FLOOD IMPACT ASSESSMENT REPORT

For Proposed Residential Dwelling

140 Alfred Street, Harris Park

April 2023

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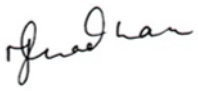
Report Description

Report Name	**Flood Impact Assessment for Proposed Residential Dwelling**	
Address	**140 Alfred Street, Harris Park**	
Client	**Paula Roumanous <paula@paularoumanous.com.au>**	
Our Reference	**FSR1961/022**	
Prepared By	**Muna Pradhan** **Flood and Drainage Engineer** **MIEAust CPEng NER**	

Revision History

Date	Version	Author	Comments
26/09/2022	V0	MP	For submission
05/04/2023	V1	MP	Updated Council's Comments

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1 Introduction

BMB Engineers was commissioned in September 2022 to carry out the flood impact assessment in relation to the proposed redevelopment of residential dwelling at 140 Alfred Street, Harris Park NSW. The flood report includes the following assessments:

- Establish hydraulic model to determine flood levels for the 5% AEP , 1% AEP and PMF storm events;
- Prepare flood extent maps at the vicinity of the development site for the 5% AEP, 1% AEP and PMF storm events for the existing and developed conditions;
- Prepare flood difference map due to the proposed development for the 5% AEP and 1% AEP storm events;
- Estimate hazard vulnerability category at the development site and
- Setting up finished floor level of proposed development.

This report has been prepared to accompany a Development Application for the proposed residential dwelling that will address City of Parramatta Council's flooding requirements. This report describes the existing characteristics of the area, proposed development and quantifies the impact of flooding due to the proposed development.

2 Site Description

The site is identified as 140 Alfred Street, Harris Park (Lot 22 DP 16064) and is located at the western side of Alfred Street.

A locality plan of the site is provided in Figure 1 below.

Figure 1: Location of Site (Source: sixmap)

The proposed development site relatively flat. Clay Cliff Creek is approximately 80m south of the development site. The site is affected by flooding from the creek in the large storm events. The elevation at the front of the site ranges between RL 4.54 m AHD to RL 4.64 m AHD. Similarly, the elevation at the rear ranges between RL 4.74 m AHD to RL 4.76 m AHD. The survey plan with spot level is provided in Figure 2 and Appendix A.

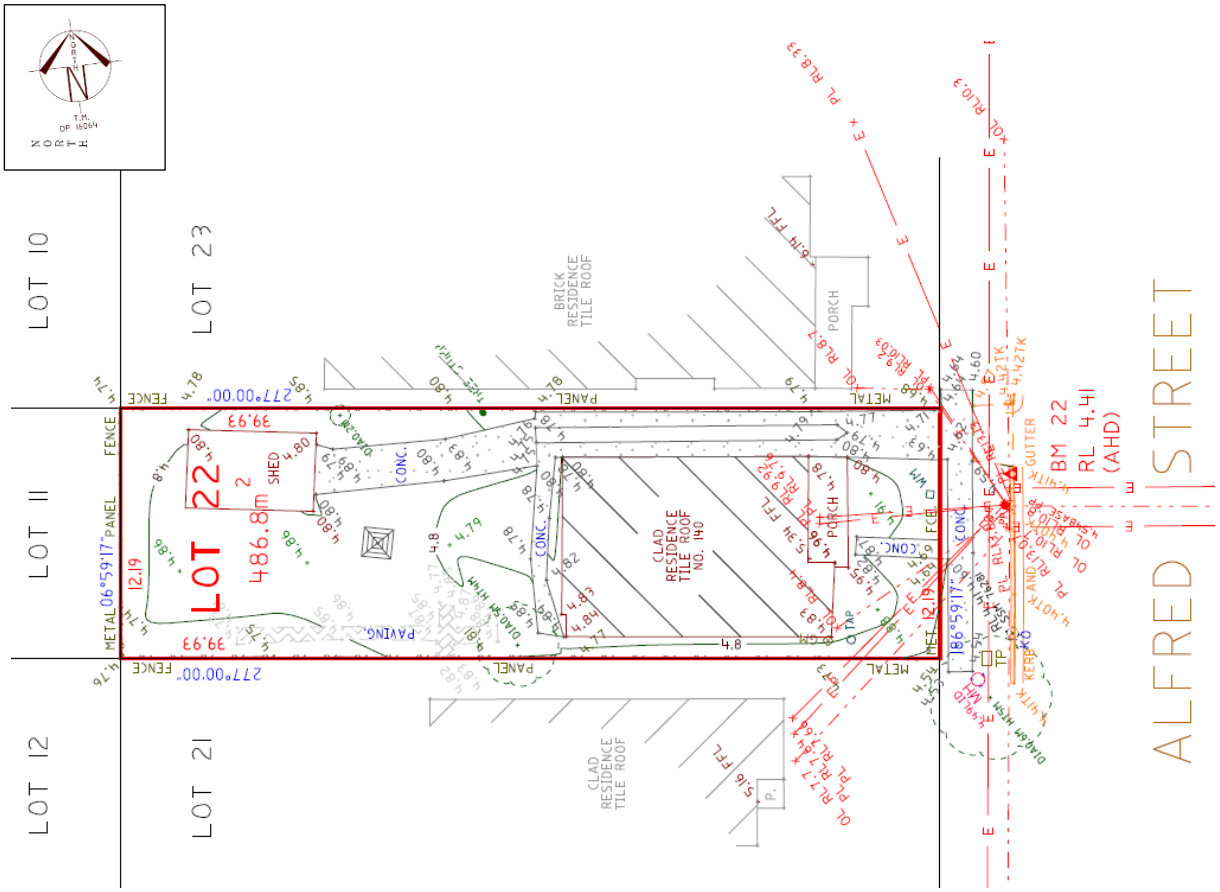


Figure 2: Survey Plan of Development Site

The existing clad building, shed and concrete strip driveway at the site has recently been demolished for redevelopment.

3 Proposed Development

The proposed development includes construction of single storey residential dwelling with attic above the PMF level at 140 Alfred Street, Harris Park. The site plan of the proposed development is presented in Figure 3 and Appendix B.

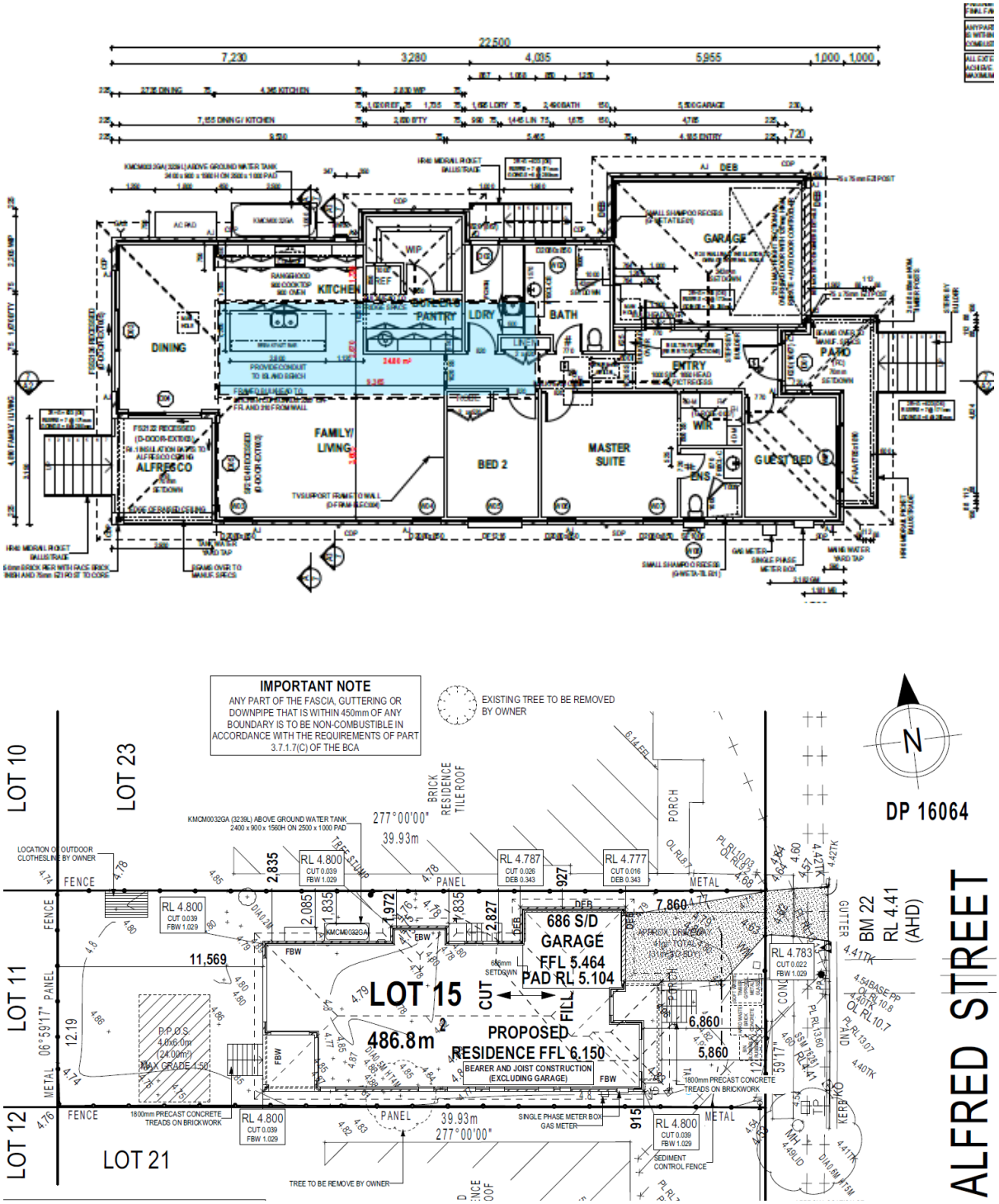


Figure 3: Site Plan of Proposed Development

4 Existing Flood Behaviour

Based on flood information provided by City of Parramatta Council, the proposed development site at 140 Alfred Street, Harris Park is affected by in the large storm events. Clay Cliff Creek exists at approximately 80m south of the development site and the Parramatta River is at approximately 370m north of the site. Based on the topography of the surrounding area and flood extent map provided by Parramatta City Council, the site is affected by flooding from Clay Cliff Creek in the storm events larger than 5% AEP. As the site is within the Probable Maximum Flood (PMF) extent of the Parramatta River, the PMF level of the Parramatta River is critical than the Clay Cliff Creek. Figure 4 presents flood extent map at the vicinity of the development site provided by the council. Flood level information obtained from Council is presented in Appendix C.

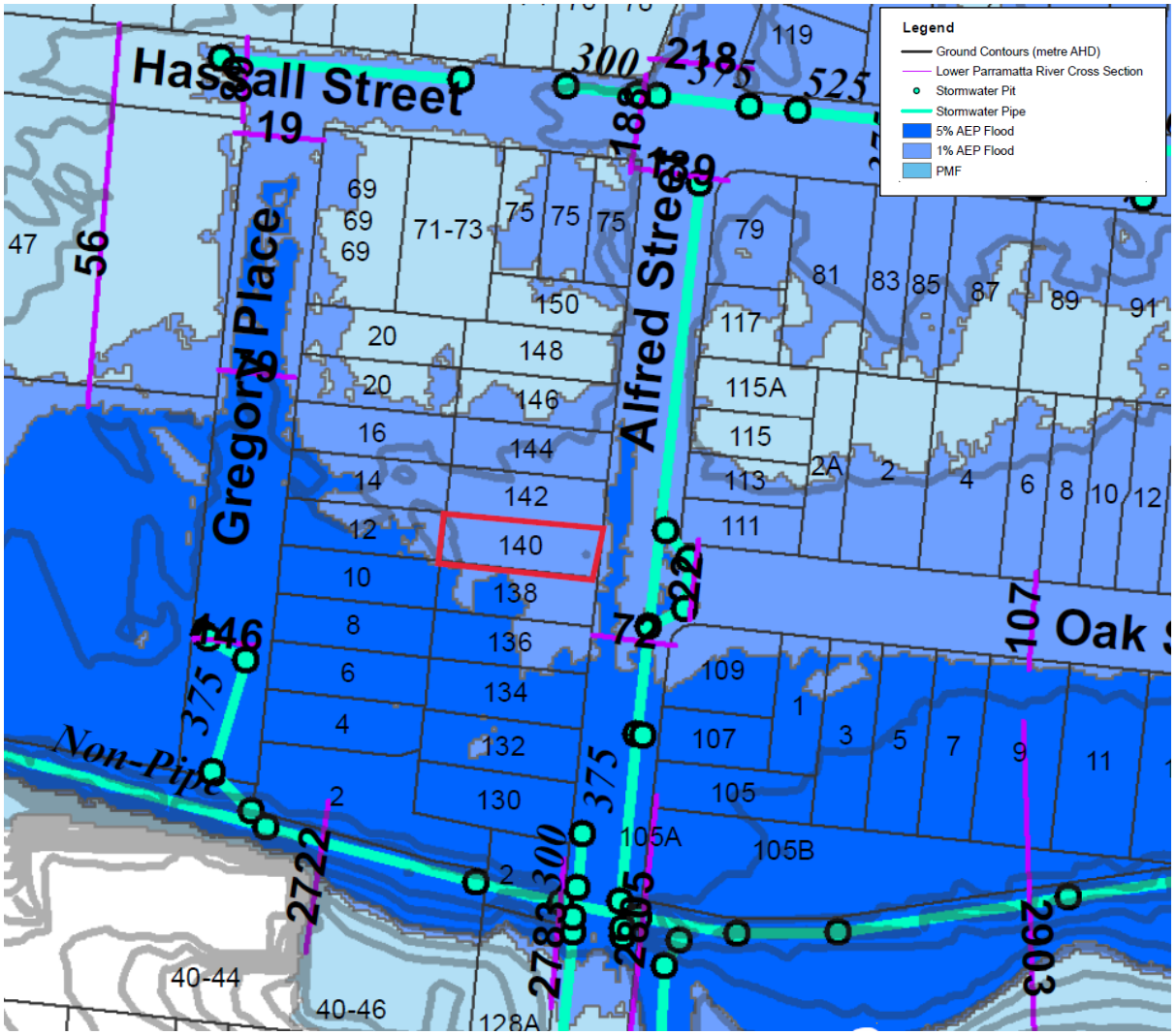


Figure 4: Flood Extent Map provided by Parramatta City Council

Based on information provided by Parramatta City Council, the 5% AEP, 1% AEP and PMF level at the development site is RL 4.50 m AHD, RL 5.60 m AHD and RL 9.30 m AHD respectively. It should be noted that the minimum natural ground level of the development site is RL 4.54 m AHD which is higher than

the 5% AEP flood level. This indicates that the site is not affected by flooding for up to the 5% AEP flood event.

5 Hydrology

5.1 Catchment Area

The possible maximum catchment area contributing flow at the Clay Cliff Creek at the vicinity of 140 Alfred Street, Harris Park has been estimated from the topographic map of the development site and surrounding area prepared from the Digital Elevation Model (DEM) obtained from Geoscience Australia and is estimated to be 276 Ha. The catchment is subdivided into four sub-catchments namely Catchment 1, Catchment 2, Catchment 3 and Catchment 4 with catchment area of 87.2 Ha, 69.2 HA, 65.8 Ha and 53.8 Ha respectively. The catchment area of the creek is shown in Figure 5.

5.2 Intensity Frequency Duration (IFD) Design Rainfall Depth

Intensity frequency duration design rainfall depth of Harris Park, NSW obtained from Bureau of Meteorology has been used to determine design precipitation of the study area. Table 1 presents intensity duration frequency design rainfall depth of Harris Park, NSW.

5.3 Rainfall Pattern

The ARR2019 method has been used to derive 5% AEP and 1% AEP design flow hydrographs of the catchment contributing flow of Clay Cliff Creek at the vicinity of 140 Alfred Street. Temporal rainfall pattern file for Harris Park is downloaded from Australian Rainfall and Runoff data hub.

For determining PMF hydrograph, PMP calculations have been undertaken using the Generalised Short-Duration Method (GSDM) recommended in Bulletin 53 issued by BOM. A summary sheet of PMP calculations is provided in Table 2.

Figure 5: Catchment Area Contributing Flow

Table 1: IFD Design Rainfall Depth

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	2.18	2.41	3.12	3.61	4.09	4.72	5.21
2 min	3.61	3.90	4.83	5.49	6.17	7.11	7.87
3 min	5.01	5.43	6.81	7.78	8.76	10.1	11.2
4 min	6.28	6.86	8.71	10.00	11.3	13.0	14.4
5 min	7.42	8.15	10.5	12.0	13.6	15.7	17.4
10 min	11.7	13.0	17.1	19.8	22.4	25.9	28.6
15 min	14.7	16.3	21.3	24.7	28.0	32.3	35.6
20 min	16.8	18.7	24.3	28.2	31.9	36.8	40.5
25 min	18.6	20.5	26.6	30.8	34.8	40.2	44.2
30 min	20.0	22.0	28.5	32.9	37.2	42.8	47.2
45 min	23.3	25.5	32.6	37.5	42.3	48.8	53.8
1 hour	25.7	28.1	35.6	40.9	46.1	53.2	58.8
1.5 hour	29.4	32.0	40.4	46.3	52.2	60.4	66.9
2 hour	32.4	35.2	44.4	50.9	57.5	66.7	74.1
3 hour	37.2	40.5	51.3	59.0	67.0	78.2	87.2
4.5 hour	43.0	47.0	60.3	70.0	80.0	93.9	105
6 hour	47.9	52.7	68.5	80.0	91.9	109	122
9 hour	56.1	62.3	83.0	98.1	114	135	153
12 hour	63.0	70.5	95.7	114	133	159	180
18 hour	74.1	84.0	117	141	167	200	227
24 hour	83.0	94.8	134	164	194	234	265
30 hour	90.4	104	149	182	217	261	297
36 hour	96.6	111	160	197	236	284	322
48 hour	107	123	179	221	265	319	361
72 hour	120	139	203	251	301	361	406
96 hour	129	149	216	267	320	381	427
120 hour	135	155	225	276	331	391	437
144 hour	139	160	230	282	336	396	440
168 hour	142	163	233	285	339	398	441

Table 2: GSDM Calculation Sheet

LOCATION INFORMATION				
Catchment: 140 Alfred Street, Harris Park			Area: 2.76 km^2	
State: NSW			Duration Limit: 6 hrs	
Latitude: 33° 49′ 22.3"S			Longitude: 151° 0′ 28.1"E	
Portion of Area Considered:				
Smooth , **S** = 1.0 (0.0 - 1.0)		Rough , **R** = 0.0 (0.0 - 1.0)		
ELEVATION ADJUSTMENT FACTOR (EAF)				
Mean Elevation: 4.6m				
Adjustment for Elevation (-0.05 per 300m above 1500m): 0				
EAF = 1.0(0.85 - 1.00)				
MOISTURE ADJUSTMENT FACTOR (MAF)				
MAF = 0.69 (0.40 - 1.00)				
PMP VALUES (mm)				
Duration (hours)	**Initial Depth - Smooth (D_S)**	**Initial Depth - Rough (D_R)**	**PMP Estimate = (D_SXS + D_RXR) X MAF X EAF**	**Rounded PMP Estimate (nearest 10 mm)**
0.25	250		172	170
0.50	359		248	250
0.75	459		316	320
1.0	566		390	390
1.5	636		439	440
2.0	706		487	490
2.5	755		521	520
3.0	804		555	560
4.0	893		616	620
5.0	953		658	660
6.0	993		685	690

5.4 Design Flow Hydrograph

A single node DRAINS-ILSAX model has been developed to determine flow hydrographs of Clay Cliff Creek for the 5% AEP, 1% AEP and PMF events. These hydrographs have been used in 2D hydraulic modelling for determining flood extent and levels and assess the impact of flooding to adjoining properties. Figure 6, Figure 7 and Figure 8 present median flow hydrographs for 5% AEP, 1% AEP and PMF events.

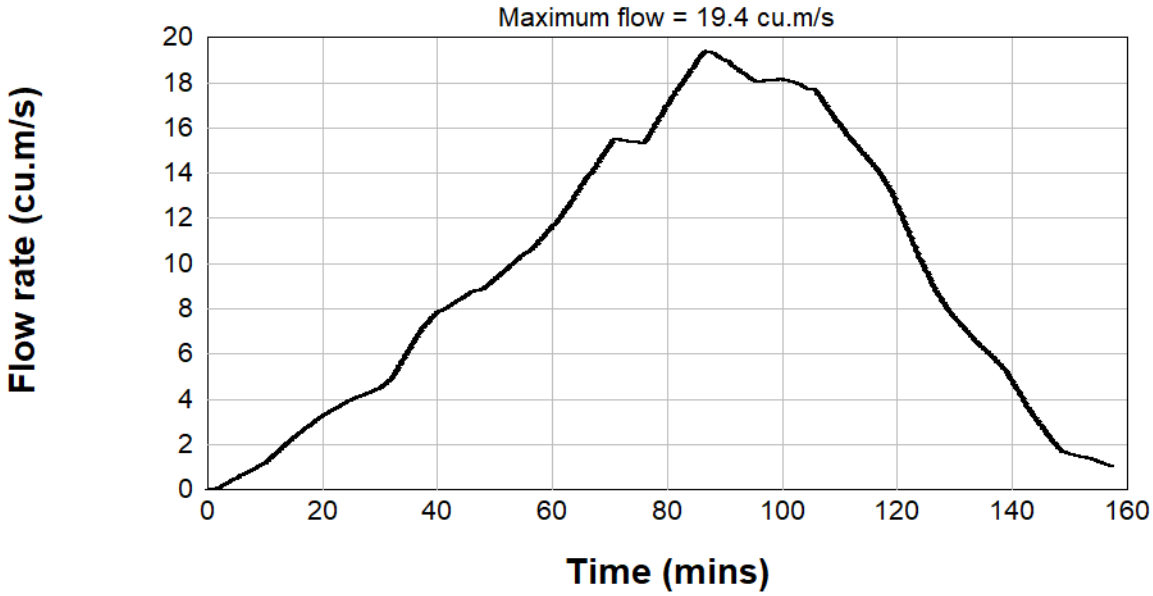


Figure 6: 5% AEP Median Flow Hydrograph from the catchment

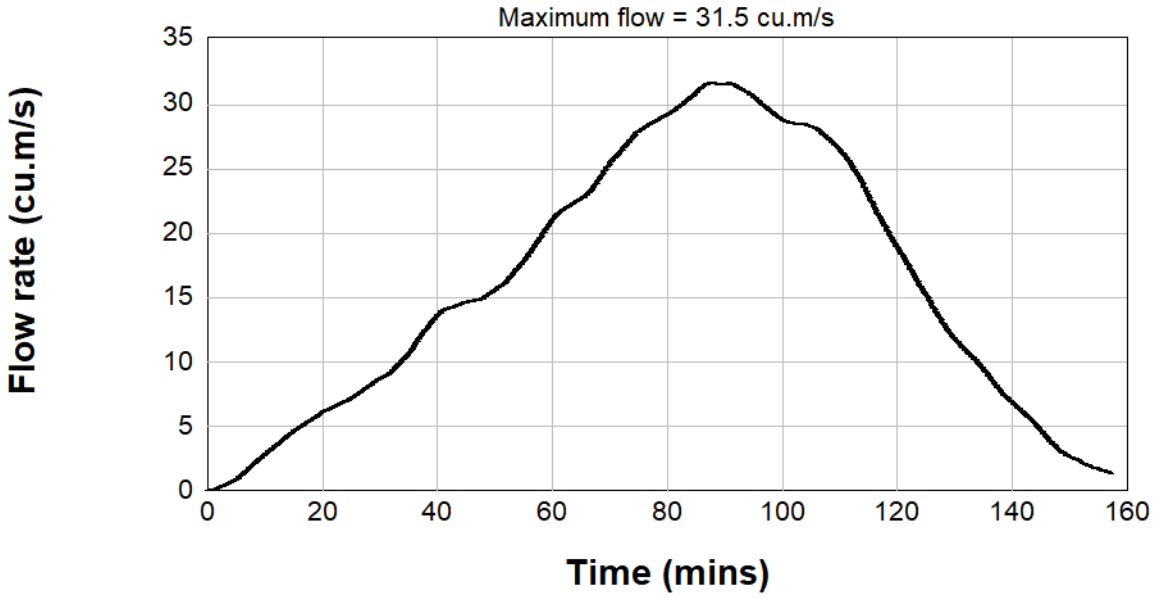


Figure 7: 1% AEP Median Flow Hydrograph from the catchment

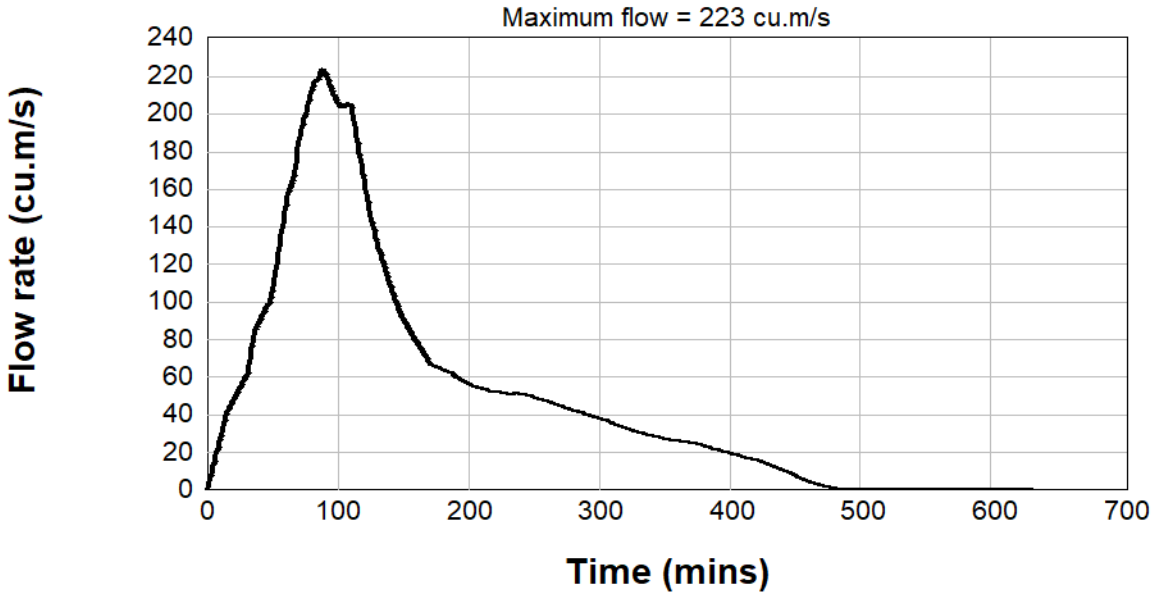


Figure 8: PMF Flow Hydrograph from the catchment

6 Hydraulic Modelling and Analysis

A TUFLOW software was used to develop 2D hydraulic model of the Clay Cliff Creek at the vicinity of the proposed development site at 140 Alfred Street, Harris Park to assess the flood behaviour at the proposed development site and quantify the impact of flooding due to the proposed development to the adjoining properties. TUFLOW is a suite of advanced numerical engines and supporting tools for simulating free-surface water flow for urban waterways, rivers, floodplains, estuaries and coastlines. The TUFLOW engines are technically superior and are industry leaders in solving all the necessary physical processes using 1D, 2D and 3D solutions.

6.1 Model Set-up

A 1.0m Digital Elevation Model in Esri ASCII Grid (2019) obtained from Australian Government Geoscience Australia has been used to develop 2D TUFLOW model of the overland flow path. The DEM of the development site developed form survey plan has been incorporated in the model. The terrain model of the modelled area is presented in Figure 9.

The possible maximum flood affected area at the vicinity of the development site is modelled in 2D-TUFLOW hydraulic software. The modelled area is splitted into grids. The grid size of 1.0 m has been used to accurately assess the extent of flooding, flood behaviour at the development site and surrounding area and impact of flooding to adjoining properties. The estimated flow hydrographs of the Clay Cliff Creek derived from DRAINS model has been assigned at the creek downstream of Hassall Street as inflow QT boundary. The downstream boundary of the catchment is modelled as HQ boundary and is assigned at the eastern side of Arthur Street. The footprints of the existing dwellings at the vicinity of the development site have been raised in DEM.

The Clay Cliff Creek Bridge at Alfred Street has been modelled using layered flow constrictions (2d_lfcsh enforcement) to more accurately model the flow through the bridge opening. The details of layered flow constriction can be found in TUFLOW user guide. A blockage factor of 20% has been considered for the flow constriction area to consider possible obstruction from the bridge abutments / walls. Schematic of model layout is presented in Figure 10.

The existing underground stormwater networks have not included in the model to be in a conservative side.

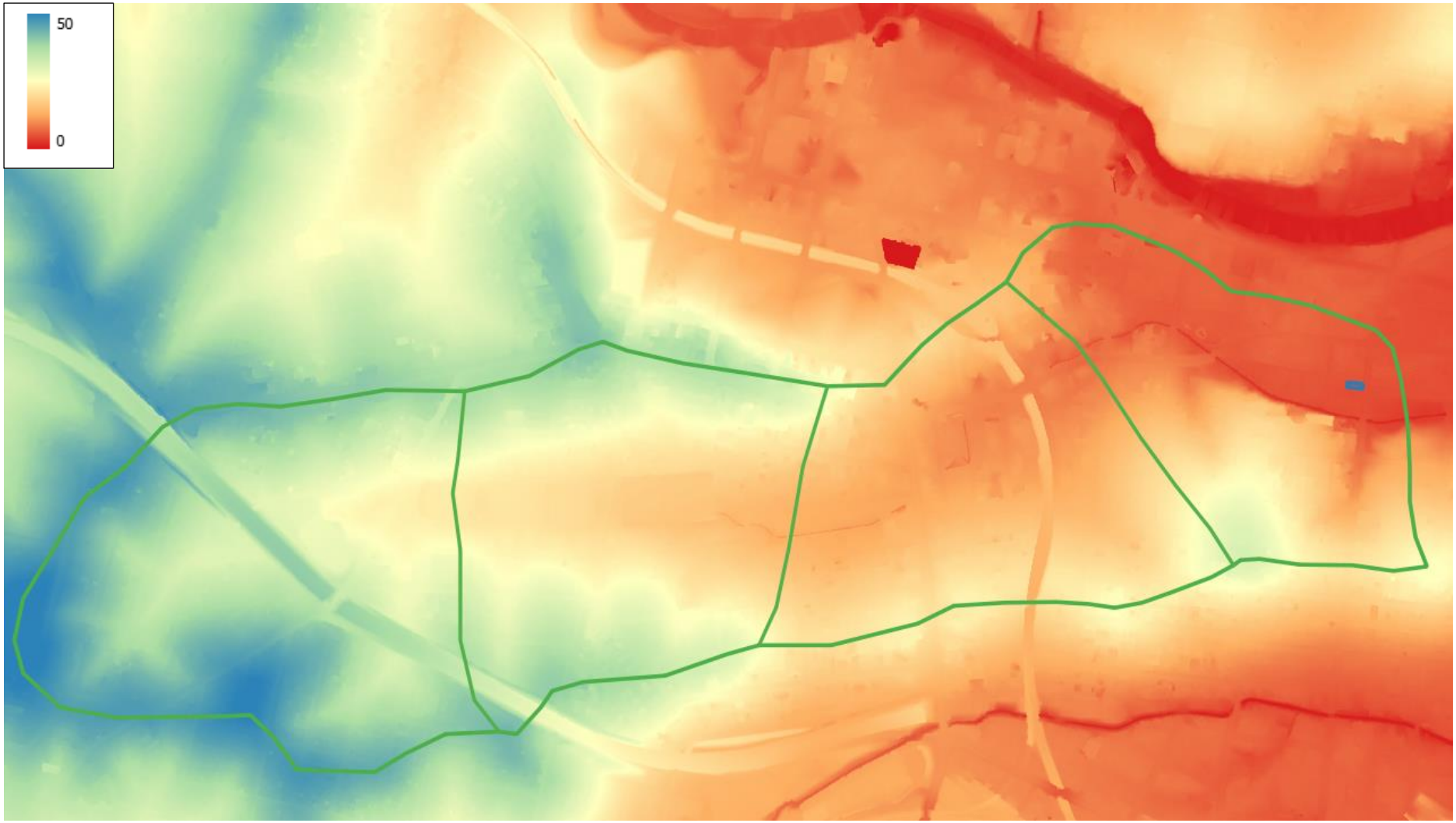


Figure 9: Terrain Model of Study Area

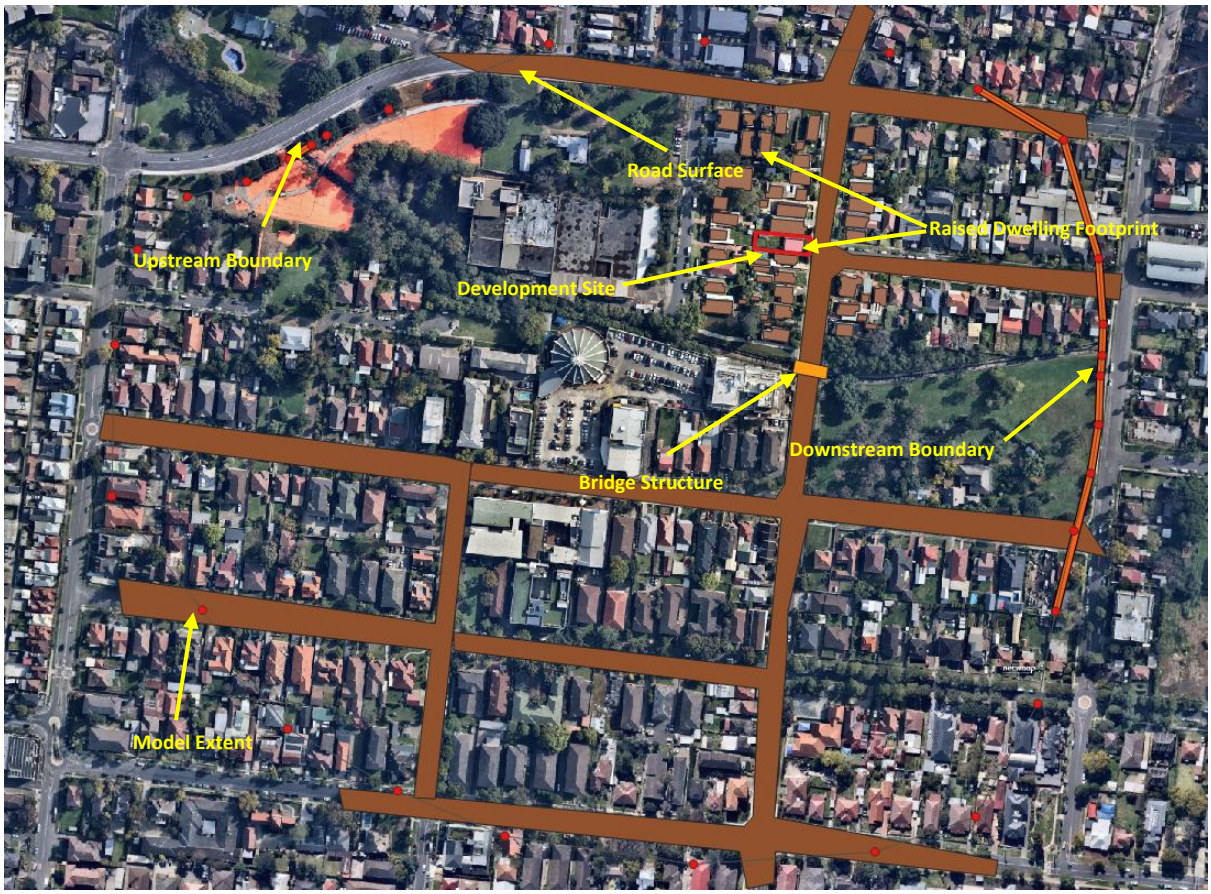
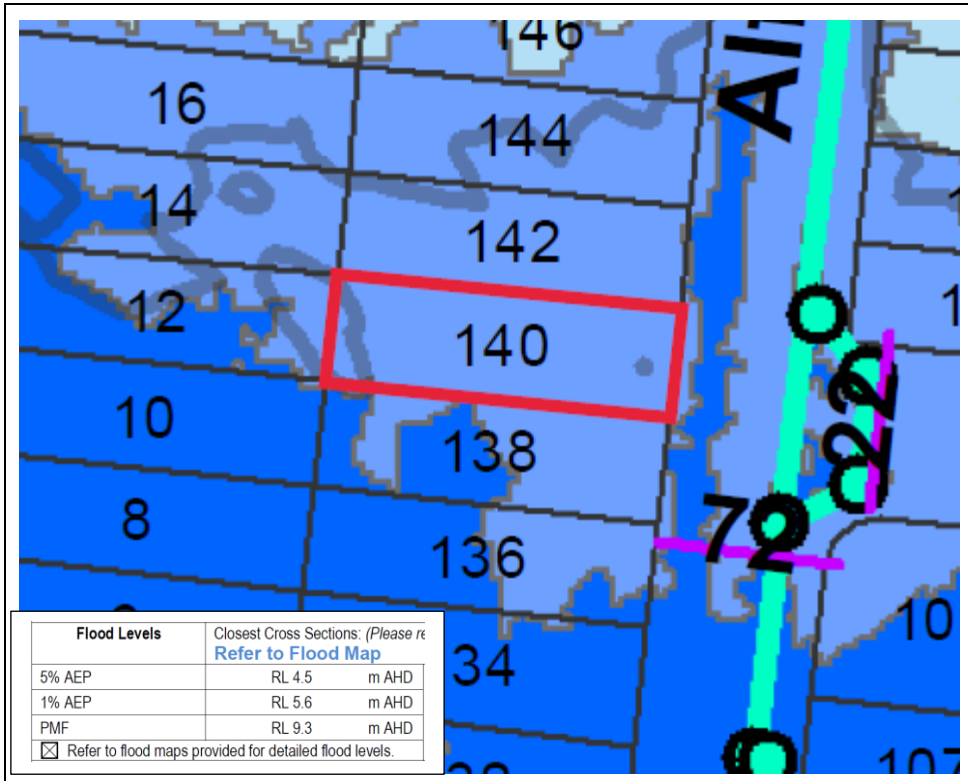


Figure 10: Schematic of Model Layout

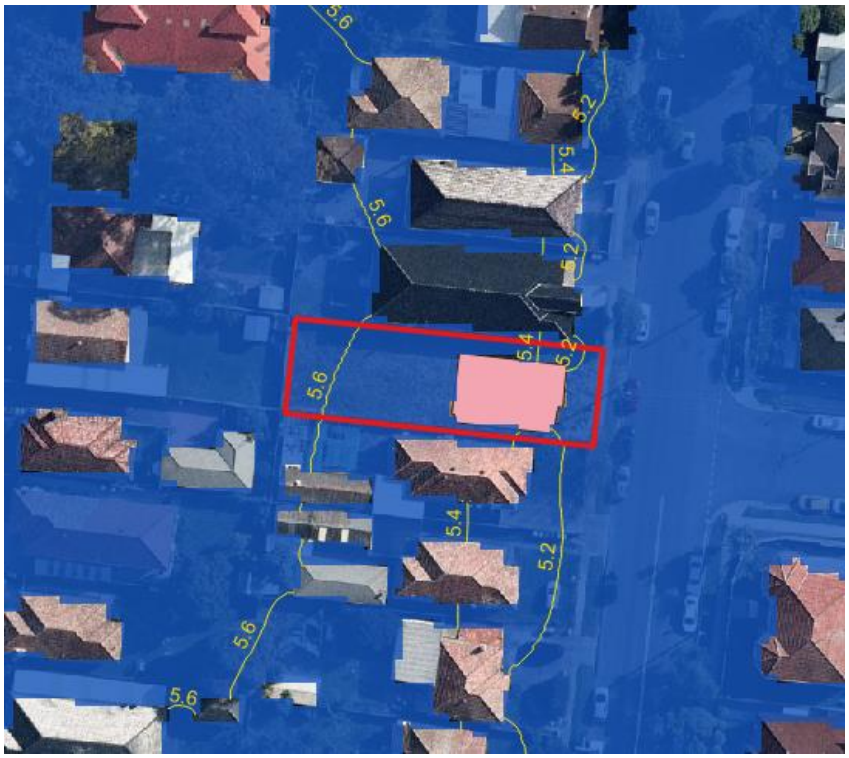
6.2 Model Calibration

Based on flood level information and flood extent map provided by Parramatta City Council, the development site at 140 Alfred Street, Harris Park is above the 5% AEP flood level. It also appeared that the site is affected by PMF flooding from the Parramatta River. The PMF flood level at the site from the Parramatta River shall be higher than the PMF level from the Clay Cliff Creek. This study did not considered modelling of Parramatta River. Hence, this model is only calibrated with the 1% AEP flood level at the development site provided by the council.

The developed TUFLOW model has been run for various Manning's roughness values and the value of 0.29 for floodplain best matches with the 1% AEP flood level provided by the council. Figure 11 provides comparison of modelled flood extent and levels with the flood extent and levels provided by the council. The modelled flood levels at the rear of 140 Alfred Street is RL 5.61 m AHD. This value is 10mm above the 1% AEP flood level provided by the council. Hence, this model is considered appropriate for flood impact assessment for the proposed redevelopment.



Flood Extent and Level Provided by Council



Modelled Flood Extent and Level

Figure 11: Comparison of Modelled Flood Extent and Level with Council's Flood Extent and Level at the Vicinity of Development Site

6.3 Model Results

The calibrated TUFLOW model was used to determine the flood level and extent at the vicinity of the proposed development site at 140 Alfred Street, Harris Park.

6.3.1 Existing Condition

The 5% AEP modelling result indicate that the development site is not affected by flooding. It also indicates that the flood level of the flood affected area closest to the site is RL 4.50 m AHD. This value is consistent with the flood level provided by the council. Figure 12 presents 5% AEP flood extent with flood level contour at the vicinity of the development site.

The 1% AEP flood extent with flood level contour, flood depth, flood velocity and velocity depth product maps are presented in Figure 13 to Figure 16. It indicates that the 1% AEP flood level at the site ranges between RL 5.17m AHD to RL 5.61 m AHD with the maximum level being at the rear and the minimum level is at the front of the site. The flood depth map (Figure 14) indicates that the flood depth at the site is up to 930mm with the maximum level being at the vicinity of the south west corner. The velocity map (Figure 15) indicates that the velocity at the site is up to 0.45 m/s with the maximum value being at the north east corner of the existing dwelling. The velocity depth product map (Figure 16) indicates that the 1% AEP velocity depth product at the development site is up to 0.25 m^2/s with the maximum value being at the area in between the existing dwellings at the adjoining properties.

The Probable Maximum Flood (PMF) at the development site provided by the council is RL 9.30 m AHD. It appeared that this level is the PMF level of the Parramatta River at this site as the PMF level of Clay Cliff Creek is unlikely to reach to this level. Modelling of the Parramatta River is not undertaken in this study. However, the flood level provided by the council is considered for flood evacuation purpose. The existing PMF extent with flood level contour, flood depth, flood velocity and velocity depth product maps are presented in Figure 17 to Figure 20.

6.3.2 Developed Condition

The building footprint of the existing dwelling has been replaced by the footprint of the proposed building and raised in DEM, i.e., blocked the proposed dwelling footprint. The proposed regrading as indicated in the site plan has been incorporated in the DEM.

The 5% AEP flood extent with flood level contour is provided in Figure 21. This map indicates that the site is not affected by flooding from the 5% AEP flood.

The 1% AEP flood extent with flood level contour, flood depth, flood velocity and velocity depth product maps are presented in Figure 22 to Figure 25. These maps are consistent with existing condition with some localised change within the development site sue to the change in building footprint.

Similarly, developed PMF extent with flood level contour, flood depth, flood velocity and velocity depth product maps are presented in Figure 26 to Figure 29. These maps are also consistent with the existing condition.

Figure 30 presents 1% AEP flood level difference at the vicinity of the development site due to the proposed development. It indicates that there is a localised increase in flood level at the western side of the proposed dwelling by up to 25mm. However, this increase ceases within the development site. The increase in flood level at property boundary is up to 13mm and adjoining property is up to 11mm. This increase is within the modelling tolerance and hence considered negligible. This showed that the proposed development will have no / negligible adverse impact of flooding to adjoining properties.

Figure 31 presents flood extent map obtained from Parramatta City Council. It indicates that the entire area in between the Parramatta River and Clay Cliff Creek is inundated. As the flood plain of the Parramatta River is much wider, the PMF level of the Parramatta River is critical for this development site and hence this level is considered for flood evacuation purpose or for the floor level of flood refuse area / shelter in place.

Based on modelling result and the flood level information from Parramatta City Council, the maximum 1% AEP flood level within the development site is RL 5.60 m AHD. Modelling result indicates that the 1% AEP flood level at the location of garage is RL 5.50 m AHD. The minimum habitable floor level is to be 500mm and garage is to be 200mm above the maximum 1% AEP flood level. ***It is recommended that the minimum habitable floor level of the proposed dwelling is to be RL 6.10 m AHD and garage is to be RL 5.70 m AHD. It is also recommended that the finished floor level of the attic shall be above PMF level i.e., RL 9.30 m AHD.***

It is recommended that any new fencing within the 1% AEP flood extent of the development site is to be of permeable (open) type to allow free flow of floodwaters and not to cause damage to surrounding land in the event of a flood.

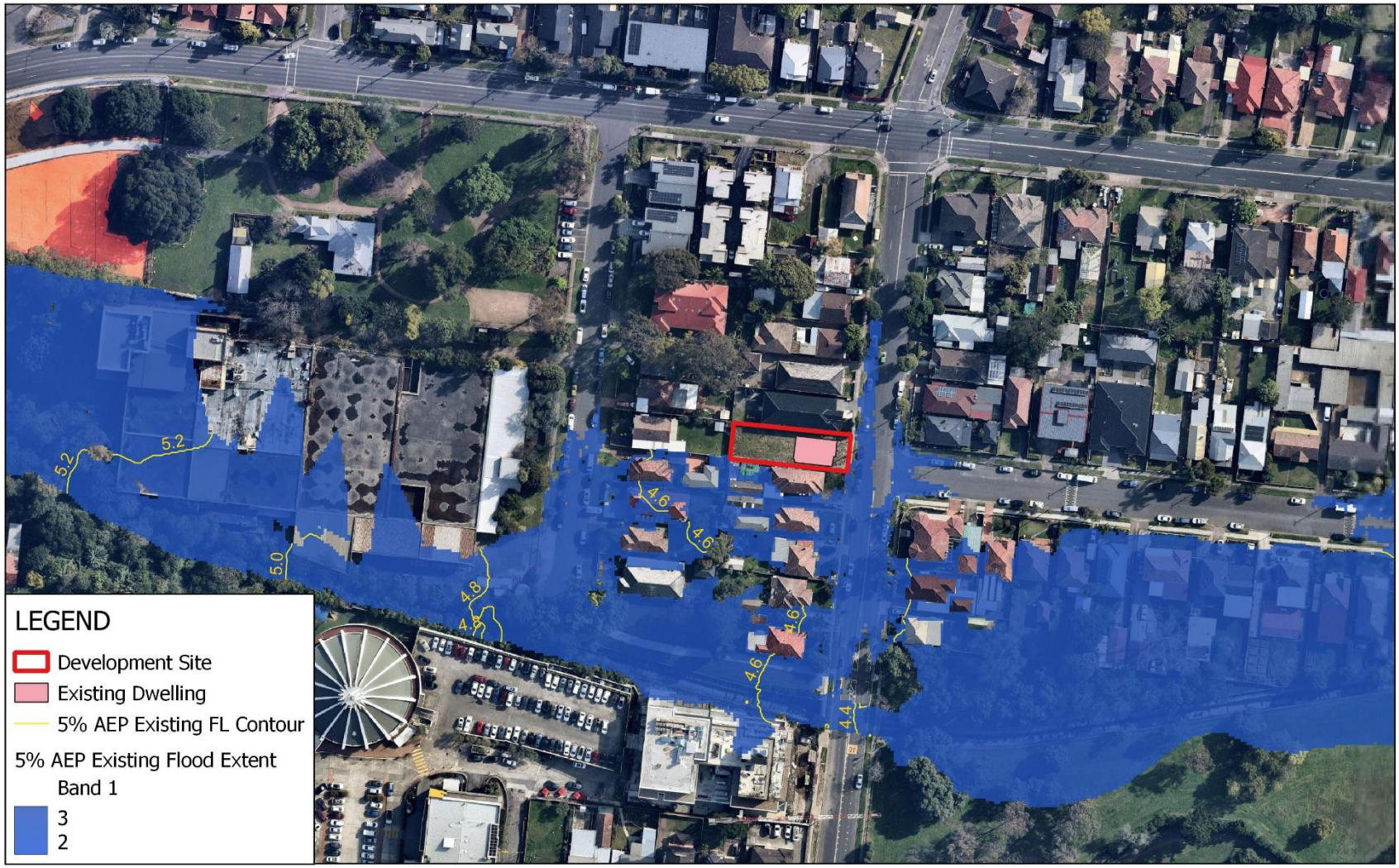


Figure 12: 5% AEP Existing Condition Flood Extent with Flood Level Contour

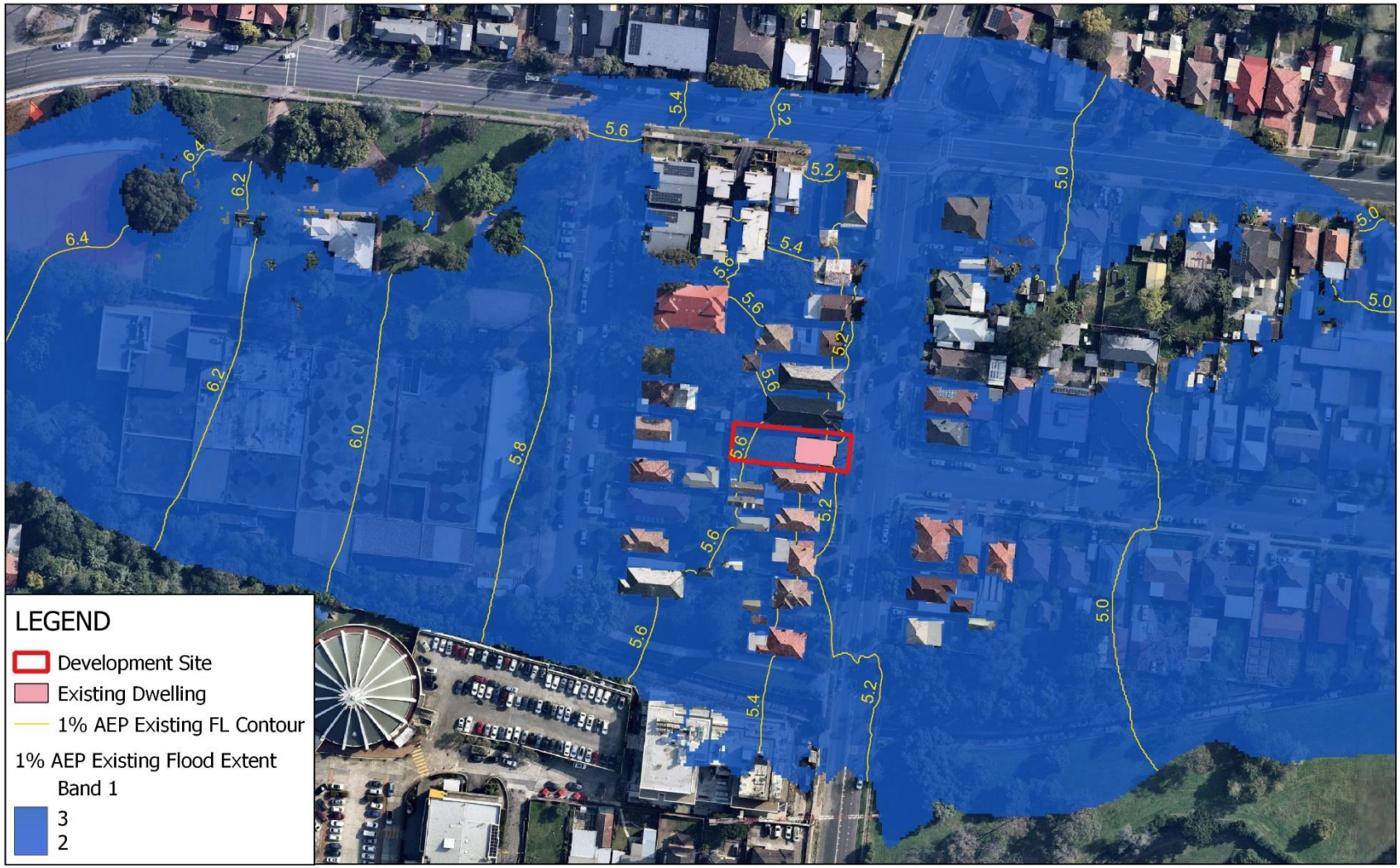


Figure 13: 1% AEP Existing Condition Flood Extent with Flood Level Contour

Figure 14: 1% AEP Existing Condition Flood Depth Map

Figure 15: 1% AEP Existing Condition Flood Velocity Map

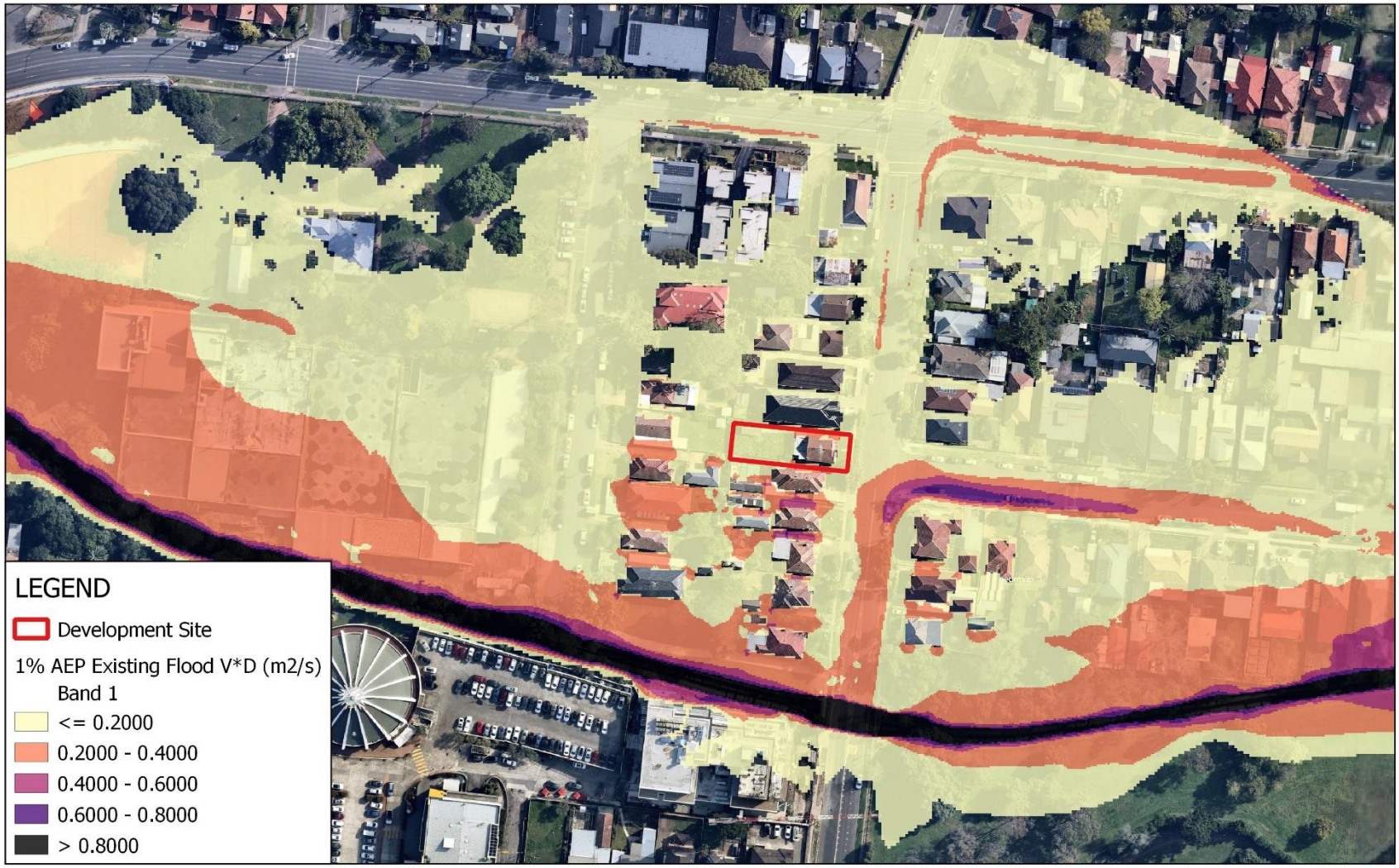


Figure 16: 1% AEP Existing Condition Velocity Depth Product (V*D) Map

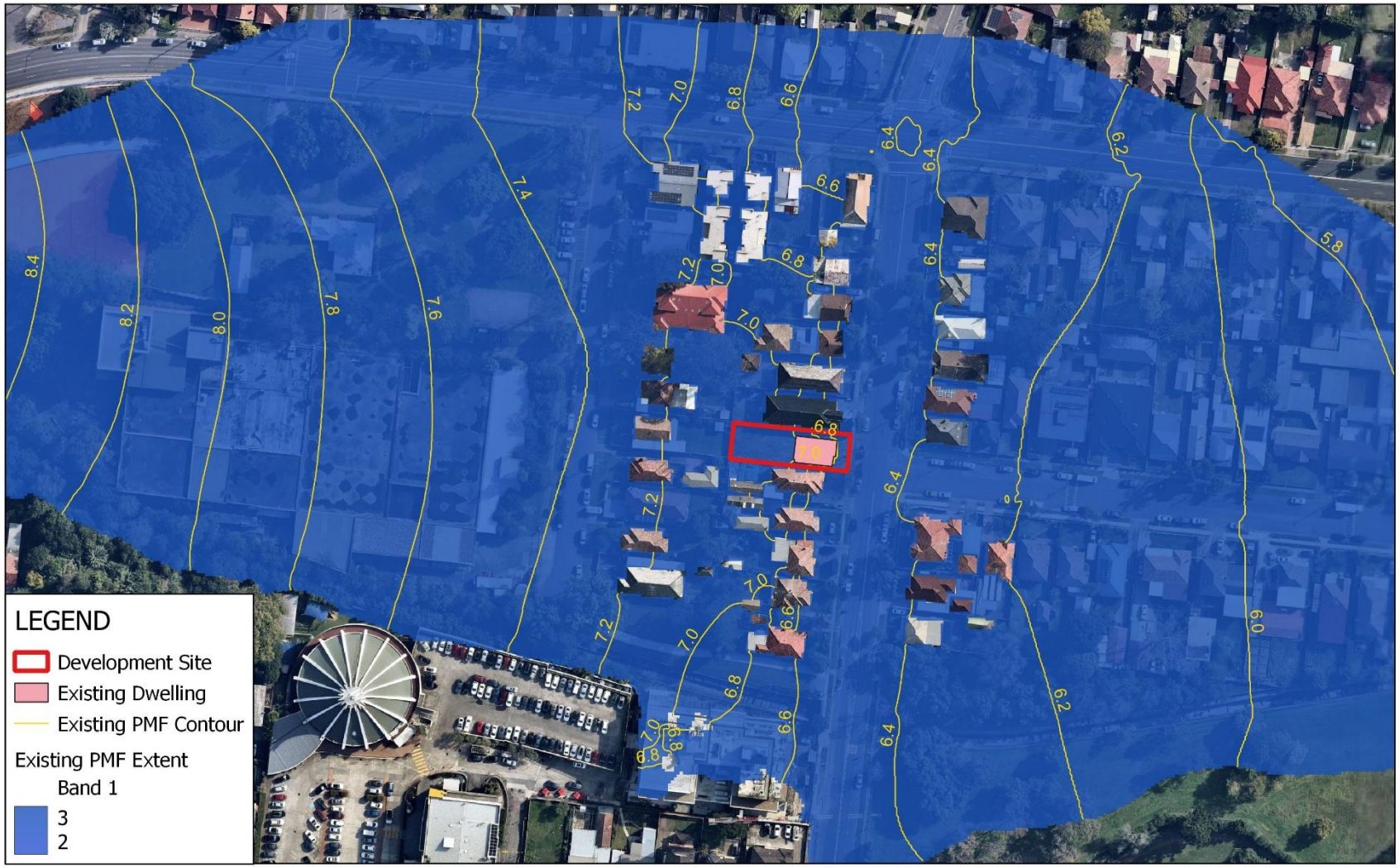


Figure 17: Existing Condition PMF Extent with Flood Level Contour

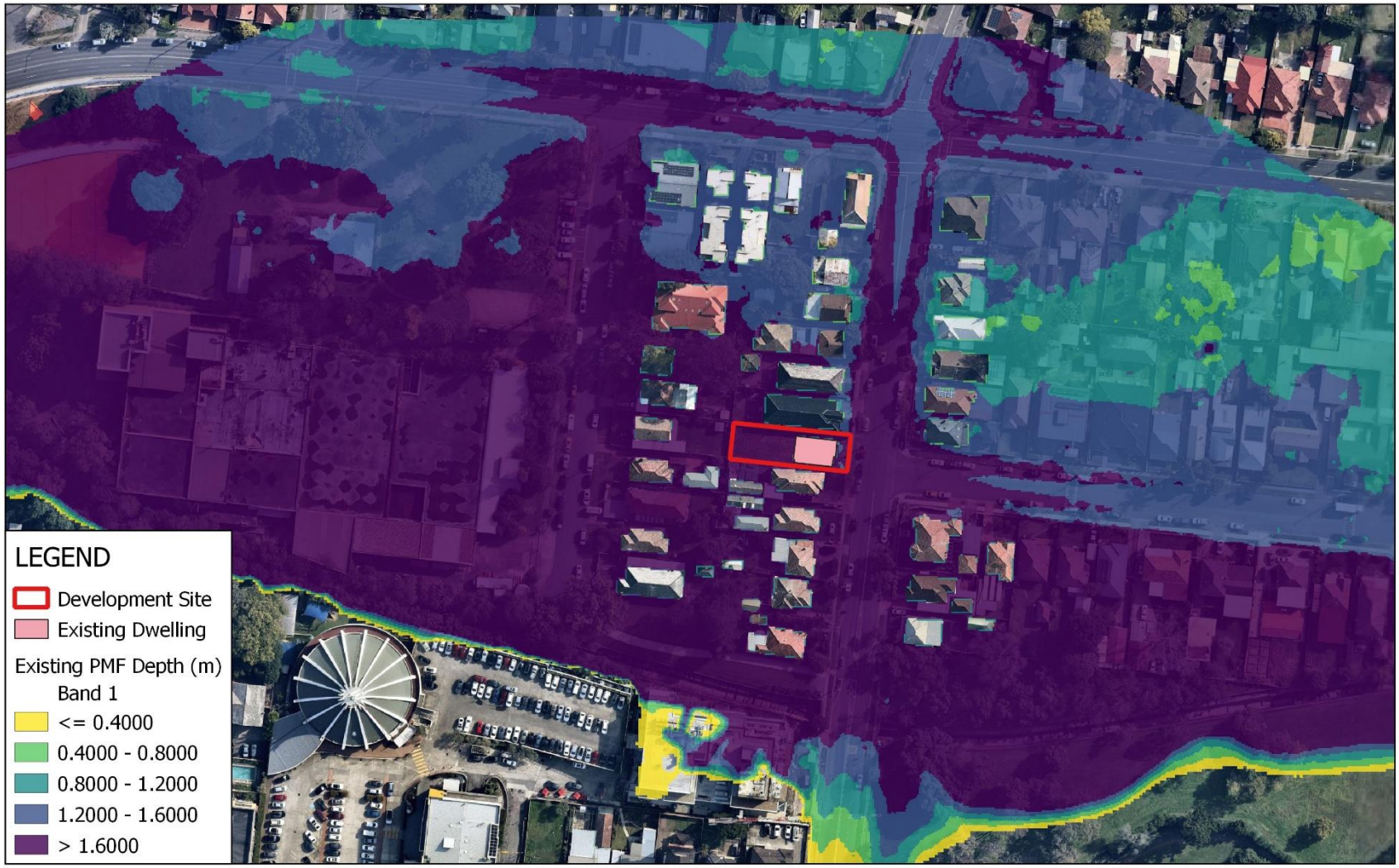


Figure 18: Exisitng Condition Flood PMF Depth Map

Figure 19: Existing Condition PMF Velocity Map

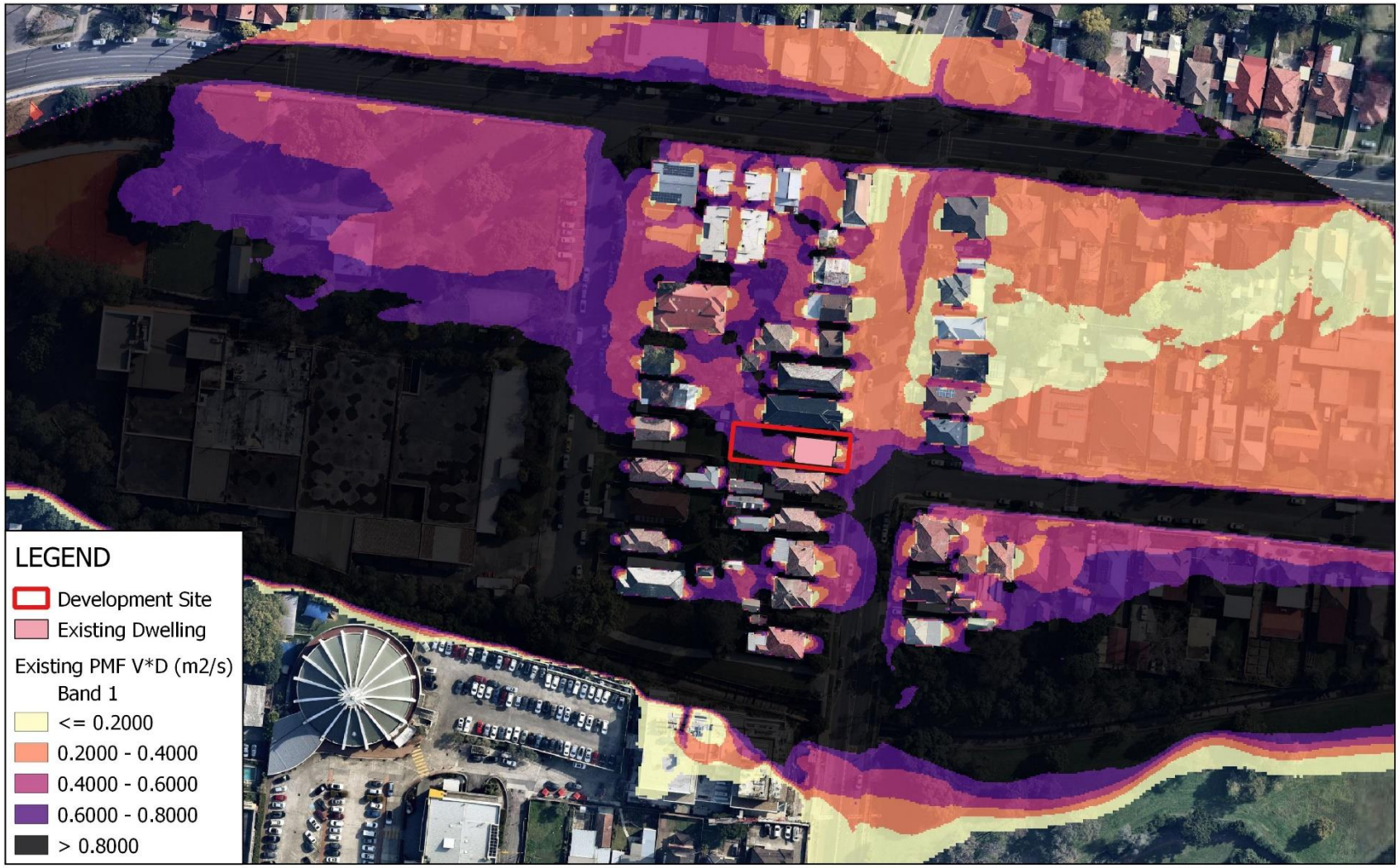


Figure 20: Existing Condition PMF Velocity Depth Product (V*D) Map

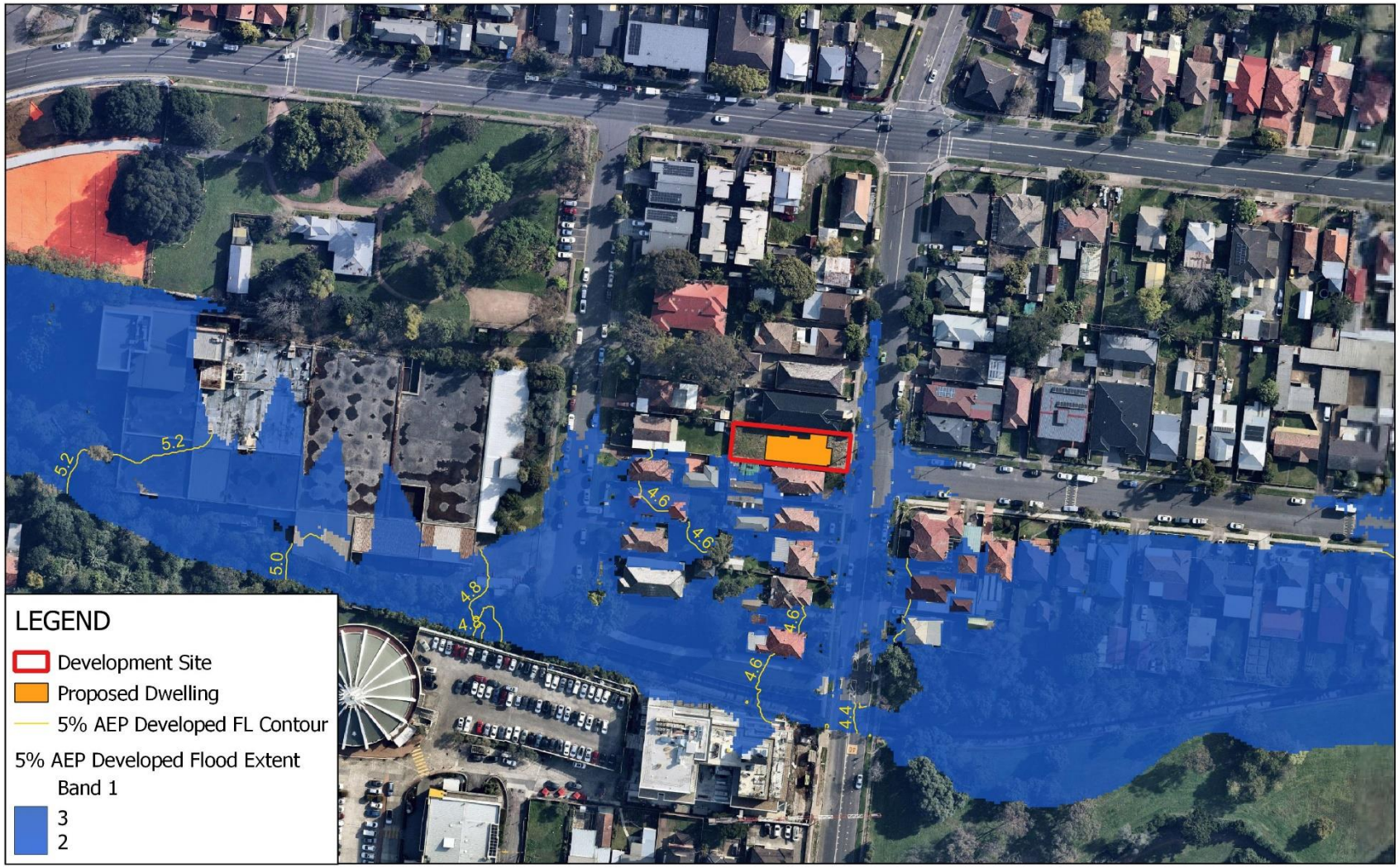


Figure 21: 5% AEP Developed Condition Flood Extent with Flood Level Contours

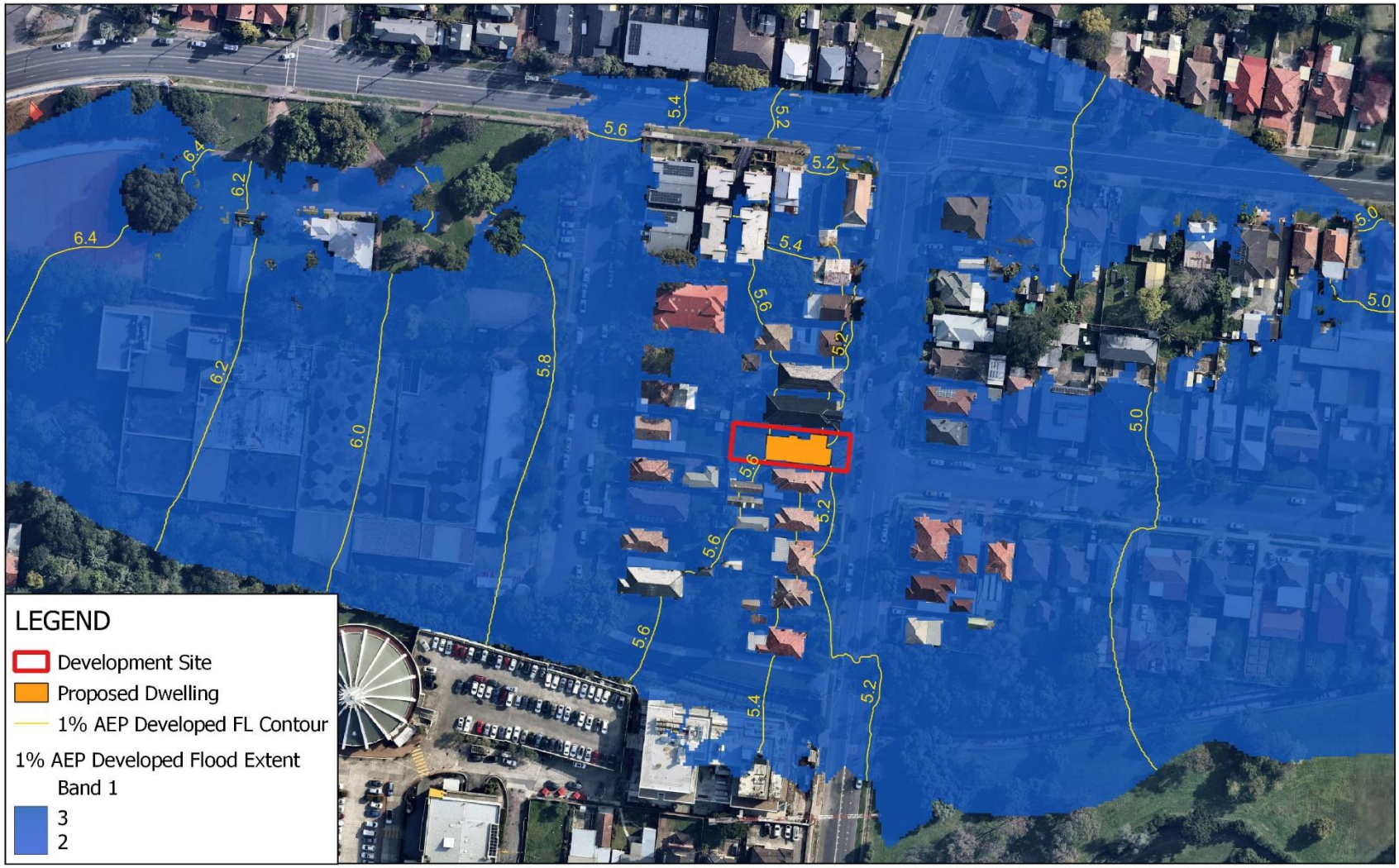


Figure 22: 1% AEP Developed Condition Flood Extent with Flood Level Contours

Figure 23: 1% AEP Developed Condition Flood Depth Map

Figure 24: 1% AEP Developed Condition Flood Velocity Map

Figure 25: 1% AEP Developed Condition Flood Hazard (Velocity Depth Product) Map

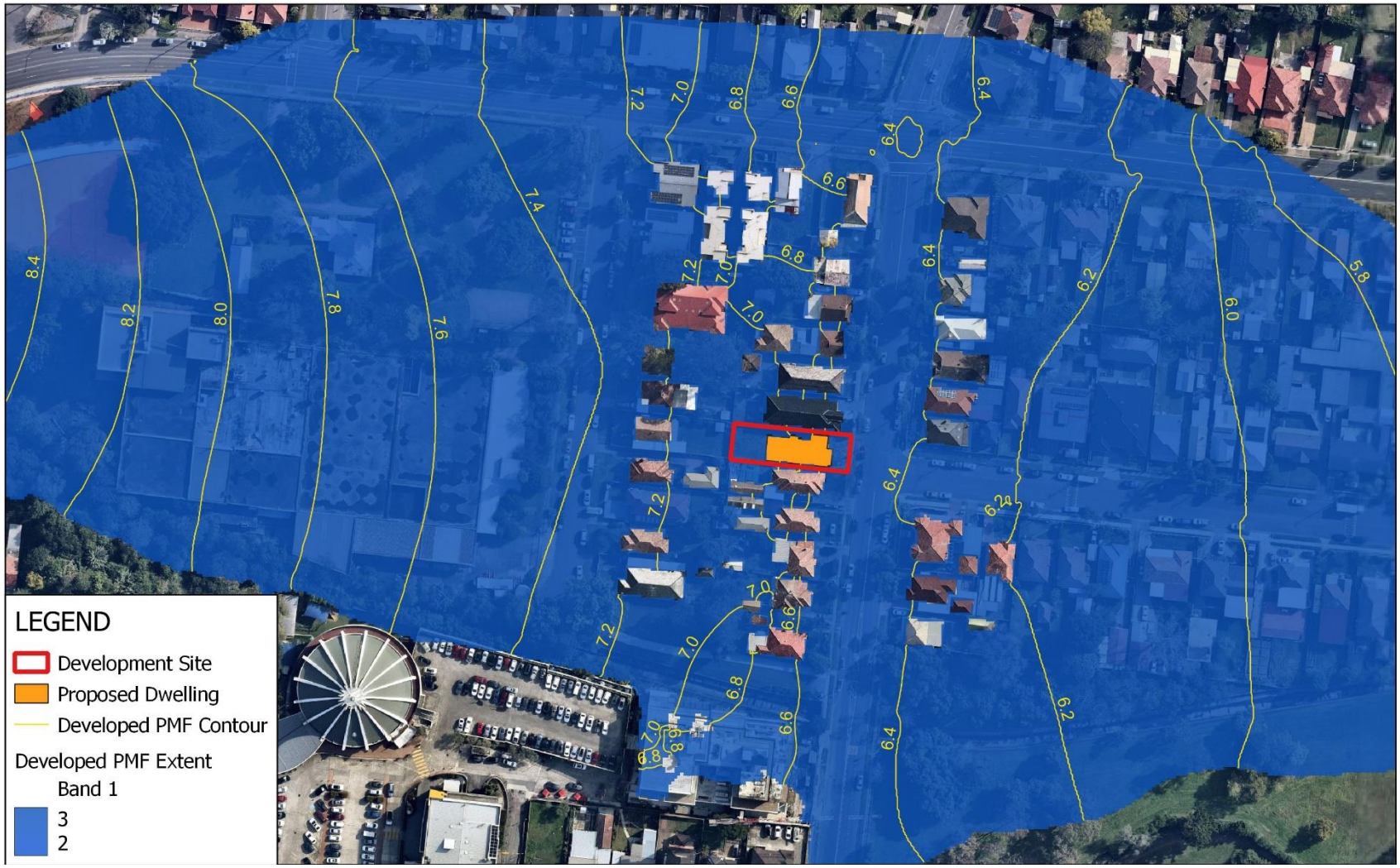


Figure 26: Developed Condition PMF Extent with Flood Level Contours

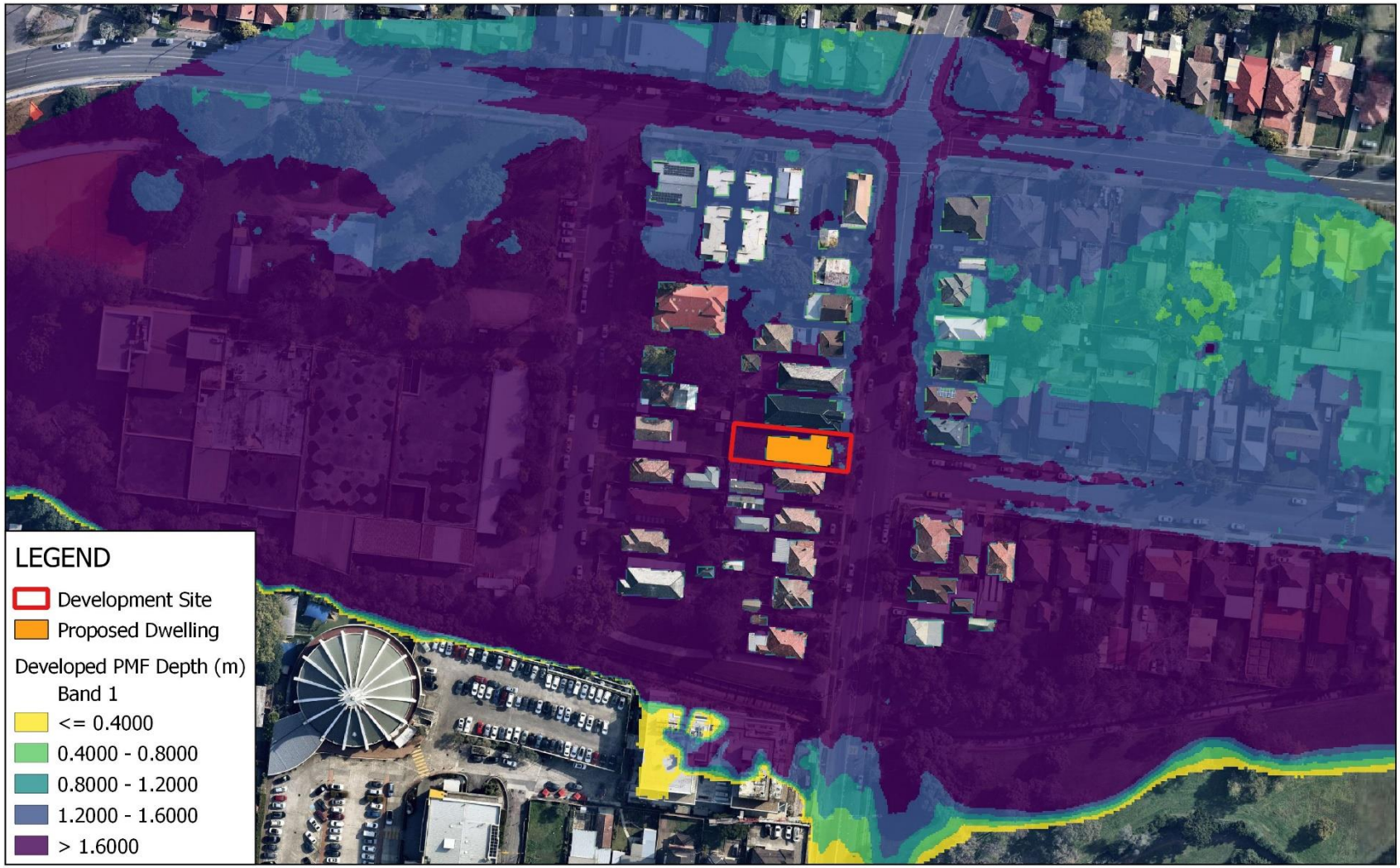


Figure 27: Developed Condition PMF Depth Map

Figure 28: 1% AEP Developed Condition PMF Velocity Map

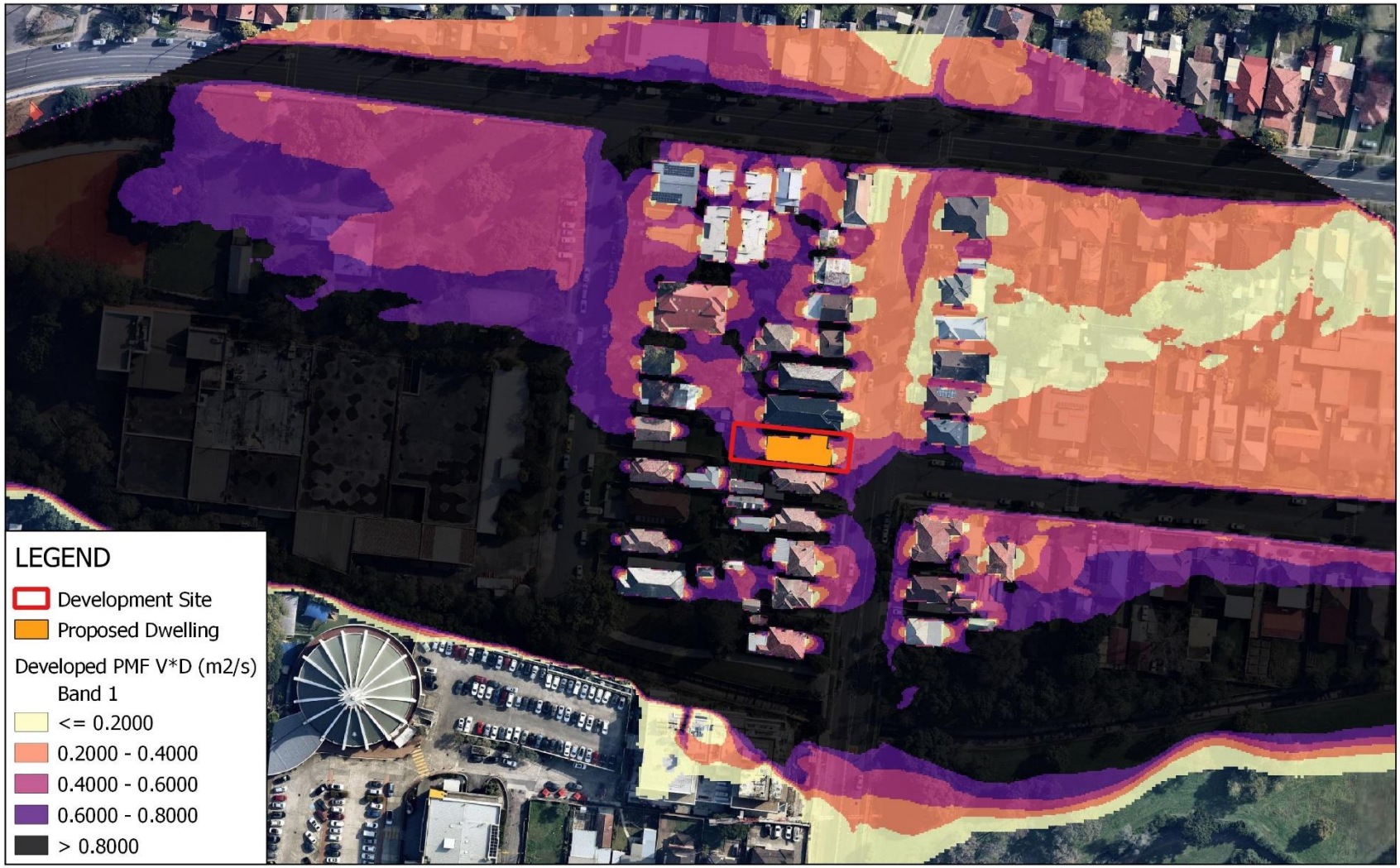


Figure 29: Developed Condition PMF Velocity Depth Product (V*D) Map

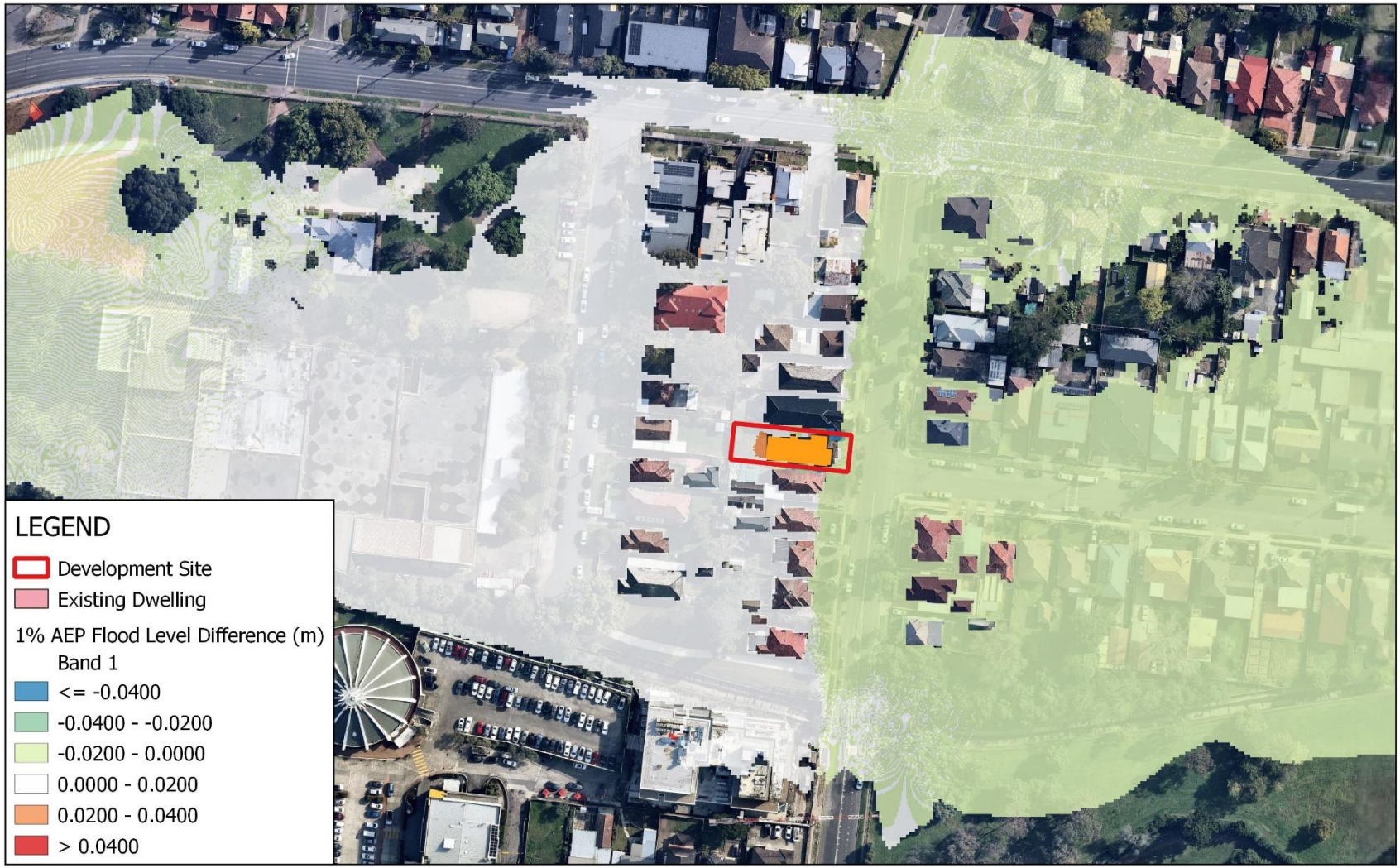


Figure 30: 1% AEP Flood Level Difference Map

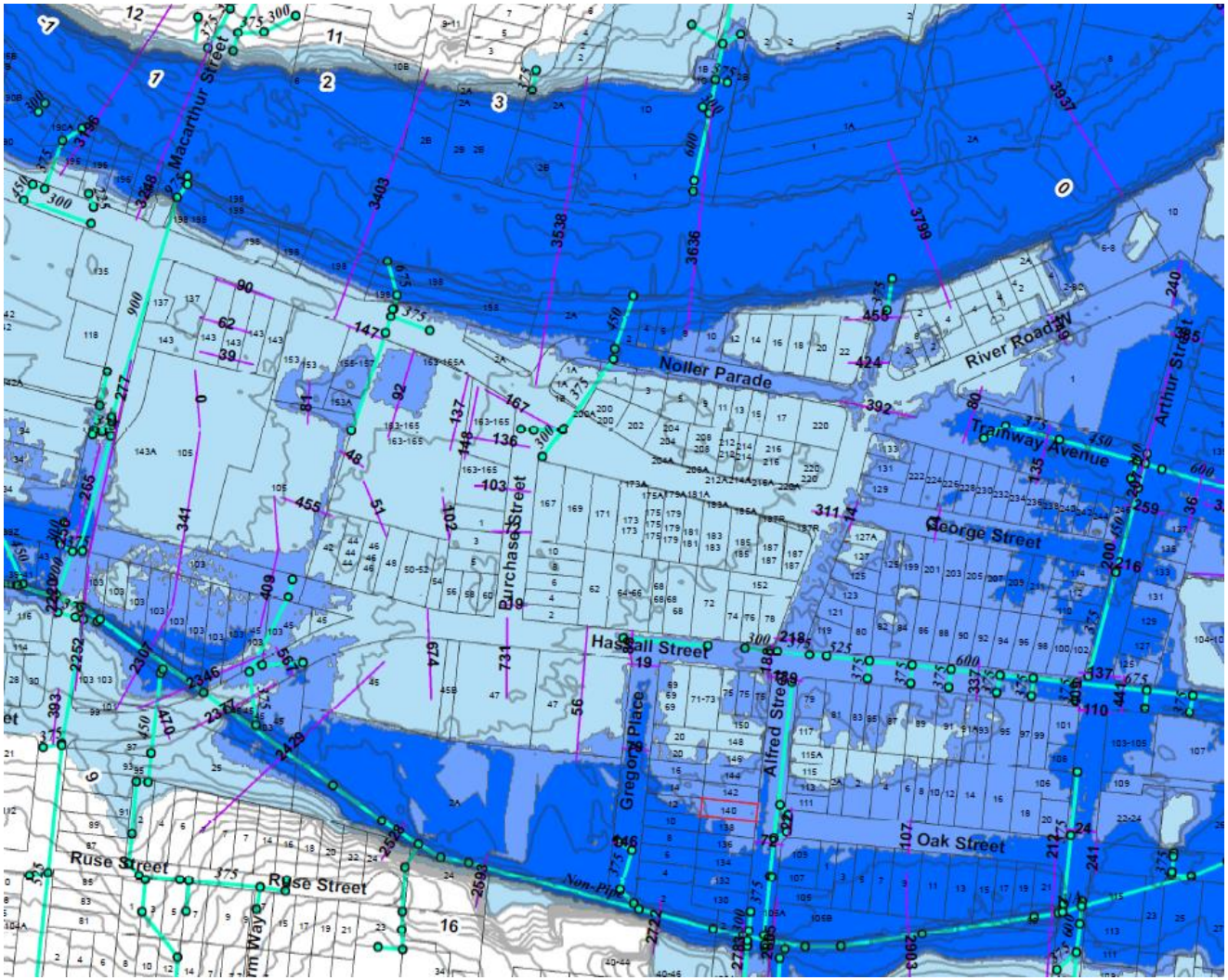


Figure 31: PMF Flood Extent Provided by Parramatta City Council

6.4 Flood Hazard Category

The risk to life and potential damages to buildings during floods varies both in time and place across the floodplain. In order to provide an understanding of the effects of a proposed development on the flood behaviour and the effects of flooding on development and people the floodplain can be sub-divided into hydraulic and hazard categories. This categorisation should not be used for the assessment of development proposals on an isolated basis, rather they should be used for assessing the suitability of future types of land use and development in the formulation of a floodplain risk management plan.

Hazard classification plays an important role in informing floodplain risk management in an area. Previously, hazard classifications were binary – either Low or High Hazard as described in the *Floodplain Development Manual (2005),* Figure 32. However, in recent years there have been a number of developments in the classification of hazard. *Managing the floodplain: a guide to best practice in flood risk management in Australia* (Figure 33– Smith et al, 2014) provides revised hazard classifications which add clarity to the hazard categories and what they mean in practice. The classification is divided into 6 categories, listed in Table 3, which indicate the restrictions on people, building and vehicles. The velocity/depth relationship for each of these categories is depicted in Figure 33.

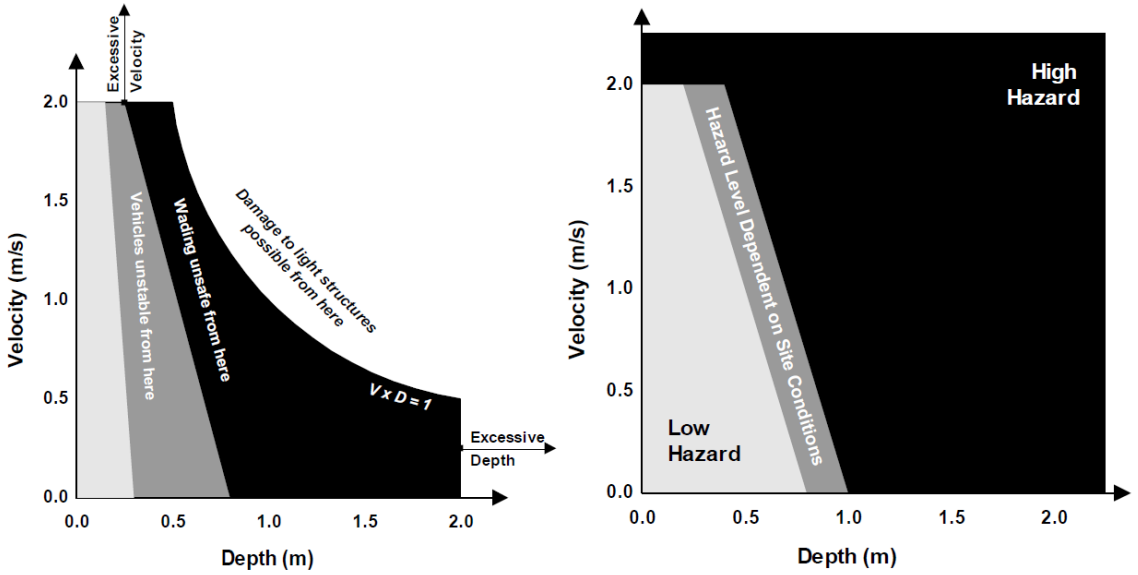


Figure 32: Provisional Flood Hazard Category (Floodplain Development Manual 2005)

Table 3: Hazard Categories –Smith et al 2014

Category	Constraint to people/vehicles	Building Constraints
H1	Generally safe	*No constraints*
H2	Unsafe for small vehicles	*No constraints*
H3	Unsafe for all vehicles, children and the elderly	*No constraints*
H4	Unsafe for all people and all vehicles	*No constraints*
H5	Unsafe for all people and all vehicles	Buildings require special engineering design and construction
H6	Unsafe for people and vehicles	All building types considered vulnerable to failure

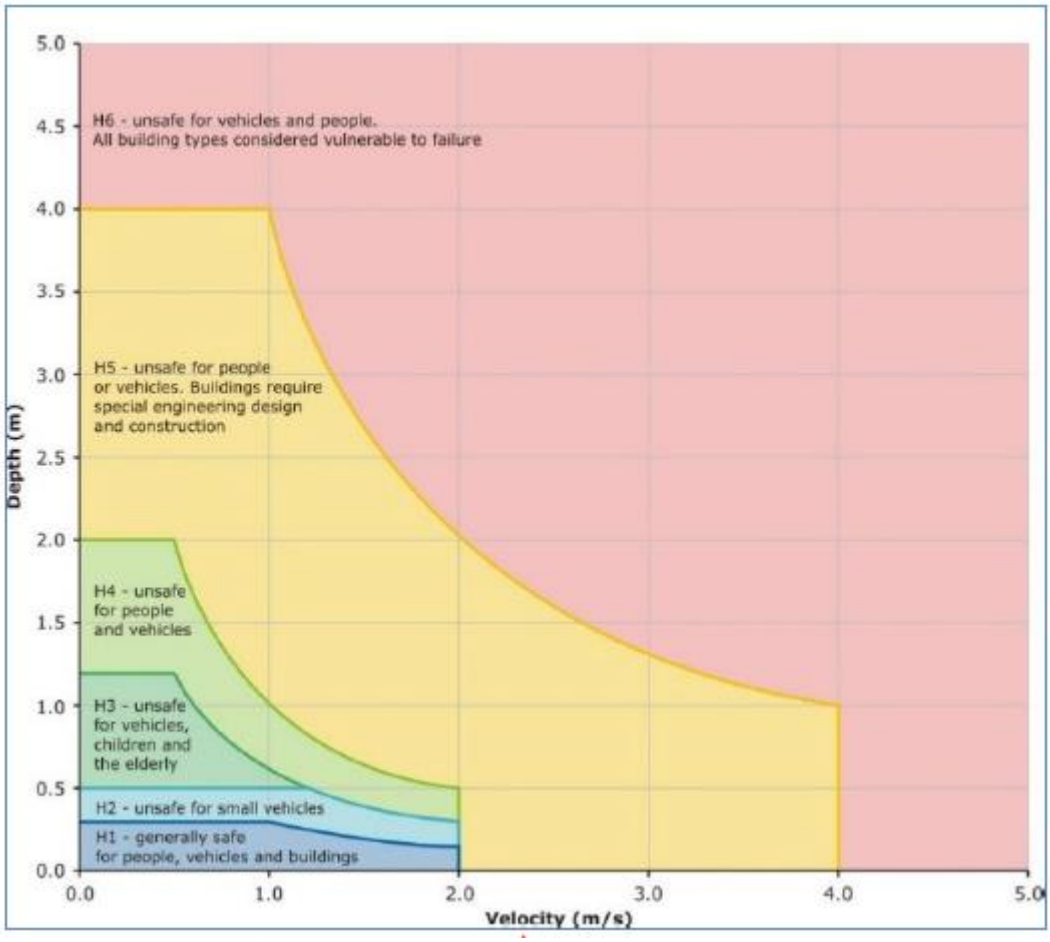


Figure 33: Hazard Classification – Smith et al 2014

Figure 34 and Figure 35 present Flood Hazard Vulnerability / Hazard Classification maps for the existing and developed conditions in the 1% AEP flood event. These maps indicate that the flood hazard vulnerability at the front of the existing / proposed dwelling is H2 – unsafe for small vehicles and rear part is H3 – unsafe for all vehicles, children and elderly.

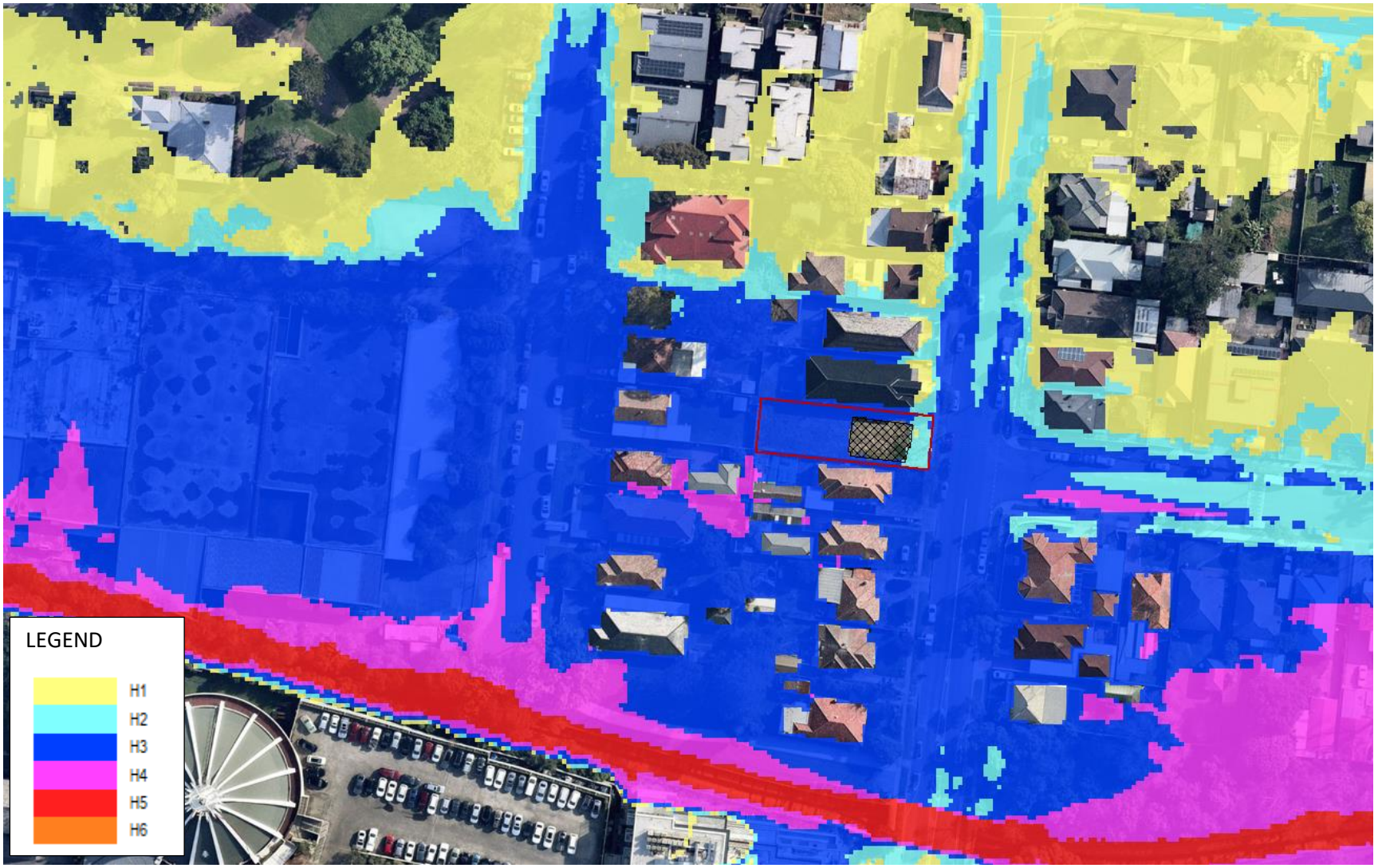


Figure 34: Hazard Classification / Vulnerability – Smith et al 2014 for Existing Condition

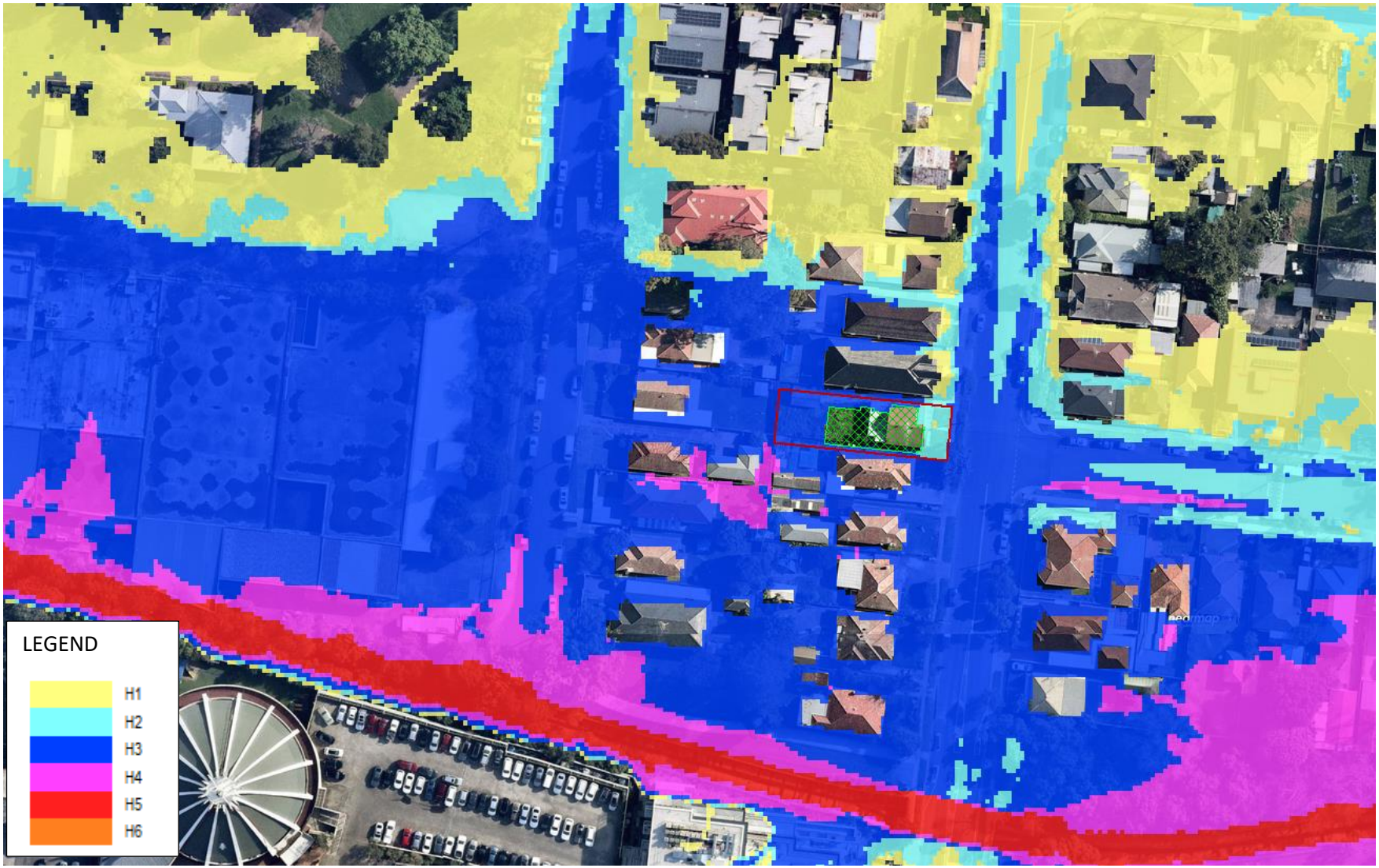


Figure 35: Hazard Classification / Vulnerability – Smith et al 2014 for Developed Condition

7 Site Flood Emergency Response Plan

As 140 Alfred Street, Harris Park is affected by flooding from Clay Cliff Creek in the 1% AEP and large storm event, the occupant of the premises should be aware of Site Flood Emergency Response Plan. The following table provides an outline of the site emergency response plan for the premises at 140 Alfred Street, Harris Park NSW.

Table 4: Site Emergency Response Plan

Be Aware	• Sign up for Parramatta City Council's flood warning system using the link "Flood Smart Parramatta Flood Warning Registration (ewn.com.au)". • Add mobile phone number to the SES contact list for the issue of SMS alerts for severe weather warnings. • During prolonged or intense rainfall in Sydney region, 140 Alfred Street, Harris Park is prone to local overland flooding and mainstream flooding. • You should maintain an Emergency Kit containing battery powered radio, spare batteries, torch, first aid kit and emergency contact details for use in the event of a flood.

Prior to an Imminent Flood	• When heavy storms or significant rainfall are forecast:
	  ○ Keep an eye on Bureau of Meteorology flood warnings for this area.
	  ○ Turn your radio to the local ABC station for emergency broadcasts.
	• Relocate motor vehicles to a higher area with substantially less risk of flooding.
	• Horizontal evacuation is not available in this area. Use the attic within the dwelling for shelter in place during extreme flood event as the finished floor level of the attic is above the Probable maximum Flood (PMF) level.
	• Locate emergency kit and have it ready.

During Flood	• The habitable floor level of the proposed dwelling is RL 6.15 m AHD which is 550mm above the 1% AEP flood level. Flood water is less likely to reach this level. Also, the dwelling has attic with permanent access which is above the PMF level i.e., RL 9.30 m AHD. This place shall be used for shelter in place during extreme flood event. Stay within the premises during flooding as much as practical as this is the safest option. • Keep eyes at the front of the block. When flood level reaches to the garage level, relocate valuables to as high as possible. • If need to leave the premises do so early in the flood event, before the flood depth reaches to 0.2m at the surrounding streets. • **Never drive, ride or walk through floodwater.** • For emergency help in floods and storms call SES on 132 500. • In the unlikely event that the building becomes inundated, remain in the building until SES has contacted the occupants and further advice has been sought. • Keep listening to emergency radio broadcasts. • Follow advice of emergency services.

After a Flood	• **<u>Never drive, ride or walk through floodwater.</u>**
	• Wait for flood water to reduce before leaving building.
	• Keep listening to emergency radio broadcasts.
	• Follow advice of emergency services
	• After floodwater have receded:
	  ○ Take photographs of flood marks and damaged areas, and prepare insurance claim for damaged areas (subject to insurance terms)
	  ○ Arrange for utilities to be inspected and repaired by qualified trades people.
	  ○ Arrange for cleaning and repair of flood affected areas.
	• Restock and replace your emergency kit.

8 Development Control

The proposed dwelling at 140 Alfred Street is assessed against City of Parramatta Council's flooding requirement. The assessments for flood controls are presented below.

8.1 Floor Level

Based on modelling result and the flood level information from Parramatta City Council, the maximum 1% AEP flood level within the development site is RL 5.60 m AHD. Modelling result indicates that the 1% AEP flood level at the location of garage is RL 5.50 m AHD. The minimum habitable floor level is to be 500mm and garage is to be 200mm above the maximum 1% AEP flood level. ***It is recommended that the minimum habitable floor level of the proposed dwelling is to be RL 6.10 m AHD and garage is to be RL 5.70 m AHD. It is also recommended that the finished floor level of the attic shall be above PMF level i.e., RL 9.30 m AHD.***

8.2 Building Component and Method

All structures of proposed residential dwelling to be constructed with flood compatible building components below the PMF level.

All electrical equipment and wiring will be situated above the habitable floor level.

Table 4 presents the flood compatible materials that can be used for the proposed dwelling.

Table 5: Flood Compatible Materials

Building Component	Flood Compatible Materials	Building Component	Flood Compatible Materials
Flooring and Sub-floor Structure	- Concrete slab-on ground - Monolith construction - Suspended reinforced concrete slab	**Doors**	- Solid panel with water proof adhesives - Flush door with marine ply filled with closed cell foam - Painted metal construction - Aluminium or galvanised steel frame

Floor Covering	- Clay tiles - Concrete, precast or in situ - Concrete tiles - Epoxy, form in place - Mastic flooring, formed in-place - Rubber sheets or tiles with chemical-set adhesives - Silicone floors formed in-place - Vinyl sheets or tiles with chemical-set adhesive - Ceramic tiles, fixed with mortar or chemical-set adhesive - Asphalt tiles, fixed with water resistant adhesive	**Wall and Ceiling Linings**	- Fibro-cement board - Brick, face or glazed - Clay tile, glazed in waterproof mortar - Concrete - Concrete block - Steel with waterproof applications - Stone, natural solid or veneer, waterproof grout - Glass blocks - Glass - Plastic sheeting or wall with waterproof adhesive
Wall Structure	- Solid brickwork, blockwork, reinforced concrete or mass concrete	**Insulation Windows**	- Foam (closed cell types) - Aluminium frame with stainless steel - Rollers or similar corrosio and water resistant materi
Roofing Structure (for Situations where the Relevant Flood Level is Above the Ceiling)	- Reinforced concrete construction - Galvanised metal construction	**Nails, Bolts, Hinges and Fittings**	- Brass, nylon or stainless steel - Removable pin hinges - Hot dipped galvanised steel wire, nails or similar
Electrical and Mechanical Equipment For dwellings constructed on land, where this plan applies, mechanical and electrical materials, equipment and installation should conform to the following requirements.		**Heating and Air Conditioning Systems** Heating and air conditioning systems should be installed at levels above the relevant flood level, to the maximum height possible. If this is not feasible, care should be taken to minimise the potential damage caused by submersion according to the following guidelines.	
Main power supply The main commercial power service equipment, including metering equipment, shall be located above the relevant flood level, subject to the approval of the relevant authority. A provision for easily disconnecting the dwelling from the main power supply shall be supplied.		**Fuel** Gas or oil fuelled heating systems should have a manually operated valve, which is to be located in the fuel supply line, to enable fuel cut-off.	

Wiring All wiring, switches and power outlets should be located above the relevant flood level, to the maximum height possible. All electrical wiring, which is installed below the relevant flood level, should be suitable for continuous submergence in water, containing no fibrous components. Earth core linkage systems (or safety switches) are to be installed. Only submersible-type splices are to be used below the relevant flood level. All conducts, located below the relevant flood level, should be self-draining in the event of flooding.	**Installation** Heating equipment and fuel storage tanks should be mounted on and securely anchored to a footing of sufficient size, in order to withstand buoyancy and to prevent movement capable of damaging the fuel supply line. All storage tanks should be vented to a level 600 millimetres above the relevant flood level.
Equipment Equipment installed below/partially below the relevant flood level should contain a method of disconnection, by a single plug and socket assembly.	**Ducting** All ductwork, located below the relevant flood level, should have openings for drainage and cleaning. A grade may be introduced within ductwork in order to facilitate self-draining. In the case where ductwork passes through a water tight wall or a floor below the flood level, the ductwork should be covered by a closure assembly which is to be operated from above the flood level.
Reconnection In the event that an electrical device and/or part of the wiring is flooded, it should be thoroughly cleaned or replaced and checked by an approved electrician before reconnecting.	**Ancillary Structures (steps, pergolas, etc.)** Suitable water tolerant materials, such as masonry sealed hardwood and corrosive resistant metals, should be used. Copper Chrome Arsenate (CCA) treated timber is not a suitable material.

8.3 Structural Soundness

Engineer's report is required certifying that the proposed structure can withstand the forces of floodwater debris and buoyancy up to the PMF level. The proposed dwelling is to be certified prior to construction.

8.4 Flood Affection

The site is affected by the 1% AEP and larger flood form the Clay Cliff Creek. The 1% AEP flood depth at the site is up to 930mm.

The modelling result for the existing and developed condition indicates that flood levels, depths, and hazard (velocity depth product) for the existing and developed condition are very consistent with some localised increase in flood level by up to 25mm at the rear of the proposed dwelling within the development site. There is no / negligible adverse impact of flooding at adjoining properties due to the proposed development.

8.5 Car Parking and Driveway Access

The recommended finished floor level of the garage is RL 5.70 m AHD which is 200m above the 1% AEP flood level at the location of the garage.

8.6 Evacuation

The proposed habitable floor level is 550mm above the 1% AEP flood level. It is less likely that flood water reaches to the floor level. Also, the dwelling has attic with permanent access, which is above the PMF level i.e., RL 9.30 m AHD. This place shall be used for shelter in place during extreme flood event. Stay within the premises during flooding as much as practical as this is the safest option. It is recommended not to leave home when there is flood water at the street. It is strongly recommended to sign up for Parramatta City Council's flood warning system and register the mobile number to SES to receive notification about flood warning when there is intense rain at Sydney region and Harris Park area.

Horizontal evacuation is not available in this area. Use the attic within the dwelling for shelter in place during extreme flood event as the finished floor level of the attic is above the Probable maximum Flood (PMF) level.

9 Conclusion & Recommendation

This study assessed the impacts on flooding due to the construction of the proposed residential dwelling at 140 Alfred Street, Harris Park.

A 2 dimensional TUFLOW model has been developed to assess the impact of flooding at the development site and surrounding area due to the proposed development. A 1m Digital Elevation Model in Esri ASCII Grid obtained from Australian Government Geoscience Australia has been used in the model. The terrain model developed from the ASCII Grid file at development location is checked with surveyed spot levels within the development site and found reasonably consistent. The DEM of the development site developed from surveyed spot levels have been incorporated in the model.

Modelling result indicates that the development site is not affected by flooding in the 5% AEP flood event. The result also indicates that the 1% AEP flood level at the site ranges between RL 5.17m AHD to RL 5.61 m AHD with the maximum level being at the rear and the minimum level is at the front of the site. The flood depth map indicates that the flood depth at the site is up to 930mm with the maximum level being at the vicinity of the south west corner. The velocity map indicates that the velocity at the site is up to 0.45 m/s with the maximum value being at the north east corner of the existing dwelling. The velocity depth product map indicates that the 1% AEP velocity depth product at the development site is up to 0.25 m^2/s with the maximum value being at the area in between the existing dwellings at the adjoining properties.

The Probable Maximum Flood (PMF) at the development site provided by the council is RL 9.30 m AHD. It appeared that this level is the PMF level of the Parramatta River at this site as the PMF level of Clay Cliff Creek is unlikely to reach this level. Modelling of the Parramatta River is not undertaken for this study. However, the flood level provided by the council is considered for flood evacuation purpose.

Modelling results for developed condition are consistent with existing condition with some localised change within the development site sue to the change in building footprint. Flood level difference map indicates that there is a localised increase in flood level at the western side of the proposed dwelling by up to 25mm. However, this increase ceases within the development site. The increase in flood level at property boundary is up to 13mm and adjoining property is up to 11mm. This increase is within the modelling tolerance and hence considered negligible. This showed that the proposed development will have no / negligible adverse impact of flooding to adjoining properties.

Flood hazard vulnerability maps indicate that the flood hazard vulnerability at the front of the existing / proposed dwelling is H2 – unsafe for small vehicles and rear part is H3 – unsafe for all vehicles, children and elderly.

Based on modelling result and the flood level information from Parramatta City Council, the maximum 1% AEP flood level within the development site is RL 5.60 m AHD. Modelling result indicates that the 1% AEP flood level at the location of garage is RL 5.50 m AHD. The minimum habitable floor level is to be 500mm and garage is to be 200mm above the maximum 1% AEP flood level. ***It is recommended that the minimum habitable floor level of the proposed dwelling is to be RL 6.10 m AHD and garage***

is to be RL 5.70 m AHD. It is also recommended that the finished floor level of the attic shall be above PMF level i.e., RL 9.30 m AHD.

Horizontal evacuation is not available in this area. Use the attic within the dwelling for shelter in place during extreme flood event as the finished floor level of the attic is above the Probable maximum Flood (PMF) level.

It is recommended that any new fencing within the 1% AEP flood extent of the development site is to be of permeable (open) type to allow free flow of floodwaters and not to cause damage to surrounding land in the event of a flood.

It is also recommended to fulfil the all design control requirements mentioned in section 8.

APPENDIX A: Survey Plan of Development Site

APPENDIX B: Site Plan of Proposed Development

APPENDIX C: Flood Advice from Parramatta City Council