Flood Impact Assessment

16 Macpherson Street, Warriewood, NSW

Final Report

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Glossary of Terms

AEP	Annual exceedance probability: the probability of a flood event occurring within a year. A 1% AEP flood has a 1% chance of occurring in any given year.
BMP	Biodiversity Management Plan
CC	Climate Change
Council	Northern Beaches Council
DA	Development Application
PDCP	Pittwater Development Control Plan
PLEP	Pittwater Local Environmental Plan
FPL	Flood planning level
FRMG	Flood Risk Management Guideline
MA	Martens & Associates Pty Ltd
NBC	Northern Beaches Council
PMF	Probable maximum flood: the most extreme flood event possible for a certain location, typically with an approximate ARI of 100,000 to 10,000,000 years.
SIP	Shelter-in-place
WWMS	Warriewood Valley Urban Land Release Water Management Specification

1 Introduction

1.1 Overview

1 Martens & Associates Pty Ltd (**MA**) have prepared this Flood Impact Assessment (**FIA**) to support a development application (**DA**) to the Northen Beaches Council (**Council**) for a proposed residential subdivision (the **Proposal**) at 16 Macpherson Street, Warriewood, NSW (the **Site**). The Proposal is the subject of a Class 1 merits appeal to the NSW Land & Environment Court in proceedings 2023/00250329 (the **Proceedings**).

2 This FIA provides updated flood modelling for the site, based on the original flood model developed by Stantec as documented in the Flood Impact and Risk Assessment, dated 5 May 2023 (**Stantec Flood Report**). The updated flood modelling completed in this report incorporates the updated civil design by Craig and Rhodes, Revision G (**Craig and Rhodes Civil Plan**).

3 The FIA assesses the significance of flood impacts arising from works arising from the proposal and has been based on the updated flood modelling documented in Section 3 and Appendix B.

1.2 Scope

4 This report provides the following:

(a) A thorough investigation of the environmental settings of the Site and surrounding area, focusing on locations affected by flood impacts.

(b) Updated flood modelling results produced utilising Craig and Rhodes Civil Plan.

(c) A detailed flood impact analysis identifying where impacts exceed threshold specified in the Pittwater Development Control Plan 21 (2007) (**PDCP**) and analyse the significance of exceedance based on risk to property, environment and safety.

(d) An assessment of the Proposal's impact on freeboard and the risk of over-floor flooding on the existing senior's living estate development located at 14 Macpherson Street to the southeast.

(e) An assessment of Proposal impacts against criteria in Section 4.5 of the NSW Flood Risk Management Guideline LU01 (**FRMG**).

(f) A compliance assessment against the criteria in clause 5.21 of the Pittwater Local Environmental Plan 2014 (**PLEP**).

(g) A compliance assessment against the Table 4.3 of the Warriewood Valley Urban Land Release Water Management Specification (**WWMS**).

1.3 Proposal

5 The Proposal consists of demolition of existing structures within the Site and creation of 29 lots, including ancillary infrastructure, roadworks, landscaping, community title subdivision and the dedication of the creek like corridor. The following is observed:

1. **Earthworks**: An overview of the Proposal, including proposed earthworks is provided at Figure 1[1] indicating that most of the Site will be filled to achieve sufficient flood immunity levels for residential land. Areas of excavation occur close to Narrabeen Creek, including works associated with the stormwater basin, and regarding works within the 25 m creek dedication corridor. In addition, the proposal includes regrading Brands Lane and lowering the area to the north of Brands Lane, with a suspended footpath connecting to the existing footbridge.

2. **Drainage**: By reference to Figure 2,[2] Site drainage will be directed to a stormwater basin located outside of the 25 m land dedication adjacent to Narrabeen Creek. Basin discharge is directed to an outlet into Narrabeen Creek. The existing drainage system within Brands Lane adjacent to the Site will also be upgraded to twin 1500x600 mm box culverts also directed to an outlet into Narrabeen Creek.

1.4 Site Inspection

6 A detailed inspection of the Site, local road and drainage system, and nearby Narrabeen Creek line was undertaken by Dr Daniel Martens and Mr Stanley Leung on 29 August 2023. Creek bed and bank conditions were viewed during the inspection.

1.5 DA Comments

7 Prior to commencement of the Proceedings, Council's had requested further information relating to flood impacts arising from the Proposal. These requests and our responses are provided in Table 1.

Table 1: Council's request for further information on flood impacts.

Request for Further Information	Response
If removal of the adverse impacts on private property is not possible, justification as to why not.	Detailed analysis and justification of impacts is provided at Section 4.3.
Mapping of the difference in Velocity x Depth product for the 1% AEP and PMF events.	VD product difference maps are provided at Set A Map 45 and Set A Map 59.

[1] Extracted from the Civil Works plans prepared by Craig & Rhodes, Drawing No. 048-22C-DA0051, dated 19 June 2024.

[2] Extracted from the Civil Works plans prepared by Craig & Rhodes, Drawing No. 048-22C-DA0102, dated 19 June 2024.

Request for Further Information	Response
Specific confirmation on whether each of the requirements in Table 4.3 of the Warriewood Valley Urban Land Release Water Management Specification (2001) have been met.	Confirmation is provided at Table 16.

1.6 SOFACs

8 The Statement of Facts and Contentions (**SOFACs**) filed in the Proceedings, dated 12 October 2023, raises a number of issues in respect of flood impact. These and our responses are provided in Table 2.

Table 2: Flood contentions.

Council Comments	Response
5. The proposed development should be refused because it will result in adverse flooding impacts on nearby private property.	(see below)
a) The proposal will result in adverse impacts on nearby private property in the 1% AEP and Probable Maximum Flood (PMF) events. In the 1% AEP event, flood levels would increase by more than the permitted tolerance of 0.02m and peak velocities would increase by more than the permitted tolerance of 10%. In the PMF event, flood levels would increase by more than the permitted tolerance of 0.05m and peak velocities would increase by more than the permitted tolerance of 10%.	Whilst there are some exceedances of thresholds specified in the PDCP, these do not cause harm to the environment, public or private property or infrastructure, and do not result in material changes to flood risks within the floodplain. Refer to the detailed flood impact analysis provided in Section 3.4.1.
b) The worst adverse impacts on private property are along the western boundary of 14 Macpherson St adjacent to Brands Lane and at the rear of 14 Macpherson St, but there are also scattered small patches of adverse impacts on the former 18 Macpherson St, 10 Macpherson St, across the road at 1 Fantail Ave & 2 Fantail Ave and east of Lorikeet Gr on the opposite side of the creek. In the PMF event, peak velocities are above 1m/s (which may be of possible concern in relation to scour) but the actual values are not provided. These values should be provided.	See response to contention 5(a). Peak velocities for the PMF event are provided at Set A Map 56.
c) Insufficient information has been submitted to demonstrate that the proposed development complies with the flood related requirements in Table 4.3 of the Warriewood Valley Urban Land Release Water Management Specification 2001. It appears from the mapping that not all of these requirements have been met, however it is difficult to determine this conclusively. Specific confirmation must be provided regarding whether each of the requirements have been met.	An assessment and confirmation of compliance is provided in Section 4.7.

1.7 Documents

9 This report relies on the following documents:

(a) Australian Rainfall and Runoff – A Guide to Flood Estimation. Commonwealth of Australia (2019) (**AR&R**).

(b) Flood Impact and Risk Assessment: 16 Macpherson Street, Warriewood, prepared by Stantec, dated 5 May 2023 (**Stantec Flood Report**).

(c) Flood Impact and Risk Assessment NSW - Flood Risk Management Guideline LU01, dated June 2023, prepared by the NSW Department of Planning (**FRMG**).

(d) NSW Floodplain Development Manual, Department of Infrastructure, Planning and Natural Resources (2005) (**FDM**).

(e) Pittwater Local Environmental Plan 2014 (**PLEP**).

(f) Pittwater Development Control Plan 21 (2007) (**PDCP**).

(g) Warriewood Brook Retirement Village and Residential Aged Care Facility, Approved s96 DA plans dated 8 February 2008 (14 Macpherson St Approved Plans).

(h) Warriewood Valley Urban Land Release Water Management Specification, Pittwater Council (2001) (**WWMS**).

2 Environmental Setting

2.1 Existing Land Use

10 Existing Site land use consists of a two-storey dwelling presenting to Macpherson Street (refer to Figure 4) and a Plant Nursery presenting to Brands Lane (refer to Figure 5). Brands Lane is sealed for around 60 m after its intersection with Macpherson Street (refer to Figure 6) and is then unsealed for the remaining approximately 155 m to Narrabeen Creek (refer to Figure 7).

11 Zoning pursuant to PLEP is R3 Medium Density Residential (refer to Figure 8).

2.2 Adjoining Development

12 There is an existing senior's living estate development adjoining Brands Lane to the southeast at 14 Macpherson Street which includes a range of building types and basement car parking (refer to Figure 9). The estate fronts Narrabeen Creek to the northeast (refer to Figure 10).

13 The sites adjoining to the southeast and northwest have been elevated to the Flood Planning Level (**FPL**), consistent with all new developments adjoining Narrabeen Creek.

2.3 Council Flood information

14 Council has provided comprehensive flood information for the site (Appendix D). This information is based on the 2019 Ingleside, Elanora, and Warriewood Overland Flow Flood Study conducted by WMAwater, completed before the approval and construction of the current housing development on 18 Macpherson Street, Warriewood. The information includes a flood risk precinct map of the site, which shows that almost the entire site is classified as Medium Risk, with High Risk areas encroaching along the creek line.

2.4 Topography

15 By reference to Figure 11, the following observations are made in respect of topography:

1. Ground levels within the Site grade generally towards the southeast and range from approximately 5.0-5.5 along the northwestern boundary to 4.5-4.6 along the southeastern boundary.

2. Site grade is generally slight with falls of around 2-3 % towards the southeast.

3. The rear of the Site adjacent to Narrabeen Creek appears to be partly filled, this constricting the flow within Narrabeen Creek at that location. Creek channel width and capacity are significantly larger adjacent to 14 Macpherson Street downstream of the Site

2.5 Riparian Corridor

2.5.1 Location and Extent

16 The riparian corridor of Narrabeen Creek adjoins the Site at the northeastern boundary. Narrabeen Creek is a perennial stream flowing in a generally south to southeastly direction from the Site for some 2.1 km before its confluence with Mullet Creek, which in turn flows to the northern shores of Narrabeen Lagoon around 730 m further downstream.

17 The riparian corridor at the Site is approximately 40-45 m wide and consists of the creek, creek bank vegetation, a pedestrian footpath and open grass areas. Immediately downstream of the Site, the corridor widens to around 60 m. In this area the right (southern) bank of the creek has been historically rehabilitated through earthworks and significant replanting of riparian vegetation. The Proposal includes the dedication of around 25 m of land adjoining the existing riparian corridor so that the corridor width is increased to around a total of 65 m, this being consistent with the width immediately downstream.

2.5.2 Site Observations

18 A detailed inspection of the riparian corridor adjacent, upstream and downstream of the Site was undertaken during the view. By reference to Figure 12, the following observations are made in respect of specific areas within the riparian corridor:

1. **Area A** – This portion of the Site is proposed to be dedicated to Council as part of the riparian corridor. At present the area is used for parking, storage of nursery materials and other goods (refer to Figure 13, Figure 14 and Figure 15).

2. **Area B** – This area includes the riparian corridor adjacent to the Site as well as a portion of the corridor upslope of the Site. The creek channel in this reach is generally rectangular and shallow, with width approximately 2-3 m in lower sections (refer to Figure 16) and slightly narrower in the upper sections at approximately 1.5-2 m (refer to Figure 17). Notable features include a pedestrian footway and associated open grass areas located within the left bank corridor (refer to Figure 18), heavily vegetated creek banks (refer to Figure 19), and a stable creek channel (refer to Figure 19). Bed and bank materials appeared variably comprised of a silty sands, sandy silts and clays. A low bench or incipient floodplain was evident adjacent to both banks.

3. **Area C** – This portion of the riparian corridor includes the pedestrian bridge crossing over Narrabeen Creek (refer to Figure 20).

4. **Area D** – This area contains the bulk of the riparian corridor downstream of the Site, including the channel and significant parts of the left and right bank corridor. The right bank area is characterised by densely revegetated riparian land (refer to Figure 21) containing areas of recent shallow depth flood deposits in the process of becoming vegetated (Figure 22). Remnant tree protection sleeves emplaced during previous revegetation were observed at the base of numerous trees (refer to Figure 23). The channel in this area was wider than upstream of Area C.

5. **Area E** – This area comprised the interface land between the Area D right bank riparian corridor and private land within 14 Macpherson Street. Adjacent to Brands Lane the area is characterised by sloping grassed landscaping with a concrete footpath (refer to Figure 24). Landscaping width varies, becoming widest where there are larger gaps between buildings (refer to Figure 25 and Figure 26). Building ground floor levels in this area are significantly elevated (about 1 m) above ground levels (refer to Figure 27).

6. **Area F** – This portion of the left bank riparian corridor exists between Lorikeet Grove and the riparian corridor proper. It is characterised by various large retaining structures supporting Lorikeet Grove comprising of sandstone blocks (refer to Figure 28) and concrete block work (refer to Figure 29). In places the retaining structures are stepped (refer to Figure 30). Adjacent and to the southeast of Area F was an area of undeveloped land characterised by grasses and scattered trees containing a south flowing overland flow path to the Creek (refer to Figure 31).

7. **Area G** – This area contains a number of artificial waterbodies forming part of the stormwater management system for land to the south and southeast of the Site (Figure 32). The final pond adjacent to the riparian corridor maintain a riprap reinforced overflow weir (refer to Figure 33).

3 Flood Modelling and Results

3.1 Stantec Flood Report

Flood modelling completed in the Stantec Flood Report is based on the results of the 2019 Ingleside, Elanora and Warriewood Overland Flow Flood Study prepared by WMA Water which was completed prior to the approval and construction of the current housing development on 18 Macpherson Street Warriewood adjacent and to the northwest of the Site. Updates to the 2019 model included incorporating Site and 18 Macpherson Street survey, incorporation of new building footprints, and adjustments to roughness zones to accommodate new development and vegetated areas.

3.2 MA Update Flood model

19 All modelling setup and parameters for existing conditions (i.e., Manning, existing terrain, rainfall data, etc.) have been retained as in the original Stantec model. For further modelling setup details, please refer to the Stantec Flood Report.

20 For the proposed condition, the Stantec model has been updated to incorporate the changes made in the Craig and Rhodes Civil Plan, and to improve impacts on the adjoining properties. The key updated civil design drawings are provided in Appendix A, in Figure 1 to Figure 3. The notable flood-specific design changes include:

- Dropping the internal Site roads and Brands Lane.
- Re-grading the area between Brands Lane and Narrabeen Creek.

3.3 Results

21 The results of the MA updated flooding modelling provided in Set A Flood Maps in Appendix B and covers flood levels, depths, velocities, hazard categories, water level afflux, and water velocity afflux, with the addition of velocity depth product, velocity depth product afflux, and the relevant afflux maps for the 1% AEP flood and PMF without climate change.

22 As per the previous comment from the Stante report, the actual probability of these CC events occurring under current day conditions is significantly lower than what is suggested by the AEP of the event. For instance, the 1% AEP + CC event has an equivalent AEP in today's terms of 0.11%, which is equivalent to a 1 in 871-year event. [3]

3.4 Discussion

3.4.1 Existing Flood Conditions

23 The following observations are made in respect of existing 1% AEP conditions, which have been assessed under no climate change and 30% CC scenarios:

[3] Refer to Stantec Flood Report at Section 4.2, pp 40-41.

1. **1% AEP Depths:** The existing 1% AEP and 1% AEP + 30% CC flood extents are provided at Set A Map 9 and Set A Map 13. In both cases, the 1% AEP flood does not extend over the entire Site. Under existing conditions, flood depths within the Site are typically < 0.3 m. Under CC conditions, flood depths increase in the order of 15-20 cm within flood affected areas and flood extents are slightly increased. Depths > 1.5 m are typically confined to the Narrabeen Creek channel and to the right bank riparian corridor adjacent to the 14 Macpherson Street development where riparian rehabilitation has been undertaken such that the 1 % AEP flows are confined to the corridor.

2. **1% AEP Velocity:** The existing 1% AEP flood velocity is provided at Set A Map 10, indicating that velocity within the Site is typically < 0.3 m/s except adjacent to the Creek where velocity ranges between 0.5-1.0 m/s. Velocities > 1.0 m/s adjacent to the Site and downstream, are experienced primarily within the creek channel and near channel overbank areas.

3. **1% AEP Flood Hazard:** The existing 1% AEP flood hazard has been provided at Set A Map 12, indicating that the Site is affected by H1, H2 and H3 hazards. Areas within the Narrabeen Creek channel reach up to H6 in a few locations, although the channel is typically H5.

3.4.2 Proposed Flood Conditions

24 The following observations are made in respect of existing 1% AEP conditions, which have been assessed under no climate change and 30% CC scenarios:

1. **1% AEP Depths:** The proposed 1% AEP and 1% AEP + 30% CC flood extents are provided at Set A Map 33 and Set A Map 40. In both cases, the 1% AEP flood does not extend into the residential areas.

2. **1% AEP Velocity:** The proposed 1% AEP flood velocity is provided at Set A Map 35, indicating that flood flows are confined to land associated with the stormwater basin and riparian corridor dedication adjoining Narrabeen Creek.

3. **1% AEP Flood Hazard:** The existing 1% AEP flood hazard is provided at Set A Map 39, indicating that flood hazard within the Site are confined to land associated with the stormwater basin and riparian corridor dedication adjoining Narrabeen Creek.

3.4.3 Flood Planning levels

25 The proposed Finished Floor Levels (FFLs) of the building pads for the future lots have been set above the Flood Planning Levels (**FPL**) as discussed in the Stantec Flood Report, which are higher than the 1% AEP + 30% CC flood levels for the existing condition, as provided in Set A Map 13. The updated and summarised FPLs are as follows:

- **Lot 2 to Lot 6:** FPL 5.91
- **Lot 7 and Lot 19 to Lot 29:** FPL 5.97
- **Lot 8 to Lot 18:** RL 6.00

4 Flood Impact Analysis

4.1 Methodology

26 The following methodology was used to analyse the flood impacts:

1. Analysis the updated flood modelling results including:
    a. Existing and proposed 1% AEP + 30% CC flood levels and impacts.
    b. Existing and proposed 1% AEP + 30% CC flood velocities and impacts.
    c. Existing and proposed 1% AEP + 30% CC flood VD products and impacts.
    d. Existing and proposed PMF + 30 % CC flood levels and impacts.
    e. Existing and proposed PMF + 30% CC flood velocities and impacts.
    f. Existing and proposed PMF + 30% CC flood VD products and impacts.
2. Identify locations where impacts exceed thresholds specified (if provided) in the PDCP.
3. Define issues to be considered to enable analysis of potential flood impacts.
4. Inspect identified locations where relevant.
5. Analyse the significance of any threshold exceedance based on risks to property, environment and safety.

4.2 Pittwater DCP

4.2.1 Objectives

27 The PDCP maintains the following objectives in respect of development on flood prone land:[4]

- Protection of people.
- Protection of the natural environment.
- Protection of private and public infrastructure and assets.

4.2.2 Controls

28 Pursuant to Section B3.11 of the PDCP, the Site's classification as being located predominantly within a Medium Flood Risk precinct and the development being for residential purposes, controls A1 and A2 apply to the Proposal in respect of considering flood effects caused by development. These are provided in Table 3.

[4] PDCP Section B3.11.

Table 3: PDCP s B3.11 residential development controls on flood effects.

Control	Desctiption
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.* *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*

29 The PDCP[5] defines 'adverse impacts' for the purpose of flood prone land referred to in control A1 as follows:

1. *Will result in less than 0.02m increase in the 1% AEP.*
2. *Will result in less than a 0.05m increase in the PMF.*
3. *Will result in less than a 10% increase in PMF peak velocity.*
4. *Will have no loss in flood storage or flood way in the 1% AEP.*

30 We note that these definitions are at odds with the intent of control A1 and the flood prone land objectives, and we have therefore assumed therefore that for points 1-3 the word 'less' should be read as 'greater', and for point 4 the words 'have no' should be read as 'result in a'. Such a reading would be consistent with Council's SOFACs (refer to Table 2). Further, The definition of 'adverse impacts' in Control A1 refers only to the velocity change criteria for the PMF, but not to the 1% AEP flood as specified in Contention 5(a) of the SOFACs.

31 In addition to these controls, the following additional controls are noted which add climate change to the flood impact assessment process and modify the assessment criteria:

1. Pursuant to Section B3.12 of the PDCP, any proposed intensification of development on flood liable land within the Warriewood Valley Land Release Area should include the effect of climate change on flood behaviour and levels.
2. Pursuant to Section C6.1 of the PDCP, any development within a release area is to assess, and where required mitigate, flood impacts with the addition of climate

[5] Definitions are provided in Section A1.9 of the PDCP.

change including changes to 50%, 20% 1% AEP and PMF flood levels, and changes to 1% AEP and PMF flow velocities.

32 In summary, there is some ambiguity and uncertainty in the PDCP regarding how to identify areas where potential adverse flood impacts may occur, and there are assessment criteria differences between what is expressed in the SOFACs and the PDCP.

4.3 Analysis

4.3.1 Investigation Locations and Criteria

33 The flood impact analysis focused on specific investigation locations described in defined Table 4. Flood maps are provided in Appendix B and have been prepared based on the updated flood model as described in Section 3.

Table 4: Flood impact analysis investigation areas and criteria.

Variable	Reference	1% AEP + 30% CC	PMF + 30% CC
Flood level (mAHD)	Criteria	Afflux > 0.02 m	Afflux > 0.05 m
	Set A Maps	40, 41	54, 55
Flow velocity (m/s)	Criteria	Increase > 10%	Increase > 10%
	Set A Maps	42, 43	56, 57
Velocity x depth product (m^2/s)	Criteria	Increase > 10%	Increase > 10%
	Maps	44, 45	58, 59

34 The following is noted in respect of the adopted criteria:

1. Flood level afflux investigation criteria are based on Section A1.9 of the PDCP and not the lower standard when CC is included.
2. Flow velocity investigation criteria includes a 10% increase threshold for the 1% AEP as requested in the SOFACs (not required by the PDCP).
3. Velocity x depth product plots have been included as these were previously requested by Council (but are not included in the SOFACs). The PDCP does not provide a threshold change criteria, hence a nominal 10% increase has been adopted to identify investigation locations to be consistent with the velocity increase investigation criteria.

4.3.2 Analysis Considerations

35 The impact of any flood impact threshold exceedances was analysed at each of the identified investigation locations by one or more considerations outlined in Table 5. These

considerations were developed so that the significance of the flood impact could be evaluated.[6]

Table 5: Flood impact analysis considerations.

Variable	Considerations
Flood level afflux	1. Is vegetation inundation materially increased? 2. Will existing land-uses be impacted? 3. Will enjoyment or amenity of the land be degraded? 4. Will there be an increase in flood risk to life or property? 5. Are flood evacuation risks increased?
Velocity increases[1]	6. Will vegetation likely be impacted? 7. Will property or infrastructure be impacted? 8. Will soil erosion likely occur? 9. Will creek channel impacts occur?
VD product increases	10. Will risk to life or public safety increase? 11. Will the use of the land be detrimentally impacted?

Notes

1. Flow velocities of > 2 m are typically assumed to have potential to scour vegetated areas.[7]

4.3.3 1% Event Analysis

4.3.3.1 Flood Levels

36 1% AEP + 30 % CC flood level increase investigation areas identified in Set A Map 40 and Set A Map 41 provided in Appendix B are described and analysed in Table 6. This finds that off-site flood level increases will not lead to any detrimental impacts on the existing riparian corridor of Narrabeen Creek, nor will the use, amenity or enjoyment of adjoining land to the northwest or southeast be detrimentally affected.

Table 6: Analysis of 1% AEP + 30% CC flood level changes.

Location	Description	Analysis
1	North of Site within and adjacent to riparian corridor	The identified flood level changes are acceptable because: • Maximum depth increases within the existing riparian corridor minor at < 20 cm. These will not impact on existing vegetation or Creek conditions as existing depths are up to 2 m or more. • Depth increases on adjoining land to the north are minor at < 20 cm and are located within vegetated land associated

[6] The adopted considerations are consistent with the approach and guidance provided in Section 3.3 Table 3 of the *NSW Flood Impact and Risk Assessment – Flood Risk Management Guideline LU01*, prepared by the NSW Department of Planning and Environment (June 2023).

[7] See for example Soil Conservation Guidelines for Queensland, Chapter 9 Waterways, Section 9.3, Table 9.1, p 10.

Location	Description	Analysis
		with the riparian corridor and land adjoining the stormwater basin. These changes will not affect the use and enjoyment of the land, will not affect amenity, and will not lead to an increase in risk to life or property. • Depth increases within Brands Lane minor at < 20 cm. These will not impact on existing vegetation or Creek conditions as existing depths are up to 2 m or more, and flood evacuation will not be affected because the impacted area is not an evacuation route.
2	Northeast of Site within riparian corridor and within landscaped area of 14 Macpherson St	The identified flood level changes are acceptable because: • Maximum depth increases within the existing riparian corridor minor at < 20 cm. These will not impact on existing vegetation or Creek conditions as existing depths are up to 2 m or more. • Depth increases on adjoining land to the landscaped area of 14 Macpherson St are minor, mostly < 5cm except a small area between 5 – 10 cm. These changes will not affect the use and enjoyment of the land, will not affect amenity, and will not lead to any material increased risk to life or property. This area is heavily vegetated (refer to Figure 10 and Figure 12 at Location E).

4.3.3.2 Flow Velocities

37 1% AEP + 30 % CC flow velocity increase investigation areas identified in Set A Map 42 and Set A Map 43 (Appendix B) are described and analysed in Table 7. This finds that off-site flood flow velocity increases will not lead to any detrimental impacts on the existing riparian corridor of Narrabeen Creek, nor will there be any likely impacts on existing vegetation, hardstand areas, property or infrastructure.

38 The analysis has found that there is a small location within Brands Lane in the riparian corridor (location 3) where peak flow velocity increases above 2 m/s following the Creek regrading works. For this area we recommend any pervious areas are rapidly stabilised following completion of earthworks with biodegradable jute matting fixed into place and then hydro mulched to ensure rapid vegetative establishment. Routine inspections and maintenance during the vegetation establishment period will ensure that the risk of soil erosion and vegetation loss is appropriately mitigated.

Table 7: Analysis of 1% AEP + 30 % CC flow velocity changes.

Location	Description	Analysis
1	Minor scattered areas in the model domain	The identified flow velocity changes are acceptable because: • The identified areas are predominantly located in regions of low velocity of < 1m/s. Changes are minor and will not lead to impacts on property or infrastructure. • Where increases occur within vegetated areas, vegetation will not be impacted because velocities are not increased above 2 m/s.
2	Areas within Macpherson St and Brands Ln	The identified flow velocity changes are acceptable because:

Location	Description	Analysis
		• Identified areas are located in regions where velocity ranges up to 1.5 m/s. Changes are minor and no impact on property or infrastructure will occur because increases are insufficient to cause damage. • Where increases occur within vegetated areas, vegetation will not be impacted because velocities are not increased above 2 m/s.
3	Within riparian corridor where creek bank is regraded	The identified flow velocity changes are acceptable because: • Velocity increases occur here because the creek regrading works increase the flow capacity of the channel at this location, directing increased flows across this part of the riparian corridor. • The small area which is identified as increasing above 2 m/s can be initially stabilised, where it is to be retained as pervious riparian area, with biodegradable jute matting fixed into place and then hydro mulched to ensure rapid vegetative cover following earthworks. Routine inspections and maintenance during the vegetation establishment period will ensure that the risk of soil erosion and vegetation loss is appropriately mitigated. • Any hardstand areas within this location will not be impacted by the velocity changes.
4	Within adjoining land to northwest	The identified flow velocity changes are acceptable because: • Velocity increases occur here because the Site creek regrading works increases flow rates due to increased floodplain drainage capacity in this area. • The area is localised near the boundary and occurs within vegetated stable land and impacts are therefore not anticipated. • No property or infrastructure is likely to be impacted.
5	Within the riparian corridor and landscaped area of 14 Macpherson St northeast of Site	The identified flow velocity changes are acceptable because: • This area is heavily vegetated (refer to Figure 10 and Figure 12 at Location E). • Velocity increases occur here because the Site creek regrading works increases flow rates due to increased floodplain drainage capacity in this area. • Velocities remain low at < 1.5 m/s and any increase will not lead to material risk of scour or loss of vegetation during a flood. • Increased soil erosion is not anticipated during a flood event given the well vegetated condition of the land. • Any hardstand areas within this location will not be impacted by the velocity changes. • No property or infrastructure is likely to be impacted.
6	Within drainage infrastructure northeast of 14 Macpherson St.	The identified flow velocity changes are acceptable because:

Location	Description	Analysis
		• Velocity increases occur here because the Site creek regrading works increases flow rates due to increased floodplain drainage capacity in this area. • Velocities remain low at < 1.5 m/s and any increase will not lead to material risk of scour or loss of vegetation during a flood. • Increased soil erosion is not anticipated during a flood event given the well vegetated condition of the land. • Any hardstand areas within this location will not be impacted by the velocity changes. • No property or infrastructure is likely to be impacted by the changes.
7	Within left bank riparian corridor downstream of Site	The identified flow velocity changes are acceptable because: • Velocities remain low at < 1.5 m/s and any increase will not lead to material risk of scour or loss of vegetation during a flood. • Increased soil erosion is not anticipated during a flood event given the well vegetated condition of the land. • No property or infrastructure, including the retaining walls at this location, is likely to be impacted by the changes.
8	Within rural residential land east of Site	The identified flow velocity changes are acceptable because: • Velocities remain low at < 1.5 m/s and any increase will not lead to material risk of scour or loss of vegetation during a flood. • Increased soil erosion is not anticipated during a flood event given the well vegetated condition of the land. • No property or infrastructure is likely to be impacted by the changes.

4.3.3.3 VD Product

39 1% AEP + 30 % CC VD product increase investigation areas identified in Set A Map 44 and Set A Map 45 (Appendix B) are described and analysed in Table 8. This finds that off-site flood VD product increases will not lead to any detrimental impacts on road infrastructure, risks to public safety or affectations in the use of land.

Table 8: Analysis of 1% AEP + 30 % CC VD product changes.

Location	Description	Analysis
1	Minor scattered areas in the model domain	The identified VD product changes are acceptable because: • VD product increases are minor at < 0.25 m^2/d. • VD product remains low and safe at < 0.4 m^2/s.[8]

[8] For example, Blacktown Council's WSUD Developer Handbook 2020 recommends at section 15.7.2 that VD product < 0.6 m2/s are safe for pedestrians.

Location	Description	Analysis
2	Areas within Macpherson St and Brands Ln	The identified VD product changes are acceptable because: • VD product remains generally low and safe at < 0.4 m^2/s except for the lower portion of Brands Ln beyond the entrance to 14 Macpherson St. • New residences within the Site where VD > 0.4 m^2/s can continue to have safe access via the new internal road.
3	Within riparian corridor where creek bank is regraded	The identified VD product changes are acceptable because: • Changes in VD product arise largely from the proposed Creek regrading which increase floodplain flow capacity at that location. • This location is within the riparian corridor which is otherwise unsafe during a flood and would not be used for public access during a flood.
4	Within adjoining land to northwest	The identified VD product changes are acceptable because: • Changes in VD product arise largely from the proposed Creek regrading which increase floodplain flow capacity at that location. • This location is within the riparian corridor which is otherwise unsafe during a flood and would not be used for public access during a flood.
5	Within the riparian corridor and landscaped area of 14 Macpherson St northeast of Site	The identified VD product changes are acceptable because: • VD product within the landscaped area of 14 Macpherson St remains low and safe at < 0.4 m^2/s. • Changes within the riparian corridor are otherwise unsafe during a flood and would not be used for public access during a flood.
6	Within drainage infrastructure northeast of 14 Macpherson St.	The identified VD product changes are acceptable because: • Changes are < 0.25 m^2/s and located within land used for drainage and riparian vegetation.
7	Within left bank riparian corridor downstream of Site	The identified VD product changes are acceptable because: • Changes are minor and do not materially change the low risk rating of < 0.4 m^2/s. • Changes within the riparian corridor are otherwise unsafe during a flood and would not be used for public access during a flood.
8	Within rural residential land east of Site	The identified VD product changes are acceptable because: • VD product increases are minor at < 0.25 m^2/d. • VD product remains low and safe at < 0.4 m^2/s.

4.3.4 PMF Event Analysis

4.3.4.1 Flood Levels

40 PMF flood level increase investigation areas identified in Set A Map 54 and Set A Map 55 are described and analysed in Table 9. This finds that off-site flood level increases will not lead

to any detrimental impacts on the use or safe evacuation of land, notably land within 14 Macpherson St to the southeast of the Site.

Table 9: Analysis of PMF + 30 % CC flood level changes.

Location	Description	Analysis
1	North of Site within and adjacent to riparian corridor	The identified flood level changes are acceptable because: • The increases are largely contained within the riparian corridor where flood depth changes are not material compared to existing depths. • Afflux on adjoining land to the northwest will not affect the use or safe evacuation of that land. • The extent of flood liable land is not materially altered.
2	Northeast of Site within riparian corridor and within landscaped area of 14 Macpherson St	The identified flood level changes are acceptable because: • The increases are largely contained within the riparian corridor where flood depth changes are not material compared to existing depths. • Afflux on adjoining land to the southeast on 14 Macpherson St will not affect the use or safe evacuation of that land. • The extent of flood liable land is not materially altered.

4.3.4.2 Flow Velocities

41 PMF + 30 % CC flow velocity increase investigation areas identified in Set A Map 56 and Set A Map 57 (Appendix B) are described and analysed in Table 10. This finds that off-site flood flow velocities will not be increased to rates inconsistent with those experienced elsewhere within the riparian corridor or road reserves, and will not likely detrimentally impact private land beyond any impacts likely to be experienced under extreme PMF flood conditions.

Table 10: Analysis of PMF + 30 % CC flow velocity changes.

Location	Description	Analysis
1	Minor scattered areas in the model domain	The identified flow velocity changes are acceptable because: • Increases are trivial and typically < 0.1 m/s.
2	Areas within Macpherson St and Brands Ln	The identified flow velocity changes are acceptable because: • Increases are largely confined to hardstand road areas which will not be materially affected by the increases. • There are some areas where velocity increases above 2m/s. However, the extent of these areas is minor and not inconsistent with higher flow velocities experienced within road corridors in the local area.
3	Within riparian corridor where creek bank is regraded	The identified flow velocity changes are acceptable because: • Velocity increases occur here because the creek regrading works increase the flow capacity of the channel at this location, directing increased flows across this part of the riparian corridor.

Location	Description	Analysis
		• High velocities are experienced throughout the Narrabeen Creek corridor during the PMF, which is the worst case conceivable flood event where potential creek impacts would be anticipated in any case. The velocities in this location are not inconsistent with those experienced elsewhere within the local creek corridor.
4	Within adjoining land to northwest	The identified flow velocity changes are acceptable because: • Changes do not result in new areas of > 2m/s velocity. • No property or infrastructure is likely to be impacted because of the Proposal.
5	Within the riparian corridor and landscaped area of 14 Macpherson St southeast of Site	The identified flow velocity changes are acceptable because: • Velocities remain < 2m/s. • No property or infrastructure is likely to be impacted because of the Proposal.
6	Within drainage infrastructure southeast of 14 Macpherson St.	The identified flow velocity changes are acceptable because: • Increases are trivial and typically < 0.1 m/s.
7	Within left bank riparian corridor downstream of Site	The identified flow velocity changes are acceptable because: • High velocities are experienced throughout the Narrabeen Creek corridor during the PMF, which is the worst case conceivable flood event where potential creek impacts would be anticipated in any case. The velocities in this location are not inconsistent with those experienced elsewhere within the local creek corridor. • The area which experiences >2 m/s velocities is slightly increased, however, this is consistent with existing creek and overbank velocities experienced at this location, particularly under the Narrabeen Creek crossing.
8	Within rural residential land east of Site	The identified flow velocity changes are acceptable because: • Increases are trivial and typically < 0.2 m/s.
9	Within right bank riparian corridor east of Site	The identified flow velocity changes are acceptable because: • Increases are trivial and typically < 0.1 m/s.

4.3.4.3 VD Product

42 PMF + 30 % CC VD product increase investigation areas identified in Set A Map 58 and Set A Map 59 (Appendix B) are described and analysed in Table 11. This finds that off-site flood VD product increases will not lead to any material risks to public safety, impacts on evacuation routes or significant affectations in the use of land.

Table 11: Analysis of PMF + 30 % CC VD product changes.

Location	Description	Analysis
1	Minor scattered areas in the model domain	The identified VD product changes are acceptable because: • VD product increases are minor at < 0.25 m^2/d. • VD product remains low and safe at < 0.4 m^2/s.

Location	Description	Analysis
2	Areas within Macpherson St and Brands Ln	The identified VD product changes are acceptable because: • The localised increases do not impact the evacuation route along Macpherson Street because the route is otherwise impacted at numerous locations at peak flow conditions by VD product > 0.6 m^2.
3	Within riparian corridor where creek bank is regraded	The identified VD product changes are acceptable because: • Changes in VD product arise largely from the proposed Creek regrading which increase floodplain flow capacity at that location. • This location is within the riparian corridor which is otherwise unsafe during a flood and would not be used for public access during a flood.
4	Within adjoining land to northwest	The identified VD product changes are acceptable because: • Changes in VD product arise largely from the proposed Creek regrading which increase floodplain flow capacity at that location. • This location is largely within the riparian corridor which is otherwise unsafe during a flood and would not be accessed during a flood.
5	Within the riparian corridor and landscaped area of 14 Macpherson St southeast of Site	The identified VD product changes are acceptable because: • Changes within the riparian corridor and landscaped areas of 14 Macpherson St are of no consequence because these areas are unsafe under existing conditions and would not be accessed during a flood.
6	Within drainage infrastructure southeast of 14 Macpherson St.	The identified VD product changes are acceptable because: • Changes are minor at < 0.25 m^2/s and located within land used for drainage and riparian vegetation. • Changes in this area are restricted to the riparian corridor.
7	Within left bank riparian corridor downstream of Site	The identified VD product changes are acceptable because: • Changes within the riparian corridor are of no consequence because these areas are unsafe under existing conditions and would not be accessed during a flood. • Changes within the road reserve are minor at < 0.25 m^2/s.
8	Within rural residential land east of Site	The identified VD product changes are acceptable because: • VD product increases are minor at < 0.25 m^2/d. • VD product remains generally low and safe at < 0.4 m^2/s.
9	Within right bank riparian corridor east of Site	The identified VD product changes are acceptable because: • Changes are minor at < 0.25 m^2/s and located within land used for drainage and riparian vegetation. • VD product remains generally low and safe at < 0.4 m^2/s.

4.4 Flood Impact on 14 Macpherson St

4.4.1 Approved Levels

43 The building on 14 Macpherson Street located closest to the Creek and the site is known as The Ferneries (**Building A**) and is approved with a floor level of 6.0 mAHD.[9]

4.4.2 Updated Flood Modelling

44 For each event, the maximum water level against Building A on 14 Macpherson St was identified and plotted. Detailed mapping of flood levels for the considered events is provided in Appendix C, with results summarised in Table 12. The following is observed:

(a) Building A floor levels are at least 0.5 m above the 1% AEP and 1% AEP + 30 % CC flood level.

(b) Building A floor levels are overtopped by the PMF and PMF + 30% CC under all conditions (existing and proposed). Apart from the PMF+CC scenario, peak flood levels decrease at Building A. In respect of the PMF + CC scenario, the change is only 3 cm and does not have any impact as the event without development is already 0.3 m above the FFL.

45 In summary, Table 12 show the Proposal will increase freeboard at Building A in the 1% AEP and 1% AEP + 30 % CC (Council's FPL defining event). While the water level increases along the northeast boundary in the 1% AEP and 1% AEP + 30 % this is not where the maximum flood level occurs and hence has no real impact on freeboard or the risk of over-floor flooding of Building A.

Table 12: Supplementary flood modelling maximum water level at Building A results.

Model Run Event	[A] Existing Conditions (mAHD)	[B] Proposed Conditions (mAHD)	[B]-[A] Change in Level (m)
1% AEP	5.25	5.21	-0.04
1% AEP + 30% CC	5.48	5.43	-0.05
PMF	6.06	6.05	-0.01
PMF + 30 %CC	6.30	6.33	+0.03

4.5 Consideration of FRMG Impact Assessment Criteria

46 Table 3 in Section 3.4 of the *Flood Impact and Risk Assessment NSW - Flood Risk Management Guideline LU01*, dated June 2023, prepared by the NSW Department of Planning (**FRMG**),

[9] Refer to 14 Macpherson St Approved Plans Drawings 0439/TF/A03 (ground floor plan), 0439/TF/A09 (elevations) and 0439/TF/A10 (sections).

provides a list of typical considerations to be undertaken when assessing impacts due to development.

47 At Table 13 these considerations, and their reasons for consideration, have been reproduced and assessed as being acceptable.

Table 13: FRMG impact considerations.

Key Consideration	Reason for Considering	Assessment
Flood level change	• May increase inundation and damage to existing development. • May inundate additional existing development. • May create new or larger floodways or flowpaths. • May isolate new areas.	Flood level changes are acceptable because: • Existing buildings will not be impacted by flood level changes. Peak 1% AEP and PMF (with and without CC) levels at 14 Macpherson St will be reduced at Building A. • Floodways and flow paths will not be increased or created under the 1% AEP or PMF (with and without CC) events. • No new areas will become isolated as a result of the Proposal.
Change in duration of flooding	• May increase damage. • May increase duration of isolation.	Impacts are acceptable because: • Duration of flooding is not materially changed. Lowered flood levels within Brands Lane and Macpherson Street indicate duration of inundation is likely to decrease. • Duration of over-floor flooding is not increased by the Proposal.
Velocity change	• May increase scour potential and/or damage to structures.	Velocity changes in the 1% AEP and PMF (with and without CC) events are acceptable because: • Changes are negligible and will not impact on existing structures or infrastructure. • Changes are not anticipated to cause increased vegetation losses or erosion during flooding.
Change in warning and evacuation time	• May decrease available warning time and time available for evacuation.	Impacts are acceptable because: • No reductions in warning and evacuation time are anticipated to occur due to the Proposal. • Flood levels during the 1% AEP and PMF (with and without CC) event will reduce within Brands Lane and Macpherson Street, this likely leading to slight improvements in evacuation capacity.

Key Consideration	Reason for Considering	Assessment
Change in frequency of inundation	• Properties may become flood affected in more frequent events. • Access may be cut more frequently. • Areas may be isolated more frequently.	Impacts are acceptable because: • No material changes in the frequency of inundation of structures, infrastructure or private land is likely to occur as a result of the Proposal. • Lowered flood levels within Brands Lane and Macpherson Street indicate frequency of extreme event inundation is likely to marginally decrease.
Flood function categorisation change	• May change categorisation (e.g. flood storage to floodway) and change impacts on flooding on existing development.	Impacts are acceptable because: • The extent of floodways, flood storage and flood fringe categories will not be altered by the Proposal.
Hazard categorisation change	• May reduce safety to vehicles, people or buildings.	Impacts are acceptable because: • Hazard levels on public and private roads and private land will not be materially increased during either the 1% AEP or PMF flood (with or without CC). • Lowered flood levels within Brands Lane and Macpherson Street result in slightly reduced hazard levels within primary egress routes.

Notes

1. Impact considerations are taken from Section 3.3 Table 3 (p13-14) of the FRMG.

4.6 Consideration of PLEP Clause 5.21(2) and Clause 5.21(3)

48 Clause 5.21(2) of the PLEP requires the consent authority to be satisfied of certain matters in respect of development within the flood planning area. These matters are reproduced and assessed at Table 14.

Table 14: Consideration of PLEP Clause 5.21(2)

Clause	Requirement	Assessment
5.21(2)(a)	*Is compatible with the flood function and behaviour on the land.*	This sub-clause is satisfied because: • The Proposal will remove flood risk at the Site and will provide floor levels at or above the PMF to enable shelter-in-place in the event that evacuation has not occurred.
5.21(2)(b)	*Will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties.*	This sub-clause is satisfied because: • By reference to Section 4.3 and Section 4.4, the development will not detrimentally impact on over-floor flooding at any existing development. • The Proposal will increase 1% AEP freeboard to the existing flood level at Building A on 14

Clause	Requirement	Assessment
		Macpherson St and reduced the extent of over-floor flooding during the PMF.
5.21(2)(c)	*Will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood.*	This sub-clause is satisfied because: • The Proposal will provide floor levels at or above the PMF to enable shelter-in-place in the event that evacuation has not occurred. • Flood levels during the 1% AEP and PMF (with and without CC) event will reduce within Brands Lane and Macpherson Street, this likely leading to slight improvements in evacuation capacity.
5.21(2)(d)	*Incorporates appropriate measures to manage risk to life in the event of a flood.*	This sub-clause is satisfied because: • The Proposal will provide floor levels at or above the PMF to enable shelter-in-place in the event that evacuation has not occurred.
5.21(2)(e)	*Will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.*	This sub-clause is satisfied because: • Changes to flood levels or velocity are not anticipated to cause increased vegetation losses or erosion during flooding, either within the channel, or in the adjoining vegetated riparian zone. • The Proposal includes a rehabilitation of the existing Creek line and establishment of a permanent vegetated riparian corridor that will ensure long-term bed and bank stability, and minimisation of erosion during extreme flood events.

49 Clause 5.21(3) of the PLEP requires the consent authority to consider certain matters when deciding whether to grant development consent on land to which this clause applies. These matters are reproduced and assessed at Table 15.

Table 15: Consideration of PLEP Clause 5.21(3)

Clause	Requirement	Assessment
5.21(3)(a)	*The impact of the development on projected changes to flood behaviour as a result of climate change.*	This sub-clause is satisfied because: • Climate change (CC) analysis to assess the impact of the development on projected changes to flood behaviour has been undertaken in accordance with Section B3.12 of the PDCP, including a 30% increase in rainfall intensity for the 50% AEP, 20% AEP, 1% AEP, PMF events. • whilst increased rainfall intensities associated with climate change will marginally increase flood levels throughout the flood model domain, the development will not modify flood behaviour in a materially different manner than under current conditions.

Clause	Requirement	Assessment
5.21(3)(b)	*The intended design and scale of buildings resulting from the development.*	This sub-clause is satisfied because: • The intended design and scale of buildings is comparable to the existing development on 16 Macpherson St and 18 Macpherson St and compatible with the local flood characteristics. • The bulk and scale of the proposed development is suitable because it does not cause unacceptable or significant flood impacts that affect infrastructure, existing structures, riparian land or the amenity of any private land.
5.21(3)(c)	*Whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood.*	This sub-clause is satisfied because: • The Proposal will provide floor levels at or above the PMF to enable shelter-in-place in the event that evacuation has not occurred.
5.21(3)(d)	*The potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.*	This sub-clause is satisfied because: • The Proposal has been sited to ensure compatibility with the existing site flood characteristics. • The Proposal will provide floor levels at or above the PMF to enable shelter-in-place in the event that evacuation has not occurred. • The development will not cause any buildings resulting from the development to be potentially modified, relocated or removed due to flood impacts.

4.7 Warriewood Valley Specification

50 A compliance assessment with Table 4.3 Flood Planning Levels in the Warriewood Valley Urban Land Release Water Management Specification, prepared by Pittwater Council (2001) (**WWMS**) is provided in Table 16.

Table 16: WWMS Table 4.3 compliance assessment.

Flood	Requirement	Assessment	Comply
50% AEP	• *50%AEP flow to be carried in-bank.*	• 50% AEP + 30% CC flows are carried in bank. Refer to Set A Map 25 - Set A Map 28.	Y
20% AEP	• *The level of walkways and cycleways adjacent to the creeks are to be above the 20%AEP flood level except under special circumstances (and exposed for only short duration's).*	• No walkways or cycleways are proposed. • Existing cycleways not impacted by Proposal.	Y
	• *Water quality control ponds, filter strips and structures are to be above the 20%AEP flood level, and can be below the 1%AEP flood level but must lie within the private buffer area as outlined in Section 4.3.2.*	• Basin is located outside of 20% AEP + 30% CC flood extents (refer to Set A Map 29). • Basin is located within private buffer area to creek.	Y

Flood	Requirement	Assessment	Comply
1% AEP	• *1%AEP flows are to be carried within the public space corridors, and are to be further designed such that floodplain management and hazard management guidelines are accommodated to minimise risk to life.*	• 1%AEP + 30% CC flood affectation occurs within the Site only adjacent to the creek corridor near to the basin and away from residential land (refer to Set A Map 40). • Design has been completed to remove 1% AEP flood hazard from residential areas and minimise risk to life.	Y
	• *Flood extent to be mapped.*	• 1% AEP and 1% AEP + 30% CC flood extents are mapped at Set A Map 33 and Set A Map 40 respectively.	Y
	• *Floor levels for properties adjacent to the creek are to be set at least 0.5 m above the 1%AEP level.*	• All floor levels will be set at or above the 0.5m above the 1% AEP +CC event water level.	Y
	• *Obverts of bridge decks of evacuation routes are to be set at least 0.5 m above the 1%AEP level.*	• No bridges are proposed as part of the Proposal.	Y
PMF	• *Evacuation planning.*	• Dwellings will be two storey and offer a suitable refuge for all residents.	Y
	• *Flood hazards and risk to life.*	• PMF and PMF + 30% CC hazards are mapped at Set A Map 53 and Set A Map 60 respectively. • Within the proposed residential areas on the Site, flood hazards are acceptable at H1 and H2 in the PMF and H1, H2 and pockets of H3 in the PMF + 30% CC.	Y
	• *Flood extent to be mapped.*	• PMF and PMF + 30% CC extents are mapped at Set A Map 47 and Set A Map 54.	Y

5 Summary and Conclusions

51 A detailed analysis of potential flood impacts arising from the development has been completed based on the updated flood modelling. The analysis methodology included:

1. Identify locations where impacts exceed thresholds specified in the PDCP.
2. Define issues to be considered to enable analysis of potential flood impacts.
3. Inspect identified locations where relevant.
4. Analyse the significance of any adopted threshold exceedance (flood level, velocity and velocity x depth product) based on risks to property, environment and safety.

52 The analysis found that whilst there are some exceedances of thresholds specified in the PDCP, these do not cause harm to the environment, public or private property or infrastructure, and do not result in material changes to flood risks within the floodplain. Specifically:

1. Flood level impacts: Flood level increases will not lead to any detrimental impacts on the existing riparian corridor of Narrabeen Creek, nor will the use, amenity or enjoyment of adjoining land to the northwest or northeast be detrimentally affected.
2. Flow velocity impacts: Flood flow velocity increases will not lead to any detrimental impacts on the existing riparian corridor of Narrabeen Creek, nor will there be any likely impacts on existing vegetation, hardstand areas, property or infrastructure.

   The analysis has found that there is a small location within Brands Lane in the riparian corridor (location 3) where peak flow velocity increases above 2 m/s following the Creek regrading works. For this area we recommend any pervious areas are stabilised following completion of earthworks with biodegradable jute matting fixed into place and then hydro mulched to ensure rapid vegetative establishment. Routine inspections and maintenance during the vegetation establishment period will ensure that the risk of soil erosion and vegetation loss is appropriately mitigated.
3. Velocity x depth (VD) product impacts: Flood VD product increases will not lead to any detrimental impacts on road infrastructure, risks to public safety or affectations in the use of land.

53 The further analysis of the water level afflux adjacent to Building A of 14 Macpherson Street found that the Proposal will increase the freeboard during Council's FPL defining event, the 1% AEP + 30% CC, by 50 mm.

Appendix A – Figures

Figure 1: Proposal with earthworks.

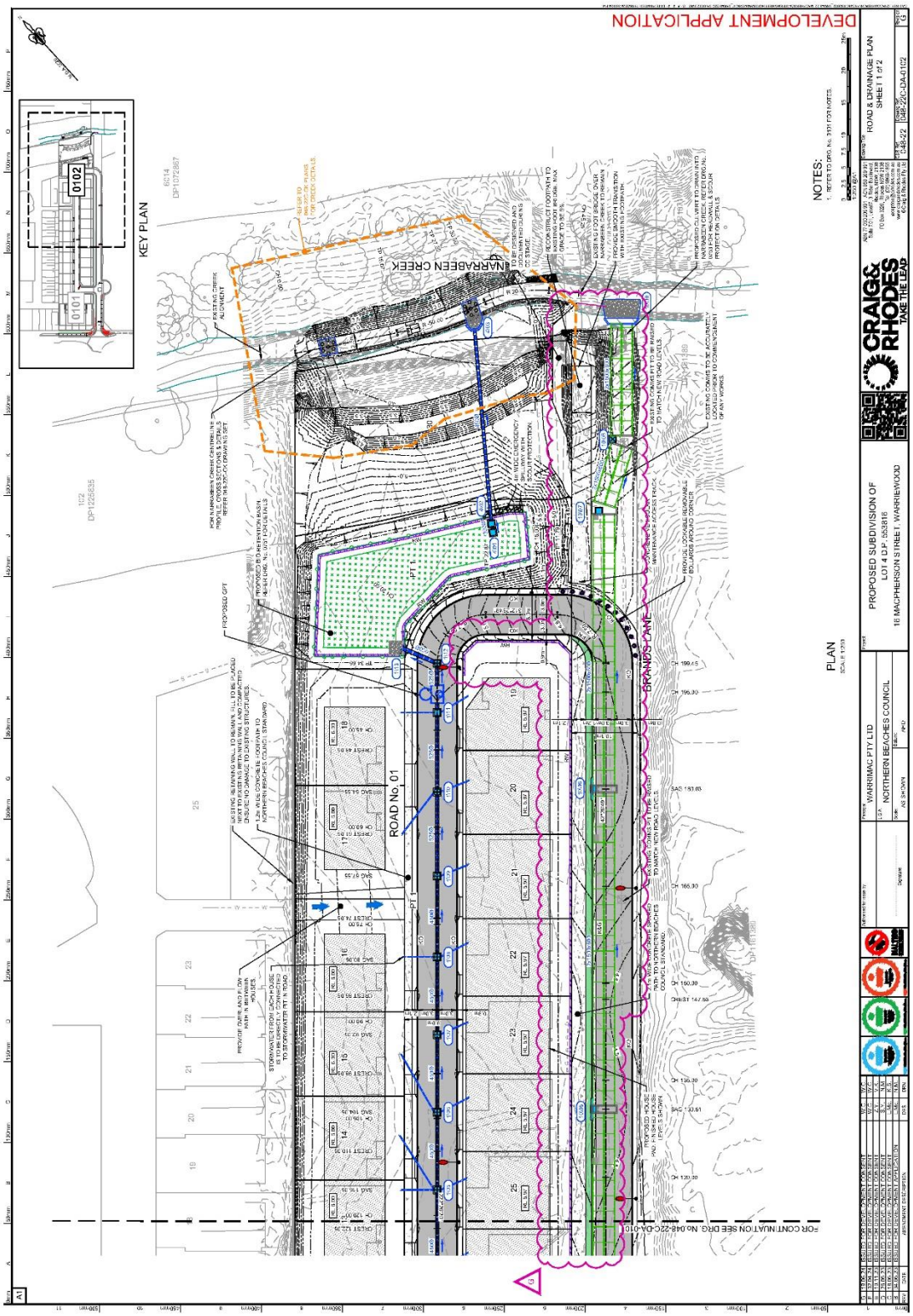

Figure 2: Proposal drainage adjacent to Narrabeen Creek, at the north side of the Site.

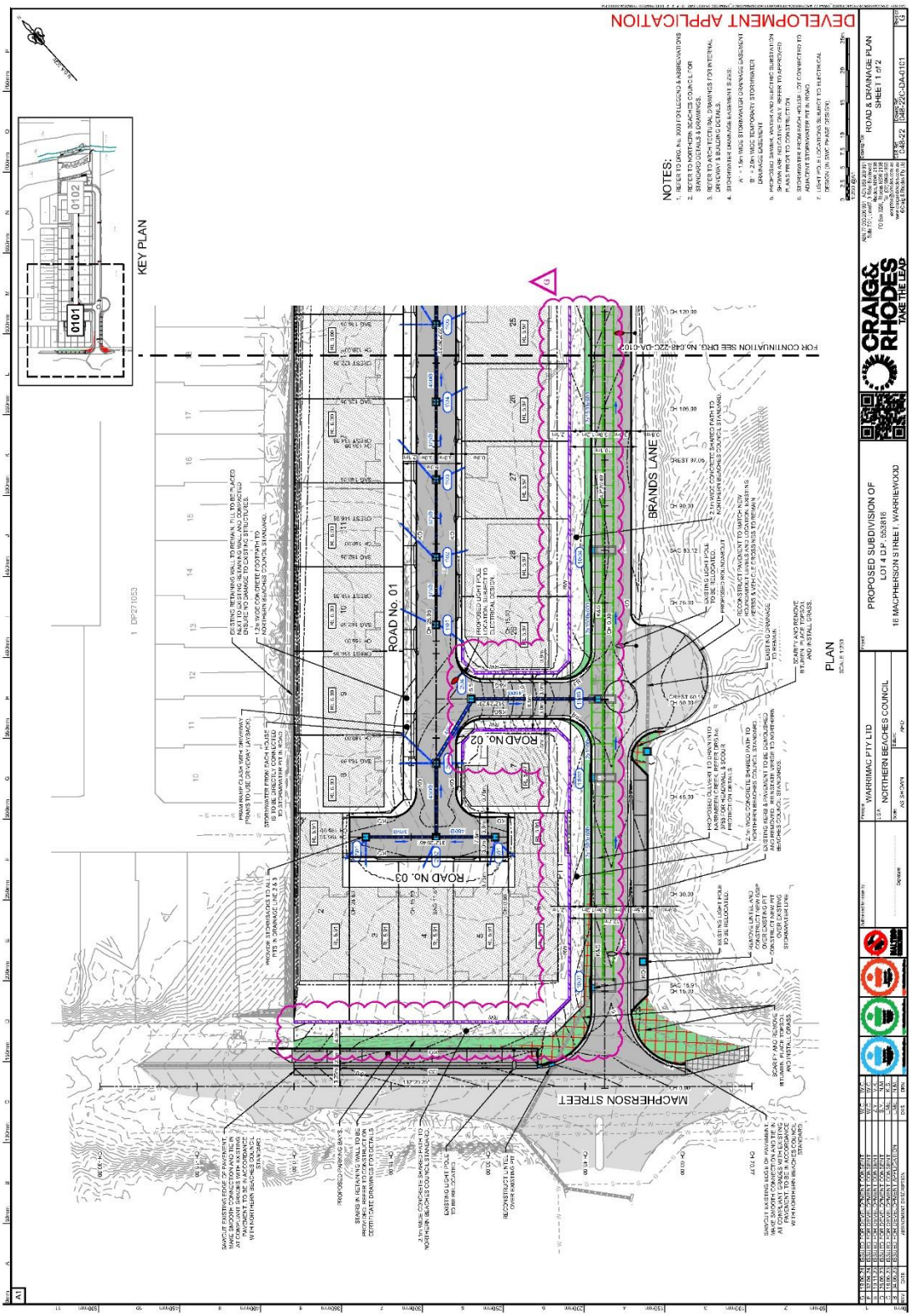

Figure 3: Proposal drainage at the south side of the Site.

Figure 4: Existing Site dwelling facing Macpherson Street.

Figure 5: Existing Site plant nursery.

Figure 6: Brands Ln looking SW towards Macpherson St.

Figure 7: Brands Ln looking NE towards Narrabeen Creek.

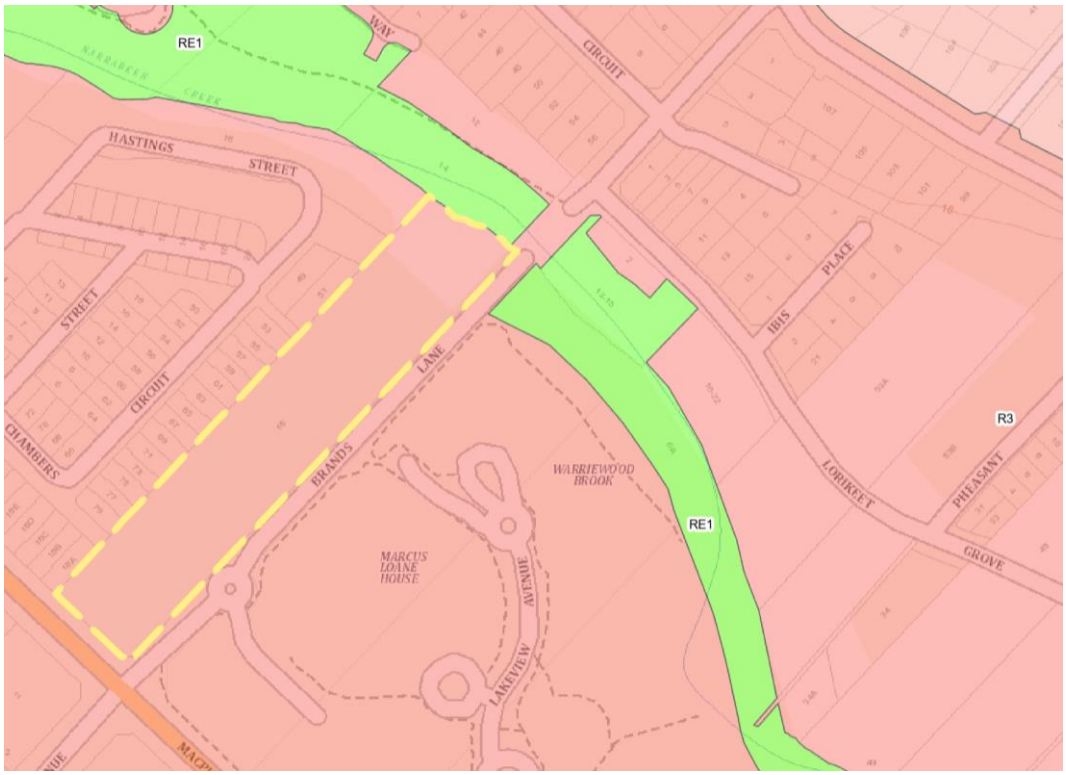

Figure 8: Site zoning.

Figure 9: Entrance to existing senior's living estate at Brands Lane.

Figure 10: Brands Ln senior's living estate frontage to Narrabeen Creek.

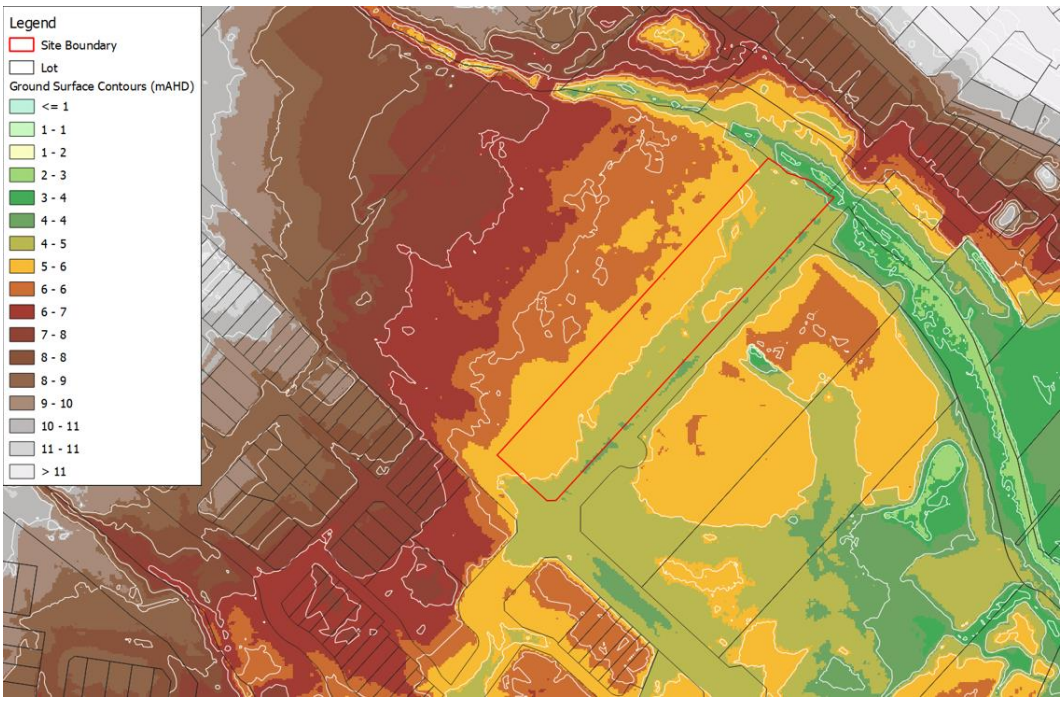

Figure 11: Local topography.

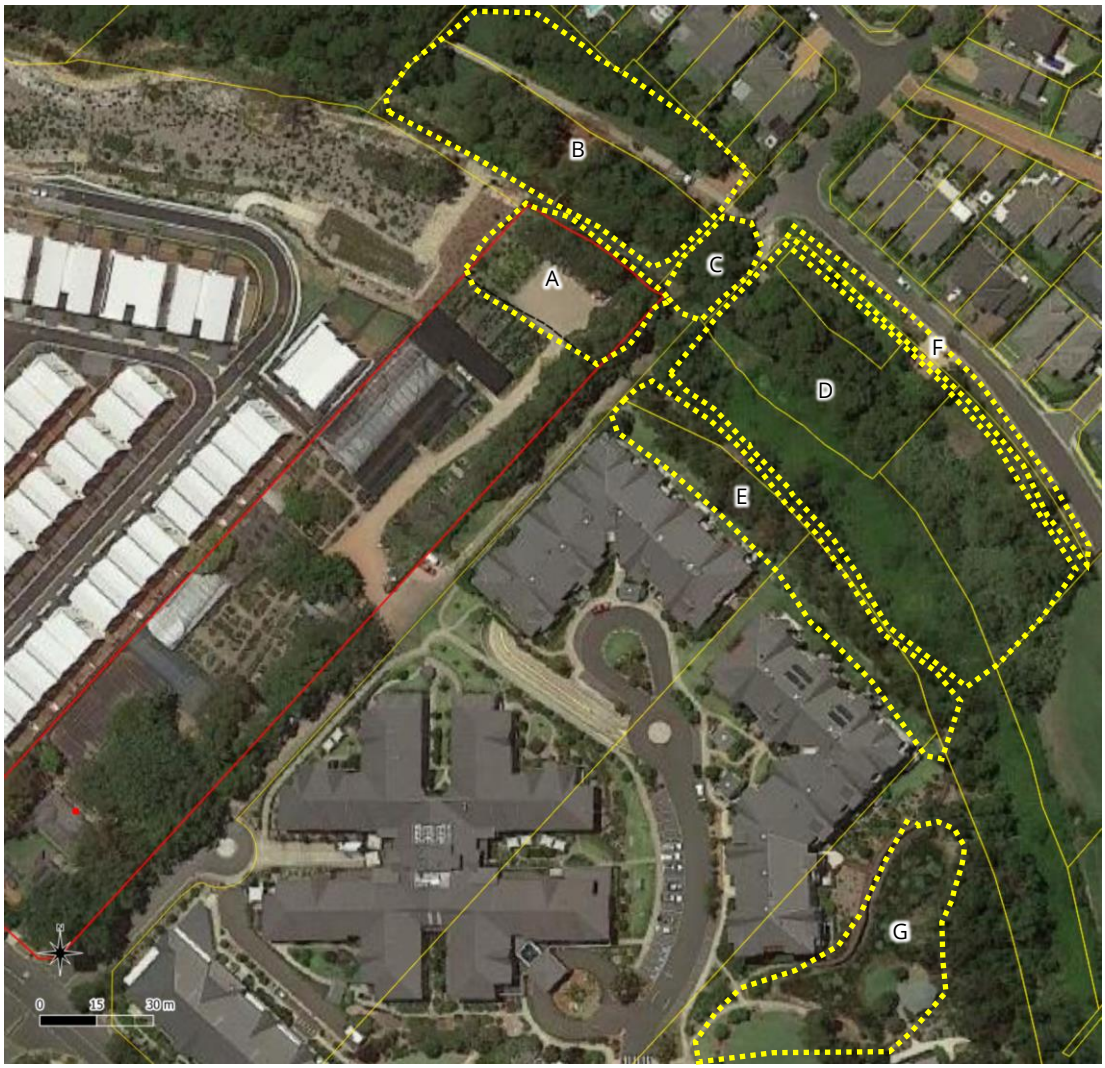

Figure 12: Site observation locations.

Figure 13: Area A nursery parking and materials storage.

Figure 14: Area A nursery parking and materials storage.

Figure 15: Area A nursery parking and materials storage.

Figure 16: Area B view looking downstream at lower section of creek channel.

Figure 17: Area B creek channel in upper reach.

Figure 18: Area B footway and open grass areas.

Figure 19: Area B heavily vegetated creek banks.

Figure 20: Area C pedestrian bridge crossing.

Figure 21: Area D right bank dense riparian vegetation.

Figure 22: Area D right bank recent shallow depth flood deposit.

Figure 23: Area D right bank remnant tree protection sleeves.

Figure 24: Area E right bank landscaping adjacent to Brands Ln.

Figure 25: Area E right bank landscaping adjacent to riparian corridor.

Figure 26: Area E right bank landscaping between buildings.

Figure 27: Area E right elevated buildings floor levels.

Figure 28: Area F sandstone block retaining wall in riparian corridor.

Figure 29: Area F concrete block retaining wall.

Figure 30: Area F stepped retaining structures.

Figure 31: Area downgradient of Area F.

Figure 32: Area G stormwater ponds.

Figure 33: Area G stormwater pond riprap overflow weir.

Appendix B – Set A Flood Maps

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Water Level (mAHD)

Water Depth (m)

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- > 5.0

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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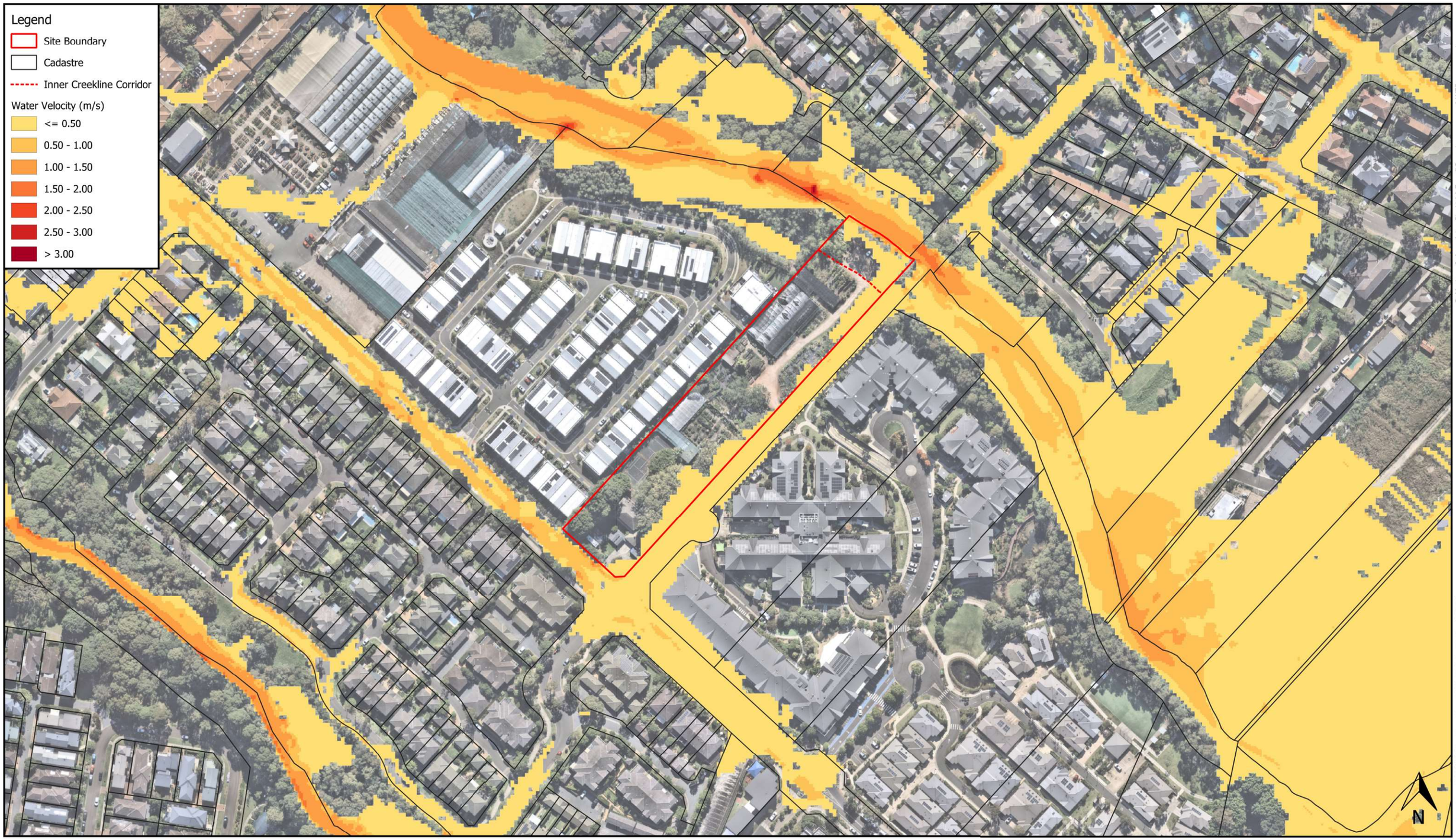
Map Title / Figure:

50% AEP + CC Existing Conditions Water Level and Water Depth

Map 01	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Map Title / Figure:

50% AEP + CC Existing Conditions Water Velocity

Map 02	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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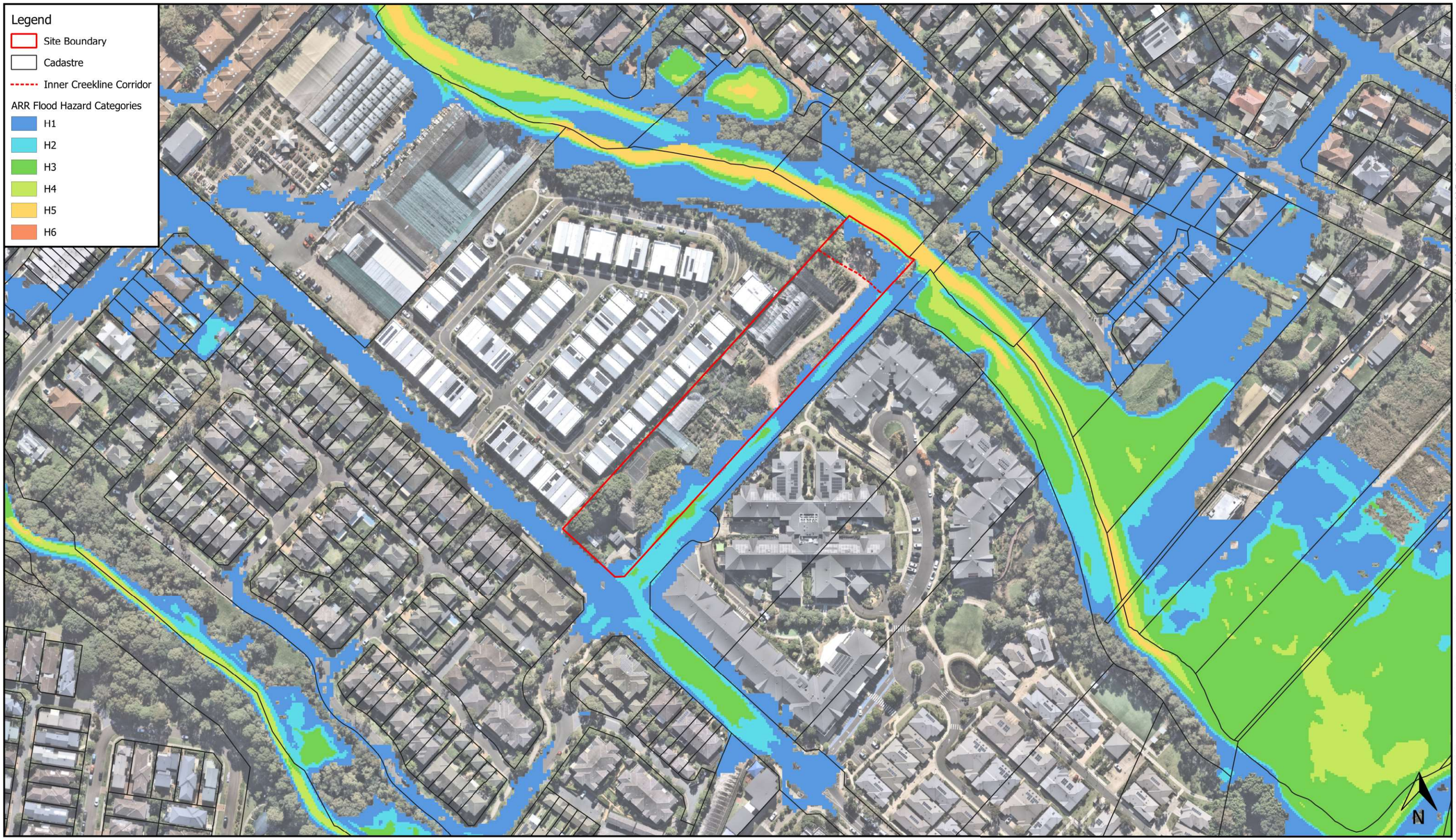
Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

50% AEP + CC Existing Conditions Velocity Depth Product

Map 03	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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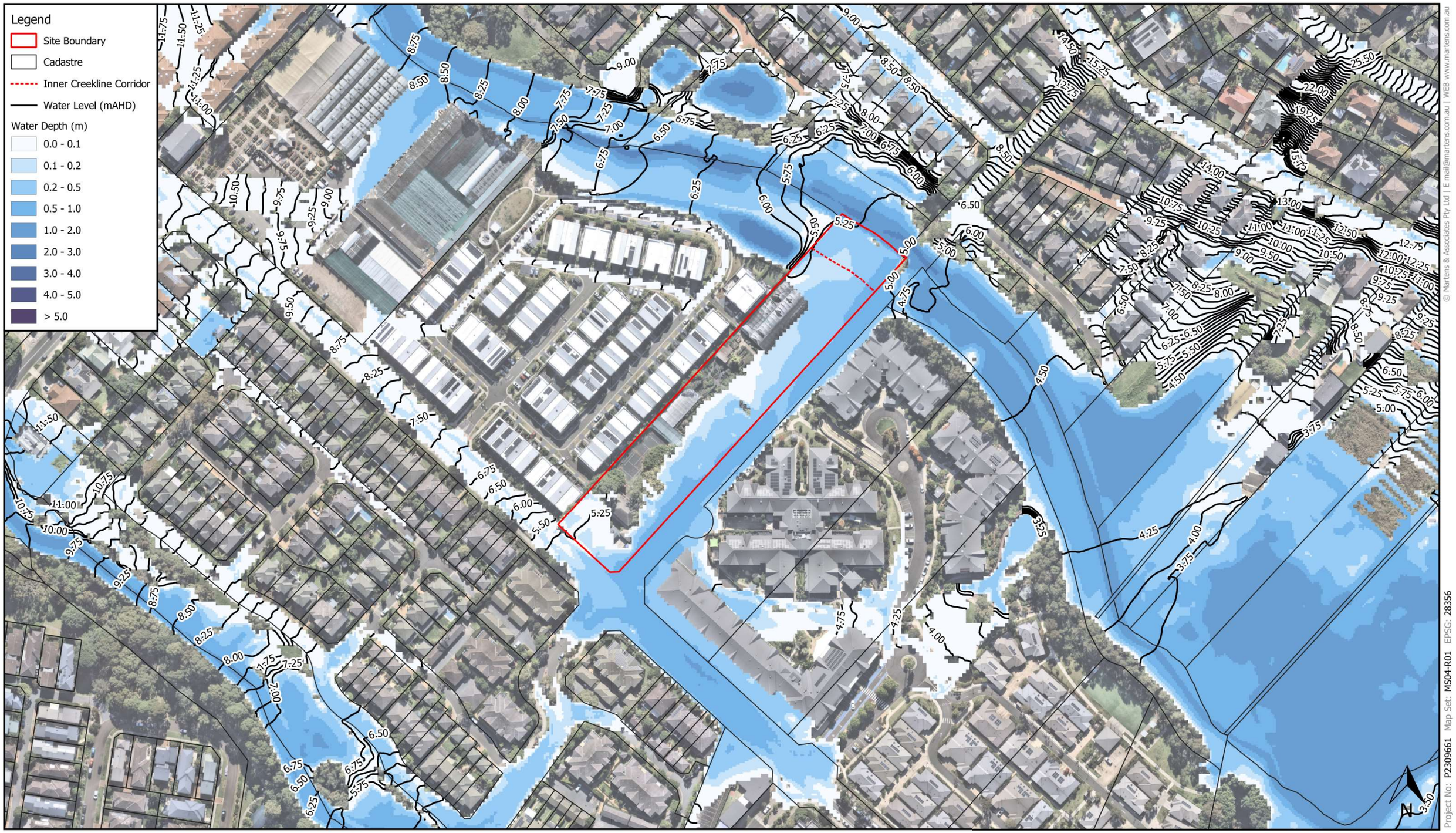
Map Title / Figure:

50% AEP + CC Existing Conditions ARR Flood Hazard

Map 04	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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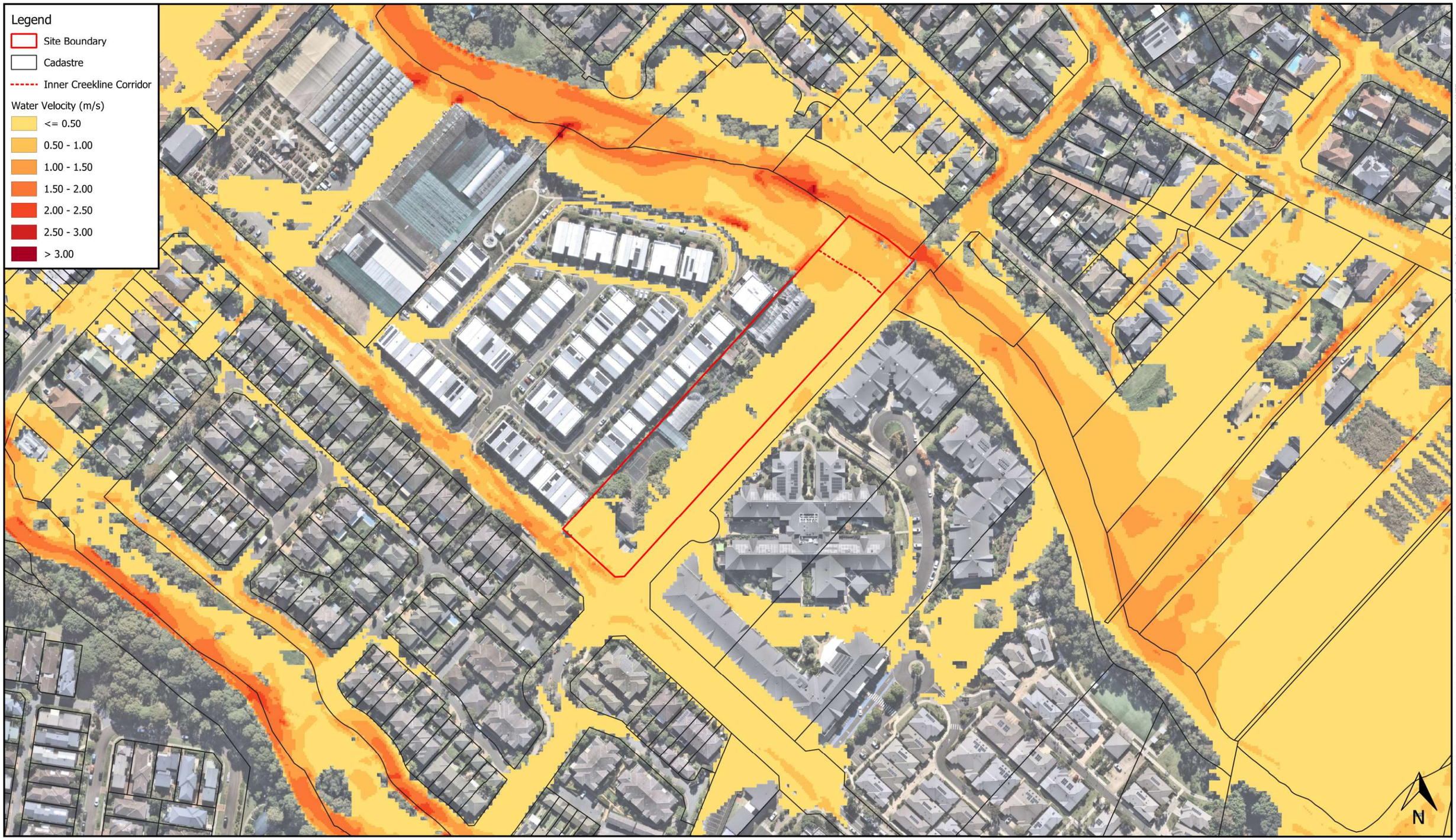
Map Title / Figure:

20% AEP + CC Existing Conditions Water Level and Water Depth

Map 05	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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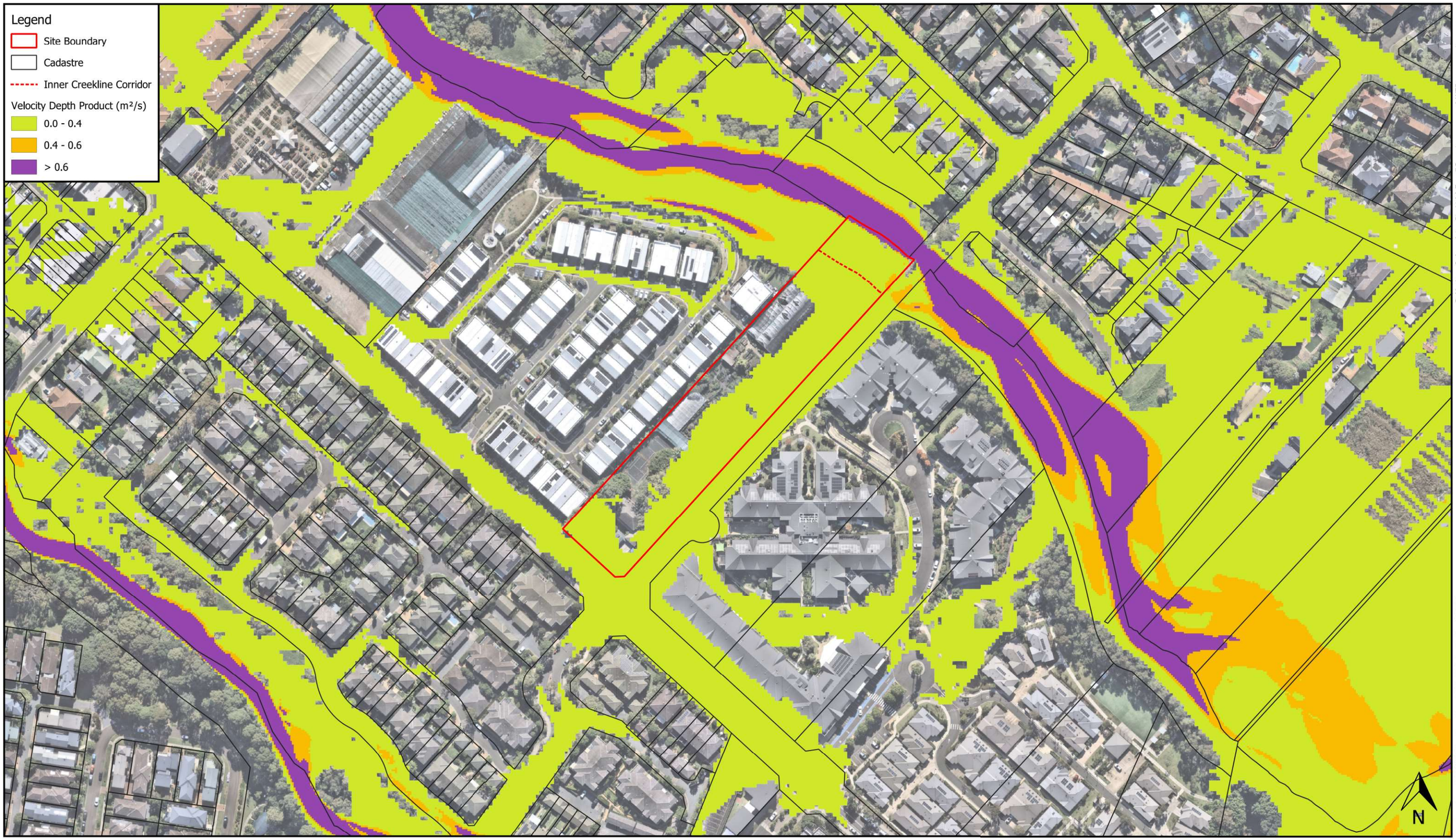
Map Title / Figure:

20% AEP + CC Existing Conditions Water Velocity

Map 06	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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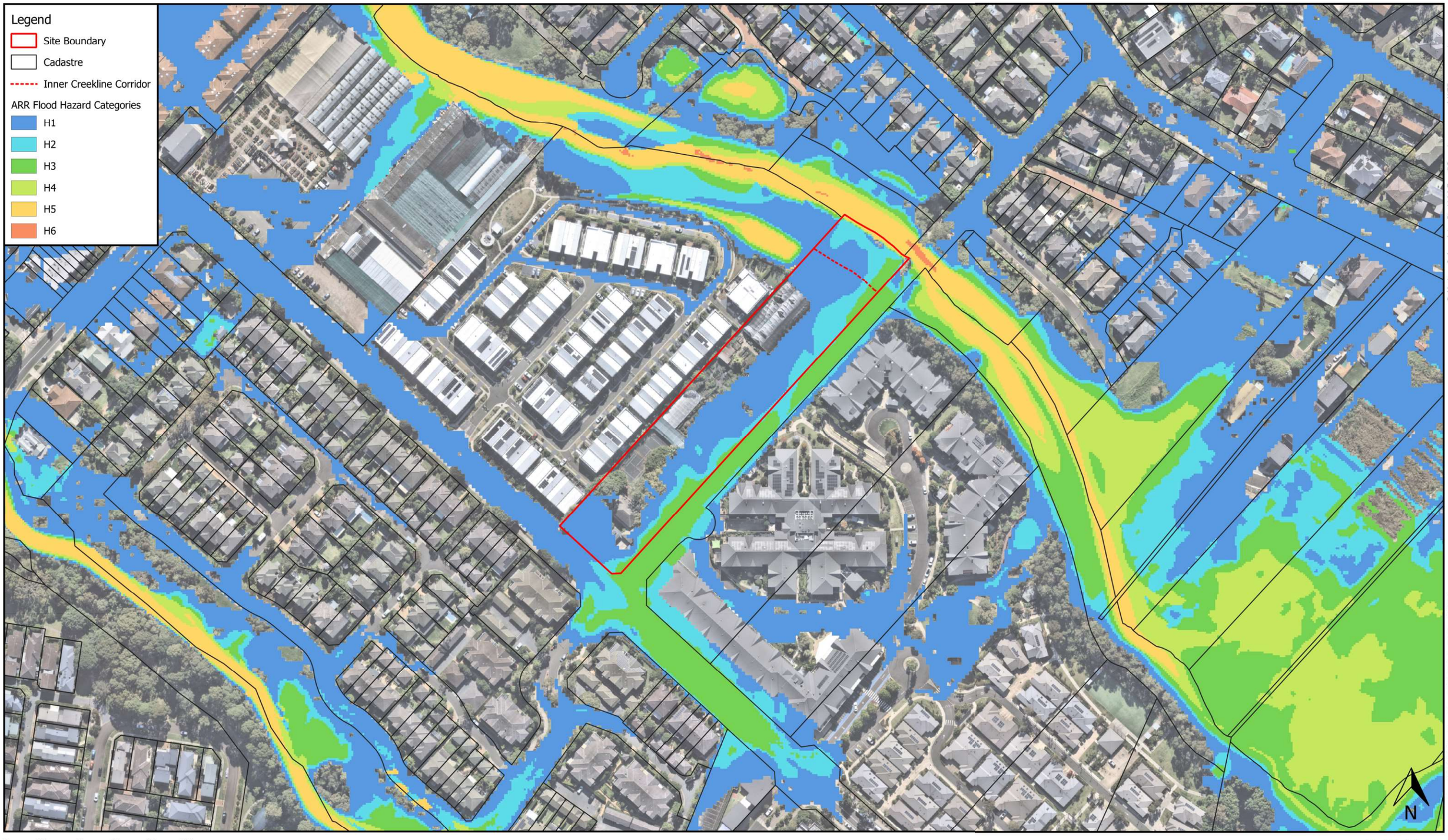
Map Title / Figure:

20% AEP + CC Existing Conditions Velocity Depth Product

Map 07	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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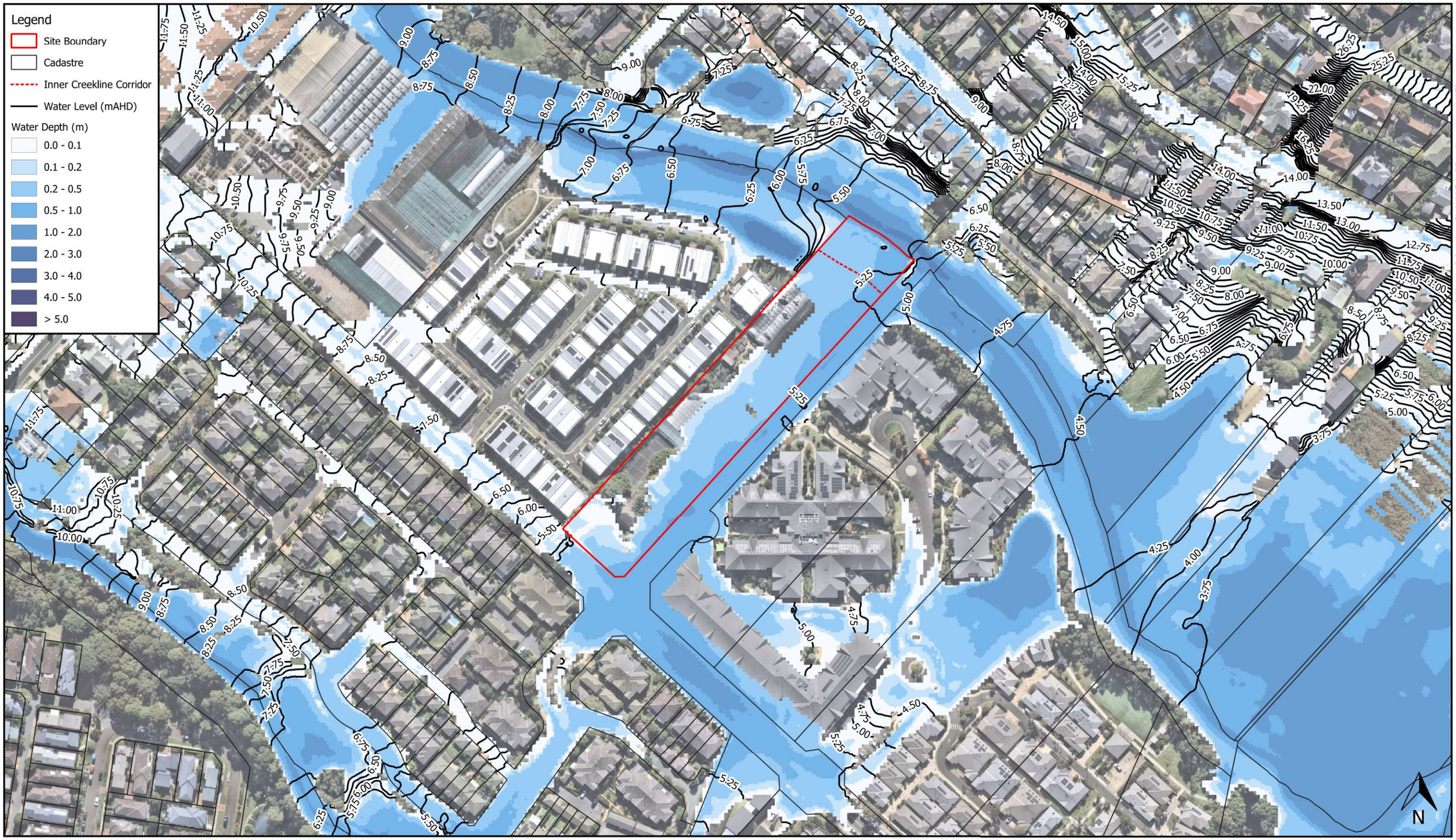
Map Title / Figure:

20% AEP + CC Existing Conditions ARR Flood Hazard

Map 08	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Map Title / Figure:

1% AEP Existing Conditions Water Level and Water Depth

Map 09	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

1% AEP Existing Conditions Water Velocity

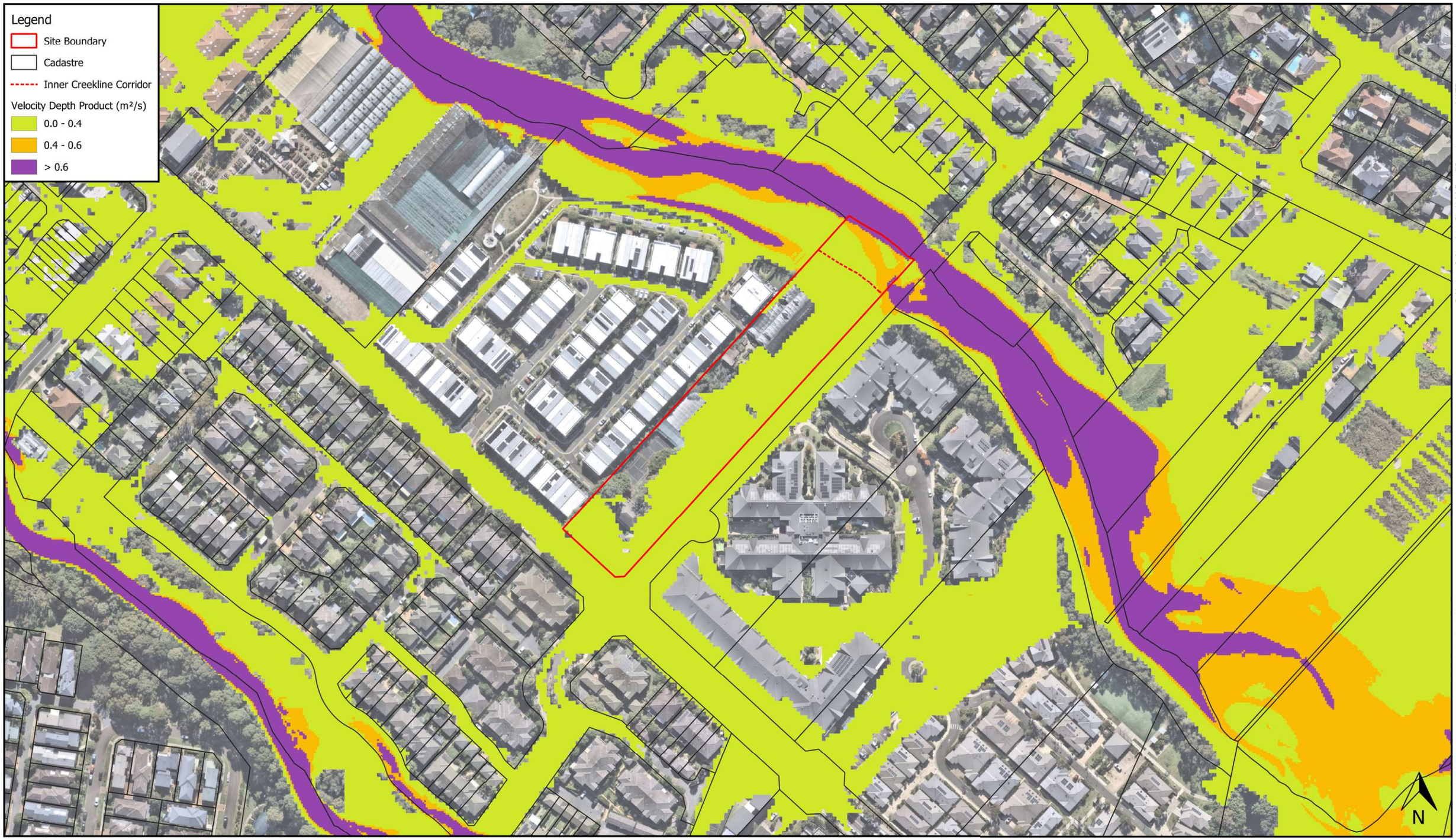
Map 10	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor

Velocity Depth Product (m²/s)

- 0.0 - 0.4
- 0.4 - 0.6
- > 0.6



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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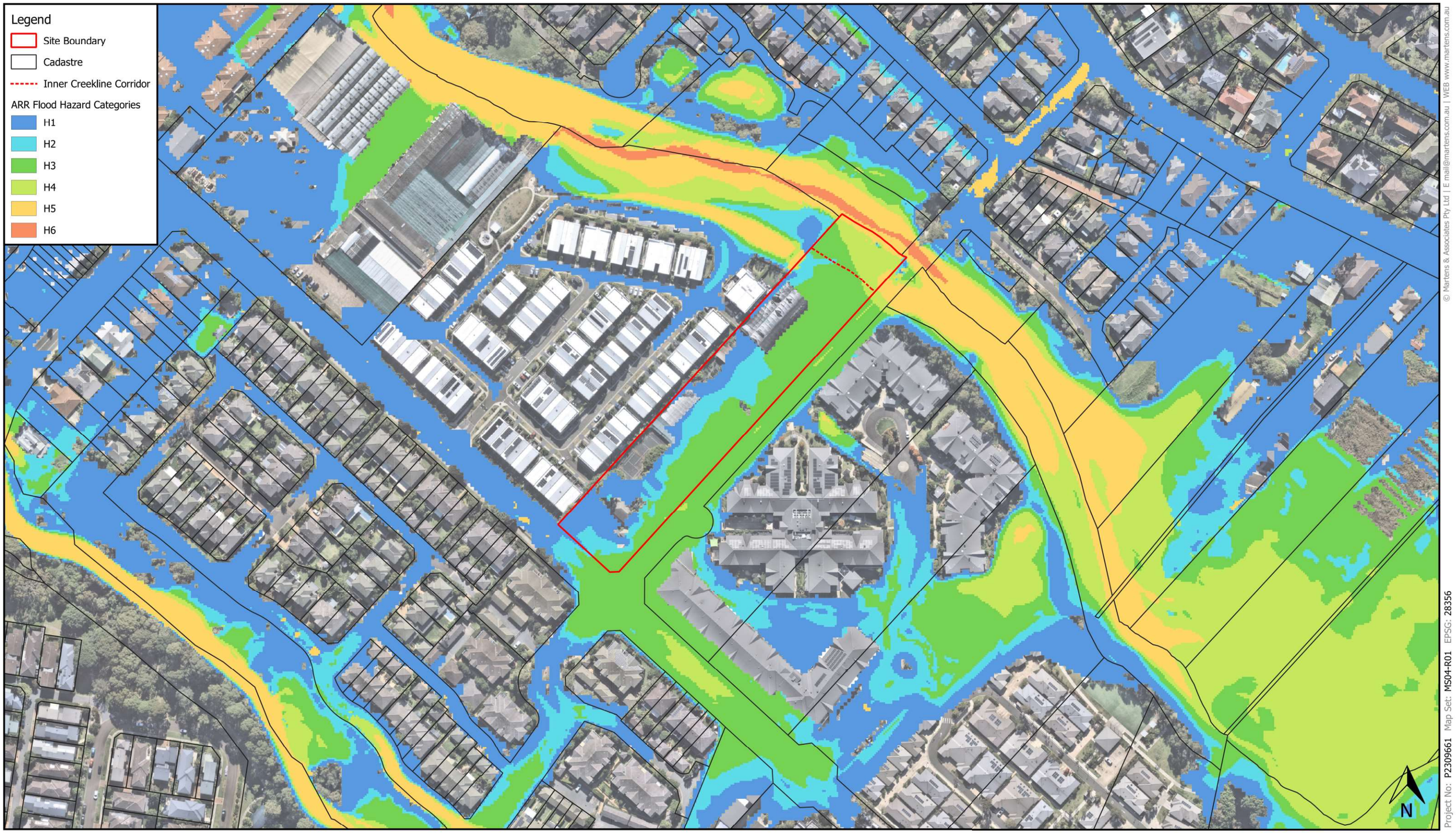
Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

N

Map Title / Figure:

1% AEP Existing Conditions Velocity Depth Product

Map 11	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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Map Title / Figure:

1% AEP Existing Conditions ARR Flood Hazard

Map 12	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Water Level (mAHD)

Water Depth (m)

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- > 5.0

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Map Title / Figure:

1% AEP + CC Existing Conditions Water Level and Water Depth

Map 13	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor

Water Velocity (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- 2.50 - 3.00
- > 3.00

N

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Map Title / Figure:

1% AEP + CC Existing Conditions Water Velocity

Map 14	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

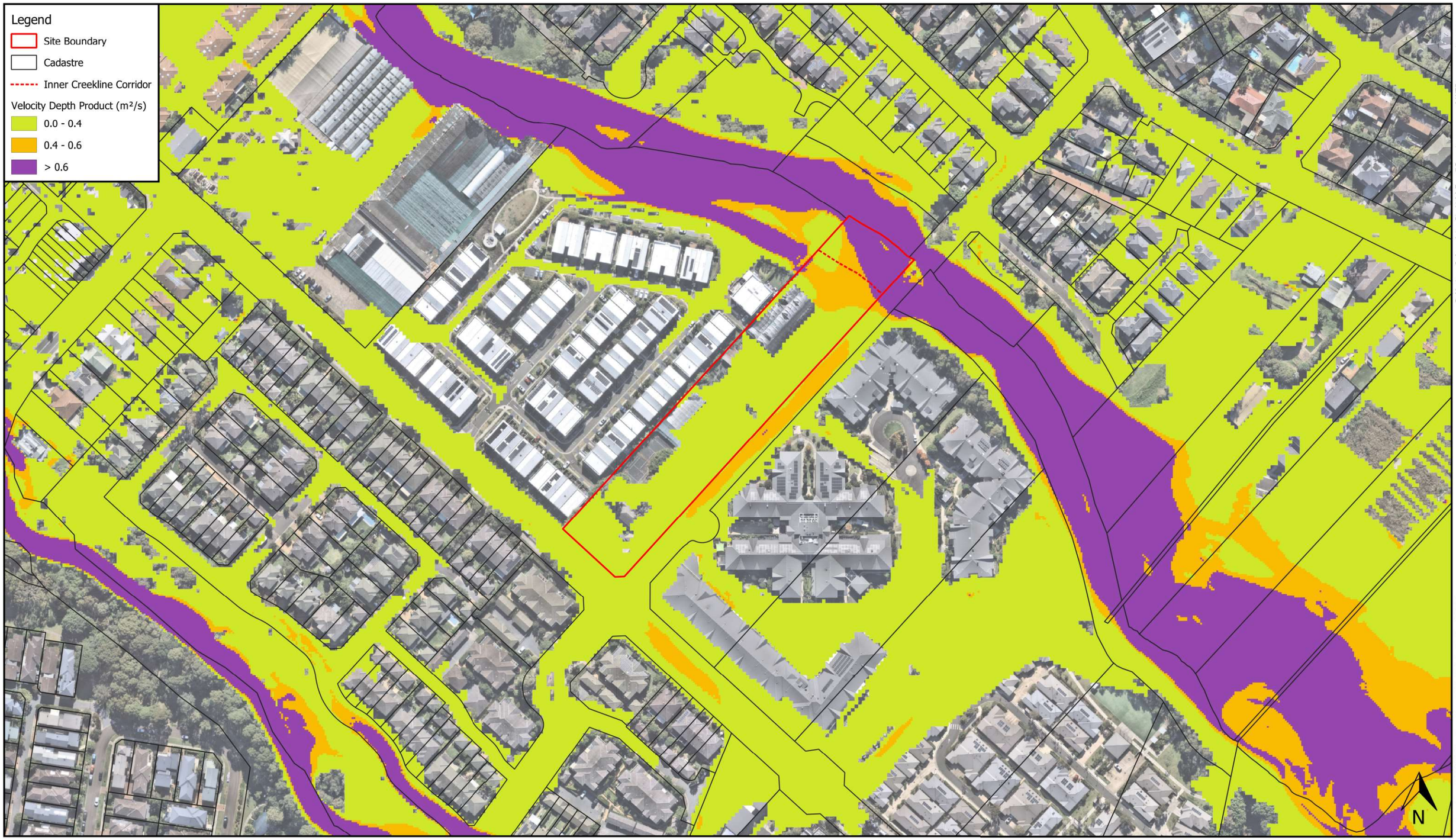
Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor

Velocity Depth Product (m²/s)

- 0.0 - 0.4
- 0.4 - 0.6
- > 0.6



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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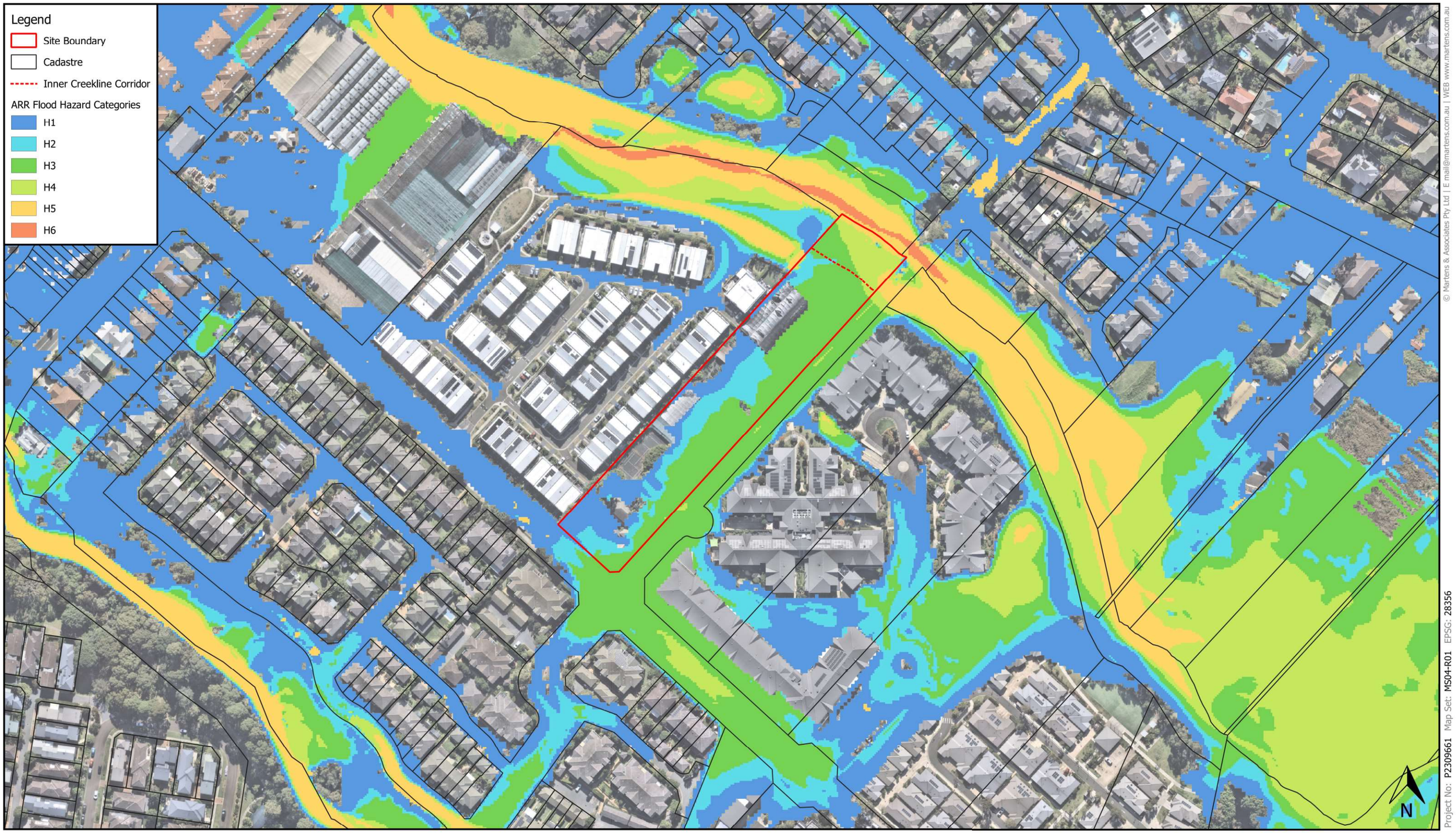
Map Title / Figure:

1% AEP + CC Existing Conditions Velocity Depth Product

Map 15	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

N

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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Map Title / Figure:

1% AEP + CC Existing Conditions ARR Flood Hazard

Map 16	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Water Level (mAHD)

Water Depth (m)

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- > 5.0

N

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

PMF Existing Conditions Water Level and Water Depth

Map 17	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor

Water Velocity (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- 2.50 - 3.00
- > 3.00

N

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Map Title / Figure:

PMF Existing Conditions Water Velocity

Map 18	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor

Velocity Depth Product (m²/s)

- 0.0 - 0.4
- 0.4 - 0.6
- > 0.6

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

N

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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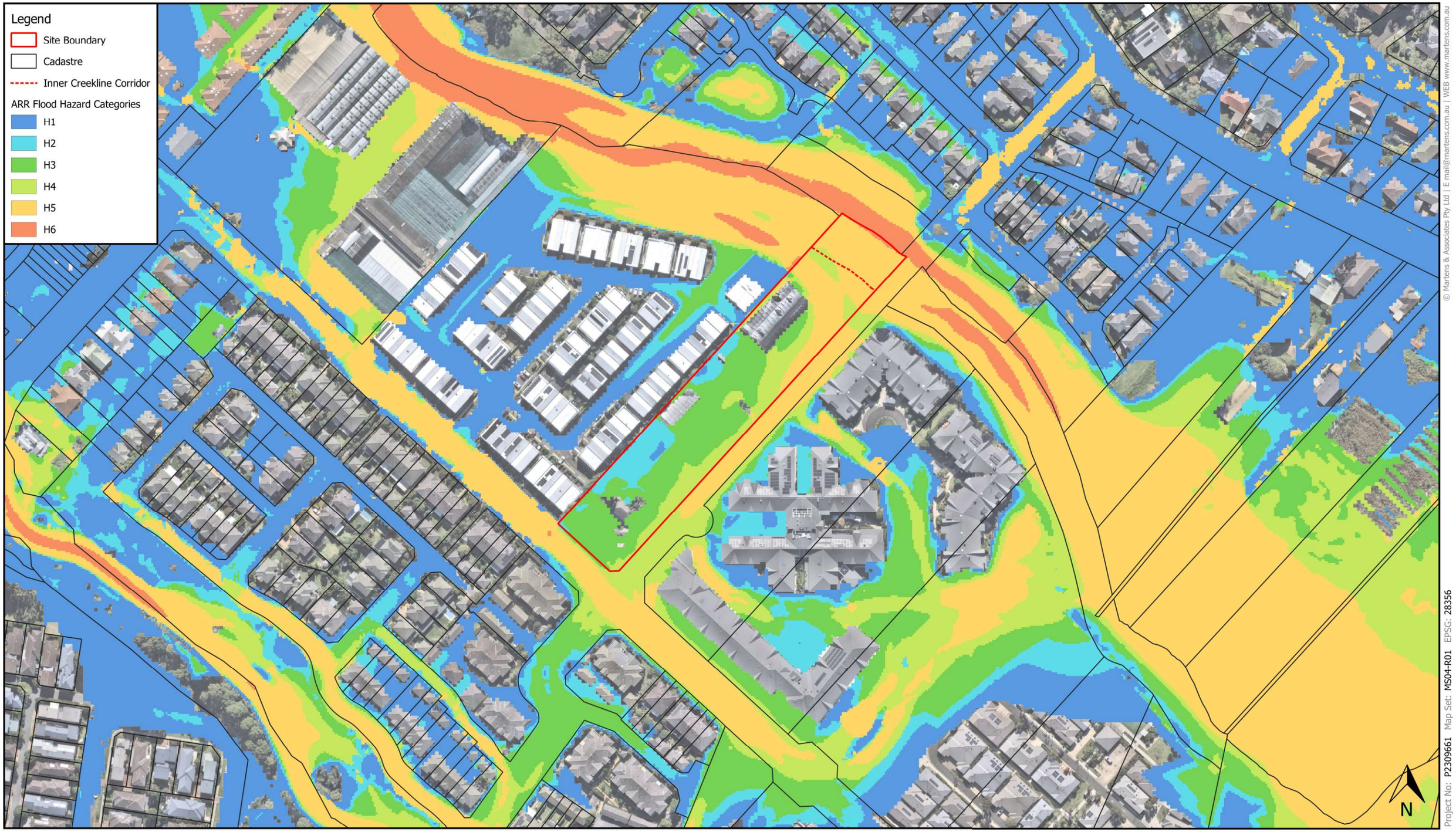
Map Title / Figure:

PMF Existing Conditions Velocity Depth Product

Map 19	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

PMF Existing Conditions ARR Flood Hazard

Map 20	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Water Level (mAHD)

Water Depth (m)

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- > 5.0

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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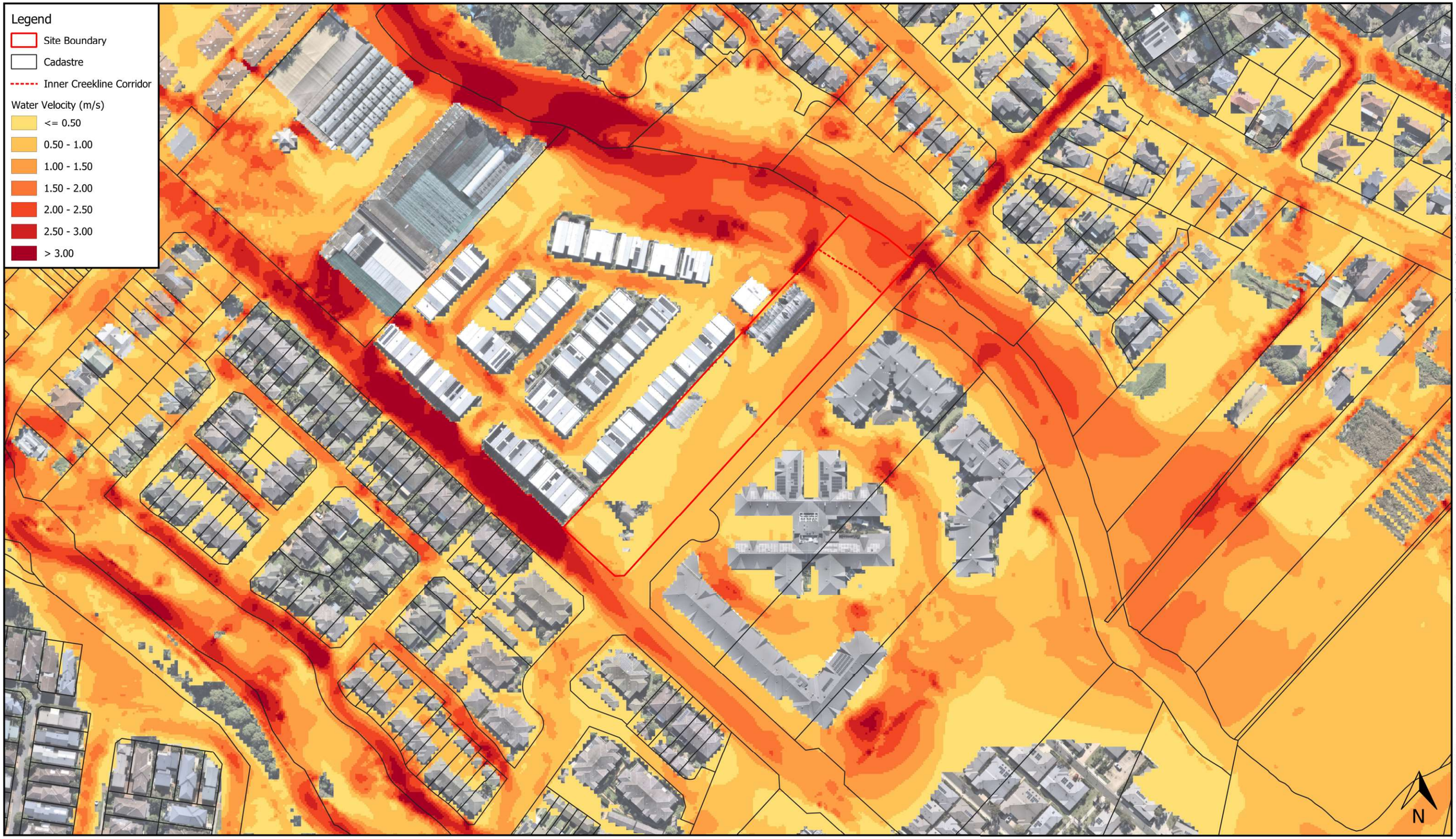
Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

N

Map Title / Figure:

PMF + CC Existing Conditions Water Level and Water Depth

Map 21	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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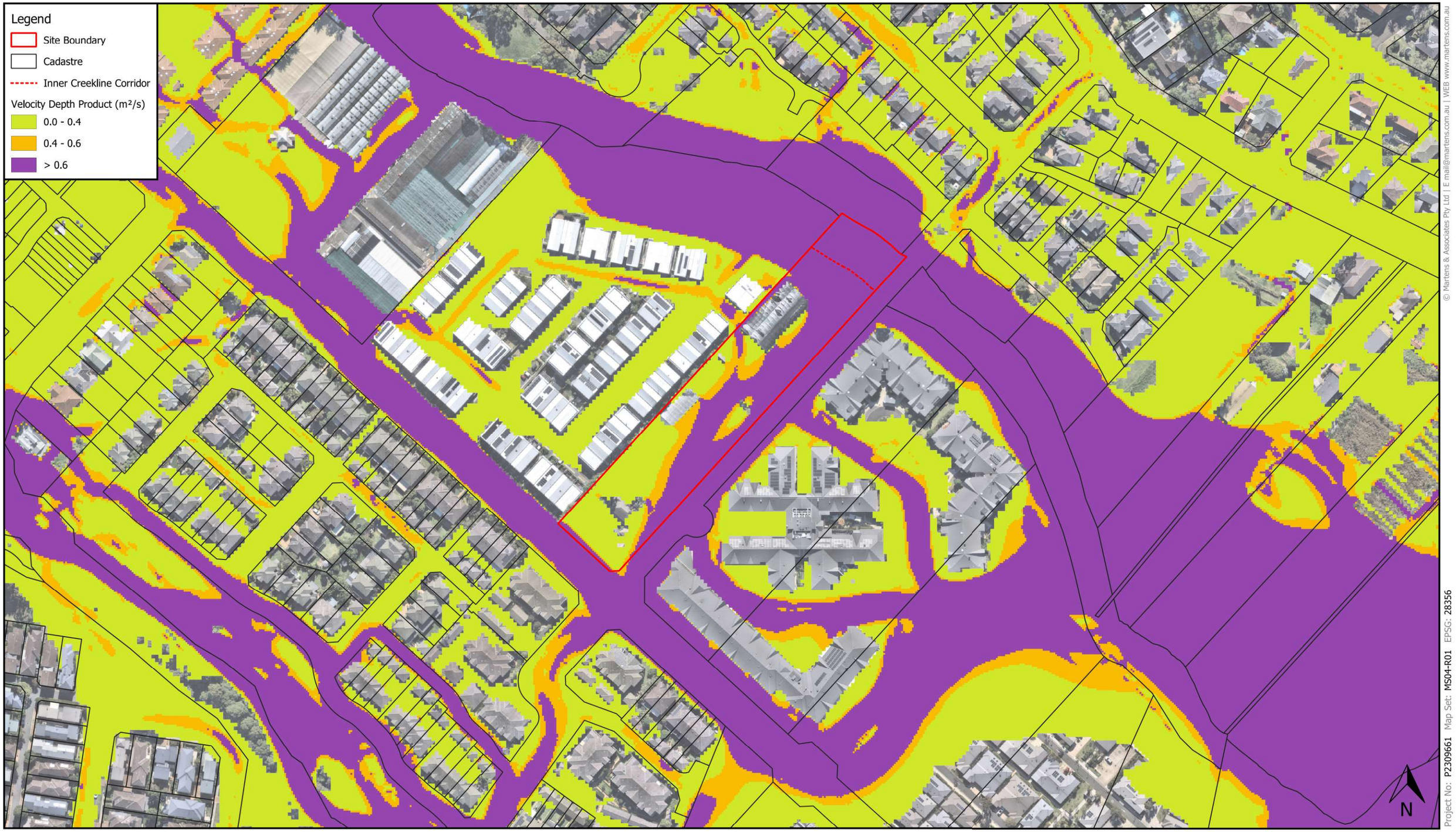
Map Title / Figure:

PMF + CC Existing Conditions Water Velocity

Map 22	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

PMF + CC Existing Conditions Velocity Depth Product

Map 23	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout

ARR Flood Hazard Categories

- H1
- H2
- H3
- H4
- H5
- H6

N

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

PMF + CC Existing Conditions ARR Flood Hazard

Map 24	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout
- Water Level (mAHD)

Water Depth (m)

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- > 5.0

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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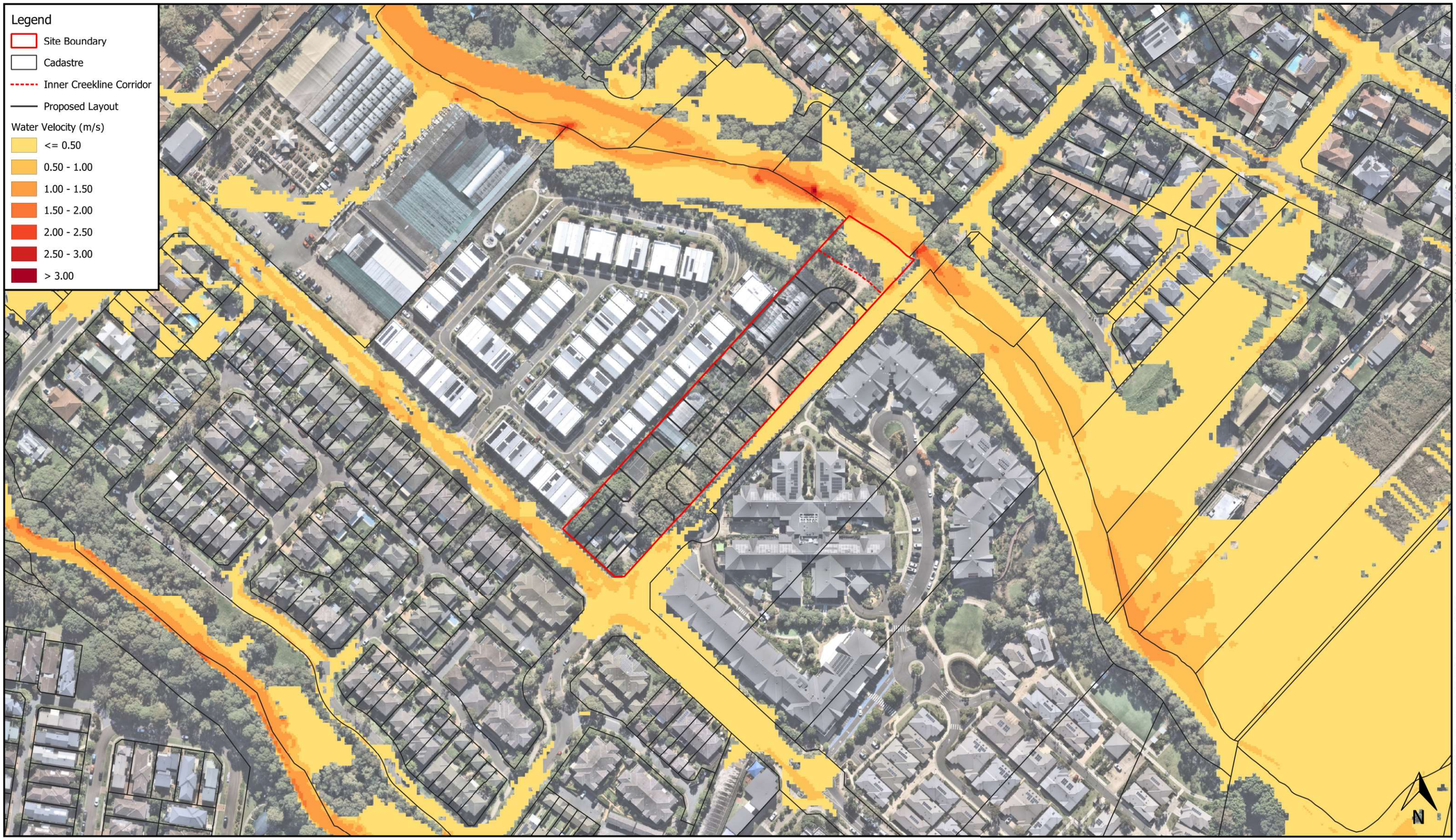
Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

50% AEP + CC Proposed Conditions Water Level and Water Depth

Map 25	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Map Title / Figure:

50% AEP + CC Proposed Conditions Water Velocity

Map 26	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Map Title / Figure:
50% AEP + CC Proposed Conditions Velocity Depth Product

Map 27	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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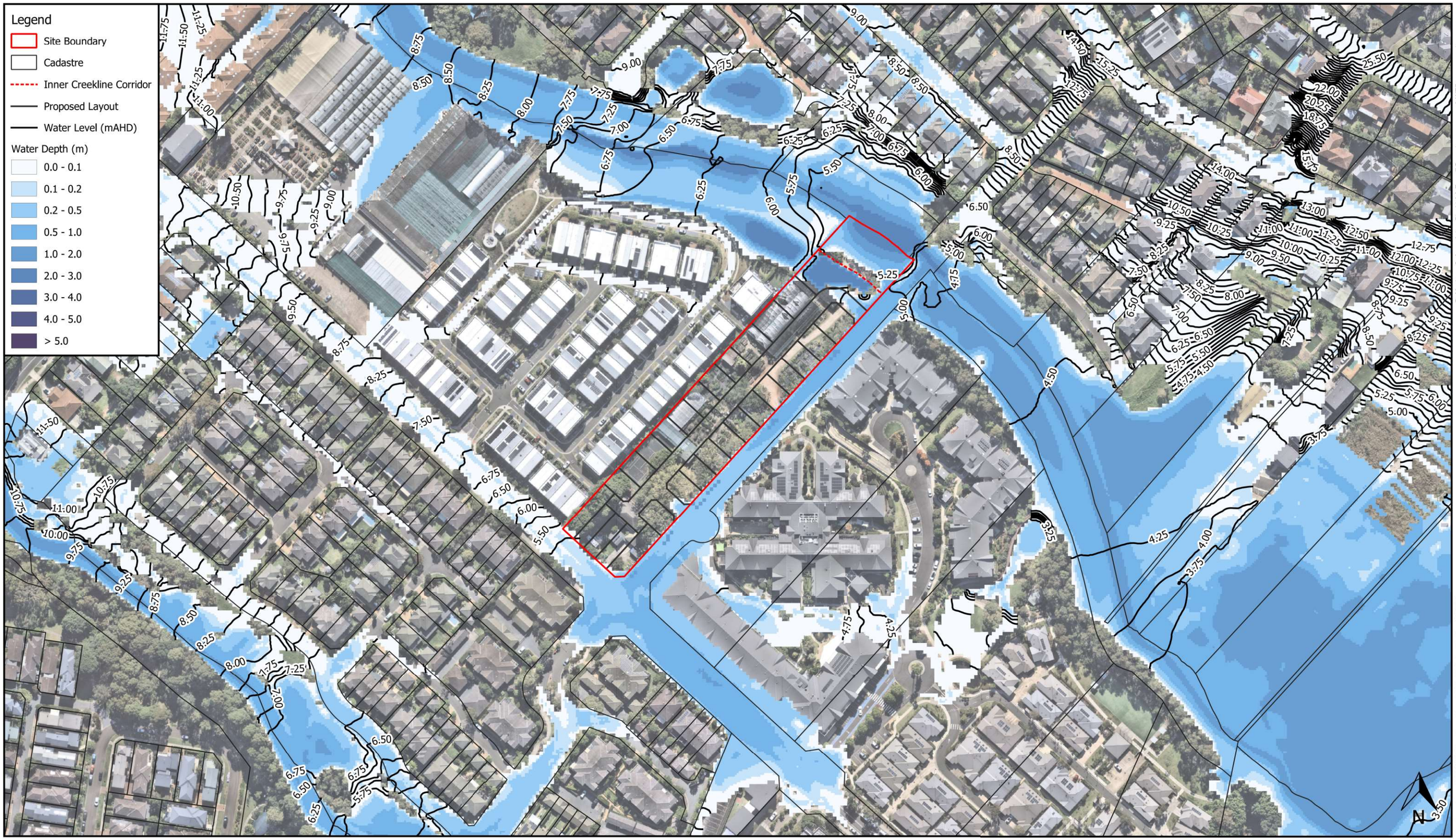
Map Title / Figure:

50% AEP + CC Proposed Conditions ARR Flood Hazard

Map 28	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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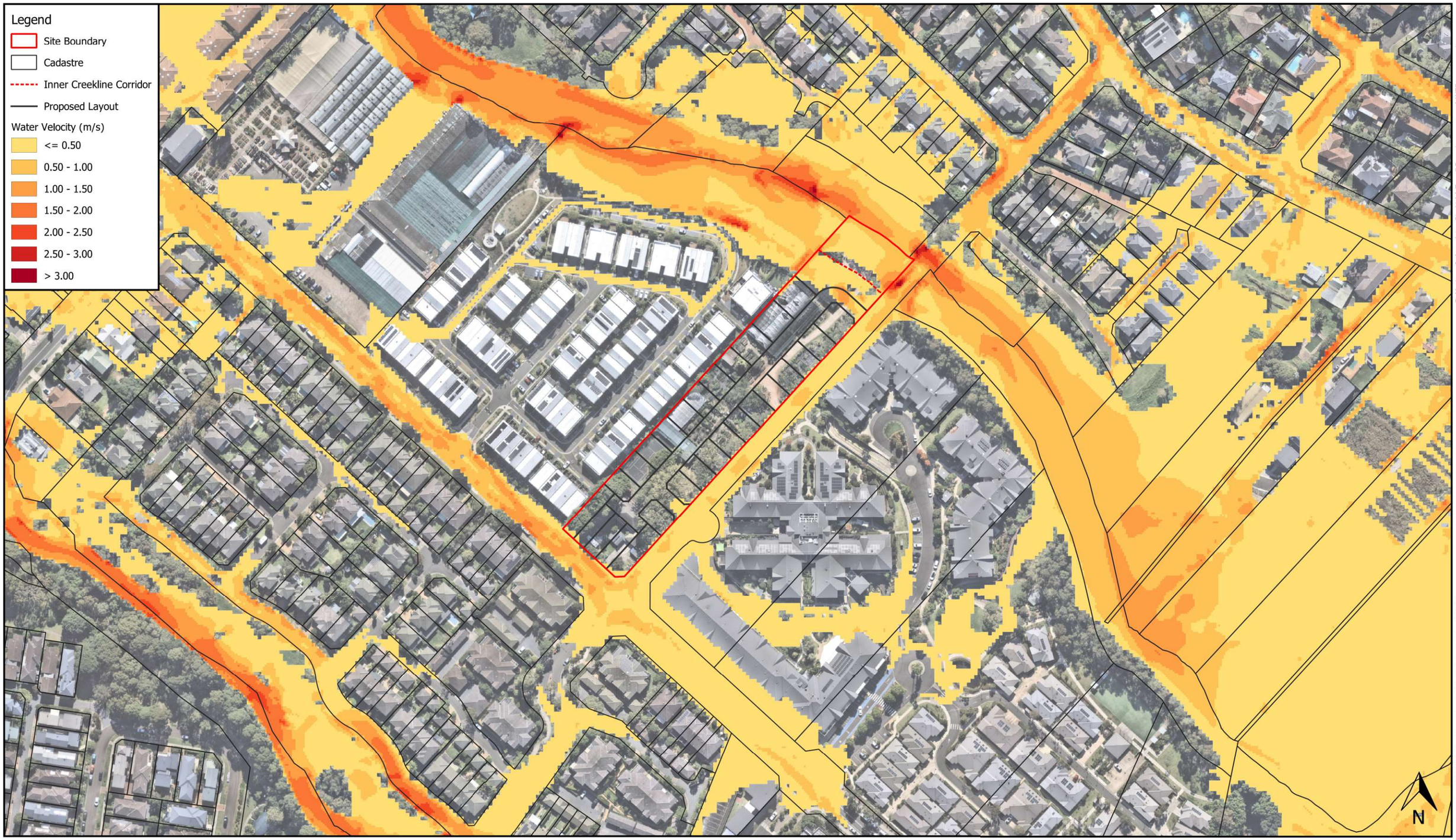
Map Title / Figure:

20% AEP + CC Proposed Conditions Water Level and Water Depth

Map 29	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Map Title / Figure:

20% AEP + CC Proposed Conditions Water Velocity

Map 30	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout

Velocity Depth Product (m²/s)

- 0.0 - 0.4
- 0.4 - 0.6
- > 0.6

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

N

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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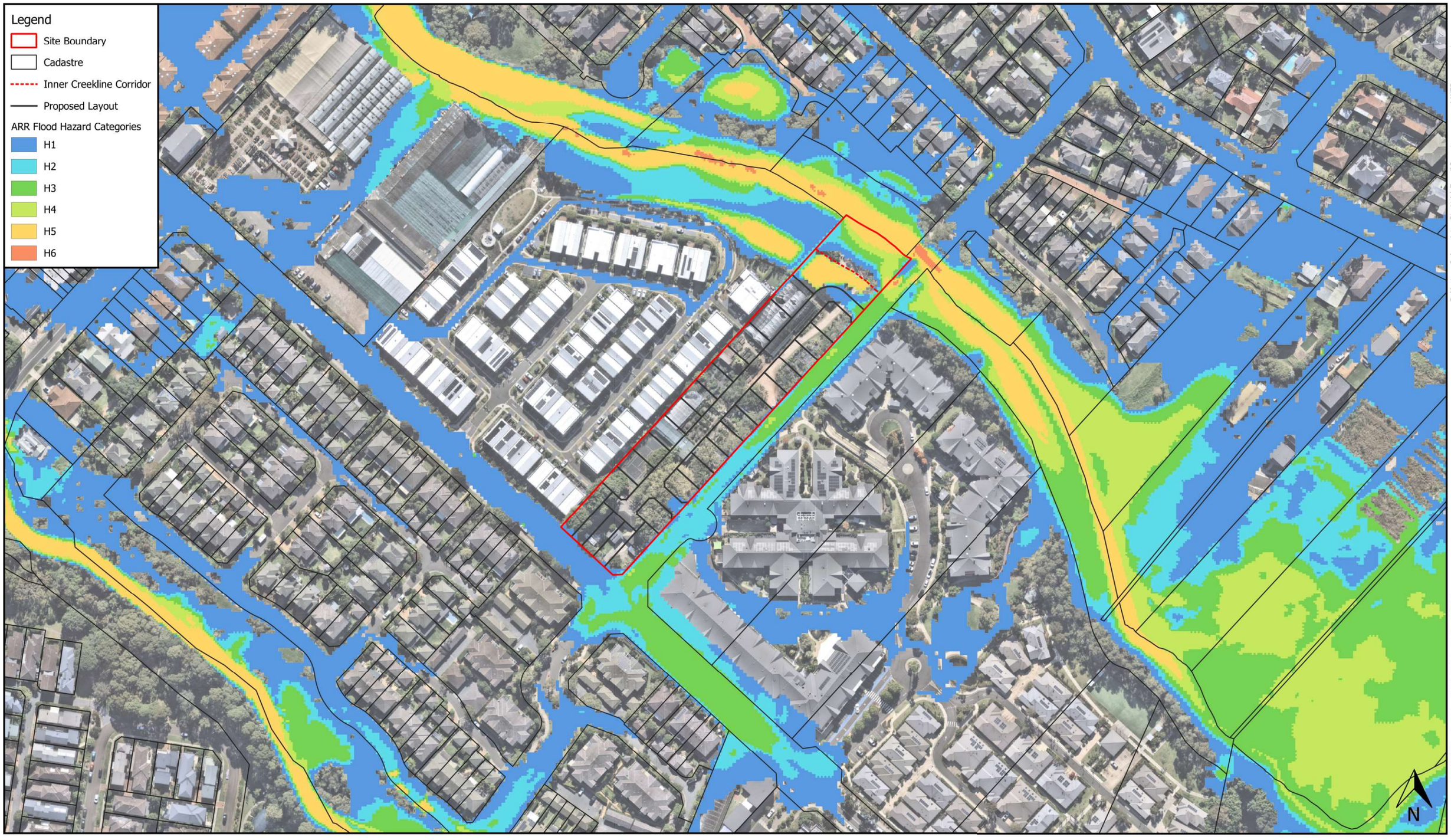
Map Title / Figure:

20% AEP + CC Proposed Conditions Velocity Depth Product

Map 31	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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Map Title / Figure:

20% AEP + CC Proposed Conditions ARR Flood Hazard

Map 32	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

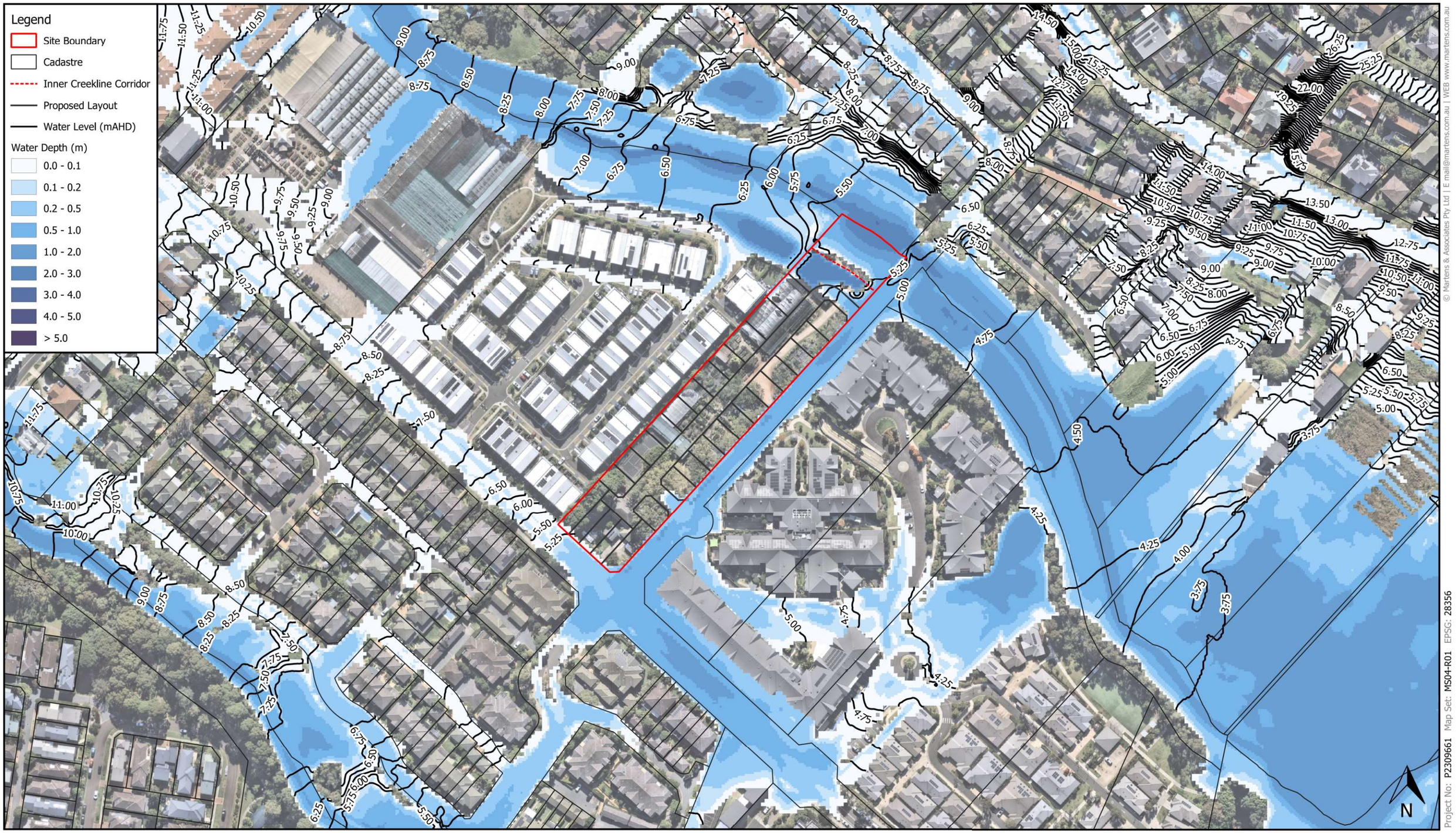
Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout
- Water Level (mAHD)

Water Depth (m)

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- > 5.0



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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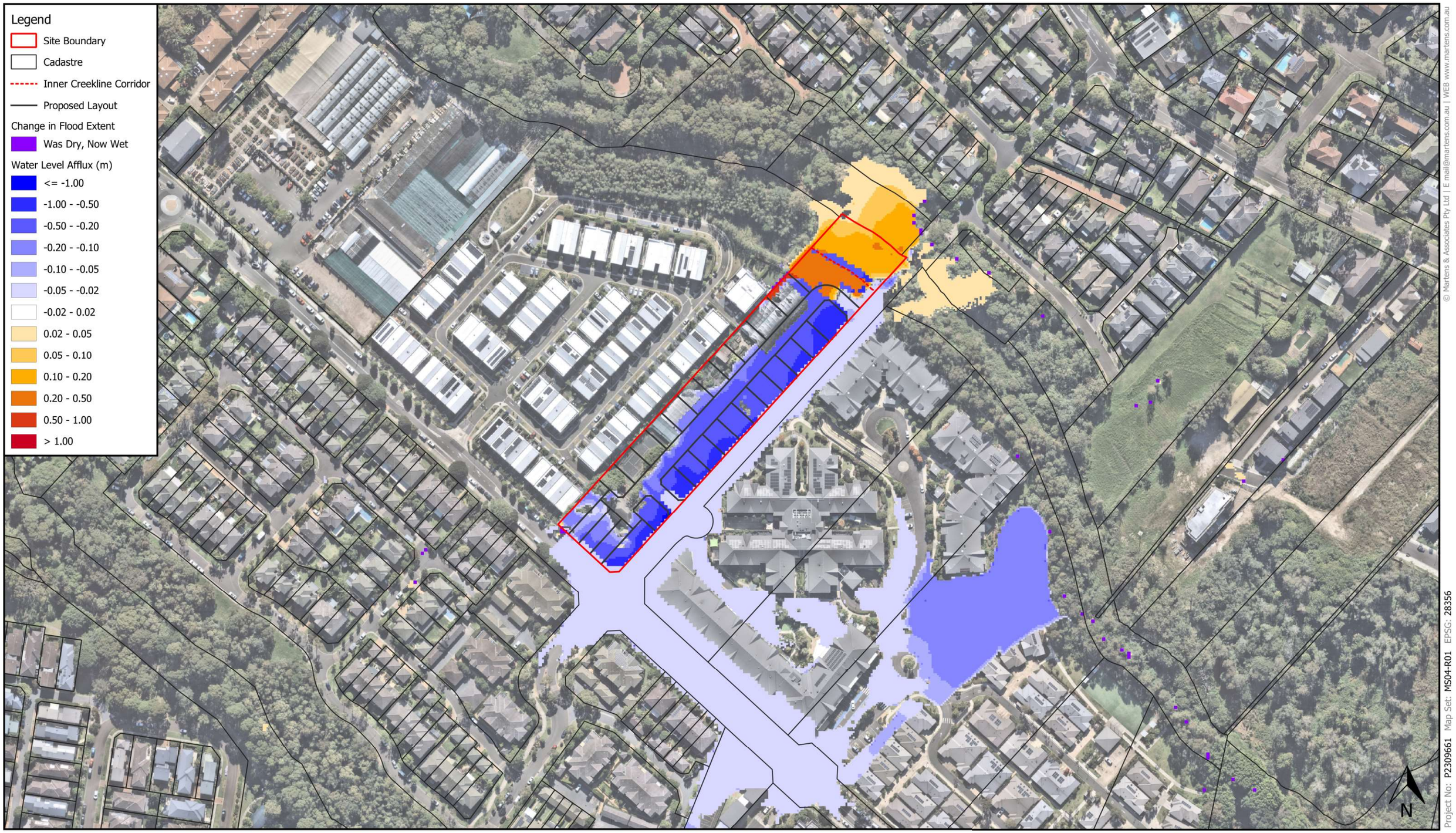
Map Title / Figure:

1% AEP Proposed Conditions Water Level and Water Depth

Map 33	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Areas coloured blue represent water level decrease.
Areas coloured yellow/red represent water level increase.

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Map Title / Figure:

1% AEP Proposed Conditions Water Level Afflux

Map 34	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout

Water Velocity (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- 2.50 - 3.00
- > 3.00

N

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Map Title / Figure:

1% AEP Proposed Conditions Water Velocity

Map 35	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

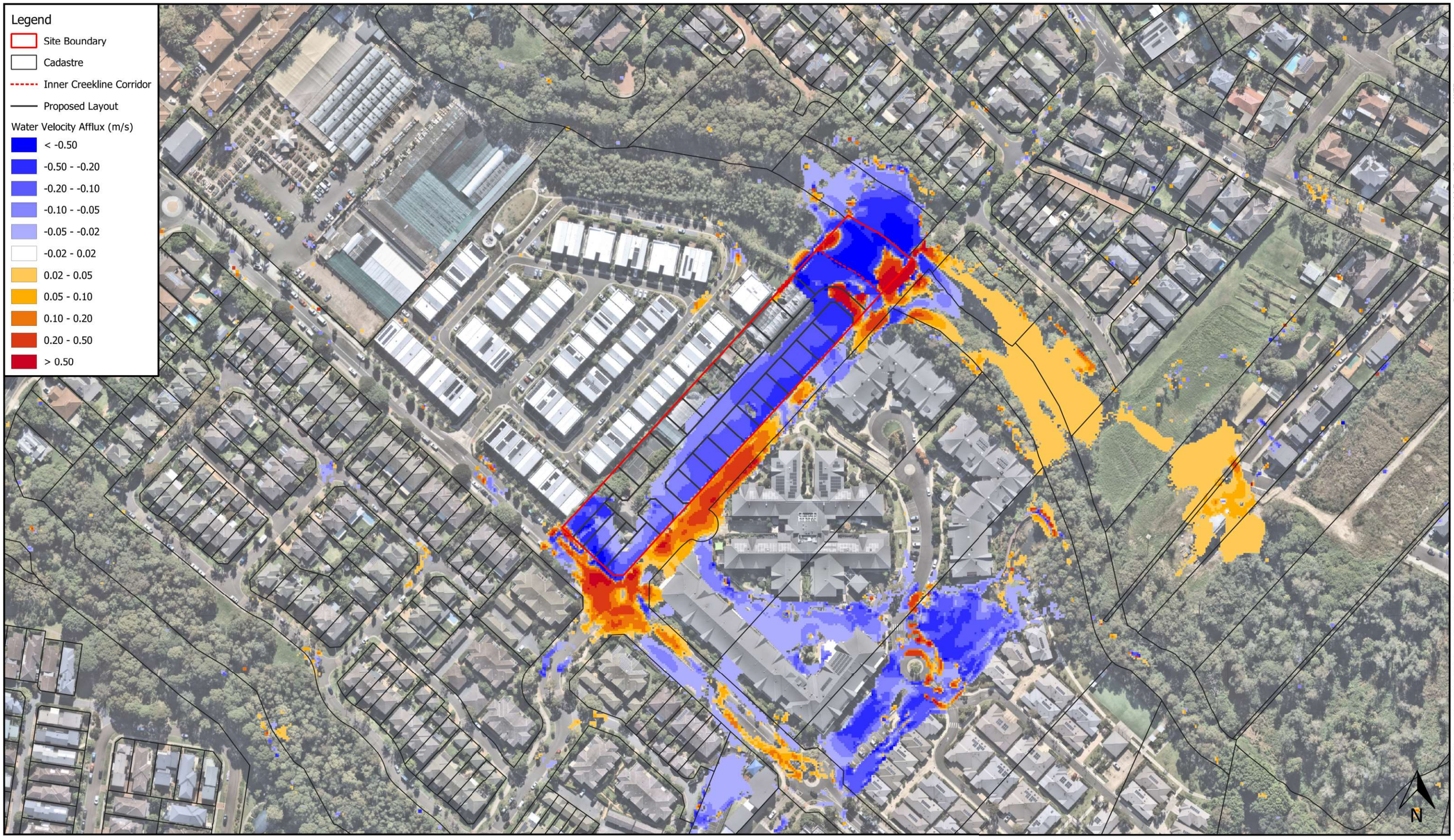
Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout

Water Velocity Afflux (m/s)

- < -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.50



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Areas coloured blue represent velocity decrease. Areas coloured yellow / red represent velocity increase.

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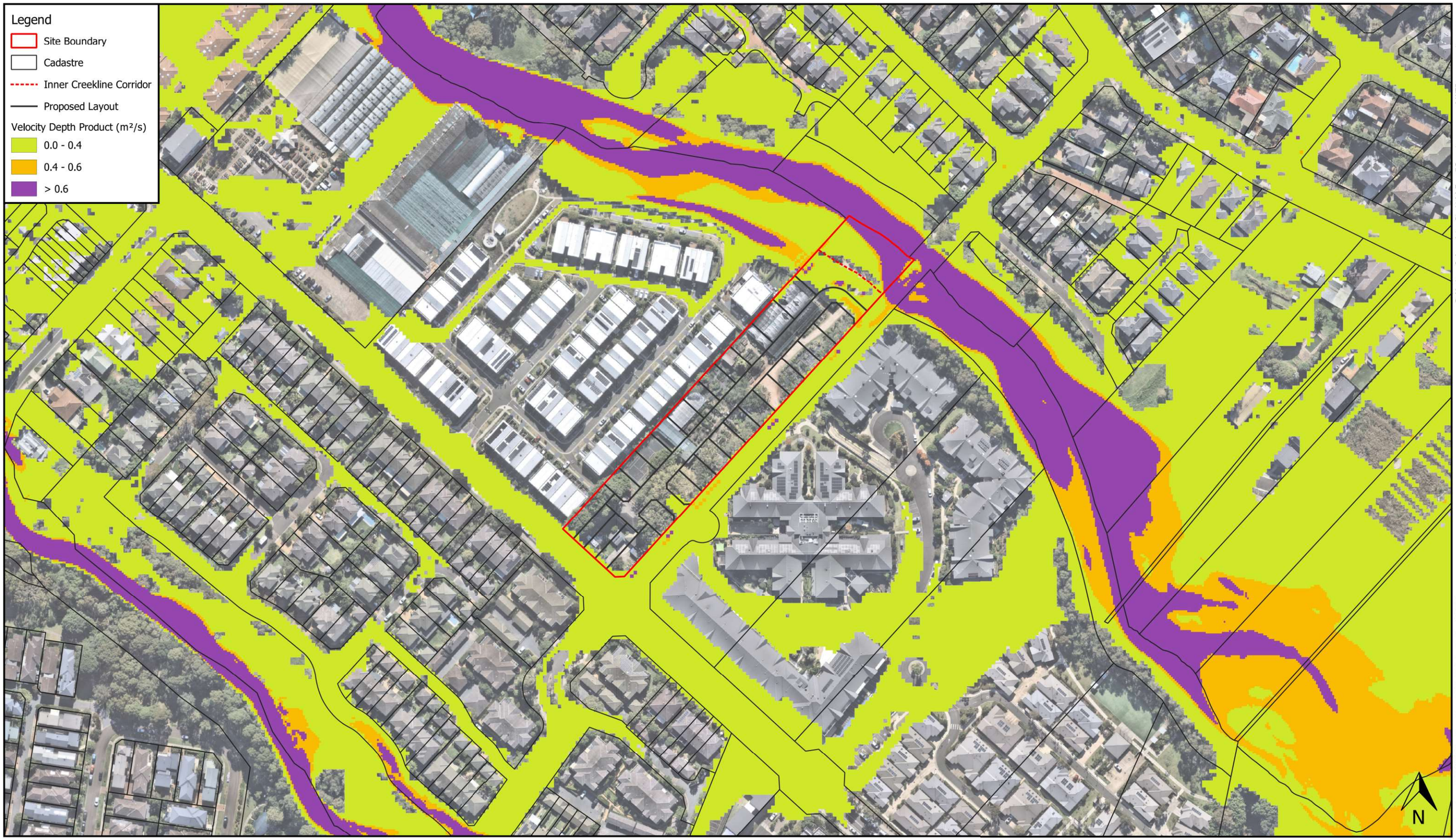
Map Title / Figure:
1% AEP Proposed Conditions Water Velocity Afflux

Map 36	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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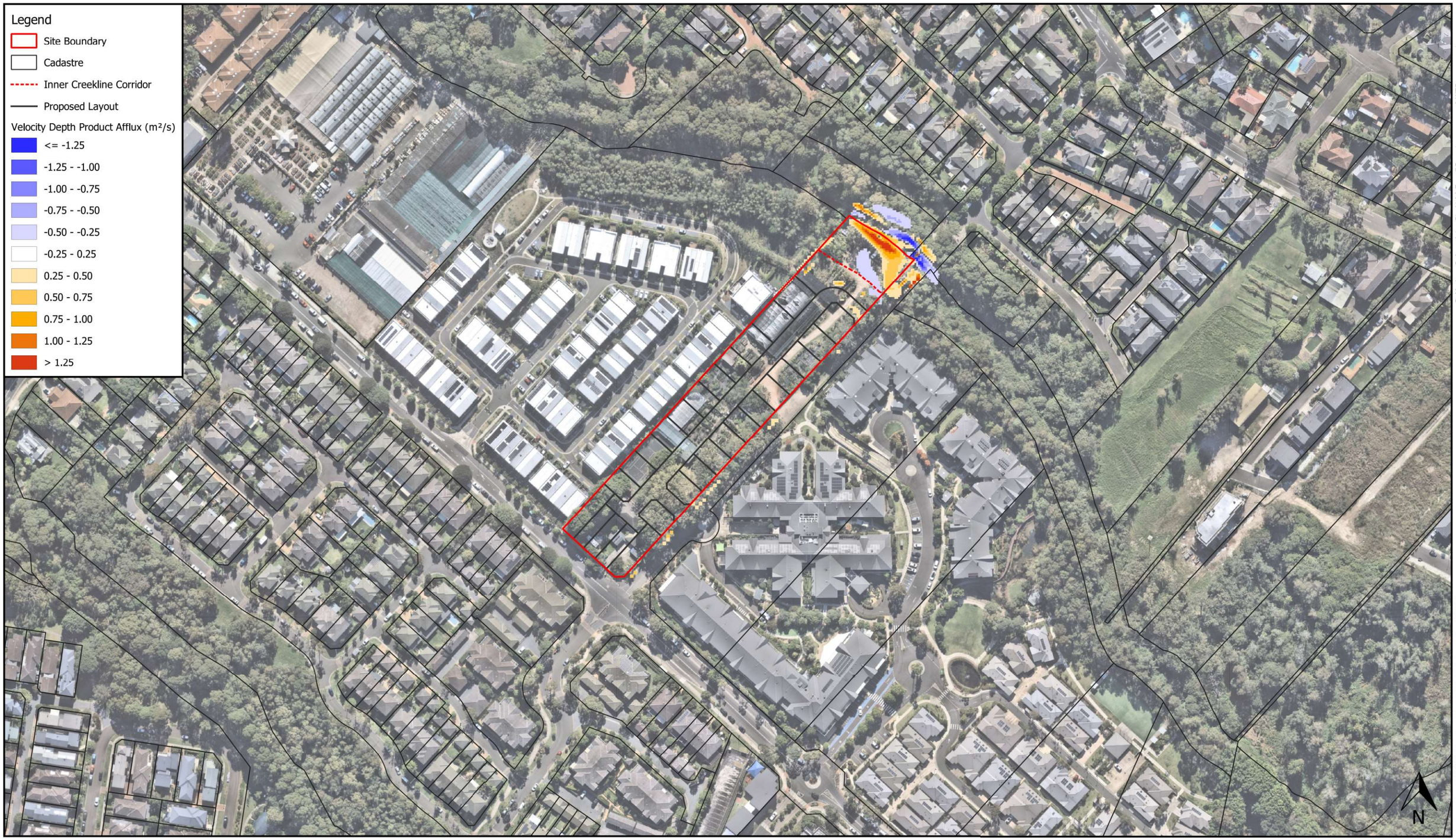
Map Title / Figure:
1% AEP Proposed Conditions Velocity Depth Product

Map 37	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Areas coloured blue represent velocity depth product decrease.
Areas coloured yellow/red represent velocity depth product.

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Map Title / Figure:

1% AEP Proposed Conditions Velocity Depth Product Afflux

Map 38	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout

ARR Flood Hazard Categories

- H1
- H2
- H3
- H4
- H5
- H6

N

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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Map Title / Figure:

1% AEP Proposed Conditions ARR Flood Hazard

Map 39	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout
- Assessment Locations

Water Level Increase

- > 0.02

Water Level (mAHD)

Water Depth (m)

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- > 5.0

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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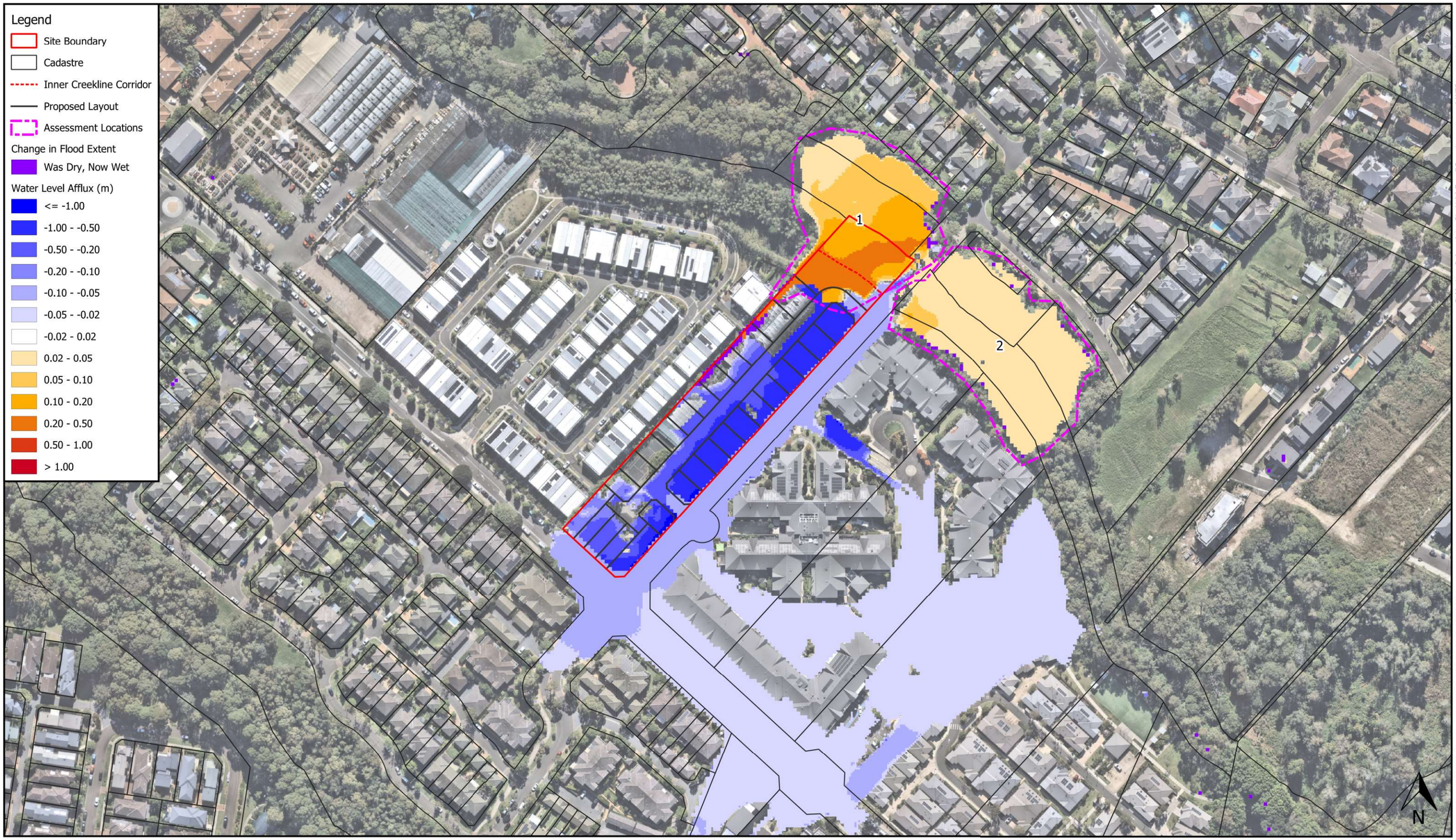
Map Title / Figure:

1% AEP + CC Proposed Conditions Water Level and Water Depth

Map 40	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Areas coloured blue represent water level decrease.
Areas coloured yellow/red represent water level increase.

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Map Title / Figure:

1% AEP + CC Proposed Conditions Water Level Afflux

Map 41	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout
- Assessment Locations

Water Velocity Increase

- > 10%

New Areas Above Water Velocity Threshold (m/s)

- > 2.00

Water Velocity (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- 2.50 - 3.00
- > 3.00

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

N

Map Title / Figure:

1% AEP + CC Proposed Conditions Water Velocity

Map 42	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout
- Assessment Locations

Water Velocity Increase

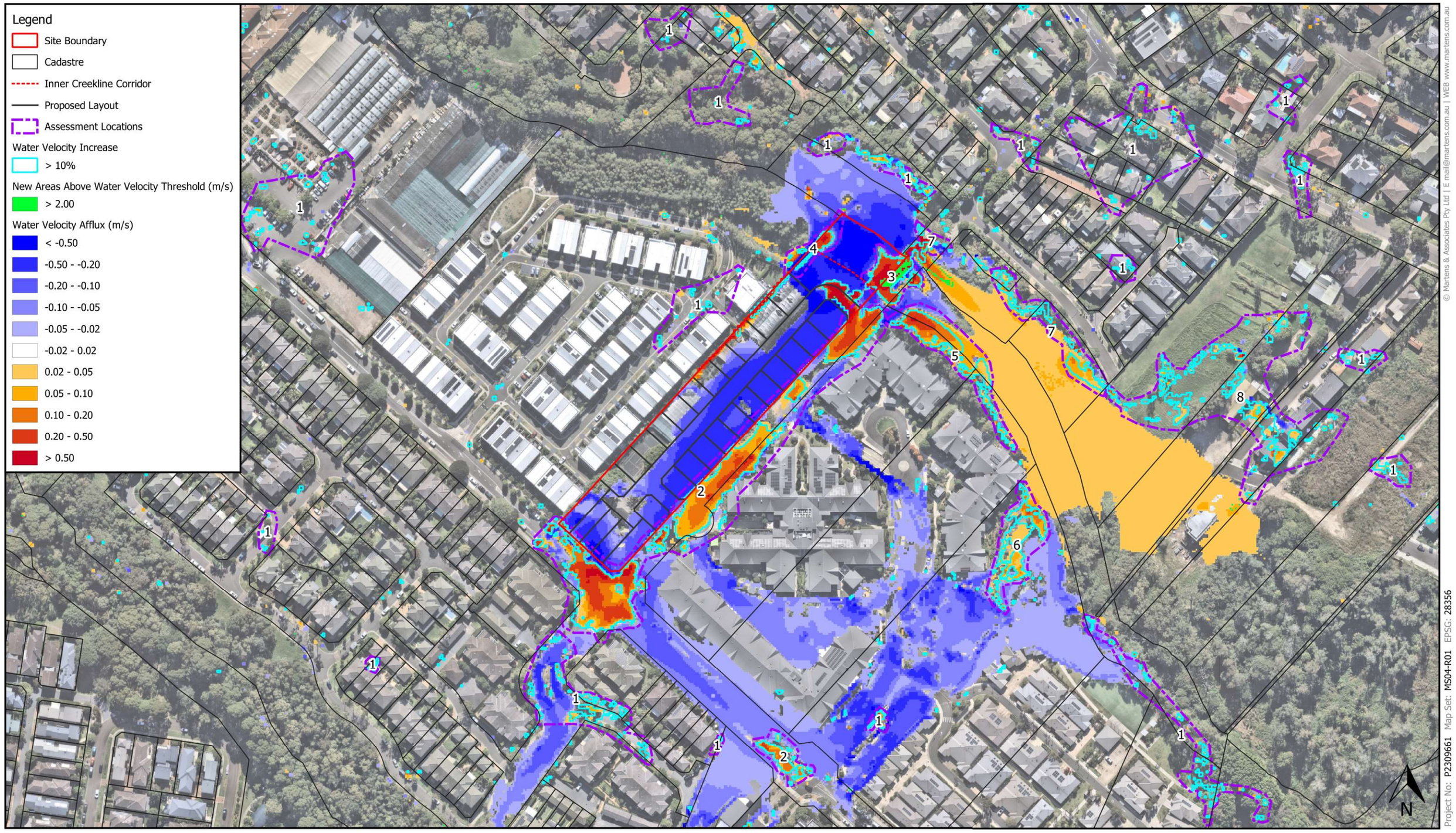
- > 10%

New Areas Above Water Velocity Threshold (m/s)

- > 2.00

Water Velocity Afflux (m/s)

- < -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.50



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Areas coloured blue represent velocity decrease. Areas coloured yellow / red represent velocity increase.

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Map Title / Figure:
1% AEP + CC Proposed Conditions Water Velocity Afflux

Map 43	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout
- Assessment Locations

Velocity Depth Product Increase

- > 10%

Velocity Depth Product (m²/s)

- 0.0 - 0.4
- 0.4 - 0.6
- > 0.6

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

N

Map Title / Figure:

1% AEP + CC Proposed Conditions Velocity Depth Product

Map 44	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Areas coloured blue represent velocity depth product decrease.
Areas coloured yellow/red represent velocity depth product.

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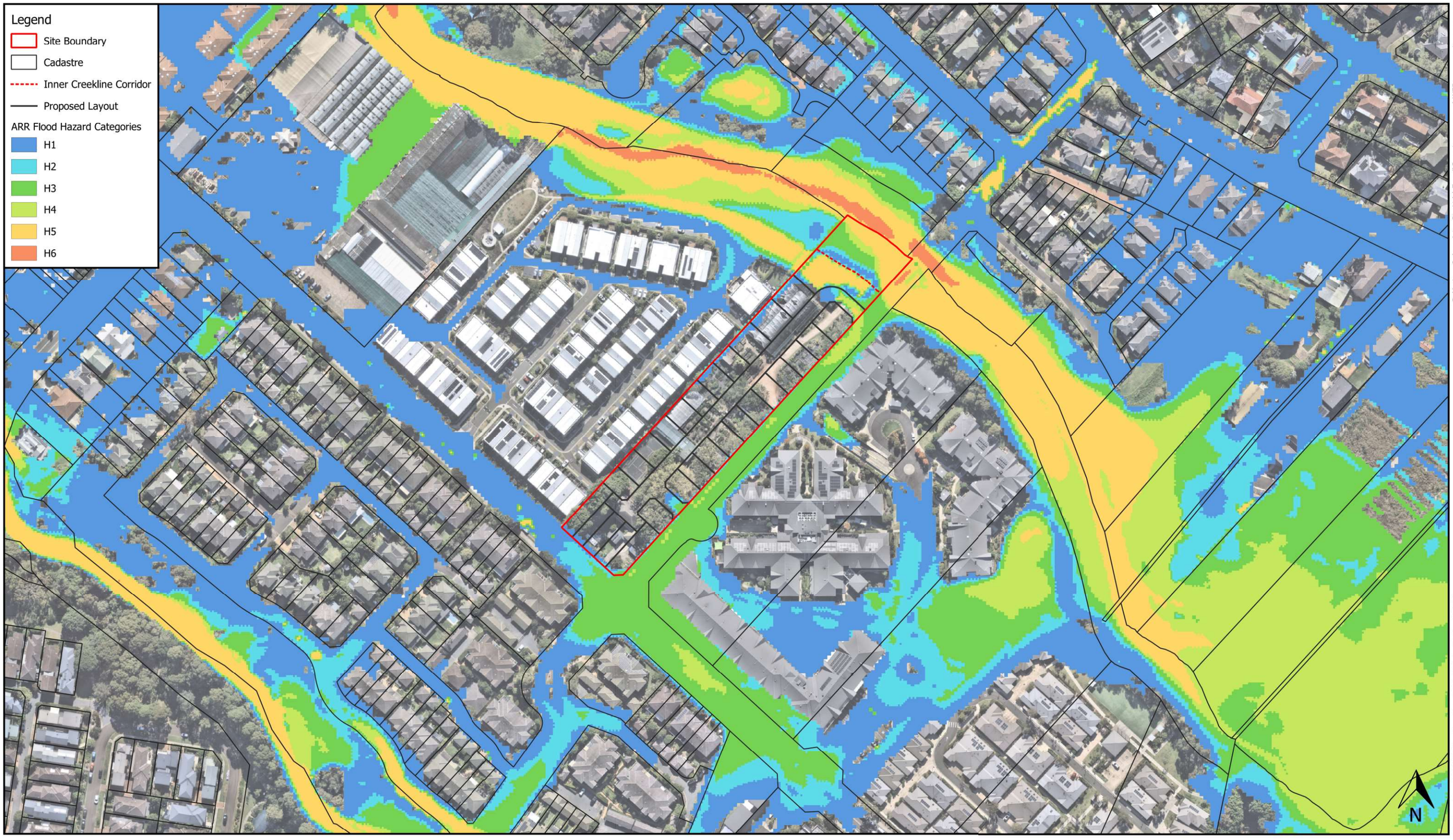
Map Title / Figure:

1% AEP + CC Proposed Conditions Velocity Depth Product Afflux

Map 45	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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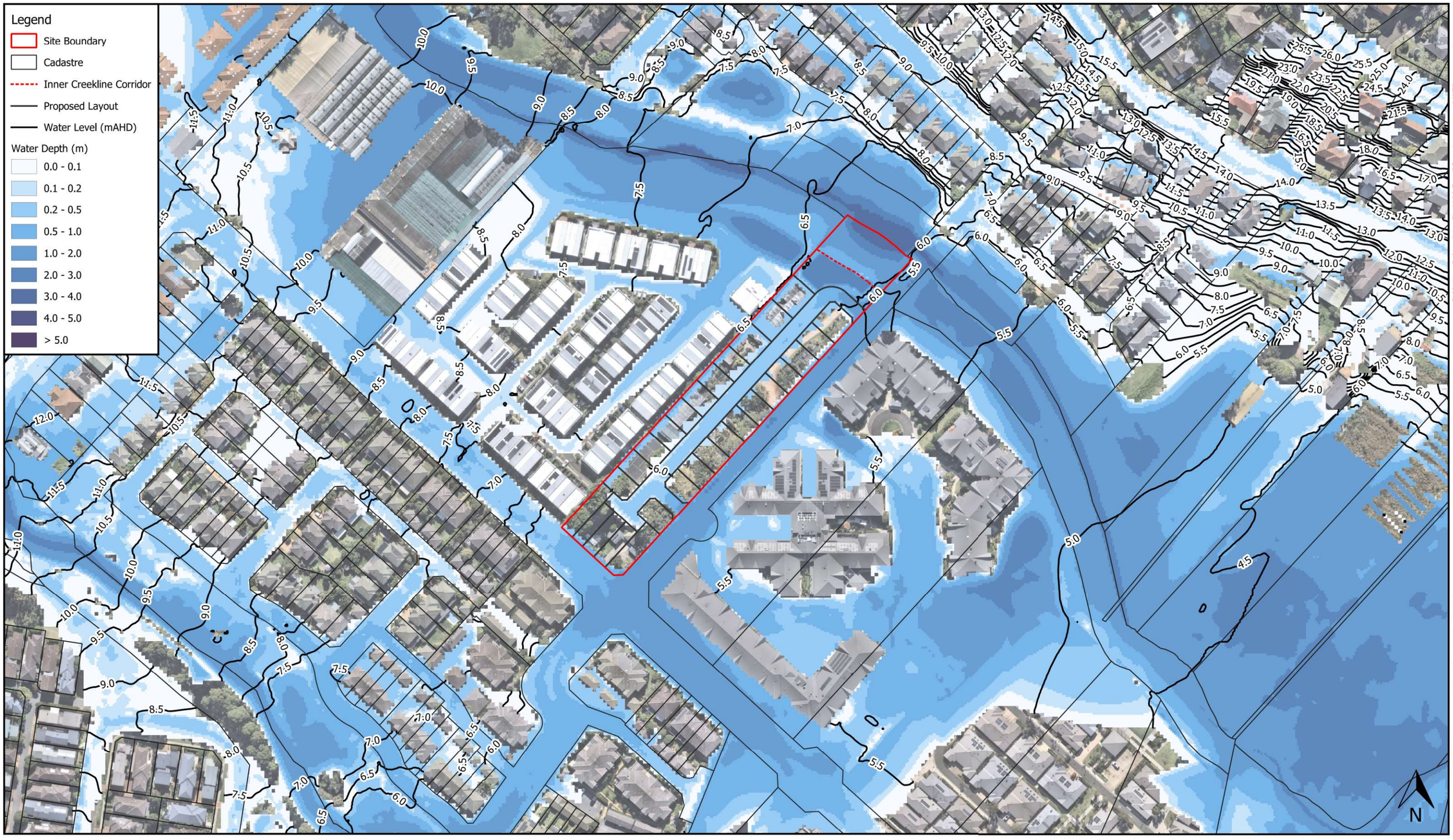
Map Title / Figure:

1% AEP + CC Proposed Conditions ARR Flood Hazard

Map 46	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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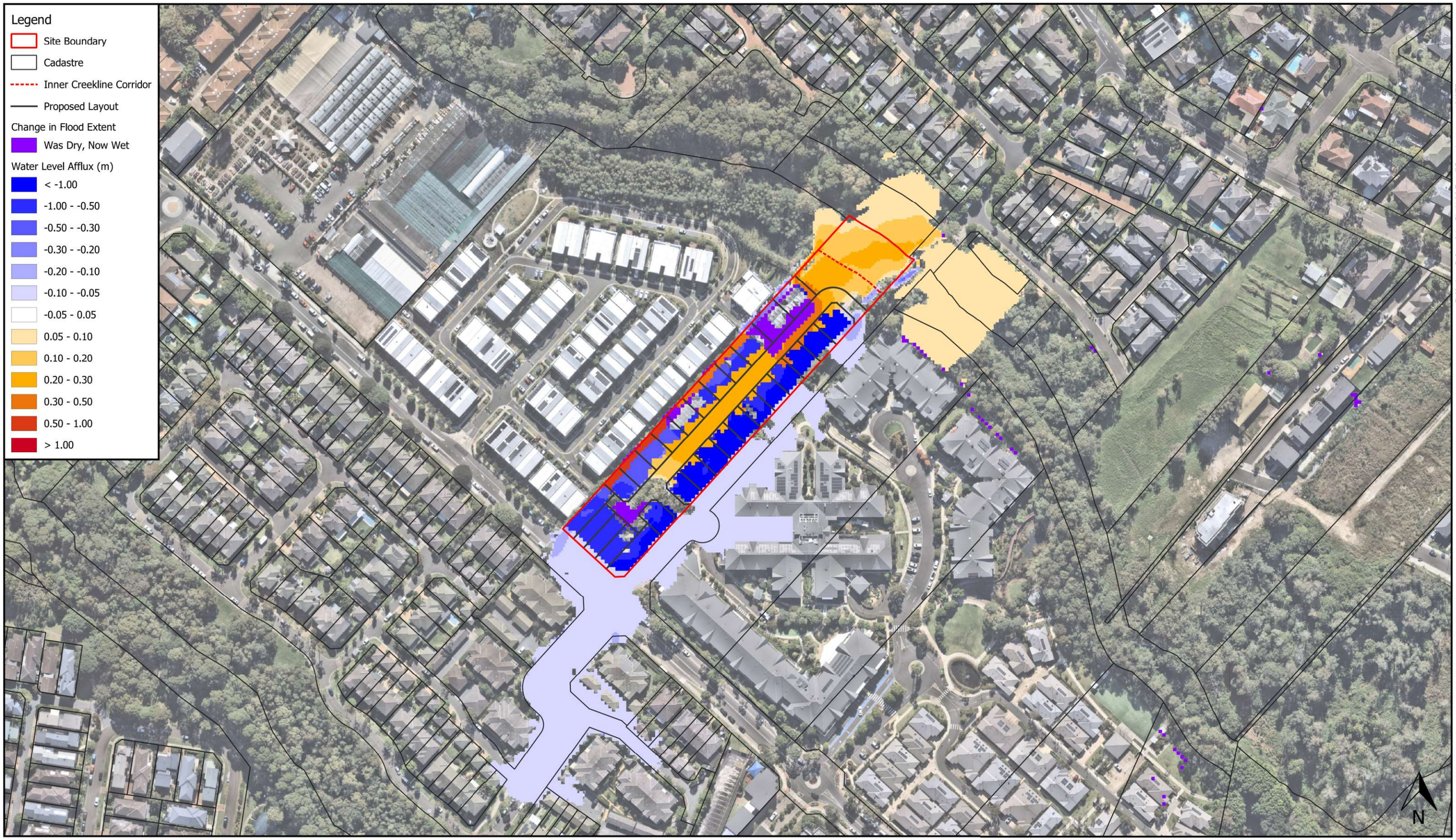
Map Title / Figure:

PMF Proposed Conditions Water Level and Water Depth

Map 47	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Areas coloured blue represent water level decrease.
Areas coloured yellow/red represent water level increase.

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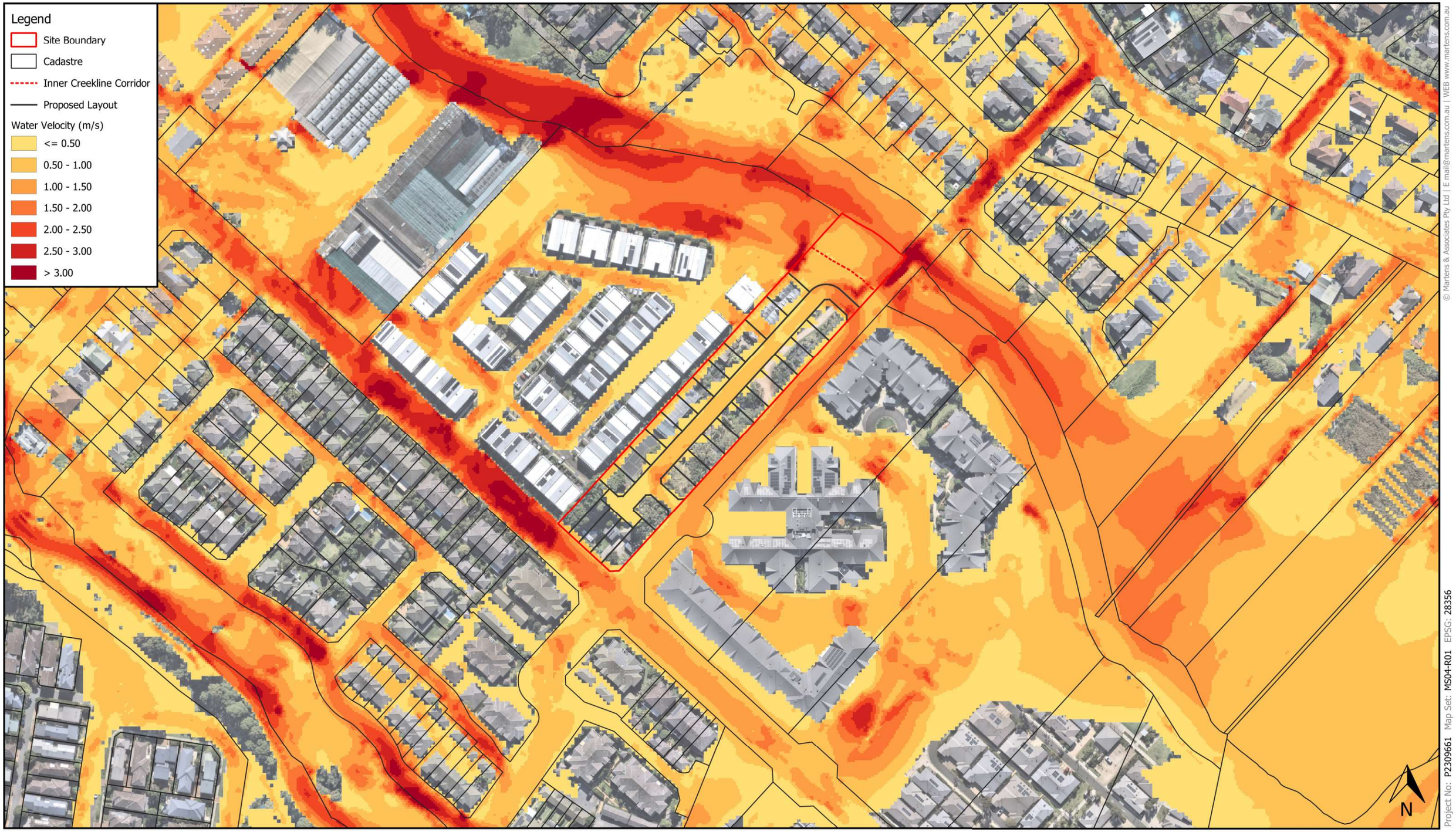
Map Title / Figure:

PMF Proposed Conditions Water Level Afflux

Map 48	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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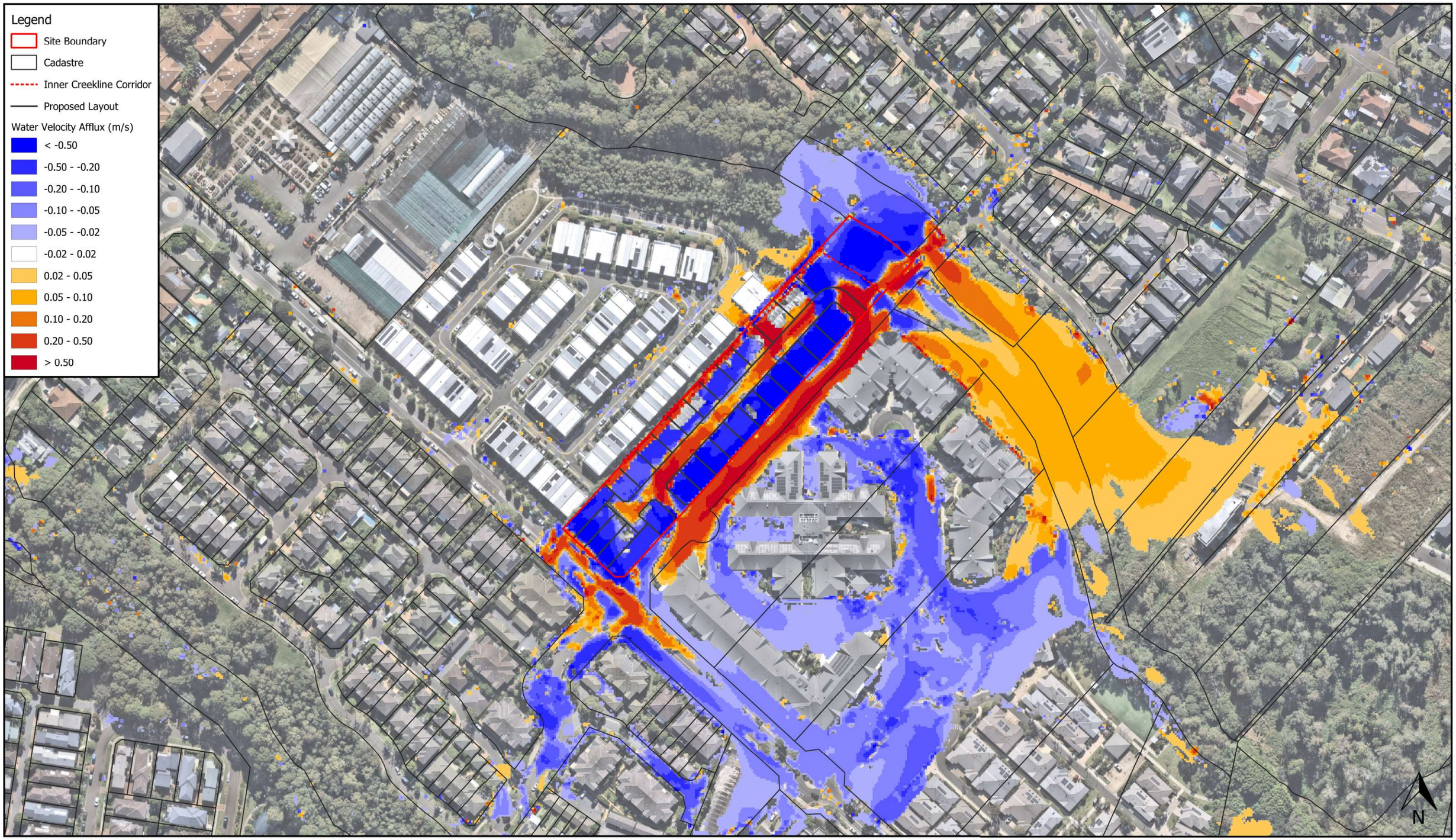
Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

PMF Proposed Conditions Water Velocity

Map 49	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Areas coloured blue represent velocity decrease. Areas coloured yellow / red represent velocity increase.

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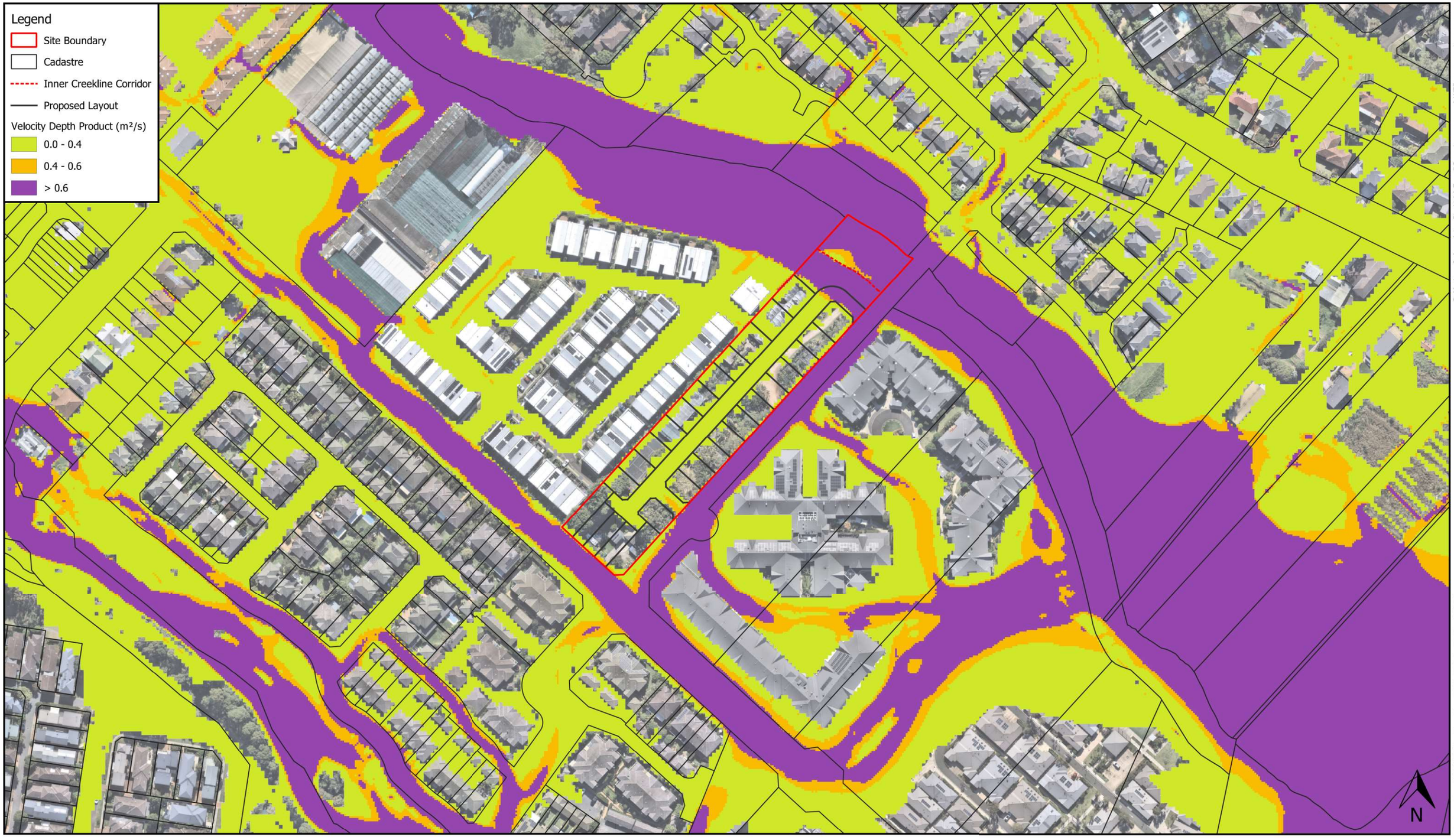
Map Title / Figure:

PMF Proposed Conditions Water Velocity Afflux

Map 50	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

PMF Proposed Conditions Velocity Depth Product

Map 51	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Areas coloured blue represent velocity depth product decrease.
Areas coloured yellow/red represent velocity depth product.

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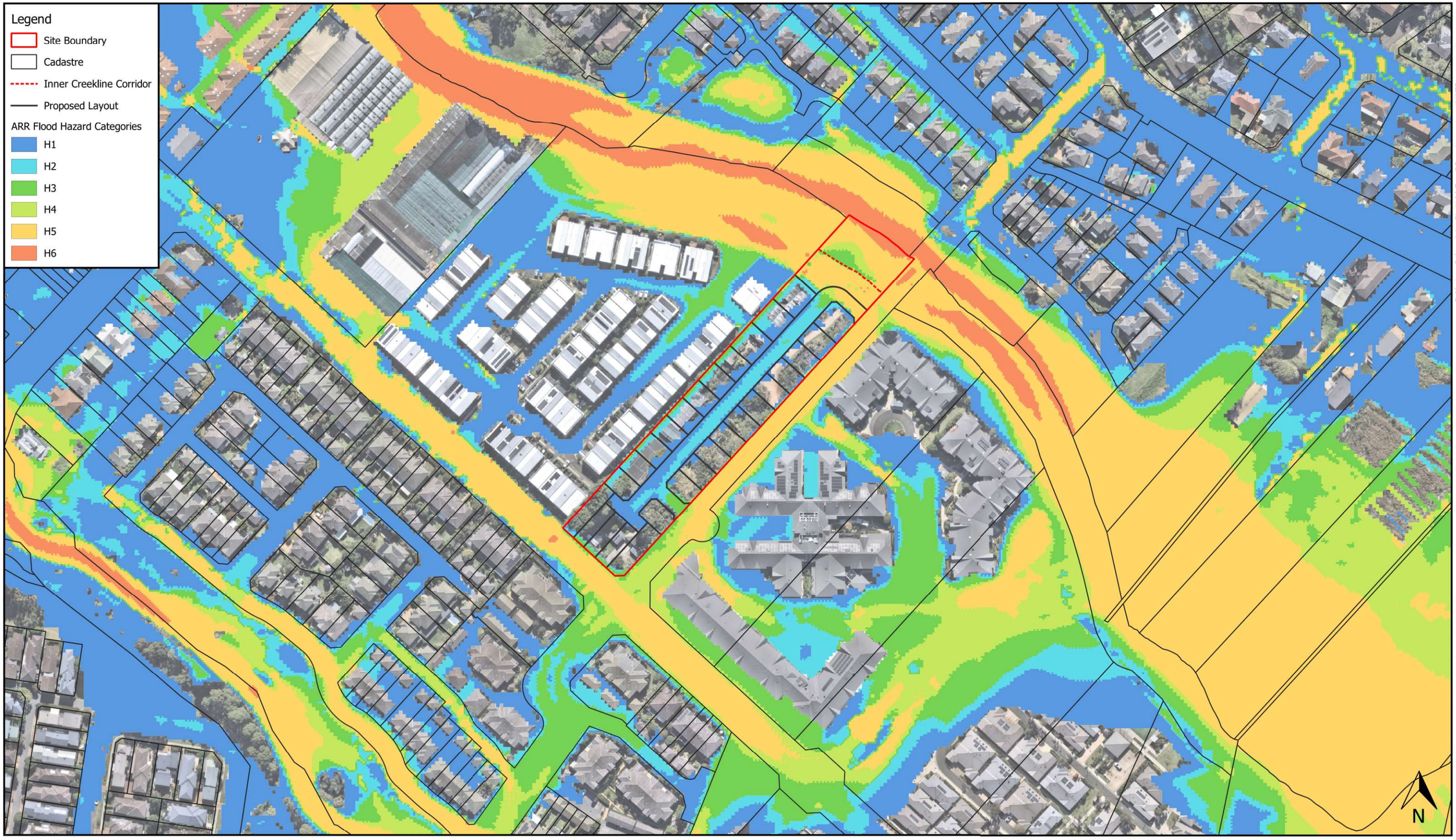
Map Title / Figure:

PMF Proposed Conditions Velocity Depth Product Afflux

Map 52	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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Map Title / Figure:
PMF Proposed Conditions ARR Flood Hazard

Map 53	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout
- Assessment Locations

Water Level Increase

- > 0.02

- Water Level (mAHD)

Water Depth (m)

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- > 5.0

1

2

N

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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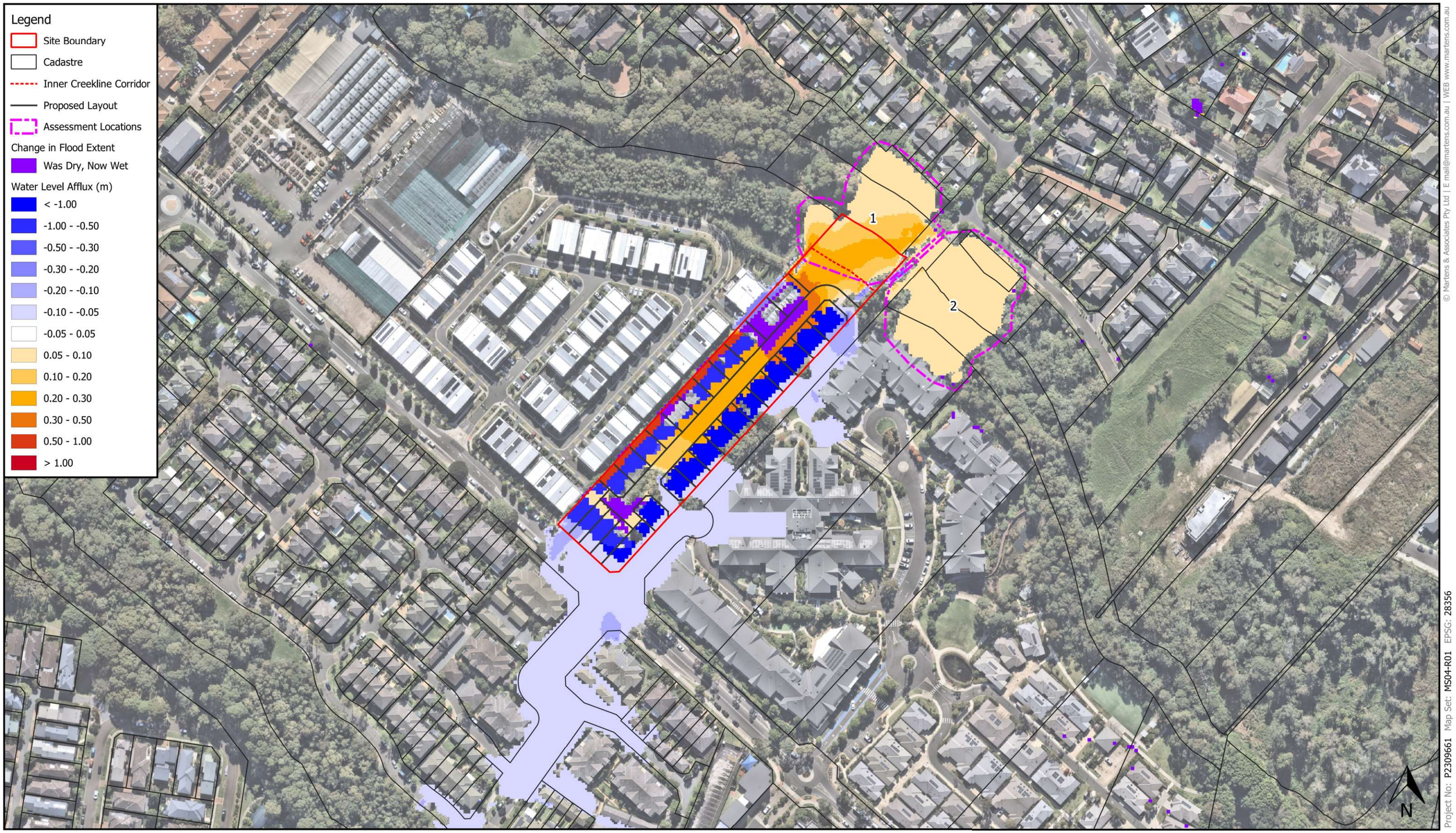
Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

PMF + CC Proposed Conditions Water Level and Water Depth

Map 54	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Areas coloured blue represent water level decrease.
Areas coloured yellow/red represent water level increase.

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Map Title / Figure:

PMF + CC Proposed Conditions Water Level Afflux

Map 55	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout
- Assessment Locations

Water Velocity Increase

- > 10%

New Areas Above Water Velocity Threshold (m/s)

- > 2.00

Water Velocity (m/s)

- <= 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- 2.50 - 3.00
- > 3.00

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Map Title / Figure:

PMF + CC Proposed Conditions Water Velocity

Map 56	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout
- Assessment Locations

Water Velocity Increase

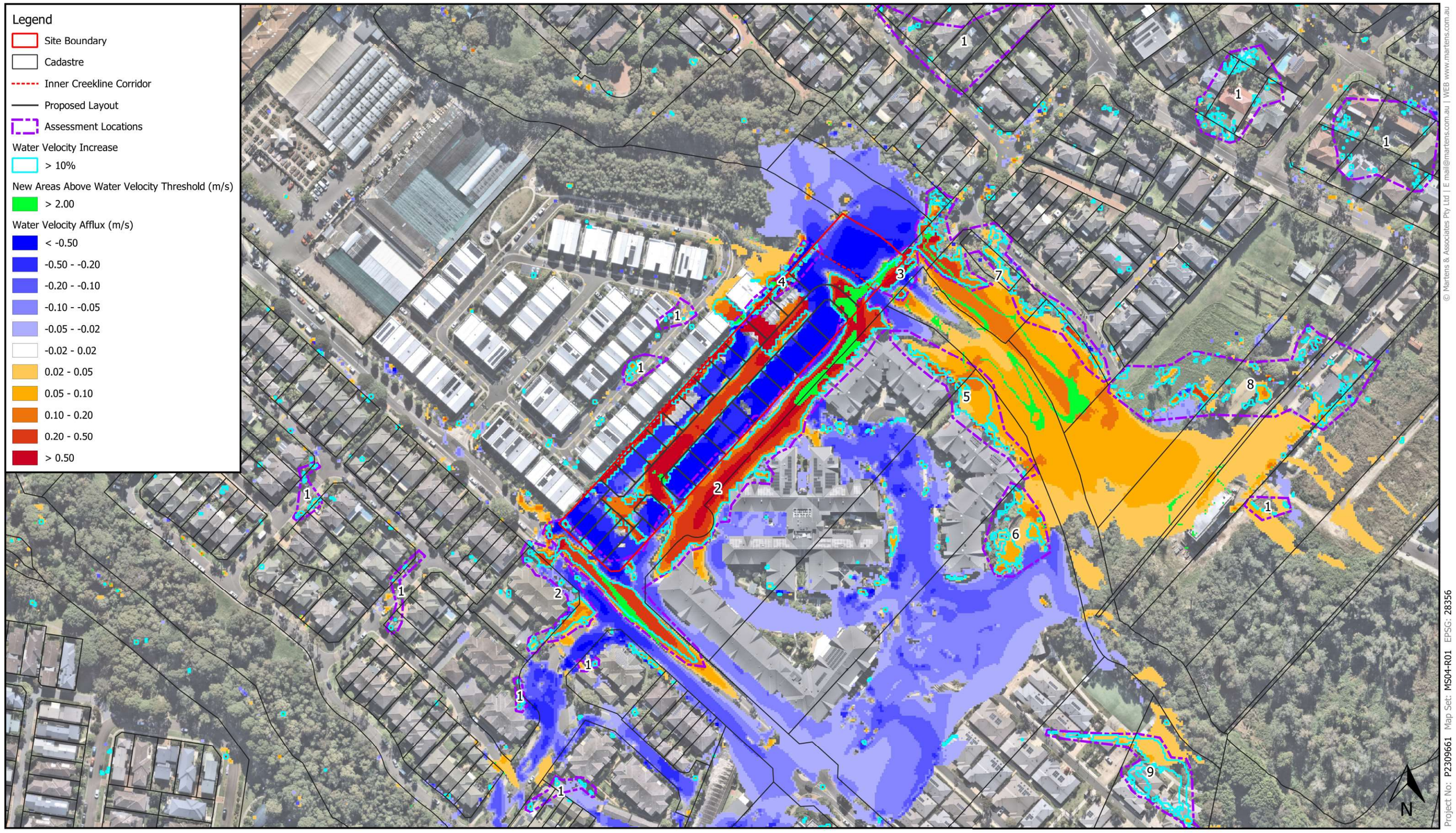
- > 10%

New Areas Above Water Velocity Threshold (m/s)

- > 2.00

Water Velocity Afflux (m/s)

- < -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.50



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Areas coloured blue represent velocity decrease. Areas coloured yellow / red represent velocity increase.

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Map Title / Figure:

PMF + CC Proposed Conditions Water Velocity Afflux

Map 57	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Inner Creekline Corridor
- Proposed Layout
- Assessment Locations

Velocity Depth Product Increase

- > 10%

Velocity Depth Product (m²/s)

- 0.0 - 0.4
- 0.4 - 0.6
- > 0.6

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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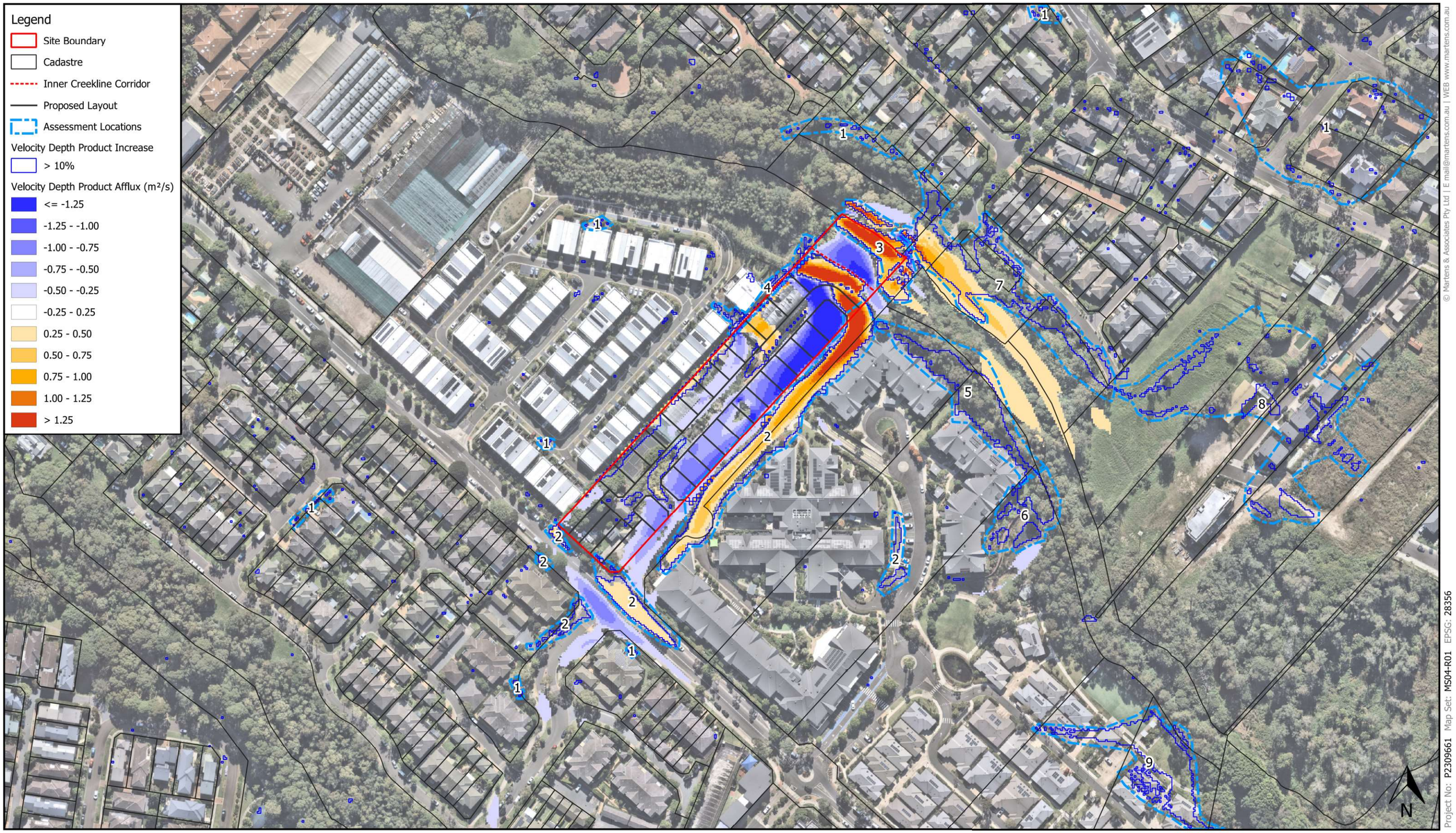
Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

N

Map Title / Figure:

PMF + CC Proposed Conditions Velocity Depth Product

Map 58	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date



0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Areas coloured blue represent velocity depth product decrease.
Areas coloured yellow/red represent velocity depth product.

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Map Title / Figure:

PMF + CC Proposed Conditions Velocity Depth Product Afflux

Map 59	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

0 20 40 60 80 100 m

1:2000 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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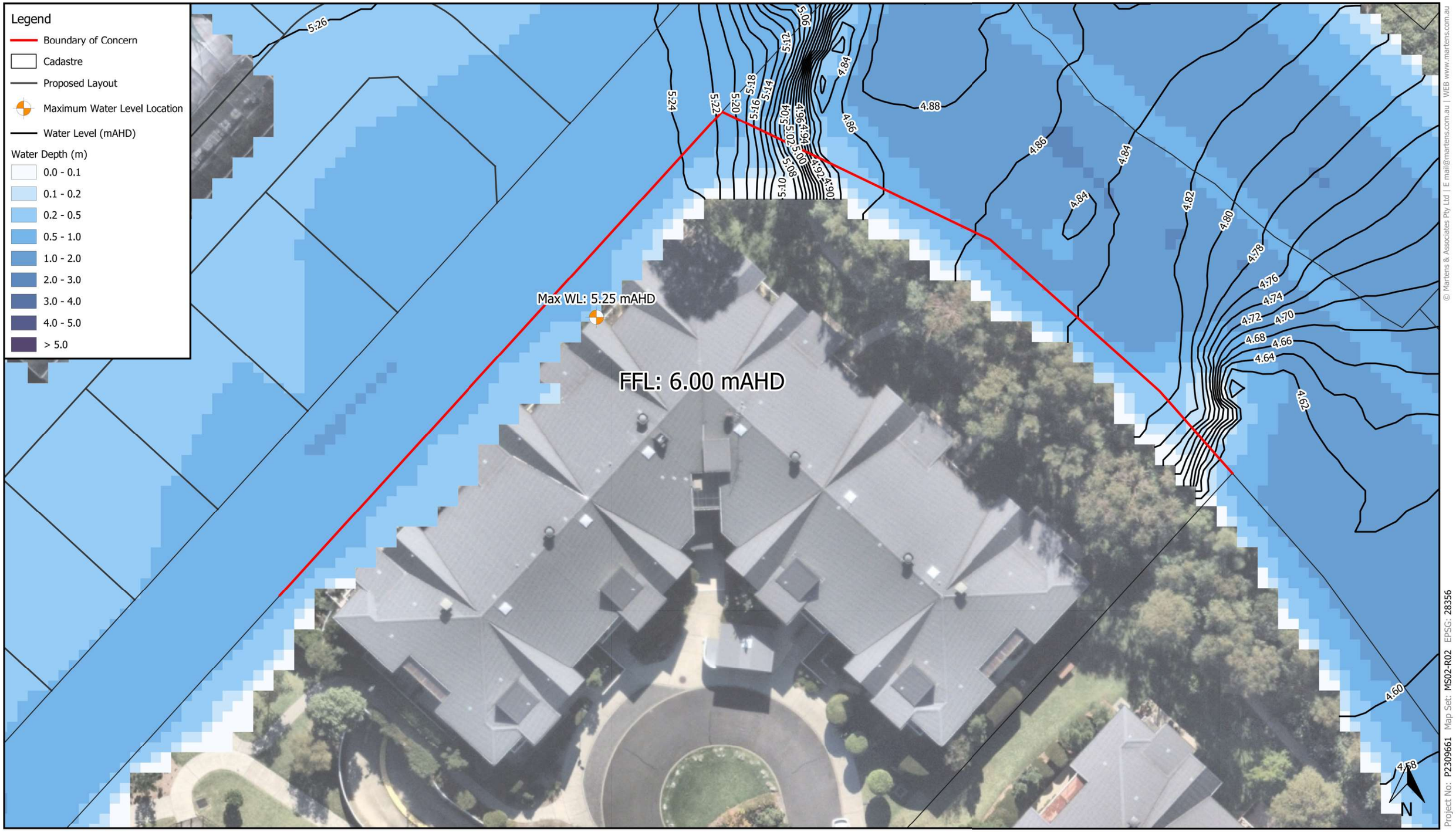
Map Title / Figure:

PMF + CC Proposed Conditions ARR Flood Hazard

Map 60	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS04-R01 EPSG: 28356

Appendix C – Set B Flood Maps



0 4 8 12 16 20 m

1:350 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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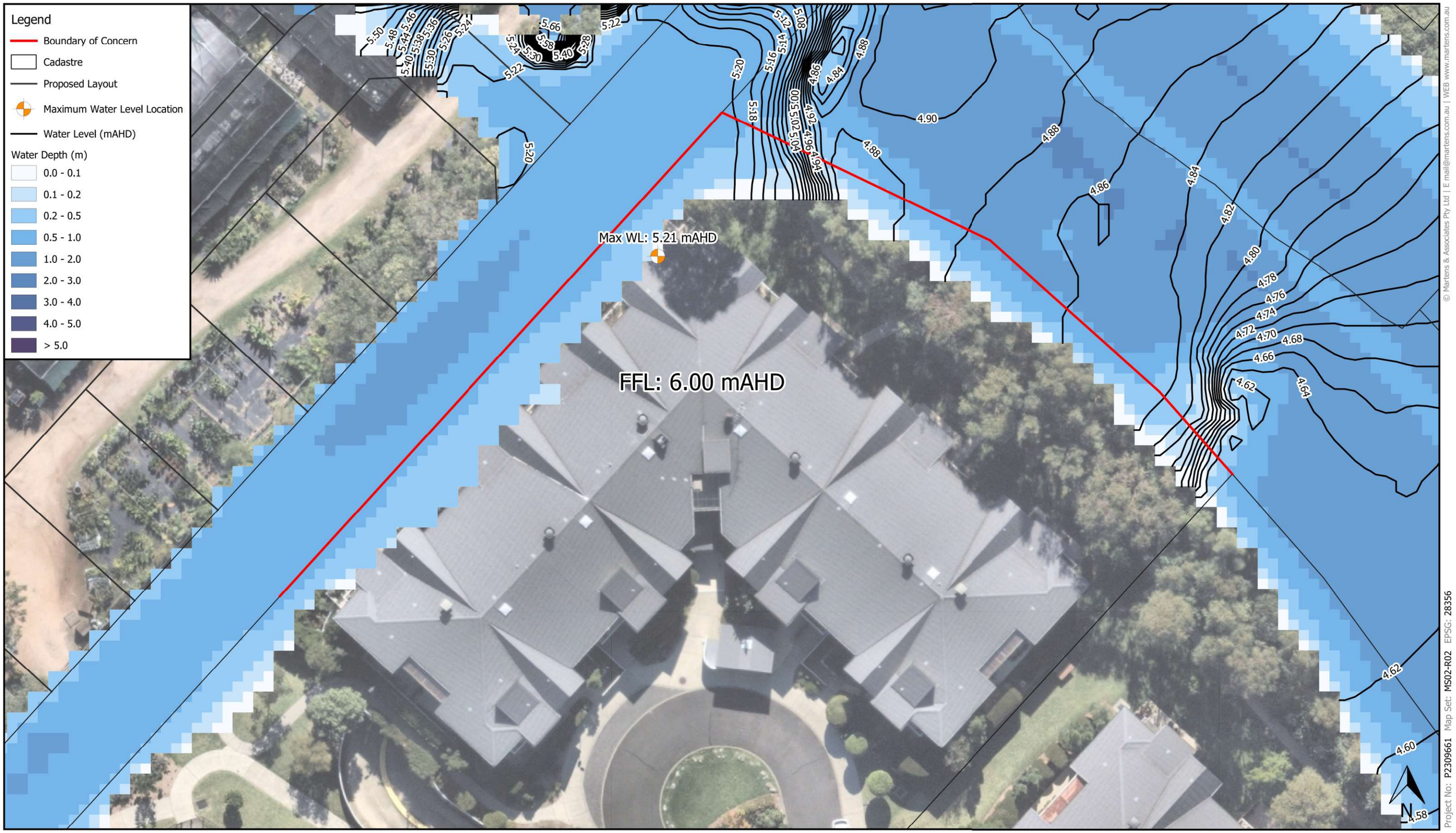
Project No: P2309661 Map Set: MS02-R02 EPSG: 28356

Map Title / Figure:

1% AEP Existing Conditions Maximum Water Level and Water Depth

Map 01	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date



0 4 8 12 16 20 m

1:350 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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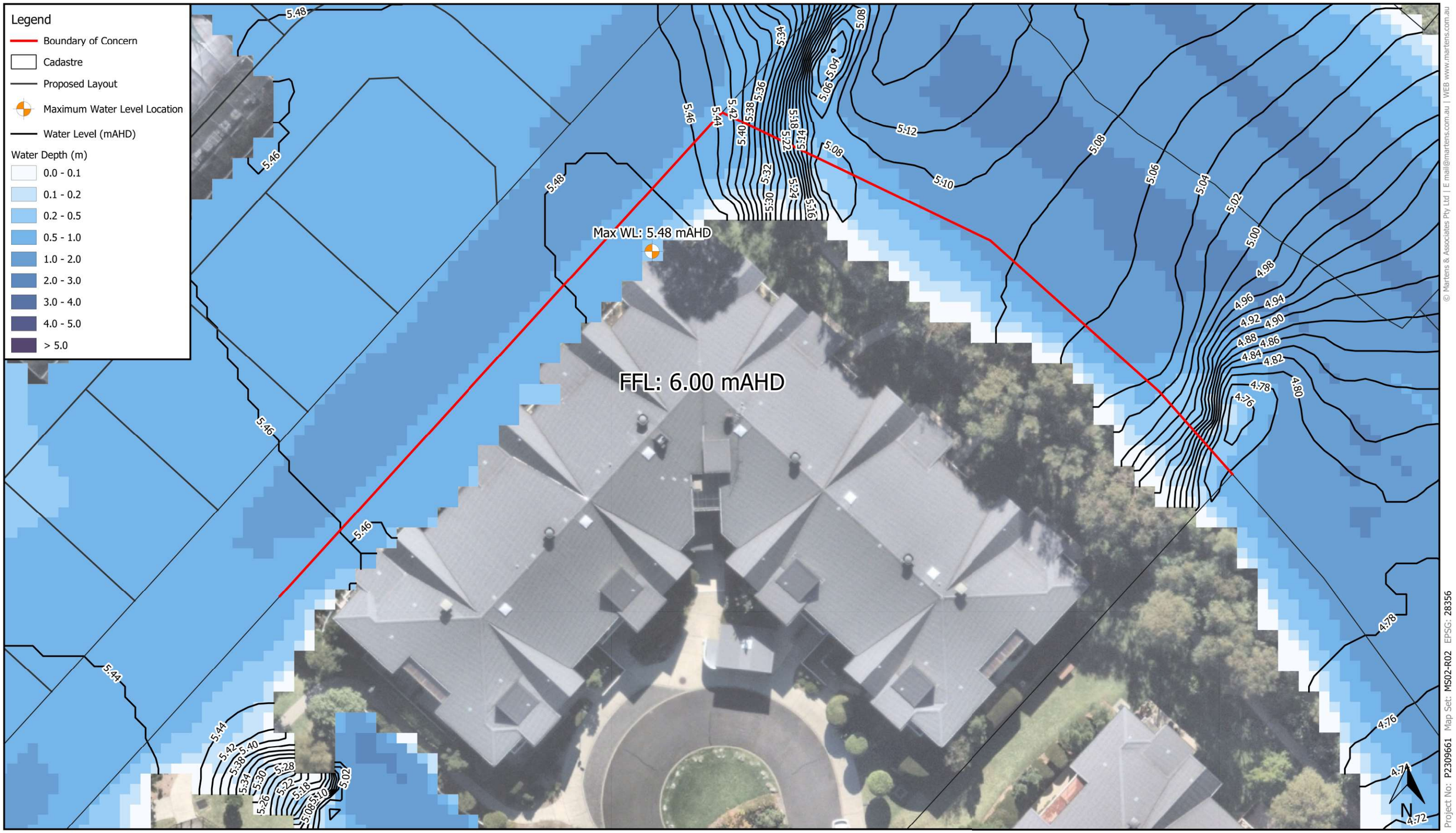
Map Title / Figure:

1% AEP Proposed Conditions Maximum Water Level and Water Depth

Map 02	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS02-R02 EPSG: 28356



1:350 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Map Title / Figure:

1% AEP +CC Existing Conditions Maximum Water Level and Water Depth

Map 03	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS02-R02 EPSG: 28356

Legend

- Boundary of Concern
- Cadastre
- Proposed Layout
- Maximum Water Level Location
- Water Level (mAHD)

Water Depth (m)

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- > 5.0

Max WL: 5.43 mAHD

FFL: 6.00 mAHD

N

0 4 8 12 16 20 m

1:350 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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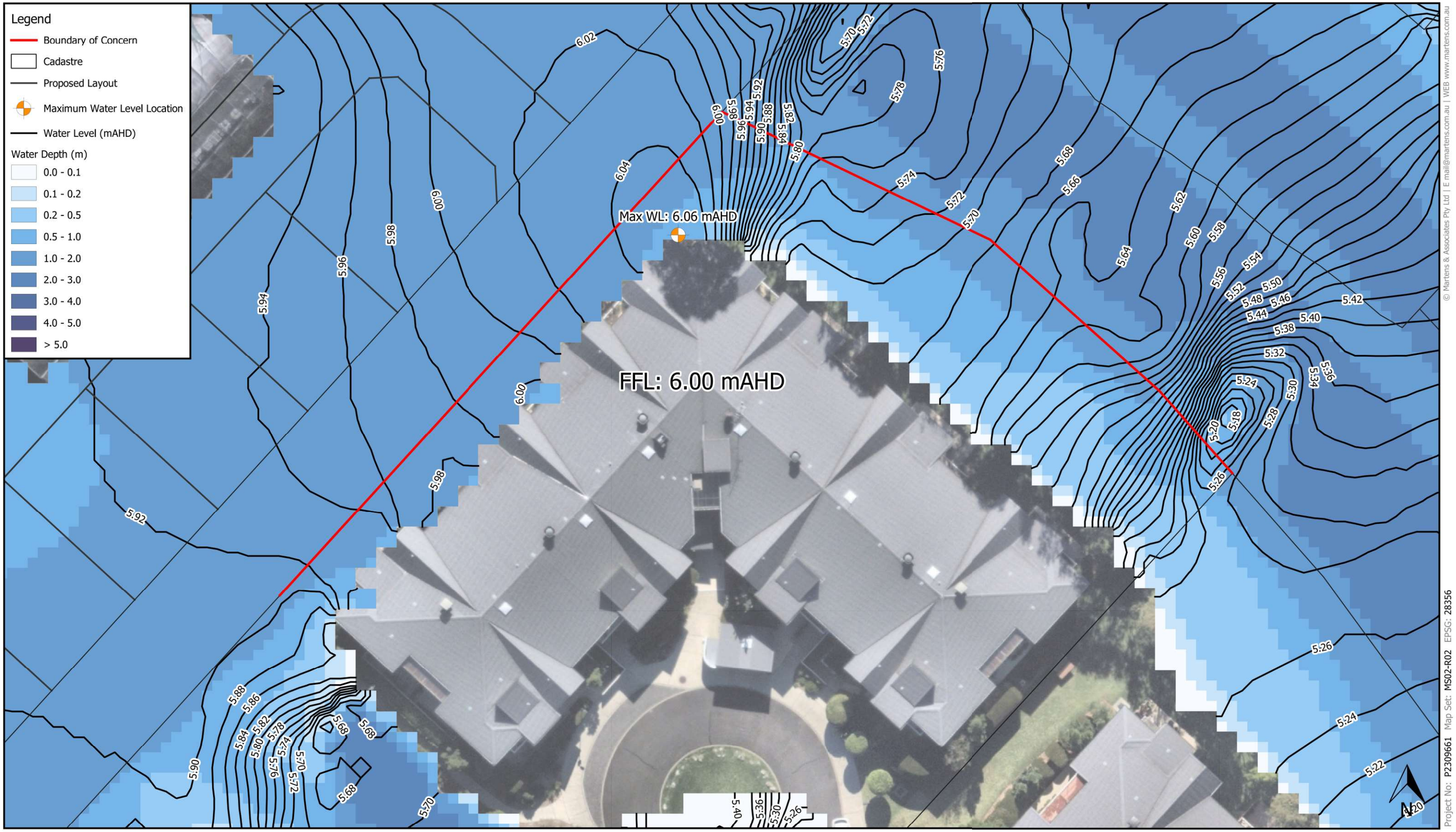
Map Title / Figure:

1% AEP +CC Proposed Conditions Maximum Water Level and Water Depth

Map 04	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS02-R02 EPSG: 28356



1:350 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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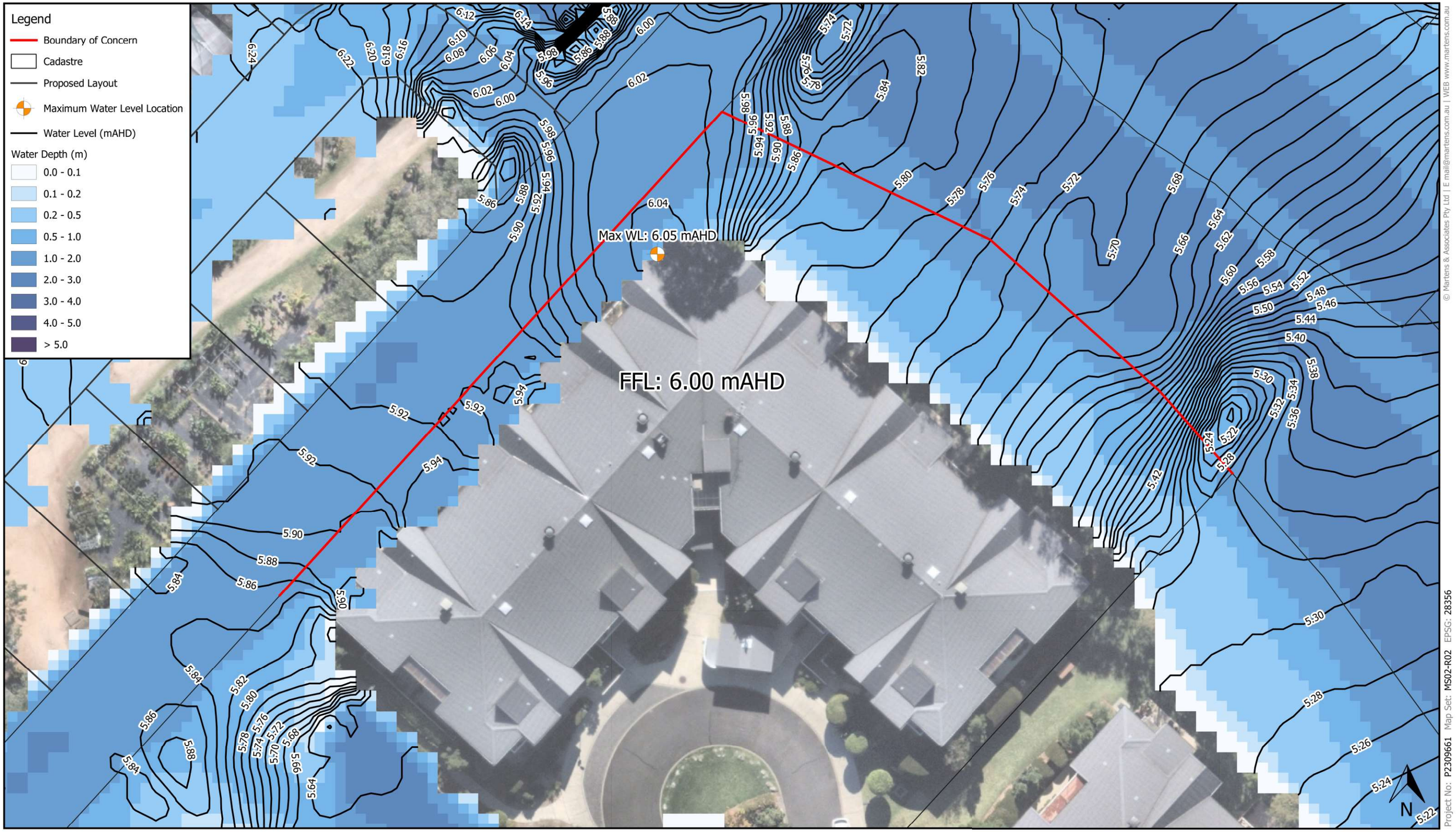
Map Title / Figure:

PMF Existing Conditions
Maximum Water Level and Water Depth

Map 05	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS02-R02 EPSG: 28356



0 4 8 12 16 20 m

1:350 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Map Title / Figure:

PMF Proposed Conditions
Maximum Water Level and Water Depth

Map 06	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS02-R02 EPSG: 28356

Legend

- Boundary of Concern
- Cadastre
- Proposed Layout
- Maximum Water Level Location
- Water Level (mAHD)

Water Depth (m)

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- > 5.0

Max WL: 6.30 mAHD

FFL: 6.00 mAHD

0 4 8 12 16 20 m

1:350 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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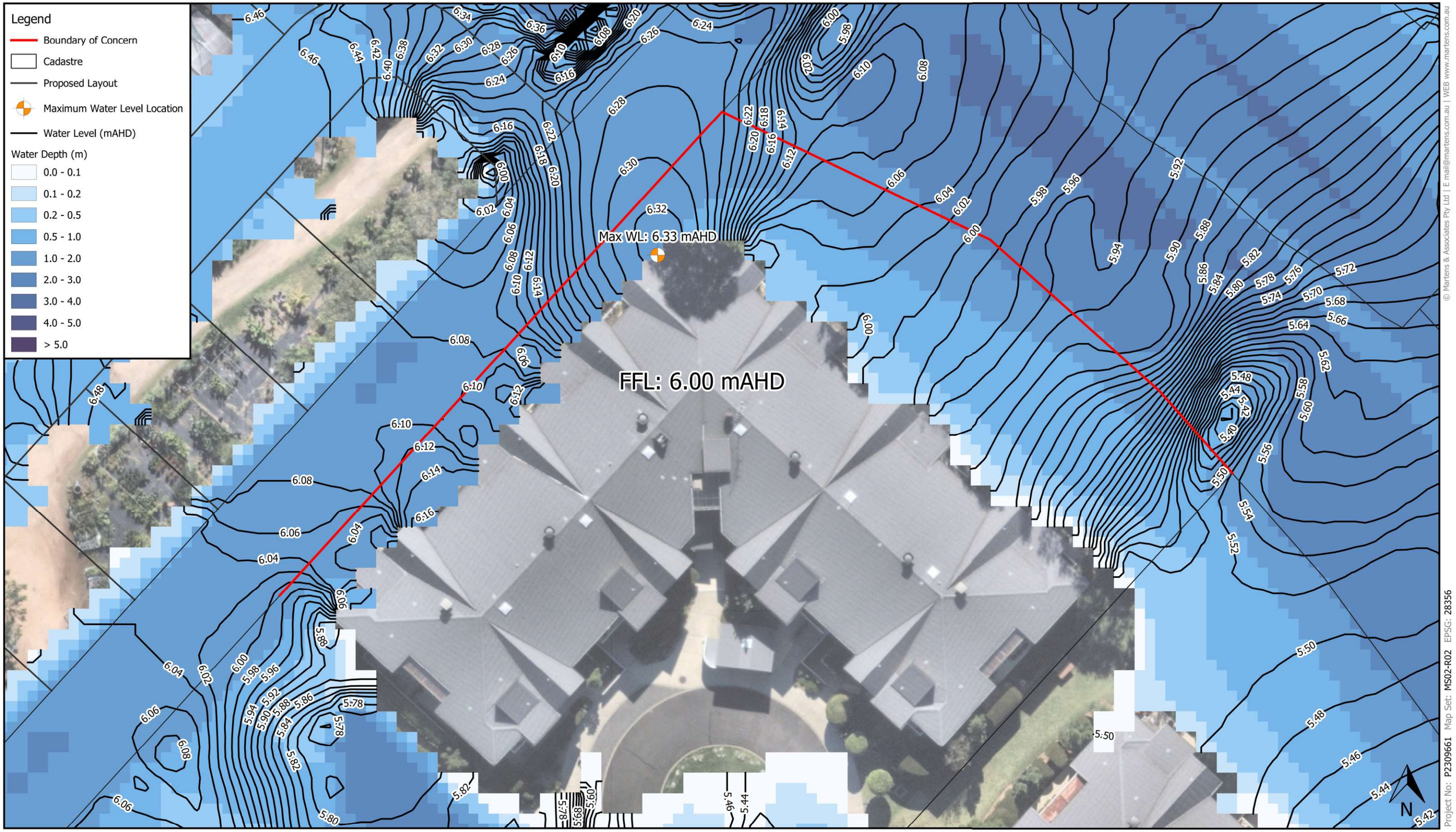
Project No: P2309661 Map Set: MS02-R02 EPSG: 28356

Map Title / Figure:

PMF +CC Existing Conditions
Maximum Water Level and Water Depth

Map 07	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date



0 4 8 12 16 20 m

1:350 @ A3

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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Map Title / Figure:

PMF +CC Proposed Conditions Maximum Water Level and Water Depth

Map 08	Map
16 Macpherson Street, Warriewood, NSW	Site
Flood Impact Analysis	Project
Flood Assessment	Sub-Project
Investment Projects Management	Client
01/07/2024	Date

Project No: P2309661 Map Set: MS02-R02 EPSG: 28356

Appendix D – Council Flood Certificate

FLOOD INFORMATION REPORT – COMPREHENSIVE

Property: 16 Macpherson Street WARRIEWOOD NSW 2102
Lot DP: Lot 4 DP 553816
Issue Date: 10/03/2022
Flood Study Reference: Ingleside, Elanora and Warriewood Overland Flow Flood Study 2019, WMAwater

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Flood Information for lot [1]:

Flood Risk Precinct – See Map A

Flood Planning Area – See Map A

Maximum Flood Planning Level (FPL) [2, 3, 4]: 6.28 m AHD

1% AEP Flood – See Flood Map B

1% AEP Maximum Water Level [2, 3]: 5.78 mAHD

1% AEP Maximum Depth from natural ground level[3]: 1.25 m

1% AEP Maximum Velocity: 1.69 m/s

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

Probable Maximum Flood (PMF) – See Flood Map C

PMF Maximum Water Level [4]: 6.20 m AHD

PMF Maximum Depth from natural ground level: 1.99 m

PMF Maximum Velocity: 3.03 m/s

PMF Hydraulic Categorisation: N/A **See Flood Map E**

Flooding with Climate Change (See Flood Map F)

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

1% AEP Maximum Water Level with Climate change [3]: 5.98 m AHD

1% AEP Maximum Depth with Climate Change[3]: 1.45 m

1% AEP Maximum Velocity with Climate Change[3]: NA

Flood Life Hazard Category – See Map G

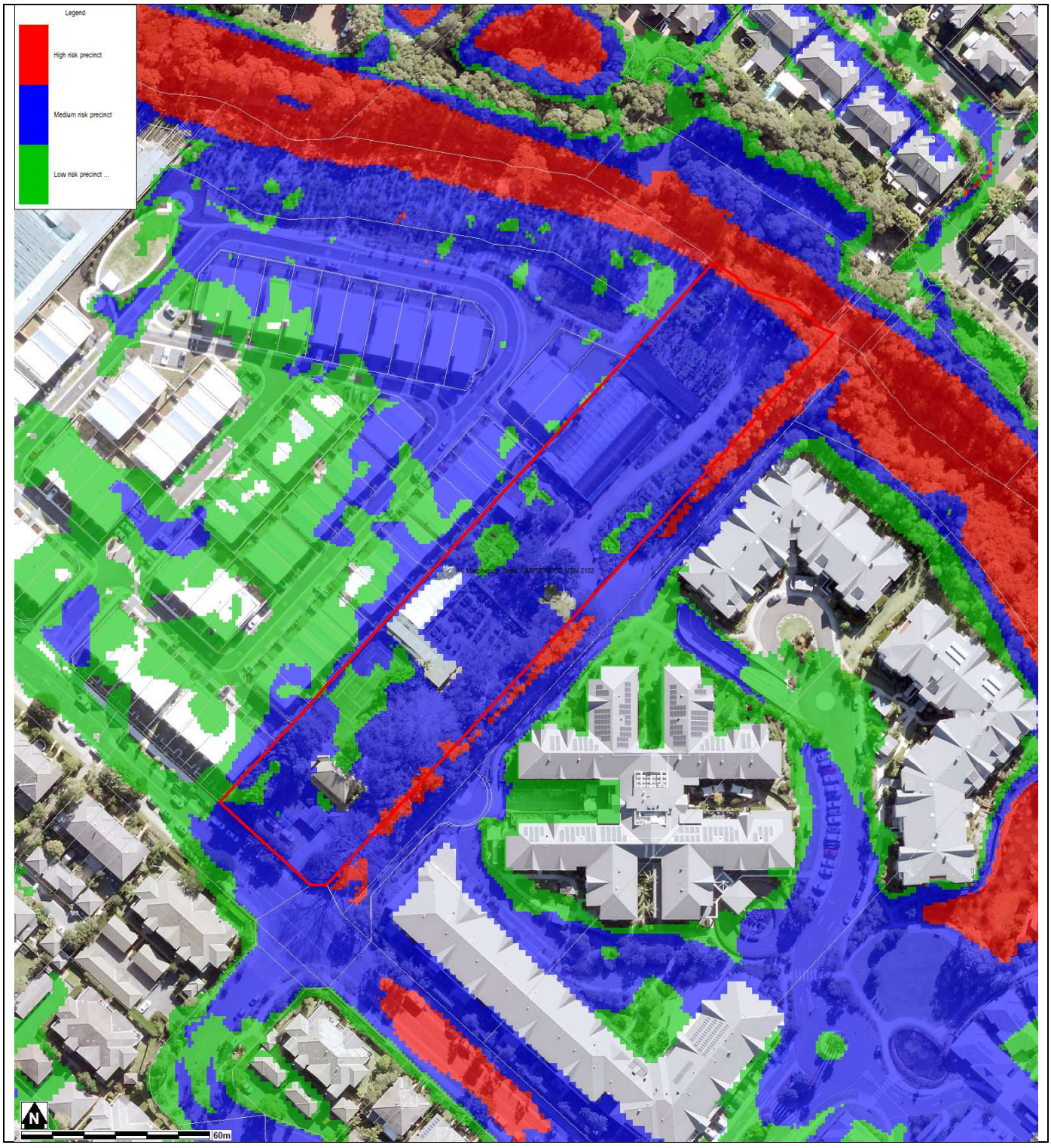
Indicative Ground Surface Spot Heights – See Map H

[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. 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.

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.

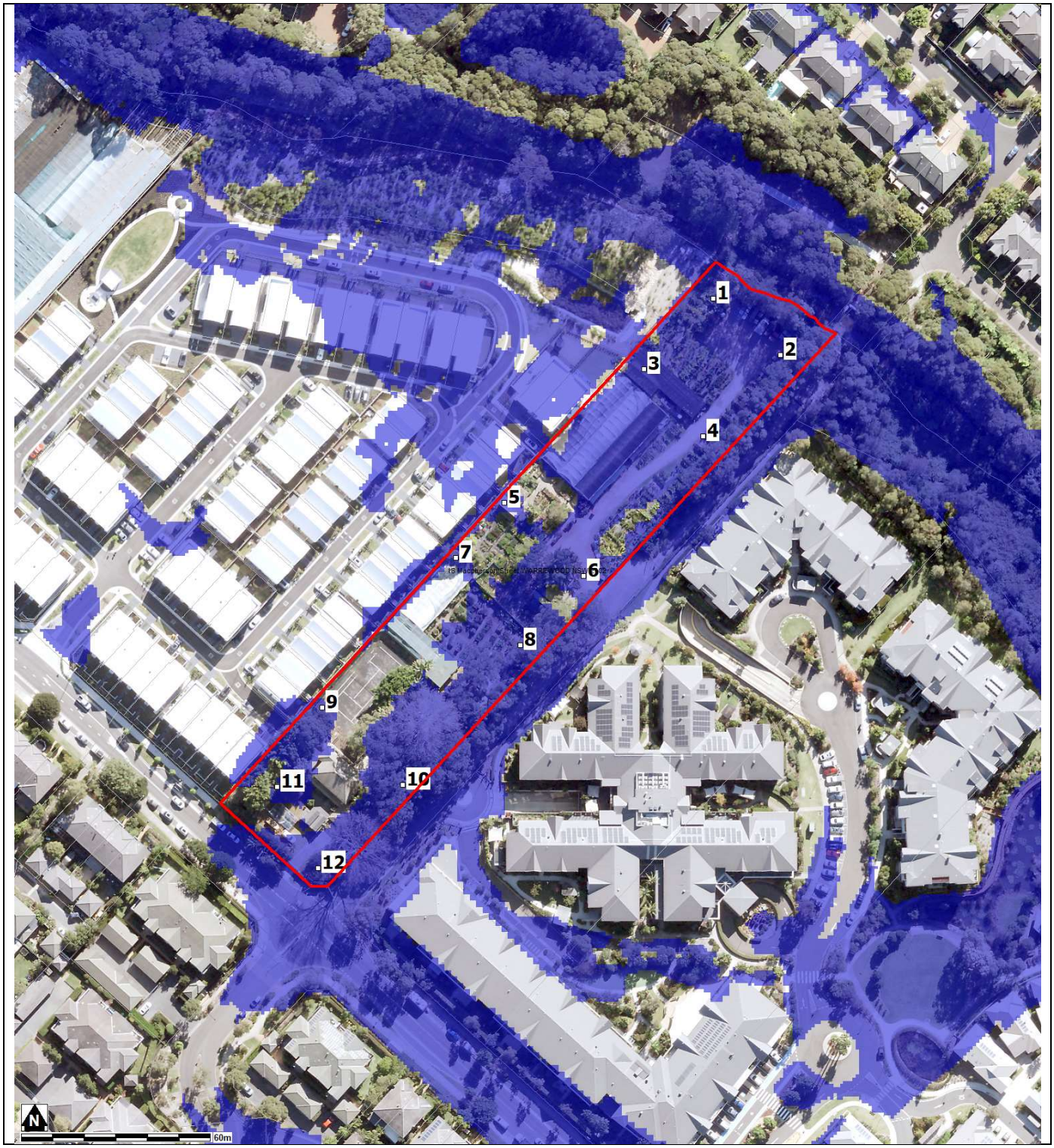
FLOOD MAP A: FLOOD RISK PRECINCT MAP



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 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.

FLOOD LEVEL POINTS



Note: Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Ingleside, Elanora and Warriewood Overland Flow Flood Study 2019, WMAwater) 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	4.99	0.16	5.29	0.49	0.75	5.79	6.01	1.21	1.21
2	4.58	0.06	5.17	0.55	0.89	5.67	5.91	1.29	1.33
3	5.20	0.20	5.30	0.30	1.02	5.80	6.02	1.02	1.18
4	4.62	0.04	5.25	0.63	0.44	5.75	6.01	1.39	0.65
5	N/A	N/A	5.78	0.18	0.91	6.28	6.05	0.50	1.52
6	5.12	0.27	5.26	0.41	0.40	5.76	5.99	1.14	0.68
7	5.55	0.21	5.63	0.28	0.47	6.13	6.11	0.76	1.18
8	5.13	0.43	5.27	0.57	0.13	5.77	5.97	1.28	0.52
9	5.39	0.23	5.41	0.25	0.21	5.91	5.97	0.80	0.72
10	5.13	0.69	5.27	0.82	0.10	5.77	5.92	1.48	0.63
11	N/A	N/A	N/A	N/A	N/A	5.88	5.91	0.68	0.69
12	5.13	0.32	5.27	0.46	0.15	5.77	5.90	1.09	0.35

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

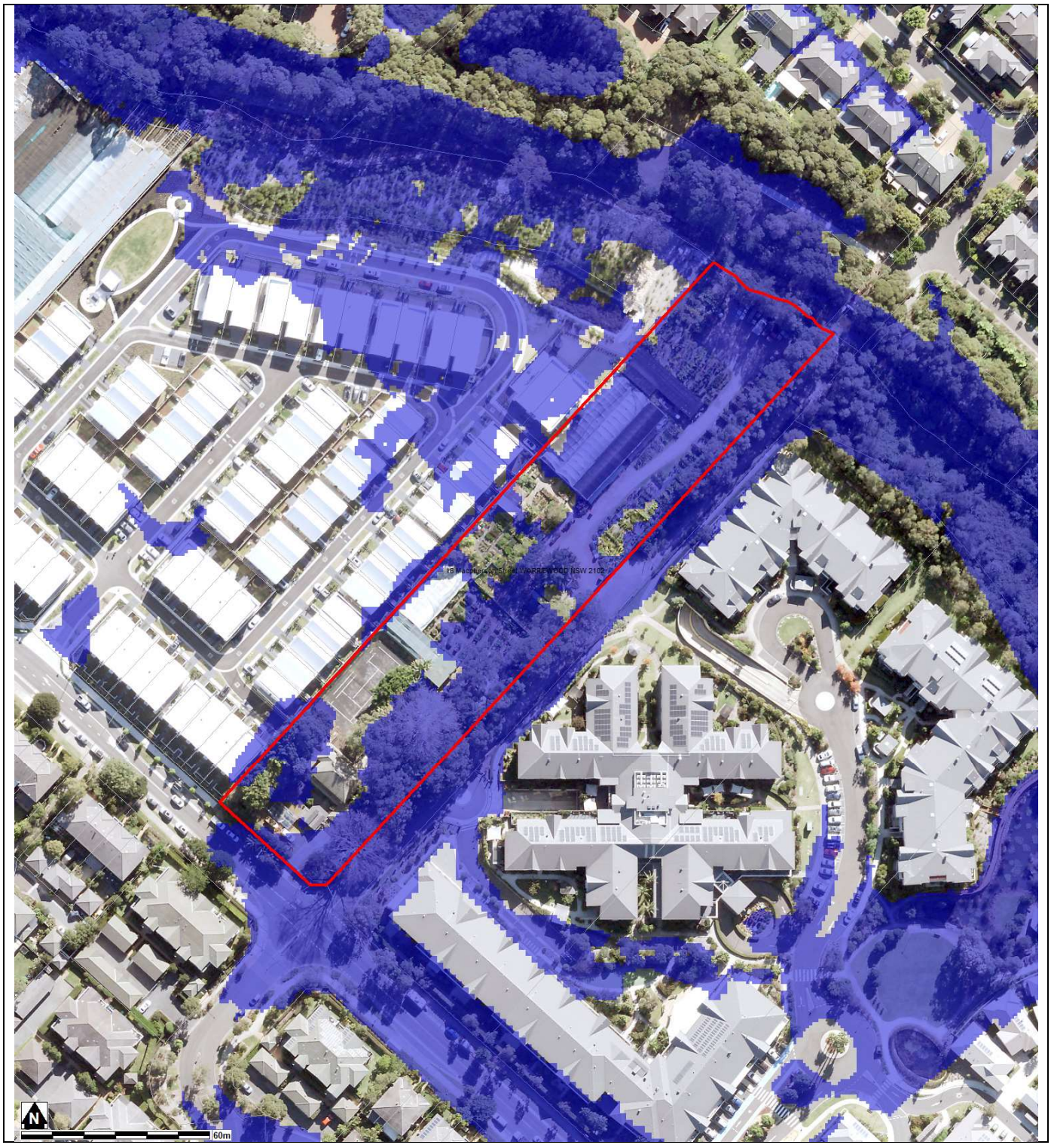
Climate Change Flood Levels (30% Rainfall intensity and 0.9m Sea Level Rise)

ID	CC 1% AEP Max WL (m AHD)	CC1 % AEP Max Depth (m)
1	5.49	0.69
2	5.37	0.75
3	5.5	0.5
4	5.45	0.83
5	5.98	0.38
6	5.46	0.61
7	5.83	0.48
8	5.47	0.77
9	5.61	0.45
10	5.47	1.02
11	5.44	0.2
12	5.47	0.66

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

A variable Flood Planning Level might apply. Freeboard is generally 0.5m above the maximum 1% AEP water level. However for overland flow with a depth less than 0.3m and a VelocityxDepth product less than 0.3m^2/s, a freeboard of 0.3m may be able to be justified.

FLOOD MAP B: FLOODING - 1% AEP EXTENT



Notes:

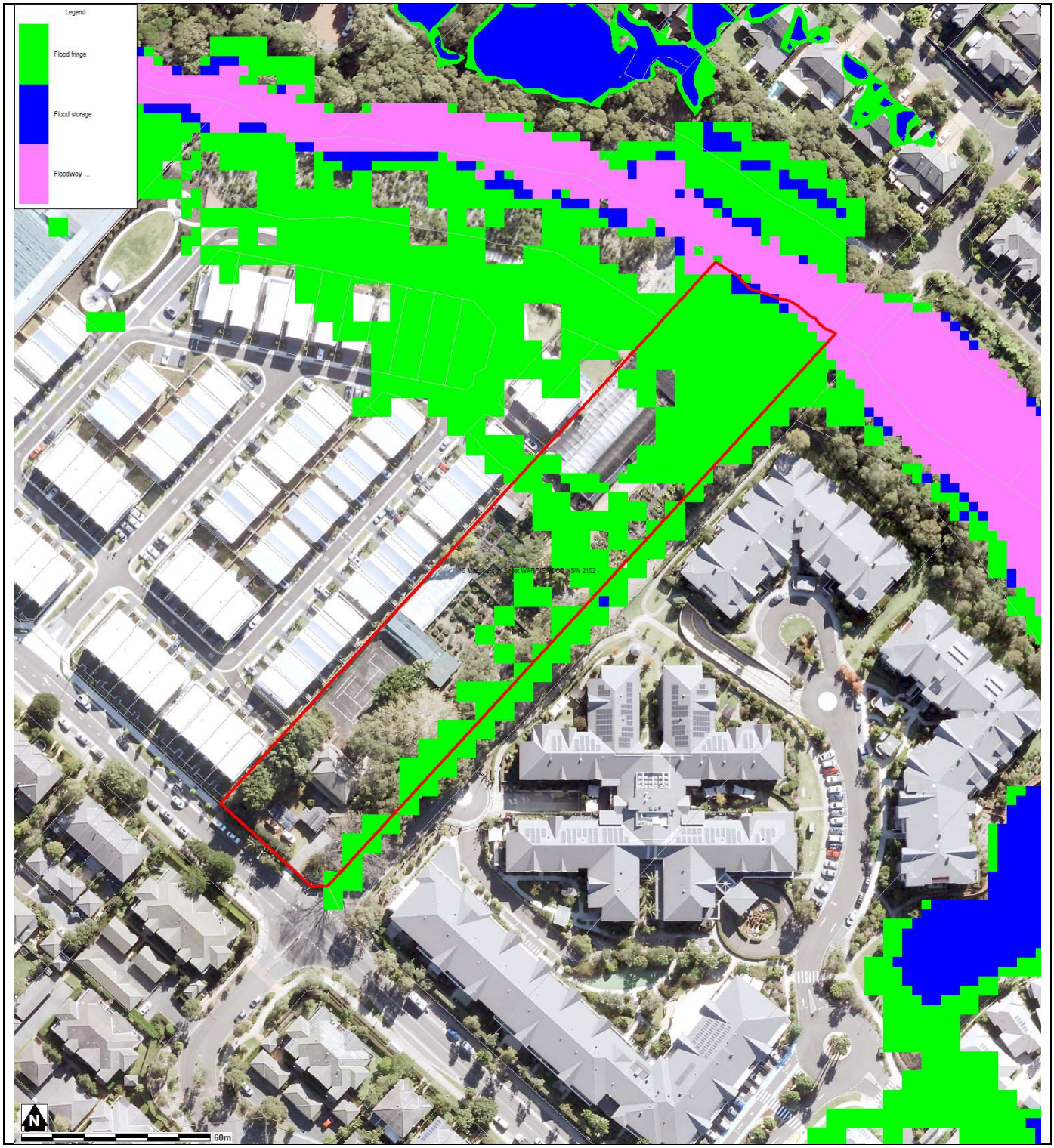
- Extent represents the 1% annual Exceedance Probability (AEP) flood event.
- Flood events exceeding the 1% AEP can occur on this site.
- Extent does not include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Ingleside, Elanora and Warriewood Overland Flow Flood Study 2019, WMAwater) and aerial photography (Source Near Map 2014) are indicative only.

FLOOD MAP C: 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: Ingleside, Elanora and Warriewood Overland Flow Flood Study 2019, WMAwater) and aerial photography (Source: NearMap 2014) are indicative only

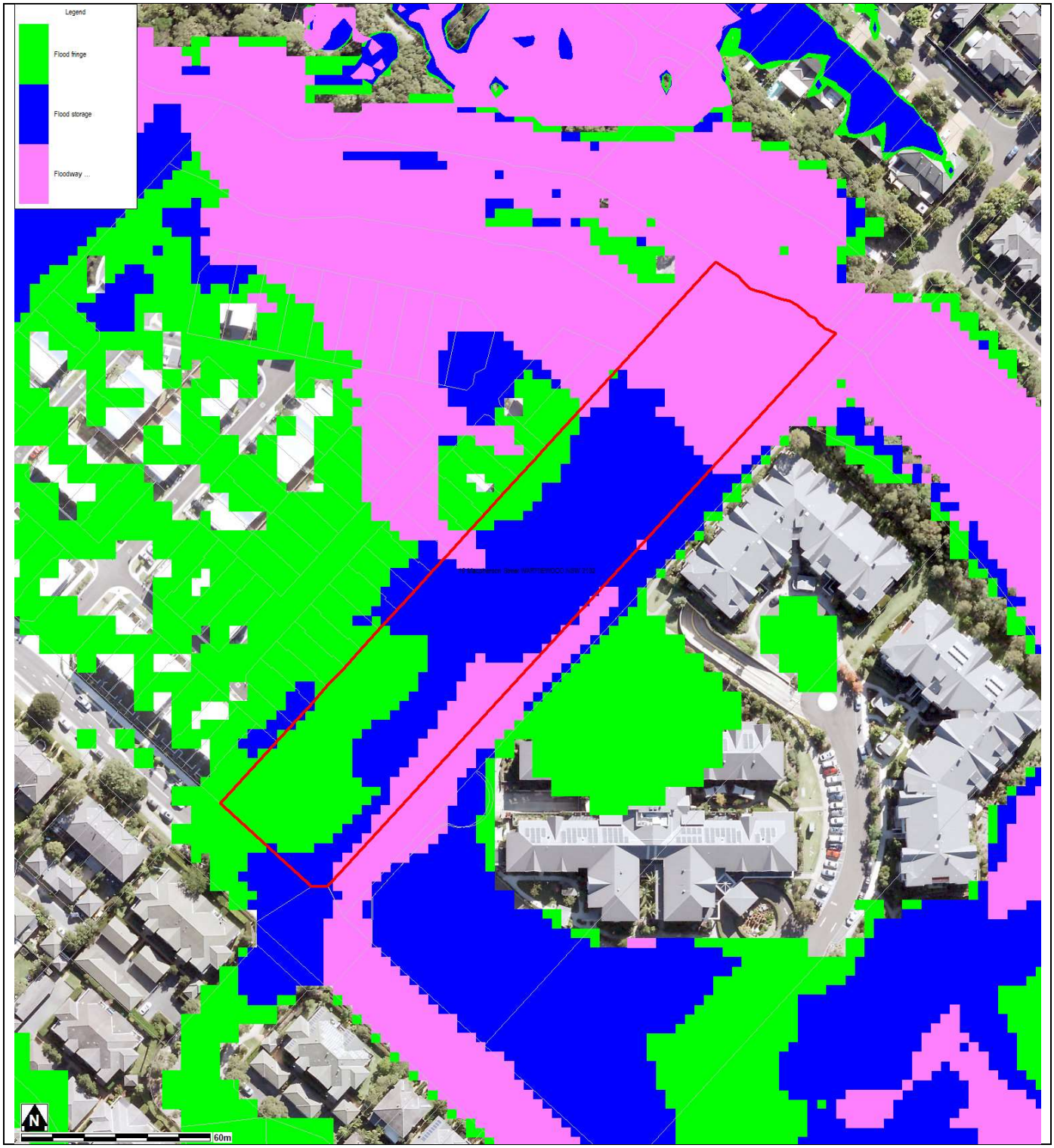
FLOOD MAP D: 1% AEP FLOOD HYDRAULIC CATEGORY EXTENT MAP



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: Ingleside, Elanora and Warriewood Overland Flow Flood Study 2019, WMAwater) and aerial photography (Source: NearMap 2014) are indicative only

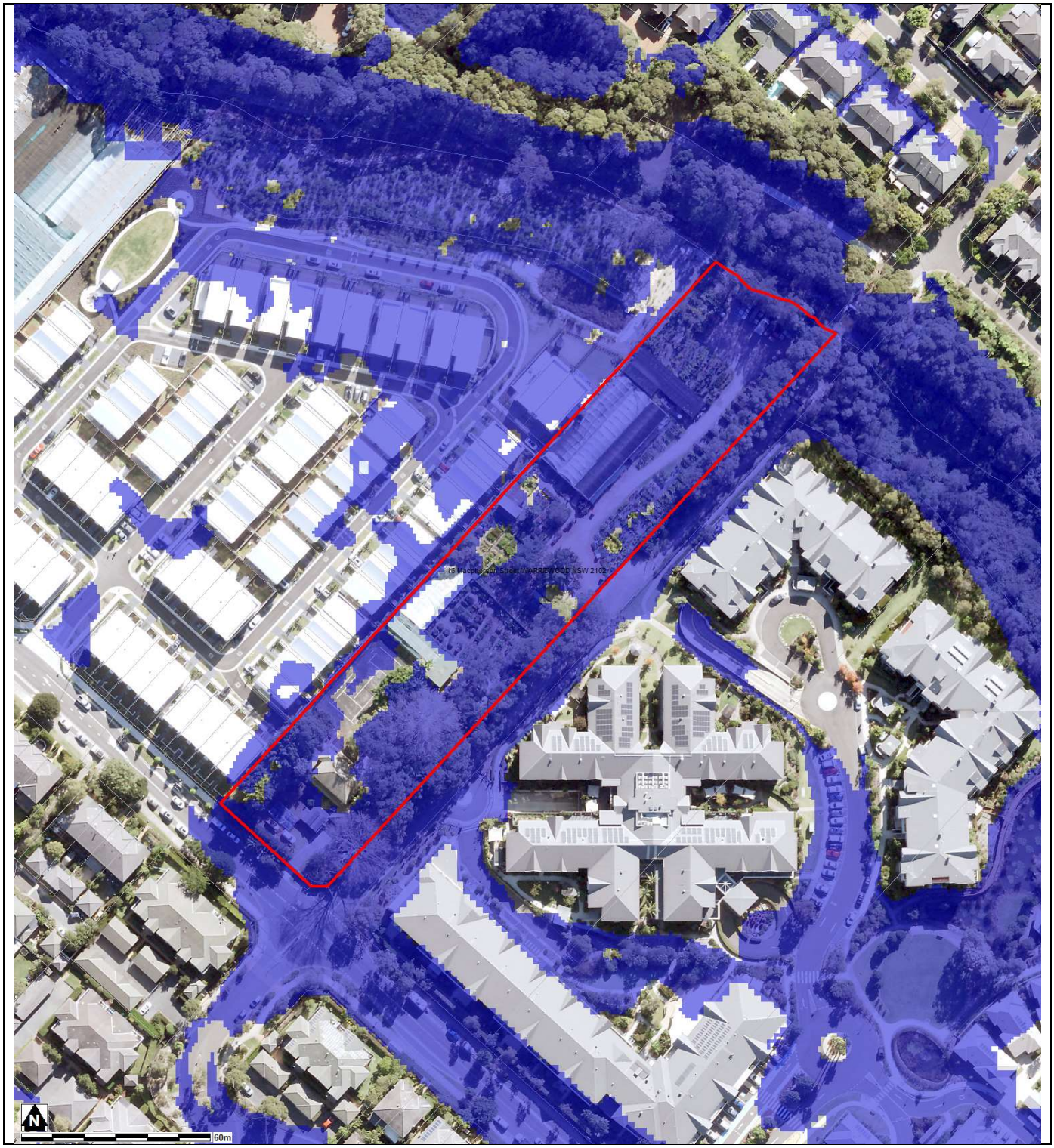
FLOOD MAP E: PMF FLOOD HYDRAULIC CATEGORY EXTENT MAP



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: Ingleside, Elanora and Warriewood Overland Flow Flood Study 2019, WMAwater) and aerial photography (Source: NearMap 2014) are indicative only

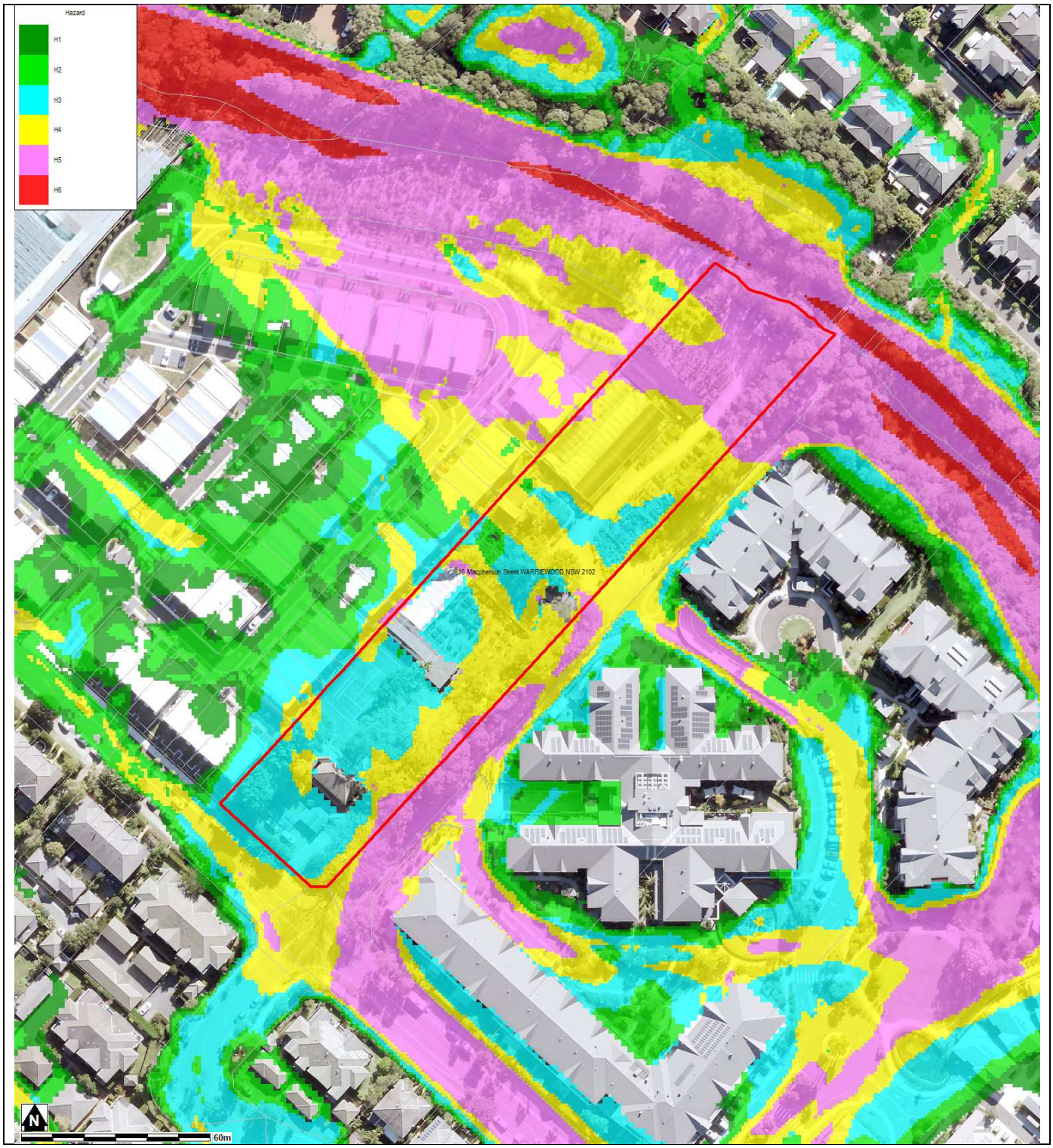
FLOOD MAP F: FLOODING – 1% AEP EXTENT PLUS CLIMATE CHANGE



Note:

- 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: Ingleside, Elanora and Warriewood Overland Flow Flood Study 2019, WMAwater) and aerial photography (Source: NearMap 2014) are indicative only

FLOOD MAP G: FLOOD LIFE HAZARD CATEGORY



Notes:

- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Ingleside, Elanora and Warriewood Overland Flow Flood Study 2019, WMAwater) and aerial photography (Source Near Map 2014) are indicative only.

MAP H: INDICATIVE GROUND SURFACE SPOT HEIGHTS


24
23
22


18
17
16
15
14

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.

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 .