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OCEANGROVE
2-6 DEE WHY PARADE
PART OF 8 DEE WHY PARADE
10-12 DEE WHY PARADE
PART OF 2 CLARENCE AVENUE
DEE WHY NSW 2099

FLOOD RISK MANAGEMENT REPORT

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1. INTRODUCTION

Triaxial Consulting have been engaged to prepare a flood management report to accompany a Planning Proposal to be submitted for a proposed extension to an existing seniors housing development at Nos. 2, 6, 8, 10 and 12 Dee Why Parade, Dee Why, and 2 Clarence Avenue, Dee Why.

The primary objectives of this report are to:

- Review existing flood information,
- Determine pre and post development overland flow path flood hydraulics and risk,
- Assess flood risk for the proposed development in accordance with Council requirements.

This report is prepared generally in accordance with:

- Australian Rainfall and Runoff: A Guide to Flood Estimation (2019), Commonwealth of Australia (Geoscience Australia).
- NSW Floodplain Development Manual (April 2005), Department of Infrastructure, Planning and Natural Resources.
- Warringah Local Environmental Plan (LEP) 2011,
- Warringah Development Control Plan (DCP) 2011,
- Northern Beaches Council Water Management for Development Policy, Version 1, dated 26 August 2020.

The following documentation has been reviewed in the preparation of this report:

- Pre-planning proposal - Proposed Extension to Oceangrove Seniors Living Development, for Dee Why RSL Club, Marchese Partners.
- Survey plan, Drawing No. 33463-03, dated 10 March 2023, Frank M Mason & Co.
- Flood Information Report (Comprehensive), dated 15 August 2023, Northern Beaches Council.
- Dee Why South Catchment Flood Study 2013, Cardno.
- Dee Why South Catchment Flood Risk Management Study, Cardno.
- Dee Why South Catchment Flood Risk Management Plan, Cardno.
- Pre-lodgement meeting notes, PLM2022/0131, dated 2 August 2022, Northern Beaches Council.

1.1. SITE INFORMATION

The proposed development site consists of:

- 2 Dee Why Parade Dee Why (Lot A DP 307103),
- 6 Dee Why Parade Dee Why (Lot B DP 307103),
- Part of 8 Dee Why Parade Dee Why (part of Lot 1 DP 1136948),
- 10-12 Dee Why Parade Dee Why (SP11488), and,
- Part of 2 Clarence Avenue Dee Why (part of Lot 2 DP 1136948)

The site currently contains a mix of existing commercial and residential development as well as the access driveway to the existing Oceangrove seniors housing development to the north.

The site predominantly falls in a northeasterly direction towards Clarence Avenue.

Figure 1 - Proposed Development Site (bounded in red) Context and Overland Flow Direction (Source: Northern Beaches Council)

1.2. LOCAL STORMWATER DRAINAGE NETWORK

Council's stormwater drainage infrastructure within the site vicinity is generally aligned with the road network to the south and east of the site and continues to the north east ultimately draining to Dee Why lagoon.

The drainage network is well aligned with the overall catchment fall to the north east.

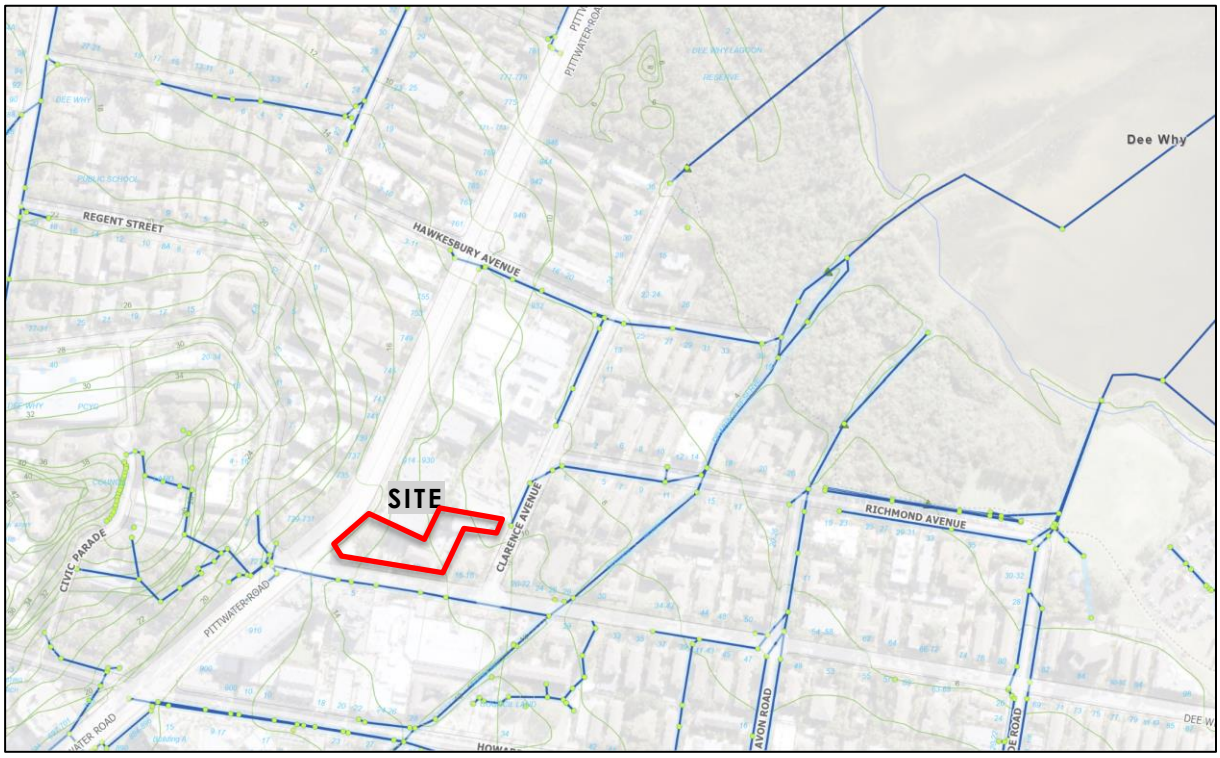


Figure 2 - Council stormwater drainage network (Source: Northern Beaches Council)

1.3. FLOOD INFORMATION BACKGROUND

A comprehensive flood information report was issued by Northern Beaches Council which contains information regarding the site's affectation by the 1% AEP and PMF flood events as well as Council's flood risk mapping.

The information contained within the report is based on the Dee Why South Catchment flood study for the Dee Why South catchment draining to Dee Why lagoon which was commissioned by the former Warringah Council and completed by Cardno in 2013.

The report indicates that the site has been identified as being predominantly within a medium flood risk precinct with a small section of the site in the west adjacent to Pittwater Road being within low or no flood risk precincts. This is shown in Figure 3 below.

Northern Beaches Council adopts the following definitions for flood risk precincts:

- **Low Flood Risk precinct** means all flood prone land not identified within the High or Medium flood risk precincts.
- **Medium Flood Risk precinct** means all flood prone land that is (a) within the 1% AEP Flood Planning Area; and (b) is not within the high flood risk precinct.

- **High Flood Risk precinct** means all flood prone land (a) within the 1% AEP Flood Planning Area; and (b) is either subject to a high hydraulic hazard, within the floodway or subject to significant evacuation difficulties (H5 or H6 Life Hazard Classification).
- The **Flood Planning Area** extent is equivalent to the Medium Flood Risk Precinct extent and includes the High Flood Risk Precinct within it. The mapped extent represents the 1% annual Exceedance Probability (AEP) flood event + freeboard.

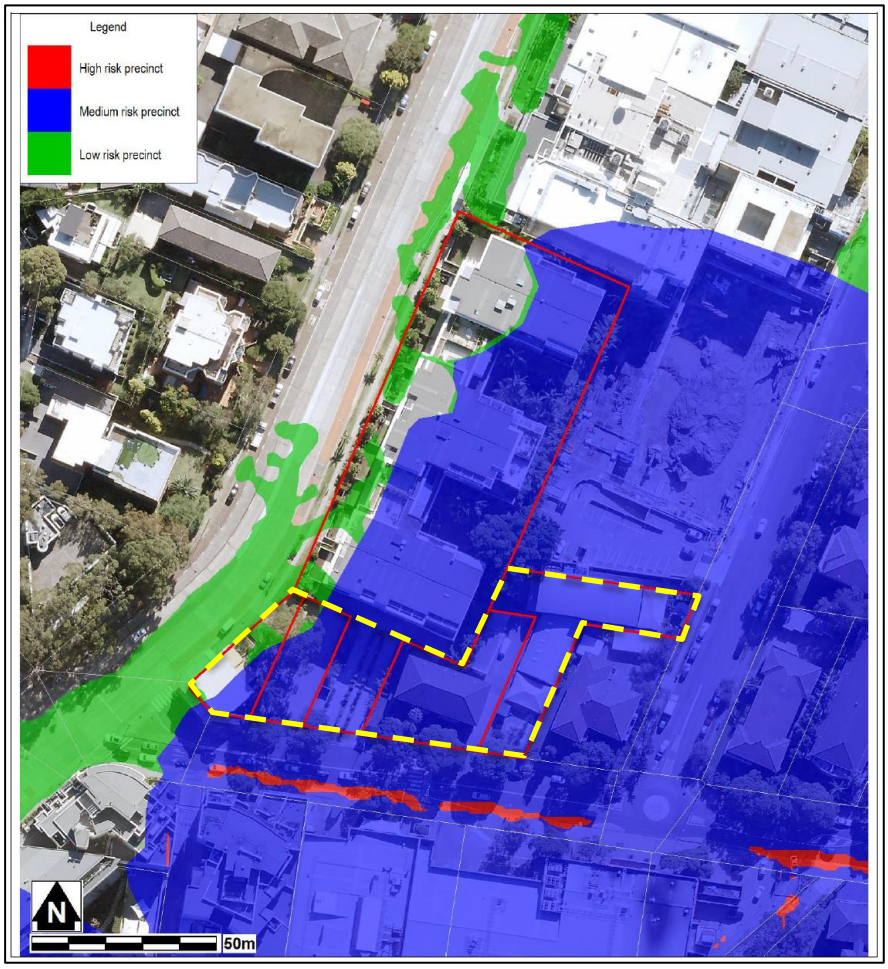


Figure 3 - Extract from Flood Information Report issued by Northern Beaches Council showing flood risk precincts with development site bounded in yellow dash (added)

The 1% AEP flood mapping indicates that floodwaters are contained on the southern side of Dee Why Parade opposite to the development site. This is shown in Figure 4 below.

The site has been classified as being predominantly within a medium flood precinct due to the definition as land within 0.5m freeboard above the 1% AEP flood level being considered for the purposes of calculating the flood planning level. However, it is not considered to be affected by the 1% AEP flood.

When climate change factors were considered in the study, the 1% AEP flood extent appears to be similar and with no significant variation. This is shown in Figure 5 below.

No 1% AEP flood levels were issued by Council which is consistent with the conclusion that the site is not affected by the 1% AEP flood.

Figure 4 - Extract from Flood Information Report issued by Northern Beaches Council showing 1% AEP flood extent

Figure 5 - Extract from Flood Information Report issued by Northern Beaches Council showing 1% AEP flood extent with climate change factors considered

The site is affected in the Probable Maximum Flood (PMF) event as shown in Figure 6 below.

It should be noted that the relevance of Council's existing PMF results is limited due to the discrepancy between the 2007 LIDAR data used in the Council flood study and current site conditions which includes the existing Oceangrove development.

A summary of the flood levels, depth and velocities in the PMF event issued by Council is presented in the table below.

ID	Flood Planning Level (m AHD)	PMF Max WL (m AHD)	PMF Max Depth (m)	PMF Max Velocity (m/s)
*1**	*12.81*	*11.64*	*0.42*	*0.85*
2	12.90	12.59	**0.23**	**1.44**
3	13.09	12.65	**0.29**	**2.84**
*4**	*11.90*	*11.57*	*0.67*	*0.89*
5	12.85	12.65	**0.67**	**0.94**
6	12.27	12.12	**0.44**	**1.53**
7	12.11	11.52	**0.43**	**2.18**
8	11.90	11.78	**0.00**	**0.00**
9	11.90	10.99	**0.75**	**1.44**
10	11.90	11.98	**0.36**	**0.85**

*Outside of the development site

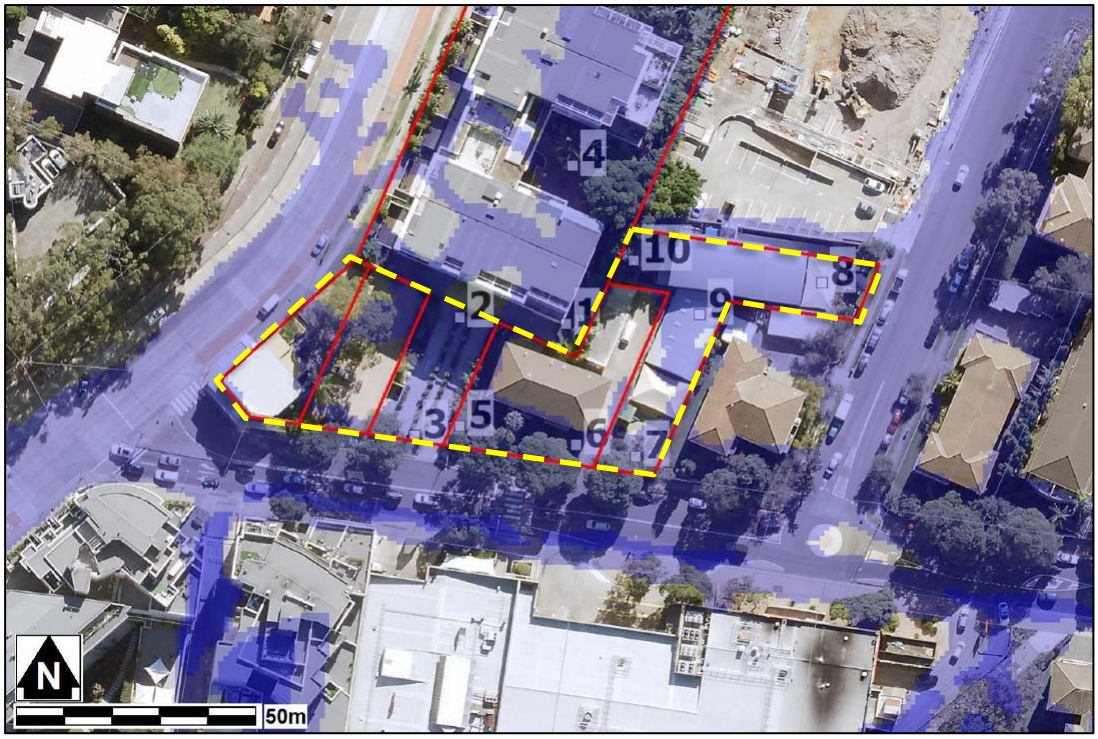


Figure 6 - Extract from Flood Information Report issued by Northern Beaches Council showing PMF extent

Hazard Vulnerability Classification is a function of hydraulic hazard (relating to the depth and velocity of floodwaters) and takes into account the vulnerability of the community and community assets to damage or danger when interacting with floodwaters.

Hazard Vulnerability Classifications are determined based on the guidelines provided in 'Technical flood risk management guidelines: Flood hazard' (Attorney-General's Department 2014) and shown in Figure 8.

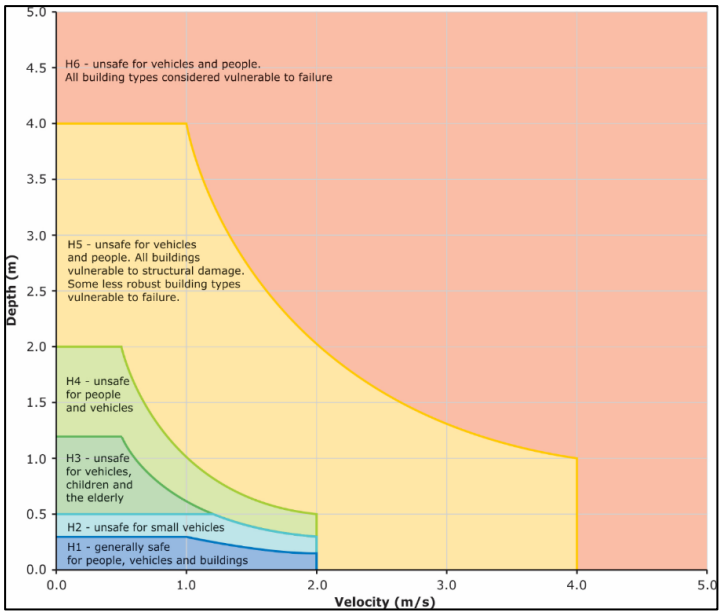


Figure 7 - Combined Flood Hazard Curves (ARR Guidelines, 2019)

The flood hazard mapping issued by Council indicates that the site is partially within the H1 to H3 hazard vulnerability classifications for the PMF event. The area subject to H3 hazard is located within a small portion to the east of the site which will form the building setback.

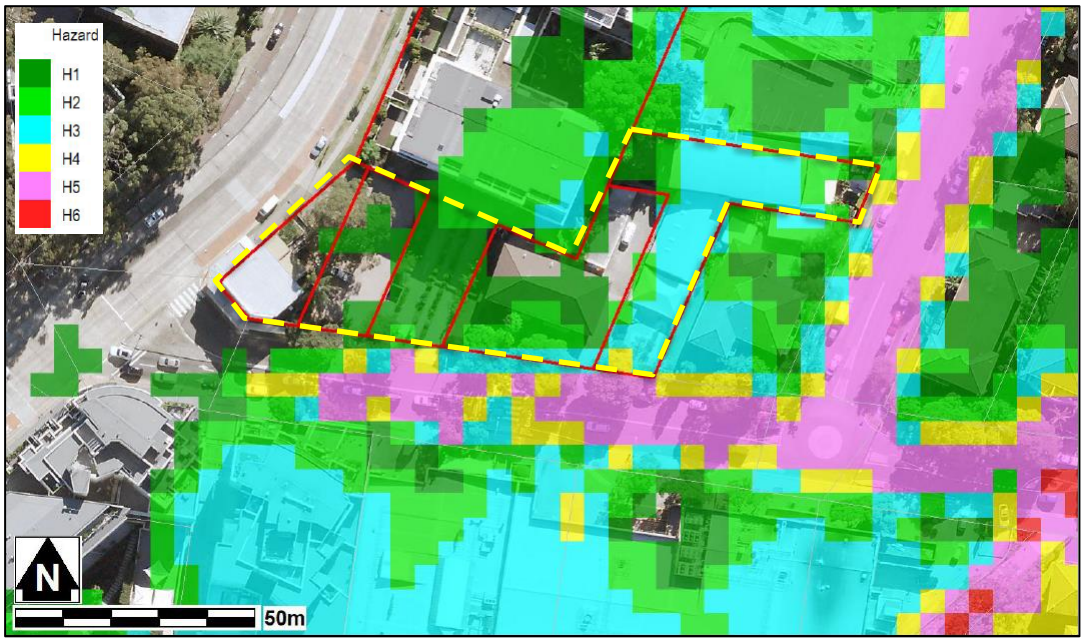


Figure 8 - PMF Flood hazard vulnerability categories issued by Northern Beaches Council

The Dee Why South Catchment flood study also considered very rare storms between the 1% AEP and PMF events. The following extracts suggest that the site is not affected in the 0.5% AEP and 0.1% AEP events.

Using the terminology adopted in ARR2019, the likelihood is considered below.

AEP (%)	AEP (1 in x)	ARI
1	100	99.5
0.5	200	199.5
0.1	1000	999.5

Annual Exceedance Probability (AEP) - the probability of an event being equalled or exceeded within a year.

Average Recurrence Interval (ARI) - the average time period between occurrences equalling or exceeding a given value.

A 0.5% AEP storm would have a 1 in 200 chance of occurring in any given year or would occur on average every 199.5 years.

A 0.1% AEP storm would have a 1 in 1000 chance of occurring in any given year or would occur on average every 999.5 years.

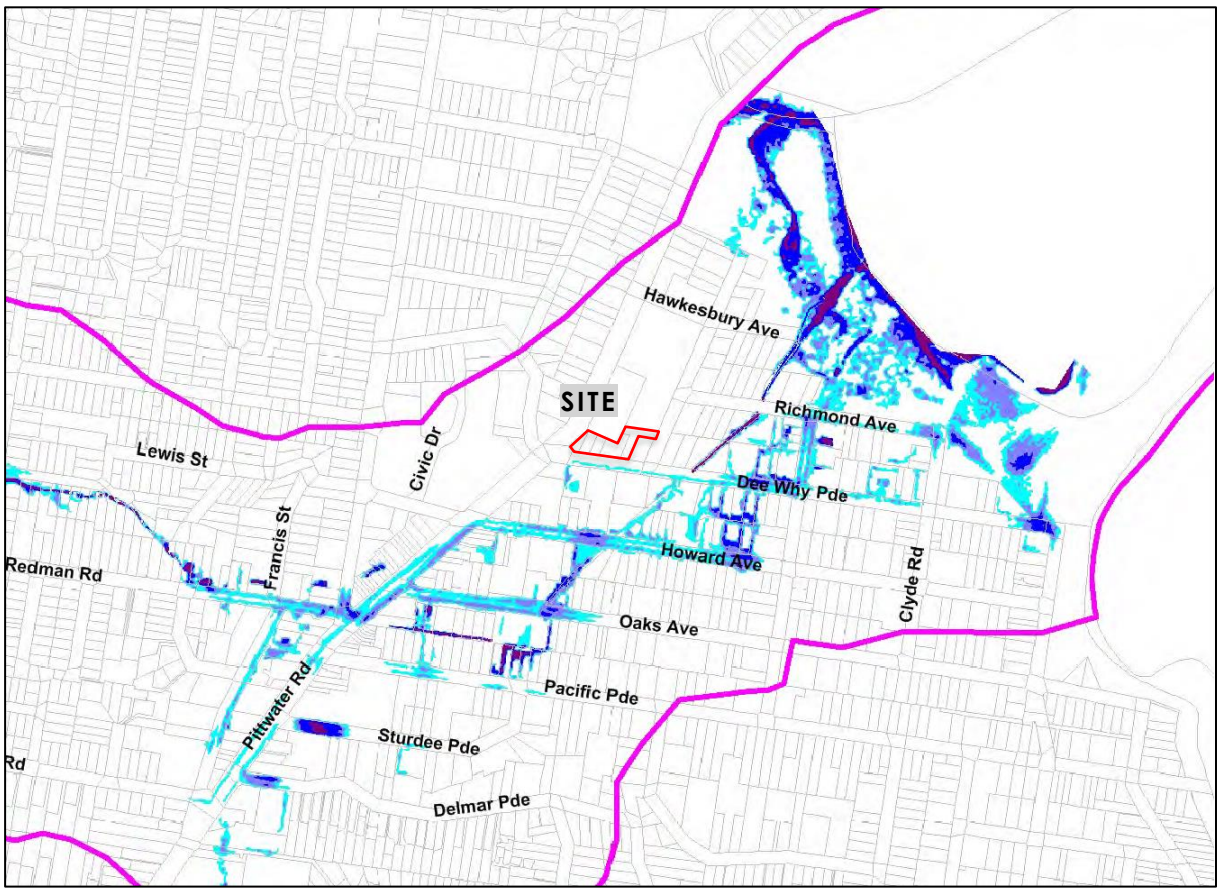


Figure 9 - Extract from Dee Why South Catchment Flood Study (Cardno, 2013) (Site bounded in red) - Figure 6-5 Design Event 0.5% AEP Peak Depth

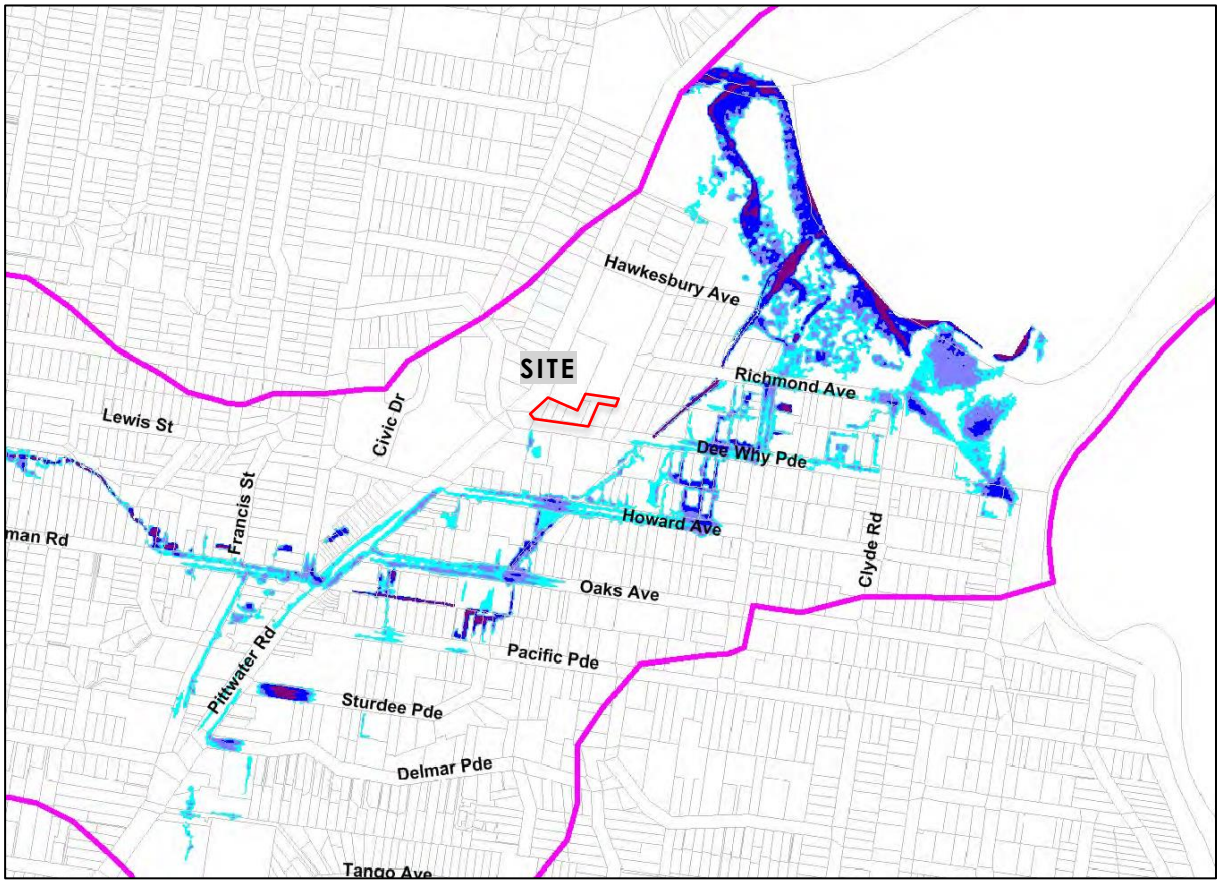


Figure 10 - Extract from Dee Why South Catchment Flood Study (Cardno, 2013) (Site bounded in red) - Figure 6-3 Design Event 0.1% AEP Peak Depth

1.4. PROPOSED DEVELOPMENT

The proposed development seeks to extend the existing seniors housing development to the south providing an additional 50 seniors housing units (and is subject to future DA) along with 700 square metres of ancillary facilities.

The existing access from Dee Why Parade to the basement car park will be maintained and a further basement carpark level is proposed below sharing the existing car park access.

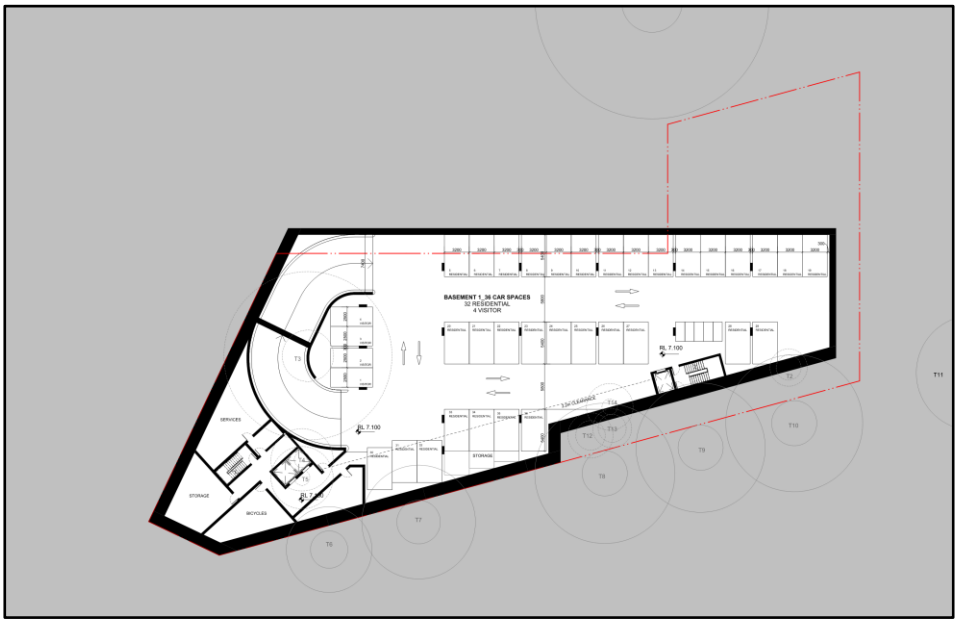


Figure 11 - Proposed basement plan (Marchese Partners)

A lower ground level is proposed to match the existing building comprising of the existing carpark access, utility area (comprising of an ambulance dock, waste collection and loading dock) and ancillary facilities for the development.

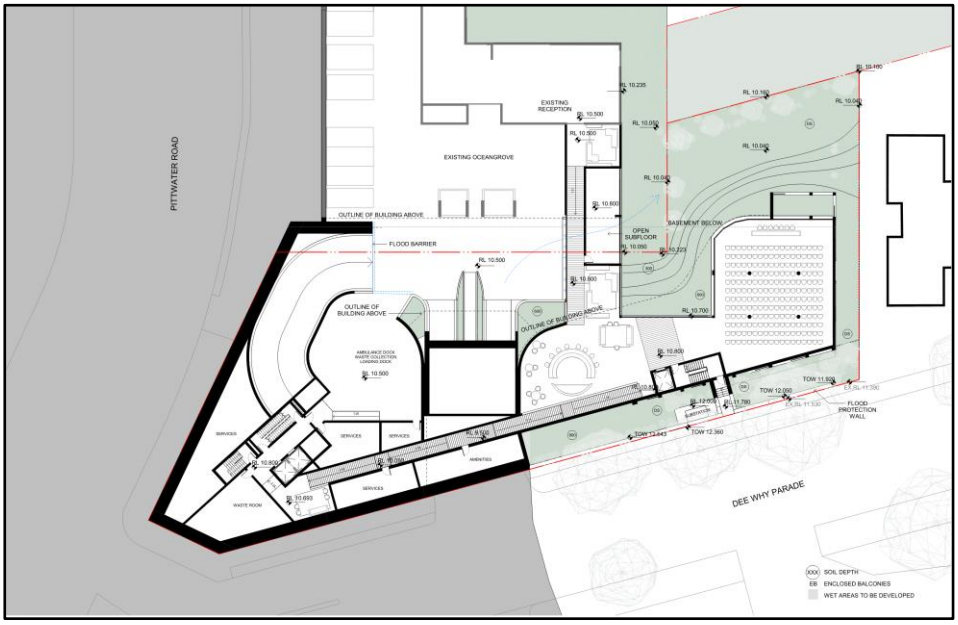


Figure 12 - Proposed lower ground floor plan (Marchese Partners)

The additional seniors housing units will be contained within two separate towers above adjacent to Pittwater Road and Dee Why Parade.

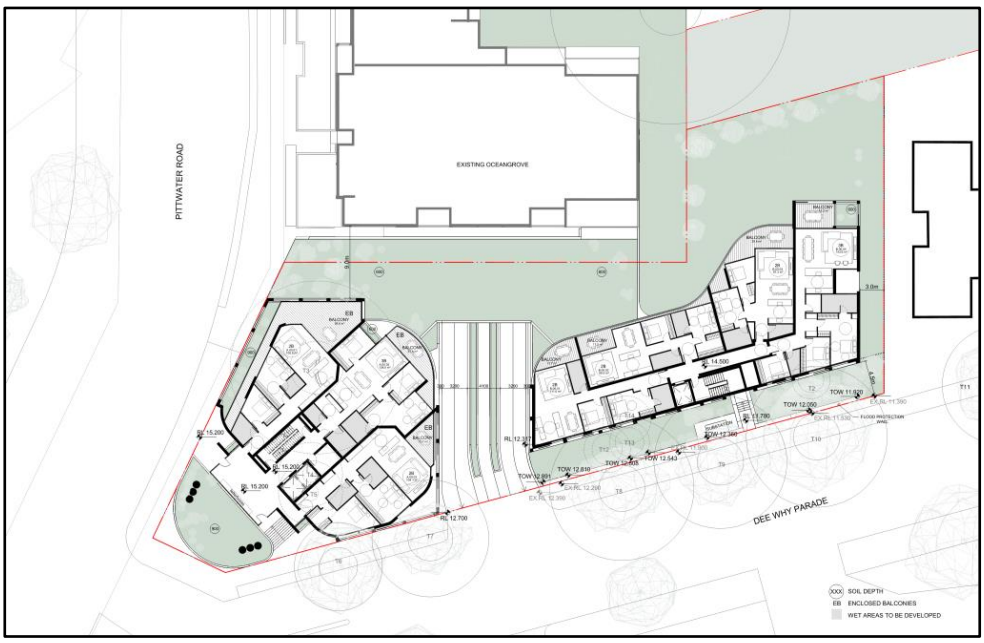


Figure 13 - Proposed Ground Floor Plan (Marchese Partners)

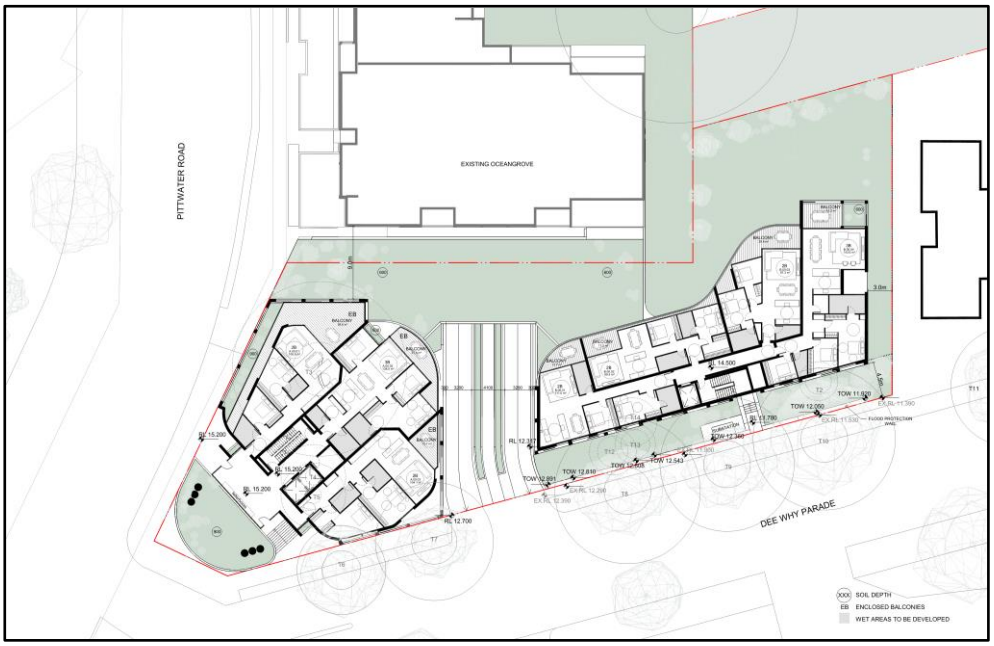


Figure 14 - Proposed upper levels floor plan (Marchese Partners)

2. FLOOD MODELLING

In accordance with Council's guidelines, the existing and proposed case flood behaviour was identified including flood depths, levels, and extents at the proximity of site for a range of flood events. A hydrological and hydraulic model has been developed as per the below methodology to assess the flood behaviour.

To assess the potential impact of overland flow on the subject site and the proposed development, a flood model was developed and calibrated to the Council issued flood levels. The flood model was used to determine any potential changes to flood behaviour and inform flood risk management measures to be incorporated into the development.

The flood modelling that has been undertaken includes the following:

- Prepare a hydrological model using 'Rain On Grid' TUFLOW model and DRAINS software,
- Prepare a 2D (2 dimensional) hydraulic model using TUFLOW software,
- Run flood model to prepare 1% AEP and PMF (Probable Maximum Flood) flood maps,
- Prepare flood mapping figures including flood depths, flood levels, flood velocity, flood hazard and flood impacts mapping,
- Comparison of 1% AEP pre and post peak flood levels to assess potential flood impacts to surrounding properties and the flood risk/levels applicable to the proposed development,
- Determine the flood and flood planning levels at site location, and,
- Assess flood risk at the development site and surrounding properties.

2.1. HYDROLOGICAL ANALYSIS

The hydrological component of the flood model was developed using the '**Rain-On-Grid**' approach to determine the peak flow rate and hydrograph within the overland flow path for input into the hydraulic model.

The catchment analysis found the size of the catchment to be approximately 4.1 hectares (ha). This was used to determine the rain-on grid area of the TUFLOW model with a buffer to determine the 2d domain to accurately represent flow routing within the catchment.

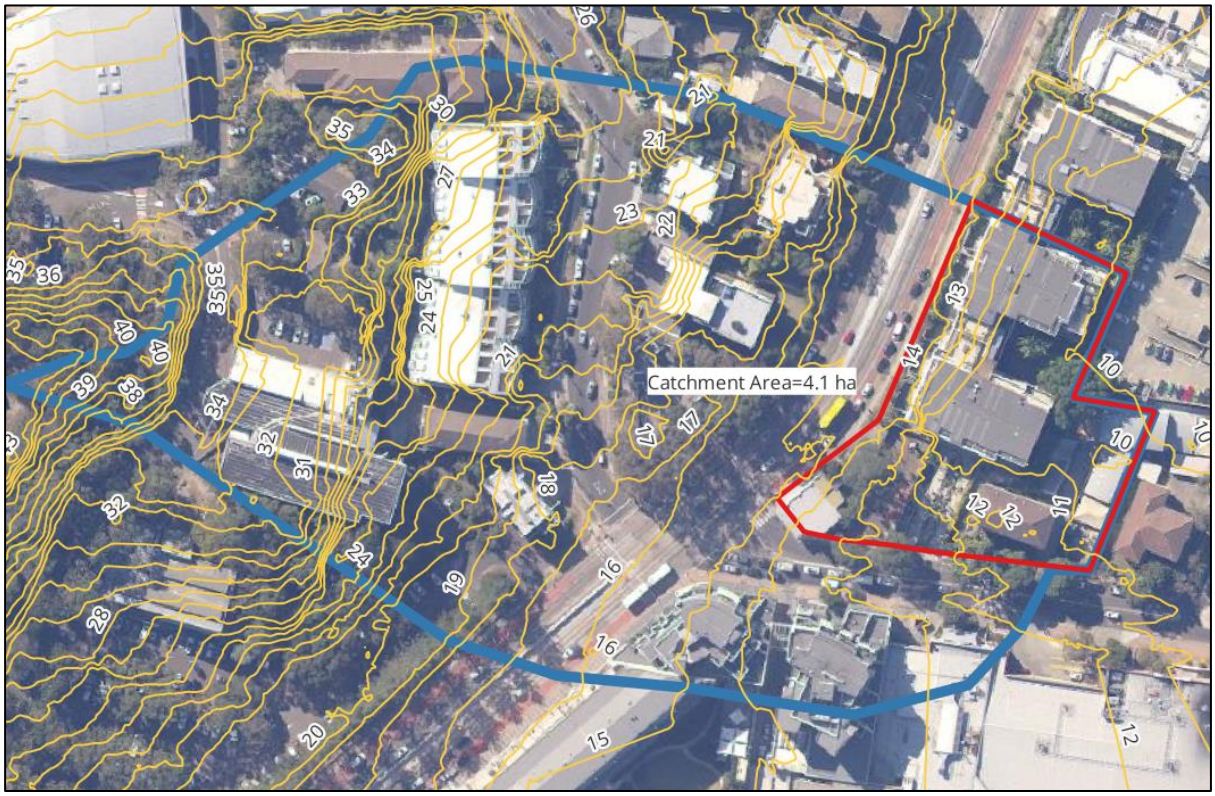


Figure 15 - Catchment Area

Design Rainfall Depths were sourced from the Australian Rainfall and Runoff (ARR) Data Hub used in the TUFLOW model.

A DRAINS model was also developed to determine the critical duration for the 1% AEP storm. The adopted DRAINS model parameters are provided below. The adopted values are overall consistent with the Dee Why South Catchment Flood Study Report (2013) adopted by Council.

- Initial Loss – Continuing Loss Type Hydrological Model
- Impervious Area Initial Loss - 0 mm
- Impervious Area Continuing Loss - 0 mm/hr
- Pervious Area Initial Loss - 10 mm
- Pervious Area Continuing Loss - 1 mm/hr

The 1% AEP critical storm duration was found to be 10 minutes which generated a peak flow of 1.4 m^3/s. The total flow hydrograph for the 1% AEP flood is provided below. The PMF flood has been run for several durations (15, 30, 45, 60 and 120 minutes) on the rain on grid model and critical duration is calculated as 15 minutes.

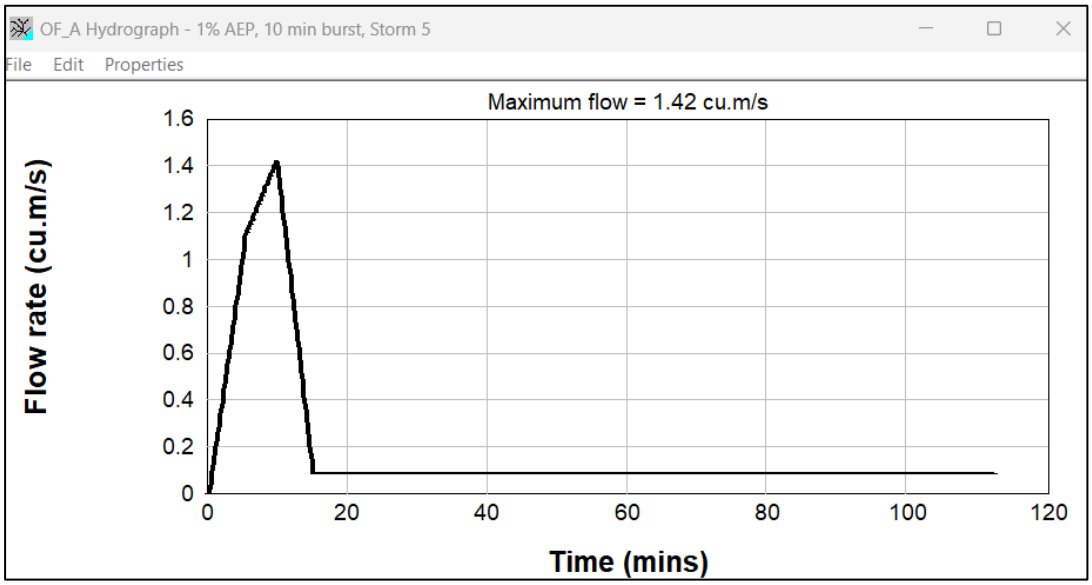


Figure 16 - DRAINS model hydrograph – 1% AEP Flow

2.2. HYDRAULIC ANALYSIS

To assess the potential impact of overland flow on the subject site, a two-dimensional hydraulic model was constructed using **TUFLOW** hydraulic modelling software. A two-dimensional analysis was undertaken, with blockages modelled with high roughness to reflect the building footprint in both the pre-development and post-development scenarios as well as the driveway extents in the post-development scenario.

The following parameters and assumptions were used in the hydraulic model:

2.2.1. 2D Domain

Council's flood study adopts a cell size of 2m, in this study the 2D hydraulic model was constructed with a one metre (1m) cell size for increased resolution and to be able to represent the flood behaviour in high detail. The model domain and roughness mapping is provided within Figure A2 of Appendix A.

The selected cell size is considered sufficient to represent the variations in catchment topography and land use within the study area. The topography has also been supplemented by site specific survey within the development with high resolution.

2.2.2. 1D Network

1D elements in the model were modelled with 100% blockage in including all pits and pipes within the catchment. This is a conservative approach, and it is likely to overestimate the flood levels and depths.

2.2.3. Building Footprints

The buildings within the site has been modelled consistent with Council's adopted flood study section 4.2.2 Buildings, the blockage to flow caused by building footprints has been modelled with their solid grid cells higher than the surrounding ground level. Other buildings within the

domain have been represented with high roughness. Building outlines were determined from aerial photographs and site survey and are shown in Figure A2.

2.2.4. Hydraulic Roughness

The following hydraulic roughness coefficients have been used in the model. The roughness values have been adopted from Dee Why South Catchment Flood Study Report (2013).

Land use classification	Roughness (Manning's 'n')
Road pavement/hardstand	0.02
Water/River Channels	0.012
Open pervious areas	0.06
Vegetation (medium)	0.06
Urban Residential	0.035

2.2.5. Boundary Conditions

A stage-discharge (water level vs flowrate) curve was imposed as the downstream boundary condition. This stage-discharge relationship was generated by TUFLOW by specifying a downstream boundary slope. The boundaries are located over 300m away from the site therefore to avoid any impacts at site location.

2.2.6. Depth Filter

Council's flood study employs a 150mm threshold for filtering results. If this threshold were applied on-site, it would not illustrate majority of the flow paths along the site. In order to demonstrate flood behaviour on a site-specific scale and with a more conservative approach, flood depths under 100mm have been filtered to differentiate between shallow and substantial flooding.

2.2.7. Model Results Comparison with Council Mapping

The TUFLOW model results match closely with Council's flood extents for the 1% AEP flood event. The TUFLOW result is likely to be more conservative and covers a slightly larger extent and generates small puddles in proximity of the site due to the higher resolution data.

The PMF flood extents comparison shows slight differences that are expected to occur due to adopting site survey, most up to date LIDAR information (Sydney202006-LID1-AHD_3406264_56_0002_0002_1m) higher resolution model results and the latest ARR2019 guidelines. However overall, the flood behaviour does not change, and the results are in good alignment with Council's adopted flood study.

The proposed development has been modelled using a 2D TUFLOW model which captures the existing and proposed storages in the floodplain. According to the comparison of pre and post conditions, there are no flood level increases and therefore no losses in flood storage. The 1% AEP Developed Case Flood Levels have been compared to the Existing Case Flood Levels refer to Figure A19- Flood Impacts Mapping.

2.3. FLOOD HAZARD

Flood hazard has been assessed using both the provisional flood hazard method described in the NSW Floodplain Development Manual (2005) and the hazard vulnerability classification method described in the 2019 ARR Guidelines.

2.3.1. Provisional Flood Hazard Category

As outlined in the Floodplain Development Manual (NSW DIPNR 2005), provisional flood hazard for the subject site has been determined using hydraulic hazard (see Figure L2 below) and the following factors:

- Size of flood
- Duration of flooding
- Flood awareness
- Type of development
- Effective warning time
- Rate of rise of floodwater
- Evacuation problems
- Effective flood access

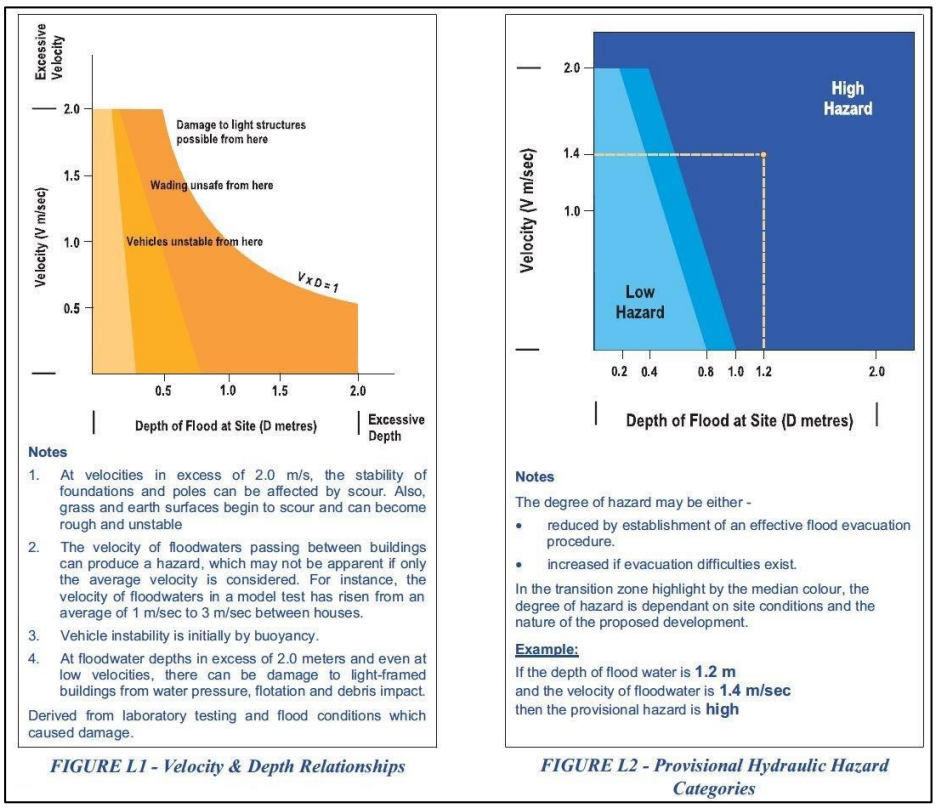


Figure 17 - Provisional flood hazard categories (NSW Floodplain Development Manual, 2005)

Provisional Hazard can be classified as being high, intermediate or low hazard.

in the 1% AEP flood event, no flood hazard is expected in pre or post development conditions (as shown in Figures A5 & A13 in Appendix A).

In the PMF event, flows within the subject site in pre-development conditions are predominantly no to low hazard (as shown in Figure A9 in Appendix A).

In post-development conditions, similar hazard conditions are maintained (as shown in Figure A17 in Appendix A).

2.3.2. Hazard Vulnerability Category

Hazard Vulnerability Classification is a function of hydraulic hazard (relating to the depth and velocity of floodwaters) and takes into account the vulnerability of the community and community assets to damage or danger when interacting with floodwaters.

Hazard Vulnerability Classifications are determined based on the guidelines provided in 'Technical flood risk management guidelines: Flood hazard' (Attorney-General's Department 2014) and in particular Figure 6.

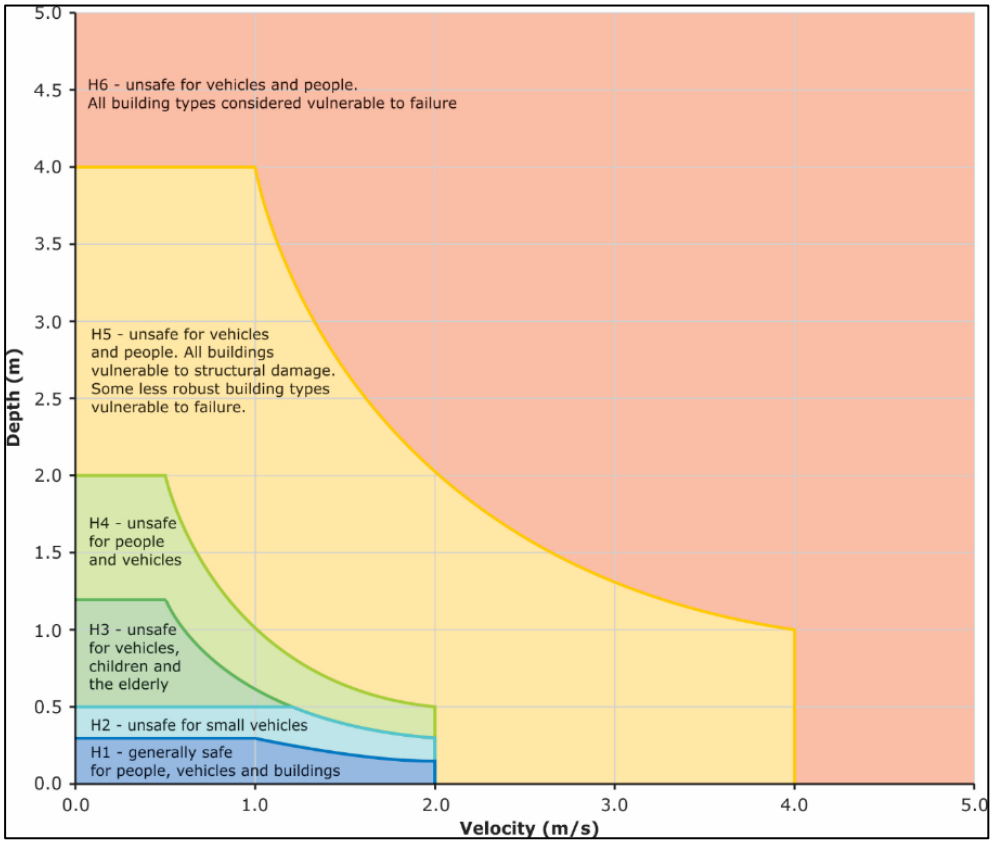


Figure 18 - Combined Flood Hazard Curves (ARR Guidelines, 2019)

in the 1% AEP flood event, no flood hazard is expected in pre or post development conditions (as shown in Figures A6 & A14 in Appendix A).

In the PMF event, flows within the subject site in pre-development conditions are predominantly no to low hazard (as shown in Figure A10 in Appendix A).

In post-development conditions, similar hazard conditions are maintained (as shown in Figure A18 in Appendix A).

2.4. FLOOD RESULTS & LEVEL RECOMMENDATIONS

The site is not affected in the 1% AEP flood event.

PMF floodwaters within the subject site are expected to reach depths between 0.1m to 0.5m. Velocities are expected to be generally less than 1.0m/s.

Provided appropriate flood risk management measures are implemented and followed, the PMF floodwaters create conditions which generally not pose an intolerable level of risk to people and vehicles.

The water level, depth, velocity and hazard of the 1% AEP and PMF floodwaters in the vicinity of the subject site were mapped for both pre- and post-development scenarios. The following maps are enclosed under **Appendix A**:

- Figure A1: Catchment Mapping
- Figure A2: TUFLOW Model Boundaries and Roughness Mapping
- Figure A3: 1% AEP pre-development flood depth & level map
- Figure A4: 1% AEP pre-development flood velocity map
- Figure A5: 1% AEP pre-development provisional flood hazard map
- Figure A6: 1% AEP pre-development hazard vulnerability classification map
- Figure A7: PMF pre-development flood depth & level map
- Figure A8: PMF pre-development flood velocity map
- Figure A9: PMF pre-development provisional flood hazard map
- Figure A10: PMF pre-development hazard vulnerability classification map
- Figure A11: 1% AEP post-development flood depth & level plan
- Figure A12: 1% AEP post-development flood velocity plan
- Figure A13: 1% AEP post-development provisional flood hazard plan
- Figure A14: 1% AEP post-development hazard vulnerability classification plan
- Figure A15: PMF post-development flood depth & level map
- Figure A16: PMF post-development flood velocity map
- Figure A17: PMF post-development provisional flood hazard map
- Figure A18: PMF post-development hazard vulnerability classification map
- Figure A19: 1% AEP flood level difference map

3. FLOOD PLANNING CONTROLS – PRE-LODGEMENT MEETING REQUIREMENTS

We refer to the pre-lodgement meeting notes part 4.4.2 which provides assessment requirements to be considered for the submission.

NSW Department of Planning and Environment – Environment and Heritage Group

(a) Detailed flood assessment needs to consider:
- *i. Modelling impacts of proposed development on flood behaviour and flood risk to the existing community*
- *ii. Impacts and risk of flooding on the development and its future users.*
- *iii. How impacts can be managed to minimize growth in risk to the community due to the development.*
- *iv. Emergency response issues and required management measures for the full range of flooding. Referred to SES – unlikely to support shelter in place*
- *v. Refer to the draft Flood Impact and Risk Assessment Guide previously exhibited as part of the Floodplain Development Manual Update for comprehensive guidance. Comprehensive guidance for the flood assessment*

(b) Noted proposal to construct apartments below ground level as problematic given PMF may exceed 0.5m in Dee Why Pde.

Triaxial's flood analysis demonstrates that the site is not inundated with overland flows from upstream catchments, with majority of the overland flow occurring within Dee Why Parade and Clarence Avenue.

There is negligible downstream and adjoining lot affectation from the proposed development and paths of flow have not been varied due to the proposed development.

We refer to the Flood Planning Controls by Northern Beaches Council which has adopted the relevant considerations by NSW Department of Planning and Environment.

NSW State Emergency Service

(a) Access to basement must be above the Probably Maximum Flood (PMF)

(b) Ensure buildings are designed for potential flood and debris loadings

(c) Flood study –
- *i. Should consider the full range of flooding*
- *ii. Risk assessment should have regard to flood warning and evacuation demand on existing and future access/egress routes. Self-evacuation of the community should be achievable in a manner consistent with SES principles. Evacuation must not require people to walk or drive through flood water.*
- *iii. Recommend that parking is investigated further to ensure this will not be a risk, particularly to access and egress during a flood.*

(d) Car parking should be above ground level to facilitate safe and effective vehicular evacuation and have pedestrian access to a podium level above PMF to increase safety.

(e) Make buildings as safe as possible to occupy during flood events and provide adequate services so people are less likely to enter flood waters – including ablutions, water, power and basic first aid equipment. On-site systems to provide power, water and sewerage during an outage.

Due to the site access constraints relating to accessibility to the existing carpark on 8 Dee Why Parade, Dee Why, the adopted approach to the proposed development will be for the installation of a flood barrier to maintain the additional freeboard requirements to the Probable Maximum Flood.

Whilst we refer to the flood planning controls by Northern Beaches Council refer to a shelter-in-place strategy for consideration, I note the SES do not adopt a similar policy, however, due to the flood duration of the Probable Maximum Flood being in the order of 30 minutes of inundation below the habitable area, and with the development being within a flash flooding region it is likely that preparations required to evacuate take longer than the flood duration itself.

Notwithstanding the above, evacuation from the site can be considered to Pittwater Road where during the PMF there is partial inundation confined to local areas up to a H1 hazard. (Refer Figure A18)

4. FLOOD PLANNING CONTROLS – NORTHERN BEACHES COUNCIL

Flood related development controls are listed in the Section E11 Flood Prone Land of the Warringah DCP 2011.

Seniors housing is classed as a 'vulnerable and critical use' and the following flood development controls apply.

A table identifying whether the proposed development complies with these controls is presented below and demonstration of compliance is detailed in Section 3.1 to 3.8 of this report.

Flood development control compliance table

	Control	Particulars	Complies?
A	Flood effects caused by development	A1, A2	Yes
B	Building Components & Structural	B1, B2, B3	Can comply
C	Floor Levels	C2, C3	Can Comply
D	Car Parking	D1, D2, D3, D4, D7	Yes, Can Comply
E	Emergency Response	E1, E2	Can comply
F	Fencing	F1	Can comply
G	Storage of Goods	G1	Can comply
H	Pools	H1	N/A

4.1. FLOOD EFFECTS CAUSED BY DEVELOPMENT

	Control	Response	Complies?
A1	Development shall not be approved unless it can be demonstrated in a Flood Management Report that it has been designed and can be constructed so that in all events up to the 1% AEP event: a) There are no adverse impacts on flood levels or velocities caused by alterations to the flood conveyance; and b) There are no adverse impacts on surrounding properties; and c) It is sited to minimise exposure to flood hazard.	Pre and post development conditions were modelled using TUFLOW. Mapping in Appendix A demonstrates no significant adverse flood impacts is expected as a result of the development.	Yes

	Major developments and developments likely to have a significant impact on the PMF flood regime will need to demonstrate that there are no adverse impacts in the Probable Maximum Flood.		
A2	Development shall not be approved unless it can be demonstrated in a Flood Management Report that in all events up to the 1% AEP event there is no net loss of flood storage. Consideration may be given for exempting the volume of standard piers from flood storage calculations. If Compensatory Works are proposed to balance the loss of flood storage from the development, the Flood Management Report shall include detailed calculations to demonstrate how this is achieved.	Pre and post development conditions were modelled using TUFLOW. Mapping in Appendix A demonstrates no significant loss of flood storage is expected as a result of the development.	Yes

4.2. BUILDING COMPONENTS & STRUCTURAL

	Control	Response	Complies?
B1	All buildings shall be designed and constructed with flood compatible materials in accordance with "Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas", Hawkesbury-Nepean Floodplain Management Steering Committee (2006).	The development would comply provided flood compatible materials are specified for all building elements subject to flooding in the PMF event. This can also be detailed at the CC stage.	Can comply
B2	All new development must be designed and constructed to ensure structural integrity up to the Flood Planning Level, taking into account the forces of floodwater, wave action, flowing water with debris, buoyancy and immersion. Where shelter-in-place refuge is required, the structural integrity for the refuge is to be up to the Probable Maximum Flood level. Structural certification shall be provided confirming the above.	The structural design of the building will need to allow for potential forces of floodwater, wave action, flowing water with debris, buoyancy and immersion up to the PMF event to ensure the structural adequacy of the building to act as a place of refuge in the PMF event. This can be detailed at the CC stage.	Can comply
B3	All new electrical equipment, power points, wiring, fuel lines, sewerage	The development would comply provided	Can comply

	systems or any other service pipes and connections must be waterproofed and/or located above the Flood Planning Level. All existing electrical equipment and power points located below the Flood Planning Level within the subject structure must have residual current devices installed that turn off all electricity supply to the property when flood waters are detected.	waterproofing measures are carried out on any services and conduits located below the PMF level. Critical infrastructure to keep the building serviced in the PMF event will also need to be considered. This can be detailed at the CC stage.	

4.3. FLOOR LEVELS

	Control	Response	Complies?
C2	All floor levels within the development shall be at or above the Probable Maximum Flood level or Flood Planning Level, whichever is higher.	**Lower Ground Level** • FFL to be at 10.8m • Provide allowance for flood flows under connection to existing building from basement car park entrance to village green • See Figure 19 below • Flood gates to be provided to new low-level carpark areas. **Upper Ground Level** • OK to retain FFL of 15.2m to Building A • OK to retain FFL of 14.5m to Building B • Both will be above PMF levels	Can Comply
C3	All new development must be designed and constructed so as not to impede the floodway or flood conveyance on the site, as well as ensuring no net loss of flood storage in all events up to the 1% AEP event. For suspended pier/pile footings: a) The underfloor area of the dwelling below the 1% AEP flood level is to be designed and constructed to allow clear passage of floodwaters, taking	See notes for lower ground level	Can Comply

	into account the potential for small openings to block; and b) At least 50% of the perimeter of the underfloor area is of an open design from the natural ground level up to the 1% AEP flood level; and c) No solid areas of the perimeter of the underfloor area would be permitted in a floodway		

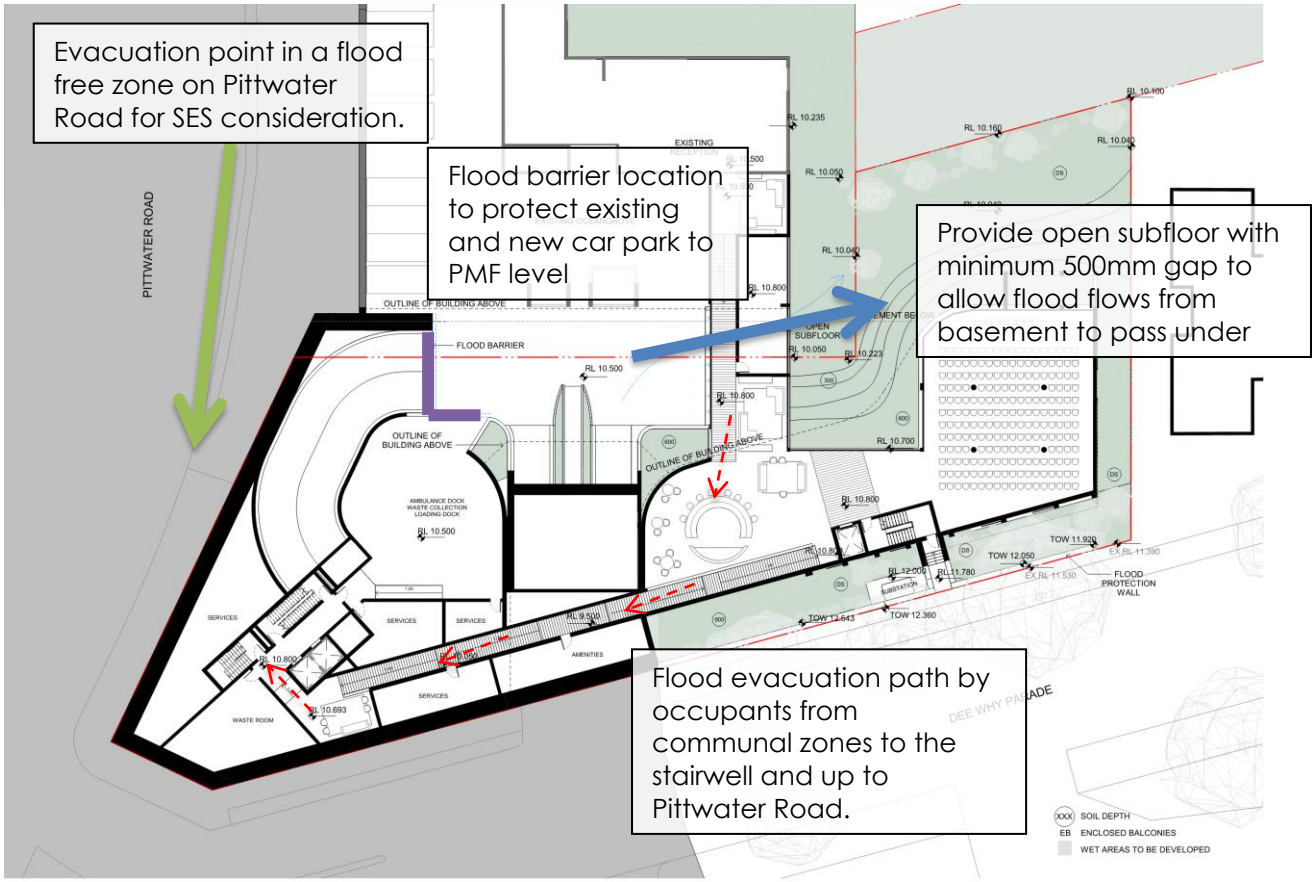


Figure 19 - Concept PMF flood mitigation measures - lower ground floor level

4.4. CAR PARKING

	Control	Response	Complies?
D1	Open carpark areas and carports shall not be located within a floodway.	All car parking areas will be located within the basement levels which will be protected up to and including PMF levels.	Yes
D2	The lowest floor level of open carparks and carports shall be constructed no lower than the natural ground levels, unless it can be shown that the carpark	No open car parks are proposed. Car parking will be located within basement levels which will be protected up to and including PMF levels.	N/A

	or carport is free draining with a grade greater than 1% and that flood depths are not increased.		
D3	Carports must be of open design, with at least 2 sides completely open such that flow is not obstructed up to the 1% AEP flood level. Otherwise it will be considered to be enclosed. When undertaking a like-for-like replacement and the existing garage/carport is located on the street boundary and ramping is infeasible, consideration may be given for dry floodproofing up to the 1% AEP flood level.	No carports are proposed. Car parking will be located within basement levels which will be protected up to and including PMF levels.	N/A
D4	Where there is more than 300mm depth of flooding in a car park or carport during a 1% AEP flood event, vehicle barriers or restraints are to be provided to prevent floating vehicles leaving the site. Protection must be provided for all events up to the 1% AEP flood event	Car parking will be located within basement levels which will be protected up to and including PMF levels. An automatic deploying flood barrier to prevent inundation from floodwaters up to and including the PMF event will be provided.	Yes
D7	All enclosed car parks must be protected from inundation up to the Probable Maximum Flood level or Flood Planning Level whichever is higher. For example, basement carpark driveways must be provided with a crest at or above the relevant Probable Maximum Flood level or Flood Planning Level whichever is higher. All access, ventilation and any other potential water entry points to any enclosed car parking shall be at or above the relevant Probable Maximum Flood level or Flood Planning Level whichever is higher.	It is proposed to provide protection to the new basement car parking levels with an automatic deploying flood barrier to prevent inundation from floodwaters up to and including the PMF event. This will need to be shown on the architectural plans. Flooding Solutions is a local supplier of such flood barriers. *Flooding Solutions* *Phone: (02) 9904 7099* *Email: info@floodingsolutions.com.au* *Website:* *https://www.floodingsolutions.com.au/*	Can Comply

4.5. EMERGENCY RESPONSE

	Control	Response	Complies?
E1	*If the property is affected by a Flood Life Hazard Category of H3 or higher, then Control E1 applies and a Flood Emergency Assessment must be included in the Flood Management Report.* *If the property is affected by a Flood Life Hazard Category of H6, then development is not permitted unless it can be demonstrated to the satisfaction of the consent authority that the risk level on the property is or can be reduced to a level below H6 or its equivalent.* *If the property is flood affected but the Flood Life Hazard Category has not been mapped by Council, then calculations for its determination must be shown in the Flood Management Report, in accordance with the "Technical Flood Risk Management Guideline: Flood Hazard", Australian Institute for Disaster Resilience (2012).* Where flood-free evacuation above the Probable Maximum Flood level is not possible, new development must provide a shelter-in-place refuge where: a) The floor level is at or above the Probable Maximum Flood level; and b) The floor space provides at least 2m^2 per person where the flood duration is long (6 or more hours) in the Probable Maximum Flood event, or 1m^2 per person for less than 6 hours; c) It is intrinsically accessible to all people on the site, plainly evident, and self-directing, with sufficient capacity of access routes for all occupants without reliance on an elevator; and d) It must contain as a minimum: sufficient clean water for all occupants; portable radio with spare batteries;	Flood hazard in the PMF event is predominantly H1 with some areas of H2 in both Council's mapping and the TUFLOW model. (See Figures A10 & A18 in Appendix A). As the flooding affected the site is caused by overland flow, only very limited warning time is available and flooding is typically of a short duration. It is considered that evacuation off site for this development may not necessarily reduce the flood risk to occupants and access to essential services (such as police, fire and Northern Beaches hospital) would be limited and also isolated due to flooding in Pittwater Road and Dee Why Parade. Therefore, shelter-in-place is considered to be a viable option to mitigate the flood risk to the development and its occupants. The ancillary facilities located on the lower ground level will have a finished floor level above the PMF flood level (once amended) and would meet the minimum requirement of 2m^2 per person (assuming 2 people per unit x 50 units). As the development is a managed facility with staff, trained staff will be tasked with managing the flood response.	Can comply

	torch with spare batteries; and a first aid kit Class 10 classified buildings and structures (as defined in the Building Codes of Australia) are excluded from this control. In the case of change of use or internal alterations to an existing building, a variation to this control may be considered if justified appropriately by a suitably qualified professional. Note that in the event of a flood, occupants would be required to evacuate if ordered by Emergency Services personnel regardless of the availability of a shelter-in-place refuge.	A further detailed flood emergency and evacuation plan can be formulated prior to the issue of the Occupation Certificate. Further to the requirements set out, additional items such as medical and support services can be made available in the short duration flash flooding events.	
E2	If a shelter-in-place refuge is required, it must contain as a minimum: sufficient clean water for all occupants; portable radio with spare batteries; torch with spare batteries; a first aid kit; emergency power; and a practical means of medical evacuation.	See above	Can comply

4.6. FENCING

	Control	Response	Complies?
F1	Fencing, (including pool fencing, boundary fencing, balcony balustrades and accessway balustrades) shall be designed so as not to impede the flow of flood waters and not to increase flood affectation on surrounding land. At least 50% of the fence must be of an open design from the natural ground level up to the 1% AEP flood level. Less than 50% of the perimeter fence would be permitted to be solid. Openings should be a minimum of 75 mm x 75mm.	Any fencing detailed on the plans will need to be of an open style complying with the requirements of this control.	Can comply

4.7. STORAGE OF GOODS

	Control	Response	Complies?
G1	Hazardous or potentially polluting materials shall not be stored below the Flood Planning Level unless adequately protected from floodwaters in accordance with industry standards.	Storage can be provided above the PMF level or within areas protected to the PMF level.	Can comply

4.8. POOLS

	Control	Response	Complies?
H1	Pools located within the 1% AEP flood extent are to be in-ground, with coping flush with natural ground level. Where it is not possible to have pool coping flush with natural ground level, it must be demonstrated that the development will result in no net loss of flood storage and no impact on flood conveyance on or from the site. All electrical equipment associated with the pool (including pool pumps) is to be waterproofed and/or located at or above the Flood Planning Level. All chemicals associated with the pool are to be stored at or above the Flood Planning Level.	N/A	N/A

5. CONCLUSION

The site is not affected in the 1%, 0.5% and 0.1% AEP flood events. Council's flood model for the PMF was not considered to be representative of current site conditions and supplementary modelling was carried out by Triaxial Consulting using DRAINS and TUFLOW software. The results of the modelling indicated that the site's affectation by PMF floodwater is limited and of low hazard. Therefore, the PMF flood is unlikely to pose an intolerable flood risk to the development provided the flood risk management measures recommended in this report are followed.

This report sets out the necessary requirements to address the flood risks associated with the proposed development, and based on the information provided, I am of the opinion that I have been provided with the necessary information to formulate my findings in this report, including acceptability proposed land-use and density.

It is recommended that the following measures are incorporated into the plans moving forward:

1. Raise FFL of lower ground level to 10.8m AHD.
2. Provide an open subfloor for flood flows under the connection to the existing building from basement car park entrance to village green.
3. Provide protection to the new basement car parking levels with an automatic deploying flood barrier to prevent inundation from floodwaters up to and including the PMF event.
4. All building materials specified below the ground floor FFLs to be 'flood compatible' – see Appendix E.
5. Ensure ancillary facilities on lower ground floor level provide at least $2m^2$ of floor space per person for the expected population of the development and sufficient amenities such as drinking water and toilets as per the shelter-in-place requirements of Northern Beaches Council.
6. An evacuation path from the proposed buildings has been provided in order to support the SES proposal where shelter-in-place is not supported.

6. REFFERENCES

- Australian Rainfall and Runoff: A Guide to Flood Estimation (2019), Commonwealth of Australia (Geoscience Australia).
- NSW Floodplain Development Manual (April 2005), Department of Infrastructure, Planning and Natural Resources.
- Warringah Local Environmental Plan (LEP) 2011,
- Warringah Development Control Plan (DCP) 2011,
- Northern Beaches Council Water Management for Development Policy, Version 1, dated 26 August 2020.
- Dee Why South Catchment Flood Study 2013, Cardno.
- Dee Why South Catchment Flood Risk Management Study, Cardno.
- Dee Why South Catchment Flood Risk Management Plan, Cardno.

7. GLOSSARY

Terminology in this Glossary has been derived or adapted from the Floodplain Development Manual (NSW DIPNR 2005), where appropriate.

Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, expressed as a percentage.
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to sea level.
Average Recurrence Interval (ARI)	The long-term average number of years between the occurrence of a flood as big as or larger than the selected event.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from superelevated sea levels and/or waves overtopping coastline defences excluding tsunami.
Flood Fringe Areas	The remaining area of the flood-prone land after floodway and flood storage areas have been defined.
Flood Hazard	A measure of the floodwaters potential to cause harm or loss. Full definitions of hazard categories are provided in Appendix L of the Floodplain Development Manual (NSW Government, 2005).
Flood Planning Area	The area of land below the FPL and subject to flood related development controls.
Flood Planning Levels (FPLs)	Combinations of flood levels (derived from significant historical flood events or floods of specific ARIs) and freeboard selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans.
Flood Proofing	A combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding, to reduce or eliminate flood damages.

Flood Risk	Potential danger to personal safety and potential damage to property resulting from flooding.
Floodplain	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land.
Floodplain Risk Management Options	The measures that might be feasible for the management of a particular area of the floodplain.
Flood Prone Land	Land susceptible to flooding by the PMF event.
Flood Storage Areas	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation.
Floodway Areas	Those areas of the floodplain where a significant discharge of waters occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.
Freeboard	Provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the FPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels etc. (see Section K5 of Floodplain Development Manual).
Habitable Room	In a residential situation: a living or working area, such as lounge room, dining room, rumpus room, kitchen, bedroom or workroom. In a commercial situation: an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.
Hazard	A source of potential harm or a situation with a potential to cause loss.
Hydraulics	The term given to the study of water flow in a river, channel or pipe, in particular, the evaluation of flow parameters such as stage and velocity.
Hydrograph	A graph that shows how the discharge changes with time at any particular location.

Hydrology	The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
Local Overland Flooding	Inundation by local runoff rather than overbank discharge from a stream, river, estray, lake or dam.
Mainstream Flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estray, lake or dam.
Peak Discharge	The maximum discharge occurring during a flood event.
Probable Maximum Flood (PMF)	The PMF is the largest flood that could conceivably occur at a particular location.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood.
Runoff	The amount of rainfall that actually ends up as stream or pipe flow, also known as rainfall excess.

APPENDIX A – FLOOD MODELLING RESULTS

Figure A1- Catchment Mapping

Figure A2- TUFLOW Model Boundaries and Roughness Mapping

Figure A3- Existing Conditions 1% AEP Flood Depth and Levels

Figure A4- Existing Conditions 1% AEP Flood Velocity

Figure A5- Existing Conditions
1% AEP Flood Hazard (FDM, 2005)

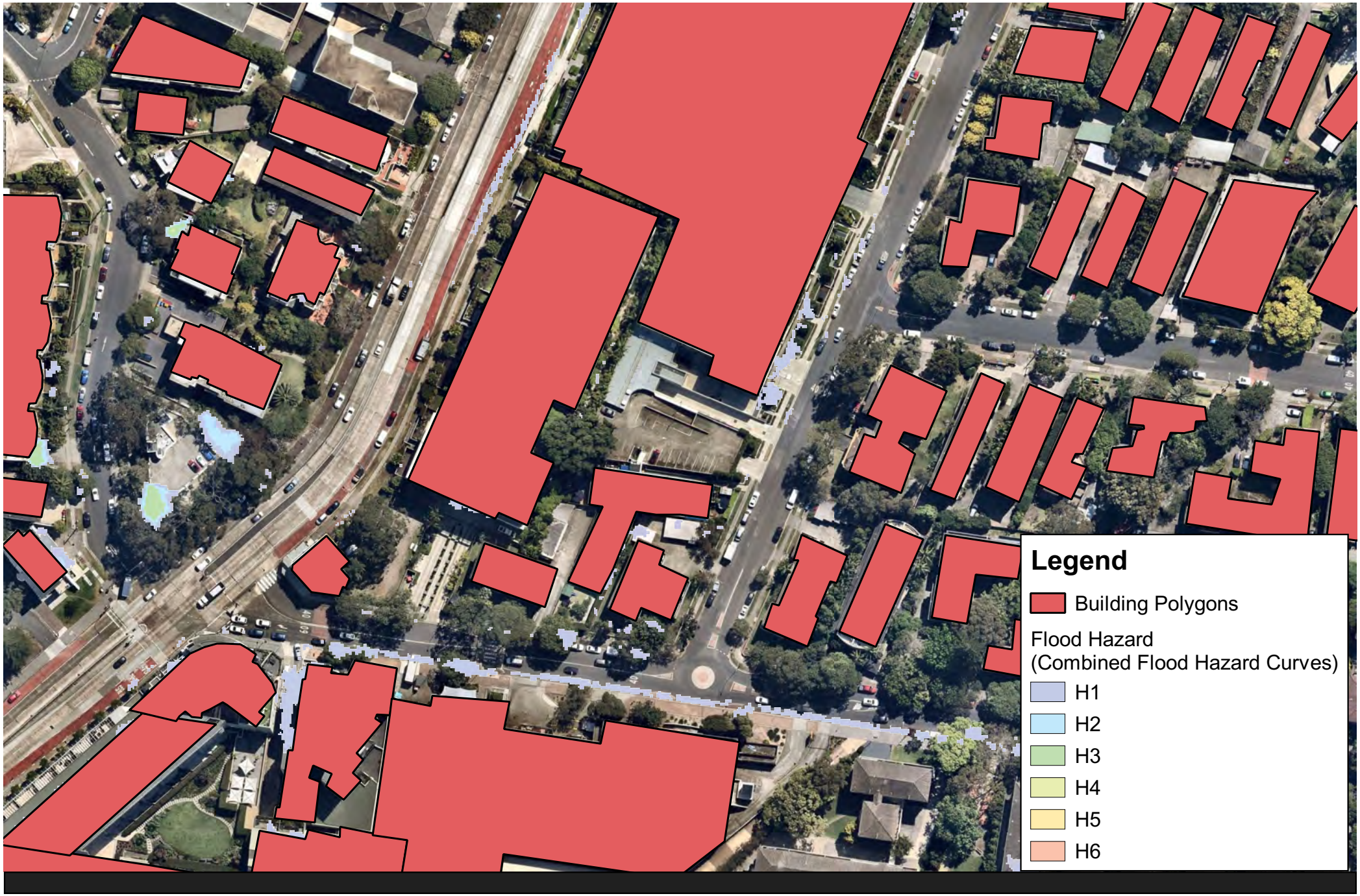
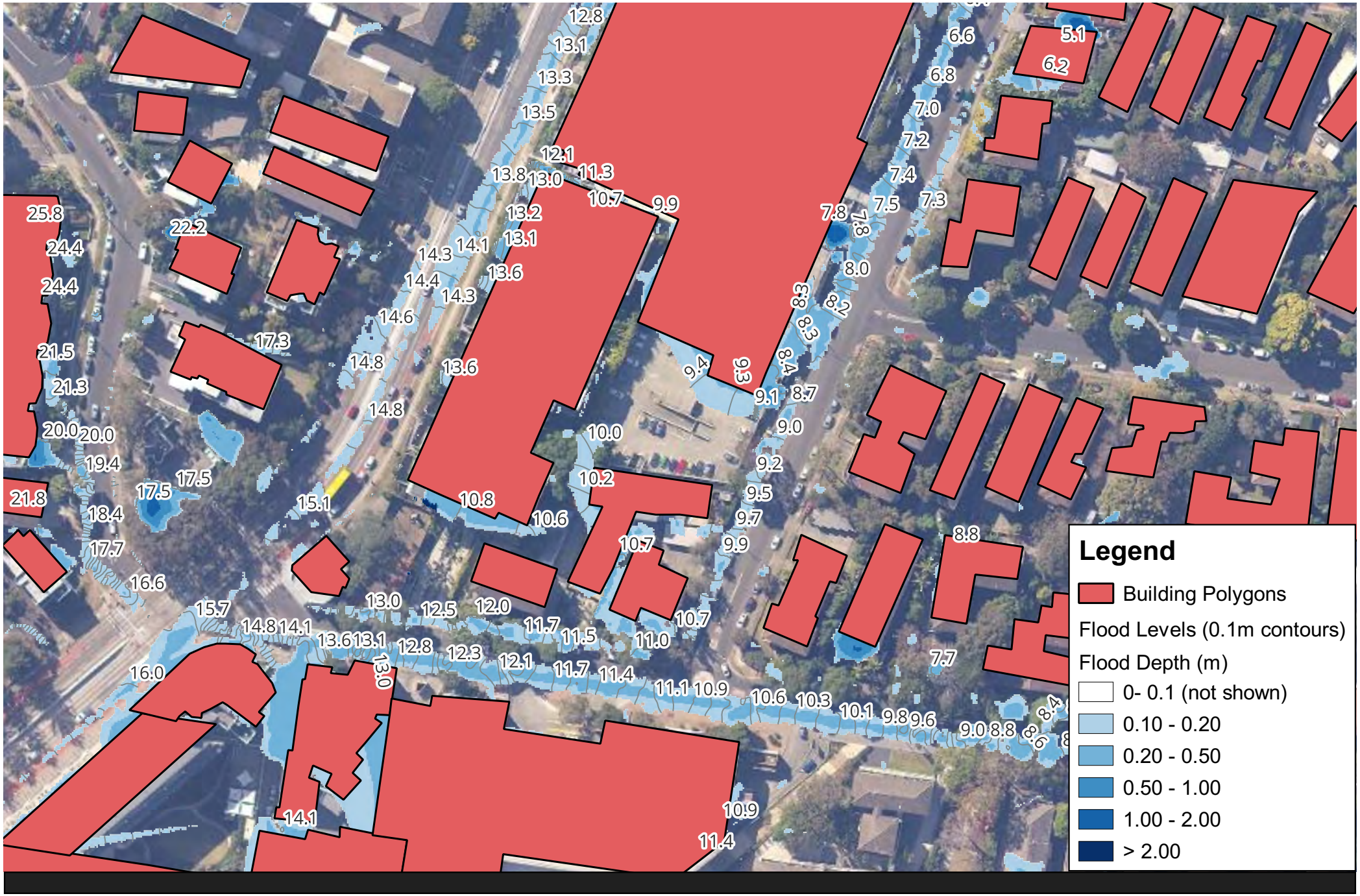


Figure A6- Existing Conditions 1% AEP Flood Hazard (Combined Flood Hazard Curves, H1-H6)



Date
14/10/2023

Figure A7- Existing Conditions PMF Flood Depths and Levels

Date
14/10/2023

Figure A8- Existing Conditions PMF Flood Velocity

Figure A9- Existing Conditions PMF Flood Hazard (FDM, 2005)

Figure A10- Existing Conditions PMF Flood Hazard (Combined Flood Hazard Curves, H1-H6)

Figure A11- Proposed Conditions 1% AEP Flood Depths and Levels

Figure A12- Proposed Conditions 1% AEP Flood Velocity

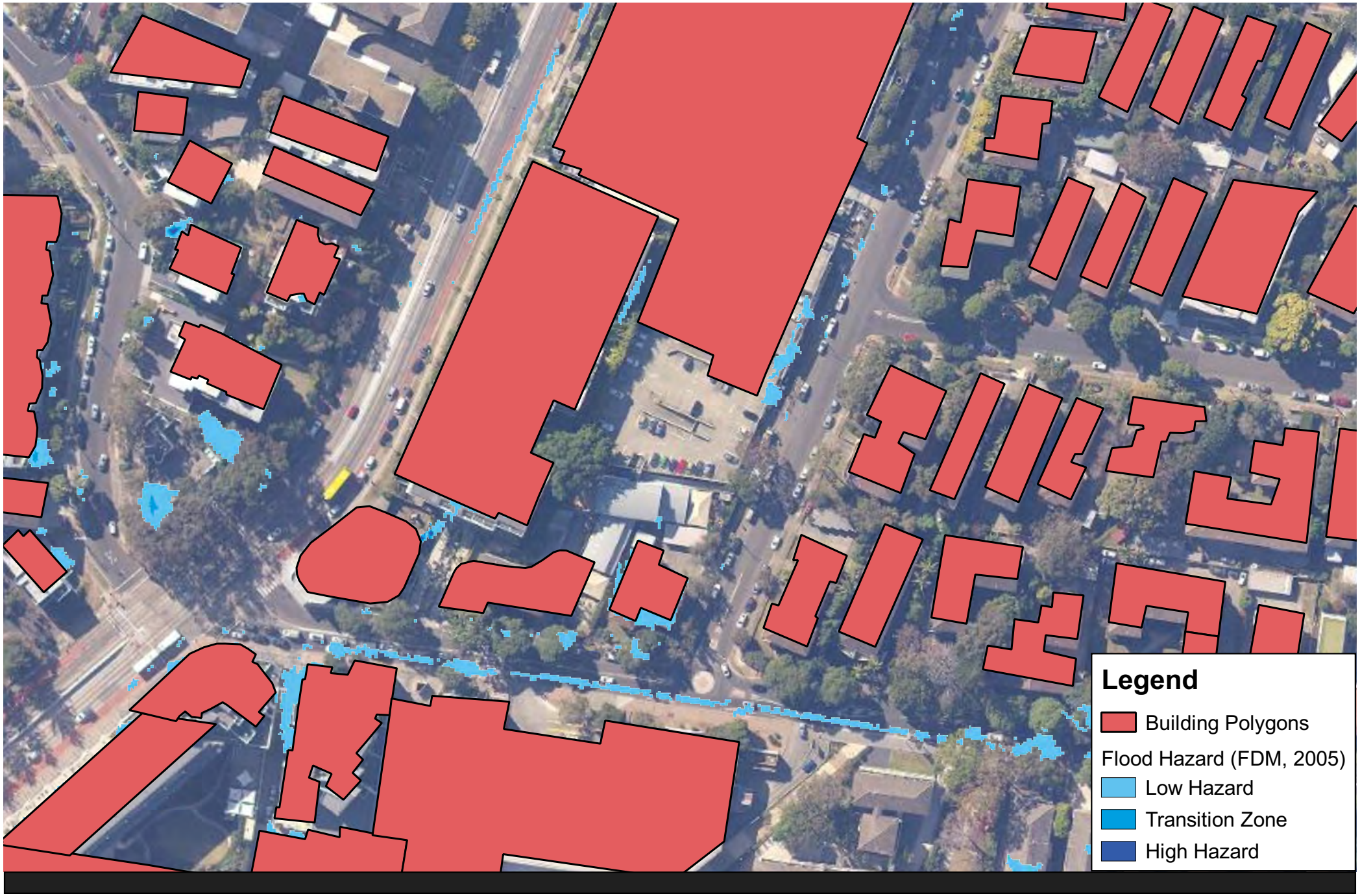


Figure A13- Proposed Conditions 1% AEP Flood Hazard (FDM, 2005)

Figure A14- Proposed Conditions 1% AEP Flood Hazard (Combined Flood Hazard Curves, H1-H6)

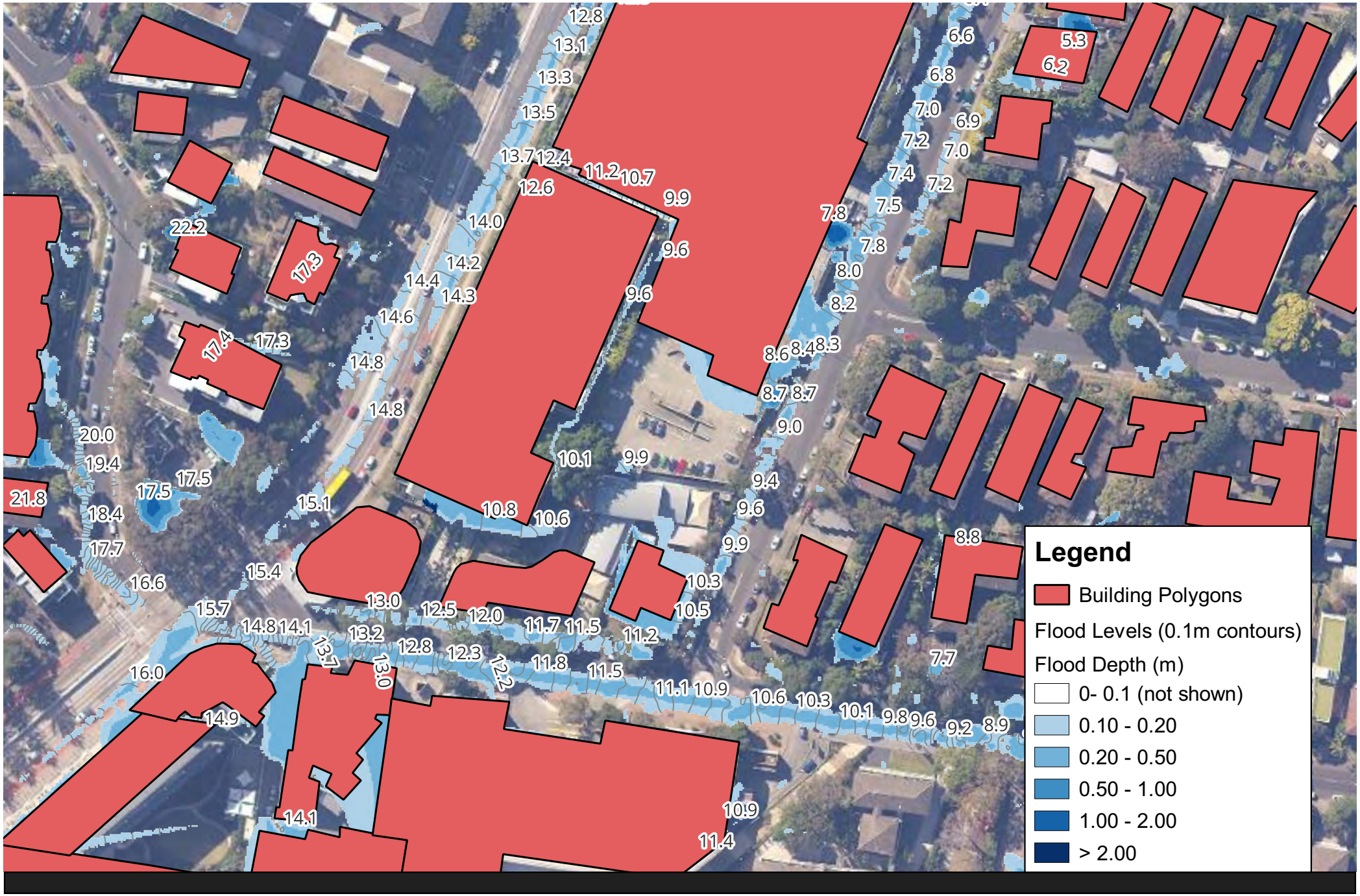


Figure A15- Proposed Conditions PMF Flood Depths and Levels

Figure A16- Proposed Conditions PMF Flood Velocity

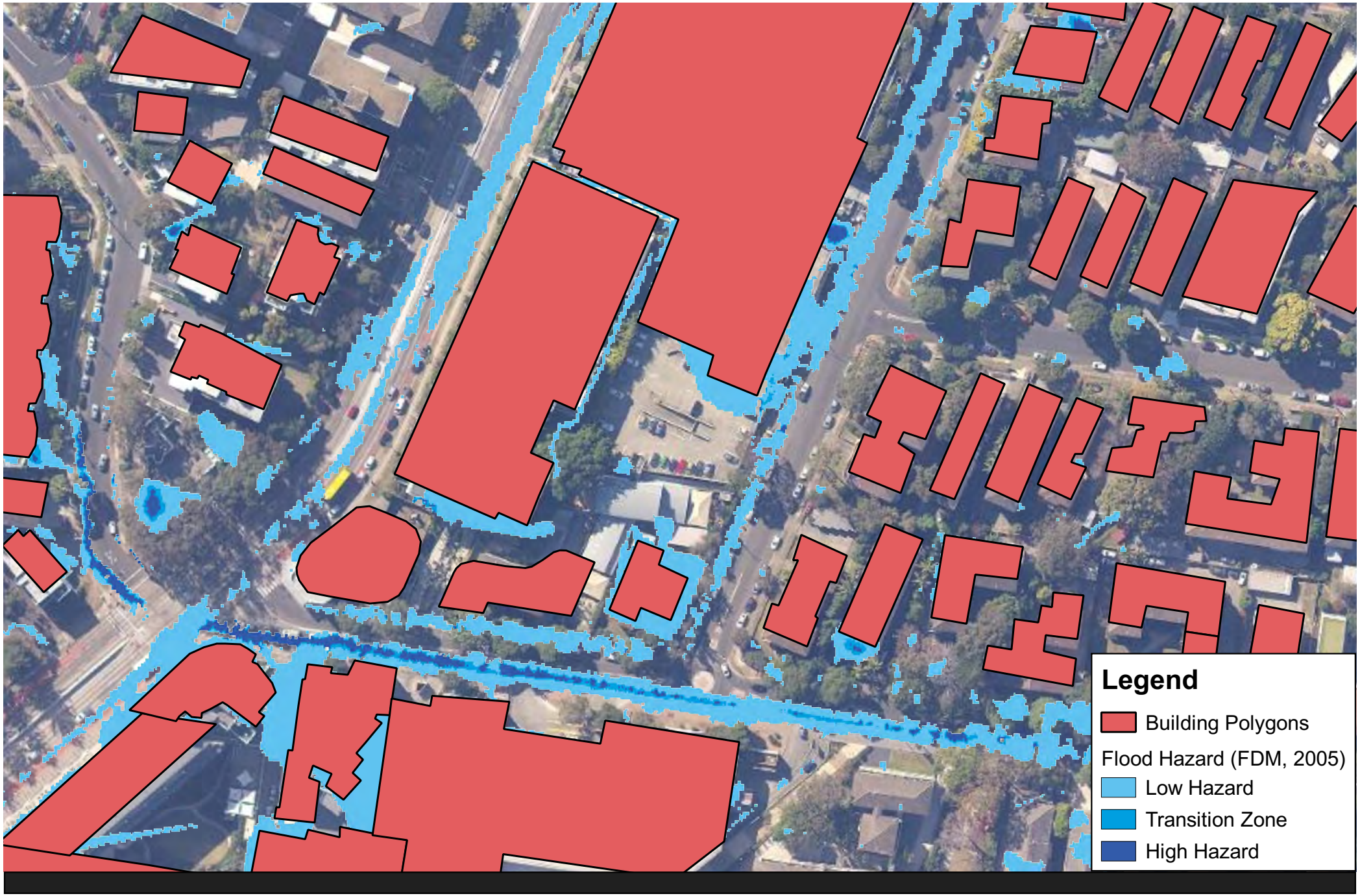
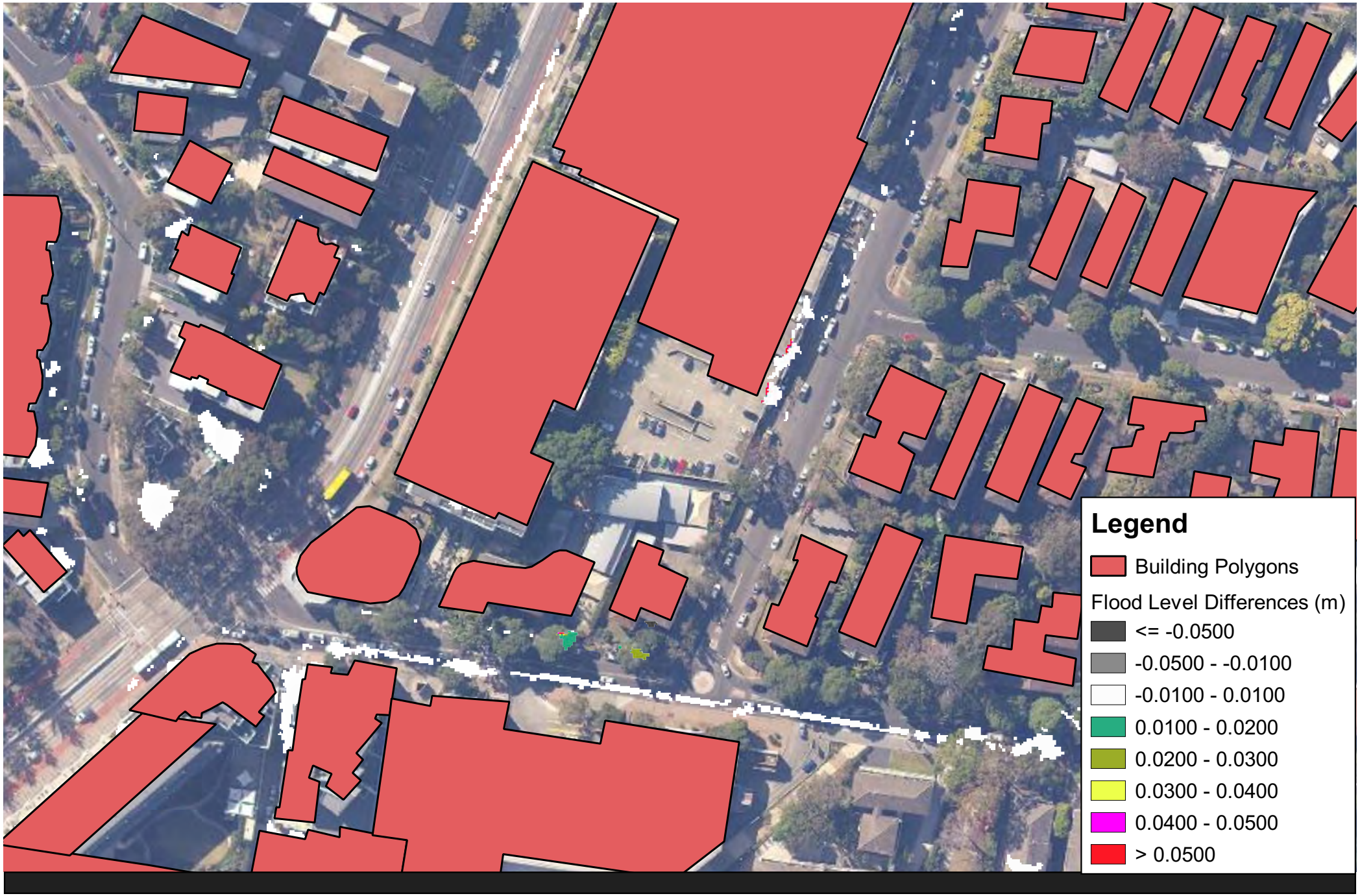


Figure A17- Proposed Conditions PMF Flood Hazard (FDM, 2005)

Figure A18- Proposed Conditions PMF Flood Hazard (Combined Flood Hazard Curves, H1-H6)



Date
14/10/2023

Figure A19- Proposed minus Existing Flood Level Differences 1% AEP Flood

APPENDIX B – COUNCIL FLOOD CORRESPONDENCE

FLOOD INFORMATION REPORT (COMPREHENSIVE)

Property: "2 Clarence Avenue DEE WHY NSW 2099","2 Dee Why Parade DEE WHY NSW 2099","5/10 Dee Why Parade DEE WHY NSW 2099","6 Dee Why Parade DEE WHY NSW 2099","914-930 Pittwater Road DEE WHY NSW 2099"
Lot DP: "Lot 1 DP 1136948","Lot 2 DP 1136948","Lot 5 SP 11488","Lot A DP 307103","Lot B DP 307103"
Issue Date: 15/08/2023
Flood Study Reference: Dee Why South Catchment Flood Study 2013, Cardno

Flood Information[1]:

Map A - Flood Risk Precincts
Maximum Flood Planning Level (FPL) [2, 3, 4]: 17.91 m AHD

Map B - 1% AEP Flood & Key points
Properties not affected by the 1% AEP extent.

Map C - 1% AEP Hydraulic Categorisation
Properties not affected by the 1% AEP extent.

Map D - Probable Maximum Flood
PMF Maximum Water Level (PMF) [4]: 16.74 m AHD
PMF Maximum Depth from natural ground level: 1.83 m
PMF Maximum Velocity: 4.37 m/s

Map E - Flooding with Climate Change
Properties not affected by the 1% AEP extent with climate change.

Map F - Flood Life Hazard Category in PMF

Map G, H, I - Indicative Ground Surface Spot Heights

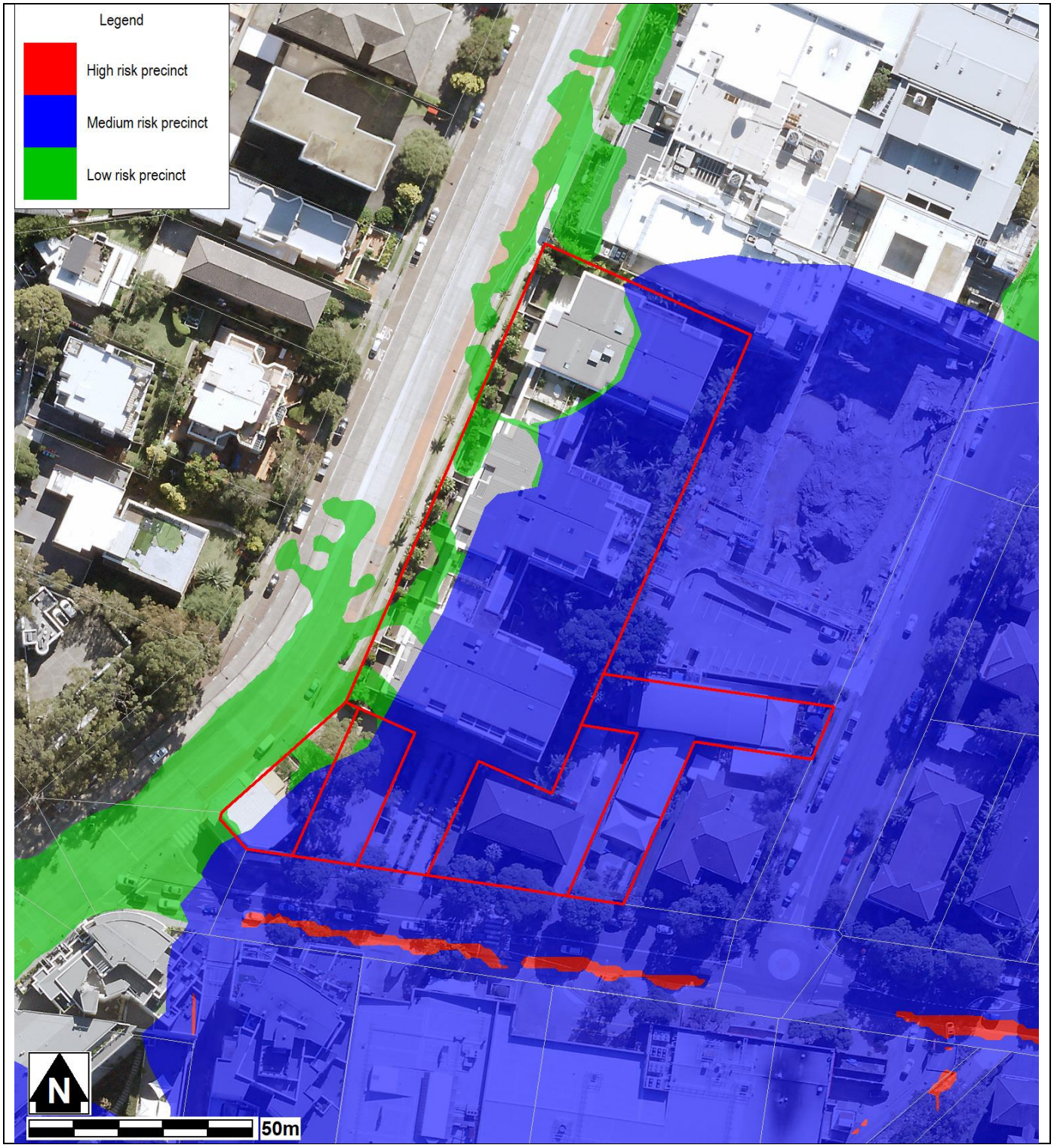
(1) The provided flood information does not account for any local overland flow issues nor private stormwater drainage systems.
(2) Overland flow/mainstream water levels may vary across a sloping site, resulting in variable minimum floor/ flood planning levels across the site. The maximum Flood Planning Level may be in a different location to the maximum 1% AEP flood level.
(3) Intensification of development in the former Pittwater LGA requires the consideration of climate change impacts which may result in higher minimum floor levels.
(4) Vulnerable/critical developments require higher minimum floor levels using the higher of the PMF or FPL

Notes

General

- All levels are based on Australian Height Datum (AHD) unless otherwise noted.
- This is currently the best available information on flooding; it may be subject to change in the future.
- Council recommends that you obtain a detailed survey of the above property and surrounds to AHD by a registered surveyor to determine any features that may influence the predicted extent or frequency of flooding. It is recommended you compare the flood level to the ground and floor levels to determine the level of risk the property may experience should flooding occur.
- Development approval is dependent on a range of issues, including compliance with all relevant provisions of Northern Beaches Council's Local Environmental Plans and Development Control Plans.
- Please note that the information contained within this letter is general advice only as a detail survey of the property as well as other information is not available. Council recommends that you engage a suitably experienced consultant to provide site specific flooding advice prior to making any decisions relating to the purchase or development of this property.
- The Flood Studies on which Council's flood information is based are available on Council's online Flood Study Reports webpage.
- If the FPL is higher than the PMF level, then the FPL should still be used as the FPL, as it includes freeboard which the PMF does not.
- If the property is affected by an Estuarine Planning Level (EPL) which is higher than the FPL, then the EPL should be used as the FPL.
- Areas affected by an EPL in the former Pittwater LGA are mapped on Council's online Estuarine Hazard Map. Note that areas in the former Manly LGA affected by an EPL have been identified and will be soon added to this map.
- Council's drainage infrastructure is mapped on Council's Stormwater Map. Note that locations are indicative only and may not be exactly as shown.

MAP A: FLOOD RISK PRECINCTS



Notes:

- **Low Flood Risk precinct** means all flood prone land not identified within the High or Medium flood risk precincts.
- **Medium Flood Risk precinct** means all flood prone land that is (a) within the 1% AEP Flood Planning Area; and (b) is not within the high flood risk precinct.
- **High Flood Risk precinct** means all flood prone land (a) within the 1% AEP Flood Planning Area; and (b) is either subject to a high hydraulic hazard, within the floodway or subject to significant evacuation difficulties (H5 or H6 Life Hazard Classification).
- The **Flood Planning Area** extent is equivalent to the Medium Flood Risk Precinct extent and includes the High Flood Risk Precinct within it. The mapped extent represents the 1% annual Exceedance Probability (AEP) flood event + freeboard.
- None of these mapped extents include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source:) and aerial photography (Source: NearMap 2014) are indicative only.

MAP B: FLOODING - 1% AEP EXTENT & KEY POINTS

Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event.
- Flood events exceeding the 1% AEP can occur on this site.
- Extent does not include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source:) and aerial photography (Source Near Map 2014) are indicative only.

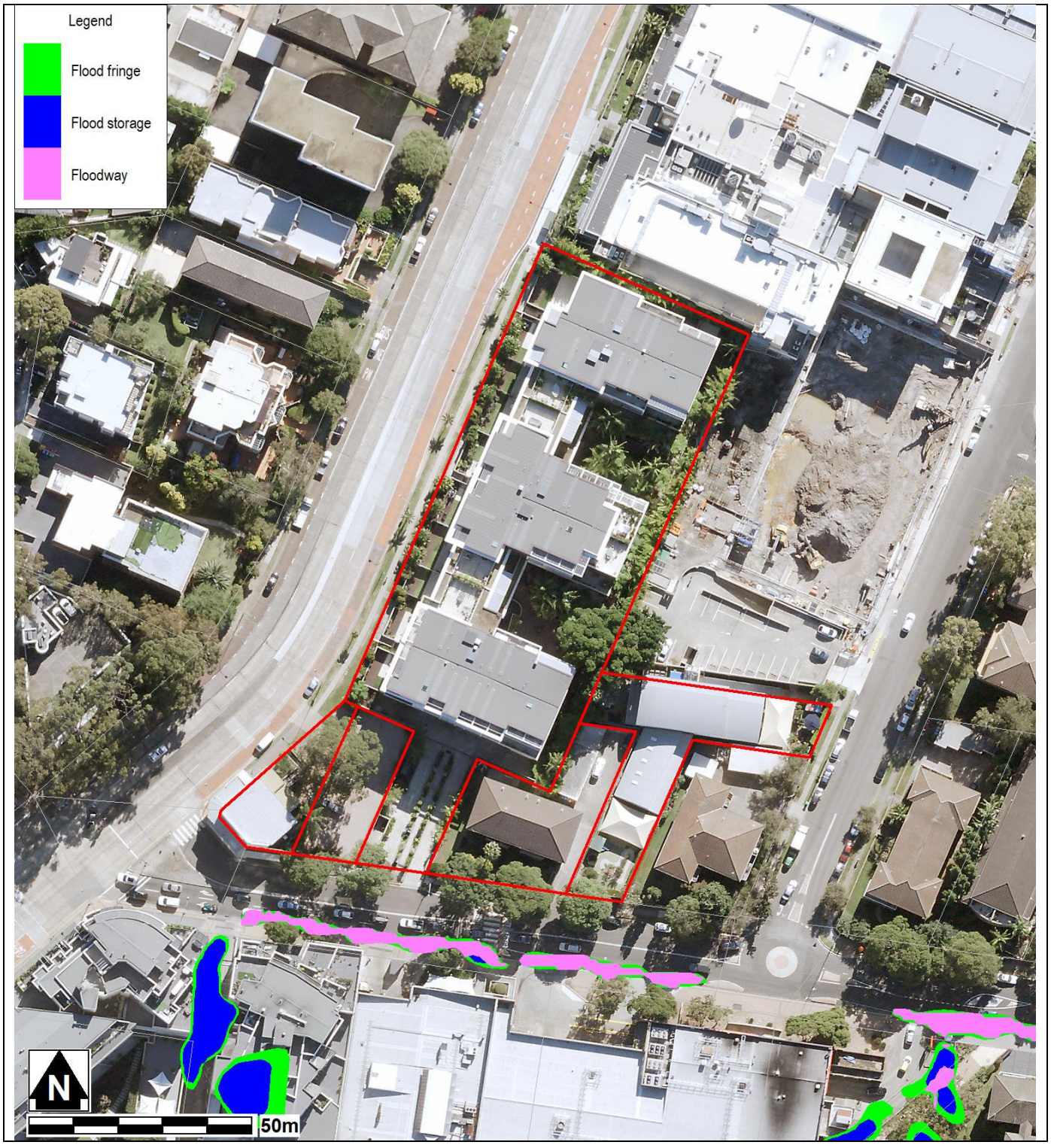
Flood Levels

ID	5% AEP Max WL (m AHD)	5% AEP Max Depth (m)	1% AEP Max WL (m AHD)	1% AEP Max Depth (m)	1% AEP Max Velocity (m/s)	Flood Planning Level (m)	PMF Max WL (m AHD)	PMF Max Depth (m)	PMF Max Velocity (m/s)
1	N/A	N/A	N/A	N/A	N/A	12.81	11.64	0.42	0.85
2	N/A	N/A	N/A	N/A	N/A	12.90	12.59	0.23	1.44
3	N/A	N/A	N/A	N/A	N/A	13.09	12.68	0.29	2.84
4	N/A	N/A	N/A	N/A	N/A	11.90	11.57	0.67	0.89
5	N/A	N/A	N/A	N/A	N/A	12.85	12.65	0.67	0.94
6	N/A	N/A	N/A	N/A	N/A	12.27	12.12	0.44	1.53
7	N/A	N/A	N/A	N/A	N/A	12.11	11.52	0.43	2.18
8	N/A	N/A	N/A	N/A	N/A	11.90	11.78	0.00	0.00
9	N/A	N/A	N/A	N/A	N/A	11.90	10.99	0.75	1.44
10	N/A	N/A	N/A	N/A	N/A	11.90	11.98	0.36	0.85

Notes:

- The flood planning levels above are calculated by adding a 0.5m freeboard to the 1% AEP water level. However, if the depth of flow is less than 0.3m and a Velocity X Depth product is less than 0.3m^2/s, a freeboard of 0.3m may be able to be justified for development.

MAP C: 1% AEP FLOOD HYDRAULIC CATEGORY EXTENT MAP



Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event
- Extent does not include climate change
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source:) and aerial photography (Source: NearMap 2014) are indicative only

MAP D: PMF EXTENT MAP

Notes:

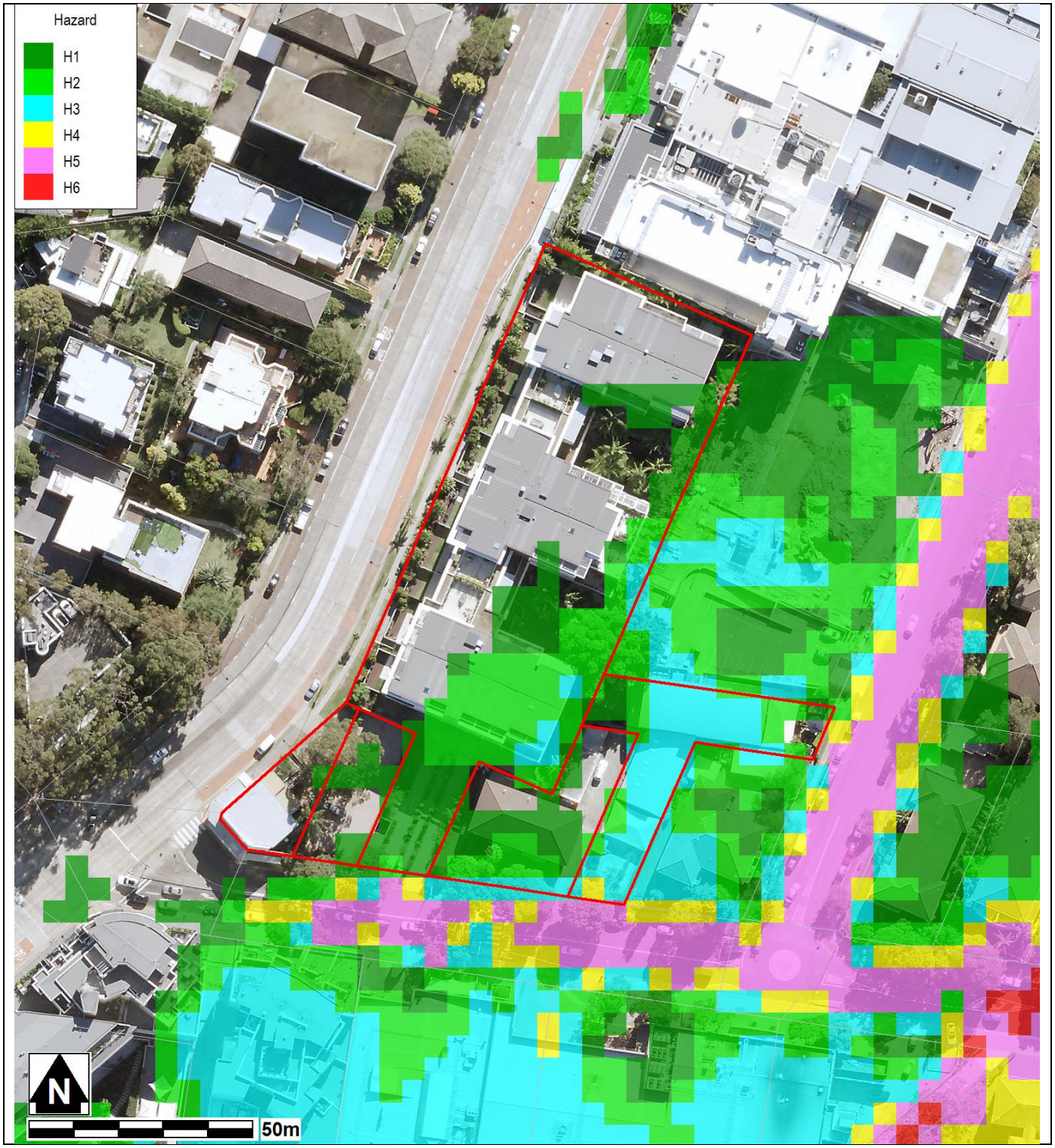
- Extent represents the Probable Maximum Flood (PMF) flood event
- Extent does not include climate change
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source:) and aerial photography (Source: NearMap 2014) are indicative only

MAP E: FLOODING – 1% AEP EXTENT PLUS CLIMATE CHANGE

Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event including 30% rainfall intensity and 0.9m Sea Level Rise climate change scenario
- Flood events exceeding the 1% AEP can occur on this site.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source:) and aerial photography (Source: NearMap 2014) are indicative only

MAP F: FLOOD LIFE HAZARD CATEGORY IN PMF



Notes:

- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source:) and aerial photography (Source Near Map 2014) are indicative only.

MAP G: INDICATIVE GROUND SURFACE SPOT HEIGHTS

Notes:

- The surface spot heights shown on this map were derived from Airborne Laser Survey and are indicative only.
- Accuracy is generally within ± 0.2m vertically and ± 0.15m horizontally, and Northern Beaches Council does not warrant that the data does not contain errors.
- If accuracy is required, then survey should be undertaken by a registered surveyor.

MAP H: INDICATIVE GROUND SURFACE SPOT HEIGHTS

Notes:

- The surface spot heights shown on this map were derived from Airborne Laser Survey and are indicative only.
- Accuracy is generally within ± 0.2m vertically and ± 0.15m horizontally, and Northern Beaches Council does not warrant that the data does not contain errors.
- If accuracy is required, then survey should be undertaken by a registered surveyor.

MAP I: INDICATIVE GROUND SURFACE SPOT HEIGHTS

Notes:

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- Accuracy is generally within ± 0.2m vertically and ± 0.15m horizontally, and Northern Beaches Council does not warrant that the data does not contain errors.
- If accuracy is required, then survey should be undertaken by a registered surveyor.

Preparation of a Flood Management Report

Introduction

These guidelines are intended to provide advice to applicants on how to determine what rules apply on flood prone land, and how to prepare a Flood Management Report. The purpose of a Flood Management Report is to demonstrate how a proposed development will comply with flood related planning requirements.

Planning Requirements for Flood Prone Land

Development must comply with the requirements for developing flood prone land set out in the relevant Local Environment Plan (LEP) and Development Control Plan (DCP). There are separate LEPs and DCPs for each of the former Local Government Areas (LGAs), although preparation of a LGA-wide LEP and DCP is currently under way.

The clauses specific to flooding in the LEPs and DCPs are as follows:

LEP Clauses	DCP Clauses
Manly LEP (2013) – 6.3 Flood Planning	Manly DCP (2013) – 5.4.3 Flood Prone Land
Warringah LEP (2011) – 6.3 Flood Planning Warringah LEP (2000) – 47 Flood Affected Land *	Warringah DCP (2011) – E11 Flood Prone Land
Pittwater LEP (2014) – 7.3 Flood Planning Pittwater LEP (2014) – 7.4 Flood Risk Management	Pittwater 21 DCP (2014) – B3.11 Flood Prone Land Pittwater 21 DCP (2014) – B3.12 Climate Change

* The Warringah LEP (2000) is relevant only for the “deferred lands” which affects only a very small number of properties, mostly in the Oxford Falls area.

Development on flood prone land must also comply with Council’s Water Management for Development Policy, and if it is in the Warriewood Release Area, with the Warriewood Valley Water Management Specification. Guidelines for Flood Emergency Response Planning are available for addressing emergency response requirements in the DCP. These documents can be found on Council’s website on the Flooding page.

Note that if the property is affected by estuarine flooding or other coastal issues, these need to be addressed separately under the relevant DCP clauses.

When is a Flood Management Report required?

A Flood Management Report must be submitted with any Development Application on flood prone land (with exceptions noted below), for Council to consider the potential flood impacts and applicable controls. For Residential or Commercial development, it is required for development on land identified within the Medium or High Flood Risk Precinct. For Vulnerable or Critical development, it is required if it is within any Flood Risk Precinct.

There are some circumstances where a formal Flood Management Report undertaken by a professional engineer may not be required. However the relevant parts of the DCP and LEP would still need to be addressed, so as to demonstrate compliance. Examples where this may apply include:

- If all proposed works are located outside the relevant Flood Risk Precinct extent
- First floor addition only, where the floor level is above the Probable Maximum Flood level
- Internal works only, where habitable floor areas below the FPL are not being increased

Note that development on flood prone land will still be assessed for compliance with the relevant DCP and LEP, and may still be subject to flood related development controls.

What is the purpose of a Flood Management Report?

The purpose of a Flood Management Report is to demonstrate how a proposed development will comply with flood planning requirements, particularly the development controls outlined in the relevant LEP and DCP clauses. The report must detail the design, measures and controls needed to achieve compliance, following the steps outlined below.

A Flood Management Report should reflect the size, type and location of the development, proportionate to the scope of the works proposed, and considering its relationship to surrounding development. The report should also assess the flood risk to life and property.

Preparation of a Flood Management Report

The technical requirements for a Flood Management Report include (where relevant):

1. Description of development
   - Outline of the proposed development, with plans if necessary for clarity
   - Use of the building, hours of operation, proposed traffic usage or movement
   - Type of use, eg vulnerable, critical, residential, business, industrial, subdivision, etc

2. Flood analysis
   - 1% AEP flood level
   - Flood Planning Level (FPL)
   - Probable Maximum Flood (PMF) level
   - Flood Risk Precinct, ie High, Medium or Low
   - Flood Life Hazard Category
   - Mapping of relevant extents
   - Flood characteristics for the site, eg depth, velocity, hazard and hydraulic category, and the relevance to the proposed development

   If the property is affected by an Estuarine Planning Level (EPL) which is higher than the FPL, then the EPL should be used as the FPL. If the FPL is higher than the PMF level, then the FPL should still be used as the FPL, as it includes freeboard which the PMF does not.

3. Assessment of impacts

- Summary of compliance for each category of the DCP, as per the table below.

	Compliance		
	N/A	Yes	No
A) Flood effects caused by Development			
B) Building Components & Structural Soundness			
C) Floor Levels			
D) Car parking			
E) Emergency Response			
F) Fencing			
G) Storage of Goods			
H) Pools			

- Demonstration of how the development complies with any relevant flood planning requirements from the DCP, LEP, Water Management for Development Policy, and if it is in the Warriewood Valley Urban Land Release Area, with the Warriewood Valley Water Management Specification (2001)
- For any non-compliance, a justification for why the development should still be considered.

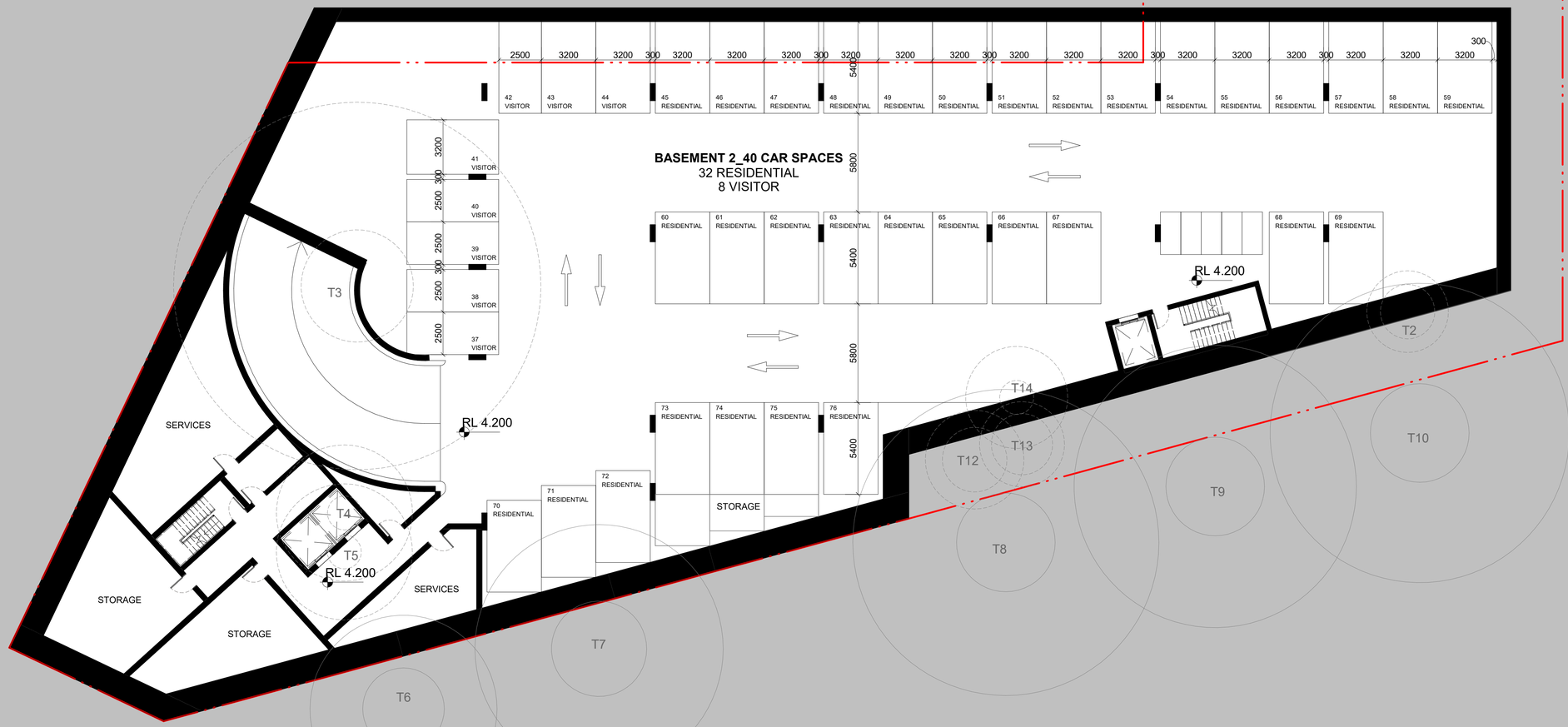
- Calculations of available flood storage if compensatory flood storage is proposed
- Plan of the proposed development site showing the predicted 1% AEP and PMF flood extents, as well as any high hazard or floodway affectation
- Development recommendations and construction methodologies
- Qualifications of author - Council requires that the Flood Management Report be prepared by a suitably qualified Engineer with experience in flood design / management who has, or is eligible for, membership to the Institution of Engineers Australia
- Any flood advice provided by Council
- Any other details which may be relevant

Further information and guidelines for development are available on Council's website at:

https://www.northernbeaches.nsw.gov.au/planning-and-development/building-and-renovations/development-applications/guidelines-development-flood-prone-land

Council's Flood Team may be contacted on 1300 434 434 or at floodplain@northernbeaches.nsw.gov.au .

APPENDIX C – ARCHITECTURAL PLANS



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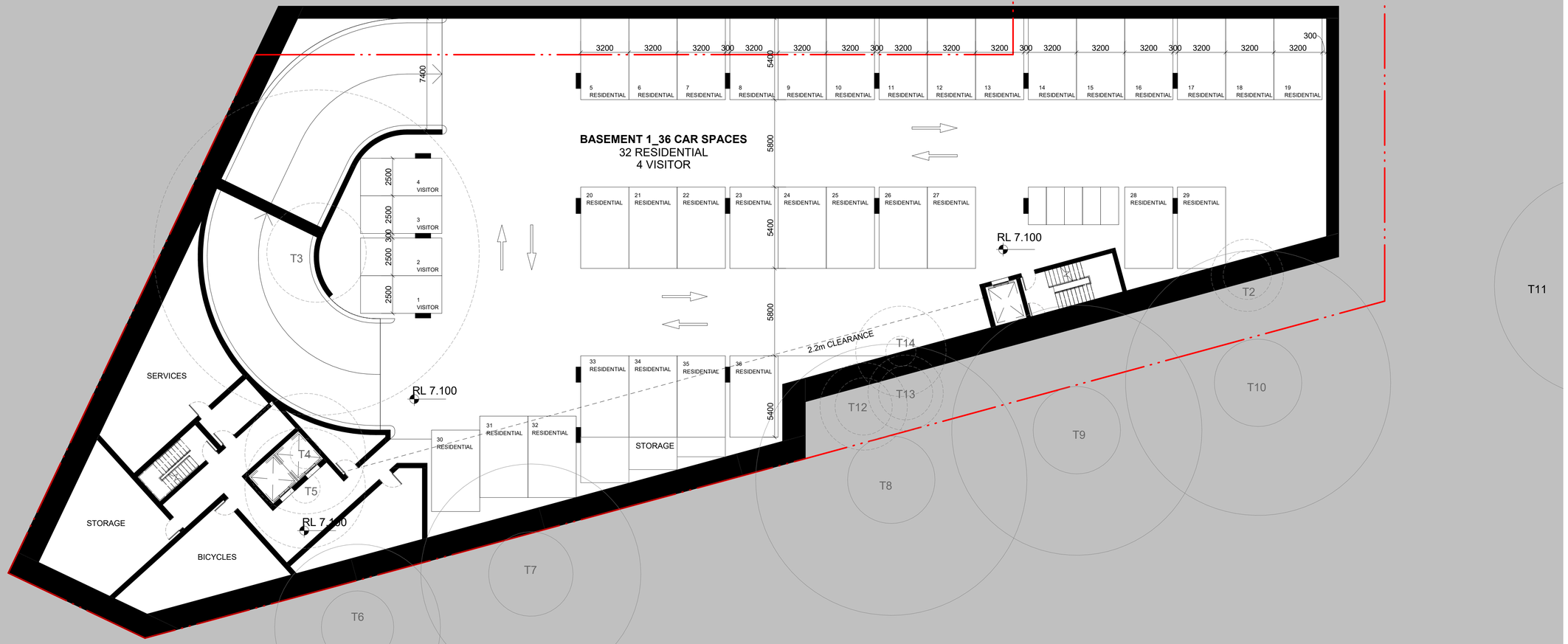

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PITTWATER ROAD

EXISTING RECEPTION

EXISTING OCEANGROVE

OUTLINE OF BUILDING ABOVE

FLOOD BARRIER

OUTLINE OF BUILDING ABOVE

AMBULANCE DOCK
WASTE COLLECTION
LOADING DOCK

SERVICES

SERVICES

SERVICES

SERVICES

WASTE ROOM

AMENITIES

OUTLINE OF BUILDING ABOVE

OPEN SUBFLOOR

BASEMENT BELOW

SUBSTATION

FLOOD PROTECTION WALL

DEE WHY PARADE

RL 10.100
RL 10.160
RL 10.040
RL 10.235
RL 10.500
RL 10.050
RL 10.500
RL 10.040
RL 10.040
RL 10.800
RL 10.050
RL 10.223
RL 10.500
RL 10.800
RL 10.700
RL 10.800
RL 10.500
RL 10.800
RL 10.693
RL 10.050
RL 9.500
RL 10.800
RL 12.000
RL 11.780
TOW 11.920
EX.RL 11.390
TOW 12.050
EX.RL 11.530
TOW 12.543
TOW 12.360

1:21
1:20
1:14
1:14
1:14
1:14
1:14

300
600
600
900
DS
DS
DS
DS

XXX SOIL DEPTH
EB ENCLOSED BALCONIES
WET AREAS TO BE DEVELOPED

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PITTWATER ROAD

EXISTING OCEANGROVE

9.0m

3.0m

4.5m

EB
BALCONY
58.6 m²

2B
A.00.01
106.8 m²

EB
BALCONY
21.8 m²

3B
A.00.02
138.5 m²

EB
BALCONY
12.7 m²

2B
A.00.03
134.1 m²

letterboxes

BALCONY
28.4 m²

BALCONY
15.2 m²

3B
B.00.04
143.6 m²

2B
B.00.03
97.3 m²

BALCONY
11.5 m²

BALCONY
12.7 m²

2B
B.00.02
99.4 m²

2B
B.00.01
111.0 m²

SUBSTATION

FLOOD PROTECTION WALL

RL 15.200
RL 15.200
RL 15.200
RL 12.700
RL 12.317
RL 14.500
RL 11.780

TOW 12.891
TOW 12.810
TOW 12.608
TOW 12.543
TOW 12.360
TOW 12.050
TOW 11.920

EX.RL 12.390
EX.RL 12.290
EX.RL 11.900
EX.RL 11.530
EX.RL 11.390

300 3200 4100 3200 300

T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 T13 T14

600 900

DEE WHY PARADE

XXX SOIL DEPTH
EB ENCLOSED BALCONIES
WET AREAS TO BE DEVELOPED

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XXX SOIL DEPTH

EB ENCLOSED BALCONIES

WET AREAS TO BE DEVELOPED

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DRAWING TITLE
FIRST FLOOR

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PITTWATER ROAD

EXISTING OCEANGROVE

9.0m

12.0m

6.0m

4.5m

RL 27.600

RL 26.900

600

3B
A.04.03
134.6 m²

EB
BALCONY
14.3 m²

3B
A.04.04
138.4 m²

EB
BALCONY
21.8 m²

EB
BALCONY
12.7 m²

3B
A.04.01
134.2 m²

BALCONY
12.2 m²

EB

2B
A.04.02
122.9 m²

T3

T4

T5

T6

T7

BALCONY
28.4 m²

BALCONY
13.4 m²

2B
B.04.03
97.3 m²

2B
B.04.04
91.3 m²

2B
B.04.02
99.4 m²

2B
B.04.01
110.2 m²

T2

T8

T9

T10

T11

T12

T13

T14

DEE WHY PARADE

XXX SOIL DEPTH

EB ENCLOSED BALCONIES

WET AREAS TO BE DEVELOPED

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FOURTH FLOOR

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XXX SOIL DEPTH
EB ENCLOSED BALCONIES
WET AREAS TO BE DEVELOPED

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G	29/11/2023	FOR COORDINATION	PS
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PROJECT
OCEANGROVE
932 PITTWATER RD
DEE WHY NSW 2099

DRAWING TITLE
FIFTH FLOOR

SCALE	DATE	DRAWN	CHECKED
1 : 150 @A1	15/12//2023	MH	PS

JOB	DRAWING	REVISION
23017	PP00.15	K

PITTWATER ROAD

EXISTING OCEANGROVE

9.0m

15.2m

COMMUNAL OPEN SPACE
86.3 m²

COMMUNAL SPACE
172.7 m²

RL 40.025

ENCLOSED PLANT AREA

6.0m

RL 33.750

RL 33.300

RL 30.200

RL 34.600

4.5m

DEE WHY PARADE

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J	13/12/2023	FOR SUBMISSION	PS
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OCEANGROVE
932 PITTWATER RD
DEE WHY NSW 2099

DRAWING TITLE
ROOF TERRACE

SCALE	DATE	DRAWN	CHECKED
1 : 150 @A1	15/12//2023	MH	PS

JOB	DRAWING	REVISION
23017	PP00.21	K

PITTWATER ROAD

EXISTING OCEANGROVE

RL 26.900
RL 26.000
RL 26.000

9.0m
15.2m

RL 40.200
RL 40.800
RL 41.400

RL 43.300
RL 43.750
RL 44.600

RL 41.400
RL 40.800
RL 40.200

RL 30.200
RL 33.300
RL 33.750
RL 30.800
RL 33.300
RL 30.200
RL 34.600

3.0m
4.5m

DEE WHY PARADE

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932 PITTWATER RD
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DRAWING TITLE
ROOF PLAN

SCALE	DATE	DRAWN	CHECKED
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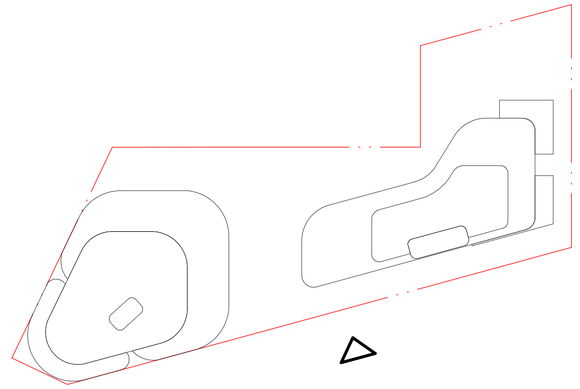
JOB	DRAWING	REVISION
23017	PP00.22	K



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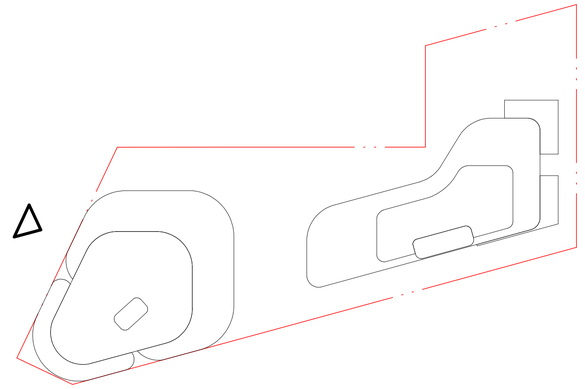
932 PITTWATER RD
DEE WHY NSW 2099

DRAWING TITLE
DEE WHY PARADE ELEVATION

SCALE	DATE	DRAWN	CHECKED
1:150 @A1	15/12//2023	MH	PS

JOB	DRAWING	REVISION
23017	PP03.01	J



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932 PITTWATER RD
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DRAWING TITLE
PITTWATER ROAD ELEVATION

SCALE	DATE	DRAWN	CHECKED
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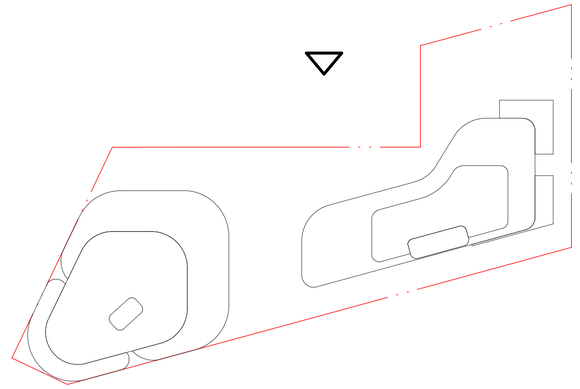
JOB	DRAWING	REVISION
23017	PP03.02	J



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DRAWING TITLE
NORTH ELEVATION

SCALE	DATE	DRAWN	CHECKED
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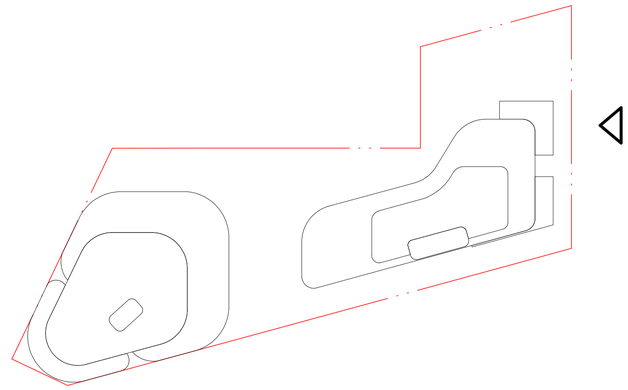
JOB	DRAWING	REVISION
23017	PP03.03	J



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G	06/12/2023	FOR COMMENTS	PS
H	13/12/2023	FOR SUBMISSION	PS
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DRAWING TITLE
EAST ELEVATION

SCALE	DATE	DRAWN	CHECKED
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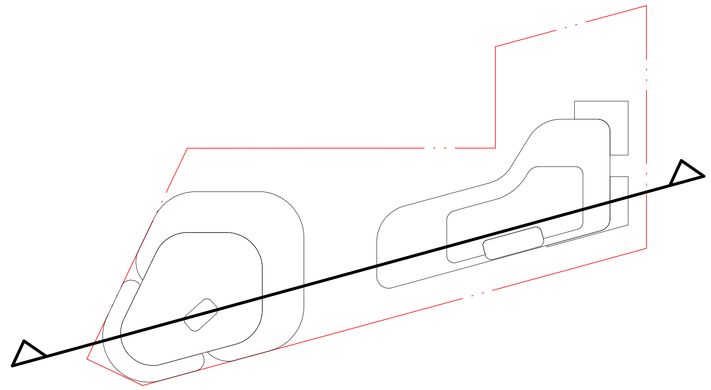
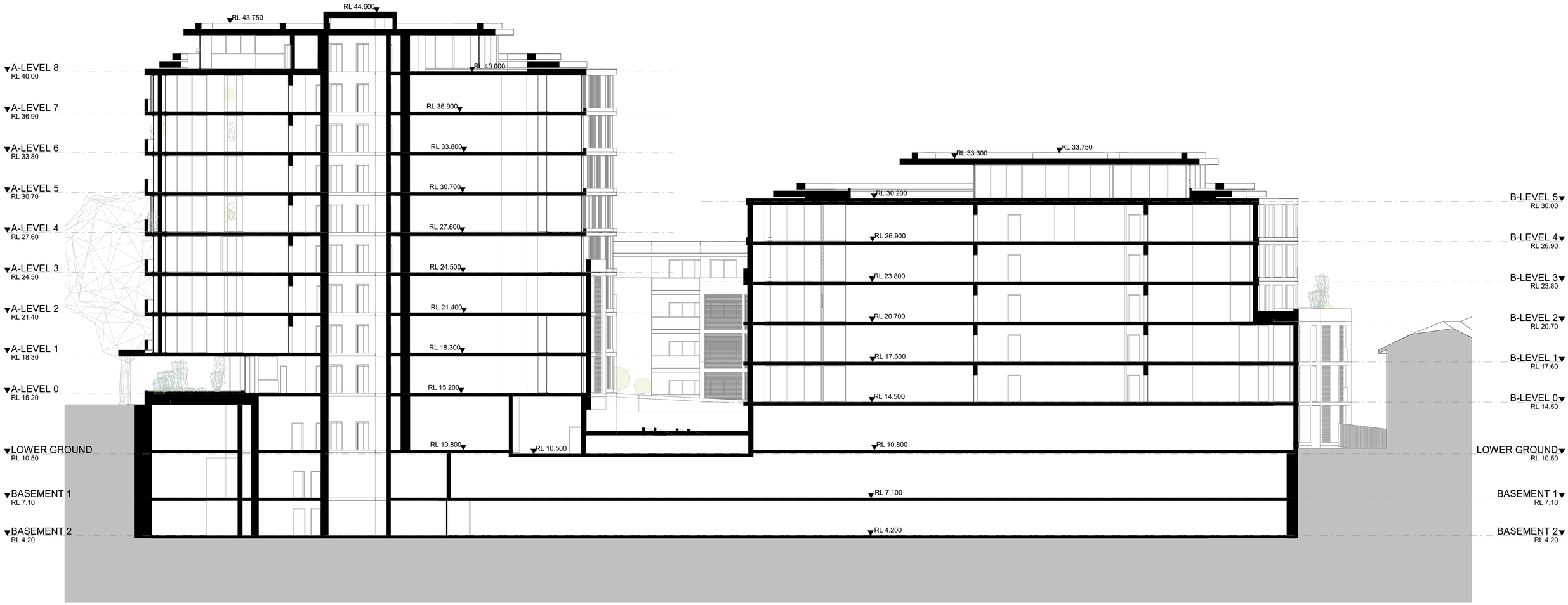
JOB	DRAWING	REVISION
23017	PP03.04	J





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932 PITTWATER RD
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DRAWING TITLE
SECTION A-A´

SCALE	DATE	DRAWN	CHECKED
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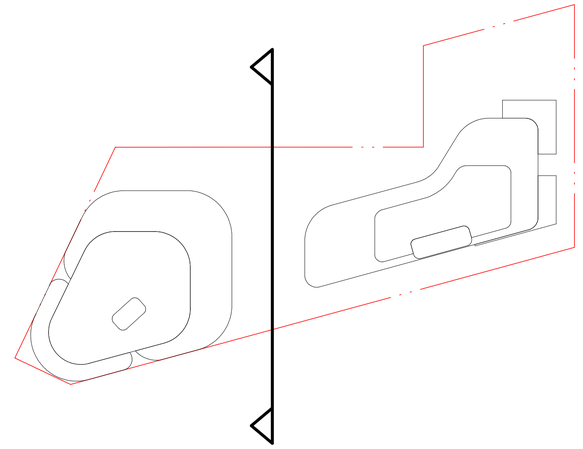
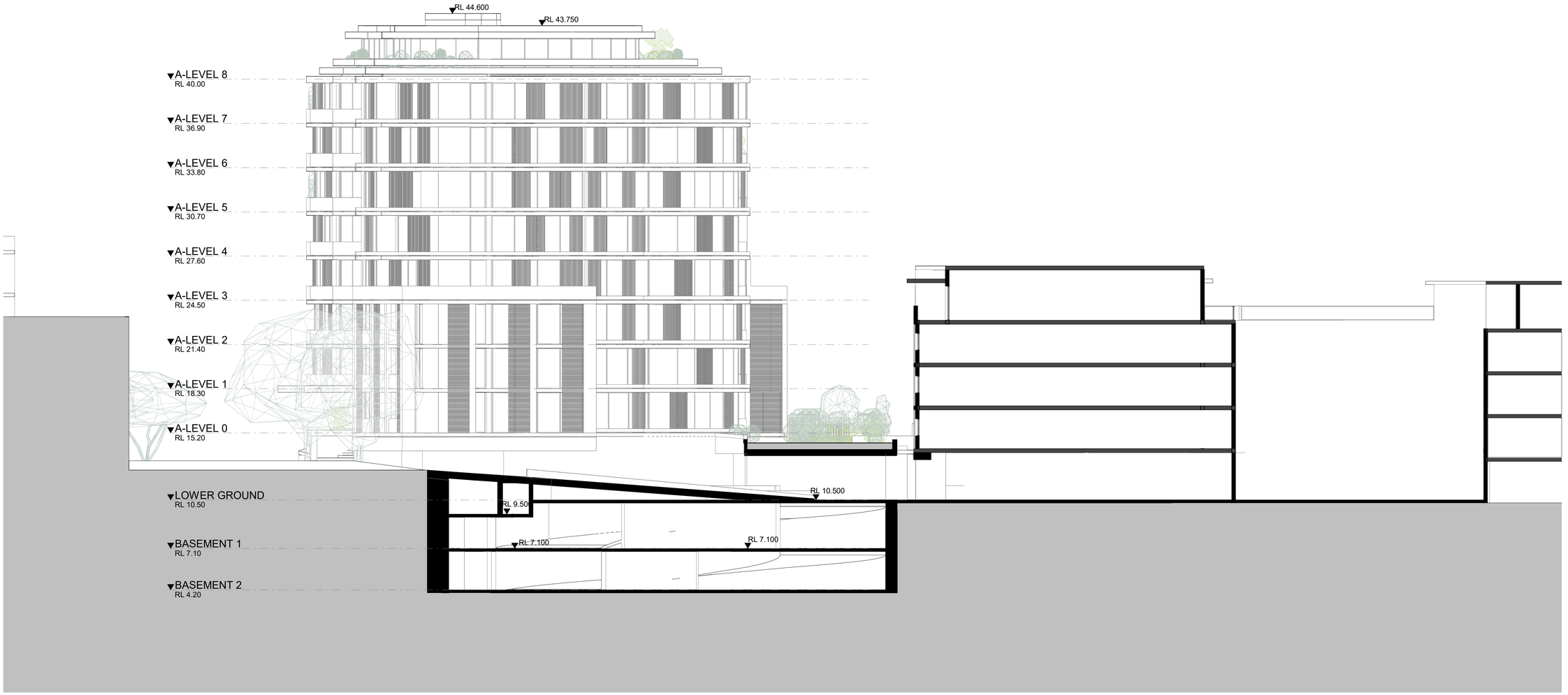
JOB	DRAWING		REVISION
23017	PP04.01		J





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J	15/12//2023	FOR APPROVAL	PS

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DRAWING TITLE
SECTION B-B´

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JOB	DRAWING	REVISION
23017	PP04.02	J

IMPORTANT NOTES	REV	DATE	DESCRIPTION	BY
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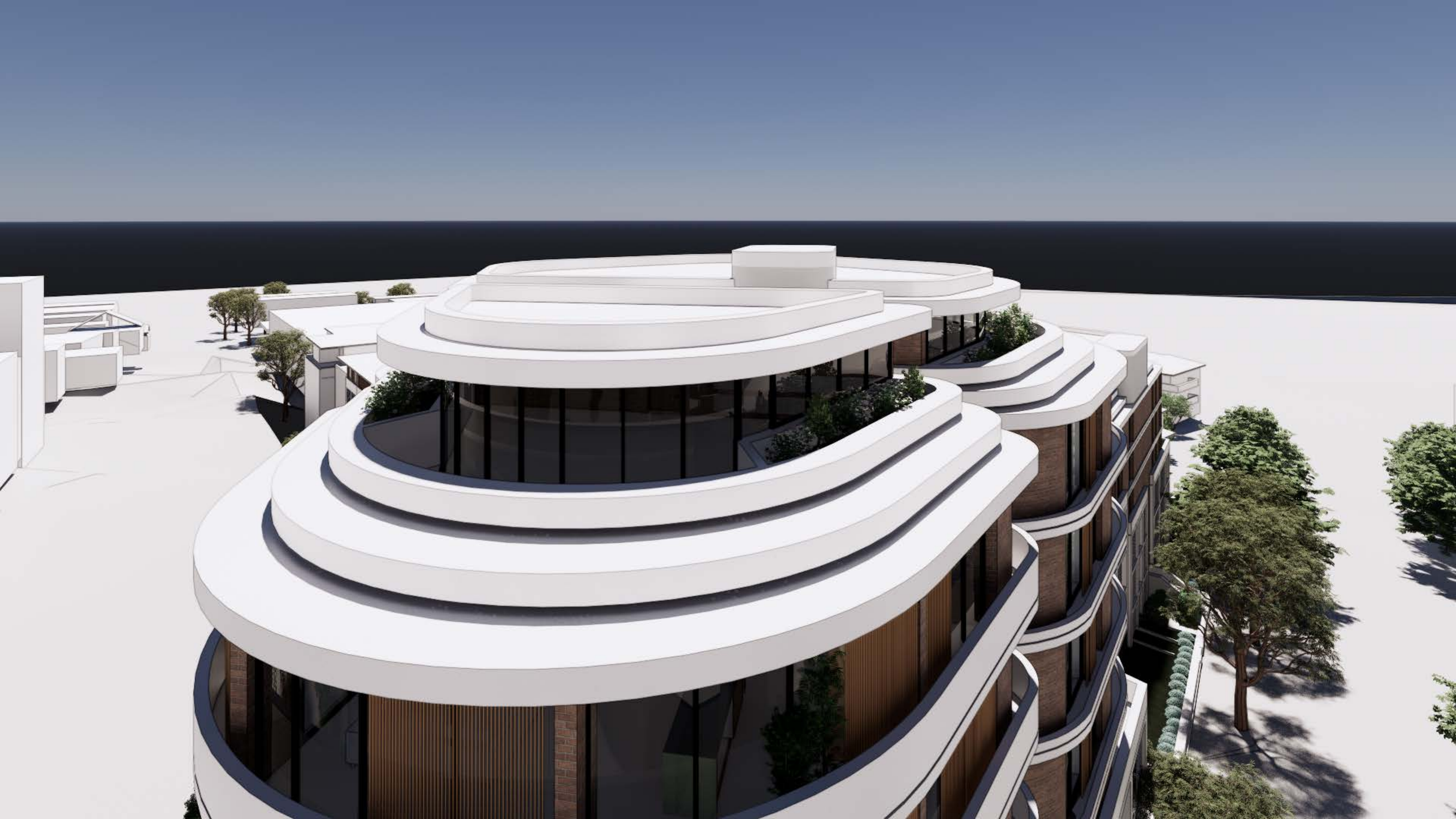
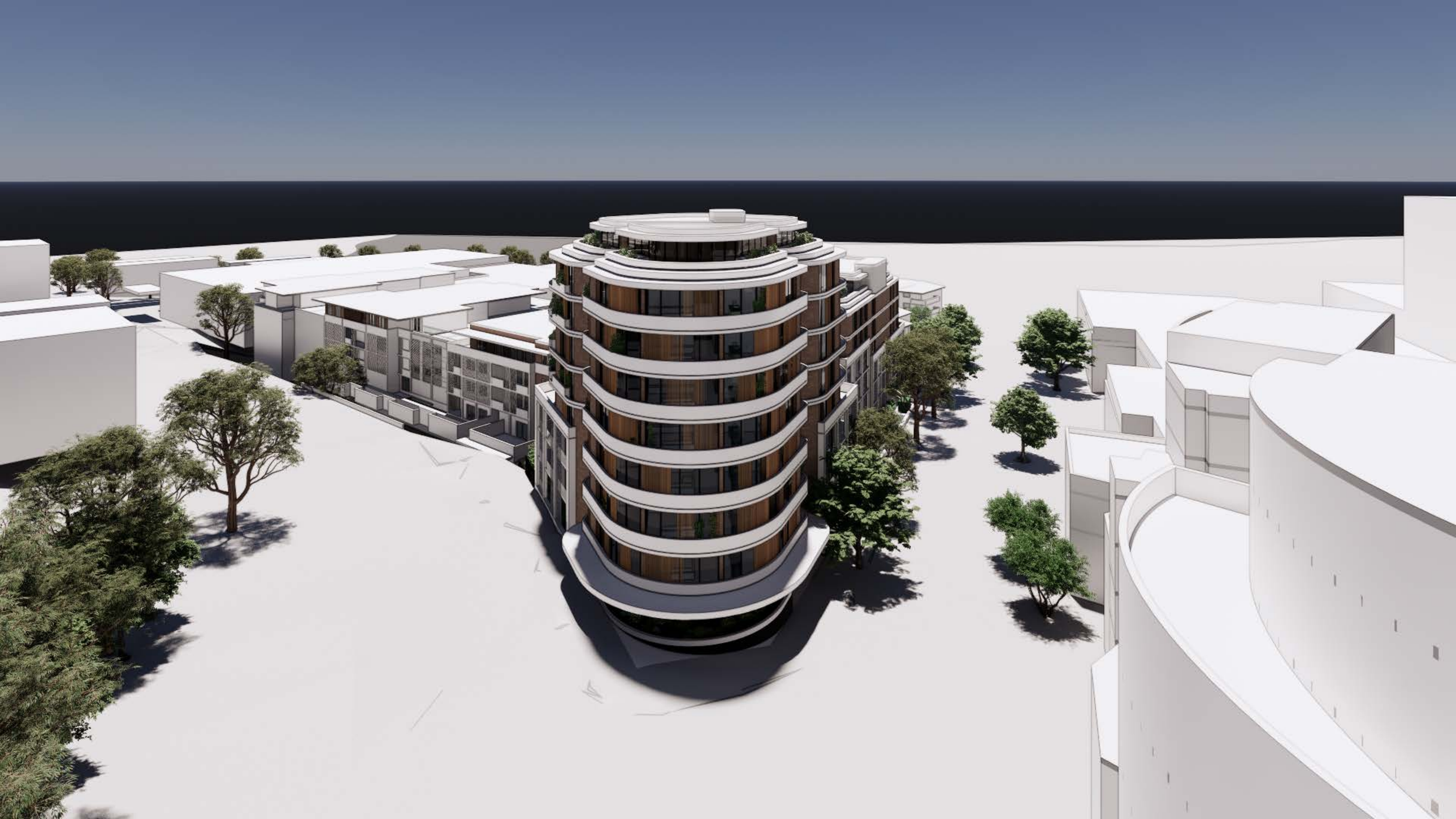
PROJECT
OCEANGROVE
932 PITTWATER RD
DEE WHY NSW 2099

DRAWING TITLE
HEIGHT OF THE BUILDING

SCALE	DATE	DRAWN	CHECKED
	15/12//2023	MH	PS

JOB	DRAWING	REVISION
23017	PP7.33	B





APPENDIX D – SITE SURVEY PLAN

APPENDIX E – FLOOD COMPATIBLE MATERIALS

Building Component	Flood Compatible Materials	Building Component	Flood Compatible Materials
Flooring and Subfloor 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	**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 corrosion and water resistant material
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
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.	**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.
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 in stalled. Only submersible-type splices are to be used below 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.

	All conducts, located below the relevant flood level, should be self-draining in the event of flooding.		
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.