC-RAS 5.0.6.

Table 1 - Roughness Parameters used for HEC-RAS analysis

Surface Type	Manning's Roughness (n)
Road / Paving	0.015
Grass	0.05

3. Analysis & Results

3.1 Peak Flow Results

A DRAINS computation analysis was completed to determine the anticipated runoff through the subject site. The site is moderately inundated by overland flows which develop from overtopping of the banks of the creek channel which extends through the property. The overtopping effect results in scattered sheet flow which spreads through the subject site and surrounding properties.

The 1% AEP & PMF storm event were computed, and the peak runoff rates are shown in Table 1 below:

Table 2 - Catchment Flow Rates for the 1% AEP & PMF Storm Event

AEP	Sub-Catchment	Area (Ha)	Piped Flow (m^3/s)	Overflow (m^3/s)	Total Flow (m^3/s)
PMF	A	11.391	N/A	135	135
	B	5.766	0.171	12.3	12.471
	C	9.096	0.247	21	21.247
	D	7.078	0.226	17.9	18.126
	E	0.9026	0.132	1.94	2.072
	F	3.774	0.156	8.82	8.976
	G	32.041	0.898	87.8	88.698
1%	A	11.391	N/A	26	26
	B	5.766	0.138	1.86	1.998
	C	9.096	0.174	4.6	4.774
	D	7.078	0.132	4.01	4.142
	E	0.9026	0.107	0.419	0.526
	F	3.774	0.127	2.1	2.227
	G	32.041	0.588	14.8	15.388

For further detail refer Appendix B.

3.1.1 Estimation of the PMF Runoff Rate

The PMF runoff rate was estimated using the Generalised Short-Duration Method (GSDM) as outlined in the *Commonwealth Bureau of Meteorology: The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method (2003)* document. The generalised methods are used for estimation of the Probable Maximum Precipitation (PMP) and consider all available data over a large region for the computation of the PMP which differs from other site-specific methods. This generally results in an increased PMP estimate for a given catchment in comparison to other methods and is therefore considered to be conservative in the estimation of the PMP. The PMP estimates were derived for the subject catchment over multiple durations and input into DRAINS to compute the PMF runoff rate using the ILSAX hydrological model for the computation. All assumptions used for the calculation of the PMPs are shown in Table 2 & 3 below.

Table 3 - Assumptions used in GSDM computation.

Catchment Area (km^2)	0.70	
Duration Limit (hrs)	6	
Portion of Area Considered	**S**	**R**
	0	1
Elevation Adjustment Factor (EAF)	1	
Moisture Adjustment Factor (MAF)	0.7	

Table 4 - PMP Values.

Duration (hrs)	Initial Depth - Rough (DR)	Initial Depth - Smooth (DS)	PMP Estimate* (mm)	Intensity (mm/hr)
0.25	245	245	170	680
0.5	350	350	250	500
0.75	440	440	310	413.3
1	510	510	360	360
1.5	580	653	460	306.67
2	646	770	540	270
2.5	690	850	600	240
3	726	940	660	220
4	794	1065	750	187.5
5	855	1177	820	164
6	900	1240	870	145

***NOTE:** PMP Estimates have been rounded to the nearest 10mm.

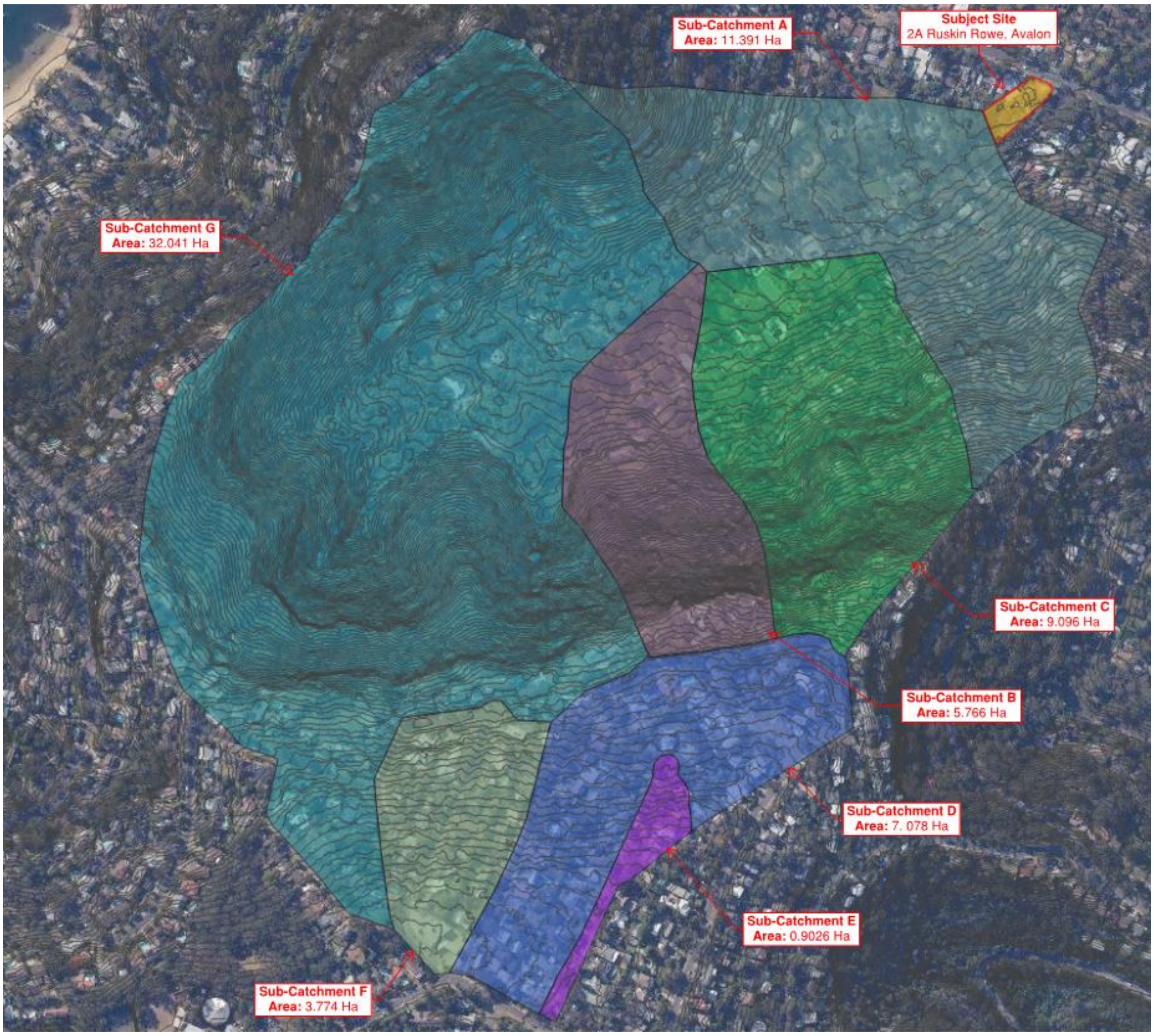

Figure 2 - Site Catchment. Source: SIX Maps

3.2 Site Flooding Extent

The 1% AEP water surface profile for the overland flow path has been estimated using the computer program HEC-RAS, consisting of a 2D hydrodynamic flow model.

3.2.1 Unsteady State Flow Analysis

An unsteady state flow analysis was used in the assessment to determine flow behaviour through the subject site. A mixed flow computation was used to simulate the effects of each storm event and account for variation of subcritical and supercritical flows through the site. The water surface elevation levels were computed at various cross sections through the channel for each storm event.

Utilising this type of model enabled a detailed analysis of the anticipated flood behaviour expected to occur through the subject site, accounting for varying flows throughout the modelled storm events. This generally provides greater accuracy in results as it simulates more realistic flow conditions.

3.2.2 2D Hydrodynamic Flow Analysis

2D hydrodynamic flood models provide numerical solutions based on depth-averaging equations. The model setup consisted of a 2D computational mesh or grid construction which represents the underlying topography using connected cells. In contrast to a 1D flood model, the 2D model requires continuous topographical data which covers the entire area being modelled in the 2D analysis. LiDAR (Light Detection and Ranging) survey information has been used to represent the underlying topography. Utilising this type of model enabled a detailed analysis of the anticipated flood behaviour expected to occur through the subject site, simulating complex flow patterns on the floodplain and calculating the resulting velocity and water surface elevations. This modelling approach combines both LiDAR data and surface roughness into a velocity field, generating results which are reflective of the anticipated flood behaviour through the site.

A Digital Elevation Model (DEM) was constructed using the software QGIS 2.18.8 to construct a surface roughness profile of the surrounding terrain. This required constructing elevated polygons to represent the surrounding buildings which have been modelled as impermeable blockages in the model. The modelled building polygons were created based on aerial imagery from online mapping services. The building polygons were superimposed onto the LiDAR data to create a complete Digital Surface Model (DSM). Furthermore, break lines have been used in the model to force an alignment of computational cell faces along elevation barriers, such as between the terrain and surrounding buildings. The 2D HEC-RAS model incorporated the three existing box culverts which are positioned at the base of the creek channel at the north-eastern corner of the subject site. A 75% blockage factor was applied to the three culverts. Inclusion of the three culverts simulates a more realistic condition of what should be expected in a large storm event. Utilising the existing box culverts required cutting in an open channel at the receiving end of the culverts to allow for conveyance of stormwater flows through the culverts. This open channel does not exist; however, its purpose is to simply allow for stormwater flows to discharge downstream of the subject site through the culvert system as it would in reality. This approach enables a realistic simulation of the 1% AEP & PMF storm events and prevents an unrealistic ponding situation at the base of the creek channel which would limit the accuracy of the flood model.

The two upstream boundary conditions used flow hydrographs representing the overland flow paths for the 1% AEP peak storm event which were computed in DRAINS. A normal depth condition has been assumed for the downstream boundary condition.

3.2.3 2D HEC-RAS Results

The proposed development does not show any new structures which will act as obstructions or encroach upon the existing overland flow path. Therefore, only one terrain profile was required in the HEC-RAS model simulation. The primary concerns in relation to the proposed development are as follows;

- The proposed single storey gym at the south-western side of the property. The Finished Floor Level (FFL) of the structure is 13.505m AHD. This achieves the minimum freeboard requirement of 500mm above the 1% AEP flood depth which is approximately 12.610m AHD. Further, the structure is also located in the floodway. Therefore, this structure is considered inadequate for providing shelter-in-place. The structure must be relocated outside of the floodway to achieve this requirement (Refer Figure 4 below).

- The proposed garage at the north-western side of the property. The ponding depth in this area exceeds 300mm in particular locations (Refer Figure 3 below). Therefore, this area must be constructed as an open carport structure with vehicular barriers and/or restraints to prevent the displacement of vehicles during heavy rainfall events. The vehicular barriers and/or restraints must be in accordance with the relevant Australian Standards and Northern Beaches Council's specifications. The proposed garage structure is not located within the floodway and therefore shall comply should it be utilised as an open structure.

- The proposed internal levels for the following areas are below either the FPL or PMF flood level;
  - Living Room
  - Lounge
  - Bed 1
  - Bed 2
  - Guest Bed

To ensure that the both the FPL and shelter-in-place requirements are satisfied, the FFLs must be raised as follows;

Table 5 - FFL requirements for FPL and Shelter-in-place requirements

Name	Proposed FFL	1% AEP Depth	PMF Depth	FPL Level Req.	S.I.P Level Req.
Living Room/Kitchen	13.260m AHD	12.402m AHD	13.230m AHD	12.903m AHD	13.230m AHD
Lounge	13.450m AHD	12.475m AHD	13.315m AHD	12.975m AHD	13.315m AHD
Bed 1	13. 450m AHD	12.537m AHD	13.445m AHD	13.037m AHD	13.445m AHD
Bed 2/3	13.450m AHD	-	13.440m AHD	-	13.440m AHD
Guest Bed	13.285m AHD	12.340m AHD	13.285m AHD	12.840m AHD	13.285m AHD
Office	12.910m AHD	12.221m AHD	12.910m AHD	12.721m AHD	12.910m AHD
Bed 5/6	13.050m AHD	12.245m AHD	13.050m AHD	12.745m AHD	13.050m AHD

*S.I.P - Shelter-In-Place
*FPL - Flood Planning Level

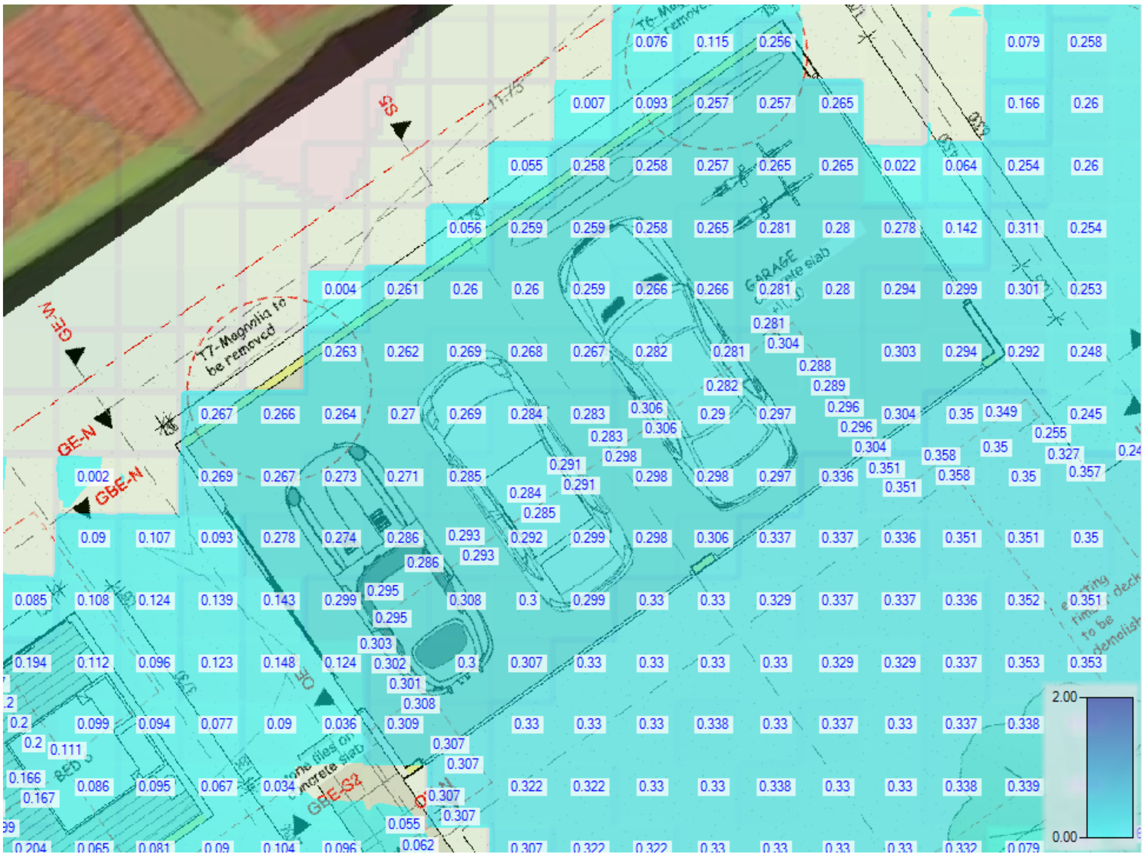

Figure 3 - Post Development Condition for Garage: Flood Depth Levels for the 1% AEP Storm Event. Source: RAS Mapper

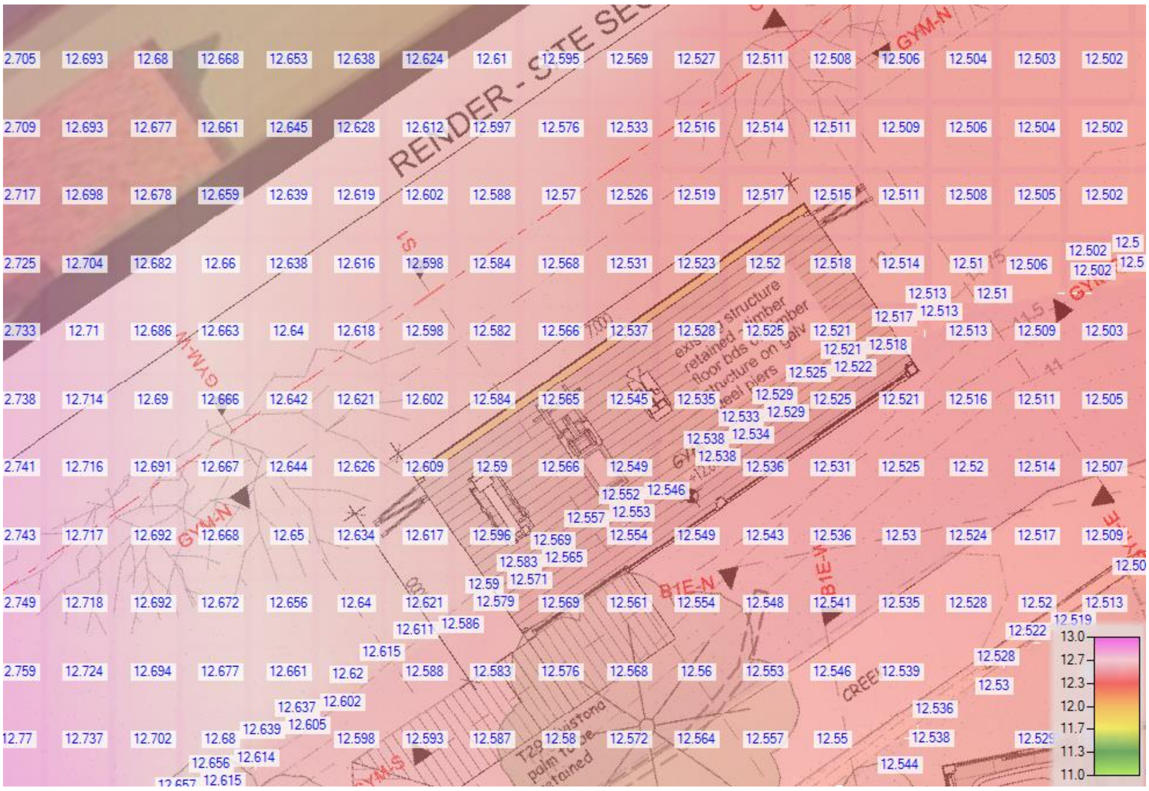

Figure 4 - Post Development Condition for Gym: Flood Depth Levels for the 1% AEP Storm Event. Source: RAS Mapper

Figure 5 - Post Development Condition for Gym: Flood Depth Levels for the PMF Storm Event. Source: RAS Mapper

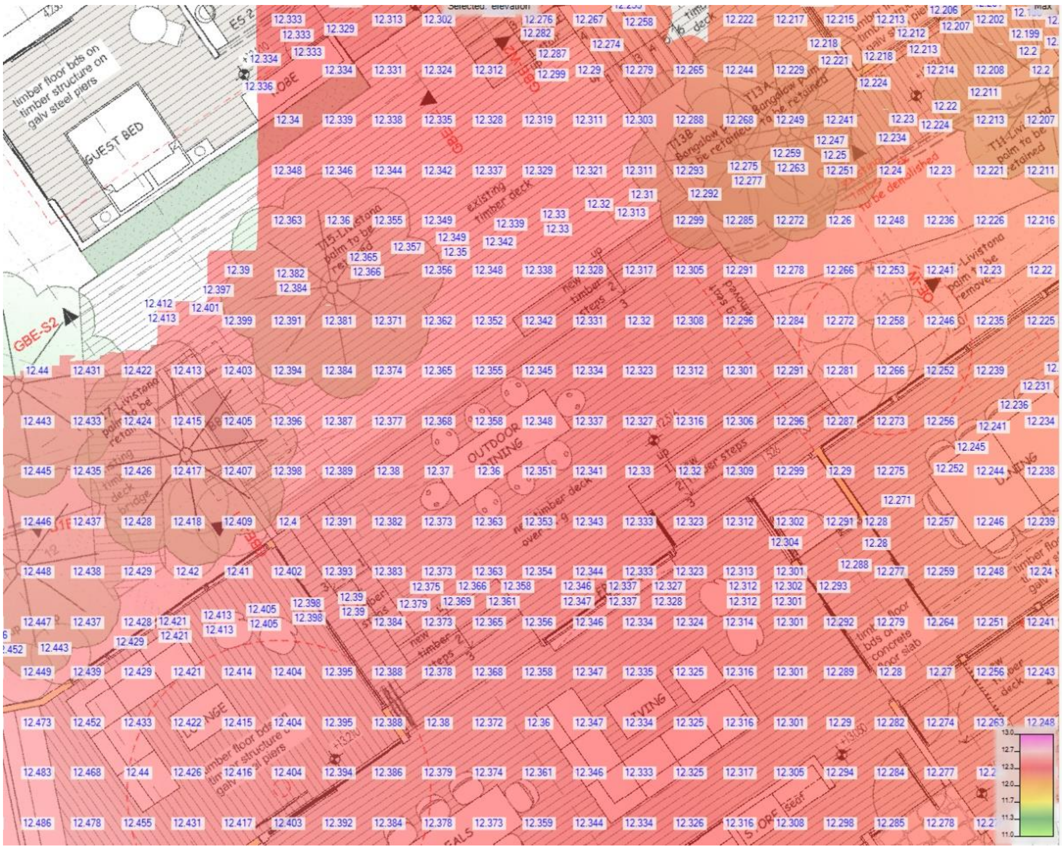

Figure 6 - Post Development Condition for Dining: Flood Depth Levels for the 1% AEP Storm Event. Source: RAS Mapper

Figure 7 - Post Development Condition for Main Dwelling: Flood Depth Levels for the PMF Storm Event. Source: RAS Mapper

A 2D HEC-RAS analysis of the existing and proposed development conditions indicated that no significant increase in flow depth or velocity occurs through any neighbouring properties. The results from a HEC-RAS analysis indicated that the water surface elevations will not be increase as a result of the proposed works. Proposed new structures are to be elevated above the Flood Planning Level (FPL) to achieve the freeboard requirements (Refer Figure 7 above). Should the above be achieved, all structures will achieve the minimum of 500mm freeboard above the top water level for the 1% AEP storm event.

3.3 Flood Velocity Hazard

The maximum depth-velocity product for the overland flow path affecting the subject site is 8.30m^2/s for the 1% AEP storm event which occurs within the creek channel adjacent to the main dwelling. This is considered a high velocity hazard area and must be avoided during large storm events. Due to the extreme high-risk factor surrounding the creek channel during heavy storm events, it is strongly recommended that all persons remain indoors during heavy rainfall events. The envisaged high velocity flows through the creek channel are extremely dangerous and could result in fatality if any person come into contact. Furthermore, it is also strongly recommended by NBCE that barriers be constructed surrounding the creek channel to act as an additional safeguard against the danger of the creek channel. This barrier must be in accordance with the relevant Australian Standards and Northern Beaches Council's specifications.

4. Recommendations

4.1 Proposed Flood Levels

The proposed development must satisfy the FPL at all locations. The associated modelling indicates no significant increase in the flood depth or flood velocity as a result of the proposed development. Therefore, it is envisaged that the new dwelling will not be affected by overland flows up to the 1% AEP storm event. The internal rooms on the ground floor level must be raised to suit the levels indicated in section 3.2.2 above, in order to achieve the shelter-in-place requirements.

4.2 Recommendations for structural design

Any proposed new structures below the FPL are to be designed to cater for the flood loads up to the FPL. Furthermore, the proposed garage must be constructed as an open structure with vehicular barriers and/or restraints in accordance with the relevant Australian Standards and Northern Beaches Council's specifications. These structures must be designed and by a suitably qualified structural engineer to withstand with following loading cases;

- Lateral flood flow loads
- Debris impact loads
- Any additional loading cases as required by Council

Furthermore, it is recommended that the banks of the creek channel be adequately inspected by a suitably qualified structural engineer and sufficiently assessed for any signs of erosion and scour which is likely to increase instability of the creek channel. In any areas with signs of erosion and scour, new retaining structures must be constructed. This must be detailed by a structural engineer. Any rectification works to the creek channel must not reduce the cross-sectional area as this would reduce the capacity of the creek channel and is likely to lead to increased flood depths in heavy rainfall events.

4.3 Types of Construction Materials

Any new structure is to be constructed of concrete, timber, steel and/or brickwork to above the flood levels. Any proposed fencing, alternative to pool type fencing, is to be designed by a structural / civil engineer to withstand hydrostatic forces up to and including the PMF event. Openings within the fencing are to be provided to ensure the PMF floodwater is able to flow unimpeded.

4.4 Waterproofing Methods

All new electrical equipment is to be fitted with circuit breakers. Other valuable materials or possessions are to be stored as above and should be acknowledged by the owner and occupants that a reasonable extent of damage to fittings below this level is to be expected during the PMF event.

- Flood warning Signage is recommended

- Hazardous Material Storage
  Hazardous chemicals are not to be stored in areas lower than the PMF flood depth. This should be acknowledged by the owner and staff.

Further, it is recommended that all the underside of all proposed new structures be flood-proofed as a precautionary measure against any impacts of flood waters passing beneath the structures.

4.5 Shelter in Place Plan

- Two residents/wardens/carers are to have basic first aid training that is regularly updated
- Relevant medical equipment (as determined by a qualified medical practitioner) is to be kept at all times on the premises and residents are to be educated on operating requirements of the equipment on an annual basis.
- Relevant medication and first aid supplies (as determined by a qualified medical practitioner) are to be kept on premises at all times and residents are to be educated on what/when/how to use the medication and first aid supplies.
- Local Warnings to trigger action of the Response Plan:
  - Assess water levels within the creek channel. Should water begin to overtop the top of the creek banks at any section within the confines of the property boundary, the kerb

residents are to remain indoors and proceed on foot to the one of the following on the Ground Floor Level;

   - South of the creek: Living Room (RL 13.230) or Bed 2 (RL 13.440)
   - North of the creek: Guest Bed (RL 13.285), Bed 5 (RL 13.210), or Office (RL 12.910)

- Review http://new.mhl.nsw.gov.au/users/NBFloodWarning/

- Flood Warning and Awareness

  Clear signage is to be displayed onsite indicating the extent of possible flooding and evacuation procedures.

- Onsite Shelter

  As the period of isolation as the site could be greater than 2 hours in a PMF, high-level on-site refuse has been considered as a secondary option or method of last resort. Should this be implemented, the development meets the shelter-in-place requirements for all flood events up to the PMF for the following reasons:

  - The proposed floor levels are elevated above the external ground levels. The proposed floor levels are also located above the PMF flood level.
  - The internal floor space area for the development, not including balconies or halls, caters for approximately 50 persons per unit ($2m^2$ per person). This exceeds the number of occupants.

- Onsite Shelter Requirements

  The shelter in place refuge is to provide:

  - Sufficient Clean water for all occupants
  - Portable Radio with spare batteries
  - Torch with spare batteries

- First Aid Kit

5. Conclusion

The proposed creek channel profile through the subject site has been modelled in HEC-RAS, with the results demonstrating that the water surface levels generally match the existing regime. The results above demonstrate that the FFLs for the proposed development achieve compliance with the relevant policies of Northern Beaches Council should the recommendations outlined above be adopted. Further, no net increase in flood levels are envisaged to occur in surrounding properties both upstream and downstream of the subject site.

In accordance with accepted engineering practice, NBCE has undertaken a flood study of the stormwater drainage system at 2a Ruskin Rowe in Avalon and can confirm the accuracy of the calculated results based on the HEC-RAS modelling. The proposed development will be safeguarded from flooding and will not adversely affect other structures or properties as a result of the proposed development. Please contact the author if further clarification is required.

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APPENDIX A

HEC-RAS Results

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Approx. Scale

TITLE:

HEC-RAS Site Plan

FIGURE:

8

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0 10 20 30 m

Approx. Scale

TITLE:

Pre-Development Overland Flow Regime
1% AEP Storm Event. Source: HEC-RAS - RAS Mapper

FIGURE:

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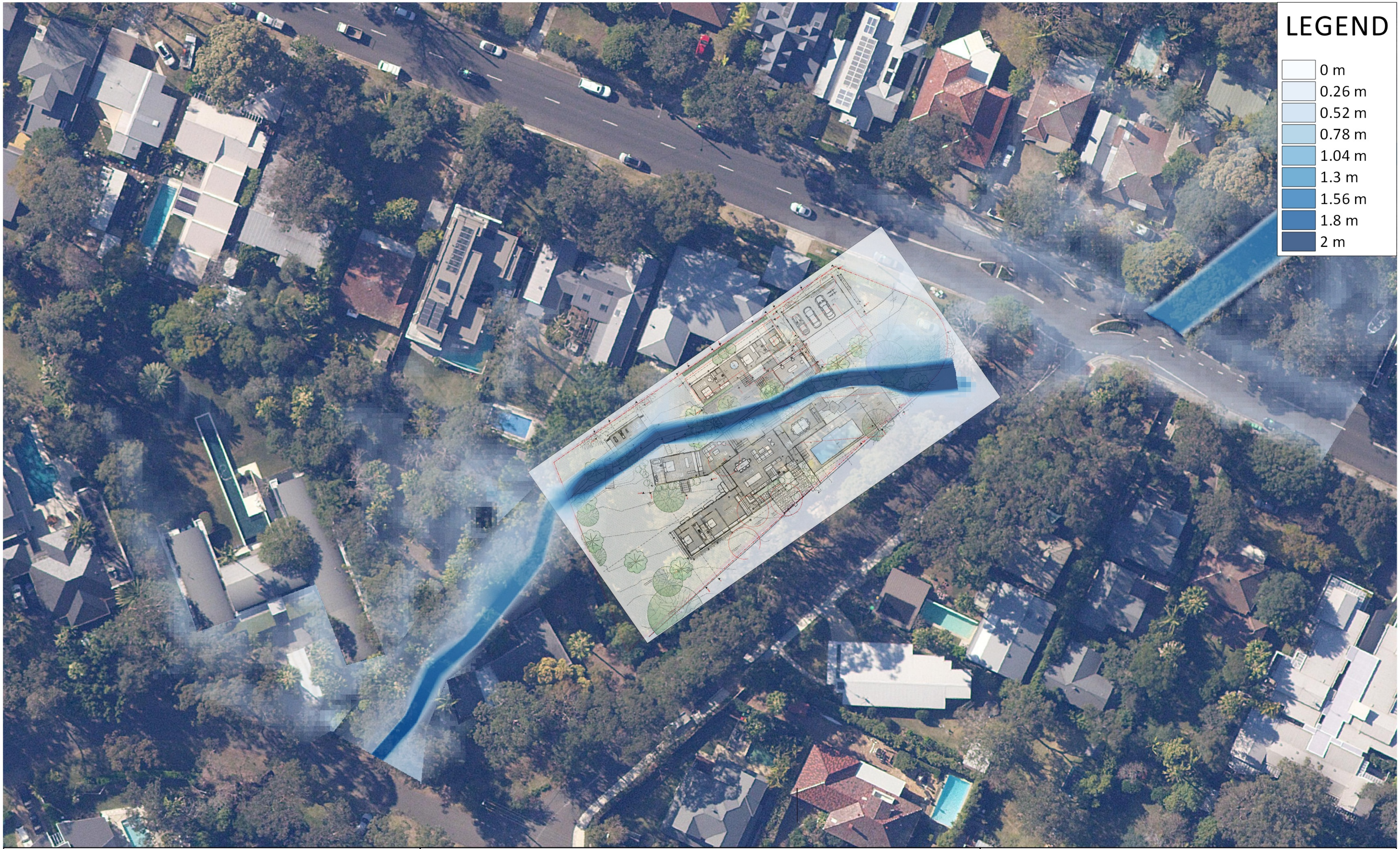

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TITLE:

Post-Development Overland Flow Regime
1% AEP Storm Event. Source: HEC-RAS - RAS Mapper

FIGURE:
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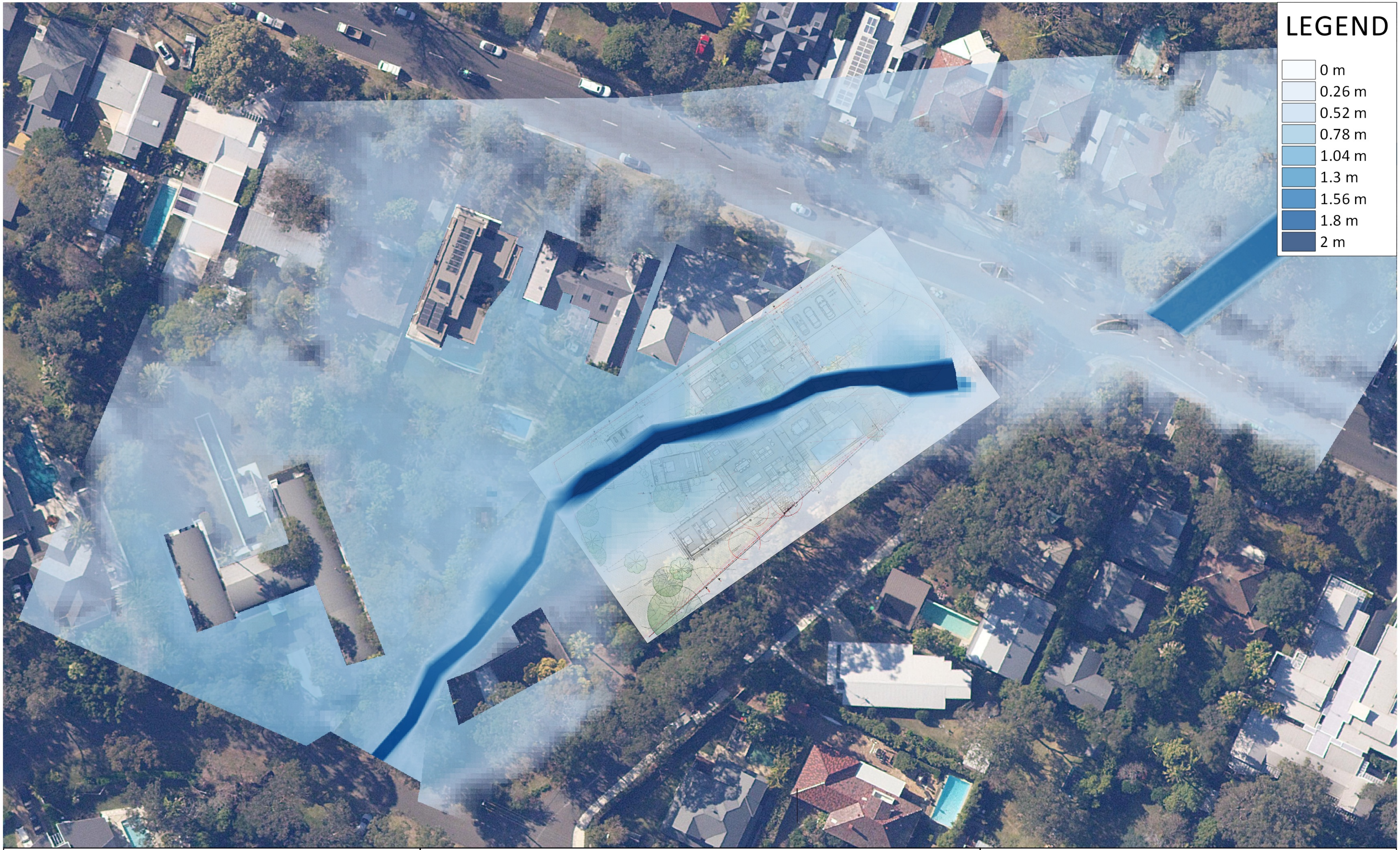

TITLE:

Post-Development Overland Flow Regime
PMF Storm Event. Source: HEC-RAS - RAS Mapper

FIGURE: 11

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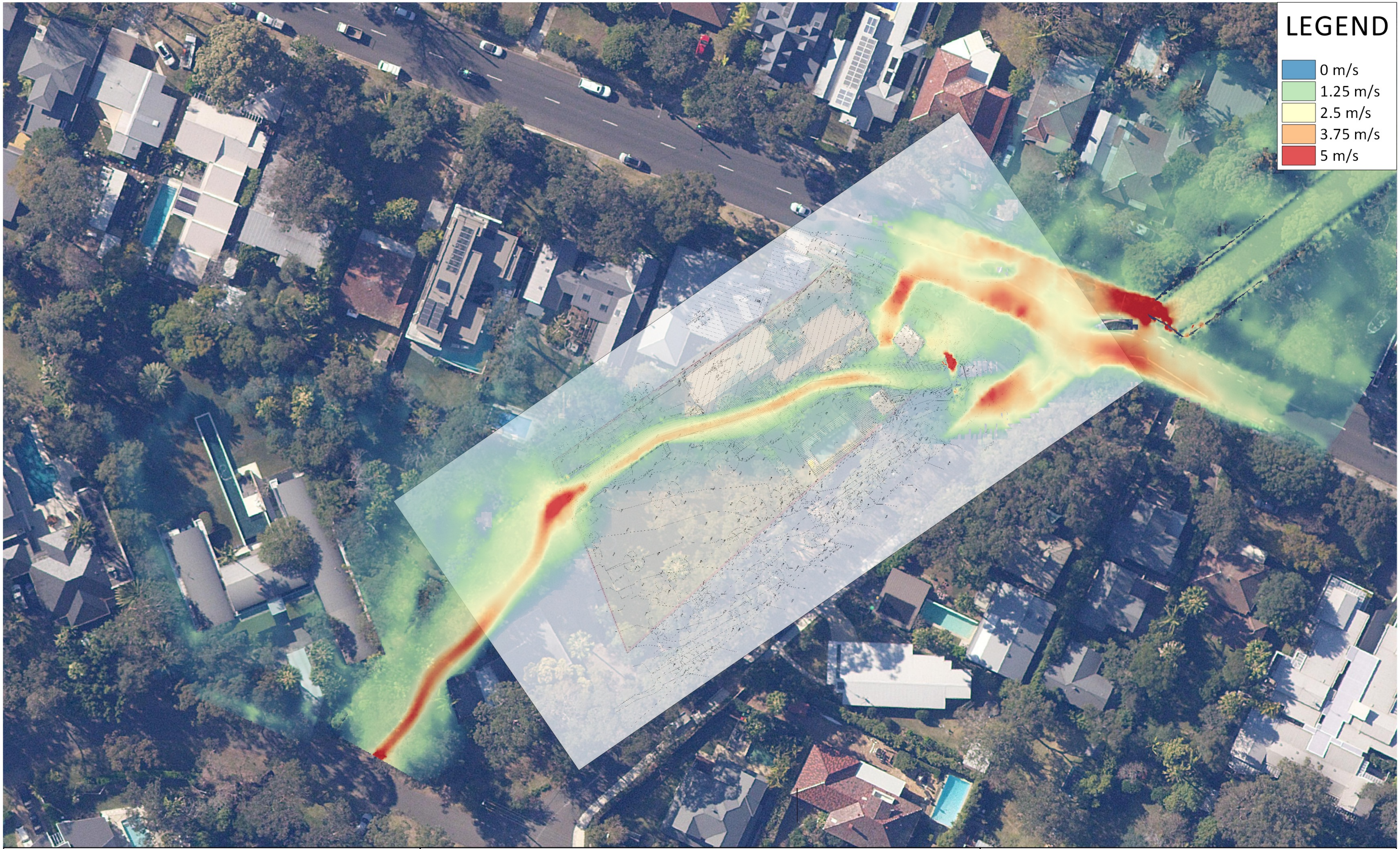

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TITLE:

Pre-Development Velocities
1% AEP Storm Event. Source: HEC-RAS - RAS Mapper

FIGURE:

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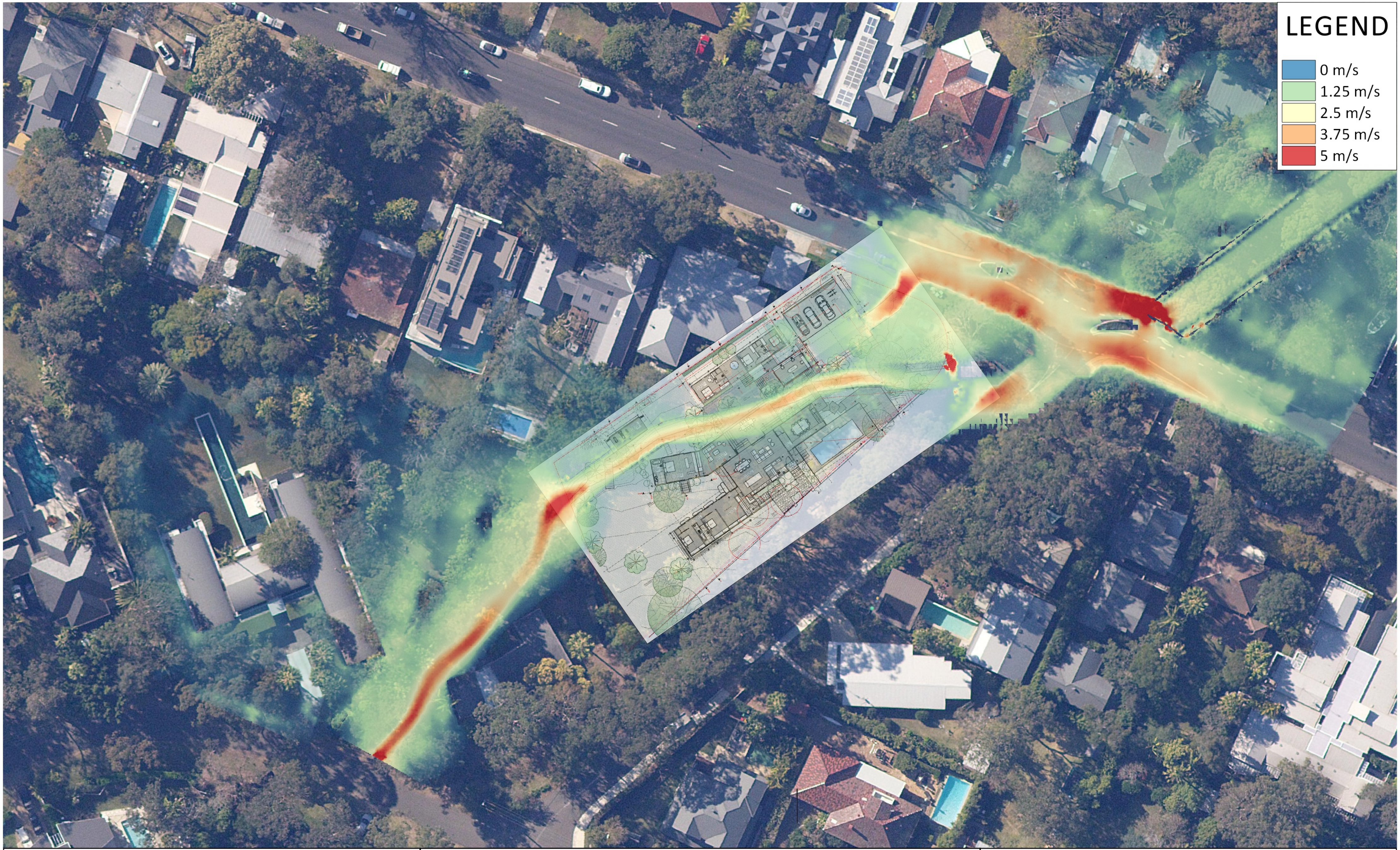

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TITLE:

Post-Development Velocities
1% AEP Storm Event. Source: HEC-RAS - RAS Mapper

FIGURE:

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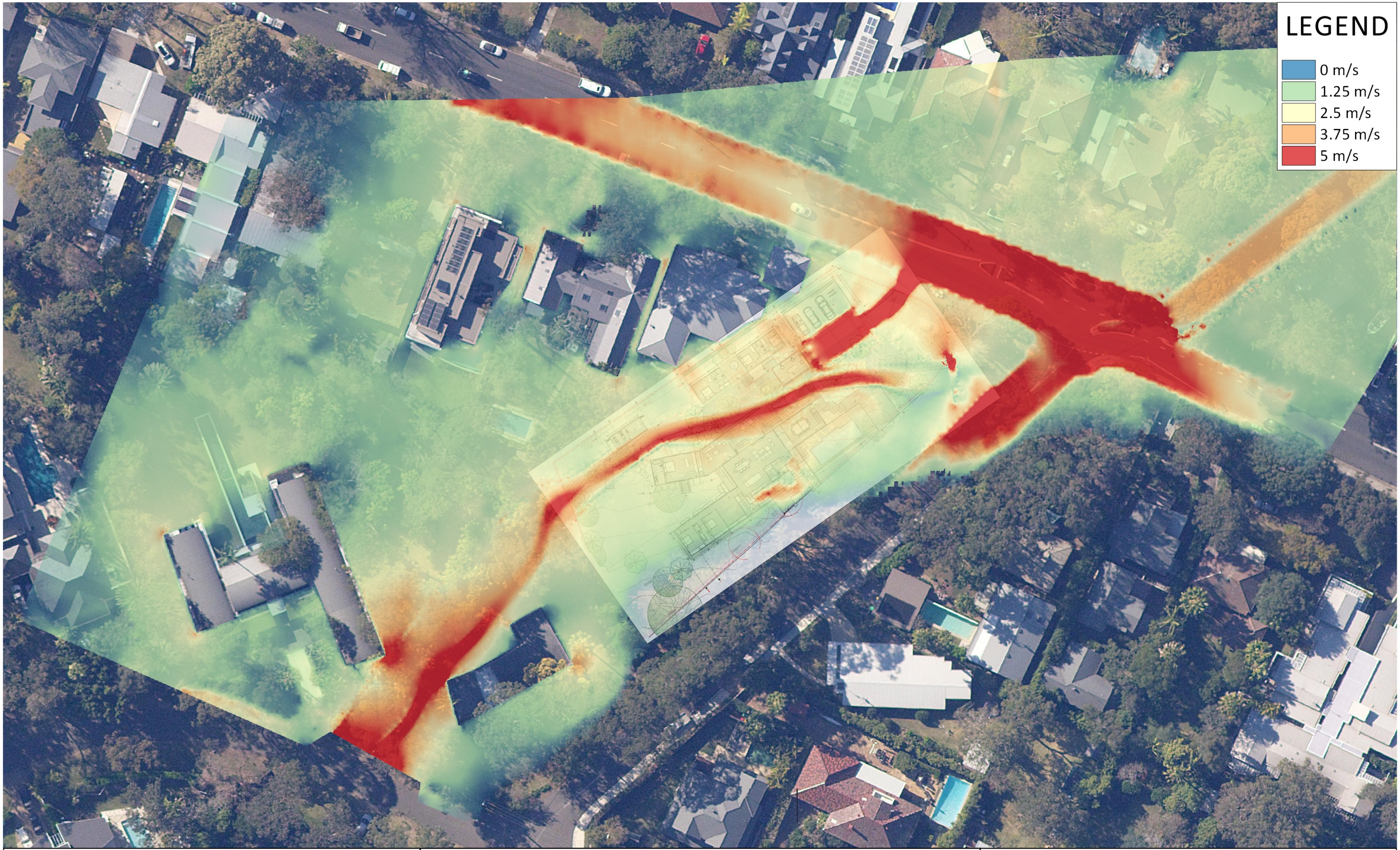

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TITLE:

Post-Development Velocities
PMF Storm Event. Source: HEC-RAS - RAS Mapper

FIGURE:	ISSUE:
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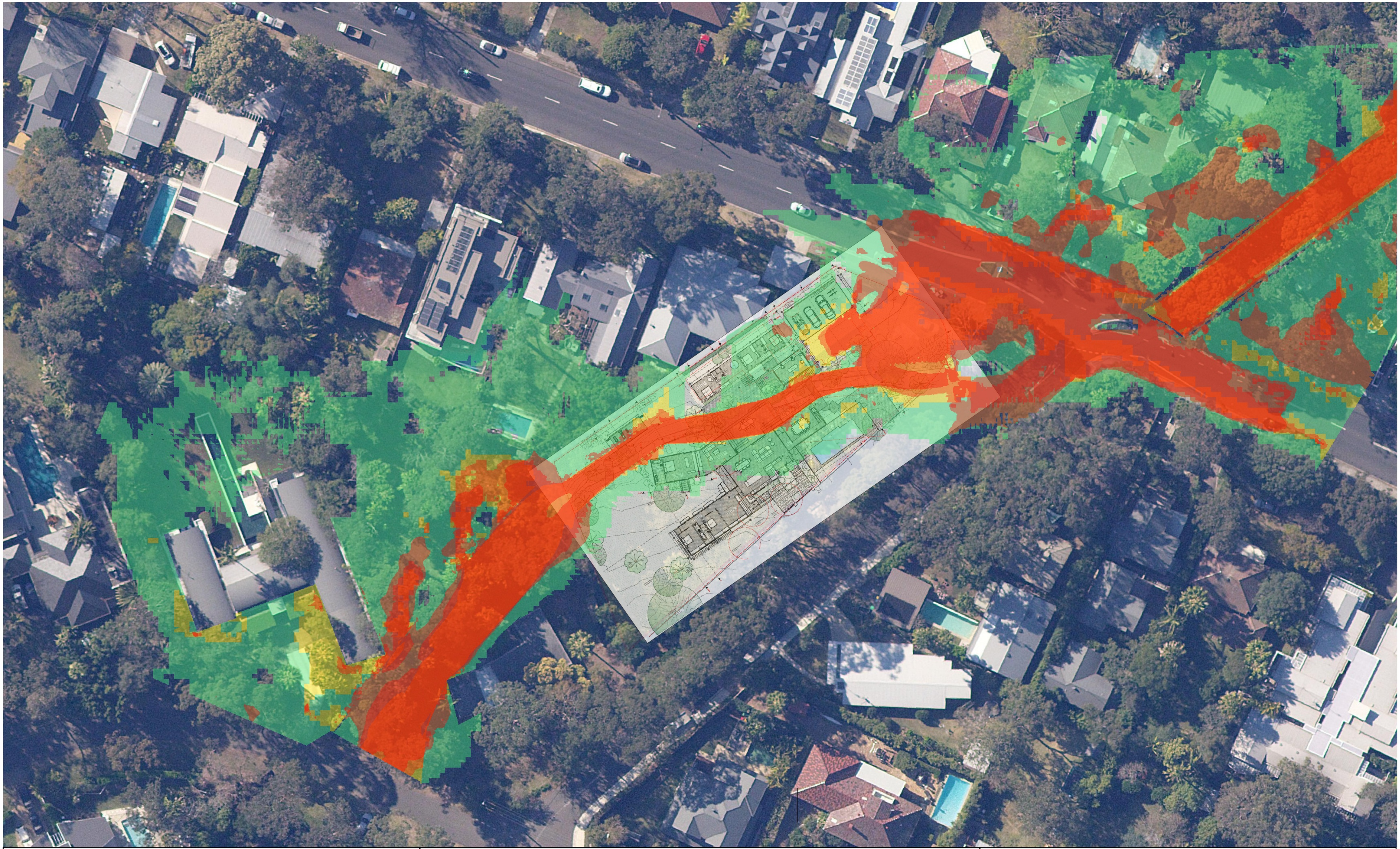

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TITLE:

Hydraulic Categories Map: Floodway (Orange), Flood Fringe (Green) & Flood Storage (Yellow) for the 1% AEP Storm Event

FIGURE:

15

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APPENDIX B

DRAINS Results

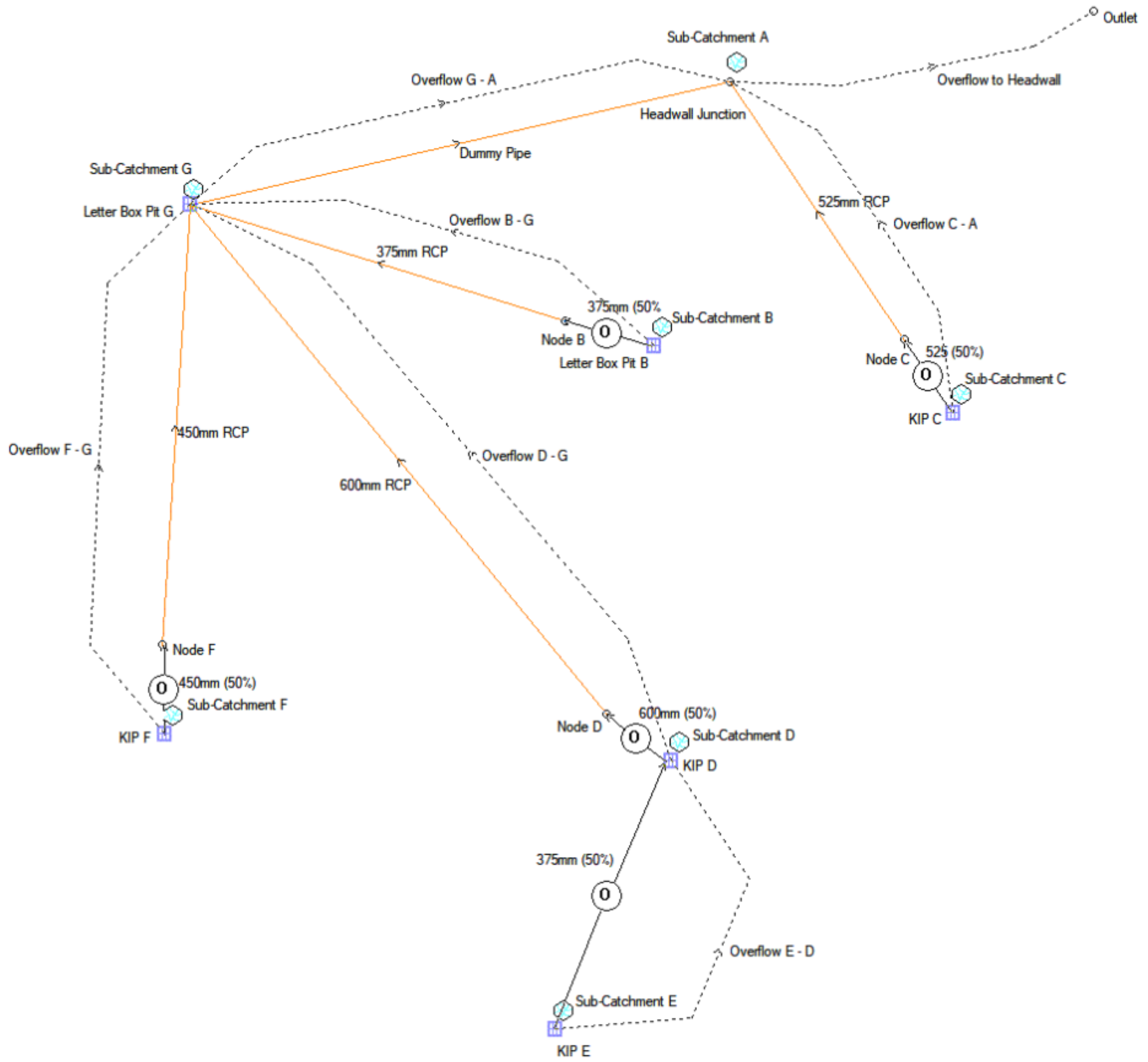

Figure 16 - DRAINS model: Catchment Configuration Layout. Source: DRAINS

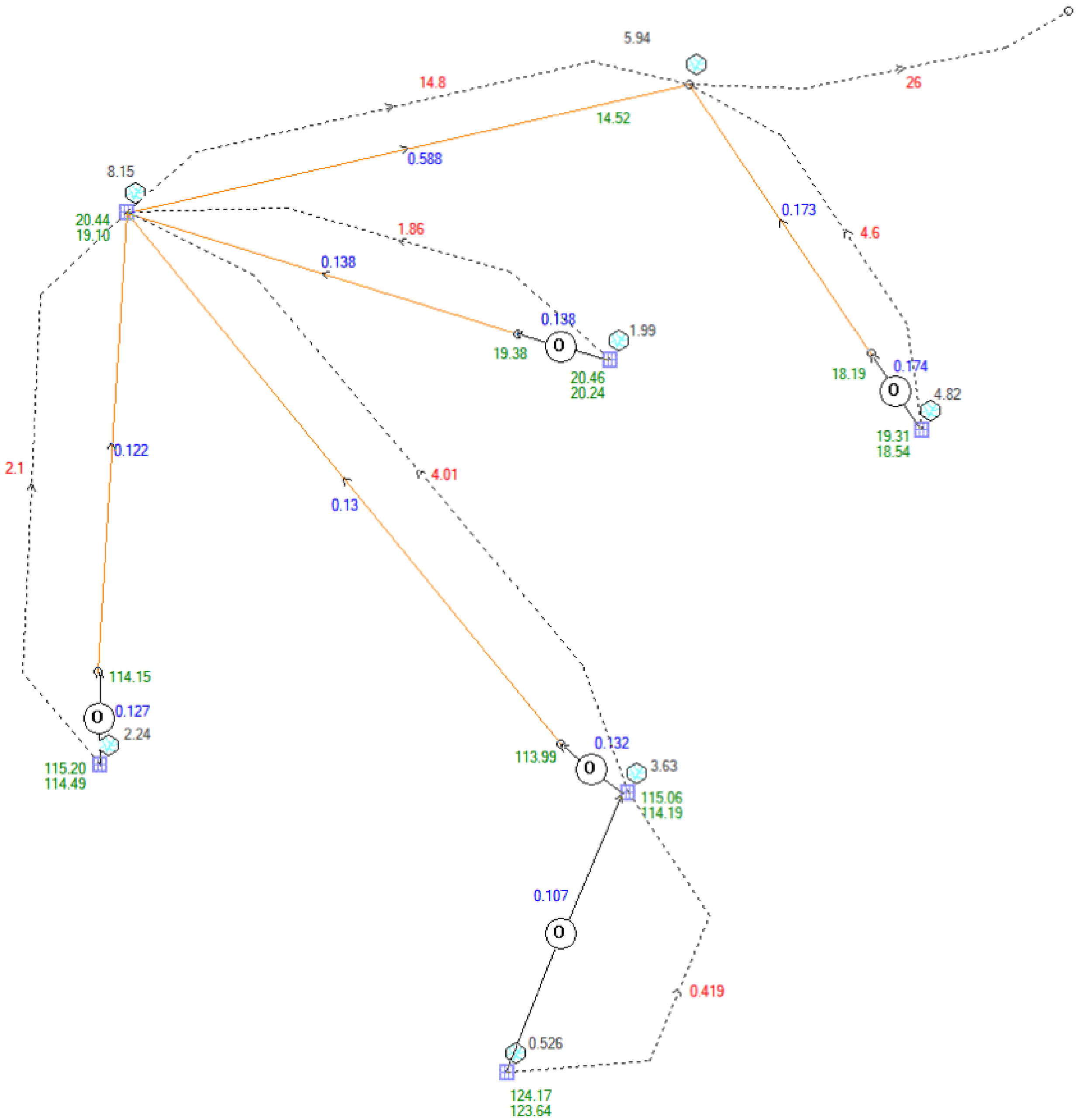

Figure 17 - DRAINS model: Catchment Flows for 1% AEP Storm Event (50% Blockage Factor Applied to Pits & Pipes). Source: DRAINS

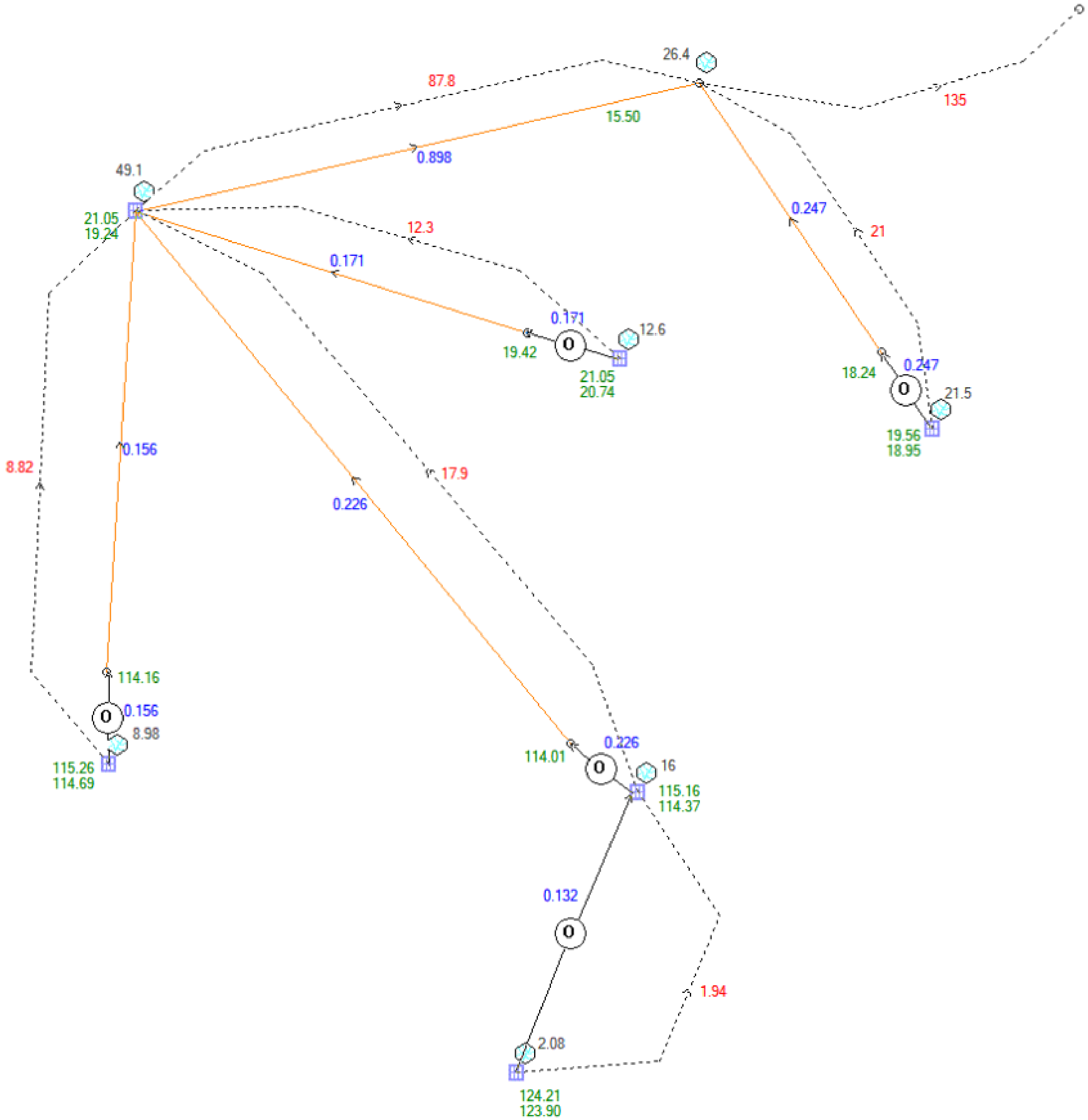

Figure 18 - DRAINS model: Catchment Flows for PMF Storm Event (50% Blockage Factor Applied to Pits & Pipes). Source: DRAINS

APPENDIX C

Site Survey Plan & Architectural Plan

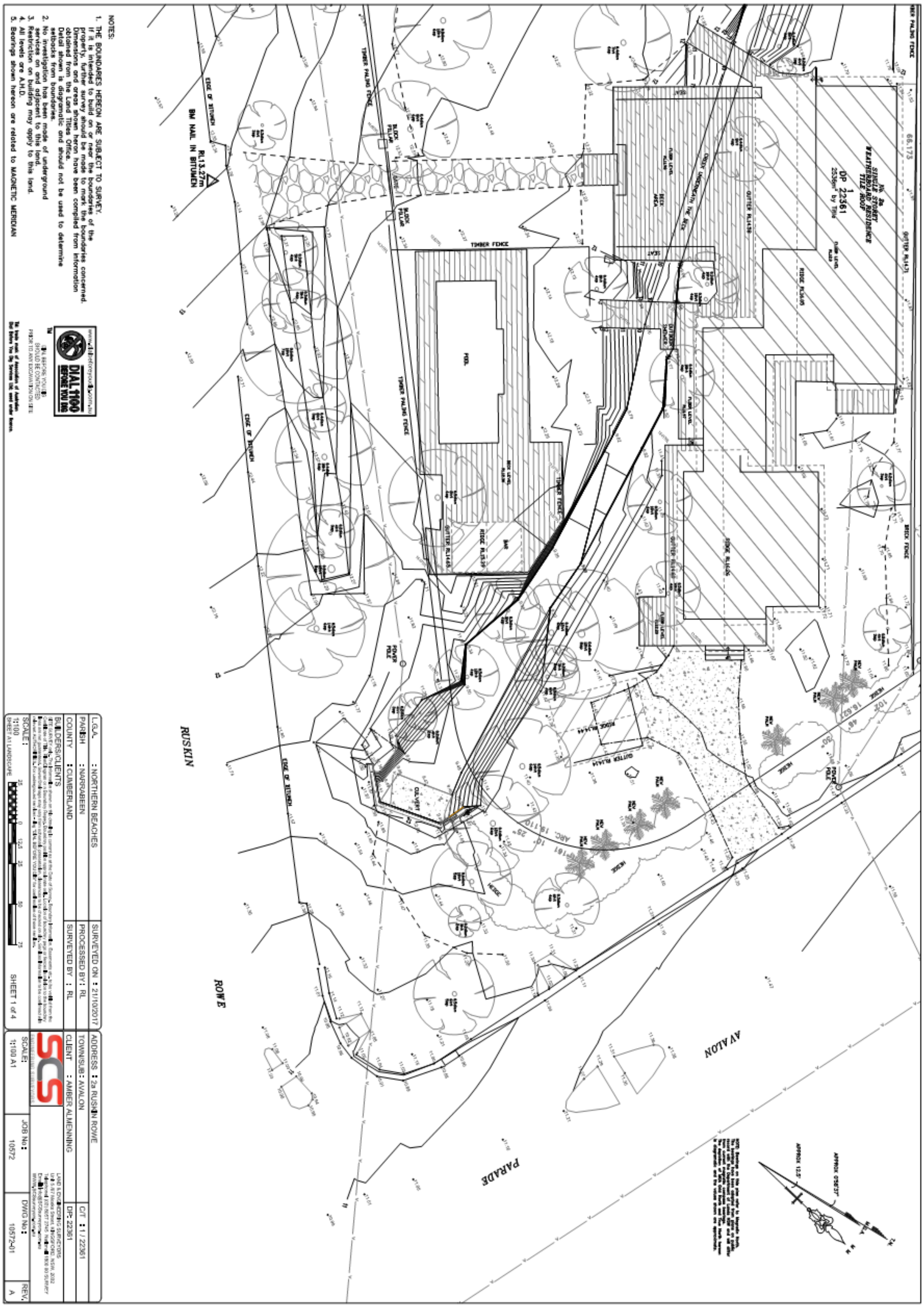

Figure 19 - Site Survey Plan. Source: SCS Engineering Surveyors. Page 1 of 4

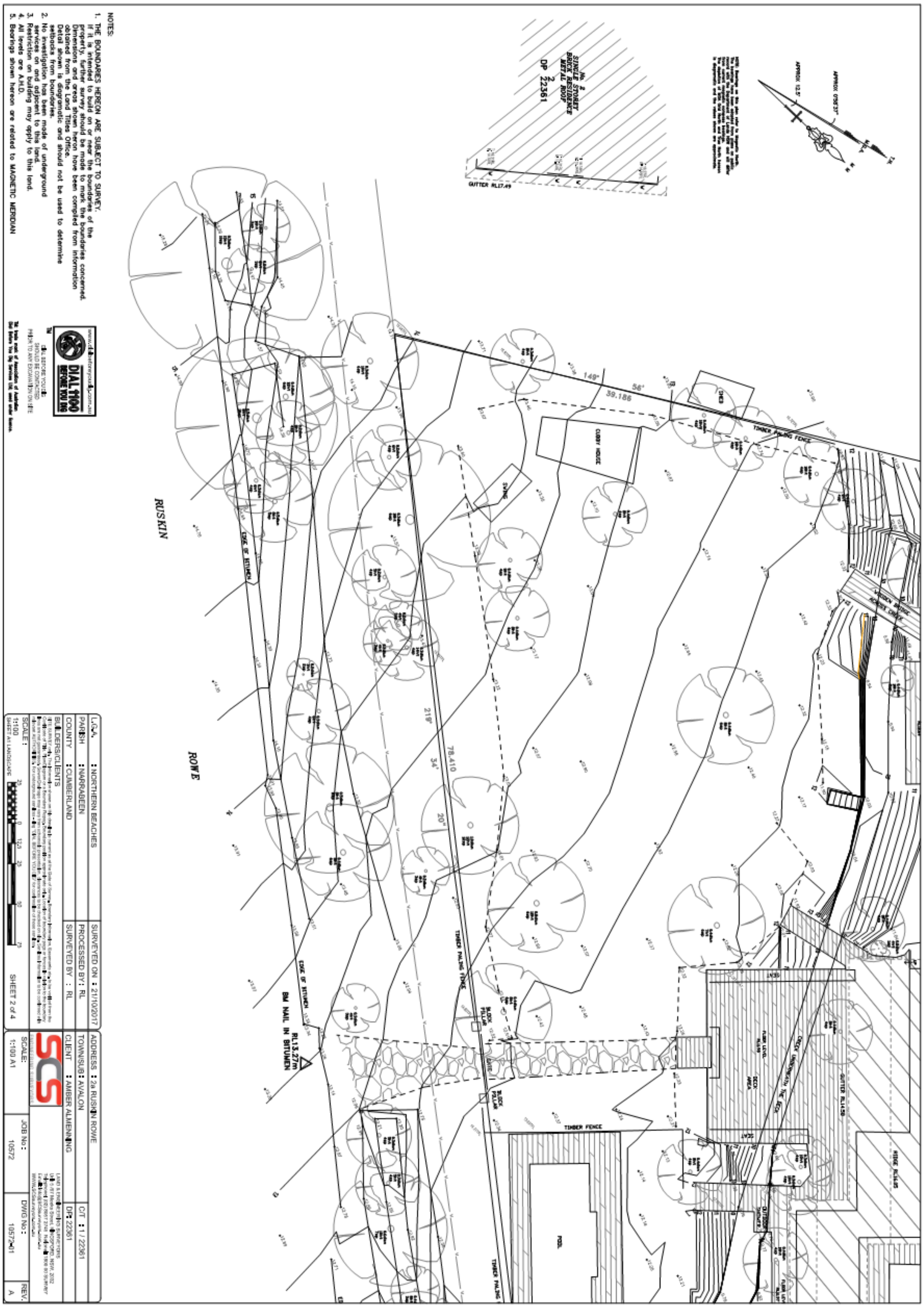

Figure 20 - Site Survey Plan. Source: SCS Engineering Surveyors. Page 2 of 4

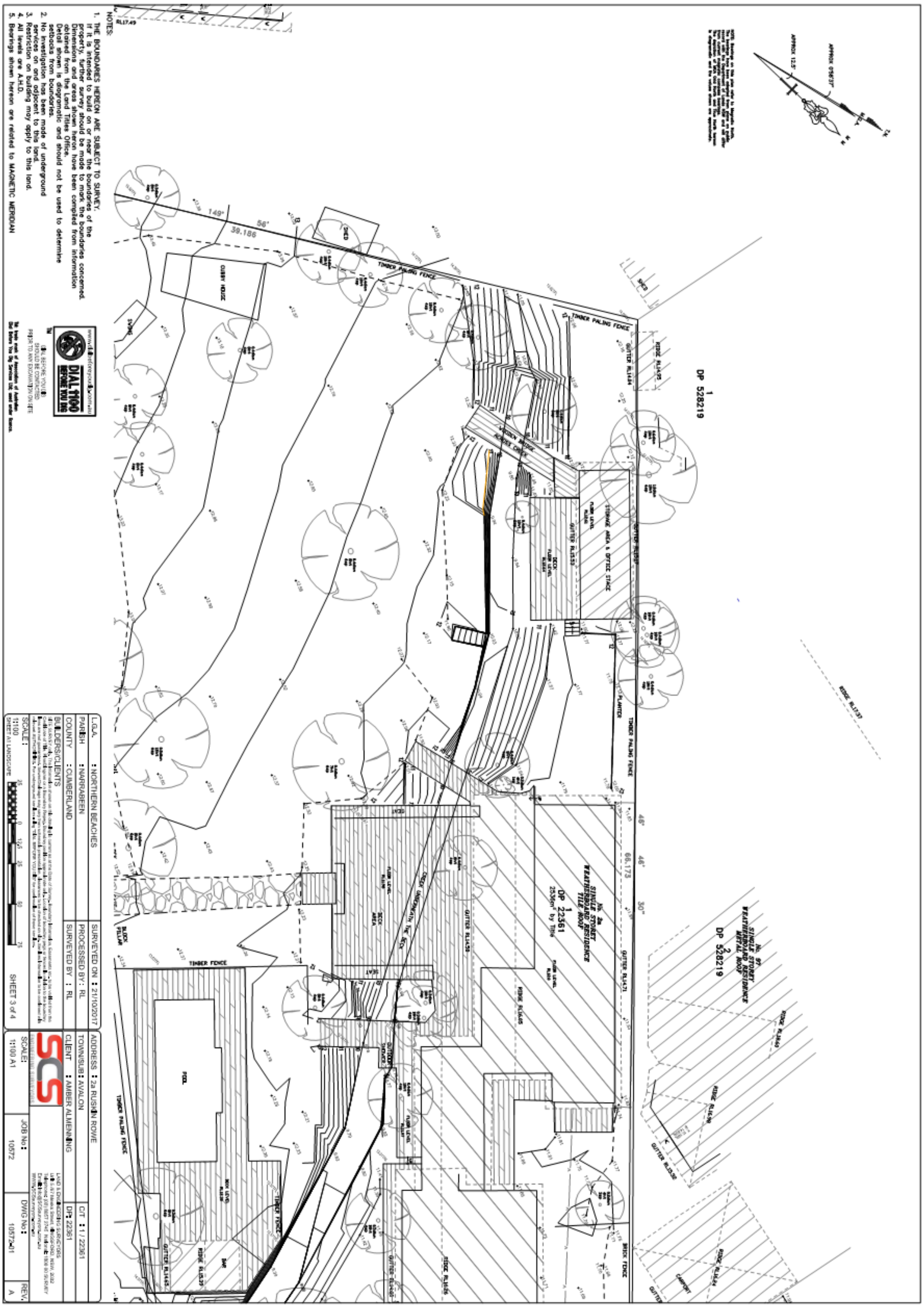

Figure 21 - Site Survey Plan. Source: SCS Engineering Surveyors. Page 3 of 4

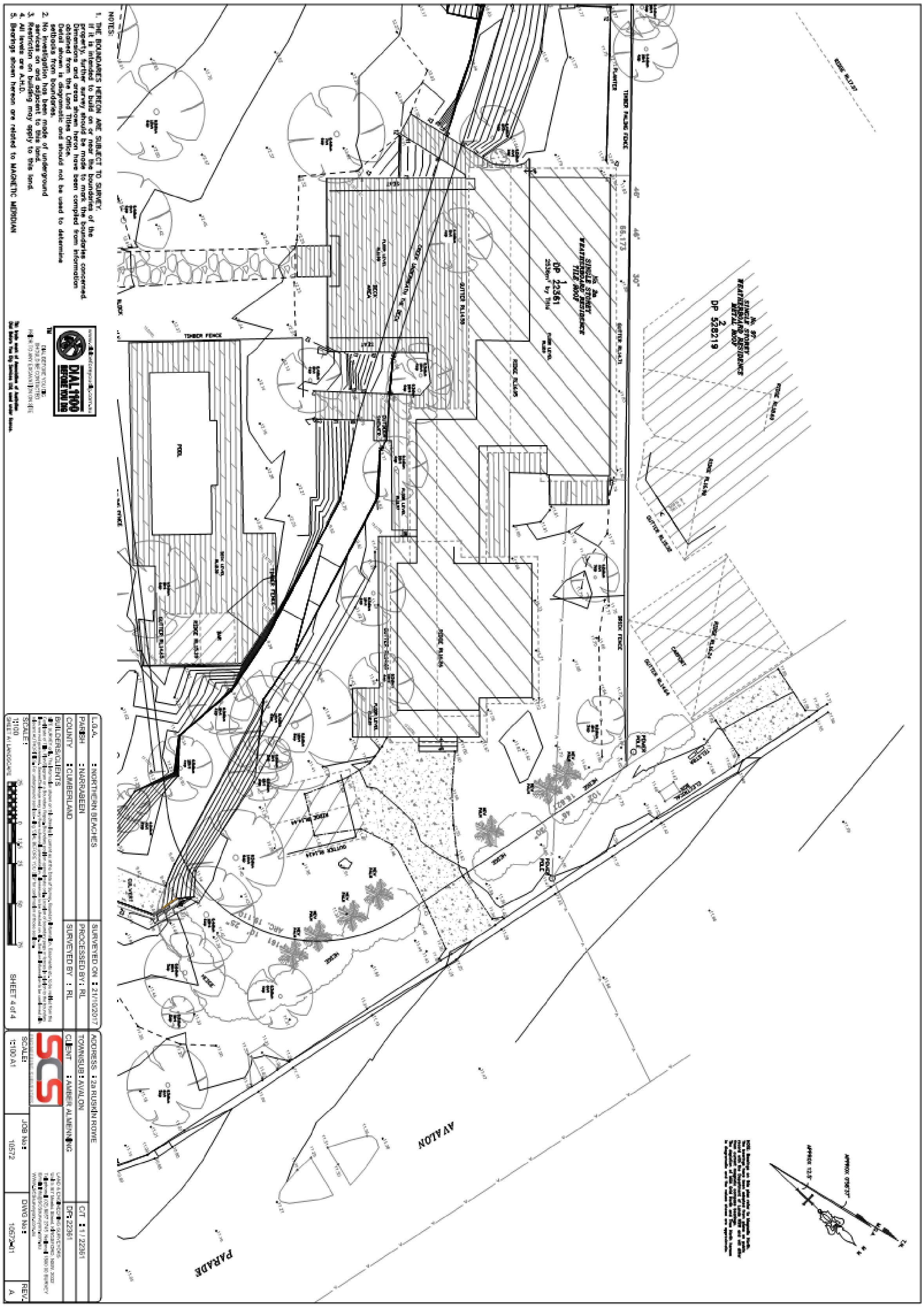

Figure 22 - Site Survey Plan. Source: SCS Engineering Surveyors. Page 4 of 4

Figure 23 - Architectural Site Plan. Source: Sandberg Schoffel Architects

Figure 24 - Architectural Floor Plan. Source: Sandberg Schoffel Architects

APPENDIX D
Council Flood Mapping Information

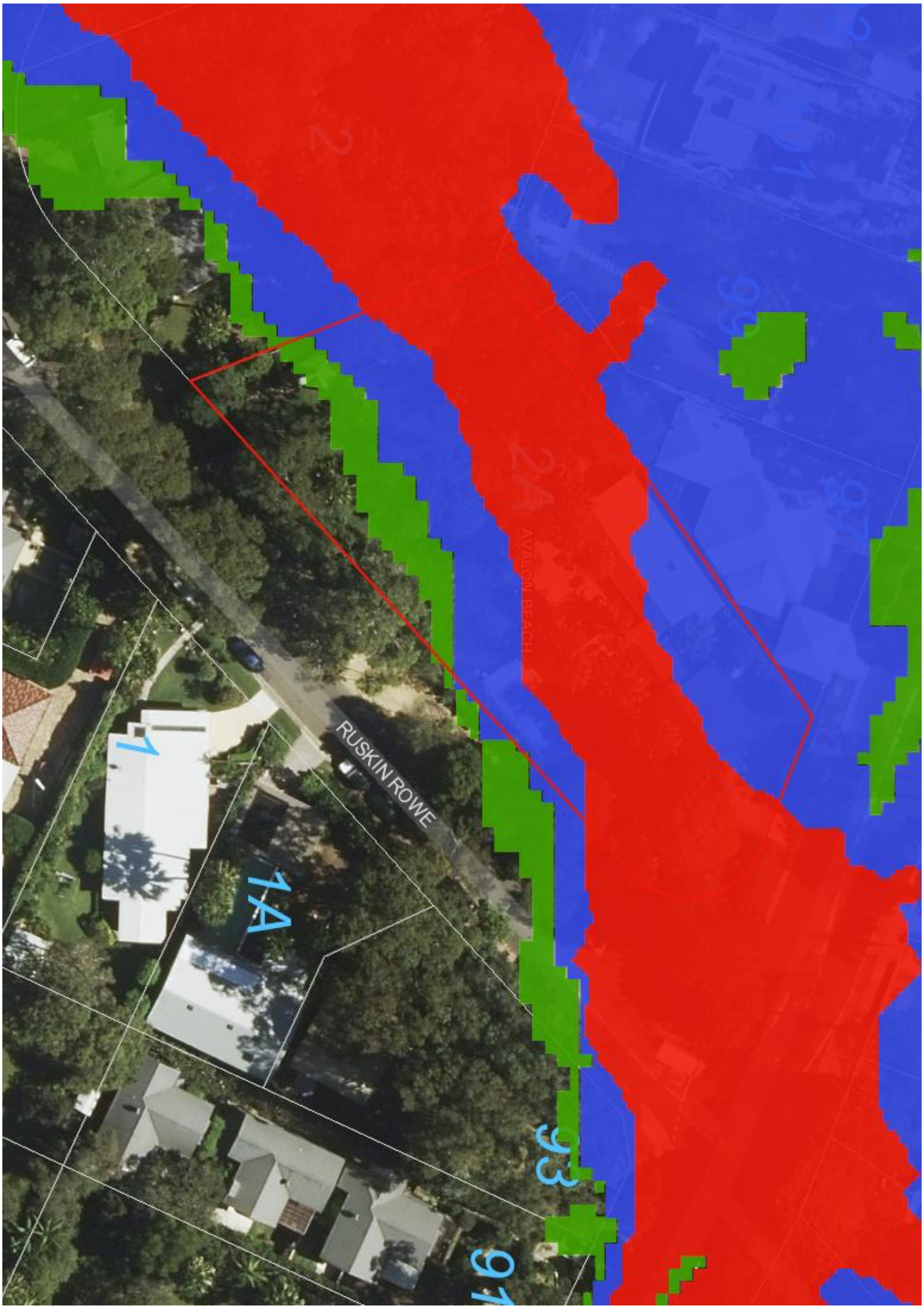

Figure 25 - Council Flood Map. Source: Northern Beaches Council Online Mapping Information

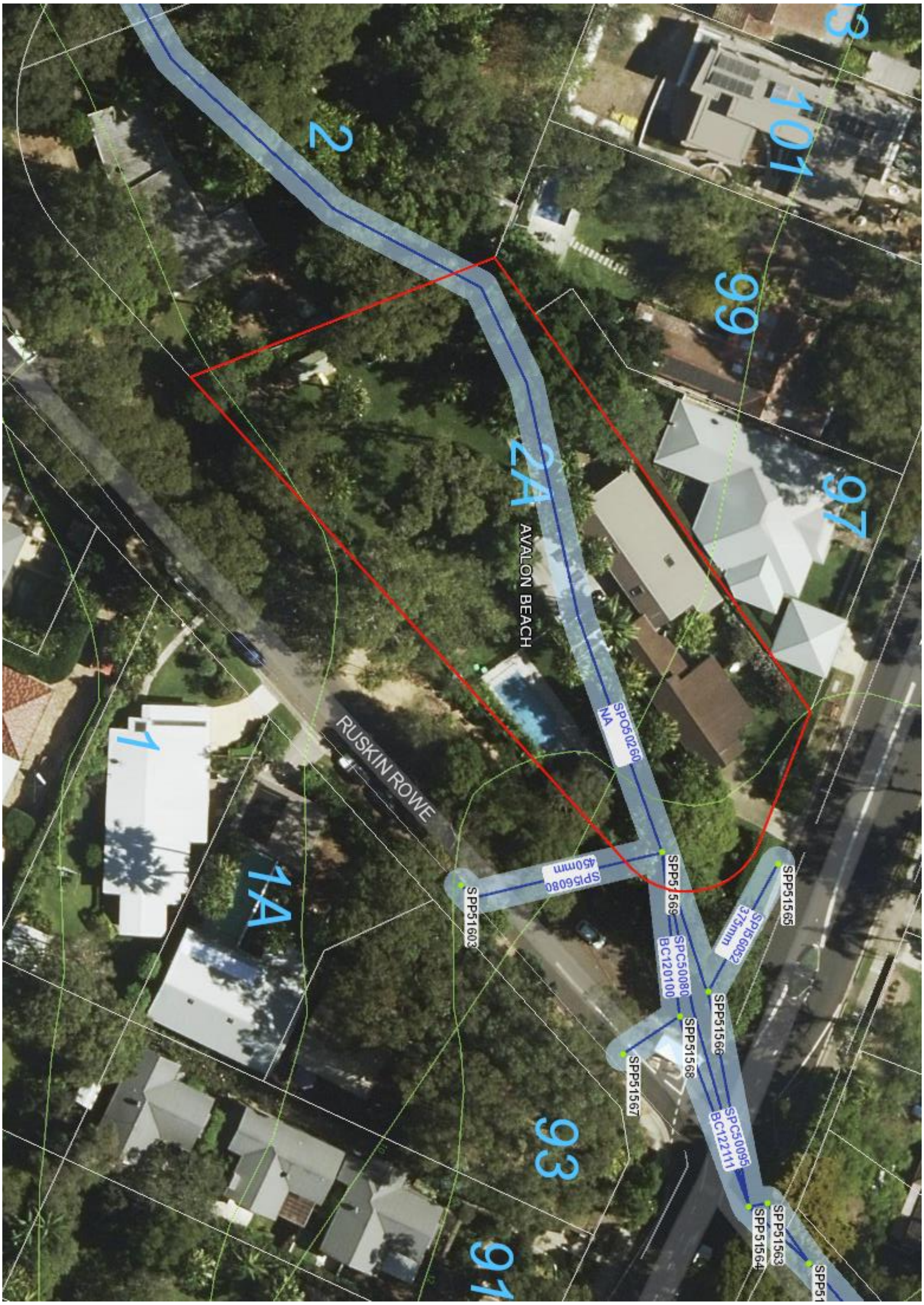

Figure 26 - Council Stormwater Map. Source: Northern Beaches Council Online Mapping Information

FLOOD EMERGENCY RESPONSE PLANNING FOR DEVELOPMENT IN PITTWATER POLICY
FORM NO. 1 – To be submitted with Development Application

Development Application for

____
(Name of Applicant)

Address of site: 2A Ruskin Rowe, Avalon

Declaration made by hydraulic engineer or engineer specialising in flooding/flood emergency response as part of a Flood Risk Emergency Assessment:

I, Rick Wray on behalf of NB Consulting Engineers
(Insert Name) (Trading or Business/ Company Name)

on this the 16/08/2019 certify that I am a hydraulic engineer or engineer
(Date)
specialising in flooding/flood emergency response and I am authorised by the above organisation/ company to issue this document and to certify that the organisation/ company has a current professional indemnity policy of at least $2million.

Flood Risk Emergency Assessment Details:

Report Title:
Flood Risk Management Report

Report Date: 08/08/2019

Author: Christian Ferry

Author's Company/Organisation: NB Consulting Engineers

I: Rick Wray
(Insert Name)
Please tick appropriate box (more than one box can be marked)

☑ have prepared the Flood Risk Emergency Assessment referenced on Form 1 in accordance with Council's guidelines and the Flood Emergency Response Planning for Development in Pittwater Policy.

☑ am willing to technically verify that the detailed Flood Risk Emergency Assessment referenced on Form 1 has been prepared in accordance with Council's guidelines and the Flood Emergency Response Planning for Development in Pittwater Policy.

☐ have examined the site and the proposed development in detail and have carried out a risk assessment (which has been attached to this form), and can confirm that:

- ☐ The addition/dwelling/building is located outside of the extents for Flood Life Hazard Categories H3-H4, H5 and H6 and a Flood Risk Emergency Assessment in not required.

☐ confirm that the results of the risk assessment for the proposed development are in compliance with the Flood Risk Management Policy for Development in Pittwater and a detailed risk assessment is not required for the subject site.

☐ have examined the site and the proposed development/alteration/addition in detail and I am of the opinion (after carrying out a risk assessment) that the Development Application does not require a Flood Risk Emergency Assessment and I have attached the risk assessment to this form.

☐ have reviewed (provide details of Report) the Flood Risk Emergency Assessment previously prepared for this property and can confirm it is up to date and is still current.

Documentation which relate to or are relied upon in report preparation:

☑ I am aware that the Flood Risk Emergency Assessment referenced on Form 1, prepared for the abovementioned site is to be submitted in support of a Development Application for this site and will be relied on by Pittwater Council as the basis for ensuring that the Flood Risk Management aspects of the proposed development have been adequately addressed to achieve an "Acceptable or Tolerable Risk" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Hydraulic engineer or engineer specialising in flooding/flood emergency response details:

Signature R. Wray

Name Rick Wray

Chartered Professional Status CPEng NER

Membership No. 803938

Company NB Consulting Engineers

Number of years specialising in flooding/emergency response 30

Adopted: 20 April 2015
In Force From: 4 May 2015