AECOM Australia Pty Ltd
Gadigal Country
Level 21, 420 George Street
Sydney NSW 2000
PO Box Q410
QVB Post Office NSW 1230
Australia
www.aecom.com

+61 2 8008 1700 tel

ABN 20 093 846 925

10 October 2023

General Manager
iNTREC
73 Reserve Rd, Artarmon NSW 2064

Dear Sir/Madam

Stormwater Management Strategy 159-167 Darley Street West, Mona Vale

We understand that the Department of Planning and Environment (DPE) as part of their gateway decision on the planning proposal (PP) have requested that the PP '*address the most recent version of Ministerial direction 4.1 flooding*'[1].

In response to this request, AECOM has prepared this letter summarising the requirements of Ministerial Direction 4.1 as well as the references to where the Preliminary Flood Review (AECOM Ref. 60613516-CI-RPT-0002 revision 2 dated 4th of May 2021) aligns with these requirements. It is anticipated that further detailed technical analysis will be required as part of future development application(s) to refine the proposal and demonstrate that compliance has been achieved consistent with the preliminary strategy. Recommendations for future works are as noted in Section 2.8 of the Preliminary Flood Review.

We note that whilst DPE have requested an updated assessment of the PP against the current Local Planning Directions, we note that the Sydney North Region Planning Panel Record of Minutes states,

"*The Panel also noted that its site-specific merit included satisfaction of flooding constraints*".

Our previous report included in the PP demonstrates that the development can achieve improved flood outcomes, including an improvement in the safety profile of local floodwaters and a strategy that provides added benefit in reducing flood depths for neighbouring downstream properties.

Table 1. Summary of Ministerial Direction

Requirements of Ministerial Direction 4.1	Response
1) A planning proposal must include provisions that give effect to and are consistent with: a) the NSW Flood Prone Land Policy b) the principles of the Floodplain Development Manual 2005 c) the Considering flooding in land use planning guideline 2021, and d) any adopted flood study and/or floodplain risk management plan prepared in accordance with the principles of the Floodplain Development Manual 2005 and adopted by the relevant council.	The Preliminary Flood Review has not identified any issues that would preclude consistency with these Policies and Guidelines. Specifically, the proposed stormwater strategy as described in Section 2.2 of the Preliminary Flood Review can be further developed to be consistent with the NSW Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005. Section 2.2 of the report demonstrates a development option that can reduce the impact of overland flows and reduce the frequency of flooding on downstream properties resulting from the new development relative to existing conditions. The 'Considering flooding in land use planning guideline 2021' supports the principles of the manual and provides advice to councils on land use planning on flood-prone land. It provides councils with greater flexibility in defining the areas to which flood-related development controls apply, with consideration of defined flood events, freeboards, low-probability/high consequence flooding and emergency management considerations.

[1] https://www.planning.nsw.gov.au/sites/default/files/2023-03/local-planning-directions.pdf

Requirements of Ministerial Direction 4.1	Response
	The proposal addresses the guideline requirements in that the proposed development includes a Flood Planning Level at or above the PMF for each building. A refined flood model will be submitted as part of the future Development Application on the site. This refined flood model will address site-based earthworks, landscaping and inground stormwater infrastructure and manage onsite flows.
2) A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Conservation Zones to a Residential, Employment, Mixed Use, W4 Working Waterfront or Special Purpose Zones.	The site is currently not zoned Recreation, Rural, Special Purpose or Conservation. Therefore, this clause is not applicable to this development.
3) A planning proposal must not contain provisions that apply to the flood planning area which: a) permit development in floodway areas b) permit development that will result in significant flood impacts to other properties c) permit development for the purposes of residential accommodation in high hazard areas d) permit a significant increase in the development and/or dwelling density of that land, e) permit development for the purpose of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate, f) permit development to be carried out without development consent except for the purposes of exempt development or agriculture. Dams, drainage canals, levees, still require development consent, g) are likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities, or h) permit hazardous industries or hazardous storage establishments where hazardous materials cannot be effectively contained during the occurrence of a flood event.	a) The proposal seeks to provide betterment to downstream properties currently impacted by flooding by diverting the existing overland flow path through the new driveway access towards the existing public road. This grading will divert approximately 70% of arriving flows in the 1% AEP event through the private driveway towards Darley Street West. b) The proposal seeks to divert flow away from downstream properties, providing betterment to those properties immediately adjacent to the subject site. The reduction in flood depths (post development) for downstream properties at 6, 8 and 10 Kunari Place range from 0.05 to 0.15m in the 1% AEP event (as shown in Figure 6 of the report). c) The site is not defined as 'high hazard' in McCarrs Creek, Mona Vale and Bayview Flood Study (2017) d) Whilst the PP will increase the development and/or dwelling density of the land, it is not considered to be a 'significant increase' in the local context, and no structures are proposed within realigned overland flow path. e) The development does not propose these land use typologies. f) Development consent will be required once the land is rezoned. g) Proposed onsite stormwater management infrastructure will be delivered by the proponent and as such there will be no requirement for government spending on emergency management services, flood mitigation or emergency response measures. h) No hazardous industries or materials are proposed to be stored within the premises.
4) A planning proposal must not contain provisions that apply to areas between the flood planning area and probable maximum flood to which Special Flood Considerations apply which: a) permit development in floodway areas b) permit development that will result in significant flood impacts to other properties c) permit a significant increase in the dwelling density of that land, d) permit the development of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate;	The PP does not contain provisions that apply to areas between the flood planning area and PMF to which special flood considerations will apply. It should be specifically noted that: a) The proposal seeks to divert the existing overland flow path and manage the flood risk to the occupants through design measures. b) The proposal seeks to divert flow away from properties immediately adjacent to the Site. c) The proposal does not permit a significant increase in the dwelling density of flood affected areas of the site. In fact, the Flood Planning Level is above the PMF for all proposed buildings.

Requirements of Ministerial Direction 4.1	Response
e) are likely to affect the safe occupation of and efficient evacuation of the lot, or f) are likely to result in a significantly increased requirement for government spending on emergency management services, and flood mitigation and emergency response measures, which can include but not limited to road infrastructure, flood mitigation infrastructure and utilities.	d) The proposal does not include the listed development types and this clause is therefore not applicable to the development. e) Section 2.8 of the Preliminary Flood Review notes a shelter in place strategy is anticipated and will be further developed as part of a subsequent Development Application. f) Proposed onsite stormwater management infrastructure will be delivered by the proponent and as such there will be no requirement for government spending on emergency management services, flood mitigation or emergency response measures.
5) For the purposes of preparing a planning proposal, the flood planning area must be consistent with the principles of the Floodplain Development Manual 2005 or as otherwise determined by a Floodplain Risk Management Study or Plan adopted by the relevant council.	The existing flood planning areas considered in the report are consistent with McCarrs Creek, Mona Vale and Bayview Flood Study (2017) as adopted by Northern Beaches Council.

In AECOM's view the detailed design can be delivered to be consistent with the Ministerial Direction and has the opportunity to result in a beneficial outcome for flooding for the downstream lots at Kunari Place.

For any further questions please contact the undersigned.

Yours faithfully

Gijs Roeffen

Associate Director, Urban & Place, NSW/ACT
M +61 466 296 868

Gijs.Roeffen@aecom.com

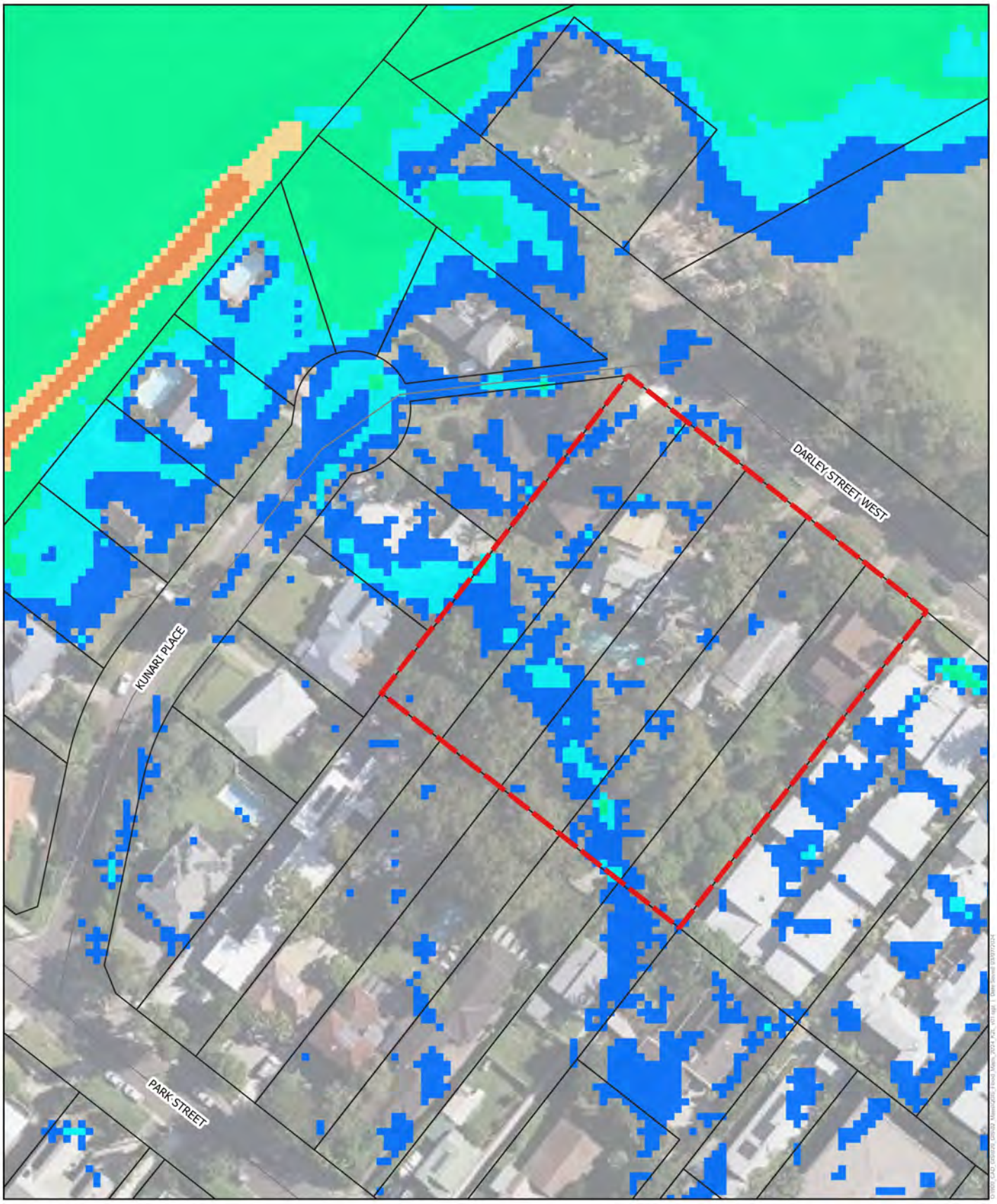

FIGURE 8: FLOOD HAZARD (1% AEP, 2HR)

Legend - Hazard

- Site Boundary
- Cadastre
- Roads

E01 - HAZARD

- H1 - No restrictions
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people or vehicles. Buildings require special engineering design and construction
- H6 - Not suitable for people, vehicles or buildings

AECOM

N 0 0.01 0.02 km

Source: Department of Finance, Service and Innovation 2018

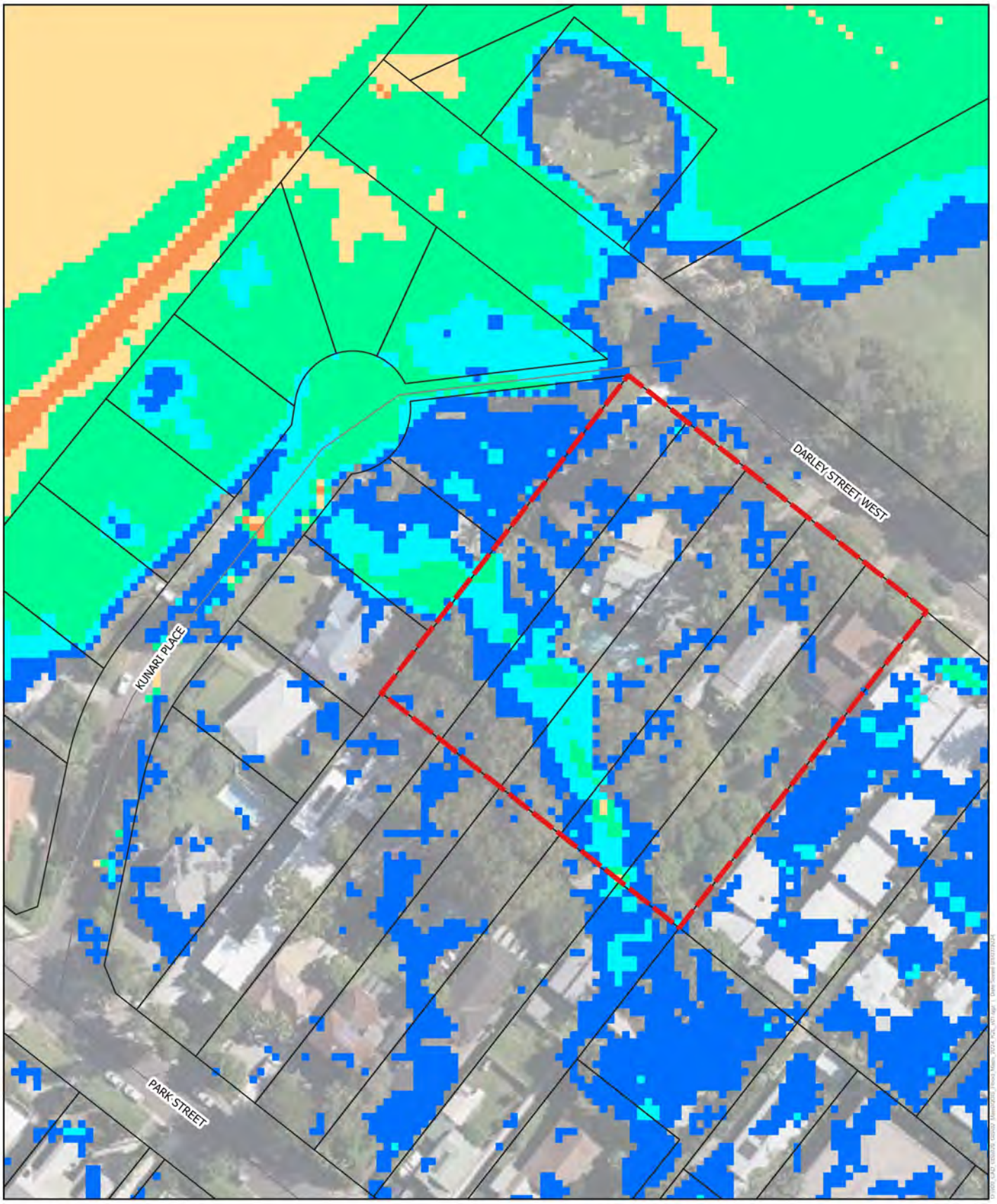

FIGURE 9: FLOOD HAZARD (PMF, 15 MIN)

AECOM

N 0 0.01 0.02 km

Legend - Hazard

Site Boundary
Cadastre
Roads

E01 - HAZARD
H1 - No restrictions
H2 - Unsafe for small vehicles
H3 - Unsafe for vehicles, children and the elderly
H4 - Unsafe for people and vehicles
H5 - Unsafe for people or vehicles. Buildings require special engineering design and construction
H6 - Not suitable for people, vehicles or buildings

Source: Department of Finance, Service and Innovation 2018

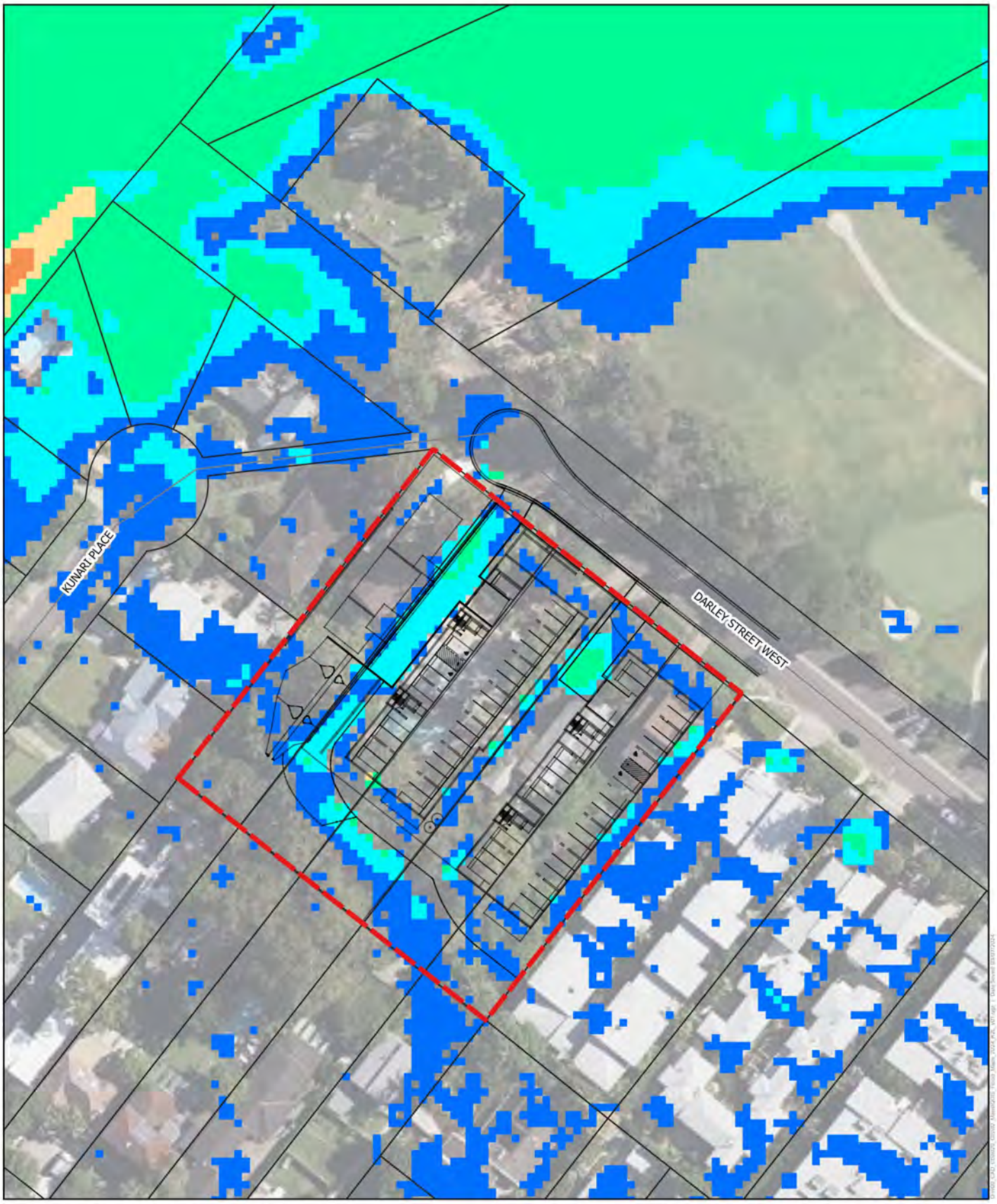

FIGURE 8: FLOOD HAZARD (1% AEP 2 HR, DESIGN D04)

AECOM

N 0 0.01 0.02 km

Legend - Hazard

Site Boundary
Cadastre
Roads

D04 - HAZARD
H1 - No restrictions
H2 - Unsafe for small vehicles
H3 - Unsafe for vehicles, children and the elderly
H4 - Unsafe for people and vehicles
H5 - Unsafe for people or vehicles. Buildings require special engineering design and construction
H6 - Not suitable for people, vehicles or buildings

Source: Department of Finance, Service and Innovation 2018

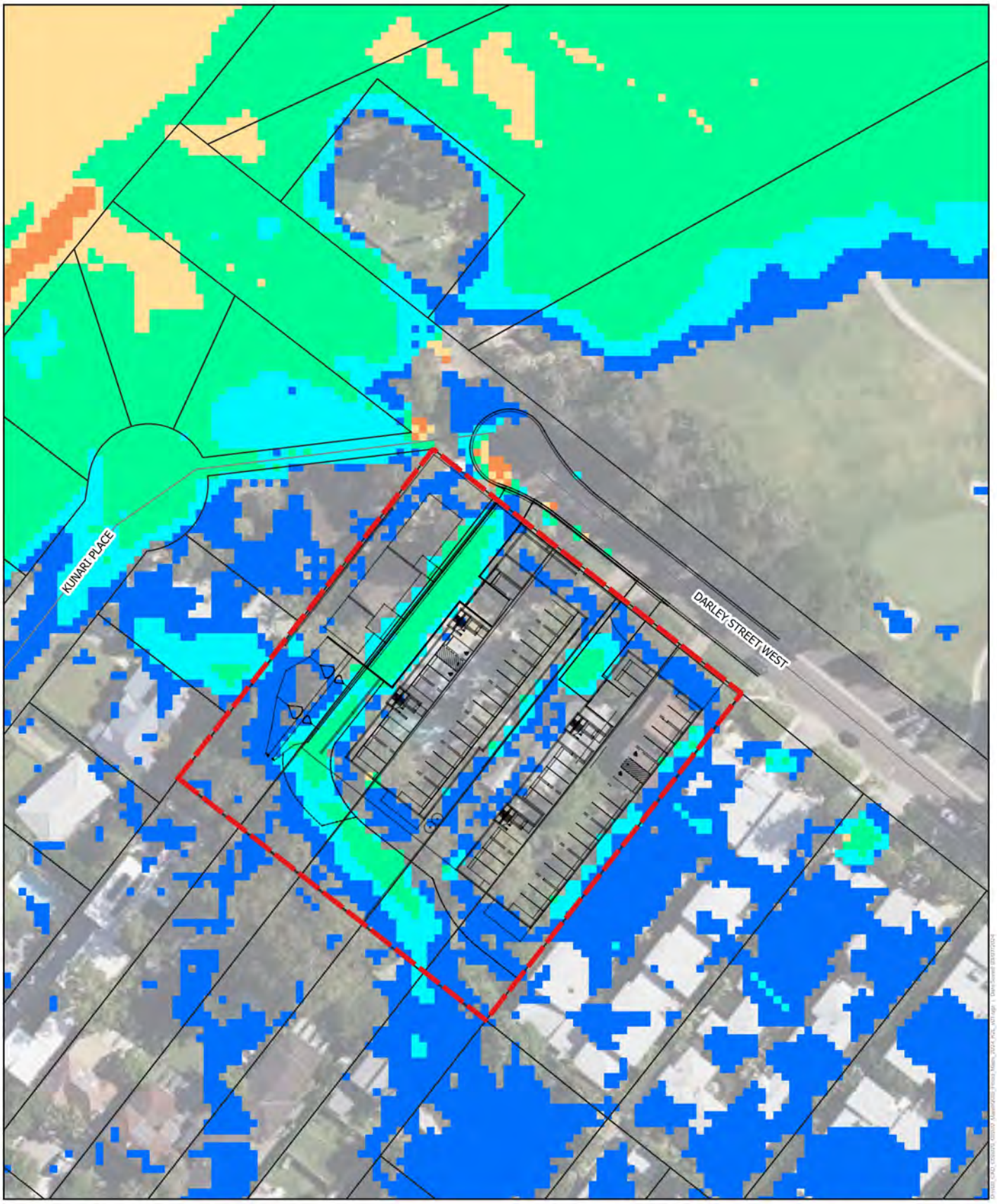

FIGURE 9: FLOOD HAZARD (PMF 15 MIN, DESIGN D04)

AECOM

N 0 0.01 0.02 km

Legend - Hazard

Site Boundary
Cadastre
Roads

D04 - HAZARD
H1 - No restrictions
H2 - Unsafe for small vehicles
H3 - Unsafe for vehicles, children and the elderly
H4 - Unsafe for people and vehicles
H5 - Unsafe for people or vehicles. Buildings require special engineering design and construction
H6 - Not suitable for people, vehicles or buildings

Source: Department of Finance, Service and Innovation 2018

iNTREC Management Pty Ltd

30-Jun-2021

159-167 DARLEY ROAD MONA VALE

STORMWATER MANAGEMENT STRATEGY

159-167 DARLEY ROAD MONA VALE

STORMWATER MANAGEMENT STRATEGY

Client: iNTREC Management Pty Ltd

ABN: 23 073 821 217

Prepared by

AECOM Australia Pty Ltd
Level 21, 420 George Street, Sydney NSW 2000, PO Box Q410, QVB Post Office NSW 1230, Australia
T +61 2 8934 0000 F +61 2 8934 0001 www.aecom.com
ABN 20 093 846 92520 093 846 92520 093 846 925

30-Jun-2021

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Date	30-Jun-2021
Prepared by	Benson Ou
Reviewed by	Gijs Roeffen

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
1	12-Apr-2021	Client Review	Nathan Mitchell Associate Director	
2	04-May-2021	Issue for Planning Submission	Nathan Mitchell Associate Director	
3	30-Jun-2021	Issue for Planning Submission	Gijs Roeffen Principal Civil Engineer	

Table of Contents

1.0 Executive Summary

iNTREC Management Pty Ltd (iNTREC) has an interest in 159-167 Darley Street in Mona Vale (the Site), located within Northern Beaches Council (NBC) Local Government Area (LGA). The existing lots are currently occupied by individual residential houses and iNTREC propose to develop the site to include a combination of townhouses apartment complexes.

According to the McCarrs Creek, Mona Vale and Bayview Flood Study (2017) completed by Royal Haskoning DHV on behalf of Northern Beaches Council (NBC), the Site is subject to flooding. Overland flow enters the Site from the upstream catchment in the south east.

The AECOM *Flooding Advice for 159-1678 Darley Street Mona Vale (20/08/2020)* memo complemented the above and recognised the existing surface runoff flowed through the subject properties and continued towards Kunari Place, subsequently inundating a number of lots including number 6, 8 and 10.

This Stormwater Management Strategy responds to the NBC Pre-lodgement Advice and incorporates a comprehensive Flood Assessment to support a proposal compliant with the Flood Prone Land 4.3 Direction of the Local Planning Directions under Section 9.1(2) of the Environmental Planning and Assessment Act 1979.

The Pre-lodgement Advice from Northern Beaches Council (appended to Appendix A, page 25 of the document, notes that: Council is supportive of opportunities to minimise flood risk to private property and divert this flow to Darley Street provided that it does not impact trafficability of roadway in flood events. The stormwater strategy is intended to support the above with the trafficability of Darley Street West in the Post-development scenario outlined in Section 2.4 of the report.

The flood assessment builds upon the modelling work done to date and incorporates additional 2D flood modelling of the existing and post-construction scenario flood regime for a range of design flood events up to and including the Probable Maximum Flood event. The model results are assessed for afflux mapping, flood regime, determination of flood planning level and minimum floor requirements for future development.

The proposed development looks to achieve a reduction of flood depths in the post-development scenarios for the 1% AEP and PMF for downstream properties 6, 8 and 10 Kunari Place ranging from 0.05 to 0.15m. This can be achieved by diverting approximately 70% of the peak 1% AEP flows arriving from the south east through a new shared access driveway.

The remaining flows continue draining towards Kunari Place. In response, proposed townhouse buildings (C, D, and E) have been elevated to a level equivalent to the 1% AEP plus 500mm freeboard associated with the diverted flows as defined in Table 4 of this report. The ground flood levels of both Building A and B are elevated above the existing overland flow paths and not impacted by local flood depths. This complements the flood planning requirements for developments of this nature within Northern Beaches Council LGA and is aligned with Pittwater LEP 2014 Clause 7.3.

The diverted flows arrive at Darley Street West and subsequently discharge overland towards the Mona Vale Golf course. The additional flows within Darley Street West will generally achieve flood depths and velocities that maintain the current flood risk hazard (low flood hazard category of H1-H2). The functionality of Darley Street West is therefore not compromised as a result of the development.

Further engagement with Northern Beaches Council is encouraged to discuss and further detail the proposed stormwater management strategy and any development conditions of consent prior to them being released.

2.0 Introduction and Background

iNTREC Management Pty Ltd (iNTREC) has an interest in 159-167 Darley Street in Mona Vale (the Site), located within Northern Beaches Council (NBC) Local Government Area (refer to Figure 1). The existing lots are currently occupied by individual residential houses and iNTREC propose to develop the site to include a combination of townhouses apartment complexes.

Figure 1 Locality Plan

AECOM has been engaged to provide civil engineering services in support of the development including a review of existing overland flows entering the property and development of an overland flow management strategy for the post-developed scenario.

iNTREC and AECOM have presented a preliminary review of existing flooding behaviours to Northern Beaches Council, both on site (dated 23/09/2020) as well as during a virtual planning meeting (dated 09/09/2020).

Feedback from NBC was presented in the Pre-Lodgement Advice letter (PLM2020/0199) included in Appendix A. This report aims to responds to the comments raised in support of a formal planning submission for the development.

It should be recognised that additional effort will be required during future development phases to provide details on the proposed stormwater management strategy and how this complements both the existing environment and built form. This effort would respond to additional coordination with NBC, the architect and landscape architect. Forward work is further discussed in Section 2.8.

2.1 Regional Flood Modelling

According to the McCarrs Creek, Mona Vale and Bayview Flood Study (2017) completed by Royal Haskoning DHV on behalf of NBC, the Site is subject to flooding. Overland flow enters the Site from the upstream catchment in the south east. The resulting flood waters are described by NBC as being of low and medium flood hazard categories during a range of storm magnitudes. The TUFLOW model provided by Council is understood to be aligned with the NBC Flood Hazard mapping adopted in 2019.

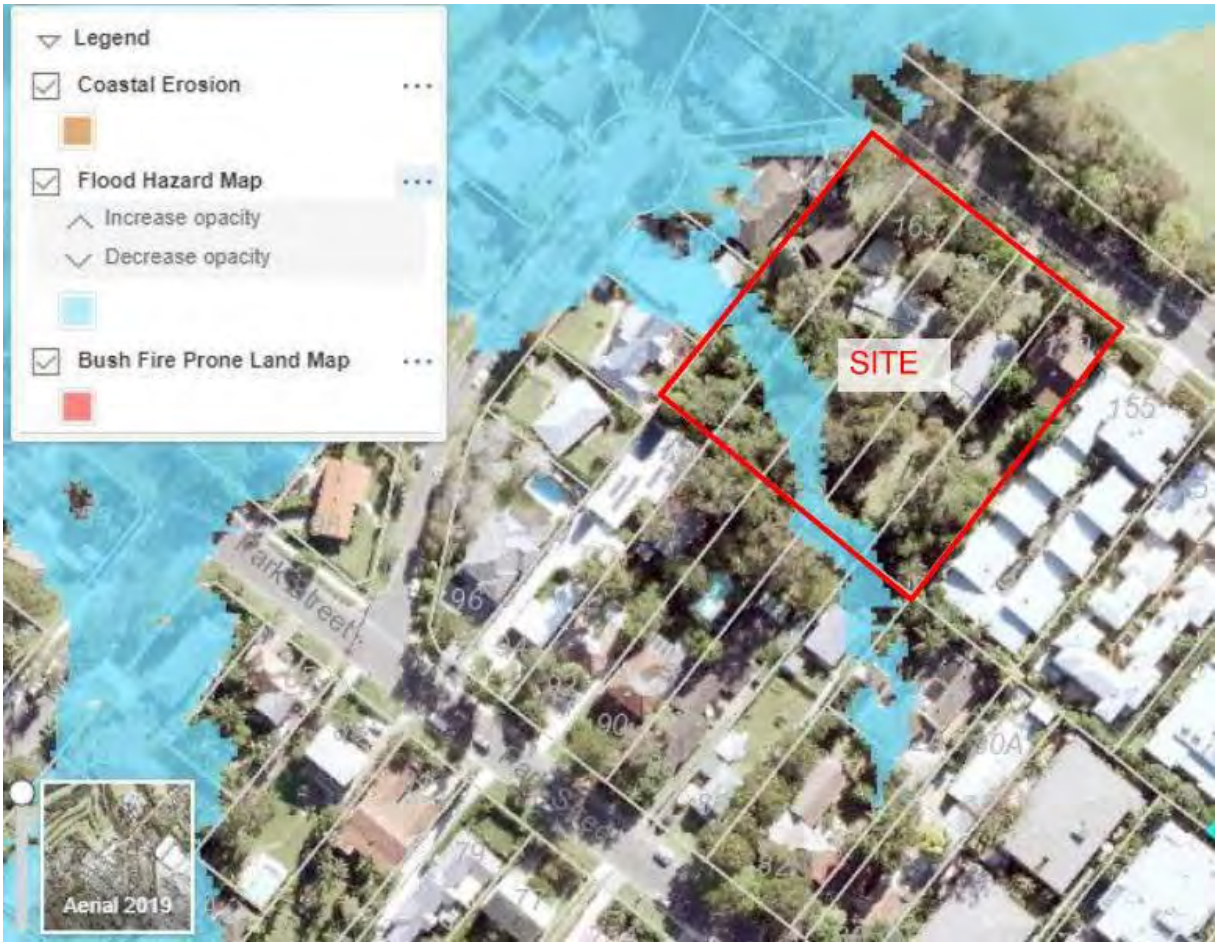

Figure 2 NBC Flood Hazard Mapping Adopted in 2019

The McCarrs Creek, Mona Vale and Bayview Flood Study (2017) was completed using TUFLOW software and adopted a combination of survey types including LiDAR data. While LiDAR data can provide a reasonable basis for defining catchment wide topography in the context of a regional flooding strategy, it does not have the granularity to assess individual sites where the change in topography can be abrupt. As such, AECOM have acquired a copy of the NBC flood model and have incorporated additional detailed site survey obtained by iNTREC to establish the existing base case scenario which better reflects the local site conditions.

The additional detailed site survey included property lots 163-165 Darley Street, and accessible sections towards the rear of property lots 159-161 and 167 Darley Street. The survey includes the key features of the overland flow path which influence and enable assessment of the behaviour of flood waters at this location.

A memorandum discussing the establishment of an existing scenario base case model and comparison to the supplied model is outlined in Memo by AECOM *Flooding Advice for 159-167 Darley Street, Mona Vale* (20/08/2020) attached in Appendix E.

2.2 Proposed Stormwater Strategy

The AECOM *Flooding Advice for 159-1678 Darley Street Mona Vale (20/08/2020)* memo recognised existing surface runoff flowed through the subject properties towards Kunari Place, subsequently inundating a number of lots including number 6, 8 and 10. Refer Figure 3.

Figure 3 Existing Overland Flow Path

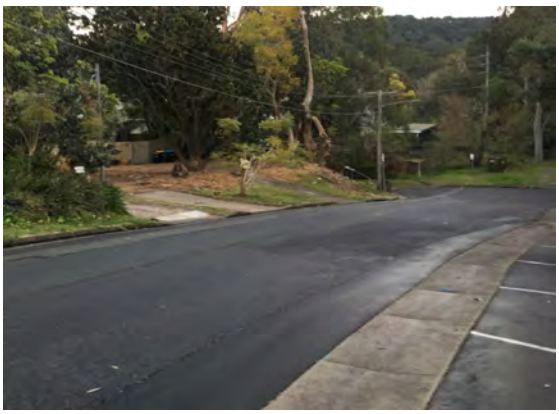

Figure 4 Existing Darley Street West

The proposed development presents an opportunity to not only reduce the impact of overland flows resulting from the new development, but also reduce the volume of overland flows entering downstream properties along Kunari Place relative to the existing conditions by safely diverting some surface runoff through a shared access driveway on the Site.

The proposed stormwater strategy adopted for the development therefore responds to this by combining:

- New in ground stormwater infrastructure connecting to existing NBC owned infrastructure in Darley Street West,
- A new overland flow path along a privately owned access driveway which services the proposed development, directing flows towards Darley Street West.
- Maintaining the existing overland flow path through number 6, 8 and 10 Kunari Place for larger magnitude storms.

To inform a future planning proposal, AECOM has developed preliminary site grading, and developed a flood model using the TUFLOW software to indicatively represent the post development scenario.

A simplistic DRAINS model has also been developed to demonstrate the potential impact on the existing Council owned drainage network, and it is proposed this be submitted to Council as part of a future detailed Development Application for the project.

The proposed stormwater strategy is illustrated in the drawings presented in Appendix B.

2.3 Preliminary Flood Risk Assessment

A preliminary flood risk assessment was undertaken to estimate the flood impacts and overland flow behaviour. The assessment then compared the existing conditions base case and proposed development scenarios.

2.3.1 Base Case Model

The base case TUFLOW model for this study has been updated with survey providing coverage of property lots 163-165 Darley Street, and sections towards the rear of property lots 159-161 and 167 Darley Street West.

A memorandum discussing the base case model is outlined in Memo by AECOM *Flooding Advice for 159-167 Darley Street, Mona Vale* (20/08/2020) attached in Appendix D. The memorandum includes details of critical storms, assumptions and parameters adopted in the flood modelling methodology.

Refer to Appendix C for flood maps illustrating the base case scenario flood depths, velocities and afflux.

2.3.2 Proposed Conditions Flood Model

The proposed conditions flood model has incorporated a three dimensional design surface developed using the 12D software which includes the following features which are generally presented in Figure 5:

- Local adjustment to the existing overland flow path to complement the proposed building and courtyard extents. Localised mounding is also included along the northern boundary fronting lots 6 and 8 Kunari Place.
- A new private access driveway which provides access to the new under croft parking area under building B as well as the new townhouses.
- Retaining walls to support the new mounding along the new townhouses in particular building E.
- Building Platforms to complement the architectural layout of the development.

Figure 5 Proposed Conditions Flood Model Development

2.3.3 Results Discussion

As requested in Council's Prelodgement Advice Letter, the post development scenario has been assessed for a range of storm durations including storm magnitudes up to and including the Probable Maximum Flood (PMF). The flood depth, velocity and afflux mapping for both the existing and proposed cases are included for PMF as well as the 1% Annual Exceedance Probability (AEP) in Appendix C and D respectively.

The proposed site grading diverts approximately 70% of the arriving flows in the 1% (AEP) event through the private access driveway towards Darley Street West. Some attenuation of the flows occurs along the private access driveway and this reduces the peak discharge estimated at the boundary ith Darley Street West. It should be noted that the flood modelling does not contemplate the proposed inground stormwater infrastructure and is therefore considered conservative.

Flow depths for the existing base case scenario within the existing overland flood path are generally less than 0.4m for the 1% AEP event, and less than 0.6m in the PMF event. Peak velocities within the Site were estimated to be 1.3 m/s in the 1% AEP event and up to 1.9 m/s in the PMF event.

Flow depths for the proposed development scenario in the same locations (within the overland flow path which has been locally adjusted) are generally less than 0.4m in the 1% AEP event and less than 0.7m in the PMF event. The observed increase in flow depth were attributed to diversion of the

overland flows along the new private access driveway and routing of floodwaters adjacent to the mounding. This increase in flood depth was limited to the subject site and no increase in flood depth was estimated in the upstream or adjacent properties.

With reference to Figure 6, Table 1 presents a summary of the estimated flow entering and exiting the site during the 1% AEP event for both the existing base case condition as well as the proposed.

Table 1. Flow Summary for the Site

Flow Boundary	Location	Flow Existing Base Case	Flow Proposed Case
Inflow	South-western boundary (Boundary 1 U.S.)	Total 0.8 m^3/s with approximately 0.5 m^3/s concentrated within the channel (Channel U.S.)	Total 0.8 m^3/s with approximately 0.5 m^3/s concentrated within the channel (Channel U.S.)
Inflow	South-east boundary (Boundary 2 U.S.)	0.3 m^3/s	0.3 m^3/s
Outflow	North-western boundary (Boundary D.S.)	Total 1.3 m^3/s with approximately 0.9 m^3/s concentrated within the channel (Channel D.S.)	0.8 m^3/s
Outflow	North-Eastern boundary (Darley D.S.)	≈ 0	0.5 m^3/s

The outflow along the north-western boundary fronting lots 6, 8 and 10 Kunari Place in the proposed case is mostly diverted towards Darley Street West. Some routing effects are observed through the new overland flow path which results in a minor reduction in total accumulated flow from the Site.

The diversion also presents flood results which demonstrate a reduction in flood depths in the post-development scenario for downstream properties 6, 8 and 10 Kunari Place ranging from 0.05 to 0.15m.

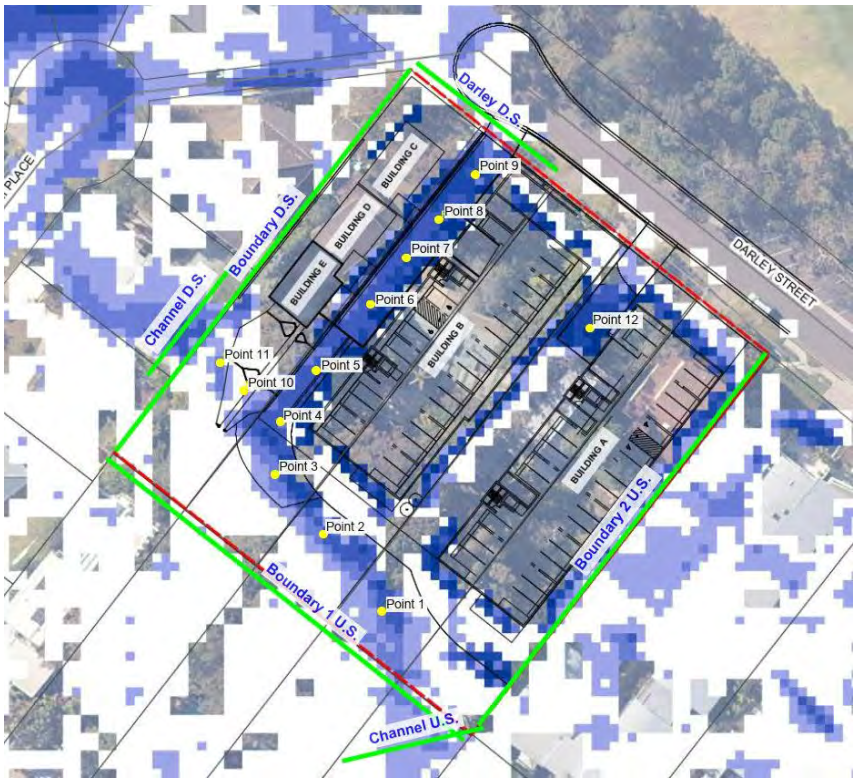

Figure 6 Sample Point Locations (1% Flood Depth Overlay)

Table 2 presents a summary of the flood depths and velocities estimated for the proposed conditions.

Table 2 Flood Depths and Velocities for the proposed conditions

Sample Point	1% AEP		PMF	
	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)
Point 1	0.29	0.40	0.55	0.64
Point 2	0.38	0.37	0.72	0.62
Point 3	0.21	0.55	0.46	0.90
Point 4	0.39	0.33	0.62	0.62
Point 5	0.46	0.37	0.63	0.56
Point 6	0.33	0.30	0.60	0.40
Point 7	0.53	0.25	0.78	0.37
Point 8	0.47	0.19	0.70	0.32
Point 9	0.49	0.23	0.66	0.40
Point 10	0.09	0.25	0.24	0.56
Point 11	0.22	0.35	0.35	0.70
Point 12	0.82	0.03	0.90	0.09

Additional flood maps for the existing and proposed conditions including flood depths, velocities and afflux are presented in Appendix C and D respectively. The maps illustrate changes to flood depths are contained within the proposed development Site.

2.3.3.1 Local Site Grading and Drainage

Local site grading of the private courtyards and external landscaped/paved areas to prevent nuisance ponding in these areas will be required as part of the future development phase scope. This includes the area along the north-east boundary (fronting 155 Darley Street West) as well as the open space between buildings A and B.

Further, the proposed flood modelling excludes 1D elements such as new grated inlet pits and stormwater pipes including those associated with the private aces driveway entrance to basement carpark under Building A (reference Point 12). This aims to represent a fully blocked pit and pipe drainage system.

The flood mapping suggests flooding of these areas, however the catchment associated with the driveway to Building A will be serviced by a new stormwater pit and drain to the existing stormwater system in Darley Street West. Therefor flooding of this location should not occur.

2.3.4 Afflux

Afflux mapping has been included as part of this preliminary flood risk assessment and included in Appendix D.

Increase in flood depths have generally been limited to the existing overland flow path contained within the proposed development lot. Exceptions include the north east boundary and Darley Street.

Reduction of flood depths in the post-development scenario is notable for downstream properties 6, 8 and 10 Kunari Place ranging from 0.05 to 0.15m.

At the north east boundary, 1% AEP afflux mapping alludes to impacts along the boundary of the upstream north-east boundary (fronting 155 Darley Street West) of up to 70 mm. However this is a resultant of the TUFLOW modelling approach which considers flows arriving from 155 Darley Street ponding against Building A which would be managed by the local drainage system.

A decrease in flood depth is estimated in some areas within the development site. This is a resultant of the proposed surface level being lowered and not a reflection of flood depths decreasing.

The afflux mapping also indicates an increase in flood depths on Darley Street West and the reserve to the north adjacent to the golf course where additional overland flows have been directed in the proposed case. The increase in flood depths at this location are in the order of 40mm. Further reference should be made to the **Figure 7** and **Figure 8** below for flood depths at this location which are tabulated in Table 3

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Figure 7 Existing Flood Depths on Darley Street

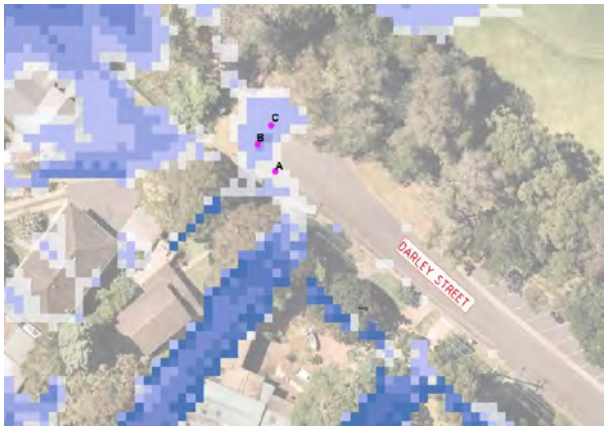

Figure 8 Proposed Flood Depths on Darley Street

Table 3 Darley Street West Flooding

Sample Point	Existing Base Case	Proposed
Depths (m)		
Point A	0.04	0.07
Point B	0.19	0.22
Point C	0.16	0.20
Velocity (m/sec)		
Point A	0.51	1.85
Point B	0.15	0.80
Point C	0.16	0.55

2.4 Trafficability of Darley Street West Post Development

The flood model results demonstrate that the proposed development will generally achieve flood depths and velocities that subsequently maintain the current flood risk hazard within Darley Street West. With reference to the Combined Flood Hazard curves and the flood classifications within ARR2019 (extract included in Figure 9), the depth and velocity estimates for the existing and proposed conditions generally carry a low flood hazard category of H1-H2 in both the existing and proposed cases.

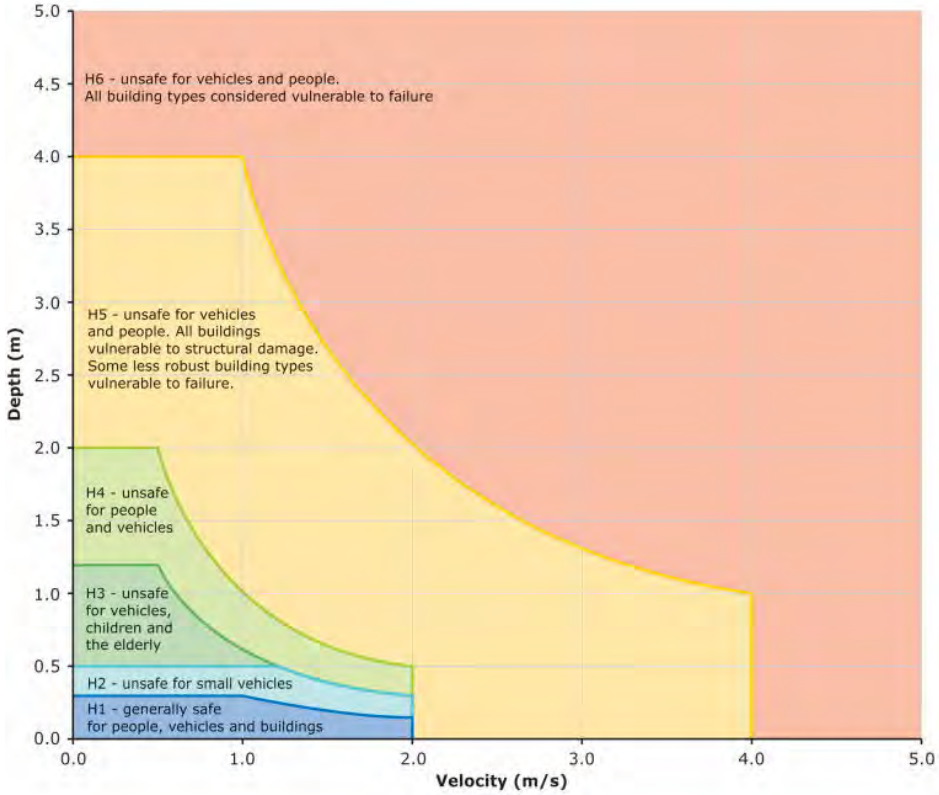

Figure 9 Combined Flood Hazard Curves

(Source Figure 6.7.9 ARR 2019)

Given the above, the increase in flood depths on Darley Street West represent a low risk at this location, and do not reduce the functionality of the existing road.

2.5 Blockage Considerations

The flood modelling approach adopted as part of this preliminary flood risk assessment assumes the local drainage infrastructure is fully blocked i.e. the proposed internal piped drainage system does not contribute and the benefits of 1D elements are not realised in the determination of flood depths. Incorporating the 1D elements into the flood modelling (even allowing for these to be partial blocked) will likely result in reduced flood depths both along the proposed overland flow path and private access road, as well as Darley Road West.

It is recommended that further consultation with Council be undertaken to identify opportunities for considering these 1D elements and/or amplifying the downstream network which may result in additional benefits to the broader catchment in this regard.

2.6 Flood Planning Requirements

As the Site is identified under the Pittwater region of the Northern Beaches Council, the flood controls as referenced in B3.11 Flood Prone Land of Pittwater 21 Development Control Plan apply. The Site is considered to be of low and medium flood risk and of residential use in the Flood Development Control Matrix.

Flood controls which apply to the development have been addressed in this planning proposal submission, demonstrating no adverse impacts on flood levels or velocities on surrounding properties up to the 1% AEP event.

Flood Planning Levels (FPL) have been nominated for habitable and non-habitable spaces local to the proposed overland flow route. These are generally listed in Table 4 with reference to the adjacent flood levels and adopted flood planning requirements:

Table 4 Preliminary Flood Planning Levels

Building Reference	FPL (mAHD)	Flood Level (mAHD)	Adopted Flood Planning Criteria and reference point
Building B Under croft Carpark	4.64	1% AEP = 4.41 PMF = 4.64	PMF Point 8
Building E	5.14	1% AEP = 4.64 PMF = 4.92	1% AEP + 0.5m Point 5
Building D	5.13	1% AEP = 4.63 PMF = 4.88	1% AEP + 0.5m Point 6
Building C	4.91	1% AEP = 4.41 PMF = 4.64	1% AEP + 0.5m Point 8
Building B Ground Floor	The ground flood levels of both Building A and B are elevated above the existing overland flow paths and not impacted by local flood depths.		
Building A Ground Floor			

While the architectural layout of Building B includes undercover parking, the proposed arrangement does not resemble a traditional basement that would otherwise retain water if submerged by flood waters. Should flooding occur on the site, flood waters up to the PMF would not enter the undercover parking area. Hence the FPL for the undercover parking area has been proposed at the PMF.

2.7 Consistency of the proposal with Section 9.1 Direction 4.3 Flood Prone Land

The Planning Circular (NSW Government Department of Planning, 2007) details the “new guideline and changes to the section 117 direction and EP&A Regulation on flood prone land”. The relevance of this document will be to ensure that the flood planning level (FPL) criteria is met for the proposed development.

As the Site is predominantly affected by mainstream flooding, it can be expected that the 1% AEP plus 0.5m to relevant residential finished floor levels shall be adopted as the residential Flood Planning Level as per **Table 4**.

We have provided a table of responses to the directions regarding flood prone land in **Table 5**.

Table 5 Darley Street West Flooding

Reference	Direction	Response
4.3 (4)	A planning proposal must include provisions that give effect to and are consistent with the NSW Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005 (including the Guideline on Development Controls on Low Flood Risk Areas).	The proposed stormwater strategy as described in section 2.2 of this report gives effect to and is consistent with the NSW Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005 by demonstrating a development option that can reduce the impact of overland flows resulting from the new development and reduce the frequency of flooding to downstream properties relative to existing conditions.
4.3 (5)	A planning proposal must not rezone land within the flood planning areas from Special Use, Special Purpose, Recreation, Rural or Environmental Protection Zones to a Residential, Business, Industrial, Special Use or Special Purpose Zone	This direction does not apply as the land is zoned as R2 in the existing condition.

4.3 (6a)	A planning proposal must not contain provisions that apply to the flood planning areas which permit development in floodway areas	The strategy as set out in Section 2.2 of this does not propose development of dwellings in overland flowpaths up-to the 1% AEP event in the post developed scenario.
4.3 (6b)	A planning proposal must not contain provisions that apply to the flood planning areas which permit development that will result in significant flood impacts to other properties	Local adjustment of the overland flow paths as set out section 2.3.2 of this are modelled to reduce the impact of overland flows on downstream properties (relative to existing conditions) up to the 1% AEP event. Furthermore, Pre-lodgement Advice from Northern Beaches Council (appended to Appendix A, page 25 of the document, notes that: Council is supportive of opportunities to minimise flood risk to private property and divert this flow to Darley Street provided that it does not impact trafficability of roadway in flood events. The stormwater strategy is intended to support the above with the trafficability of Darley Street West in the Post development scenario outlined in Section 2.4 of this report.
4.3 (6c)	A planning proposal must not contain provisions that apply to the flood planning areas which permit a significant increase in the development of that land	The Planning Proposal does not seek to amend the FSR or height controls for the site to permit a significant increase in the development of the site. The rezoning proposal does not change the potential developable area of the site. The proposed development scenario addresses the flooding risks and includes suitable solutions. The development scenario will not affect surrounding areas in terms of flooding. It will provide benefit in reducing the depths of floodwater in storm events for 6, 8 and 10 Kunari Place (neighbouring downstream).
4.3 (6d)	A planning proposal must not contain provisions that apply to the flood planning areas which are likely to result in a substantially increased requirement for government spending on flood mitigation measures, infrastructure or services	Proposed Flood planning Levels as set out in Section 2.6 of this report consider the modelled post-development flood scenario. The development scenario does not require government spending on flood mitigation measures. The proposed design safely diverts approximately 70% of the peak 1% AEP flows arriving from the south east through a new shared access driveway. The remaining flows continue draining towards Kunari Place.
4.3 (6e)	A planning proposal must not contain provisions that apply to the flood planning areas which permit development to be carried out without development consent except for the purposes of agriculture (not including dams, drainage canals, levees, buildings or structures in floodways or high hazard areas), roads or exempt development.	The strategy as set out in Section 2.2 this report do not propose development of dwellings in overland flowpaths up-to the 1% AEP event in the post developed scenario. Development without consent is not proposed.
4.3 (7)	A planning proposal must not impose flood related development controls above the residential flood planning level for residential development on land, unless a relevant planning authority provides adequate justification for those controls to the satisfaction of the Director-General (or an officer of the Department nominated by the Director-General).	Proposed Flood planning Levels as set out in Section 2.6 of this report are aligned with Section B3.11 (Flood Prone Land) of Pittwater 21 DCP. No changes are proposed to clause 7.3 of Pittwater LEP 2014.
4.3 (8)	For the purposes of a planning proposal, a relevant planning authority must not determine a flood planning level that is inconsistent with the Floodplain Development Manual 2005 (including the Guideline on Development Controls on Low Flood Risk Areas) unless a relevant planning authority provides adequate justification for the proposed departure from that Manual to the satisfaction of the Director-General (or an officer of the Department nominated by the Director-General).	The proposed stormwater strategy as described in section 2.2 of this report gives effect to and is consistent with the NSW Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005 by demonstrating a development option that can reduce the impact of overland flows resulting from the new development and reducing the frequency of downstream properties relative to existing conditions. As noted above, this report confirms that the 1% AEP plus 0.5m to relevant residential finished floor levels should be adopted as the residential Flood Planning Levels in Table 4. This is consistent with Clause 7.3 of the Pittwater LEP 2014.

2.8 Forward Work

While this report aims to provide preliminary advice with regards to a flood planning strategy for the development, we recognise that additional work will be required as part of future design stages to confirm the approach. We anticipate the following works will be required and we look forward to engaging with NBC in this regard:

- Coordination with NBC Council on flood planning requirements for the development including undercroft parking, openings that connect to the basement carpark associated with Building A i.e. lift cores, stairs, ventilation, driveway entrances etc, and other habitable floor areas.
- Refinement of the flood modelling to complement developments in the architectural and landscape architectural design.
- Development of Flood evacuation strategies. At this point in time we anticipate the flood evacuation strategy will include a shelter in place approach.

2.9 Conclusion

Given the above, we believe the development can achieve the flood planning requirements, improve the safety profile of local floodwaters and offer a stormwater strategy that provides added benefit in reducing flood depths for neighbouring downstream properties.

With Council's in-principle support; we have developed a Stormwater Management Strategy with detailed 2D flood modelling to support the minimisation of flood risk to neighbouring private property by diverting overland flow to Darley St through a new shared access driveway, whilst maintaining the level of trafficability and flood risk hazard (low hazard of H1-H2) of the Darley St roadway.

Proposed townhouse buildings (C, D, and E) have been elevated to a level equivalent to the 1% AEP plus 500mm freeboard associated with the diverted flows as defined in Table 4 of this report. The ground flood levels of both Building A and B are elevated above the existing overland flow paths and not impacted by local flood depths. This complements the flood planning requirements for developments of this nature within Northern Beaches Council LGA and is aligned with Pittwater LEP 2014 Clause 7.3.

We also recognise the potential public benefit in considering upgrades to the existing network which would likely reduce the frequency and time that this section of road becomes inundated during storm events.

It is recommended further engagement with Northern Beaches Council is required to discuss the proposed stormwater management strategy and any development conditions of consent prior to them being released.

Appendix A

Council Pre-Lodgement Advice

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PRELODGEMENT ADVICE

Application No:	PLM2020/0199
Meeting Date:	9 September 2020
Property Address:	159-167 Darley Street West, Mona Vale (Lots 1 to 5 of DP 11108)
Attendees for Council:	Adonna See – Principal Planner, Strategic & Place Planning Kye Miles – Student Planner, Strategic & Place Planning Phillip Devon – Manager, Transport Network Duncan Howley – Team Leader, Floodplain Management
Attendees for applicant:	Andrew Thurlow - Intrec Gary White - Macroplan Martin Abell - Macroplan Nathan Mitchell - Aecom

General Comments/Limitations of these Notes

These notes have been prepared by Council on the basis of information provided by the applicant and a consultation meeting with Council staff. Council provides this service for guidance purposes only. These notes are an account of the specific issues discussed and conclusions reached at the pre-lodgement meeting. These notes are not a complete set of planning and related comments for the proposed development. Matters discussed and comments offered by Council will in no way fetter Council's discretion as the Consent Authority. A determination can only be made following the lodgement and full assessment of the planning proposal.

In addition to the comments made within these notes, it is a requirement of the applicant to address ALL relevant pieces of legislation including (but not limited to) any SEPP and any applicable clauses of Pittwater Local Environment Plan 2014 within the supporting documentation of a planning proposal.

You are advised to carefully review these notes. If there is an area of concern or non-compliance that cannot be supported by Council, you are strongly advised to review and reconsider the appropriateness of the proposal and the adverse impacts that may arise as a result.

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Proposal:	This planning proposal proposes to rezone 159 to 167 Darley Street West, Mona Vale from R2 – Low Density Residential land to R3 – Medium Density Residential, in order to facilitate the redevelopment of these sites for medium density residential housing (residential flat buildings and multi dwelling housing).
Accompanying Documents:	Preliminary Planning Proposal from MacroPlan Preliminary Flooding Advice from Aecom
Site Characteristics:	The subject site consists of five (5) parcels of land, as seen as the hatched area on Figure 1. The parcels of land and current uses are as follows: 1. Lot 1 is known as 167 Darley Street West and is occupied by a detached dwelling 2. Lots 2 & 3 are known as 163 Darley Street West and are occupied by a detached dwelling 3. Lot 4 is known as 161 Darley Street West and is occupied by a detached dwelling 4. Lot 5 is known as 159 Darley Street West and is occupied by a detached dwelling The subject site has a total area of approximately 6,120m². The subject site has frontage to Darley Street West and is located on a cul-de-sac at the end of the street. The subject site has a moderate slope from the southern corner of the site to the northern corner. The subject site is located opposite the Bayview Golf Course and carpark to the northeast. Darley Street West is largely characterised by 2 and 3 storey RFBs and multi dwelling housing to the southeast.

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	 **Subject Site**
Local Planning Context	**Pittwater LEP 2014** The subject site is currently zoned R2 Low Density Residential (shown has hatched in the image below).  The draft Proposal seeks to change zoning from R2 to R3, the objectives and permissible uses for which are as follows:

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	1 Objectives of zone *• To provide for the housing needs of the community within a medium density residential environment.* *• To provide a variety of housing types within a medium density residential environment.* *• To enable other land uses that provide facilities or services to meet the day to day needs of residents.* *• To provide for a limited range of other land uses of a low intensity and scale, compatible with surrounding land uses.* ***2 Permitted without consent*** *Home businesses; Home occupations* ***3 Permitted with consent*** *Attached dwellings; Bed and breakfast accommodation; Boarding houses; Building identification signs; Business identification signs; Centre-based child care facilities; Community facilities; Dual occupancies; Dwelling houses; Environmental protection works; Exhibition homes; Group homes; Health consulting rooms; Home-based child care; Home industries; Multi dwelling housing; Neighbourhood shops; Oyster aquaculture; Places of public worship; Residential flat buildings; Respite day care centres; Roads; Secondary dwellings; Semi-detached dwellings; Seniors housing; Serviced apartments; Tank-based aquaculture; Veterinary hospitals* ***4 Prohibited*** *Pond-based aquaculture Any development not specified in item 2 or 3* Other local planning/development controls of note that apply to the site include: • PLEP 2014 – Acid Sulfate Soils – Classes 3 & 5 **Other Policies** The subject site is affected by Low Risk and Medium Risk flood hazard in accordance with the NBC Flood Hazard Map adopted in 2019. This is discussed in further detail below. A range of State Government planning policies and guidelines are also applicable to any proposed rezoning and redevelopment of the subject site. These have not been considered as part of this pre-lodgement advice but would need to be assessed within any future planning proposal.

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Referral Body	**Comments**
Strategic & Place Planning	• **Greater Sydney Region Plan 2036 & North District Plan** Mona Vale is identified as a Strategic Centre within both the Greater Sydney Region Plan 2036 and the North District Plan. In these documents, strategic centres are the focus of housing, employment and transportation. As per the District Plan, *Mona Vale strategic centre is a mixed use area including retail, commercial, community, light industrial and residential uses. It is a thriving centre during business hours, providing amenity, convenience and a sense of community for residents.* In both the regional and the district plans, the focus for this centre is in its commercial and retail function including a job target of between 700-1700 jobs by 2036. There are currently technical studies underway to determine how to best achieve these targets in the context of the Strategic Centre and the entire LGA. Based on Council's preliminary research, the LGA's five-year housing target (2016-2021) under the North District Plan is 3,400 new dwellings and is likely to be met under existing planning controls without the need for unplanned uplift. • **Local Strategic Planning Statement** Northern Beaches Council's Local Strategic Planning Statement, *Towards 2040,* was made by the Chief Executive Officer under delegated authority based on Council's resolution 25 February 2020 and a letter of support from the Greater Sydney Commission (GSC) for consistency with the *Greater Sydney Region Plan* and *North District Plan*. This new planning document sets out a 20-year vision for land use in the area. Priority 27 of the document recognises Mona Vale as the contemporary, urban heart of the north. Actions for this strategic centre focus on place planning and revitalisation of the commercial centre as well as improvements to circulation and transportation both within the centre and in terms of access to other areas of the LGA. *Towards 2040* also indicates that other studies will inform how Council is able to achieve housing, employment and other infrastructure targets into the future. Council has commissioned a number of technical studies including an Employment Study and Housing Strategy for this purpose. There is no clear link between the Northern Beaches LSPS and the provision of additional housing beyond the existing Mona Vale strategic centre. As noted above, recent research indicates that existing planning controls will be able to deliver short term targets with an emphasis on new

Specialist Advice	
	dwellings being provided in already identified precincts such as Frenchs Forest. • **Affordable Housing Policy** Any areas subject to uplift would be subject to the provision of affordable housing in accordance with Council's adopted Affordable Housing policy. In particular, the proposal must provide for the delivery of the 10% rental housing target (all strategic plans and planning proposals for urban renewal or greenfield development). • **Pittwater LEP 2014** Discussion was had in relation to the possibility of introducing Additional Permitted Uses to the site to ensure that development occurs as intended by the objectives of the Planning Proposal. Council is unable to provide formal comment on the use of APUs for this site given that this matter does not form part of the prelodgment documents. Further discussion may be held separately for this matter. The proposal to remove clause 4.5A in relation to density controls for residential accommodation is not supported. • **Pittwater 21 DCP** Although the concept design for a Planning Proposal is not legally binding, any proposal should consider current Pittwater 21 DCP provisions and other applicable design guidelines to inform the built form outcomes and ensure that they are in character with the existing area. • **General Comments** There are a number of key strategic studies currently under preparation by Council. These include the Northern Beaches Housing Strategy (scheduled to be reported to Council in November 2020) and Northern Beaches Employment Study. Having regard for the timing of the preparation of these studies, it is considered that any proposal submitted prior to the release of these studies would be premature. The North District Plan and Local Strategic Planning Statement do not specifically require the need for additional housing in the location of the subject site. In consideration of the above, the documents submitted by the proponent have not demonstrated why this planning proposal should be progressed

Specialist Advice	
	ahead of the completion of such studies and without the demonstrable strategic need for additional housing in this location. Further, the proposal does not adequately justify the rezoning of the subject property over and before other land adjoining the Mona Vale town centre zone R2 land (or other land across LGA with similar characteristics and attributes). Consideration of rezoning of the subject site has the risk of setting a precedent for adjoining landowners to consider rezoning under the same premises. Having regard for the above, it is recommended that the proponent wait for the Housing Strategy to be released as this will provide clarity about where additional growth might occur.
Referral Body	**Comments**
Stormwater, Floodplain Engineering	The Proposal must show compliance with the Flood Prone Land (4.3) Direction of the Local Planning Directions under Section 9.1(2) of the Environmental Planning and Assessment Act 1979. Under this directions, the following applies: *(4) A planning proposal must include provisions that give effect to and are consistent with the NSW Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005 (including the Guideline on Development Controls on Low Flood Risk Areas).* *(5) A planning proposal must not rezone land within the flood planning areas from Special Use, Special Purpose, Recreation, Rural or Environmental Protection Zones to a Residential, Business, Industrial, Special Use or Special Purpose Zone.* *(6) A planning proposal must not contain provisions that apply to the flood planning areas which:* *(a) permit development in floodway areas,* *(b) permit development that will result in significant flood impacts to other properties,* *(c) permit a significant increase in the development of that land,* *(d) are likely to result in a substantially increased requirement for government spending on flood* *mitigation measures, infrastructure or services, or* *(e) permit development to be carried out without development consent except for the purposes of agriculture (not including dams, drainage canals, levees, buildings or structures in floodways or high hazard areas), roads or exempt development.* *(7) A planning proposal must not impose flood related development controls above the residential flood planning level for residential development on land, unless a relevant planning authority provides adequate justification for those controls to the satisfaction of the Director-*

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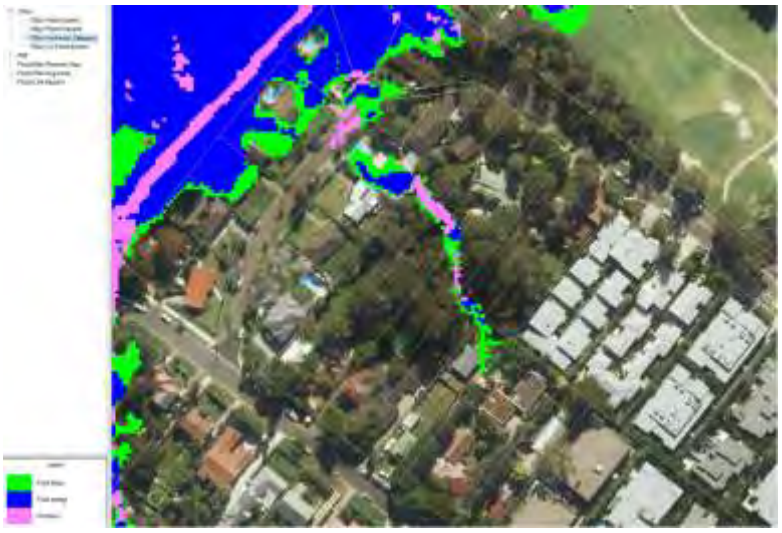
	General (or an officer of the Department nominated by the Director-General). *(8) For the purposes of a planning proposal, a relevant planning authority must not determine a flood planning level that is inconsistent with the Floodplain Development Manual 2005 (including the Guideline on Development Controls on Low Flood Risk Areas) unless a relevant planning authority provides adequate justification for the proposed departure from that Manual to the satisfaction of the Director-General (or an officer of the Department nominated by the Director-General)* Below shows floodways mapped in pink ((McCarrs Cr, Mona Vale and Bayview Flood Study, 2017).  Flood planning area is below in blue (McCarrs Cr, Mona Vale and Bayview Flood Study, 2017).

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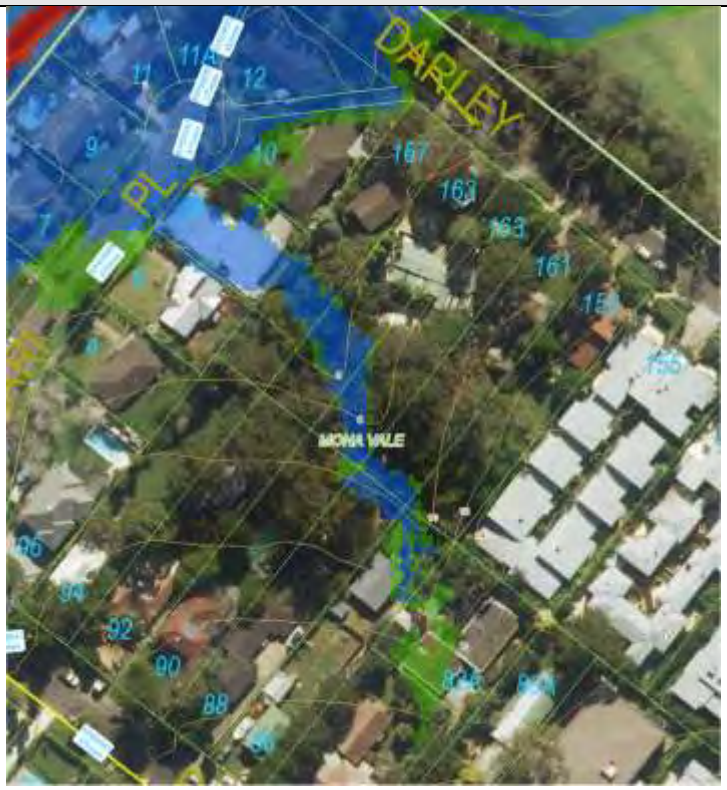
Specialist Advice	
	 With regard to this Planning Direction, given that the proposal would permit a significant increase in the development of floodprone land, the applicant must demonstrate that the cumulative impact of the development will not affect surrounding areas. The planning proposal has the potential to set a precedent for adjoining properties to upzone without the benefit of a wider housing review or the impacts to flood prone land to the northwest of the subject site. An overland flow path traverses the site and it is located in the medium and low flood risk precincts as demonstrated in the McCarrs Creek, Mona Vale and Bayview Flood Study, 2017. Any future Planning Proposal for the site would need to provide: • A comprehensive Flood Risk Assessment which includes: o 2D flood modelling of the existing flood regime for a range of design flood events up to and including the Probable Maximum Flood event o Flood modelling of the post construction scenario for the same design flood events up to and including the Probable Maximum Flood event

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	o Afflux mapping to demonstrate the impact of the development on the flood regime, including the impact on flood depths and velocities o Consideration of the potential for blockage and how this will be mitigated o Determination of the required Flood Planning Level and resultant minimum floor level requirements for future development. o An assessment of the flood risk to life associated with the development including appropriate flood emergency response planning o Detail of any required civil works to mitigate flood risk o Commentary on the consistency of the proposal with Section 9.1 Direction 4.3 Flood Prone Land • Council is supportive of opportunities to minimise flood risk to private property and divert this flow to Darley Street provided that it does not impact the trafficability of the roadway in flood events. • The Proposal would need to outline how any future Development Application on the site could comply with Council's Local Environmental Plan and Development Control Plan provisions for flood prone land.
Referral Body	**Comments**
Transport Network	• All access would be through Darley Street (West) and comply with AS2890 for the classification of the car parking provided. • Onsite parking is to comply with the DCP and AS 2890 requirements • As the site will result in an intensification there is the need to potentially provide tactile traffic calming in a minimum of two locations along the Darley Street corridor. • Applicant is to consider Active Transport provision and pedestrian and other connections from/to the Mona Vale Town Centre • The applicant should also consider provision of electric vehicle infrastructure in any future development application.

Concluding Comments
These notes are in response to a pre-lodgement meeting held on 9 September 2020 to discuss a Planning Proposal at 159-167 Darley Street West, Mona Vale. The submitted documents have not adequately established site specific or strategic merit in relation to district and local planning documents. Council acknowledges that the imminent Housing Strategy as well as Northern Beaches LEP have not been completed and therefore cannot be considered as part of this prelodgement.

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Concluding Comments
Other concerns that must be considered include: permitted uses under the R3 zoning that are not appropriate or desirable at the proposed location; and inconsistency with Local Planning Direction 4.3 Flood Prone Land.

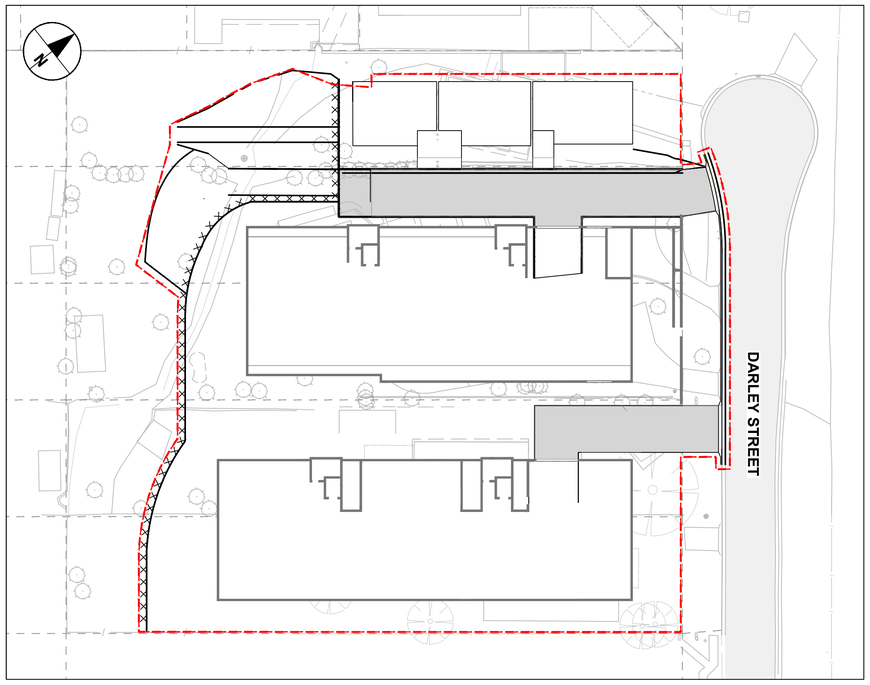
Appendix B

Civil Plans

FOR DEVELOPMENT APPLICATION

159-167 DARLEY STREET

MONA VALE



DRAWING INDEX

DRAWING NUMBER	DRAWING TITLE
60613516-SHT-00-1000-CI-0001	COVER SHEET AND DRAWING INDEX
60613516-SHT-00-1000-CI-0100	GENERAL ARRANGEMENT OVERALL PLAN
60613516-SHT-00-1000-CI-0141	TYPICAL SECTIONS - SHEET 1
60613516-SHT-00-1000-CI-0541	DRIVEWAY ALIGNMENT LONGITUDINAL SECTIONS - SHEET 1
60613516-SHT-00-1000-CI-0620	DRAINAGE OVERALL PLAN
60613516-SHT-00-1000-CI-0651	DRAINAGE LONGITUDINAL SECTIONS - SHEET 1
60613516-SHT-00-1000-CI-0652	DRAINAGE LONGITUDINAL SECTIONS - SHEET 2
60613516-SHT-00-1000-CI-0670	DRAINAGE CATCHMENT OVERALL PLAN

PLANNING PROPOSAL SUBMISSION

CONSULTANT

AECOM Australia Pty Ltd
A.B.N 20 093 846 925
www.aecom.com

PROJECT

URBAN DESIGN
159-167 DARLEY ST
MONA VALE
NORTHERN BEACHES

CLIENT

SCALE BAR

0 10 20 m
1:400

SAFETY IN DESIGN INFORMATION

ARE THERE ANY ADDITIONAL HAZARDS / RISKS NOT NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING?
☐ NO
☐ YES

PROJECT MANAGEMENT INITIALS

CS	BO	NM
DESIGNER	CHECKED	APPROVED

PROJECT DATA

DATUM		SURVEY	

ISSUE/REVISION

02	30.04.2021	PLANNING PROPOSAL
01	12.04.2021	PLANNING PROPOSAL
I/R	DATE	DESCRIPTION

PROJECT NUMBER

60613516

SHEET TITLE

COVERSHEET AND DRAWING INDEX

SHEET NUMBER

60613516-SHT-00-1000-CI-0001

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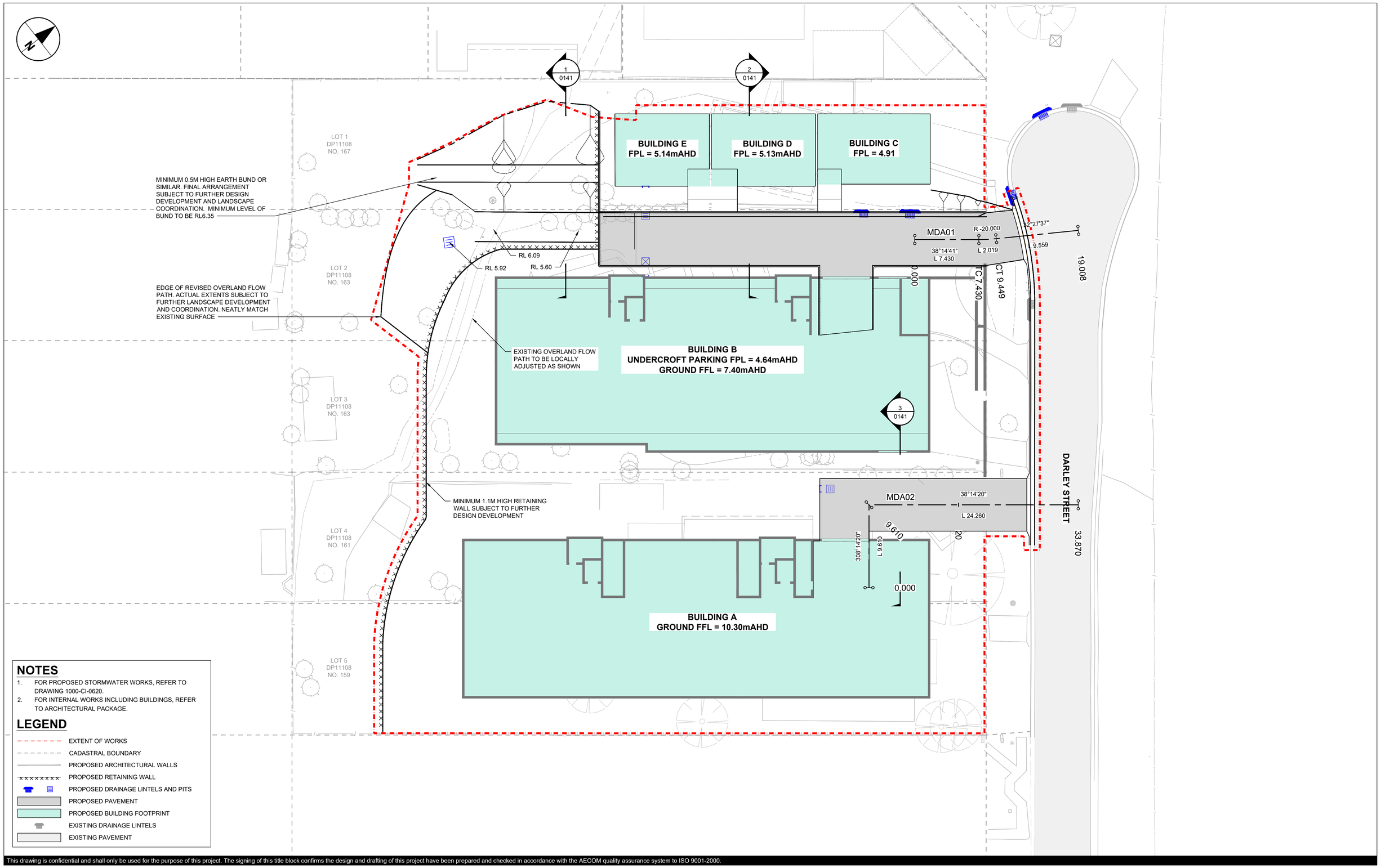

NOTES

1. FOR PROPOSED STORMWATER WORKS, REFER TO DRAWING 1000-CI-0620.
2. FOR INTERNAL WORKS INCLUDING BUILDINGS, REFER TO ARCHITECTURAL PACKAGE.

LEGEND

- EXTENT OF WORKS
- CADASTRAL BOUNDARY
- PROPOSED ARCHITECTURAL WALLS
- PROPOSED RETAINING WALL
- PROPOSED DRAINAGE LINTELS AND PITS
- PROPOSED PAVEMENT
- PROPOSED BUILDING FOOTPRINT
- EXISTING DRAINAGE LINTELS
- EXISTING PAVEMENT

CONSULTANT
AECOM Australia Pty Ltd
A.B.N 20 093 846 925
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PROJECT
URBAN DESIGN
159-167 DARLEY ST
MONA VALE
NORTHERN BEACHES

CLIENT
INTREC

SCALE BAR
0 5 10 m
1:200

SAFETY IN DESIGN INFORMATION
ARE THERE ANY ADDITIONAL HAZARDS / RISKS NOT NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING?
☐ NO
☐ YES

PROJECT MANAGEMENT INITIALS

CS	BO	NM
DESIGNER	CHECKED	APPROVED

PROJECT DATA

DATUM		SURVEY	

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	30.04.2021	PLANNING PROPOSAL
01	12.04.2021	PLANNING PROPOSAL

PROJECT NUMBER
60613516

SHEET TITLE
GENERAL ARRANGEMENT
OVERALL PLAN

SHEET NUMBER
60613516-SHT-00-1000-CI-0100

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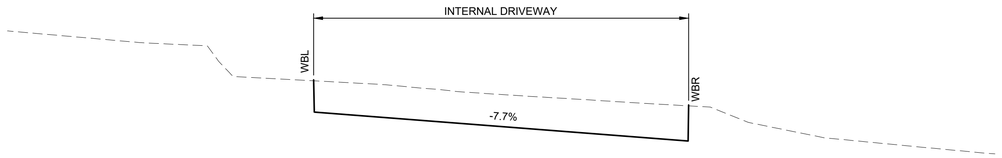

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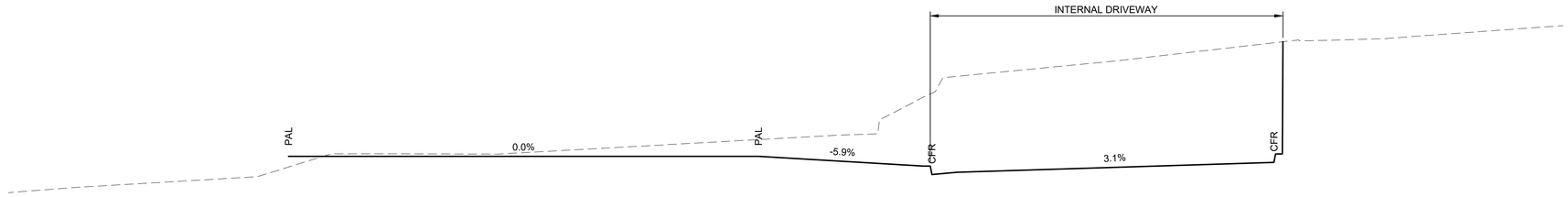

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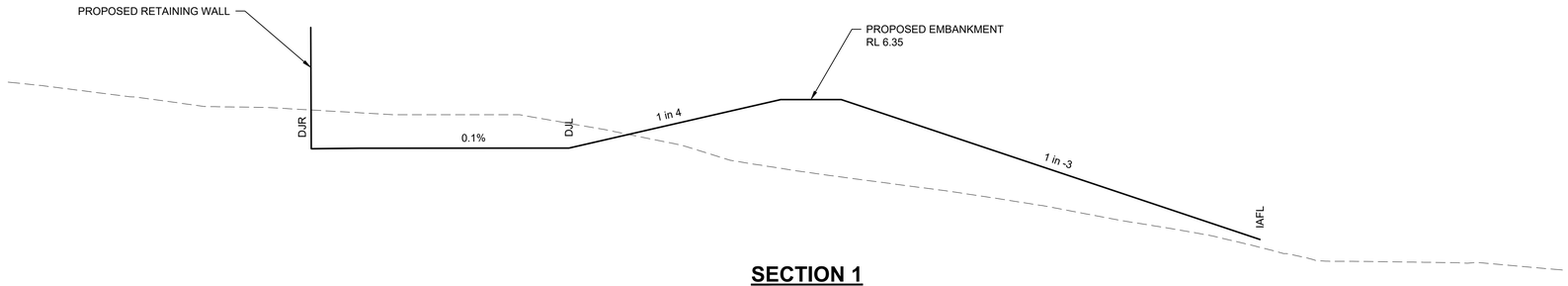

SECTION 1
Scale 1:50

CONSULTANT

AECOM Australia Pty Ltd
A.B.N 20 093 846 925
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PROJECT

URBAN DESIGN
159-167 DARLEY ST
MONA VALE
NORTHERN BEACHES

CLIENT

INTREC

SCALE BAR

0 1.25 2.5 m
1:50

SAFETY IN DESIGN INFORMATION

ARE THERE ANY ADDITIONAL HAZARDS / RISKS NOT NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING?
☐ NO
☐ YES

PROJECT MANAGEMENT INITIALS

CS	BO	NM
DESIGNER	CHECKED	APPROVED

PROJECT DATA

DATUM		SURVEY	

ISSUE/REVISION

02	30.04.2021	PLANNING PROPOSAL
01	12.04.2021	PLANNING PROPOSAL
I/R	DATE	DESCRIPTION

PROJECT NUMBER

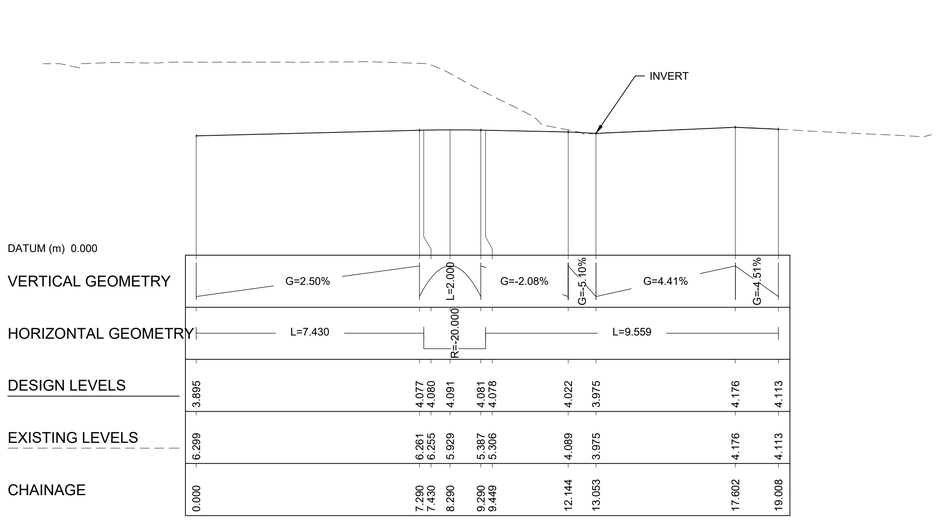
60613516

SHEET TITLE

TYPICAL SECTIONS
SHEET 1

SHEET NUMBER

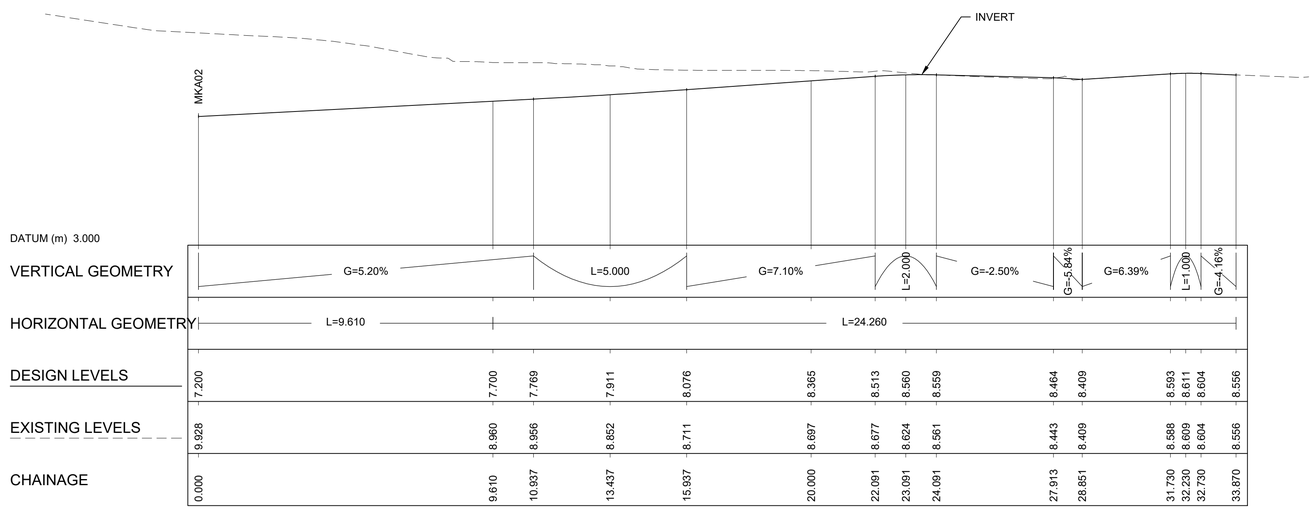
60613516-SHT-00-1000-CI-0141



LONGITUDINAL SECTION - MDA01

A1 HORIZONTAL SCALE 1:100

A1 VERTICAL SCALE 1:100



LONGITUDINAL SECTION - MDA02

A1 HORIZONTAL SCALE 1:100

A1 VERTICAL SCALE 1:100

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PROJECT

URBAN DESIGN
159-167 DARLEY ST
MONA VALE
NORTHERN BEACHES

CLIENT

INTREC

SCALE BAR

0 2.5 5 m
0 2.5 5
H=1:100
V=1:100

SAFETY IN DESIGN INFORMATION

ARE THERE ANY ADDITIONAL HAZARDS / RISKS NOT NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING?

☐ NO
☐ YES

PROJECT MANAGEMENT INITIALS

CS	BO	NM
DESIGNER	CHECKED	APPROVED

PROJECT DATA

DATUM		SURVEY	

ISSUE/REVISION

02	30.04.2021	PLANNING PROPOSAL
01	12.04.2021	PLANNING PROPOSAL
I/R	DATE	DESCRIPTION

PROJECT NUMBER

60613516

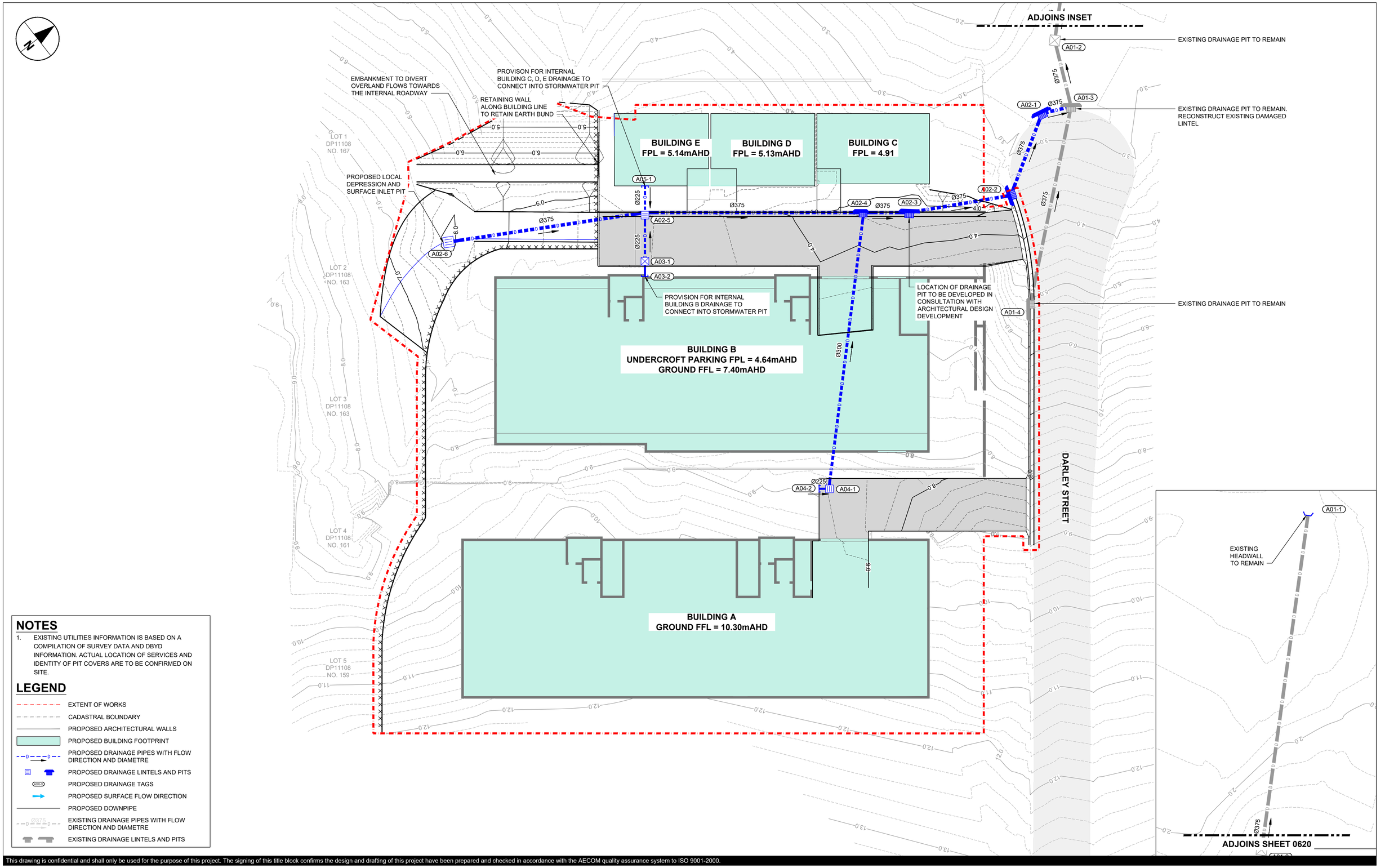
SHEET TITLE

DRIVEWAY ALIGNMENT
LONGITUDINAL SECTIONS
SHEET 1

SHEET NUMBER

60613516-SHT-00-1000-CI-0541

ISO A1 594mm x 841mm



NOTES

1. EXISTING UTILITIES INFORMATION IS BASED ON A COMPILATION OF SURVEY DATA AND DBYD INFORMATION. ACTUAL LOCATION OF SERVICES AND IDENTITY OF PIT COVERS ARE TO BE CONFIRMED ON SITE.

LEGEND

- EXTENT OF WORKS
- CADASTRAL BOUNDARY
- PROPOSED ARCHITECTURAL WALLS
- PROPOSED BUILDING FOOTPRINT
- PROPOSED DRAINAGE PIPES WITH FLOW DIRECTION AND DIAMETRE
- PROPOSED DRAINAGE LINTELS AND PITS
- PROPOSED DRAINAGE TAGS
- PROPOSED SURFACE FLOW DIRECTION
- PROPOSED DOWNPIPE
- EXISTING DRAINAGE PIPES WITH FLOW DIRECTION AND DIAMETRE
- EXISTING DRAINAGE LINTELS AND PITS

CONSULTANT
AECOM Australia Pty Ltd
A.B.N 20 093 846 925
www.aecom.com

PROJECT
URBAN DESIGN
159-167 DARLEY ST
MONA VALE
NORTHERN BEACHES

CLIENT
INTREC

SCALE BAR
0 5 10 m
1:200

SAFETY IN DESIGN INFORMATION
ARE THERE ANY ADDITIONAL HAZARDS / RISKS NOT NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING?
☐ NO
☐ YES

PROJECT MANAGEMENT INITIALS

CS	BO	NM
DESIGNER	CHECKED	APPROVED

PROJECT DATA

DATUM		SURVEY	

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	30.04.2021	PLANNING PROPOSAL
01	12.04.2021	PLANNING PROPOSAL

PROJECT NUMBER
60613516

SHEET TITLE
DRAINAGE OVERALL PLAN
SHEET 1

SHEET NUMBER
60613516-SHT-00-1000-CI-0620

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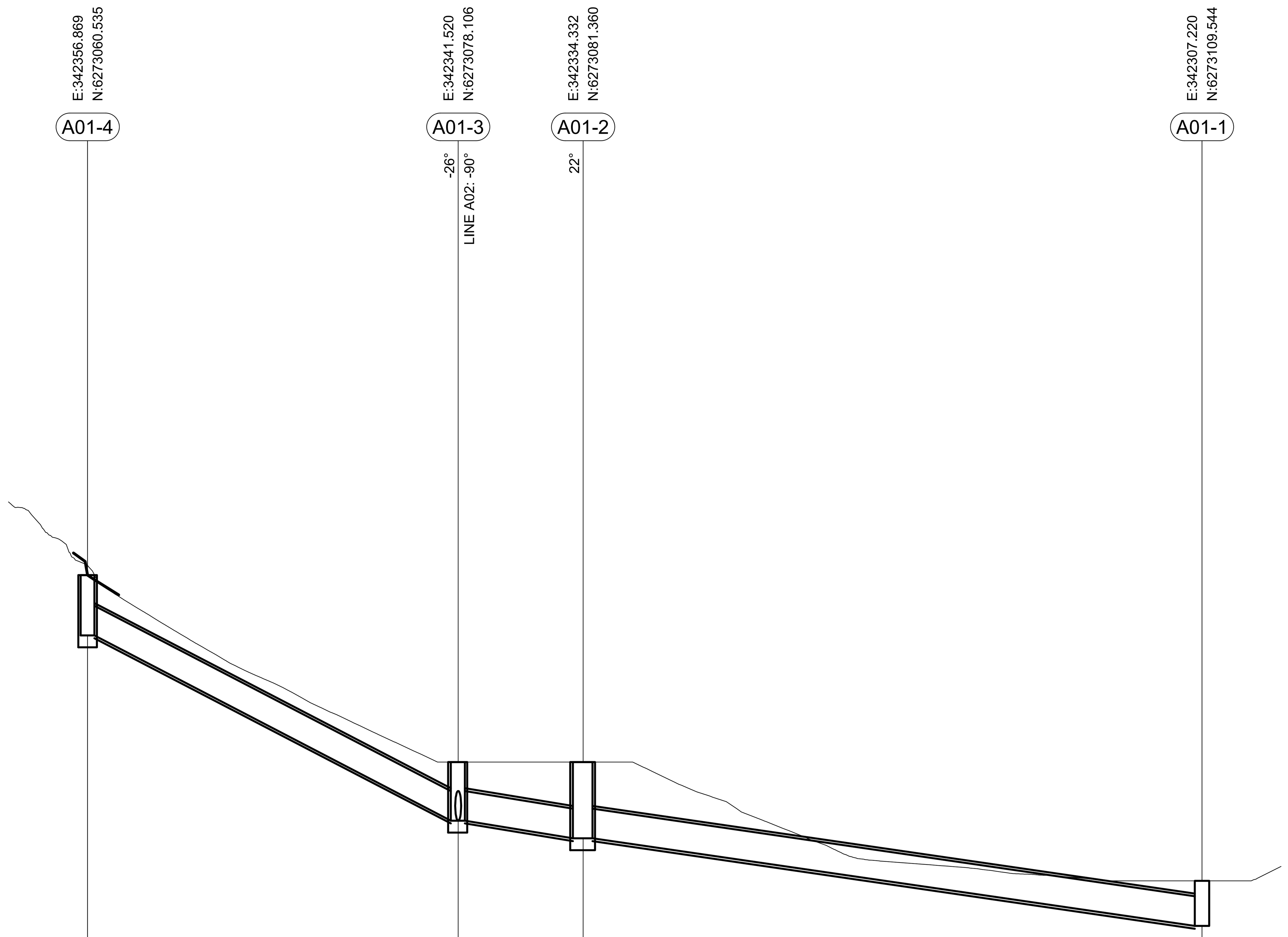
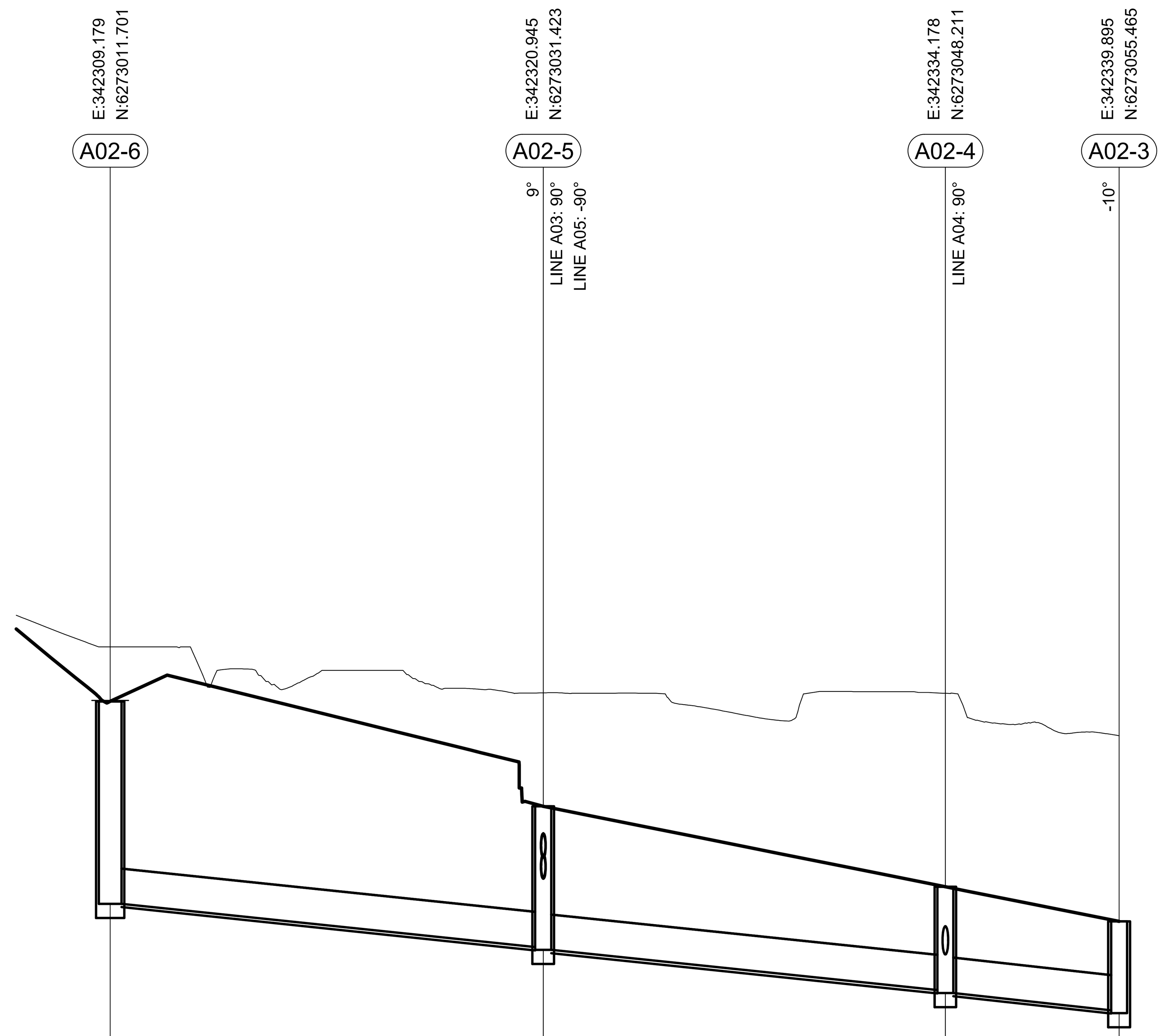


	A01-4		A01-3		A01-2		A01-1
PIPE SIZE (mm) & CLASS		Ø375 EXISTING		Ø375 EXISTING		Ø375 EXISTING	
PIPE GRADE		9.99% 1 in 10		2.83% 1 in 35		2.83% 1 in 35	
DATUM (m)	-6.00						
FINISHED (& EXISTING) SURFACE LEVEL	5.11 (5.23)		2.75		2.75		1.25
INVERT LEVEL	4.35		2.01		1.79		0.68
DEPTH TO INVERT	0.76		0.74		0.96		0.57
PIPE CHAINAGE	0.00		23.42		31.31		70.42

LINE A01



	A02-6		A02-5		A02-4		A02-3
PIPE SIZE (mm) & CLASS		Ø375 RCP		Ø375 RCP		Ø375 RCP	
PIPE GRADE		2% 1 in 50		2% 1 in 50		2% 1 in 50	
DATUM (m)	-5.00						
FINISHED (& EXISTING) SURFACE LEVEL	5.92 (6.50)		4.80 (6.01)		3.95 (6.01)		3.58 (5.56)
INVERT LEVEL	3.77		3.31 3.28		2.85 2.82		2.64
DEPTH TO INVERT	2.15		1.50 1.53		1.10 1.13		0.95
PIPE CHAINAGE	0.00		23.03		44.40		53.64

LINE A02

CONSULTANT

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A.B.N 20 093 846 925
www.aecom.com

PROJECT

URBAN DESIGN
159-167 DARLEY ST
MONA VALE
NORTHERN BEACHES

CLIENT

INTREC

SCALE BAR

0 6.25 12.5 m H=1:250
0 0.5 1 V=1:50

SAFETY IN DESIGN INFORMATION

ARE THERE ANY ADDITIONAL HAZARDS / RISKS NOT NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING?
☐ NO
☐ YES

PROJECT MANAGEMENT INITIALS

CS	BO	NM
DESIGNER	CHECKED	APPROVED

PROJECT DATA

DATUM		SURVEY	

ISSUE/REVISION

I/R	DATE	DESCRIPTION
02	30.04.2021	PLANNING PROPOSAL
01	12.04.2021	PLANNING PROPOSAL

PROJECT NUMBER

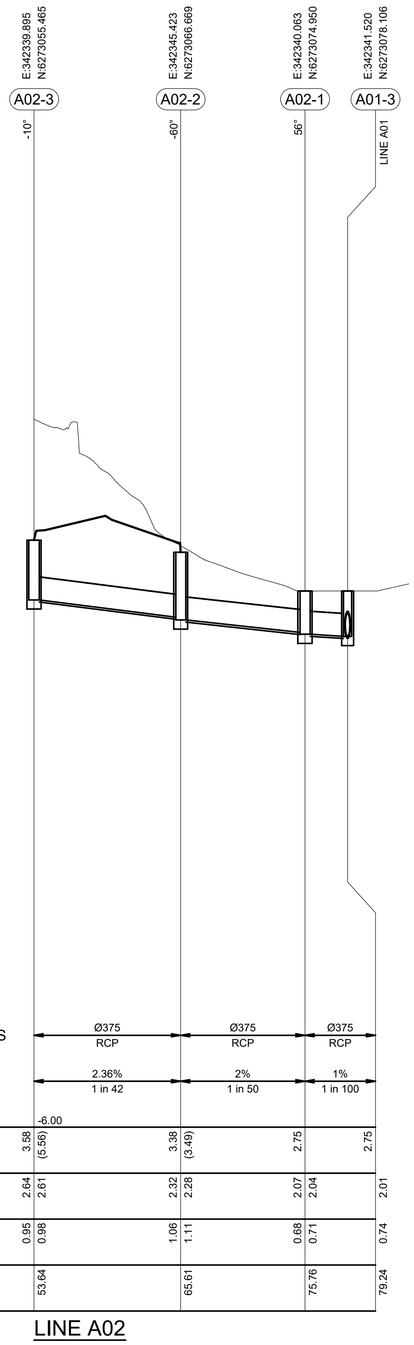
60613516

SHEET TITLE

DRAINAGE
LONGITUDINAL SECTIONS
SHEET 1

SHEET NUMBER

60613516-SHT-00-1000-CI-0651



PIPE SIZE (mm) & CLASS		Ø375 RCP			Ø375 RCP			Ø375 RCP			
PIPE GRADE		2.36% 1 in 42			2% 1 in 50			1% 1 in 100			
DATUM (m)		-6.00									
FINISHED (& EXISTING) SURFACE LEVEL	3.58	(5.56)		3.38	(3.49)		2.75		2.75		
INVERT LEVEL	2.64	2.61		2.32	2.28		2.07	2.04		2.01	
DEPTH TO INVERT	0.95	0.98		1.06	1.11		0.68	0.71		0.74	
PIPE CHAINAGE		53.64			65.61			75.76			79.24

LINE A02

AECOM

CONSULTANT

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PROJECT

URBAN DESIGN
159-167 DARLEY ST
MONA VALE
NORTHERN BEACHES

CLIENT

INTREC

SCALE BAR

0 6.25 12.5 m H=1:250 V=1:50
0 0.5 1

SAFETY IN DESIGN INFORMATION

ARE THERE ANY ADDITIONAL HAZARDS / RISKS NOT NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING?
☐ NO
☐ YES

PROJECT MANAGEMENT INITIALS

CS	BO	NM
DESIGNER	CHECKED	APPROVED

PROJECT DATA

DATUM		SURVEY	

ISSUE/REVISION

02	30.04.2021	PLANNING PROPOSAL
01	12.04.2021	PLANNING PROPOSAL
I/R	DATE	DESCRIPTION

PROJECT NUMBER

60613516

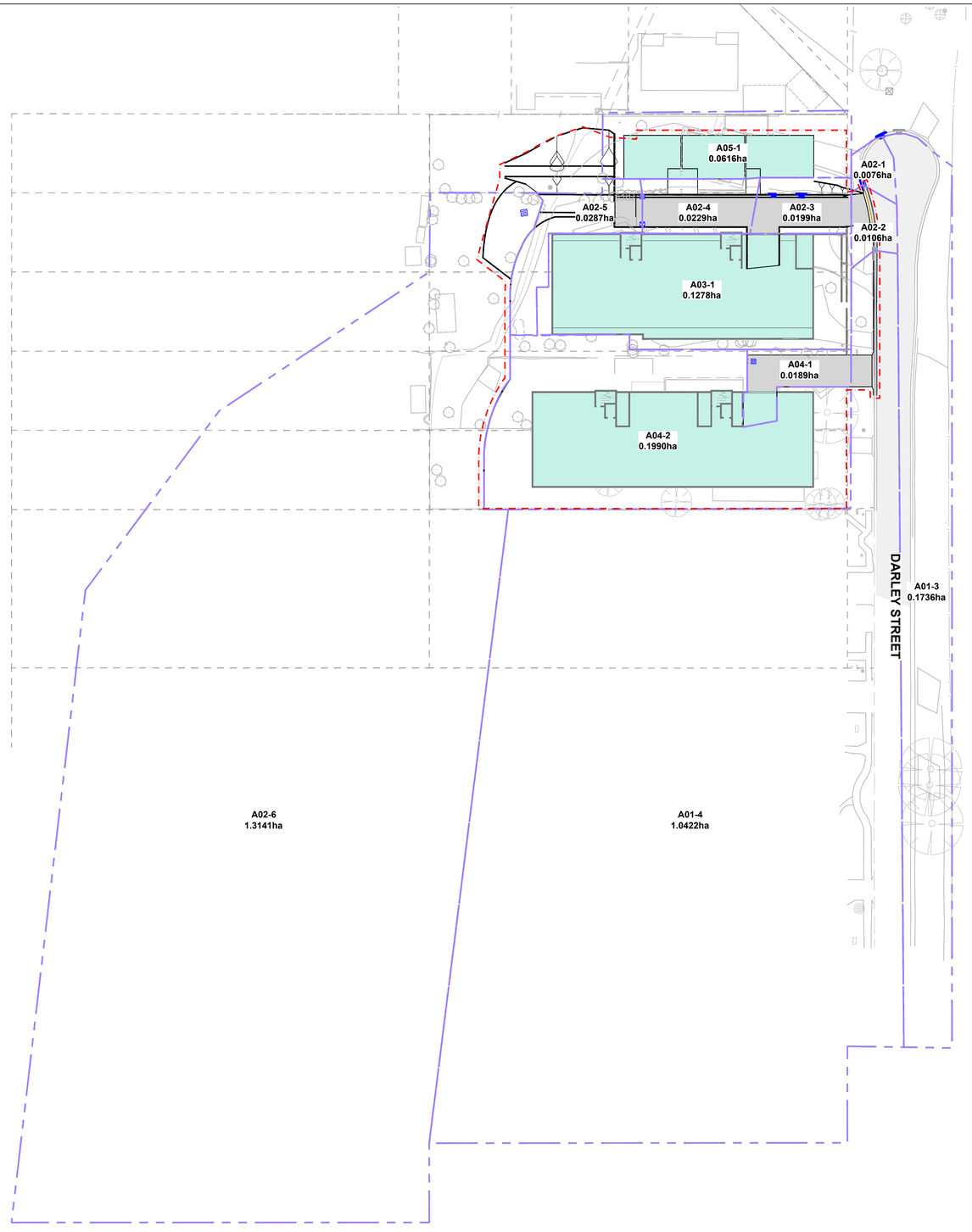
SHEET TITLE

DRAINAGE
LONGITUDINAL SECTIONS
SHEET 2

SHEET NUMBER

60613516-SHT-00-1000-CI-0652

ISO A1 594mm x 841mm



LEGEND

- EXTENT OF WORKS
- CADASTRAL BOUNDARY
- PROPOSED ARCHITECTURAL WALLS
- PROPOSED BUILDING FOOTPRINT
- CATCHMENT BOUNDARY
- PROPOSED DRAINAGE LINTELS AND PITS
- EXISTING DRAINAGE LINTELS

AECOM

CONSULTANT

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A.B.N 20 093 846 925
www.aecom.com

PROJECT

URBAN DESIGN
159-167 DARLEY ST
MONA VALE
NORTHERN BEACHES

CLIENT

INTREC

SCALE BAR

0 12.5 25 m
1:500

SAFETY IN DESIGN INFORMATION

ARE THERE ANY ADDITIONAL HAZARDS / RISKS NOT NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING?
☐ NO
☐ YES

PROJECT MANAGEMENT INITIALS

CS	BO	NM
DESIGNER	CHECKED	APPROVED

PROJECT DATA

DATUM		SURVEY	

ISSUE/REVISION

02	30.04.2021	PLANNING PROPOSAL
01	12.04.2021	PLANNING PROPOSAL
I/R	DATE	DESCRIPTION

PROJECT NUMBER

60613516

SHEET TITLE

DRAINAGE CATCHMENT
OVERALL PLAN

SHEET NUMBER

60613516-SHT-00-1000-CI-0670

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Appendix C

Flood Maps - Existing

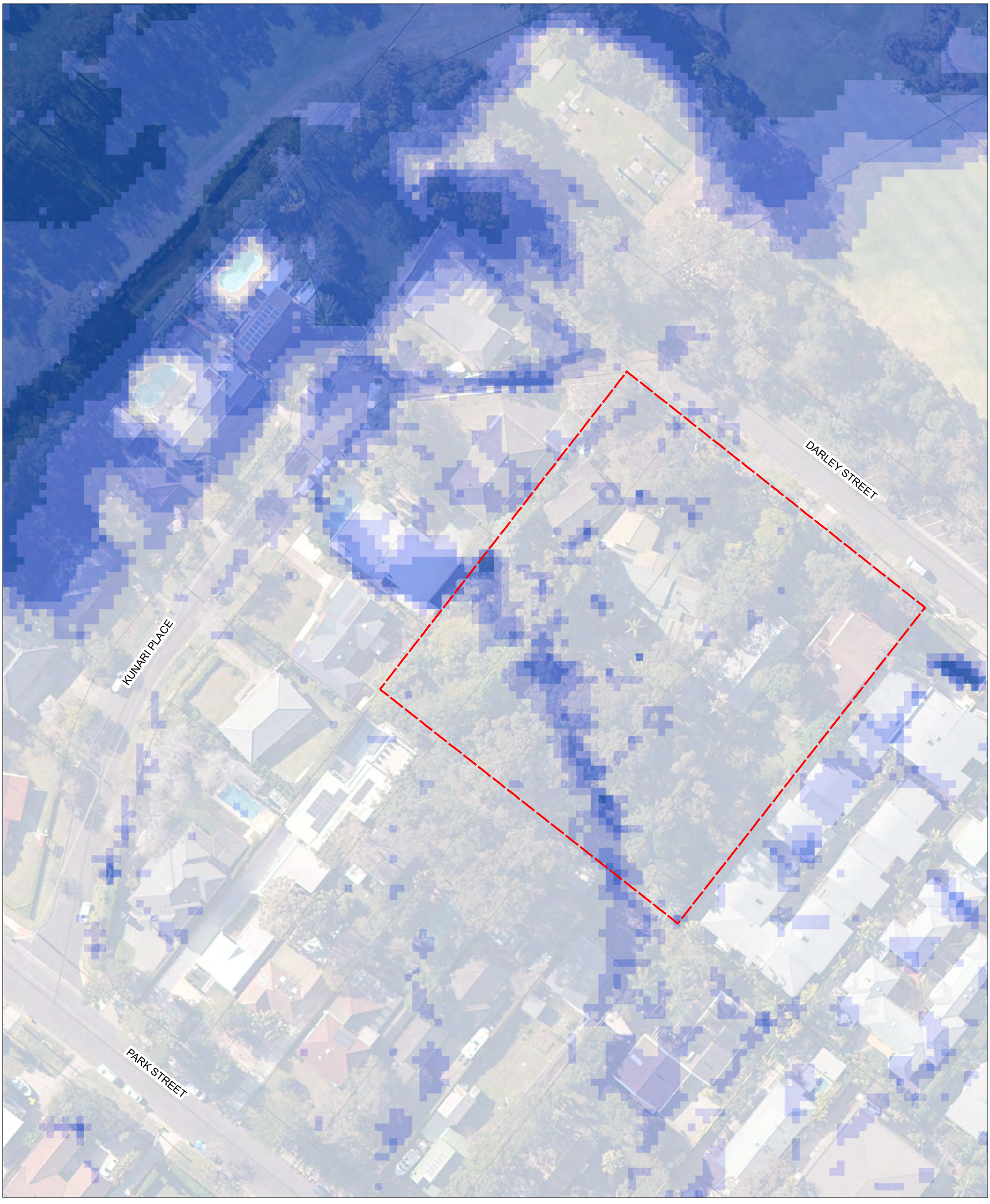

FIGURE 3: PEAK FLOOD DEPTH (1% AEP, 2HR)

Legend

Site Boundary
Cadastre
Roads

Peak Flood Depth (m)

0 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.5
0.5 - 1
> 1

AECOM

N

0 0.01 0.02 km

Source: Nearmap

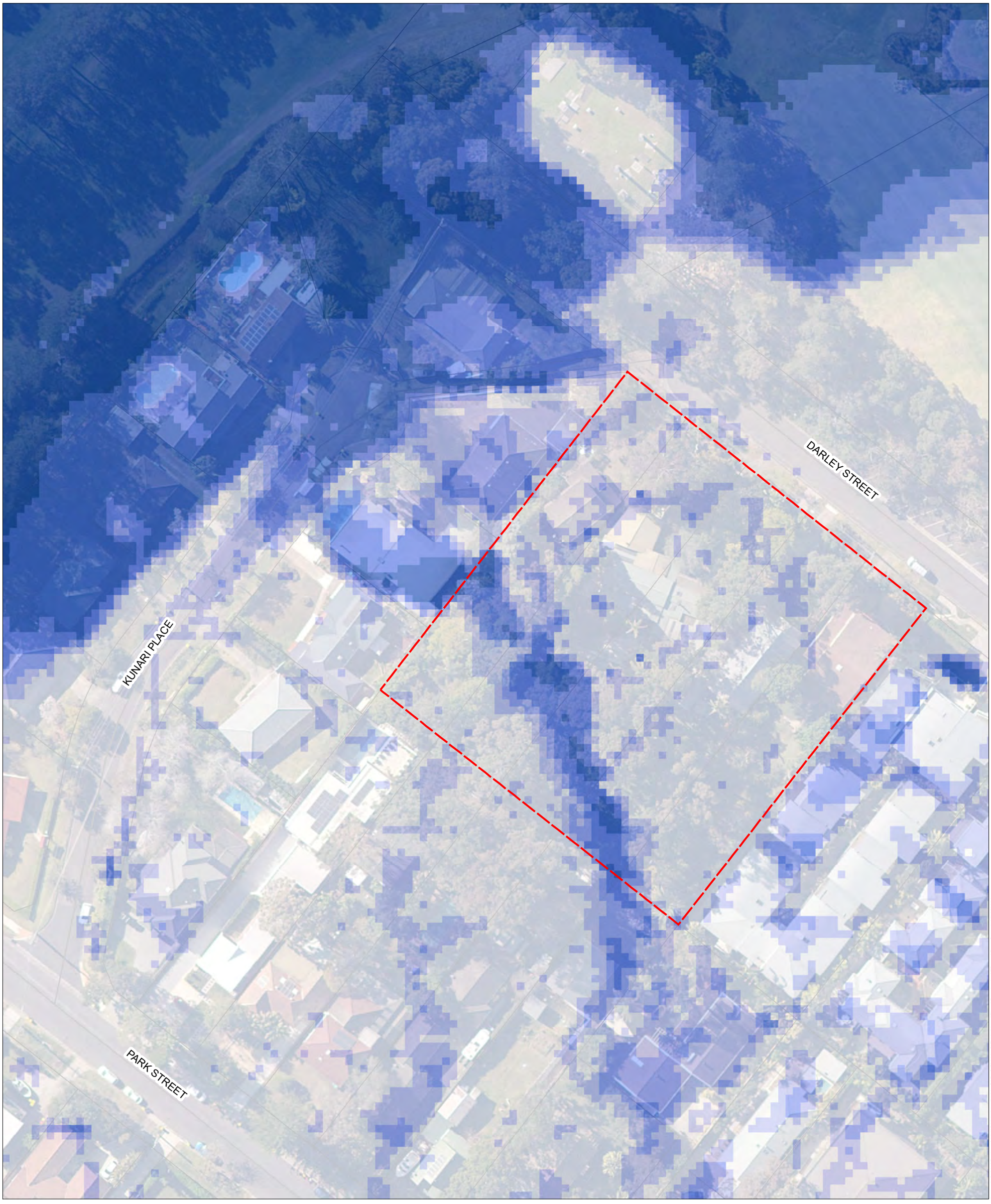

FIGURE 4: PEAK FLOOD DEPTH (PMF, 15MIN)

Legend

Site Boundary

Cadastre

Roads

Peak Flood Depth (m)

0 - 0.1

0.1 - 0.2

0.2 - 0.3

0.3 - 0.5

0.5 - 1

> 1

AECOM

N

0 0.01 0.02 km

Source: Nearmap

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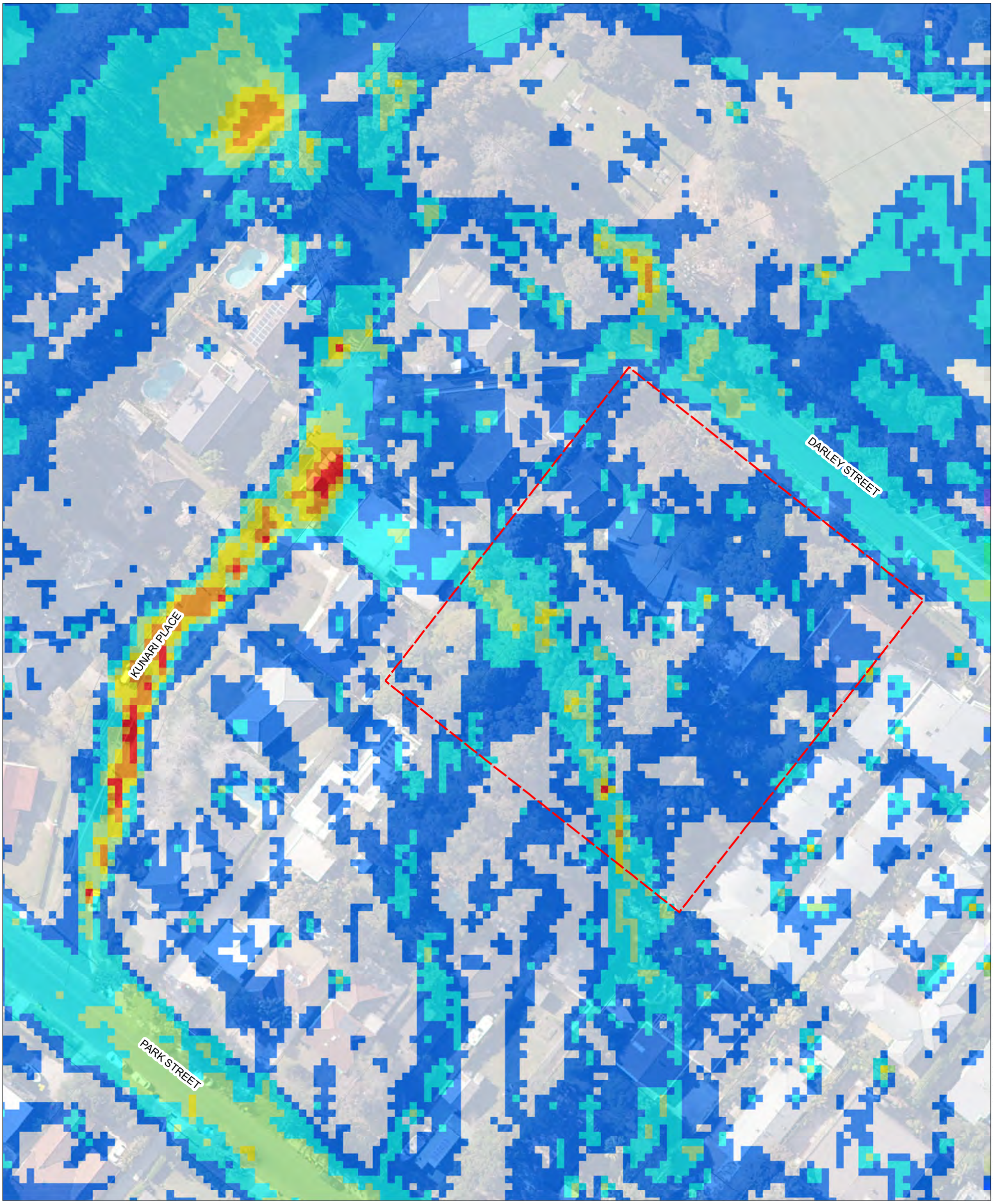

FIGURE 6: PEAK FLOOD VELOCITY (1% AEP, 2HR)

Legend

Site Boundary
Cadastre
Roads

Peak Flood Velocity (m/s)

0 - 0.1
0.1 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1
1 - 1.25
> 1.25

AECOM

N

0 0.01 0.02 km

Source: Nearmap

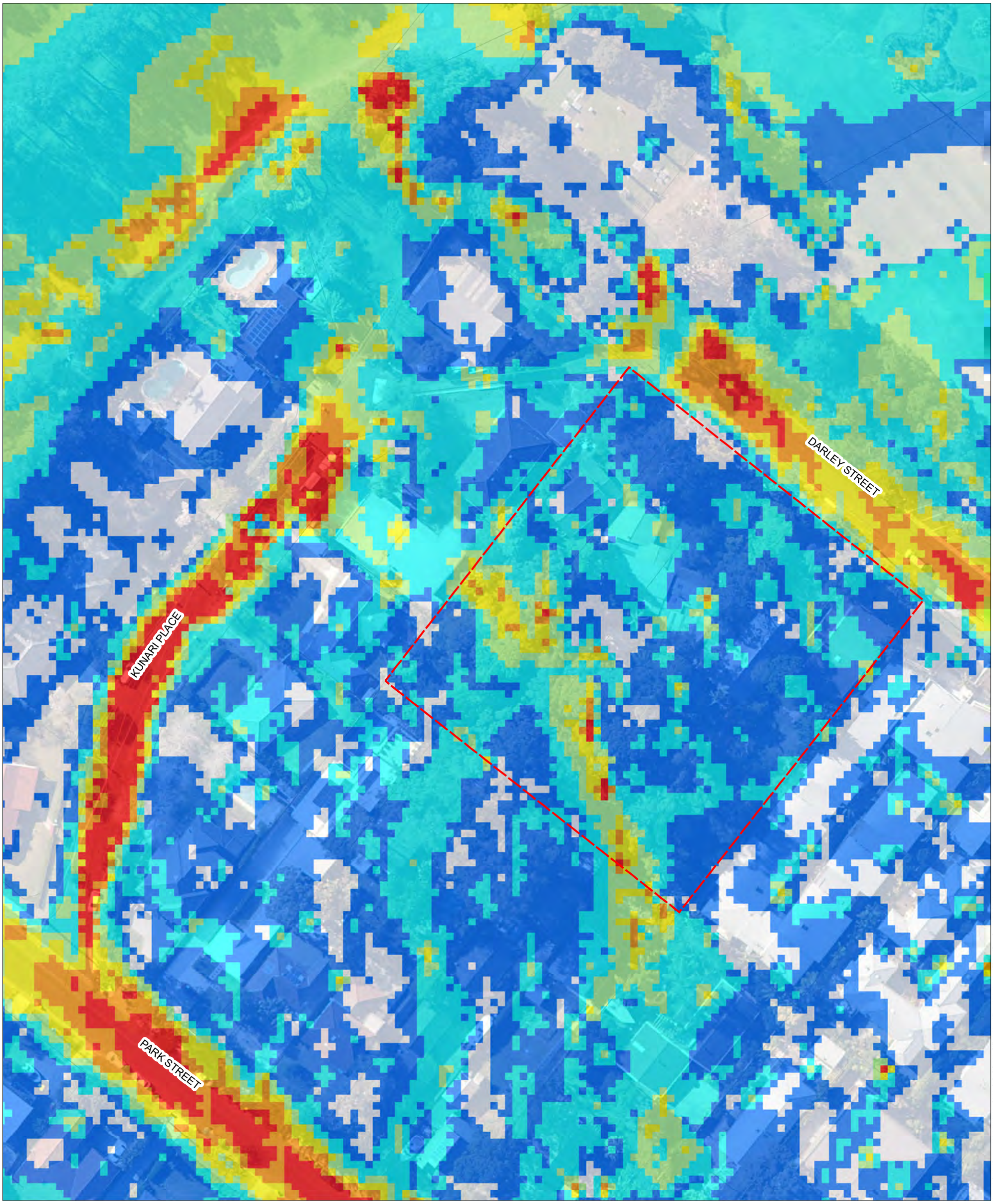

FIGURE 7: PEAK FLOOD VELOCITY (PMF, 15MIN)

Legend

Site Boundary
Cadastre
Roads

Peak Flood Velocity (m/s)

0 - 0.1
0.1 - 0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1
1 - 1.25
> 1.25

AECOM

N

0 0.01 0.02 km

Source: Nearmap

Appendix D

Flood Maps - Proposed

FIGURE 1: SITE LAYOUT

Legend

- Site Boundary
- Cadastre
- Roads

AECOM

N

0 0.01 0.02 km

Source: Nearmap

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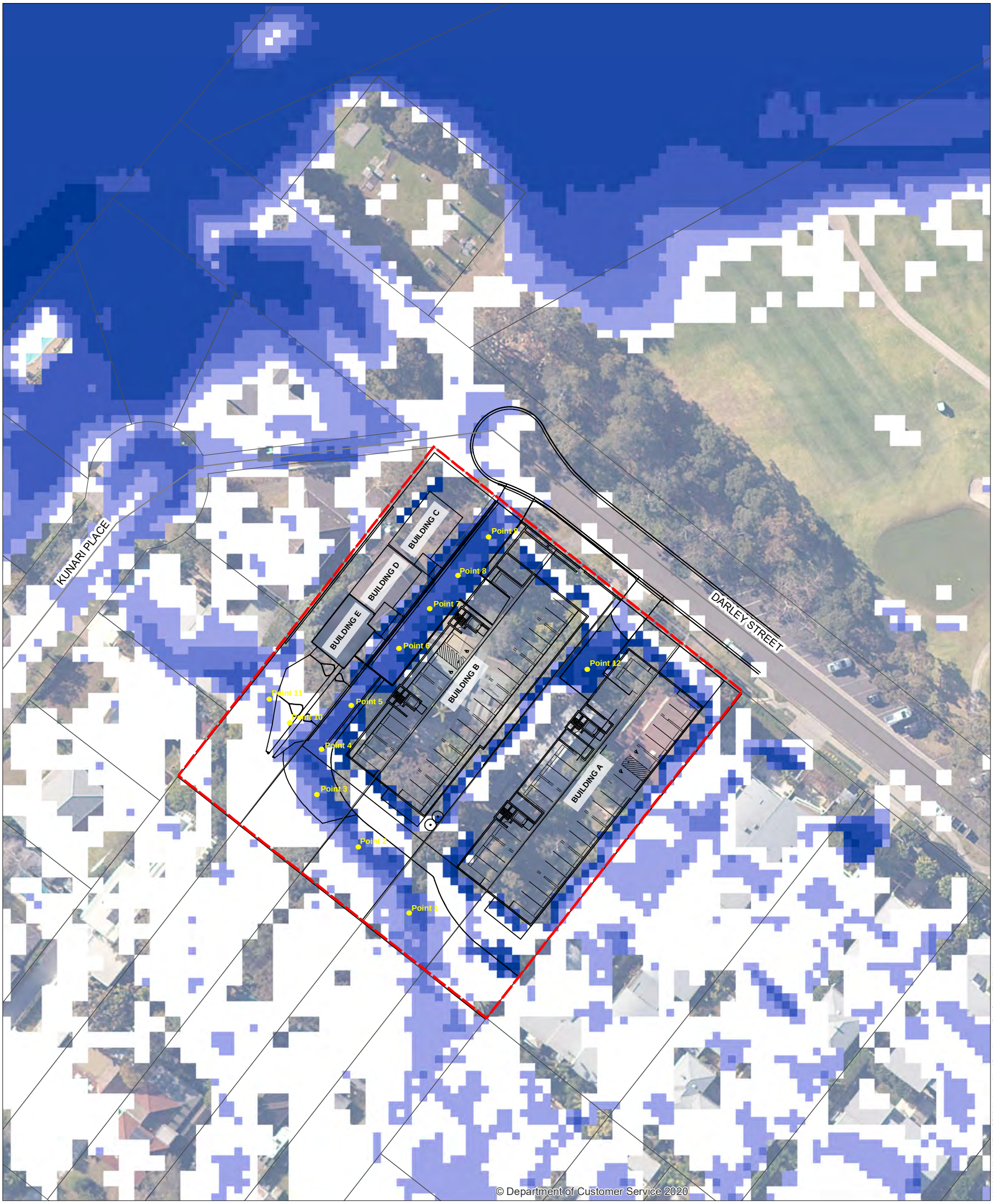

FIGURE 2: FLOOD DEPTH (1% AEP 2 HR, DESIGN D04)

Legend

- Site Boundary
- Cadastre
- Roads

D04 1% AEP 2hr Depth (m)

- 0.02 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- > 1.0

AECOM

N

0 0.01 0.02 km

Source: Nearmap

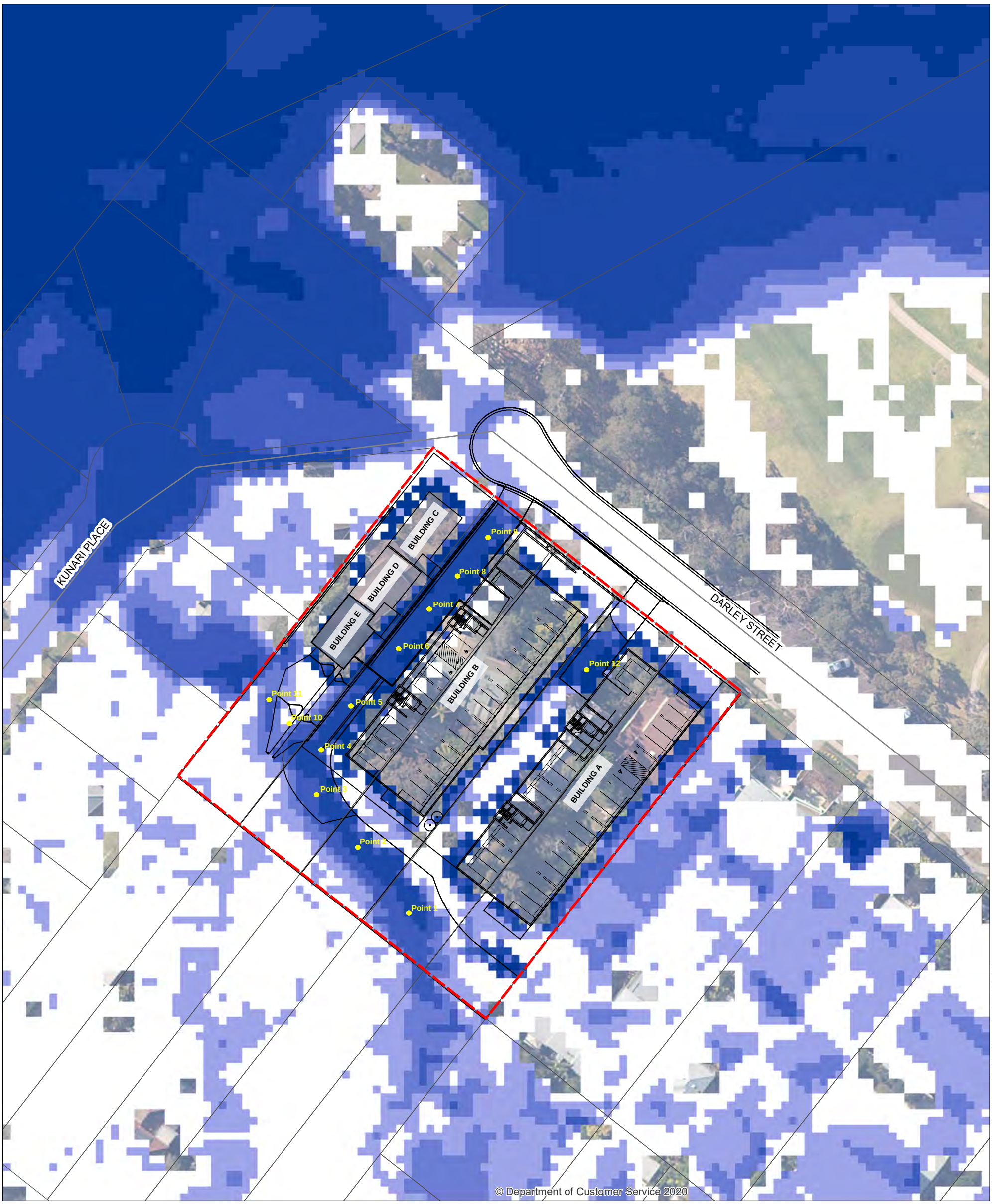

FIGURE 3: FLOOD DEPTH (PMF 15 MIN, DESIGN D04)

Legend

- Site Boundary
- Cadastre
- Roads

D04 PMF 15min Depth (m)

- 0.02 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- > 1.0

AECOM

N

0 0.01 0.02 km

Source: Nearmap

V:\606X\606135161\2.HYD\10_GIS\02_Workspace\Maps\Flood Maps.mxd Date Saved: 27/04/2021

KUNARI PLACE
DARLEY STREET
BUILDING A
BUILDING B
BUILDING C
BUILDING D
BUILDING E
Point 1
Point 2
Point 3
Point 4
Point 5
Point 6
Point 7
Point 8
Point 9
Point 10
Point 11
Point 12
© Department of Customer Service 2020
VA\60BX\60613516\02.HYD\10_GIS\02_Workspace\Maps\Flood Maps.mxd Date Saved: 27/04/2021

FIGURE 4: FLOOD VELOCITY (1% AEP 2 HR, DESIGN D04)

Legend

Site Boundary
Cadastre
Roads

D04 1% AEP 2hr Velocity (m/s)

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- > 1.25

AECOM

N

0 0.01 0.02 km

Source: Nearmap

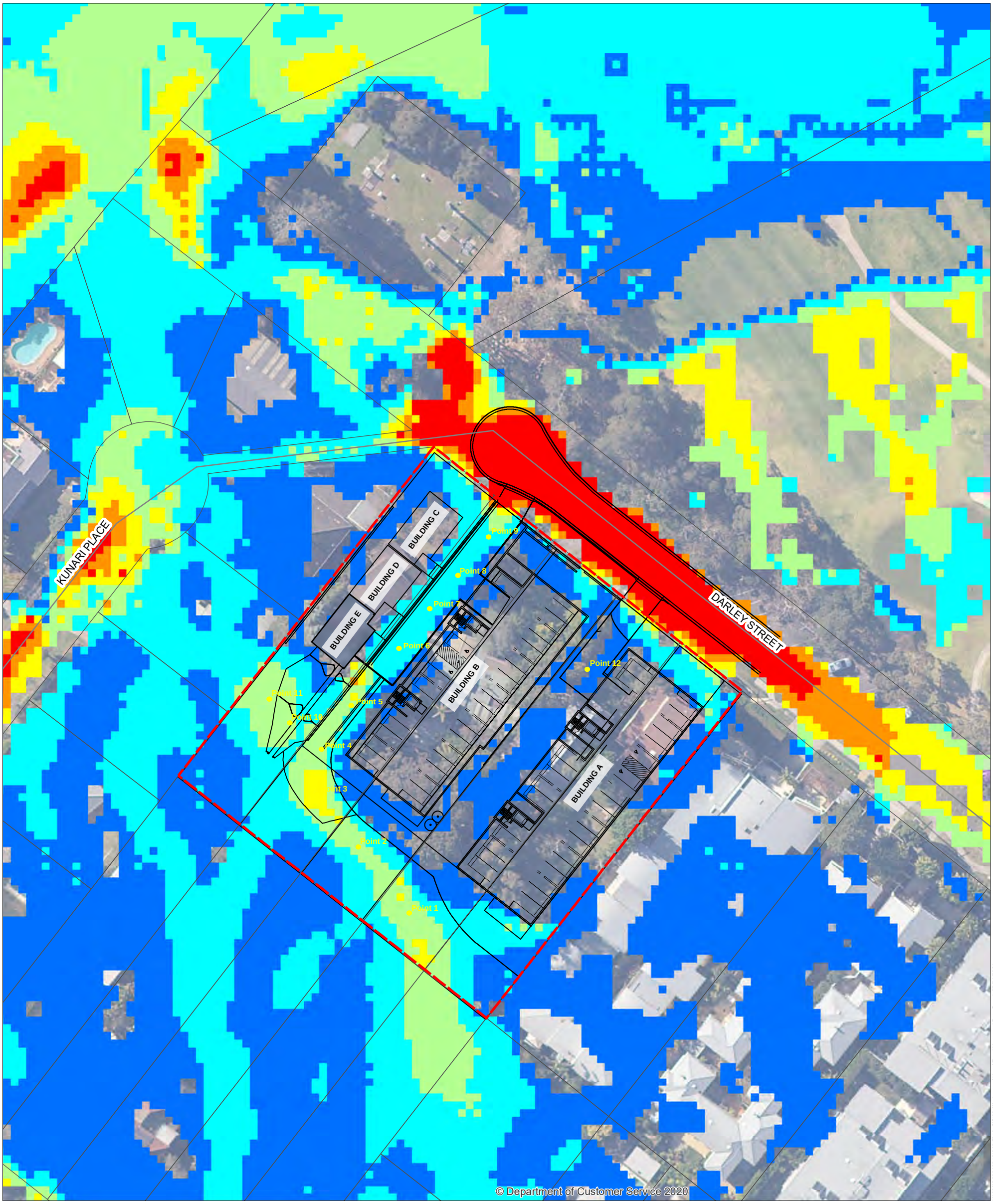

FIGURE 5: FLOOD VELOCITY (PMF 15 MIN, DESIGN D04)

Legend

Site Boundary

Cadastre

Roads

D04 PMF 15 min Velocity (m/s)

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- > 1.25

AECOM

N

0 0.01 0.02 km

Source: Nearmap

V:\606X\606135616\2_HYD\10_GIS\02_Workspace\Maps\Flood Maps.mxd Date Saved: 27/04/2021

FIGURE 6: AFFLUX (1% AEP 2 HR, D04-E01)

Legend

Site Boundary

Cadastre

Roads

D04-E01 1% AEP 2hr Afflux (m)

- < -0.5
- -0.5 to -0.25
- -0.25 to -0.15
- -0.15 to -0.05
- -0.05 to 0.05
- 0.05 to 0.15
- 0.15 to 0.25
- 0.25 to 0.5
- > 0.5

AECOM

N

0 0.01 0.02 km

Source: Nearmap

FIGURE 7: AFFLUX (PMF 15 MIN, D04-E01)

Legend

Site Boundary

Cadastre

Roads

D04-E01 PMF 15min Afflux (m)

- < -0.5
- -0.5 to -0.25
- -0.25 to -0.15
- -0.15 to -0.05
- -0.05 to 0.05
- 0.05 to 0.15
- 0.15 to 0.25
- 0.25 to 0.5
- > 0.5

AECOM

N

0 0.01 0.02 km

Source: Nearmap

Appendix E

Flooding Advice for 159-167 Darley Street, Mona Vale (20/08/2020)

AECOM Australia Pty Ltd
Level 21, 420 George Street
Sydney NSW 2000
PO Box Q410
QVB Post Office, NSW 1230

T: +61 2 8934 0000
F: +61 2 8934 0001
aecom.com

ABN 20 093 846 925

To:
Andrew Thurlow
Development Director
iNTREC Management Pty Ltd
73 Reserve Road
Artarmon NSW 2064 Australia

CC:

Project name:
159-167 Darley Road

Project ref:
60613516

Date:
August 20, 2020

Memo

Subject: Flooding Advice for 159-167 Darley Street, Mona Vale

Dear Andrew,

We refer to our proposal regarding the above and are pleased to provide the following flood advice as detailed in this memorandum. This preliminary advice is intended to inform the concept design general arrangement of a medium density development and assist discussions with Northern Beaches Council regarding the Planning Proposal.

Project Appreciation

iNTREC Management Pty Ltd (iNTREC) has an interest in 159-167 Darley Street in Mona Vale (the Site). The existing lots are currently occupied by individual residential houses and iNTREC are investigating options for development of the Site to potentially include a combination of townhouses apartment complexes.

According to the McCarrs Creek, Mona Vale and Bayview Flood Study (2017) completed by Royal HaskoningDHV on behalf of Northern Beaches Council (NBC), the Site is subject to flooding. Overland flow enters the Site from the upstream catchment in the south east. The resulting flood waters are described by NBC as being of low and medium flood hazard categories during a range of storm magnitudes.

The McCarrs Creek, Mona Vale and Bayview Flood Study (2017) was completed using the TUFLOW software and adopted a combination of survey types including LiDAR data. While LiDAR data can provide a reasonable basis for defining catchment wide topography in the context of a regional flooding strategy, it does not have the granularity to assess individual sites where the change in topography can be abrupt. AECOM have acquired a copy of the NBC flood model and have incorporated a detailed site survey obtained by iNTREC to better reflect the local site conditions and aid in developing a strategy to manage flood waters for the Site.

Site Description

The Site is located adjacent to Cahill Creek, which discharges to the Pittwater Estuary. The Site location is illustrated in Figure 1 in Appendix A. Overland flows arrive at the site from the south/south-east and flow towards Cahill Creek. The overland flows concentrate in an undefined valley through 167 Darley Street. There is a defined flow path through the rear of the properties directing water through several neighbouring properties before discharging towards Kunari Place. The overland flow path through the lots aligns with an existing Sydney Water owned ø150 PVC waste-water pipe identified in the detailed site survey. Due to the defined nature of the flow path, careful consideration of the type of development adopted is required to ensure impacts on neighbouring properties are mitigated to as low as reasonably practical.

Available Information

A summary of the data referenced in development of this technical memorandum is presented in Table 1.

Table 1. Available information

Data	Type	Source	Description
Flood Report	Pdf	Northern Beaches Council	McCarrs Creek, Mona Vale and Bayview Flood Study Review (2017) prepared by Royal HaskoningDHV.
Flood Model	TUFLOW (MID/MIF)	Northern Beach Council	The McCarrs Creek, Mona Vale and Bayview flood model (2017) prepared by Royal HaskoningDHV. Is intended to be used in conjunction with the McCarrs Creek, Mona Vale and Bayview Flood Study Review (2017) report.
Topographic Data	dwg	C-Side Surveyors	Site survey (dated 01/10/2019) capturing details within the Site with focus on 163-165 Darley Street and sections of Darley Street and Kunari Place. The survey includes the key features of the overland flow path which generally influence the behaviour of flood waters at the development site which is the primary focus of this assessment. It has been used to update the terrain incorporated into the TUFLOW model.

Flood Assessment

Supplied Model

The TUFLOW model obtained from Northern Beaches Council (Supplied Model) contains three model areas based on the nature of the sub-catchments within the model areas. The model areas include 'Rural' catchments, 'Pittwater' catchments and 'Urban' catchments. For the purpose of the current investigation, only the 'Urban' model has been used as it covers the Cahill Creek, Mona Vale Main Drain, Hillcrest and Mona Vale Golf Course sub-catchments.

The 'Urban' model extent and layout is shown in Figure 1. A number of assumptions and parameters of the supplied TUFLOW model developed by Royal HaskoningDHV are described below:

- Modelling was undertaken using TUFLOW Build 2016-03-AA with Classic engine
- Model boundaries:
    - Inflows have been applied as 2D Rainfall on Grid with temporal patterns taken from Australian Rainfall and Runoff (AR&R87) (Institute of Engineers Australia, 1987)
    - The downstream boundaries were set as height vs time (HT) & height vs flow (HQ) boundaries. Half of the model sub-catchments drain north to the Pittwater Estuary and half drain east to the Pacific Ocean at Mona Vale Beach.
    - Ocean tailwater levels and estuary tailwater levels
- A 3 metre grid size was adopted.
- Ground surface elevations were based on:
    - 1 metre gridded Airborne Light Detection and Ranging (LiDAR) survey captured September 2011;
    - Previously acquired survey information;
    - Detailed survey acquired by Mepsteads & Associates surveyors as part of the McCarrs Creek, Mona Vale and Bayview Flood Study (Royal HaskoningDHV, 2017) (survey completed in 2015), which was used to modify the terrain through a series of break lines
- Underground stormwater system incorporated as 1D elements within the modelling extents. It should be noted that there is a stormwater system along Darley Street that can be seen in Google Street View that is not represented by the TUFLOW model.
- According to the flood report, the following storms were considered critical local to the subject Site:
    - 2 hour storm for the 20% AEP event
    - 2 hour storm for the 1% AEP
    - 15 minute storm for the PMF event

The material roughness representing the bed resistance to overland flow are commonly represented by Manning's 'n' values. The values adopted by the Study were assigned based on aerial photography and cadastral information and distinguish between different materials such as roads, grassed areas and various types of development.

Base Case Model

The base case TUFLOW model for this study has been updated based on the Supplied Model by NBC. The base case terrain is generally the same as the one used in the Supplied Model but with the inclusion of the detailed site survey listed in Table 1. Within the Site, the survey provides coverage of property lots 163-165 Darley Street, and sections towards the rear of property lots 159-161 and 167 Darley Street. While the survey does not cover the 5 lots, it includes the key features of the overland flow path which generally influence the behaviour of flood waters at this location which is the primary focus of this assessment. The detailed survey extents are considered suitable for the purposes of this high-level preliminary study. The brick retaining wall on the Site adjacent to the overland flow path was also included in the base case using break lines.

The same storm durations as for the Supplied Model were used.

Base Case Modelling Results

Table 3 provides a summary of flood depths and velocities at a selection of locations across the site for the 20% AEP, 1% AEP and PMF events (refer also to Figure 2 to 7 in Appendix A). Flow depths are generally less than 0.4m for the 20% AEP and 1% AEP events, and less than 0.6m in the PMF event, with the exception of some localised deeper sections in the flow path. Velocities within the Site can reach 1 m/s in the 20% AEP,1.3 m/s in the 1% AEP event and up to 1.9 m/s in the PMF event. The magnitude of peak velocities at the Site do not differ from those of the Supplied Model.

From Figure 4, it can be seen that the Site is located outside mainstream flooding around Cahill Creek and is only affected by an overland flow path (approximately 13m wide). Additional maps that present the difference between the flood depth estimated in the NBC model and those obtained by incorporating the detailed site survey 20% AEP, 1% AEP and PMF events are also included for discussion purposes.

Table 2 shows a summary of the flow estimated to be entering and exiting the site during the 1%AEP event (Figure 8).

Table 2. Flow Summary for the Site

Flow Boundary	Location	Flow
Inflow	South-western boundary (Boundary 1 U.S.)	Total 0.8 m^3/s with approximately 0.5 m^3/s concentrated within the channel (Channel U.S.)
Inflow	South-east boundary (Boundary 2 U.S.)	0.3 m^3/s
Outflow	North-western boundary (Boundary D.S.)	Total 1.3 m^3/s with approximately 0.9 m^3/s concentrated within the channel (Channel D.S.)

Table 3. Depth and velocity results and point locations across the Site considering new detailed site survey (refer to Figure 8 for Sample Point locations)

Sample Point	20% AEP		1% AEP		PMF	
	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)
Point 1	0.30	0.8	0.36	1.0	0.54	1.3
Point 2	0.46	1.0	0.53	1.3	0.73	1.9
Point 3	0.33	0.6	0.41	0.6	0.64	0.8
Point 4	0.25	0.7	0.32	0.8	0.52	0.8
Point 5	0.33	0.2	0.40	0.3	0.62	0.5
Point 6	0.35	0.4	0.39	0.8	0.58	1.0
Point 7	0.54	0.1	0.59	0.3	0.74	0.4
Point 8	0.18	0.0	0.18	0.1	0.20	0.2
Point 9	0.16	0.0	0.16	0.0	0.18	0.1
Point 10	0.33	0.3	0.35	0.3	0.39	0.3
Point 11	0.28	0.2	0.30	0.2	0.33	0.3
Point 12	0.15	0.1	0.17	0.2	0.22	0.3

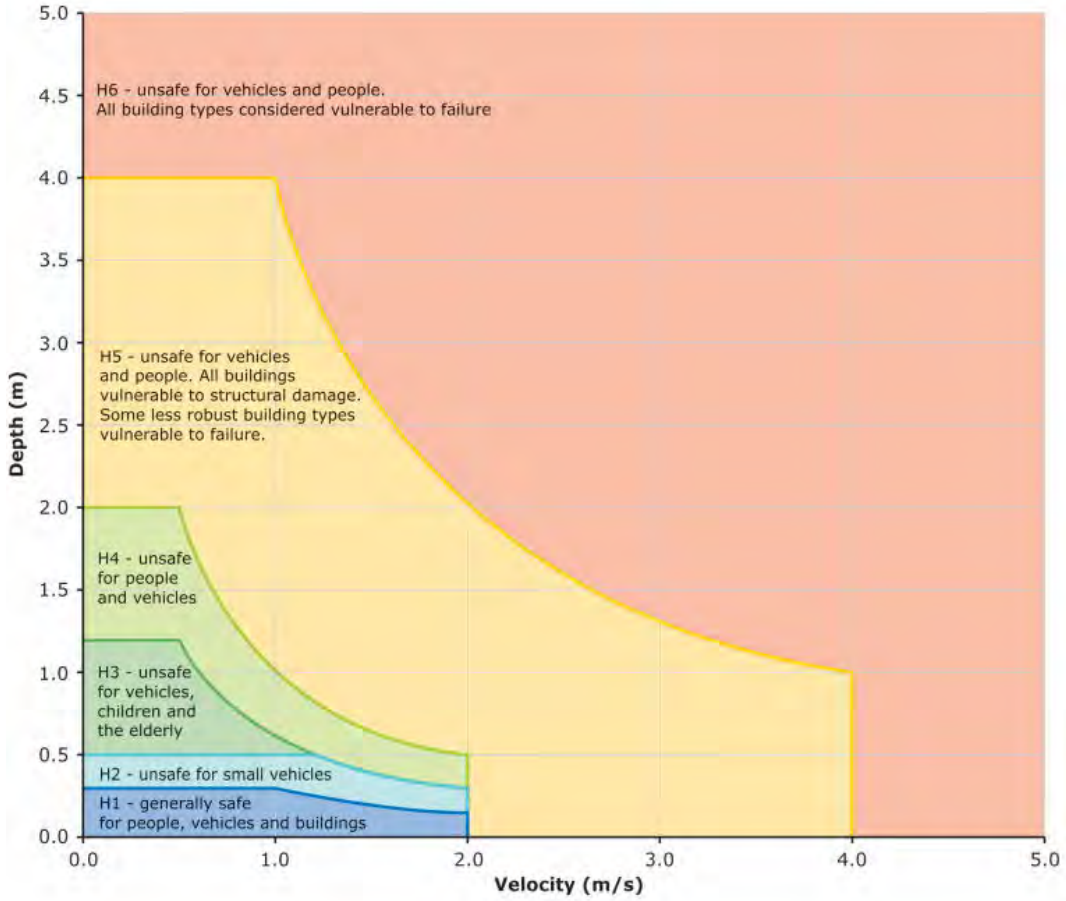

Figure 1 Combined Flood Hazard Curves

(Source Figure 6.7.9 ARR 2019)

With reference to the Combined Flood Hazard curves and the flood classifications within ARR2019 (extract included in Figure 1), the depth and velocity estimates for the existing conditions generally carry a low risk to buildings. The proposed development should aim to incorporate measures that also consider the risk to people and vehicles where applicable which we anticipate can be managed as part of the development.

Comparison of Supplied Model Results and Base Case Modelling Results

A comparison of flood levels between the Supplied Model and base case model was also undertaken. The level differences in the 20% AEP, 1% AEP and PMF events are shown in Figure 9 to 11. The results show that the flood extent within the property is very similar, with some localised changes in flood levels as a result of the detailed site survey.

An additional map that presents the difference in terrain between the Supplied Model and the base case has also been included for discussion purposes in Figure 12. This terrain difference map shows that the overland flow path is closer to the existing buildings on the property, rather than running very close to the property line which is what the Supplied Model indicated. This shows how the localised changes in flood level spatially correspond to the changes in model terrain. A cross section shown in Figure 8 shows how the terrain and water level has changed is presented in Figure 13 below.

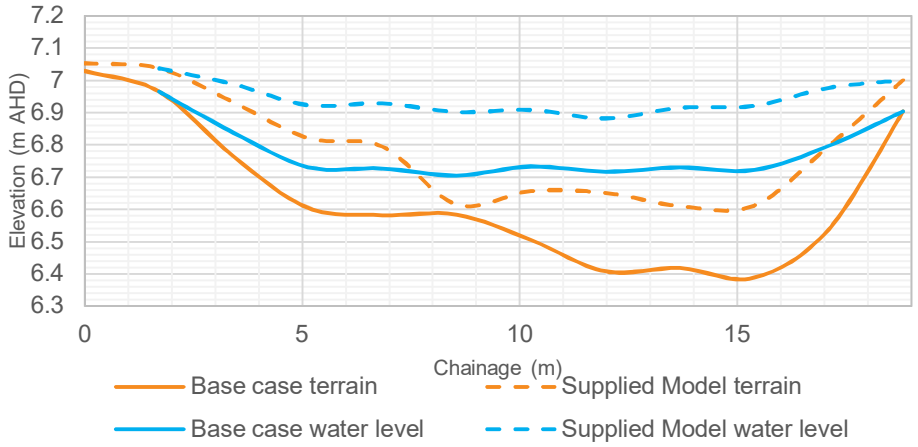

Figure 23. Terrain and water level at channel cross-section for Base Case Model and Supplied Model (1% AEP)

Recommendations

The base case modelling results indicate that the primary flow path through the back of the property at 159-167 Darley Street has slightly changed positions compared to the Supplied Model. The overland flow entering the Site from the neighbouring property is closer to Darley Street than what was indicated in the Supplied Model.

The survey presents a reasonable representation of the main overland flow path through the development and is generally suitable for this preliminary assessment, it is recommended a detailed survey be obtained which covers the full extent of the development area to ensure interfaces with existing developments are incorporated into the design.

From the supplied information, the elevation of the channel is lower than the Supplied Model suggests in some locations, and while the magnitude of peak flood depths has not changed, the relative level of the flood waters within the channel is lower. The revised modelling also suggests the peak velocities within the Site are very comparable to those indicated by the Supplied Model.

There are several options that could be pursued in consideration of development for the site. These should be pursued in consultation with NBC. Two mitigation measures have been described below, but the feasibility of each option is subject to site constraints and compatibility of the preferred site layout and NBC approval.

1. Site Layouts compatible with overland flows

   Incorporate overland flow paths either through the lot (such as swales or open spaces) to maintain existing flood behaviours or divert the overland flood towards Darley Street (e.g. via roadways or paths). This option could minimise direct impacts to neighbouring properties and is unlikely to require work outside of the Site boundary. Further investigation is required to confirm whether the Darley Street stormwater networks have enough capacity as the diverted overland flow may result in surcharging of the network and could have impacts to adjacent properties along Darley Street.

2. On-Site Drainage System

   An On-site Drainage System may reduce flood impacts by capturing overland flows and discharging them to the existing local stormwater network. Further investigation is required including approval from relevant authorities. Further, site constrains such as capacity of the existing network, the existing sewer line that traverses the Site and minimum cover/space for the pit and pipe installation may preclude this.

A combination of the above could also provide a flexible solution to managing the flood risk both on the site as well as on adjacent properties.

Ministerial Direction

The Planning Circular (NSW Government Department of Planning, 2007) will need to be addressed at the Planning Proposal stage. The Planning Circular details the “new guideline and changes to the section 117 direction and EP&A Regulation on flood prone land”. The relevance of this document will be to ensure that the flood planning level (FPL) criteria is met for the proposed development. The standard FPL for residential developments is the 100-year (1% AEP) flood level plus an appropriate freeboard, typically 0.5m.

Further discussion with Northern Beaches Council is recommended on flood planning requirements and the classification on the flooding behaviour (defined as either mainstream or major overland flow paths). Pending these discussions and confirmation on the development details, and resulting flooding behaviour in the proposed conditions, one of the two planning requirements may apply:

1. Mainstream Flooding: the 1% AEP flood level plus 0.5m is applied to residential finished floor levels (FFL) that do not provide a connection to a basement level; or
2. Major Overland Flow Paths: the 1% AEP is adopted as the residential FFL, however a 5m buffer is applied to the modelled flood extent.

It should be noted that the sketch provided in Figure 14 (Appendix A) is based on existing conditions. It is recommended that a proposed conditions flood model be developed as part a future detailed Development Application submission to estimate the impact on the overland flow regime, as this may influence the flood planning levels proposed.

Additionally, as the current Urban Design Study by Giles Tribe indicates basement parking, a higher level of protection may be required for all openings that connect to the basement i.e. lift cores, stairs, ventilation, driveway entrances etc. It is recommended that this be discussed with NBC and to confirm all final requirements.

If you have any questions regarding the above, please do not hesitate to contact the undersigned.

Nathan Mitchell
Principal Civil Engineer
D +61 2 8934 0570 M +61 439 228 678
Nathan.Mitchell@aecom.com