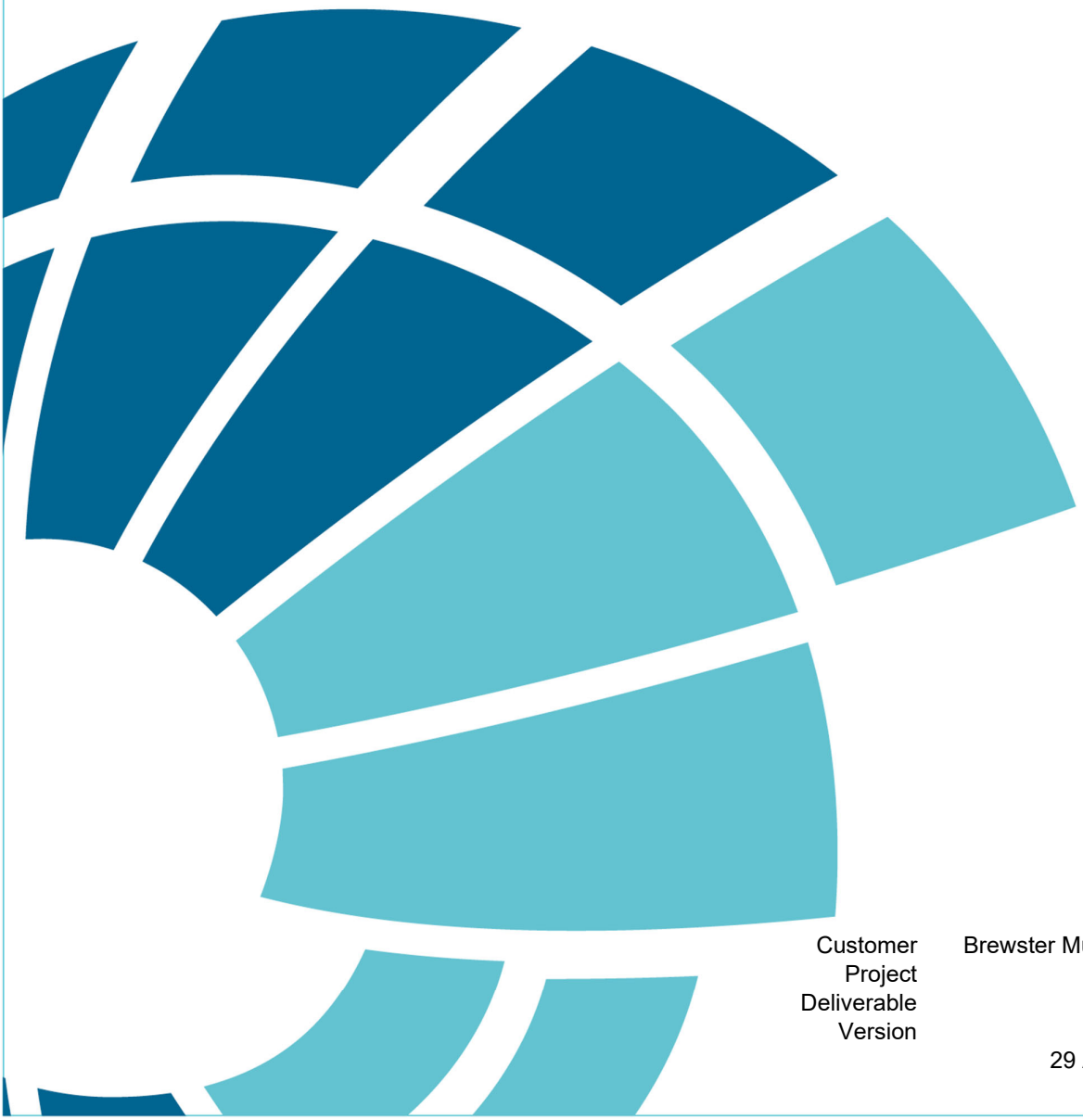
Senior Housing Development at 40-46 Eighteenth Avenue, Sawtell

Flood Impact Assessment



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Synopsis	Detailed flood impact assessment to accompany a development application (DA) for Senior Housing Development at 40-46 Eighteenth Avenue, Sawtell.

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1 Introduction

The NSW Land and Housing Corporation (LAHC) proposes to develop senior housing at 40-46 Eighteenth Avenue, Sawtell, NSW ('the "Site'). Brewster Murray Pty Ltd ("BM") has been coordinating the work of sub-contractors on behalf of LAHC. BMT Commercial Australia Pty Ltd (BMT) was commissioned by BM to undertake a Flood Impact Assessment (FIA) to accompany a Development Application (DA) through 'Part 5 – Review of Environmental Factors (REF)' state approval pathway.

The development Site is located within the Middle Creek catchment and is affected by overland flow flooding. Therefore, it is necessary to undertake a FIA to demonstrate that the proposed development is compatible with the flood behaviour and shall not result in an adverse flood impact beyond the boundaries of the site.

This report documents detailed information about the methodology and outcomes of the FIA.

1.1 Outline of Report

This FIA report includes the following sections:

- Section 1 provides introduction, Site and development description and a brief summary of available studies relevant to this FIA.
- Section 2 presents a description of the hydrologic and hydraulic modelling methodology.
- Section 3 presents the flood modelling results and discussion.
- Section 4 presents a high-level flood emergency response strategy.
- Section 5 presents responses to requirements of LEP 2013.
- Section 6 presents the conclusions of the FIA.

1.2 Site and Development Description

The Site is located within the Coffs Harbour City Council (CHCC) Local Government Area (LGA). It is bounded by the Toormina Saints AFL ground to north, Eighteenth Avenue to the south and residential properties to the east and west (Refer to Figure 1.1). The Site currently has residential dwellings and includes timber fencing along the northern, eastern, and western boundaries of the Site.

The proposed development layout supplied by BM (Drawing No. DA04 Rev B, dated 26/05/2023) is shown Figure 1.2 and is also included in Annex A of this report. The plan incorporates six 2-bedroom units, five 1-bedroom units, eleven above-ground carparks, concrete pathways, ramps in the street frontage, and a concrete access driveway. It is also noted that fences will have a 100mm gap at the base to allow floodwater to flow through. The design surface levels were informed and optimised by an iterative flood modelling exercise. The key design levels relevant to the flood modelling are summarised below:

- Finished floor level of 5.96m AHD for all the proposed units;
- Carpark level ranging between 5.05 to 5.10 m AHD. The access driveway level ranging between 5.04m AHD at the intersection with Eighteenth Avenue to 5.05m AHD at the intersection with the carpark. Concrete pathways and ramps graded and linked with building entrances, carpark, and driveway in such a way to reduce abrupt level changes and assist with accessibility.

Figure 1.1 Site Locality Map

Figure 1.2 Proposed Development Layout (BM, 2023)

1.3 Available Flood Studies

BMT on behalf of CHCC previously completed the following catchment study (divided into 2 volumes) that is pertinent to the Site and this FIA:

- Middle Creek Flood Study (Volume 1, Reference R.N21098.002.03) (BMT, 2021a); and
- Middle Creek Floodplain Risk Management Study & Plan (Volume 2, Reference: R.N21098.003.02) (BMT, 2021b).

The above-stated study utilised the XP-RAFTS hydrologic and TUFLOW hydraulic software packages to undertake a flood study in accordance with the Australian Rainfall and Runoff 2019 (ARR 2019) guideline. The main objective of the study was to define the mainstream (Middle Creek) flood behaviour for a range of design flood events including the 5% (1 in 20), 2% (1 in 50),1% (1 in 100), 0.5%(1 in 200) and 0.2% (1 in 500) Annual Exceedance Probability (AEP) and the Probable Maximum Flood (PMF) events.

Therefore, the existing flood behaviour within and around the Site is informed based on the above-stated study. BM provided BMT with a Flood Certificate applicable to the Site issued by CHCC (dated 24/3/2022) based on the flood study. The flood certificate nominates, amongst others:

- 1% AEP Design Flood Level (DFL) of 5.30m AHD;
- Flood Planning Level (FPL) of 5.80m AHD; and
- 1% AEP + 2100 Climate Change peak flood level of 5.39m AHD.

Based on the above-stated flood study the existing (baseline) flood behaviour within and around the Site can be described further:

- During the 1% AEP design flood event, the majority of the Site is predicted to contain areas of flood fringe, and no areas of floodway and flood storage exist within the Site (Refer to Figure 1.3). Relatively speaking, flood behaviour is deemed less sensitive to changes that impact on flood fringe areas than floodway or flood storage.
- The 1% AEP flood hazard within Eighteenth Avenue is ‘H1’. It is noted that ‘H1’ flood hazard is deemed generally safe for people and vehicles in accordance with the Australian Institute for Disaster Resilience (AIDR, 2017)[1].
- The 1% AEP flood hazard within the Site ranges between ‘H1’ to ‘H2’.

[1] AIDR. (2017) Guideline 7-3 Flood Hazard (supporting documentation for the implementation of Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia).

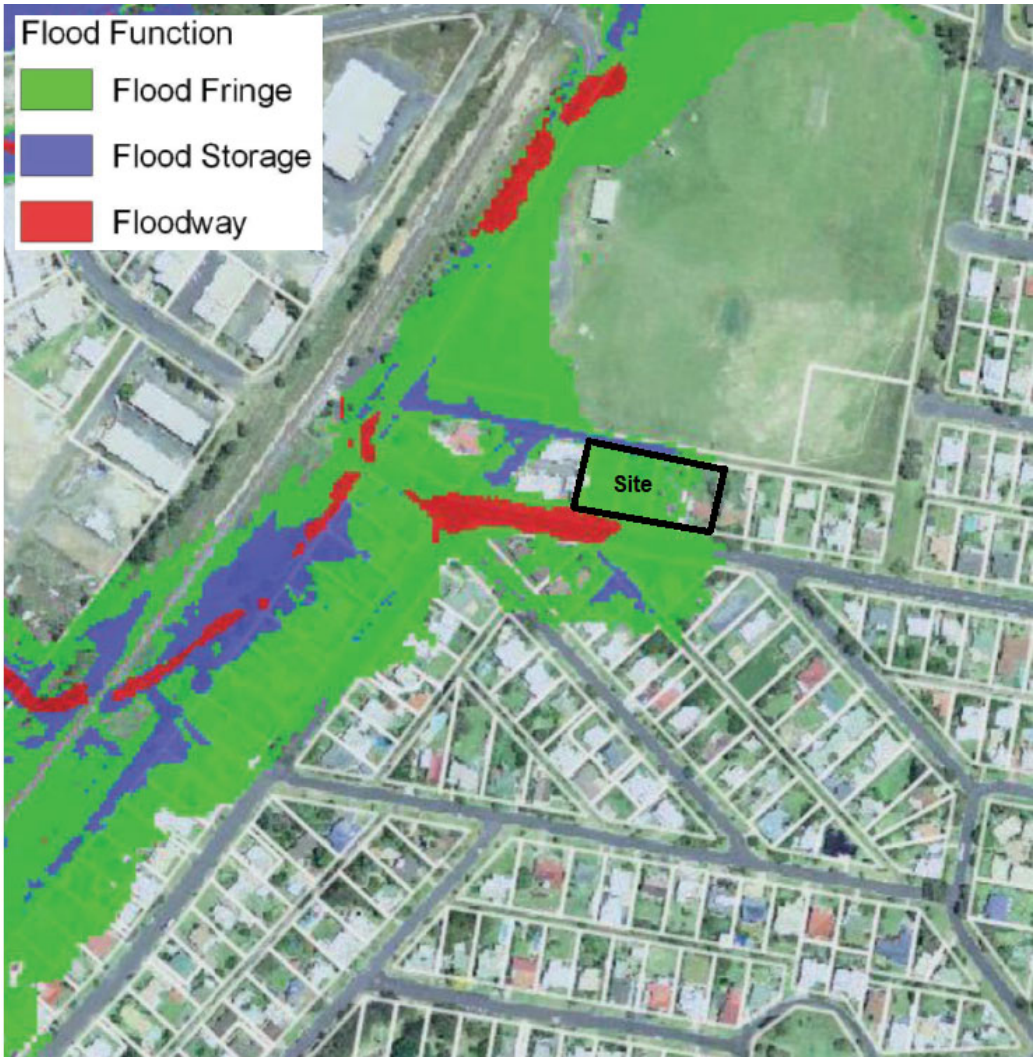


Figure 1.3 1% AEP Flood Function (BMT, 2021b)

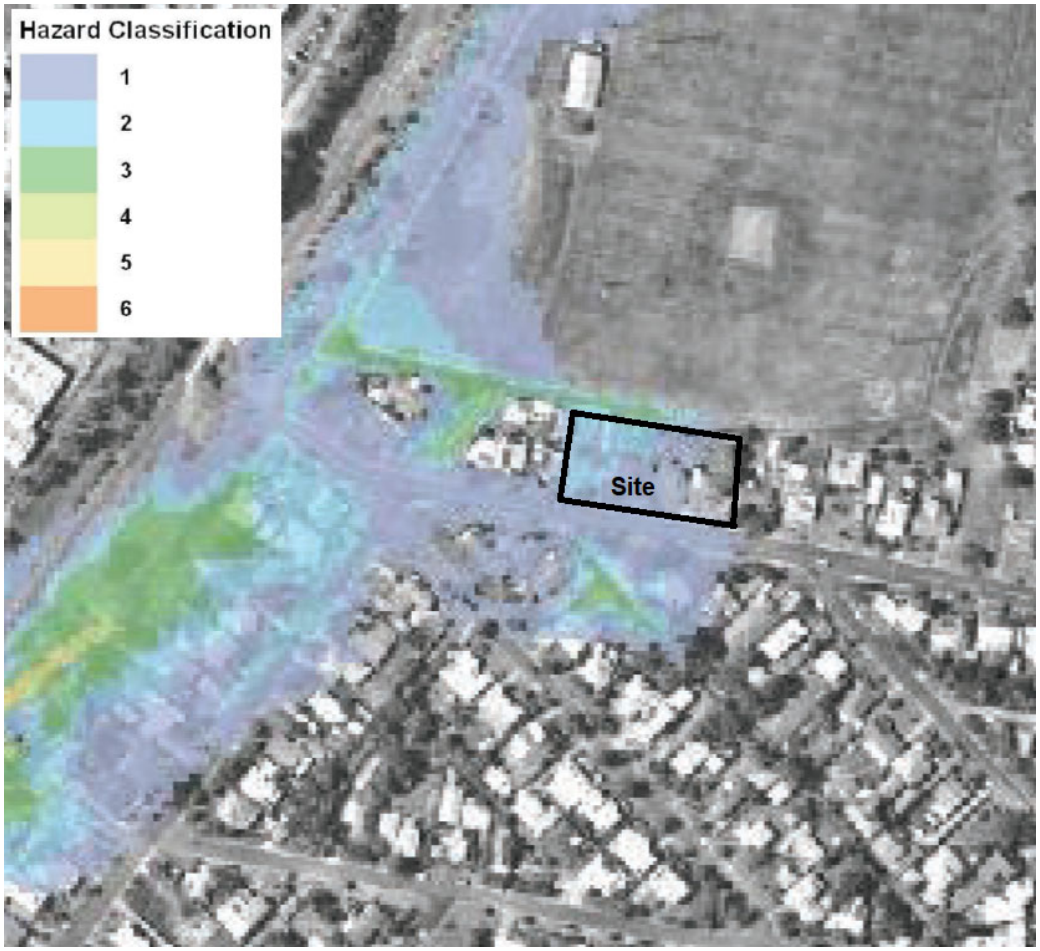


Figure 1.4 1% AEP Flood Hazard Classification (BMT, 2021b)

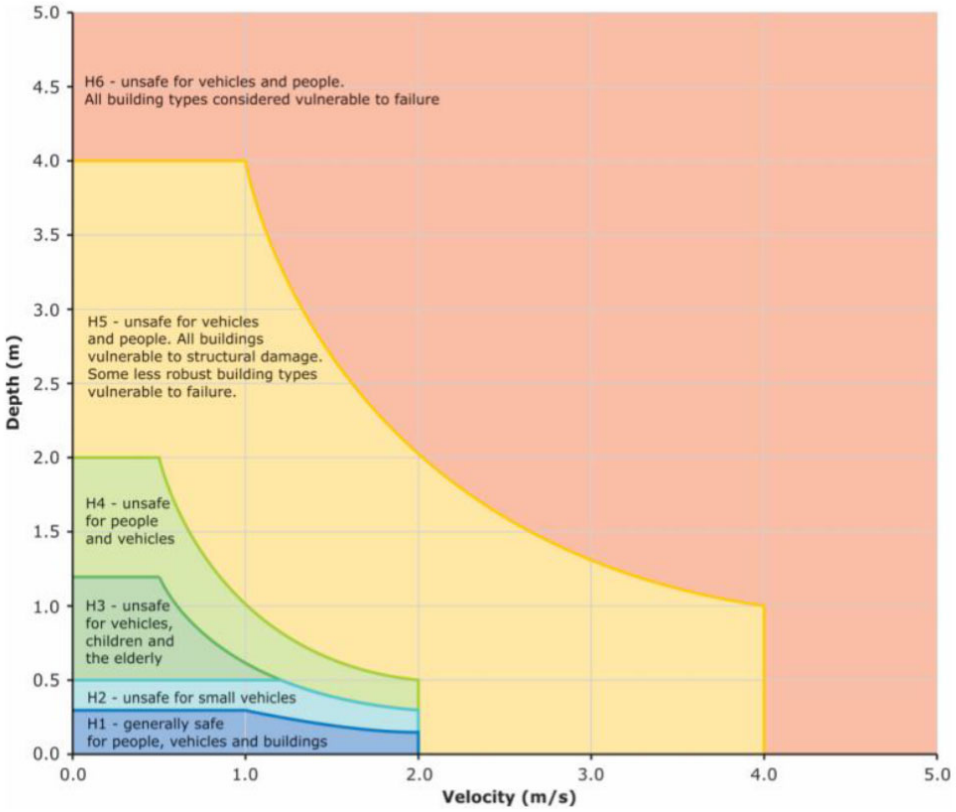


Figure 1.5 Flood Hazard Classification System (AIDR, 2017)

2 Flood Modelling Methodology

This FIA used the XP-RAFTS hydrologic and TUFLOW hydraulic models of Middle Creek as per the BMT 2021a study as a basis for flood modelling. Necessary modifications were made to the hydrologic and hydraulic models to include site-specific ground survey to make the models more suitable for a local overland flow assessment at the Site.

The hydrologic and hydraulic modelling exercise assessed the pre-development (base case) and post-development scenarios, as detailed in the following sections.

2.1 Pre-Development Scenario

As the main objective of the BMT 2021a study was to define mainstream (creek) flood behaviour, the assessment adopted relatively coarse-scale hydrologic and hydraulic models suitable for the purpose of mainstream flood assessment. These coarse-scale models have some limitations in terms of their applicability for the Site. Given the regional nature of the study, the following limitations have been identified that could have implications for the Site:

- The Eighteenth Avenue drainage (catchment) area was lumped as a single ‘sub-catchment 24’ (digitised as a blue polygon in Figure 2.1) whereby its inflow (digitised as a green polygon in Figure 2.1) was applied in TUFLOW model at the downstream end of the sub-catchment bypassing the Site.
- In addition, the upstream inflow from part of the Toormina Saints AFL ground was lumped with sub-catchment 24. This setup does not adequately simulate the local flow (generated from the AFL ground) traversing along the back of the Site.6
- Whilst the existing main stormwater pipe and pit network was included in the hydraulic model, the sub-surface (pipe) capacity was not modelled adequately due to the lumped inflow application.

Given the above-stated limitations, it was necessary to refine the Middle Creek hydrologic and hydraulic models to simulate and assess the overland flow flood behaviour within the Eighteenth Avenue drainage area (containing the Site) more accurately. With reference to Figure 2.1, it is evident (based on the flood level gradient during the 1% AEP design event) that the Site has the potential to be impacted more by the upstream overland flow than by the backwater flood from the downstream area. Therefore, site-specific modifications were made to the Middle Creek hydrologic and hydraulic models to make the models more suitable for a local overland flow assessment at the Site. The key modifications are described in the following sections.

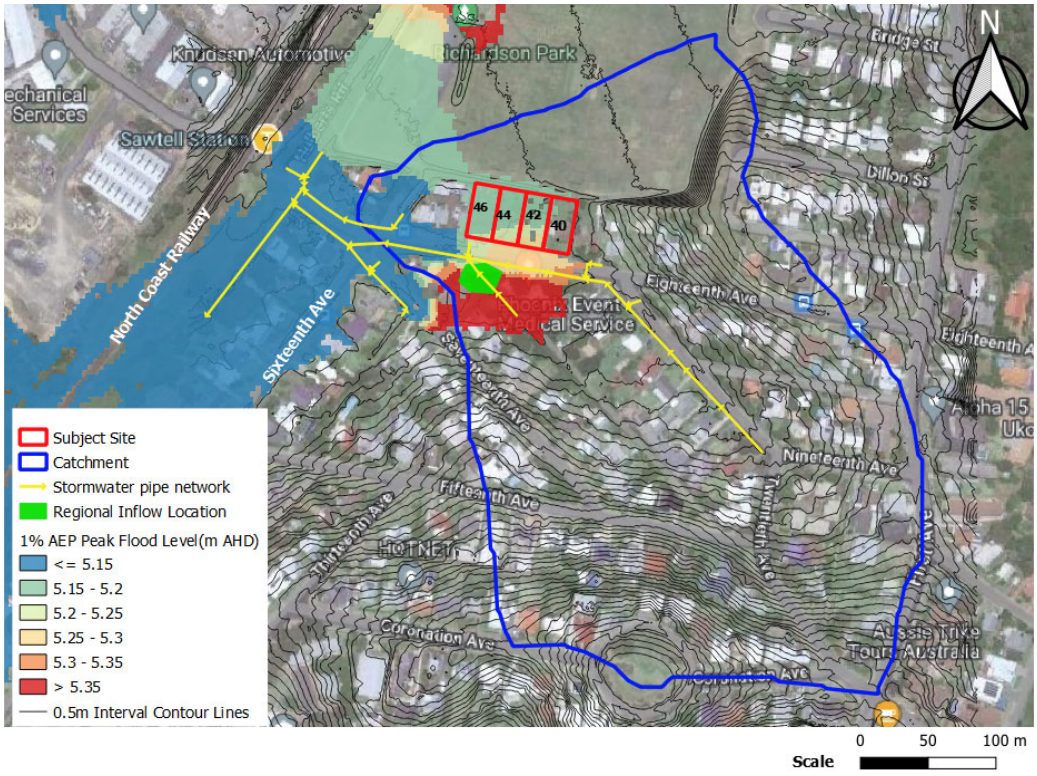


Figure 2.1 Hydrologic and Hydraulic Model Setup as per BMT 2021a Study

2.1.2 Hydrologic Model Update

The BMT 2021a XP-RAFTS hydrologic model represented the single sub-catchment 24 with a lumped area of 12.85 hectares. As part of this FIA, sub-catchment 24 was divided seven (7) sub-catchments (24 and 24a to 24f) as shown in Figure 2.2. Table 2.1 presents the key properties of the modified sub-catchments modelled. It is noted that the Site is located within sub-catchment 24c. The slopes and Manning's 'n' values for the modified sub-catchments were kept consistent with the lumped sub-catchment 24.

Table 2.1 Modified Sub-Catchment Key Properties

Sub-catchment ID	Area (ha)	Imperviousness (%)
24	3.22	50
24a	3.66	50
24b	0.51	50
24c	2.92	50
24d	0.63	50
24e	1.40	0
24f	0.52	0
Total	**12.86**	**n/a**

n/a Not applicable

Figure 2.2 Modified Base Case XP-RAFTS Model Sub-catchment Layout

2.1.3 Hydraulic Model Update

To reflect the above-stated hydrologic changes, the base case TUFLOW model was updated with the following modifications:

- The total inflow from sub-catchment 24b (24a+24b) was applied as a 1D (one-dimensional) inflow at the upstream end of the stormwater pipe system. When the hydraulic grade line in the pipe exceeds the ground surface, flow was surcharged to above ground.
- The local inflow from sub-catchment 24c and 24d were applied as a 1D (one-dimensional) inflow at the upstream end of the stormwater pipe system. When the hydraulic grade line in the pipe exceeds the ground surface, flow was surcharged to above ground.
- For the remainder of the sub-catchments (i.e., 24, 24e and 24f) the inflows were applied as 2D (two-dimensional) inflow on the ground.

In addition, a ground survey of the Site and part of Eighteenth Avenue was supplied by BM[2] and this was included in the TUFLOW model. Figure 2.4 shows the ground survey extent.

[2] 7802 3d faces MGA94 GRID.dwg

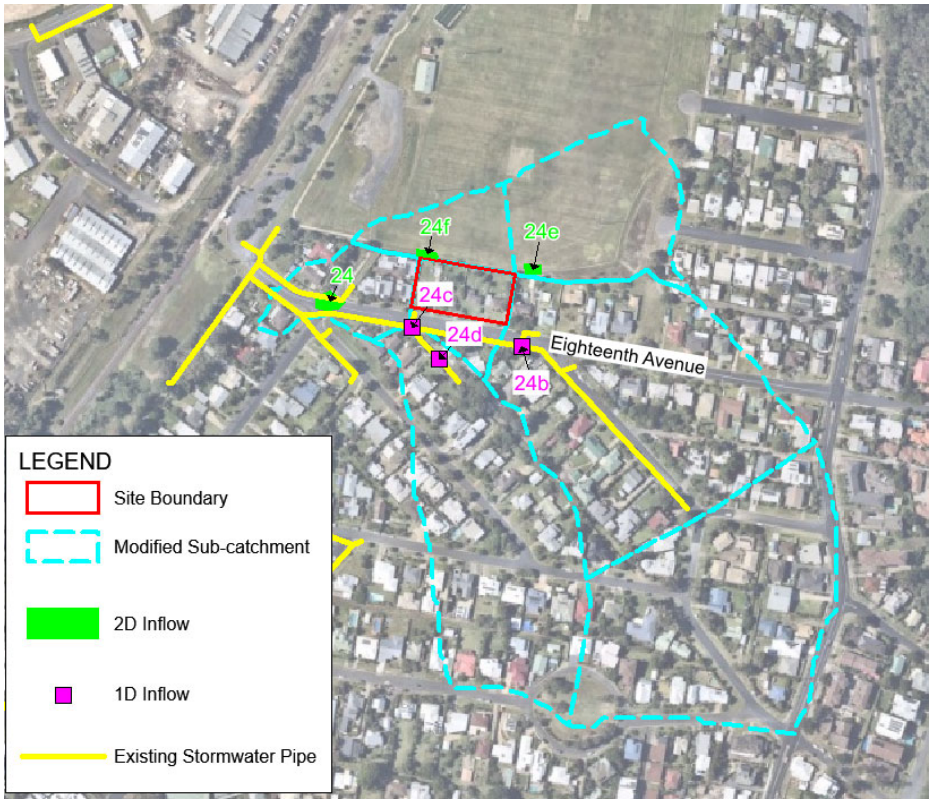


Figure 2.3 Modified Base Case TUFLOW Model Layout

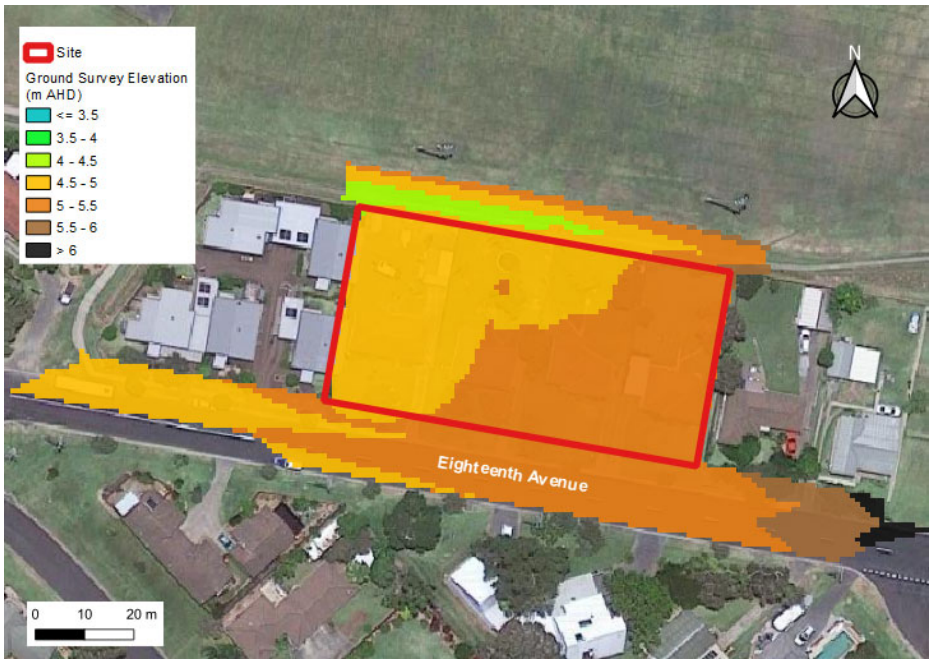


Figure 2.4 Ground Survey Extent

2.1.4 Design Flood Events Modelled

As per the BMT 2021a flood study, a suite of design flood events, critical duration and temporal patterns were modelled, these are presented in Table 2.2.

Table 2.2 Design Flood Events and Storms Modelled

	Critical Duration	Temporal Pattern
0.2% AEP	- 120min - 180min	- TP02 & TP10 - TP09
0.5% AEP	- 120min - 180min	- TP02 & TP10 - TP09
1% AEP	- 120min - 180min	- TP02 & TP10 - TP09
2% AEP	- 120min - 180min	- TP02 & TP10 - TP09
5% AEP	- 180min - 360min	- TP05 - TP10
PMF	- 120min -180min	- GSDM* - GSDM*

**** Note: Globalised Short Duration Method***

2.2 Post-Development Scenario

The post-development conditions (described in Section 1.2 and shown Figure 1.2) have been modelled in the TUFLOW model. The key design levels that were modelled are listed below:

- Finished floor level of 5.96m AHD for all the proposed units;
- Carpark level ranging between 5.05 to 5.10 m AHD;
- Access driveway level ranging between 5.04m AHD at the intersection with Eighteenth Avenue to 5.05m AHD at the intersection with the carpark; and
- Concrete pathways and ramps graded and linked with building entrances, carpark, and driveway in such a way to reduce abrupt level changes and assist with accessibility.

The above modifications were represented within TUFLOW model using concept shape files. Figure 2.5 shows the pre-development topography, Figure 2.6 shows the post-development topography and Figure 2.7 shows the topography difference between the two scenarios.

Appropriate Manning's 'n' values were adopted as per Table 2.3.

It is noted that in terms of hydrology, the post-development scenario assumed the same hydrology (inflows) as per pre-development scenario on the basis that the increase in the level of urbanisation of the Site (increased hardstand areas) would be managed by a stormwater detention basin system to be assessed by others.

Table 2.3 Manning's 'n' Values

Surface Type	Manning's 'n'
Driveway and Carpark, Concrete pathways, and ramps	0.025
Landscape Area	0.03 to 0.04
Buildings	0.40
Boundary Fence	0.12

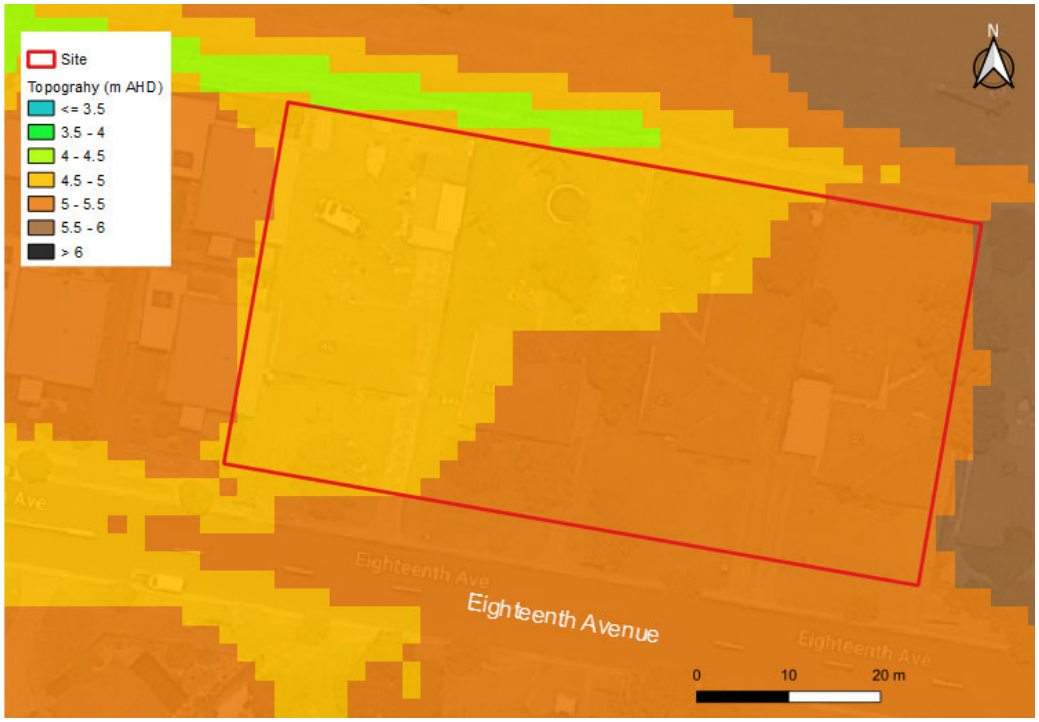


Figure 2.5 Pre-Development Scenario Modelled Topography

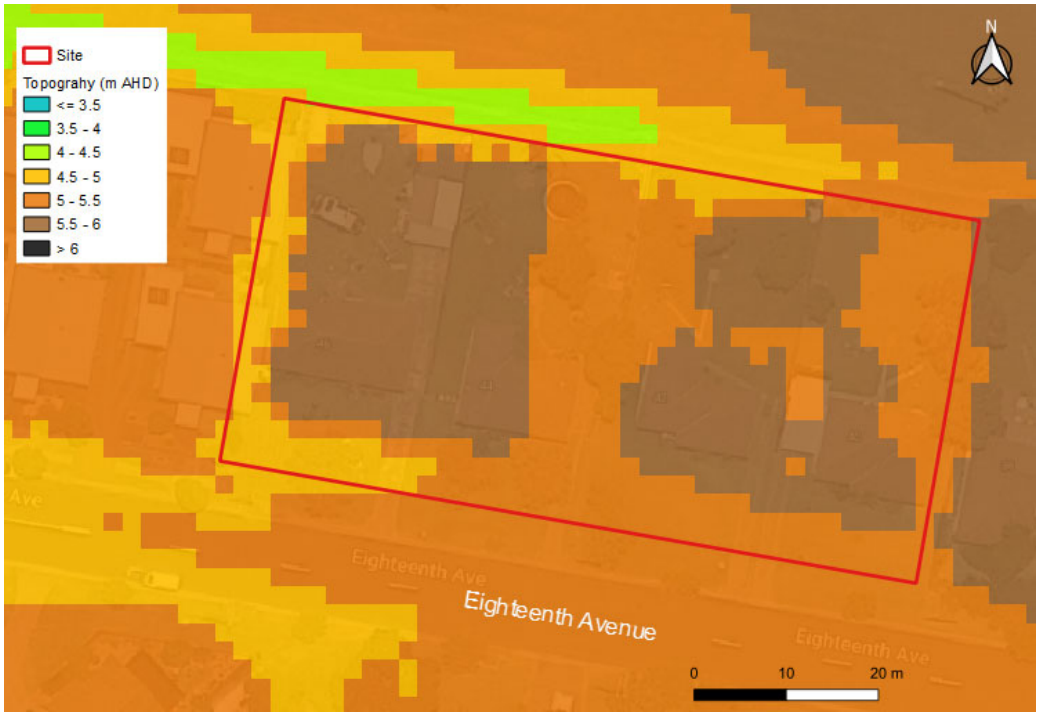


Figure 2.6 Post-Development Scenario Modelled Topography

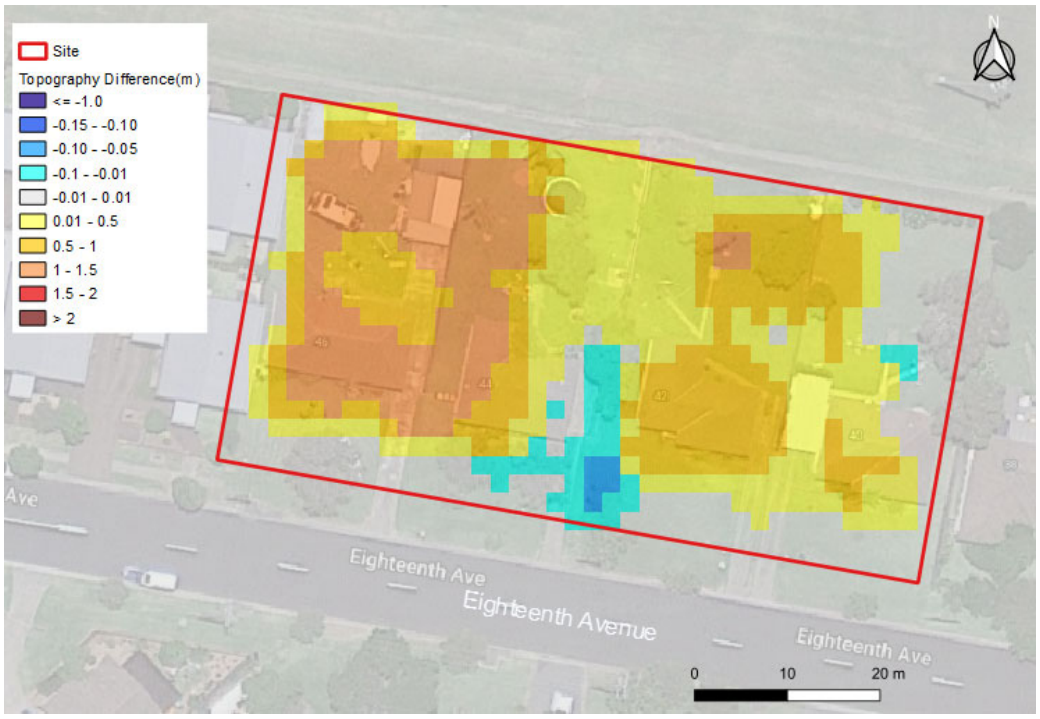


Figure 2.7 Post-Development Topography minus Pre-Development Topography

3 Flood Modelling Results and Discussion

A suite of design flood events was simulated to define the pre-development and post-development flood behaviour within and around the site. The flood modelling results are summarised in the following sections.

3.1 Pre-Development Flood Behaviour

Annex B contains the pre-development flood maps as listed below:

- Figures B.1 to B.6 show peak flood level maps for the 1 in 20, 1 in 50, 1 in 100, 1 in 200 and 1:500 AEP and PMF events.
- Figures B.7 to B.12 show peak flood depth maps for the 1 in 20, 1 in 50, 1 in 100, 1 in 200 and 1:500 AEP and PMF events.
- Figures B.13 to B.18 show peak flood hazard maps for the 1 in 20, 1 in 50, 1 in 100, 1 in 200 and 1:500 AEP and PMF events.

The following sections present commentaries on the flood modelling results.

3.1.1 Peak Flood Level

To compare the flood level predictions from this FIA with Council's flood certificate, relevant peak flood levels were at the southeast corner of the Site boundary (42 Eighteenth Avenue). The results are presented in Table 3.1 which demonstrate that the peak flood levels correspond reasonably.

Table 3.1 Comparison of Pre-Development Peak Flood Levels

Design Event	Flood Level as per CHCC Flood Certificate (m AHD)	Flood Level as per this FIA (m AHD)
1 in 20 AEP	5.22	5.28
1 in 100 AEP	5.30	5.35
1 in 500 AEP	5.35	5.39
PMF	6.16	6.15

3.1.2 Peak Flood Hazard

The peak flood hazard within the road reserve of Eighteenth Avenue is predicted to be 'H1' for the design flood events up to and including the 1 in 500 AEP. H1 flood hazard is deemed generally safe for people and vehicles.

In the case of PMF, the flood hazard within the road reserve is predicted to be 'H3' which is deemed unsafe for people and vehicles.

3.2 Post-Development Flood Behaviour

Post-Development Flood Maps and Annex D contain the post-development flood maps as listed below:

- Figures C.1 to C.6 show peak flood level maps for the 1 in 20, 1 in 50, 1 in 100, 1 in 200 and 1:500 AEP and PMF events.
- Figures C.7 to C.12 show peak flood depth maps for the 1 in 20, 1 in 50, 1 in 100, 1 in 200 and 1:500 AEP and PMF events.
- Figures C.13 to C.18 show peak flood hazard maps for the 1 in 20, 1 in 50, 1 in 100, 1 in 200 and 1:500 AEP and PMF events.
- Figures D.1 to D.6 show the peak flood level impact (afflux) maps for the 1 in 20, 1 in 50, 1 in 100, 1 in 200 and 1:500 AEP and PMF events.

The following sections present commentaries on the flood modelling results.

3.2.1 Flood Inundation and Hazard

- The proposed buildings are predicted to be flood-free up to and including the 1 in 500 AEP event. It is noted that the finished floor levels of the proposed buildings (5.96m AHD) is higher than the minimum FPL required by Council's flood certificate (5.80m AHD).
- The proposed carpark bay, driveway and concrete pathways are predicted to be inundated with 'H1' flood hazard for the 1 in 20 to 1 in 500 AEP inclusive. H1 flood hazard is deemed generally safe for people and vehicles.
- The proposed buildings are predicted to be inundated during the PMF event with a maximum flood depth of 0.19m or H1 flood hazard. Given the extreme (low probability) nature of PMF event, the predicted flood hazard is deemed acceptable.
- The PMF flood hazard within the proposed carpark bay, driveway and concrete pathways is predicted to be 'H3' which is deemed unsafe for people and vehicles.

3.2.2 Peak Flood Level Impact

With reference to the peak flood level impact (afflux) maps contained in Annex D, the impact of the proposed development is summarised as follows:

- During the 1 in 20 AEP event, a localised offsite afflux up to 39mm is predicted at the southeast boundary of a private lot west of the Site. The extent of the affected area is very small and there is no change in the flood hazard (i.e., the flood hazard is 'H1' for both the pre-development and post-development scenarios). There is also a localised afflux up to 49mm within the road reserve of Eighteenth Avenue, but there is no change in the flood hazard level (i.e., the flood hazard is 'H1' for both the pre-development and post-development scenarios). The predicted afflux in the road reserve will not cause an adverse impact on the trafficability of the road.
- During the 1 in 50 AEP event, a localised offsite afflux up to 30mm is predicted within the road reserve of Eighteenth Avenue, but there is no change in the flood hazard (i.e., the flood hazard is 'H1' for both the pre-development and post-development scenarios). The predicted afflux in the road reserve will not cause an adverse impact on the trafficability of the road.
- For the remainder of the design flood events (i.e., 1 in 100, 1 in 200, 1 in 500 AEP and PMF events), no adverse offsite food impact is predicted.

4 High-Level Flood Emergency Response Strategy

4.1 Constraints and Opportunities

Based on the post-development flood behaviour at the Site discussed in Section 3 of this report, the following constraints and opportunities have been taken into consideration to formulate a high-level flood emergency response strategy.

4.1.1 Constraints

- Rapid onset of inundation of the Site and the surrounding roads during a PMF event, giving little or no warning time for an effective evacuation.
- During a PMF event, the developed Site (outside of builidngs) is impacted by H3 hazard floodwaters. H3 is hazard is considered unsafe for people and vehicles (AIDR, 2017).
- During a PMF event, the surrounding roads are not accessible by vehicle due to H3 to H4 hazard classification (Refer to Figure E.6 of Annex E). Therefore, the proposed senior housing could be isolated, and it would not be possible to access or evacuate the premise by vehicle or on foot.

4.1.2 Opportunities

- The ground floor of the proposed buildings is flood free up and including the 1 in 500 AEP event. During the PMF event, the ground floor of the buildings is impacted by a maximum of H1 flood hazard (with a maximum depth of less than 0.2m). H1 hazard is deemed generally safe for people and vehicles (AIDR, 2017).
- The carpark, driveway, and concrete pathways are impacted by a maximum of H1 flood hazard up to and including the 1 in 500 AEP event. H1 hazard is deemed generally safe for people and vehicles, whilst noting that current best practice is to avoid entering floodwaters wherever possible, and under no circumstances should floodwater be considered “safe”.
- Given the flash flood nature at the Site and within Middle Creek catchment, inundation durations at the Site and within the floodplain are deemed to be relatively short during all flood events up and including the PMF.

Figures E.1 to E.6 of Annex E show the flood hazard along the surrounding roads within the wider Middle Creek floodplain.

4.2 Proposed Flood Emergency Response Strategy

4.2.1 Assessment of Available Strategies

There are two primary flood emergency response strategies, namely evacuation off-site and Shelter-in-place (SIP), where SIP is the movement of occupants to a suitable flood-free location to shelter during a flood event (e.g., vertical refuge on the site or near the site at an elevation above the PMF level).

In accordance with the Department of Planning and Environment (DPE)’s ‘Support for emergency management planning - Flood risk management guideline EM01’ (DPE, 2023), the preferred emergency management approach is evacuation, where evacuation capacity and capability has been demonstrated as the most effective strategy to manage risks. However, in this case evacuation off-site is not recommended for the following reasons:

- It is not possible to evacuate off-site via vehicles or on foot during the local PMF event due to floodwaters classified as H3 hazard classification and above within and surrounding the Site and across the wider area.

- Rapid onset of flooding and unsafe flood hazard for egress along adjoining roadways during a PMF event. It would require considerable coordination and effort to evacuate the number of on-Site occupants given the short warning time available. Therefore, neither pedestrian nor vehicular evacuation is recommended after the onset of a severe rainfall event during a PMF event.

4.2.2 Recommended Strategy

Given the above-mentioned constraints and opportunities, SIP is considered to be preferrable over evacuation off-site for the proposed development following the onset of a flood producing rainfall event. Recommended considerations and design principles to ensure an effective SIP strategy for the proposal development include:

- Appropriate triggers and communication protocol should be formulated considering the local overland flow and Middle Creek flooding conditions.
- Appropriate flood signs should be installed on-site.
- Buildings must demonstrate structural stability up to the PMF so as to withstand the hydrostatic, hydrodynamic, buoyancy and debris loads of PMF conditions. Verification by a suitably qualified structural engineer and compliance with the Building Code of Australia would be required.
- A standalone generator should be installed above the highest PMF level.
- Access to on-Site systems and provision of adequate power, water, and sewerage services must be available during and beyond the event for the full range of flooding.
- The location of storage of food, water and medical emergency for SIP purposes should be above the highest PMF level and available during and beyond flood event.
- Education is critical to ensuring that the occupants of the Site are aware of actions to be taken before, during and after SIP and the key triggers that require SIP. There needs to be ongoing education campaigns for the areas where SIP will apply.
- A detailed flood emergency response plan (FERP) should be prepared in consultation with Council and SES including provisions for accessibility of shelter-in-place refuge, consideration of flood warning systems, serviceability requirements, roles and responsibilities and what actions are required before, during and after a flood.

5 Responses to Requirements of LEP 2013

Table 5.1 provides BMT's responses to key requirements of Clause 5.21 of CHCC's Local Environmental Plan (LEP) 2013.

Table 5.1 Responses to Clause 5.21 of LEP 2013

Clause and Requirements	BMT's Response
5.21(2). Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development:	
(a). is compatible with the flood function and behaviour on the land, and	Section 3.2 of this FIA report has demonstrated that the proposed development is compatible with the flood function and behaviour on the land. It is expected that the proposed buildings must demonstrate structural stability up to the PMF so as to withstand the hydrostatic, hydrodynamic, buoyancy and debris loads of PMF conditions.
(b). will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and	Section 3.3.3 of this FIA has demonstrated that the proposed development will not cause an adverse flood impact to adjoining properties.
(c). will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and	The proposed development will not adversely affect existing evacuation routes.
(d). incorporates appropriate measures to manage risk to life in the event of a flood, and	The finished floor level of the senior housing is such that it is flood-free up and including the 1 in 500 AEP event, and the maximum flood hazard is H1 during a PMF event. H1 is deemed generally safe for people. Hence, there is no risk to life. Appropriate and detailed FERP should be prepared and implemented to manage residual flood risk to avoid exposure to high flood hazard outside of the building.
(e). will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.	The proposed development is not expected to cause environmental damages.
5.21(3). In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters:	

Clause and Requirements	BMT's Response
(a).the impact of the development on projected changes to flood behaviour as a result of climate change	The finished floor level of the building has 0.57m freeboard above the 1% AEP + 2100 climate change.
(b).the intended design and scale of buildings resulting from the development	Refer to development layout.
(c).whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,	The finished floor level of the senior housing is such that it is flood-free up and including the 1 in 500 AEP event, and the maximum flood hazard is H1 during a PMF event. H1 is deemed generally safe for people. Hence, there is no risk to life. Appropriate and detailed FERP should be prepared and implemented to manage residual flood risk to avoid exposure to high flood hazard outside of the building.
(d).the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.	The proposed buildings are located 0.57m above the 1 in 500 AEP peak flood level. During the PMF event, the flood hazard within the ground floor building is H1 which is deemed generally safe for people. Therefore, the potential to modify, relocate or remove buildings due to impact of catchment flooding is unlikely.

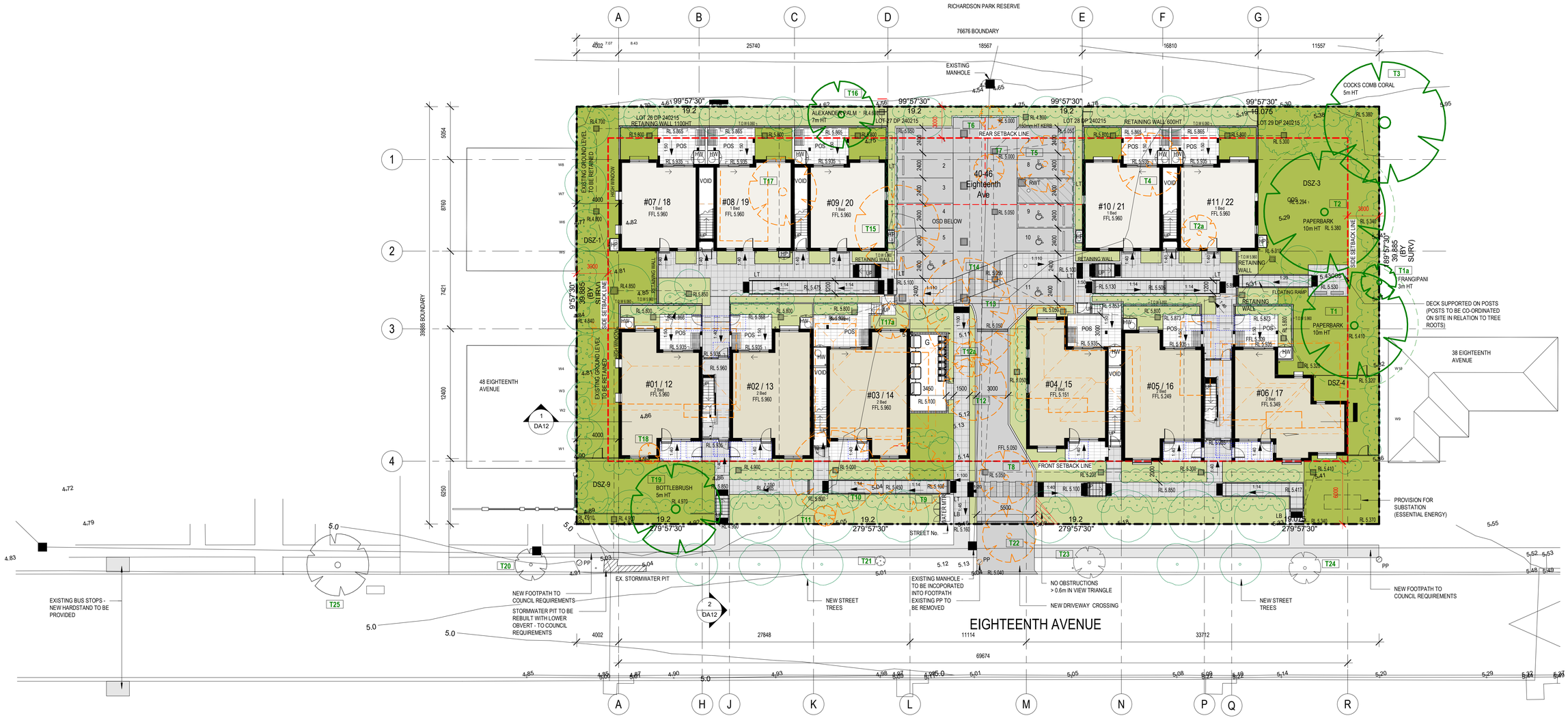
6 Conclusions

BMT used the XP-RAFTS hydrologic and TUFLOW hydraulic models of Middle Creek as per the BMT 2021a study as a basis for flood modelling to assess the proposed senior housing at 40-46 Eighteenth Avenue, Sawtell, NSW. The development Site is located within the Middle Creek catchment and is affected by overland flow flooding. Therefore, it is necessary to undertake a FIA to demonstrate that the proposed development is compatible with the flood behaviour and shall not result in an adverse flood impact beyond the boundaries of the site.

The outcomes of the flood modelling are summarised below:

- The proposed buildings are predicted to be flood-free up to and including the 1 in 500 AEP event.
- The finished floor levels of the proposed buildings (5.96m AHD) is higher than the minimum FPL required by Council's flood certificate (5.80m AHD).
- The proposed carpark bay, driveway and concrete pathways are predicted to be inundated with 'H1' flood hazard for the 1 in 20 to 1 in 500 AEP inclusive. 'H1' flood hazard is deemed generally safe for people and vehicles.
- The proposed buildings are predicted to be inundated during the PMF event with a maximum flood depth of 0.19m or 'H1' flood hazard. Given the extreme (low probability) nature of PMF event, the predicted flood hazard ('H1') is deemed acceptable.
- The PMF flood hazard within the proposed carpark bay, driveway and concrete pathways is predicted to be 'H3' which is deemed unsafe for people and vehicles.
- During the 1 in 20 AEP event, a localised offsite afflux up to 39mm is predicted at the southeast boundary of a private lot west of the Site. The extent of the affected area is very small and there is no change in the flood hazard (i.e., the flood hazard is 'H1' for both the pre-development and post-development scenarios). There is also a localised afflux up to 49mm within the road reserve of Eighteenth Avenue, but there is no change in the flood hazard level (i.e., the flood hazard is 'H1' for both the pre-development and post-development scenarios). The predicted afflux in the road reserve will not cause an adverse impact on the trafficability of the road.
- During the 1 in 50 AEP event, a localised offsite afflux up to 30mm is predicted within the road reserve of Eighteenth Avenue, but there is no change in the flood hazard (i.e., the flood hazard is 'H1' for both the pre-development and post-development scenarios). This impact will not cause an adverse impact on the trafficability of the road.
- For the remainder of the design flood events (i.e., 1 in 100, 1 in 200, 1 in 500 AEP and PMF events), no adverse offsite flood impact is predicted.
- A high-level SIP is recommended a primary flood emergency response strategy. It is recommended that a detailed FERP should be prepared in consultation with Council and SES to provide details of the SIP plan prior to occupation of the proposed senior housing.

Annex A Development Layout



LEGEND

- COMMON AREA
- 1 BEDROOM UNIT
- 2 BEDROOM UNIT
- BALCONY / PATIO
- CONCRETE / PATHWAY
- DRIVEWAY
- LANDSCAPE AREA
- DEEP SOIL ZONE

P.O.S.	PRIVATE OPEN SPACE
PP	POWER POLE
T	TELSTRA PIT
H	HYDRANT
SW	STORMWATER
RL	INDICATIVE RELATIVE LEVEL
C.O.S.	COMMON OPEN SPACE
G	GARBAGE BINS
LT	EXTERIOR WALL MOUNT LIGHT

- 00 EXISTING TREE TO BE RETAINED MEDIUM RETENTION VALUE (WITH TPZ DASHED)
- 00 EXISTING TREE TO BE RETAINED LOW RETENTION VALUE (WITH TPZ DASHED)
- EXISTING TREE - TO BE DEMOLISHED
- NEW PROPOSED TREES
- NEW PROPOSED LANDSCAPING - REFER TO LANDSCAPE PLAN

North

NSW GOVERNMENT
LOCKED BAG 5022
PARRAMATTA NSW 2124
Ph 1800 738 718
www.dpie.nsw.gov.au/land-and-housing-corporation

NOMINATED ARCHITECT:	SIGNATURE:
MICHAEL BULLEN	

REV	DATE	NOTATION/AMENDMENT
B	26/05/23	FOR REVIEW
A	23/03/23	FOR REVIEW

DO NOT SCALE DRAWINGS. CHECK ALL DIMENSIONS ON SITE. FIGURED DIMENSIONS TAKE PRECEDENCE.

ARCHITECT: BREWSTER MURRAY PTY LTD PH (02) 9299 0988
CONSULTING ENGINEERS: GREENVIEW CONSULTING
BCA CONSULTANT:
LANDSCAPE CONSULTANT: GREENLAND DESIGN

CLIENT: **DEPARTMENT OF PLANNING & ENVIRONMENT LAND & HOUSING CORPORATION**

PROJECT: **SENIORS HOUSING DEVELOPMENT UNDER NSW HOUSING SEPP 2021**

40-46 EIGHTEENTH AVE, SAWTELL, NSW
LOT 26-29 (INCLUSIVE) IN DP 240215

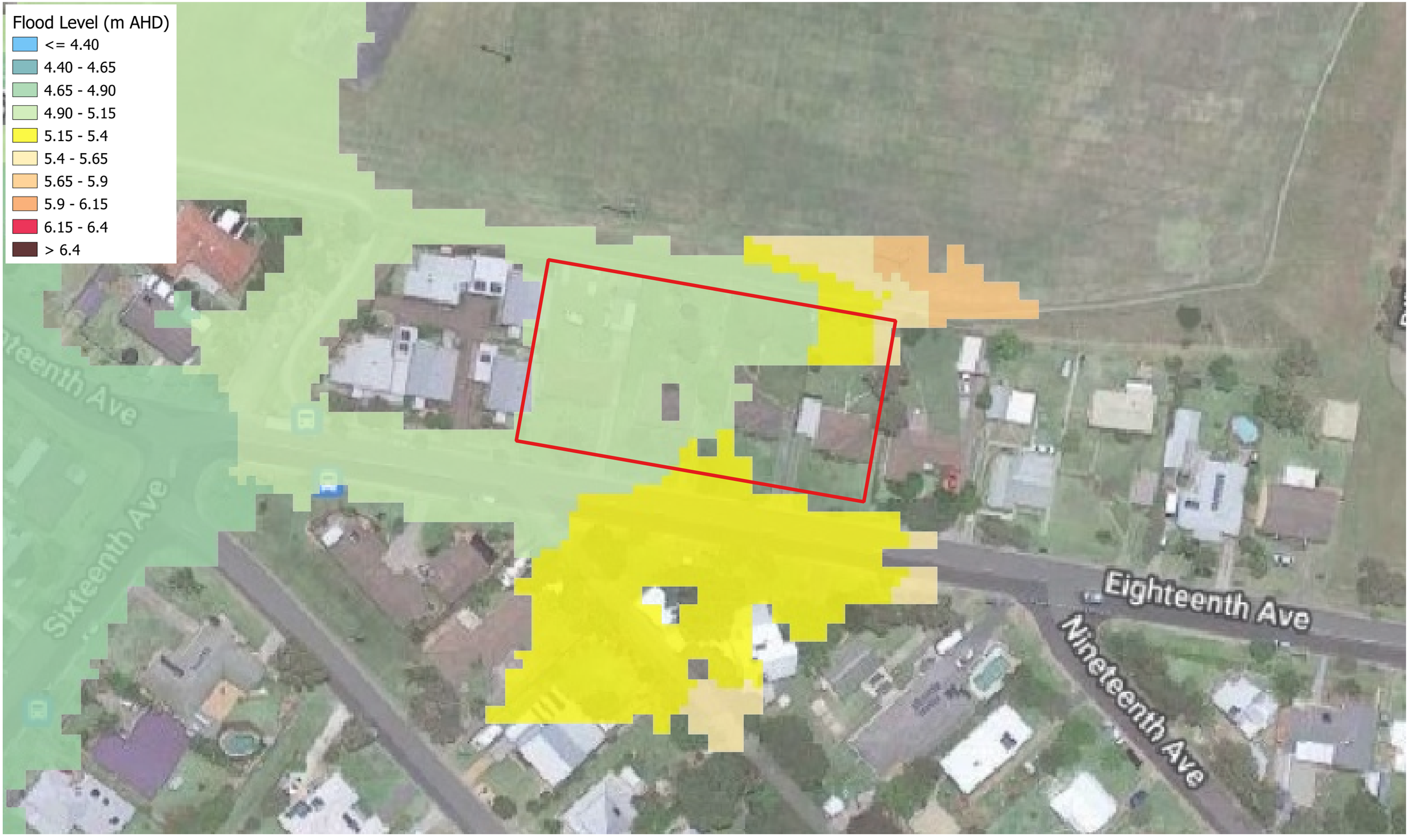
TITLE: SITE PLAN

FILE: | PLOTTED:

STATUS: **SKETCH DESIGN**

DATE	SCALE	PROJ	PROJECT No
26/05/23	1:200	MB	BGYVU
STAGE	SHEET SIZE	DESIGNER	CHECKED
	A1	AG	MB
TYPE	SHEET		REV
	DA04		B

Annex B Pre-Development Flood Maps



Legend

Site

Title:

1 in 20 AEP Peak Flood Level |Base Case|

Drawing: **B.1**

Rev: **A**

0 19 38 m

BMT
www.bmt.org

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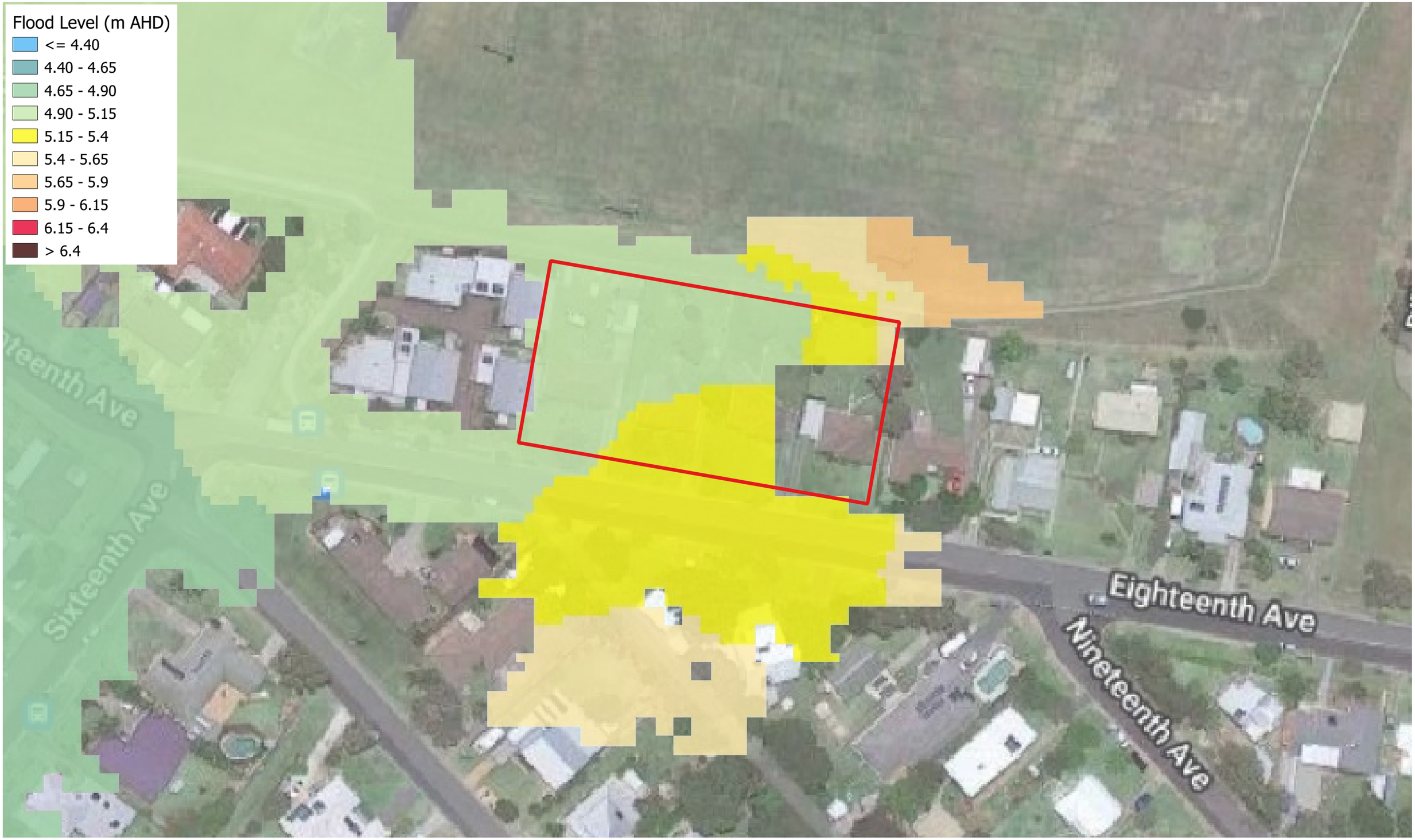

Legend

Site

Title:

1 in 50 AEP Peak Flood Level |Base Case|

Drawing: B.2

Rev: A

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0 19 38 m

BMT
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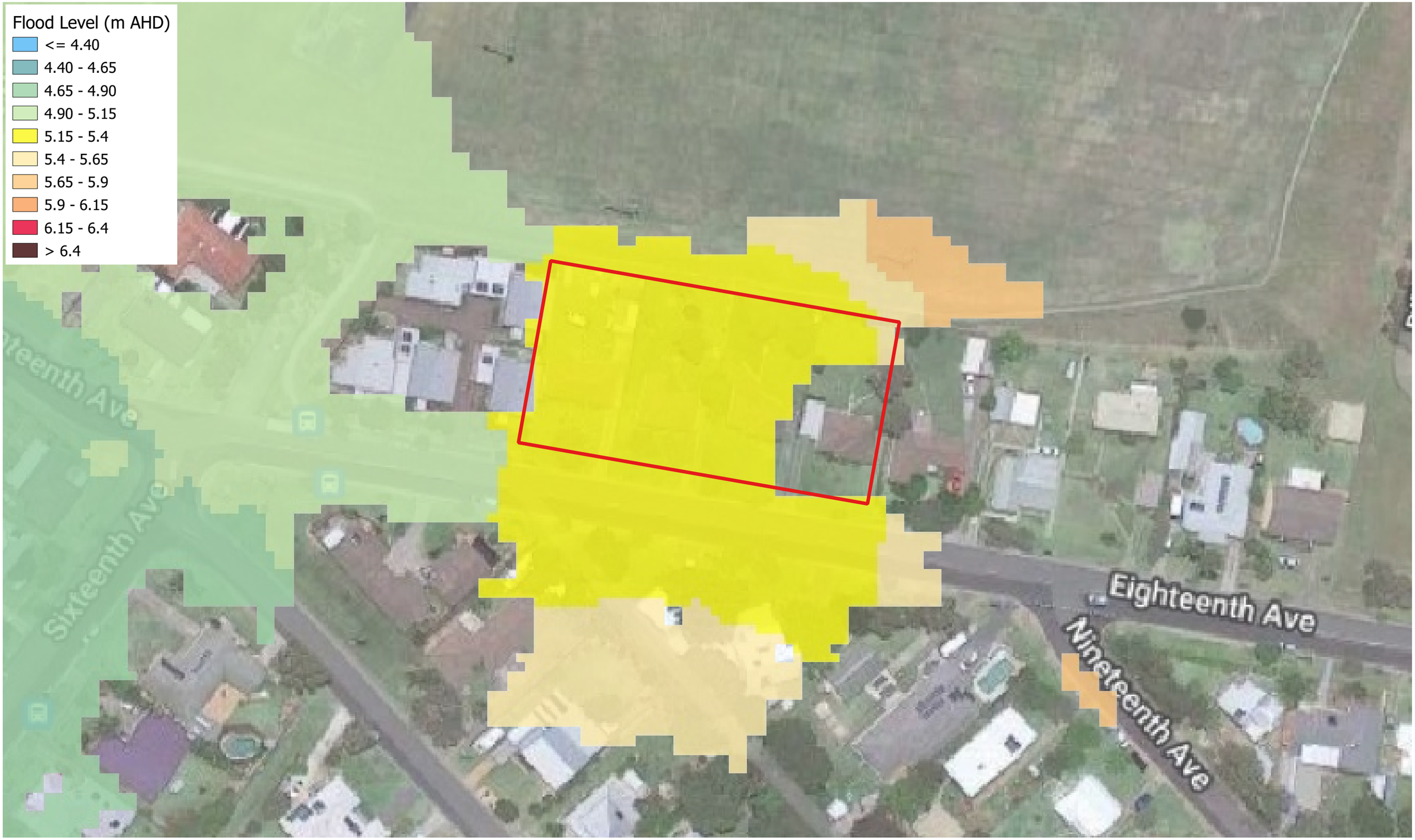
Filepath: I:\A12026_40-46_18thAvenue_Sawtell\QGIS\Figure_Generator_210504\AppB\AppB.qgz



Legend

Site

Title:

1 in 100 AEP Peak Flood Level |Base Case|

Drawing: **B.3**

Rev: **A**

0 19 38 m

BMT
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Filepath: I:\A12026_40-46_18thAvenue_Sawtell\QGIS\Figure_Generator_210504\AppB\AppB.qgz

Flood Level (m AHD)
- <= 4.40
- 4.40 - 4.65
- 4.65 - 4.90
- 4.90 - 5.15
- 5.15 - 5.4
- 5.4 - 5.65
- 5.65 - 5.9
- 5.9 - 6.15
- 6.15 - 6.4
- > 6.4

Sixteenth Ave

Eighteenth Ave

Nineteenth Ave

Legend

Site

Title:

1 in 200 AEP Peak Flood Level |Base Case|

Drawing: B.4

Rev: A

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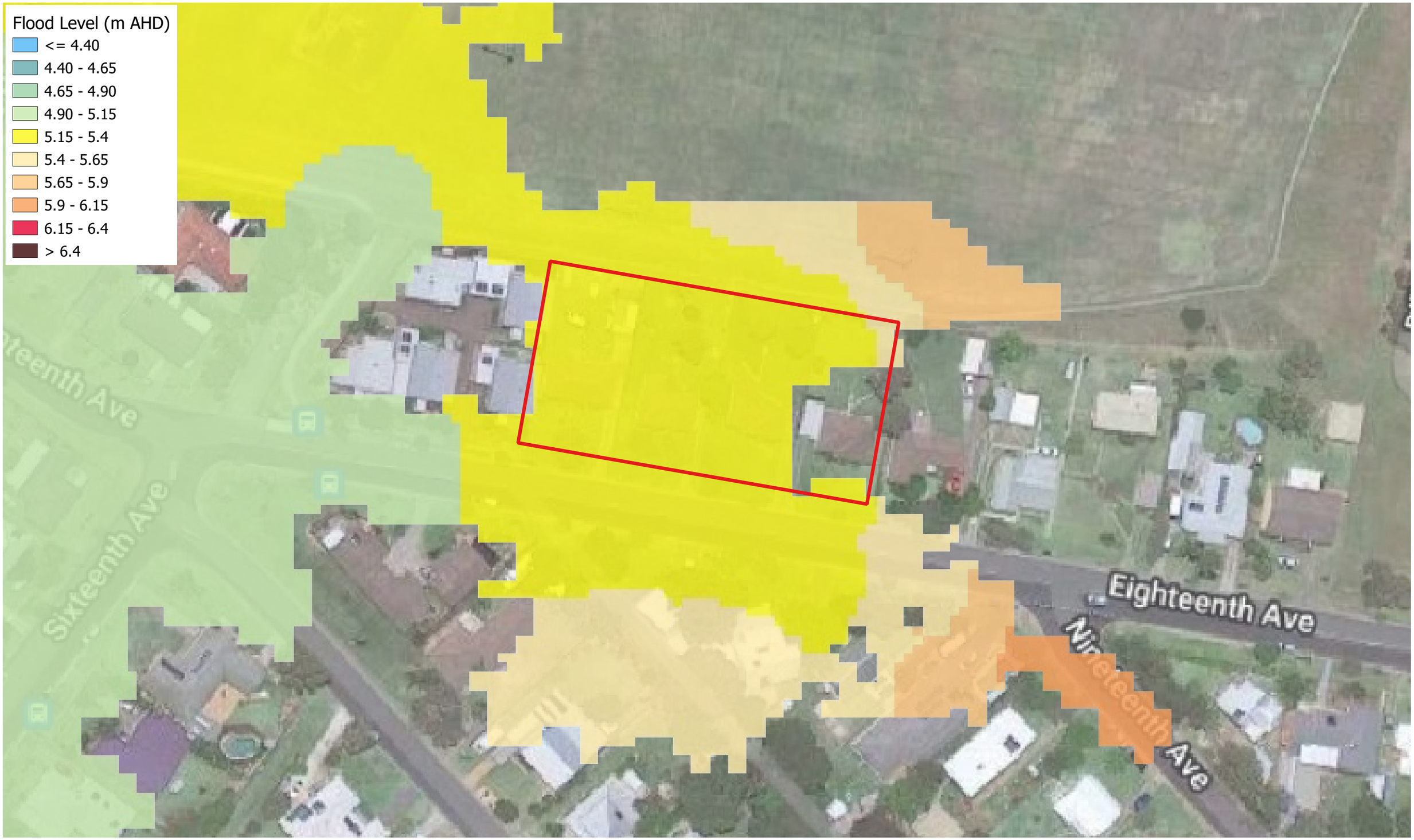

Legend

Site

Title:

1 in 500 AEP Peak Flood Level |Base Case|

Drawing: **B.5**

Rev: **A**

0 19 38 m

BMT
www.bmt.org

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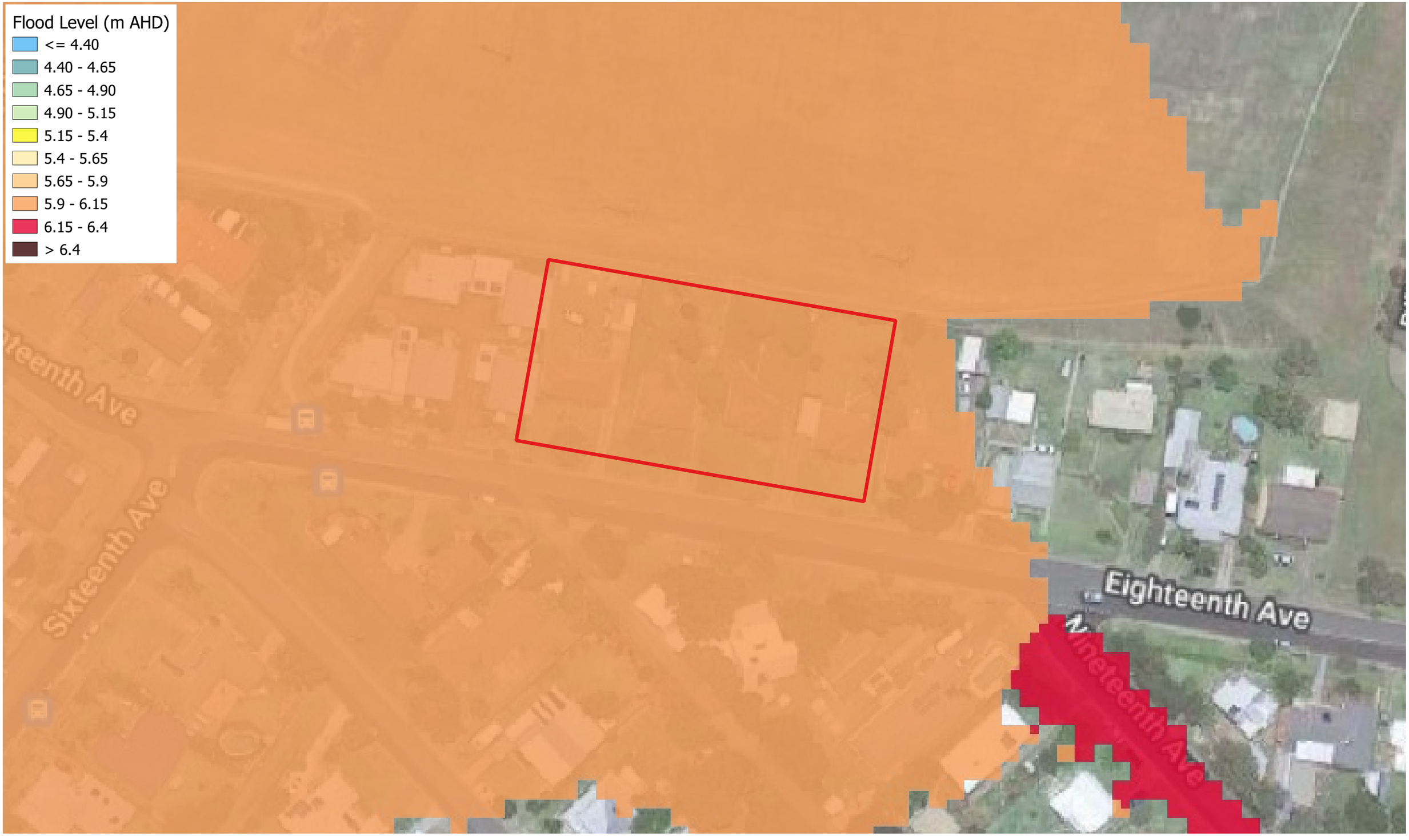

Legend

Site

Title:

PMF Peak Flood Level |Base Case|

Drawing: B.6

Rev: A

0 19 38 m

BMT
www.bmt.org

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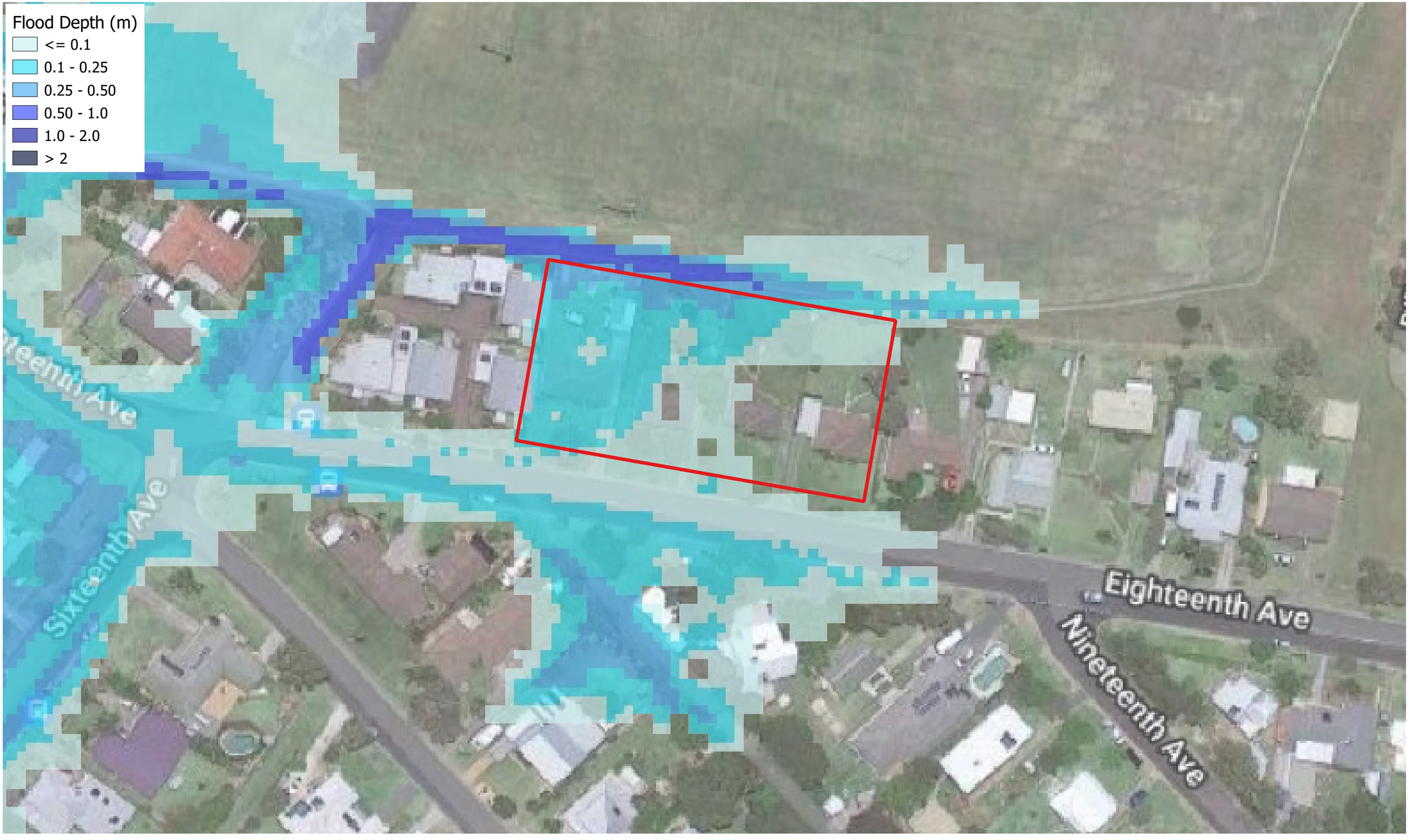


Legend

Site

Title:

1 in 20 AEP Peak Flood Depth |Base Case|

Drawing: B.7

Rev: A

0 19 38 m

BMT
www.bmt.org

Filepath: I:\A12026_40-46_18thAvenue_Sawtell\QGIS\Figure_Generator_210504\AppB\AppB.qgz

Legend

Site

Title:

1 in 50 AEP Peak Flood Depth |Base Case|

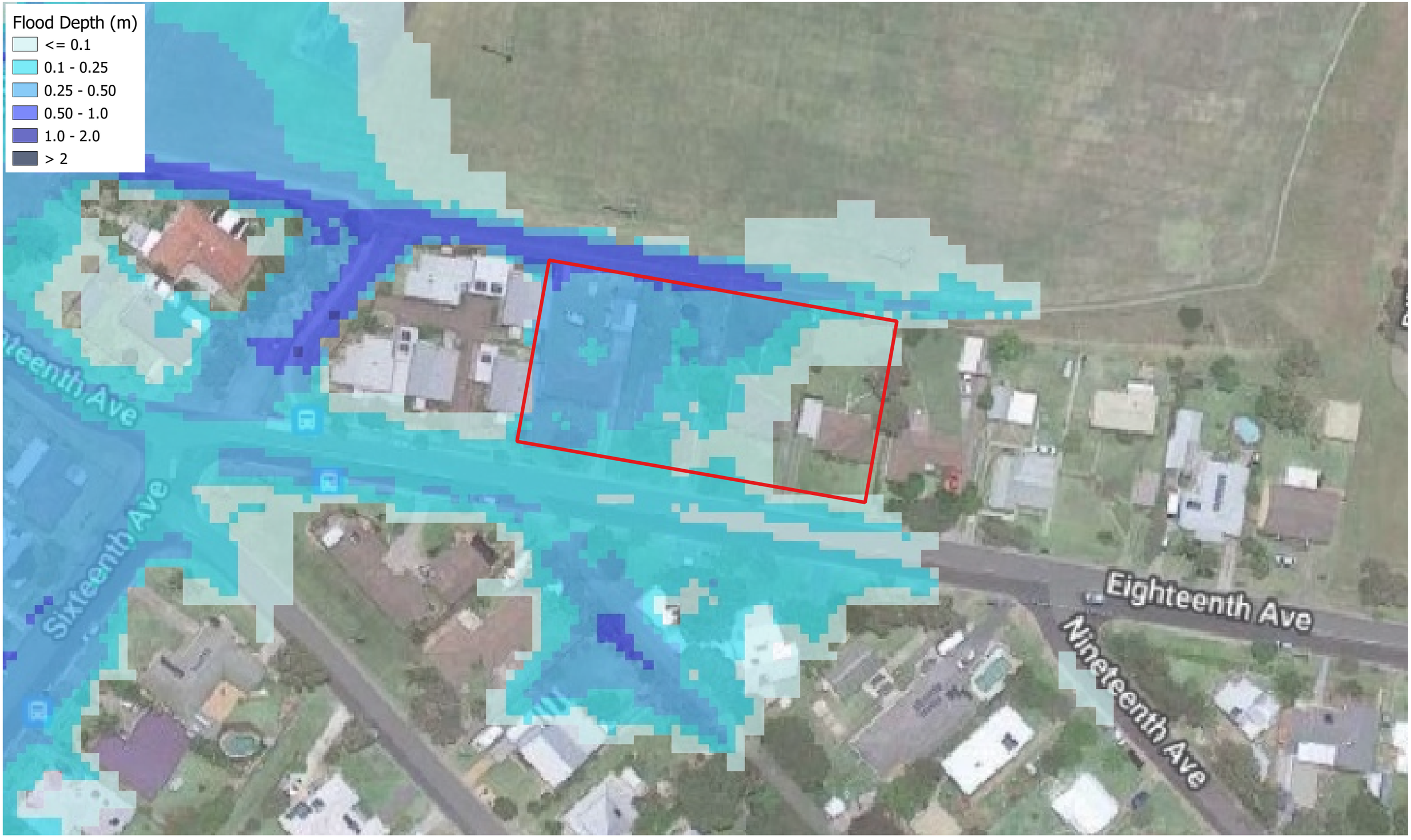
Drawing: B.8

Rev: A

0 19 38 m

BMT
www.bmt.org

Filepath: I:\A12026_40-46_18thAvenue_Sawtell\QGIS\Figure_Generator_210504\AppB\AppB.qgz



Legend

Site

Title:

1 in 100 AEP Peak Flood Depth |Base Case|

Drawing: **B.9**

Rev: **A**

0 19 38 m

BMT
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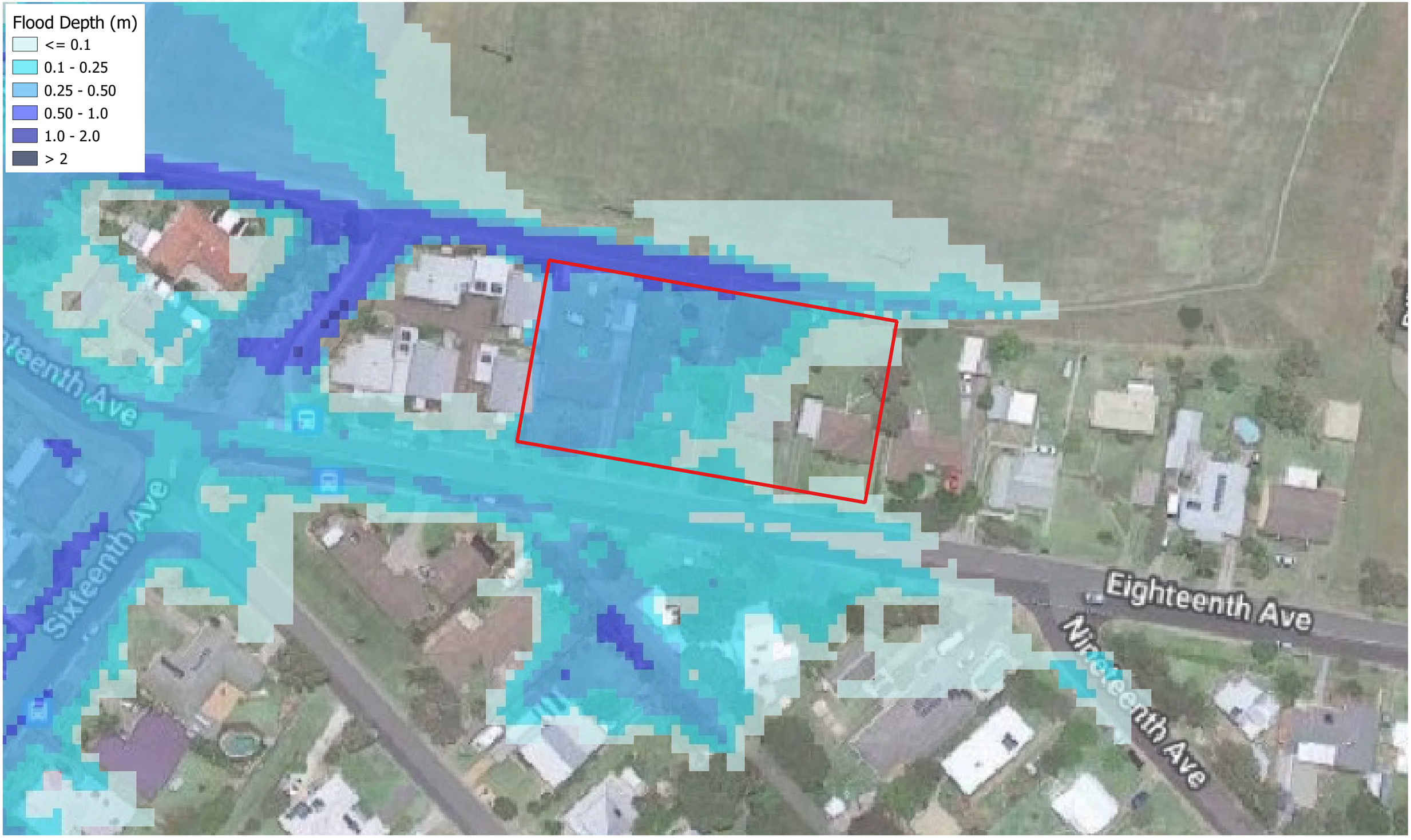

Legend

Site

Title:

1 in 200 AEP Peak Flood Depth |Base Case|

Drawing: **B.10**

Rev: **A**

0 19 38 m

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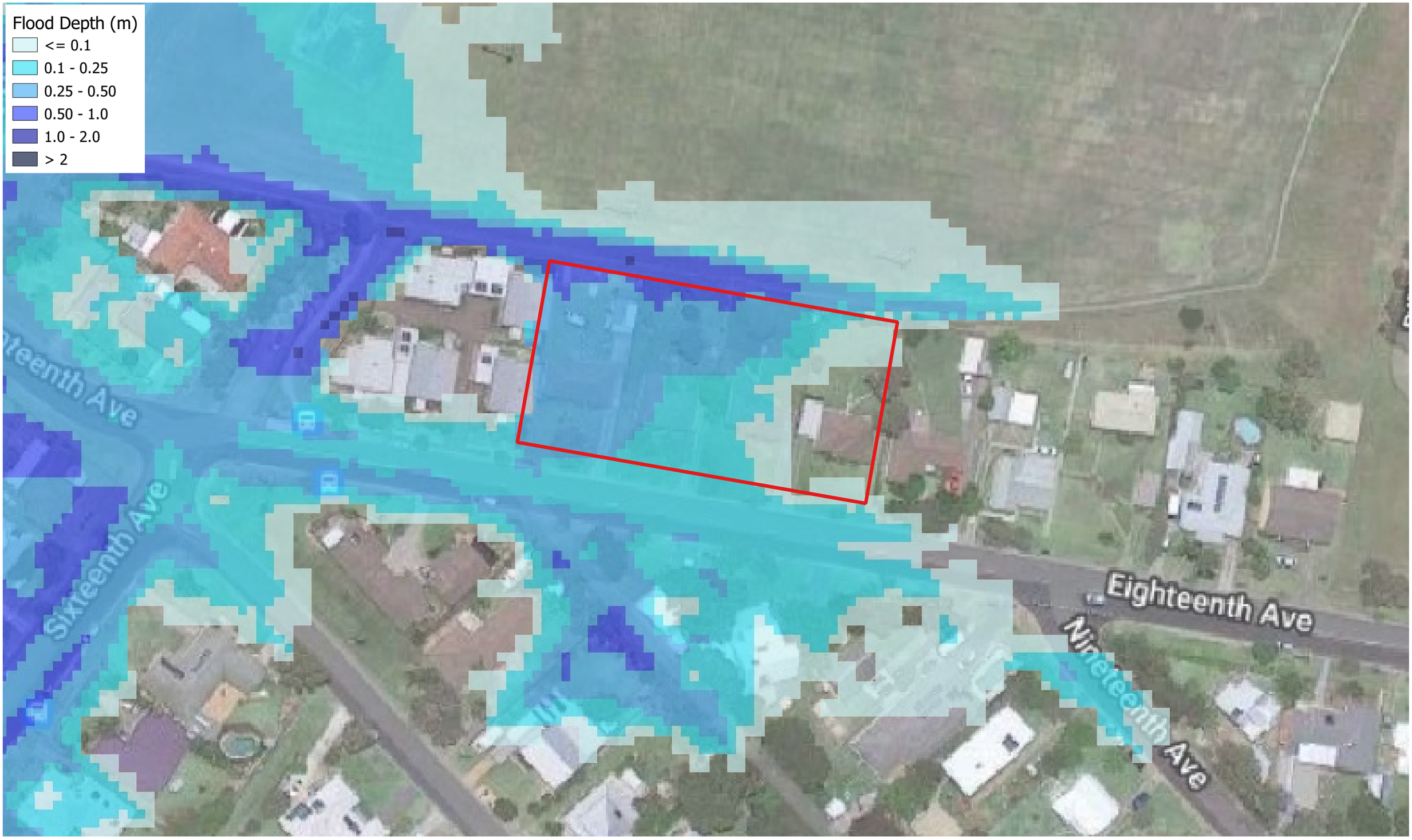

Legend

Site

Title:

1 in 500 AEP Peak Flood Depth |Base Case|

Drawing: **B.11**

Rev: **A**

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0 19 38 m

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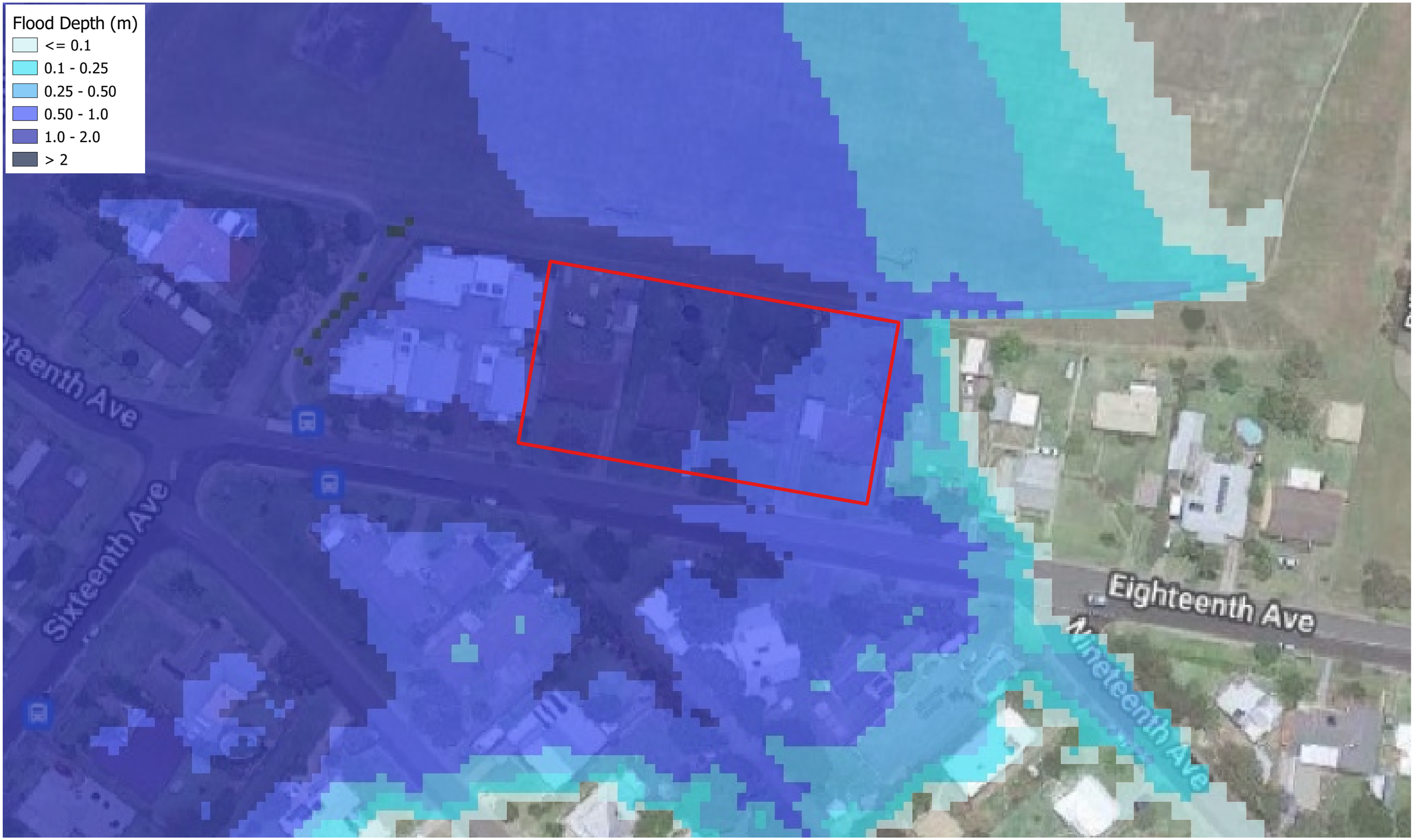

Legend

Site

Title:
PMF Peak Flood Depth |Base Case|

Drawing: **B.12**

Rev: **A**

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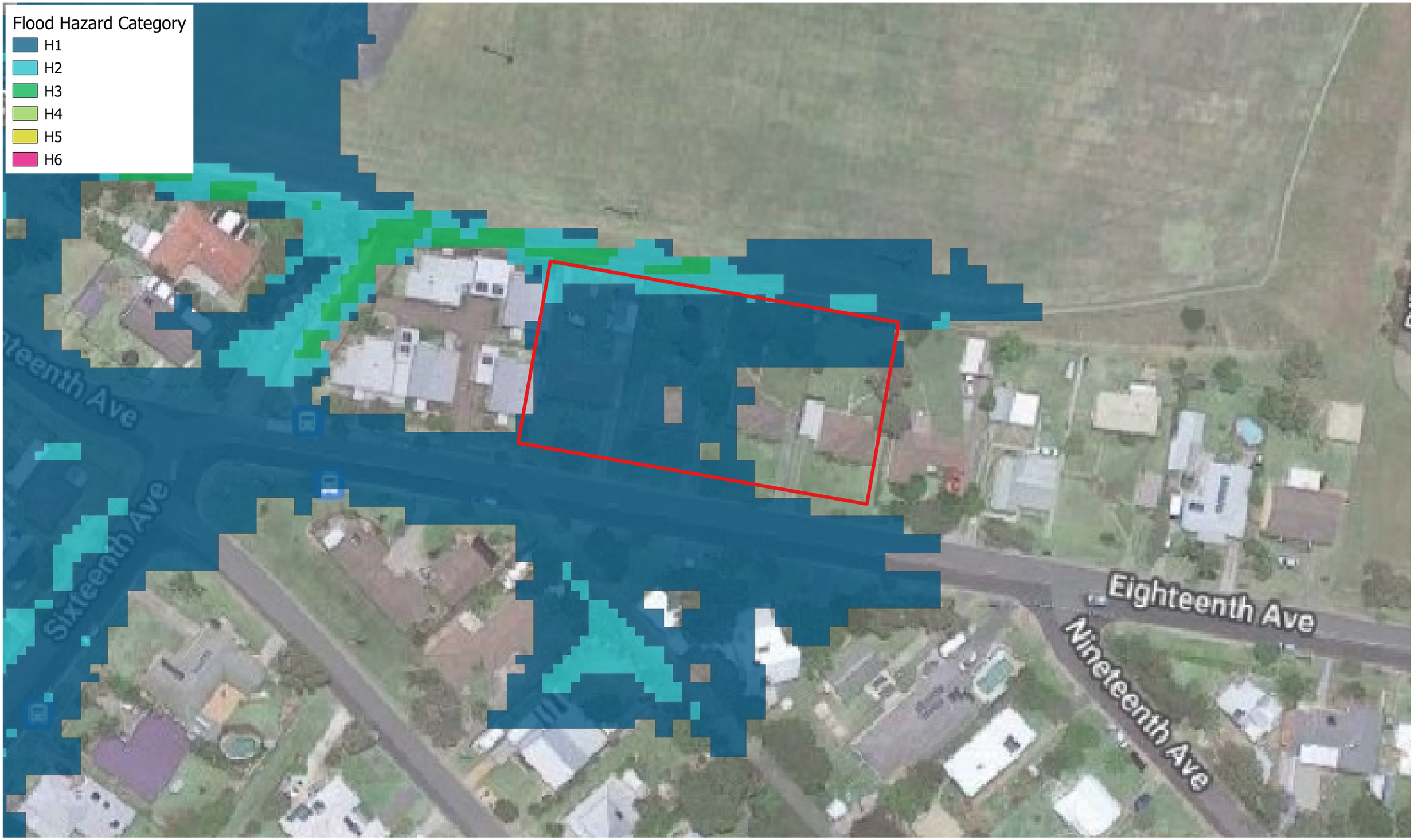

Legend

Site

Title:

1 in 20 AEP Peak Flood Hazard |Base Case|

Drawing: **B.13**

Rev: **A**

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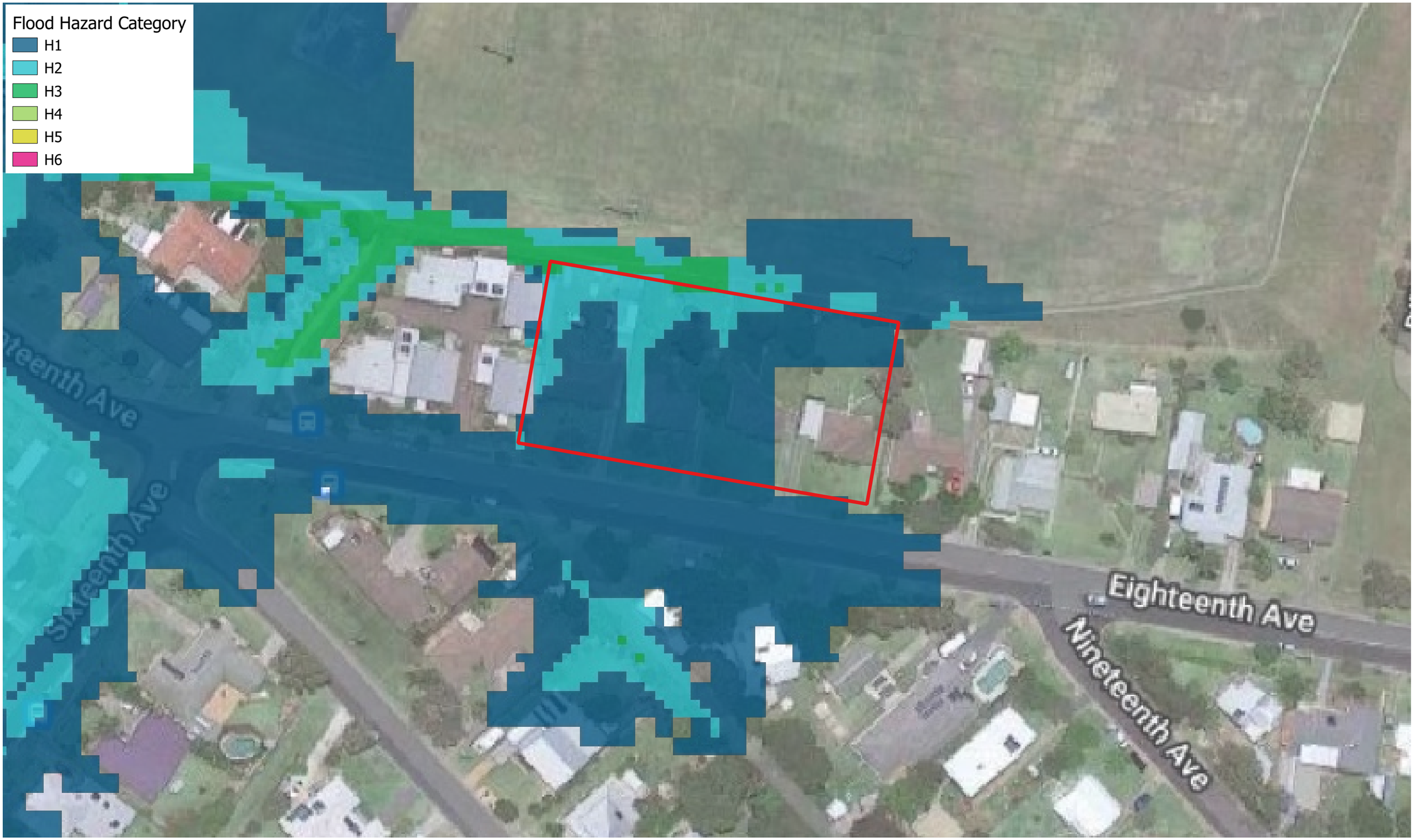

Legend

Site

Title:

1 in 50 AEP Peak Flood Hazard |Base Case|

Drawing: **B.14**

Rev: **A**

0 19 38 m

BMT
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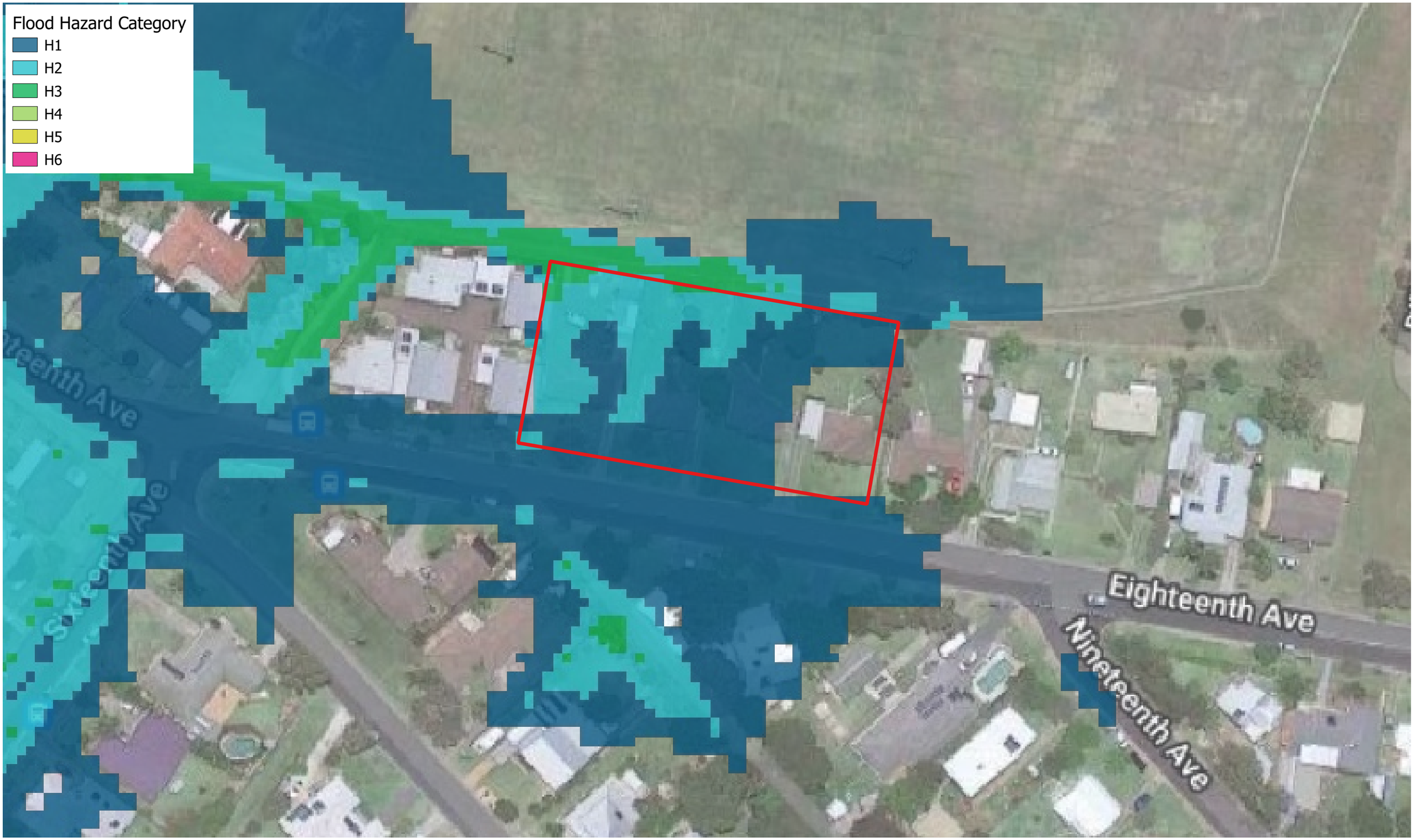

Legend

Site

Title:

1 in 100 AEP Peak Flood Hazard |Base Case|

Drawing: **B.15**

Rev: **A**

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0 19 38 m

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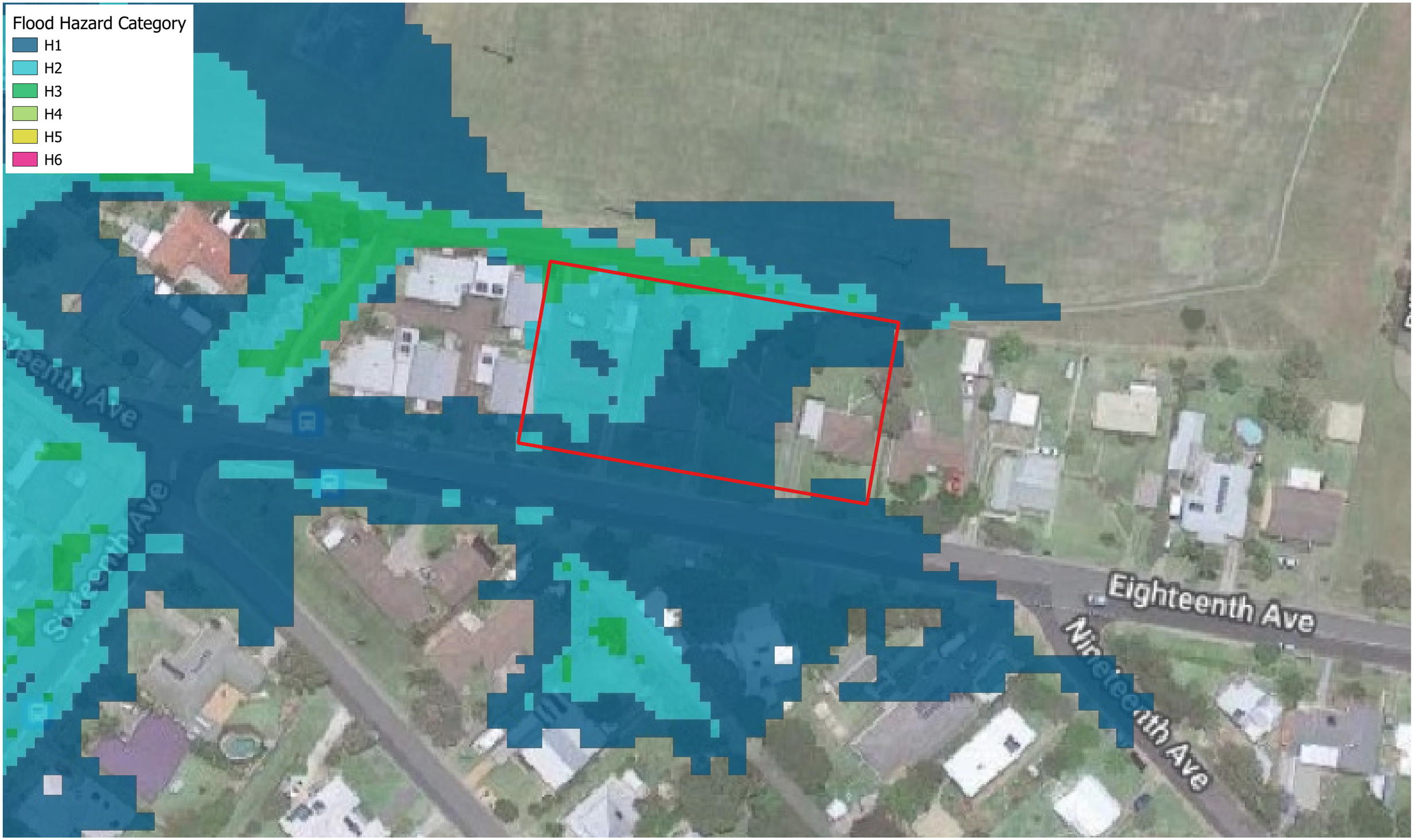

Legend

Site

Title:

1 in 200 AEP Peak Flood Hazard |Base Case|

Drawing: **B.16**

Rev: **A**

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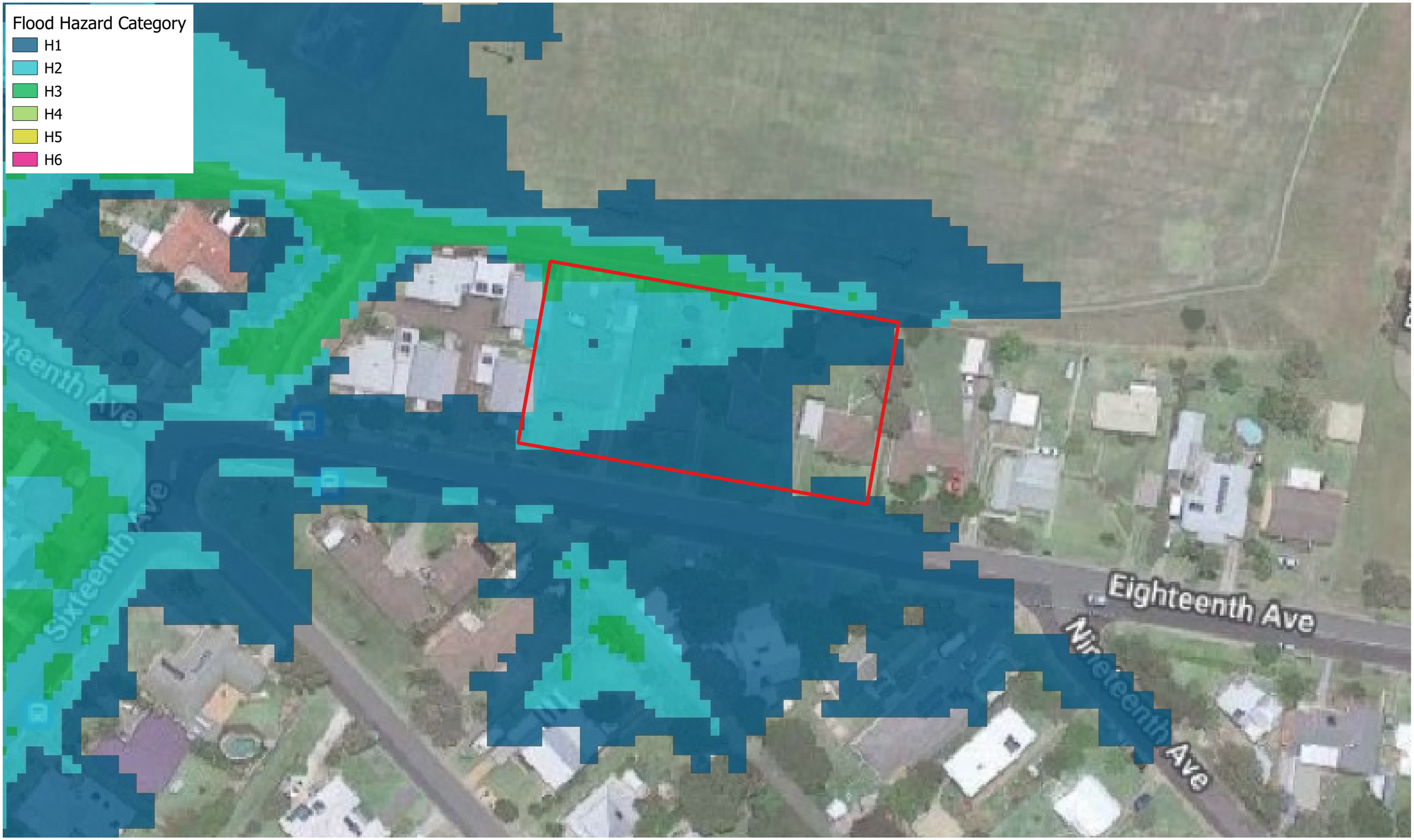

Legend

Site

Title:

1 in 500 AEP Peak Flood Hazard |Base Case|

Drawing: **B.17**

Rev: **A**

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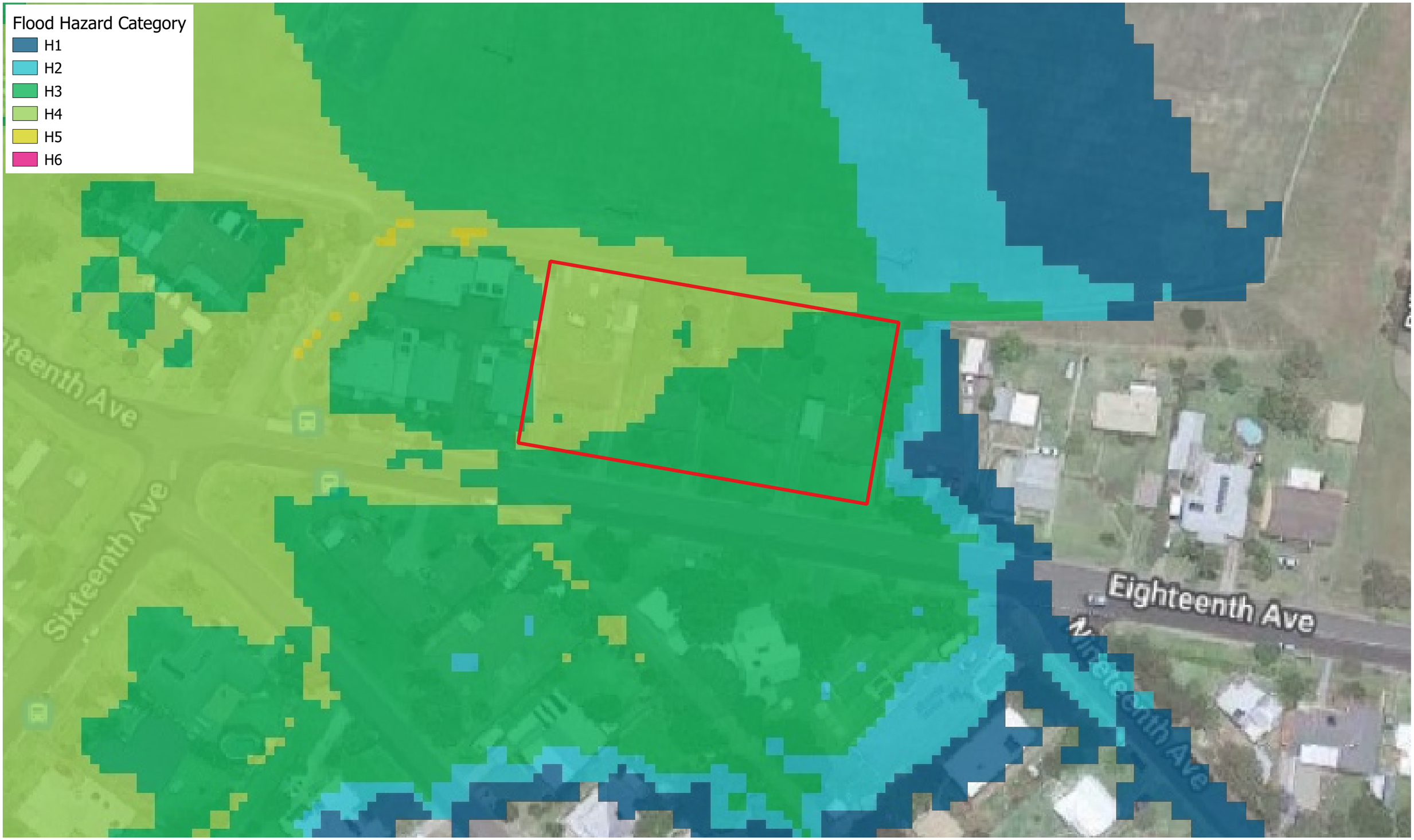

Legend

Site

Title:

PMF Peak Flood Hazard |Base Case|

Drawing: **B.18**

Rev: **A**

0 19 38 m

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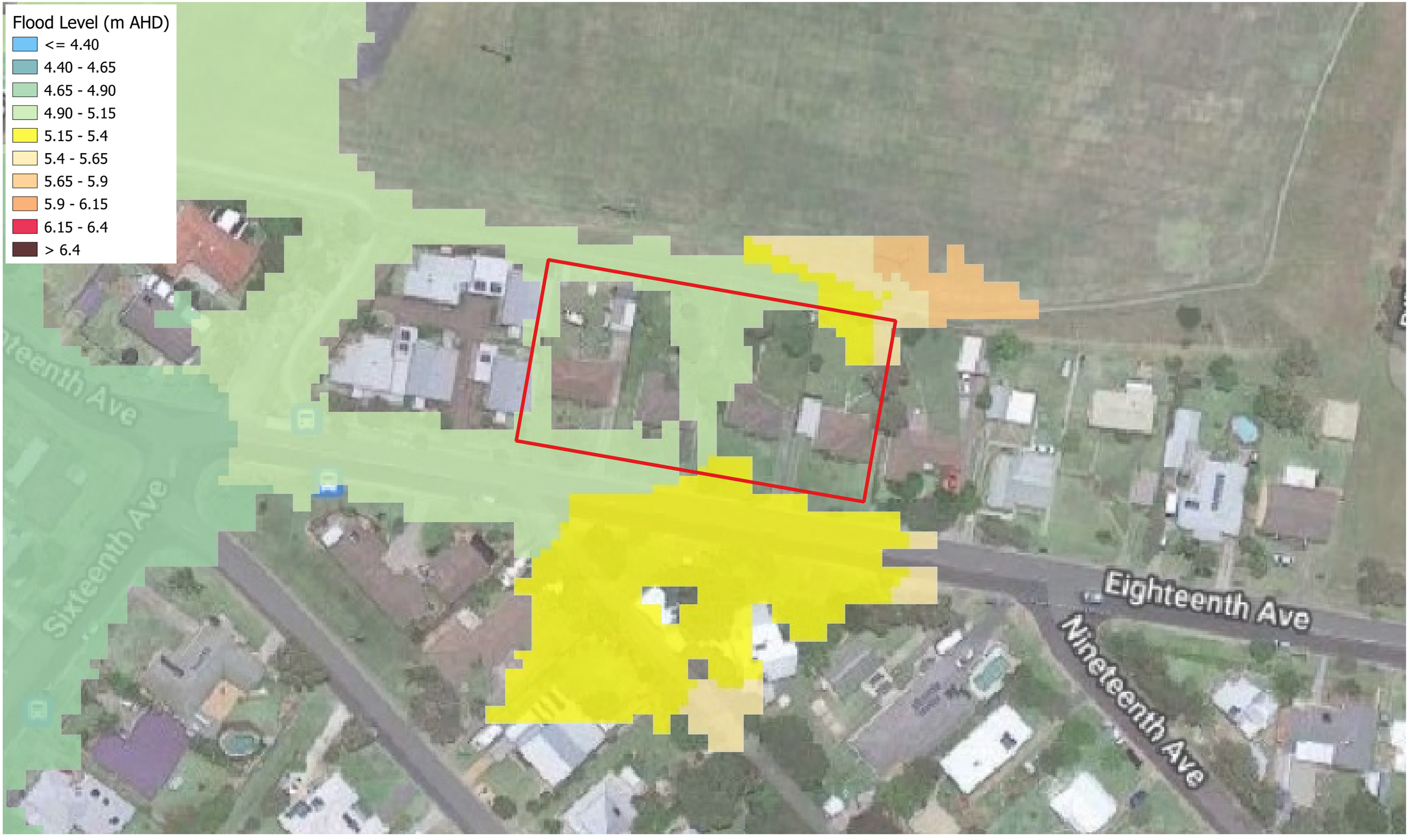
Annex C Post-Development Flood Maps



Legend

Site

Title:

1 in 20 AEP Peak Flood Level |Developed Case|

Drawing: **C.1**

Rev: **A**

0 19 38 m

BMT
www.bmt.org

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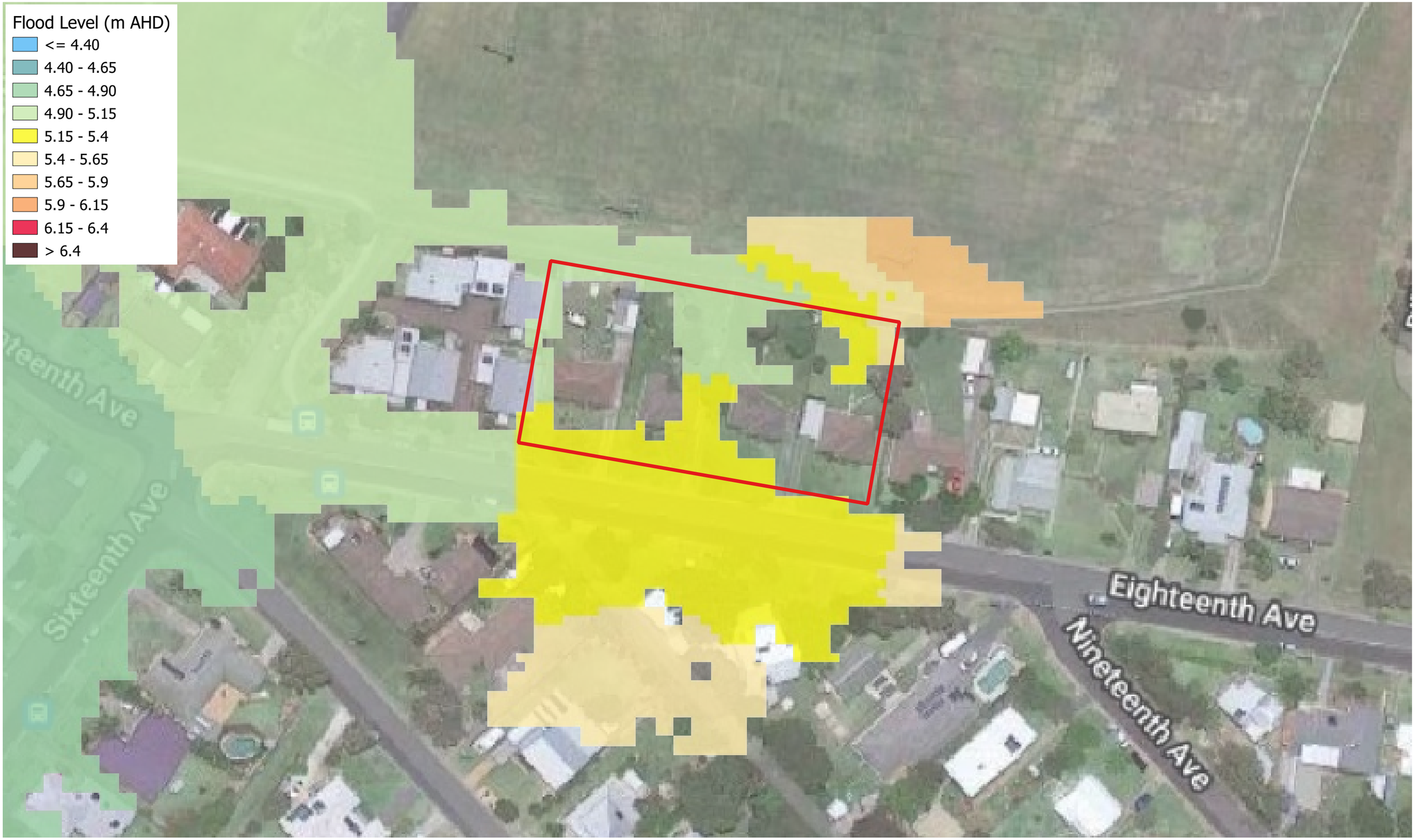

Legend

Site

Title:

1 in 50 AEP Peak Flood Level |Developed Case|

Drawing: C.2

Rev: A

0 19 38 m

BMT
www.bmt.org

Filepath: I:\A12026_40-46_18thAvenue_Sawtell\QGIS\Figure_Generator_210504\AppC\AppC.qgz

Legend

Site

Title:

1 in 100 AEP Peak Flood Level |Developed Case|

Drawing: **C.3**

Rev: **A**

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0 19 38 m

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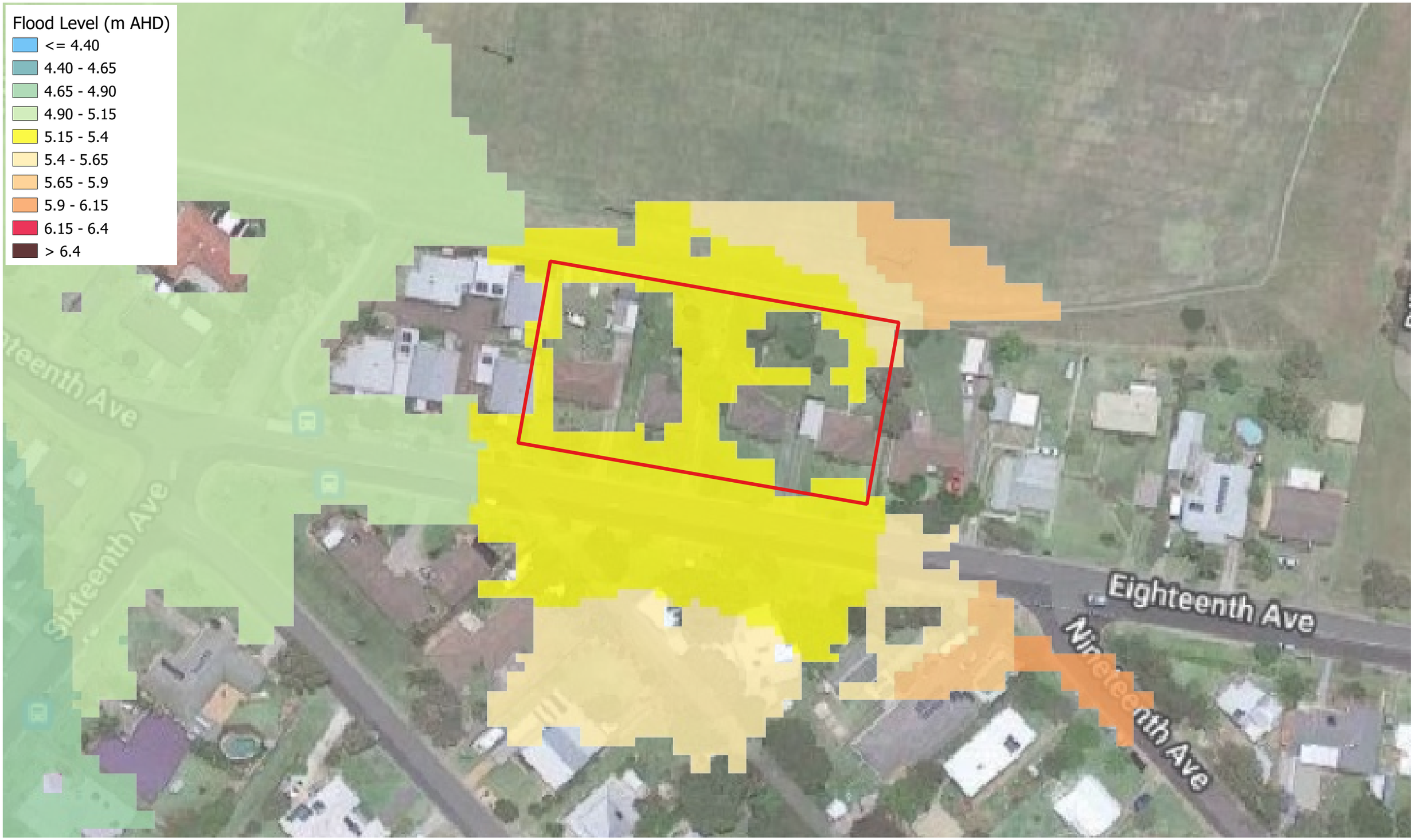

Legend

Site

Title:

1 in 200 AEP Peak Flood Level |Developed Case|

Drawing: **C.4**

Rev: **A**

0 19 38 m

BMT
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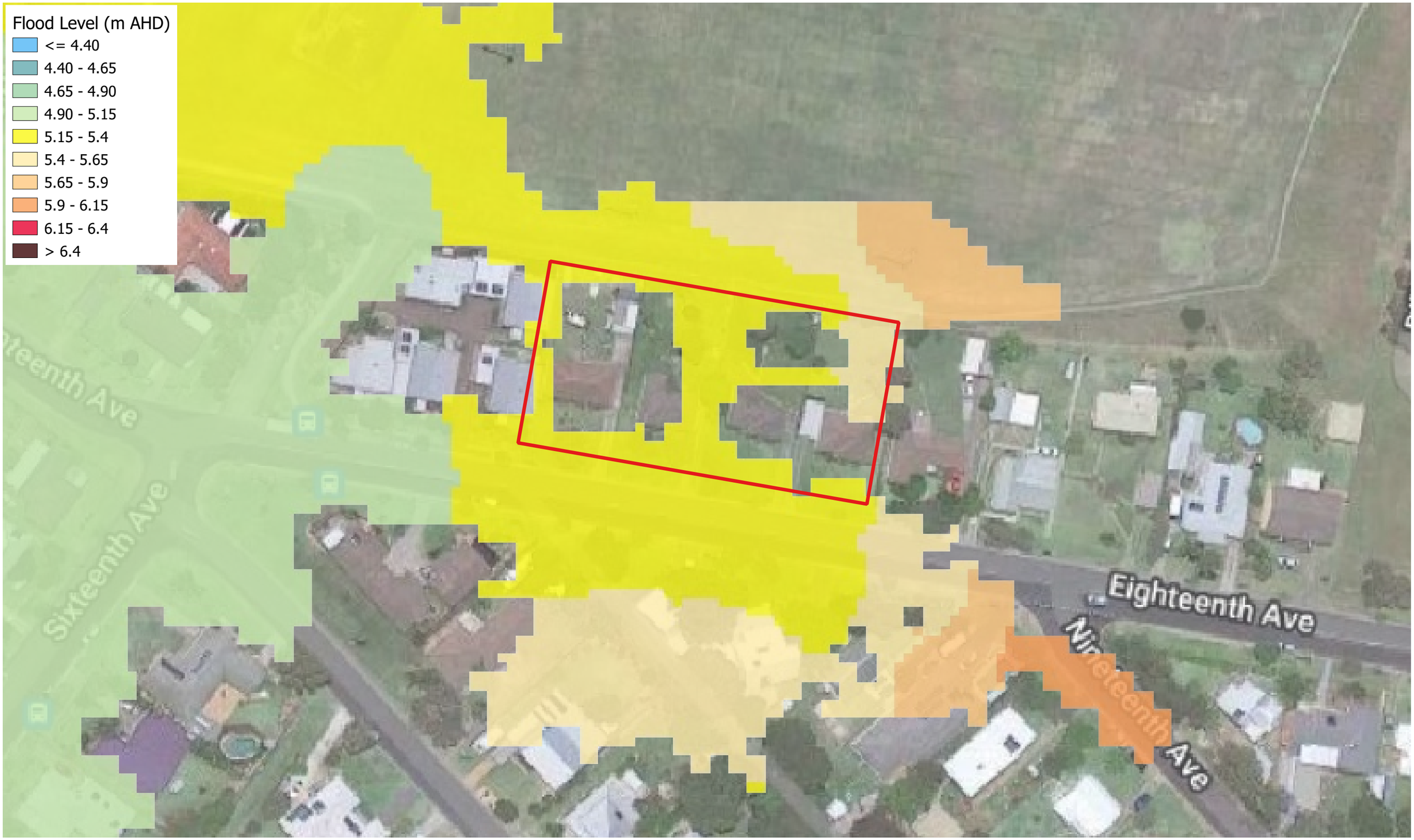

Legend

Site

Title:

1 in 500 AEP Peak Flood Level |Developed Case|

Drawing: **C.5**

Rev: **A**

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0 19 38 m

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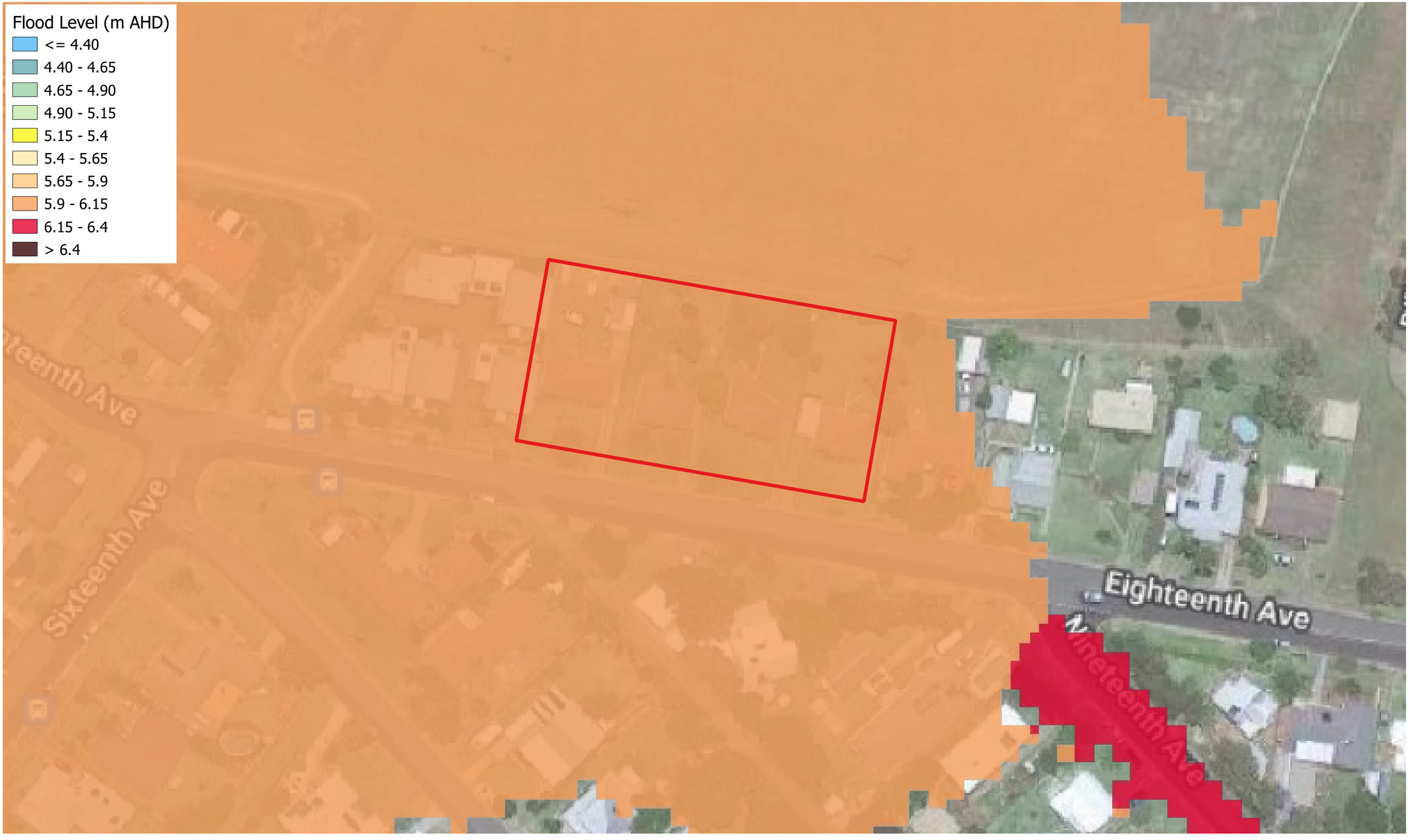

Legend

Site

Title:

PMF Peak Flood Level |Developed Case|

Drawing: **C.6**

Rev: **A**

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Legend

Site

Title:

1 in 20 AEP Peak Flood Depth |Developed Case|

Drawing: **C.7**

Rev: **A**

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0 19 38 m

BMT
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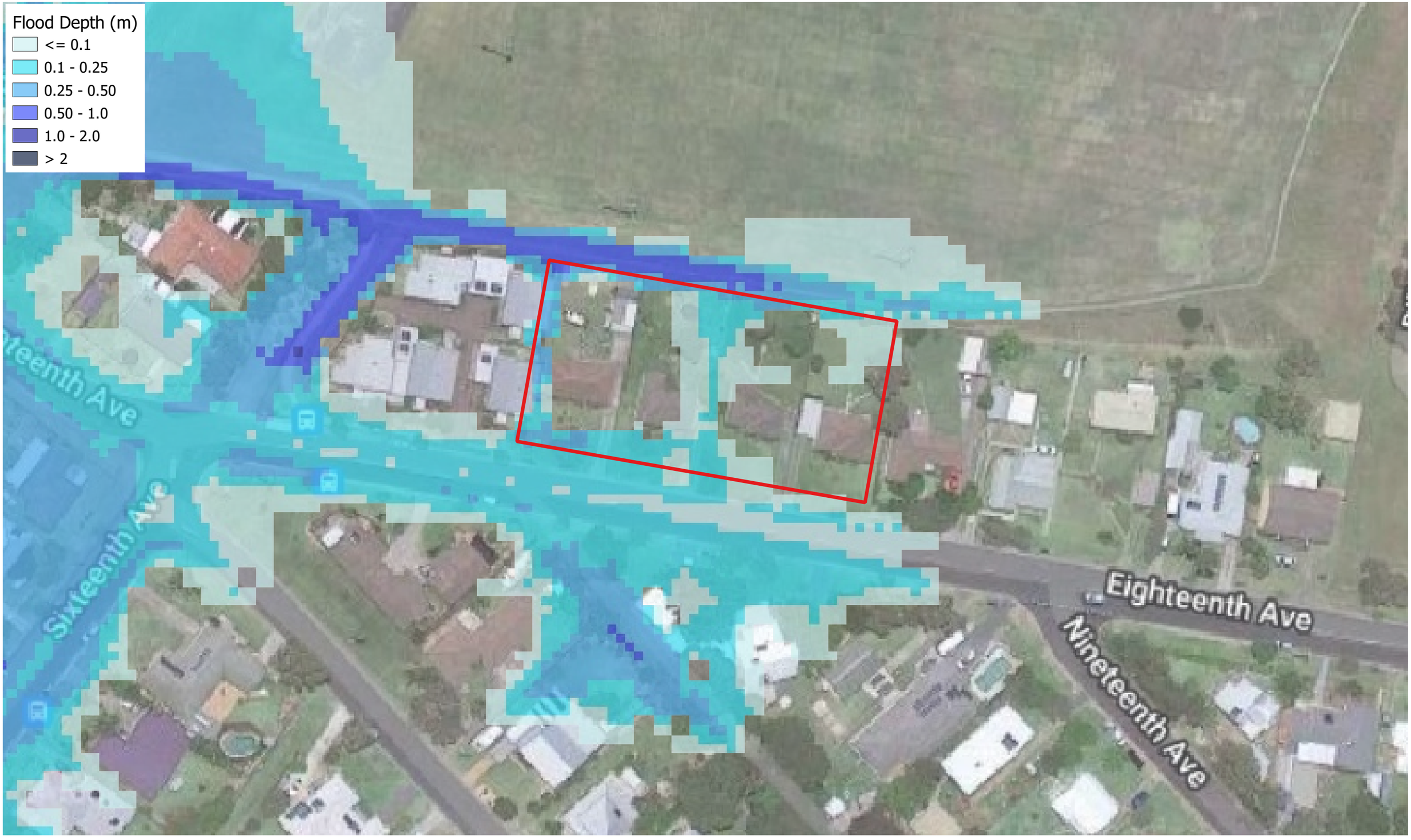


Legend

Site

Title:

1 in 50 AEP Peak Flood Depth |Developed Case|

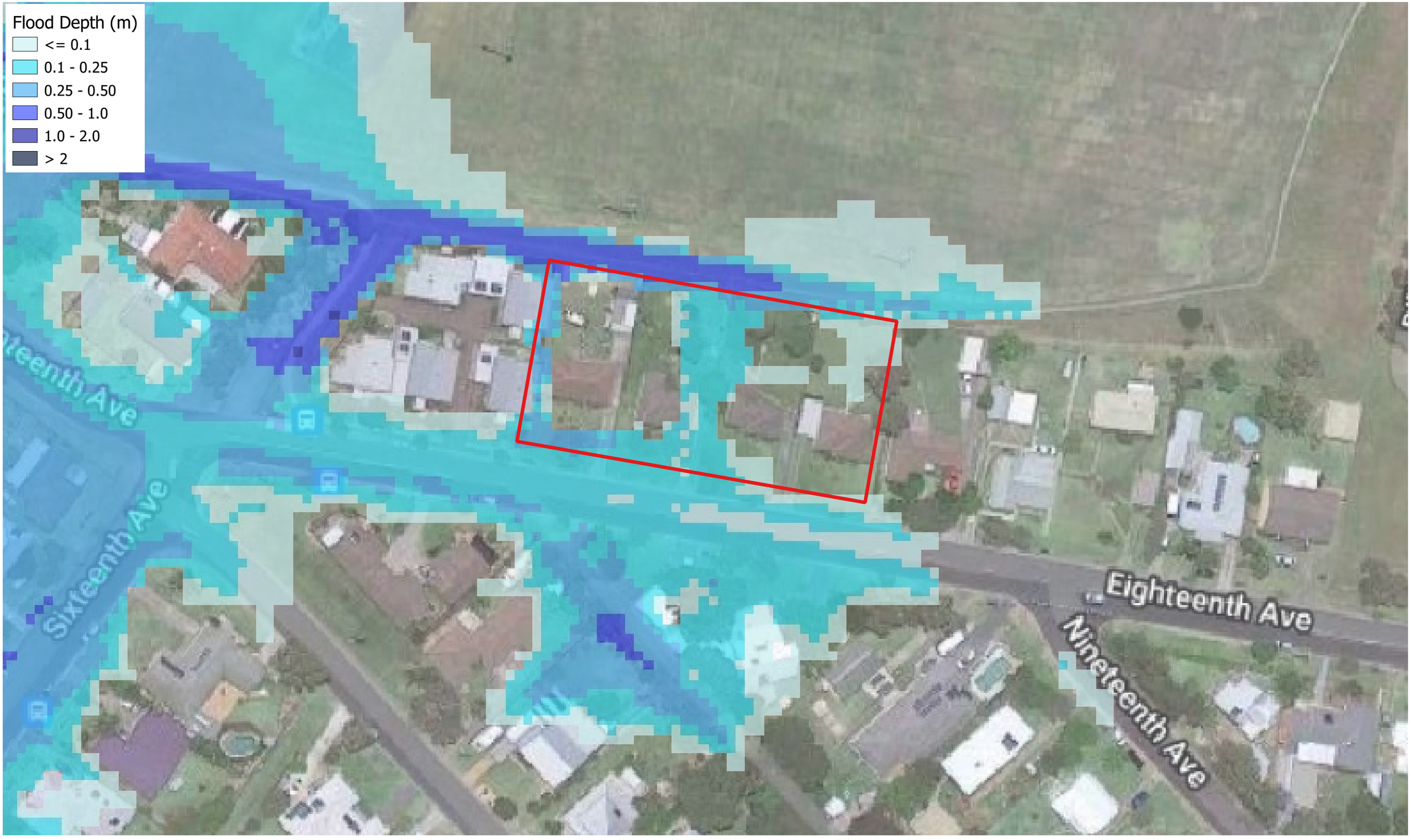
Drawing: **C.8**

Rev: **A**

0 19 38 m

BMT
www.bmt.org

Filepath: I:\A12026_40-46_18thAvenue_Sawtell\QGIS\Figure_Generator_210504\AppC\AppC.qgz



Legend

Site

Title:

1 in 100 AEP Peak Flood Depth |Developed Case|

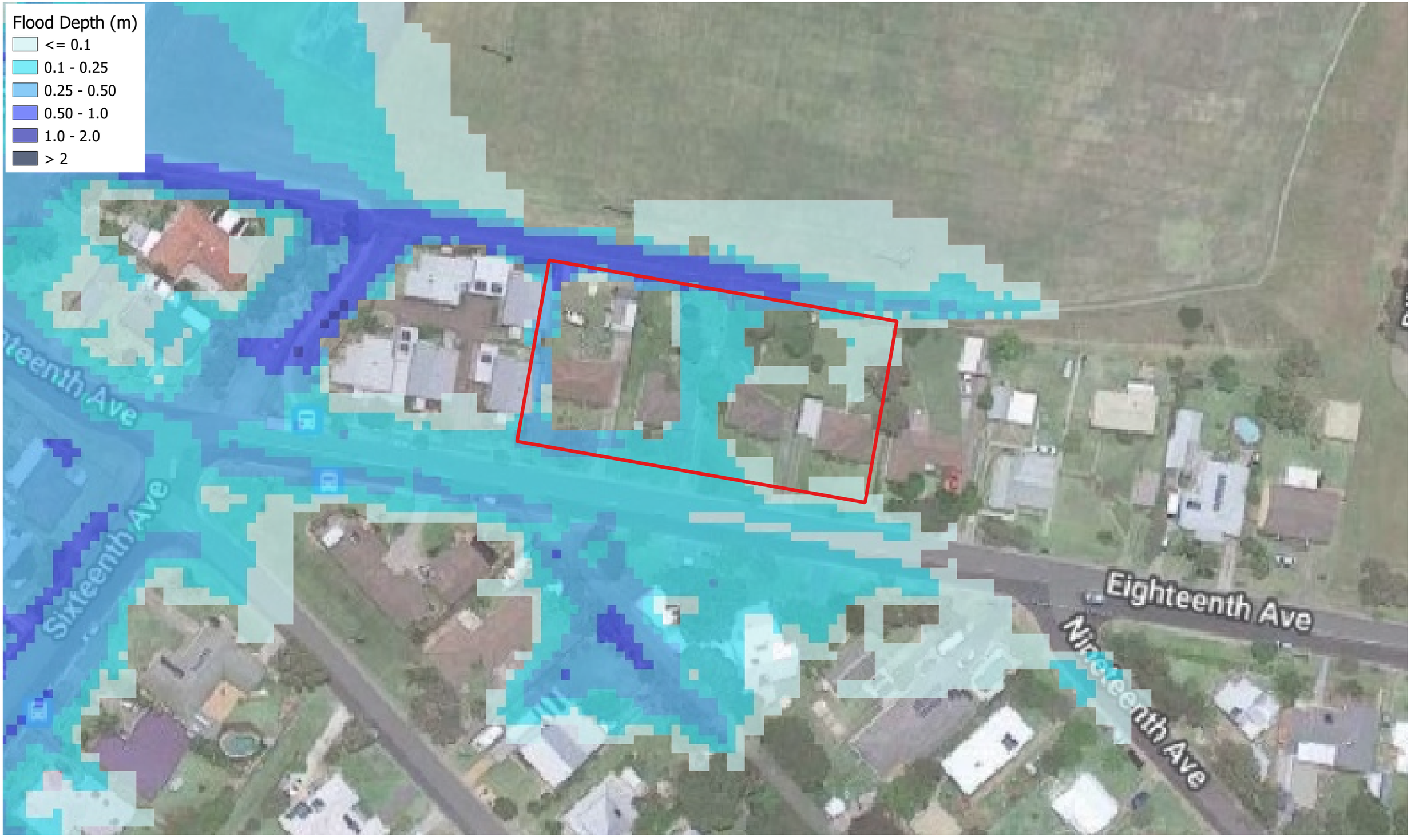
Drawing: **C.9**

Rev: **A**

0 19 38 m

BMT
www.bmt.org

Filepath: I:\A12026_40-46_18thAvenue_Sawtell\QGIS\Figure_Generator_210504\AppC\AppC.qgz



Legend

Site

Title:

1 in 200 AEP Peak Flood Depth |Developed Case|

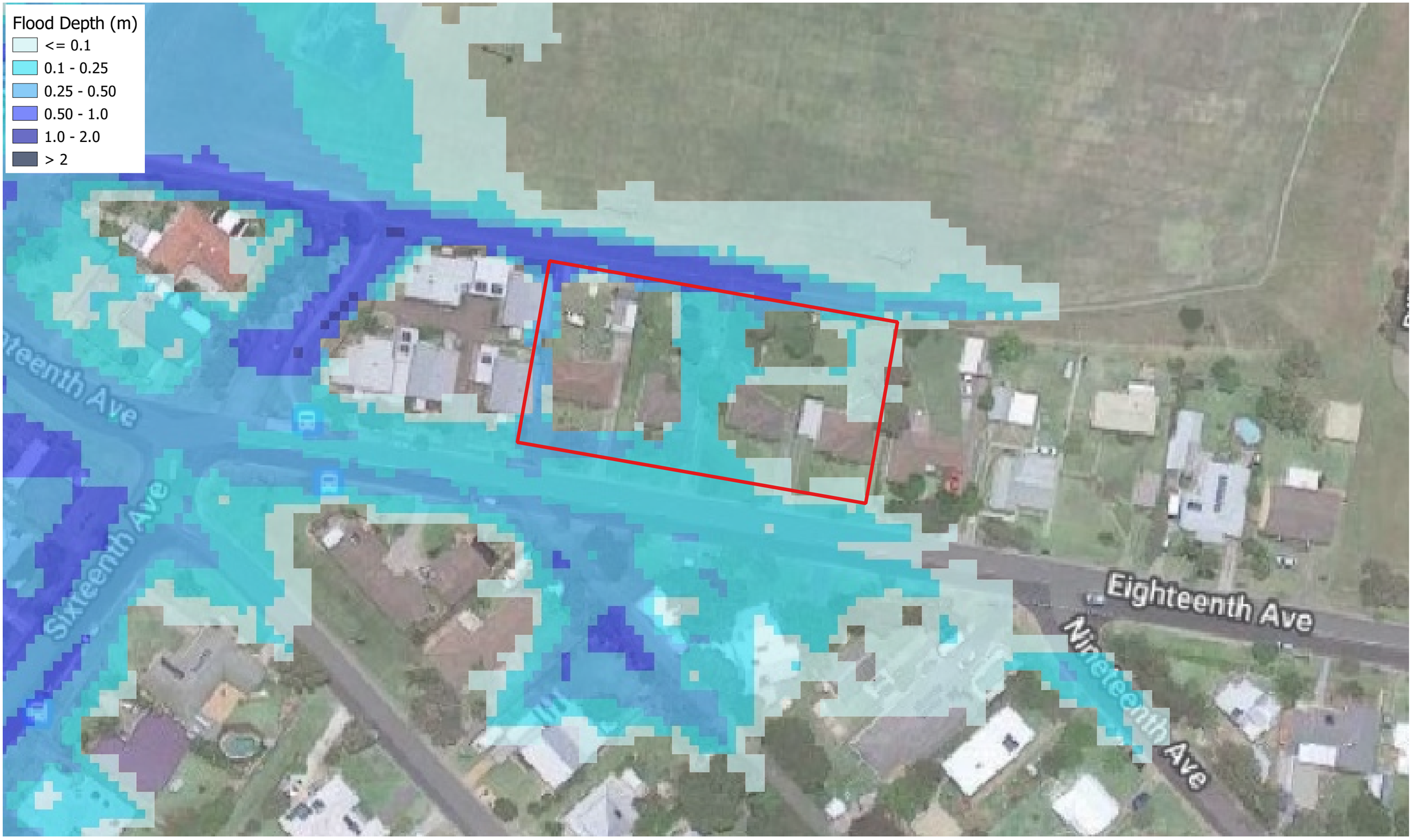
Drawing: **C.10**

Rev: **A**

0 19 38 m

BMT
www.bmt.org

Filepath: I:\A12026_40-46_18thAvenue_Sawtell\QGIS\Figure_Generator_210504\AppC\AppC.qgz



Legend

Site

Title:

1 in 500 AEP Peak Flood Depth |Developed Case|

Drawing: **C.11**

Rev: **A**

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0 19 38 m

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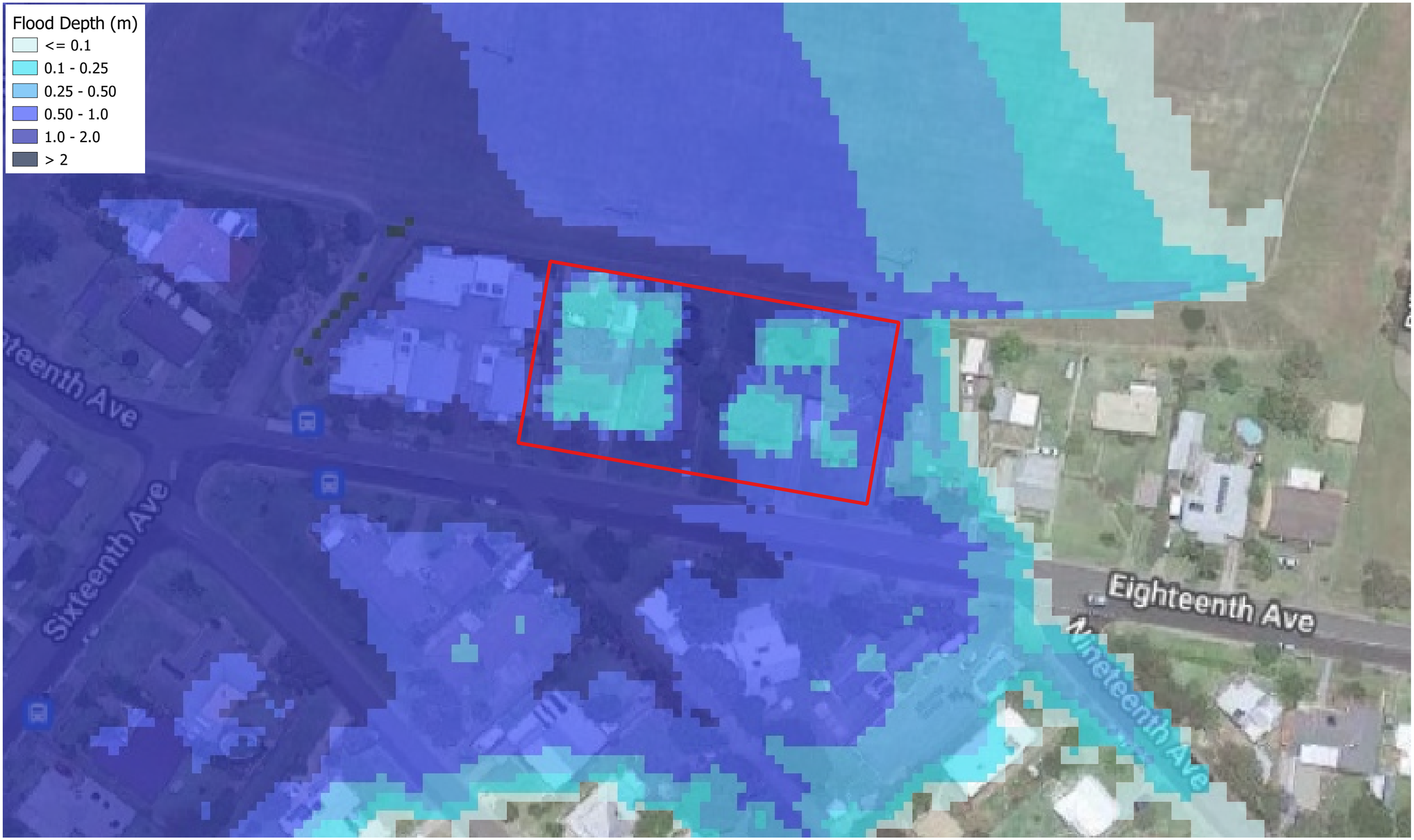

Legend

Site

Title:
PMF Peak Flood Depth |Developed Case|

Drawing: **C.12**

Rev: **A**

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0 19 38 m

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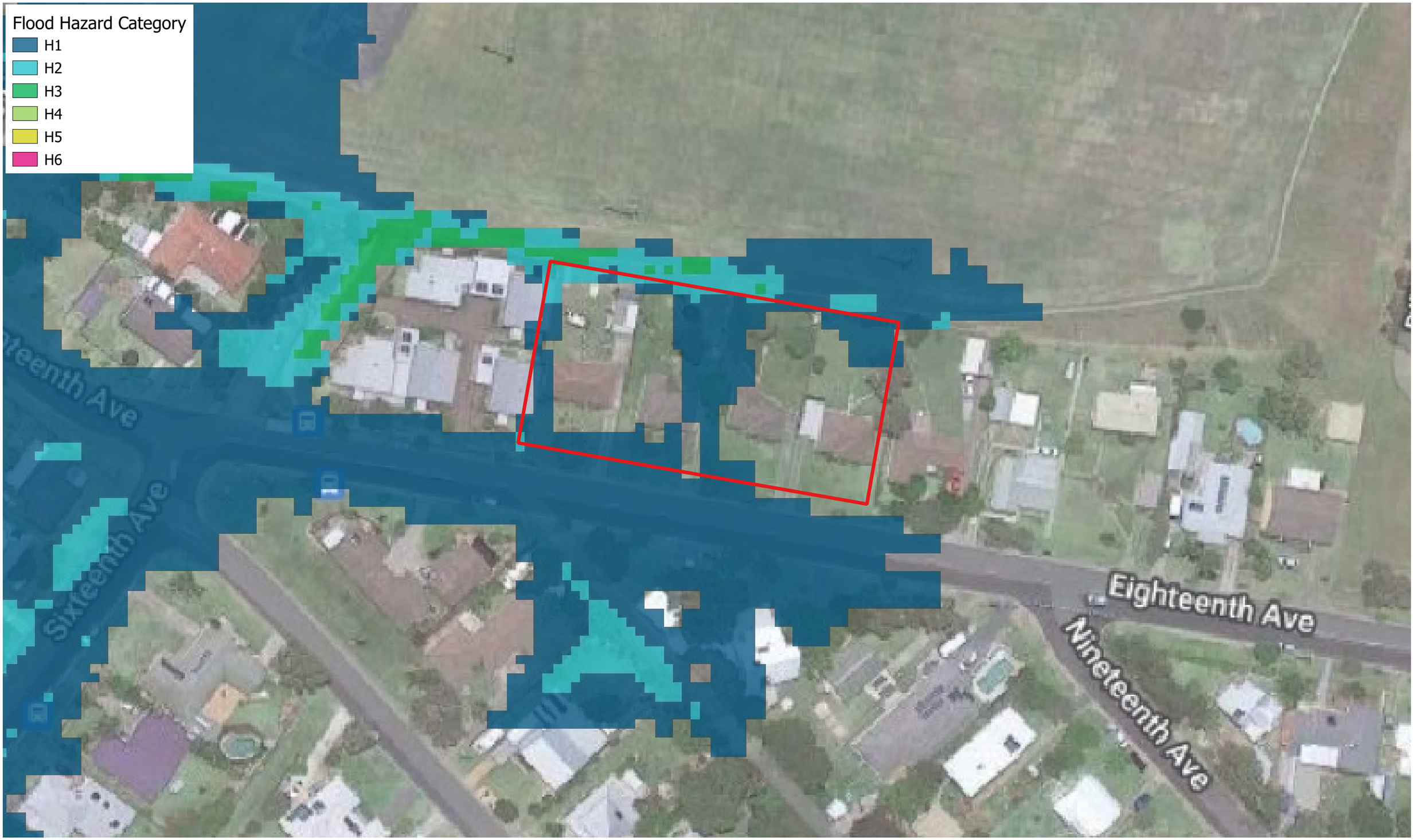

Legend

Site

Title:

1 in 20 AEP Peak Flood Hazard |Developed Case|

Drawing: C.13

Rev: A

0 19 38 m

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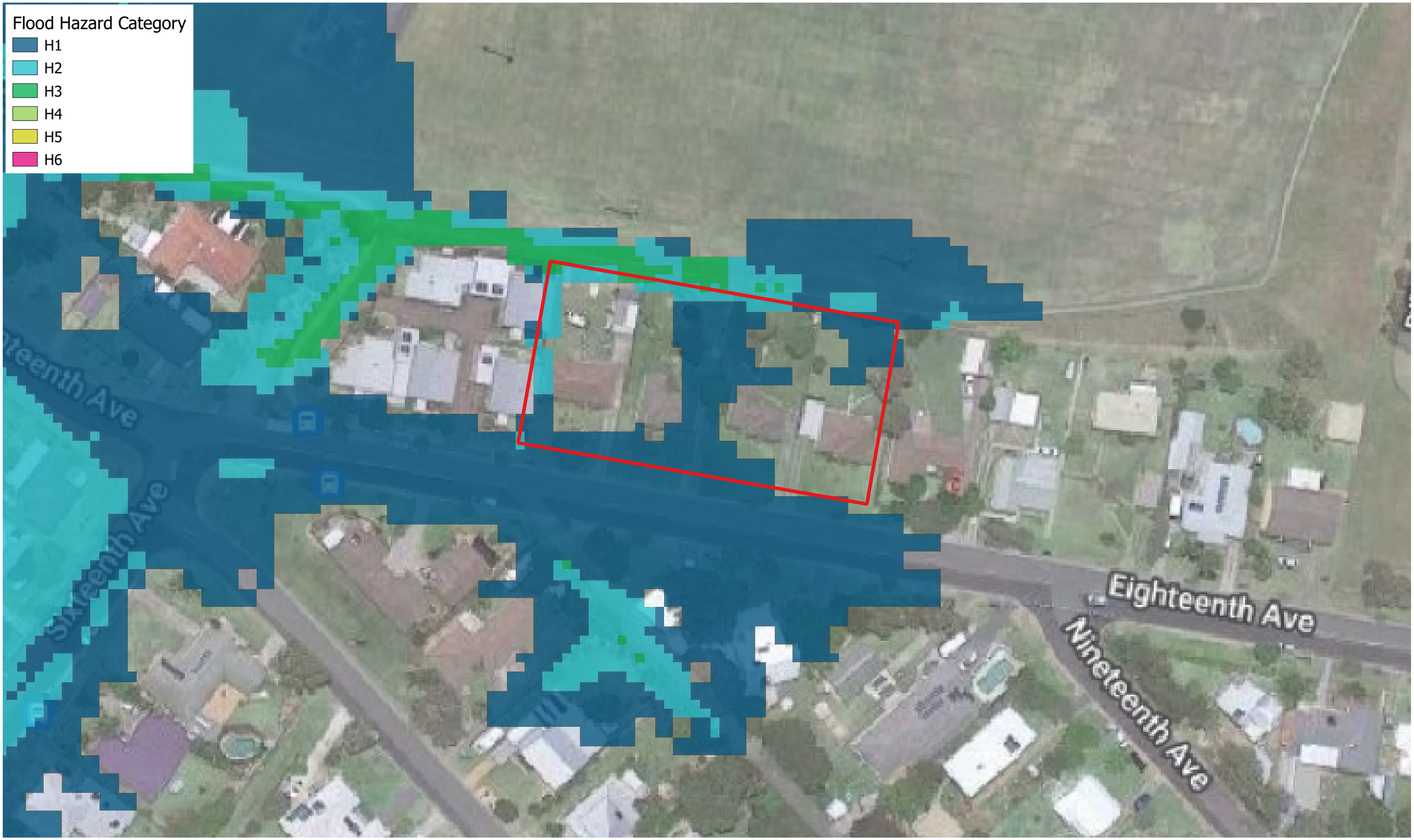

Legend

Site

Title:

1 in 50 AEP Peak Flood Hazard |Developed Case|

Drawing: **C.14**

Rev: **A**

0 19 38 m

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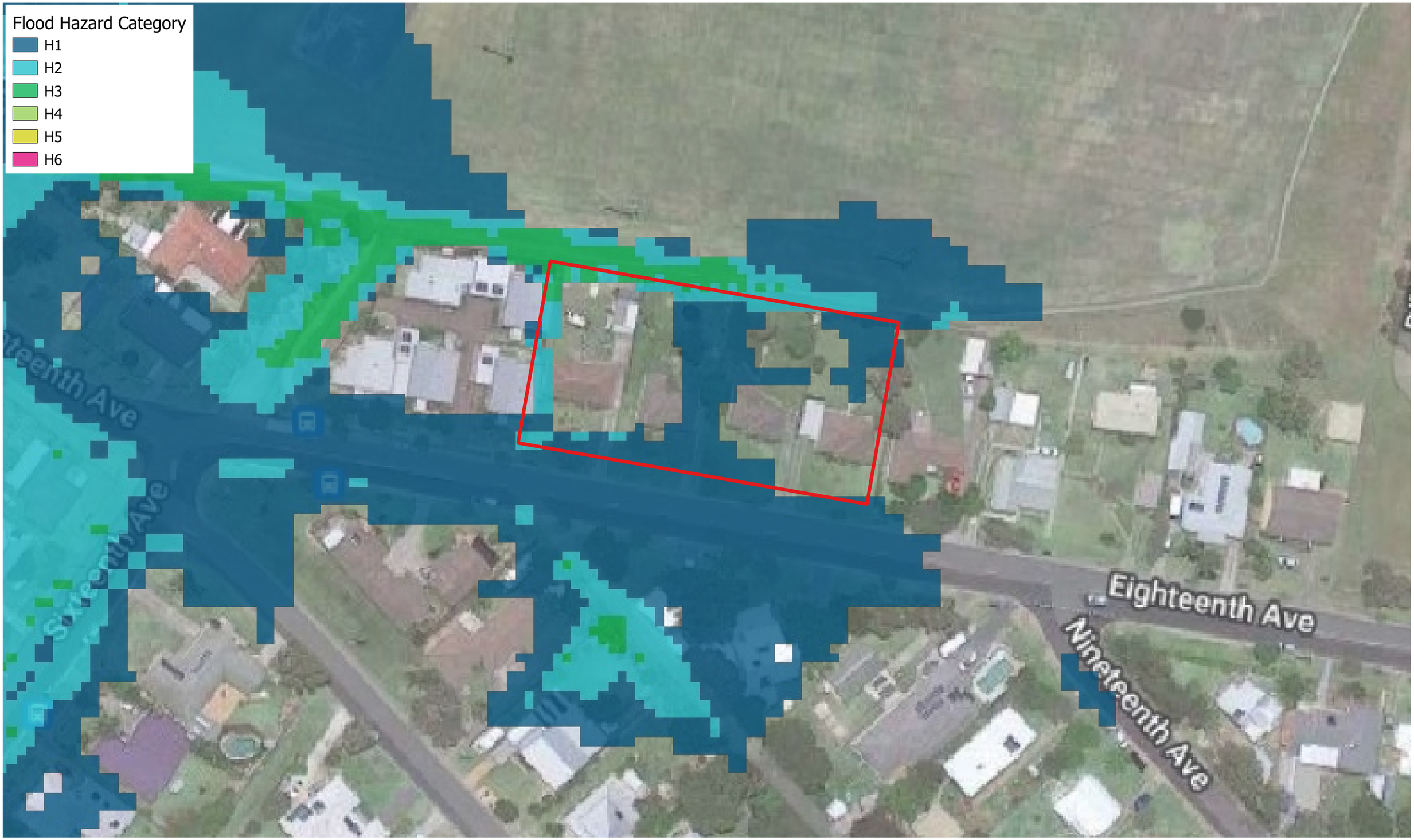

Legend

Site

Title:

1 in 100 AEP Peak Flood Hazard |Developed Case|

Drawing: **C.15**

Rev: **A**

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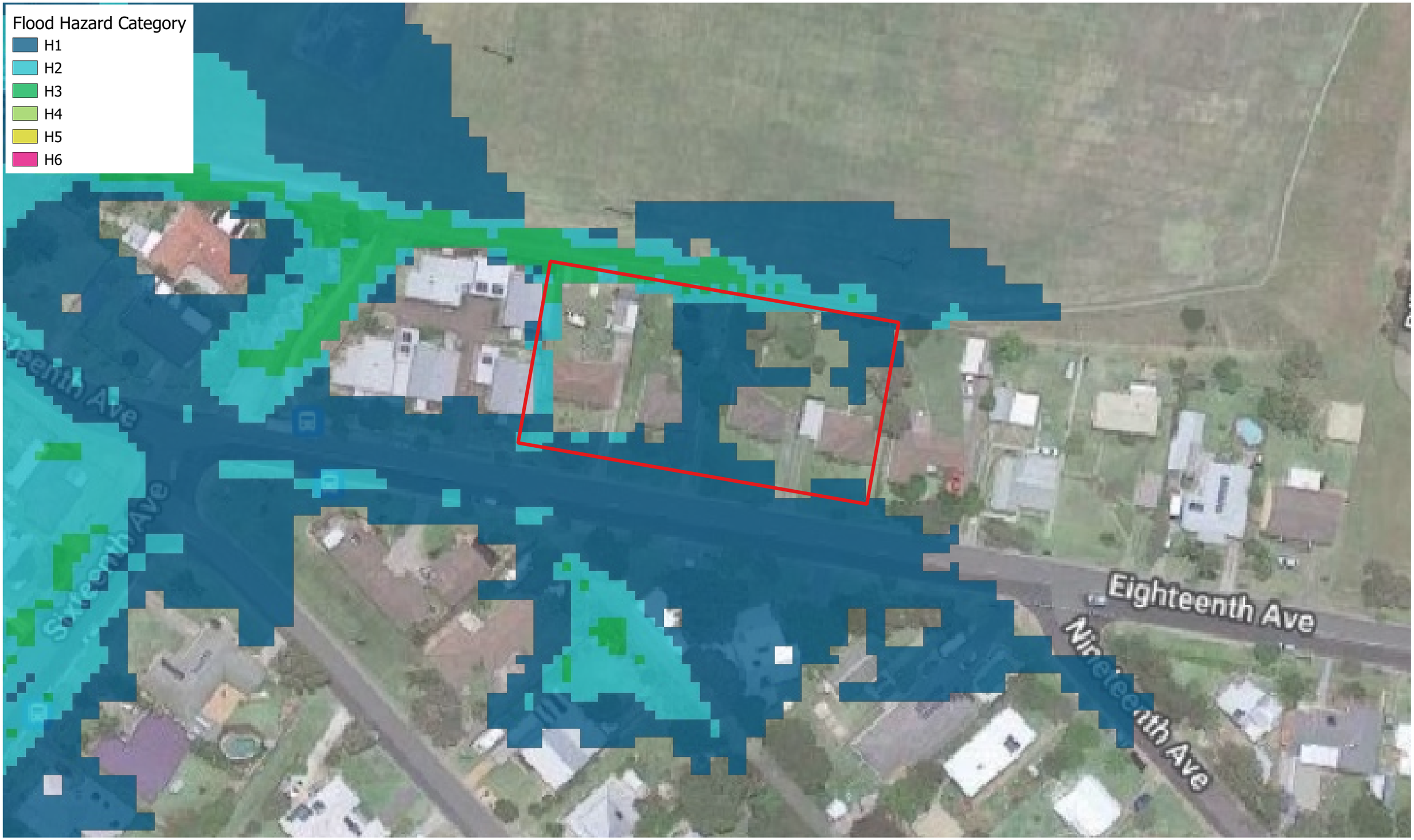

Legend

Site

Title:

1 in 200 AEP Peak Flood Hazard |Developed Case|

Drawing: **C.16**

Rev: **A**

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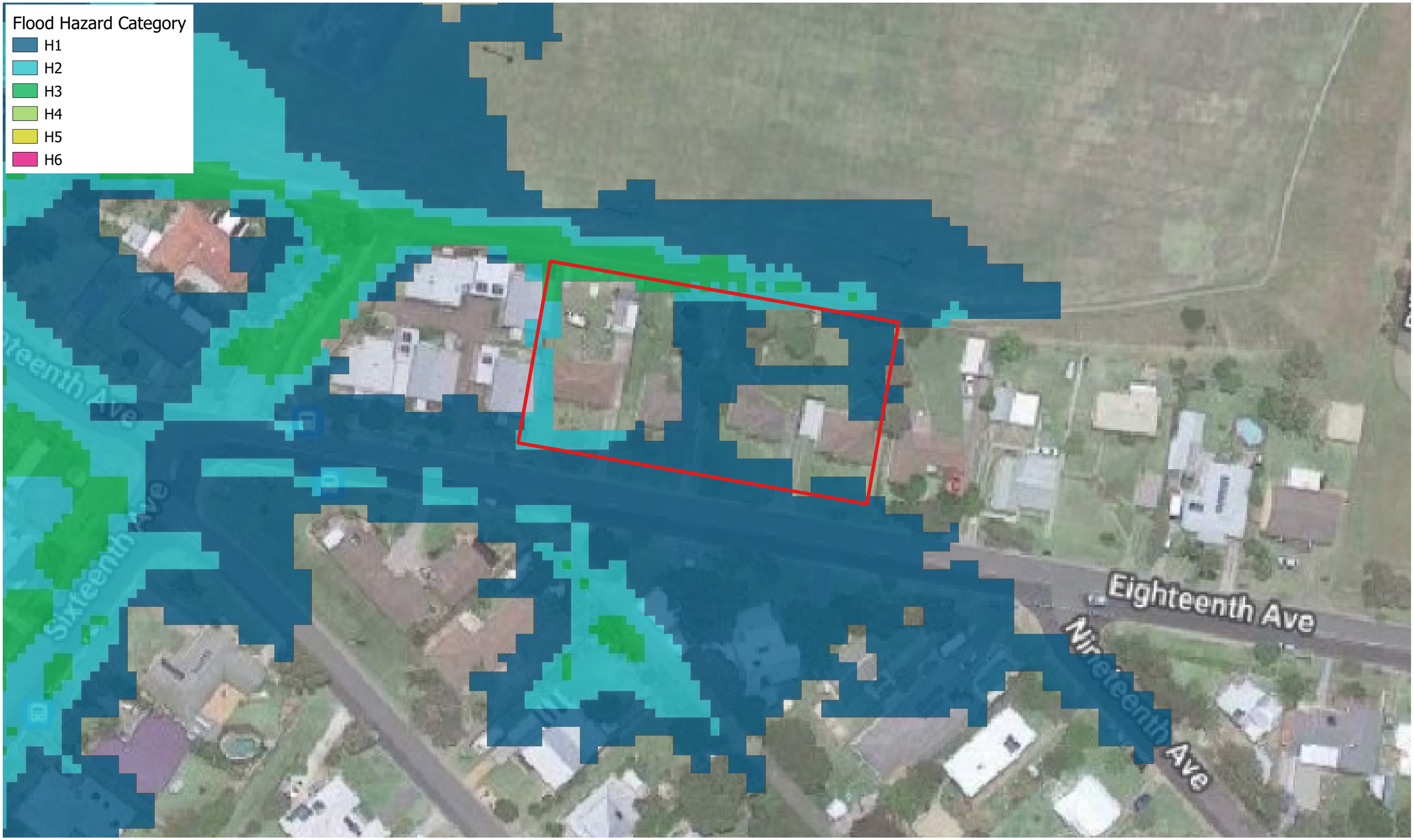

Legend

Site

Title:

1 in 500 AEP Peak Flood Hazard |Developed Case|

Drawing: **C.17**

Rev: **A**

0 19 38 m

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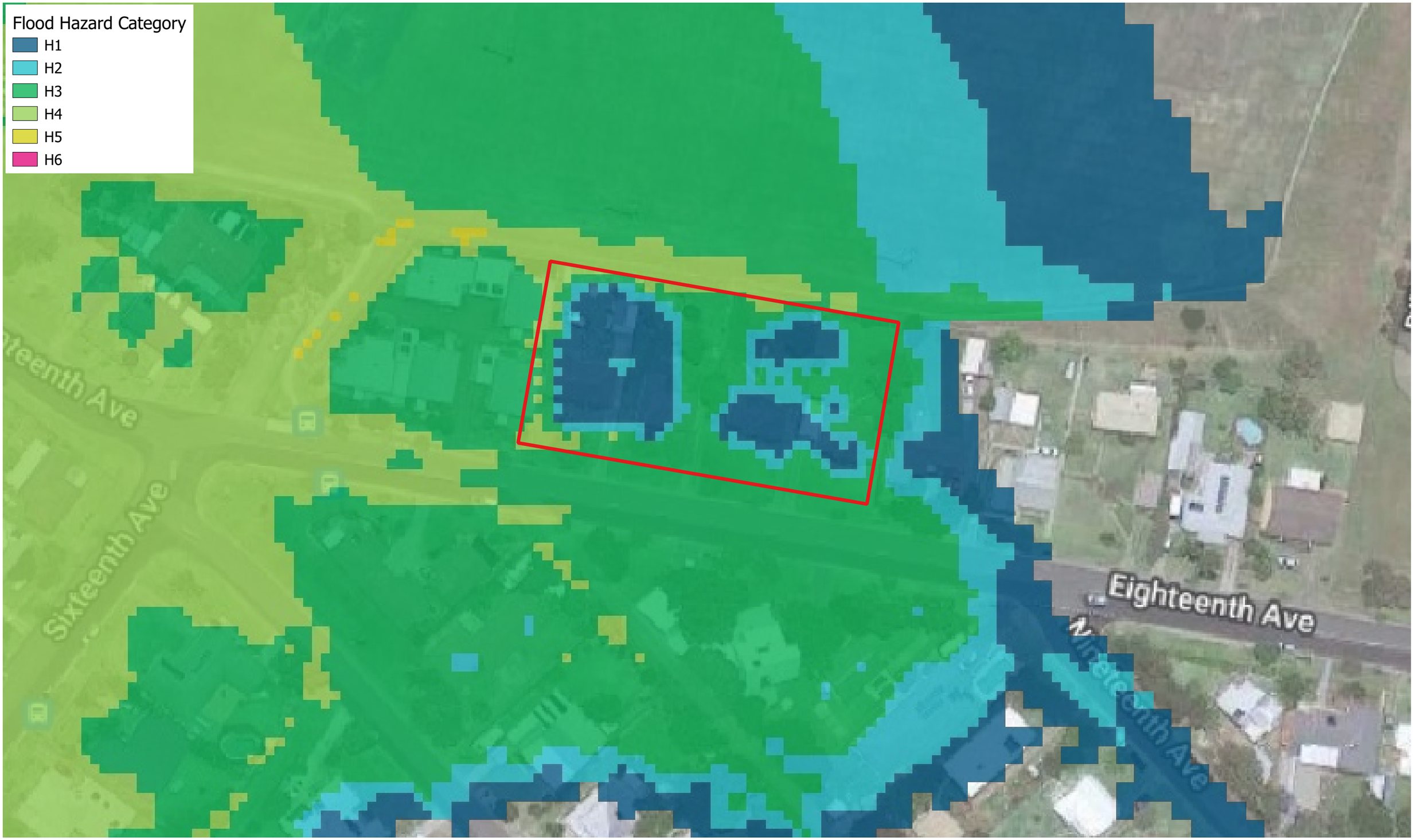

Legend

Site

Title:
PMF Peak Flood Hazard |Developed Case|

Drawing: **C.18**

Rev: **A**

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0 19 38 m

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Annex D Flood Level Impact (Afflux) Maps

Legend

- Site
- Cadastral Boundary

Title:

1 in 20 AEP Peak Flood Level Impact|Developed Case minus Base Case|

Drawing: D.1

Rev: A

0 50 100 m

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Filepath: I:\A12026_40-46_18thAvenue_Sawtell\QGIS\Figure_Generator_210504\AppD\AppD.qgz

Legend

- Site
- Cadastral Boundary

Title:

1 in 50 AEP Peak Flood Level Impact|Developed Case minus Base Case|

Drawing: D.2

Rev: A

0 50 100 m

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Filepath: I:\A12026_40-46_18thAvenue_Sawtell\QGIS\Figure_Generator_210504\AppD\AppD.qgz

Change in Inundation Extent
- Was Wet Now Dry
- Was Dry Now Wet

Change in Peak Flood Level (m)
- <= -0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Legend
- Site
- Cadastral Boundary

Title:
1 in 100 AEP Peak Flood Level Impact|Developed Case minus Base Case|

Drawing: **D.3**

Rev: **A**

0 50 100 m

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Change in Inundation Extent
- Was Wet Now Dry
- Was Dry Now Wet

Change in Peak Flood Level (m)
- <= -0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- => 0.2

Legend
- Site
- Cadastral Boundary

Title:
1 in 200 AEP Peak Flood Level Impact|Developed Case minus Base Case|

Drawing: D.4

Rev: A

0 50 100 m

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Filepath: I:\A12026_40-46_18thAvenue_Sawtell\QGIS\Figure_Generator_210504\AppD\AppD.qgz

Legend

- Site
- Cadastral Boundary

Title:

1 in 500 AEP Peak Flood Level Impact|Developed Case minus Base Case|

Drawing: D.5

Rev: A

0 50 100 m

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Legend

- Site
- Cadastral Boundary

Title:

PMF Peak Flood Level Impact|Developed Case minus Base Case|

Drawing: D.6

Rev: A

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0 50 100 m

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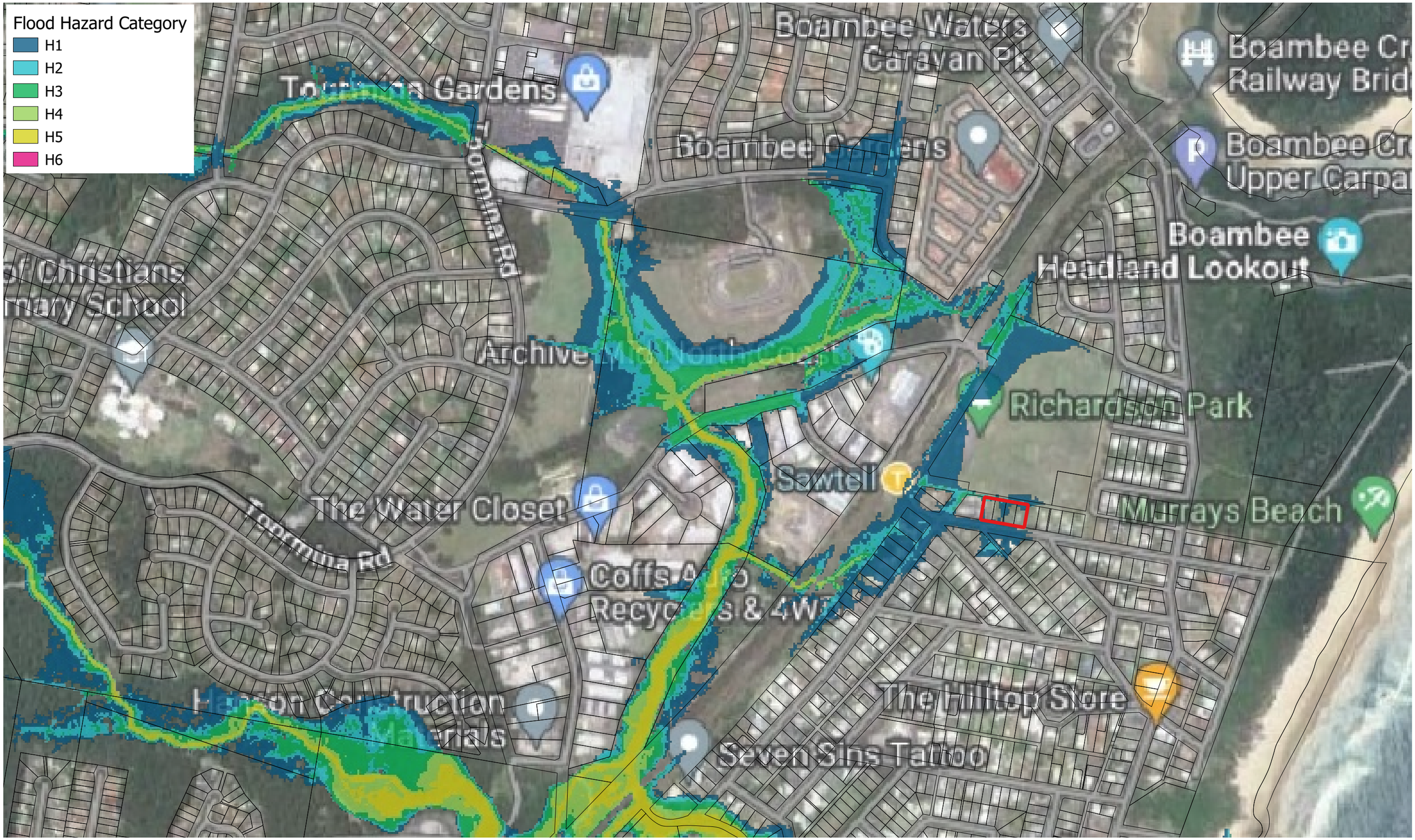
Annex E Flood Hazard Mapping within the Wider Floodplain



Legend

- Site
- Cadastral Boundary

Title:

1 in 20 AEP Peak Flood Hazard |Developed Case|

Drawing: E.1

Rev: A

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0 150 300 m

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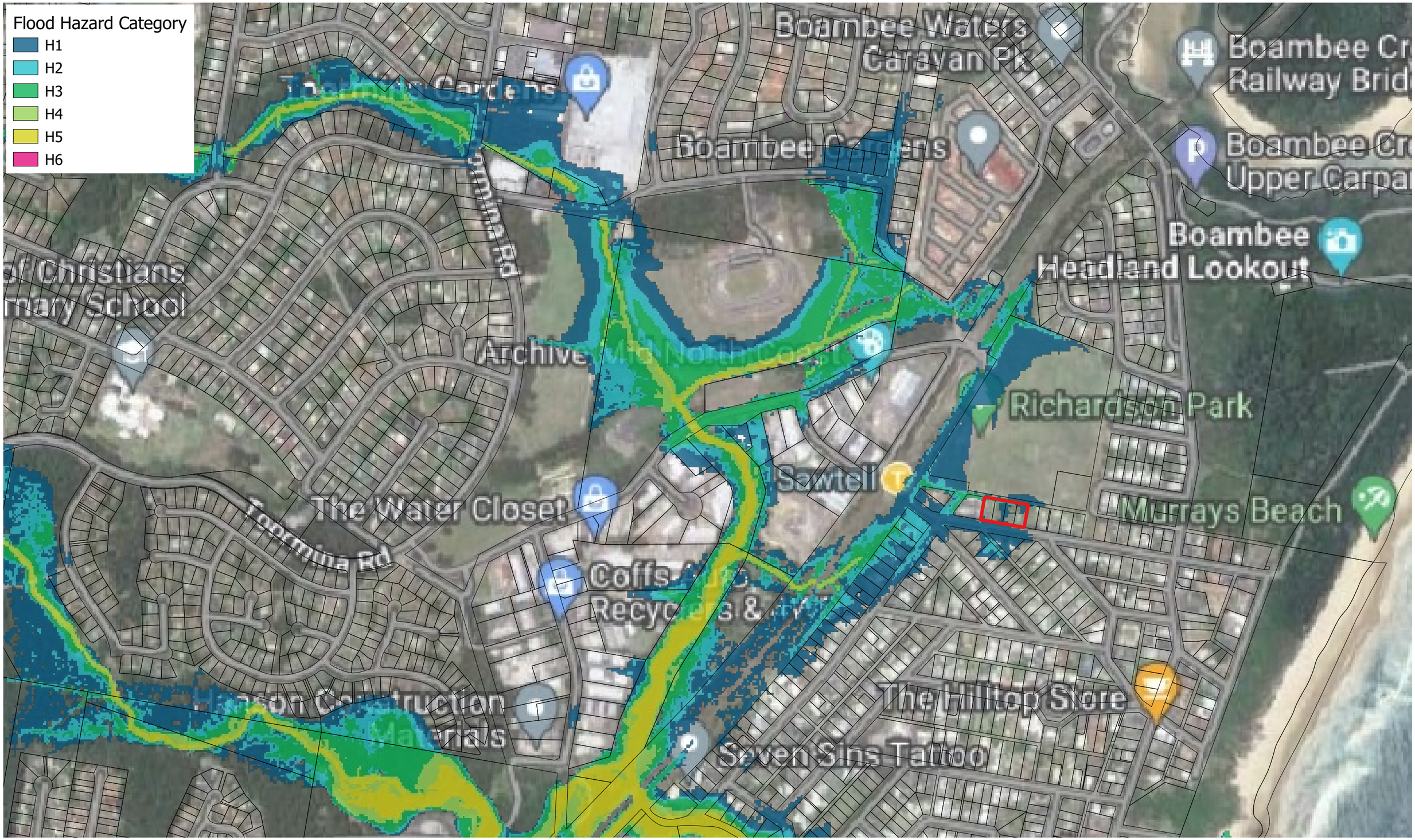

Legend

- Site
- Cadastral Boundary

Title:

1 in 50 AEP Peak Flood Hazard |Developed Case|

Drawing: E.2

Rev: A

0 150 300 m

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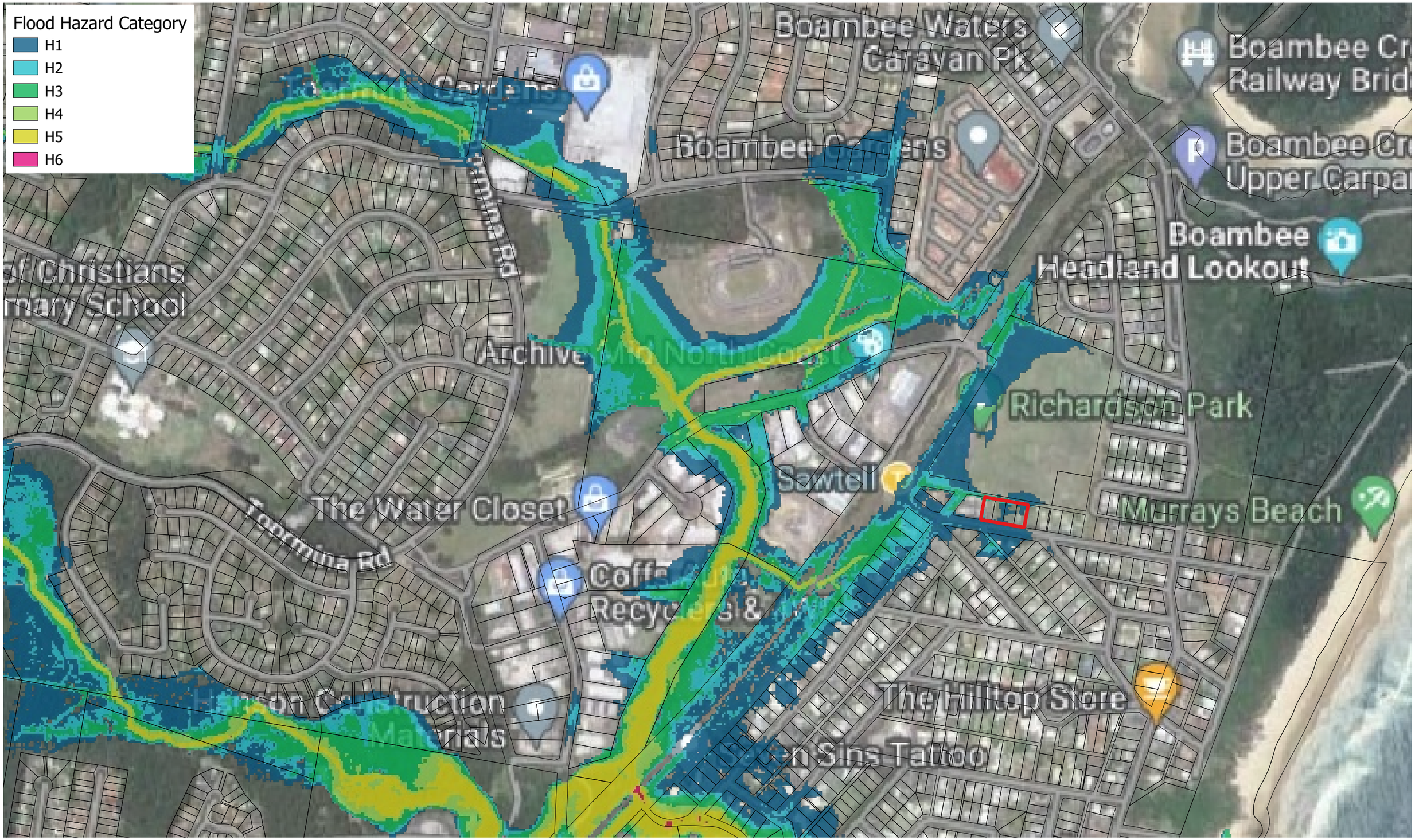
Filepath: \\BMT-BNE-FS01\drafting\A12026_40-46_18thAvenue_Sawtell\QGIS\Figure_Generator_210504\FERP\AppE.qgz



Legend

- Site
- Cadastral Boundary

Title:

1 in 100 AEP Peak Flood Hazard |Developed Case|

Drawing: E.3

Rev: A

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0 150 300 m

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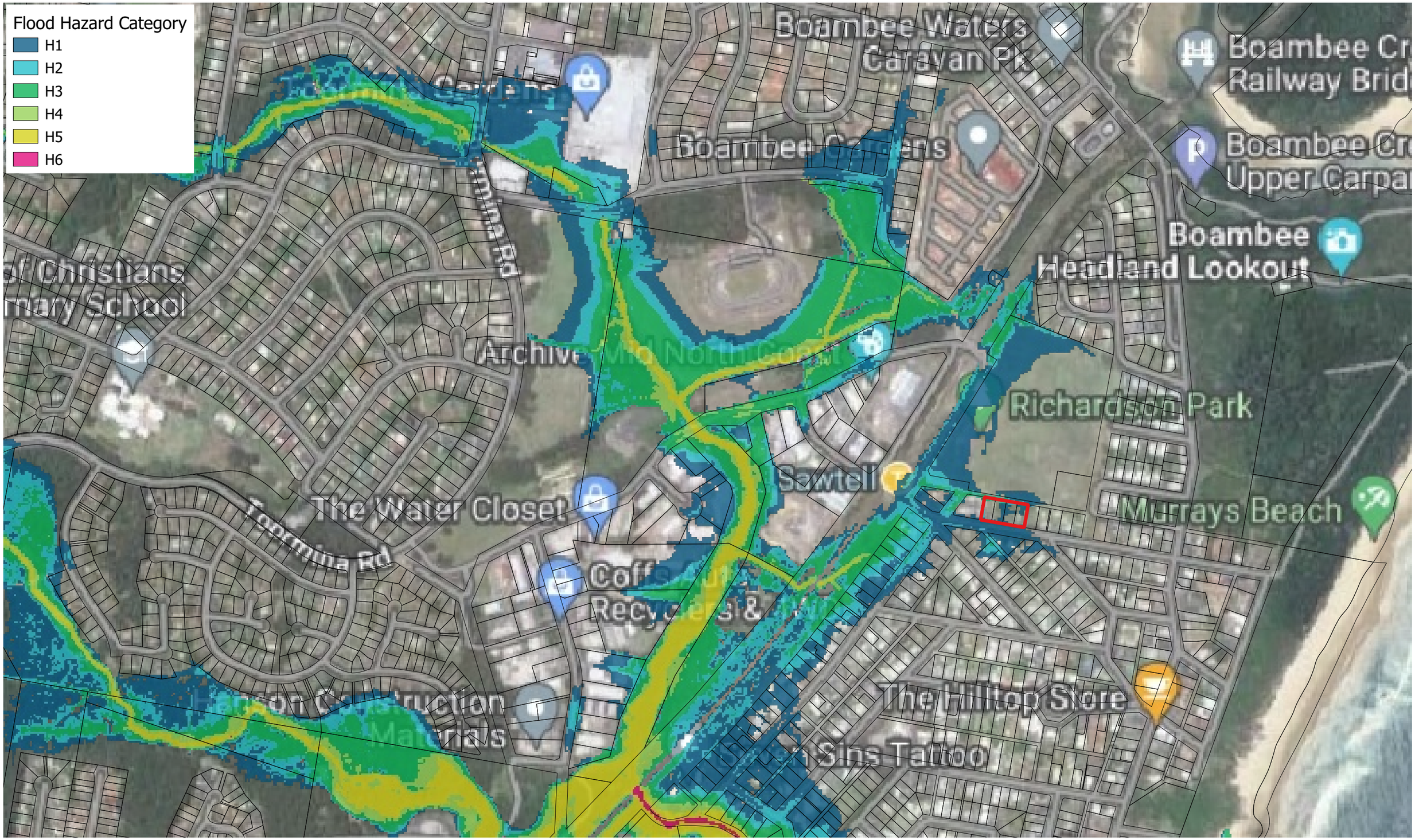

Legend

- Site
- Cadastral Boundary

Title:

1 in 200 AEP Peak Flood Hazard |Developed Case|

Drawing: E.4

Rev: A

0 150 300 m

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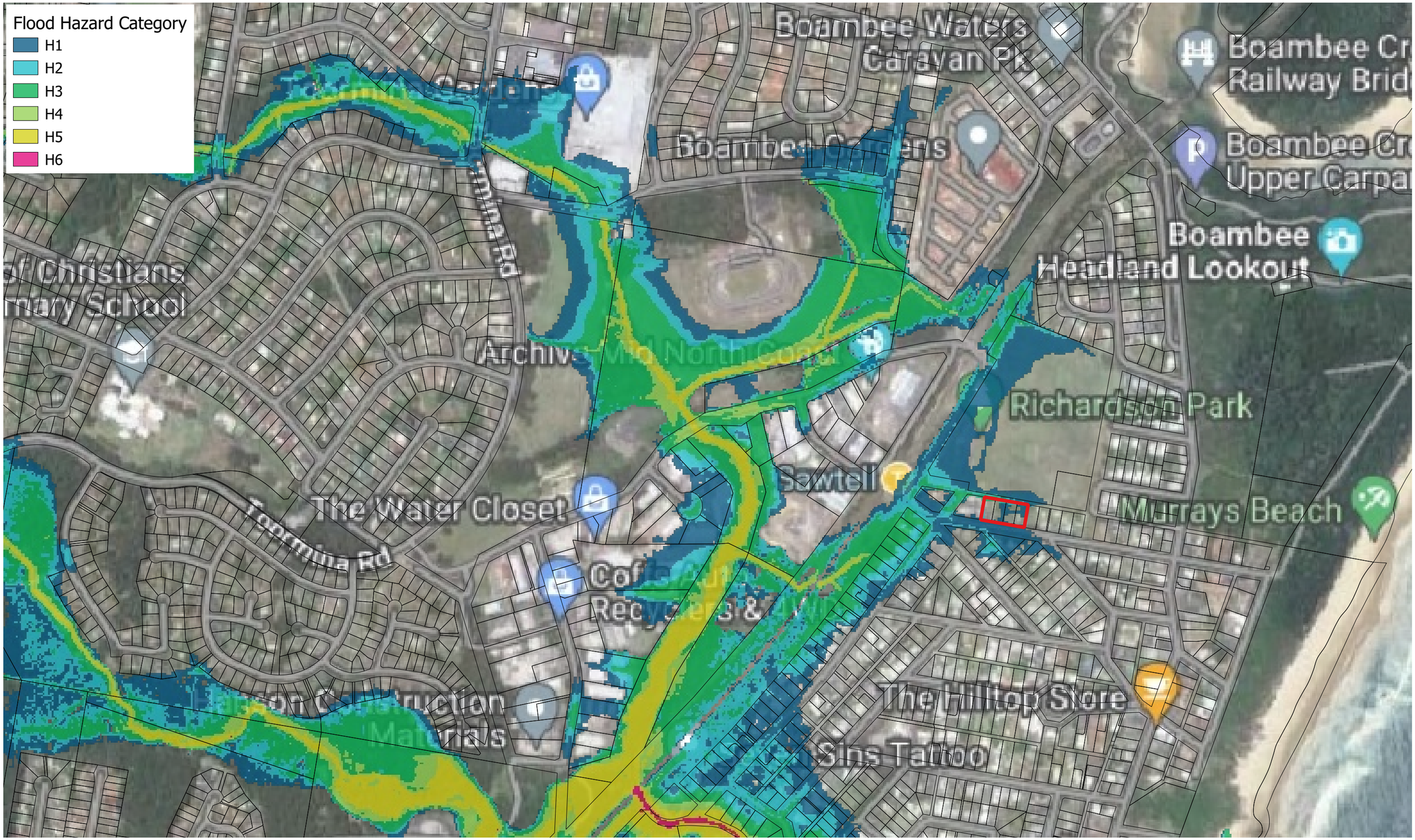

Legend

- Site
- Cadastral Boundary

Title:

1 in 500 AEP Peak Flood Hazard |Developed Case|

Drawing: E.5

Rev: A

0 150 300 m

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Legend

- Site
- Cadastral Boundary

Title:

PMF Peak Flood Hazard |Developed Case|

Drawing: E.6

Rev: A

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0 150 300 m

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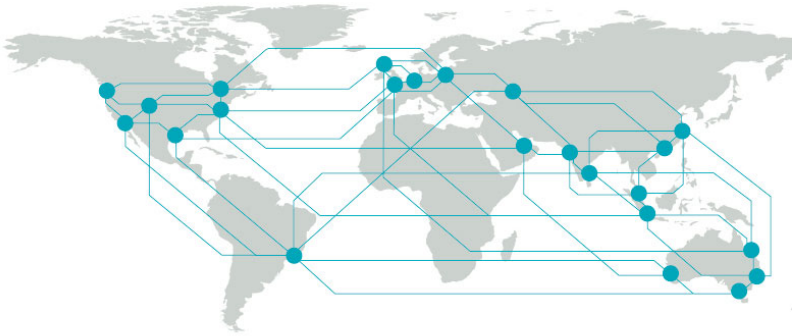

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