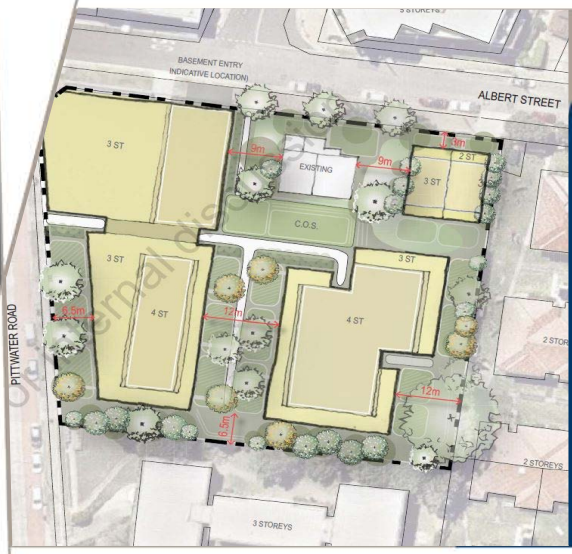
1294-1300 Pittwater Road & 2-4 Albert Street, Narrabeen

Flood Risks Assessment

59918094



Prepared for
Highgate Management Pty Ltd

26 November 2018

Cardno
Shaping the Future

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Cover Image: The extent of 1294-1300 Pittwater Road and 2-4 Albert Street, Narrabeen (Source: GMU - Urban Design and Architecture Pty Ltd, November 2018)

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1 Introduction

1.1 Background

Cardno (NSW/ACT) Pty Ltd ('Cardno') was commissioned by Highgate Management Pty Ltd to undertake a Flood Risk Assessment for 1294-1300 Pittwater Road and 2-4 Albert Street, Narrabeen. This assessment has been undertaken to inform development options for the site to reduce flood damage and risk to life.

GM Urban Design & Architecture (GMU) have been engaged by the owners of the site located at No.1294-1300 Pittwater Road and 2-4 Albert Street, Narrabeen, to prepare an initial built form study for the subject site. It described the site as follows:

> *The site is located on Pittwater Road approximately 26 km north of Sydney's CBD. Pittwater Road is an arterial connection linking villages and centres on Sydney's Northern Beaches. The area has no light or heavy rail connection but benefits from the new B-Line Priority bus services. Pittwater Road is the major connector between Mona Vale and major employment centres in the area as well as to Sydney's CBD.*
>
> *The site is located at the 'entry' to Narrabeen Village from the south. The site is visible from a significant distance due to its prominent location, where the main road turns in a north-westerly direction towards the bridge and North Narrabeen. The site occupies the corner immediately opposite the village retail centre. The site currently provides existing commercial uses. It is perceived as the termination of the retail strip.*
>
> *According to the survey information provided (Byrne & Associates), the site area by title is approximately 4,718m2 and consists of 6 lots. The properties are legally known as Lot 2 DP 84490, Lot 1 DP 613541, Lot 6A DP 200030, Lot 100 DP 773884, Lot 1 DP 615179 and Lot 8C DP 200030 and located at Nos. 1294, 1296, 1298, 1300 Pittwater Road and No. 2 and 4 Albert Street, Narrabeen (the site).*
>
> *The block is bounded by Albert Street (north), King Street (south), Ocean Street (east) and Pittwater Road (west). The site has a frontage to Pittwater Road, which is approximately 61.7m as well as a frontage to Albert Street, of approximately 75m in length. Currently, a number of buildings are located on the site(s) including a heritage cottage at No. 2 Albert St, a residential dwelling and the corner commercial building occupied by Financial Services, Medical Consulting rooms and Dental Surgery.*
>
> *The site slopes approximately 6m from the eastern boundary to the western boundary along Pittwater Road.*

The location of the site is presented in **Figure 1.**

1.2 Flooding Considerations

The *Narrabeen Lagoon Flood Study* was prepared in 2013 by BMT WBM for the former Warringah Council and Pittwater Council (now Northern Beaches Council) to define the 'mainstream' flood behaviour in the study area. The Flood Study (BMT WBM, 2013) has subsequently been adopted by Council. The Flood Study provides the flood data used for this assessment.

The flooding hazard maps for the site were prepared by Northern Beaches Council and are given in **Appendix A** while the 100 year ARI and PMF flood extents estimated in the 2013 Flood Study as given in **Appendix B**.

1.3 Purpose of this Study

The objective of the study is to address the following considerations for planned development of the site:

- Indicative impact of planned development on flooding;
- Flood emergency response;
- Flood warning and evacuation;
- The levels and approach the development will need to adopt to comply with requirements of Northern Beaches Council DCP and LEP 2011.

The study is provided as part of the planning proposal submission for the proposed redevelopment of the site.

This study has been undertaken as a Desktop Review only.

2 Previous Study

The proposed development on 1294-1300 Pittwater Road, Narrabeen is potentially subject to flooding by floodwaters spilling from Narrabeen Lagoon and its catchment. Consequently previous studies of flooding in the Narrabeen Lagoon are relevant to the subject site.

2.1 Narrabeen Lagoon Flood Study (Final Report) (BMT WBM, 2013)

This flood study describes the process undertaken to determine the design flood event levels for the Narrabeen Lagoon catchment.

The flood study developed a RAFTS hydrological model and a TUFLOW hydraulic model to define the flooding behaviour in the study area. The models were calibrated to the April 1998 event. This calibration was validated against two additional historical events, August 1998 and March 2011.

The flood study assessed the 20%, 5%, 2% and 1% AEP events, and the PMF event. The design events were run for both catchment and ocean flooding. It was observed that for major events catchment derived flows controlled the majority of flooding within both the Lagoon and catchment. Whilst ocean inundation scenarios produce flooding of some foreshore areas, the extent and severity of flooding is significantly less than the corresponding catchment derived flood event magnitude.

The flooding behaviour within the study area was found to have some sensitivity to the berm conditions adopted. For a 0.7 m increase in initial berm level (i.e. 2.0 m AHD instead of 1.3 m AHD), an increase of 0.2 m in the peak flood level was recorded within the Lagoon.

Roads throughout the study area were found to be overtopped by flooding in multiple locations in the 5% AEP event.

The study also found that flooding within the study area was sensitive to sea level rise associated with climate change.

3 Flooding Assessment

The assessment of flooding under existing conditions and the indicative assessment of the impact or otherwise of the development was undertaken using results from the 2013 flood study.

3.1 Existing Conditions

The location of the site is presented in **Figure 1.**

Survey of existing ground levels and buildings is given in **Figure 2.**

3.1.1 Flood Extents, Depths and Velocities

Plots of the flood extents and flood contours, depths and velocities were prepared based on Narrabeen Lagoon model results for the subject site.

3.1.2 Pedestrian and Vehicular Stability

When initially considering pedestrian and vehicular stability, three velocity x depth criteria have been typically adopted as follows:

Velocity x Depth	Comment
≤ 0.4 m^2/s	This is typically adopted by Councils as a limit of stability for pedestrians
0.4 – 0.6 m^2/s	Unsafe for pedestrians but safe for vehicles if overland flood depths do not exceed around 0.3 m
> 0.6 m^2/s	This is typically adopted by Councils as a limit of stability for vehicles

More recently ARR2016 has provided the following guidance on pedestrian and vehicular stability:

> *Cox et al., 2010 concluded that self-evacuation of the most vulnerable people in the community (typically small children, and the elderly) is limited to relatively placid flow conditions. Furthermore, a D.V as low as 0.4 m2s-1 would prove problematic for people in this category, i.e. the more vulnerable in the community. These hazard regimes for tolerable flow conditions (D.V) as related to the individual's physical characteristics (H.M) are presented in Figure 9.2.4 …...*

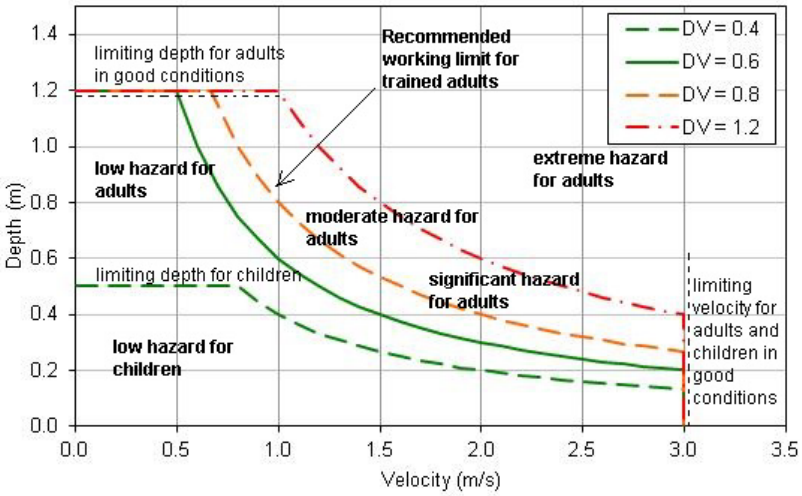


Figure 9.2.4. Safety Criteria for People in Variable Flow Conditions (After Cox et al, 2010)

Determining safety criteria for vehicles requires an understanding of the physical characteristics of the vehicle along with the nature of the flow.

The measure of physical attributes for vehicle stability analysis is the vehicle classification as based on length (L, m), kerb weight (W, kg) and ground clearance (GC, m). Three vehicle classifications are suggested:

- *Small passenger: L < 4.3 m, W < 1250 kg, GC < 0.12 m*
- *Large passenger: L > 4.3 m, W > 1250 kg, GC > 0.12 m*
- *Large 4WD: L > 4.5 m, W > 2000 kg, GC > 0.22 m*

The measure of flow attributes for vehicle stability analysis is D.V m2s-1, determined as the product of flow depth (D, m) and flow velocity (V, ms-1).

Limiting conditions exist for each classification based on limited laboratory testing of characteristic vehicles. The upper tolerable velocity for moving water is defined based on the frictional limits, and is a constant 3.0 ms-1 for all vehicle classifications.

The upper tolerable depths within still water are defined by the floating limits:

- *Small passenger vehicles: 0.3 m*
- *Large passenger vehicles: 0.4 m*
- *Large 4WD vehicles: 0.5 m*

The upper tolerable depths within high velocity water (at 3.0 ms^{-1}) are defined by the frictional limits:

- *Small passenger vehicles: 0.1 m*
- *Large passenger vehicles: 0.15 m*
- *Large 4WD vehicles: 0.2 m*

… Stability criteria based on the best available information for stationary small passenger cars, large passenger cars and large 4WD vehicles in various flow situations are presented in Figure 9.2.6 …..

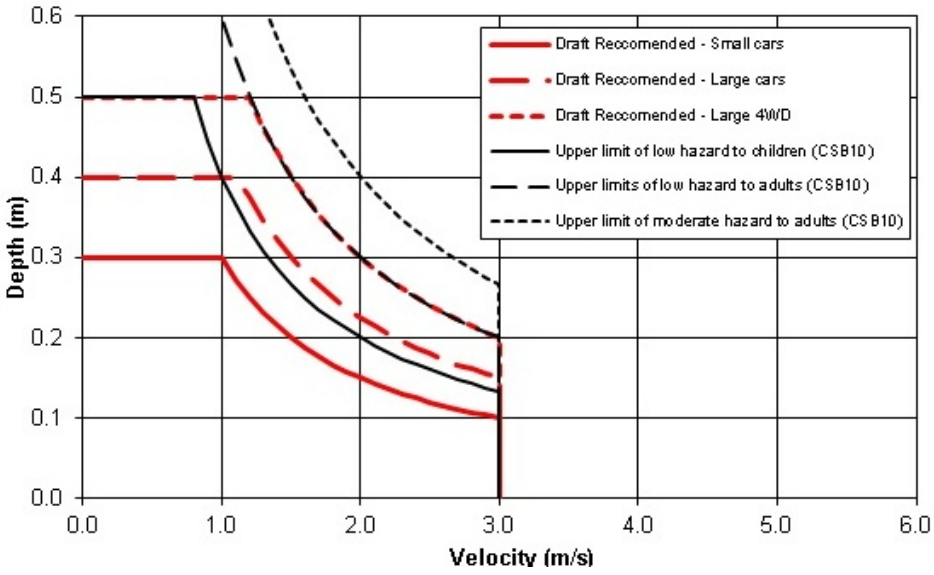


Figure 9.2.6. Interim Safety Criteria for Vehicles in Variable Flow Conditions (After Shand et al, 2011)

Shand et al (2011) concludes that the available datasets do not adequately account for the following factors and that more research is needed in these areas:

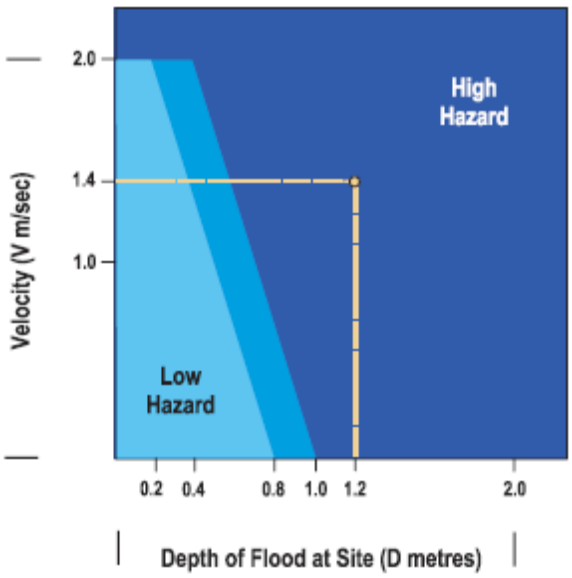
- *Friction coefficients for contemporary vehicle tyres in flood flows;*
- *Buoyancy changes in modern cars;*
- *The effect of vehicle orientation to flow direction (including vehicle movement);*
- *Information for additional categories including small and large commercial vehicles and emergency service vehicles*

3.1.3 Flood Hazard

2005 NSW Floodplain Development Manual

Experience from studies of floods throughout NSW and elsewhere has allowed authorities to develop methods of assessing the hazard to life and property on floodplains. This experience has been used in developing the NSW Floodplain Development Manual to provide guidelines for managing this hazard. These guidelines are shown schematically below.

To use the diagram, it is necessary to know the average depth and velocity of floodwaters at a given location. If the product of depth and velocity exceeds a critical value (as shown below), the flood flow will create a **high hazard** to life and property. There will probably be danger to persons caught in the floodwaters, and possible structural damage. Evacuation of persons would be difficult.



Provisional Hazard Categories (after Figure L2, NSW Government, 2005)

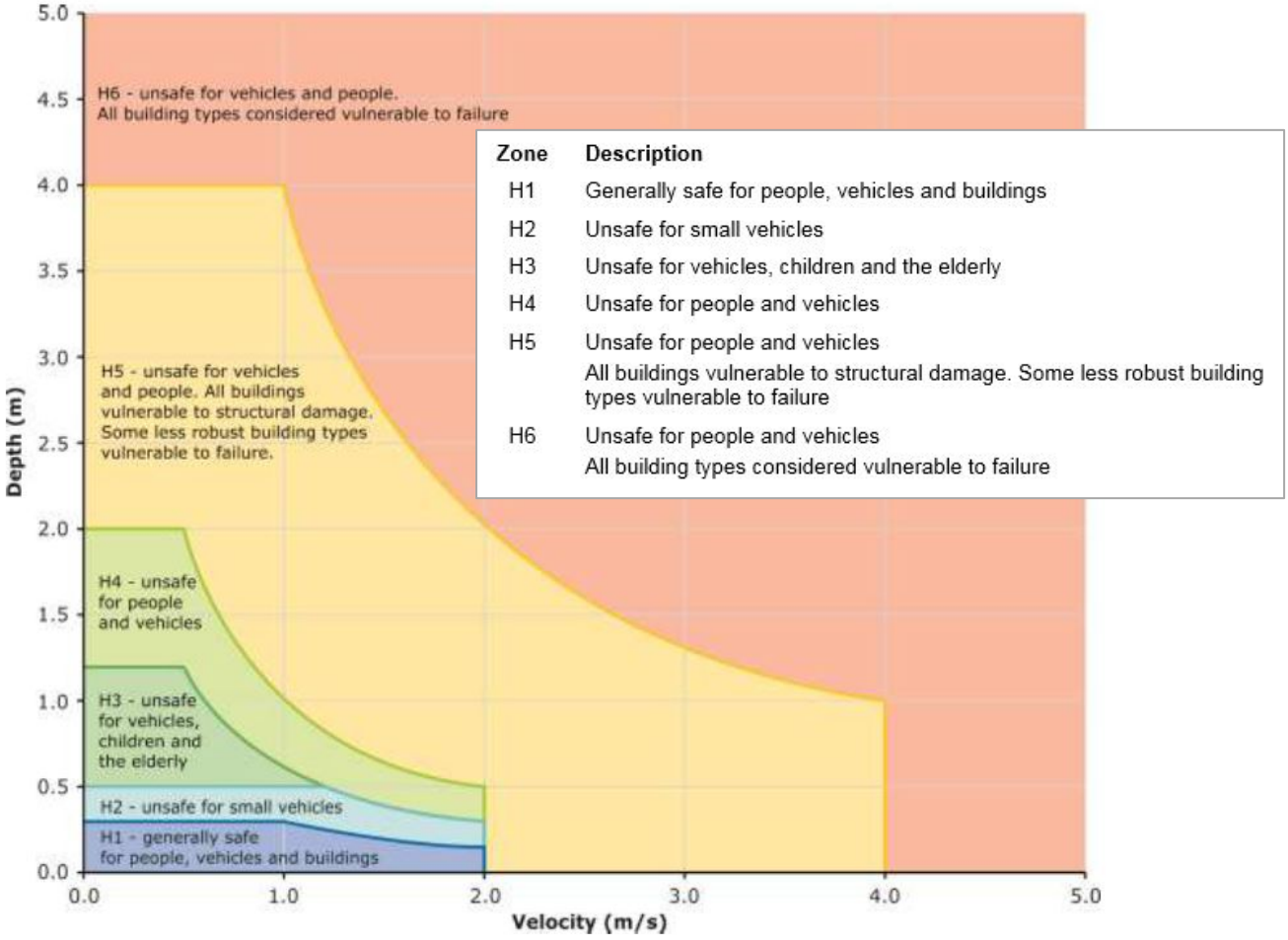
By contrast, in **low hazard** areas people and their possessions can be evacuated safely by trucks. Between the two categories a transition zone is defined in which the degree of hazard is dependent on site conditions and the nature of the proposed development.

This calculation leads to a provisional hazard rating. The provisional hazard rating may be modified by consideration of effective flood warning times, the rate of rise of floodwaters, duration of flooding and ease or otherwise of evacuation in times of flood.

2013 AEMHS Handbook 7

The AEMHS Handbook 7 "Managing the floodplain: a guide to best practice in flood risk management in Australia "*has been developed with consideration of the National strategy for disaster resilience (COAG 2011), and the findings of recent State and national reviews following the multiple flood events of 2010 to 2012 that resulted in widespread flooding. It is intended to provide broad advice on all important aspects in managing flood risk in Australia*".

The supporting document titled "Technical flood risk management guideline: Flood Hazard" includes a plot of flood hazard vulnerability curves based on six categories H1 – H6 as follows:



3.2 Peak Flood Levels

The following section provides a review of Council's flood levels and mapping in relation to the subject site.

Flood levels have been reviewed within the vicinity of the subject site. **Figure 3** highlights the 100 year flood extents within the local vicinity.

The 2013 flood study results indicate that the 1300 Pittwater Road site is partially affected at Buildings A and B in the 100 year and PMF event.

For planning purposes Council has adopted a 1% AEP catchment flood coincident with a 5% AEP ocean level. Based on this scenario the following flood levels apply to the subject site:

- 1%AEP + coincident 5% AEP ocean level: 3.05 m AHD
- PMF 4.99 m AHD.

The 1% AEP flood level adopted for the review of the development flood levels is rounded up to 3.1m AHD while the PMF level is rounded to 5.0 m AHD.

The minimum habitable floor level for the site is to be not less than the Flood Planning Level (FPL) which is 3.6 m AHD.

3.3 Concept Future Conditions

GM Urban Design & Architecture (GMU) have prepared an initial built form study for the subject site. It is described in part as follows:

> *The indicative masterplan for the site proposes a mixed use development containing 3 built forms and a smaller multi-unit building (terrace house typology) aligning with Albert Street, between the existing heritage cottage and the seniors housing estate (Furlough House).*
>
> *Vehicular entry is likely to be provided from Albert Street, located to minimise impacts to adjoining properties and contained within the indicative built form to minimise visual exposure. Basement car parking should be provided.*
>
> ***Built form massing***
>
> *The proposed building footprints and maximum massing as follows:*
>
> *Potential Built form A*
>
> *Is located to the north-western corner of the site aligning with the northern and western boundary. This massing would celebrate the prominent corner location, announcing the entry to Narrabeen Town Centre. This built form could align with the existing buildings to the northern side of Albert Street.*
>
> *Potential massing could provide a 3 storey form consistent with existing streetwall heights to the north.*
>
> *Commercial and/or retail uses could be provided for the lower levels with residential apartments for the upper floor.*
>
> *Potential Built form B*
>
> *Located immediately to the south of potential massing A, massing B could be joined by a recessed element. Massing B would align with Pittwater Road, providing a 6.5m front setback to the western boundary facing Pittwater Road. It could include residential uses with private gardens to Pittwater Road at ground floor and apartments above.*
>
> *Potential massing B could provide a 3 storey streetwall height in response to the adjoining residential development to the south with a recessed 4th upper level within a roof form.*
>
> *Potential Built form C*
>
> *Located to the south-eastern corner of the site, this massing could include a 3 storey form fronting internal open space with a 4th storey contained within a roof form.*
>
> *A potential setback of 12 meters could be provided to the south eastern corner to allow for retention of the existing mature fig tree.*
>
> *A 6.5m setback to the eastern boundary (for the northern part) would ensure separation and landscape opportunities.*
>
> *A 14m setback could be provided to the northern interface and the heritage cottage.*

Potential Built form D

(Terrace house typology)

Respond to the existing 2 storey streetwall height to Albert Street and recess upper levels.

Provide a sensitive response to the heritage cottage setback by aligning with the existing cottage.

Provide transition to the lower scale to the east.

Provide fine grain articulation along Albert Street.

Allow for buffer plantings through landscaped setbacks. Built form proportions should correspond to those of smaller scale residential developments to the east.

Share basement car parking between future building forms.

The Cottage

Retain the existing cottage via adaptive reuse.

The preliminary built form massing is plotted in **Figure 11** while the preliminary built form is reproduced in **Figure 12**.

3.4 Indicative Flood Impact Assessment

The indicative impact of development to the western boundary of 1294-1300 Pittwater Road (based on the preliminary built form given in **Figure 11** and **12**) was estimated using Manning's equation applied to a cross section which extended through 1300 Pittwater Road and across Narrabeen Lagoon. The alignment of the cross section is given in **Figure 13**.

Indicative roughness values were also assigned to varying zones along the cross section based on the roughness zones identified in the 2016 flood study as reproduced in **Figure 14.**

The flow conveyance through the cross section in the 1% AEP flood was estimated under Existing Conditions. The cross section was then truncated to the western boundary of 1300 Pittwater Road and the change in water level required to match the conveyance under Existing Conditions was calculated.

If the increase in 1% AEP water level is uniform across the complete cross section then the estimated impact of development on 1300 Pittwater Road would be around 0.002 m. However it is unlikely that the impact of development would be uniformly distributed. Rather it is expected that any impact in a 1% AEP flood would be local to the site and would be of the order of 0.01 – 0.02 m.

4 Flood Risks

The flood risks at and in the vicinity of 1294-1300 Pittwater Road, Narrabeen are discussed as follows.

4.1 Flood Levels, Velocities and Hazards

The estimated 1% AEP flood depths, velocities, velocity x depth and flood hazard categories are plotted in **Figures 3, 4, 5** and **6** respectively.

The estimated PMF depths, velocities, velocity x depth and flood hazard categories are plotted in **Figures 7, 8, 9** and **10** respectively.

4.2 Flood Risk Precincts

The flood risk precincts have been mapped by Council and included in **Appendix A.** The site includes Medium and Low Flood Risk precincts.

4.3 Rate of Rise of Floodwaters

To understand the likely warning times and associated response times during extreme flood events it is necessary to estimate the expected rate of rise of floodwaters. At 1294-1300 Pittwater Road, Narrabeen the estimated rate of rise of flooding in a PMF event is around 1.75 m/hr.

The planned development either includes or will need to include the following features:

- The ground level along the Pittwater Road boundary is around 2.3 m AHD;
- It is proposed to grade the 6.5 m setback zone from the Pittwater Road boundary to around 2.6 m AHD at the edge of Building B;
- Proposed ground floor levels shops and apartments of 3.6 m AHD which provides 500 mm freeboard above the 1% AEP flood level;
- Proposed Level 1 floor levels of the apartments will be above 6.65 m AHD which is higher than the PMF level;
- A crest level of say 5.0 m AHD on the driveway access from Albert Street to the multi-storey car parking levels to provide 1.9 m freeboard above the 1% AEP flood level and would at the PMF level;
- A minimum entry level of 3.60 m AHD for any building with external access to the upper basement adjacent to Pittwater Road.

It is concluded that the ground floor apartments would have a freeboard of 500 mm above the 1% AEP flood level but that this freeboard would be overwhelmed in a PMF event. The PMF is estimated to reach a level of around 5.0 m AHD. A crest level of say 5.0 m AHD on the driveway access from Albert Street to the multi-storey car parking levels to provide 1.9 m freeboard above the 1% AEP flood level and would at the PMF level. If external access from Pittwater Road to the upper basement is proposed then this would need to be via a flood door to prevent inundation of the car parking levels.

4.4 Duration of Inundation

During a PMF the indicative duration that flood waters would exceed the flood planning level for Buildings A and B (refer Figure 11) could be 6 – 9 hours.

4.5 Flood Warning and Evacuation

In the case of a PMF event there may be insufficient lead time to evacuate any staff, residents and/or visitors from the ground floor of Buildings A or B prior to the peak of the PMF. Consequently staff, residents and/or visitors may need to shelter in place in the early stages of the flood. However if warranted by the expected duration of extreme flooding, it would be possible to evacuate residents and visitors from Buildings A and B to Albert Street via the external paths and open space which is set at 6.65 m AHD or 7.60 m AHD well above the PMF level.

5 Planning Considerations

5.1 Warringah Local Environment Plan 2011

Section 6.3 of the *Warringah Local Environment Plan (LEP) 2011* outlines the minimum requirements for the Flood Planning Level (FPL) which is defined as land the 100 year AR flood level plus 0.5 metre freeboard.

The LEP notes development consent should not be granted unless Council is satisfied the development:

a) *to minimise the flood risk to life and property associated with the use of land;*

b) *to allow development on land that is compatible with the land's flood hazard, taking into account projected changes as a result of climate change;*

c) *to avoid significant adverse impacts on flood behaviour and the environment.*

This clause applies to land at or below the flood planning level.

Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:

a) *is compatible with the flood hazard of the land;*

b) *is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties;*

c) *incorporates appropriate measures to manage risk to life from flood;*

d) *is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and*

e) *is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.*

A word or expression used in this clause has the same meaning as it has in the Floodplain Development Manual (ISBN: 0 7347 5476 0), published in 2005 by the NSW Government, unless it is otherwise defined in this clause.

In this clause:

flood planning level means the level of a 1:100 ARI (average recurrent interval) flood event plus 0.5 metre freeboard.

5.2 Warringah Development Control Plan 2011

The Warringah DCP 2011 defines the all floor level shall be set at the required prescriptive level with *additional consideration for the following:*

The passage of flood waters;

The purpose for which that floor area is to be used;

The relationship with the surrounding roadways;

The relationship with the existing building if the proposal is an extension; and

Surrounding built form and streetscape.

5.3 Flood Planning Level

The flood planning level adopted by Council is 100 yr ARI flood level + 500 mm. The flood planning level for the site is 3.6 m AHD.

5.4 Development Controls

The guideline for flood management report describes the assessment of impacts to be addressed for the various elements of the relevant LEP and DCP. The following controls are applicable to the development based Council's Flood Risk Management as below:

Table 1 Council's Compliance Table

	Compliance		
	Not Applicable	Yes	No
A Flood effects cause by Development			
B Drainage Infrastructure & Creek Works			
C Building Components & Structure			
D Storage of Goods			
E Flood Emergency Response			
F Floor Level			
G Car Parking			
H Fencing			
I Pools			

Details of what is required under each categories as defined in the *Development Control Plan for Flood Prone Land* matrix is summarised as follows.

5.4.1 Flood Effects cause by Development

A1 Jetty

Not applicable for this site.

A3 The applicant shall include in their submission, calculations to illustrate that any fill or other structures that reduce the total flood storage are replaced by Compensatory Works.

This requirement is noted and would be addressed in a flood impact assessment which would accompany any Development Application. Preliminary flood volume calculations for the 1% AEP flood indicate that compensatory storage achieved by re-grading the 6.5 m setback zone from the Pittwater Road boundary at around 2.3 m AHD to around 2.6 m AHD at the edge of Building B would compensate for the loss of flood storage due to Building A.

5.4.2 Drainage Infrastructure & Creek Works

B1 Flood mitigation works or stormwater devices that modify a major drainage system, stormwater system, natural water course, floodway or flood behaviour within or outside the development site may be permitted subject to demonstration through a Flood Management Report that they comply with the Flood Prone Land Design Standard found on Council's webpage.

This requirement is noted and would be addressed in a flood impact assessment which would accompany any Development Application.

B2 A Section 88B notation under the Conveyancing Act 1919 may be required to be placed on the title describing the location and type of flood mitigation works with a requirement for their retention and maintenance.

This requirement is noted.

5.4.3 Building Components & Structure

C1 All buildings shall be designed and constructed as flood compatible buildings in accordance with Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas, Hawkesbury-Nepean Floodplain Management Steering Committee (2006).

This requirement would apply to Buildings A and B only which will be designed and constructed as flood compatible buildings in accordance with this requirement.

A Structural report is required to be provided at Construction Certificate Stage.

C2 All structures must be designed and constructed to ensure structural integrity up to the Flood Planning Level, taking into account the forces of floodwater, wave action, flowing water with debris, buoyancy and immersion. Structural certification shall be provided confirming the above. Where shelter-in-place refuge is to be provided the structural integrity is to be to the Probable Maximum Flood level.

This requirement would apply to Buildings A and B which will be designed and constructed to ensure structural integrity up to PMF level on the basis of proposed shelter-in-place, taking into account the forces of floodwater, wave action, flowing water with debris, buoyancy and immersion.

The Structural report is required to be provided at Construction Certificate Stage.

C3 All new electrical equipment, power points, wiring, fuel lines, sewerage systems or any other service pipes and connections must be waterproofed and/or located above the Flood Planning Level. All existing electrical equipment and power points located below the Flood Planning Level must have residual current devices installed that turn off all electricity supply to the property when flood waters are detected.

All new electrical equipment's will need to be located above 3.6m AHD.

The electrical report is required to be provided at Construction Certificate Stage.

5.4.4 Storage of Goods

D1 Hazardous or potentially polluting materials shall not be stored below the Flood Planning Level unless adequately protected from floodwaters in accordance with industry standards.

All hazardous or potentially pollutant materials will need to be stored above 3.6m AHD.

D2 Goods, materials or other products which may be highly susceptible to water damage are to be located/stored above the Flood Planning Level.

All goods and materials in Building A and B that may be highly susceptible to water damage be stored above 3.6m AHD.

5.4.5 Flood Emergency Response

E1 Development shall comply with Council's Flood Emergency Response Planning for Development in Pittwater Policy and the outcomes of any Flood Risk Emergency Assessment Report where it applies to the land.

In the case of a PMF event there may be insufficient lead time to evacuate any staff, residents and/or visitors from the ground floor of Buildings A or B prior to the peak of the PMF. Consequently staff, residents and/or visitors may need to shelter in place in the early stages of the flood. However if warranted by the expected duration of extreme flooding, it would be possible to evacuate residents and visitors from Buildings A and B to Albert Street via the external paths and open space which is set at 6.65 m AHD or 7.60 m AHD well above the PMF level.

E2 New development must provide an appropriately sized area to safely shelter in place above the Probable Maximum Flood level and appropriate access to this area should be available from all areas within the development.

A detailed flood evacuation plan will need to be provided during detailed design. Safe refuge is required to be sought on higher levels within the Buildings A and B above RL 5.00. The design need to include provision for any visitors or residents any basement car park to evacuate vertically to a level higher than the PMF. This could be into Building C or Building D.

5.4.6 Flood Levels

F1 New floor levels within the development shall be at or above, the Flood Planning Level. A reduced Flood Planning Level may be considered only where it is permitted in this Development Control Plan.

The structure must be flood proofed (wet or dry) to the Flood Planning Level. This control cannot be applied to critical or vulnerable uses.

The minimum habitable floor level is to be no lower than 3.6 m AHD for Buildings A and B.

F2 All development structures must be designed and constructed so as not to impede the floodway or flood conveyance on the site, as well as ensuring no loss of flood storage in a 1% AEP event. Where the dwelling is located over a flow path it must be elevated on suspended pier/pile footings such that the level of the underside of all floors including balconies and decks within the flood affected area are at or above, or raised to the Flood Planning Level to allow clear passage of the floodwaters under the building. The development must comply with the Flood Prone Land Design Standard.

This requirement is noted and would be addressed in a flood impact assessment which would accompany any Development Application. The site is on the flood fringe and any change in flood storage would be assessed in a flood impact assessment. It is expected that any impact in a 1% AEP flood would be local to the site and would be of the order of 0.01 – 0.02 m.

F3 Where the lowest floor has been elevated to allow the passage of flood waters, a restriction shall be imposed on the title of the land, pursuant to S88B of the Conveyancing Act confirming that the undercroft area is not to be enclosed.

This requirement is noted.

F6 Any existing floor level may be retained below the Flood Planning Level when undertaking a first floor addition provided that:

(a) it is not located within a floodway;

(b) there is no increase to the building footprint below the Flood Planning Level;

(c) it is flood proofed to the Flood Planning Level;

Not applicable at this stage of development or expected for the site as all existing buildings except the Cottage will be demolished and rebuilt.

F8 The minimum floor level of any first floor additions shall be at or above the Probable Maximum Flood Level.

Not applicable

F10 Consideration may be given to a minimum floor level for the first 5 metres from the street front of new development in business zonings below the Flood Planning Level provided it can be demonstrated that it complies with the Flood Prone Land Design Standard.

This consideration is noted.

5.4.7 Car Parking

G1 Open carpark areas and carports shall not be located within a floodway.

Not applicable for this development.

G2 The lowest floor level of open carparks and carports (unroofed or with open sides) shall be constructed no lower than the natural ground levels.

Not applicable for this development. It is not expected any open carpark or carport for this development.

G3 All enclosed car parks must be protected from inundation up to the relevant flood planning level. For example, basement carparks must be provided with a crest at the entrance, the crest of which is at the relevant Flood Planning Level.

A crest level of say 5.0 m AHD on the driveway access from Albert Street to the multi-storey car parking levels would provide 1.9 m freeboard above the 1% AEP flood level and would at the PMF level.

All access, ventilation and any other potential water entry points to any enclosed car parking shall be above the relevant Flood Planning Level.

This requirement is noted.

Council will not accept any options that rely on electrical, mechanical or manual exclusion of the floodwaters from entering the enclosed carpark

This constraint is noted.

G4 Vehicle barriers or restraints are to be provided to prevent floating vehicles leaving the site where there is more than 300mm depth of flooding in a 1% AEP flood event.

The minimum height of the vehicle barriers or restraints must be at or above the Flood planning Level.

Vehicle barriers or restraints must comply with the Flood Prone Land Design Standard.

While this requirement is noted it is not expected to apply to the proposed development.

G5 Enclosed Garages must be located at or above the 1% AEP level

A crest level of say 5.0 m AHD on the driveway access from Albert Street to the multi-storey car parking levels would provide 1.9 m freeboard above the 1% AEP flood level and would at the PMF level and would protect any parked vehicles from flooding up to the PMF level subject to access, ventilation and any other potential water entry points to any enclosed car parking excluding PMF floodwaters.

G6 Carports must comply with the Flood Prone Land Design Standard

Not applicable for this development.

G7 Where a driveway is required to be raised it must be demonstrated that there is no loss to flood stage in the 1% AEP flood event and no impact on flood conveyance through the site

This requirement is noted and would be addressed in a flood impact assessment which would accompany any Development Application. Preliminary flood volume calculations for the 1% AEP flood indicate that compensatory storage achieved by re-grading the 6.5 m setback zone from the Pittwater Road boundary at around 2.3 m AHD to around 2.6 m AHD at the edge of Building B would compensate for the loss of flood storage due to Building A.

5.4.8 Fencing

H1 Fencing, including pool fencing, shall be designed so as not to impede the flow of flood waters and not to increase flood affectation on surrounding land. Appropriate fencing must comply with the Flood Prone Land Design Standard in addition to other regulatory requirements of pool fencing.

This requirement is noted. Also noted is Council's view that fencing (including pool fencing, boundary fencing, balcony balustrades and accessway balustrades) needs to be open for passage of flood waters - All new fencing on a property should be flood compatible with 50-75% of the fence being of an open design between the natural ground level and the Flood Planning Level. Only 25- 50% of the perimeter fence would be permitted to be solid. Openings should permit a 75 mm sphere to pass through, and should not impede the flow of water. If fencing is required the above control will apply.

5.4.9 Pools

I1 Pools located within the 1% AEP flood extent are to be in-ground, with coping flush with natural ground level. Where it is not possible to have pool coping flush with natural ground level, it must be demonstrated that the development will result in no net loss of flood storage and no impact on flood conveyance on or from the site.

All electrical equipment associated with the pool (including pool pumps) is to be waterproofed and/or located at or above the Flood Planning Level.

All chemicals associated with the pool are to be stored at or above the flood planning level.

If a pool is included in the development then the above control will apply. It is recommended that any pool be located east of Buildings A and B.

6 References

BMT WBM (2013) “Narrabeen Lagoon Flood Study”, *Final Report*, prepared for Warringah and Pittwater Councils, September

Northern Beaches Council (2011) Northern Beaches *Development Control Plan (DCP) 2011*.

Northern Beaches Council (2011) Northern Beaches *Local Environment Plan (LEP) 2011*.

Northern Beaches Council (2017) “Guidelines for Preparing a Flood Management Report, 2017”.

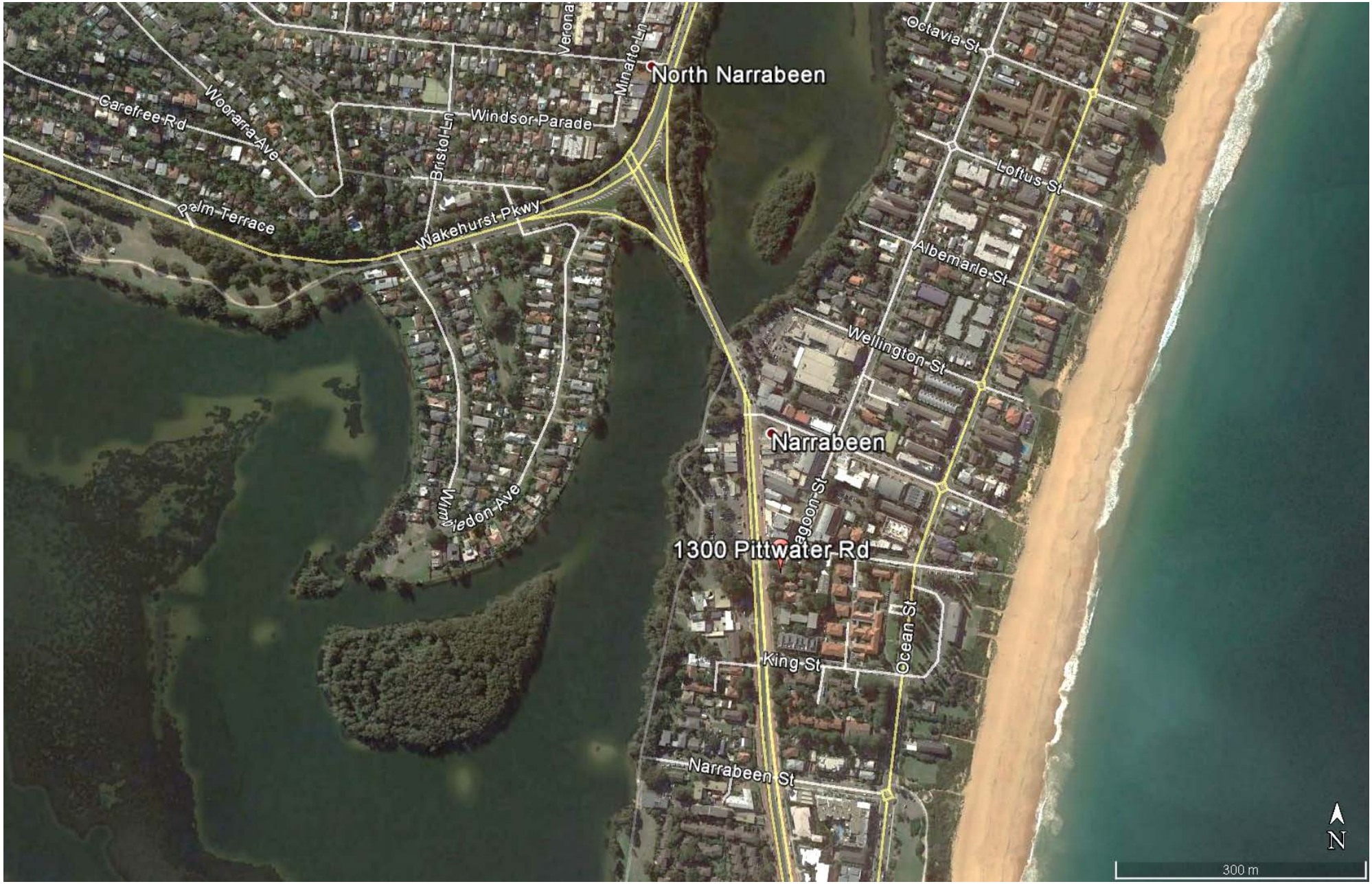


Figure 1 Location of 1294-1300 Pittwater Road, Narrabeen (Source: Google Earth, Image dated 15 March 2016, accessed 4 December 2017)

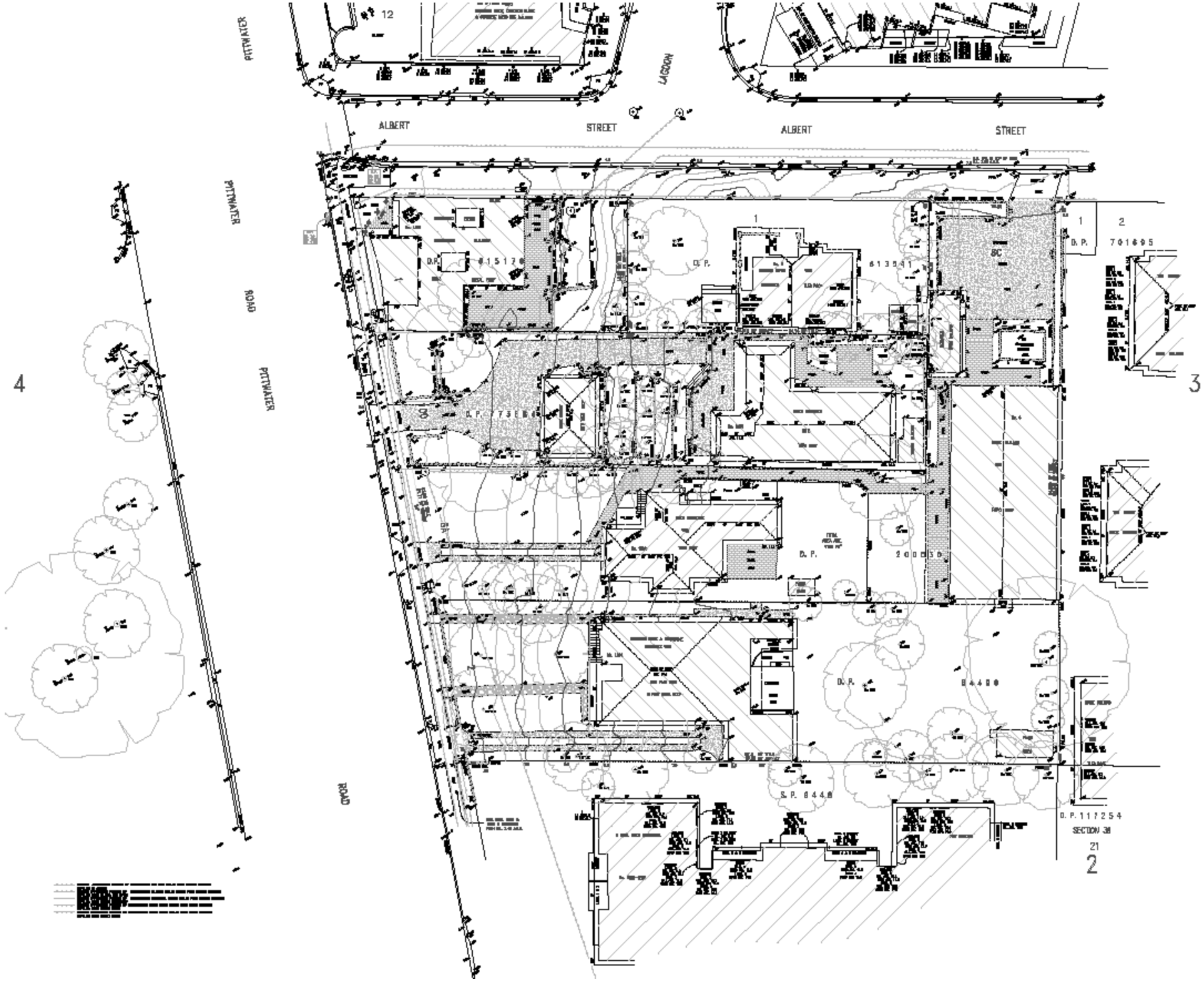


Figure 2 Survey of Existing Conditions

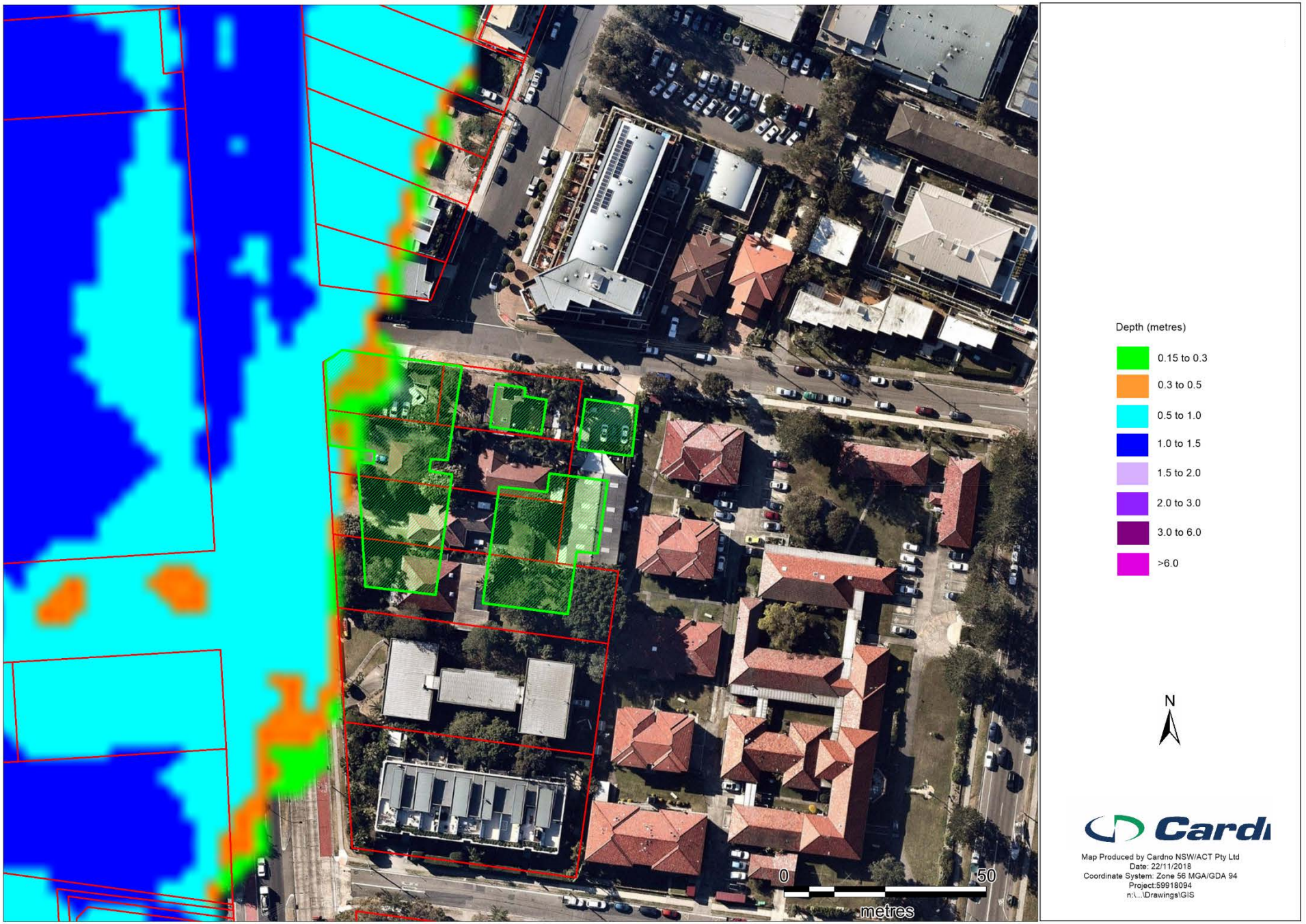


Figure 3 1% AEP Flood Depths under Existing Conditions

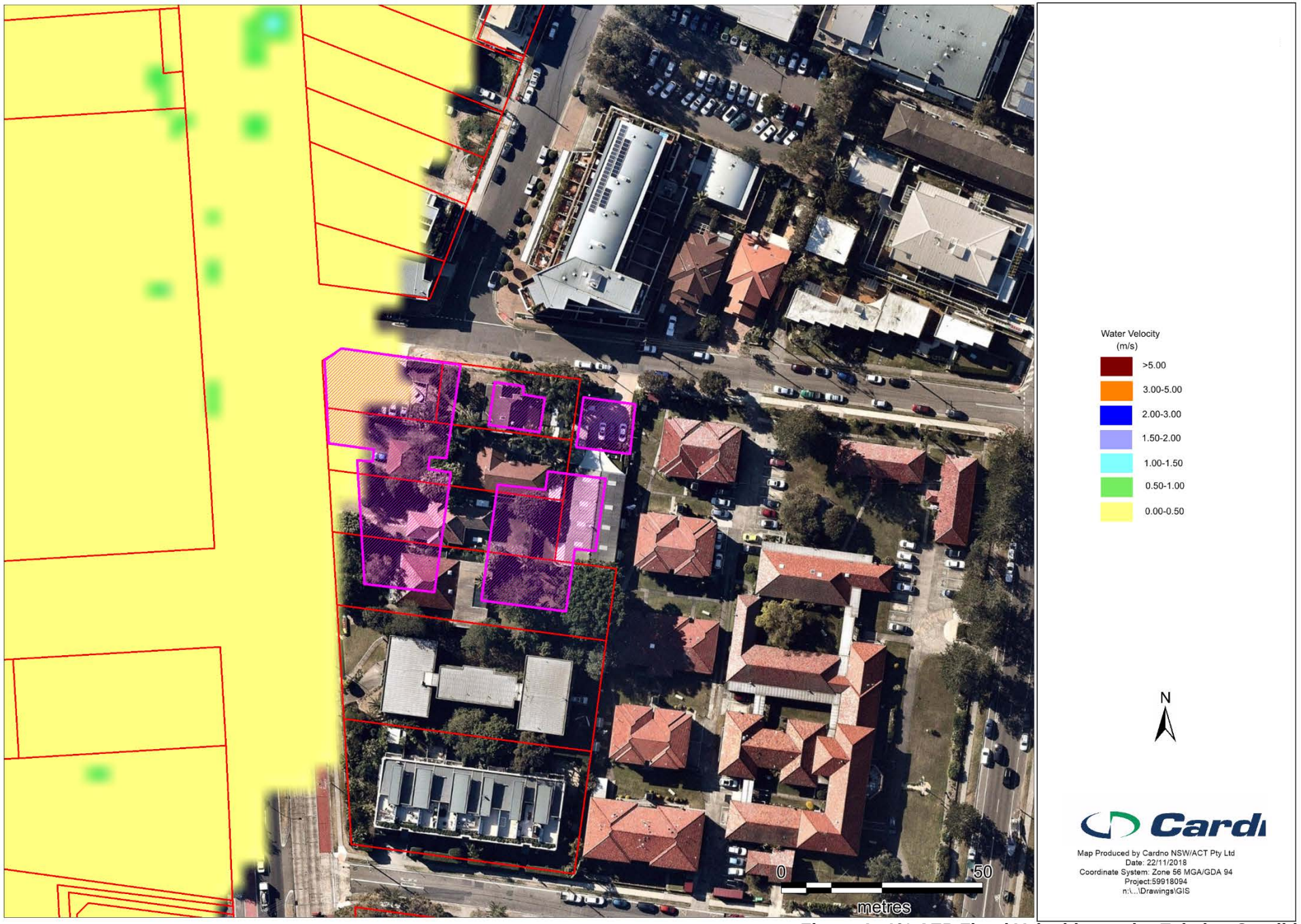


Figure 4 1% AEP Flood Velocities under Existing Conditions

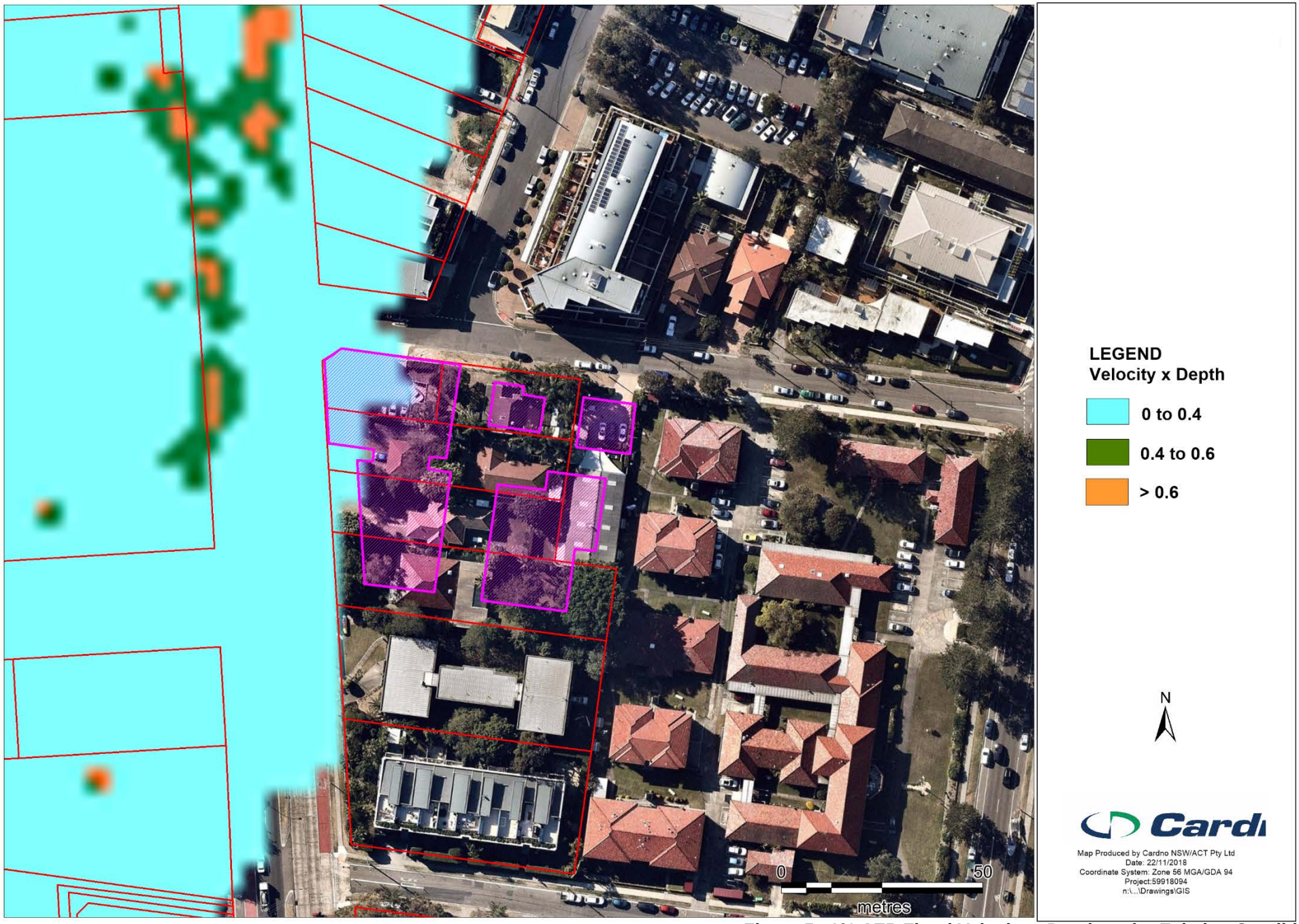


Figure 5 1% AEP Flood Velocity x Depth under Existing Conditions

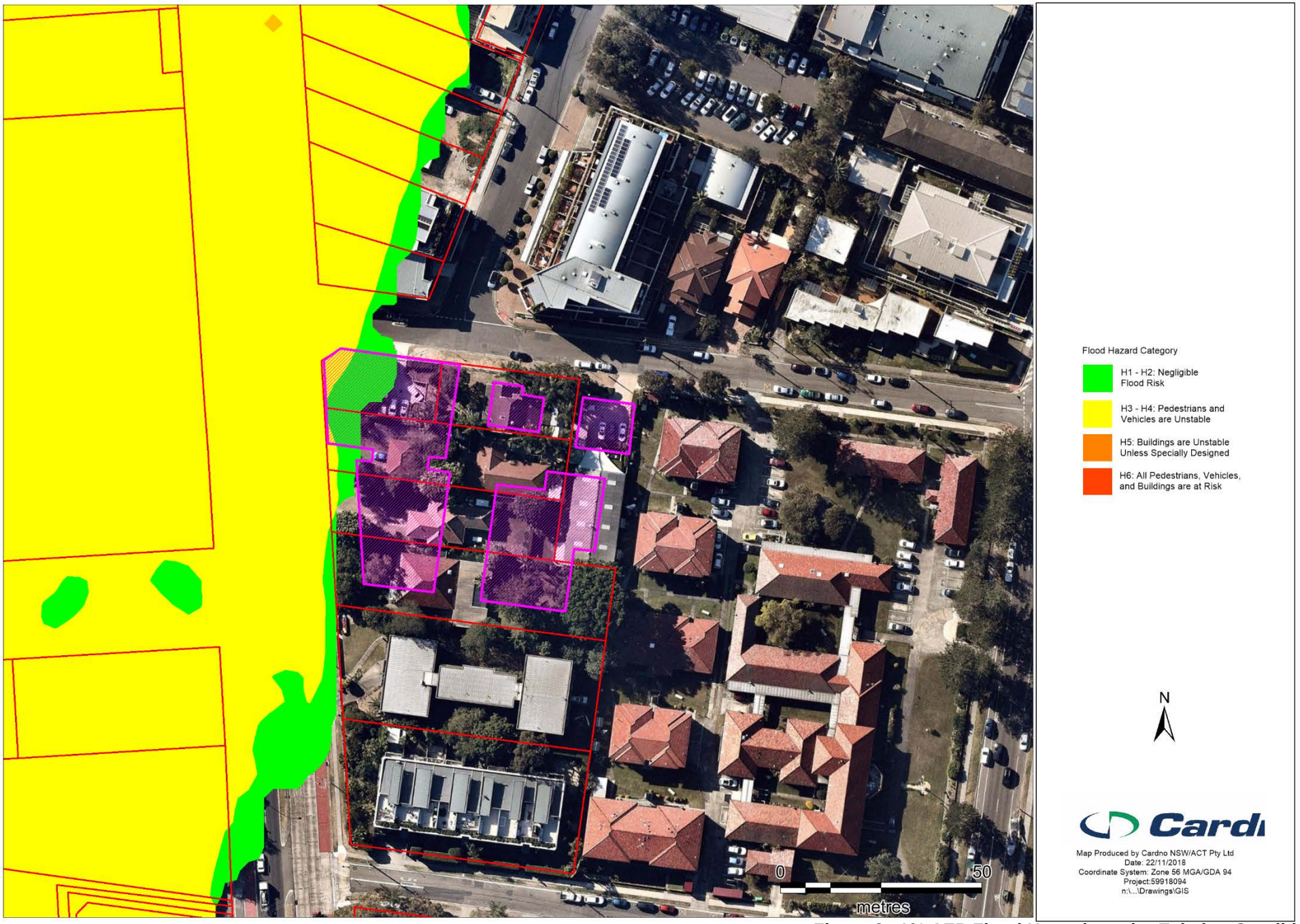


Figure 6 1% AEP Flood Hazards under Existing Conditions

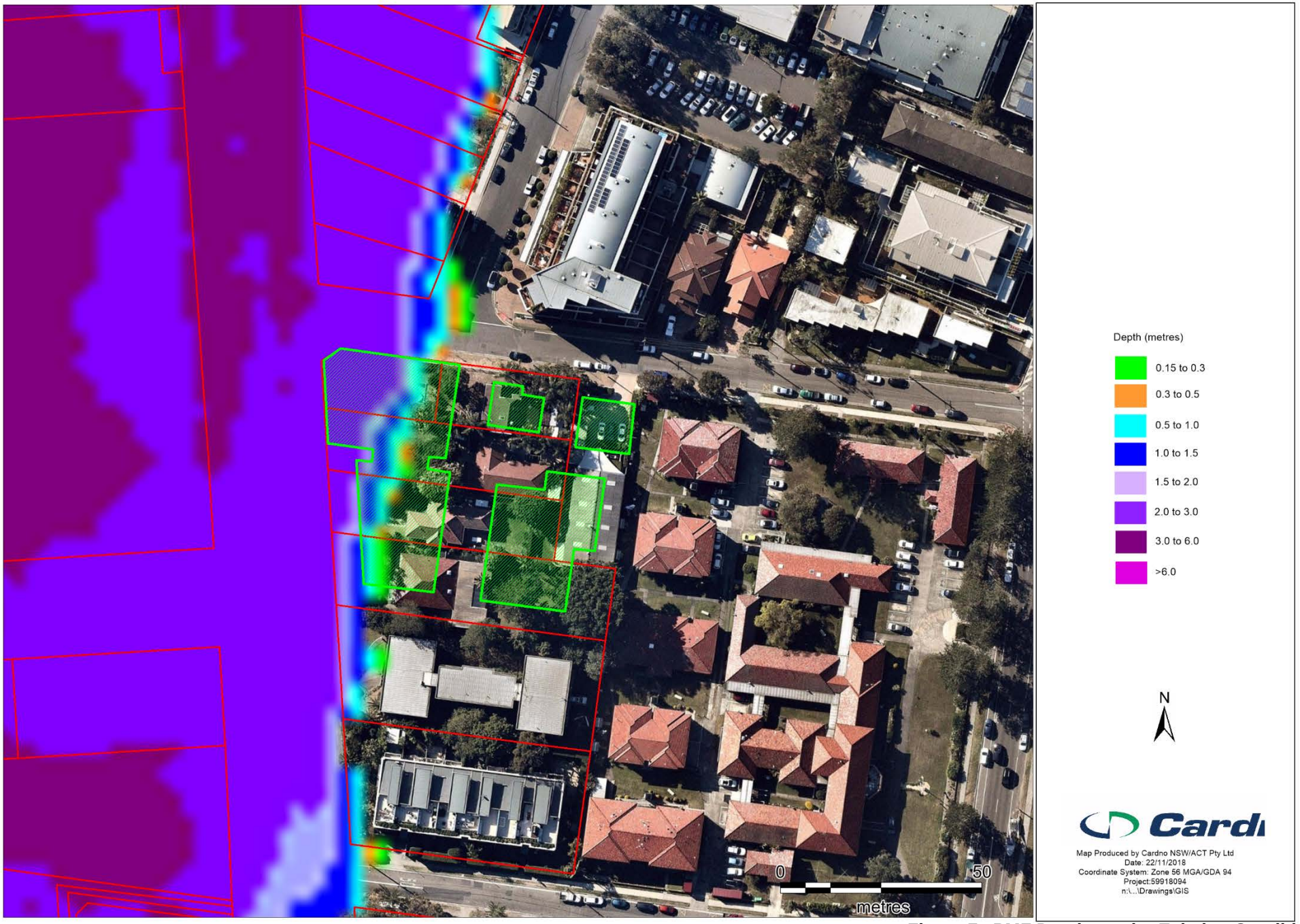


Figure 7 PMF Depths under Existing Conditions

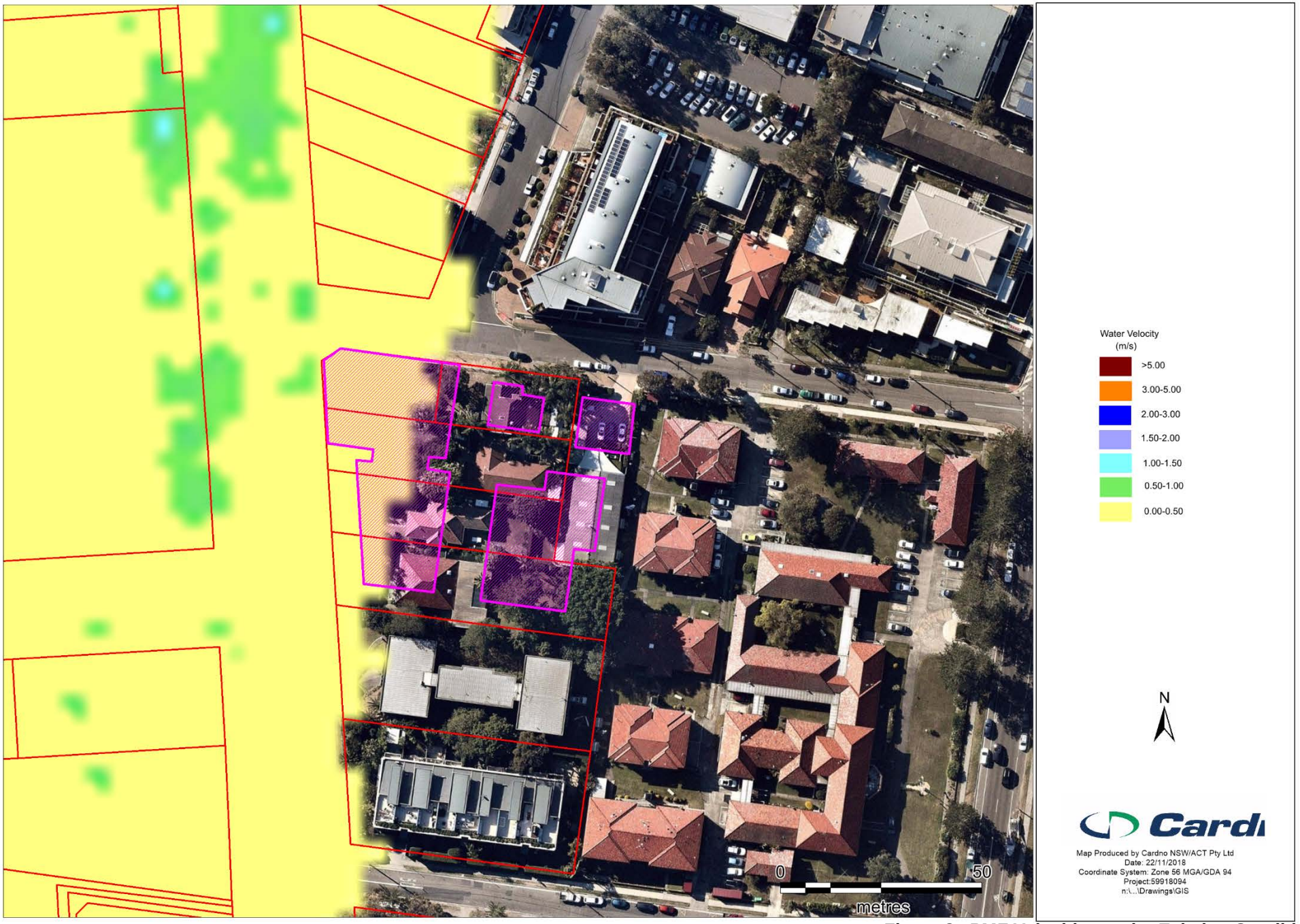


Figure 8 PMF Velocities under Existing Conditions

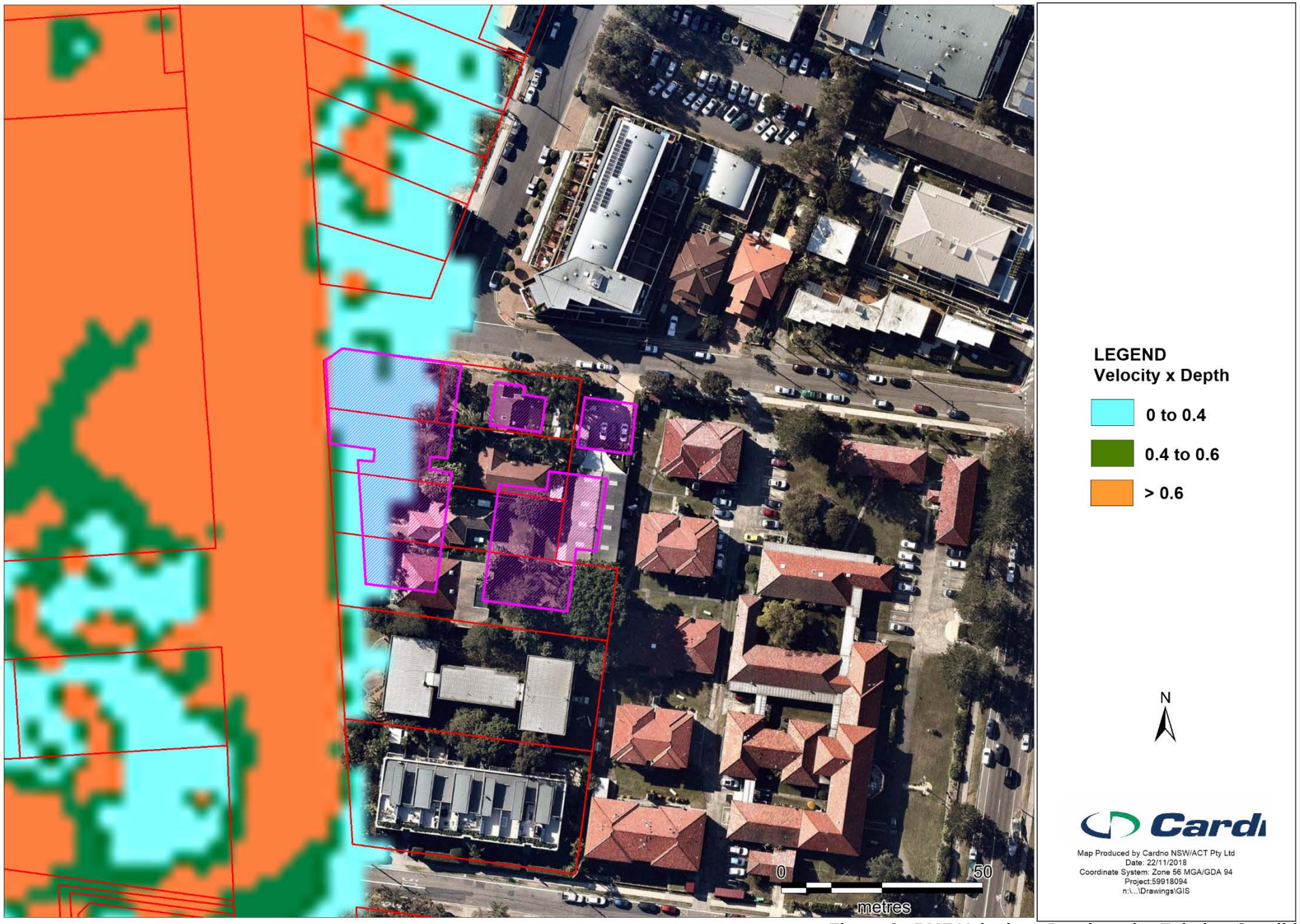


Figure 9 PMF Velocity x Depth under Existing Conditions

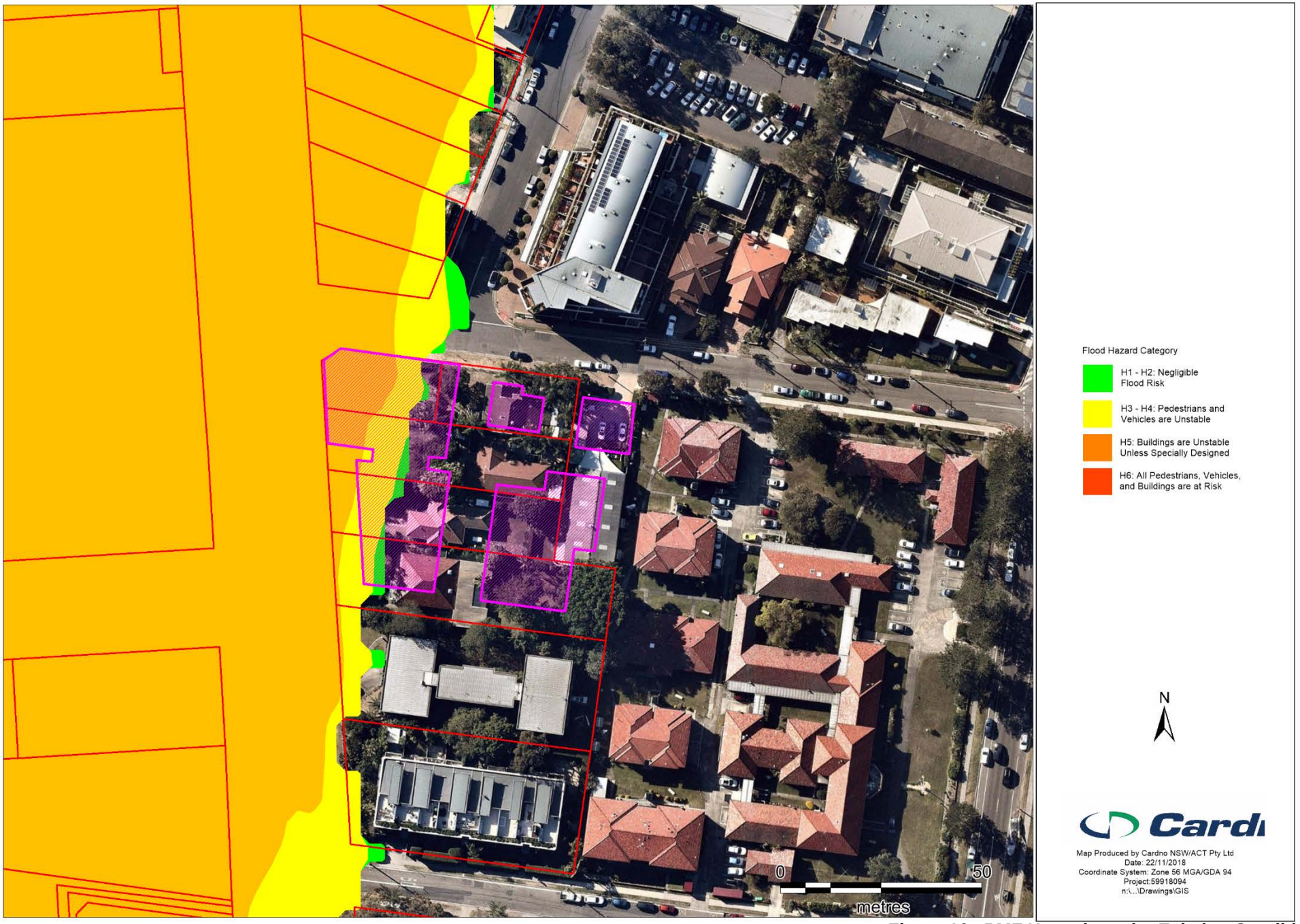


Figure 10 PMF Hazards under Existing Conditions

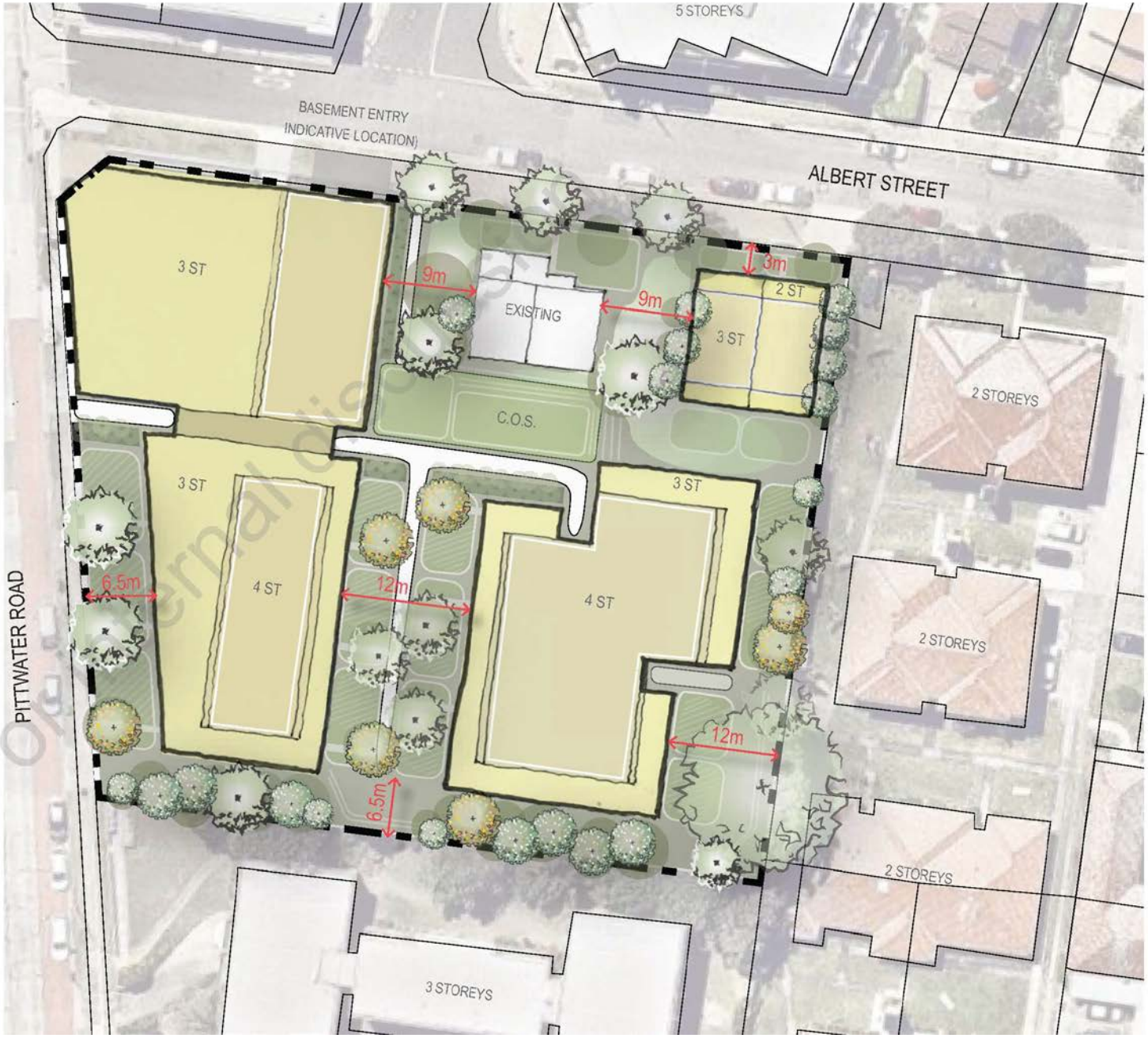


Figure 11 Preferred Masterplan (after GMU, 2018)

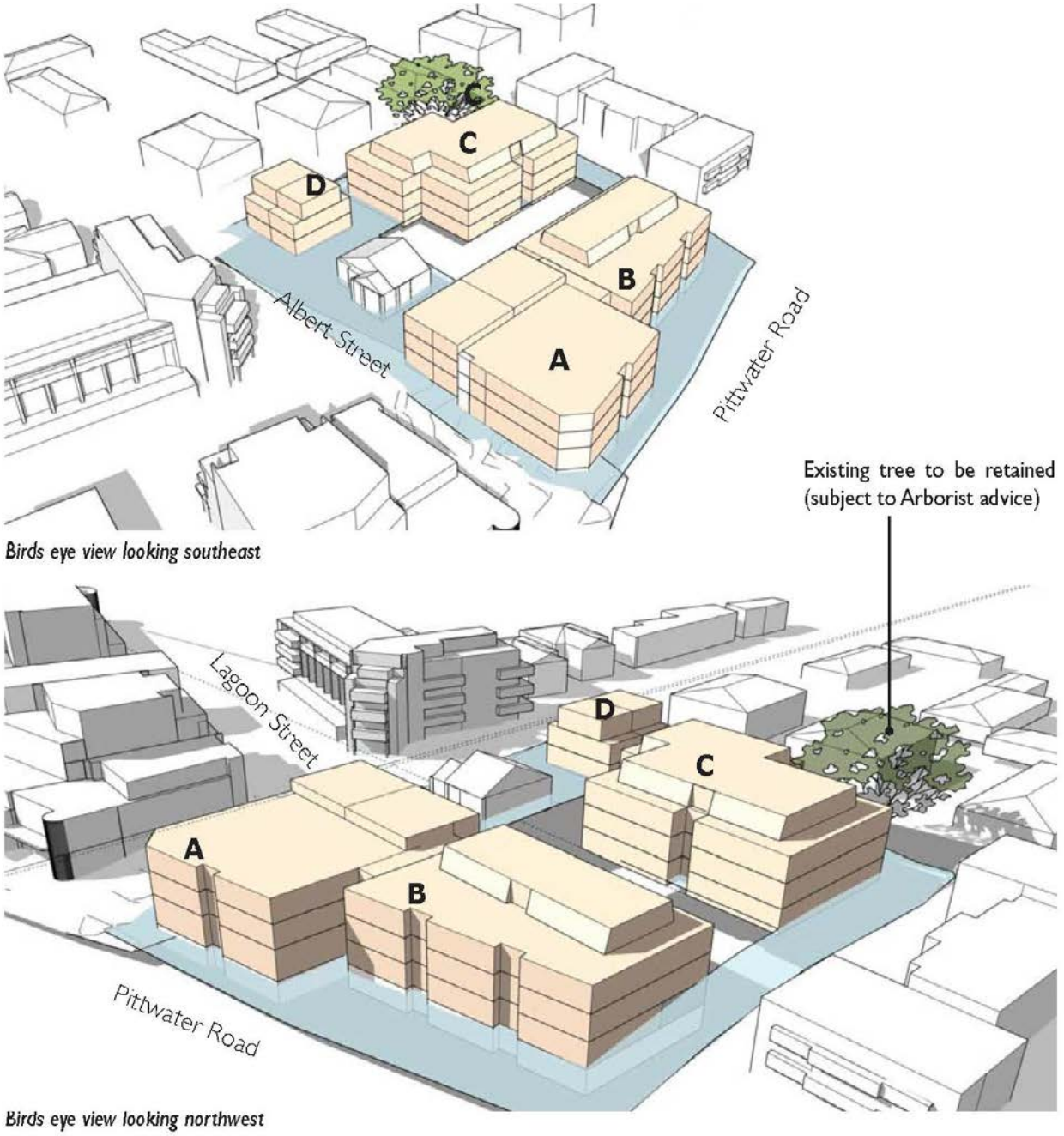


Figure 12 Preliminary Built Form (after GMU, 2018)

Figure 13 Alignment of Indicative Section

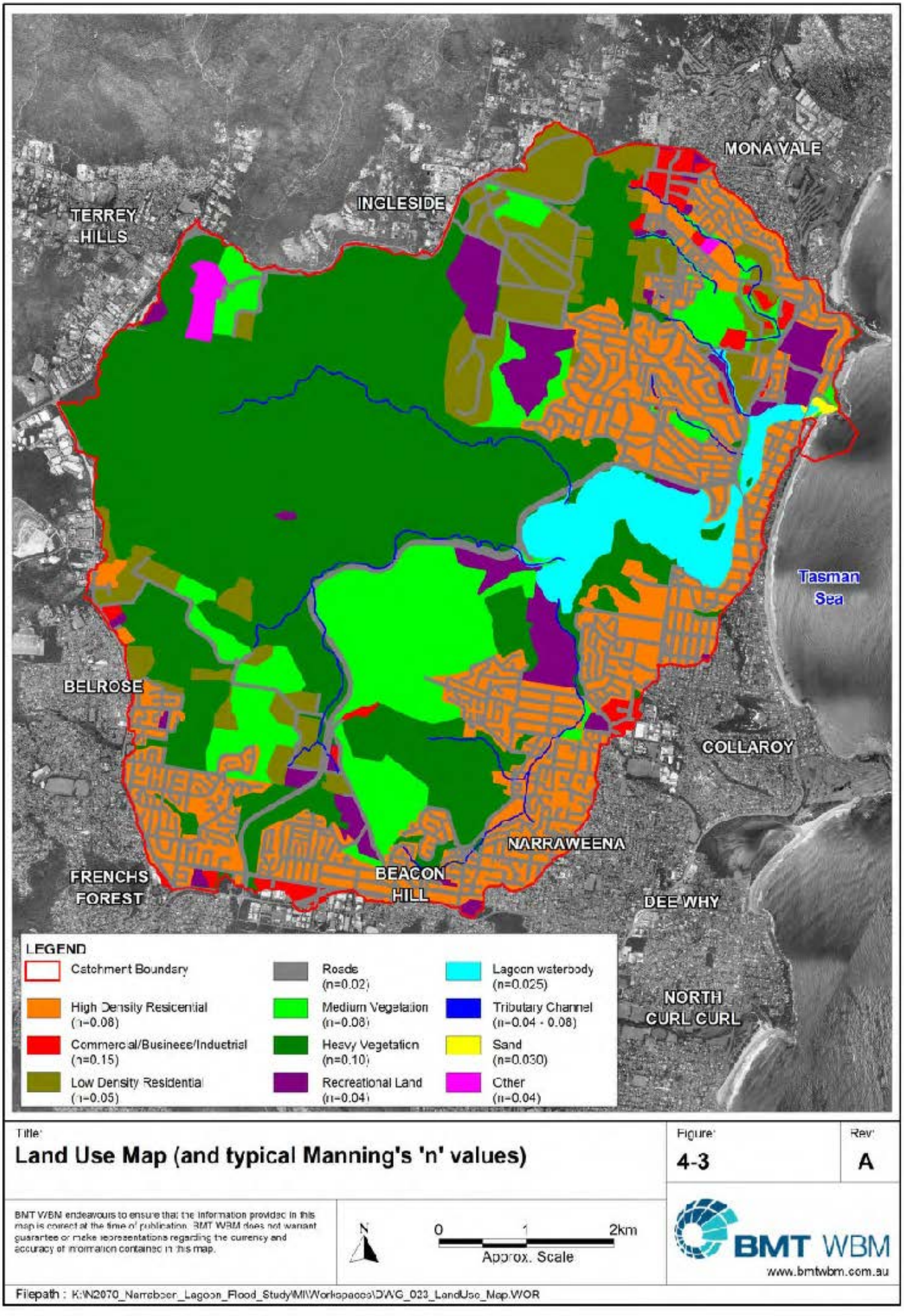
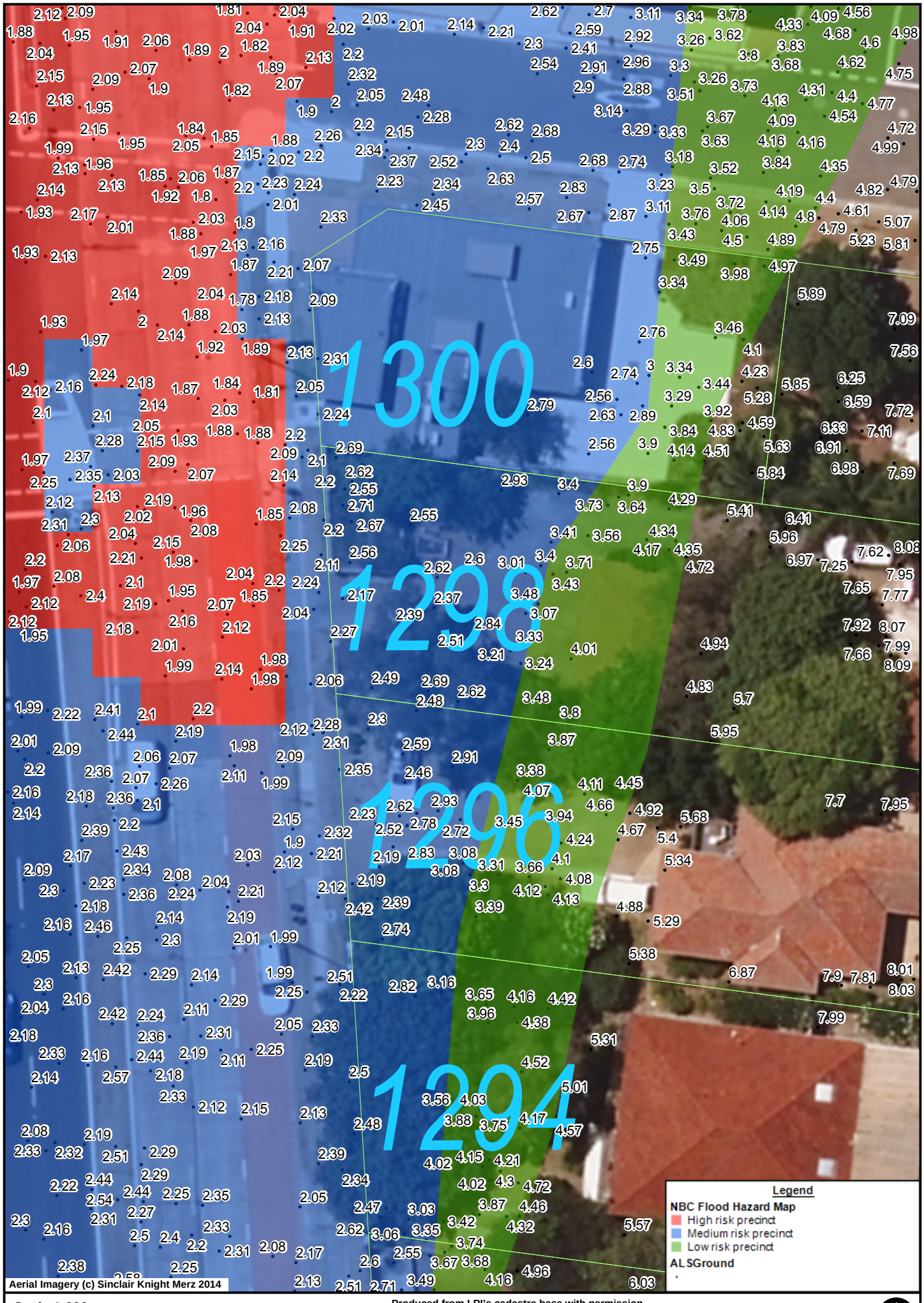


Figure 14 Floodplain Roughness (after Figure 4-3, BMT WBM, 2013)

APPENDIX A
NORTHERN BEACHES COUNCIL MAPS

Cardno
Shaping the Future



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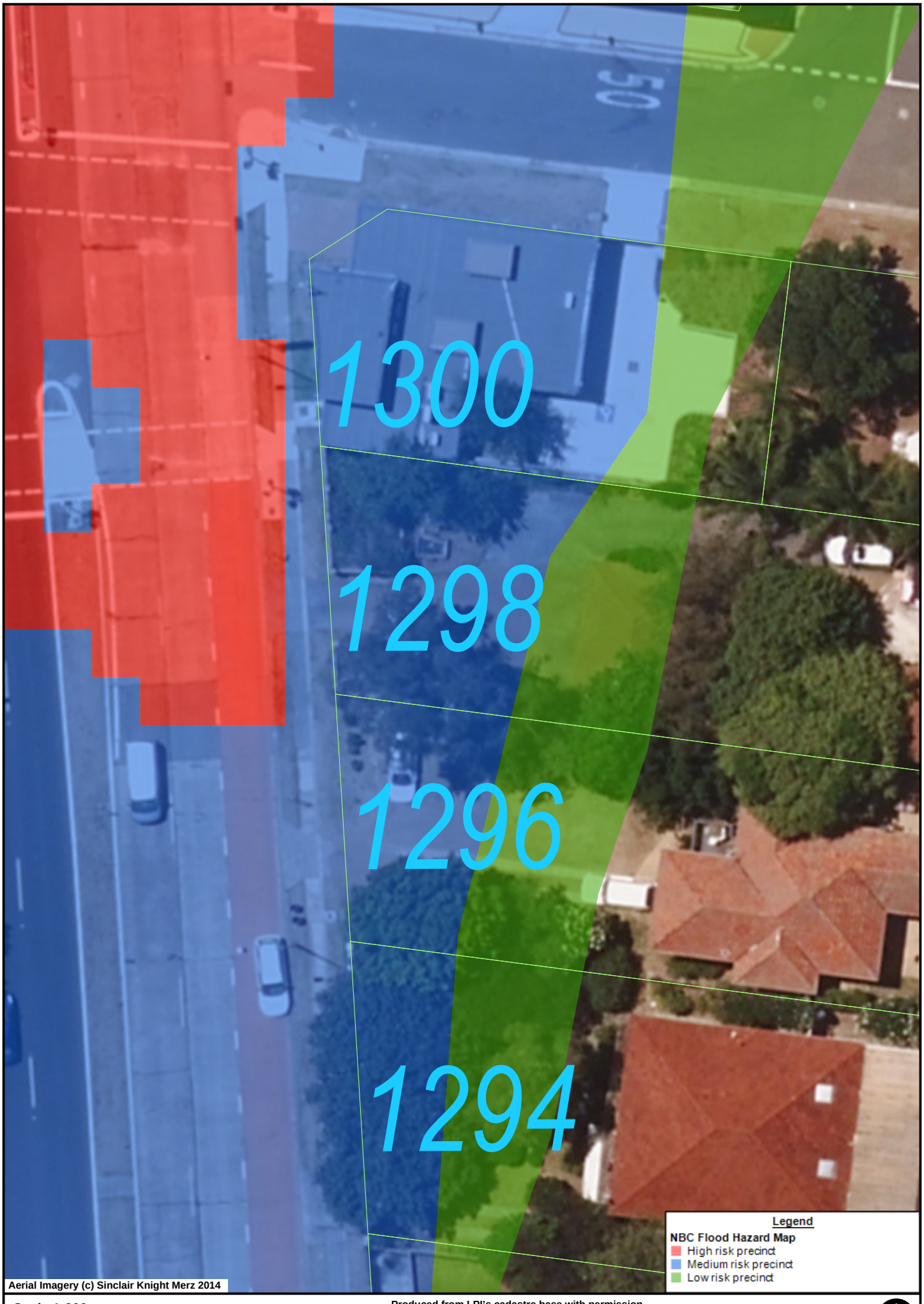

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