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25 May 2016

Mr A and Mrs N Currie
3 Bilgola Avenue
Bilgola Beach NSW 2107
c/o Rebecca Froud, The Site Foreman
by email: rebecca@thesiteforeman.com.au

Dear Andrew and Norma-Jean,

Subject: ***3 Bilgola Avenue, Bilgola Beach - Flood Risk Emergency Assessment***

1. Introduction

This assessment has been undertaken as part of the requirements for a Development Application for the proposed alterations and additions to the existing dwelling at 3 Bilgola Avenue, Bilgola Beach.

Flood information for the site has been provided by Pittwater Council and is included in Appendix A. The site is affected by both Low Hazard and High Hazard flood conditions resulting from local overland flows during the 1% Annual Exceedance Probability (AEP) event.

The flood risk assessments for the entire site during the 1% AEP and PMF events are tabulated below.

Table 1 Flood Risk Assessment – 1% AEP event – flood level 11.18mAHD

Hazard	Likelihood	Consequence	Risk Level
Person in dwelling being impacted by floodwaters	5	Minor	Low
Persons entering floodwaters on property	5	Minor	Low
Dwelling being impacted by floodwaters – structural viability	5	Minor	Low
Vehicles being impacted by floodwaters	1	Major	Low
Floodwaters entering carport/garage	1	Major	Low
Floodwaters entering dwelling	5	Minor	Low

Table 2 Flood Risk Assessment – PMF event – flood level 11.50mAHD

Hazard	Likelihood	Consequence	Risk Level
Person in dwelling being impacted by floodwaters	5	Minor	Low
Persons entering floodwaters on property	1	Severe	Extreme
Dwelling being impacted by floodwaters – structural viability	1	Moderate	Medium
Vehicles being impacted by floodwaters	1	Severe	Extreme
Floodwaters entering carport/garage	1	Severe	Extreme
Floodwaters entering dwelling	5	Minor	Low

The identification of significant risk level categories during the PMF event has necessitated the preparation of this Flood Risk Emergency Assessment.

2. Description of existing site and flood regime

The site occupies 870m^2 on the southern side of Bilgola Avenue, in the Bilgola Basin, east of Barrenjoey Road. It is split into two lots by an open stormwater drainage channel that runs roughly along the east-west axis of the site and forms the basis of a major overland flow path. The flow path is categorised as medium to high risk where it traverses the site. The principle dwelling is located on the northern lot, with a garage situated on the southern lot, accessed by two pedestrian bridges over the drainage channel.

The proposed works would be located in the low flood hazard area on the northern side of the drainage channel. The peak 1% AEP flood level for the site would be RL 11.23m AHD, with an associated Flood Planning Level (FPL) of RL 11.73m AHD. The 1% AEP hydraulic categorisation for the site varies from flood fringe to floodway. The Flood-Life Hazard category would be H3-H4.

A secondary arm of the overland flow path affects the north-eastern corner of the site during the Probable Maximum Flood (PMF) event only. This has resulted in the identification of an area of low to medium flood risk to the north of the site along the pedestrian access to Bilgola Avenue, although this area has not been identified as being subject to flooding during storms up to and including the 1% AEP flood event.

The peak PMF level for the site is RL 12.55m AHD, corresponding to this secondary flow path and the higher ground levels along the northern boundary at the Bilgola Road access path. The natural ground level in this area is approximately between RL 12m AHD and RL 12.5m AHD, indicating the depth of overland flow would be less than 500mm. Instead, the peak PMF flow depth of 1.2m would be associated with the drainage channel to the rear of the dwelling, where the PMF level would be approximately RL 11.5m AHD.

The existing dwelling has been constructed with a floor level of RL 13.7m AHD; providing over one metre freeboard to the PMF. The existing garage, constructed with a ground floor level of RL 10.68m AHD and located on the southern side of the drainage channel, would be affected by both the 1% AEP and PMF events.

3. Description of proposed development and impact on local flood behaviour

3.1 Flood Planning Level and Flood Storage

The proposed works would result in a three bedroom home as detailed on the architectural plans by The Site Foreman accompanying the Development Application. The rear of the existing dwelling would be replaced with a split level addition, including a kitchen, family room, study and bathroom on the lower floor at RL 12.5m AHD and a master bedroom, ensuite and sitting room on the upper floor at RL 15.5m AHD. The lower level family room would open to a timber deck to the south. The works would be categorised as *Residential* land-use for the purposes of a flood risk to life assessment under Pittwater Council's DCP.

The proposed addition would be four to five metres from the rear of the existing dwelling towards the drainage channel, extending 12m^2 over the 1% AEP flood extent. The minimum floor level would be RL 12.5m AHD, providing over one metre freeboard to the 1% AEP event. The works would be of timber and steel framed construction with an elevated, piered subfloor to allow for the passage of floodwaters, however a number of piered footings would be located within the 1% AEP flood extent, as indicated in Figure 1. The removal of existing vegetation, including four palm trees, would generally offset the construction of the proposed works. The proposed stairway access from the deck to the rear garden would also have an open structure, although it would be clear of the 1% AEP flood extent.

All works below the PMF would be constructed from flood compatible materials designed to withstand the hydraulic forces from the 1% AEP and PMF flow velocities.

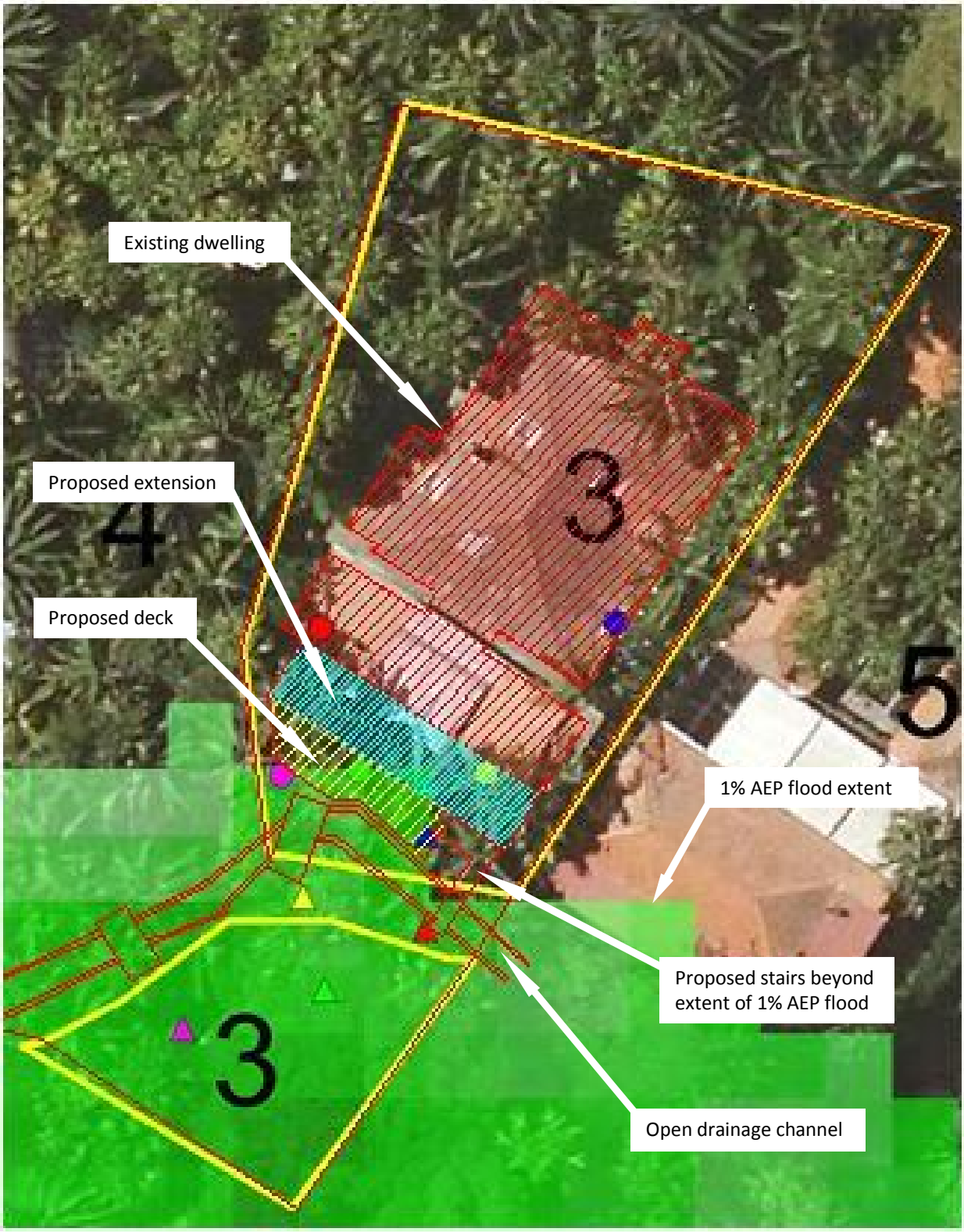

Figure 1 Extent of proposed works in relation to 1% AEP flood extent

3.2 Evacuation Response and Shelter-In-Place Development Controls

The site falls within the Bilgola Beach catchment, which covers approximately 35 ha, rising in Newport Heights and discharging to Bilgola Beach. Due to the steep topography and confined area, the critical flood durations range from 90 to 120 minutes, indicating that the catchment is prone to flash flooding and there will be very limited notice that can be provided to ensure safe evacuation of the site.

The site does, however, have dual street access. Vehicular access to the rear garage on the southern side of the site is from the Bilgola Beach carpark access lane, while the main residence on the northern side of the site can also be accessed by pedestrians from Bilgola Avenue. While pedestrian access would be available during all events up to the 1% AEP, vehicular evacuation would be limited by the high flood hazard area to the south of the site. Flood evacuation would therefore be regarded a secondary response for the site and the shelter-in-place controls have been addressed for the property.

The existing dwelling and proposed works would be constructed above the PMF level, providing a suitable option for residents to "shelter in place" during significant flood events. The dwelling would have three bedrooms, four bathrooms, a kitchen and multiple living rooms with a minimum floor level of RL 12.5m AHD. The prescriptive controls required to satisfy Pittwater Council's shelter in place requirements are summarised below.

Table 3 Shelter-in-Place Requirements

Flood Life Hazard Category	H3-H4
Land Use Group	Residential
Control 1b – Flood Risk Emergency Assessment	Accompanying report prepared
Control 2 – Minimum Floor Level	The minimum proposed floor level would be RL 12.5m AHD, providing one metre freeboard to the PMF level at the rear of the dwelling and an extensive shelter-in-place refuge.
Control 3 – Floor Space Requirement	The existing residence and proposed addition are wholly located above the PMF level, providing a shelter-in-place refuge area suitable for either long or short duration flood events. The total floor area at completion of the proposed works would exceed 300m^2, providing ample floor space per resident for a three bedroom home.
Control 4 – Accessibility	The existing dwelling is accessed by a short flight of stairs from the adjacent ground. The proposed works would not affect accessibility.
Control 5a – Building Stability	The building would be designed to withstand the flood effects of the PMF design flood depths and velocity (up to 1.2m depth at 0.5m/s).
Control 6a – Serviceability	The shelter-in-place refuge would be fitted with the following emergency items: • sufficient clean water for all occupants; and • portable radio with spare batteries; and • torch with spare batteries; and • first aid kit.

5. Conclusion

The proposed works are not expected to have an impact on upstream or downstream flood levels, flow velocities or distribution, flood response or hazards, or upon the safe evacuation of the property or neighbourhood. All prescriptive controls of Pittwater Council's shelter in place requirements can be satisfied by the proposal, designating the development a tolerable flood risk for flood emergency response planning in accordance with Pittwater 21 DCP.

Please do not hesitate to contact me if you have any queries regarding the above assessment.

Yours sincerely,

Kate Waddington
BE(Hons) MEngSci (Water Resources)
MIEAust CPEng NER

References

Pittwater Overland Flow Flood Study and Mapping. Cardno, October 2013

PITTWATER COUNCIL

FLOOD INFORMATION REQUEST – GENERAL-PURPOSE

Property: 3 Bilgola Ave, Bilgola Beach
Lot DP: 133/752046 and 53//517038
Issue Date: 21 April 2016
Flood Study Reference: 2013 Pittwater Overland Flow Flood Study (Cardno)

A property can be impacted by more than one Category of flooding.

Flood Categories defined by the Pittwater 21 Development Control Plan include:

- **Flood Category 1 Areas**- Properties identified on the Flood Hazard Maps and located within Primary Floodplain Areas where the lowest point of the property is affected by the Flood Planning Level (FPL) (1% AEP flood level plus 500mm Freeboard). Flood Category 1 areas are further defined under flood hazard subcategories of high hazard and low hazard.
- **Flood Category 2 Areas**- Properties identified on the Flood Hazard Maps where the lowest point of the property lies above the Flood Planning Level but below the level of the Probable Maximum Flood.
- **Flood Category 3 Areas**- Properties generally located outside or adjacent to the Primary Floodplain Areas that are affected by flooding hazards associated with major stormwater drainage systems, local overland flow paths or drainage easements. Flood Category 3 Areas are further defined under the subcategories of Overland Flow Path – Major and Overland Flow Path – Minor.

Flood Information for lots:

Flood Life Hazard Category – See Map A

Flood Category 1 (Mainstream) - See Flood Map C

Flood Category 2 (PMF) – See Flood Map D

Probable Maximum Flood (PMF) Level[4]: 12.55m AHD

PMF Maximum Depth from natural ground level: 1.2m

PMF Maximum Velocity: >3.5m/s

Flood Category 3[5] (Overland Flow) – See Flood Map E

1% Annual Exceedance Probability (1% AEP): See Flood Map B

1% AEP Overland Flow Maximum Water Level[3&4]: 11.23m AHD

1% AEP Overland Flow Maximum Depth from Natural Ground Level[3&4]: 0.8m

1% AEP Overland Flow Maximum Velocity: >2.5m/s

Minimum Floor Level[1,2,3 &4]: 0.5m above the 1% AEP Major overland flow extent and 0.3m above the 1% AEP Minor overland flow extent

1% AEP Overland Flow Provisional Flood Hazard: See Map F

1% AEP Overland Flow Hydraulic Categorisation: See Flood Map G

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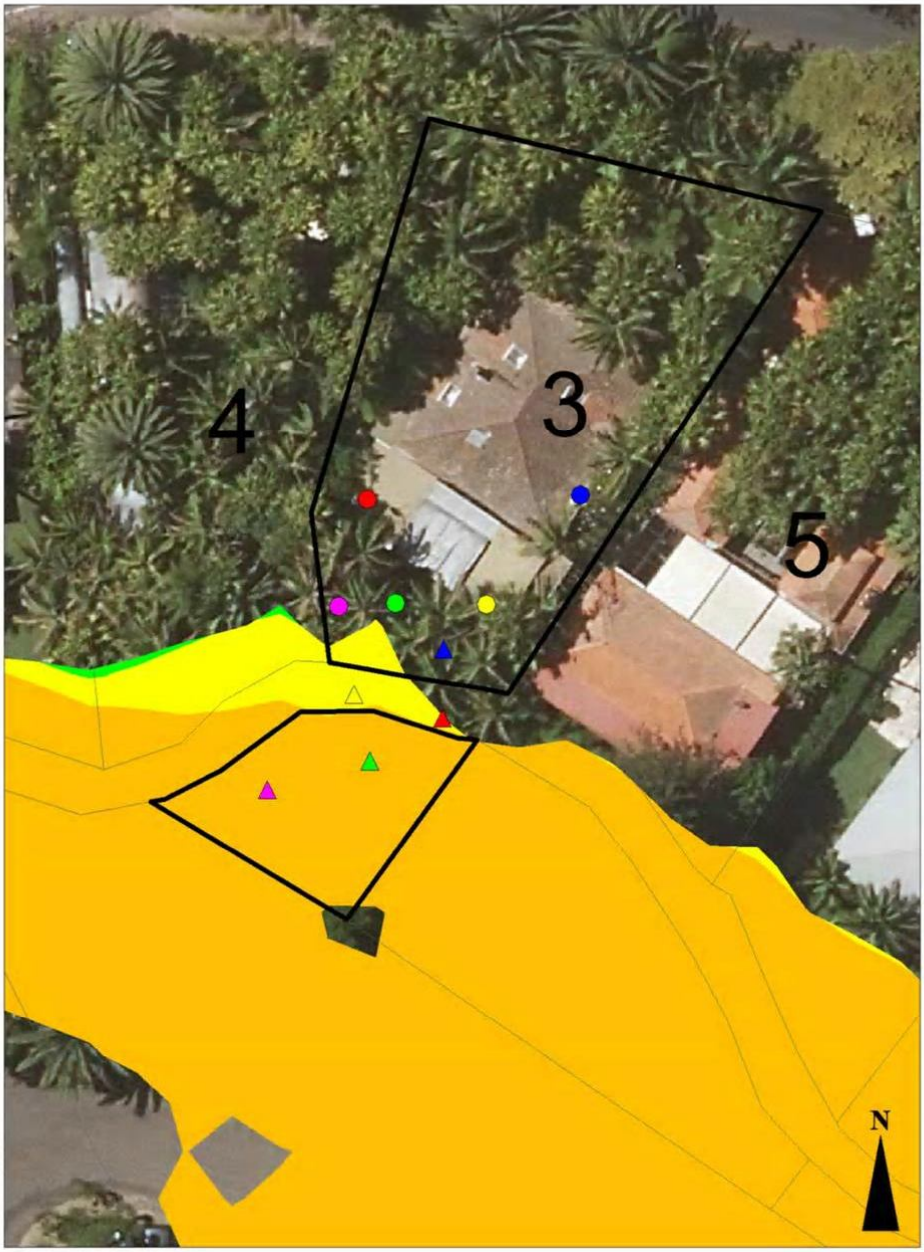
[1]The flood information does not take into account any local overland flow issues with a depth below 0.15m nor private stormwater drainage systems.
[2]Overland flow/mainstream water levels may vary across a sloping site, resulting in variable minimum floor/ flood planning levels across the site.
[3]Intensification of development requires the consideration of climate change impacts which may result in higher minimum floor levels than those indicated on this flood advice.
[4]Special Flood Protection developments require higher minimum floor levels using the higher of the PMF and the 1%AEP+0.5m.
[5]The applicable Flood Category 3 classification applied for the purpose of development assessment unless otherwise demonstrated in the Flood Risk Management Report that a different classification should apply (dependent on the location of the proposed development).

General Notes:

- All levels are based on Australian Height Datum (AHD) unless otherwise noted.
- The source information on this advice was obtained from numeric modelling prepared by consultants for Pittwater Council for existing site conditions at the time of the flood study. Separate review and flood model verification has not been undertaken by Council.
- The interpolated information is for the purpose of planning only. Detailed flood data for individual land areas were not determined from the exercise.
- Flood models only approximate flood behaviour. Site specific ground and building survey levels should be used to relate flood levels and to assess the impact of flooding. A site specific flood study/risk assessment may be required for any future development. Care and expertise is required in the interpretation of these flood levels. Engage a suitably qualified engineer to assist you in this matter.
- You need to refer to the Pittwater 21 DCP flood development controls, if you are planning to lodge a Development Application.The advice may be reviewed and amended by Pittwater Council in the course of assessment of a specific development application.
- While this advice is periodically updated, it is possible that the Council holds further information dealing with the flooding which has not been incorporated into the above advice.
- Estuarine/coastal inundation has not been taken into account in the flood information.
- Council is currently reviewing the 2013 Pittwater Overland Flow Flood Study and as such the property's flood classification and flood level may be subject to changes as a result of the updated flood modelling.

FLOOD MAP A: FLOOD LIFE HAZARD CATEGORY



Flood Life Hazard Categories:

H6 H5 H3-H4 H1-H2

Lot Boundary

Map not to Scale

Notes:

- Refer to Pittwater 21DCP for 'Flood Emergency Response Planning for Development in Pittwater Policy (Appendix 15) 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: Flood study reference) and aerial photography (Source Near Map 2014) are indicative only.

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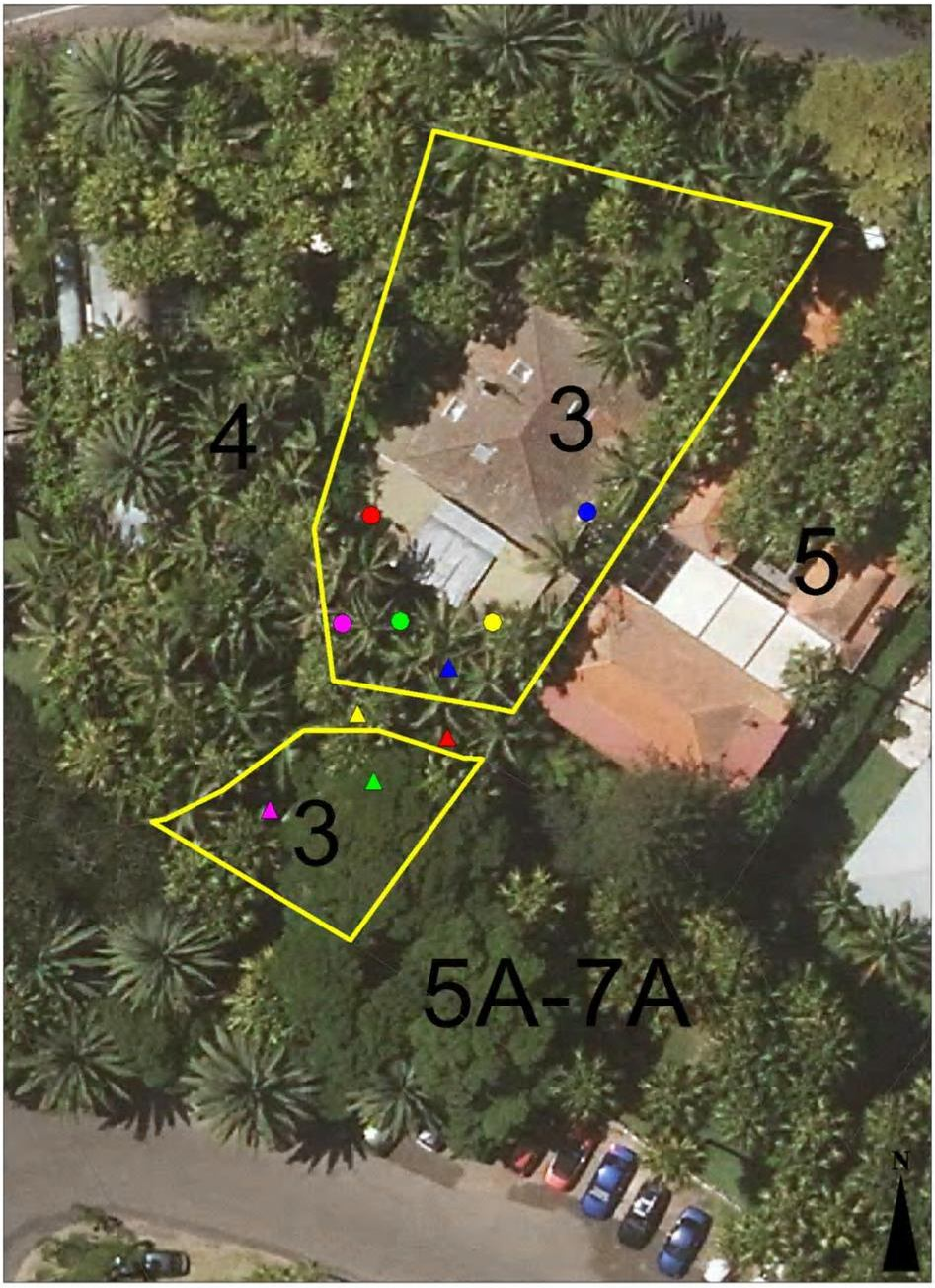
FLOOD LEVEL POINTS



Lot Boundary

Map not to Scale

Note: Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Flood study reference) and aerial photography (Source: NearMap 2014) are indicative only.

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Flood Levels

	5% AEP Max WL (m AHD)	5% AEP Max Depth (m)	5% AEP Max Velocity (m/s)	1% AEP Max WL (m AHD)	1% AEP Max Depth (m)	1% AEP Max Velocity (m/s)	PMF Max WL (m AHD)	PMF Max Depth (m)	PMF Max Velocity (m/s)
●	Null	Null	Null	Null	Null	Null	Null	Null	Null
●	Null	Null	Null	Null	Null	Null	Null	Null	Null
●	Null	Null	Null	Null	Null	Null	11.49	0.03	0.42
●	11.07	0.17	0.31	11.13	0.23	0.31	11.47	0.33	0.41
●	11.17	0.00	0.37	11.18	0.01	0.37	11.49	0.29	0.38
▲	11.08	0.07	0.49	11.13	0.12	0.58	11.43	0.26	0.94
▲	10.92	0.25	0.86	10.98	0.30	0.94	11.34	0.59	1.55
▲	10.98	0.49	1.03	11.04	0.55	0.95	11.42	0.80	1.13
▲	10.88	0.57	1.27	10.94	0.63	1.32	11.35	1.02	1.82
▲	11.04	0.44	0.98	11.09	0.50	1.32	11.50	0.92	2.18

WL – Water Level
PMF – Probable Maximum Flood
Null = no peak water level/depth identified in flood event.

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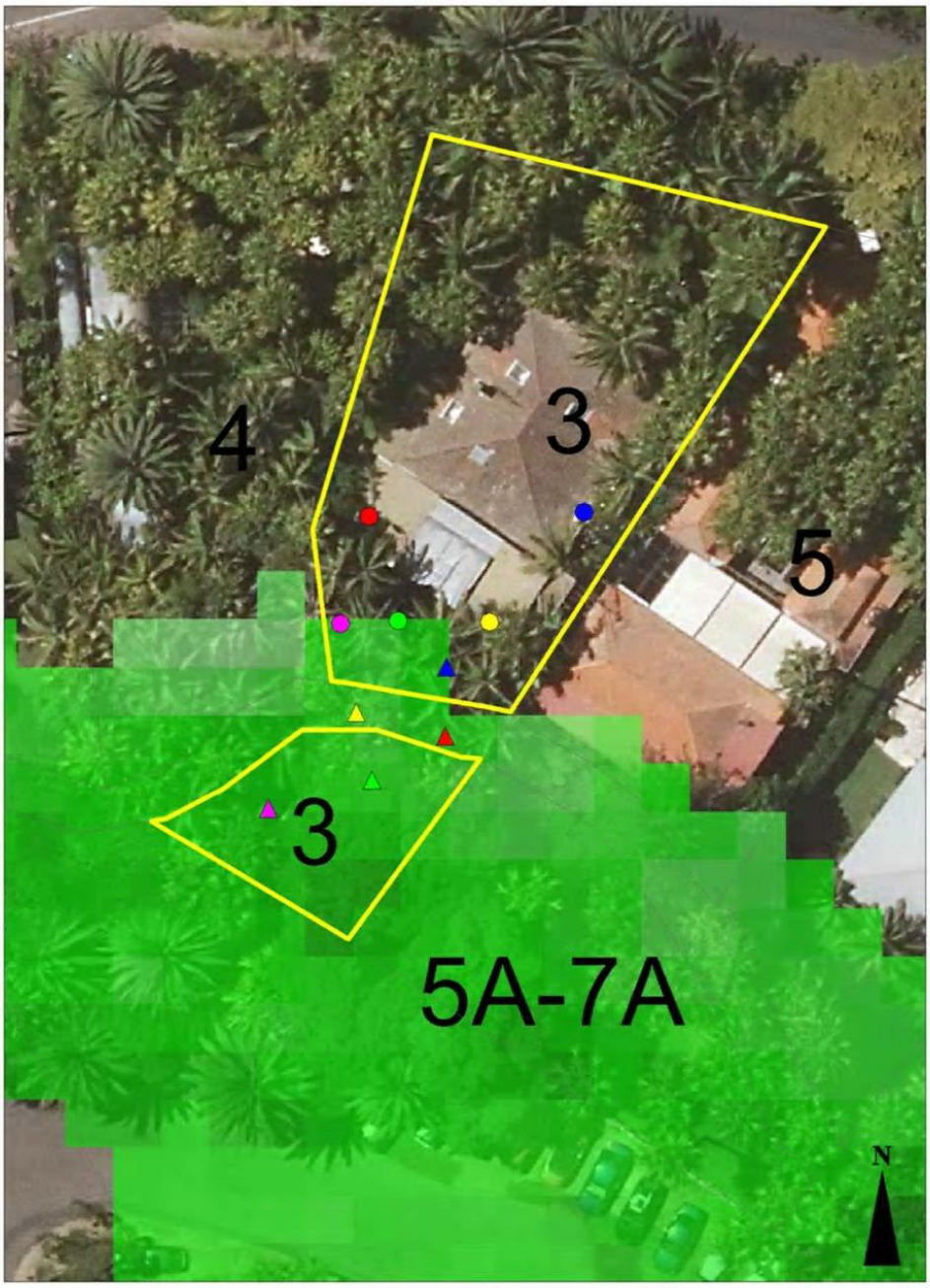
FLOOD MAP B: FLOODING - 1% AEP EXTENT



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: Flood study reference) and aerial photography (Source Near Map 2014) are indicative only.

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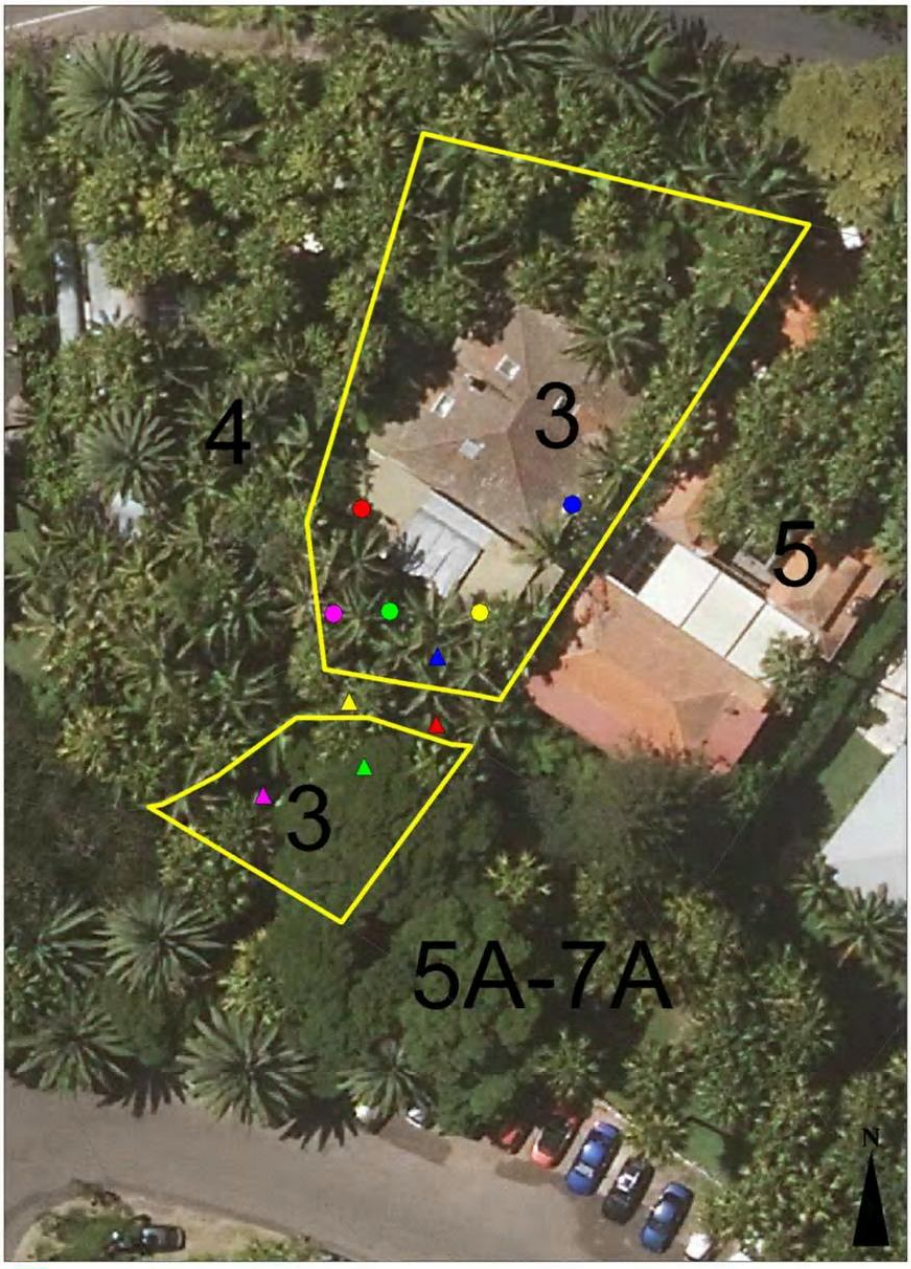
FLOOD MAP C: MAINSTREAM FLOODING EXTENT



This Property is currently not identified as being affected by Mainstream flooding based off the 2013 Pittwater Overland Flow Flood Study. Council is however undertaking a review of this model/Flood Study, and as a result this property's flood classification may change because of the update to the mainstream model.

Notes:

- extent represents the 1% annual Exceedance Probability (AEP) flood event
- extent does not include climate change
- Mainstream FPL – Mainstream Flood Planning Level includes the 0.5m freeboard on the 1% AEP extent for planning purposes
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Flood study reference) and aerial photography (Source: NearMap 2014) are indicative only

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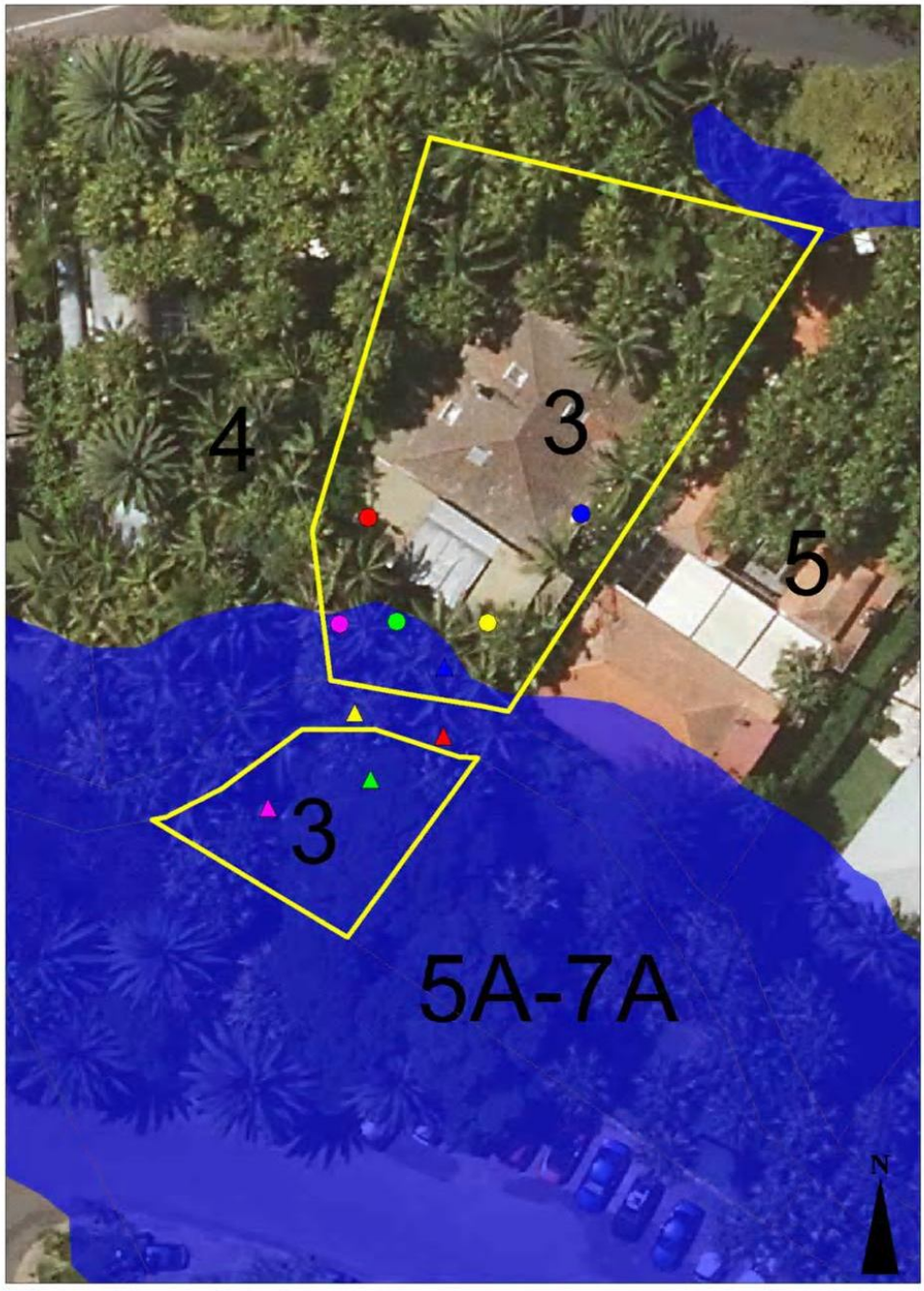
FLOOD MAP D - PMF EXTENT MAP



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: Flood study reference) and aerial photography (Source: NearMap 2014) are indicative only

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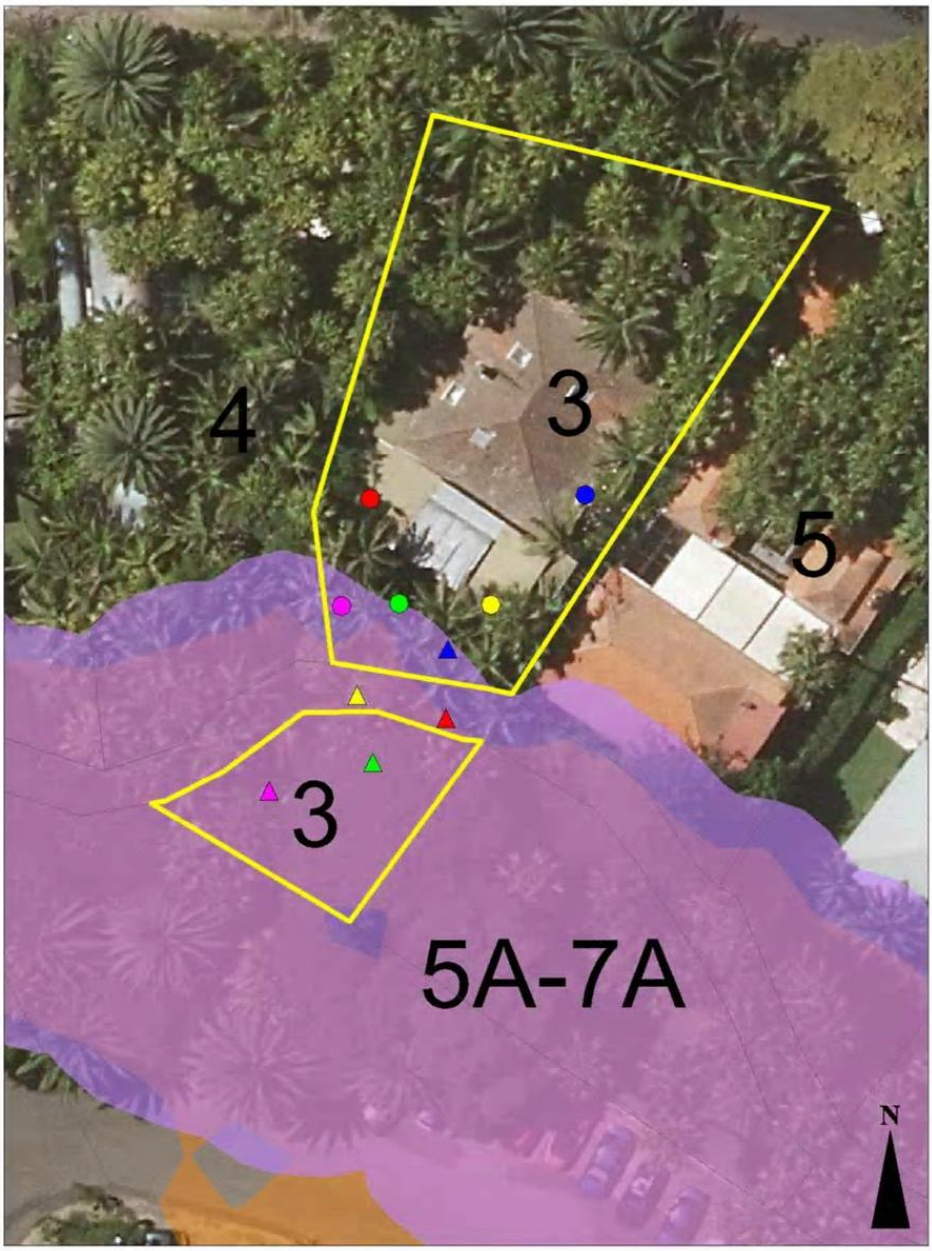
FLOOD MAP E – OVERLAND FLOW EXTENT MAP



Category 3 - Major extent with buffer

Lot Boundary

Category 3 - Minor extent

Map not to Scale

Notes:

- extent represents the 1% annual Exceedance Probability (AEP) flood event
- extent does not include climate change
- Overland Flow Path Major includes a fixed 5m horizontal planning buffer on the 1% AEP extent for planning purposes
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Flood study reference) and aerial photography (Source: NearMap 2014) are indicative only

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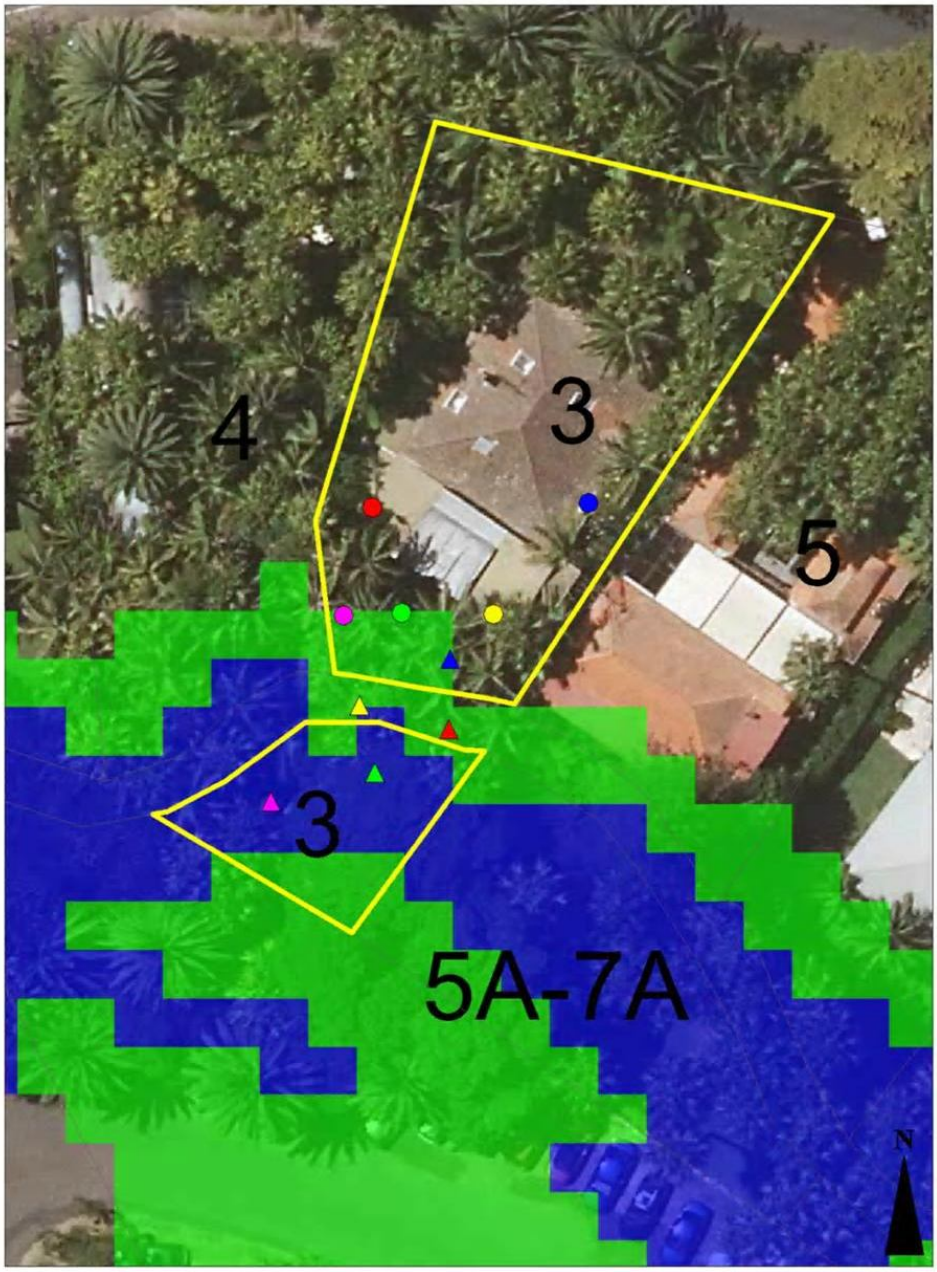
FLOOD MAP F – 1% AEP FLOOD HAZARD EXTENT MAP



High Hazard

Low Hazard

Lot Boundary

Map not to Scale

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: Flood study reference) and aerial photography (Source: NearMap 2014) are indicative only

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FLOOD MAP G – 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: Flood study reference) and aerial photography (Source: NearMap 2014) are indicative only

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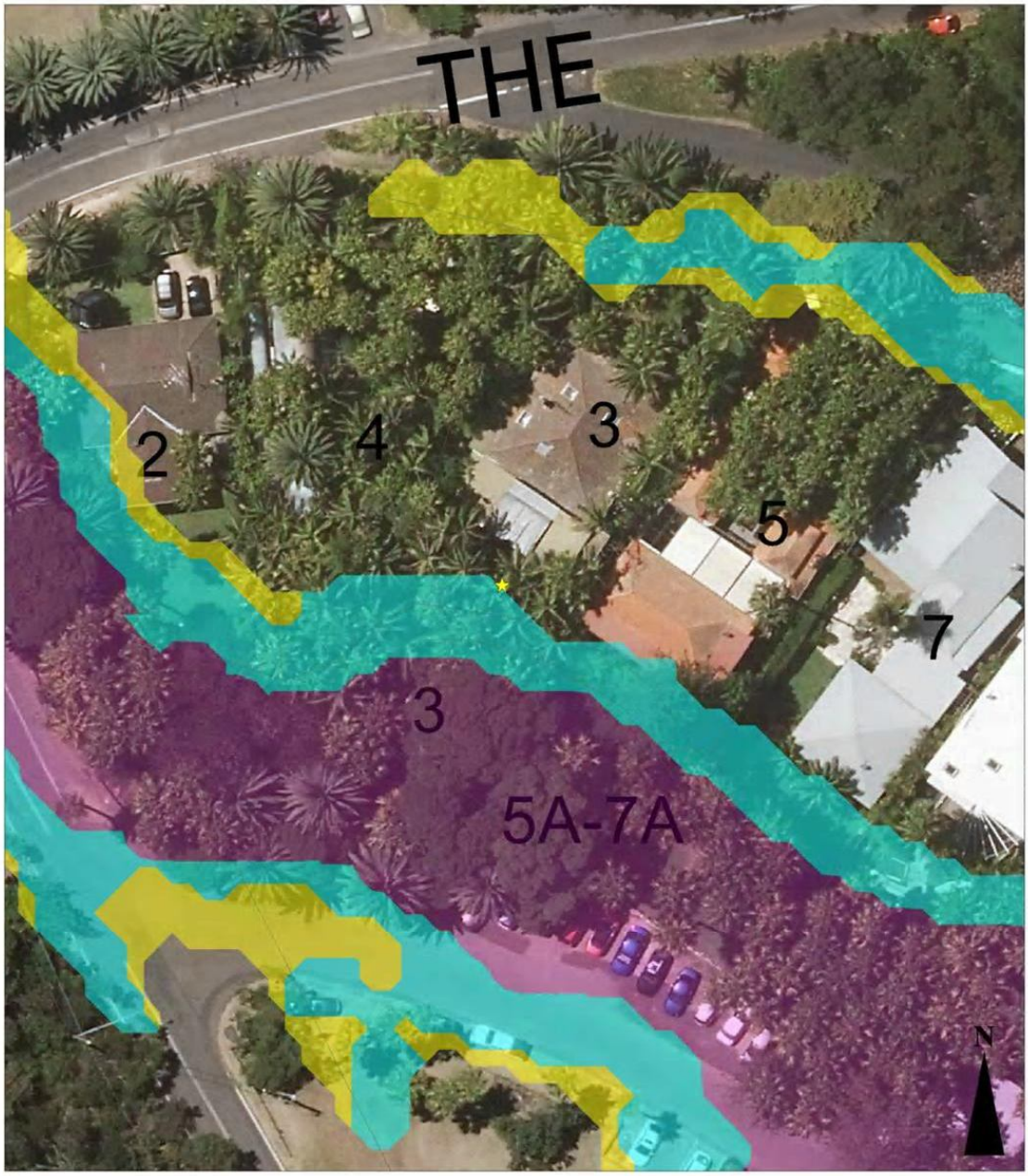
Draft Avalon to Palm Beach Flood Map

3 Bilgola Ave, Bilgola Beach



Flood Planning Area (FPA) High Risk extent

Flood Planning Area (FPA) Medium Risk extent

Property

Flood Planning Area (FPA) Low Risk extent

Notes:
1.* extent represents the 1% annual Exceedance Probability (AEP) flood event
2.Flood Planning Area includes the 0.5m freeboard on the
1% AEP extent of 5m horizontal buffer for planning purposes
3.Cadastre Lines, flood extents, aerials locations are indicative only

Not to Scale
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