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# Flood Assessment Report

## 15-23 Hunter Street and 105-107 Pitt Street NSW 2000

**Prepared for Milligan Group Pty Ltd** / 18 February 2022

CAAA 201321

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# Executive Summary

Taylor Thomson Whitting (TTW) have prepared this flood assessment to support a development application (DA) for a proposed mixed use high-rise development at 15-23 Hunter Street and 105-107 Pitt Street NSW 2000 (the site). This report documents the procedures and findings of hydrologic and hydraulic modelling of the site in existing and proposed conditions.

The flood assessment concluded that:

- The proposed development is flood free in all flood events up to and including the 1% AEP.
- The proposed development would have no offsite flood level impacts beyond the acceptable tolerance of 20mm during the 1% AEP flood event.
- Flood planning level requirements for different building areas as well as for the underground car park are highlighted in Figure 15 of the report.
- Future access to Metro West station is protected for all events up to the PMF.
- Risk to persons during major flood events greater than the 1% AEP event is manageable through evacuation from the street front retails and shelter-in-place within the proposed building (other than the street front retail floors).

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**Contents**



| Rev | Date | Remarks | Prepared By | Approved By |
|---|---|---|---|---|
| **1** | 18/01/2022 | Draft for comment | Ali Attar | Nemesio Biason Jr |
| **2** | 15/02/2022 | Draft for comment | Ali Attar | Nemesio Biason Jr |
| **3** | 15/02/2022 | Final | Ali Attar | Nemesio Biason Jr |
| | 18/02/2022 | Final (Arch. plan updated) | Ali Attar | Nemesio Biason Jr |

# 1. Introduction

Taylor Thomson Whitting (TTW) has been engaged by Milligan Group Pty Ltd to provide a flood assessment for the proposed development at 15-23 Hunter Street and 105-107 Pitt Street NSW 2000. This report has been prepared to support the Development Application (DA) for the project.

## 1.1 Existing Site

The development site is located at the southwestern corner on Pitt Street and Hunter Street intersection and occupies the following lots:

- 15-17 Hunter Street (lot A & B of DP109825, lot 1 of DP630190)
- 19-21 Hunter Street (lot 1 & B of DP59754)
- 23-25 Hunter Street (SP69888)
- 105 Pitt Street (SP60693)
- 107 Pitt Street (SP63966)

The site location is demonstrated in Figure 1 and covers an area of 2,094 square metres.

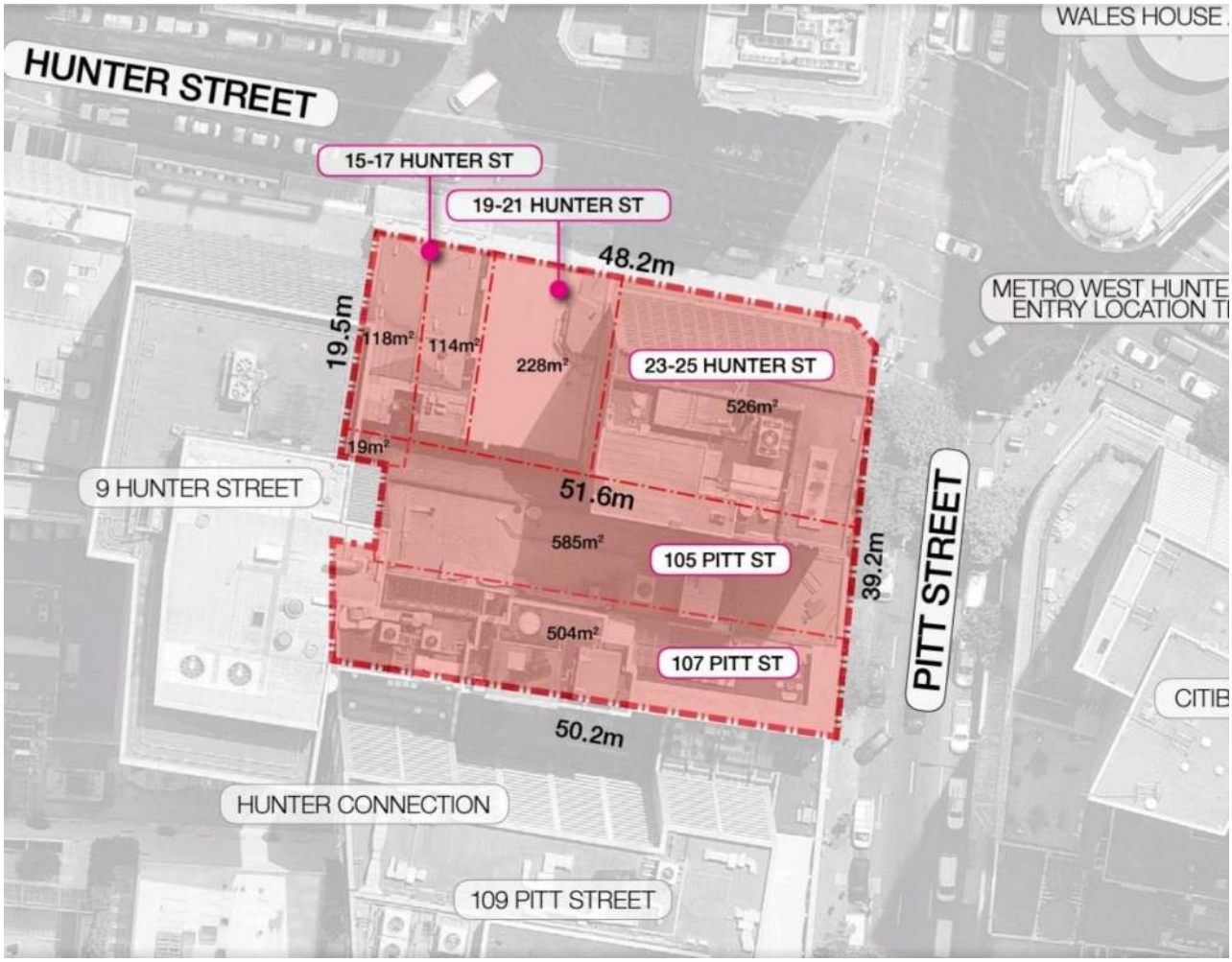


*Figure 1 - Site Location (Six Maps)*

The site is situated within the Sydney City Council with current land zoning of Metropolitan Centre (B8) based on Sydney City Council's Local Environmental Plan (2012). The current site contains a multi-story building.

The site typically grades from southeast to northwest direction (approximate grade of 3.2%).

The site currently drains via overland flow, roof downpipes and an inground drainage pipe network through an existing sag point on Hunter Street at the northern site boundary.

## 2. Proposed Development

Architectural plans prepared by Bates Smart indicate that the redevelopment will consist of a multi-purpose fifty-story high-rise building containing office and retail spaces in addition of six underground levels including retail and car park spaces with access to Metro West Station. A proposed shared way through the site connects Hunter Street to Pitt Street.

The proposed ground floor layout of site is shown in Figure 2 below.

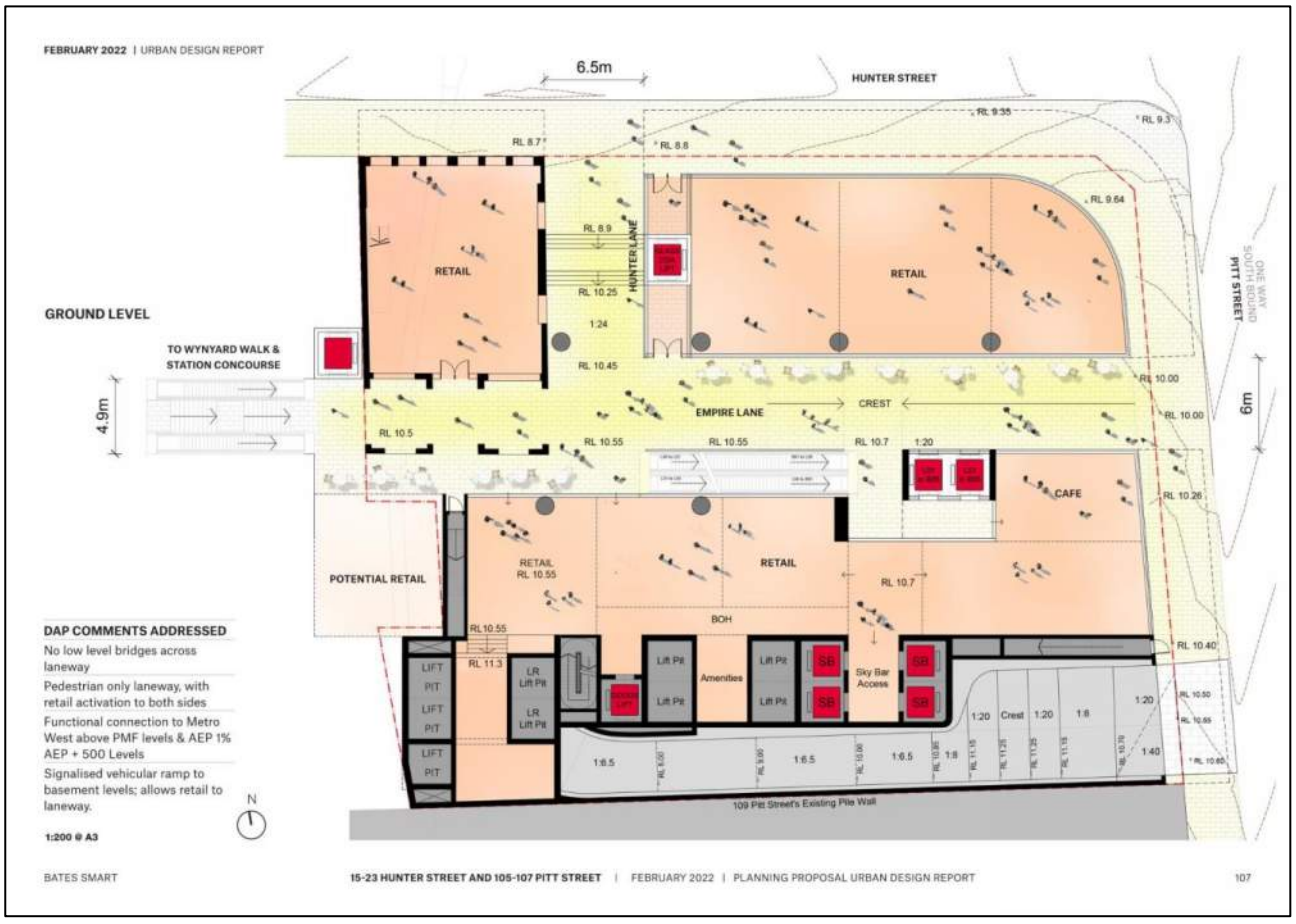


*Figure 2 - Proposed Architectural Layout (Ground Floor) by Bates Smart*

# 3. Site Flood Assessment

The following provides an assessment on flood conditions of the site and summarises the flood modelling results for both existing and proposed site conditions in the 1% Annual Exceedance Probability (AEP) and Probable Maximum Flood (PMF) events. A flood impact assessment was also undertaken to investigate the potential flood impacts on neighboring properties due to the proposed redevelopment.

## 1.2 Objectives and Methodology

The objective is to define the local flooding in accordance with the Floodplain Development Manual (NSW DIPNR 2005) and address the flood planning requirements of City of Sydney Development Control Plan (DCP), 2012 – Chapter 3.7 – Water and Flood Management, with regards to the proposed redevelopment. It involved the following methodology:

- Obtain the latest City Area Catchment hydraulic model (TUFLOW) from City of Sydney Council and determine the site existing flood characteristics for the 1% AEP and PMF events.
- Incorporate the site survey and proposed design and assess the site flood characteristics in proposed site conditions for the 1% AEP and PMF events.
- Prepare relevant flood maps including flood extents, depths, levels, velocities, hazards and impacts.
- Comment on flood characteristics and model outcomes in existing and proposed conditions.
- Carry out a compliance assessment to ensure compliance with the

## 1.3 Relevant Guidelines

This flood assessment has been prepared in accordance with the following guidelines and policies:

- Australian Rainfall and Runoff – A Guide to Flood Estimation, Commonwealth of Australia (Geoscience Australia), 2019.
- NSW Government's Floodplain Development Manual, NSW Department of Infrastructure Planning and Natural Resources, 2005.
- City of Sydney Local Environmental Plan (LEP, 2012)
- City of Sydney Development Control Plan (DCP, 2012)
- Interim Floodplain Management Policy, City of Sydney Council (2014)

## 1.4 Previous Flood Studies

The development site is located within the City Area catchment based on the City of Sydney floodplain management plan. BMT WBM completed a flood study and modelling for the City Area Catchment on behalf of Sydney City Council and summarised the findings in the City Area Catchment Flood Study (BMT WBM, 2014). This flood study was the basis in preparation of City Area Catchment Floodplain Risk Management Plan (WMAwater, 2016).

The BMT WBM flood study and model (2014) was used to assess the flood conditions of the site.

## 1.5 Hydraulic Model

TTW obtained the TUFLOW model from Council as described in Section 1.4 and used it as the basis to determine flood extents, levels & depths, velocities and hydraulic hazard during the critical 1% AEP flood event in existing and proposed site conditions.

### 1.5.1 2D Model Domain

The model domain received from Council covers an area of 1.99km$^2$ including the subject site and uses a 2m$^2$ grid cell size.

The grid cell size of 2m$^2$ is sufficiently fine to appropriately represent the variations in topography and land use within the study area. It should be noted that TUFLOW samples elevation points at the cell centres, mid sides and corners therefore, a 2 m$^2$ cell size results in surface elevations being sampled every 1m.

### 1.5.2 TUFLOW 1D Model Domain

The existing 1D network was retained inside the model, consistent with the Council's model. Pit blockages were also retained consistent with the Council's model and based on the blockage factors for storm events rarer than the 5 Year ARI with on-grade pits being 50% blocked and sag pits being 100% blocked (refer City Area Catchment Flood Study Report, 2014, Section 6.3 for more details).

### 1.5.3 Topography

The existing TUFLOW model surface was merged with the available site survey DTM triangles data to increase the accuracy of the existing model surface at the site proximity. The survey DTM provided by Total Surveying Solutions (November 2019) covers the site area as well as parts of Pitt Street and Hunter Steet adjacent to the site.

### 1.5.4 Boundary Conditions

**Upstream boundary:**

BMT WBM (2014) adopted the direct rainfall method and applied the design rainfall directly to the individual cells of the 2D hydraulic model. The design rainfall data and temporal patterns used in the model were based on the AR&R (2001) which has been superseded by AR&R (2019) procedure.

Thus, the direct rainfall data was updated in the model using AR&R (2019) procedure and the critical 1% AEP storm duration was determined for the site in existing conditions (refer Section 1.6).

**Downstream boundary:**

The downstream boundary was reinstated consistent with the Council model. To model the 1% AEP storm event, downstream tailwater level was set to 1.38m AHD (corresponding to 5% AEP water level at Sydney Harbor) as per recommended in City Area Catchment Flood Study Report (2014), Section 6.2.

Similarly, to model the PMF event, downstream tailwater level was set to 1.44m AHD (corresponding to 1% AEP water level at Sydney Harbor)

### 1.5.5 Building Footprints

The footprints of buildings have been nulled in the model domain. Building outlines of the existing buildings onsite as well as the nearby buildings were refined based on the site survey and aerial photographs.

The proposed building outlines onsite were replaced with the existing buildings based on the latest architectural plans to enable assessing the proposed conditions.

### 1.5.6 Hydraulic Roughness and Rainfall Losses

The hydraulic roughness of a material is an estimate of the resistance to flow and energy loss due to friction between a surface and the flowing water. A higher hydraulic roughness indicates more resistance to the flow. Roughness in TUFLOW is modelled using the Manning's (n) roughness co-efficient. Manning's roughness materials and rainfall losses are consistent with the Council's model Manning zones were also further adjusted based on the available site survey and aerial photographs. Manning's values and rainfall losses detailed in Table 1.

*Table 1 Manning's Values Based on City Area Catchment Study Report (BMT WBM, 2014), Table 5-2*

| Land use category | Manning's (n) | Initial Loss (mm) | Continuous Loss (mm/h) |
|---|---|---|---|
| Roads | 0.02 | 1.0 | 0.0 |
| Buildings | N/A | 1.0 | 0.0 |
| Public Recreation | 0.05 | 10.0 | 2.5 |
| Metro Centre | 0.04 | 1.0 | 2.5 |
| Rail Corridor | 0.04 | 1.0 | 2.5 |
| General Residential | 0.04 | 1.0 | 2.5 |

## 1.6 Critical Storm Duration

BMT WBM (2014) has investigated the catchment peak flood levels under various flood durations and determined the associated critical flood durations across the catchment and found out the critical 1% AEP event duration for the site was 90 minutes using ARR1987 rainfall data and temporal patterns.

TTW however, updated the model using rainfall data and temporal patterns in accordance with the ARR2019 procedures. Then, model was run for a range of 1% AEP storm durations from 30 minutes to 120 minutes in conjunction with the complete temporal patterns and eventually, critical 1% AEP storm duration and temporal pattern were identified.

The critical 1% AEP storm duration for the site was determined to be 60 minutes in conjunction with temporal pattern TP05.

Similarly, the TUFLOW model was run for a range of PMF event durations from 15minutes to 90 minutes and the critical PMF event duration for the site was confirmed to be 30 minutes.

## 1.7 Flood Model Results

The behaviour of the overland floodwaters across the site and in the vicinity of the site during the critical 1% AEP and PMF events for the existing and proposed site conditions are described in general terms, and offsite flood impacts due to the proposed development are investigated.

### 1.7.1 Existing Conditions

The peak flood levels depths, velocities and hazards in the critical duration 1%AEP event for existing site conditions are shown in Figure 3, Figure 4 and Figure 5 respectively.

Flood results show that the site is flood affected along the northern and eastern site boundaries. Pitt Street is a major catchment flow path. A portion of floodwaters through Pitt Street, Hunter Street and O'Connell Street flow towards an existing sag point at the northern site boundary, and then flow northward through Hamilton Street.

Peak 1% AEP flood levels along the site boundary vary from 10.75m AHD at southeastern site boundary to 9.07m AHD at northwestern site boundary.

Flood flows are up to 0.3m deep at the eastern site boundary (along Pitt Street) and up to 0.55m deep at the Hunter Street sag point at northern site boundary.

Flood velocities are relatively high at Pitt Street along the eastern site boundary (2.0 to 2.4 m/s) with high flood hazards. However, flood flows slowdown moving towards the sag point at Hunter Street and are of low hazard at the northern site boundary.

Model results also show a local ponding (400mm deep) at a trapped low point through existing access between 23-25 Hunter Street and 105 Pitt Street.

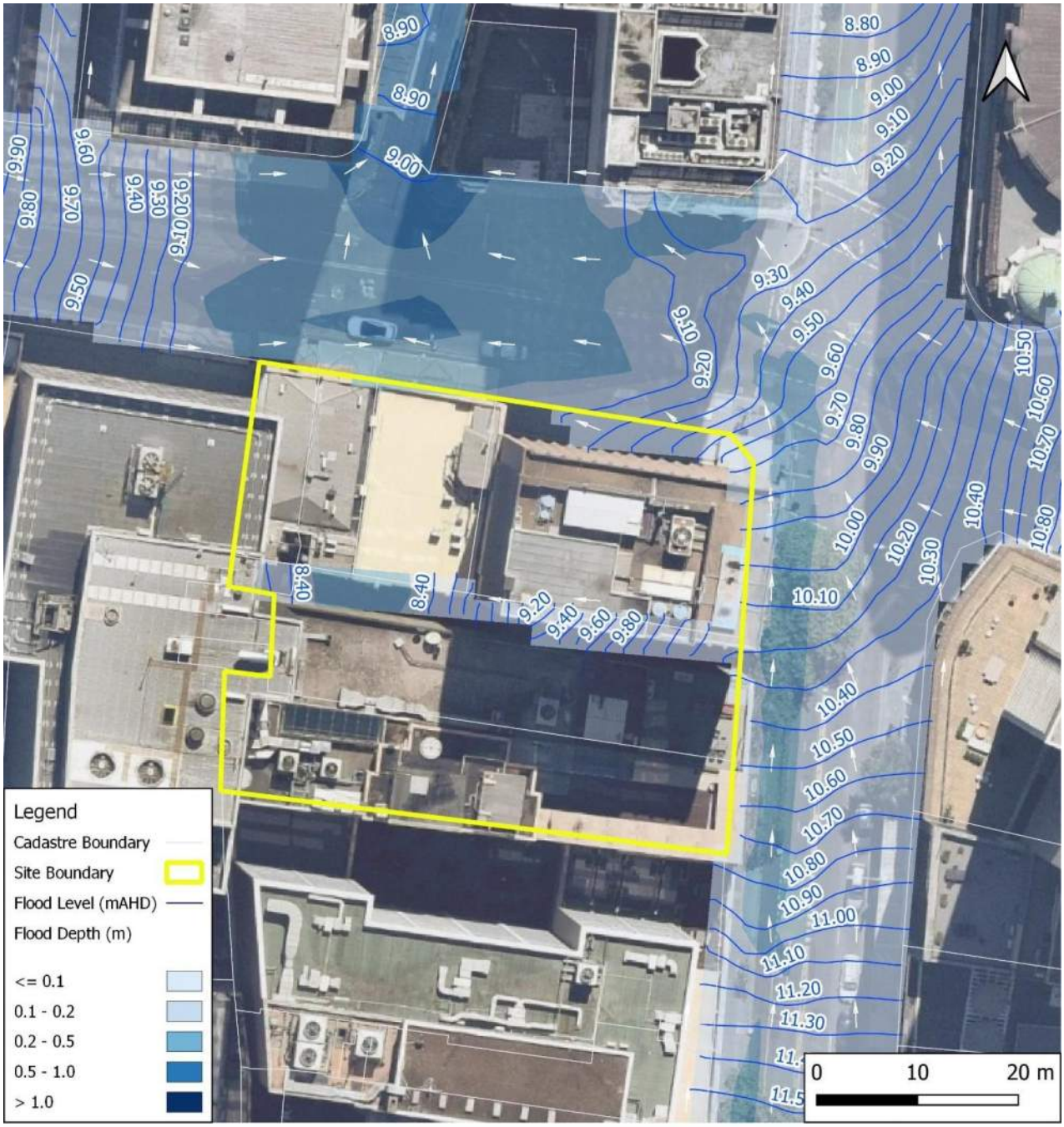


*Figure 3 - Flood Depths & Levels - 1% AEP Flood Event- Existing Conditions*

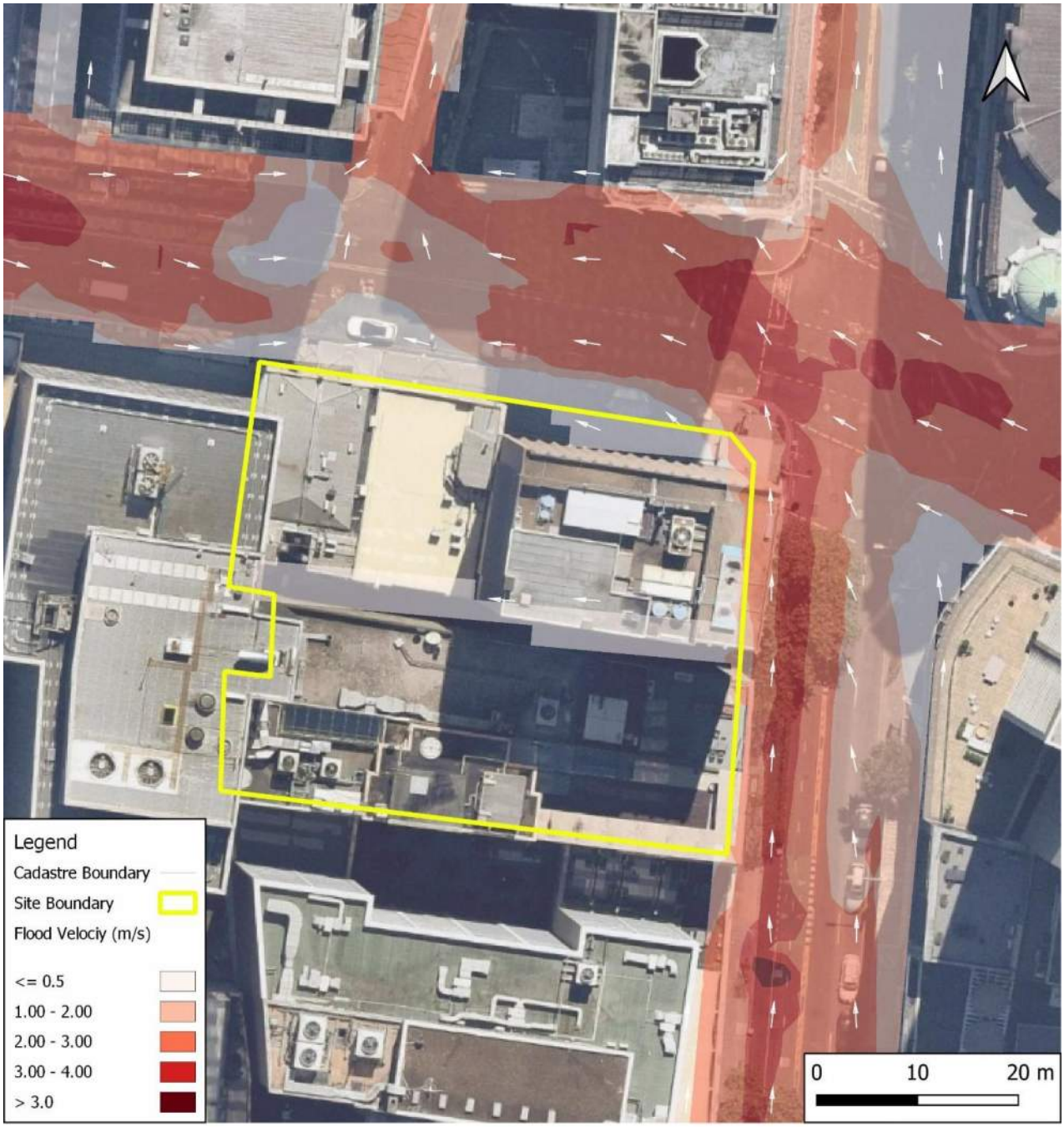


*Figure 4 - Flood Velocities - 1% AEP Flood Event- Existing Conditions*

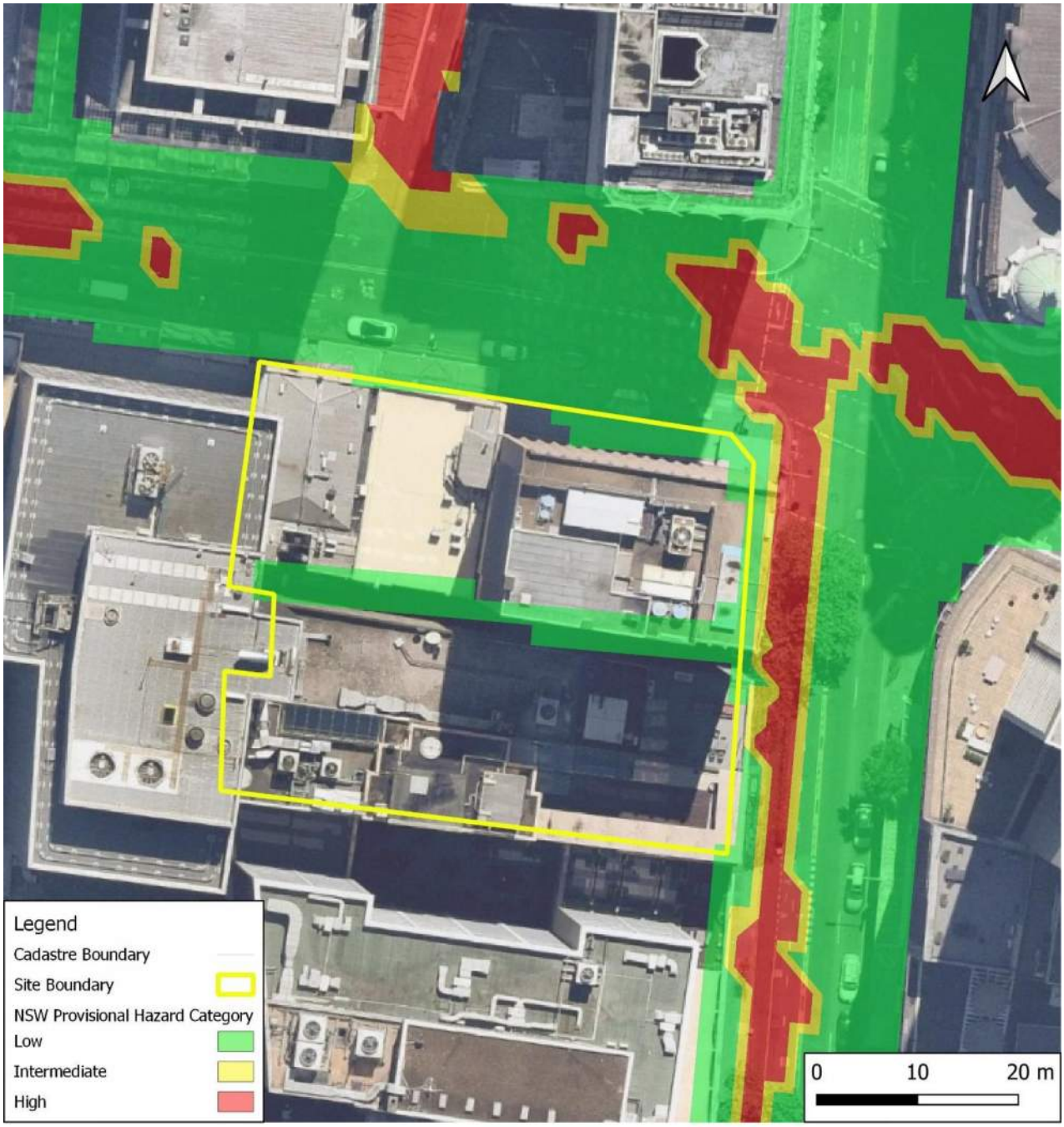


*Figure 5 - NSW Provisional Hazard Categories - 1% AEP Flood Event- Existing Conditions*

The peak flood levels depths, velocities and hazards in the critical duration PMF event for existing site conditions are shown in Figure 6, Figure 7Figure 4 and Figure 8 respectively.

PMF flood levels reach up to 11.50m AHD at southeastern site boundary reducing to 10.40m AHD over the Hunter Street at the northern site boundary.

Flood flows are approximately 0.9m deep at the eastern site boundary (along Pitt Street) and deepen as moving towards the sag point at the Hunter Street where the flood flows are as deep as 1.90m.

Flood velocities are up to 5.0 m/s at Pitt Street along the eastern site boundary and are of high flood hazards along the eastern and northern site boundaries.

local ponding at the existing trapped low point between 23-25 Hunter Street and 105 Pitt Street is as deep as 2.70m AHD.

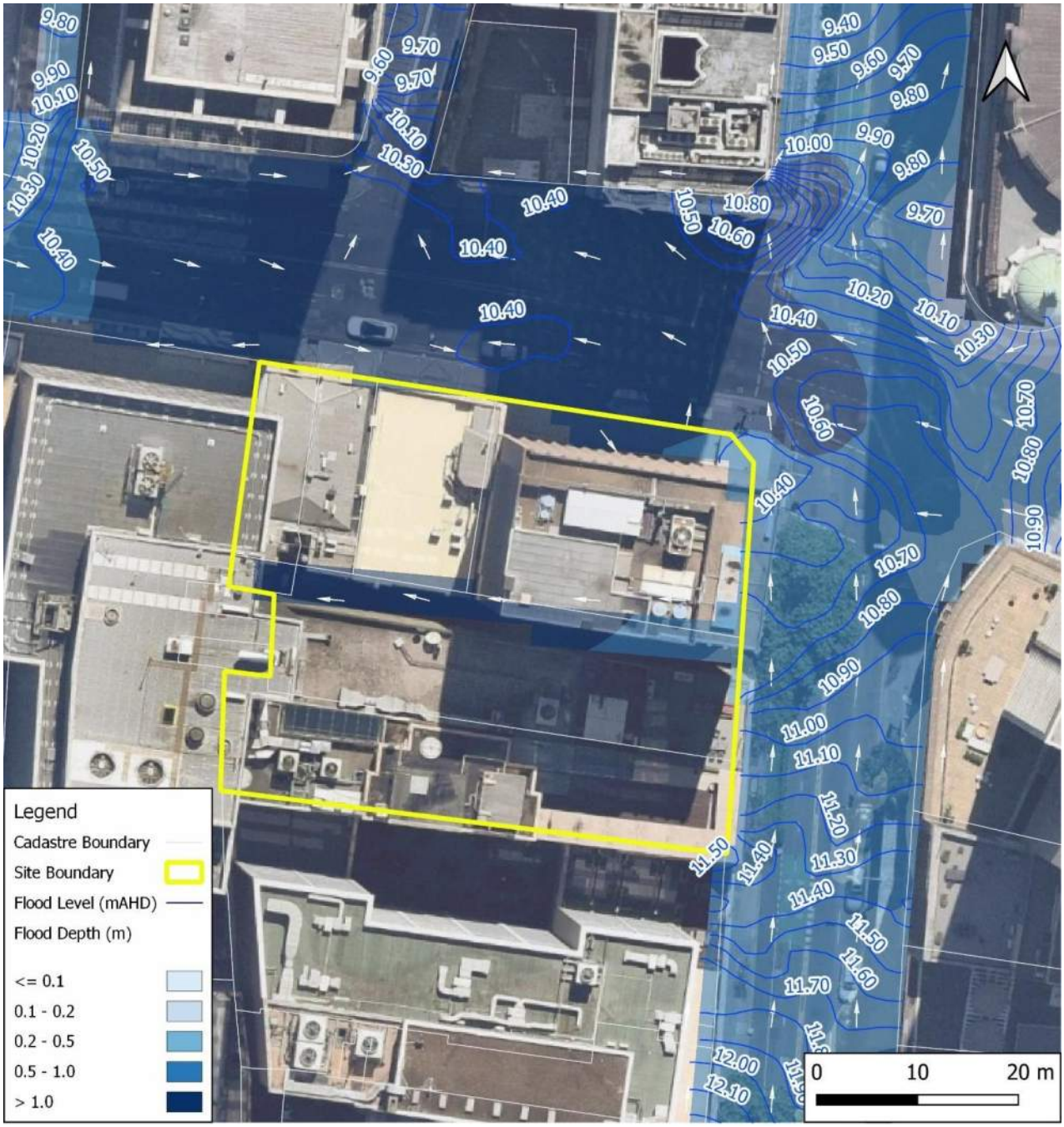


*Figure 6 - Flood Depths & Levels - PMF Flood Event- Existing Conditions*

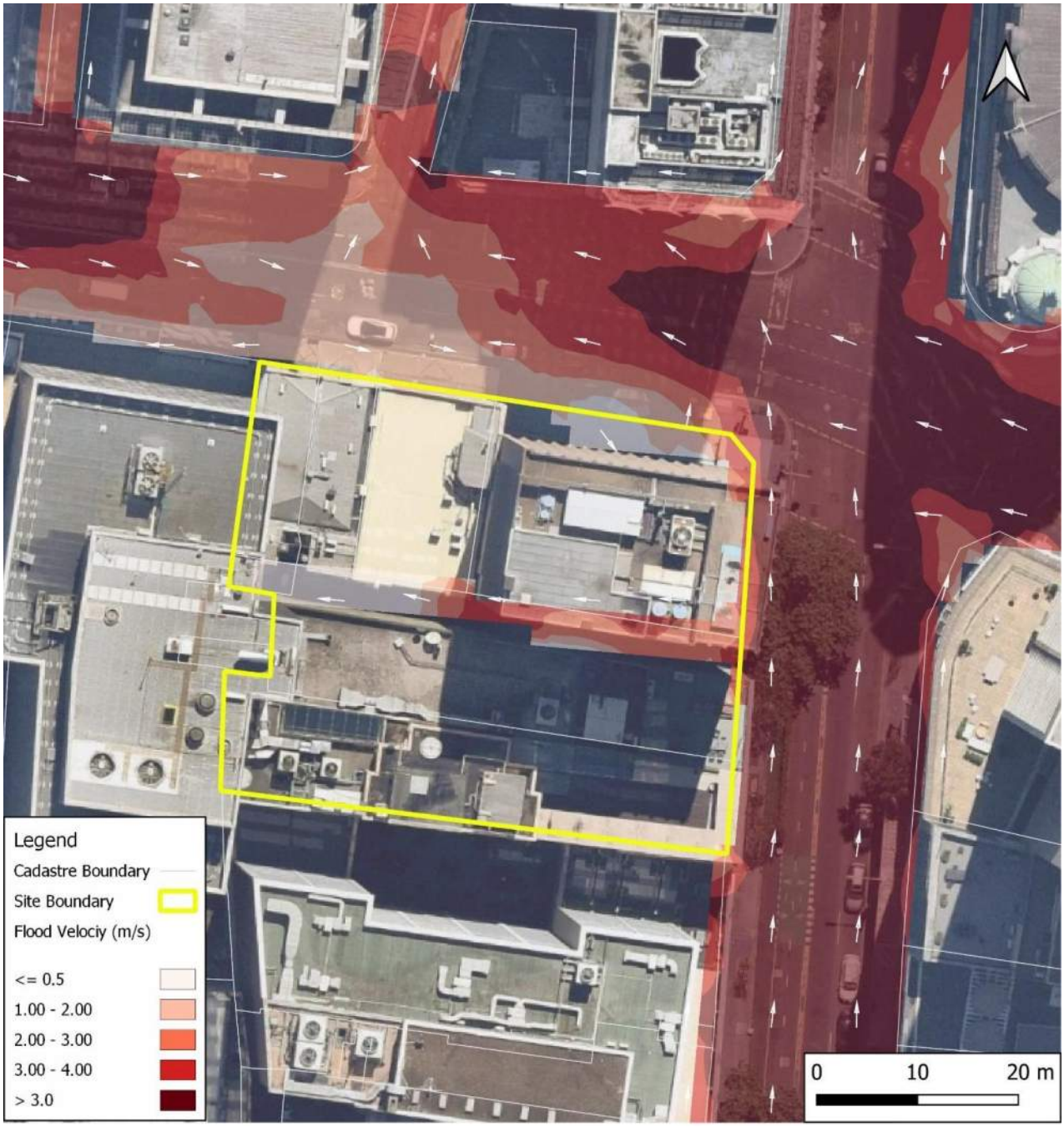


*Figure 7 - Flood Velocities - PMF Flood Event- Existing Conditions*

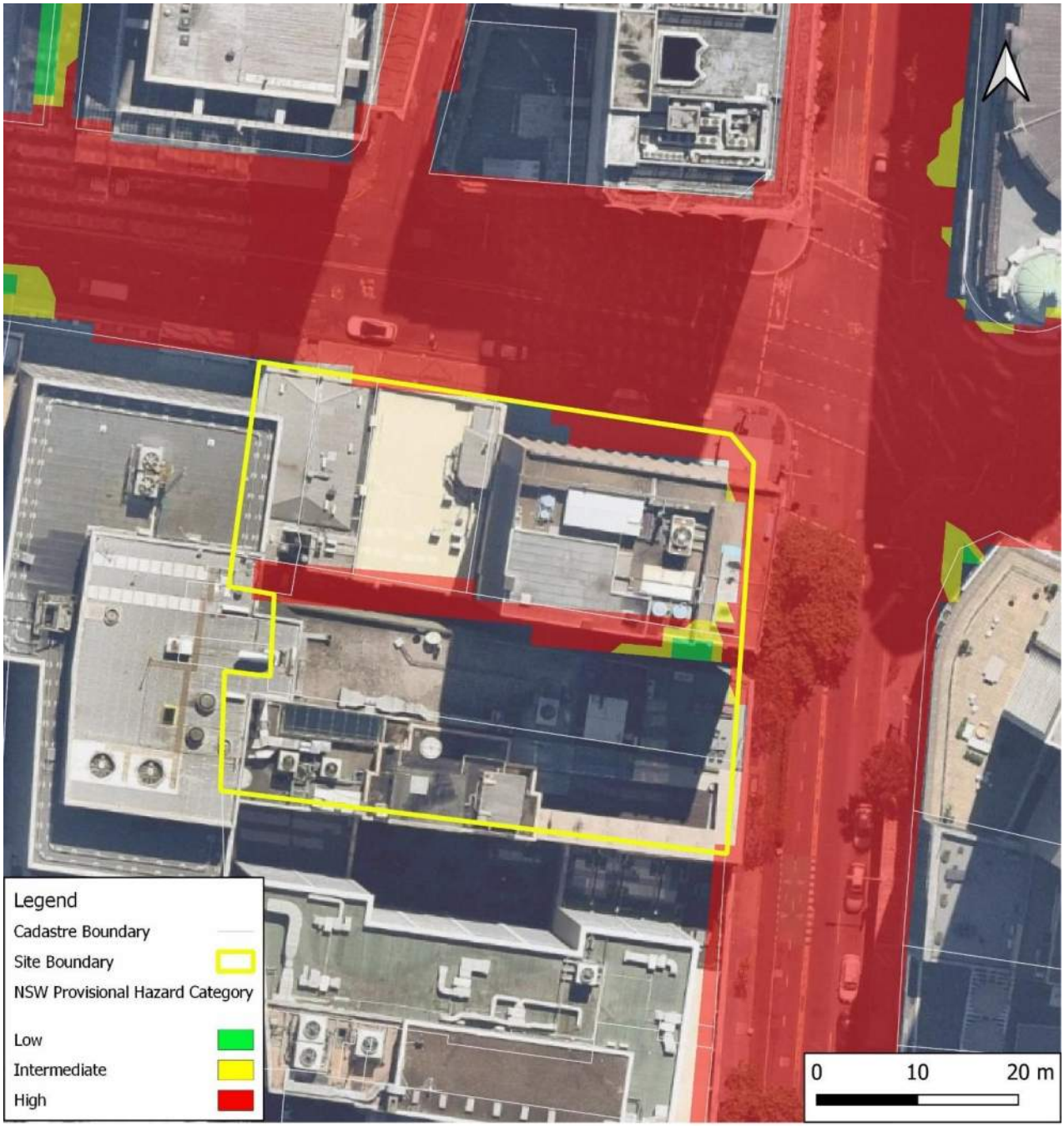


*Figure 8 - NSW Provisional Hazard Categories - PMF Flood Event- Existing Conditions*

### 1.7.2 Proposed Conditions

To assess the site in proposed conditions, the existing building onsite was removed from the model and replaced with the proposed building. In addition, the proposed shared way through the building was incorporated into model to enable flow assessment through the proposed shared way.

Flood results confirm that the flood flow behaviour in the proposed conditions is relatively consistent with the existing conditions during both 1% AEP and PMF events.

The site in proposed conditions is generally flood free during all flood events up to the PMF however, the model results show a minor ponding at the northern site ingress, immediately next to the existing sag point at Hunter Street which is of low hazard during the 1% AEP event.

Flood hazards are generally low along Hunter Street, however, vary from low to high at Pitt Street in the 1% AEP event.

Flood hazards are high on Hunter Street as well as on Pitt Street during the PMF.

Peak flood levels & depths, velocities and hazards for proposed site conditions in the critical duration 1% AEP event are presented in Figure 9, Figure 10 and Figure 11 respectively.

Similarly, Figure 12, Figure 13 and Figure 14 show the peak flood levels & depths, velocities and hazards during the PMF event.

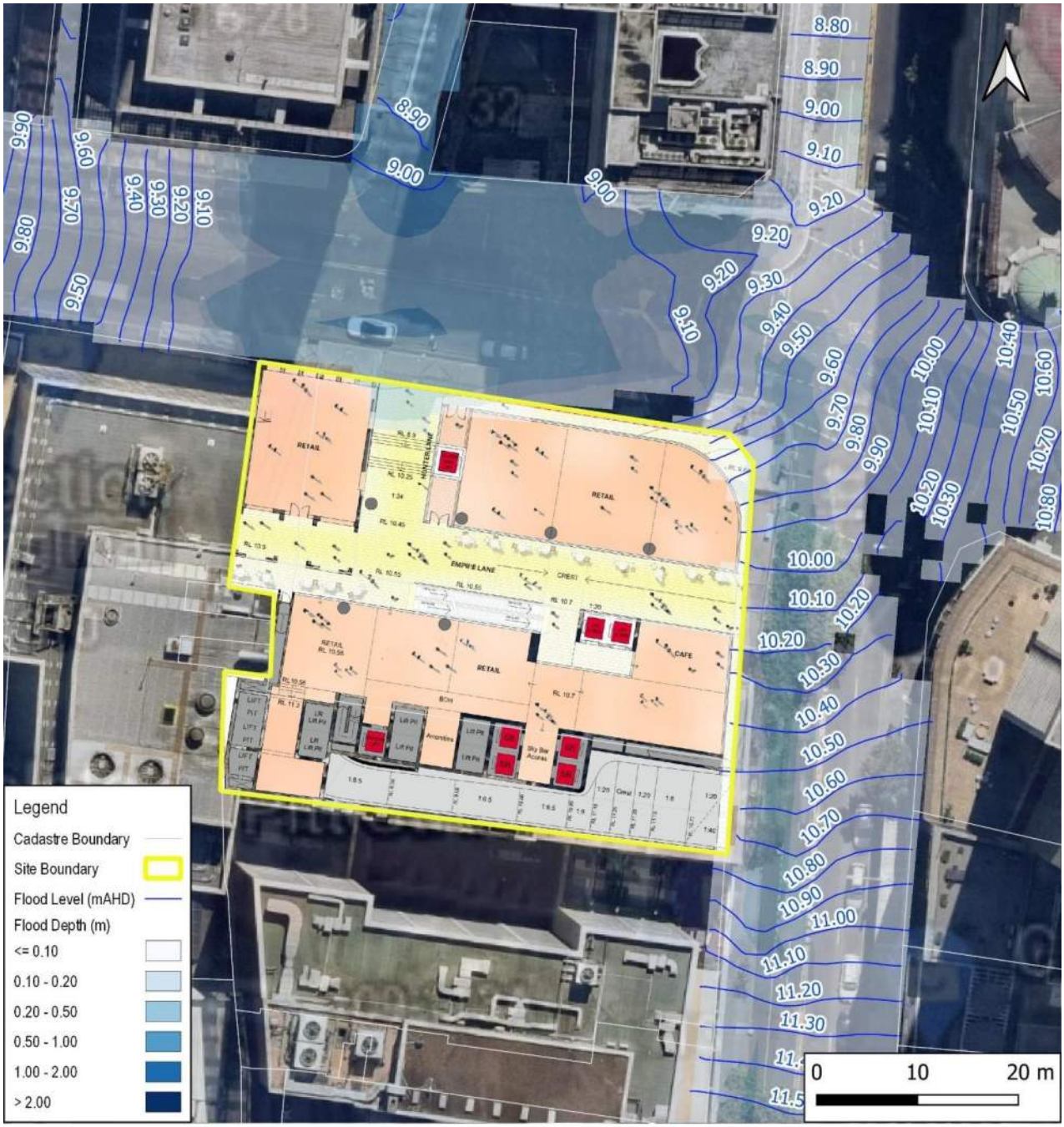


*Figure 9 - Flood Depths & Levels - 1% AEP Flood Event- Proposed Conditions*

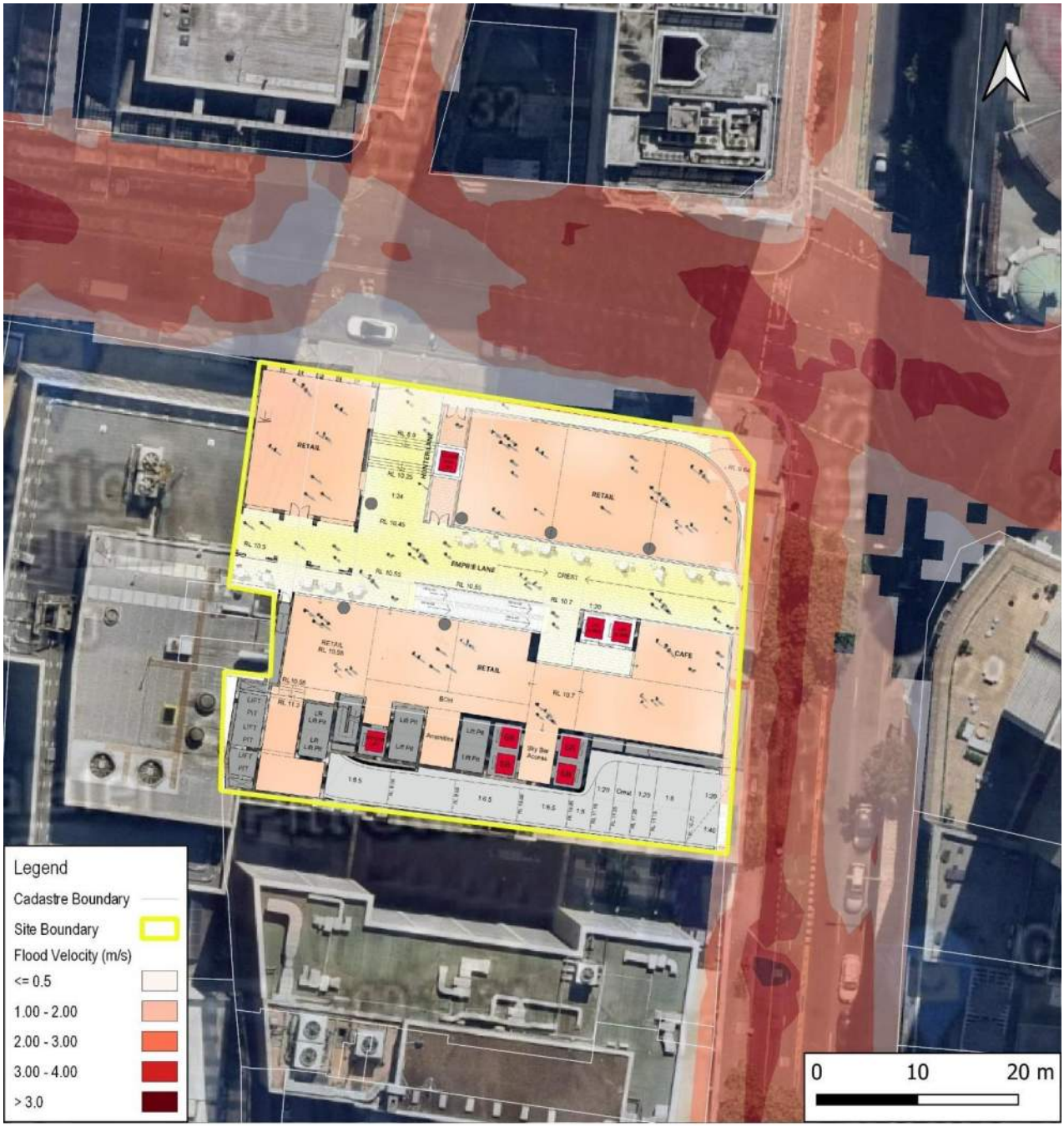


*Figure 10 - Flood Velocities - 1% AEP Flood Event- Proposed Conditions*

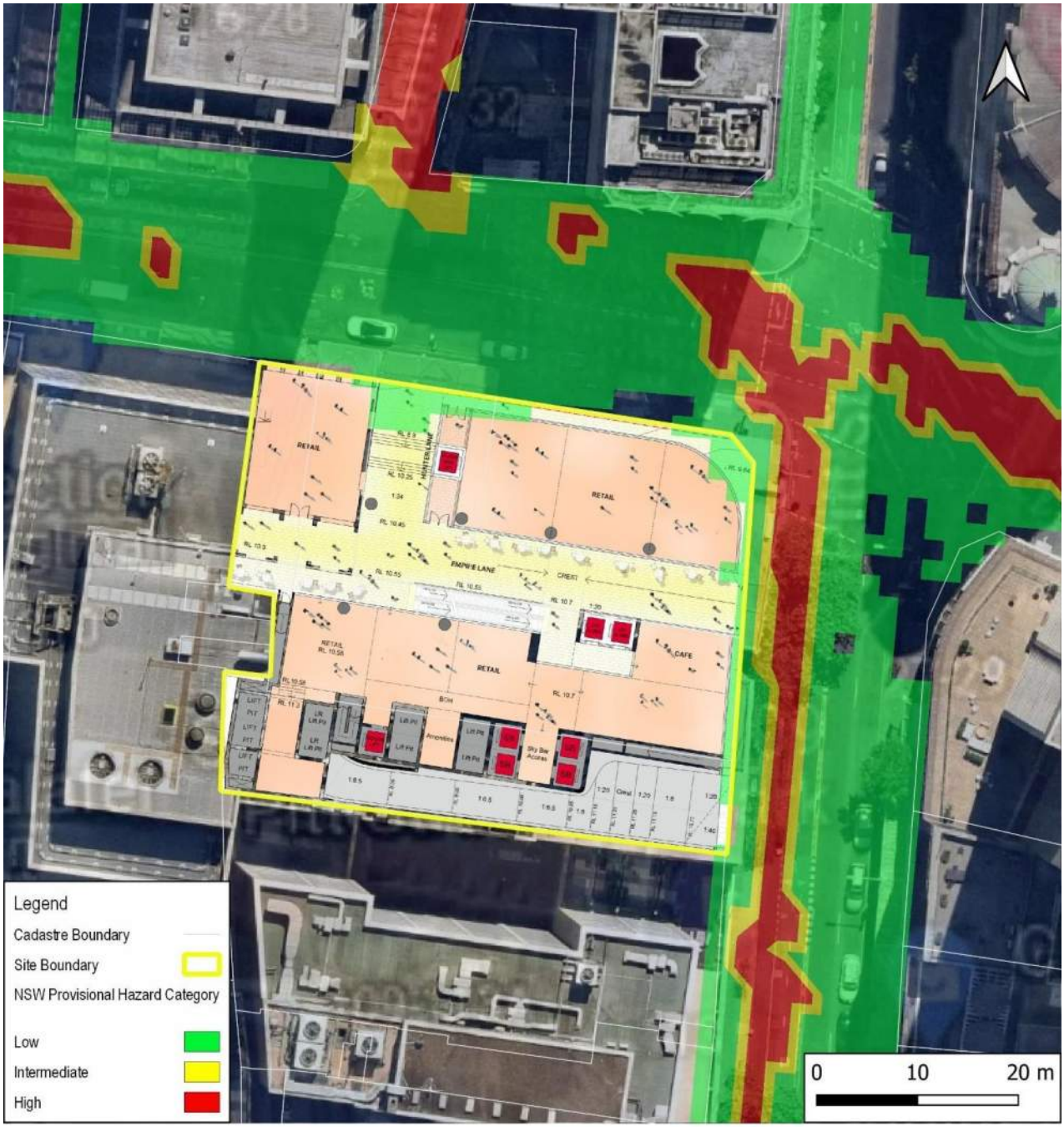


*Figure 11 - NSW Provisional Hazard Categories - 1% AEP Flood Event- Proposed Conditions*

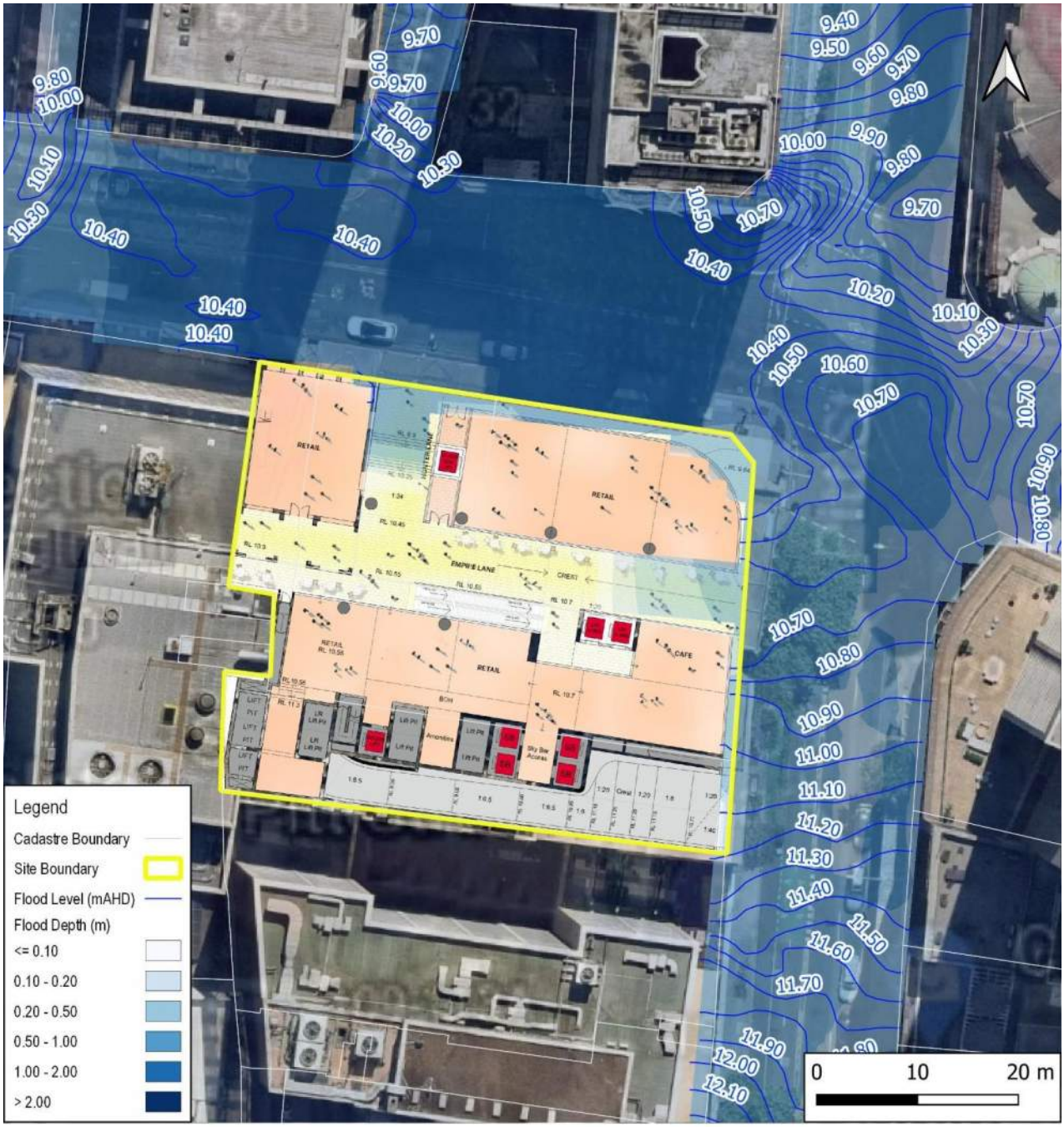


*Figure 12 - Flood Depths & Levels - PMF Flood Event- Proposed Conditions*

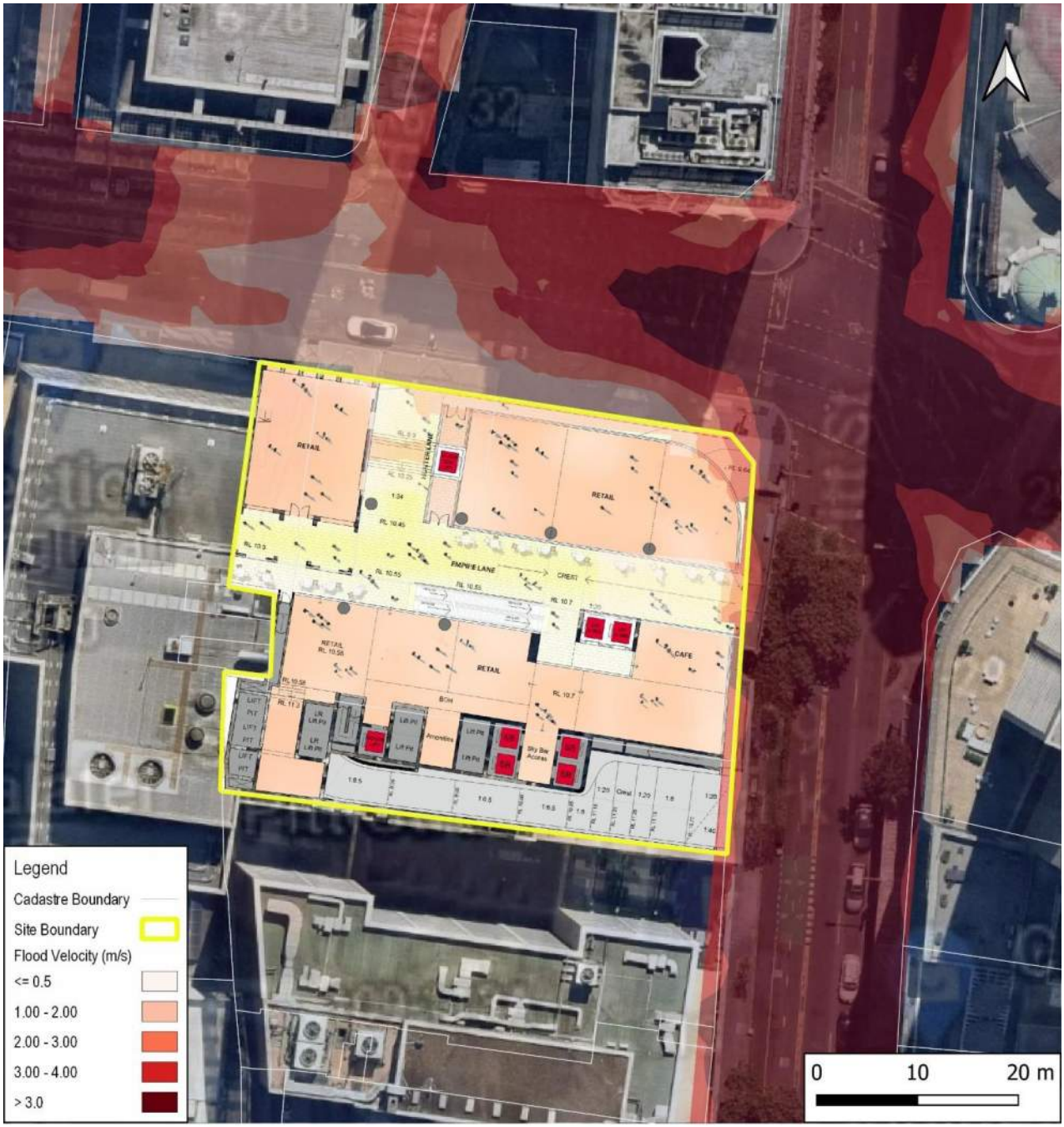


*Figure 13 - Flood Velocities - PMF Flood Event- Proposed Conditions*

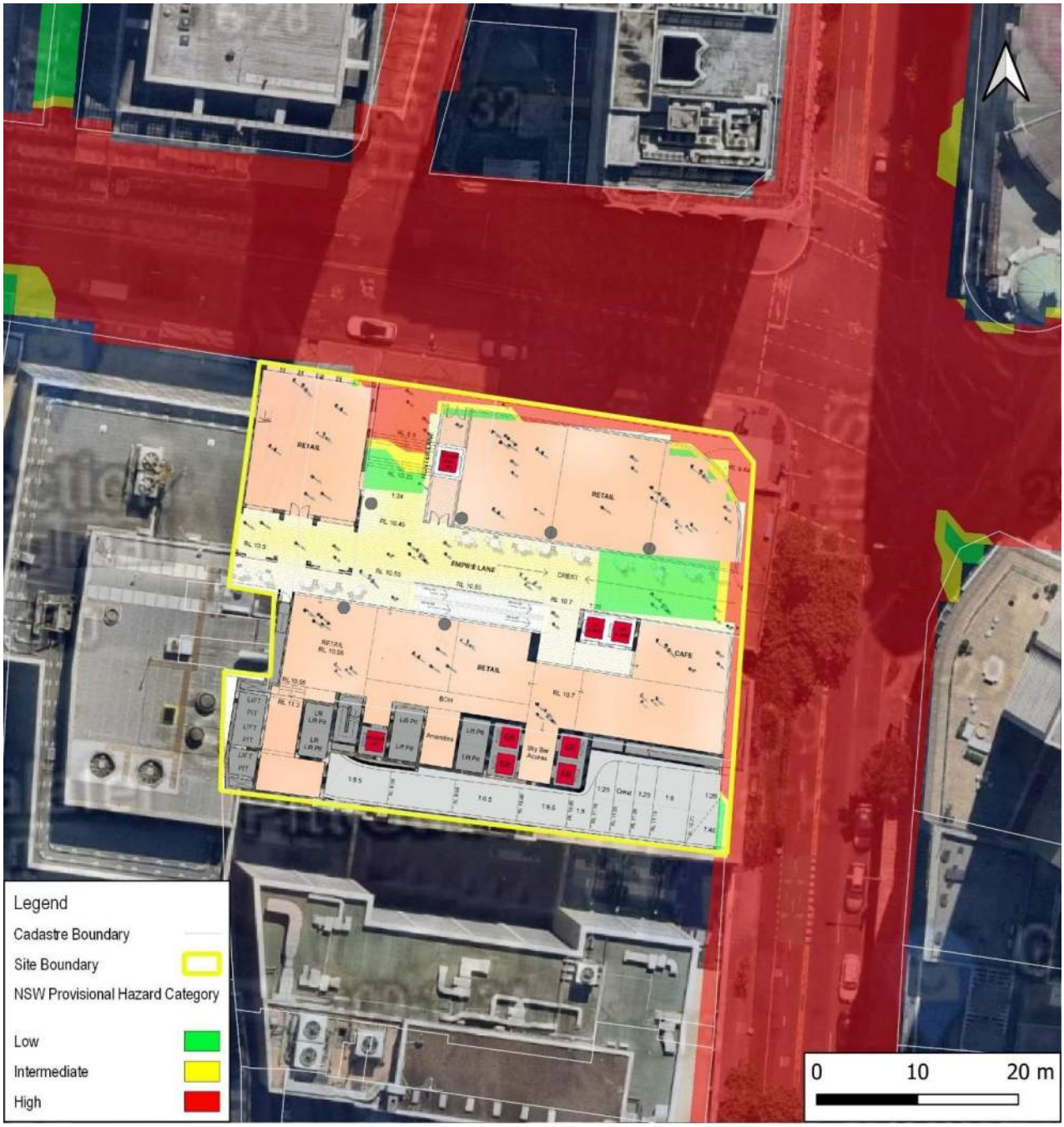


*Figure 14 - NSW Provisional Hazard Categories - PMF Flood Event- Proposed Conditions*

# 4. Flood Planning Requirements

The proposed development is to comply with the requirements outlined in the NSW State Government Floodplain Development Manual 2005, Sydney Development Control Plan (DCP) 2012, and Sydney Local Environmental Plan (LEP) 2012.

Additionally, Interim Floodplain Management Policy (2014) provides the flood related development controls with respect to flood planning requirements.

The proposed development is commercial and includes underground car parks. Based on the Interim Floodplain Management Policy (2014), Flood Planning Levels (FPLs) for the proposed development are summarised in Table 2.

*Table 2. Flood Planning levels - Interim Floodplain Management Policy (2014)*

| Commercial Development | Flood Planning Level |
|---|---|
| Business | Merits approach presented by the applicant with a minimum of the 1% AEP flood level |
| Retail floor levels | Merits approach presented by the applicant with a minimum of the 1% AEP flood. The proposal must demonstrate a reasonable balance between flood protection and urban design outcomes for street level activation. |
| Below-ground car parks[1] | 1% AEP flood level + 0.5m or the PMF (whichever is the higher) |

Notes:
1. The below ground garage/car park level applies to all possible ingress points to the car park such as vehicle entrances and exits, ventilation ducts, windows, light wells, lift shaft openings, risers and stairwells.

Minimum Flood Planning Levels (FPLs) for the proposed development are shown in Figure 15.

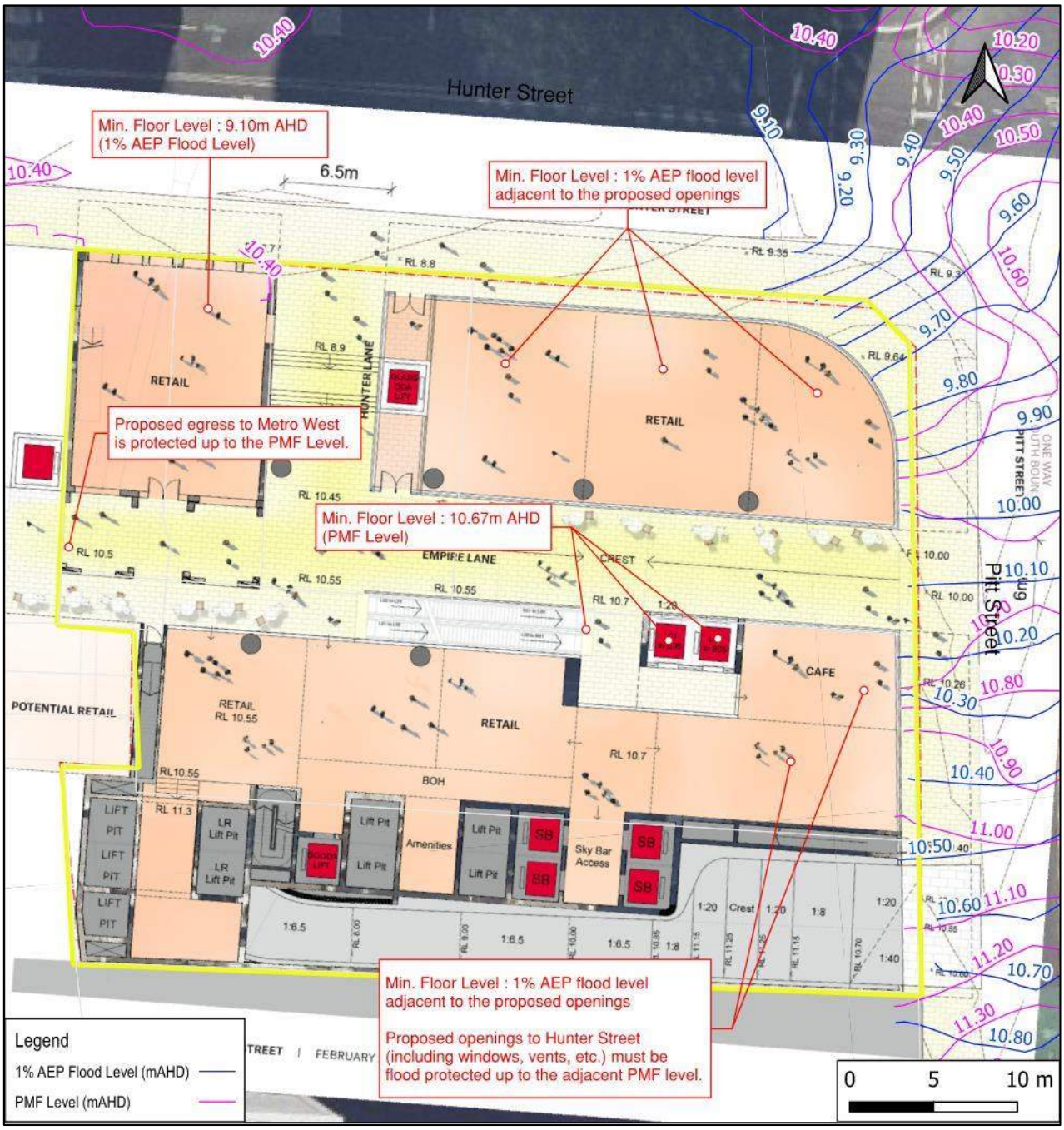


*Figure 15 - Minimum Required Finished Floor Levels (FPLs)*

## 1.8 Flood Compatible Materials

Council's Interim Floodplain Management Policy (2014) also requires the proposed development to comply with the compatible material requirements up to the flood planning levels. Flood compatible materials for different building components are listed in Table 3 below.

*Table 3 Flood Compatible Materials - Interim Floodplain Management Policy (2014)*

| Component | Flood Compatible Material |
|---|---|
| Flooring and Sub-floor | ▪ Concrete slab-on-ground monolith construction<br>▪ Suspended reinforced concrete slab |
| Wall Structure | ▪ Solid brickwork, blockwork, reinforced concrete or mass concrete |
| Wall and Ceiling Linings | ▪ Fibro-cement board<br>▪ Brick, face or glazed<br>▪ Clay tile glazed in waterproof mortar<br>▪ Concrete<br>▪ Concrete block<br>▪ Steel with waterproof applications<br>▪ Stone, natural solid or veneer, waterproof grout<br>▪ Glass blocks<br>▪ Glass<br>▪ Plastic sheeting or wall with waterproof adhesive |
| Roof Structure | ▪ Reinforced concrete construction<br>▪ Galvanised metal construction |
| Doors | ▪ Solid panel with waterproof adhesives.<br>▪ Flush door with marine ply filled with closed cell foam.<br>▪ Painted metal construction<br>▪ Aluminium or galvanised steel frame |
| Insulation | ▪ Closed cell solid insulation<br>▪ Plastic/polystyrene boards |
| Windows | ▪ Aluminium frame with stainless steel rollers or similar corrosion and water-resistant material. |
| Nails, Bolts, Hinges and Fittings | ▪ Brass, nylon or stainless steel<br>▪ Removable pin hinges<br>▪ Hot dipped galvanised steel wire nails or similar |
| Main Power Supply | ▪ Subject to the approval of the relevant authority the incoming main commercial power service equipment, including all metering equipment, shall be located above the designated flood planning level. Means shall be available to easily disconnect the dwelling from the main power supply. |
| Wiring | ▪ All wiring, power outlets, switches, etc., should be located above the designated flood planning level. All electrical wiring installed below this level should be suitable for continuous underwater immersion and should contain no fibrous components. This will not be applicable for below-ground car parks where the car park complies with flood planning level requirements.<br>▪ Earth leakage circuit-breakers (core balance relays) or Residual Current Devices (RCD) must be installed. |

| Component | Flood Compatible Material |
|---|---|
| | ▪ Only submersible type splices should be used below maximum flood level.<br>▪ All conduits located below the relevant designated flood level should be so installed that they will be self-draining if subjected to flooding. |
| Electrical Equipment | ▪ All equipment installed below or partially below the designated flood planning level should be capable of disconnection by a single plug and socket assembly.<br>▪ |
| Heating and Air Conditioning Systems | ▪ Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off.<br>▪ The heating equipment and related fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line.<br>▪ The tanks should be vented above the flood planning level. |
| Fuel storage for heating purposes | ▪ Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off.<br>▪ The heating equipment and related fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line.<br>▪ The tanks should be vented above the flood planning level. |
| Ducting for heating/cooling purposes | ▪ All ductwork located below the relevant flood level should be provided with openings for drainage and cleaning. Self-draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a water-tight wall or floor below the relevant flood level, a closure assembly operated from above relevant flood level should protect the ductwork. |

# 5. Flood Impact Assessment

A flood impact assessment for the proposed development was carried out to ensure no offsite impacts are caused as a result of the development. Based on the assessment, the flood level impacts are constrained within ±20 mm and therefore, the proposed development would generally result in negligible offsite impact on the surrounding properties in the 1% AEP flood event.

Flood level impacts during the critical 1% AEP event are shown in Figure 16 below.

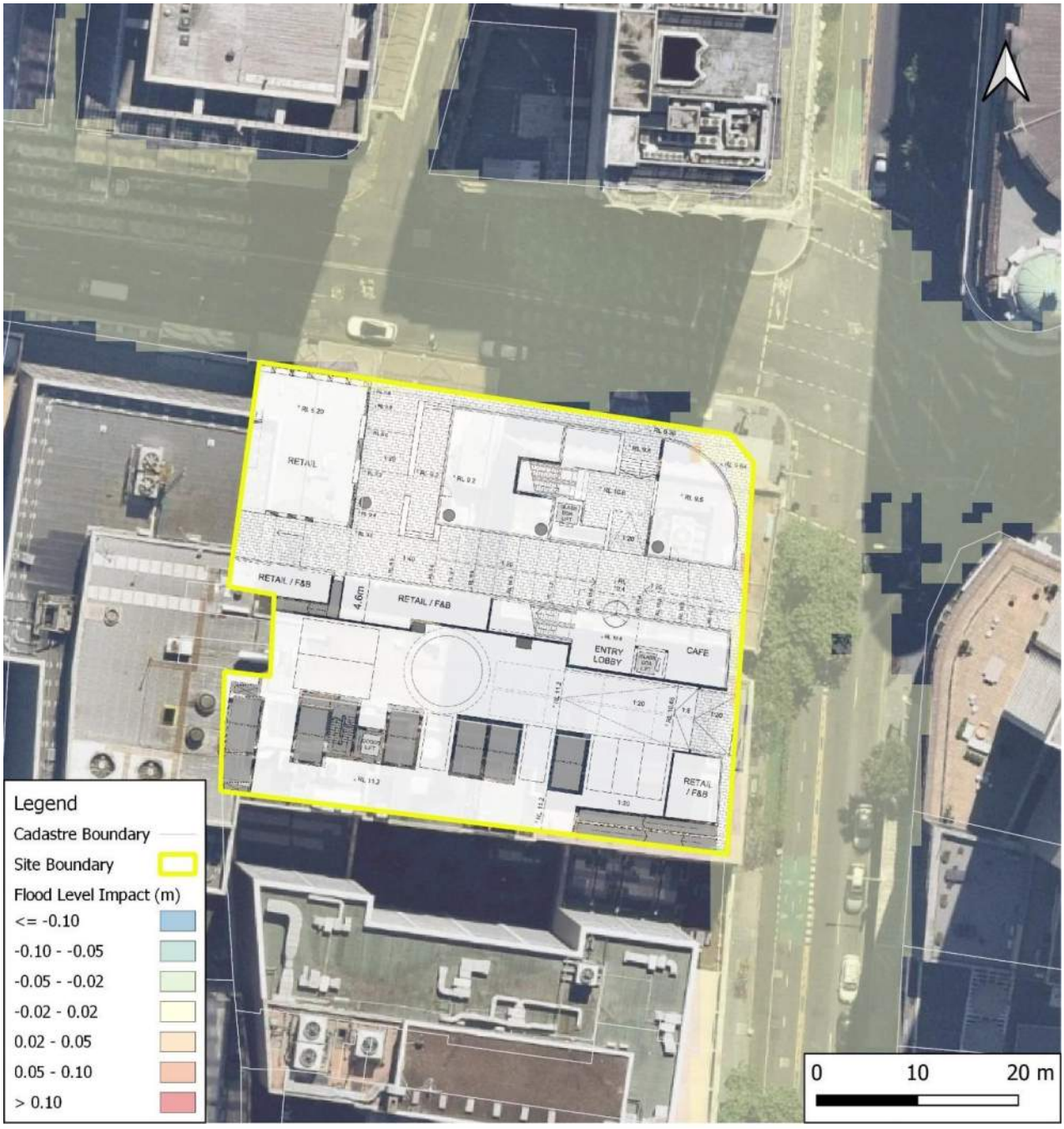


*Figure 16 - 1% AEP Flood Level Impact (m)*

# 6. Flood Emergency Response Strategy (FERS)

The site is not majorly flood affected during the 1% AEP flood event. Flood flows are generally low hazard at the northern site boundaries and low to high hazard at the eastern site boundary.

During the PMF event though, flood flows are of high hazard through Pitt Street and Hunter Street. Therefore, there is no flood free evacuation route externally available during the PMF.

The proposed development (except for the street front retails) will not be flood affected in the PMF. Thus, the Flood Emergency Response Plan (FERP) for events greater than the 1% AEP is shelter-in-place.

During flood events greater than the 1% AEP, site users must evacuate the street front retail areas and shelter-in-place on the building floors (other than the street front retail floors) and follow the orders from State Emergency Service (SES) or other authorised emergency services personnel until floodwaters recede.

# 7. Conclusions

A detailed hydraulic model has been carried out based on the available City Area Catchment Flood Study and model prepared by BMT WBM (2014) to assess local flood characteristics for the site in the 1% AEP and PMF events under both existing and proposed conditions. Modelling concluded that:

- The site is generally flood free during the flood events up to and including the PMF.
- The proposed flood characteristics are largely consistent with existing conditions, and differences due to the proposed development are negligible.
- The development will have no material offsite flood level impacts.
- The development will not increase the flood hazard or risk to other properties.
- Minimum Finished Floor Levels (FFLs) for different areas of the proposed building are highlighted in Figure 15.
- The proposed connection to Metro West is flood protected up to the PMF event.
- Recommended flood emergency response strategy (FERS) during the floods rarer than 1% AEP would be evacuation from the street front retails and shelter-in-place on the building floors.
- Flood evacuation will be available onsite and on higher levels via the internal stairs.

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