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FLOOD INVESTIGATION REPORT
and
FLOOD RISK MANAGEMENT PLAN
for a
PROPOSED SENIORS LIVING DEVELOPMENT

Client: **Armada Avalon Pty Ltd**

Property: **Lots 32 & 33 in DP 8394 (No.'s 27 & 29)**
North Avalon Road, Avalon Beach

Date: **23 September 2020**

Document Identification

Our Reference: **CC200310**

For and on behalf of

ACOR Consultants (CC) Pty Ltd

Version	Description	Date	Author	Signature	Reviewer	Signature
1.0	Flood Investigation Report	23/09/2020	Nathan Broadbent		Bruce Kenny	

Distribution

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1 (v 1.0)	pdf	Environa Studio	23/09/2020

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ANNEXURES

1.0 Introduction

ACOR Consultants (CC) Pty Ltd (ACOR) has been commissioned to prepare a Flood Investigation and Flood Risk Management Report (Report) in support of an application for a Seniors Living Development. The Report has been prepared having due regard to the requirements of Pittwater 21 Development Control Plan Amendment 22 (Pittwater 21 DCP) Section B3.11 Flood Prone Land; Northern Beaches Council Flood Prone Land Design Standard; Flood Emergency Response Planning for Development in Pittwater Policy; and Pittwater Local Environmental Plan 2014 (Amendment No 8) (Pittwater LEP 2014) Part 7.3 and 7.4. The Report is supported by a flood study which investigates flood behaviour throughout the overland flooding catchment impacting the subject site. This includes the analysis of:

- Surface runoff across the catchment.
- Flooding towards the lower part of the catchment.
- Backwater flooding impact on the subject site.

A two-dimensional computer model of the catchment was established to analyse overland flood behaviour under existing and proposed catchment conditions. The model provides information on the extent of flood inundation, flood depths and flood velocities throughout the catchment for the PMF overland flood event. Results from this study form the technical basis for the subsequent flood risk management plan which identifies problem areas and investigates options to reduce the risk of flooding.

1.1 Objective

The objective of the study is to define local overland flooding in accordance with the Floodplain Development Manual (NSW DIPNR 2005) and Pittwater 21 DCP Section B3.11. It involved the following steps:

- Attend the site to assess the anticipated extent and nature of flooding and identify hydraulic controls likely to impact on flooding behaviour.
- Develop hydrologic model to determine flood hydrographs.
- Develop hydraulic model to determine flood levels, velocities and hazard categories.
- Review flooding behaviour and provide recommendations to ensure that future redevelopment of the site will meet flood compatibility standards.

1.2 Site Description

The subject site is known as Lots 32 & 33 in DP 8394 (No.'s 27 & 29) North Avalon Road, Avalon Beach. The site is located on the southern side of North Avalon Road and surrounded by residential development.

The subject site comprises an area of 2226 square metres and is zoned R2 Low Density Residential under Pittwater LEP 2014. The subject site currently supports single residential dwellings and several ancillary structures.

The site falls from east to west with elevations generally within the range RL 14.7 m AHD to RL 17.7 m AHD.

The applicant proposes to demolish the existing structures and construct a Seniors Living development. The principal details of the proposed development and site improvements are depicted in architectural plans prepared by Environa Studio, project No. 991, Revision R, dated 21 September 2020.

1.3 Flood Characteristics

During certain storms which exceed the 1% AEP flood event, the subject site will be impacted by overland flow. Land use within the overland flow catchment is mainly residential. Surface elevations within the catchment are generally within the range RL 0.0 m AHD to RL 112 m AHD.

Flood behaviour in the vicinity of the site is described within 'Avalon to Palm Beach Floodplain Risk Management Study and Plan' prepared by Manly Hydraulics Laboratory (MHL), reference MHL2321, dated 20 August 2020 and also in the Flood Advice issued by Northern Beaches Council, dated 18 February 2019.

We note that subject site is not impacted by 1% AEP overland floodwaters (MHL 2017).

We note that the subject site is partially impacted by PMF floodwaters which range in elevation between RL 15.16 m AHD an RL 15.90 m AHD, resulting in inundation depths between 0.00 m and 0.3 m (MHL 2017).

In this regard we refer to Northern Beaches Council Flood Information Request – Multi Purpose date 18 February 2019 (copy enclosed under Annexure C)

2.0 Available Data

This flood study used topographic, flooding and rainfall data obtained from a number of sources. The origin and types of information underpinning the assumptions used in this study are presented below.

2.1 Published Flood Data

Published flood information is contained within 'Avalon to Palm Beach Floodplain Risk Management Study and Plan' prepared by Manly Hydraulics Laboratory (MHL), reference MHL2321, dated 20 August 2020. The document describes the behaviour of PMF floodwaters, as outlined in Section 1.3. The site is located within the Low Risk precinct (MHL 2017)

2.2 Survey Data

Survey information adopted for this study has been collated from the following sources:

- ALS survey provided by the NSW Land and Property Information Department (NSW LPI).
- GIS layers of cadastre and satellite imagery provided by the NSW LPI.

- Site survey prepared by Hammond Smeallie & Co Pty Ltd, reference 14535, revision C, dated 7 March 2019.

3.0 Hydrologic Modelling

Hydrologic modelling was undertaken within TUFLOW using the Direct Rainfall ('rainfall on the grid') methodology. In the hydraulic model, rainfall is applied directly to the 2D terrain, and the hydraulic model automatically routes the flow as determined by the elevation and roughness grids and any included 1D pipeline network.

Direct rainfall modelling is a relatively new feature of hydraulic modelling and it is still being tested on a number of catchments to ensure it is reliably representing the flood behaviour of a given catchment. Runoff is generated over the entire catchment, rather than the more traditional approach of calculating an inflow hydrograph and lumping this in at an assumed location(s). This 'direct rainfall' approach means the whole catchment will be 'wet' and the hydraulic modelling results need to be filtered to show only those cells that genuinely represent areas of catchment flooding. This was achieved by only mapping inundation at cells with a flood depth greater than 0.10 metres.

Direct rainfall was applied to the area indicated as '2D model domain' on our plan, Reference CC200310, Sheet F1, Revision C (copy enclosed under Annexure A). The hydrologic and hydraulic modelling considered 100% blockage of Council's piped drainage system.

4.0 Hydraulic Modelling

A TUFLOW 1D/2D model was used to hydraulically route flows through the catchment and to derive flow depths, velocities and hazard for the pre-development and post-development scenarios. This section describes the hydraulic modelling approach and hydraulic model development.

4.1 Choice of Hydraulic Model

Different hydraulic modelling approaches can be applied according to the floodplain's hydraulic characteristics and the objectives of the study. The simpler methods lump the left and right overbank floodplain areas and the main channel into a one-dimensional (1D) representation. This approach is relatively simple and computationally fast and is generally appropriate for modelling flows through pipe networks and straight sections of formed open channel. The main limitation of such 1D modelling approaches is that flow is assumed to occur in a linear direction, and the water levels across the floodplain are assumed to be at the same level as the main channel.

A more detailed two-dimensional (2D) approach is recommended in areas where significant differences can occur between the channel flood level and the floodplain flood levels. This approach is also preferable where separate flow paths and flow around catchment obstructions occur, as is the case in this study. This is a more complex analysis, which requires greater data requirements and computational resources.

The TUFLOW 1D/2D model was chosen to model the catchment hydraulics. This modelling system dynamically couples the one-dimensional and two-dimensional flow paths in the floodplain.

4.2 TUFLOW 1D Model Domain

The effects of the piped drainage network within the catchment was not represented in the TUFLOW model, as described in Section 3. In this regard, there is no 1D model domain in the flood model.

4.3 TUFLOW 2D Model Domain

The model included a square grid, with a grid size of 2 metres. Each grid element contains information on ground topography (see Section 4.3.1), surface resistance to flow (see Section 4.3.4) and initial water level.

The grid cell size of 2 metres is considered to be sufficiently fine to appropriately represent the variations in floodplain 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. As a consequence, a 2 m square cell size results in surface elevations being sampled every 1 m.

Linear features that potentially influence flow behaviour, such as gullies and levees were incorporated into the topography using 3D 'breaklines' to ensure that these were accurately represented in the model. It is noted that although brick walls and fences could also significantly affect local overland flow paths, these have not been explicitly incorporated into the model in urban areas unless deemed critical to the study, and were instead considered in the setting of appropriate Manning's 'n' values for these areas.

4.3.1 Topography

A 1 m grid Digital Elevation Model (DEM) was generated for the catchment using ALS survey data. This DEM was used to represent ground elevations throughout the catchment.

Land use categories were assigned to areas of the catchment based on examination of aerial photography and satellite imagery. These land use categories were used to assign roughness and infiltration parameters during modelling. Further detail on the modelling of infiltration and catchment roughness is contained in Section 4.3.3 and Section 4.3.4 respectively.

4.3.2 Building Footprint

The footprints of existing and proposed buildings surrounding critical flow paths are modelled as blocked elements within the 2D domain. Building footprints were digitised and removed from the active 2D domain to prevent floodwaters entering buildings. Building outlines were determined from aerial photographs and site survey.

In general, buildings far away from the subject site or far from critical flow paths were modelled at ground level with other landform disturbances by adjusting the Manning's 'n' hydraulic roughness value (see Section 4.3.4).

4.3.3 Infiltration

Infiltration losses were modelled using an Initial Loss/Continuing Loss (IL/CL) infiltration model. Initial losses and continuing loss rates were defined for each land use category and are based on the losses in Council's adopted 'Avalon to Palm Beach Floodplain Risk Management Study and Plan' (MHL 2017). The adopted loss parameters are presented in Table 2 in Section 4.3.4, alongside the roughness parameters, for each land use category.

4.3.4 Roughness

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 flow resistance; for example, a concrete path has a lower hydraulic roughness than a rough vegetated channel as water flows more freely over concrete than through a vegetated channel. Roughness in TUFLOW is modelled using the Manning's 'n' roughness co-efficient.

The catchment land use parameters are based on the land use parameters presented in Council's 'Avalon to Palm Beach Floodplain Risk Management Study and Plan' (MHL 2017). Table 2 lists the adopted Manning's roughness for each land use.

Table 2: Adopted roughness and infiltration parameters (MHL 2017)

Land use category	Initial loss (mm)	Continuing loss (mm/hr)	Manning's n
Roads	0.0	0.0	0.025
Residential and urban land	5.0	2.5	0.11

4.4 Boundary Conditions

This section describes the boundary conditions imposed upon the model. Typical model boundary conditions include flows entering the model domain from upstream, backwater effects from hydraulic controls such as chokes and streams downstream, and the flow predicted through the model domain by a separate hydrologic model.

4.4.1 Direct Rainfall

A direct rainfall boundary condition was applied to the area indicated as '2D model domain'. The direct rainfall methodology is described in Section 3.

4.4.2 Upstream Boundary

The use of direct rainfall and the selected 2D model domain means hydrologic and hydraulic modelling commenced at the top of the catchment. As such, no upstream boundary conditions were applied.

4.4.3 Downstream Boundary

A stage-discharge (water level versus flowrate) curve was adopted as the downstream boundary condition. This stage-discharge relationship was generated by TUFLOW by specifying a downstream boundary slope.

5.0 Flood Model Results

This section summarises the results of the hydrologic and hydraulic modelling of overland flows within the catchment. The behaviour of the PMF overland floodwaters within the vicinity of the subject site are described in general terms, and the impact of overland flooding on the subject site is discussed. Measures to address the risk posed by flooding at the site are presented in Section 6.

5.1 Flood Model Validation

Published PMF flood information is contained within (copy enclosed under Annexure B). The document provides information regarding the PMF flood extents, flood depth, provisional hazard and Life Hazard category which can be used to validate the performance of the ACOR flood model.

A summary of flood depths, levels and hazard categories is provided in Table 3 below.

Table 3: Comparison of modelled PMF flood behaviour

Item	Council issued information	ACOR model
Flood level	15.16 m AHD to 15.9 m AHD	15.0 m AHD to 16.2 m AHD
Flood depth	0.00 m to 0.26 m	0.00 m to 0.5 m
Provisional hazard	Low	Low
Life Hazard category	H1 to H2	H1 to H3

Table 3 reveals the PMF flood levels, depths and hazard categorisations predicted by ACOR's flood model are generally in close agreement with Council's adopted flood levels. We note that there are minor differences in depth which is a consequence of the buildings being represented as full obstructions within the ACOR TUFLOW model. We note this method is deemed appropriate for vulnerable use development which requires minimum floor levels to be at or above the PMF flood level. As a consequence, the results presented in this flood study provide a conservative outcome in relation to design flood levels and flood risk mitigation.

Based on the foregoing, we are of the view that the ACOR flood model produces an appropriate description of PMF flood behaviour within the catchment which is deemed fit for purpose.

5.2 Critical Duration

The critical duration for the PMF storm event is the 1 hour duration (MHL 2017).

5.3 Design Peak Flood Flow

The PMF peak flowrate passing through the site is 2.3 cumecs which occurs approximately 20 minutes after the commencement of rainfall.

5.4 Design Flood Characteristics

The flood velocity, flood depth, provisional flood hazard and life hazard category for the PMF event were mapped for the existing and proposed site conditions.

Based on the foregoing the generated flood maps illustrating the PMF flood behaviour are enclosed under Annexure A.

5.5 Provisional Flood Hazard

The degree of Provisional Hazard attributed to flooding at the subject site is a function of Hydraulic Hazard (relating to the depth and velocity of floodwaters) and is adjusted to account for the following factors:

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

Hazard categories are defined as either high, intermediate or low hazard and are based on the guidelines outlined in the Floodplain Development Manual (NSW DIPNR 2005) and in particular Figure L.2.

5.6 Life Hazard Category

The Life Hazard Category attributed to flooding at the subject site is based upon the Hazard Vulnerability Classification of the floodwaters. The Hazard Vulnerability Classification is a function of the Hydraulic Hazard (relating to the depth and velocity of floodwaters) and is adjusted to account for 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 guideline: Flood hazard' (Attorney-General's Department 2014) and in particular Figure 6. The available Hazard Vulnerability Classifications are described in Table 4 below.

Table 4: Description of Hazard Vulnerability Classifications (Attorney-General's Department 2014)

Hazard Vulnerability Classification	Description
H1	Generally safe for all people, vehicles and buildings.
H2	Unsafe for small vehicles. Generally safe for people and buildings.
H3	Unsafe for vehicles, children and the elderly. Generally safe for able-bodied adults.
H4	Unsafe for vehicles and people.
H5	Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.

5.7 Flood Affectation of the Site

The PMF floodwaters enter the site from the east, through No. 31 North Avalon Road, and from the north from North Avalon Road. The PMF floodwaters primarily impact the northern parts of the site close to North Avalon Road. The post developed PMF levels are generally within the range RL16.2 m AHD to RL 15.0 m AHD. The site is located within the Low Risk Precinct (MHL 2017).

The PMF floodwaters reach a maximum velocity within the site at 1.5 m/s, occurring in isolation at the corner of proposed Dwelling 1. This isolated velocity is a consequence of modelling the buildings as full obstructions. The PMF floodwater velocities are generally less than 0.7 m/s.

The PMF stormwater flows pose Low Hazard to future occupants of the site in both the pre and post development scenarios.

The PMF stormwater flows impacting the site are classified as Life Hazard category H1 to H3 in both pre and post development scenarios. We note the isolated occurrence of H3 floodwaters will not cause risk to future occupants of the site during a PMF event. We note our TUFLOW model considers a fully blocked pit and pipe system throughout the catchment. This produces a conservative scenario. We anticipate that the inclusion of a full pit and pipe network within the TUFLOW model would likely result in H1 to H2.

Low Hazard pedestrian access is available from the site during the PMF flood event.

6.0 Flood Risk Management

The behaviour of the PMF floodwaters at the site has been described in Section 5 for pre and post development site conditions.

Based on the foregoing we offer the following response, having due regard for the requirements of Pittwater 21 DCP Section B3.11 Flood Prone Land, Northern Beaches Council Flood Prone Land Design Standard, Flood Emergency Response Planning for Development in Pittwater Policy, Pittwater LEP 2014 Part 7.3 and 7.4, the Floodplain Development Manual (NSW DIPNR 2005) and discussions with Council's Team Leader for Floodplain Planning and Response.

6.1 Floor Level

In accordance with the requirements of Pittwater DCP 21 Section B3.11, Matrix 1, Vulnerable Use development within the Low Risk Precincts are required to comply with controls F2, F3 and F7 of the matrix. In this regard, we offer the following.

The subject site is not impacted by 1% AEP floodwaters (MHL 2017) and therefore will not impact on 1% AEP flood behaviour.

The proposed development includes flood mitigation works. In this regard, we refer to the details depicted on our document titled PMF Flood Mitigation Works Plan reference CC2000310, Sheet C, Revision B (copy enclosed under Annexure B). The proposal requires partially elevated access ramps and a driveway crest to protect the basement.

The habitable floors are proposed above PMF flood levels we refer Table 5 following.

Table 5 – Floor Level Requirements

Dwelling No.	PMF Level (m AHD)	Proposed Floor Level (m AHD)
1	15.55	15.60
2	15.80	15.90
3	16.10	16.2

In this regard, the proposed development complies with the requirements of Pittwater DCP 21 Section B3.11.

6.2 Drainage Infrastructure and Creek Works

The proposed development does not include works on drainage infrastructure or natural creeks. In this regard, control B of Pittwater 21 DCP Section B3.11 Flood Prone Land is not applicable to the proposed development.

6.3 Building Components and Structural Soundness

The proposed development is to be constructed of flood compatible building materials where the development is not flood protected to a level at or above the PMF. Extensive guidance on flood compatible building materials and methods is provided in 'Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas' (HNFMSC 2006); a selection of the flood compatible materials and practices described in this resource, supplemented with additional guidance provided in Pittwater 21 DCP Section B3.11 Flood Prone Land, is summarised below.

The proposed buildings shall be structurally certified to withstand the forces imposed by PMF floodwaters including, flowing water with debris, buoyancy and immersion.

Flood compatible deflection wall materials include reinforced or mass concrete and masonry.

Connection to mains power supply, including metering equipment should be located above the PMF.

All electrical wiring, switches and outlets which are not flood protected, where possible should be located above the PMF. All wiring, connections and conduit below the PMF should be suitable for submergence in water. Conduits shall be installed so they will be self-draining in the event of flooding.

Heating and air-conditioning systems, including fuel supply and ducting, should be installed above the PMF. Where this is not possible, they should be installed in such a manner as to minimise damage from submersion.

If the above structural soundness requirements and flood compatible building guidelines are adhered to, it is our view the proposed development will comply with the requirements of control C of Pittwater 21 DCP Section B3.11 Flood Prone Land.

6.4 Storage of Goods

It is anticipated that goods and materials which are susceptible to water damage, may become hazardous or potentially pollute floodwaters will be stored within the proposed dwelling and garage. We note that the proposed dwelling and garage provide space for storage of goods and materials above, or flood protected to, the PMF.

In this regard, we are of the view that the proposed development satisfies the requirements of control D of Pittwater 21 DCP Section B3.11 Flood Prone Land.

6.5 Flood Emergency Response

The proposed development is located within the H1 to H2 Flood Life Hazard Category, refer 'Flood Map A: Flood Life Hazard Category' of 'Flood Information Request – Multi Purpose' issued by Northern Beaches Council, dated 18 February 2019 (copy enclosed under Annexure C). As such, the Flood Emergency Response Planning for Development in Pittwater Policy does not apply. We note that the proposed development will provide internal habitable floor levels at or above the PMF level. Based on the foregoing, occupants may remain on-site during all flood event up to an including the PMF event.

The State Emergency Service of New South Wales (NSW SES) is responsible for providing flood updates and issuing Flood Evacuation Warnings and Flood Evacuation Orders. Flood information issued by the NSW SES may be received by local, radio and television news, SMS messaging, Facebook and door-knocking in affected communities. The timing for evacuation of persons is to be established in consultation with the NSW SES.

In the event that the 1% AEP flood event is expected to be exceeded, strategies should be adopted in accordance with NSW Government operational guidelines and SES Emergency Evacuation operational guidelines.

In this regard, we are of the view that the proposed development satisfies the requirements of control E of Pittwater 21 DCP Section B3.11.

6.6 Flood Effects Caused by Development

Through site specific flood study, it has been determined that the proposed development may result in an isolated increase in the PMF flood level within the footpath reserve near the north-western corner of the site. in this regard we confirm having had discussions with Northern Beaches Council's Team Leader for Floodplain Management. Based on these discussions, we understand that the prescriptive requirements for the post developed 1% AEP and PMF flood behaviour associated with this application are as follows:

- Off-site less than 20mm increase in 1% AEP flood levels
- No loss in flood storage or floodway for the 1% AEP event.
- Off-site less than 50mm increase in PMF flood levels
- Increase in flood velocities during the PMF event not to exceed 10%

We note the localised post developed PMF increase in flood level over the footpath is approximately 70mm. We note that this minor departure lies within acceptable tolerances of the model and we also understand that this is acceptable to Council.

Based on the foregoing , we are of the view that the proposed development will meet the intent of Control A of Pittwater 21 DCP Section B3.11 Flood Prone Land.

6.7 Car Parking

The entrance to the proposed basement car parking area shall be protected with a crest that is not below the PMF level of RL 16.0 m AHD.

In this regard, we are of the view that the proposed car parking area generally satisfies the requirements of control G of Pittwater 21 DCP Section B3.11 Flood Prone Land and Northern Beaches Council's Flood Prone Land Design Standard.

6.8 Pools

A pool is not proposed as part of the proposed development.

6.9 Fencing

The proposed dwelling is not located within the Flood Planning Area (MHL 2017) refer 'Flood Map C: Flood Life Hazard Category' of 'Flood Information Request – Multi Purpose' issued by Northern Beaches Council, dated 18 February 2019 (copy enclosed under Annexure C).

In this regard, we are of the view that the proposed development satisfies the requirements of control H of Pittwater 21 DCP Section B3.11 Flood Prone Land.

7.0 Conclusion

Based on the foregoing, we are of the view that the proposed development generally complies with the Pittwater 21 Development Control Plan Amendment 22 (Pittwater 21 DCP) Section B3.11 Flood Prone Land; Northern Beaches Council Flood Prone Land Design Standard; Flood Emergency Response Planning for Development in Pittwater Policy; and Pittwater Local Environmental Plan 2014 (Amendment No 7) (Pittwater LEP 2014) Part 7.3 and 7.4 provisions for Vulnerable Use development located on flood prone land.

8.0 References

Attorney-General's Department. (2014). *Technical flood risk management guideline: Flood hazard*. Barton, ACT: Author.

Hawkesbury-Nepean Floodplain Management Steering Committee (HNFMSC). (2006). *Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas*. Parramatta, NSW: Author. Available from http://www.ses.nsw.gov.au/content/documents/pdf/resources/Building_Guidelines.pdf

New South Wales Department of Infrastructure, Planning and Natural Resources (NSW DIPNR). (2005). *Floodplain Development Manual: the management of flood liable land*. Sydney, NSW: Author.

Northern Beaches Council. (n.d.). *Flood Prone Land Design Standard*.

Pilgrim D H (Ed.). (1998). *Australian Rainfall and Runoff*. Barton, ACT: Institution of Engineers Australia.

Pittwater Local Environmental Plan 2014

Pittwater Council. (2017b). *Pittwater 21 Development Control Plan Amendment 22*.

Manly Hydraulics Laboratory (MHL). (2017). *Avalon to Palm Beach Floodplain Risk Management Study and Plan: Final Report*. Manly Vale, NSW: Author.

9.0 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 mean 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 mainstream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.

Design flood	A flood event to be considered in the design process.
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 super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
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). In summary: • High: conditions that pose a possible danger to personal safety; evacuation by trucks difficult; able-bodied adults would have difficulty wading to safety; potential for significant structural damage to buildings. • Low: conditions such that people and their possessions could be evacuated by trucks; able-bodied adults would have little difficulty wading to safety.
Flood planning area	The area of land below the FPL and thus 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 freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans.
Floodplain, flood-prone land	Land susceptible to inundation by the probable maximum flood (PMF) event, i.e. the maximum extent of flood liable land.
Floodplain risk management options	The measures that might be feasible for the management of a particular area of the floodplain.

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).
Geographical information systems (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.
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.
Hydraulic category	A classification of floodwater hydraulic behaviour. The categories are: • Floodway: those areas of the floodplain where a significant discharge of water 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. • Flood storage: those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. Loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. • Flood fringe: remaining area of flood-prone land after floodway and flood storage areas have been defined
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, estuary, lake or dam.
Mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, 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.
Probable Maximum Precipitation (PMP)	The PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location.
Probability	A statistical measure of the expected frequency or occurrence of flooding.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. For this study, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
Runoff	The amount of rainfall that actually ends up as stream or pipe flow, also known as rainfall excess.

ANNEXURE A

ACOR (CC) Pty Ltd Flood Plans

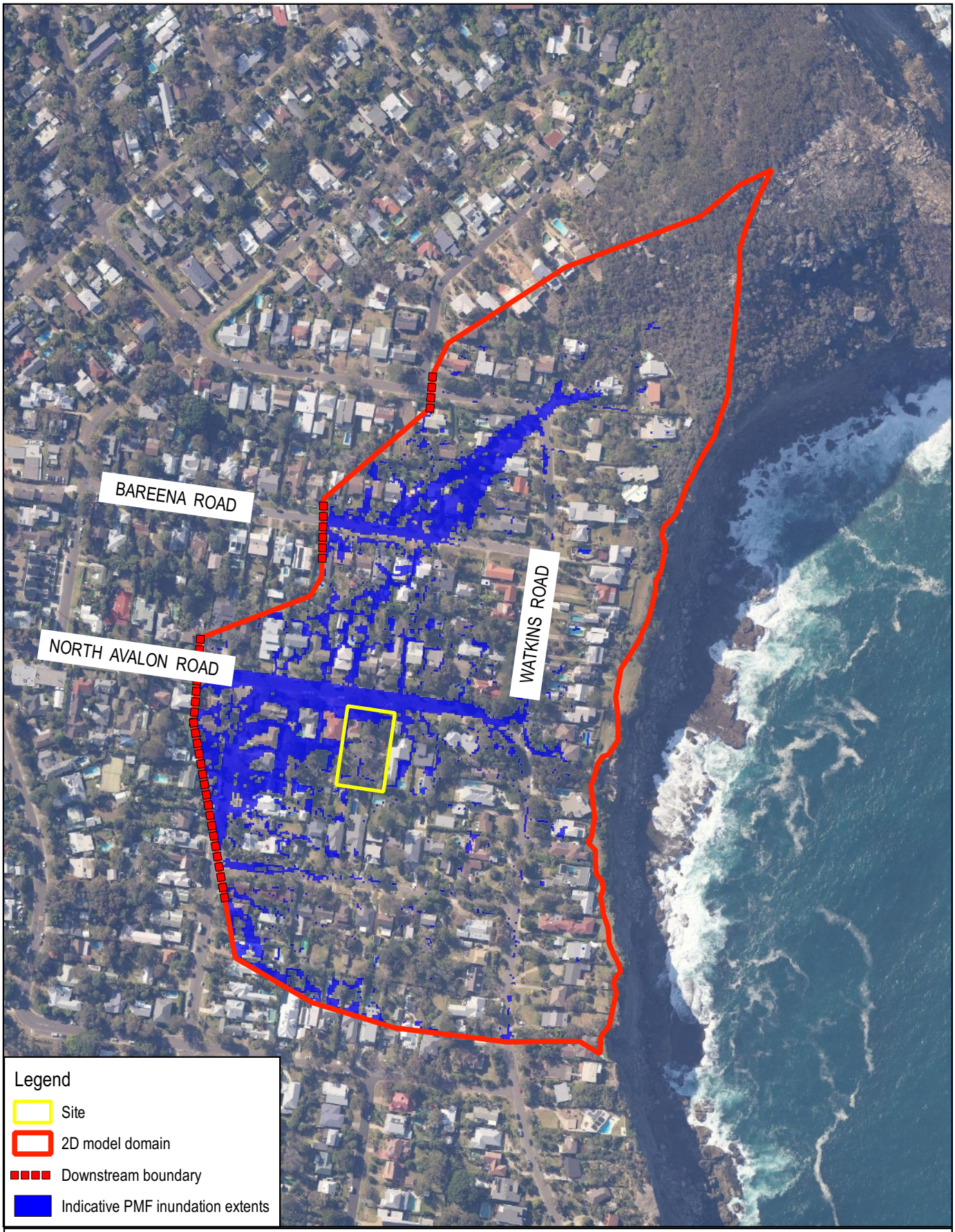
Reference CC200310

Sheets F1 to F10

Revision C

dated

18 September 2020.



Title: TUFLOW MODEL PLAN

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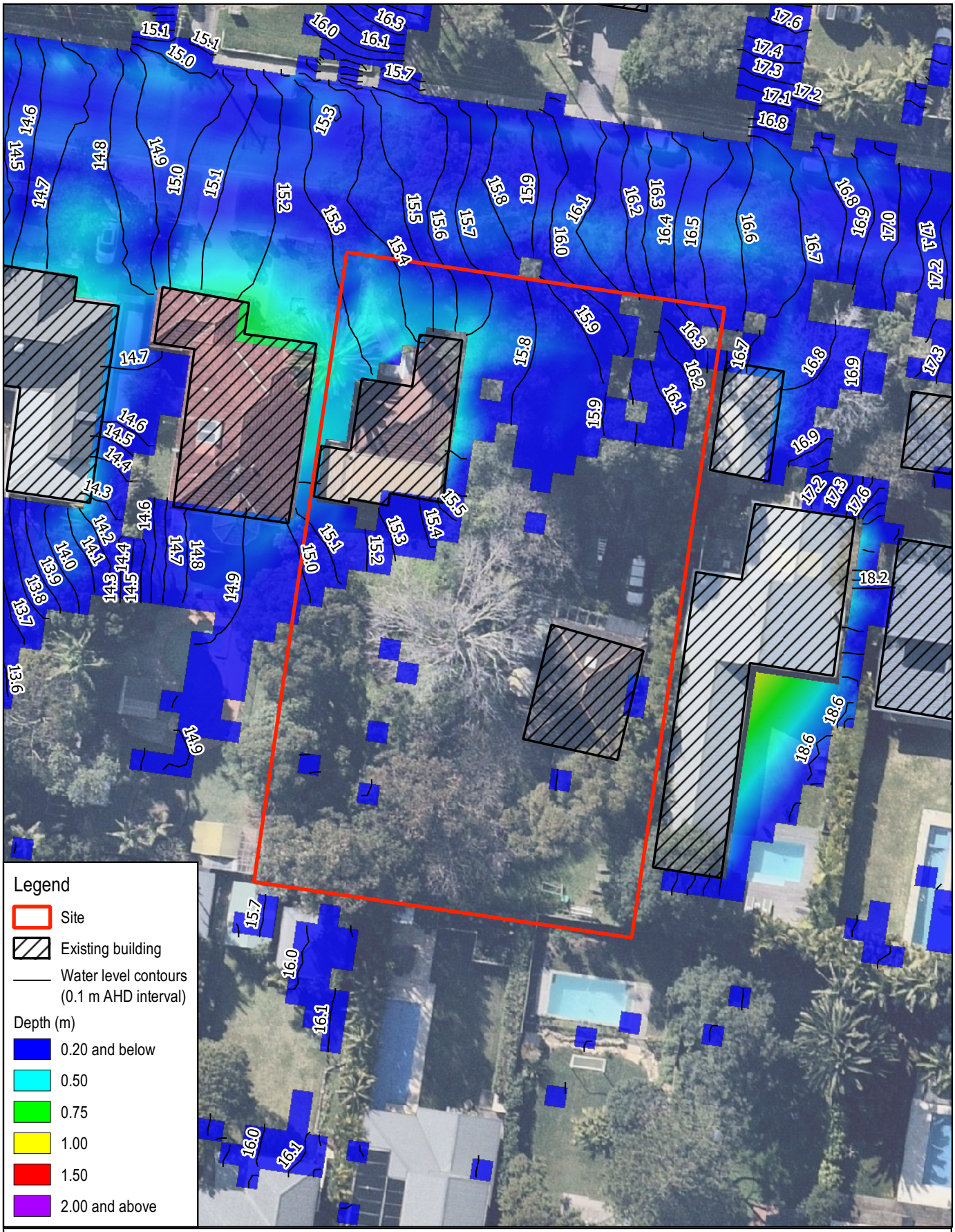
Project: PROPOSED SENIORS LIVING DEVELOPMENT
No.'s 27 - 29
NORTH AVALON ROAD
AVALON BEACH

Client: ARMADA AVALON PTY LTD

North:

Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
CC200310	F1	C	18.09.2020	BK	NB	1:4,000



Title: PRE DEVELOPMENT PMF FLOOD DEPTH AND LEVEL PLAN

ACOR CONSULTANTS
ENGINEERS | MANAGERS | INFRASTRUCTURE PLANNERS | DEVELOPMENT CONSULTANTS

ACOR Consultants (CC) Pty Ltd
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T +61 2 4324 3499

Project: PROPOSED SENIORS LIVING DEVELOPMENT
No.'s 27 - 29
NORTH AVALON ROAD
AVALON BEACH

Client: ARMADA AVALON PTY LTD

North:

Job Number	Sheet	Revision	Date	Designed	Drawn	Scale
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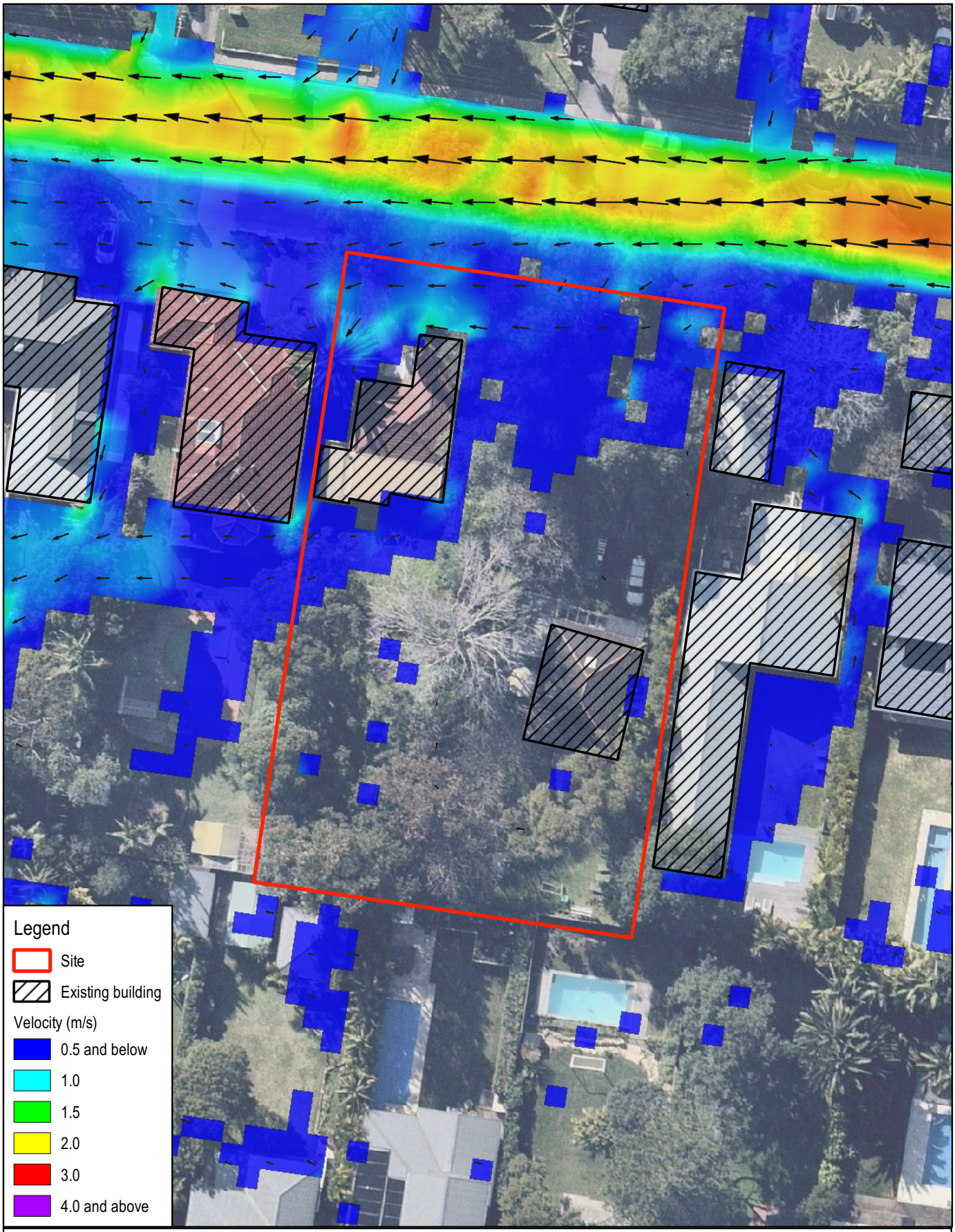

Title: PRE DEVELOPMENT PMF FLOOD VELOCITY PLAN

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Project: PROPOSED SENIORS LIVING DEVELOPMENT
No.'s 27 - 29
NORTH AVALON ROAD
AVALON BEACH

Client: ARMADA AVALON PTY LTD

North:

Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
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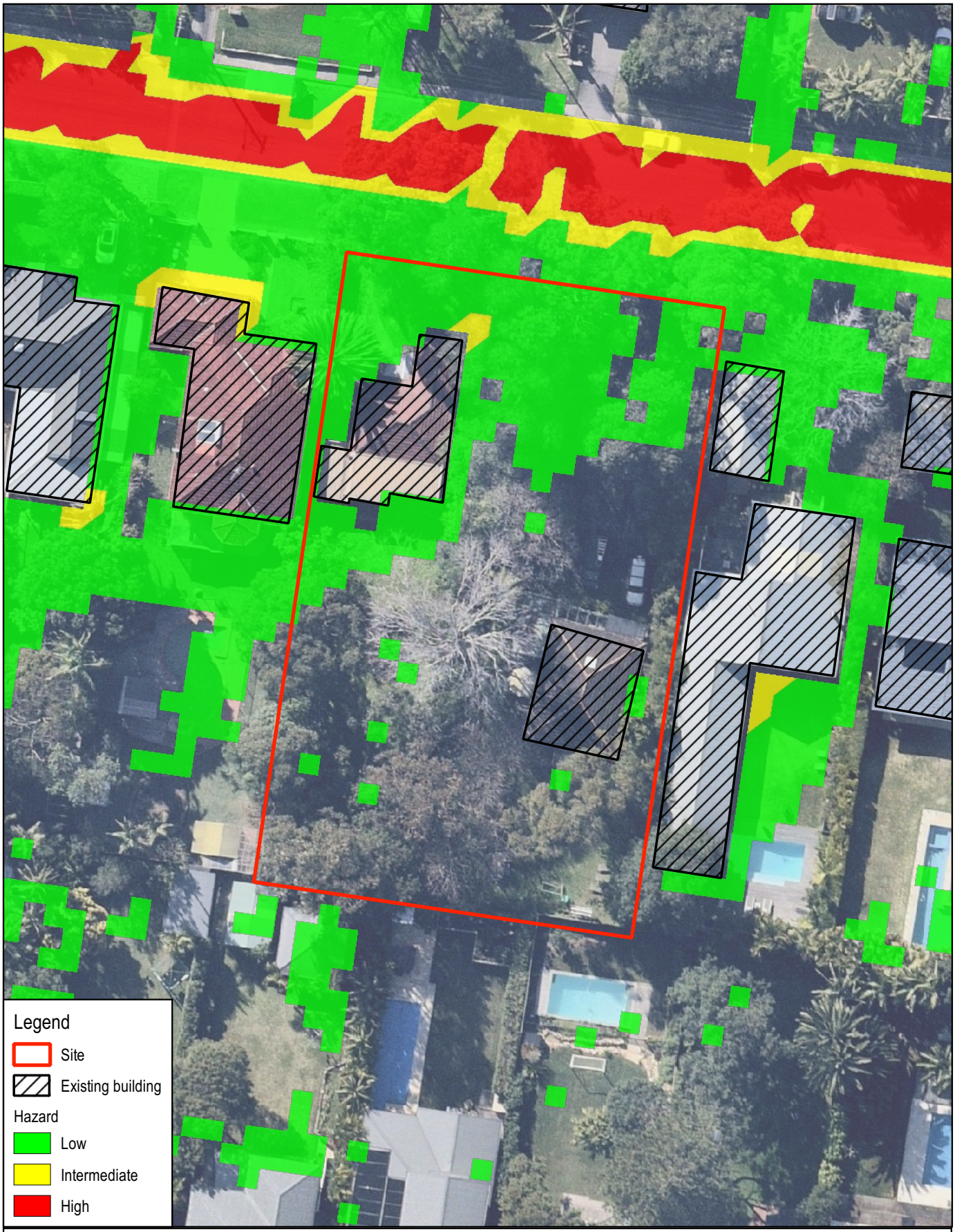

Title: PRE DEVELOPMENT PMF PROVISIONAL FLOOD HAZARD PLAN

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Project: PROPOSED SENIORS LIVING DEVELOPMENT
No.'s 27 - 29
NORTH AVALON ROAD
AVALON BEACH

Client: ARMADA AVALON PTY LTD

North:

Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
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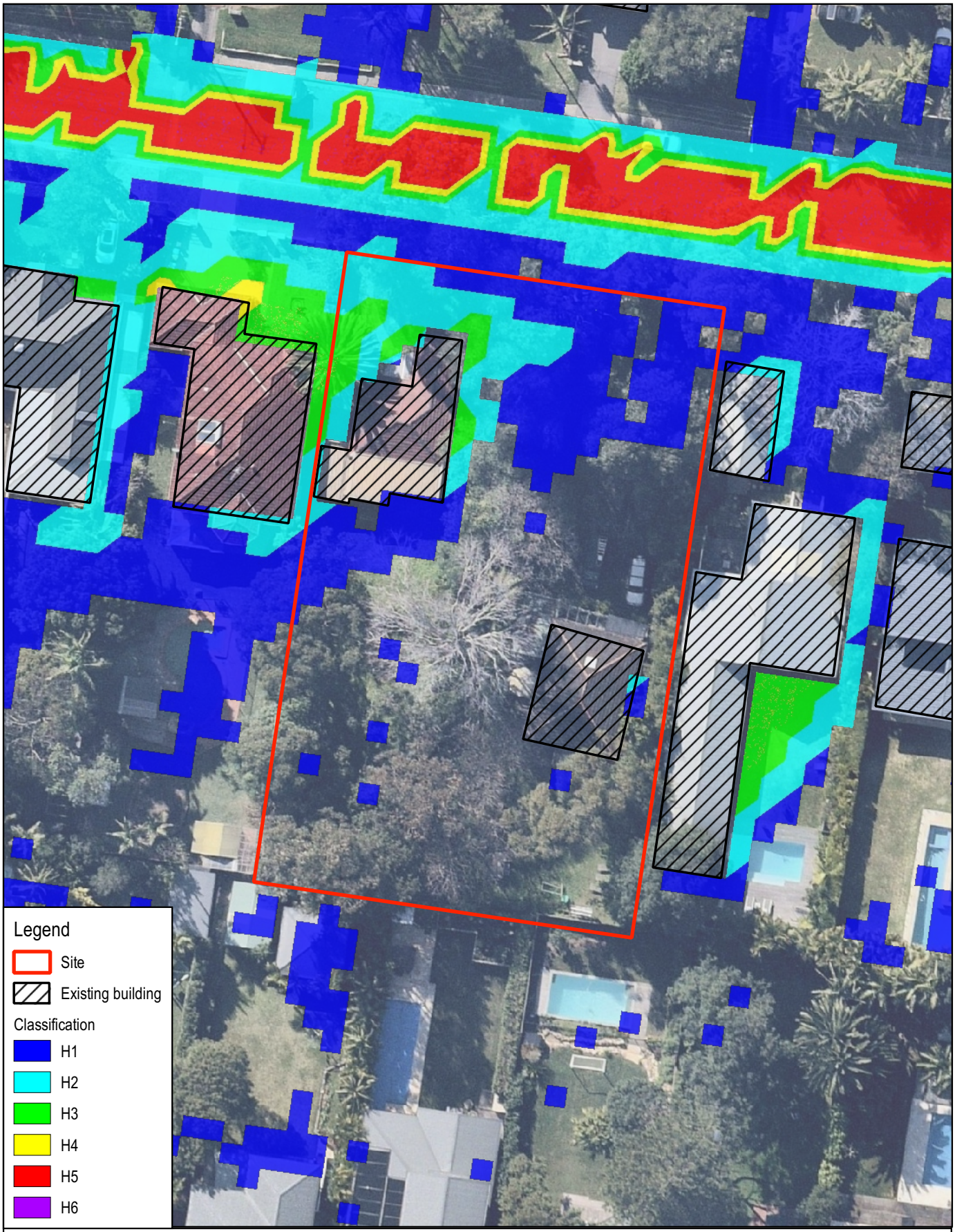

Title: PRE DEVELOPMENT PMF FLOOD HAZARD VULNERABILITY CLASSIFICATION PLAN

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Project: PROPOSED SENIORS LIVING DEVELOPMENT
No.'s 27 - 29
NORTH AVALON ROAD
AVALON BEACH

Client: ARMADA AVALON PTY LTD

North:

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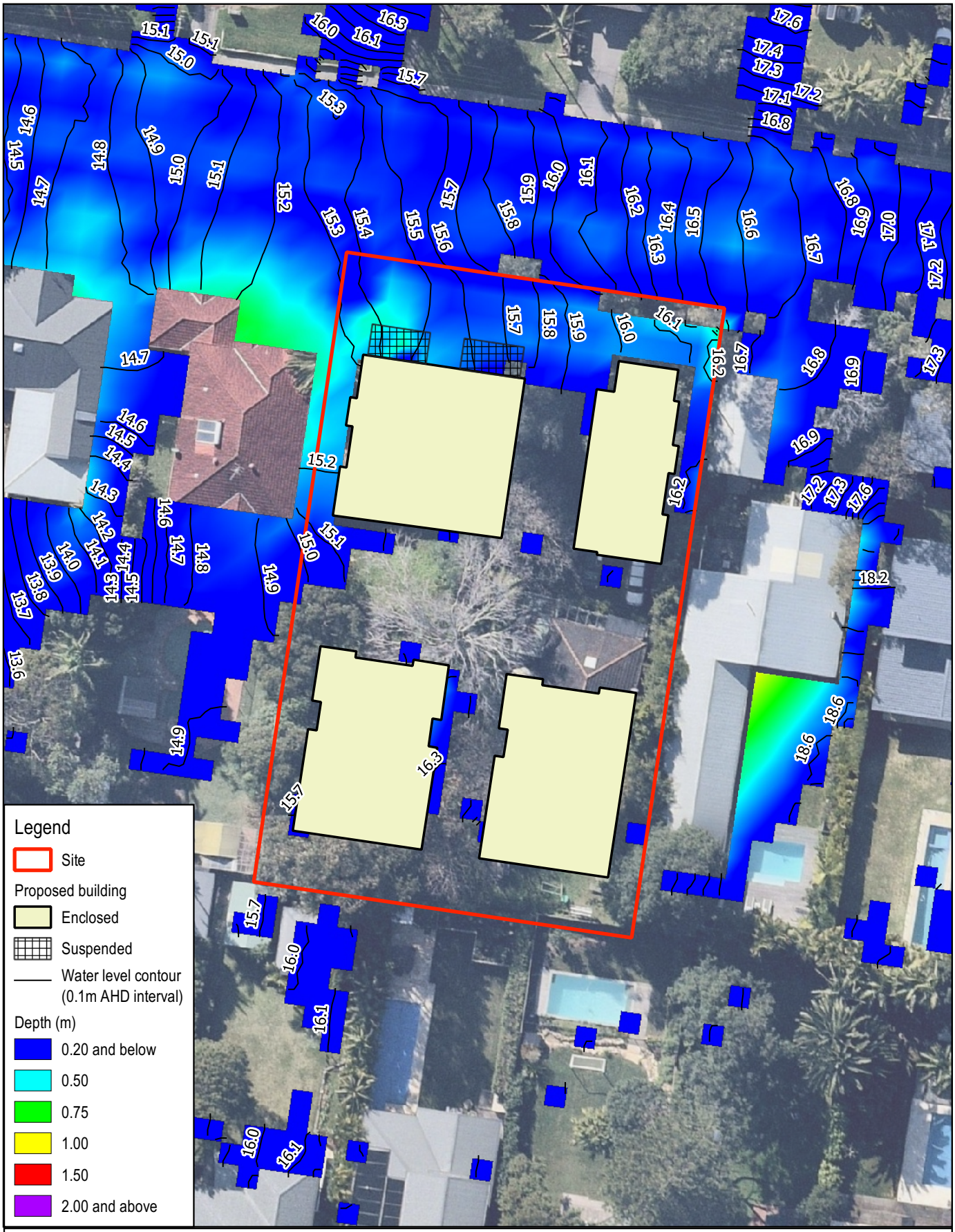

Title: POST DEVELOPMENT PMF FLOOD DEPTH AND LEVEL PLAN

ACOR CONSULTANTS

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Project: PROPOSED SENIORS LIVING DEVELOPMENT
No.'s 27 - 29
NORTH AVALON ROAD
AVALON BEACH

Client: ARMADA AVALON PTY LTD

North:

Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
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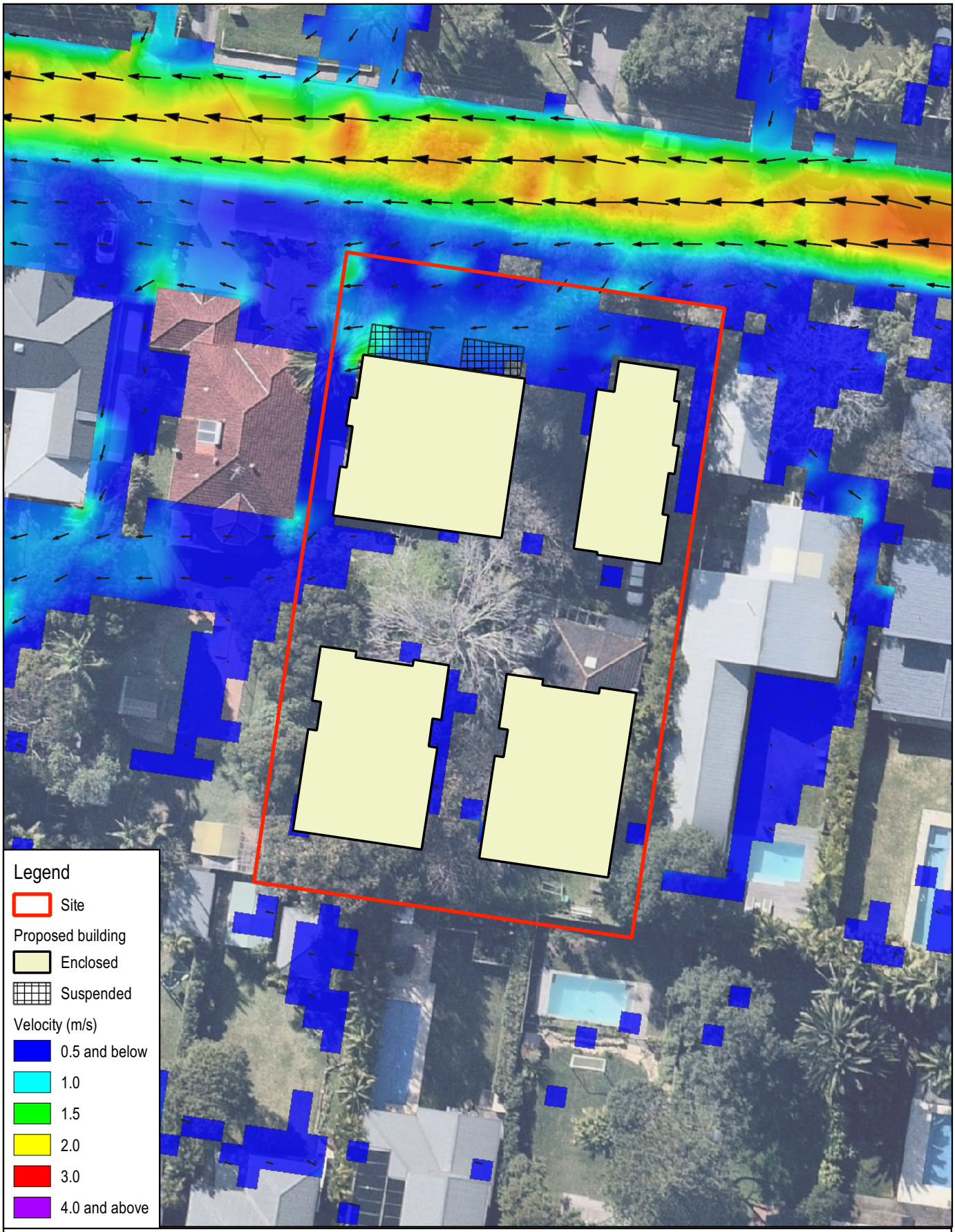

Title: POST DEVELOPMENT PMF FLOOD VELOCITY PLAN

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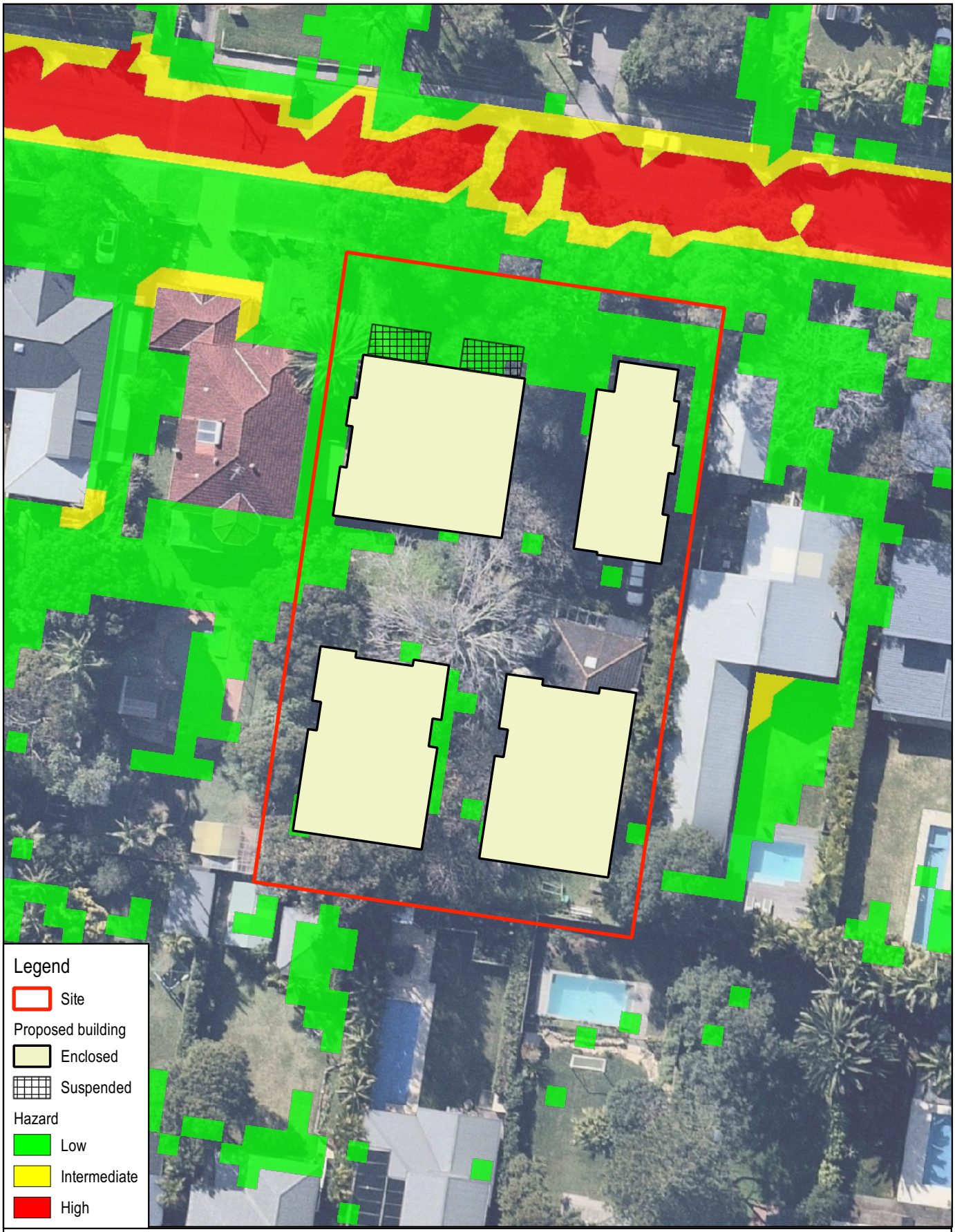

Title: POST DEVELOPMENT PMF PROVISIONAL FLOOD HAZARD PLAN

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Project: PROPOSED SENIORS LIVING DEVELOPMENT
No.'s 27 - 29
NORTH AVALON ROAD
AVALON BEACH

Client: ARMADA AVALON PTY LTD

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Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
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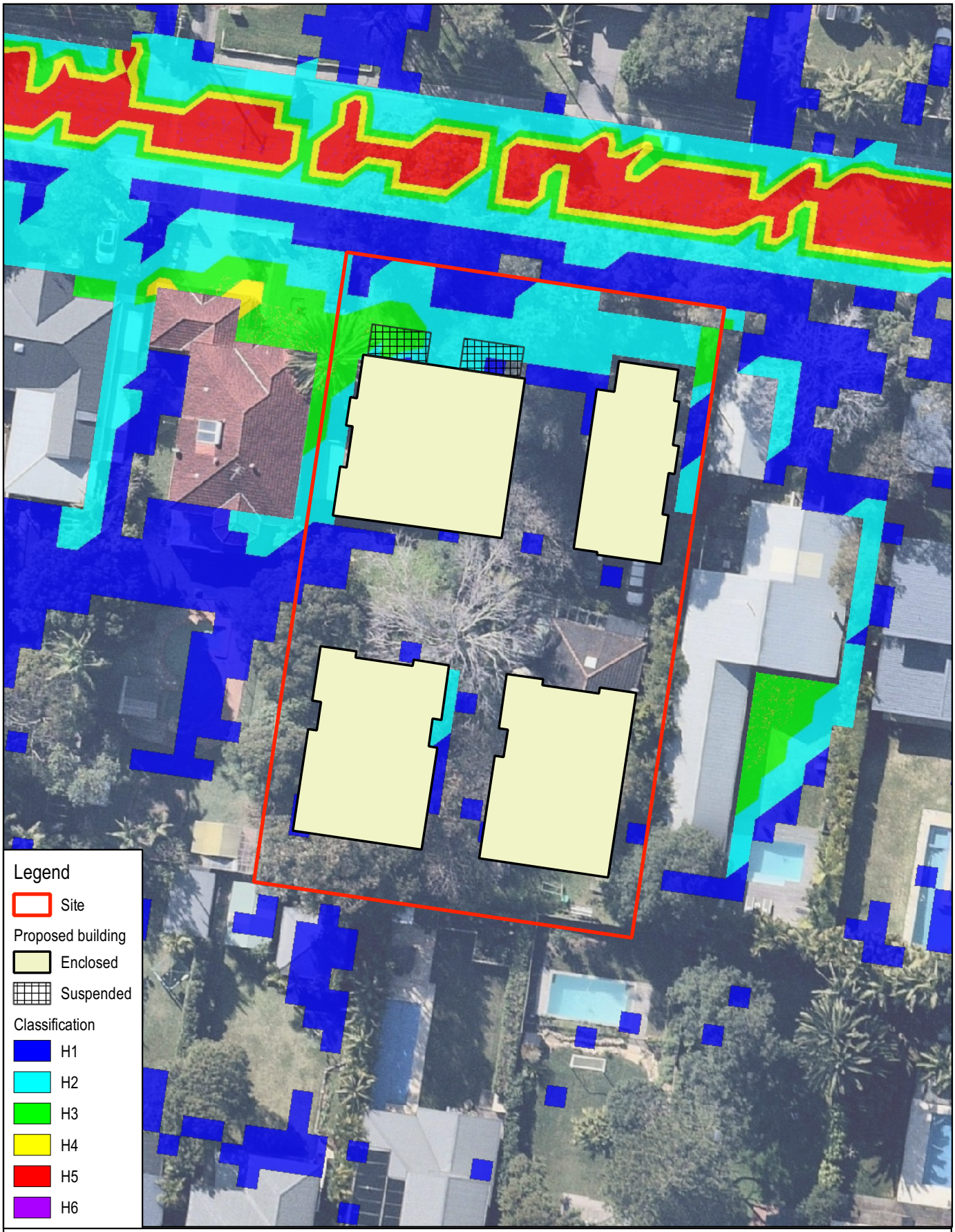

Title: POST DEVELOPMENT PMF PROVISIONAL FLOOD HAZARD PLAN

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Project: PROPOSED SENIORS LIVING DEVELOPMENT
No.'s 27 - 29
NORTH AVALON ROAD
AVALON BEACH

Client: ARMADA AVALON PTY LTD

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Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
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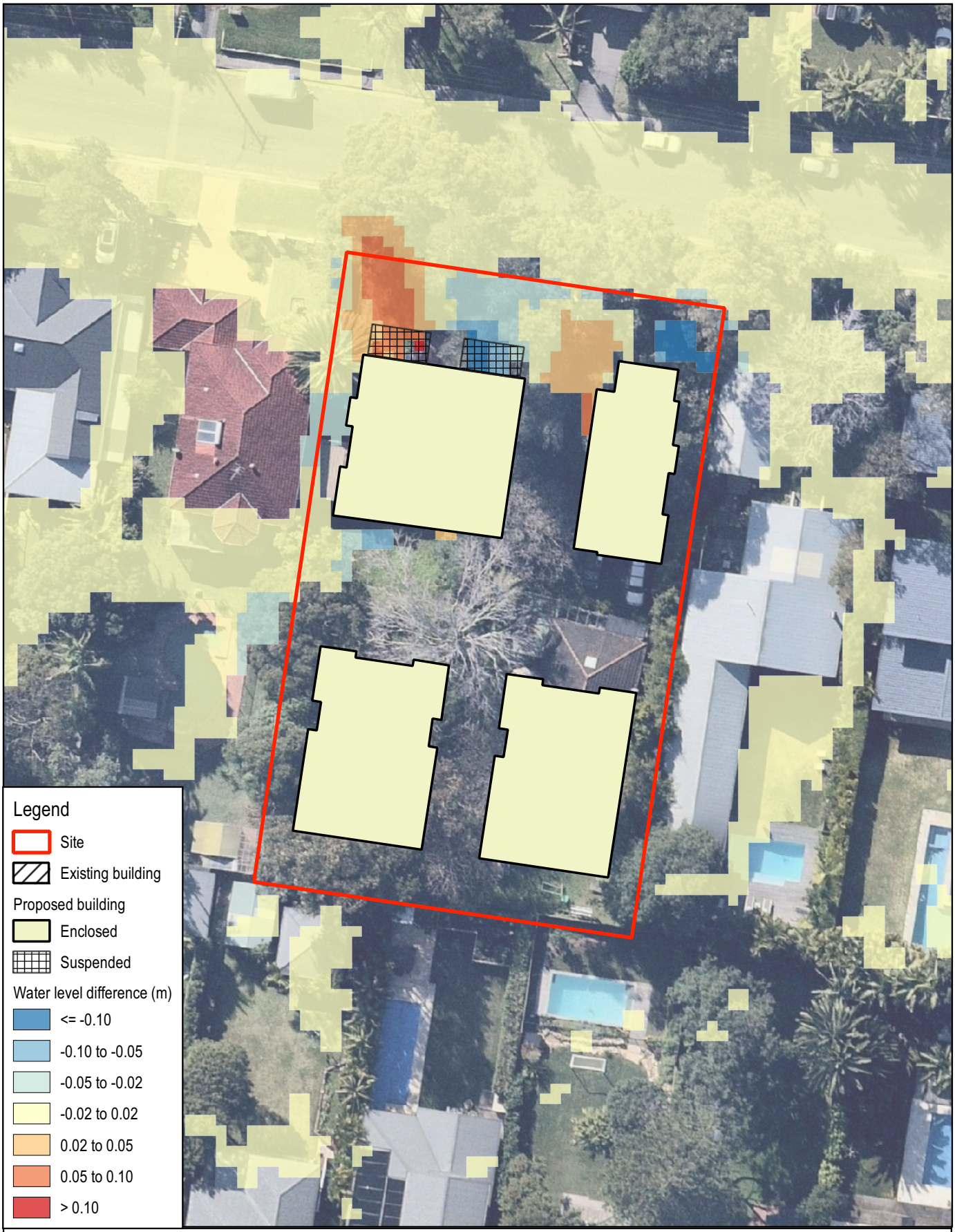

Title: POST DEVELOPMENT PMF WATER LEVEL DIFFERENCE PLAN

ACOR CONSULTANTS

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Project: PROPOSED SENIORS LIVING DEVELOPMENT
No.'s 27 - 29
NORTH AVALON ROAD
AVALON BEACH

Client: ARMADA AVALON PTY LTD

North:

Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
CC200310	F10	C	18.09.2020	BK	NB	1:500

ANNEXURE B

ACOR (CC) Pty Ltd Stormwater Management Plans

Sheets C1 to C6

Issue B

dated

22 September 2020

PROPOSED DEVELOPMENT
No.27 - 29 NORTH AVALON ROAD, AVALON BEACH
STORMWATER MANAGEMENT PLANS

LEGEND

- DENOTES ON-SITE DETENTION TANK
- DENOTES ON-SITE RETENTION TANK
- DENOTES DWELLING FOOTPRINT
- SW — DENOTES 100mm DIA. STORMWATER/SURFACE WATER SYSTEM PIPE AT 1% MIN. GRADE U.N.O.
- RW — DENOTES 100mm DIA. FULLY SEALED RAINWATER SYSTEM PIPE U.N.O.
- 150 RW — DENOTES RAINWATER PIPE AND DIA. WHEN PIPE EXCEEDS 100mm DIA.
- 150 SW — DENOTES STORMWATER/SURFACE WATER PIPE AND DIA. WHEN PIPE EXCEEDS 100mm DIA.
- 65 W/RM — DENOTES RISING MAIN AND PIPE DIA. U.N.O.
- 100 SS — DENOTES SUBSOIL DRAINAGE LINE AND DIA. WRAPPED IN GEOFABRIC U.N.O.
- DP — DENOTES DOWNPIPE
- IO — DENOTES INSPECTION OPENING WITH SCREW DOWN LID AT FINISHED SURFACE LEVEL
- CO — DENOTES INSPECTION OPENING WITH SCREW DOWN LID AT FINISHED SURFACE LEVEL FOR SYSTEM FLUSHING PURPOSES
- STORMWATER PIT - SOLID COVER
- STORMWATER PIT - GRATED INLET
- DENOTES GRATED DRAIN
- DENOTES ABSORPTION TRENCH
- NON RETURN VALVE
- PUMP
- STOP VALVE (ISOLATION VALVE)
- 240v REQUIRED
- IL23.31 — DENOTES LEVEL OF INLET /OUTLET OF STORMWATER PIPE. NOTE: UNLESS NOTED OTHERWISE, THE BASE OF THE PIT IS THE SAME AS THE PIPE INLET/OUTLET.

DIAL BEFORE YOU DIG

DIAL BEFORE YOU DIG www.1100.com.au

IMPORTANT: THE CONTRACTOR IS TO MAINTAIN A CURRENT SET OF "DIAL BEFORE YOU DIG" DRAWINGS ON SITE AT ALL TIMES.

GENERAL NOTES

1. THESE PLANS SHALL BE READ IN CONJUNCTION WITH OTHER RELEVANT CONSULTANTS' PLANS, SPECIFICATIONS, CONDITIONS OF DEVELOPMENT CONSENT AND CONSTRUCTION CERTIFICATE REQUIREMENTS. WHERE DISCREPANCIES ARE FOUND ACOR CONSULTANTS (CC) MUST BE CONTACTED IMMEDIATELY FOR VERIFICATION
2. WHERE THESE PLANS ARE NOTED FOR DEVELOPMENT APPLICATION PURPOSES ONLY, THEY SHALL NOT BE USED FOR OBTAINING A CONSTRUCTION CERTIFICATE NOR USED FOR CONSTRUCTION PURPOSES
3. SUBSOIL DRAINAGE SHALL BE DESIGNED AND DETAILED BY THE STRUCTURAL ENGINEER. SUBSOIL DRAINAGE SHALL NOT BE CONNECTED INTO THE STORMWATER SYSTEM IDENTIFIED ON THESE PLANS UNLESS APPROVED BY ACOR CONSULTANTS (CC)

STORMWATER CONSTRUCTION NOTES

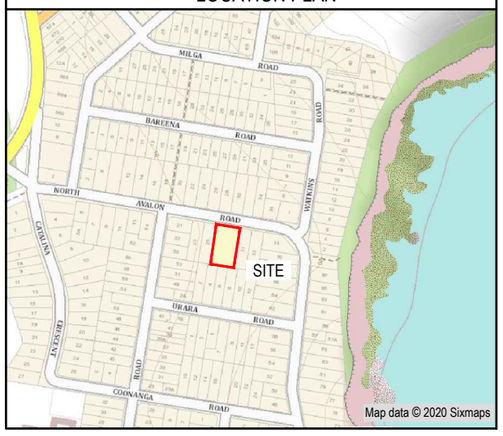
1. ALL WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH AS/NZS 3500 (CURRENT EDITION) AND THE REQUIREMENTS OF THE LOCAL COUNCIL'S POLICIES AND CODES
2. THE MINIMUM SIZES OF THE STORMWATER DRAINS SHALL NOT BE LESS THAN DN90 FOR CLASS 1 BUILDINGS AND DN100 FOR OTHER CLASSES OF BUILDING OR AS REQUIRED BY THE REGULATORY AUTHORITY
3. THE MINIMUM GRADIENT OF STORMWATER DRAINS SHALL BE 1%, UNLESS NOTED OTHERWISE
4. COUNCIL'S TREE PRESERVATION ORDER IS TO BE STRICTLY ADHERED TO. NO TREES SHALL BE REMOVED UNTIL PERMIT IS OBTAINED
5. PUBLIC UTILITY SERVICES ARE TO BE ADJUSTED AS NECESSARY AT THE CLIENT'S EXPENSE
6. ALL PITS TO BE BENCHED AND STREAMLINED. PROVIDE STEP IRONS FOR ALL PITS OVER 1.2m DEEP
7. MAKE SMOOTH JUNCTION WITH ALL EXISTING WORK
8. VEHICULAR ACCESS AND ALL SERVICES TO BE MAINTAINED AT ALL TIMES TO ADJOINING PROPERTIES AFFECTED BY CONSTRUCTION
9. SERVICES SHOWN ON THESE PLANS HAVE BEEN LOCATED FROM INFORMATION SUPPLIED BY THE RELEVANT AUTHORITIES AND FIELD INVESTIGATIONS AND ARE NOT GUARANTEED COMPLETE NOR CORRECT. IT IS THE CLIENT & CONTRACTOR'S RESPONSIBILITY TO LOCATE ALL PRIOR TO CONSTRUCTION
10. ANY VARIATION TO THE WORKS AS SHOWN ON THE APPROVED DRAWINGS ARE TO BE CONFIRMED BY ACOR CONSULTANTS (CC) PRIOR TO THEIR COMMENCEMENT

RAINWATER RE-USE SYSTEM NOTES

1. RAINWATER SUPPLY PLUMBING TO BE CONNECTED TO OUTLETS WHERE REQUIRED BY BASIX CERTIFICATE (BY OTHERS)
2. TOWN WATER CONNECTION TO RAINWATER TANK TO BE TO THE SATISFACTION OF THE REGULATORY AUTHORITY. THIS MAY REQUIRE PROVISION OF:
   2.1. PERMANENT AIR GAP
   2.2. BACKFLOW PREVENTION DEVICE
3. NO DIRECT CONNECTION BETWEEN TOWN WATER SUPPLY AND THE RAIN WATER SUPPLY
4. AN APPROVED STOP VALVE AND/OR PRESSURE LIMITING VALVE AT THE RAINWATER TANK
5. PROVIDE AT LEAST ONE EXTERNAL HOSE COCK ON THE TOWN WATER SUPPLY FOR FIRE FIGHTING
6. PROVIDE APPROPRIATE FLOAT VALVES AND/OR SOLENOID VALVES TO CONTROL TOWN WATER SUPPLY INLET TO TANK IN ORDER TO ACHIEVE THE TOP-UP INDICATED ON THE TYPICAL DETAIL
7. ALL PLUMBING WORKS ARE TO BE CARRIED OUT BY LICENSED PLUMBERS IN ACCORDANCE WITH AS/NZS3500.1 NATIONAL PLUMBING AND DRAINAGE CODE
8. PRESSURE PUMP ELECTRICAL CONNECTION TO BE CARRIED OUT BY A LICENSED ELECTRICIAN
9. ONLY ROOF RUN-OFF IS TO BE DIRECTED TO THE RAINWATER TANK . SURFACE WATER INLETS ARE NOT TO BE CONNECTED
10. PIPE MATERIALS FOR RAINWATER SUPPLY PLUMBING ARE TO BE APPROVED MATERIALS TO AS/NZS3500 PART 1 SECTION 2 AND TO BE CLEARLY AND PERMANENTLY IDENTIFIED AS 'RAINWATER'. THIS MAY BE ACHIEVED FOR BELOW GROUND PIPES USING IDENTIFICATION TAPE (MADE IN ACCORDANCE WITH AS2648) OR FOR ABOVE GROUND PIPES BY USING ADHESIVE PIPE MARKERS (MADE IN ACCORDANCE WITH AS1345)
11. EVERY RAINWATER SUPPLY OUTLET POINT AND THE RAINWATER TANK ARE TO BE LABELED 'RAINWATER' ON A METALLIC SIGN IN ACCORDANCE WITH AS1319
12. ALL INLETS AND OUTLETS TO THE RAINWATER TANK ARE TO HAVE SUITABLE MEASURES PROVIDED TO PREVENT MOSQUITO AND VERMIN ENTRY

SHEET INDEX

LOCATION PLAN



This drawing has been assigned an electronic code that signifies the drawing has been checked and approved by: MR MICHAEL GOODWIN MIEAust CPEng NER

Issue	Description	Date	Drawn	Approved
B	ISSUED FOR COUNCIL APPROVAL	22.09.20	SJ	BK
A	ISSUED FOR CLIENT REVIEW	21.09.20	SJ	BK

0 1cm at full size 10cm

North

Client: ARMADA AVALON PTY LTD

Architect: ENVIRONA STUDIO

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Project: PROPOSED RESIDENTIAL DEVELOPMENT
No.27 - 29
NORTH AVALON ROAD
AVALON BEACH

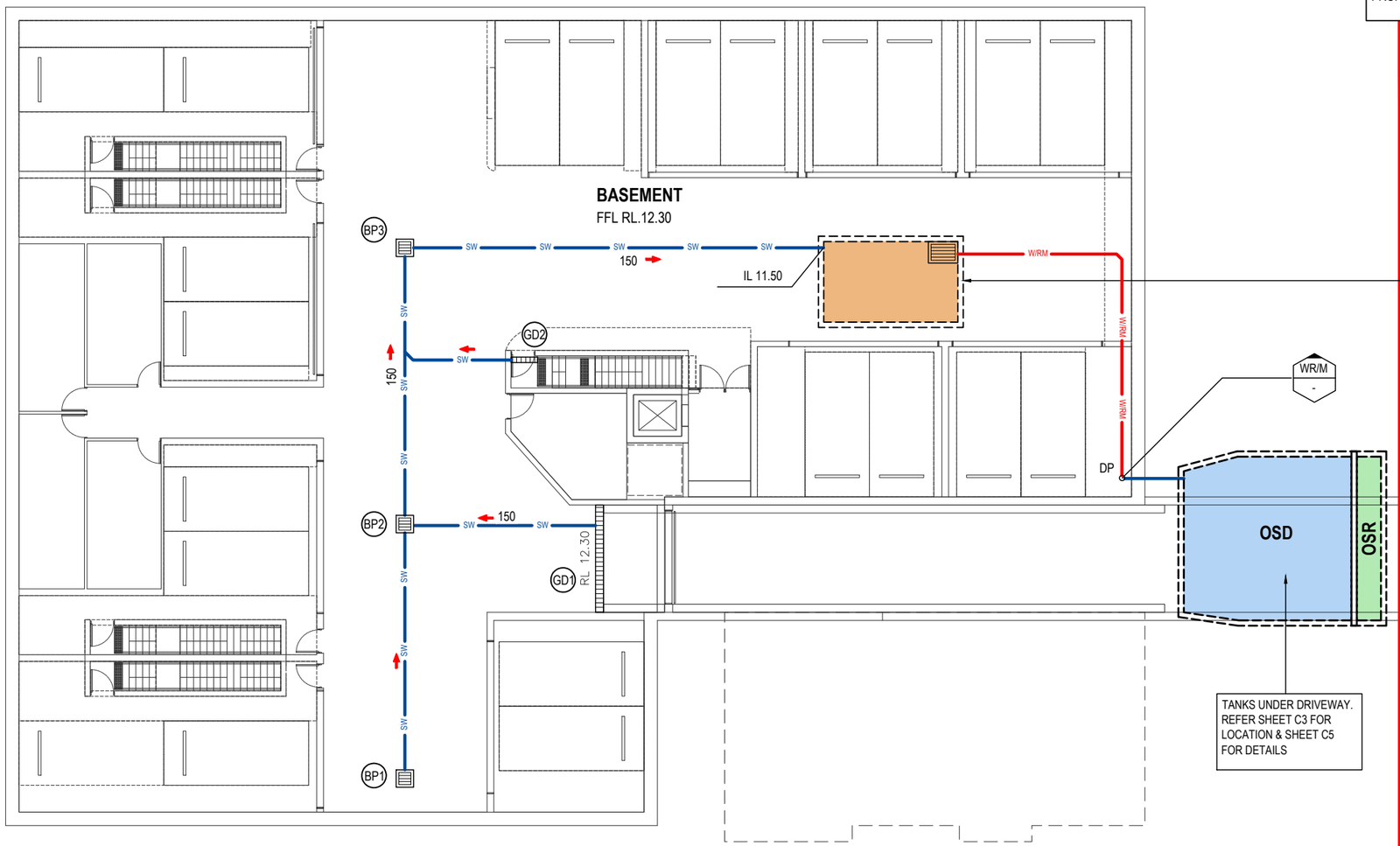
Drawing Title: COVER SHEET & NOTES

Drawn	Date	Scale A1	Q.A. Check	Date
SJ	18.09.20	AS NOTED	-	-
Designed	Project No.	Dwg. No.	Issue	
BK	CC200310	C1	B	

PIT SCHEDULE

PIT No.	TYPE	SIZE	TOP GRATE	INVERT
BP1	HD GRATED INLET	450 x 450	12.25	11.85
BP2	HD GRATED INLET	450 x 450	12.25	11.75
BP3	HD GRATED INLET	450 x 450	12.25	11.65
GD1	HD GRATED INLET	300 WD x 200 DP	12.30	11.85
GD2	HD GRATED INLET	300 WD x 200 DP	12.30	11.85

PROPOSED PIT SURFACE LEVELS AND INVERTS TO BE CONFIRMED ON SITE PRIOR TO CONSTRUCTION



BASEMENT PUMPOUT TANK

REFER TO SHEET C4 FOR DETAILS
MINIMUM STORAGE CAPACITY BASED ON DRIVEWAY CATCHMENT AREA OF 110m² = 15m³
APPROXIMATE TANK DIMENSIONS
INTERNAL LENGTH 5.0m
INTERNAL WIDTH 3.0m
INTERNAL DEPTH 1.00m
COVER LEVEL 12.25 NOM.
TANK INVERT LEVEL 11.05 NOM

STORMWATER LEGEND

- RW — DENOTES 100mm DIA. FULLY SEALED UNDERGROUND RAINWATER SYSTEM PIPE U.N.O.
- SW — DENOTES 100mm DIA. UNDERGROUND STORMWATER / SURFACE WATER SYSTEM PIPE AT 1% MIN. GRADE U.N.O.
- 150 RW — DENOTES RAINWATER PIPE AND DIA. WHEN PIPE EXCEEDS 100mm DIA.
- 150 SW — DENOTES STORMWATER/SURFACE WATER PIPE AND DIA. WHEN PIPE EXCEEDS 100mm DIA.
- W/RM — DENOTES WATER RISER MAIN (BY OTHERS)
- 150 — DENOTES SEALED AERIAL LINE RAINWATER PIPE (UNDER SLAB) AND DIA. WHEN PIPE EXCEEDS 100mm DIA. INSTALLED IN ACCORDANCE WITH AS3500.3
- 150 — DENOTES SEALED AERIAL LINE STORMWATER PIPE (UNDER SLAB) AND DIA. WHEN PIPE EXCEEDS 100mm DIA. INSTALLED IN ACCORDANCE WITH AS3500.3
- DR1 / 150 — DENOTES THE LOCATIONS OF STORMWATER DROPPERS AND SPECIFIED DIAMETER.
- SO — DENOTES SURFACE OUTLET.
- PO — DENOTES PLANTER BOX OUTLET.
- BT — 300 DIA BUCKET TRAP

STORMWATER MANAGEMENT PLAN - BASEMENT

SCALE - 1:100/A1, 1:200/A3

0 1 2 4 6 8 10m

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1cm at full size

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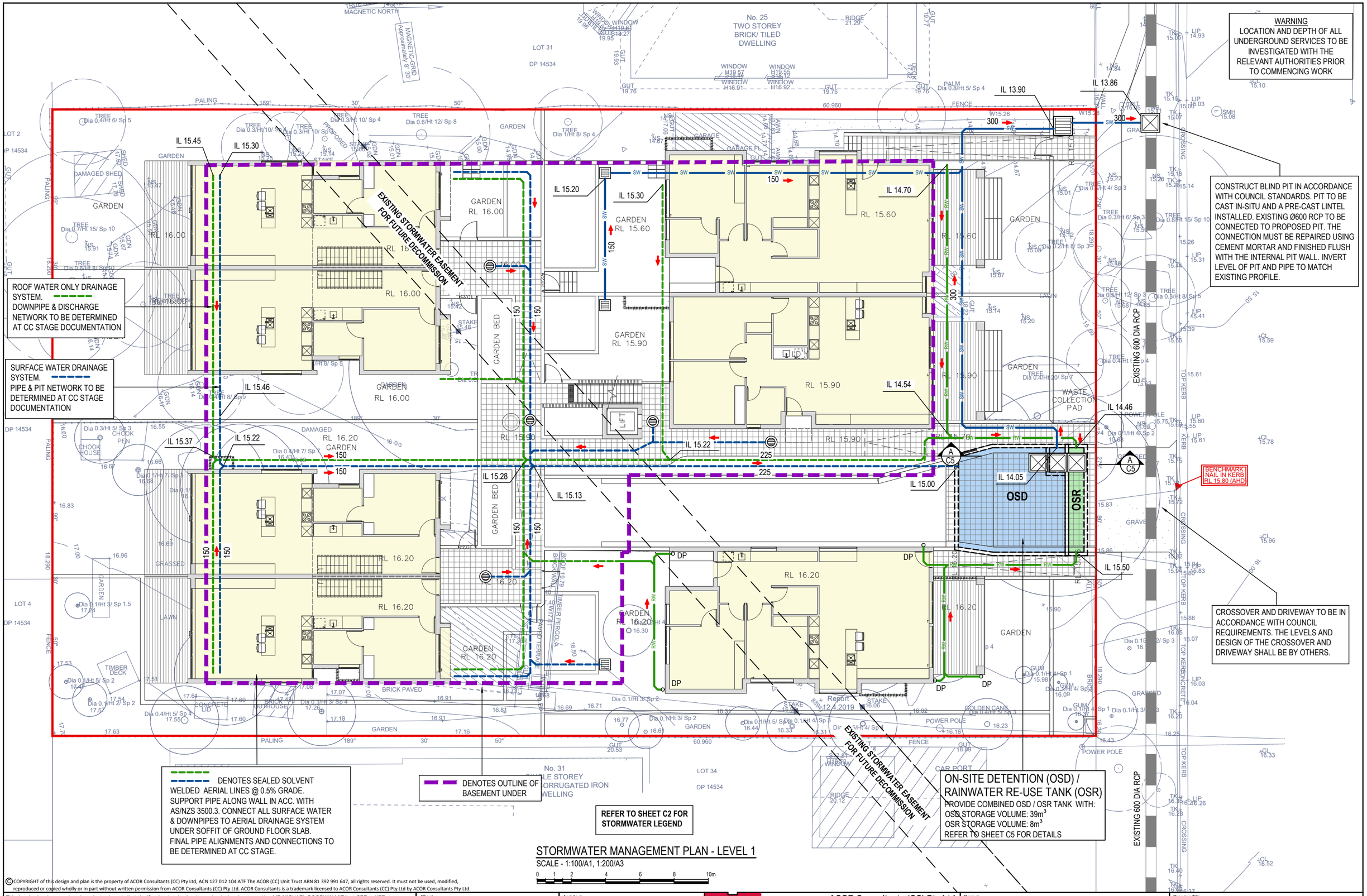
Project: PROPOSED RESIDENTIAL DEVELOPMENT
No.27 - 29
NORTH AVALON ROAD
AVALON BEACH

Drawing Title: STORMWATER MANAGEMENT PLAN - BASEMENT

Drawn	Date	Scale A1	Q.A. Check	Date
SJ	18.09.20	AS NOTED	-	-

Designed	Project No.	Dwg. No.	Issue
BK	CC200310	C2	B



STORMWATER MANAGEMENT PLAN - LEVEL 1

SCALE - 1:100/A1, 1:200/A3

0 1 2 4 6 8 10m

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A	ISSUED FOR CLIENT REVIEW	21.09.20	SJ	BK

1 0 1cm at full size 10cm

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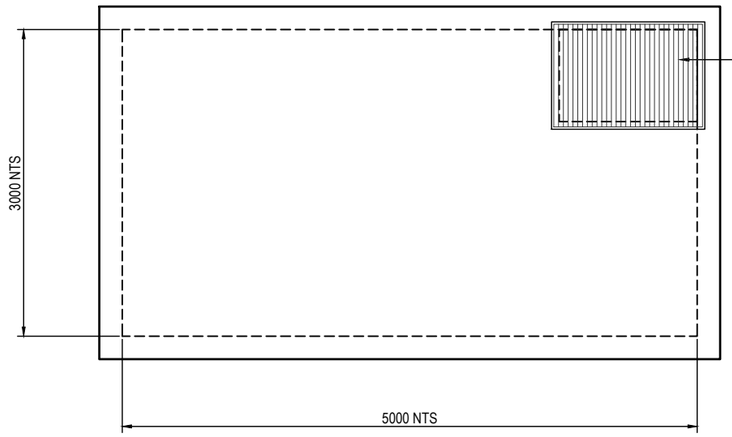
Drawing Title: STORMWATER MANAGEMENT PLAN - LEVEL 1

Drawn	Date	Scale A1	Q.A. Check	Date
SJ	18.09.20	AS NOTED	-	-
Designed	Project No.		Dwg. No.	Issue
BK	CC200310		C3	B



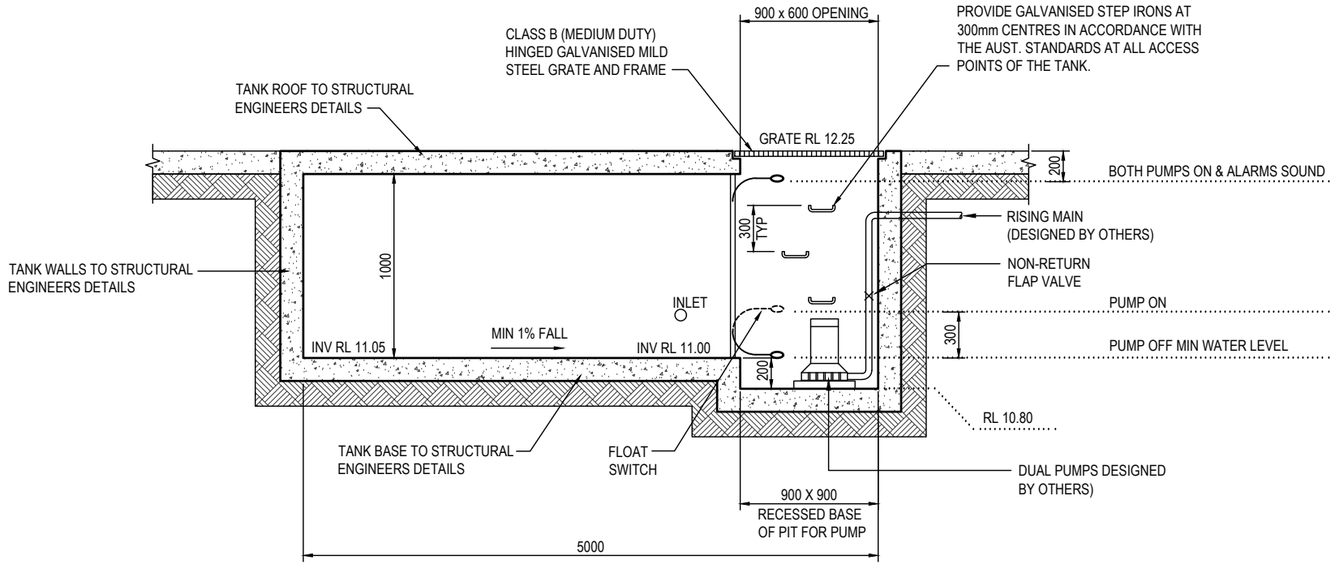
PUMP OUT TANK PLAN
SCALE 1:20/A1, 1:40/A3

INSTALL CONFINED SPACE WARNING SIGN

STANDARD PUMP OUT DESIGN NOTES

THE PUMP SYSTEM SHALL BE OPERATED IN THE FOLLOWING MANNER:-

1. THE PUMPS SHALL BE PROGRAMMED TO WORK ALTERNATELY TO ALLOW BOTH PUMPS TO HAVE AN EQUAL OPERATION LOAD AND PUMP LIFE
2. A FLOAT SHALL BE PROVIDED TO ENSURE THAT THE MINIMUM REQUIRED WATER LEVEL IS MAINTAINED WITHIN THE SUMP AREA OF THE BELOW GROUND TANK. IN THIS REGARD THIS FLOAT WILL FUNCTION AS AN OFF SWITCH FOR THE PUMPS AT THE MINIMUM WATER LEVEL. THE SAME FLOAT SHALL BE SET TO TURN ONE OF THE PUMPS ON UPON WATER LEVEL IN THE TANK RISING TO APPROXIMATELY 300mm ABOVE THE MINIMUM WATER LEVEL. THE PUMP SHALL OPERATE UNTIL THE TANK IS DRAINED TO THE MINIMUM WATER LEVEL.
3. A SECOND FLOAT SHALL BE PROVIDED AT A HIGH LEVEL, WHICH IS APPROXIMATELY THE ROOF LEVEL OF THE BELOW GROUND TANK. THIS FLOAT SHALL START THE OTHER PUMP THAT IS NOT OPERATING AND ACTIVATE THE ALARM.
4. AN ALARM SYSTEM SHALL BE PROVIDED WITH A FLASHING STROBE LIGHT AND A PUMP FAILURE WARNING SIGN WHICH ARE TO BE LOCATED AT THE DRIVEWAY ENTRANCE TO THE BASEMENT LEVEL. THE ALARM SYSTEM SHALL BE PROVIDED WITH A BATTERY BACK-UP IN CASE OF POWER FAILURE.
5. A CONFINED SPACE DANGER SIGN SHALL BE PROVIDED AT ALL ACCESS POINTS TO THE PUMP OUT STORAGE TANK.



PUMP OUT TANK
AVERAGE HEIGHT = 1.0m
WIDTH = 3.0m
LENGTH = 5.0m
VOLUME PROVIDED = 15.0m^3

TYPICAL SECTION THROUGH PUMP OUT TANK
SCALE 1:20/A1, 1:40/A3

PUMP-OUT TANK MAINTENANCE SCHEDULE

MAINTENANCE CONTRACT

NOTE: A 24 HOUR X 12 MONTHLY EMERGENCY AND MAINTENANCE CONTRACT SHALL BE OBTAINED FROM A COMPANY CAPABLE OF EXECUTING THE WORK AND SHALL BE KEPT IN FORCE BY THE PROPERTY OWNER(S) FOR THE LIFE OF THE BUILDING.

THE MAINTENANCE CONTRACT SHALL BE CARRIED OUT EVERY THREE (3) MONTHS AND SHALL INCLUDE THE FOLLOWING ACTIVITIES:

1. CLEAN OUT ALL PITS OF SILT AND DEBRIS.
2. CHECK AND CLEAN OUT, IF NECESSARY, ALL PIPELINES.
3. CHECK:
   - 3.1. PUMPS FOR WEAR
   - 3.2. PUMP OIL SEALS
   - 3.3. PUMP STRAINER AND CLEAN
4. CARRY OUT ROUTINE MAINTENANCE TO PUMPS AS RECOMMENDED BY THE MANUFACTURER.
5. CHECK OPERATIONAL SEQUENCE OF LEVEL SWITCHES, PUMPS AND CONTROL PANEL.
6. THE EMERGENCY CONTRACT SHALL PROVIDE FOR A 24 HOUR X 7 DAY PER WEEK SERVICE.

THE CONTRACTOR SHALL PROVIDE A NAME PLATE STATING NAME, WORKING HOURS, TELEPHONE NUMBER AND OUT OF HOURS NUMBER AND SUCH NAME PLATE SHALL BE FIXED TO THE FRONT OF THE CONTROL PANEL.

This drawing has been assigned an electronic code that signifies the drawing has been checked and approved by: MR MICHAEL GOODWIN MIEAust CPEng NER

Issue	Description	Date	Drawn	Approved
B	ISSUED FOR COUNCIL APPROVAL	22.09.20	SJ	BK
A	ISSUED FOR CLIENT REVIEW	21.09.20	SJ	BK

North

1cm at full size

Client: ARMADA AVALON PTY LTD

Architect: ENVIRONA STUDIO

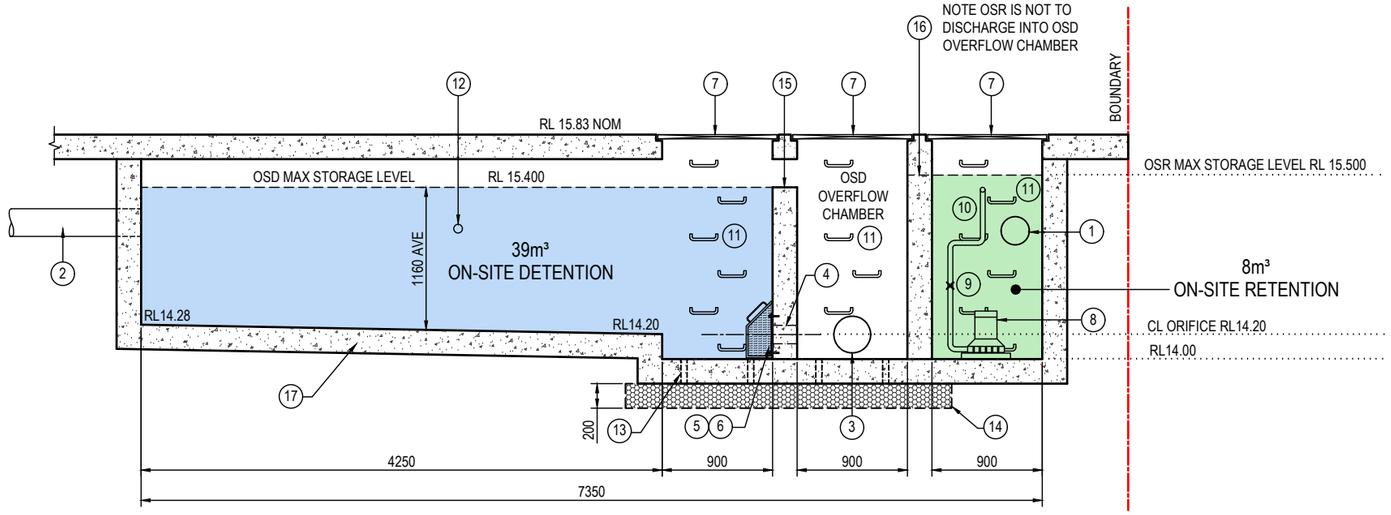
ACOR Consultants (CC) Pty Ltd
Platinum Building, Suite 2.01, 4 Ilya Avenue
ERINA NSW 2250, Australia
T +61 2 4324 3499
ENGINEERS | MANAGERS | INFRASTRUCTURE PLANNERS | DEVELOPMENT CONSULTANTS

Project: PROPOSED RESIDENTIAL DEVELOPMENT
No.27 - 29
NORTH AVALON ROAD
AVALON BEACH

Drawing Title: STORMWATER MANAGEMENT DETAILS SHEET No.1

Drawn	Date	Scale A1	Q.A. Check	Date
SJ	18.09.20	AS NOTED	-	-

Designed	Project No.	Dwg. No.	Issue
BK	CC200310	C4	B



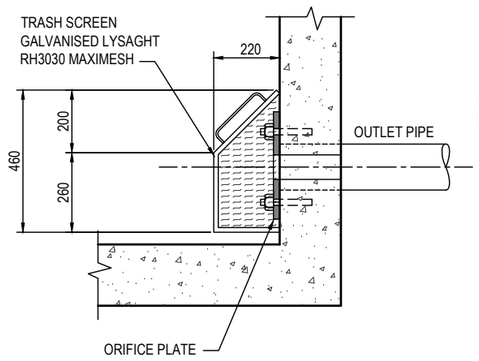
SECTION A
SCALE: 1:25/A1, 1:50/A3 C3

(TYPICAL ON-SITE DETENTION / RETENTION TANK SECTION)

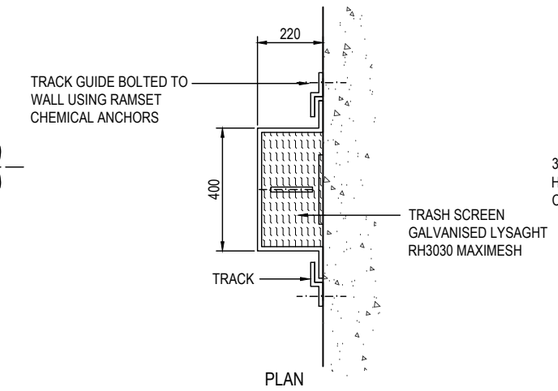
PROVIDE CONFINED SPACE SIGNAGE AT ENTRY POINTS INTO TANK.

LEGEND

1. ROOFWATER INLET PIPE
2. SURFACE WATER INLET PIPE
3. 300 DIA DISCHARGE PIPE
4. 150 DIA LINK PIPE
5. 350 x 350 x 4 PL 316SS 4 HOLES 12 DIA FOR M10 CHEMSETS
6. TRASH SCREEN LYSAGHT RH3030 GALV. REMOVABLE WITH HANDLE
7. 900 x 900 SOLID COVER BOLTED DOWN
8. RE-USE PUMP TO MANUFACTURERS SPECIFICATIONS
9. NON-RETURN VALVE
10. 50 DIA PVC PIPE CLASS '16' RISING MAIN
11. PROVIDE GALVANISED STEP IRONS AT 300mm CENTRES WHERE DEPTH EXCEEDS 1100mm IN ACCORDANCE WITH THE AUST. STANDARDS AT ALL ACCESS POINTS OF THE TANK, TYP.
12. RISING MAIN FROM PUMP-OUT TANK TO HYDRAULIC ENGINEERS SPECIFICATIONS
13. PROVIDE 4 / 20 DIA HOLES IN PIT BASE FILLED WITH AGGREGATE
14. 100mm MIN THICK, 14mm BLUE METAL LAYER, WRAPPED IN GEOTEXTILE FABRIC
15. OSD OVERFLOW WEIR
16. OSR OVERFLOW WEIR
17. TANK STRUCTURE TO STRUCTURAL ENGINEERS DETAILS

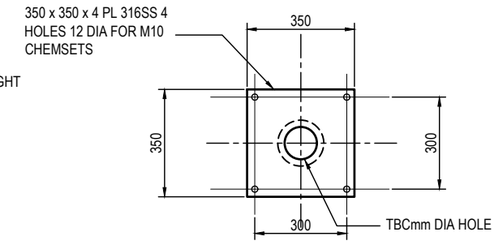


SIDE VIEW CROSS SECTION



PLAN

DETAIL 1 - TRASH SCREEN
SCALE 1:10/A1, 1:20/A3



DETAIL 2 - ORIFICE PLATE
SCALE 1:10/A1, 1:20/A3

This drawing has been assigned an electronic code that signifies the drawing has been checked and approved by: MR MICHAEL GOODWIN MIEAust CPEng NER

North

Issue	Description	Date	Drawn	Approved
B	ISSUED FOR COUNCIL APPROVAL	22.09.20	SJ	BK
A	ISSUED FOR CLIENT REVIEW	21.09.20	SJ	BK

1 0 1cm at full size 10cm

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Project: PROPOSED RESIDENTIAL DEVELOPMENT
No.27 - 29
NORTH AVALON ROAD
AVALON BEACH

Drawing Title: STORMWATER MANAGEMENT DETAILS SHEET No.2

Drawn	Date	Scale A1	Q.A. Check	Date
SJ	18.09.20	AS NOTED	-	-
Designed	Project No.		Dwg. No.	Issue
BK	CC200310		C5	B

POOL TYPE FENCING FROM GROUND TO PMF LEVEL TO ALLOW FOR SURFACE WATER FLOW

START OF KERB

DRIVEWAY CREST RL 16.000

DEFLECTION WALL

DEFLECTION WALL

DWELLING 1
FFL 15.60

DWELLING 2
FFL 15.90

DWELLING 3
FFL 16.20

LEGEND

- DENOTES SURFACE TO BE REGRADED TO LEVELS NOTED
- + 15.80 — DENOTES REGRADED FINISHED SURFACE LEVELS
- DENOTES EXTENTS OF SUSPENDED FOOTPATH OVER
- DENOTES EXTENTS OF PROPOSED DRIVEWAY AT GRADE
- DENOTES LOCATION OF DRIVEWAY CREST (CREST LEVEL 16.000)
- DENOTES EXTENTS OF PROPOSED FOOTPATH AT GRADE
- DENOTES EXTENTS OF BALONIES TO BE SUSPENDED OVER EXISTING SURFACE LEVELS
- + 15.80 * — DENOTES NATURAL SURFACE LEVEL
- DENOTES NATURAL SURFACE

PMF FLOOD MITIGATION PLAN

SCALE - 1:50/A1, 1:100/A3

0 0.5 1 2 3 4 5m

This drawing has been assigned an electronic code that signifies the drawing has been checked and approved by: MR MICHAEL GOODWIN MIEAust CPEng NER

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A	ISSUED FOR CLIENT REVIEW	21.09.20	SJ	BK

North

1 0 1cm at full size 10cm

Client: ARMADA AVALON PTY LTD

Architect: ENVIRONA STUDIO

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Project: PROPOSED RESIDENTIAL DEVELOPMENT
No.27 - 29
NORTH AVALON ROAD
AVALON BEACH

Drawing Title: PMF FLOOD MITIGATION WORKS PLAN

Drawn	Date	Scale A1	Q.A. Check	Date
SJ	18.09.20	AS NOTED	-	-
Designed	Project No.		Dwg. No.	Issue
BK	CC200310		C6	B

ANNEXURE C

‘Flood Information Request – Multi-purpose’ issued by Northern Beaches Council
dated
18 February 2019

FLOOD INFORMATION REQUEST – MULTI-PURPOSE

Property: 27 North Avalon Road, Avalon Beach
Issue Date: 18/02/2019
Flood Study Reference: Avalon to Palm Beach Floodplain Risk Management Study and Plan 2017, NSW Public Works - MHL

Flood Information for lot:

Flood Life Hazard Category – See Map A

1% AEP – See Flood Map B

1% AEP Maximum Water Level[3]: N/A mAHD

1% AEP Maximum Peak Depth from natural ground level[3]: N/A m

1% AEP Maximum Velocity: N/A m/s

1% AEP Provisional Flood Hazard: N/A **See Flood Map E**

1% AEP Hydraulic Categorisation: N/A **See Flood Map F**

Flood Planning Area – See Flood Map C

Flood Planning Level (FPL)[1,2, 3 &4]: N/A m AHD

Probable Maximum Flood (PMF) – See Flood Map D

PMF Maximum Water Level[2]: 15.90 m AHD

PMF Maximum Depth from natural ground level: 0.26 m

PMF Maximum Velocity: 0.88 m/s

PMF Flood Hazard: Low **See Flood Map G**

PMF Hydraulic Categorisation: Flood fringe **See Flood Map H**

Flood Risk Precinct – See Map K

Flooding with Climate Change (See Flood Map I)

The following is for the 30% Rainfall intensity increase and 0.9m Sea Level Rise Scenario:

1% AEP Maximum Water Level with Climate change[1&3]: 15.15 m AHD

1% AEP Maximum Depth with Climate Change[3]: 0.17 m

1% AEP Maximum Velocity with Climate Change[3]: N/A m/s

PMF Maximum Water Level from natural ground level with SLR[3]: N/A m

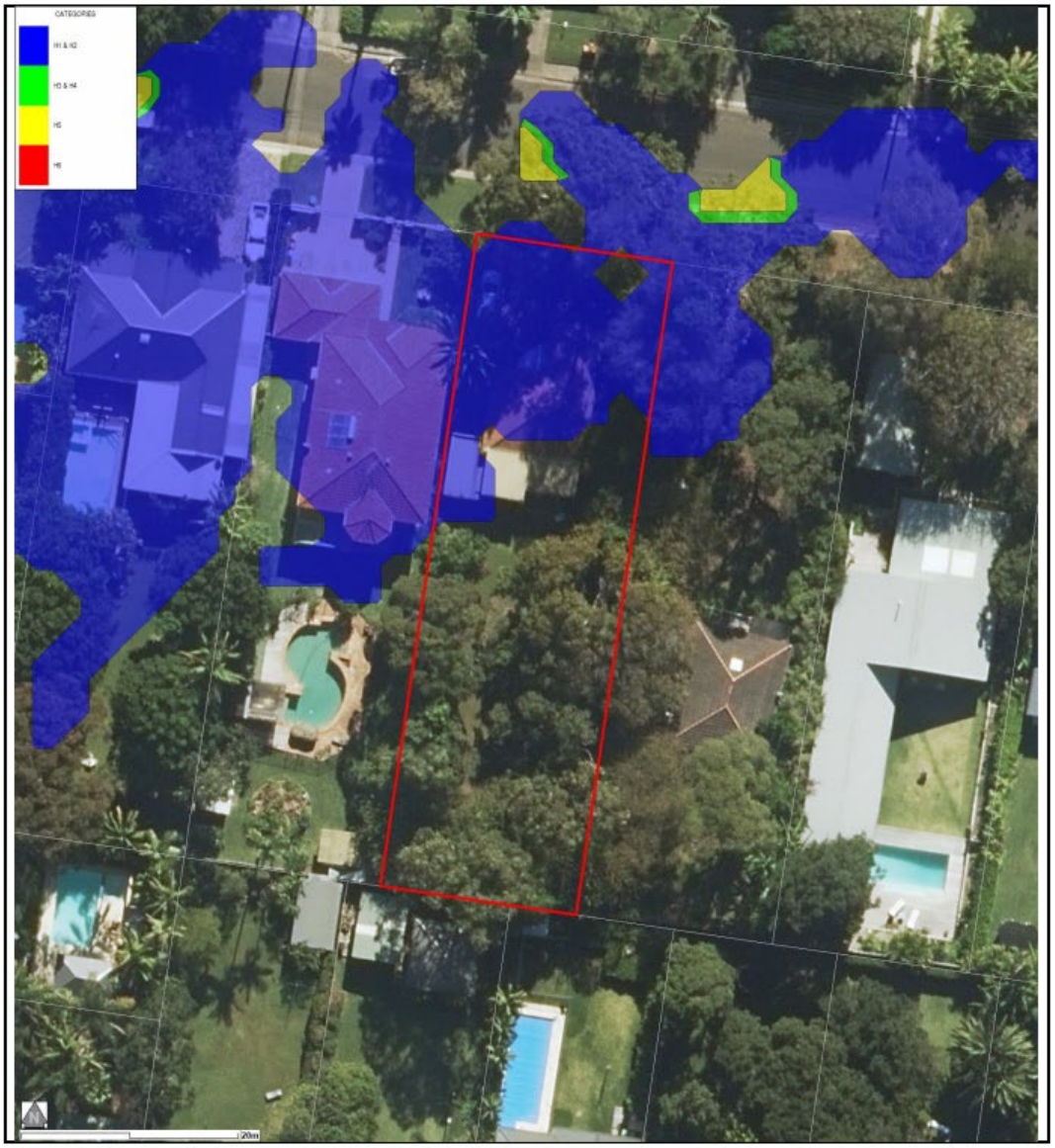
PMF Maximum Depth from natural ground level with SLR[3]: N/A m

[1]The flood information does not take into account 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.
[3]Intensification of development in the former Pittwater LGA requires the consideration of climate change impacts which may result in higher minimum floor levels than those indicated on this flood advice.
[4]Vulnerable/critical developments require higher minimum floor levels using the higher of the PMF or Flood Planning Level

General Notes:

- 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 website.

FLOOD MAP A: FLOOD LIFE HAZARD CATEGORY



Notes:

- Refer to 'Flood Emergency Response Planning for Development in Pittwater Policy for additional information on the Flood Life Hazard Categories and Pittwater 21 DCP Control B3.25.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Avalon to Palm Beach Floodplain Risk Management Study and Plan) and aerial photography (Source Near Map 2014) are indicative only.

FLOOD LEVEL POINTS

Note: Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Avalon to Palm Beach Floodplain Risk Management Study and Plan) and aerial photography (Source: NearMap 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	N/A	15.18	0.21	0.48
2	N/A	N/A	N/A	N/A	N/A	N/A	15.45	0.17	0.55
3	N/A	N/A	N/A	N/A	N/A	N/A	15.70	0.17	0.48
4	N/A	N/A	N/A	N/A	N/A	N/A	15.16	0.17	0.43
5	N/A	N/A	N/A	N/A	N/A	N/A	15.17	0.24	0.50

WL – Water Level
PMF – Probable Maximum Flood
N/A = no peak water level/depth/velocity available in flood event

Climate Change Flood Levels (30% Rainfall intensity and 0.9m Sea Level Rise)

ID	CC 1% AEP Max WL (m AHD)	CC1 % AEP Max Depth (m)
1	N/A	N/A
2	N/A	N/A
3	N/A	N/A
4	N/A	N/A
5	15.08	0.16

A variable Flood Planning Level might apply - 0.5m above 1% AEP max water level (for Mainstream flooding) or 0.5m above the 1% AEP max water level flow path extent with depth greater than 0.3m and 0.3m above the 1% AEP max water level flow path with depth 0.3m and less (for overland flow)

WL – Water Level
PMF – Probable Maximum Flood
N/A = no peak water level/depth/velocity available in flood event.

FLOOD MAP B: FLOODING - 1% AEP EXTENT

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: Avalon to Palm Beach Floodplain Risk Management Study and Plan) and aerial photography (Source Near Map 2014) are indicative only.

FLOOD MAP C: FLOOD PLANNING AREA EXTENT

Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event + freeboard.
- Extent does not include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Avalon to Palm Beach Floodplain Risk Management Study and Plan) and aerial photography (Source Near Map 2014) are indicative only.

FLOOD 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: Avalon to Palm Beach Floodplain Risk Management Study and Plan) and aerial photography (Source: NearMap 2014) are indicative only

FLOOD MAP E – 1% AEP FLOOD HAZARD EXTENT MAP

Notes:

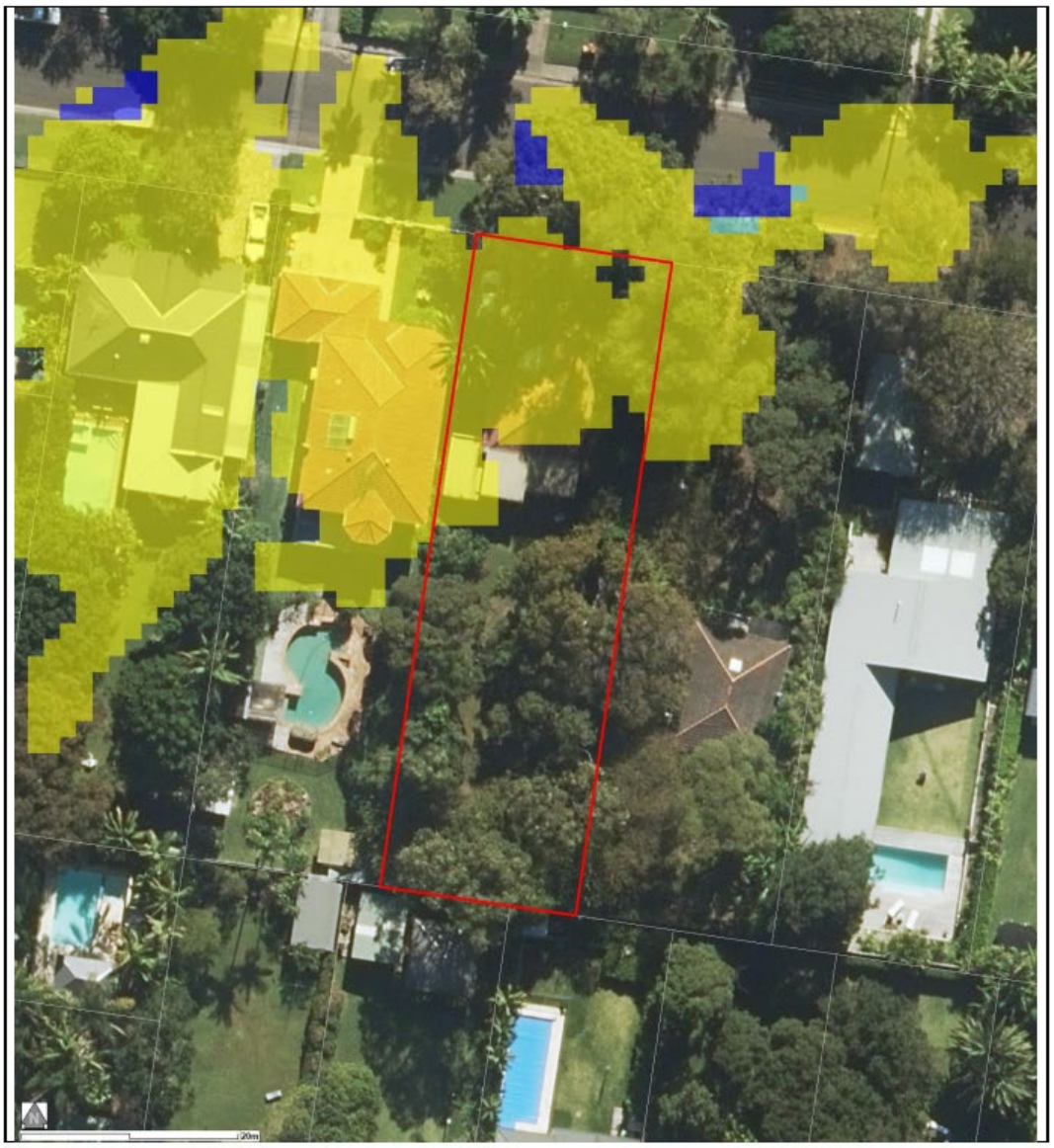
- extent represents the 1% annual Exceedance Probability (AEP) flood event
- extent does not include climate change
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Avalon to Palm Beach Floodplain Risk Management Study and Plan) and aerial photography (Source: NearMap 2014) are indicative only

FLOOD MAP F – 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: Avalon to Palm Beach Floodplain Risk Management Study and Plan) and aerial photography (Source: NearMap 2014) are indicative only

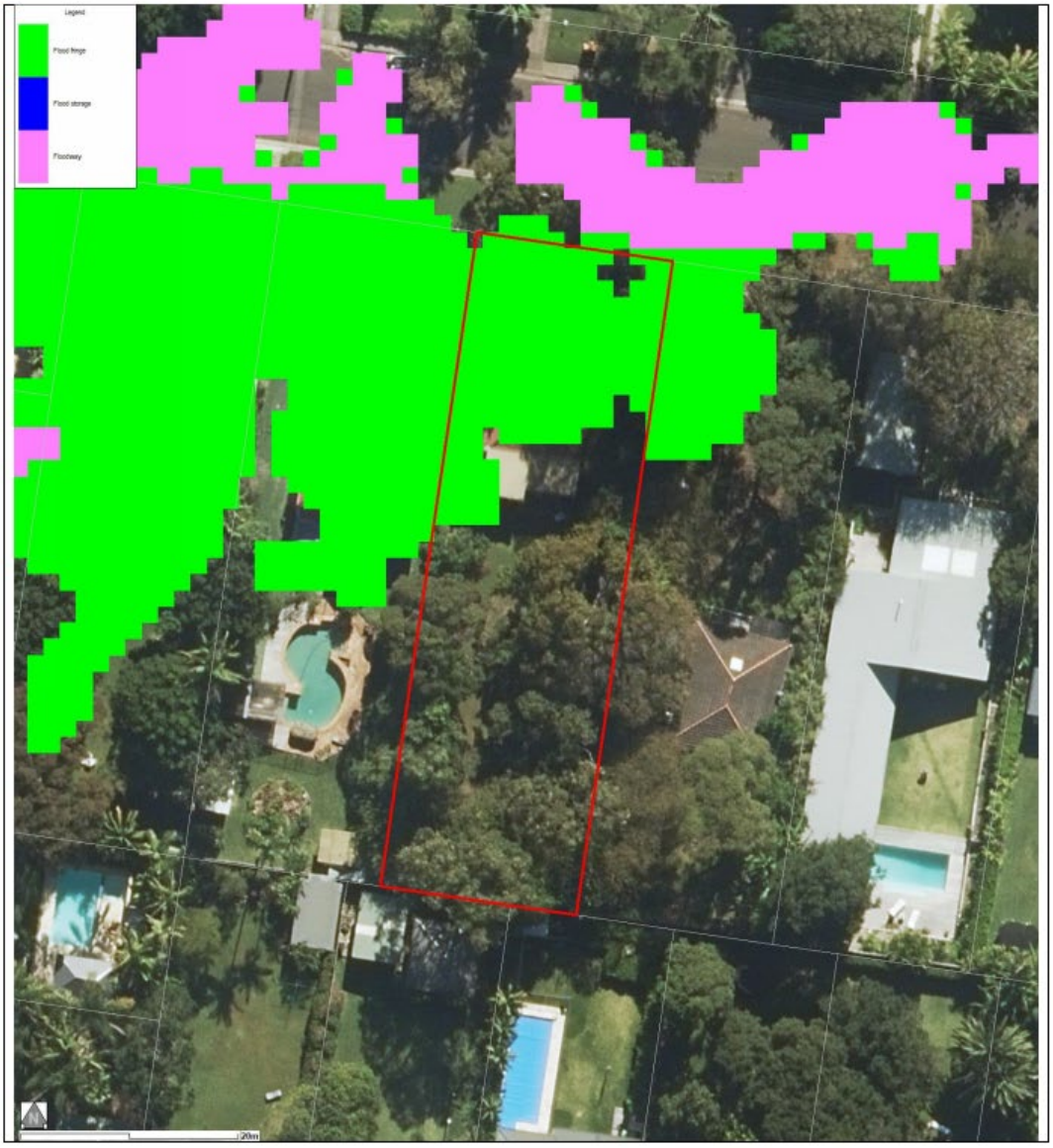
FLOOD MAP G – PMF FLOOD HAZARD EXTENT MAP



Notes:

- extent represents the 1% annual Exceedance Probability (AEP) flood event
- extent represents the Probable Maximum Flood (PMF) event
- extent does not include climate change
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Avalon to Palm Beach Floodplain Risk Management Study and Plan) and aerial photography (Source: NearMap 2014) are indicative only

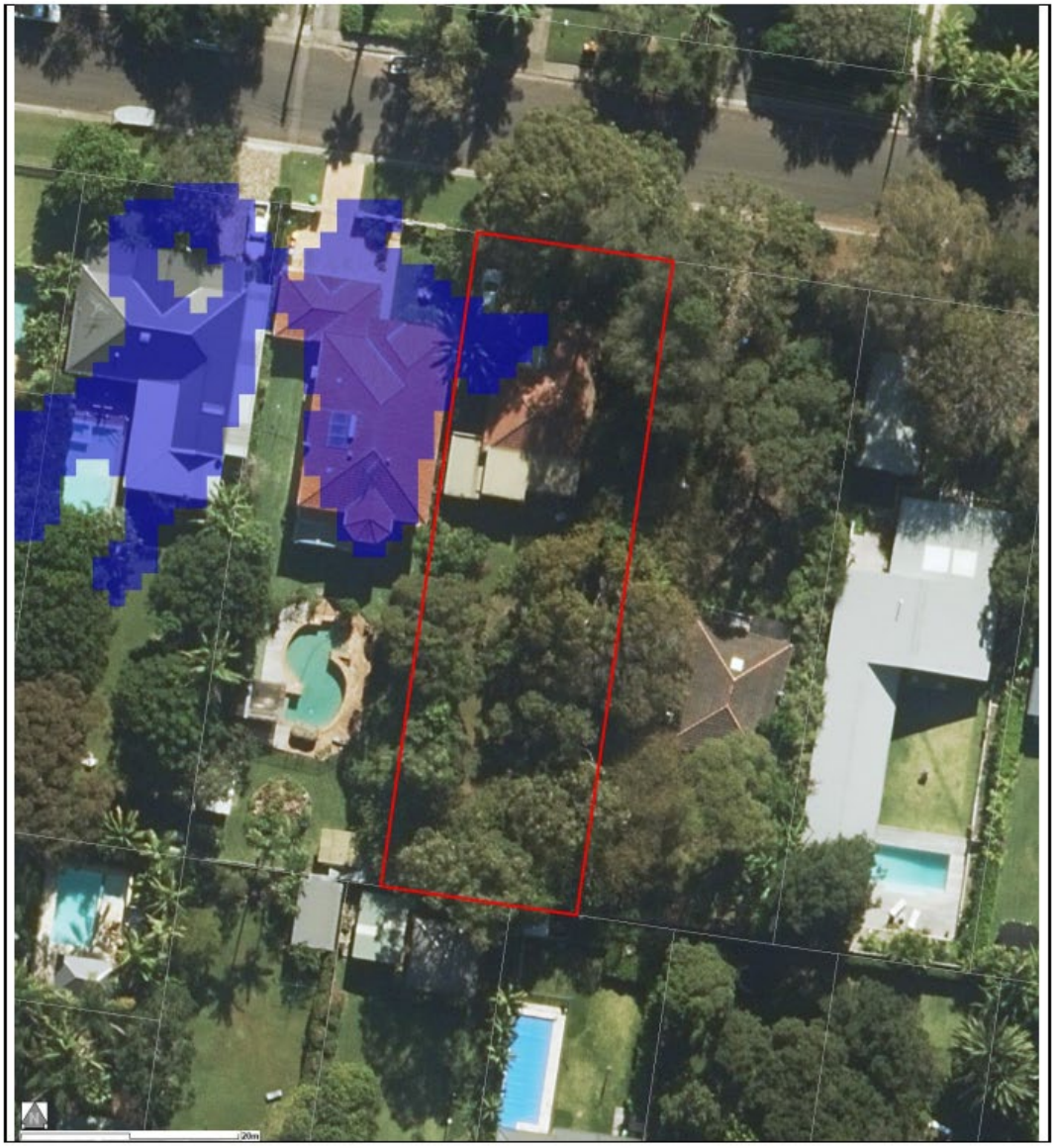
FLOOD MAP H – PMF FLOOD HYDRAULIC CATEGORY EXTENT MAP



Notes:

- extent represents the Probable Maximum Flood (PMF) event
- extent does not include climate change
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Avalon to Palm Beach Floodplain Risk Management Study and Plan) and aerial photography (Source: NearMap 2014) are indicative only

FLOOD MAP I: FLOODING – 1% AEP EXTENT PLUS CLIMATE CHANGE



Note Notes:

- extent represents the 1% annual Exceedance Probability (AEP) flood event
- includes 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: Avalon to Palm Beach Floodplain Risk Management Study and Plan) and aerial photography (Source: NearMap 2014) are indicative only

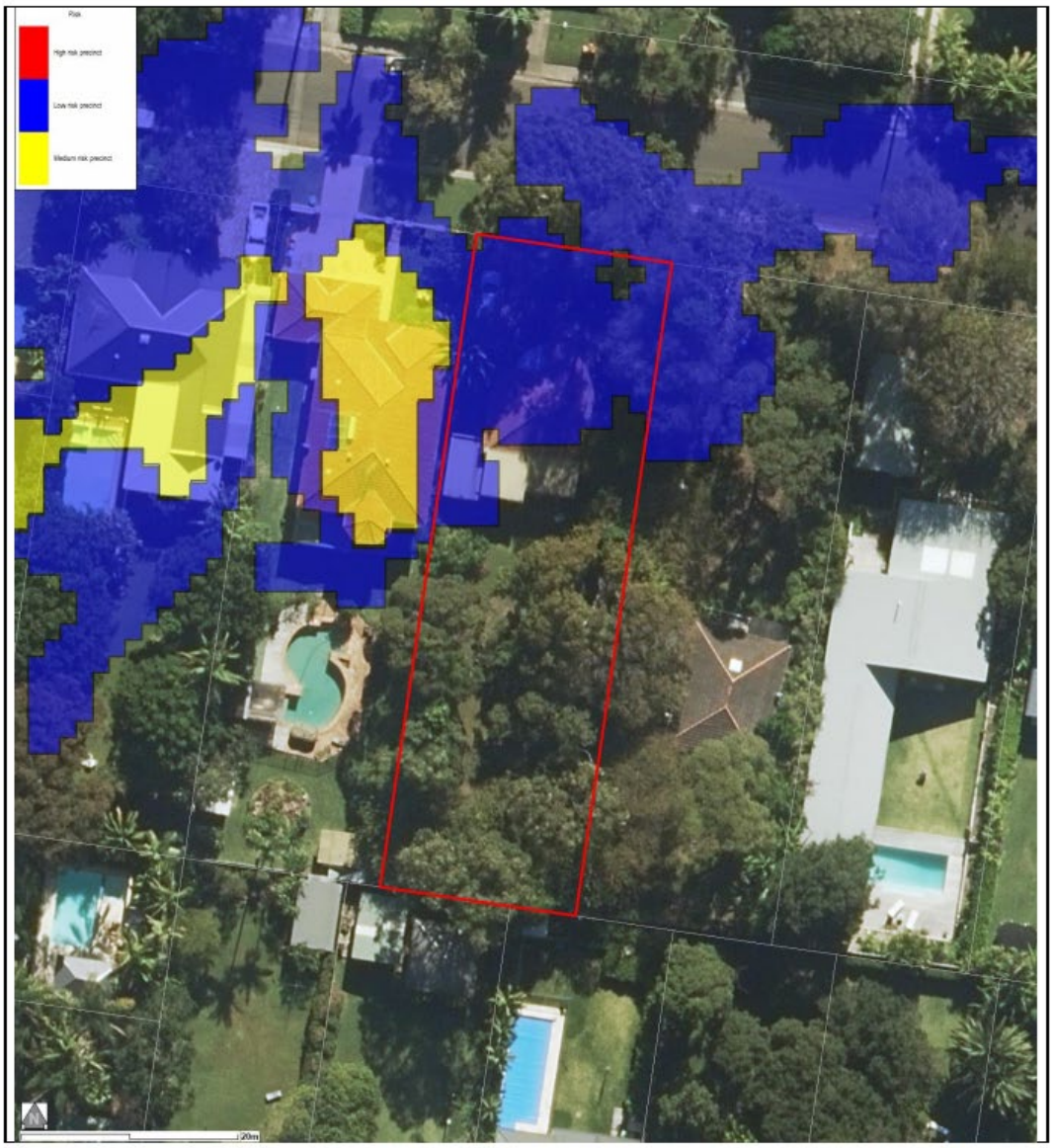
FLOOD MAP J: FLOODING – PMF EXTENT PLUS SEA LEVEL RISE

****No data available for this property.**

Note Notes:

- extent represents the PMF flood event
- includes 0.9m Sea Level Rise climate change scenario
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Avalon to Palm Beach Floodplain Risk Management Study and Plan) and aerial photography (Source: NearMap 2014) are indicative only

FLOOD MAP K – FLOOD RISK PRECINCT MAP



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 and or H6 Life Hazard Classification).
- Does not include climate change