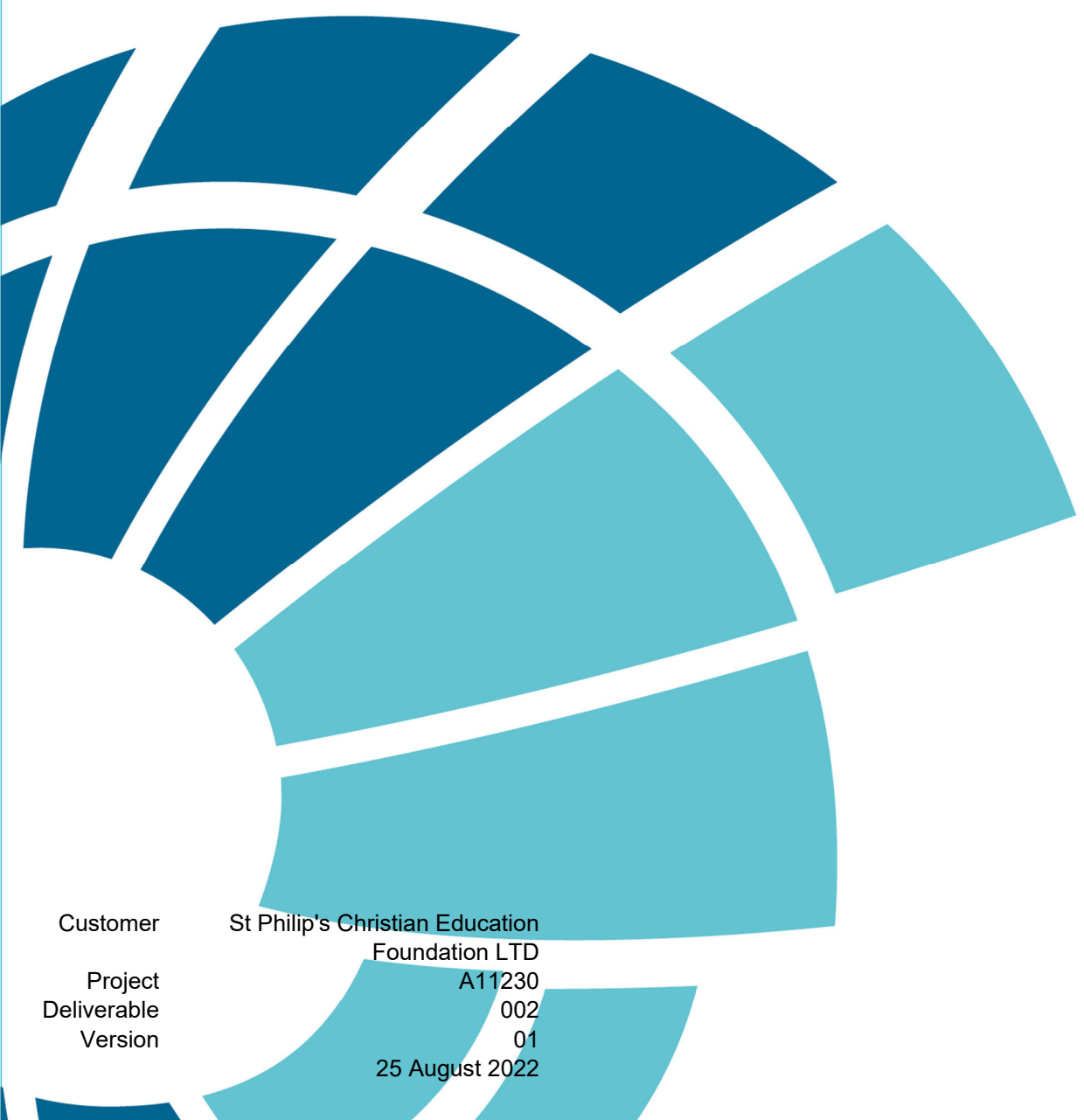


St Philip's Christian College, 10 Lomas Lane, Nulkaba

Flood Emergency Response Plan



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Project	A11230
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1 Introduction

This Flood Emergency Response Plan (FERP) has been prepared for the proposed development at St Philip's Christian College (SPCC) Cessnock Campus (the "Site") located on the corner of Lomas Lane and Wine Country Drive, Nulkaba NSW. The Site is bounded by Lomas Lane to the north, a rural property with large open space to the south, Wine Country Drive to the west and Black Creek to the east.

The proposed development is located within the Black Creek floodplain and is affected by backwater flooding from the creek. The Site is subject to mainstream flooding in rarer and extreme flood events, with flood depths and extent of inundation increasing in magnitude up to the Probable Maximum Flood (PMF).

Accordingly, an assessment of the flood risks for events up to the PMF has been undertaken based on information documented in the *St Philip's Christian College, 10 Lomas Lane, Nulkaba Flood Impact Assessment* (BMT, 2021) herein referred to as the "Flood Impact Assessment (FIA)".

This report outlines the proposed strategy for flood emergency management for the Site, taking into consideration the nature of flooding, proposed development and relevant local and state government policies and guidelines, including the *NSW Floodplain Development Manual* (NSW Government, 2005). The report describes the requirements for the proposed buildings, such as required finished floor levels, as well as procedures for flood evacuation, warning systems, signage, and responsibilities of building wardens in case of flood emergency during school operational phase. It is to be read in conjunction with the FIA for the development.

The development of this FERP has been undertaken in consultation with Cessnock City Council ("Council") and the NSW State Emergency Services (SES).

It is noted that the masterplan design was completed as part of the FIA, prior to the undertaking of this FERP. Therefore, the plan documented in this report only represents a preliminary strategy for emergency management to reflect the masterplan design from the FIA. The FERP may need to be further refined if the masterplan design changes in the future or in the detailed design stage of the development process.

2 Description of Proposed Development and Site Flood Behaviour

2.1 Proposed Development Summary

The proposed development is the upgrade of the school campus located on Site, with the works consisting of the construction of seven (7) new buildings and additions/alterations to six (6) existing buildings for the use of up to 1,732 students. Existing road access to the Site is via Lomas Lane (to the north) which currently has three access points, with an additional access point on Wine Country Drive (along the south-western boundary) proposed as part of the development. The proposed masterplan Site layout is shown in Figure 2.1. For the purpose of this FERP, this figure identifies several points of interest for the purpose of flooding timeline assessment.

2.2 Proposed Access Arrangement

Information regarding the proposed access arrangement has been sourced from the traffic report undertaken as part of this project *St Philip's Christian College, Cessnock - Transport and Accessibility Impact Assessment* (Stantec, 2022). The access arrangement is described below:

2.2.1 Lomas Lane (Northern Arrangement):

There are three proposed entryways along Lomas Lane:

- An entry for vehicles at the east (herein referred to as the NE access) that will consist of a bus turnaround bay.
- An exit for vehicles at the west (herein referred to as the NW Exit) which will service the northern set-down and pick-up area by the junior and middle schools.
- A dedicated pedestrian access at the centre (herein referred to as the NC pedestrian access). It is understood that the development proposes to close the existing central access to vehicles during non-emergency situations as part of this work.

2.2.2 Wine Country Drive (Southern Arrangement):

A new access point is proposed on Wine Country Drive towards the southern end of the site (herein referred to as the southern access) that will serve as an alternate entry to and exit from the school. The exit will service the southern set-down and pick-area by the senior school.

It is understood that the entry and exit arrangement (split between the northern and southern access points) has been designed with consideration of existing traffic constraints, such as the avoidance of a right turn onto the fast-moving traffic on Wine Country Drive during peak hours.

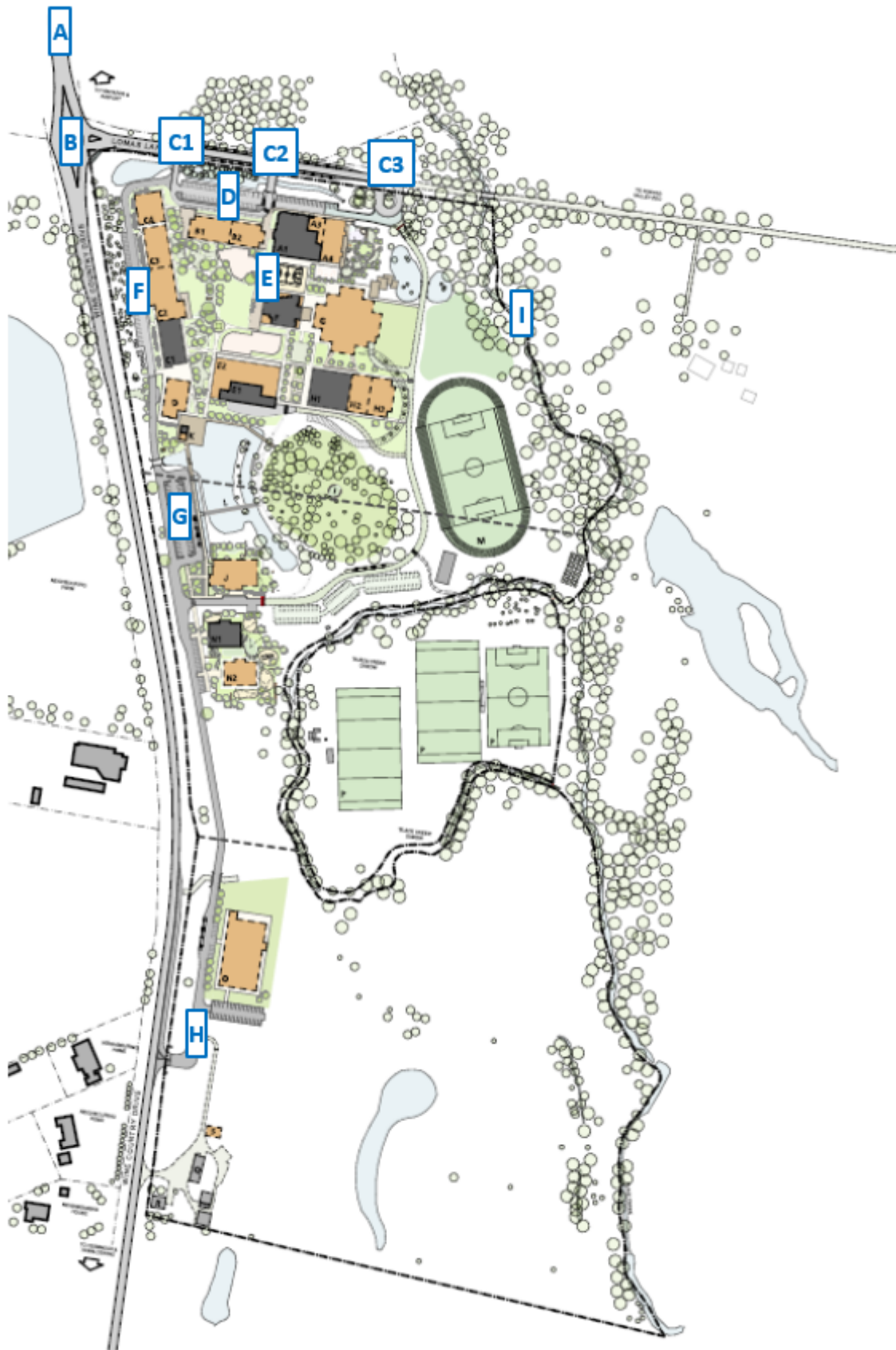


Figure 2.1 Masterplan Layout and Points of Interest

2.3 Post-Development Flood Behaviour

Flood levels applicable to the Site were established as part of the FIA and are provided in Table 2.1. Points of interest are noted on Figure 2.1. The FIA is included for reference as Annex A.

Table 2.1 Peak Flood Levels at Points of Interest

Points of Interest		Peak Flood Level (mAHD)			
ID	Description	1% AEP	0.5% AEP	0.2% AEP	PMF
A	Wine Country Drive north of Site	N/A	N/A	59.1	60.7
B	Intersection of Wine Country Drive and Lomas Lane	N/A	N/A	N/A	60.7
C1	NW Exit	58.2	58.4	58.7	60.7
C2	NC Pedestrian Access	58.2	58.4	58.7	60.7
C3	NE Access	58.3	58.5	58.7	60.8
D	Building B Carpark	N/A	N/A	58.7	60.7
E	School Site	N/A	N/A	N/A	60.8
F	Building C Carpark	N/A	N/A	N/A	60.9
G	Building J Carpark	N/A	N/A	N/A	61.2
H	Wine Country Drive Accessway	N/A	N/A	N/A	61.6
I	Black Creek	58.3	58.5	58.7	60.8

The FIA prepared as part of the development submission indicates that the Site is subject to backwater flooding from Black Creek, which first inundates the Site at the field/wetland areas to the south-east and along Lomas Lane at the north-east. PMF depths on-Site in the proximity of the proposed building footprints are in the order of 1.2 m to 2.5 m. High PMF flood depths would also be expected in carparks at the north and south of the Site and along potential egress routes from the Site.

2.3.2 Flood Hazard

The best practice flood risk management approach to flood hazard mapping (AIDR, 2017) classifies the floodplain into the six distinct hazard classifications (“H1” to “H6”) shown in Figure 2.2. These hazard classifications are based on adopted thresholds of flood depth, velocity and depth-velocity product that identify when flood conditions are likely to present a risk to people, vehicles and buildings. A description of each hazard threshold is provided in Table 2.2.

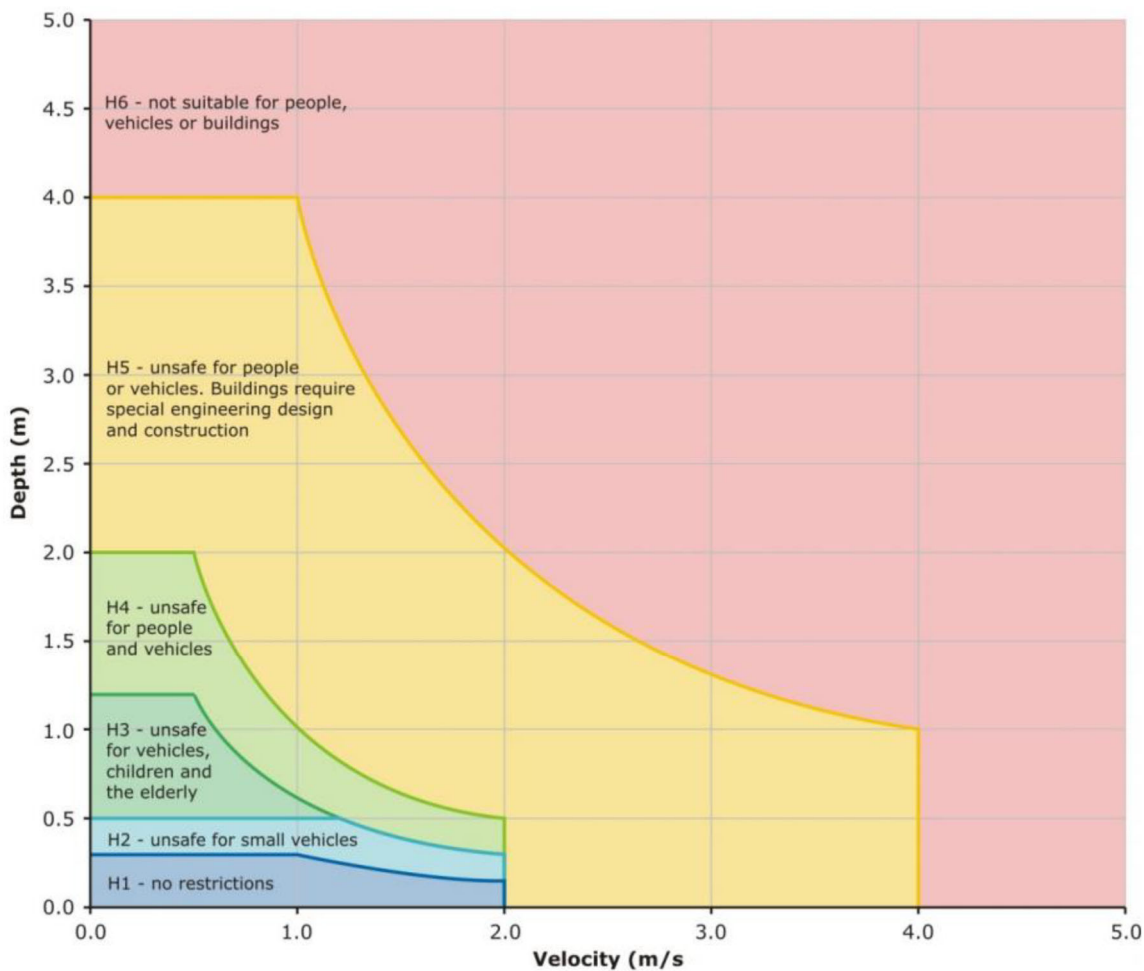


Figure 2.2 Flood Hazard Curves (AIDR, 2017)

Table 2.2 Flood Hazard Classification Thresholds (AIDR, 2017)

Hazard Classification	Description
H1	Relatively benign flow conditions. No vulnerability constraints.
H2	Unsafe for small vehicles.
H3	Unsafe for all vehicles, children and the elderly.
H4	Unsafe for all people and vehicles.
H5	Unsafe for all people and vehicles. Buildings require special engineering design and construction.
H6	Unconditionally dangerous. Not suitable for any type of development or evacuation access. All building types considered vulnerable to failure.

For all events up to and including the 0.2% AEP, floodwaters are not expected to inundate the existing or proposed buildings. However, as shown in Figure 2.3, the modelling results indicate that while the area around the buildings would generally remain flood free in a 0.2% AEP event a peak hazard classification of “H5” is predicted along the eastern boundary of the Site and along Lomas Lane

adjacent to the Black Creek watercourse, with floodwaters in those regions considered unsafe for all people and vehicles.

In the PMF event (see Figure 2.4), the Site would be fully inundated with “H4” hazards within buildings and “H5” hazards elsewhere. This indicates hazards in these areas would be considered unsafe for all people and vehicles and that buildings would require special engineering design and construction.

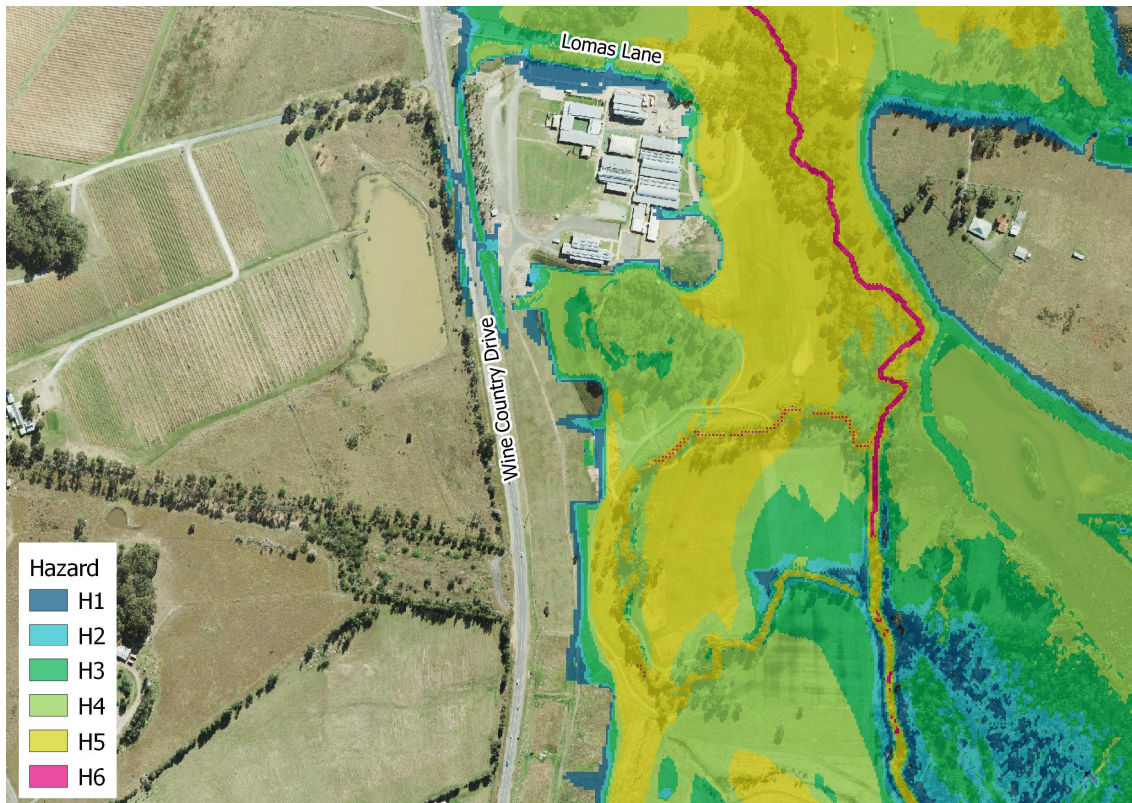


Figure 2.3 Peak 0.2% AEP Flood Hazard

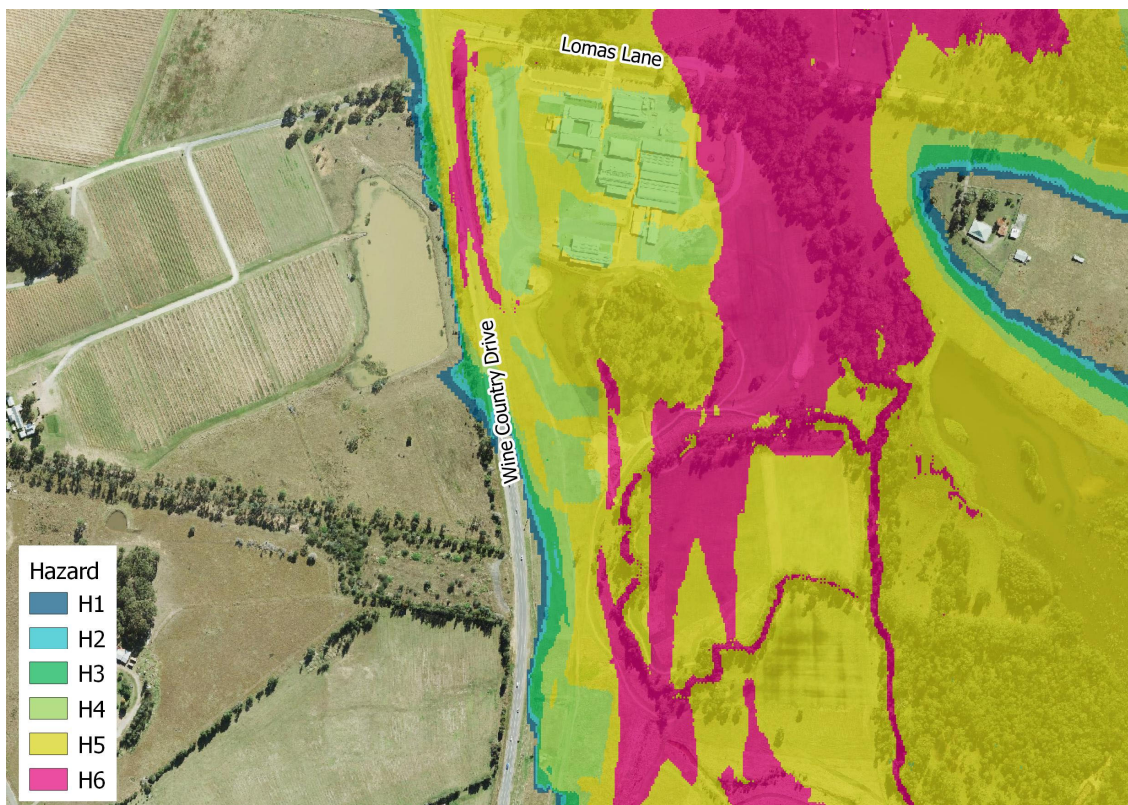


Figure 2.4 Peak PMF Flood Hazard

2.4 Available Flood Warning Time and Rate of Rise

Flood modelling undertaken as part of the FIA has been used to determine flood behaviour across various points on Site, including available flood warning time, average rate of rise and the duration of flooding. The points of interest are noted in Figure 2.1, with a summary of flood behaviour in the following sections. Post-development flood behaviour across the Site will be used to identify an appropriate flood emergency management strategy, discussed in Section 5.

2.4.1 Locations A and B

The available flood warning time, peak flood level and total inundation duration along Wine Country Drive for the flood events nominated in Table 2.1 are shown in Figure 2.5 to Figure 2.6.

Figure 2.5 and Figure 2.6 indicate that for all events up to and including the 0.2% AEP event, the intersection of Wine Country Drive and Lomas Lane (Location B) will remain flood free and that Wine Country Drive to the north of the Site (Location A) will be subject to depths of less than 0.1 m in a 0.2% AEP event. In the PMF event, peak flood depths along Wine Country Drive will vary between 1.6 m and 1.9 m. Based on the PMF event, flooding would occur along Wine Country Drive between 3 and 4 hours following the onset of rain with an average rate of rise of approximately 0.5 m/hour.

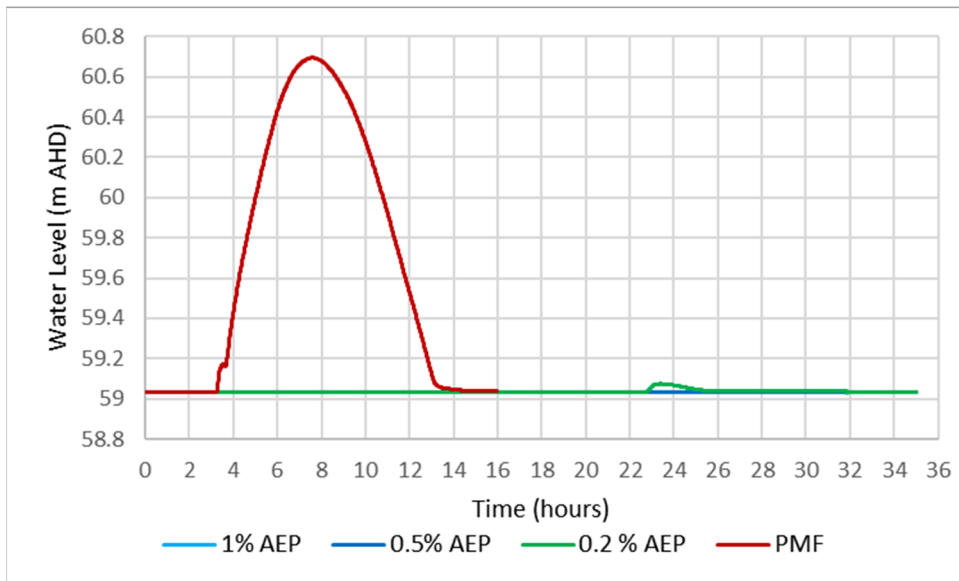


Figure 2.5 Rate of Rise at Wine Country Drive North of Site (Location A)

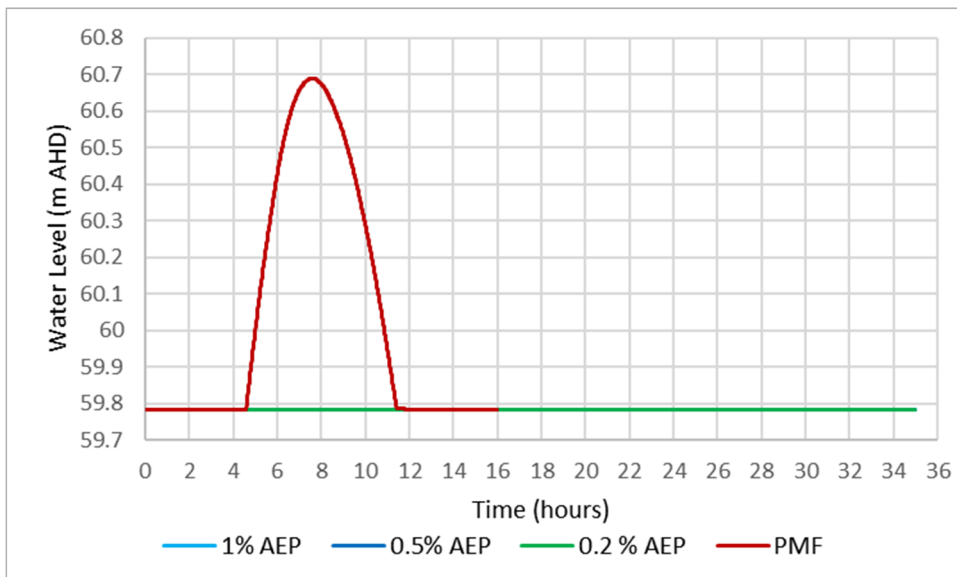


Figure 2.6 Rate of Rise at Intersection of Wine Country Drive and Lomas Lane (Location B)

2.4.2 Locations C1-C3 (Northern Access)

The available flood warning time, peak flood level and total inundation duration along Lomas Lane for the three school access locations nominated in Table 2.1 are shown in Figure 2.7 to Figure 2.9. Additional flood events have been considered for Locations C1-C3 as Lomas Lane is a critical evacuation route.

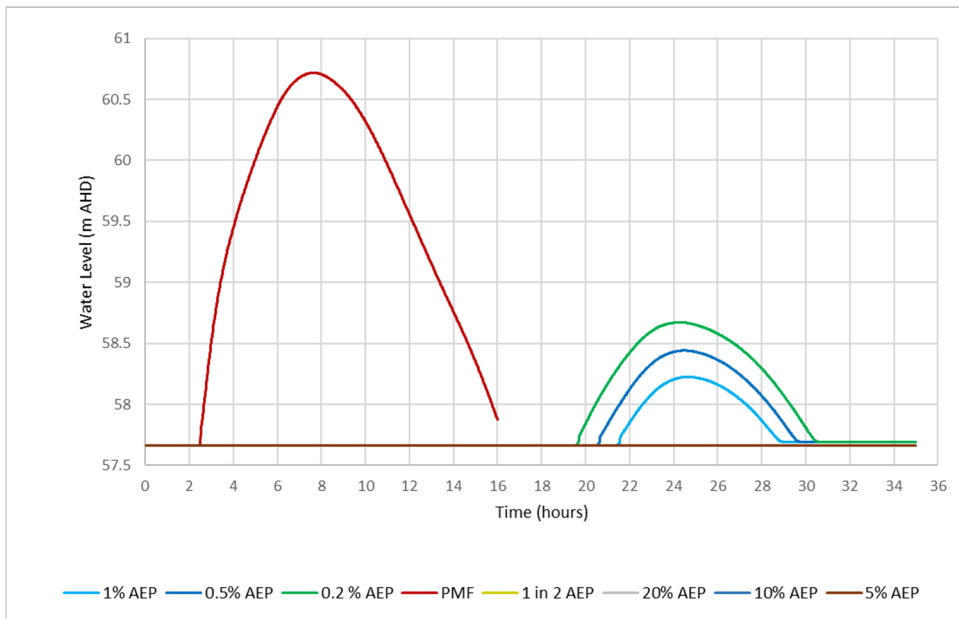


Figure 2.7 Rate of Rise at NW Exit (Location C1)

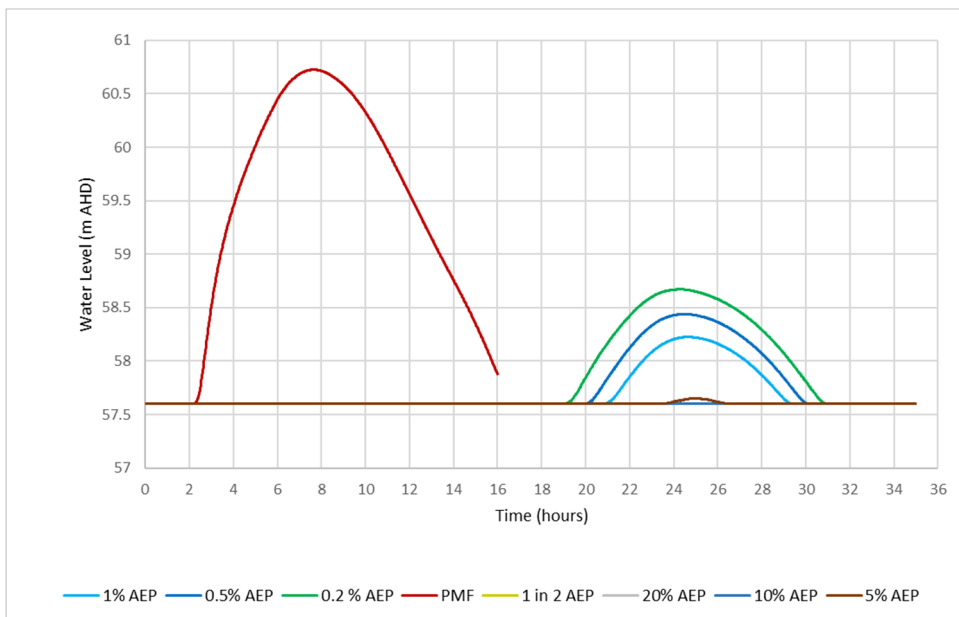


Figure 2.8 Rate of Rise at NC Pedestrian Access (Location C2)

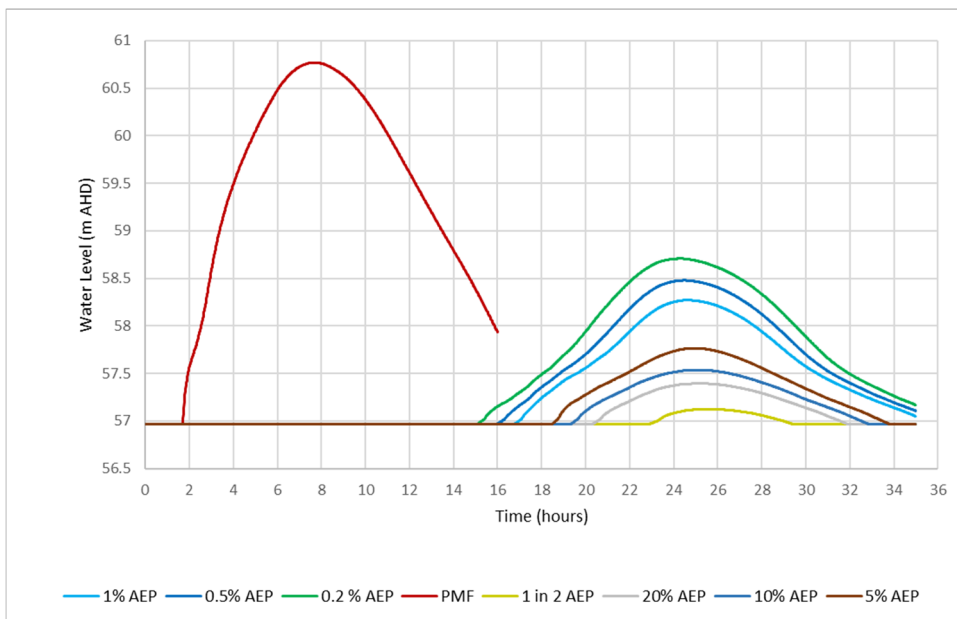


Figure 2.9 Rate of Rise at NE Access

Figure 2.9 indicates that the NE access point (the proposed bus turnaround bay) will be inundated in the 1 in 2 AEP event to a maximum depth of 0.4 m. Access will be cut off from a 20% AEP event, with heavy inundation occurring in all events beyond this point. Figure 2.8 indicates that the NC Pedestrian access will be flood free for all events up to a 5% AEP event with only minor shallow ponding occurring at this point. However, for events rarer than the 1% AEP event, flooding at this access point would exceed 0.6 m. Figure 2.7 indicates that the NW Exit will be flood free for all events up to and including the 5% AEP event. For events rarer than the 1% AEP event, flooding at this access point would exceed 0.6 m.

In the PMF event, flood levels along Lomas Lane will vary between 3.1 m and 3.8 m. Based on the PMF event, flooding would occur along Lomas Lane between approximately 2 and 3 hours following the onset of rain with an average rate of rise of approximately 0.8 m/hour. It is noted that the PMF event is an extreme event and hence the calculated timelines are deemed conservative. For perspective, for the 1% AEP event, flooding occurs approximately 21 hours following the onset of rain with an average rate rise of 0.2 m/hr at the NW Exit (Location C1).

The above information demonstrates that the northern main entry (NE access) has a low level of flood immunity (lower than the 1 in 2 AEP). Hence, the accessibility of this entry point is the most critical factor that will govern the proposed evacuation timeline.

2.4.3 Main School Site (Locations D-F)

The available flood warning time, peak flood level and total inundation duration at the Main School Site (northern portion) for the flood events nominated in Table 2.1 are shown in Figure 2.10 to Figure 2.12.

Figure 2.10 indicates that the Building B carpark (Location D) will be flood-free for all events up to and including the 0.5% AEP and subject to depths of less than 0.25 m in the 0.2% AEP, between 20 to 22 hours following the onset of rain with an average rate of rise of 0.1 m/hour. In the PMF event, peak flood depths in the Building B carpark would be in excess of 2 m, with flooding occurring approximately 3 hours following the onset of rain with an average rate of rise of 0.55 m/hour.

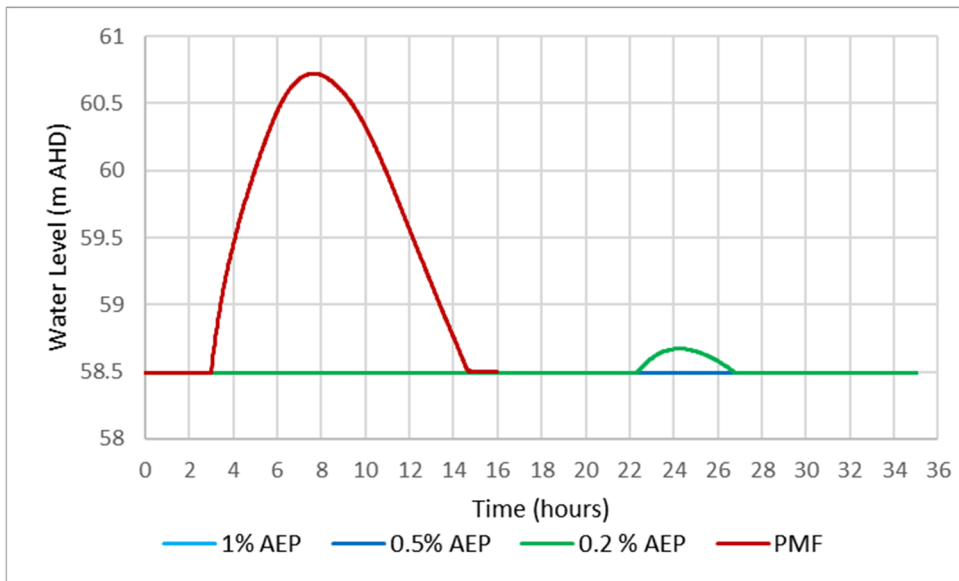


Figure 2.10 Rate of Rise Building B Carpark (Location D)

Figure 2.11 and Figure 2.12 indicate that for all events up to and including the 0.2% AEP event, the Main School Site and carpark adjacent Building C will remain flood free. In the PMF event, peak flood depths at the Main School Site and at the Building C Carpark will vary between 1.6 m and 1.8 m. Flooding would occur at both locations approximately 4 hours following the onset of rain with an average rate of rise of 0.43 m/hour.

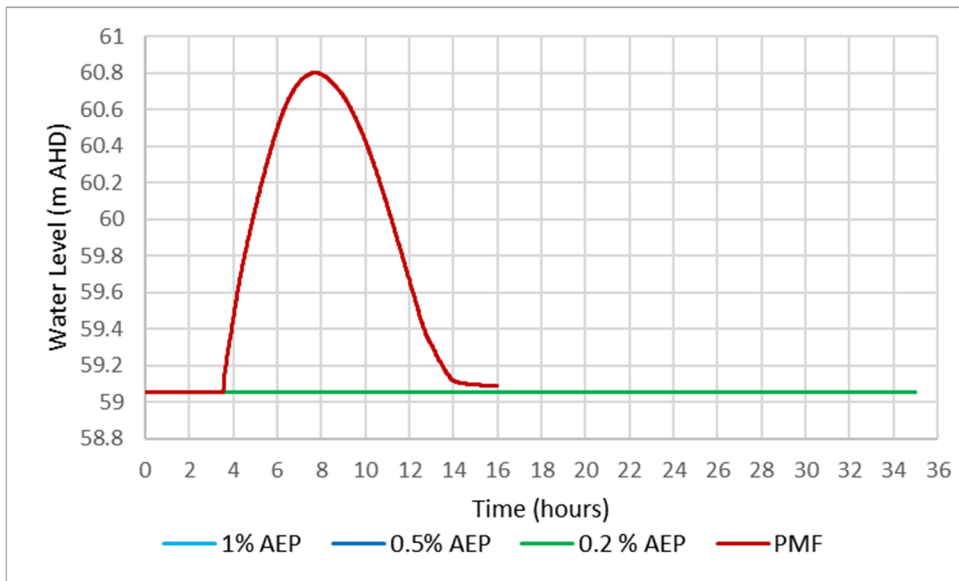


Figure 2.11 Rate of Rise at Main School Site (Location E)

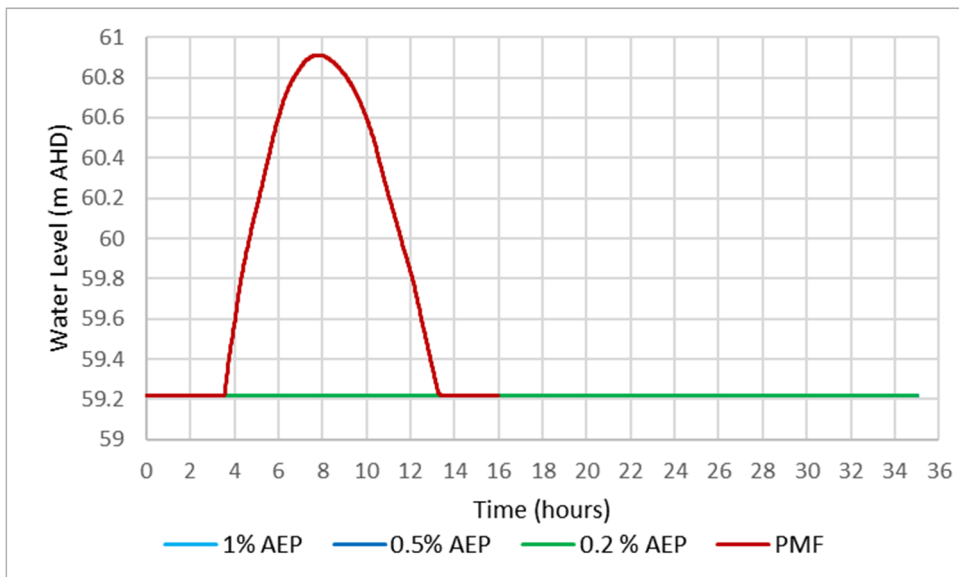


Figure 2.12 Rate of Rise at Building C Carpark (Location F)

2.4.4 Southern Wine Country Drive (Locations G-H)

The available flood warning time, peak flood level and total inundation duration at the Building J Carpark and the Wine Country Drive accessway for the flood events nominated in Table 2.1 are shown in Figure 2.13 and Figure 2.14 respectively. Figure 2.13 and Figure 2.14 indicate that for all events up to and including the 0.2% AEP event, the carpark and accessway adjacent Wine Country Drive along the south-west boundary of the Site will remain flood free. In the PMF event, peak flood depths along this boundary vary between 1.8 m and 2.0 m. Flooding would occur at both locations approximately 3 to 4 hours following the onset of rain with an average rate of rise of 0.43 m/hour.

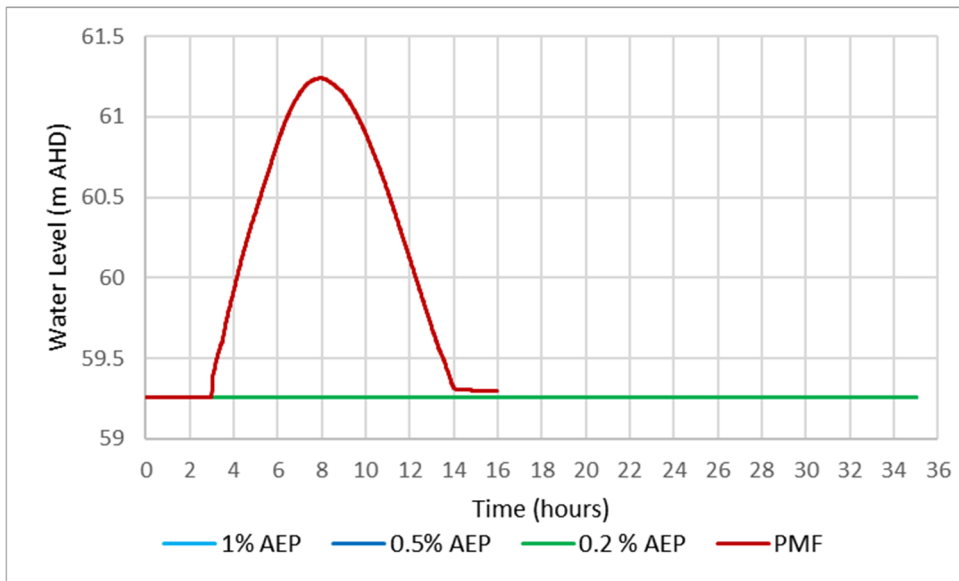


Figure 2.13 Rate of Rise Building J Carpark (Location G)

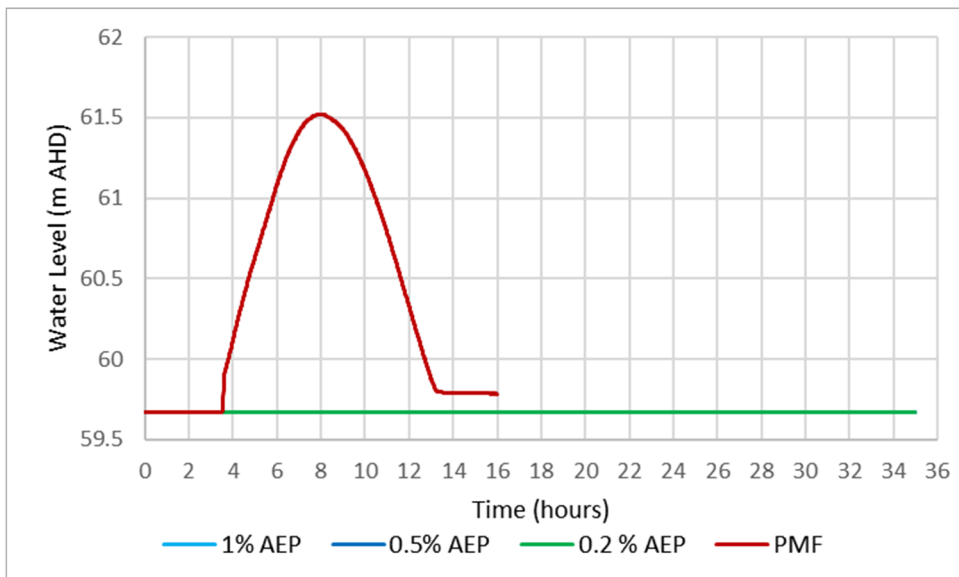


Figure 2.14 Rate of Rise Wine Country Drive Accessway (Location H)

2.4.5 Black Creek (Location I)

The available flood warning time, peak flood level and total inundation duration at Black Creek for the flood events nominated in Table 2.1 is shown in Figure 2.15. Figure 2.15 indicates that for events between 1% AEP and 0.2% AEP peak flood depths in Black Creek will vary between 3.3 m and 3.7 m. Flooding would occur in Black Creek approximately 6 hours following the onset of rain with an average rate of rise of 0.2 m/hour. In the PMF event, peak flood depths at the same location would be approximately 5.8 m with flooding occurring approximately 1 hour following the onset of rain with an average rate of rise of approximately 0.62 m/hour.

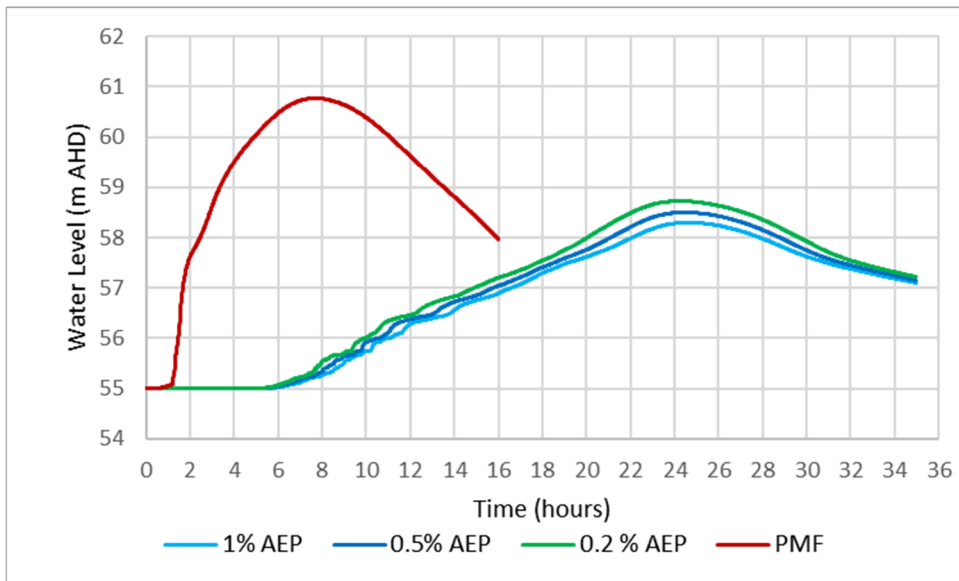


Figure 2.15 Rate of Rise in Black Creek (Location I)

2.5 Summary of Flood Behaviour and Available Flood Warning Time

A summary of potential flood depths and flood timing across the locations of interest is included below in Table 2.3. As noted in Figure 2.5 to Figure 2.15 and Table 2.3, the Site will be largely flood free for all events up to and including the 0.2% AEP outside of minor flood depths at Location A and Location D in the 0.2% AEP event. The notable exception is the accessway to the school on Lomas Lane (Location C1-C3) for which flooding is expected to occur for all events between the 1 in 2 AEP and 0.2% AEP event (Refer to Section 2.5.1 for more details). The southern access point (Location H) will be flood free for all events up to and including the 0.2% AEP event.

The Site will be flooded in the PMF event for all nominated locations by flood depths of between 0.9 m and 3.8 m. Flooding would be expected to occur between 2 hours and 4 hours following the onset of rain for this extreme event.

Black Creek would be expected to reach peak depths of between 3.3 m and 3.7 m for events between the 1% AEP and 0.2% AEP events, and 5.8 m in the PMF event. For all events up to and including the 0.2% AEP event, flooding would occur just before 5 hours 30 minutes from the onset of rain steadily rising to a peak approximately 24 hours after the onset of rain. In the PMF event, flooding would be expected to occur within 1 hour of the onset of rain, rising to a peak approximately 8 hours after the onset of rain.

Table 2.3 Peak Flood Depths at Points of Interest

Points of Interest		0.2% AEP Event		PMF Event	
ID	Description	Peak Flood Depth (m)	Onset of flooding after rain (hours)	Peak Flood Depth (m)	Onset of flooding after rain (hours)
A	Wine Country Drive north of Site	0.04	22.8	1.7	3.3
B	Intersection of Wine Country Drive and Lomas Lane	0	N/A	0.9	4.6
D	Building B Carpark	0.18	22.4	2.2	3
E	School Site	0	N/A	1.7	3.6
F	Building C Carpark	0	N/A	1.7	3.6
G	Building J Carpark	0	N/A	2.0	3.0
H	Wine Country Drive Accessway	0	N/A	1.9	3.5
I	Black Creek	3.7	5.4	5.8	0.8

2.5.1 Northern Access Points

Access to the school entryways along Lomas Lane will experience inundation at a much more frequent rate than the remaining areas of the Site. With reference to Table 2.4 the flood immunity levels of the northern access points (NE, NC and NW) are summarised below:

- The NE access point at the bus turnaround bay will be inundated in the 1 in 2 AEP event to a maximum depth of 0.2 m. The access will be cut off from the 20% AEP event.
- The NC pedestrian access and NW exit will be flood free for all events up to and including the 10% AEP event.
- The NC pedestrian access will be inundated in the 5% AEP event to a maximum depth of less 0.05 m.
- The NW exit will be flood free for all events up to and including the 5% AEP event.

All 3 exits will be inaccessible from the 2% AEP event. Peak flood depths at each location are shown for the 1% AEP event.

The above information demonstrates that the northern access points (NE, NC and NW) have relatively low levels of flood immunity when compared to the rest of the Site and hence the flooding behaviour at these points is critical to the proposed emergency management strategy.

Table 2.4 Peak Flood Depths at Northern Access Points

Points of Interest		20% AEP Event		10% AEP Event		5% AEP Event		1% AEP Event	
ID	Description	Peak Flood Depth (m)	Onset of flooding after rain (hours)	Peak Flood Depth (m)	Onset of flooding after rain (hours)	Peak Flood Depth (m)	Onset of flooding after rain (hours)	Peak Flood Depth (m)	Onset of flooding after rain (hours)
C1	NW Exit	0	N/A	0	N/A	0	N/A	0.6	21.4
C2	NC Pedestrian Access	0	N/A	0	N/A	0.05	23.6	0.6	20.9
C3	NE Access	0.4	20.3	0.6	19.3	0.8	18.5	1.3	16.8

2.6 Regional Evacuation Routes

Regional flood evacuation routes in the Cessnock Local Government Area are set out in the *Cessnock City Local Flood Plan* (SES, 2009). Cessnock is divided into three sectors for the purpose of evacuation during extreme flood events, with the Site falling within the 'Branxton' area. In the event of a dam-failure or other extreme flood event, evacuations from this area are to occur along Wine Country Drive towards evacuation centre locations in Nulkaba.

According to Council's flood mapping, Wine Country Drive is flood-free up to the 1% AEP event in the south towards Cessnock. During the 1% AEP event, Wine Country Drive at the intersection with Fleming Street is predicted to be inundated with a flood hazard category of "H1" (benign flow conditions).

Wine Country Drive is flood-free up to the 1% AEP event in the north towards Rothbury. During the 1% AEP event, Wine Country Drive at the intersection with Wills Hill Road is predicted to be inundated with a flood hazard category of "H2" (low hazard flow but unsafe for small vehicles).

3 Existing Flood Emergency Response

The existing SPCC Site is subject to flooding as discussed in Section 2. The below outlines the existing arrangements that the SPCC management makes during flood events and the existing flood emergency response plan utilised by the SPCC management.

3.1 Existing Arrangements During Flood Events

The SPCC management is aware of the potential for flood affectation at the Site. Historically, the Site has been subject to flooding resulting in an evacuation in 2015 and other instances whereby parents were advised of the possibility of flooding and encouraged to keep their children at home.

The existing arrangement adopted by the SPCC management during flood events is to visually monitor encroachment of water from Black Creek onto Lomas Lane in combination with the use of the 'Flood Near Me' app, the Cessnock Disaster dashboard and monitoring of weather forecasts. In the event of a flood, the preliminary response strategy is to take refuge in the upper floor levels of the existing buildings which are set at or above the PMF level (see Section 3.2 below).

3.2 Existing SMEC Flood Emergency Response Plan

The existing SPCC Site began construction in 2011. As part of the works a Flood Emergency Response Plan (SMEC, 2011) was developed for the Site, herein referred to as the 'Existing SMEC FERP'.

The Existing SMEC FERP identified several flood-related hazards present at the Site, including:

- The low available effective warning time particularly for the PMF event and lack of an existing flood warning system for the Black Creek catchment;
- The potential for hazardous flood condition on Site during a flood event; and
- The potential for long duration of flooding.

The Existing SMEC FERP proposed a flood emergency response centred around the extreme PMF event and called for the provision of *"on-site flood refuge for all student and staff"* as the proposed emergency management strategy. Specifically, the Existing SMEC FERP required:

- Flood refuge in structurally sound buildings with floor levels set at or above the predicted PMF level;
- Emergency access to flood refuge locations along Wine Country Drive with the minimum access level to be no lower than 0.5 m below the PMF level; and
- In the event of a flood, for all staff and students to shelter-in-place in the designated flood refuge buildings until advised by the SES.

4 Consideration of Evacuation Requirements

4.1 Overview

Physical protection of buildings or a site through considered design to exclude floodwaters for all events up to and including the PMF is generally not practical and/or cost effective. It also does not consider the risks arising from isolation of occupants nor the risk to emergency services personnel who may be required to assist isolated occupants to evacuate in emergencies. As such, an emergency management plan is required to assist in mitigation of the residual flood risk to people during extreme flood events. With consideration of the factors listed below,

- The likely Site occupants (namely school students and staff);
- The number of potential occupants;
- Potential isolation periods and conditions (including but not limited to a lack of electricity power, water and food);
- The lack of access to emergency care or provisions; and
- The potential placement of emergency service personnel or other community members (specifically parents of the school students) at risk if assistance is required.

The principal flood emergency management strategy proposed herein is evacuation prior to inundation of both evacuation routes and buildings, with a preference towards non-attendance of the Site if there is potential for a flood event to occur based on rainfall or flood forecast by the Bureau of Meteorology (BoM).

The SES have indicated in their response to this development (see Annex B) that:

- *"Development strategies relying on...sheltering in buildings surrounded by flood water are not equivalent, in risk management terms, to evacuation."*
- *"Sheltering in a building within the flood extent is not safe" and*
- *"Development strategies relying on an assumption that mass rescue may be possible where evacuation fails or is not implemented are not acceptable to the NSW SES."*

Therefore, a shelter-in-place strategy is not considered suitable for the Site for any scenario except where it cannot be avoided due to unexpected changes in conditions which either made evacuation impossible or provided inadequate warning time (such as in the PMF event). In such an event, temporary shelter-in-place on the upper floor levels of the proposed new buildings would situate occupants well above the PMF level. In line with the above considerations and SES response, it is noted that this should only occur in an extremely unlikely scenario such as the PMF event.

4.2 Initial Consideration of Site Access Constraints and Opportunities

Consideration was given to the Site access constraints and opportunities to inform the evacuation strategy for the school. Initial consideration was given to two evacuation options as outlined below:

4.2.1 Option 1: School evacuation using the Lomas Lane NE and southern entry points

This option will use the southern access point to service evacuation from the southern set-down/pick-up area.

To service the northern set-down/pick-area, this option considered the use of the Lomas Lane NE access. As the NE access has a low-level flood immunity (lower than the 1 in 2 AEP event), this option will require school evacuation prior to this access point becoming inundated (the 1 in 2 AEP event) and then completely cut off (the 20% AEP event). This means that evacuation would have to be triggered at a low flood level (smaller than the 63% AEP or 1 year ARI flood event). It is noted that the 63% AEP event could be exceeded multiple times in any given wet season, leading to multiple school evacuations. For this reason, this option has not been selected, and an alternative option that will require relatively less frequent school evacuation has been considered as described as follows.

4.2.2 Option 2: School evacuation using the Lomas Lane NC pedestrian access and southern entry points

Like Option 1, Option 2 will use the southern access point to service evacuation from the southern set-down/pick-up area.

However, this option will prohibit the use of the Lomas Lane NE access point (as it becomes inundated in the 1 in 2 AEP event) and instead will require the use of Lomas Lane NC pedestrian access for vehicles during a flood emergency to service the northern set-down/pick-up area. As the NC access point is flood-free for all events up to and including the 10% AEP event (with a low flood hazard in the 5% AEP event), a less frequent evacuation trigger is required which in turn allows for less frequent school evacuations.

4.2.3 Adopted Evacuation Option

From the above-stated evacuation options, Option 2 has been adopted as the preferred strategy for the following reasons:

- Whilst Option 1 allows the use of the Lomas Lane NE access point, due to potential for inundation in frequent events in that area an evacuation would likely be required yearly and in some cases multiple times per year.
- Option 2 still allows use of the Lomas Lane NC access point (allowing for egress to occur from the northern set-down and pick-up area) but requires less frequent school evacuation.

The principal aim of the adopted evacuation strategy is to evacuate the school without requiring direct assistance from SES, with students and staff evacuated from the Site and heading to their homes prior to evacuation routes and buildings become inundated. Egress from the Site is via Wine Country Drive either:

- Northbound towards Cessnock Airport, or
- Southbound toward Nulkaba.

The details of the proposed evacuation timings and procedures based on Option 2 are provided in Section 5.3.1.

4.3 Flood Protection

In the case of an extreme flood, floodwaters may inundate parts of the ground floor level and potentially enter into stairways, lift shafts and storage units. Future design development should attempt to

minimise opportunities for water ingress through suitable design including waterproofing and physical protection.

5 Flood Emergency Response Plan

A Flood Emergency Response Plan (FERP) is to be prepared by the school operator that will formalise flood evacuation planning and strategy with respect to flood intelligence, the flood behaviour presented in this report, and relevant procedures. The FERP will be expected to build on the strategy and intent presented in this report.

The SES recommends that all flood prone properties prepare their own emergency management plans as SES resources are scarce during emergencies and it is often the case that they cannot service all affected parties in case of flood, particularly given mobilisation time. The FERP shall be used as a guide for building wardens and other responsible parties nominated in the evacuation strategy. The aim of the FERP is to inform the future operators of the building of the appropriate response measures required in the event of an extreme flood. In addition, the FERP will include a summary of the actions required in the form of warning systems and signage that are to be displayed at common muster points such as the ground floor entry, stairways, carpark and visible points along the ground floor. Maintenance activities must also be nominated in the FERP to ensure that all emergency management systems are in full working order at all times.

Key elements to be included in the FERP are outlined in the following sections.

5.1 Flood Response Personnel

Positions and responsibilities will need to be assigned to on-Site personnel for managing flood response. A chief flood warden or head warden will need to be nominated to manage the evacuation of the Site during a flood. Individual building wardens will also need to be nominated for the following 12 buildings to manage evacuation:

- Building A;
- Building B;
- Building C;
- Building D and K;
- Building E;
- Building F and G;
- Building H;
- Building J;
- Building K;
- Building N;
- Building O; and
- Building Q, R and S.

Warden responsibilities shall include evacuation of students, staff and any visitors. Contact details of the head warden and all individual building wardens shall be presented in the FERP to facilitate contact with the SES.

The wardens will be identified by wearing reflective safety vests and coloured hard hats so that visitors to the site will be able to recognise the wardens with ease. The wardens will need to be familiar with the details in the FERP and will direct people to safety via the evacuation routes.

The warden's responsibilities may involve checking classrooms, vehicles and other spaces to ensure there are no personnel remaining, before directing all parties towards the Lomas Lane/northern access point and Wine Country Drive/southern access point. Wardens will coordinate evacuation of students, staff and visitors from this point via private car and/or bus as appropriate.

If the SES takes control of the Site, then they may override the provisions of the FERP. Further coordination of the proposed FERP will need to be undertaken with the SES. Regular drills will be required of the wardens to ensure the flood/emergency awareness and preparedness of the wardens and employees.

5.2 Emergency Warning Systems

Warning in case of a flood event is required to alert wardens and other people on-Site that an extreme flood event may be imminent. As extreme events are typically very infrequent, a warning system in the form of an audible alarm is considered appropriate to communicate the urgency of the situation. An emergency siren and building Public Address (PA) system that is installed for other emergencies or day-to-day facility use is likely suitable for communicating with building occupants during other building emergencies such as a flood emergency. These emergency warning systems are to be located above the PMF level.

Flood levels can rise rapidly, and it is necessary to ensure that sufficient warning time is given so that personnel may evacuate to safety. Triggers and notification are required to alert the head warden or others about the need to trigger the building emergency system. Triggers and notifications could include:

- On-Site Flood Warning System, outlined in Section 5.2.1;
- Existing Flood Warning System, outlined in Section 5.2.2;
- Rainfall intensity notifications from the BoM or a subscription to the BoM to send updates to flood wardens on anticipated heavy rainfall events ahead of time and to enable timely preparation.

These triggers could be communicated to the head warden and other key personnel using an automated SMS system. Back-up triggers, such as manually read flood markers, may be required to ensure the reliability of the warning system. Current SPCC practice is to observe rising floodwaters in the vicinity of Lomas Lane to trigger evacuation and/or closure of the school. It is recommended that manually read flood markers be installed at the NE Access on Lomas Lane as a minimum.

It is noted that the alert and trigger levels are to be based on regional flooding from Black Creek. It is therefore advised to stay tuned to local media outlets or the local SES Centre to get an understanding of flooding and flood emergency situations across the broader area to verify that regional flooding is taking place. This will assist to minimise the potential for false triggers that may be caused by local catchment flooding.

5.2.1 On-Site Flood Warning System

To maximise the available warning time and facilitate an orderly response, it is recommended that a flood warning system be installed. This system is to consist of the following components:

- Water level sensors;
- Monitoring control unit;
- Communications; and
- Power supply.

It is noted that Council supports the installation of an on-site flood warning system (see Annex C).

The system should be designed by an experienced supplier. Redundancy should be incorporated into the design such that failure of a single item does not result in failure of the overall warning system. The system supplier should also provide appropriate documentation to enable ongoing maintenance and calibration. It is recommended that the SPCC management engages the same system supplier in the ongoing maintenance and calibration of the on-Site flood warning system.

Water Level Sensors

Water level sensors are to be installed at the location nominated in Figure 5.1. Placement of the water level sensor adjacent to the Black Creek waterway is aimed at informing Site occupants of rising floodwaters and (once a nominated level is reached) indicating that evacuation should commence. Placement of the water level sensor along access points on Lomas Lane is aimed at informing Site occupants of when access to Lomas Lane should be closed and that evacuation should occur only via the Wine Country Drive Access Point.

There are a variety of sensors that can be used for this purpose and specific advice should be sought from the suppliers to indicate and confirm the most appropriate hardware. The sensors that are selected should be:

- Reliable – for example, the supplier should be able to demonstrate that the selected sensor has been used in similar installations.
- Stable – the calibration of the sensor should not unduly drift over time or be affected by external factors (such as changes in temperature).

There are a number of ultrasonic, pressure and capacitive sensors available that are able to meet these requirements. However, it is likely that periodic calibration and maintenance of the sensors will still be required. Facilities should be provided to calibrate the sensor (for example, by allowing adjustment to survey levels).

Typically, the sensor housing will be integrated into the surrounds in a discrete manner and protect the sensor from vandalism or other interference. However, easy access for maintenance and calibration should be provided.

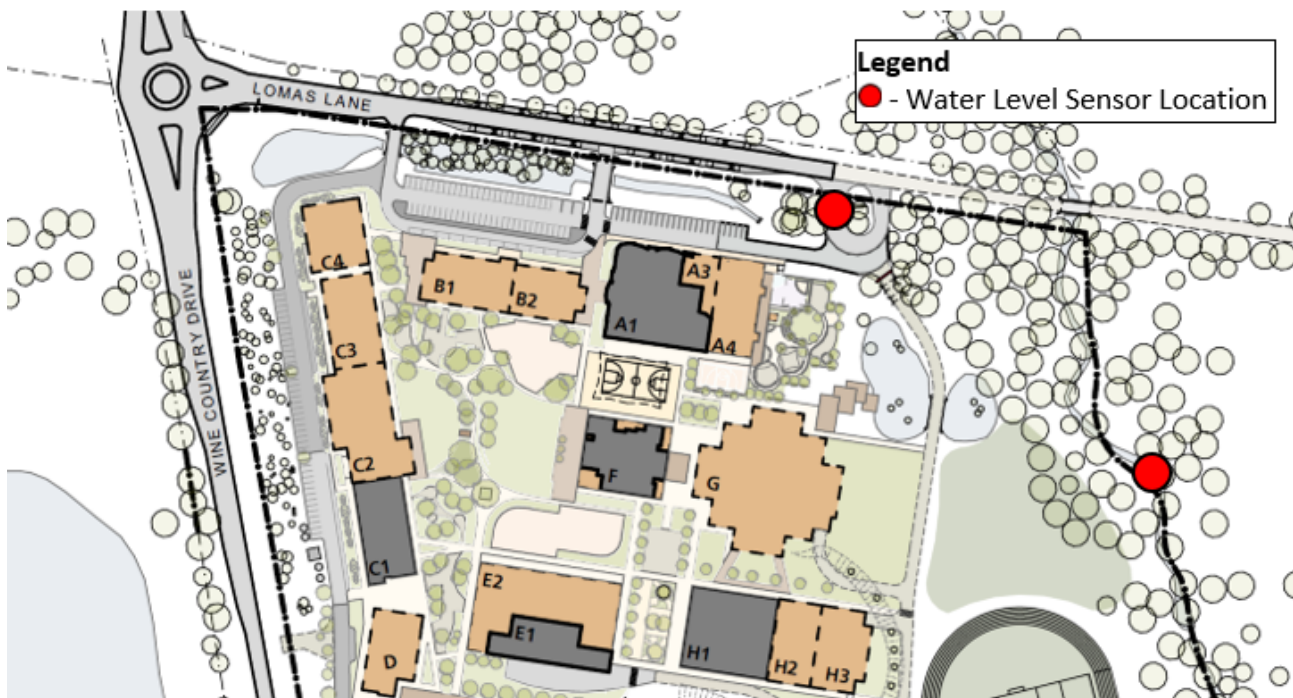


Figure 5.1 Water Level Sensor Locations

Control Unit

To accompany the sensors, a control or measuring unit will be required. This unit will undertake the following functions:

- Making the measurements from the sensors;
- Issuing alerts once the defined thresholds are exceeded;
- Monitoring the power supply;
- Cross-checking the data from the multiple sensors to ensure consistency (and provide warning of a potential malfunction); and
- Periodically polling the communication channels so that key users can be alerted of a system failure.

There are a range of commercially available data loggers that can provide these functions (e.g. Campbell Scientific).

The control unit can be co-located with the sensor or installed in a separate housing within the building. In either case the unit should be immune to inundation by floodwater (e.g. by locating the unit above the PMF).

Communications

To communicate the warning to the occupants, the system will need to include a communications facility. Systems or processes will be required to identify and communicate the following events:

- Floodwater exceeding the identified thresholds;

- Sensor disagreements (indicating potential need for recalibration or failure);
- Power supply issues (including loss of primary power supply and low battery levels); and
- Failure of the loggers or communications systems.

This can be integrated into the on-Site emergency warning system. It may also be necessary to provide building wardens with more specific detail (for example, by SMS) so that they can co-ordinate an appropriate response. Some aspects, such as the failure of the loggers and communications systems, may require some degree of routine monitoring including confirmation that the system is active when a storm warning is issued.

Power Supply

The flood warning system will require a redundant power supply. Typically, the primary power would be drawn from the electricity grid. However, an independent back-up should be provided to enable the system to continue functioning in the event that power is cut.

Documentation

Accompanying the system design, appropriate documentation of the system should be provided by the system supplier. This documentation should cover:

- System components (including their location within the building);
- Use of the user interfaces;
- Software interfaces (including the use network connections and protocols);
- Wiring diagrams;
- Calibration procedures; and
- System maintenance requirements.

The documentation should be able to be understood by a suitably qualified professional and without requiring reference to additional documents that are not otherwise readily available. Diagrams and other graphics should be provided where appropriate.

5.2.2 Existing Flood Warning System

Warning in case of a flood event is required to alert Site occupants that a flood event may be imminent. Flood levels can rise rapidly (particularly during the PMF) and it is necessary to ensure that sufficient warning time is given so that Site occupants may evacuate to safety. Triggers and notification are required to alert occupants to evacuate and should include flood warning, flood watch and weather warnings including rainfall intensity notifications from the BoM, Council and the SES.

Council have recommended observation of the Cessnock Airport AWS gauge (061260), operated by BoM, as the most appropriate means by which to inform potential flooding events at the school. The gauge is located approximately 1.7 km north of the Site along Wine Country Drive. Forecast rainfall and storm conditions at the gauge should be used to prepare for the possibility of flooding or to make the decision to close the school prior to opening.

The BoM's Flood Warning System should provide effective flood warning to facilitate safe evacuation. While there is no gauge in the BoM's Flood Warning System within the Black Creek catchment, the Wollombi Brook at Wollombi gauge (561169) is part of the BoM's Flood Warning System. While the

Wollombi Brook gauge is located on a neighbouring catchment, it is considered to represent similar behaviour to that likely experienced in the Black Creek catchment and provides additional information to assist emergency management planning.

BoM service level specifications for the Wollombi Brook at Wollombi gauge are summarised in Table 5.1.

Table 5.1 Wollombi Brook at Wollombi Flood Warning Gauge Classification Levels

Gauge Location	SES Flood Classification Level (m)		
	Minor	Moderate	Major
Wollombi Brook at Wollombi	6.7	8.6	12.2

The BoM has a target warning lead time of 6 hours for minor flood classifications at the gauge.

5.3 Evacuation Routes and Timings

5.3.1 Evacuation Off-Site

Evacuation in a safe manner is dependent on warning time and availability of easily identifiable routes. Proposed evacuation off-site is proposed via private vehicles and buses along Wine Country Drive in both northerly and southerly directions, with access via both:

- The southern/Wine Country Drive accessway with marshalling/pickup at the Building J carpark; and
- The northern/Lomas Lane accessway with marshalling/pickup at the Building B carpark.

The evacuation routes are indicated in Figure 5.2. Confirmation has been provided by the Traffic Engineer (refer Annex E) that evacuation can be accommodated in both locations providing minor modifications are made to the NC Pedestrian Access on Lomas Lane.

Total flood warning time – consisting of the time from when the evacuation trigger level is reached in Black Creek to the time when Wine Country Drive will become inaccessible due to floodwaters – will vary with event rarity. However, as Wine Country Drive is not expected to be overtopped by floodwater until a 0.2% AEP event, this event has been nominated for evacuation assessment. Effective evacuation of the Site must utilise the total flood warning time available to ensure that evacuation of the Site will occur prior to inundation of evacuation routes.

Flood modelling undertaken as part of the FIA indicates that in a 0.2% AEP event, water levels will rise consistently in Black Creek before overtopping the NE access, NC pedestrian access and NW exit points on Lomas Lane. Flood levels would continue to rise beyond this point, completely inundating Lomas Lane. Rising waters would then inundate the western portion of the Site and eventually overtop Wine Country Drive to the north and south. The peak flood level at the gauge would be reached approximately 24 hours after the onset of rain and water levels would fall steadily from this point.

Indicative evacuation timelines for the 0.2% AEP event and the peak flood level at the proposed gauge location on Black Creek are shown in Table 5.2 and Figure 5.2 respectively.

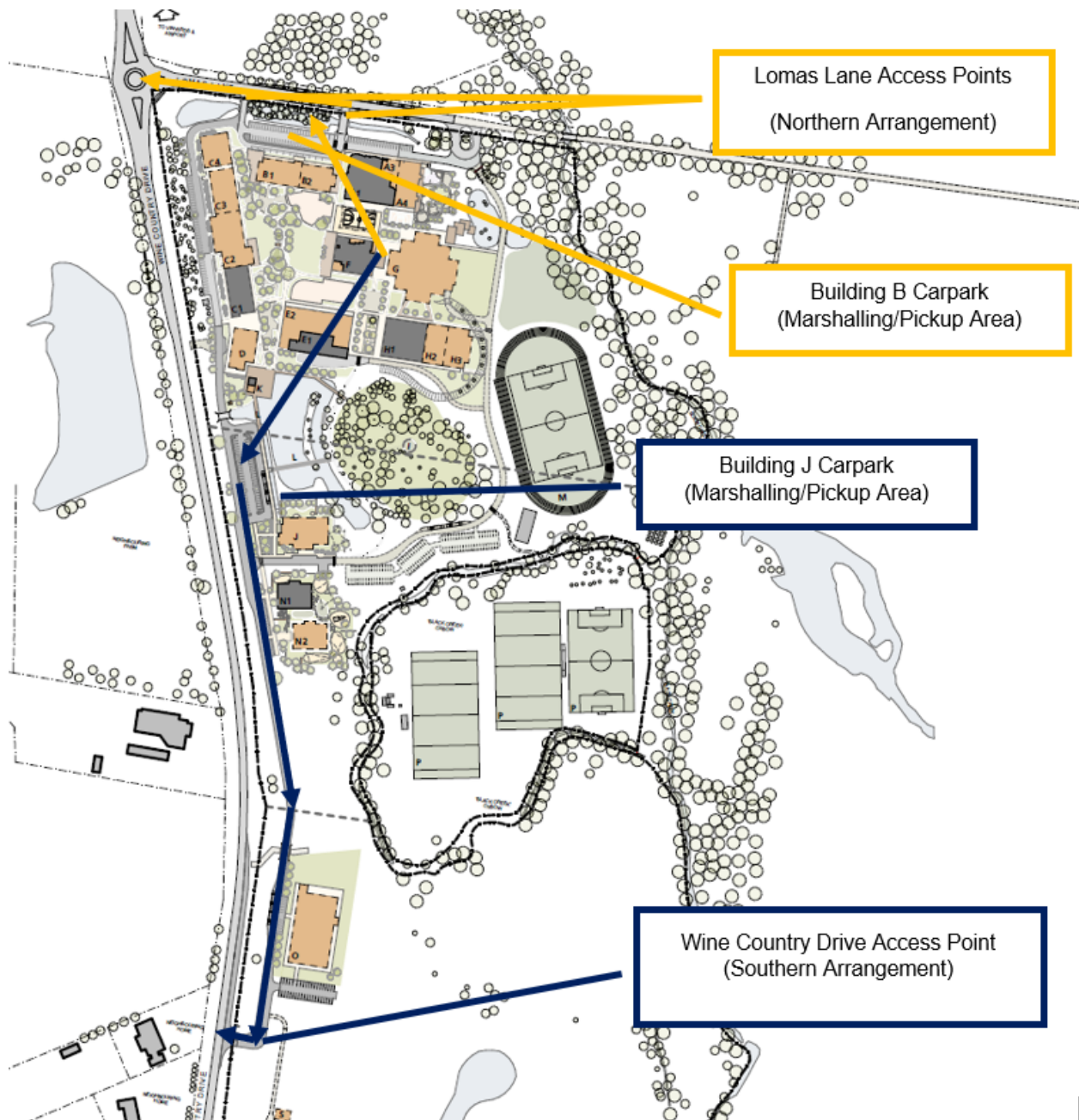


Figure 5.2 Recommended Evacuation Routes

Table 5.2 Timing of Inundation in the 0.2% AEP Event

Time from Rainfall Onset	Inundation Occurrence
5 hours 30 minutes	Water levels begin to rise in Black Creek
15 hour 45 minutes	Water levels in Black Creek reach a 1 in 2 AEP flood level. NE Access inundated
17 hours 30 minutes	Water levels in Black Creek reach a 20% AEP flood level. NE Access closed
18 hours 15 minutes	Water levels in Black Creek reach a 10% AEP flood level
19 hours 15 minutes	Water levels in Black Creek reach a 5% AEP flood level. NC Pedestrian Access inundated.
20 hours 15 minutes	Water levels in Black Creek reach a 2% AEP flood level. Lomas Lane overtopped by floodwaters. NW Exit and NC Pedestrian Access closed.
21 hours 15 minutes	Water levels in Black Creek reach a 1% AEP flood level.
22 hours 45 minutes	Wine Country Drive (north) overtopped by floodwaters
24 hours 45 minutes	Wine Country Drive (south) overtopped by floodwaters

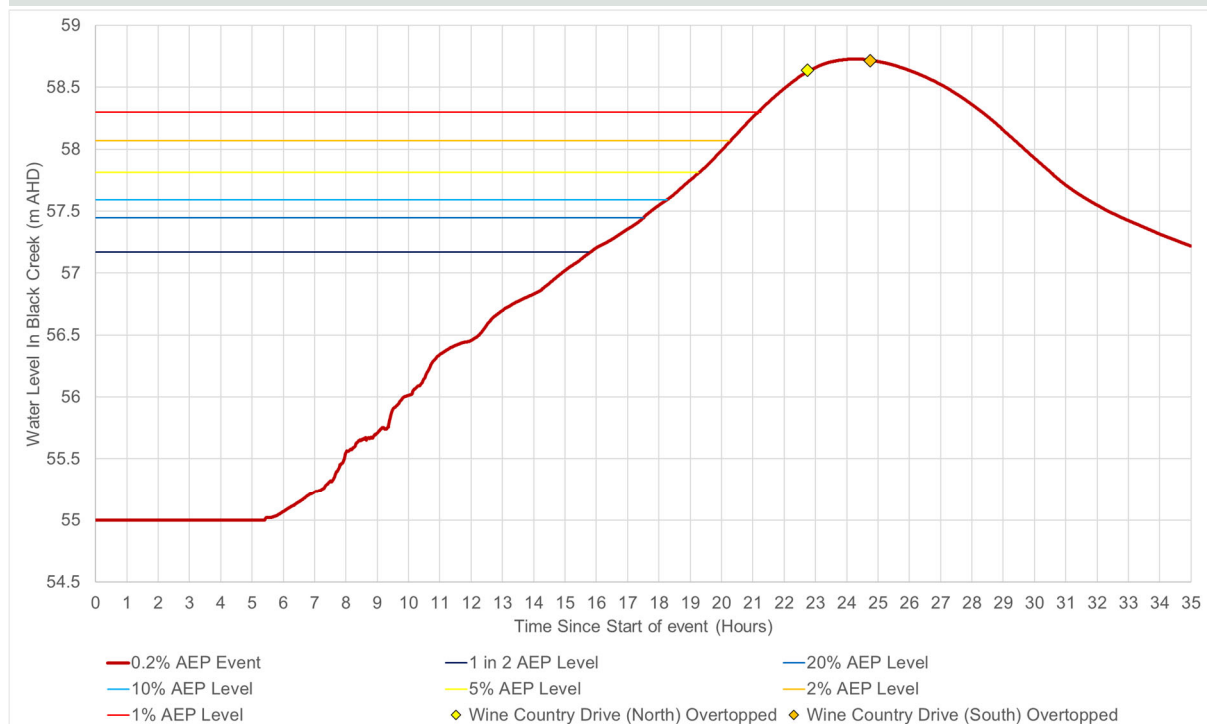

Figure 5.3 Black Creek Water Level During 0.2% AEP Event

Table 5.2 and Figure 5.3 indicate that there would be 10 and a half hours from the point at which water levels begin to rise in Black Creek prior to the 1 in 2 AEP level being reached. Following this point, water levels would continue to steadily rise until the point at which Wine Country Drive is overtopped approximately 7 to 9 hours later.

Under the proposed Option 2 evacuation scenario (see Section 4.2.2) evacuation will occur along Lomas Lane from both the NC pedestrian access and NW Exit points. Given both of these locations will be flood-free for all events up to an including the 10% AEP event, but will be inundated from the 5% AEP event (albeit by low hazard flows) it is recommend that the evacuation threshold level be set at the 20% AEP flood level of approximately 57.5 mAHD. The timeline calculation indicates that there will be approximately 2 hours between the 20% AEP flood level (trigger level) and 5% AEP flood level. Once the 5% AEP flood level is reached (trigger for closure of the Lomas Lane access and exit ways), there would be 3 and a half hours before the southern access starts to become inundated (albeit by low hazard flows). Therefore, the above-stated timeline will provide:

- Just under 2 hours for evacuation to occur along Lomas Lane prior to floodwaters overtopping this evacuation route; and
- Just over 5 hours for evacuation to occur along Wine Country Drive prior to floodwaters overtopping this evacuation route. It is noted that Wine Country Drive is only expected to be overtopped by low hazard, low flood depth floodwaters (less than 0.04 m) in a 0.2% AEP event, however the evacuation strategy calls for complete egress prior to evacuation route inundation.

Confirmation has been provided by the Traffic Engineer (refer Annex E) that a flood evacuation period of 5 hours (with the first 2 hours able to accommodate access and entry via Lomas Lane) is considered adequate to accommodate full evacuation.

Given the long warning time available from the onset of rain to the 20% AEP threshold level being reached, consideration should be given to closure of the school prior to commencement if peak flood levels approach the threshold and further rain is forecast. It is noted that school closure would be in line with current SPCC practice, which is to advise parents of possible flooding events the day before they occur and suggest that children be kept at home (see Section 3.1).

If a school closure is not undertaken, efforts should be made to notify parents about the possible need for evacuation. Proposed trigger levels and evacuation points are nominated in Table 5.3 below.

Table 5.3 Proposed Trigger Level and Evacuation Procedures

Recorded Flood Level or Visual inspection	Action to take
Flood level reaching 56.90m AHD (approximately 63% AEP event or 1-year ARI flood) and flood level keeps rising	-Stop using the NE access point and keep monitoring flood level sensor. Consider closure of school if level is reached outside of regular school hours and a severe storm or flood warning is issued by BoM.
Flood level reaching 57.5m AHD (20% AEP event)	-Trigger school evacuation -Start using NC access for vehicle entrance and the NW exit to service the northern set-down/pick-up area -Use the southern access for vehicle entrance and exit to service the southern set-down/pick-up area

Recorded Flood Level or Visual inspection	Action to take
Flood level reaching 57.81m AHD (5% AEP event)	-Begin closing both the NC and NW access points -Keep using the southern access point for vehicle entrance and exit to complete any outstanding evacuations

5.3.2 Structural Soundness

Although the proposed new buildings are not affected by flooding until an event rarer than the 0.2% AEP, given the need for emergency shelter-in-place facilities the buildings will need to be designed to ensure the structural integrity should not be compromised for all flood events up to and including the PMF event. This will require confirmation by a suitably qualified structural engineer as part of the detailed design process.

5.4 Signage

To accompany the flood warning system, the building should include appropriate signage indicating what actions are to be undertaken in the event of flooding. This should consist of instructions (including direction arrows) that can be interpreted if the flood wardens are not available.

The following signs are recommended:

1. Flood depth indicators at visible locations such as the entry to the building;
2. Entry/exit points to stairwells; and
3. Evacuation routes (refer drawings in Section 5.3.1).

An example of the typical signage that might be displayed at key points is given in Figure 5.4

FLOOD EVACUATION STRATEGY

- IF FLOOD WARNING SYSTEM HAS BEEN TRIGGERED, OR FLOODING REACHES THE WARNING MARKER ON THE FLOOD DEPTH INDICATOR, FOLLOW THE INSTRUCTIONS OF FLOOD/EMERGENCY WARDEN
- START EVACUATION TO THE FLOOD REFUGE
- CALL THE SES AND INFORM THEM HOW MANY PEOPLE ARE ON SITE AND ASK FOR ANY HELP THAT MAY BE REQUIRED
- TAKE A MOBILE PHONE TO THE FLOOD REFUGE TO ALLOW FOR COMMUNICATION.
- EVERYONE SHOULD STAY AT THE FLOOD REFUGE UNTIL THE FLOOD/EMERGENCY WARDEN OR SES HAS DEEMED IT SAFE TO DO SO.

Figure 5.4 Typical Flood Evacuation Signage

5.5 Consultation with Council and SES

The FERP has been prepared as part of future design development for the St Philip's Christian College Cessnock Campus Site in consultation with the following stakeholders:

- SES; and
- Cessnock City Council.

The consultation outcome is to develop a management plan which coordinates with the parties which may be involved during the event of a flood evacuation and implements the most suitable evacuation procedures. The feedback received from SES and Council are included in Annex B and Annex C, respectively, with BMT's responses to the feedback also included in Annex D.

6 Flood Emergency Response Procedure

This section describes some of the specific actions to be undertaken in anticipation of a flood event, as well as actions recommended during and after a flood event.

6.1 Before A Flood

Outlined below are several flood safety actions to be followed by students, staff and visitors on Site in anticipation of a potential flooding event:

- Review and be familiar with the applicable *SES Emergency Business Continuity Plan*.
- Ensure that the plan is up to date.
- Check (or prepare) the contents of the Emergency Flood Kit(s) and ensure that it is at the correct location.
- Identify the needs of vulnerable persons likely to be on-Site during the flood emergency (i.e. elderly, disabled, young children).
- Inspect the property for hazardous substances, furniture, equipment and sensitive belongings, and relocate to another flood free area if possible.
- Check communication devices such as internet connections, mobile phone, landline phone or radio. If a device has become inoperable, identify a suitable alternative (such as a back-up device or using the device of someone else in the building).
- Communicate to all students, parents, staff, and visitors of the premises the requirements of the applicable *SES Emergency Business Continuity Plan*, location of the Emergency Flood Kit, and discuss the risk of flooding to the site, contact/communication methods, and actions to take before, during and after a flood event.
- Ensure that any electrical equipment located below the PMF level is disconnected or isolated from the electricity and gas supplies.

6.2 During a Flood

Outlined below are key flood safety measures to be followed by occupants during a flood or a severe weather event that may lead to flooding.

- Follow the procedures outlined in the applicable *SES Emergency Business Continuity Plan*.
- Locate the Emergency Flood Kit.
- Listen and respond to directions from emergency services or others with a special responsibility.
- Monitor the BoM website, ABC radio broadcasts, local emergency services social media pages, and local news outlets for severe thunderstorm warnings.
- Follow all advice and instructions given by emergency services.
- Ensure all occupants on-Site are informed and in agreement on the evacuation approach.

- Only if safe to do so, turn off all utilities possible and relocate belongings to higher ground above the predicted flood level if possible.
- Monitor local rainfall (in particular the Cessnock Airport gauge), BoM Severe Thunderstorm Warnings and the Black Creek water gauge. If the 20% AEP level is reached commence evacuation proceedings. This should ideally commence prior to the onset of heavy rainfall. If the Black Creek water gauge is approaching the 20% AEP level prior to school commencement and heavy rain is predicted, consider cancelling school.
- Begin contacting students' parents/guardians to request they attend to pick-up children. Contact bus company to arrange evacuation transport to nominated evacuation location.
- Evacuate all students, staff and visitors on Site to the Building B and J carparks for marshalling. All students, staff and visitors are to then be evacuated from this location via private vehicles or emergency evacuation buses. Avoid driving directly through floodwaters wherever possible. Remain at the evacuation location until advised safe to do so by the SES.
- In the event that evacuation does not occur in time, or there are floodwaters present along the evacuation route, or there is a rapid rise in floodwaters on-Site akin to a PMF event, immediately commence shelter-in-place proceedings on the upper floors of the nominated buildings. Note that this is not the recommended option as it presents isolation risks both for occupants and SES personnel, but it is a safer option than attempting to evacuate through potentially hazardous floodwater. If the situation arises where the option is unavoidable, shelter in place until floodwaters have subsided off-Site and are no longer overtopping Wine Country Drive, or until advised safe to do so by the SES.

6.3 After a Flood

Outlined below are a few key flood safety measures to be followed by all occupants after a flood event has occurred:

- Check that electrical power and gas has been isolated to all flood affected areas of the building. If electrical systems or appliances (including items such as hot water systems) have become inundated, these should be inspected by a qualified electrician. Gas appliances and any gas bottles should also be inspected for safety before use.
- Check any flooded areas for safety hazards and structural stability. For example, items may have moved as a result of floodwater. Have flood sensors and alarm system professionally assessed to ensure they are still in working order following event.
- Review evacuation performance during the flood. Identify any areas for improvement and update flood emergency response plan if required.

Further information is provided in the SES "*After a flood*" fact sheet.

7 Conclusion and Recommendations

This report outlines a flood emergency management strategy for the St Philip's Christian College Cessnock Campus Site that has been developed with consideration of the nature of flooding and flood hazard at the Site for events up to the PMF, the proposed building designs and use of the Site, and relevant information contained in applicable floodplain risk management plans.

The development of this FERP has been undertaken in consultation with Cessnock City Council and the NSW State Emergency Services (SES).

A set of flood emergency evacuation measures and requirements have been established for implementation with the redevelopment of the Site. The preliminary strategy presented in this report is based on details available at this stage of the development planning process and provides a suitable basis for further refinement in future stages as more definitive details are developed. In particular, refinements will be required to address the specific needs of the people expected to use the proposed spaces once further design work has been undertaken and the function and occupants of each space is clarified.

The differing nature of flooding at the Site in rare and extreme events means that multiple emergency management strategies must be considered. In rare events, the potential for both long warning times and potential long isolation periods means school evacuation is the best emergency management procedure.

The principal flood emergency management strategy is school evacuation prior to evacuation routes and buildings becoming flooded. It is proposed to install an automatic flood level sensor/s in Black Creek at the north-east part of the school and along the north-east access point to monitor flooding conditions that will be utilised to set trigger levels for the evacuation, as outlined below:

- As the NE entryway (bus turnaround bay) is subject to flooding in the 1 in 2 AEP event, it is proposed to prohibit the use of this entryway when the flood level reaches approximately the 63% AEP (1-year ARI event).
- It is proposed to trigger school evacuation when the flood level reaches the 20% AEP (5-year ARI event). It is proposed to access the site via the north central (NC) access from Lomas Lane and the southern access from Wine Country Drive. School egress will be via the northwest (NW) exit on Lomas Lane servicing the northern set-down area, and the southern exit on Wine Country Drive servicing the southern set-down area.
- It is proposed to prohibit the use of Lomas Lane entry and exit when the flood level reaches the 5% AEP (20-year ARI event). Based on the timeline calculations, there will be approximately 2 hours between the trigger level and the 5% AEP flood level. It is anticipated that school evacuation will be completed prior to this flood level is reached. If required, any further outstanding evacuations could be undertaken via the southern access up to the 0.2% AEP (500-year ARI) flood level, providing an extra 3 and a half hours (over 5 hours total) after closure of the Lomas Lane access and exit ways.

In the unlikely event of an extreme flood (PMF), the potentially rapid rise in floodwater and extremely hazardous conditions along potential evacuation routes means the opportunity for off-site evacuation are limited. It is proposed to utilise the school buildings (that have upper floor levels above the PMF level) as a shelter-in-place refuge.

The following are further considerations to be made beyond this flood emergency strategy report:

- Development of a site-specific FERP incorporating updated information available during the detailed design stage of the development process; and
- Periodic review and revision of FERP after it is finalised and implemented.

8 References

Australian Institute for Disaster Resilience (2017) *Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*.

BMT (2021) *St Philip's Christian College, 10 Lomas Lane, Nulkaba Flood Impact Assessment*.

NSW Government (2005) *NSW Floodplain Development Manual*.

SES (2009) *Cessnock City Local Flood Plan*.

SMEC (2011) *Flood Emergency Response Plan*, St Phillips Christian College Nulkaba Campus

Stantec (2022) *St Philip's Christian College, Cessnock - Transport and Accessibility Impact Assessment*.

Annex A St Philip's Christian College, 10 Lomas Lane, Nulkaba Flood Impact Assessment (BMT, 2021)

St Philip's Christian College, 10 Lomas Lane, Nulkaba

Flood Impact Assessment



St Philip's Christian Education Foundation Ltd
Report
01
16 December 2021

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Executive Summary

BMT Commercial Australia Pty Ltd (BMT) has prepared this flood impact assessment (FIA) report, on behalf of St Philip's Christian Education Foundation Ltd, to support a State Significant Development Application (SSDA) for alterations and additions to the existing school known as St Philip's Christian College (SPCC) Cessnock. The school is located on the corner of Lomas Lane and Wine Country Drive, Nulkaba. The site is bounded by Lomas Lane to the north, a rural property with large open space to the south, Wine Country Drive to the west and Black Creek to the east.

The proposed development, to be constructed in several stages, consists of seven (7) new buildings and additions/alterations to six (6) existing buildings. As part of the development certain existing prefabricated buildings will be removed to make way for new permanent buildings. The proposed development also incorporates infrastructure works external to the site associated with provision of a new intersection on Wine Country Drive providing direct access to the school at the southern end of the campus (immediately south of the proposed aquatic centre), and the upgrade of the intersection of Wine Country Drive and Lomas Lane to a roundabout. Widening of Lomas Lane on the eastern side will also be carried out to facilitate the provision of bus bays and a bus layover area. The SSDA application seeks approval for an increase in student numbers up to 1,732.

The school site is located within the Black Creek floodplain and affected by backwater flooding from the creek. It is therefore necessary to undertake a FIA to assess and ensure that the proposed development will not cause an adverse flood impact beyond the boundaries of the site. This report also included a high-level review and commentary on the flood emergency response plan (FERP) previously prepared by Worley Parsons as part of the 2009 Development Application (DA) submission in relation to the proposed 2021 masterplan.

The flood impact assessment herein utilised the XP-RAFS hydrologic and TUFLOW hydraulic models of the local study area developed previously as part of the SPCC masterplan flood impact assessment undertaken in 2017 (BMT, 2017). Necessary modifications have been incorporated within the TUFLOW model to reflect the latest site information and the proposed development conditions as per the 2021 masterplan.

The detailed flood impact assessment herein includes or demonstrates the following flooding outcomes:

- The pre-development and post-development mainstream flood behaviour, such as peak flood level, depth and flood hazard have been defined for a range of design flood events, including the 20%, 10%, 5%, 2%, 1%, 0.5%, 0.2% AEP and Probable Maximum Flood (PMF) events.
- The existing elevated or developed part of the school (the north western quadrant block) is not inundated during events up to and including the 0.2% AEP (1 in 500 AEP). This part of the school nevertheless is subject to inundation in the PMF event, with a flood depth of up to 1.5m and flood hazard classification of "H4" to "H5" (i.e. unsafe flow conditions for people and vehicles).
- The existing main access point (easternmost access) from Lomas Lane is subject to inundation during the 1 in 5 AEP flood event. However, the central and western access points to the northern carpark from Lomas Lane are either flood-free or trafficable during flood events up to and including the 1 in 20 AEP events.

- Lomas Lane is subject to inundation and not trafficable during rare flood events up to and including the 1 in 50 AEP flood event. However, the northern carpark is elevated and flood-free for flood events up to and including the 1 in 200 AEP.
- The proposed internal road along Wine Country Drive (north-south alignment) leading to the new access point via Wine Country Drive on the southern side is predicted to be flood-free during flood events up to and including the 1 in 500 AEP.
- The proposed development will not result in an adverse increase in peak flood level beyond the boundaries of the site for events up to and including the 1 in 20 AEP (i.e., the afflux is within 20mm which is considered minor and acceptable). For events larger in magnitude than the 1 in 20 AEP, the proposed development has been predicted to result in increases in peak flood level greater than 20mm beyond the boundaries of the site. However, the exceedance above the 20mm threshold is marginal. During the PMF event, the proposed development is predicted to result in a maximum off-site afflux of 140mm predominately to the east of Black Creek. However, more importantly, the proposed development is not predicted to significantly alter the flood hazard level (classification) in the areas impacted. However, more importantly, the proposed development is not predicted to increase the flood hazard level in the areas impacted and surrounding roads. Hence, as the proposed development will not result in a change in the peak flood hazard level beyond the boundaries of the site, it is considered that the development does not significantly alter existing flood risks in the PMF event.
- A sensitivity testing has been conducted based on a 20% increase in the peak flows on the 1% AEP event, and this demonstrated that the 1% AEP peak flood levels would increase by 0.3m within the site.
- A review of Cessnock City Council's flood mapping indicates that Wine Country Drive leading to Cessnock is flood-free during the 1% AEP event, except at the intersection with Fleming Street. During the PMF event, Wine Country Drive is inundated for the section between SPCC and Cessnock.
- The FERP for the proposed development site consists of onsite refuge located above the PMF level based on the approved FERP prepared by Worley Parsons (2009). The review indicates that the FERP needs to be updated at a detailed design phase or prior to construction works to ensure that the plan is fit for the amended development masterplan.
- Overall, based on the flood impact assessment herein, the proposed development is not anticipated to cause adverse social and economic impacts associated with flooding.

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1 Introduction

1.1 Overview

BMT Commercial Australia Pty Ltd (BMT) has prepared this flood impact assessment (FIA) report, on behalf of St Philip's Christian Education Foundation Ltd, to support a State Significant Development Application (SSDA) for alterations and additions to the existing school known as St Philip's Christian College (SPCC) Cessnock. The school caters for students from Kindergarten to Year 12, and also incorporates an Early Education Centre and Preparation program as well as a special school for students requiring an alternate learning environment. The school has a current enrolment of approximately 1,470 students in total.

The school is located on the corner of Lomas Lane and Wine Country Drive, Nulkaba and its land holdings incorporate four large lots described as Lot 1 DP 126765, Lot 1 DP 744377, Lot 2 DP 600895 and Lot 518 DP 837571. The site is irregular in shape and has an overall area of 41.8 hectares. The northern boundary of the site has frontage to Lomas Lane of approximately 390 metres and its western boundary fronts Wine Country Drive with a length of approximately 1,030 metres. The eastern boundary of the site is bounded by Black Creek.

The school site is located within the Black Creek floodplain and affected by backwater flooding from the creek. It is therefore necessary to undertake a FIA to assess and ensure that the proposed development will not cause an adverse flood impact beyond the boundaries of the site.

1.2 Background

In 2009, Cessnock City Council ("Council") granted a development consent to develop the site as per the approved "SPCC Flood Impact Assessment" (Worley Parsons, 2009). It is understood that the cut and fill work as approved in the 2009 masterplan have been completed on the site, as such these works will form the baseline conditions at the site against which impacts of the proposed development will be assessed.

BMT subsequently completed the "St Philip's Christian College Cessnock Flood Impact Assessment" (BMT, 2017) to assess the flooding impacts of the revised 2017 masterplan design as part of a Development Application (DA) with Council. It is understood that the DA for the 2017 masterplan did not proceed.

A revised 2021 masterplan has now been completed for which an approval is being sought through the SSDA pathway. The SSDA requires an Environmental Impact Statements (EIS) that includes, amongst others, a flood impact assessment to address the Secretary's Environmental Assessment Requirements (SEARs).

1.3 SEARs and Scope of Assessment

This FIA will address Item 17 (Flooding) of the project SEARs (Application No. SSD-10360337). The specific requirements under Item 17 include the following:

- Identify any flood risk on-site in consultation with Council and having regard to the most recent flood studies for the project area and the potential effects of climate change, sea level rise and an increase in rainfall intensity.
- Assess the impacts of the development, including any changes to flood risk onsite or off-site, and detail design solutions to mitigate flood risk where required.

To address the above-stated SEARs, a detailed flood modelling has been undertaken in accordance with the NSW Floodplain Development Manual (DIPNR, 2005). The modelling and flood impact assessment herein utilised the hydrologic and hydraulic models developed as part of the BMT (2017) FIA. This report also included a high-level review and commentary on the flood emergency response plan (FERP) previously prepared by Worley Parsons as part of the 2009 DA submission in relation to the proposed 2021 masterplan.

1.4 Outline of Report

Section 2 provides description of the existing and development site conditions.

Section 3 describes the data collation process and review of available data.

Section 4 details the development and validation of the hydraulic model.

Section 5 provides the design flood modelling results, incorporating flood mapping.

Section 6 provides a high-level review and commentary on the FERP previously prepared as part of the 2009 DA submission.

Section 7 presents the conclusions of the study.

2 Description of Development Site

2.1 Existing Conditions

The locality of the site is shown in Figure 2.1. The site is situated between Black Creek and Wine Country Drive, on the southern side of Lomas Lane. The eastern boundary of the site is aligned with the Black Creek channel. The Lomas Lane forms the northern site boundary.

The Black Creek catchment area upstream of Lomas Lane is in the order of 84km² and the Creek is joined by Pokolbin Creek around 1km downstream of the site which provides an additional 35km² of contributing catchment area. Local topography in the vicinity of the site, as defined by the available topographic data, is shown in Figure 2.2. The floodplain slopes at a grade of approximately 0.4%, with typical elevations in the order of 56.0m AHD to 59.5m AHD. The Black Creek channel reach along the upstream, eastern site boundary has perched banks, elevated around 0.5m above the adjacent floodplain.

The existing development of the St Philip's campus largely sits within the north western quadrant of the block and is elevated out of the floodplain at over 58.0m AHD (as depicted in Figure 2.2). A landscaped earthen mound has been constructed on the western edge of the fill platform adjacent to the Wine Country Drive road reserve. Survey data available for the site shows that the crest of the mound ranges from around 60.3m AHD to 61.0m AHD. The floodplain between the fill platform and the Black Creek channel lies at around 57.2m AHD to 56.0m AHD.

The Black Creek floodplain in the vicinity of the site is relatively flat, containing several remnant channels and ponds – the most significant being a tight meander upstream of the site which has since been by-passed. A small bridge provides for the passage of Black Creek underneath Lomas Lane.

2.1.1 Existing Access Arrangement

The school has three access points via Lomas Lane (i.e. eastern, central, and western) as shown in Figure 2.3. The functions of the access points are described below.

- The easternmost access functions as a turning bay for buses; and access for service vehicles needing to access the northern part of the site and/or eastern service road.
- The central access currently functions as a vehicle entry point for cars accessing the northern carpark/kiss and drop areas.
- The western access functions as a vehicle-exit point.

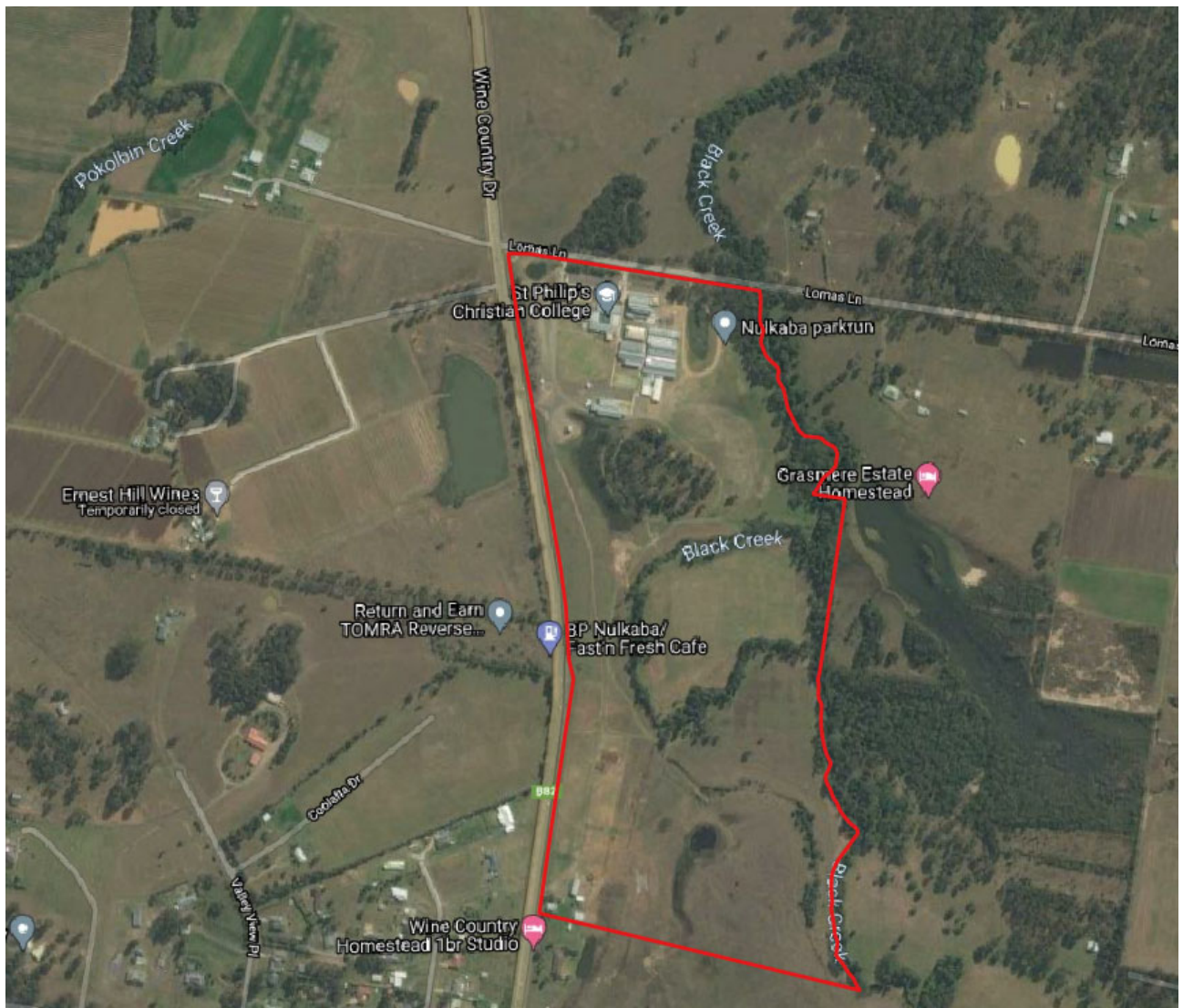


Figure 2.1 Site Locality Map

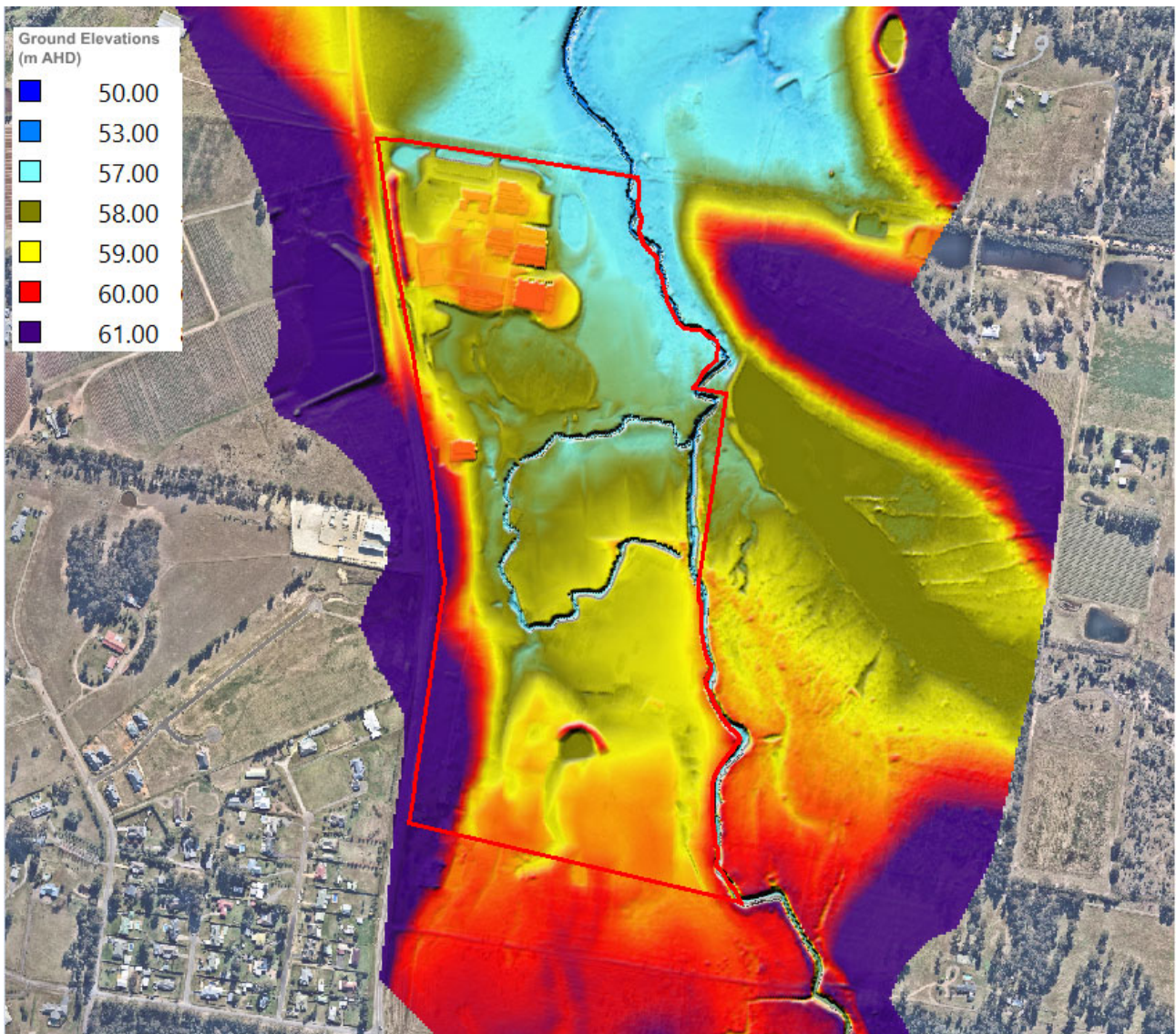


Figure 2.2 Existing Topography



Figure 2.3 Existing Access Points from Lomas Lane

2.2 Proposed Conditions

The proposed development, to be constructed in several stages, consists of seven (7) new buildings and additions/alterations to six (6) existing buildings. As part of the development certain existing prefabricated buildings will be removed to make way for new permanent buildings.

The proposed development also incorporates infrastructure works external to the site associated with provision of a new intersection on Wine Country Drive providing direct access to the school at the southern end of the campus (immediately south of the proposed aquatic centre), and the upgrade of the intersection of Wine Country Drive and Lomas Lane to a roundabout. Widening of Lomas Lane on the eastern side will also be carried out to facilitate the provision of bus bays and a bus layover area. The SSDA application seeks approval for an increase in student numbers by up to 1,732. Figure 2.4 shows the 2021 masterplan development layout. Annex A also contains the masterplan layout.

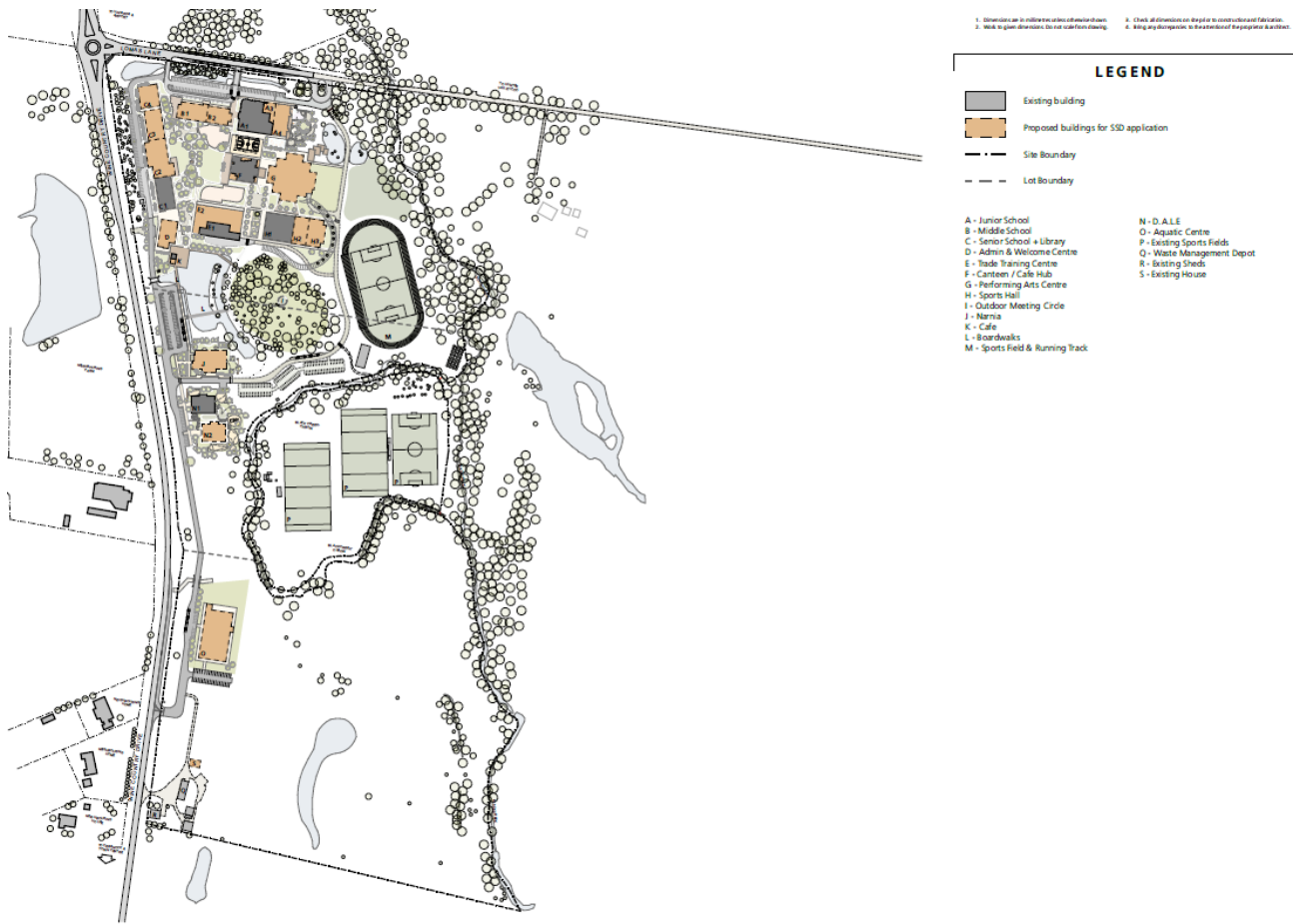


Figure 2.4 2021 Masterplan Development Layout

3 Review of Background Materials

This section provides a review of Cessnock City Council flood-related development controls and previous studies that have been considered and/or used in the preparation this flood impact assessment.

3.1 Council Development Control Plan

The Cessnock Development Control Plan (DCP) 2010 is Council's document used to guide and regulate developments. Chapter 9 of the DCP: Development on Flood Prone Land deals with developments within floodplains. The following sections provide a summary of the flooding aspects that have been considered in the preparation of this flood impact assessment. It is however noted that this is not an exhaustive review (nor a compliance assessment against the DCP), as the State Environmental Planning Policy (Educational Establishments and Childcare Centres) 2017 provides that a provision of a development control plan that specifies a requirement, standard or control in relation to development for the purpose of a school is of no effect, regardless of when the development control plan was made.

3.1.1 Objectives of the Chapter

The main objectives of Chapter 9 of the DCP include:

- Reduce risk to life and property resulting from floods by controlling development on flood prone land.
- Ensure that the impacts of the full range of flood sizes up to and including the Probable Maximum Flood (PMF) are considered when assessing development on flood prone land.
- Ensure that developers and the community are conscious of the potential flood hazard and consequent risk associated with the use and development of land within the floodplain.
- Ensure that all land uses, and essential services are appropriately sited and designed in recognition of all potential floods.
- Ensure that sensitive uses and facilities and critical infrastructure are not impacted by flood events.
- Ensure the future use of flood prone land does not cause undue stress to individuals or unduly increases potential flood liability to individuals or the community.
- Ensure that development on flood prone land does not place an unacceptable financial burden on landowners or the community.
- Ensure that development does not have a significant impact on flood behaviour, people's safety, surrounding properties and structures, and the natural environment.
- Protect the integrity of the flood plain, including riparian vegetation, fluvial geomorphologic environmental processes, and water quality.
- Ensure that the impact of climate change is considered when assessing development on flood prone land.

- Ensure that development on flood prone land is consistent with the NSW Flood Prone Land Policy and NSW Floodplain Development Manual 2005.

3.1.2 Council Flood Hazard and Risk Classification System

Hazard classification is to be based on the Australian Rainfall and Runoff Guidelines (ARR 2016) using the “H1” to “H6” classification system, with “H1” being the lowest hazard classification and “H6” being the highest. Based on Chapter 9 of the DCP, the hazard classification relates to the 1% AEP event except for critical infrastructure which is related to the PMF event. It notes that the following additional factors should be taken into consideration when locating and designing development:

- Isolation: are there safe evacuation routes to flood free land?
- Effective warning time: lack of effective warning times can increase the exposure of people to hazard.
- Rate of rise – a rapid rise in flood waters can lead to people evacuating being cut off from safe refuge or being overwhelmed.

3.2 Council Flood Mapping

Council has an online GIS database that contains different types of flood maps. The relevant flood inundation extents have been extracted for the 1% AEP and PMF events, hydraulic categorisation (flood function) for the 1% AEP event as well as the flood planning area (FPA). These are shown in Figure 3.1 to Figure 3.4.

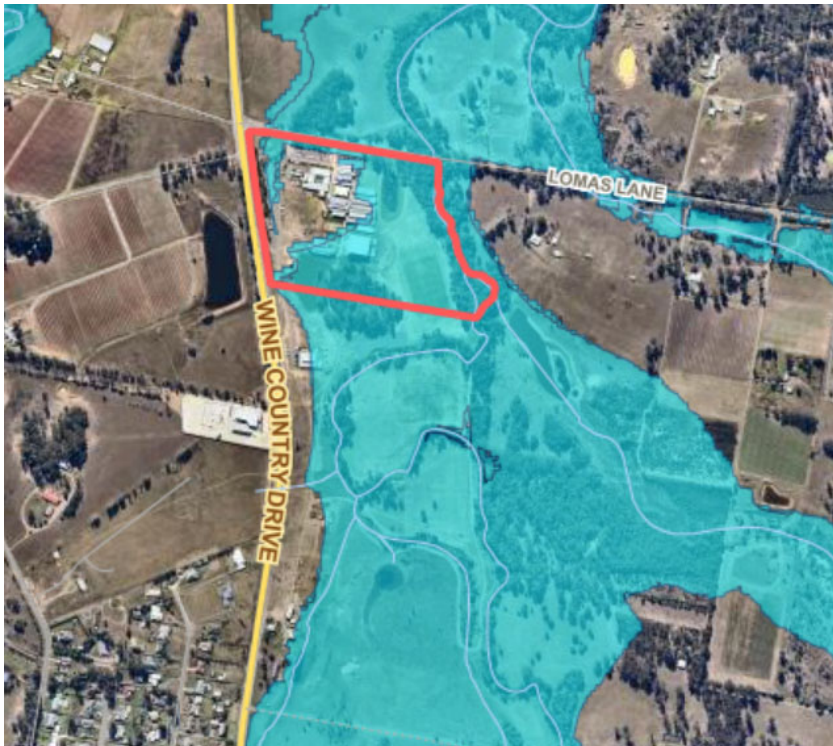


Figure 3.1 Council 1% AEP Inundation Extent

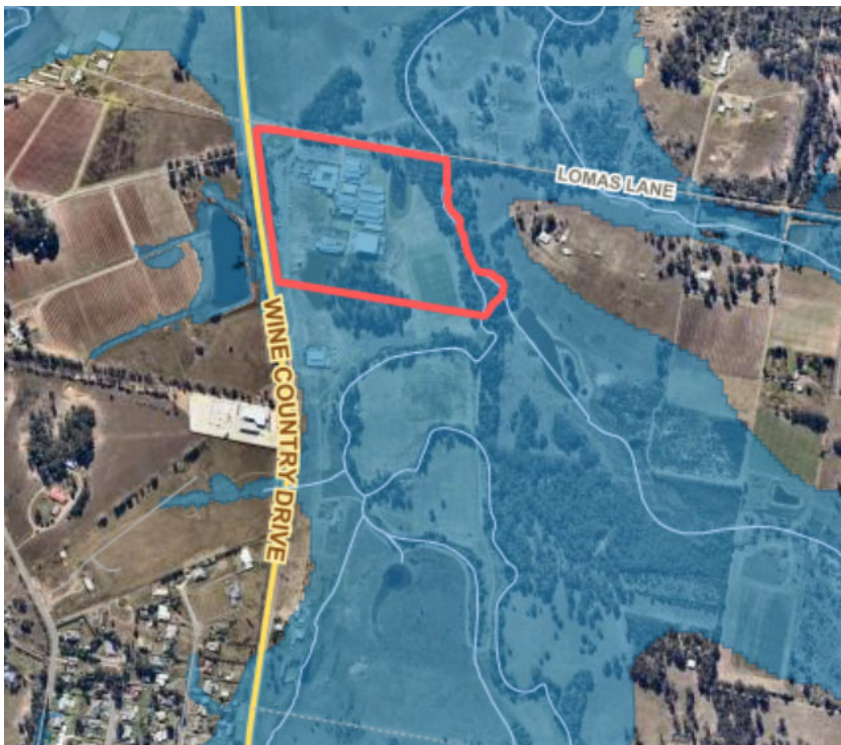


Figure 3.2 Council PMF Inundation Extent

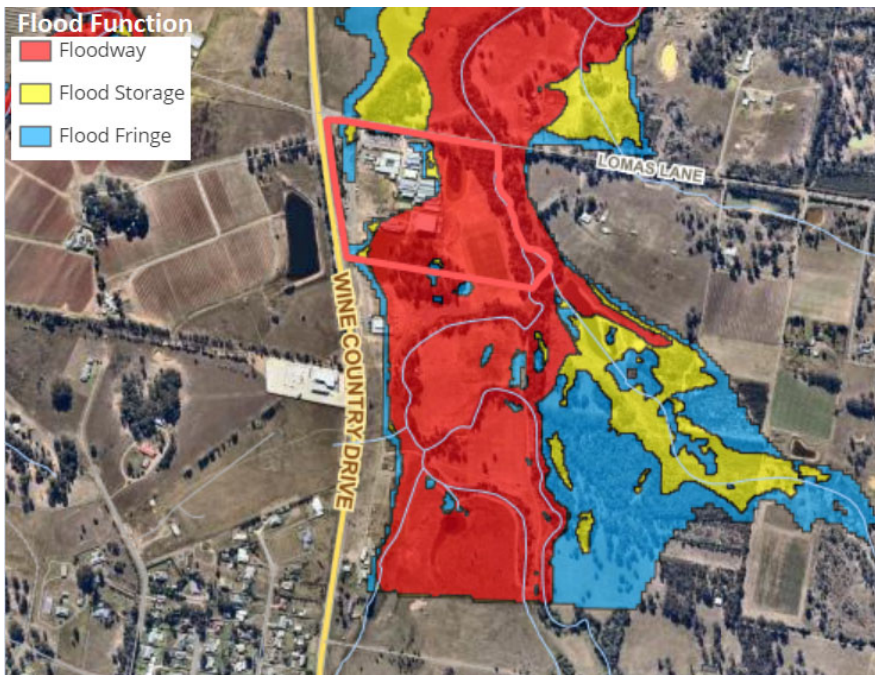


Figure 3.3 Council Black Creek Stage 2 1% AEP Flood Function



Figure 3.4 Council Flood Planning Area

3.3 Previous Studies

Several flood studies encompassing the study site have previously been undertaken and reviewed herein. Key model development details from each study are summarised as follows.

3.3.1 Black Creek Flood Study (DHI, 2010)

The “Black Creek Flood Study” (DHI, 2010) centres on the Cessnock CBD and covers the catchment area draining into Black Creek, upstream of Lovedale Road Bridge (Bancroft’s Bridge). The study developed an XP-RAFTS hydrologic model of the Black Creek catchment to Lomas Lane. The study found that the 9-hour storm was the critical duration for most of the area upstream of Fleming Street. The hydrologic model did not include Pokolbin Creek, as it is located outside of the study area.

The study utilised the MIKEFLOOD hydraulic modelling software package to define the flood behaviour for the upper Black Creek reaches. The MIKEFLOOD model couples MIKE-11 (1D (one-dimensional) representation of main channels) with MIKE-21 (2D (two-dimensional) overland flow modelling of the urban floodplain area of Cessnock). The area of interest for this study (i.e., between Fleming Street and Lovedale Road) was represented in the 1D model domain. The hydraulic model was calibrated to the June 2007 historical event, where the peak flood levels at Lomas Lane were predicted to be in the order of 58.8m AHD.

3.3.2 Black Creek Flood Study Stage 2 (WMAwater, 2015)

The “Black Creek Flood Study Stage 2” (WMAwater, 2015) focused on the reach of Black Creek downstream of Lomas Lane to Branxton. It included inflows from many tributaries including Pokolbin Creek. The study utilised the WBNM hydrologic modelling package to calculate inflows for the tributaries (including Pokolbin Creek) and the local Black Creek catchment within the study area as these were not available from the DHI (2010) study. The upstream model inflow at Lomas Lane was extracted from the DHI (2010) study.

The hydraulic model consisted of a fully 2D TUFLOW model of the entire study area. A 2D grid size of 10m was adopted. Modelled peak flood levels at Bancroft Bridge were 56.6m AHD for the 1% AEP and June 2007 historical event.

3.3.3 Black Creek FRMSP (Cardno, 2015)

The “Black Creek Floodplain Risk Management Study and Plan” (FRMSP) (Cardno, 2015) considers the same area included in the Black Creek Flood Study (DHI, 2010), i.e. the Black Creek catchment area upstream of Bancroft’s Bridge. The hydrologic model setup was as per the DHI (2010) study. The hydraulic model was similar to the DHI (2010) study, but the 2D area of the MIKEFLOOD model developed was extended to include LiDAR survey data captured in 2011. The updated model was validated against the June 2007 historical event to ensure consistency between the two models.

3.3.4 Approved SPCC Flood Impact Assessment (Worley Parsons, 2009)

The SPCC flood impact assessment undertaken by Worley Parsons (2009) was completed to support the DA for the original campus development proposal. This DA (including the flood impact assessment) has been approved by Council.

The study applied the flow hydrographs at Lomas Lane determined by DHI (2010) as the upstream model inflow boundary. A climate change assessment was included in the study which considered a

20% increase in flow rates. As the DHI (2010) XP-RAFTS model did not include Pokolbin Creek, an estimate of the 1% AEP peak flow rate at the Wine Country Drive Bridge was made based on relative catchment areas, providing an additional 120m³/s at the confluence of Black and Pokolbin Creeks.

A 1D HEC-RAS hydraulic model was developed for the area, extending from Fleming Street to Bancroft's Bridge (Lovedale Road). Peak flood levels from the 1% AEP design event including climate change were recommended as the final 1% AEP levels to assist in planning at the site. Modelled 1% AEP design peak flood levels upstream of Lomas Lane were in the order of 58.3m AHD.

3.3.5 SPCC Flood Impact Assessment (BMT, 2017)

BMT previously completed the "St Philip's Christian College, Cessnock Flood Impact Assessment" (BMT, 2017). This FIA developed an XP-RAFTS hydrologic and TUFLOW hydraulic model of the Black Creek covering the area between Fleming Street (upstream model extent) and 275m downstream of Lovedale Road bridge (downstream model extent). The BMT (2017) assessment defined the baseline flood behaviour based on the 2009 approved development conditions.

For the study herein, the XP-RAFTS model from the BMT (2017) assessment has been used (without modifications), while the TUFLOW model has been modified to incorporate the latest site survey information (including drainage structures) and representation of the existing school buildings, as detailed in the following sections.

4 Development of Models

4.1 Hydrologic Model

A hydrologic model converts the gross rainfall (falling on a catchment) into effective rainfall, and then into runoff/streamflow and predicts the attenuation of the streamflow as it travels down the catchment. This hydrologic process is dependent on several factors, such as catchment area and level of urbanisation; rainfall intensity and its temporal pattern and spatial distribution; and antecedent conditions of the catchment (rainfall losses).

The hydrologic model of the study area has been developed as part of the BMT (2017) assessment using the XP-RAFTS software. The following sections describe the key model inputs and hydrologic parameters used in the XP-RAFTS model in accordance with the Australian Rainfall and Runoff 1987 (AR&R 87) guideline. It is noted that for the FIA herein, the XP-RAFTS model from the BMT (2017) assessment has been used without modifications.

4.1.1 Catchment Characteristics

The combined Black Creek and Pokolbin Creek catchment was delineated into thirty-five sub-catchments based on available digital elevation model (DEM) derived from LiDAR survey. Figure 4.1 shows the sub-catchment layout used in the XP-RAFTS model.

Each sub-catchment was modelled as two discrete areas (impervious and pervious) to reflect the level of urbanisation. Predominately urbanised sub-catchments were assumed to be 55% impervious and 45% pervious, while undeveloped sub-catchments were assumed to be 100% pervious (in other words, no impervious areas).

The sub-catchments were assigned with appropriate Manning's 'n' (PERN) values depending on the level of urbanisation, as listed in Table 4.1.

Table 4.1 PERN Values

Catchment Condition	PERN Value
Urban Areas	0.04
Cleared Land	0.06
Densely Vegetated	0.12

4.1.2 Rainfall Loss

The hydrologic analysis implemented the initial-continuing loss approach which is an accepted industry practice. The ARR1987 recommends an initial loss (IL) of 10mm and continuing loss (CL) of 2.5mm/hr for the NSW East Coast area, and hence these have been adopted.

4.1.3 Streamflow Routing

The sub-catchment inflows were routed through the next downstream sub-catchments in a cascading manner using the “Lag time” approach. The Lag times were calculated for each reach using an average velocity of 0.5m/s.

4.1.4 Rainfall Intensity and Temporal Pattern

Rainfall depths are usually determined from standard design rainfall intensity-frequency-duration (IFD) curve for a given locality or catchment for events up to and including the 0.2% AEP. Table 4.2 presents the relevant design rainfall intensities (mm/hr) for the study area for a range of annual exceedance probability (AEP) events.

In terms of temporal distribution of the rainfall, this study used the design temporal pattern Zone 1 for design events up to and including the 0.2% AEP.

For the Probable Maximum Flood (PMF) event, the rainfall depths and temporal pattern were defined in accordance with the Generalised Short Duration Method (GSDM) (Bureau of Meteorology, 2003).

Table 4.2 Average Rainfall Intensity

Durations	10% AEP	5% AEP	2% AEP	1% AEP
6	12.5	14.5	17.2	19.2
9	9.70	11.4	13.3	15.2
12	8.16	9.53	11.3	12.8
24	5.34	6.23	7.42	8.35
36	4.15	4.80	5.70	6.40
48	3.43	3.98	4.72	5.29

4.1.5 Critical Durations and Calculated Peak Flows

A range of storm durations were simulated with the XP-RAPTS software and it was found that the 36-hour rainfall event resulted in the critical flow condition at the site for events up to and including the 0.2% AEP events. For the PMF event, the 6-hour storm was found to be critical for the catchment.

The predicted peak discharge rates upstream of Lomas Lane, derived from the XP-RAPTS model, are presented in Table 4.3.

Table 4.3 Predicted Peak Discharge Rates Upstream of Lomas Lane

Peak Discharge Rates (m ³ /s)							
20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	0.2% AEP	PMF
122	154	196	238	281	324	385	1780

4.1.6 Validation of Hydrologic Model Predictions

The predicted peak discharge rates herein have been compared to those adopted in previous studies, as presented in Table 4.4. With reference to these results, the 1% AEP flow rate calculated at Lomas lane in this current study is within 15% of that adopted by WMAwater (2105), verifying that the XP-RAFTS hydrological model developed for this study is broadly consistent with that adopted in the Council's flood study.

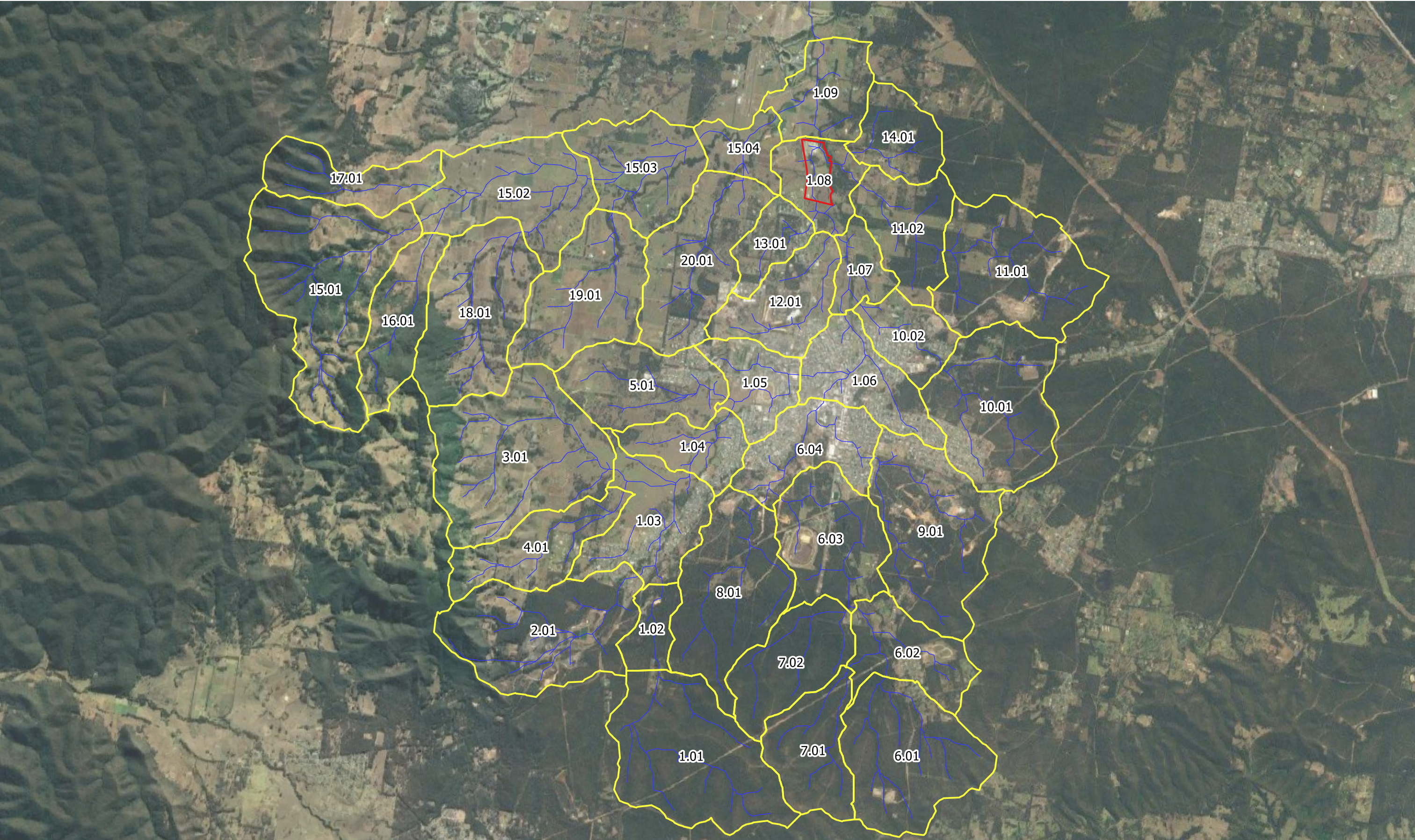
The peak PMF flow rates have also been compared between studies and are presented in Table 4.5. The PMF flow adopted for Worley Parsons (2009) was provided by DHI and is significantly lower than the flow determined by WMAwater (2015) and that derived for this current study. The PMF flow rate calculated for this study is within the range (and closer to the upper limit) of flows determined by the previous studies.

Table 4.4 Comparison of the 1% AEP Peak Discharge Rates at Lomas Lane

Study	Peak Flow (m ³ /s)	Critical Duration (min)
DHI (2010)	318	9h
WMAwater (2015)	325	36h
Worley Parsons (2009)	382	9h
This Assessment	281	36h

Table 4.5 Comparison of PMF Peak Discharge Rates at Lomas Lane

Study	Peak Flow (m ³ /s)	Critical Duration (min)
DHI (2010)	1180	6h
WMAwater (2015)	2130	6h
Worley Parsons (2009)	910	6h
This Assessment	1780	6h

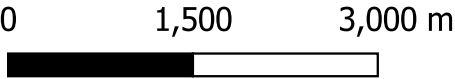


Legend

- Site Boundary
- Sub-Catchment
- Streams

Title:
XP-RAFTS Sub-catchment Layout

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



Drawing:
4-1

Rev:
A



4.2 Hydraulic Model

A 2D model of Black Creek (containing the subject site) has been developed using the TUFLOW software package (Build 2018-03-AC-iSP) as per the BMT (2017) assessment. The key components of the hydraulic model setup are described in the following sections.

4.2.1 Model Extent and Topography

The 2D domain covers the area between Fleming Street (upstream model extent) and 275m downstream of Lovedale Road bridge (downstream model extent), as shown in Figure 4.2.

The 2D domain adopted a cell size of 4m to provide an accurate definition of the floodplain, including local topographical features. The underlying model DEM has been generated from a combination of a 1m resolution DEM derived from the 2011 LPI LiDAR elevation dataset and a more recent site survey completed by Marshall Scott Surveying and Land Development Consultants (Drawing Reference: 22972-DET.dwg, dated 23/07/2021).

4.2.2 Boundary Conditions

Upstream boundary conditions of the hydraulic model have been defined as inflows along Black Creek and Pokolbin Creek. Local sub-catchment inflows were also applied within the model domain within the subject site.

The downstream boundary was defined by a water level-discharge relationship, where discharge estimates for a range of water levels are determined based on the channel cross-section and geometry of the Lovedale Road bridge.

4.2.3 Structures

The model included the following structures:

- Existing bridges under Lomas Lane and Lovedale Road crossings of Black Creek and Wine Country Drive crossing of Pokolbin Creek. These were represented within the model as a 2D layered flow constriction.
- Existing cross drainages within the site and underneath Wine Country Drive on the western boundary of the site. These were represented as 1D structures embedded within the 2D domain with a dynamic linkage between the two (1D and 2D) domains.

4.2.4 Hydraulic Roughness Parameters

Another input required in the development of the TUFLOW model is the assignment of different hydraulic roughness zones to represent the variation in flow resistance. The Manning's 'n' roughness values adopted for this study are listed in Table 4.6.

Table 4.6 Adopted Hydraulic Roughness Parameters

Surface Condition	Manning's 'n' Value
Cleared Land	0.06
Creeks	0.08
Dense Vegetation	0.12
Road Reserve and Paved Areas	0.02
Existing Buildings within the Site	0.40
Well Maintained Grass	0.035

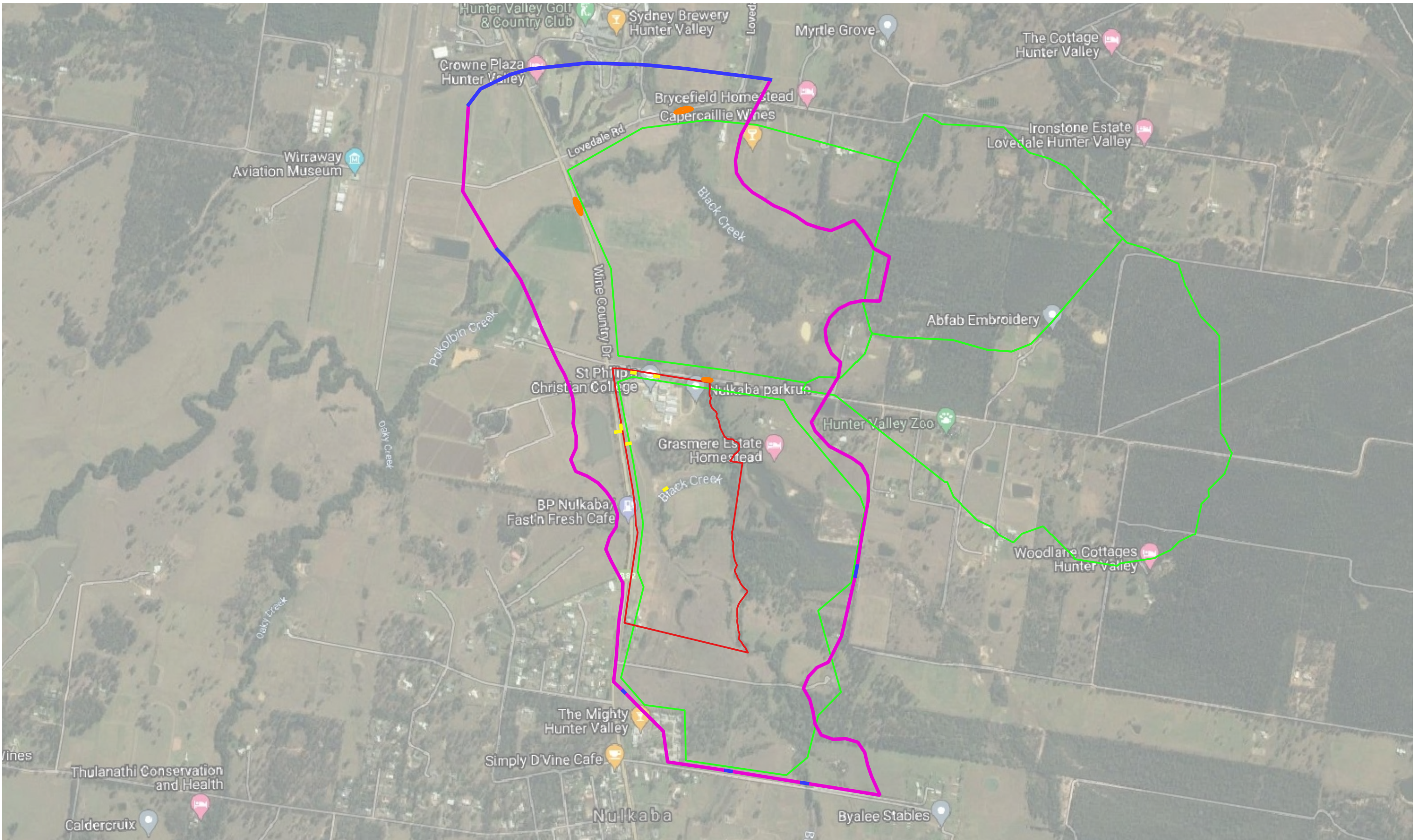
4.2.5 Validation of Base Case Hydraulic Model Performance

Peak flood levels at two locations, namely upstream of Lomas Lane (US LL) and upstream of Bancroft's Bridge (US BB) have been extracted and compared, as presented in Table 4.7. Evidently, there is a considerable discrepancy between the modelled peak flood levels between each of the studies, especially when considering the reduced upstream inflow adopted for this current study. The difference in peak flood levels is most likely a function of the different hydraulic models used and the adopted model parameters, such as Manning's roughness values. It is noted that this study did not involve calibration of the hydraulic model using the Manning's roughness values.

For some historical context, during the April 2015 event, a peak water level mark was recorded 300mm under the existing school building at the SPCC site, located on the eastern side of the fill platform. From available LiDAR information, this level is estimated to be around 58.0m AHD. The WMAwater (2015) study estimated that the 2015 historical event rainfall was in the order of 5% AEP to 2% AEP, when compared to the Bureau of Meteorology (BoM) IFD data. Under the existing scenario (i.e. the site topography in the model is representative of what is currently on the ground), peak flood levels modelled at the flood mark location in this study were 58.0m AHD and 58.2m AHD for the 5% AEP and 2% AEP, respectively. This demonstrates that the models developed for this study provide a reasonable consistency with the observed historical flood conditions at the site.

Table 4.7 Comparison of Base Case TUFLOW Model Performance

Study	1% AEP Event		PMF Event	
	US LL	US BB	US LS	US BB
DHI (2010)	-	-	-	-
WMAwater (2015)	57.6	56.6	60.3	59.0
Worley Parsons (2009)	58.3	57.5	59.4	58.8
This Assessment	58.3	57.0	60.8	59.7



Legend Existing Culvert Existing Bridge Site Boundary Boundary Conditions 2D Domain Local Inflows		Title: Base Case TUFLOW Layout		Drawing: 4-2	Rev: A
		BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.	0300600 m	BMT www.bmt.org	
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4.2.6 Modelling of Proposed Development

The proposed development will involve filling associated with the proposed new buildings and alterations to existing buildings. It also involves filling associated with the proposed internal roads, including a new access from Wine Country Drive on southern end of the site (immediately south of the proposed aquatic centre). BMT iteratively optimised the proposed fill extent and levels within the TUFLOW model in coordination with Northrop Consulting Engineers (civil designers for the site). The design has been optimised to achieve the following design criteria:

- The building fill levels are based on the height of the 1% AEP peak flood level + 0.5m freeboard.
- The internal road levels are based on the height of the 1% AEP peak flood level.
- The fill extents do not result in an adverse flood impact beyond the boundaries of the site.

Northrop provided the design DEM (Reference: XP_NL167397_DESIGN_DTM.dwg) dated 26 October 2021. Figure 4.3 shows the extent and levels of the proposed site grading (fill). Figure 4.4 shows the topography difference (post-development minus pre-development) derived from the modelled DEM output check file.

To represent the flow-obstruction effects of the proposed new buildings during larger flood events (greater in magnitude than the 1% AEP events), a Manning's 'n' value of 0.4 was assigned to the buildings.

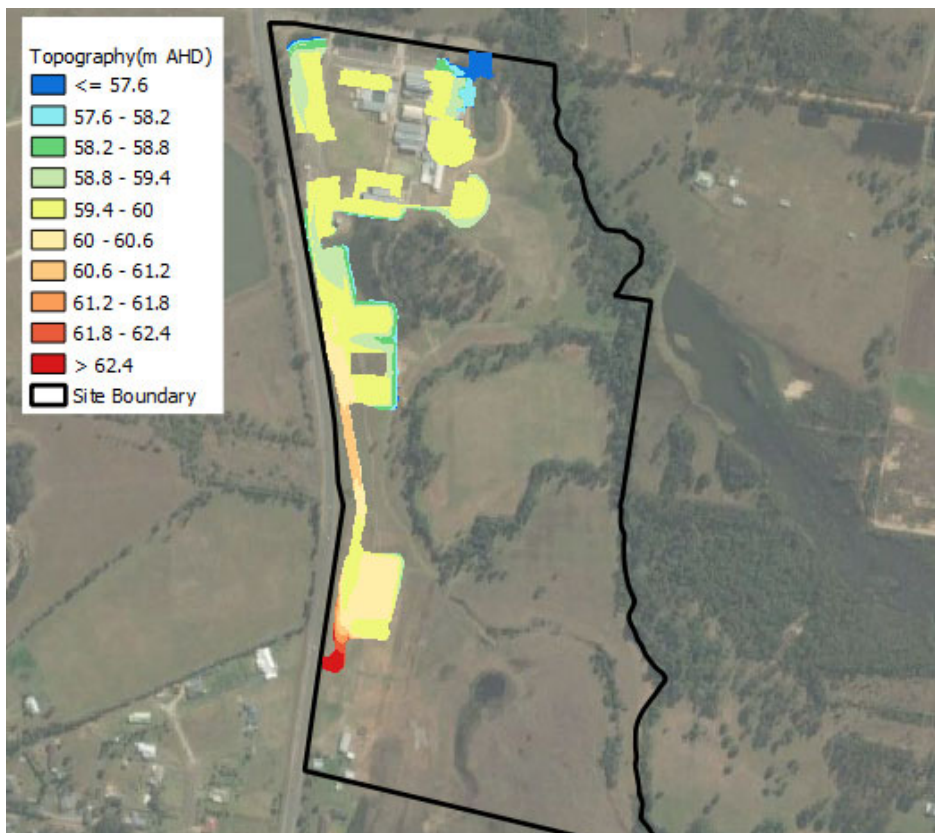


Figure 4.3 Proposed Site Grading Elevations

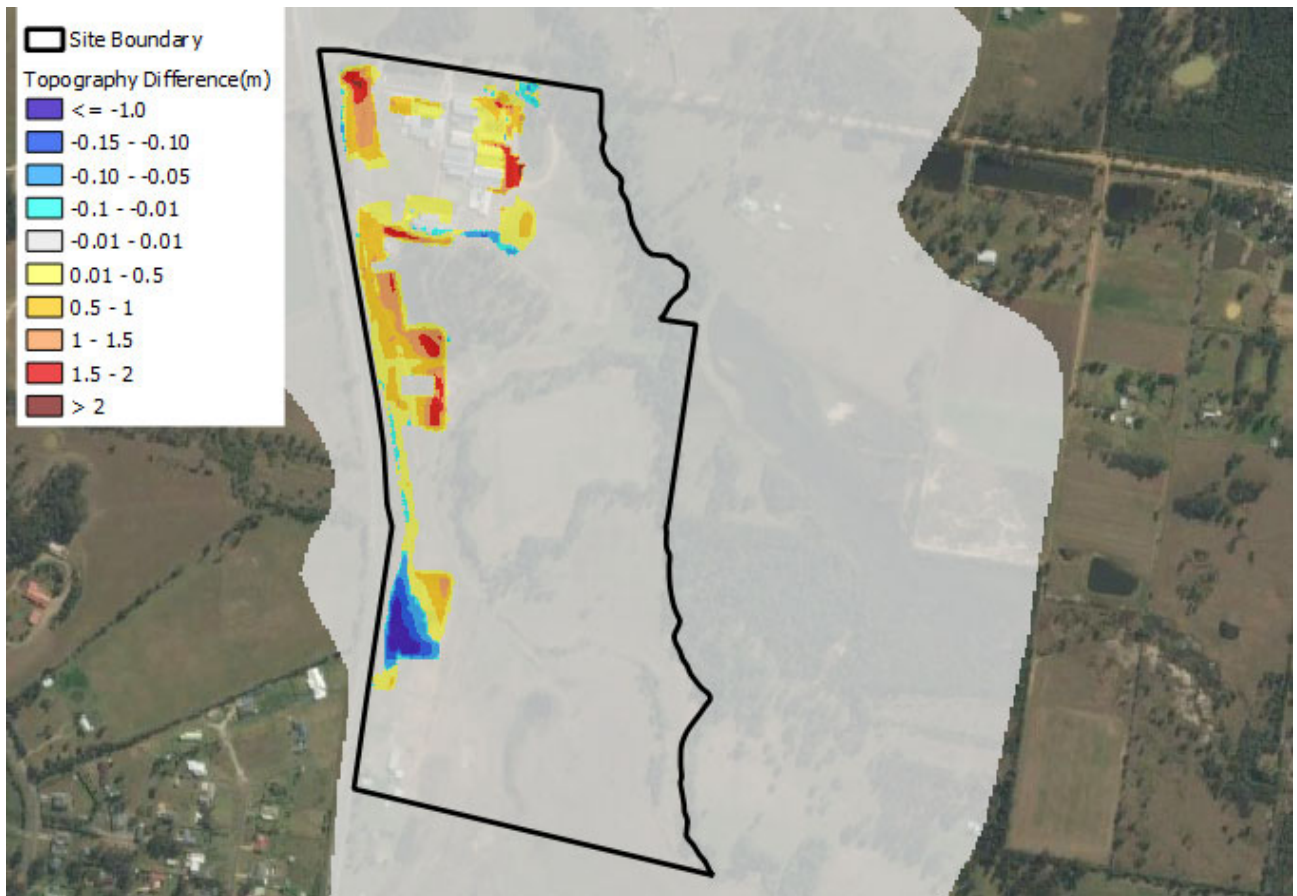


Figure 4.4 Topography Difference Between Post-Development and Pre-development Scenarios

5 Hydraulic Model Results

5.1 Pre-development Flood Behaviour

The predicted pre-development (baseline) flood behaviour, including peak flood level, flood depth and flood hazard classification) have been extracted from the TUFLOW model results and mapped for a range of flood including the 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2% AEP and PMF events. These are contained in Annex B, as listed below.

- Figure B-1 to B-8 show the pre-development peak flood level maps.
- Figure B-9 to B-16 show the pre-development peak flood depth maps.
- Figure B-17 to B-24 show the pre-development peak flood hazard classification maps.

Based on the pre-development modelling results, the following key flooding conditions are observed in and around the subject site.

- The existing elevated or developed part of the school (the north western quadrant block) for the most part is not inundated during events up to and including the 0.2% AEP (1 in 500 AEP). This part of the school is subject to inundation in the PMF event, with a flood depth of up to 1.5m and flood hazard classification of “H4” to “H5”, i.e., unsafe flow conditions for people and vehicles. Figure 5.1 Refer to the Australian Institute of Disaster Resilience (AIDR) Hazard classification system.
- The existing main access point (easternmost access) from Lomas Lane is subject to inundation in the 20% AEP (1 in 5 AEP) event with a peak flood depth up to 0.4m, as shown in Figure 5.2. However, the central and western access points to the northern carpark from Lomas Lane are either flood-free or trafficable during flood events up to and including the 5% AEP (1 in 20 AEP) events.
- Lomas Lane is subject to inundation and not trafficable during rare flood events including the 2% AEP (1 in 50 AEP). However, the northern carpark is elevated and flood-free for flood events up to and including the 0.5% AEP (1 in 200 AEP).
- The road alignment of the proposed exit from the northern carpark to the southern part of the school (immediately south of the existing western dam) is subject to inundation (and not trafficable) during flood events including the 10% AEP (1 in 10 AEP). Figure 5.3 shows this proposed alignment overlaid on the 1% AEP peak flood depth map.

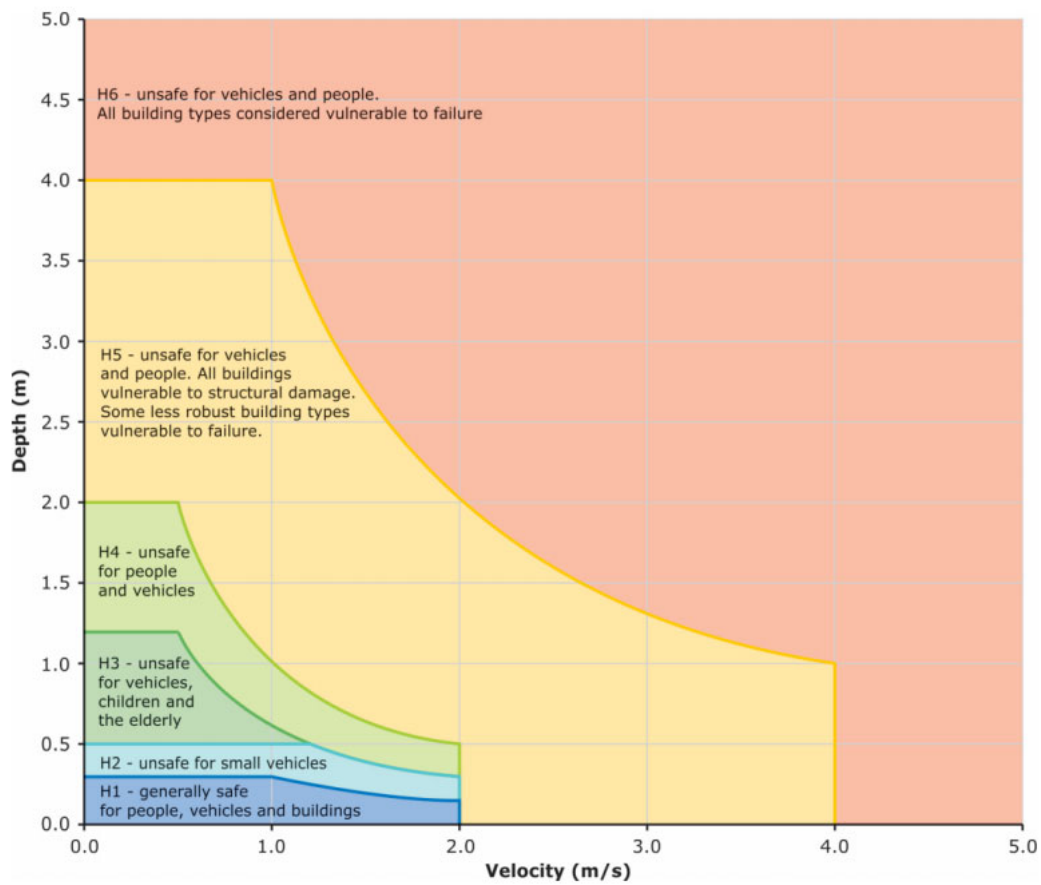


Figure 5.1 AIDR Flood Hazard Classification System

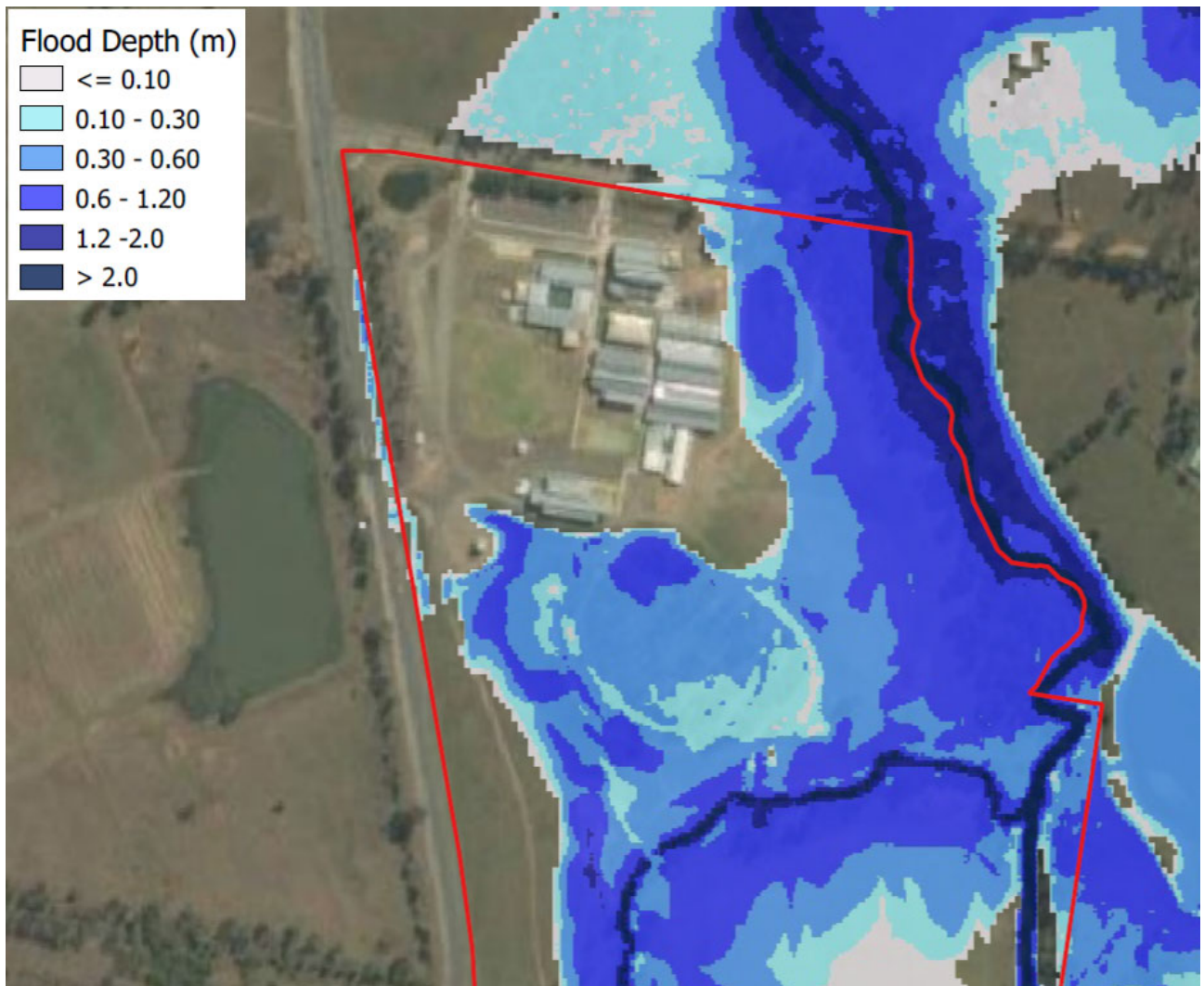


Figure 5.2 1 in 5 AEP Pre-development Peak Flood Depth at Existing Access Point

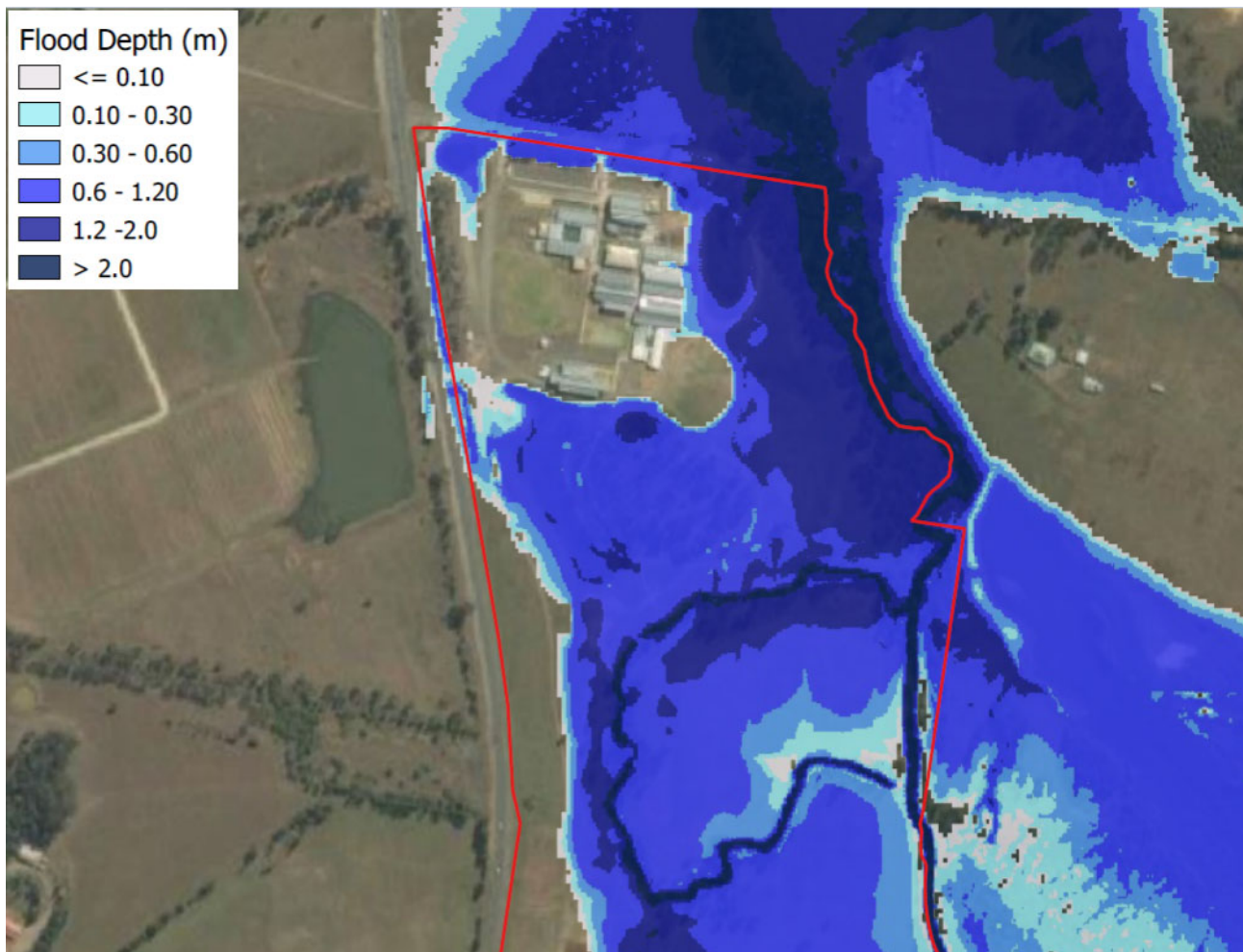


Figure 5.3 1 in 100 AEP Pre-development Peak Flood Depth

5.2 Post-development Flood Behaviour

The predicted post-development flood behaviour, including peak flood level, flood depth and flood hazard classification have been extracted from the TUFLOW model results and mapped for a range of flood including the 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2% AEP and PMF events. These are contained in Annex C, as listed below.

- Figure C-1 to B-8 show the post-development peak flood level maps.
- Figure C-9 to C-16 show the post-development peak flood depth maps.
- Figure C-17 to C-24 show the post-development peak flood hazard classification maps.

Based on the post-development modelling results, the following key flooding conditions are observed in and around the subject site.

- The existing and proposed new school buildings will be flood-free during flood events up to and including the 0.2% AEP (1 in 500 AEP).

- The proposed internal road along Wine Country Drive (north-south alignment) leading up to the new access point via Wine Country Drive (immediately south of the proposed aquatic centre) is predicted to be flood-free during flood events up to and including the 1 in 500 AEP. For perspective, Figure 5.4 shows the 1 in 100 AEP peak flood depth map.
- The existing and new school buildings are inundated during the PMF event, with a flood hazard classification of “H4”, with the hazard increasing to “H5” in carparking and ground areas, as shown in Figure 5.5.

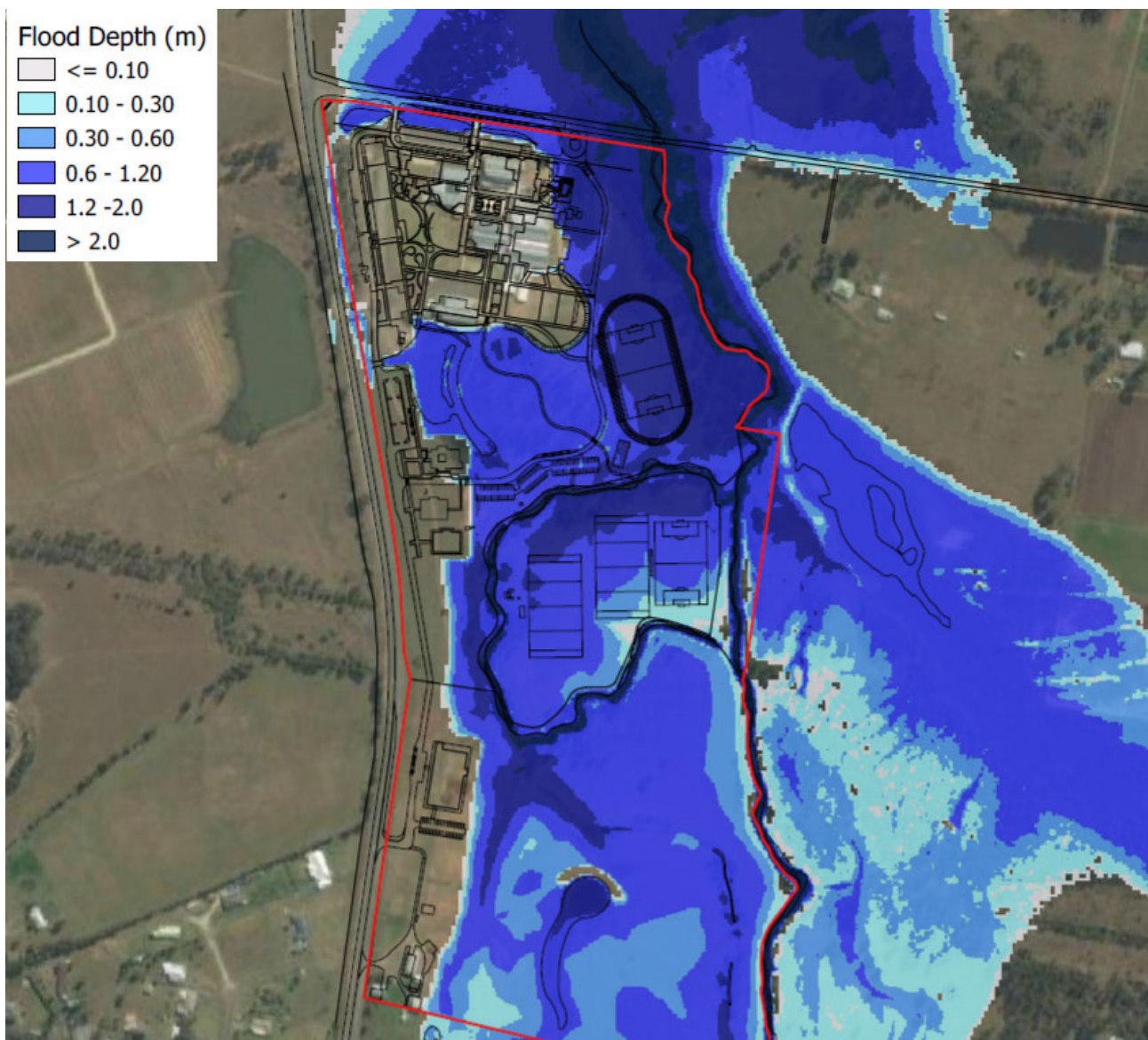


Figure 5.4 1 in 100 AEP Post-development Peak Flood Depth Map

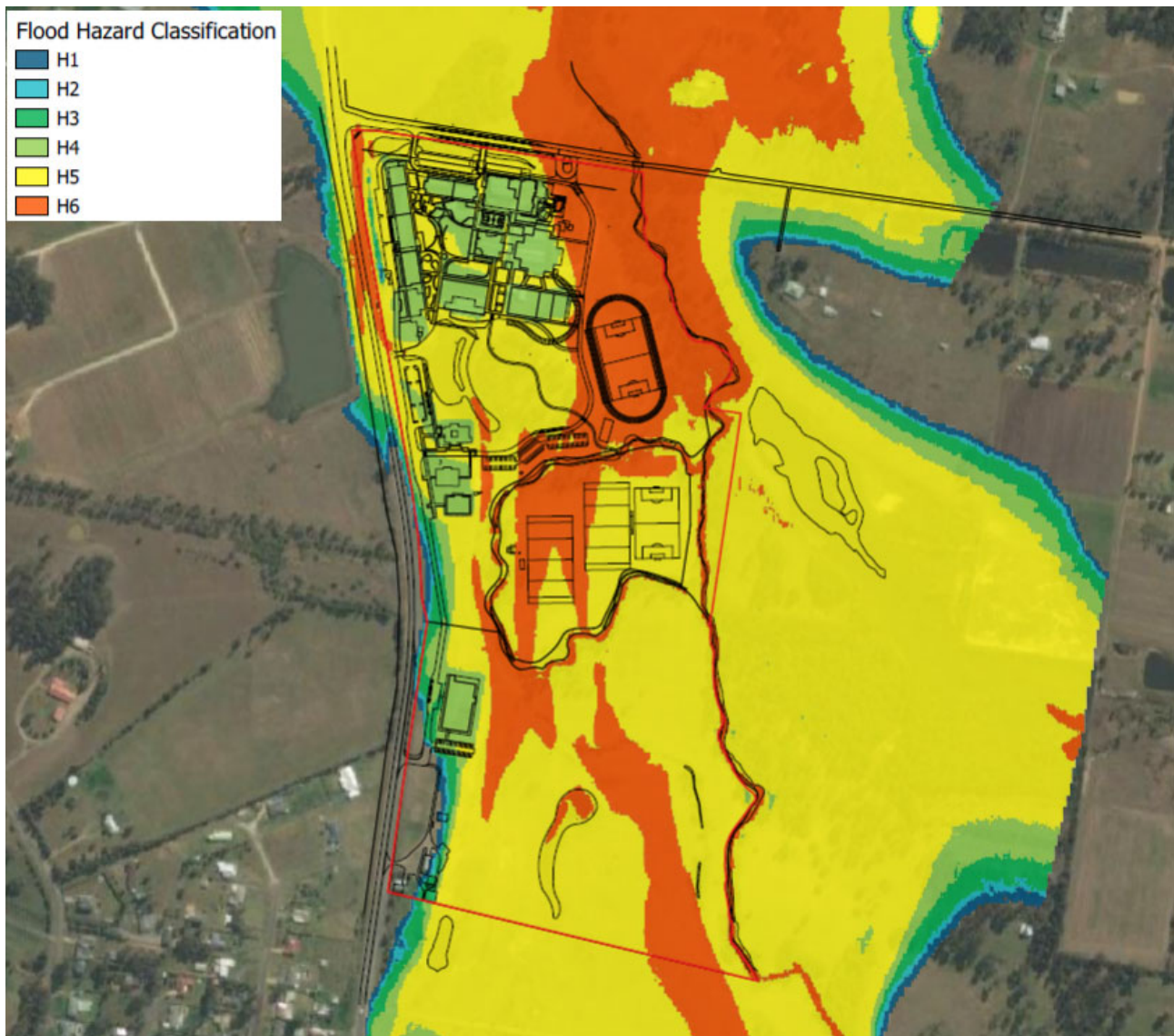


Figure 5.5 PMF Post-development Flood Hazard Classification

5.2.2 Off-site Flooding Impacts

The predicted increase in peak flood levels (afflux) have been determined and mapped for the 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2% AEP and PMF. These are contained in Annex D of this report. The predicted afflux results are summarised as follows:

- The proposed development will not result in an adverse increase in peak flood level beyond the boundaries of the site for events up to and including the 1 in 20 AEP (i.e., the afflux is within 20mm which is considered minor and acceptable).
- For events larger in magnitude than the 1 in 20 AEP, the proposed development has been predicted to result in increases in peak flood level greater than 20mm beyond the boundaries of the site. Table 5.1 provides the predicted affluxes in the adjoining lot immediately east of Black Creek (See the reporting point in Figure 5.6 below) for a range of events up to and including the PMF. The

results indicate that the exceedance above the 20mm threshold is marginal for events up to and including the 1 in 500 AEP events.

- During the PMF event, the proposed development is predicted to result in a maximum off-site afflux of 140mm predominately to the east of Black Creek. However, more importantly, the proposed development is not predicted to significantly alter the flood hazard level (classification) in the areas impacted. It is noted that the PMF provides an upper limit of flooding and is mainly used for emergency response planning purposes to address the safety of people (NSW Floodplain Development Manual, 2005) and to ensure that no serious risk to life and property would occur. It is an improbable event with a notional AEP of 1 in 10,000,000 (BoM, 2003). Hence, as the proposed development will not result in a change in the peak flood hazard classification beyond the boundaries of the site, it is considered that the development does not significantly alter existing flood risks in the PMF event.

Table 5.1 Offsite Flood Impacts at Reporting Point East of Black Creek

AEP	Afflux (mm)
1 in 5	3
1 in 10	9
1 in 20	14
1 in 50	22
1 in 100	25
1 in 200	27
1 in 500	32
PMF	110

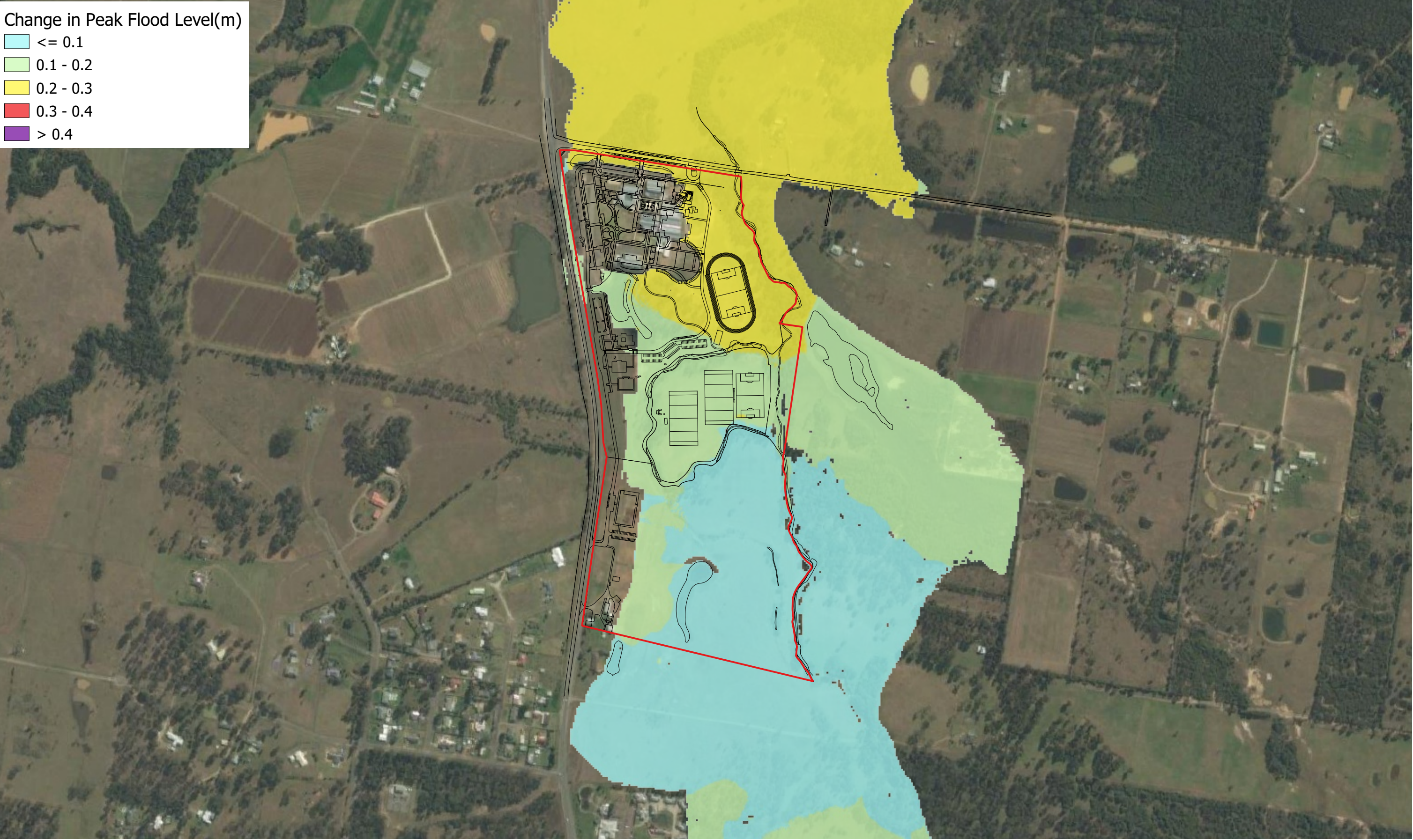


Figure 5.6 1 in 100 AEP Zoomed-in Afflux Map

5.3 Climate Change Impact on Flooding

A climate change assessment has been undertaken based on a 20% increase in flow rates to mimic the influence of rainfall increase (due to climate change) on flooding. For the analysis, the 1% AEP event has been used wherein the inflow hydrographs were increased by 20% in the post-development TUFLOW model.

Figure 5.7 shows the predicted increases in the 1% AEP peak flood level. The modelling predicted a maximum flood level increase of 0.3m within the site. This indicates that school building floor levels (designed based on the height of the 1% AEP +0.5m freeboard) would remain higher than the 1% AEP peak flood levels under the climate change scenario.



Legend

□ Site Boundary

— Development Layout

Title: Climate Change Impact on the 1% AEP Flood Event		Drawing: 5-7	Rev: A
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5.4 Social and Economic Impacts

As demonstrated in the preceding sections, the proposed development is not predicted to result in significant modifications of flood behaviour beyond the boundaries of the site (i.e., no significant increase in peak flood level during events up to and including the 1 in 500 AEP. For the PMF event, the proposed development will not significantly alter the flood hazard level in the surrounding properties and roads. This will ensure that any potential existing evacuation routes in the locality (emergency management arrangement) will not be adversely impacted.

Therefore, the proposed development is not anticipated to result in an adverse social and economic impact associated with flooding.

6 Review of Previous FERP

As part of this flood impact assessment, BMT undertook a high-level review of the preliminary flood emergency response plan (FERP) previously prepared by Worley Parsons (2009) as part of the approved DA, Council's flood mapping in conjunction with the flood modelling results documented herein. The outcomes of the review are summarised in the following sections.

6.1 Worley Parsons (2009) FERP

The Worley Parsons (2009) flood assessment report included a preliminary flood emergency response plan (FERP). The main flood emergency or evacuation issues and findings identified in the study are outlined below:

- Calculations undertaken by Worley Parsons estimated that the flood levels during a PMF would be expected to be above the 1% AEP flood level for approximately 6 hours.
- Given the problems associated with the evacuation of up to 1,500 students during adverse weather conditions associated with an extreme flood such as a PMF, the proposed evacuation strategy is to provide on-site flood refuge for all students and staff. This will effectively minimise the evacuation distances and therefore timeframes, and also the requirement for assistance from emergency services.
- Calculations undertaken by Worley Parsons estimated that the 4-hour duration storm as the governing storm duration and suggested that the effective warning time during a PMF event would be in the order of 1 to 1.5 hours. The proposed FERP must be able to be practically implemented in this short timeframe under the adverse weather conditions associated with a PMF. It is therefore recommended that the FERP is implemented if inundation of the school playing fields occurs following heavy rainfall and/or State Emergency Services (SES)/ BoM storm warnings.

Key components of the preliminary FERP proposed in the Worley Parsons (2009) flood assessment report are summarised as follows:

- Initially, the flood refuge point will be located in the Stage 1 specialist facilities building during the early years of school operation. The flood refuge will be relocated to the auditorium once it is constructed (potentially 5 to 10 years after the school opening). Both buildings will comprise a minimum floor level set at the predicted PMF level. As such, these flood refuge locations are considered flood free.
- Access to both of the flood refuge locations will be provided through the emergency access to Wine Country Drive, located to the west of the site. The minimum level of this access will be 59m AHD, which is 0.5 m above the 1% AEP peak flood level and up to 0.7m below the PMF level. This access road would be trafficable by 4WD or emergency vehicles during the peak of the PMF.
- The proposed site grading has been configured to provide continuously rising evacuation paths to the higher portion of the fill pad (designated by the 59m AHD contour) that is located in the western portion of the site. This higher area contains both flood refuge buildings as well as the emergency access.

Figure 6.1 shows an extract of the preliminary evacuation plan from the Worley Parsons (2009) report.

The Worley Parsons (2009) report also recommended that a detailed Flood Emergency Response Plan (FERP) will need to be developed in close coordination with the SES and Council. In addition, the following guidelines were recommended:

- As soon as a Black Creek flood warning is issued by the SES, or floodwater is sighted in the lower areas of the floodplain, the school will initiate their FERP. This plan will incorporate the following actions:
 - The school will contact the SES and brief them on their situation. SES will advise the school on the predicted severity of the flood and the appropriate action.
 - If the SES advises the implementation of the FERP, or if the school staff observes that the flood waters are a significant risk to the school, the school staff will evacuate all students and staff to the flood refuge location. Once at the flood refuge, a full roll call will be performed to confirm all students, staff and visitors/contractors on the site are present or to identify any missing persons. No staff, student or other member of the public will seek to exit the site via vehicle until advised by the SES.
 - The flood refuge should not be vacated at any time until instructed by the SES as floodwaters may still be rising upstream of the site.
- To maximise the flood preparedness, the Worley Parsons (2009) study recommended the following on-going measures:
 - The school will take a roll call every morning, including an inventory of all visitors/contractors on the premises to ensure an accurate head count can be undertaken if there is an emergency.
 - All staff at the school will be aware of the FERP and will have designated roles in the plan execution.
 - The school will maintain a SES approved radio communication device onsite at all times to ensure that communication with the SES and other authorities can be maintained in the event of power outage/phone lines being cut.
 - The school will restrict student access to the lower playing fields and courts during or following periods of heavy rainfall.

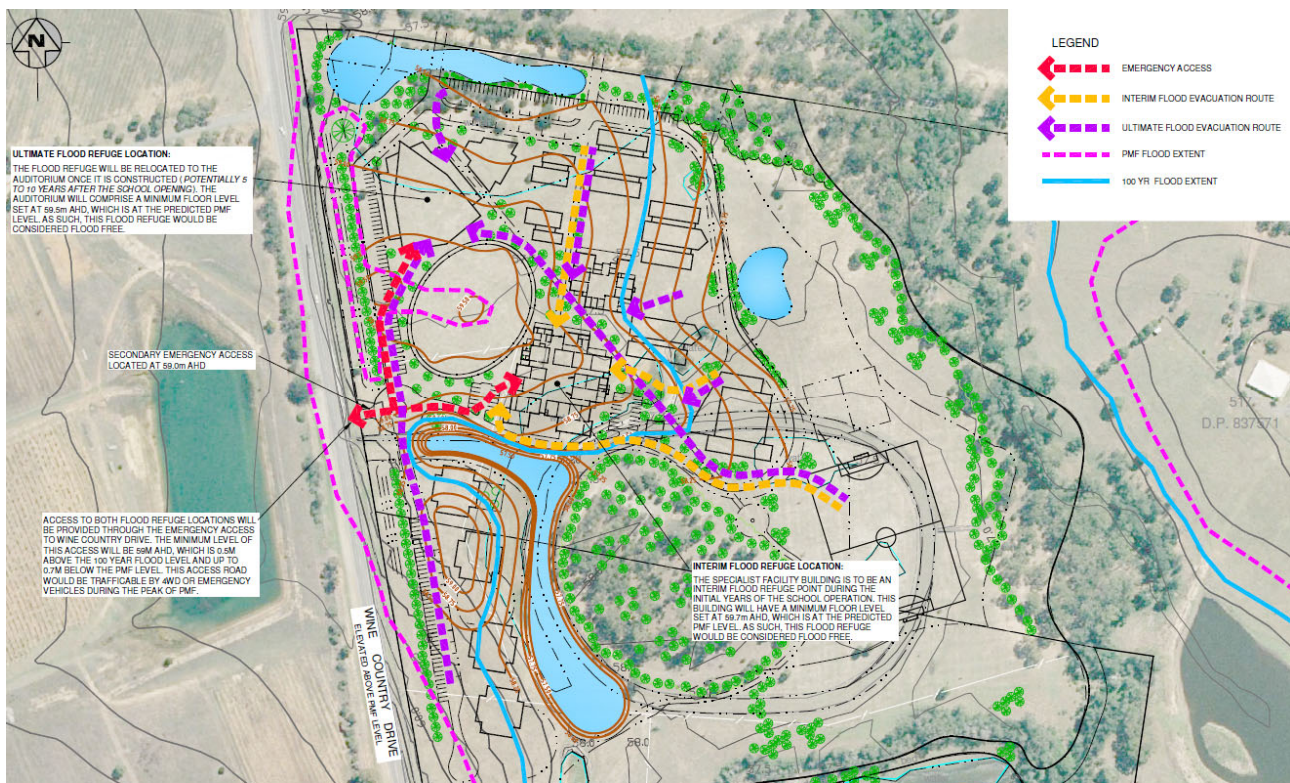


Figure 6.1 Worley Parsons (2009) Preliminary Flood Evacuation Plan

6.2 Commentary on the FERP

As part of this flood impact assessment, BMT also undertook a high-level review of the surrounding evacuation routes based on Council's flood mapping and the latest flood modelling results documented herein. Commentary on the FERP is given below:

- The new proposed access point from Wine Country Drive is situated further south of the old access point nominated in the Worley Parsons FERP. The Worley Parsons FERP claimed that the old access point (inundated by 0.7m in the PMF event) could be accessible by 4WD or emergency vehicles during such an event. This claim is not in line with current industry best practice.
- The proposed internal road along Wine Country Drive (north-south alignment) leading up to the new access point via Wine Country Drive (immediately south of the proposed aquatic centre) is predicted to be flood-free during flood events up to and including the 1 in 500 AEP.
- The existing and new school buildings are inundated during the PMF event, with a flood hazard classification of "H4", with the hazard increasing to "H5" in carparking and ground areas. Hence, the proposed onsite PMF refuge locations need to be designed commensurate with the predicted PMF flood hazard. The floor levels of the flood refuges need to be set at or above the PMF peak flood level.
- According to Council's flood mapping, Wine Country Drive leading to Cessnock is flood-free for the most part (during the 1 in 100 AEP event), except at the intersection with Fleming Street. However, the predicted flood hazard at this intersection is H1 and hence safe for people and vehicles in accordance with the AIDR flood hazard classification system.

- According to Council's flood mapping Wine Country Drive leading to Cessnock is subject to flood inundation during the PMF event for the section between the site and Cessnock.
- The Worley Parsons (2009) flood assessment considered up to 1,500 students, while the current approval seeks approval for an increase in student numbers up to 1,732. Hence, the FERP for the site needs to cater for the increased school occupancy.

In conclusion, the above review indicates that the FERP needs to be updated at a detailed design phase or prior to construction works to ensure that the plan is fit for the amended development masterplan.



Figure 6.2 Council's 1% AEP Inundation at Wine Country Drive and Fleming Street Intersection

7 Conclusions

BMT has prepared this flood impact assessment (FIA) report, on behalf of St Philip's Christian Education Foundation Ltd, to support a State Significant Development Application (SSDA) for alterations and additions to the existing school known as St Philip's Christian College (SPCC) Cessnock.

The school site is located within the Black Creek floodplain and affected by backwater flooding from the creek. It is therefore necessary to undertake a FIA to assess and ensure that the proposed development will not cause an adverse flood impact beyond the boundaries of the site. The flood impact assessment utilised the XP-RAFTS hydrologic and TUFLOW hydraulic models of the local study area. The detailed flood impact assessment has demonstrated the following flooding outcomes:

- The pre-development and post-development mainstream flood behaviour, such as peak flood level, depth and flood hazard have been defined for a range of design flood events, including the 20%, 10%, 5%, 2%, 1%, 0.5%, 0.2% AEP and PMF events.
- The existing elevated or developed part of the school (the north western quadrant block) is not inundated during events up to and including the 0.2% AEP (1 in 500 AEP). This part of the school, however, is subject to inundation in the PMF event, with a flood depth of up to 1.5m and flood hazard classification of "H4" to "H5" (i.e. unsafe flow conditions for people and vehicles).
- The existing main access point (easternmost access) from Lomas Lane is subject to inundation during the 1 in 5 AEP flood event. However, the central and western access points to the northern carpark from Lomas Lane are either flood-free or trafficable during flood events up to and including the 1 in 20 AEP events.
- Lomas Lane is subject to inundation and not trafficable during rare flood events including the 1 in 50 AEP flood event. However, the northern carpark is elevated and flood-free for flood events up to and including the 1 in 200 AEP.
- The proposed internal road along Wine Country Drive (north-south alignment) leading to the new access point via Wine Country Drive on the southern side is predicted to be flood-free during flood events up to and including the 1 in 500 AEP.
- The proposed development will not result in an adverse increase in peak flood level beyond the boundaries of the site for events up to and including the 1 in 20 AEP (i.e., the afflux is within 20mm which is considered minor and acceptable). For events larger in magnitude than the 1 in 20 AEP, the proposed development has been predicted to result in increases in peak flood level greater than 20mm beyond the boundaries of the site. However, the exceedance above the 20mm threshold is marginal. During the PMF event, the proposed development is predicted to result in a maximum off-site afflux of 140mm predominately to the east of Black Creek. However, more importantly, the proposed development is not predicted to significantly alter the flood hazard level (classification) in the areas impacted. However, more importantly, the proposed development is not predicted to increase the flood hazard level in the areas impacted and surrounding roads. Hence, as the proposed development will not result in a change in the peak flood hazard level beyond the boundaries of the site, it is considered that the development does not significantly alter existing flood risks in the PMF event.

- A sensitivity testing has been conducted based on a 20% increase in the peak flows on the 1% AEP event, and this demonstrated that the 1% AEP peak flood levels would increase by 0.3m within the site.
- A review of Council's flood mapping indicates that Wine Country Drive leading to Cessnock is flood-free during the 1% AEP event, except at the intersection with Fleming Street. During the PMF event, the road section between the school and Cessnock is inundated.
- Based on review of the preliminary flood emergency response plan previously prepared by Worley Parsons (2009), the main FERP consists of onsite PMF refuge located above the PMF flood level. The review indicates that the FERP needs to be updated at a detailed design phase or prior to construction works to ensure that the plan is fit for the amended development masterplan.
- Overall, based on the flood impact assessment herein, the proposed development is not anticipated to cause adverse social and economic impacts associated with flooding.

Annex A: Development Layout

Drawing and design © SHAC Pty Ltd. The signed control copy of this drawing is held by SHAC Pty Ltd. | Ref: BIMcloud: BIMSERVER24 - BIMcloud Basic for ARCHICAD 244347 SPCC Cessnock Campus SSD date: 3/12/21 time: 3:04 pm



For Information

1. Dimensions are in millimetres unless otherwise shown.

2. Work to given dimensions. Do not scale from drawing.
3. Check all dimensions on site prior to construction and fabrication.

4. Bring any discrepancies to the attention of the proprietor & architect.

LEGEND

- Existing building
- Proposed buildings for SSD application
- Site Boundary
- Lot Boundary

- A - Junior School

B - Middle School

C - Senior School + Library

D - Admin & Welcome Centre

E - Trade Training Centre

F - Canteen / Cafe Hub

G - Performing Arts Centre

H - Sports Hall

I - Outdoor Meeting Circle

J - Narnia

K - Cafe

L - Boardwalks

M - Sports Field & Running Track
- N - D.A.L.E

O - Aquatic Centre

P - Existing Sports Fields

Q - Waste Management Depot

R - Existing Sheds

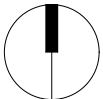
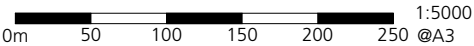
S - Existing House

4347
CD1003

RevB - WIP 03.12.21

Proposed Site Plan - Overall

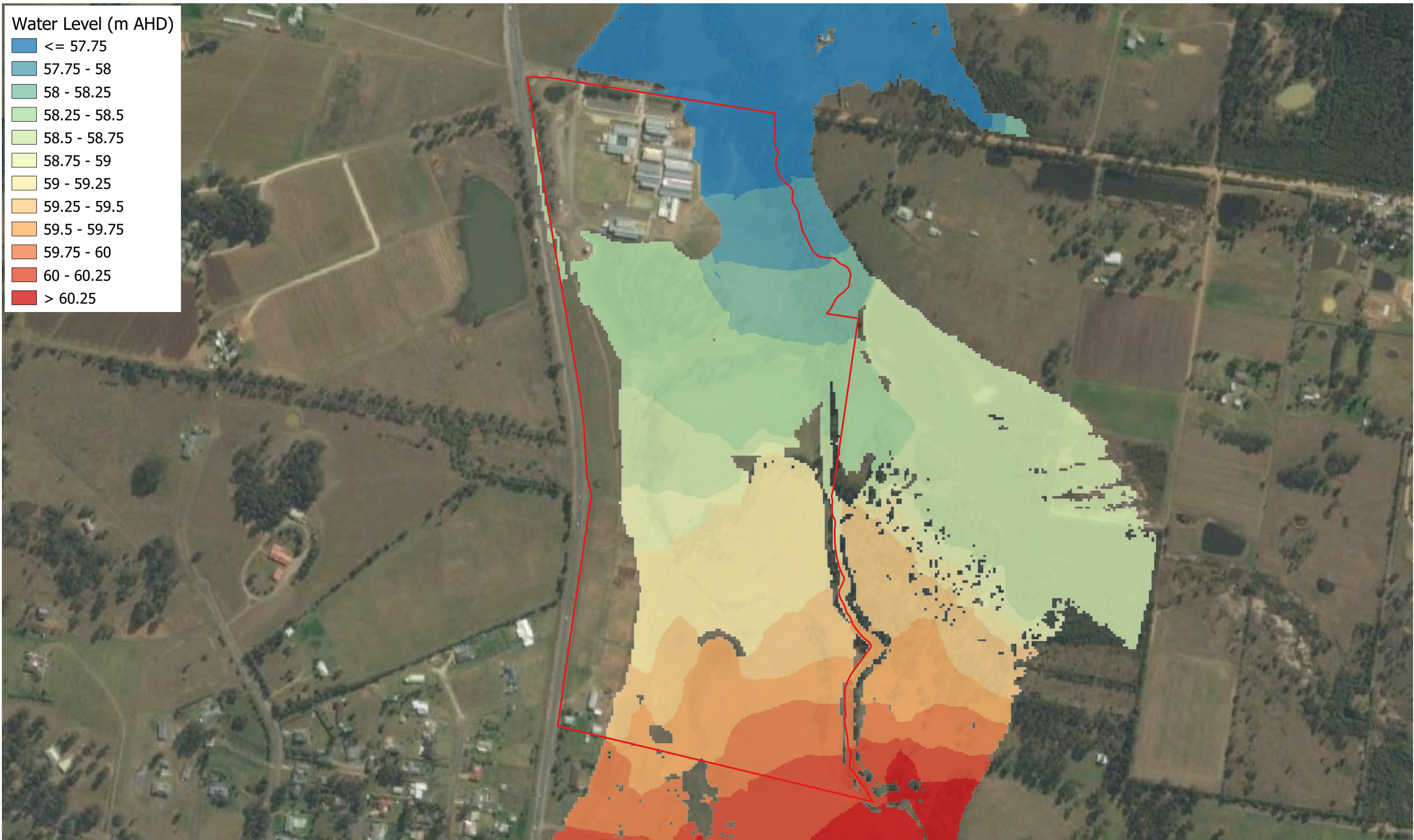
St Philip's Christian College Cessnock
10 Lomas Lane, Nulkaba



SHAC

Nominated Architect Justin Hamilton (6160) | ABN 32 131 584 846

Annex B: Pre-development Flood Maps



Legend

 Site Boundary

Title:

20% AEP Pre-development Peak Flood Level

Drawing:

B-1

Rev:

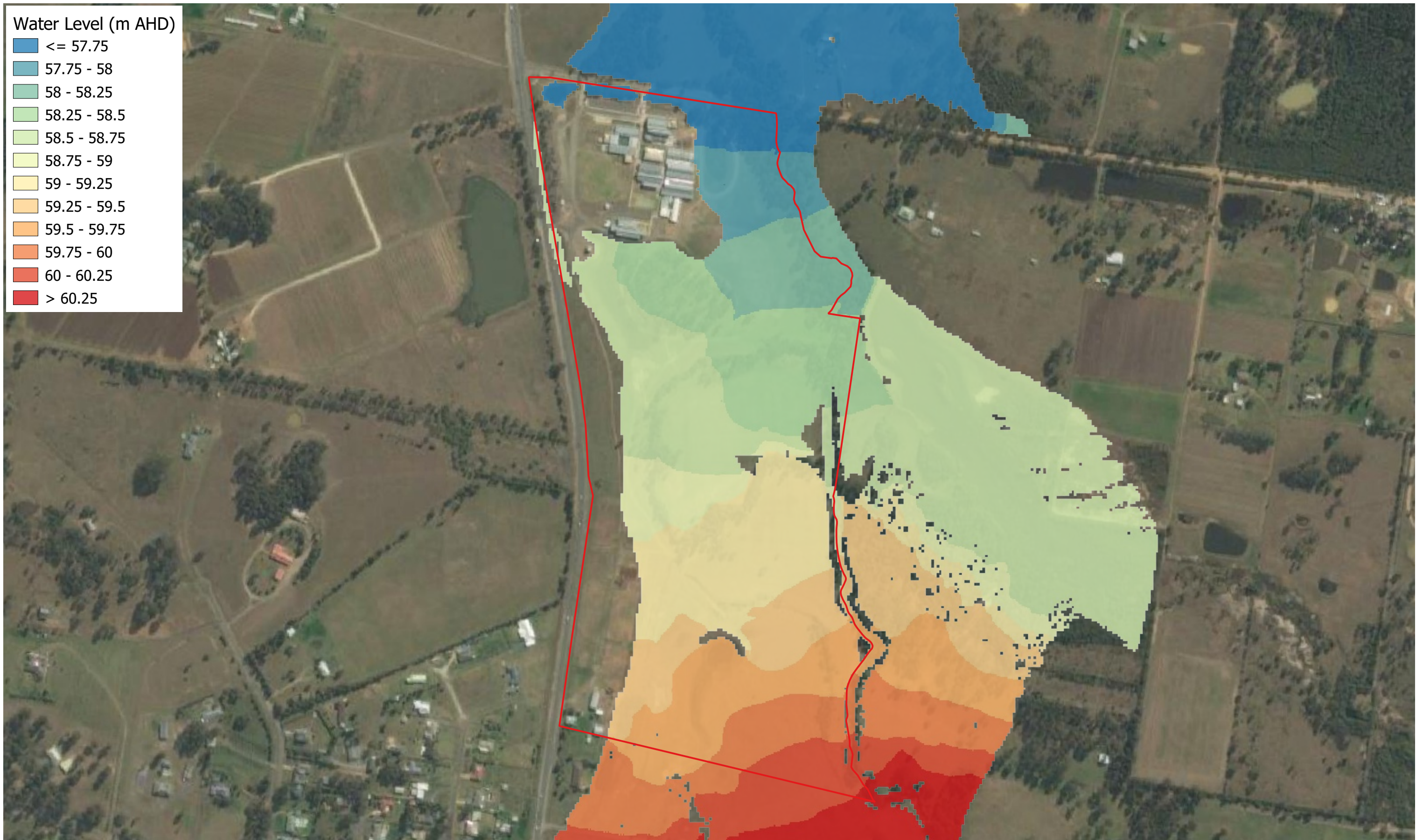
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0 100 200 m



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Legend

 Site Boundary

Title:

10% AEP Pre-development Peak Flood Level

Drawing:

B-2

Rev:

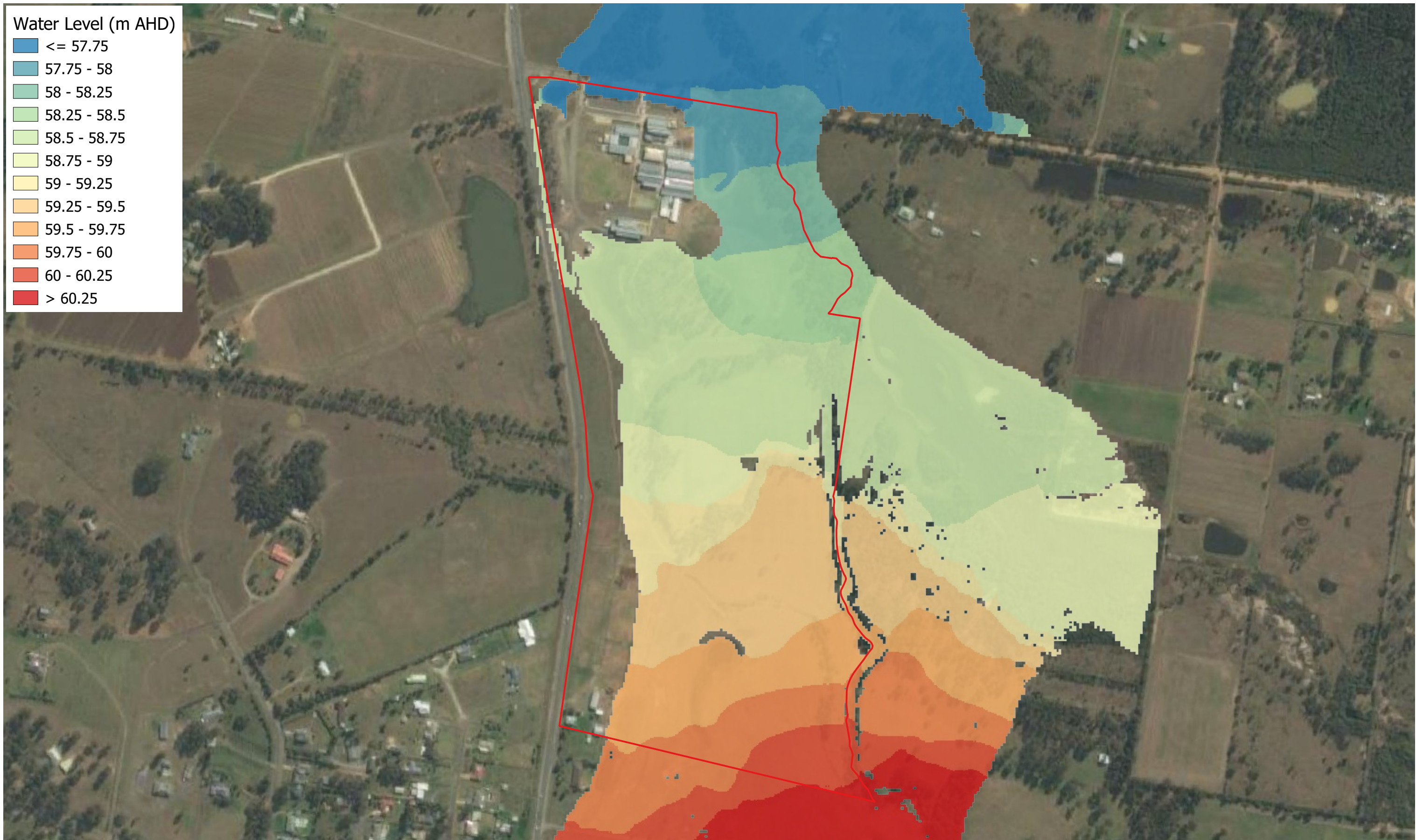
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Legend

 Site Boundary

Title:

5% AEP Pre-development Peak Flood Level

Drawing:

B-3

Rev:

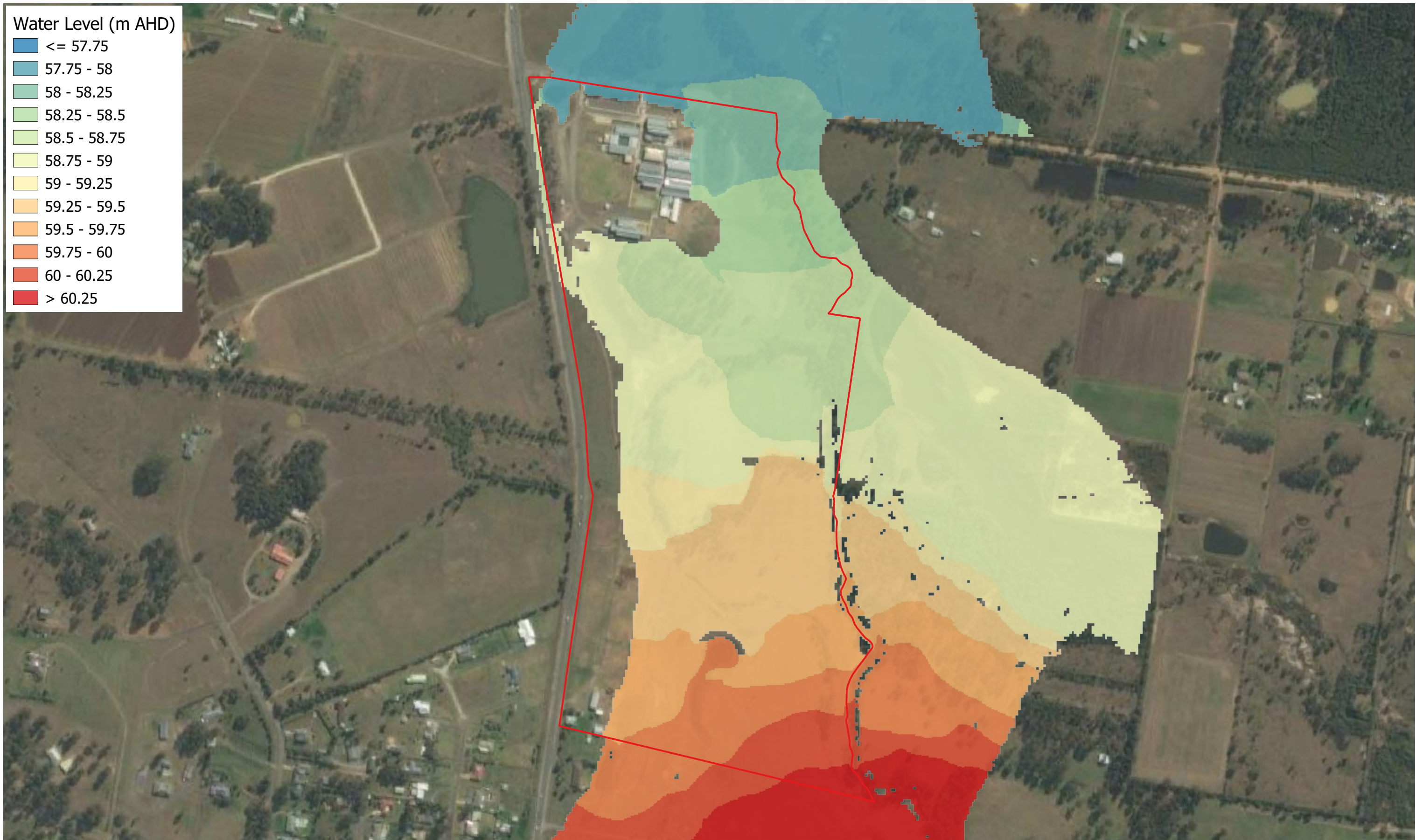
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Legend

 Site Boundary

Title:

2% AEP Pre-development Peak Flood Level

Drawing:

B-4

Rev:

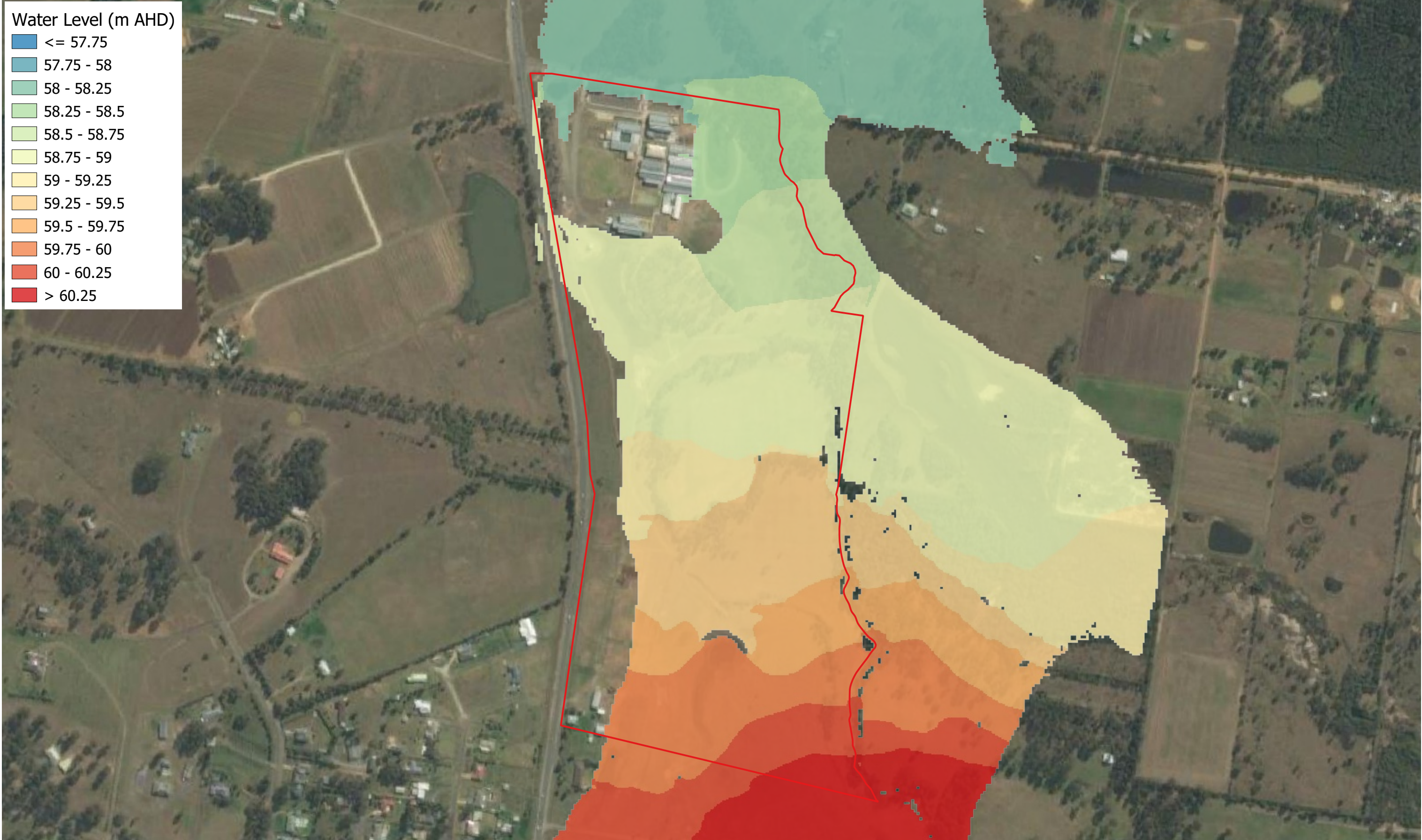
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0 100 200 m



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Legend

 Site Boundary

Title:

1% AEP Pre-development Peak Flood Level

Drawing:

B-5

Rev:

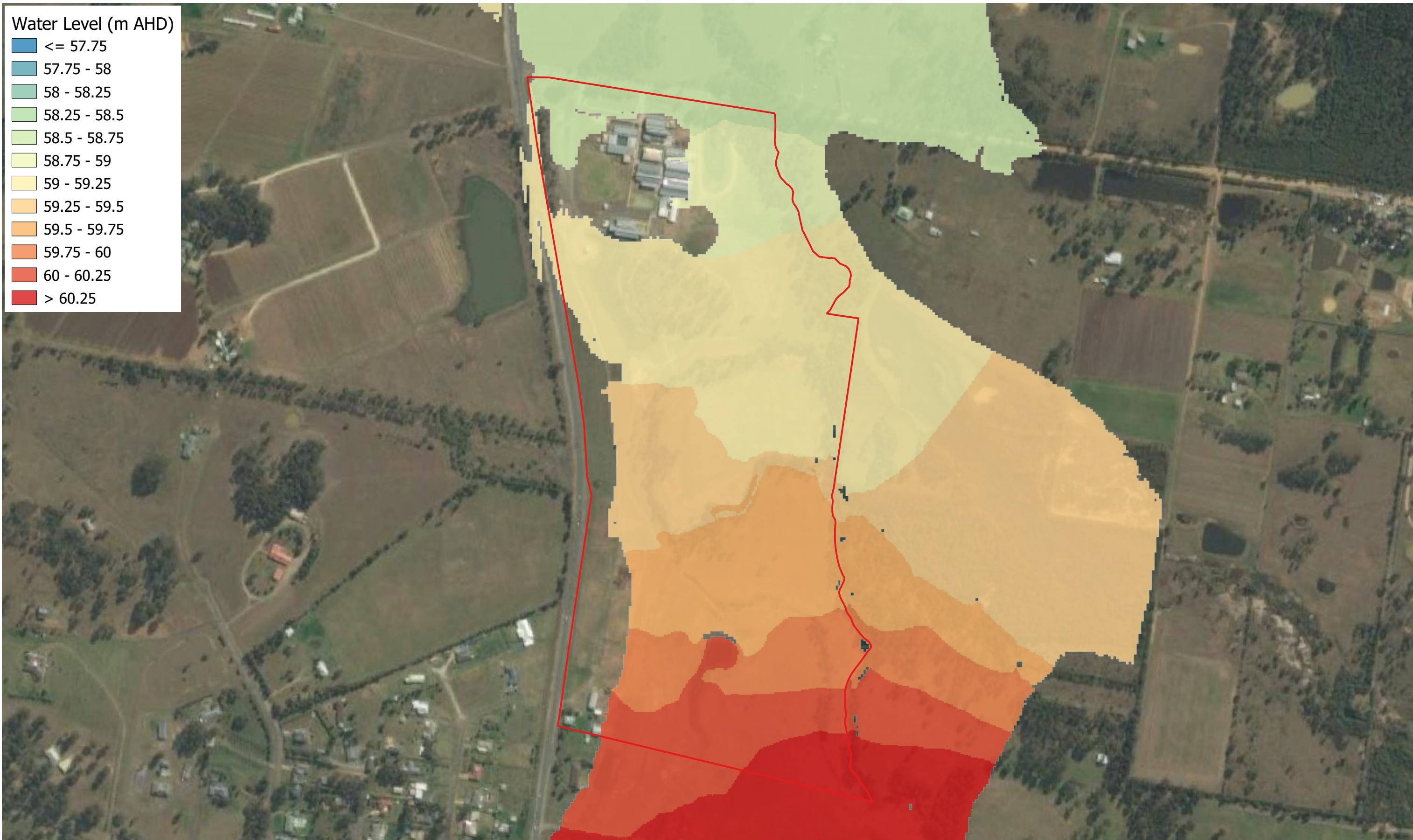
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0 100 200 m



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Legend

 Site Boundary

Title:

0.2% AEP Pre-development Peak Flood Level

Drawing:

B-7

Rev:

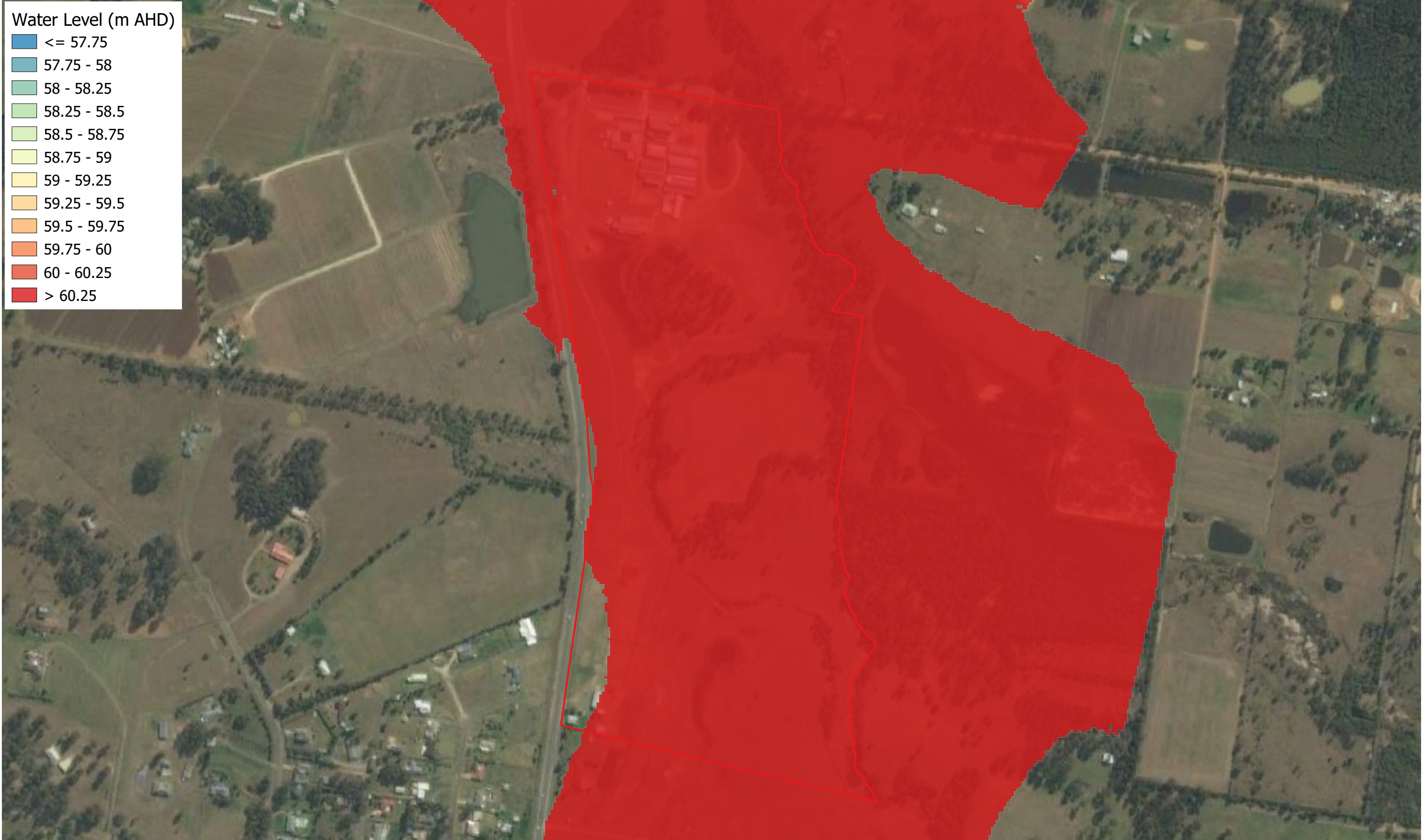
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Legend

 Site Boundary

Title:

PMF Pre-development Peak Flood Level

Drawing:

B-8

Rev:

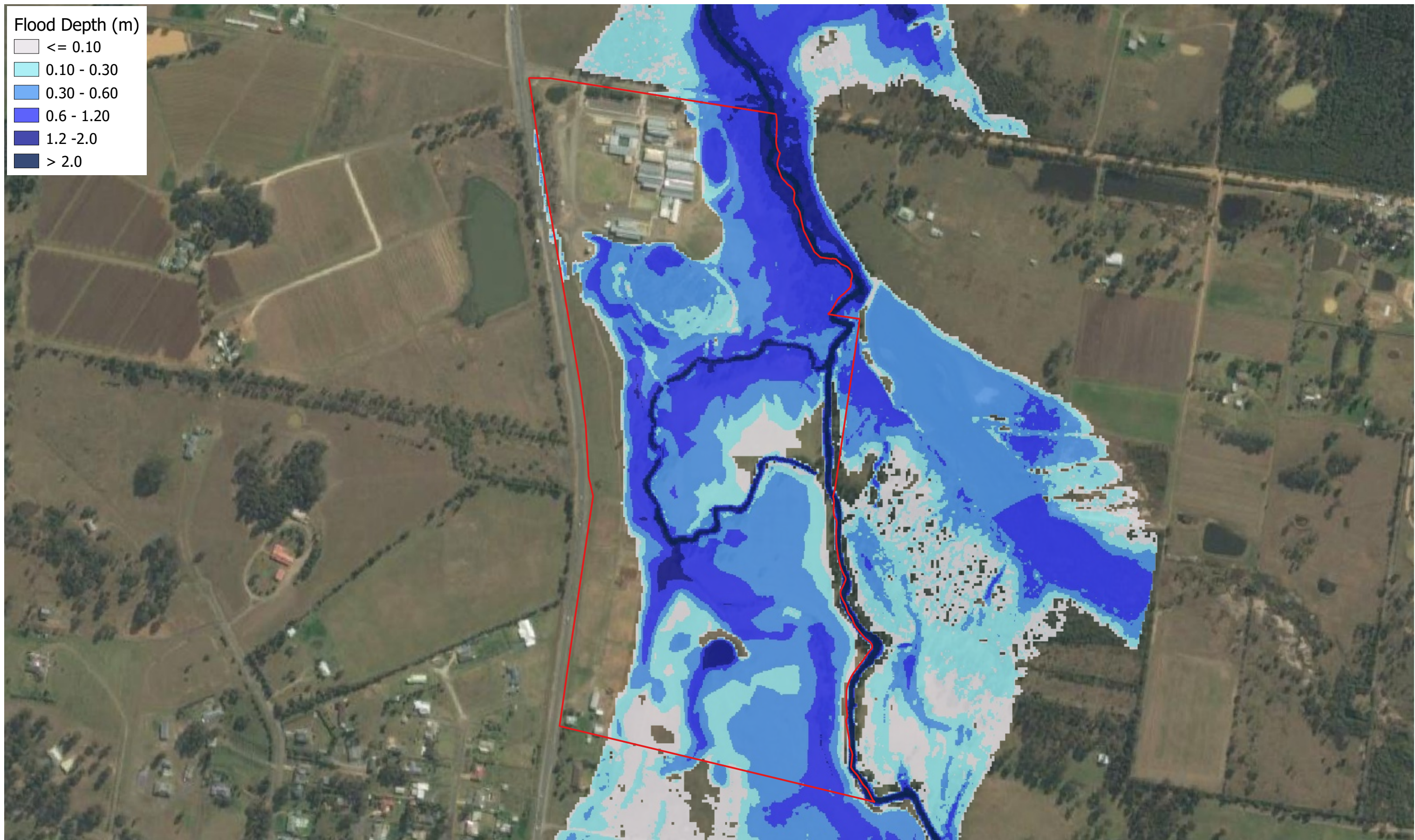
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Legend

 Site Boundary

Title:

20% AEP Pre-development Peak Flood Depth

Drawing:

B-9

Rev:

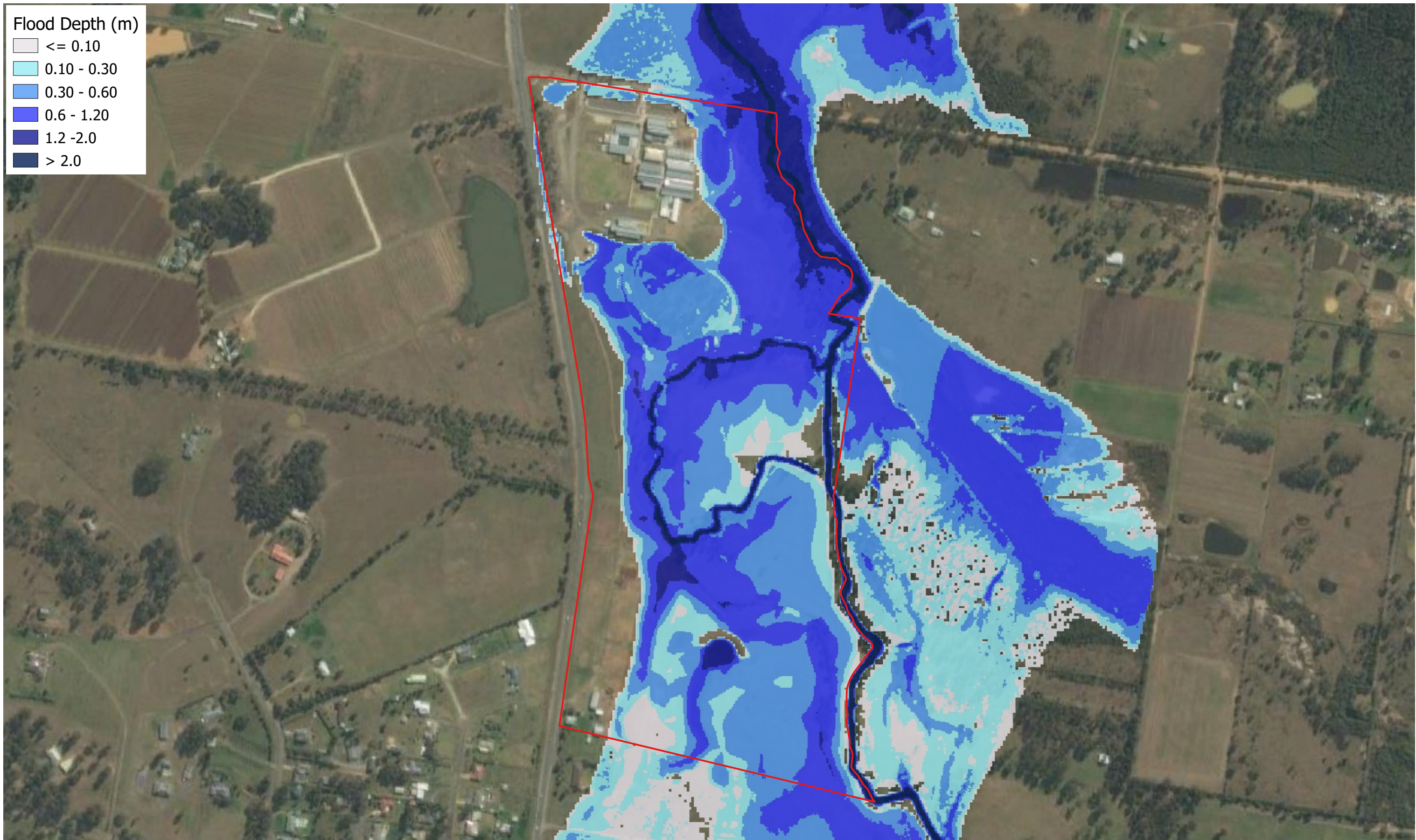
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Legend

 Site Boundary

Title:

10% AEP Pre-development Peak Flood Depth

Drawing:

B-10

Rev:

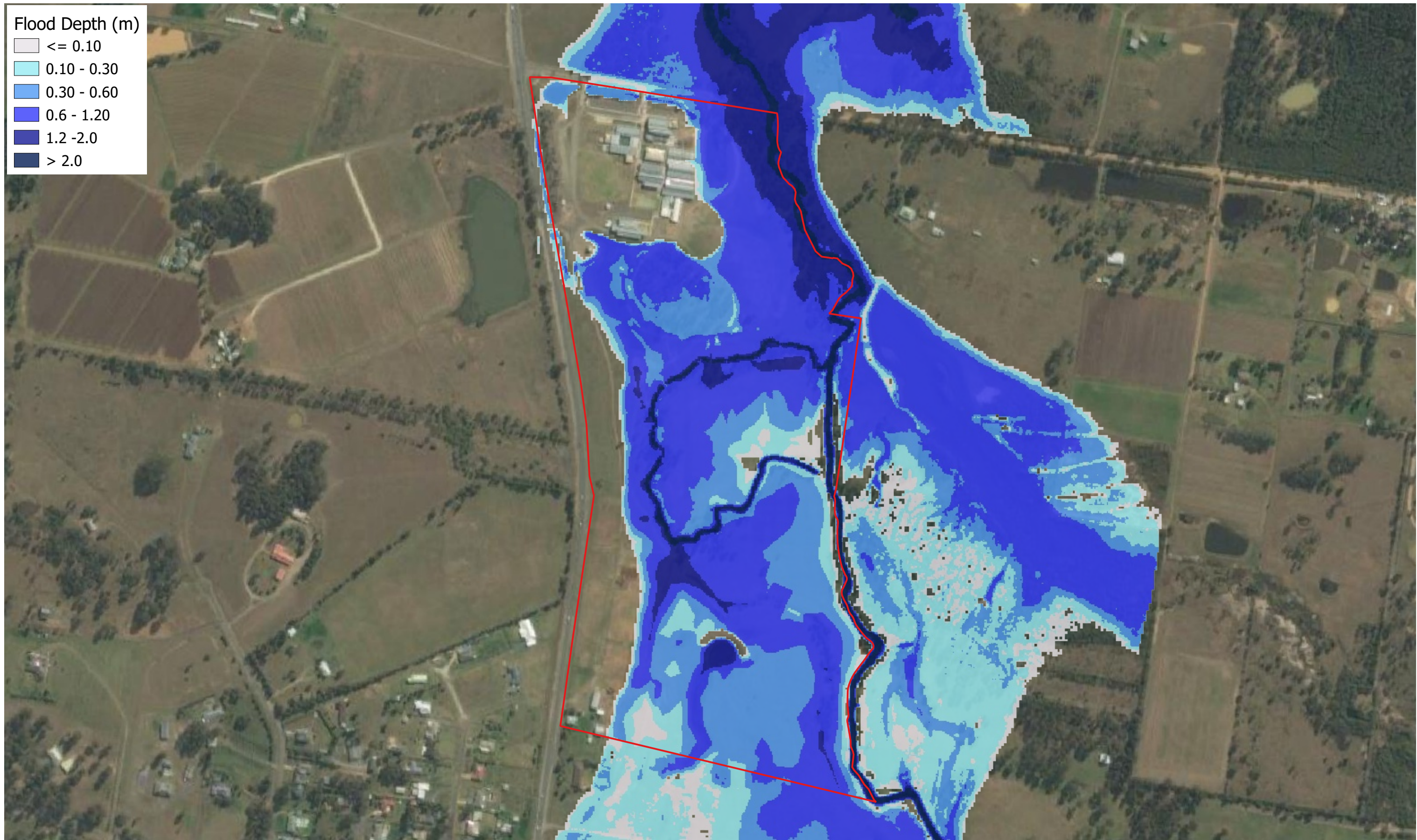
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BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 100 200 m



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Legend

 Site Boundary

Title:

5% AEP Pre-development Peak Flood Depth

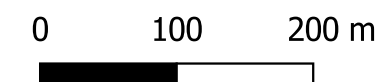
Drawing:

B-11

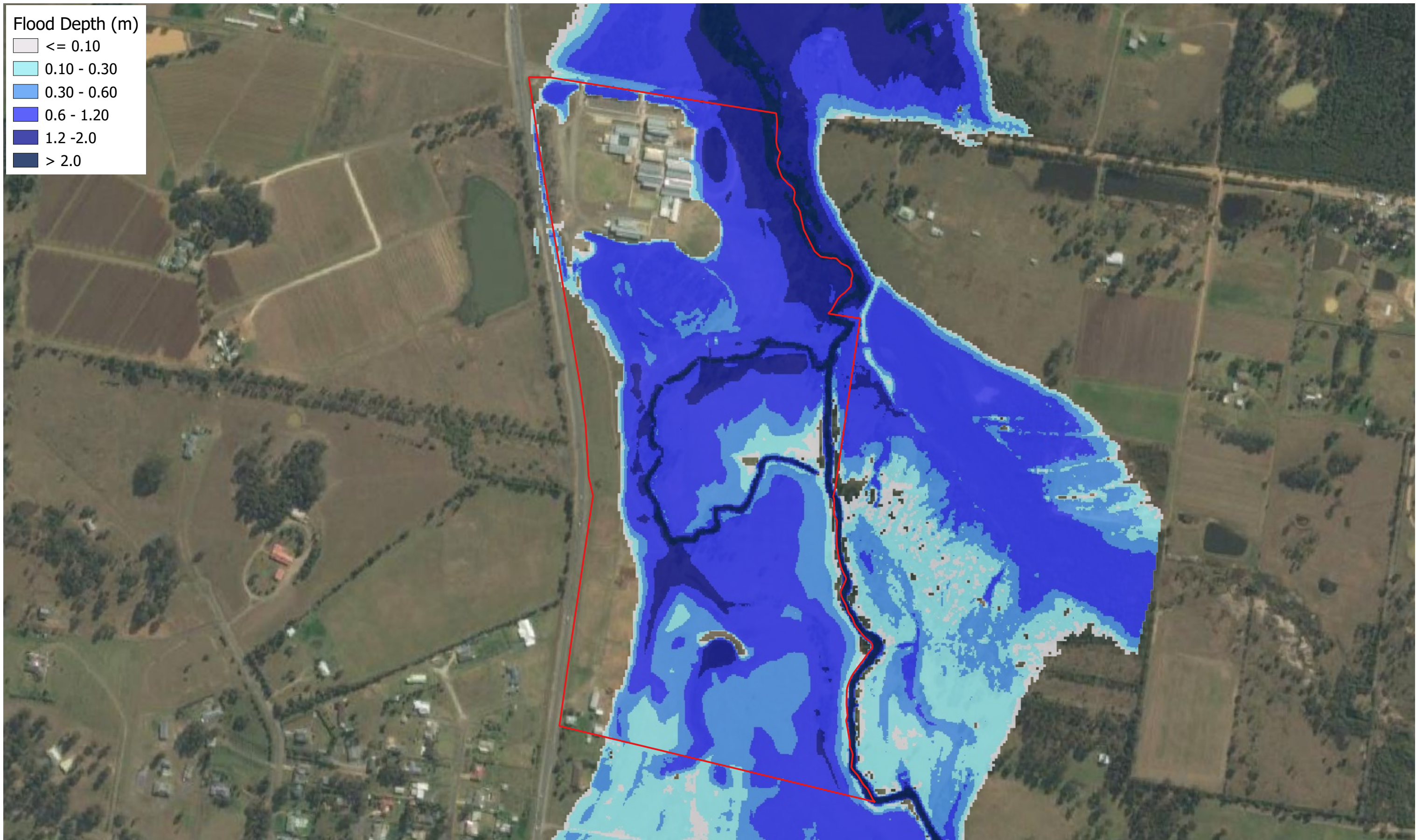
Rev:

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Legend

 Site Boundary

Title:

2% AEP Pre-development Peak Flood Depth

Drawing:

B-12

Rev:

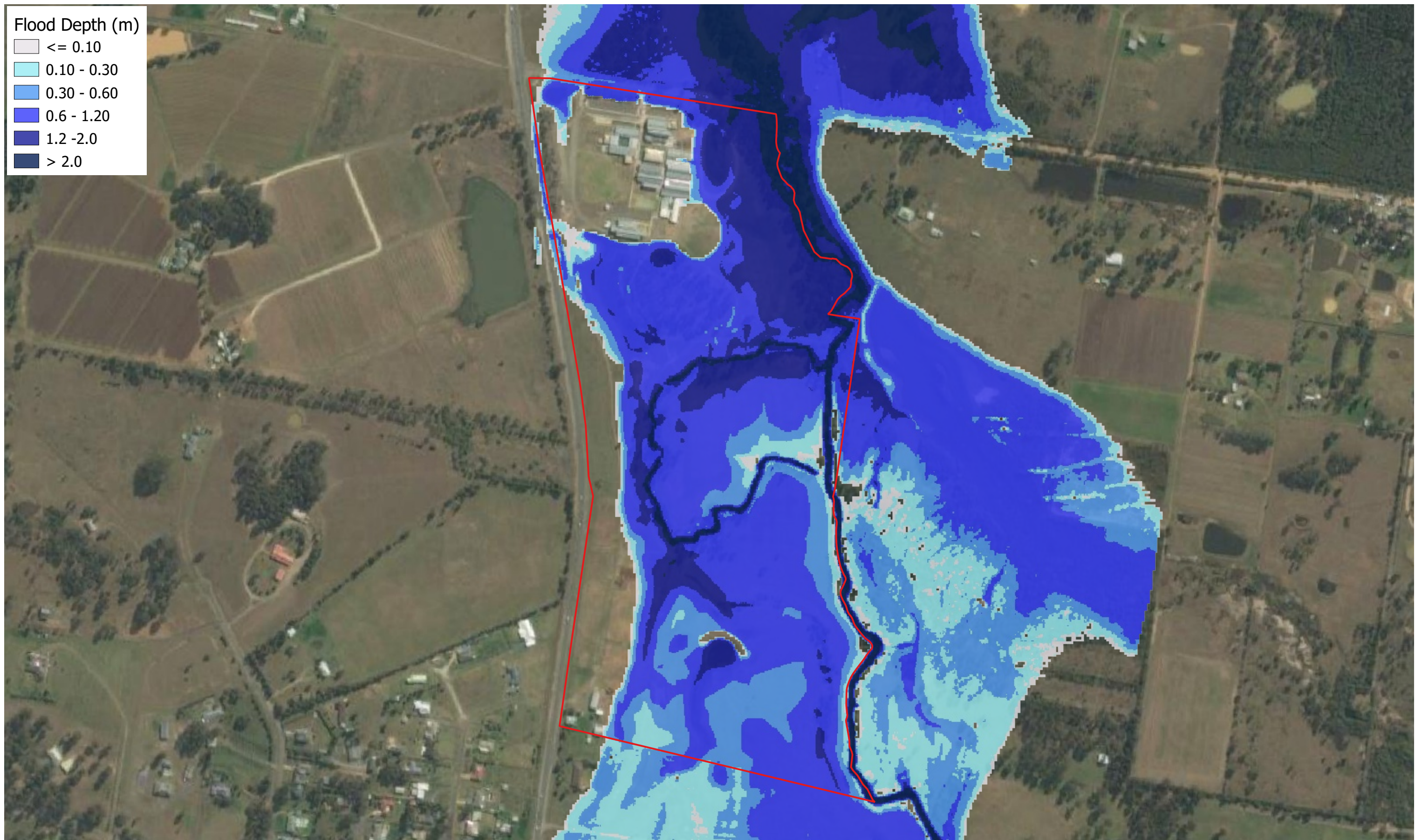
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Legend

 Site Boundary

Title:

1% AEP Pre-development Peak Flood Depth

Drawing:

B-13

Rev:

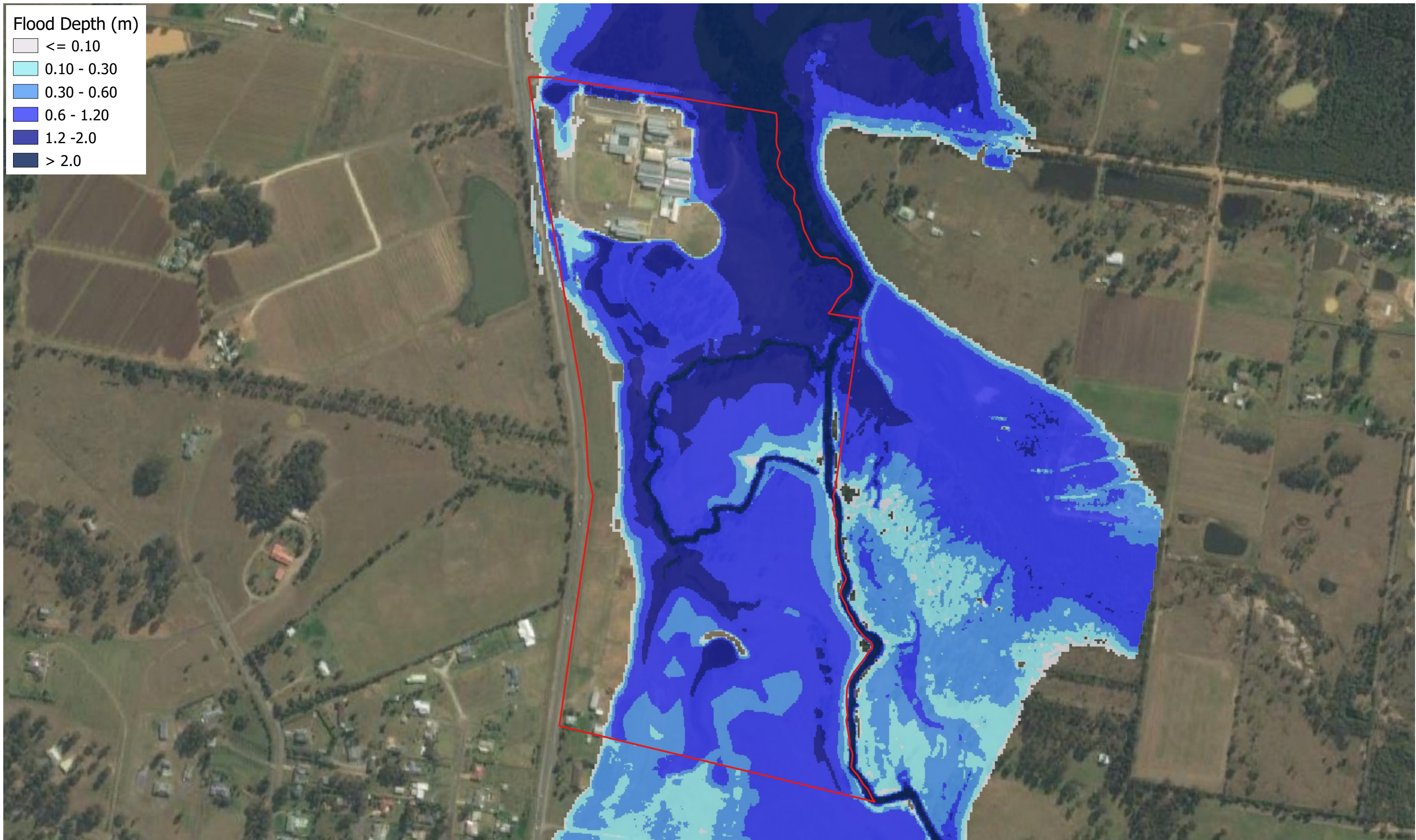
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Legend

 Site Boundary

Title:

0.5% AEP Pre-development Peak Flood Depth

Drawing:

B-14

Rev:

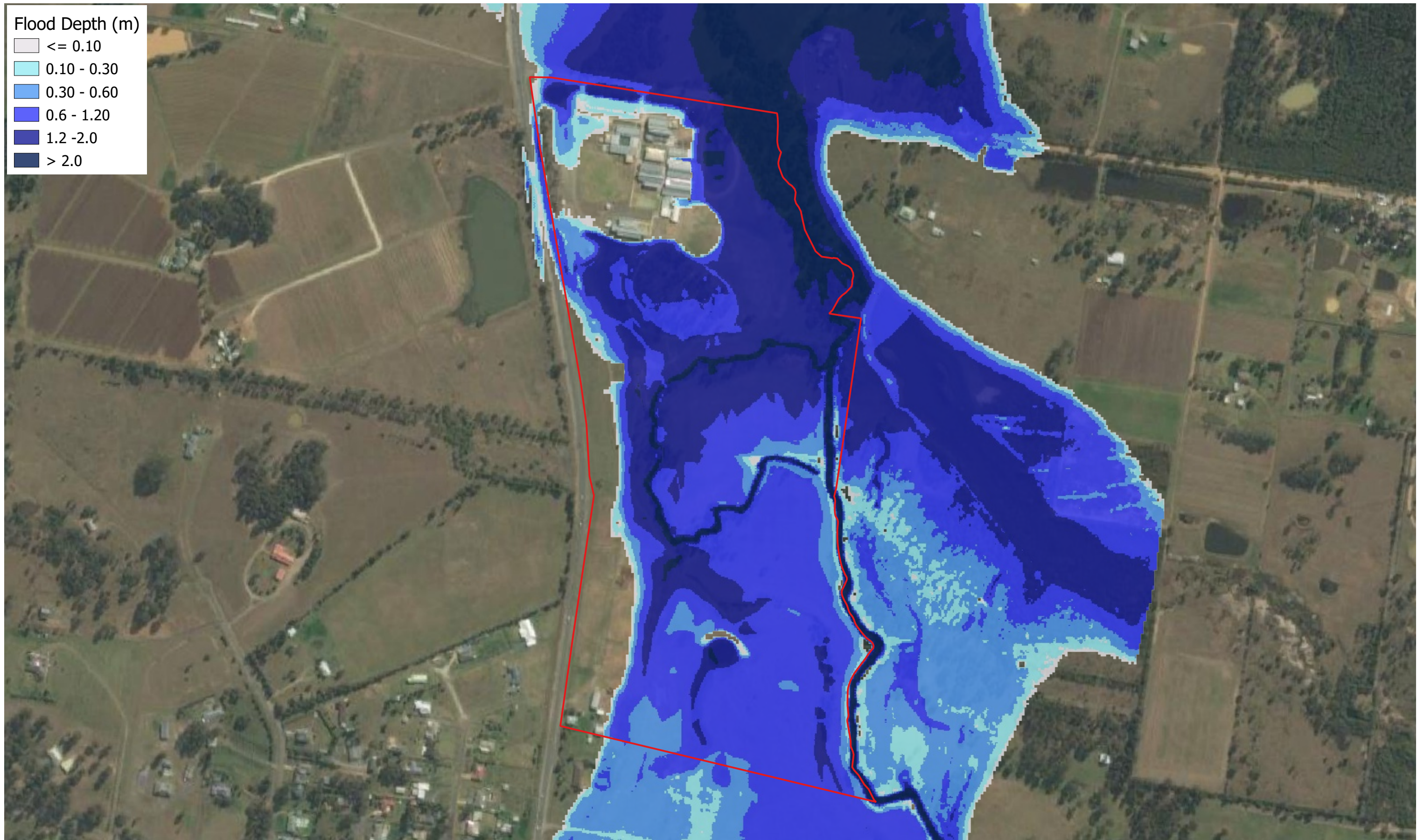
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0 100 200 m



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Legend

 Site Boundary

Title:

0.2% AEP Pre-development Peak Flood Depth

Drawing:

B-15

Rev:

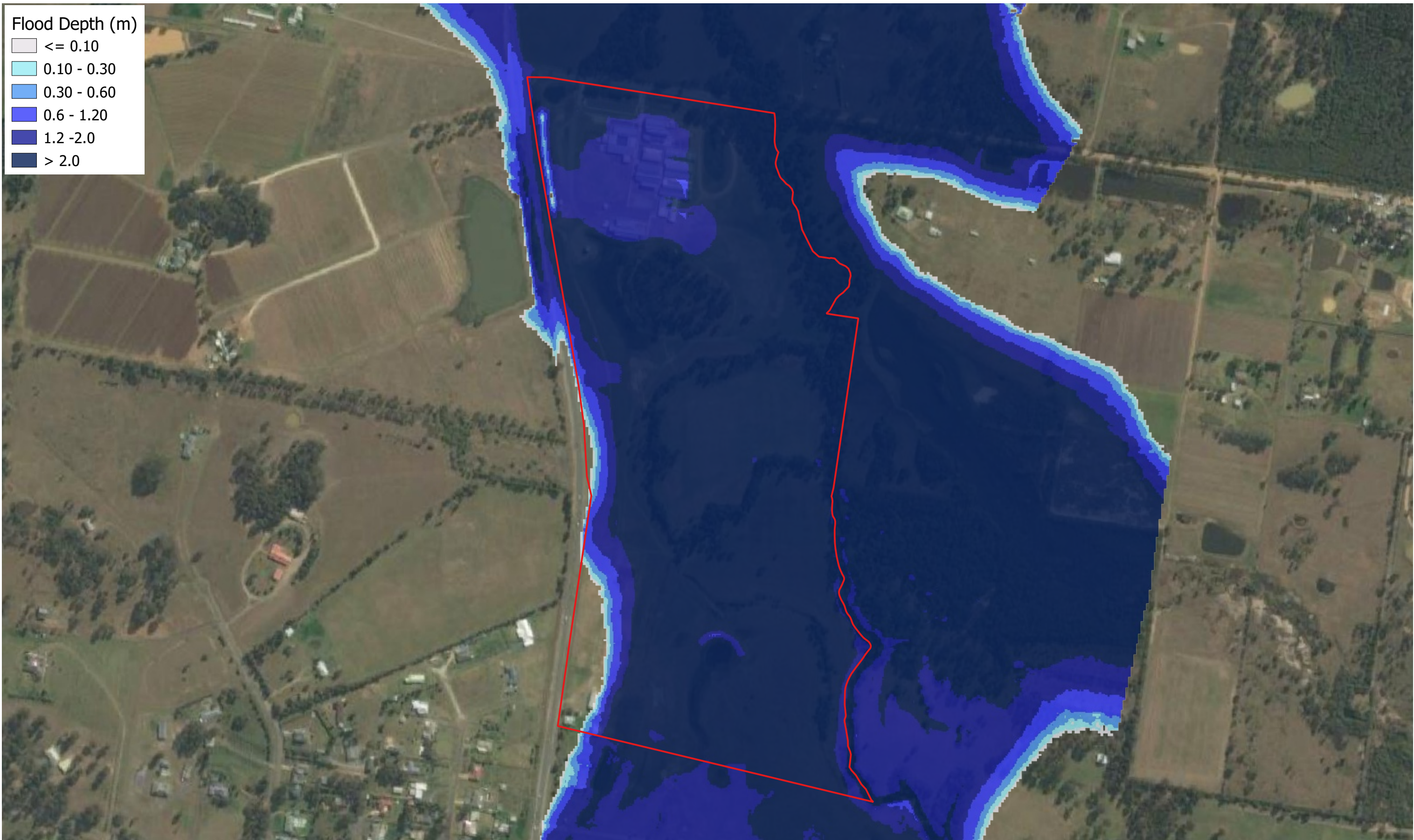
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Legend

 Site Boundary

Title:

PMF Pre-development Peak Flood Depth

Drawing:

B-16

Rev:

A

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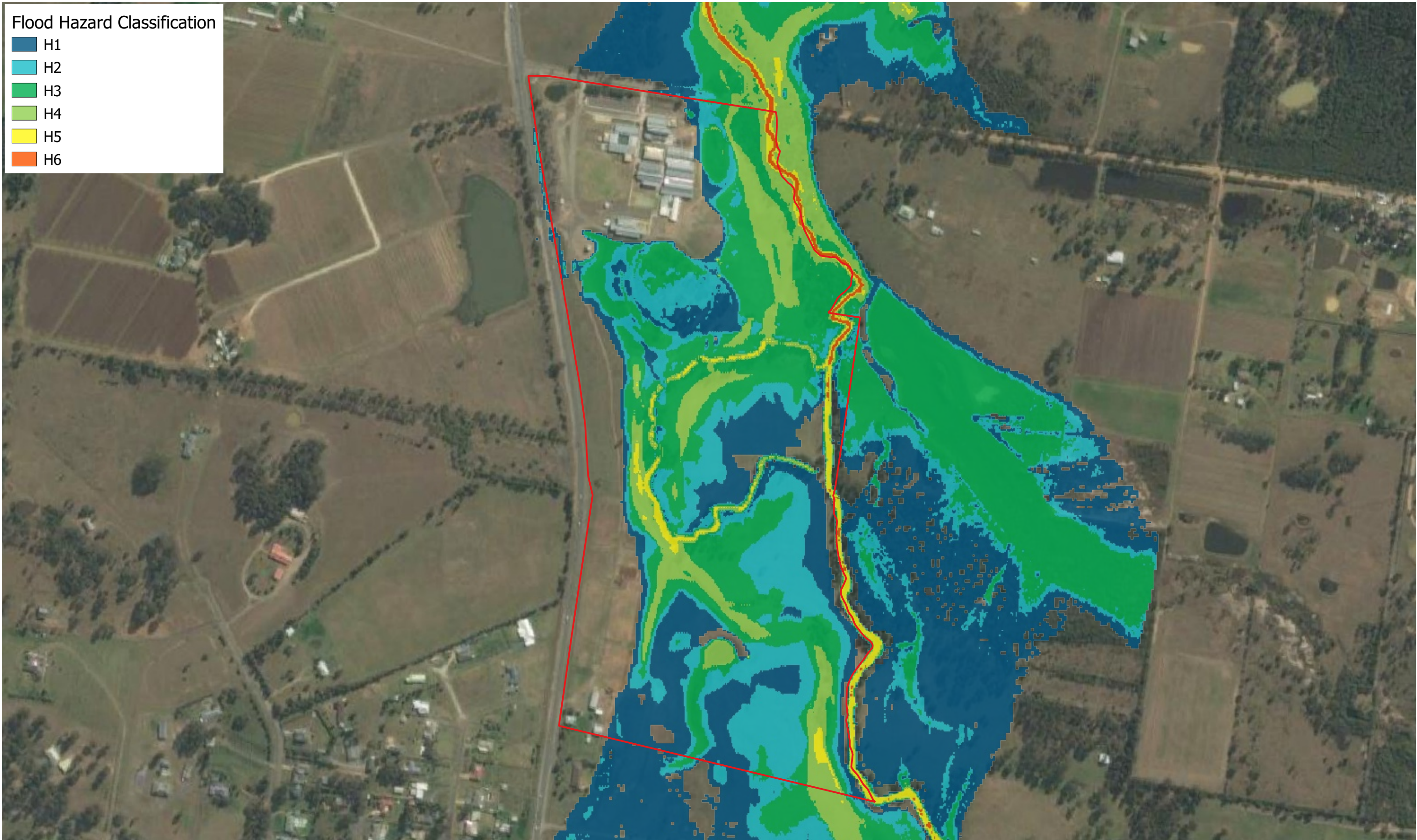
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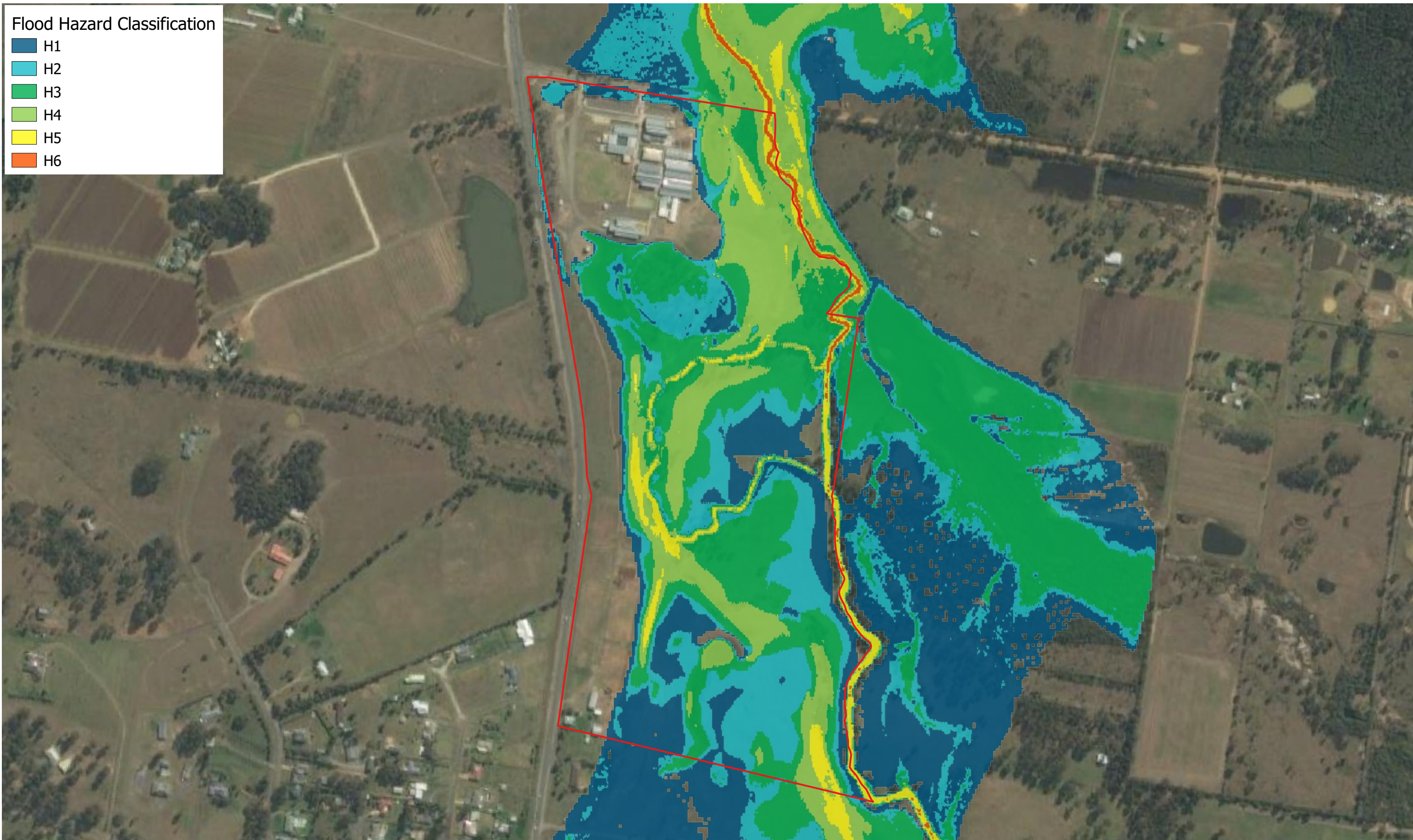
Flood Hazard Classification

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

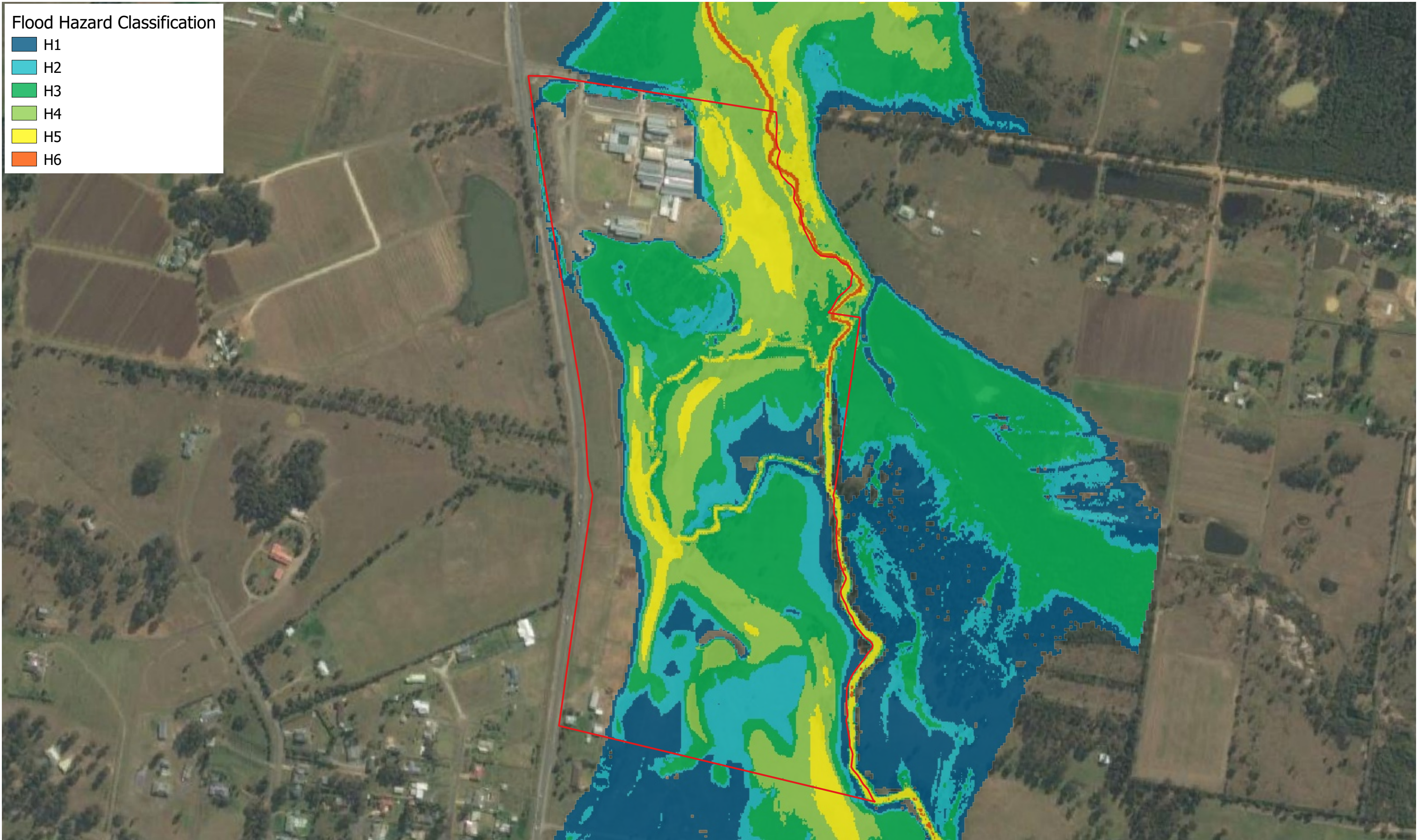


Legend Site Boundary	Title: 20% AEP Pre-development Peak Flood Hazard BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.	Drawing: B-17 Rev: A  BMT www.bmt.org

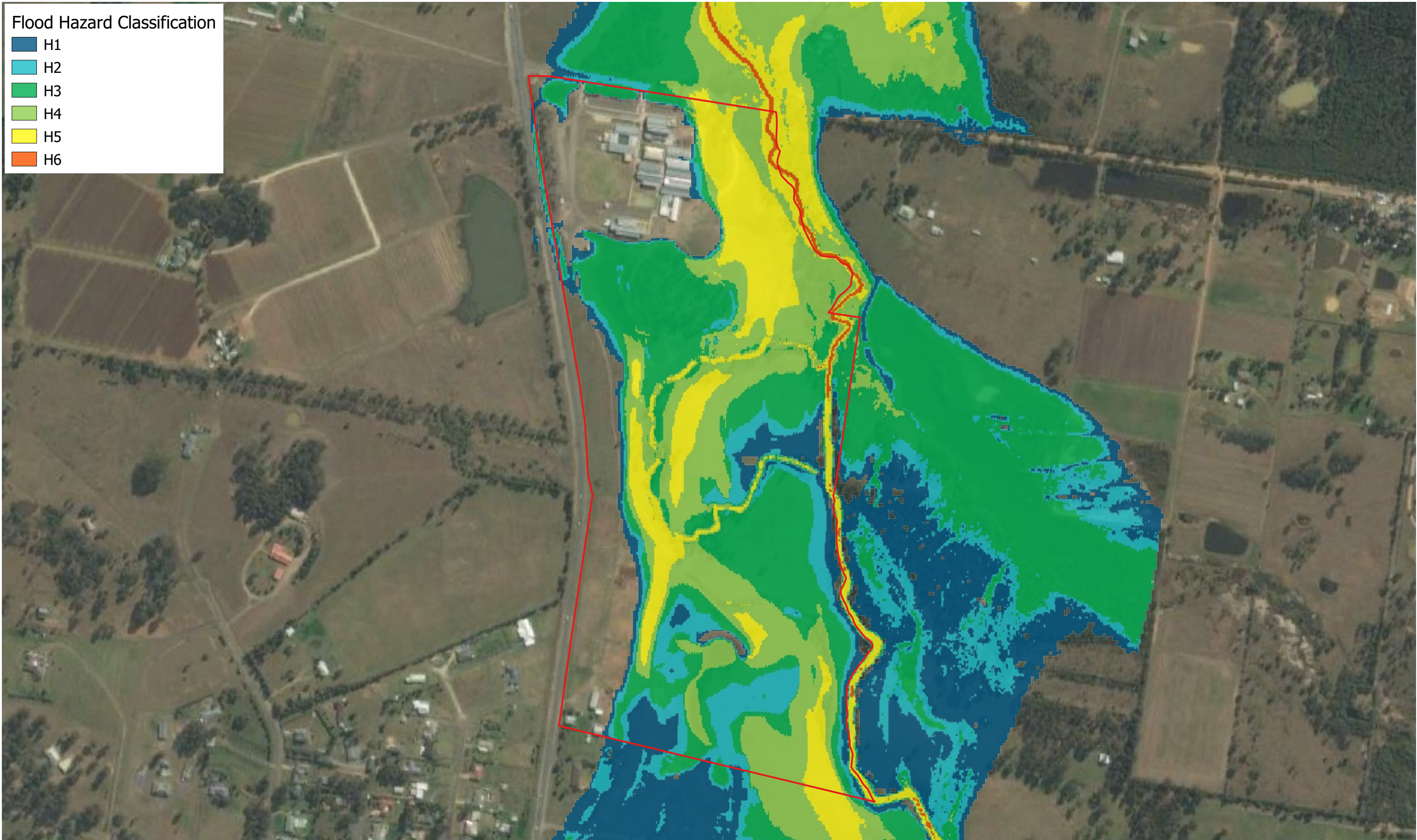
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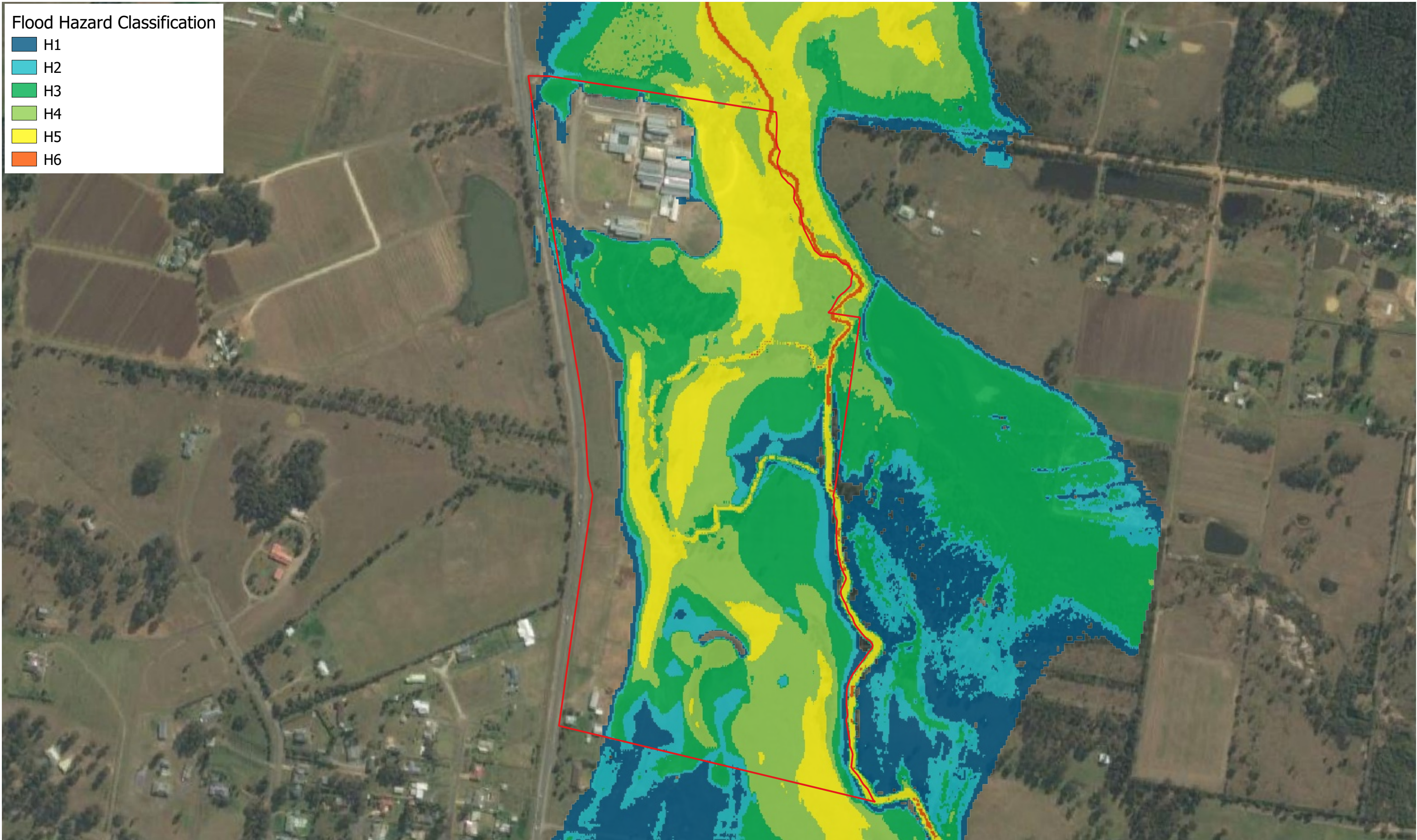
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Legend Site Boundary	Title: 5% AEP Pre-development Peak Flood Hazard		Drawing: B-19	Rev: A
	BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.	0100200 m	 www.bmt.org	
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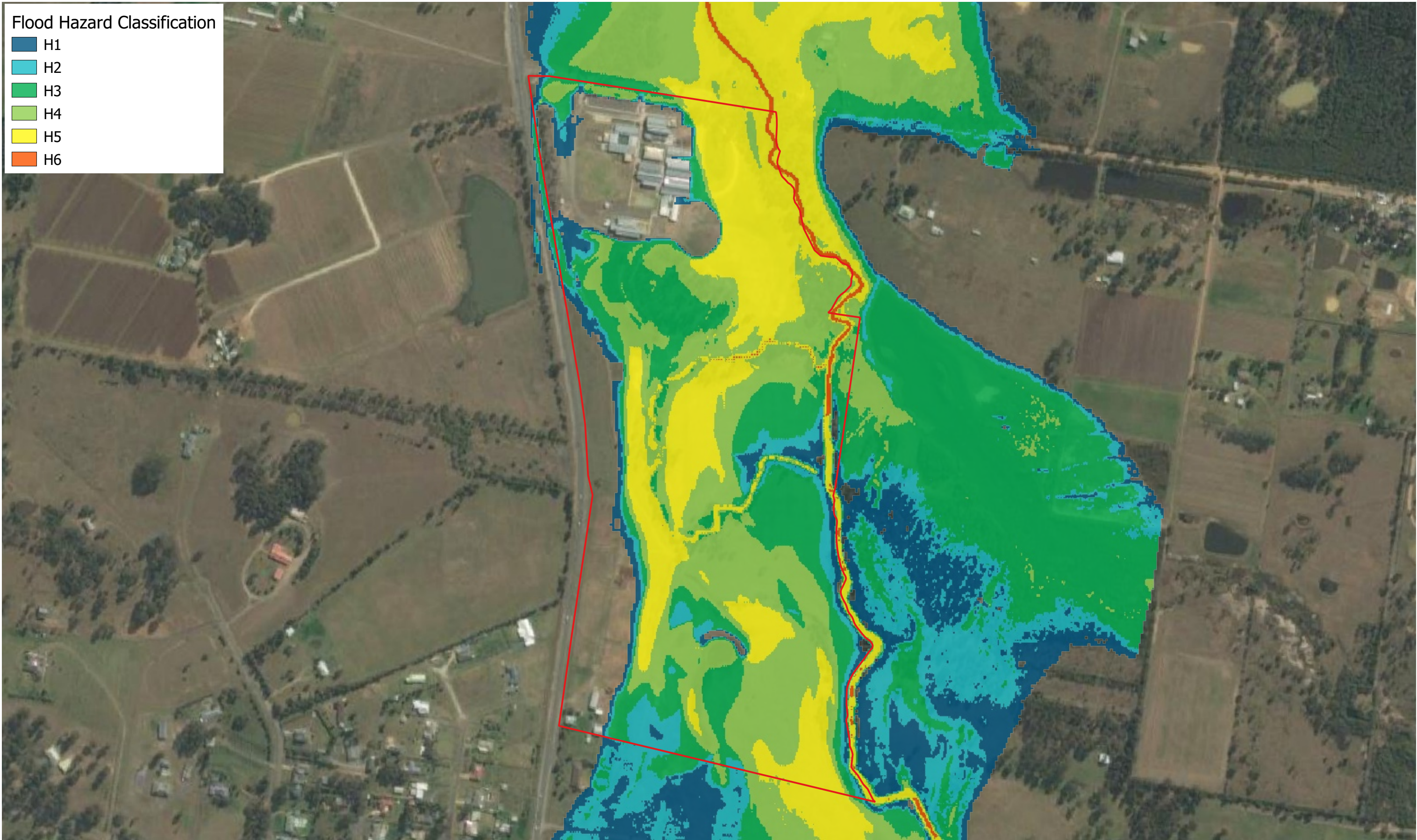
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	BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.	0100200 m	 www.bmt.org
Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\A11230_StPhilipsCC_Cessnock_FIA\MapInfo\AnnexB\AnnexB.qgz			



Flood Hazard Classification

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

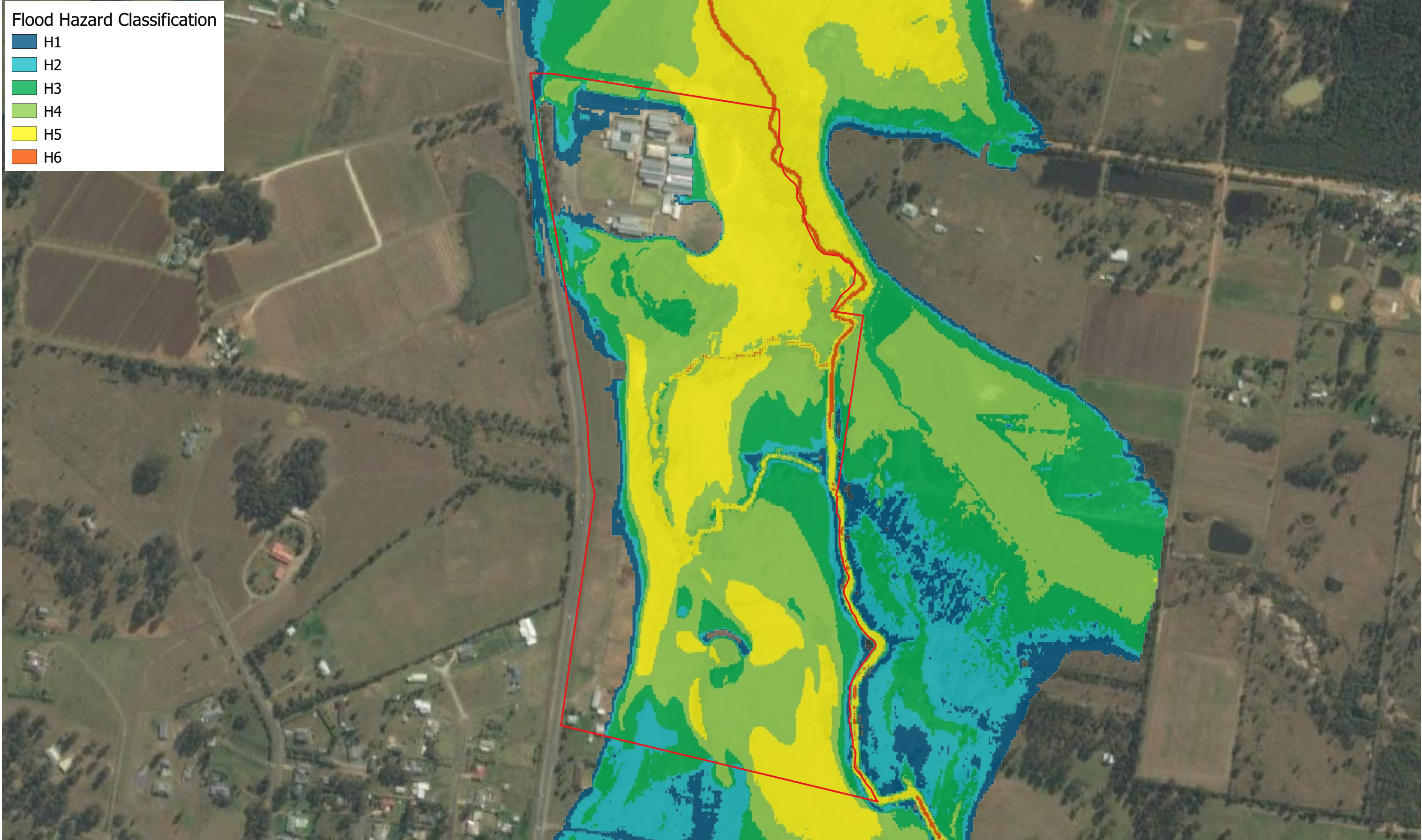
Legend Site Boundary	Title: 1% AEP Pre-development Peak Flood Hazard BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map. 0 100 200 m Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\A11230_StPhilipsCC_Cessnock_FIA\MapInfo\AnnexB\AnnexB.qgz	Drawing: B-21 Rev: A  BMT www.bmt.org
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Legend Site Boundary	Title: 0.5% AEP Pre-development Peak Flood Hazard		Drawing: B-22	Rev: A
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Flood Hazard Classification

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

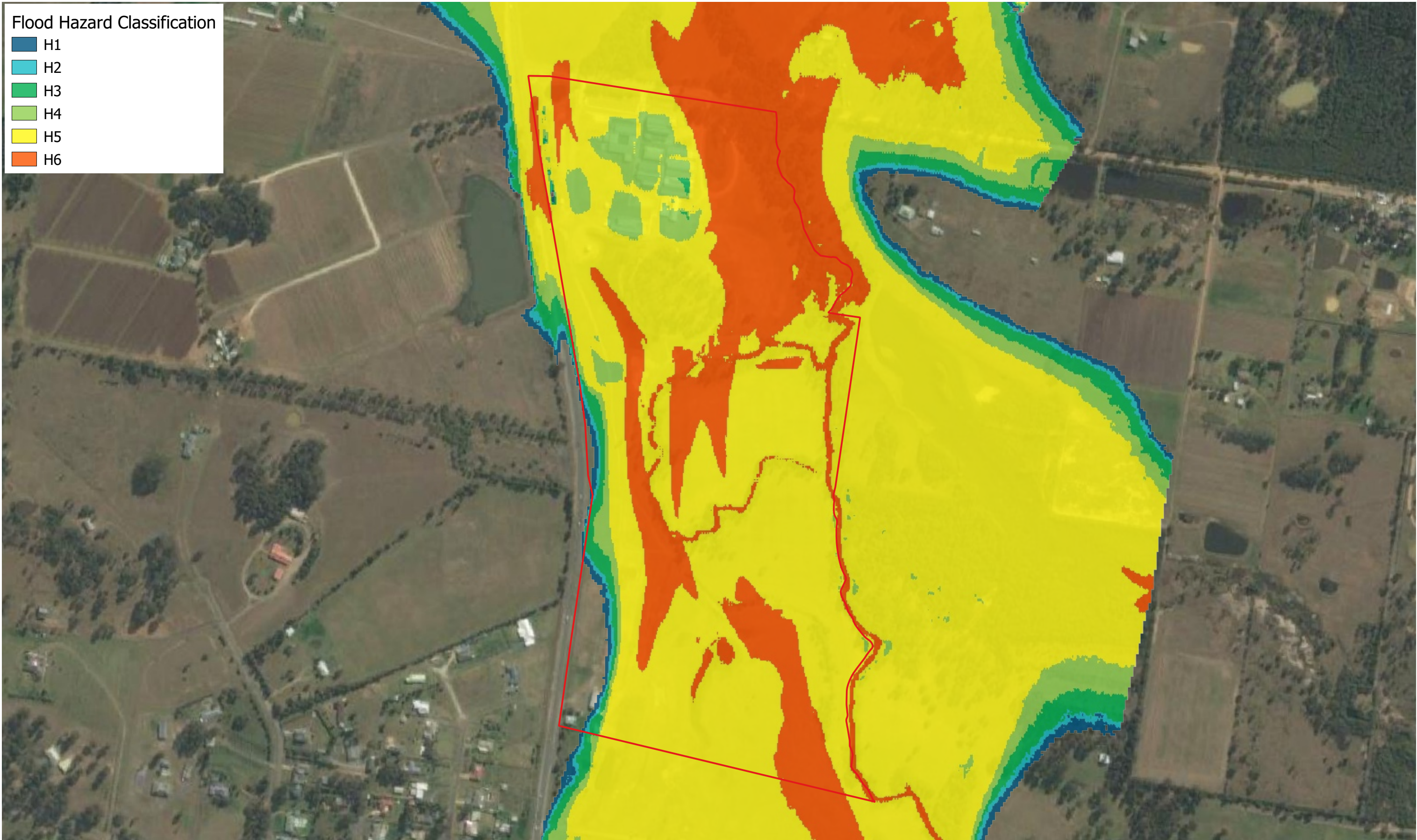


Legend

Site Boundary

Title: 0.2% AEP Pre-development Peak Flood Hazard		Drawing: B-23	Rev: A
BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.		0100200 m	
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Legend Site Boundary	Title: PMF Pre-development Peak Flood Hazard	Drawing: B-24	Rev: A
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Annex C: Post-development Flood Maps



Legend

-  Site Boundary
-  Development Layout

Title:

20% AEP Post-development Peak Flood Level

Drawing:

C-1

Rev:

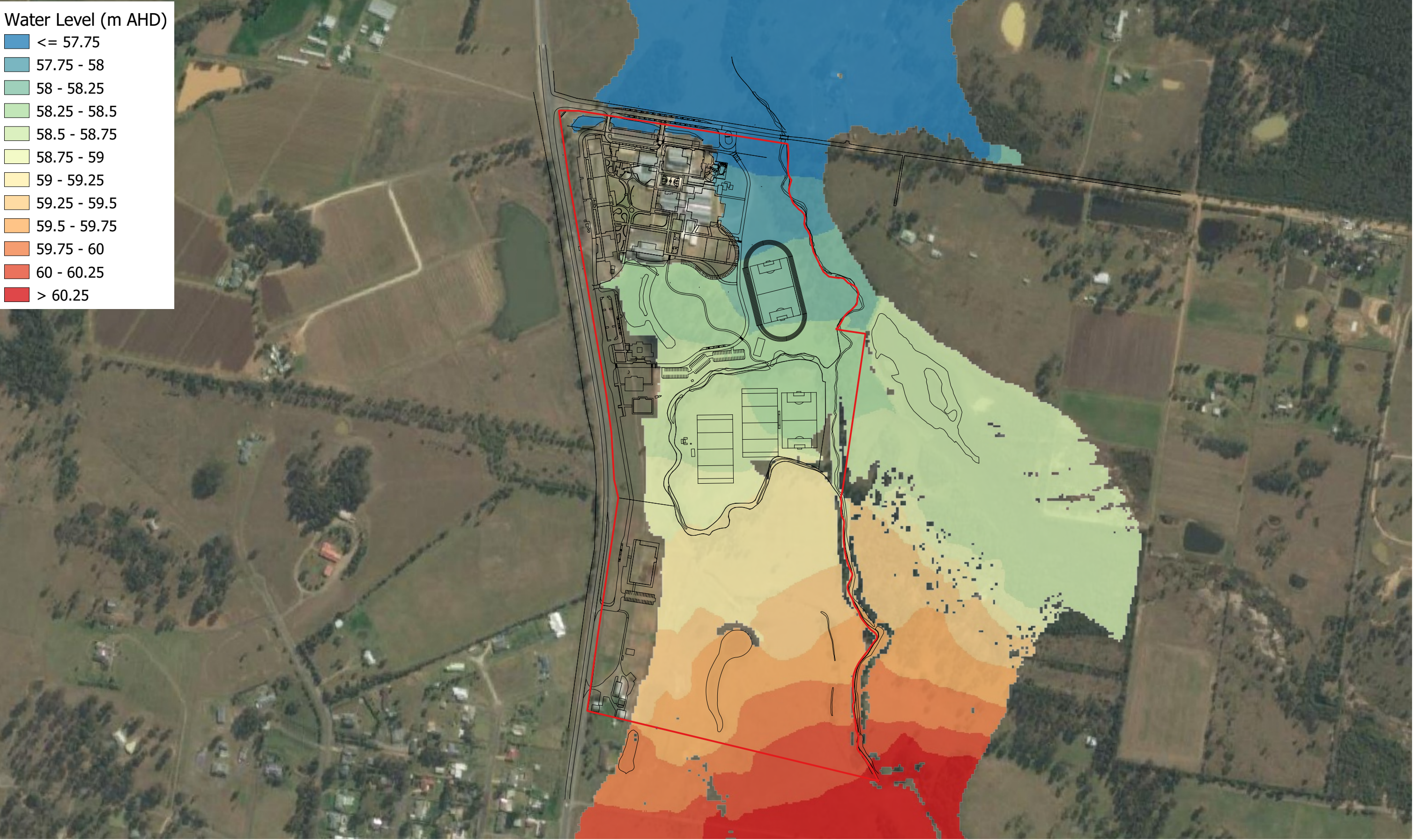
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0 150 300 m



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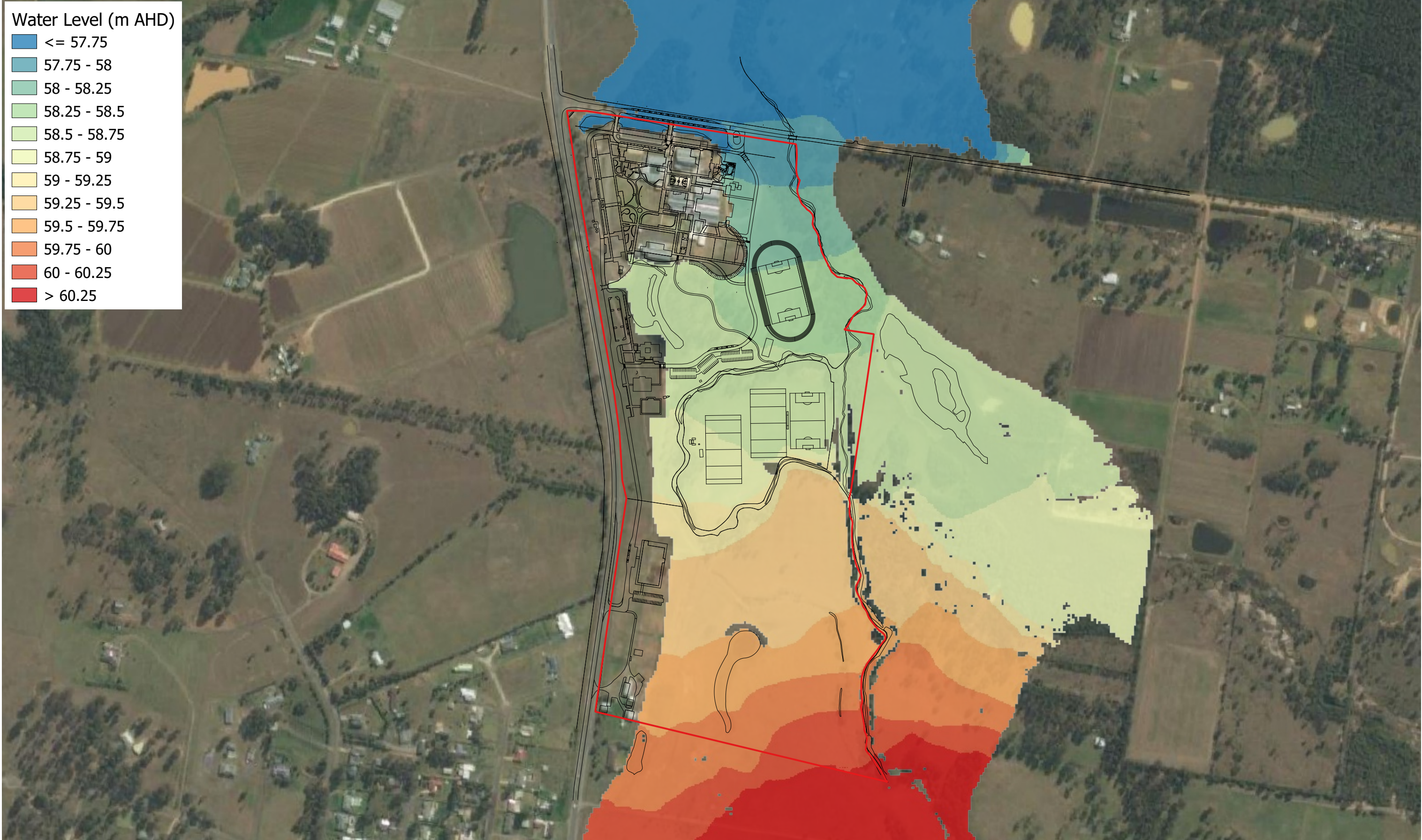


Legend

-  Site Boundary
-  Development Layout

Title: 10% AEP Post-development Peak Flood Level		Drawing: C-2	Rev: A
BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.			
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Legend

-  Site Boundary
-  Development Layout

Title:

5% AEP Post-development Peak Flood Level

Drawing:

C-3

Rev:

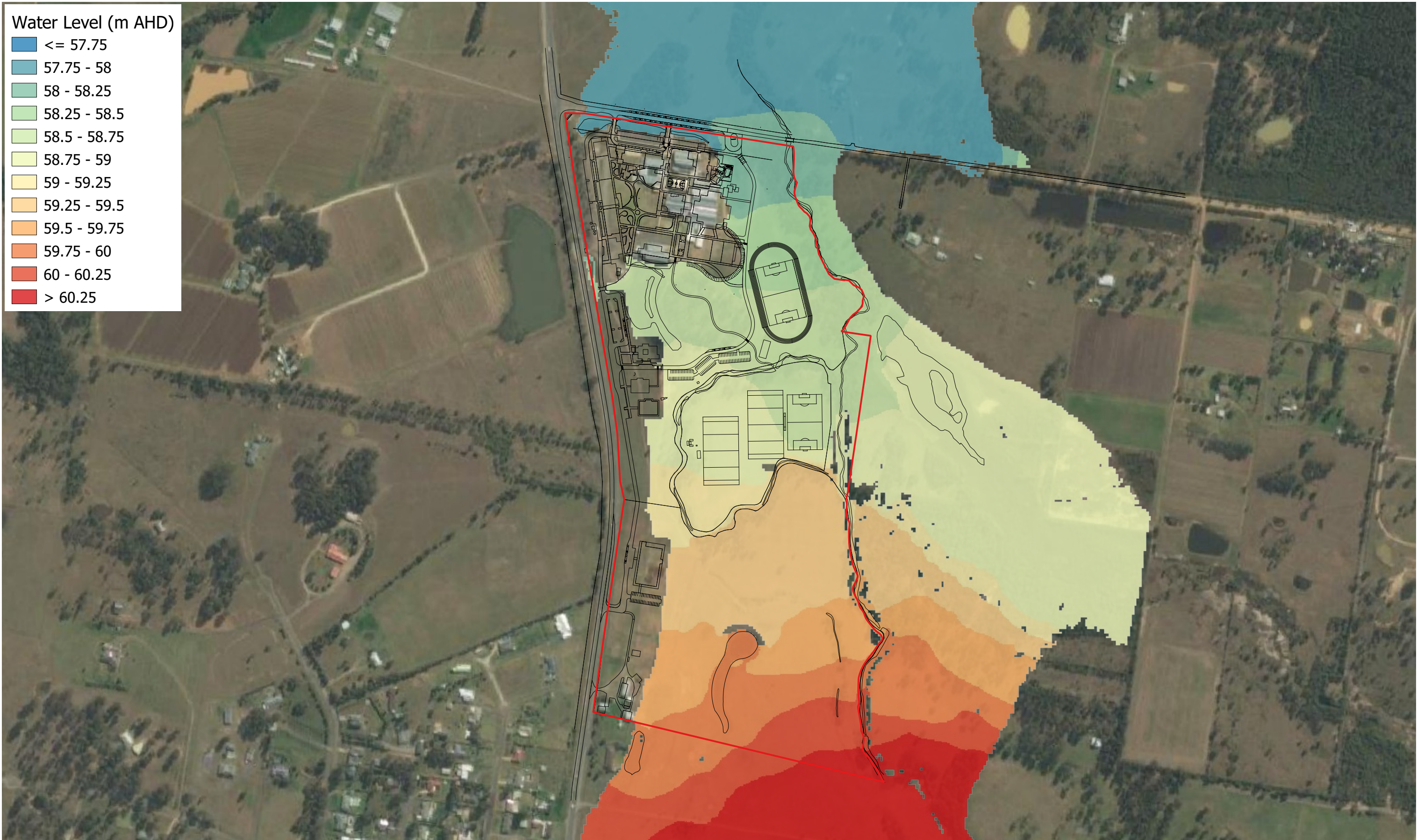
A

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0 150 300 m



Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\A11230_StPhilipsCC_Cessnock_FIA\MapInfo\AnnexC\AnnexC.qgz



Legend

-  Site Boundary
-  Development Layout

Title:

2% AEP Post-development Peak Flood Level

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0 150 300 m



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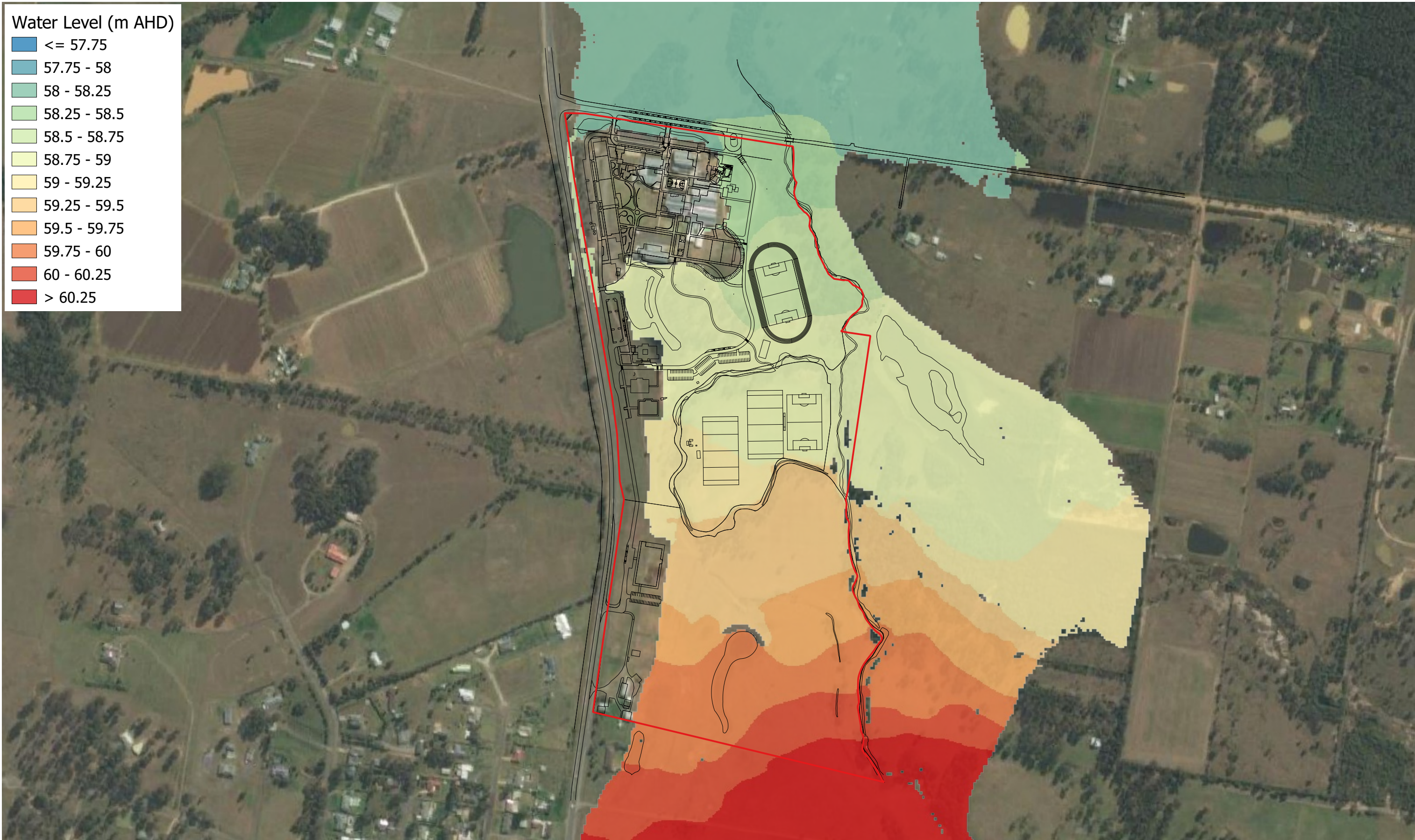
Drawing:

C-4

Rev:

A





Legend

- Site Boundary
- Development Layout

Title:

1% AEP Post-development Peak Flood Level

Drawing:

C-5

Rev:

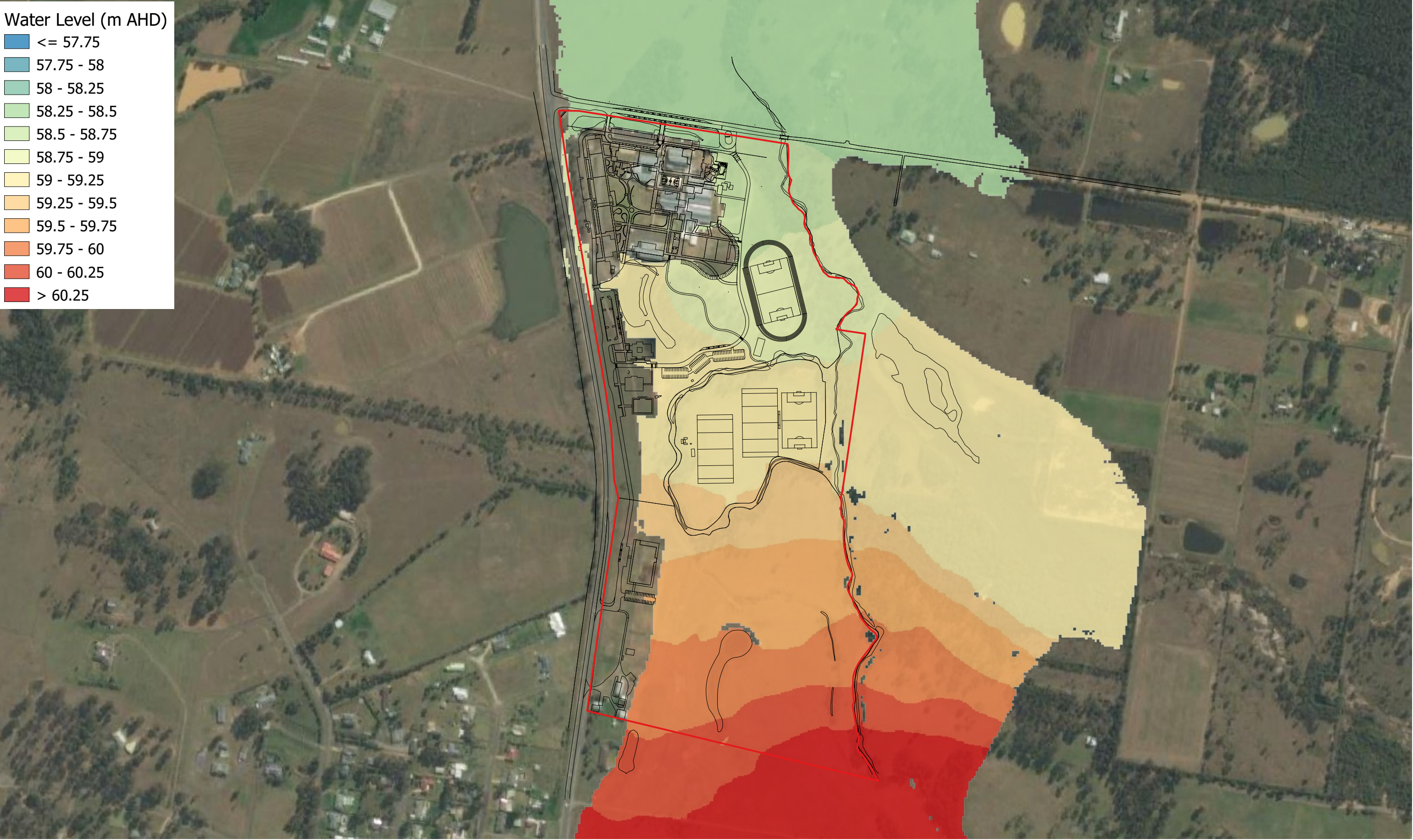
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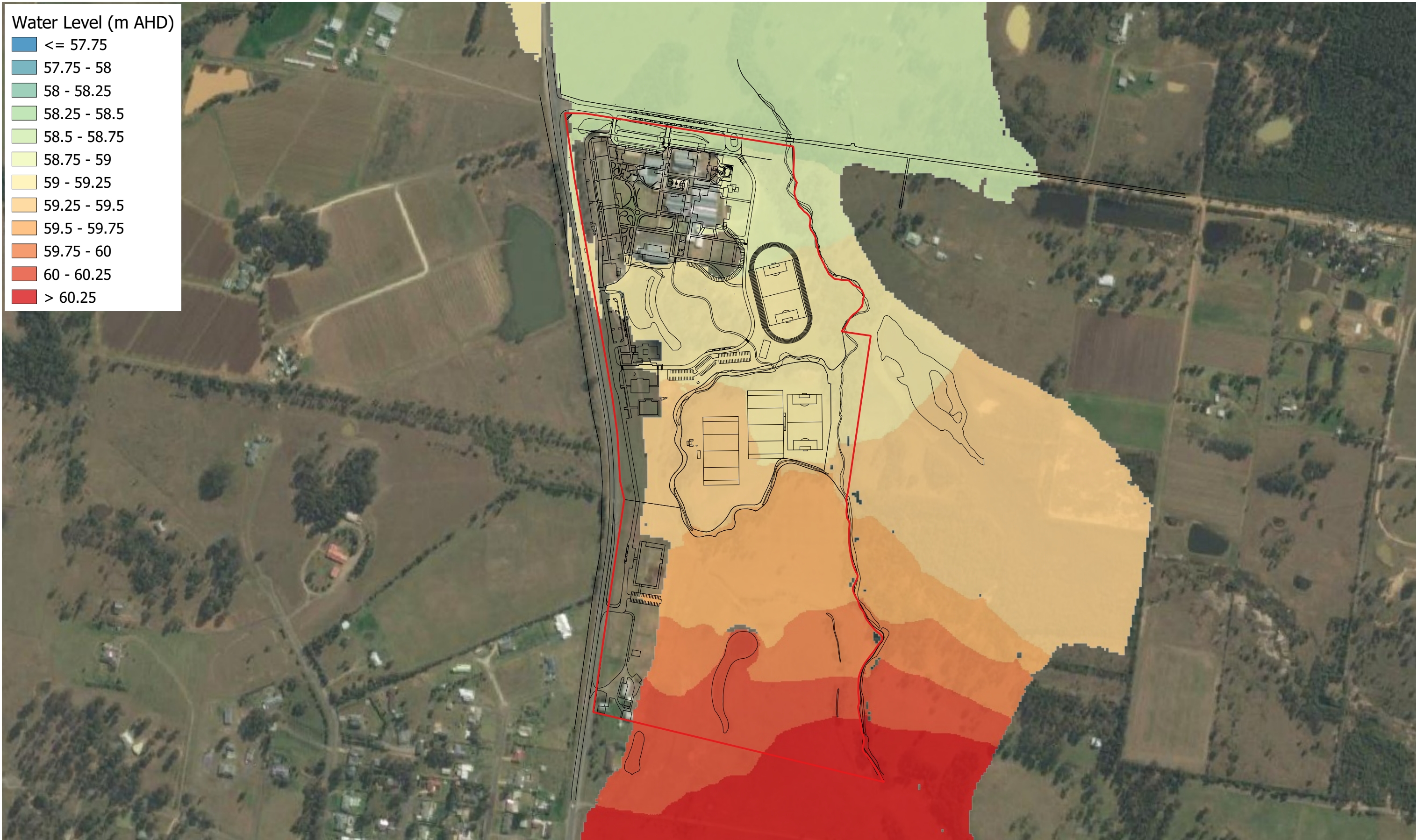
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Legend

-  Site Boundary
-  Development Layout

Title: 0.5% AEP Post-development Peak Flood Level		Drawing: C-6	Rev: A
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Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\A11230_StPhilipsCC_Cessnock_FIA\MapInfo\AnnexC\AnnexC.qgz			



Legend

-  Site Boundary
-  Development Layout

Title:

0.2% AEP Post-development Peak Flood Level

Drawing:

C-7

Rev:

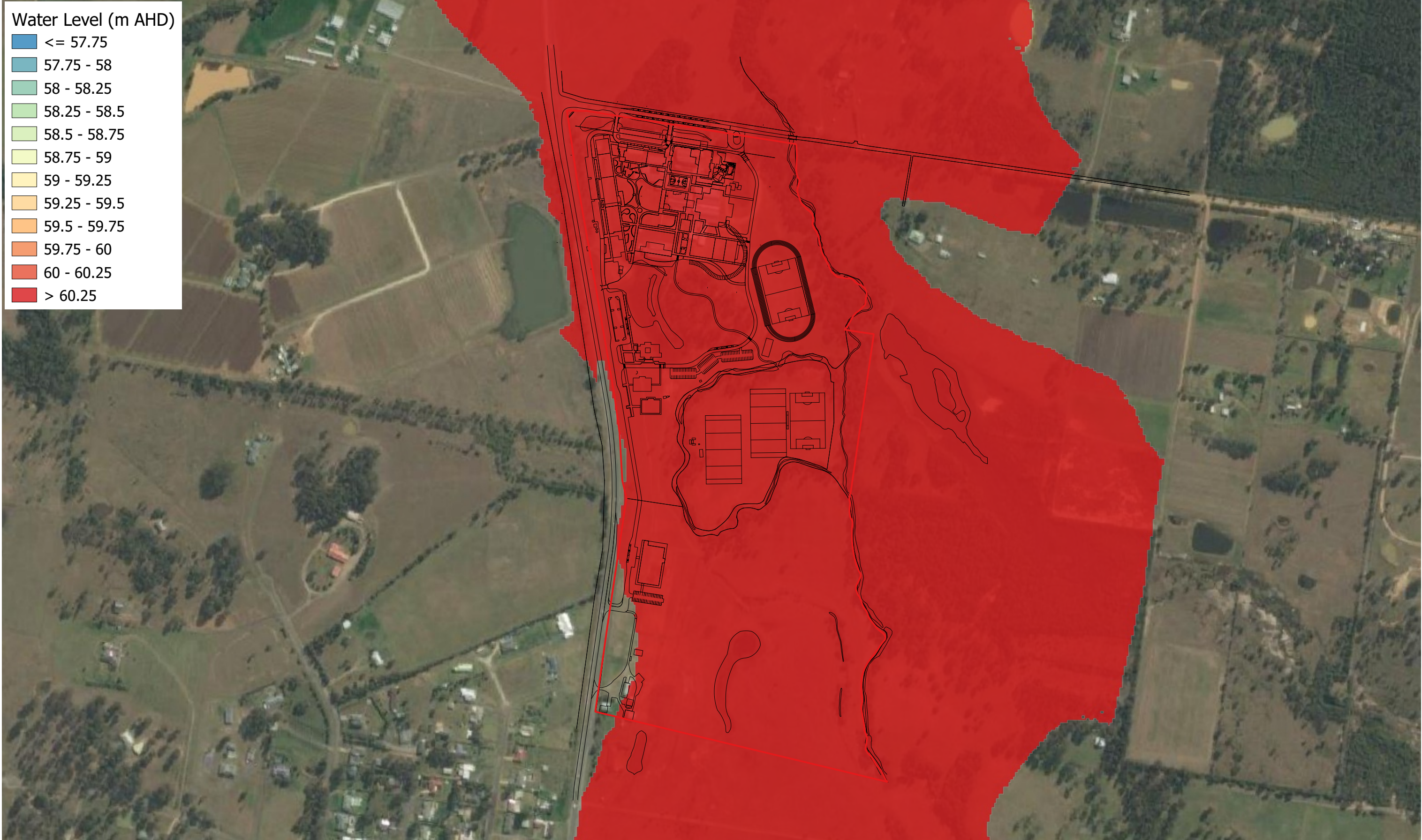
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BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 150 300 m



Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\A11230_StPhilipsCC_Cessnock_FIA\MapInfo\AnnexC\AnnexC.qgz



Legend

-  Site Boundary
-  Development Layout

Title:

PMF Post-development Peak Flood Level

Drawing:

C-8

Rev:

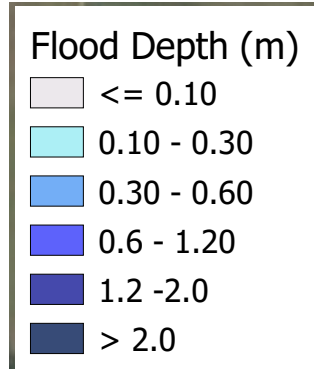
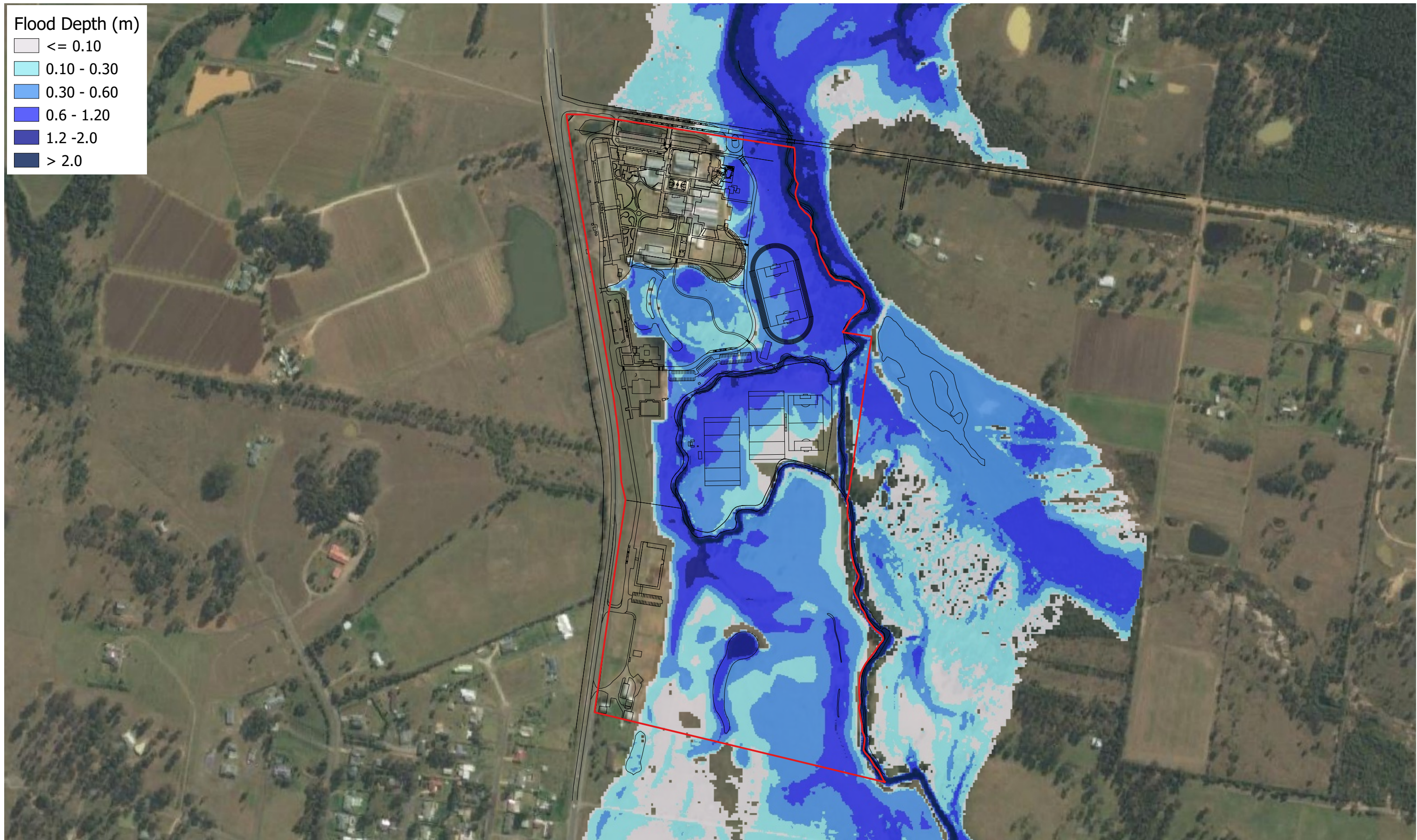
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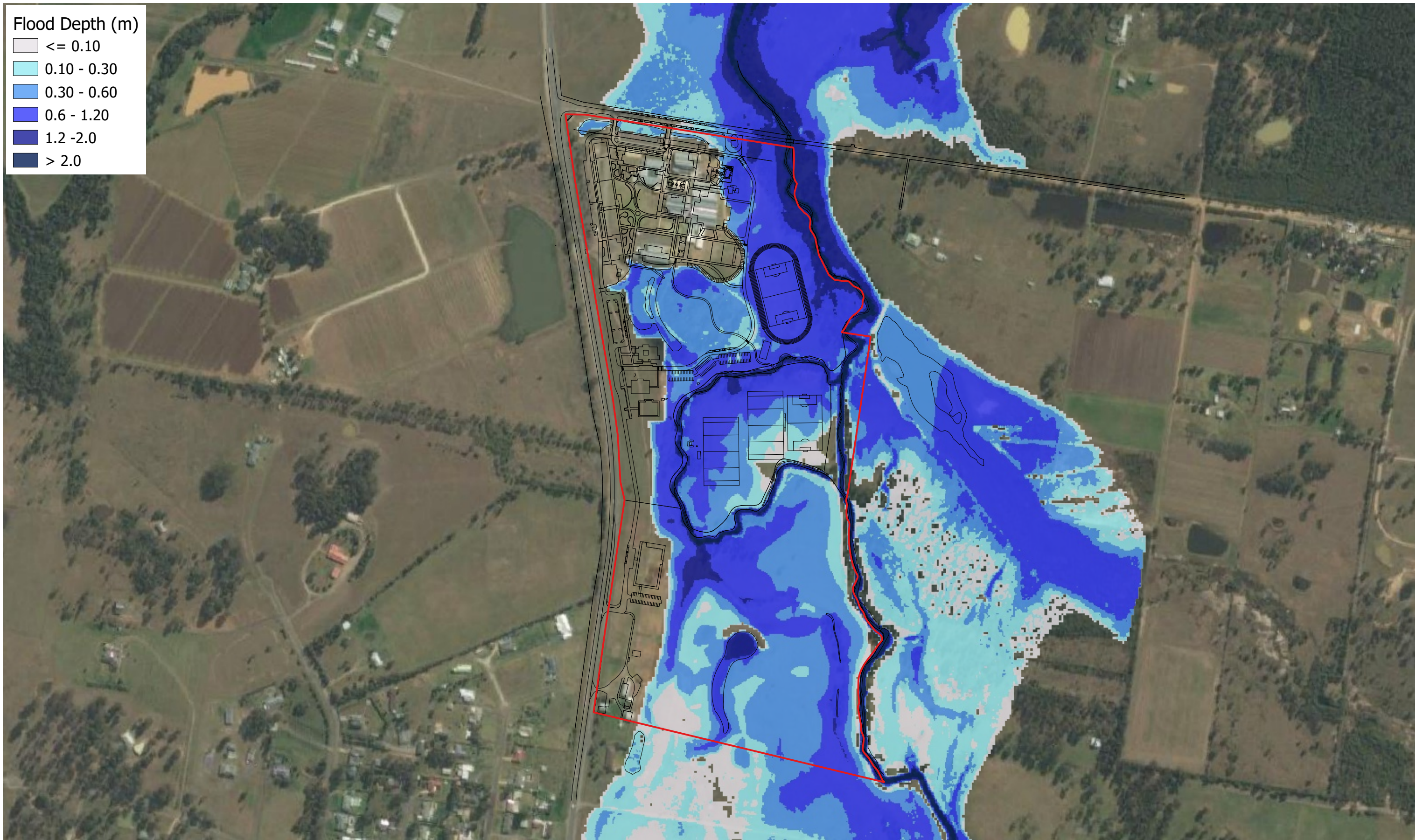
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Legend Site Boundary Development Layout	Title: 20% AEP Post-development Peak Flood Depth	Drawing: C-9	Rev: A	
	BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.	0150300 m	 www.bmt.org	
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Legend

- Site Boundary
- Development Layout

Title:

10% AEP Post-development Peak Flood Depth

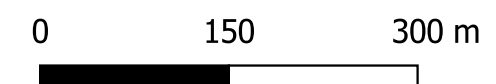
Drawing:

C-10

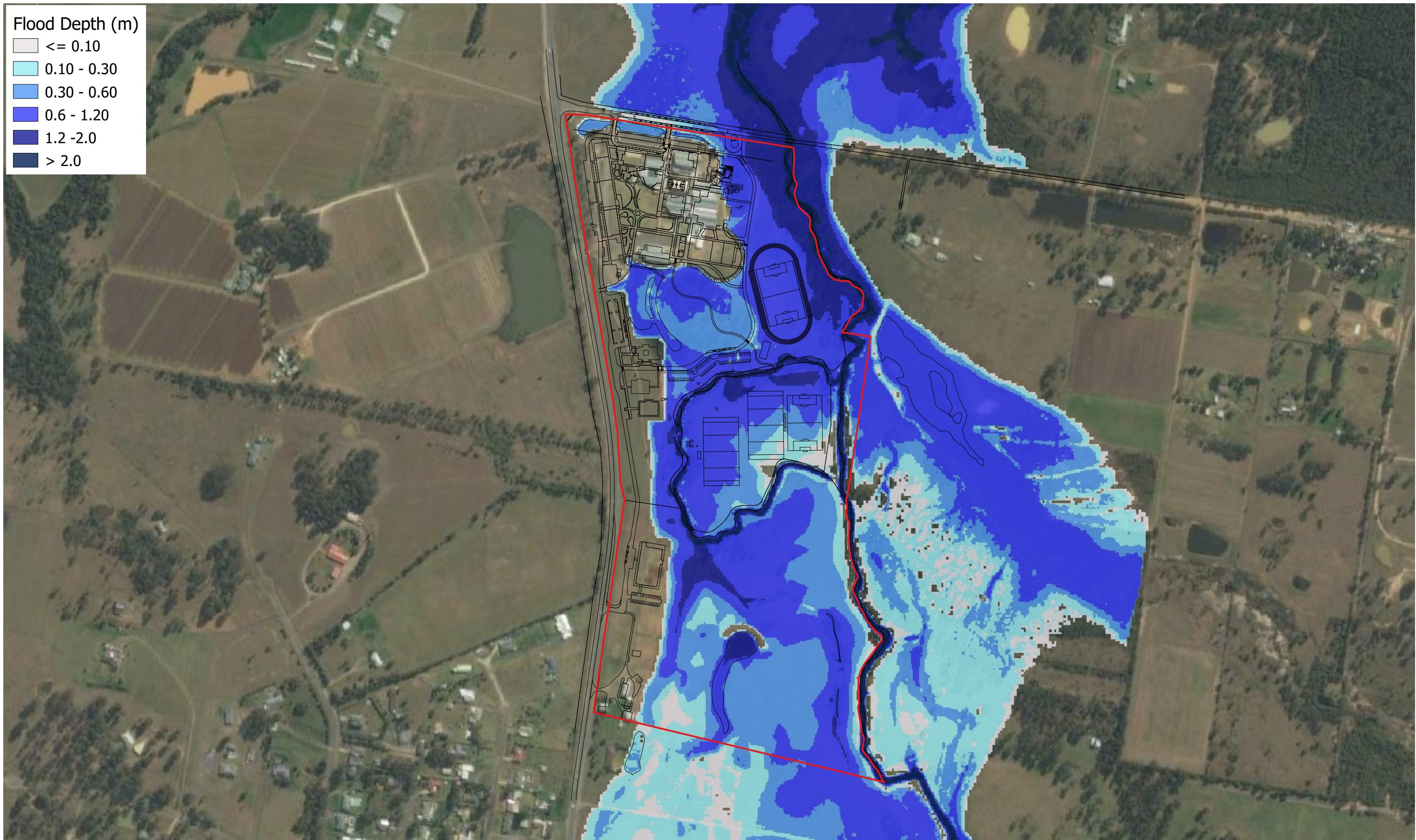
Rev:

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BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



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Legend

- Site Boundary
- Development Layout

Title:

5% AEP Post-development Peak Flood Depth

Drawing:

C-11

Rev:

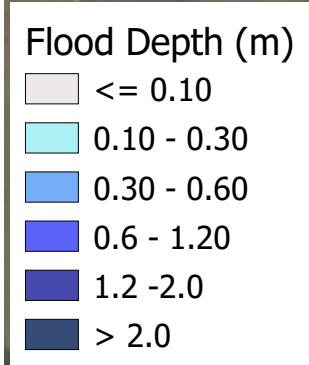
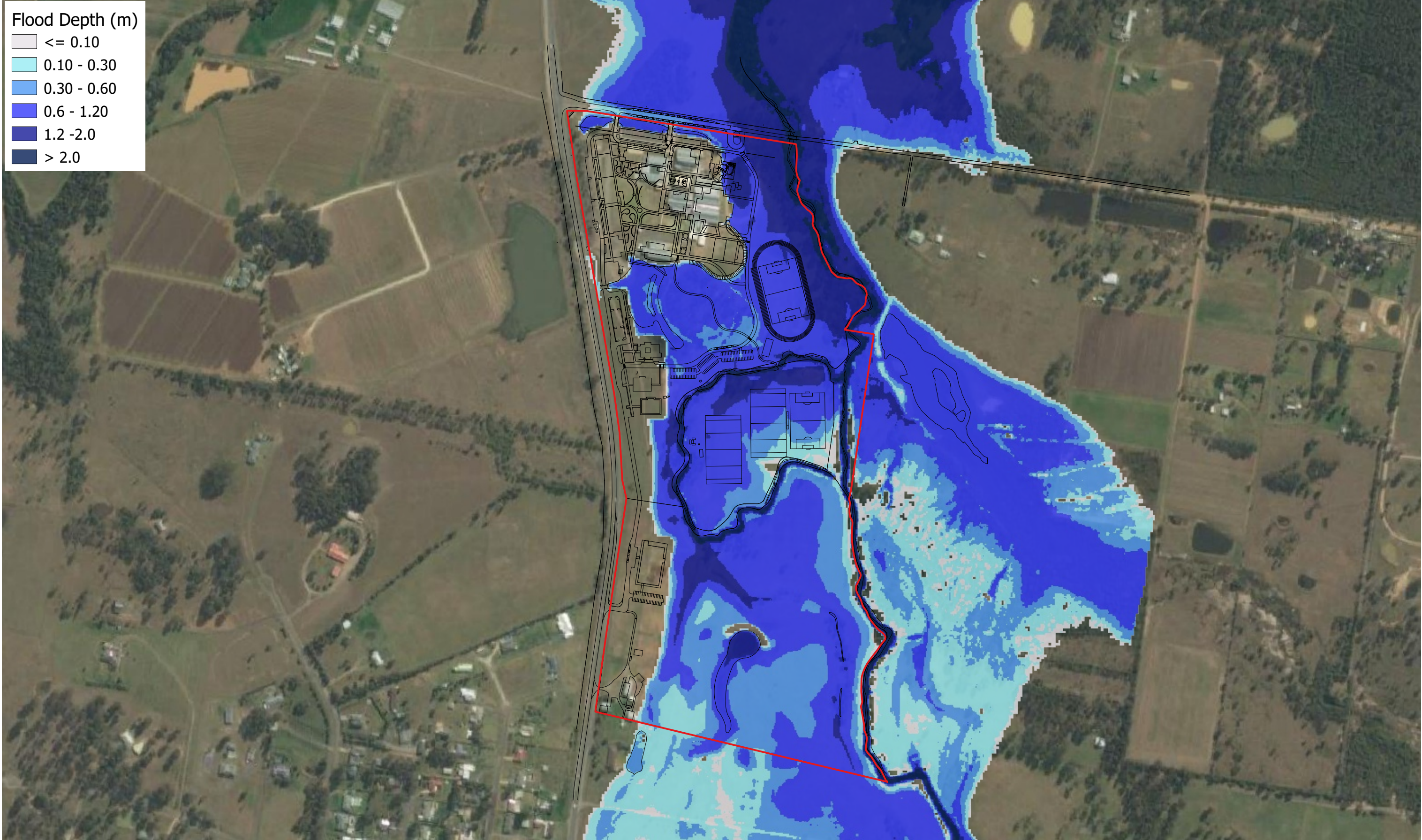
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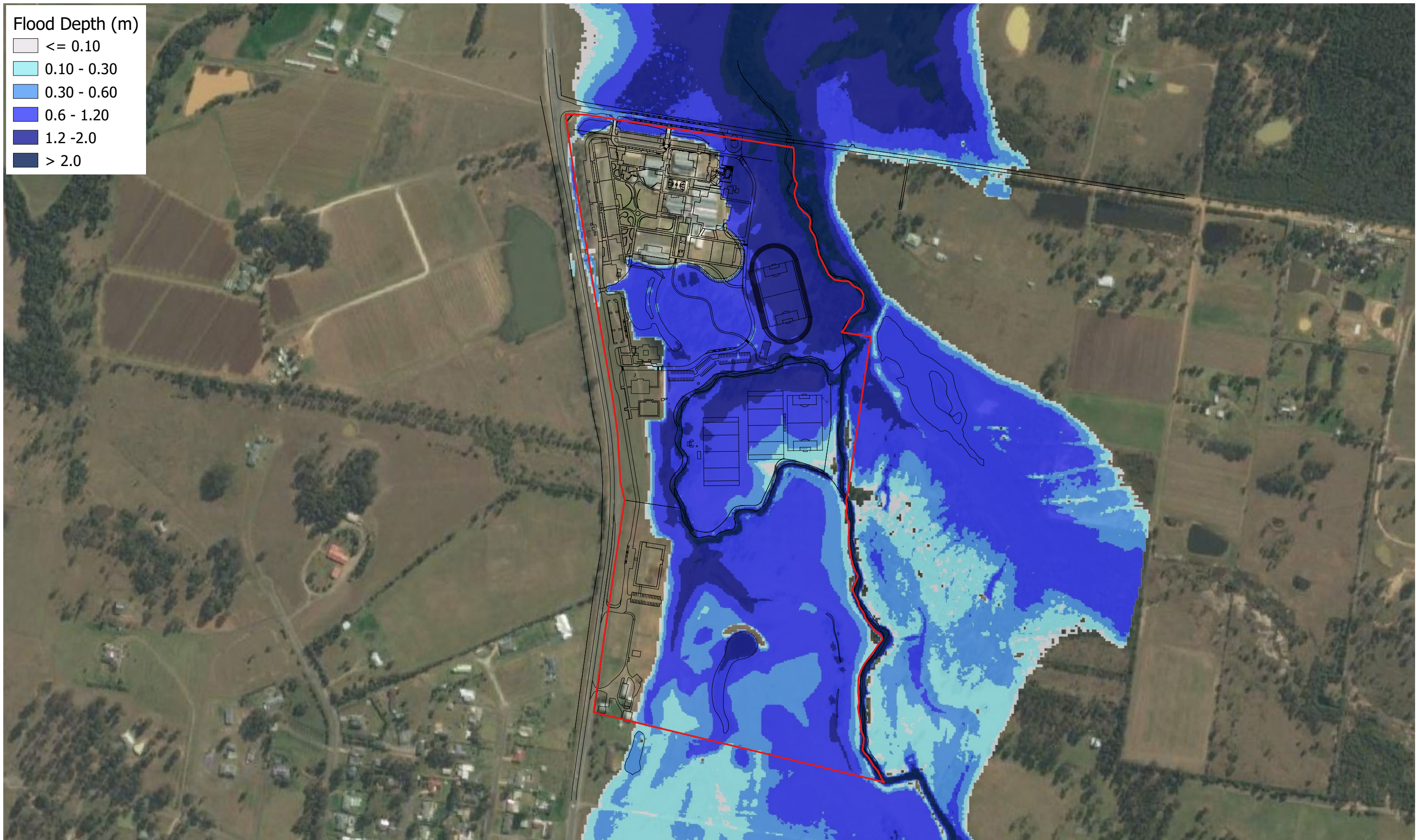
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	BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.	0150300 m	 www.bmt.org
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Legend

- Site Boundary
- Development Layout

Title:

1% AEP Post-development Peak Flood Depth

Drawing:

C-13

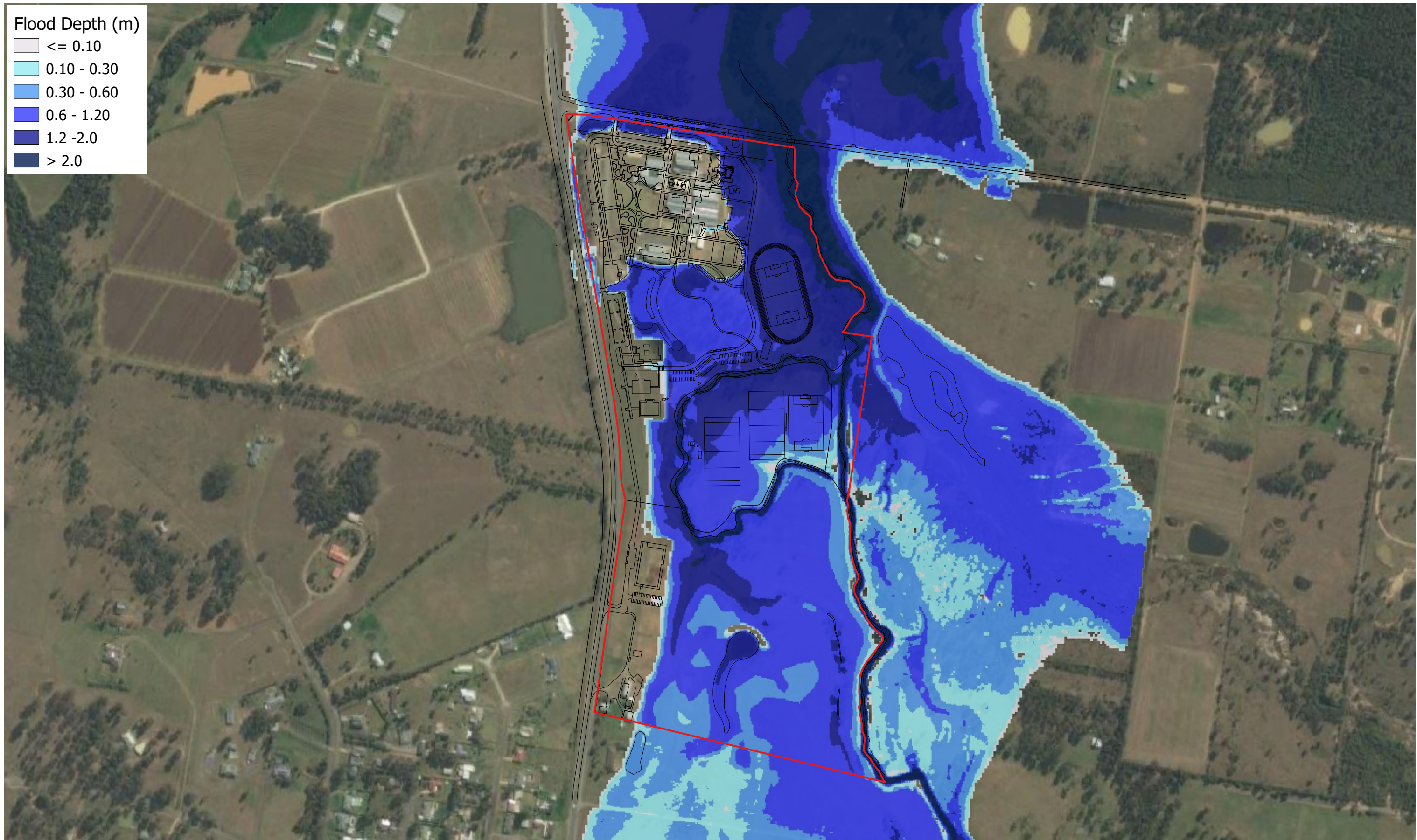
Rev:

A

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Legend

- Site Boundary
- Development Layout

Title:

0.5% AEP Post-development Peak Flood Depth

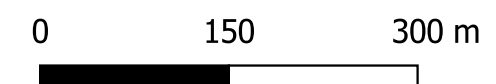
Drawing:

C-14

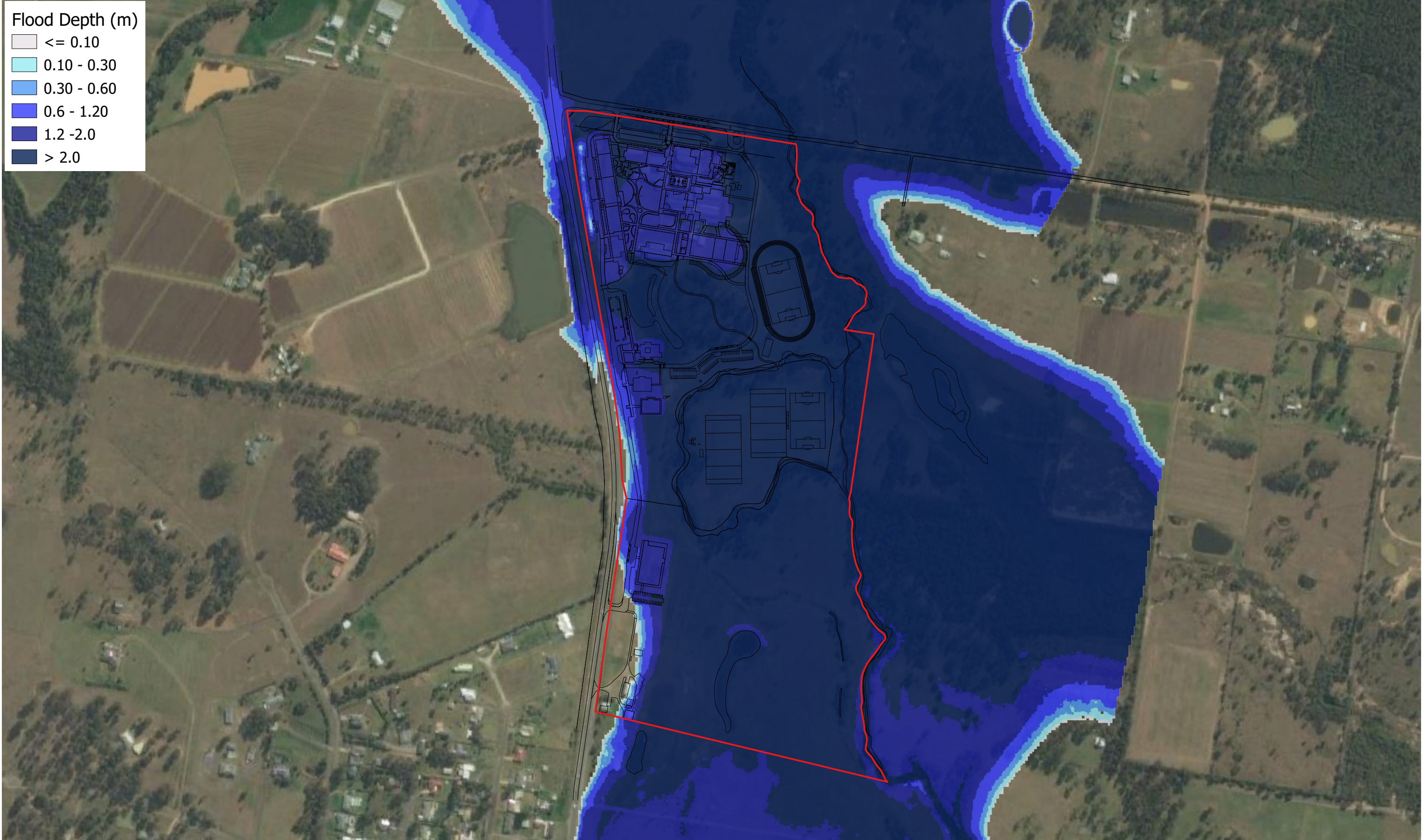
Rev:

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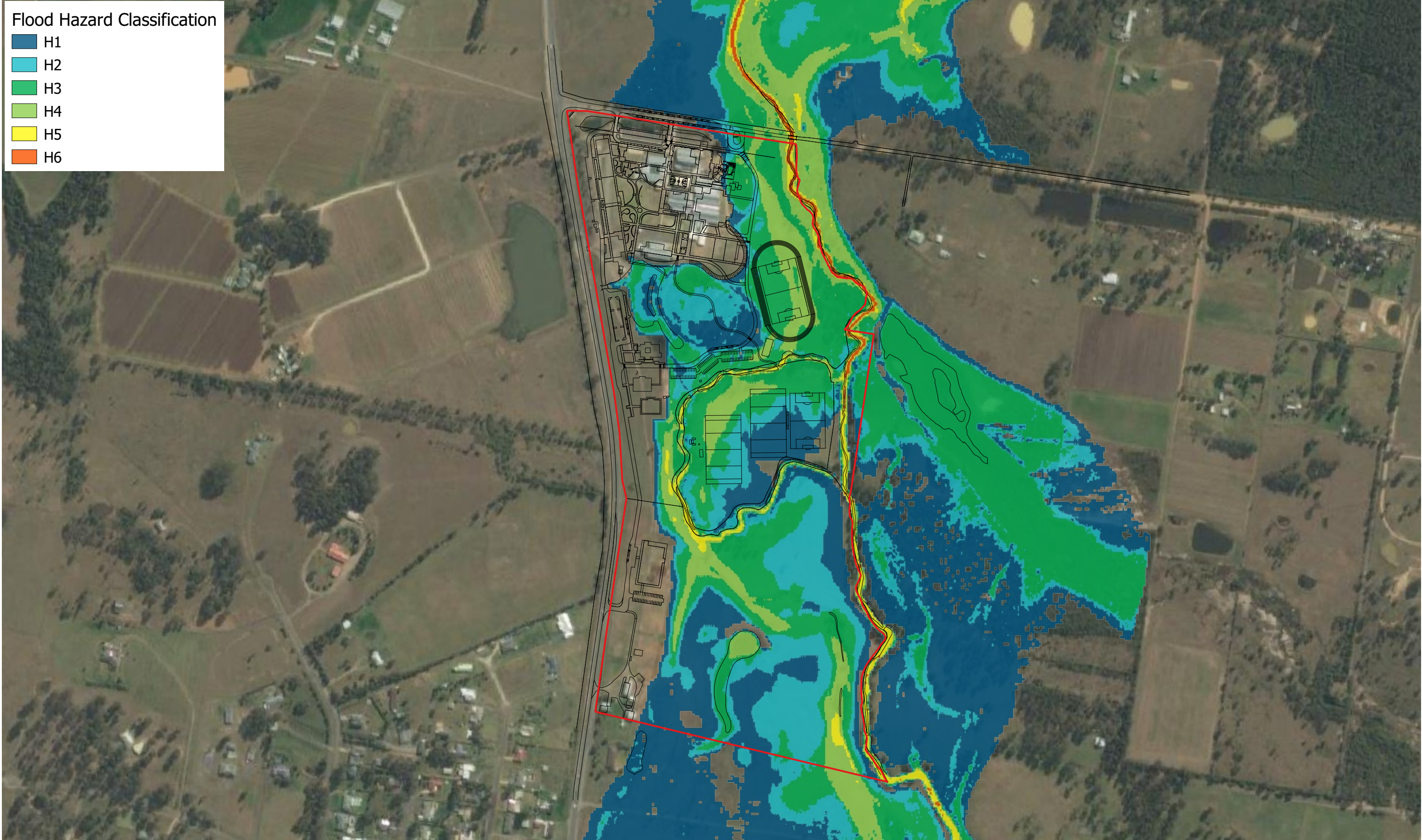
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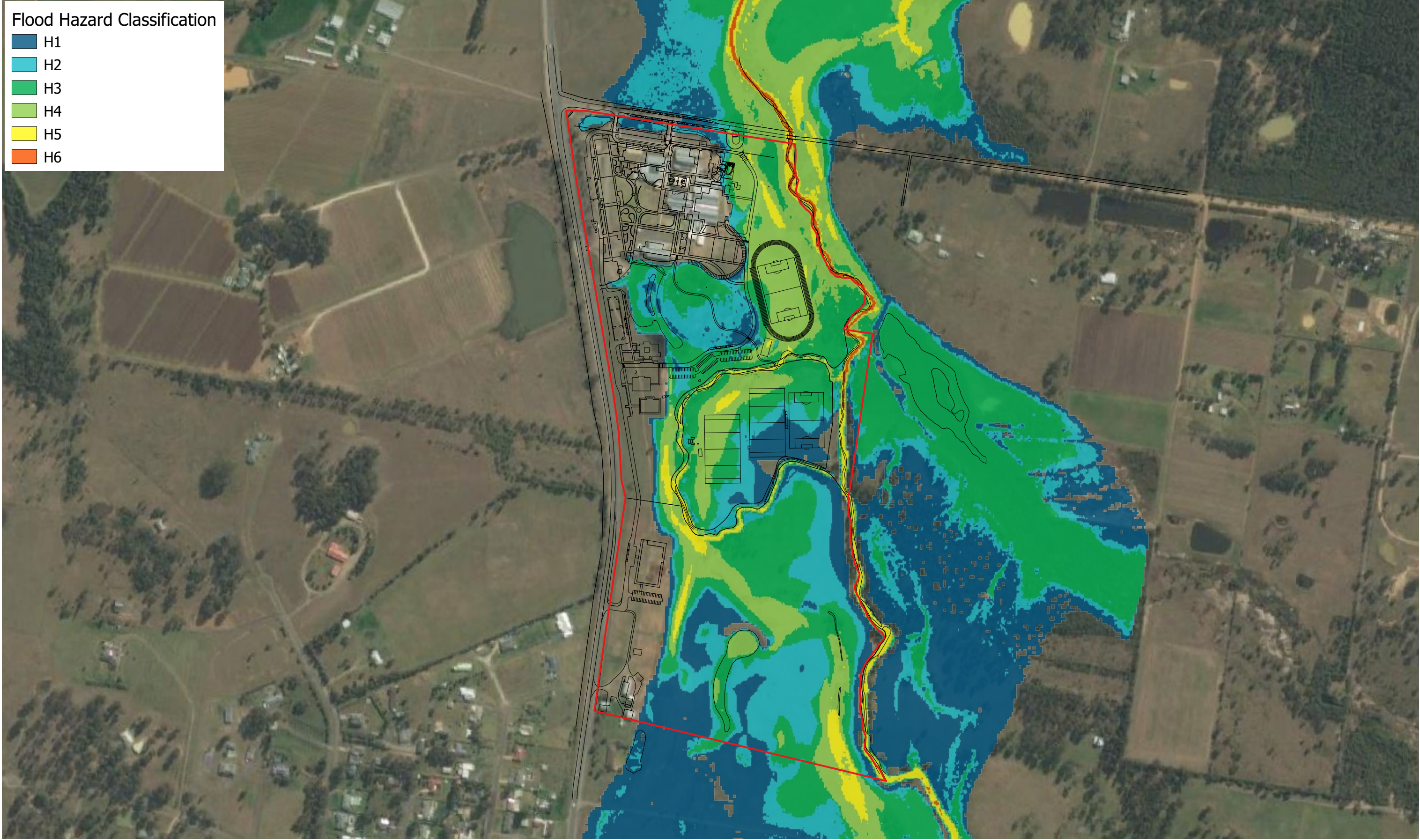
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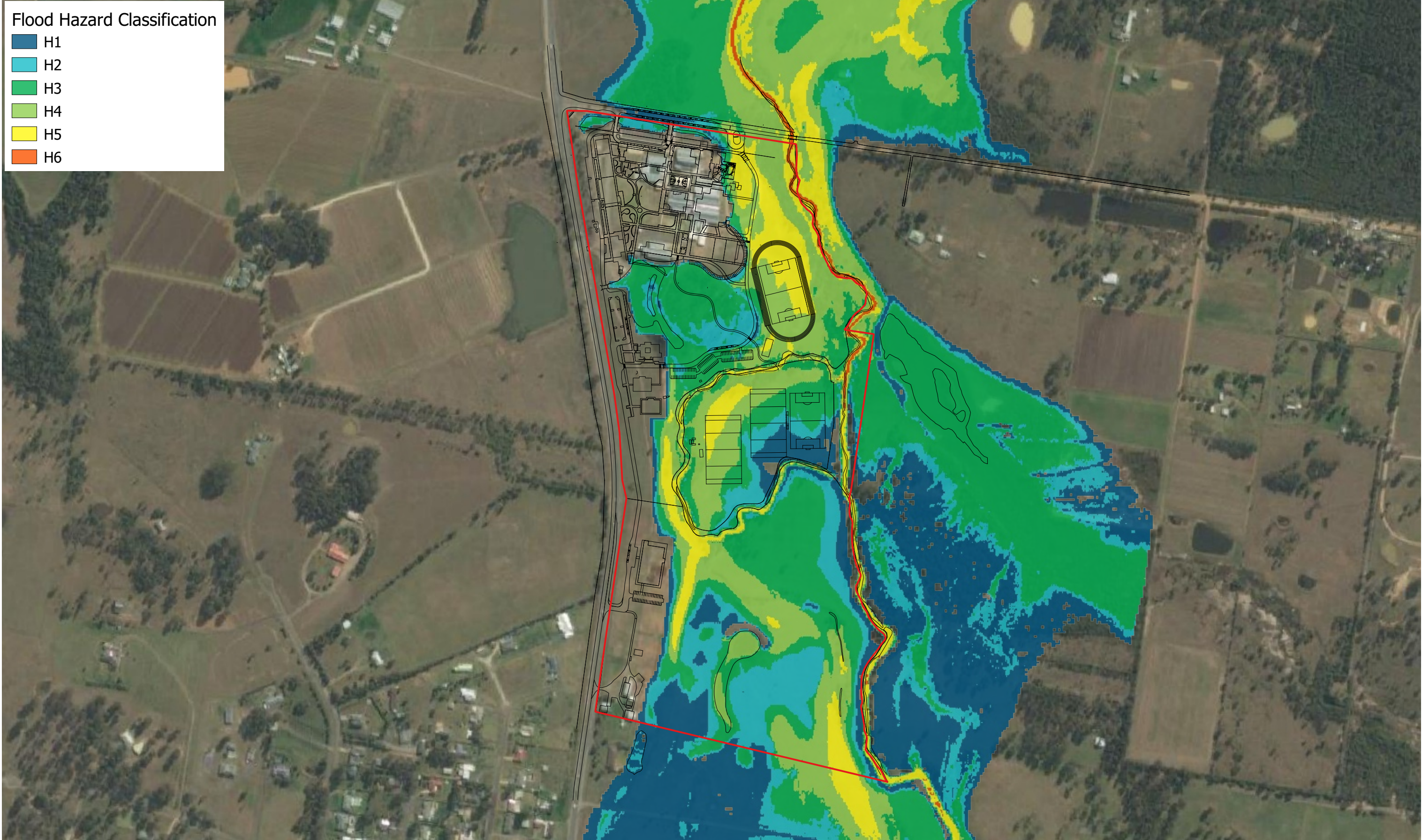
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Flood Hazard Classification

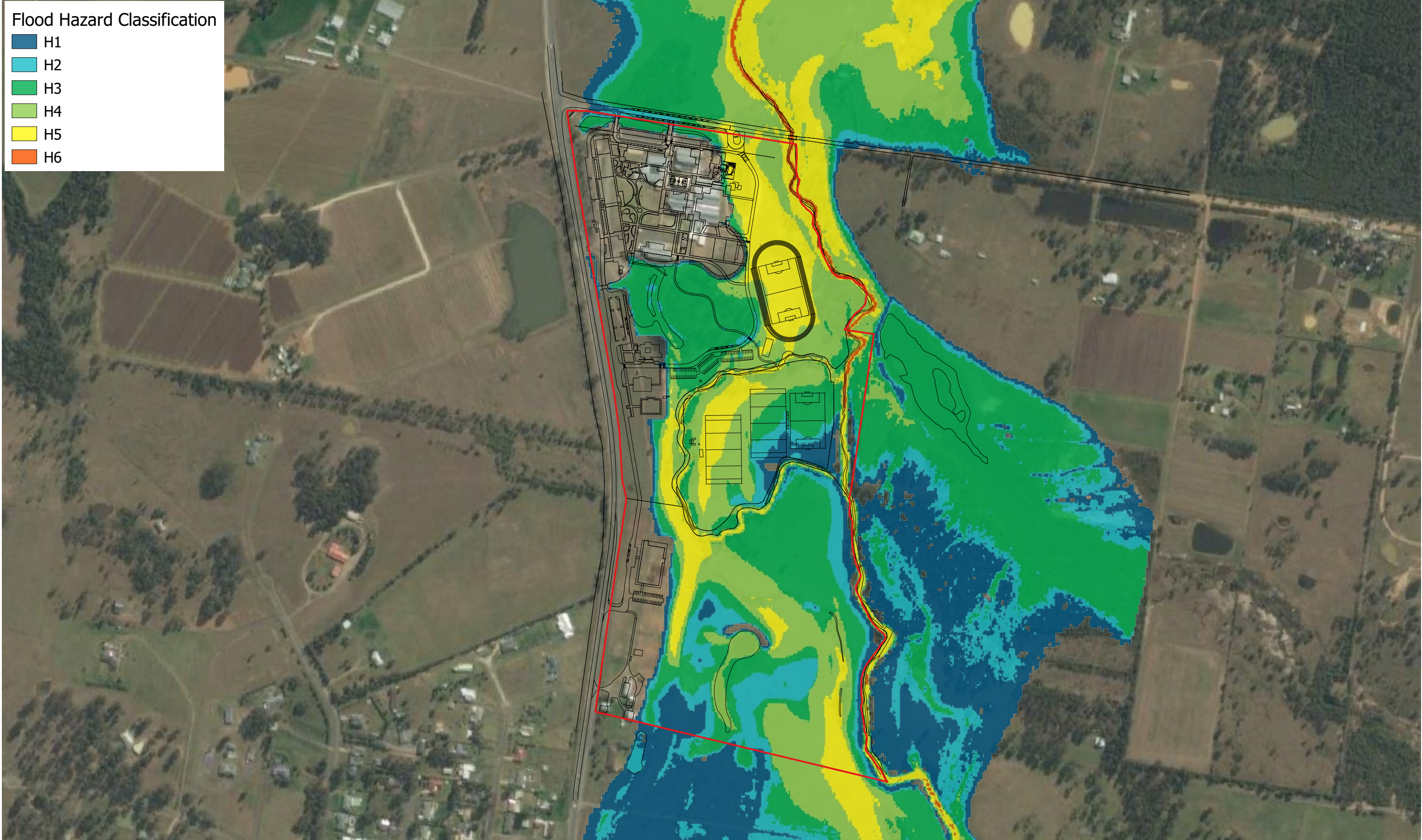
- H1
- H2
- H3
- H4
- H5
- H6



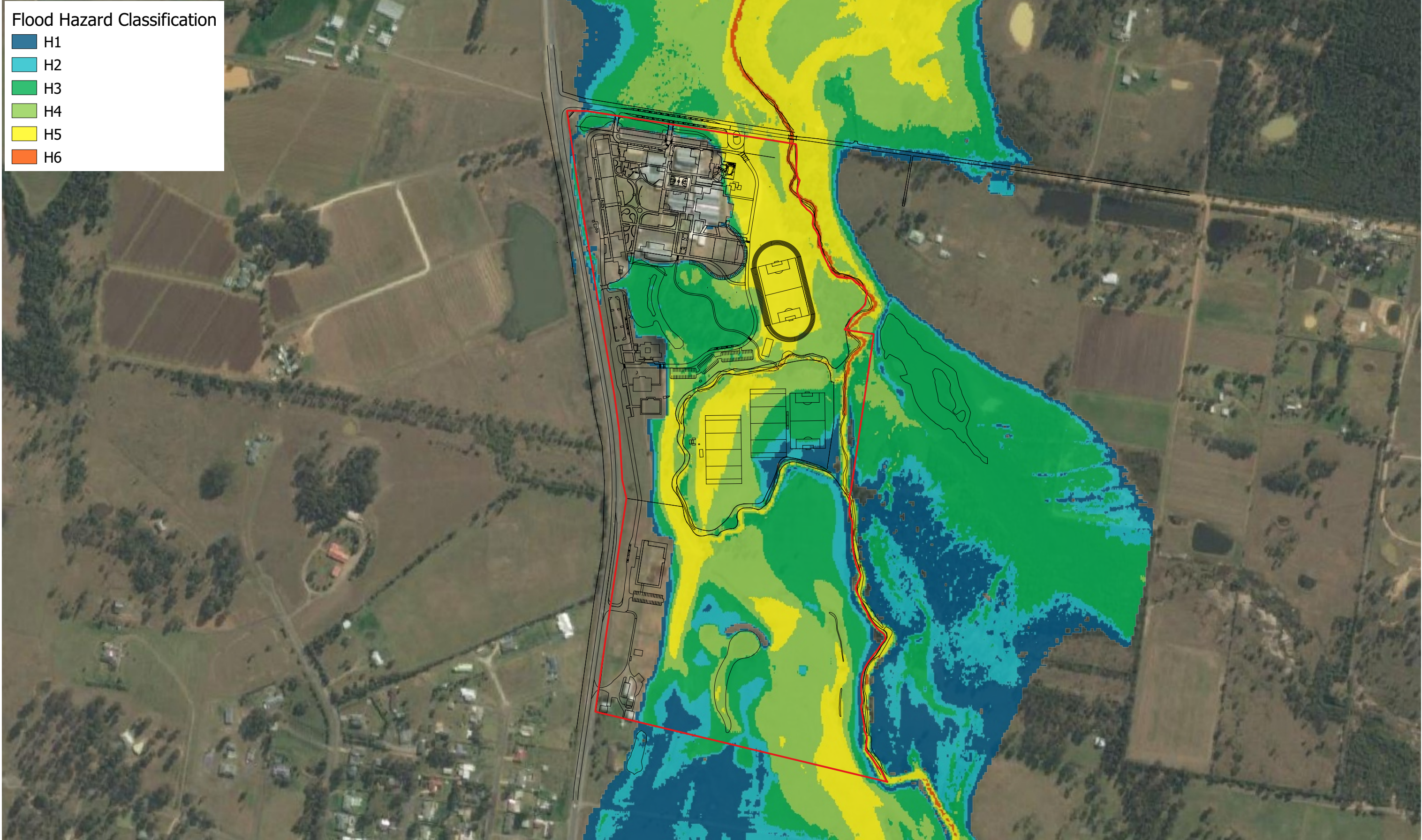
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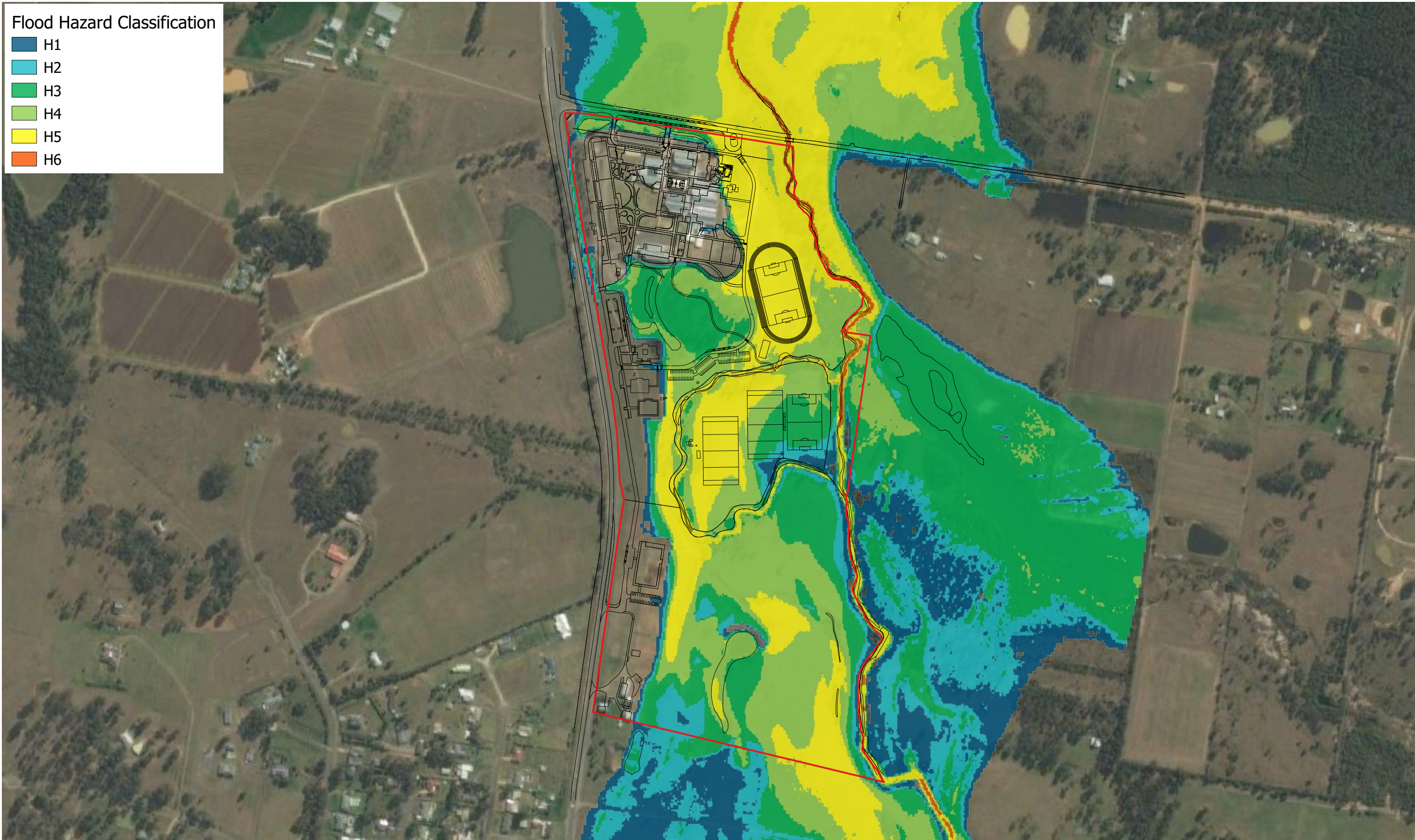
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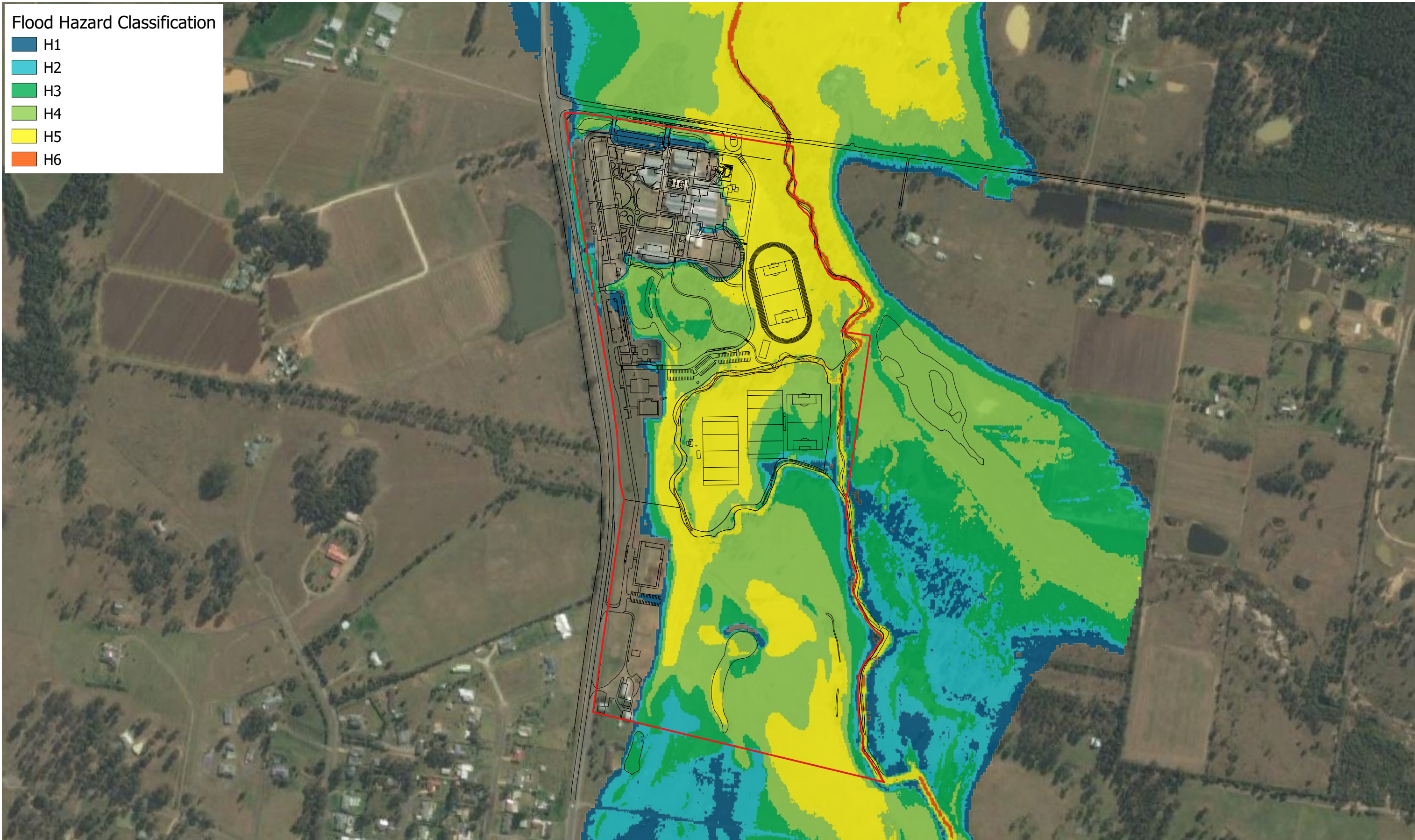
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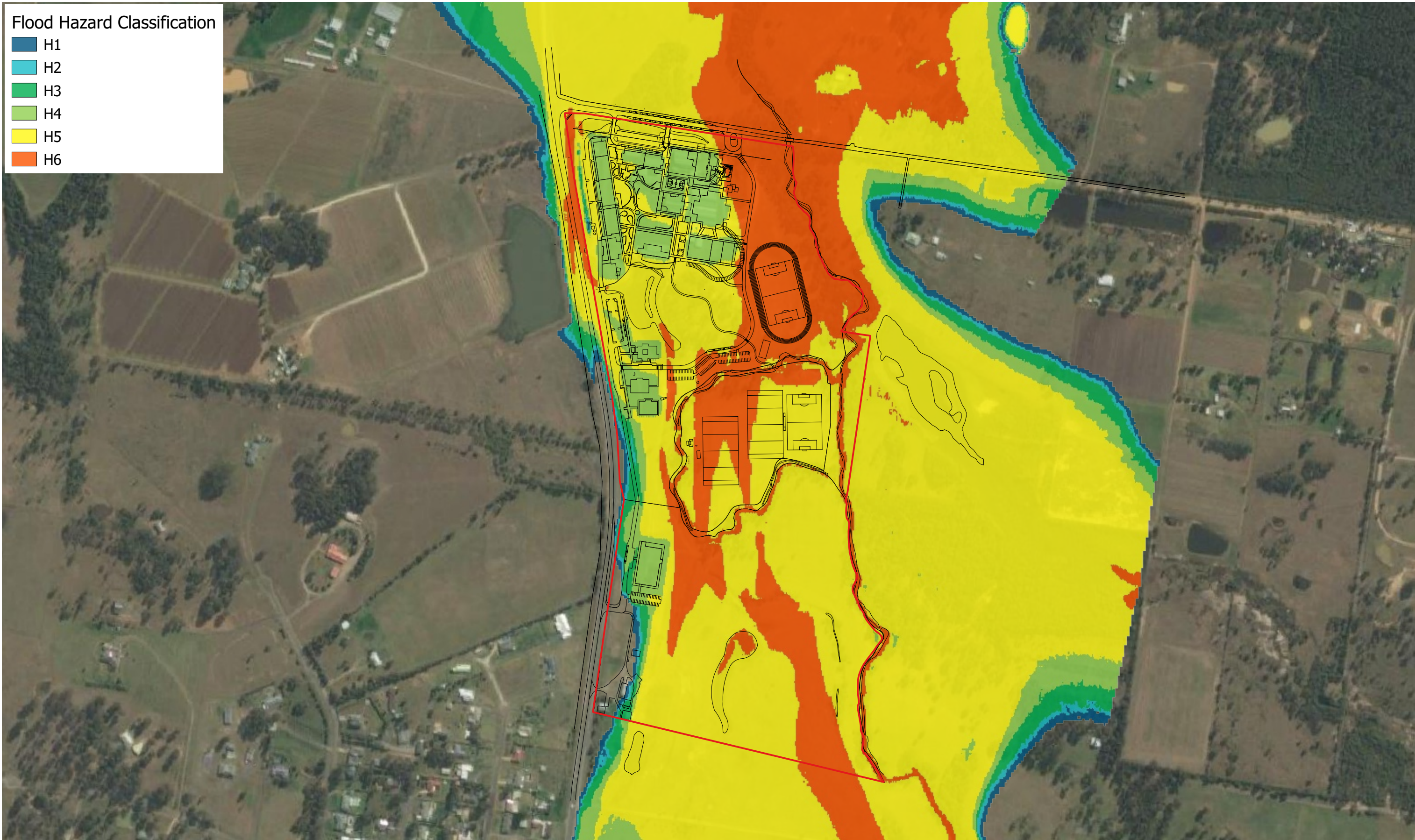
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Legend Site Boundary Development Layout	Title: 0.5% AEP Post-development Peak Flood Hazard	Drawing: C-22	Rev: A
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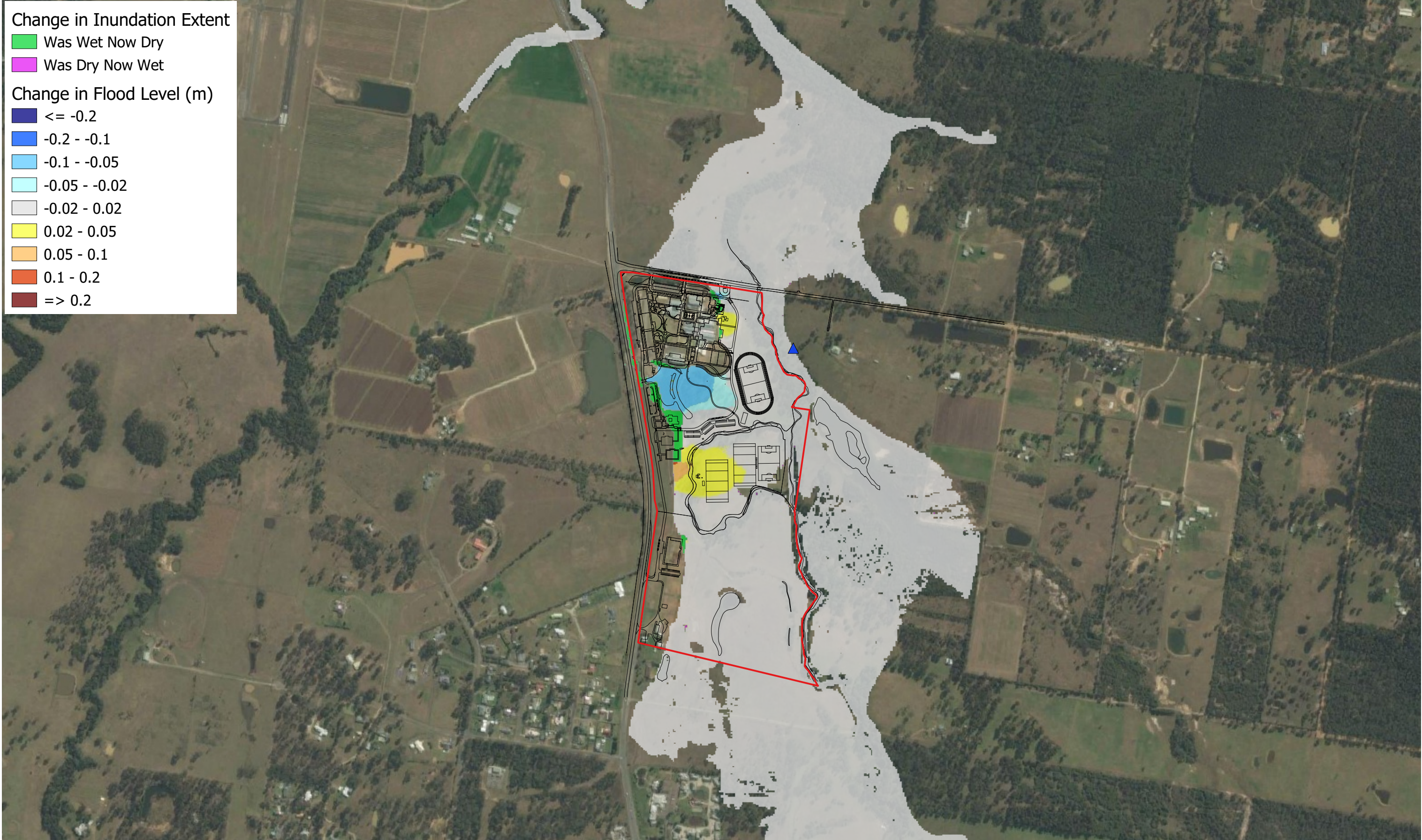


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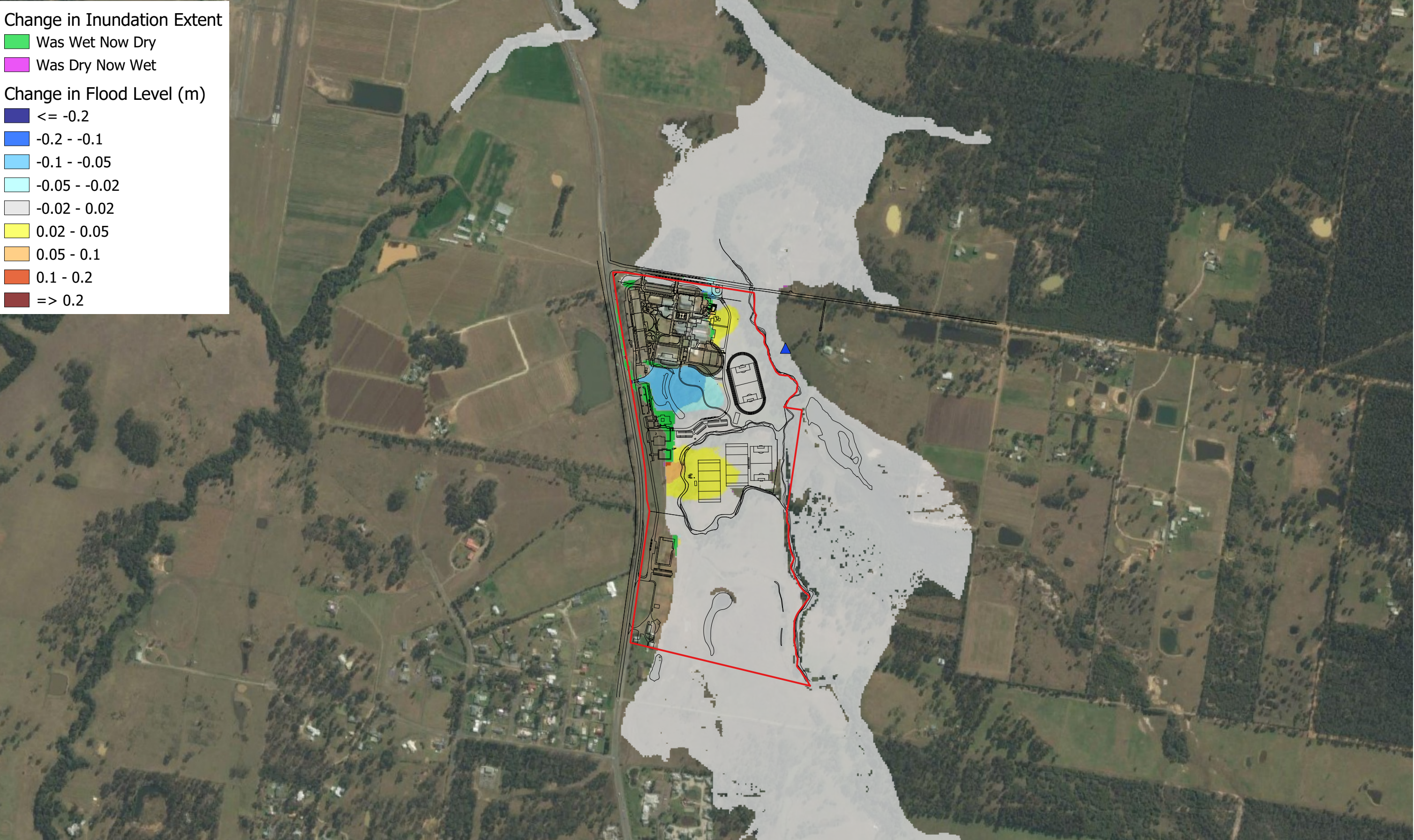


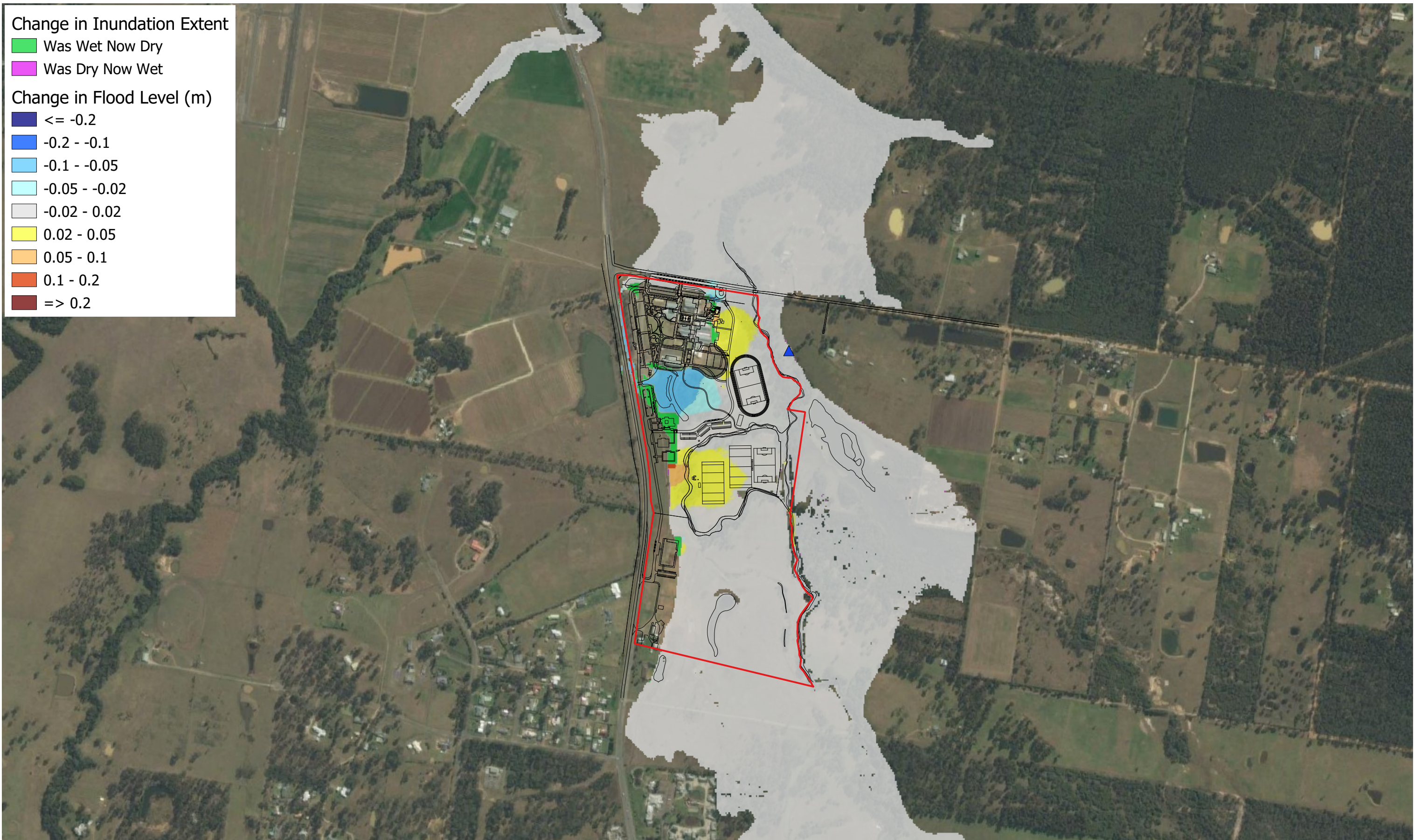
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Annex D: Peak Flood Level Impact Maps

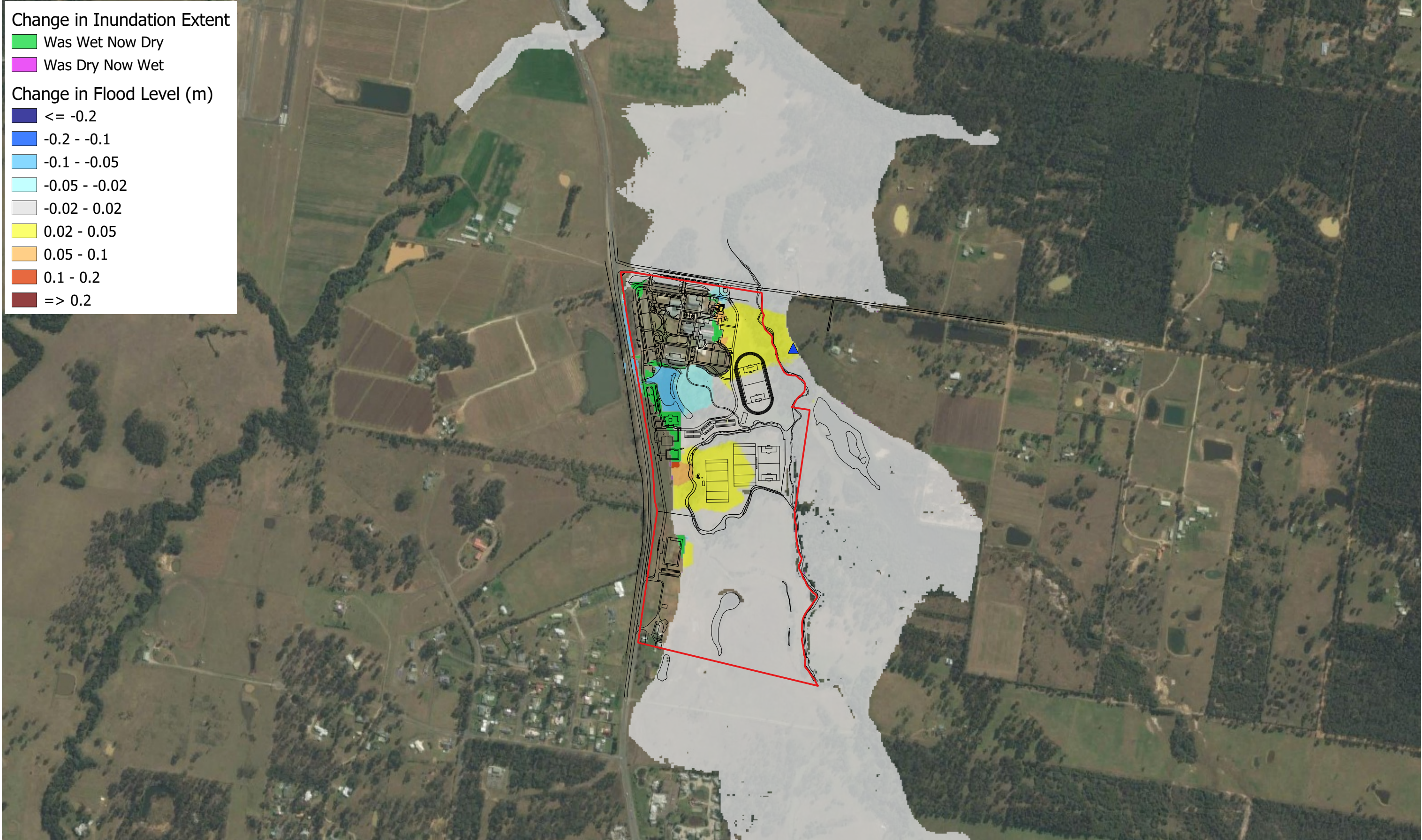


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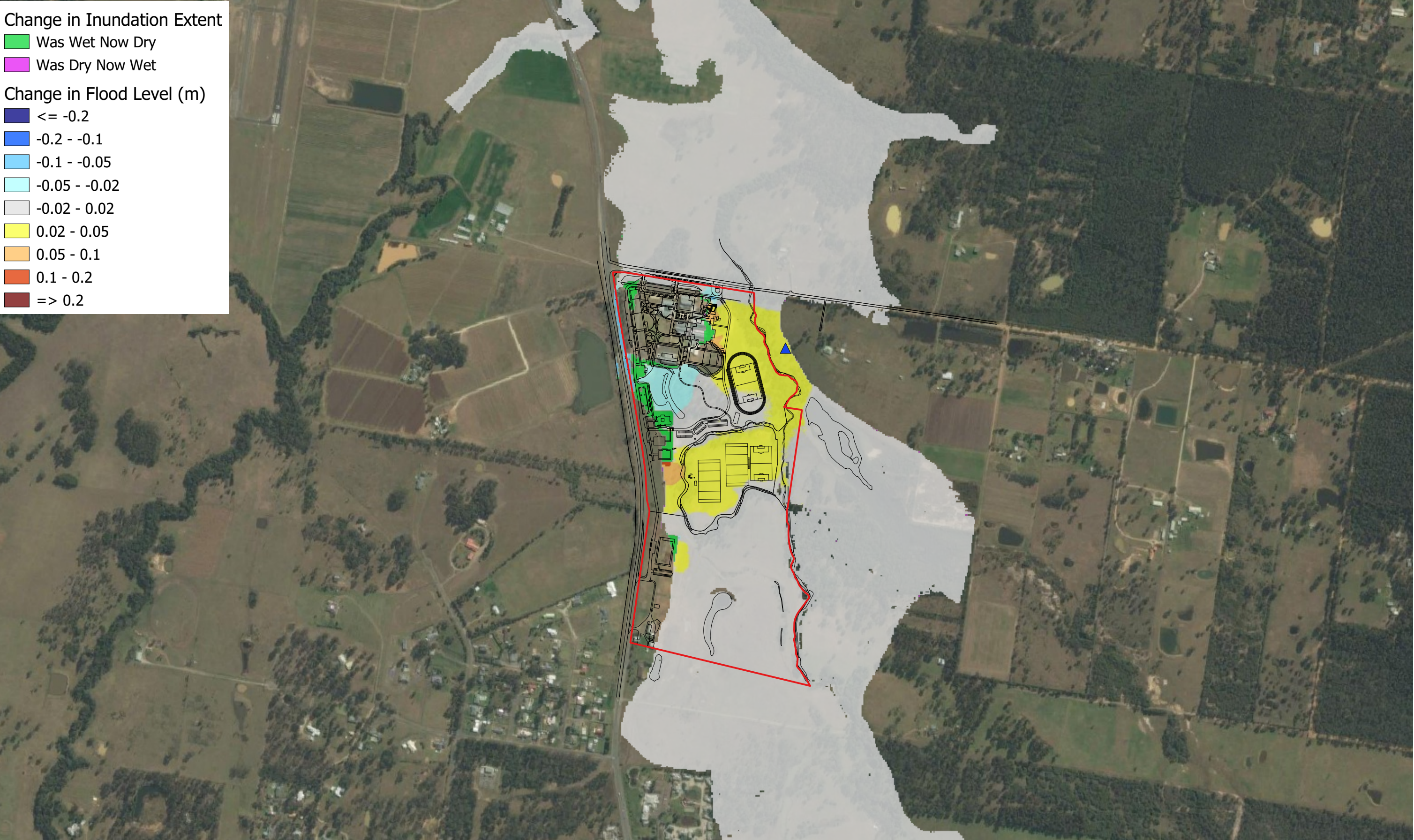


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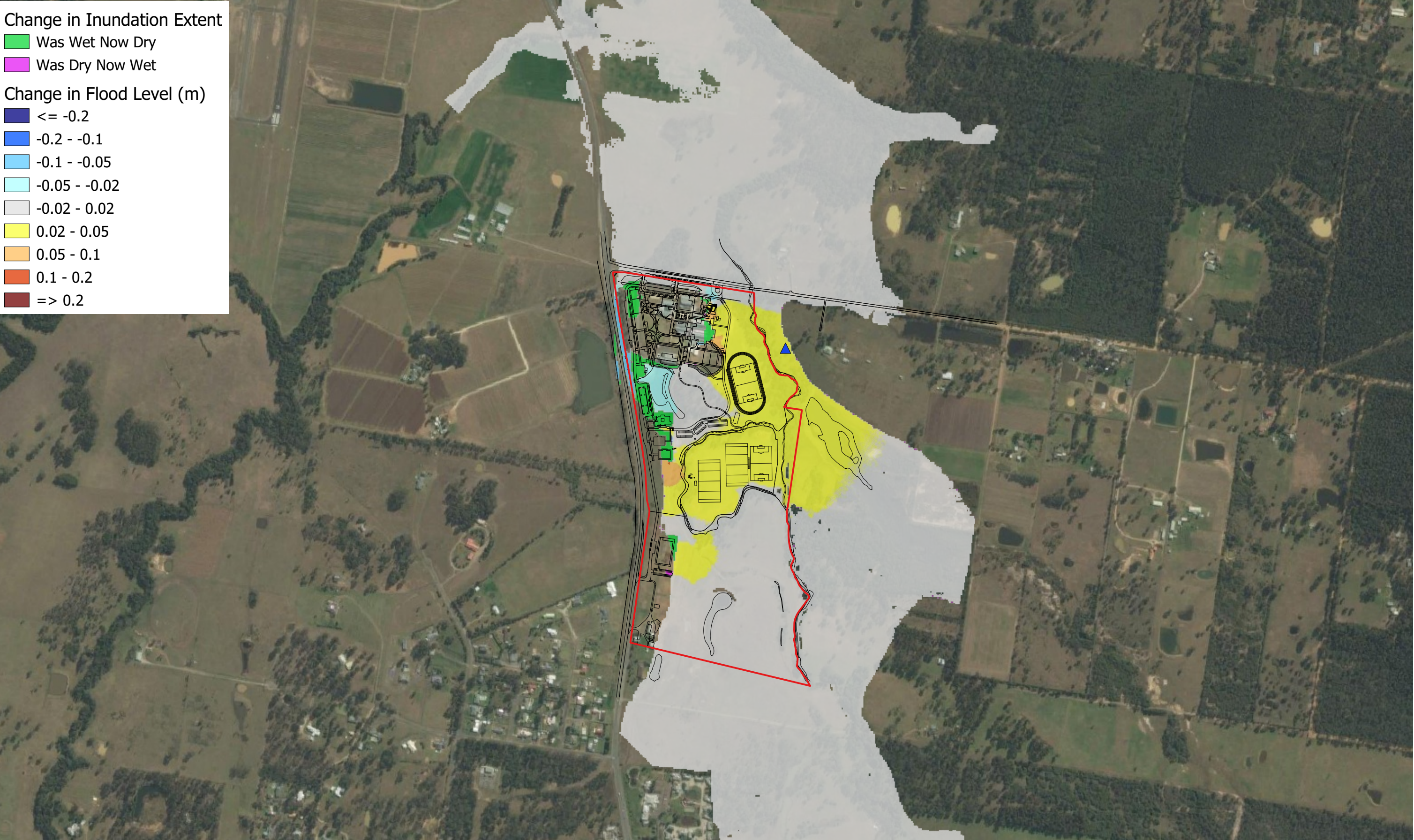


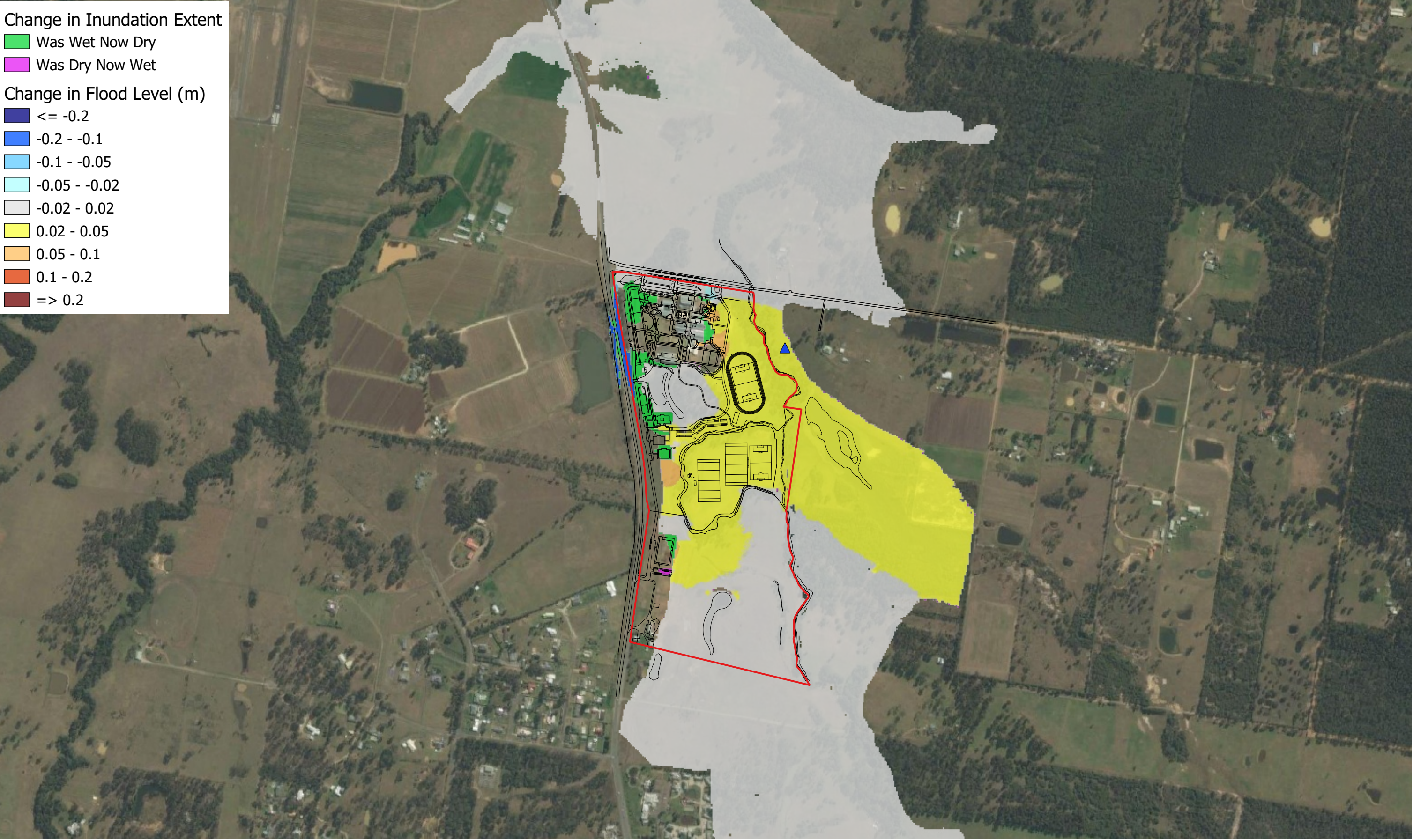


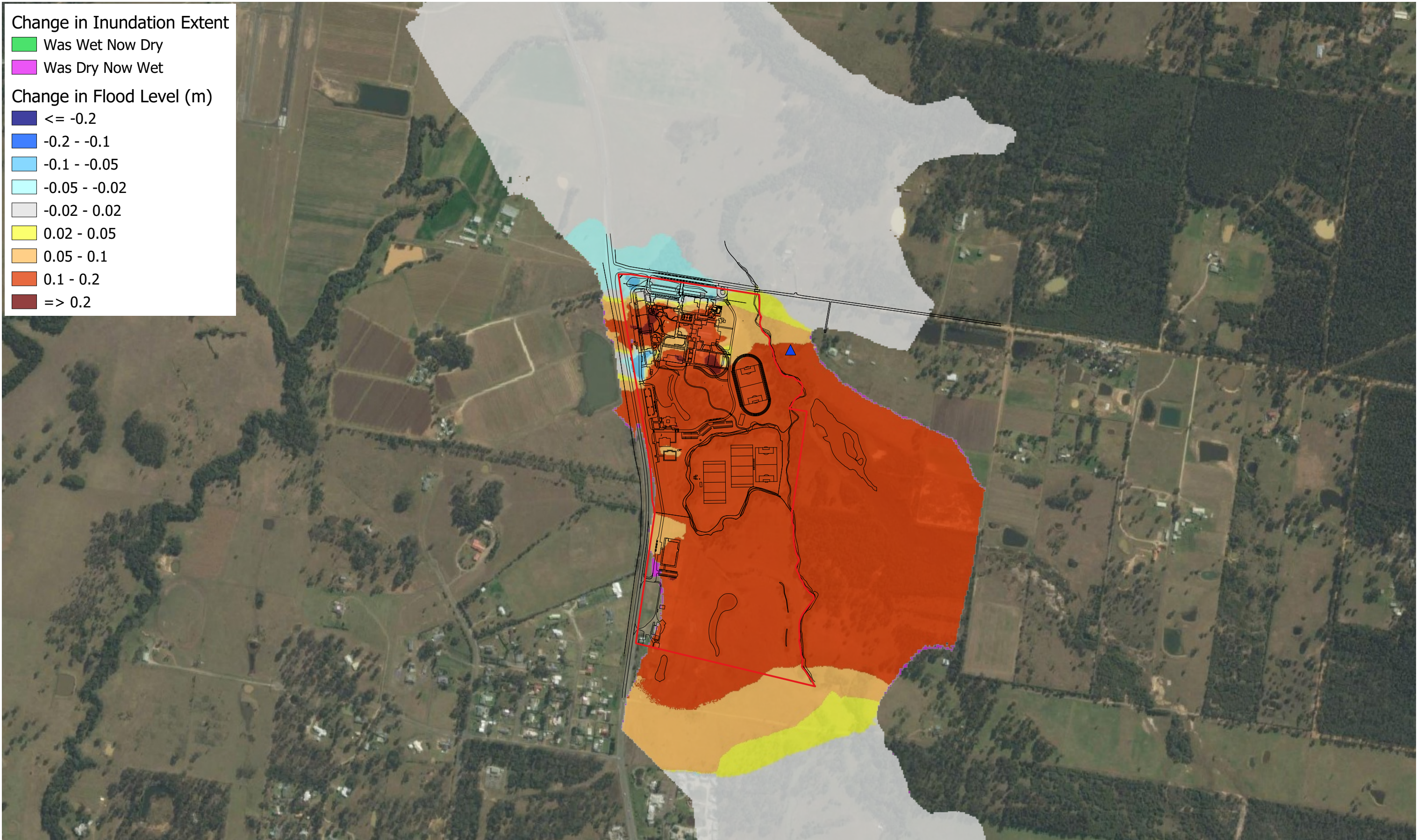
Legend

- Reporting Point
- Site Boundary
- Development Layout

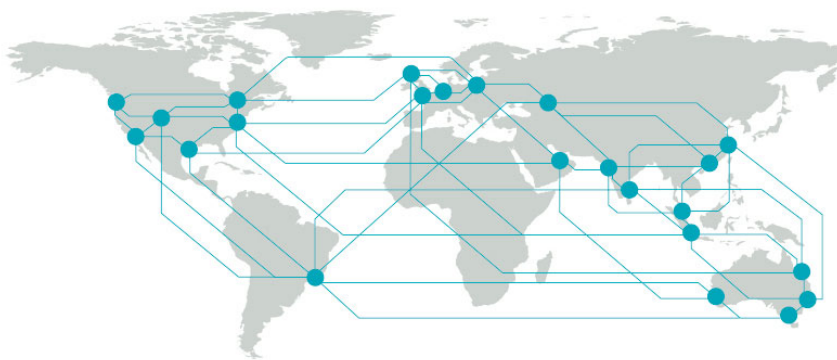
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Annex B SES Responses to Proposed FERP

Our Ref: ID1673
Your Ref: A11230

15 August 2022

Nathan Cheah
Department of Planning and Environment
Locked Bag 5022,
Parramatta NSW 2124

email: nathan.cheah@bmtglobal.com

Dear Nathan,

Re: Flood Emergency Response Plan (FERP) for St Phillip's Christian College Cessnock

I refer to your correspondence dated 18 July 2022 regarding the Flood Emergency Response Plan (FERP) for St Phillip's Christian College Cessnock at 10 Lomas Lane, Nulkaba. The proposed development adds an additional seven buildings and alters six existing buildings for the use of up to 1732 students. The FERP recommends the installation of an on-site flood warning gauge with a trigger of a 20% Annual Exceedance Probability (AEP) flood event for evacuation along Lomas Lane and Wine Country Drive.

The NSW State Emergency Service (NSW SES) is the agency responsible for dealing with floods, storms and tsunami in NSW. This role includes, planning for, responding to and coordinating the initial recovery from floods. As such, the NSW SES has an interest in the public safety aspects of the development of flood prone land, particularly the potential for changes to land use to either exacerbate existing flood risk or create new flood risk for communities in NSW.

It is the preference of NSW SES that all schools follow the application of sound land use planning and flood risk management. This includes site design and stormwater management measures that minimise any risk to the community. Furthermore, schools or sections of schools that are at known risk of flooding or isolation are closed prior to flooding commencing and when there is an indication that flooding is likely, for example, when there is a flood warning.

The NSW SES has reviewed the proposed FERP and the flood risk information (e.g. Local Flood Plan, Flood Studies etc.) available to the NSW SES, noting the proposed development is at risk of flooding in a and the adjacent roads may be cut by floodwaters. In accordance with sections 3.6, A-5, L-5, L-6.9.6 and N-7 of the NSW Floodplain Development Manual, 2005 (the Manual), the NSW SES is opposed to the imposition of development consent conditions requiring private flood evacuation plans rather than the application of sound land use planning and flood risk management. The NSW SES also does not have statutory authority to endorse or

approve flood emergency response plans, which is referred to in the Manual (particularly section N7), however provides the following advice based on the principles outlined in the Manual:

- **The Flood Impact Assessment should consider the full range of flooding, including events up to the Probable Maximum Flood (PMF).** It is noted that the site itself is prone to flooding from Black Creek (page 4 of the Draft FERP and Black Creek Floodplain Risk Management Study and Plan 2015), with high depth and hazard in a PMF (1.2 to 2.5 metres depth). This is unsafe for children, and therefore they must not be exposed to the floods. The Black Creek Floodplain Risk Management Study and Plan does indicate earlier flooding at this site and Wine Country Drive than the 0.2% cited in the FERP. It is recommended that advice is sought from Council regarding any updated flood information available for this site.
- **Risk assessment should have regard to flood warning and evacuation demand on existing and future access/egress routes.** Consideration should also be given to the impacts of localised flooding on evacuation routes. The local and regional road network is prone frequent flooding and would require caregivers to ensure they have adequate time to collect the children prior to the roads becoming flooded. As this age group of students are largely unable to self-evacuate, the evacuation time would require additional travel time required for caregivers to reach the building prior to access becoming affected and proceed to safety. **Evacuation must not require people to drive or walk through flood water.** Therefore, ideally the school would be closed prior to the impact of flooding on the evacuation routes as indicated in the FERP, and preferably prior to the commencement of school for that day.
- **Development strategies relying on deliberate isolation or sheltering in buildings surrounded by flood water are not equivalent, in risk management terms, to evacuation.** Sheltering in a building within the flood extent is not safe, as proposed in of the FERP (section 4.3.2 of the FERP). Sheltering in buildings where entrances and exits may become flooded in the larger floods may result in isolating the children potentially without food or water for several hours or more depending on the weather system/s. Isolation also increases the risk of fire or medical emergencies and likelihood of caregivers entering floodwater to get to their children. It is unrealistic to assume parents or caregivers will not attend the school to pick up children in circumstances of flooding.
- **Development strategies relying on an assumption that mass rescue may be possible where evacuation either fails or is not implemented are not acceptable to the NSW SES.** This may occur if caregivers are unable to safely reach the children during a flood.

It should be noted that gauges can go offline or become damaged or destroyed in severe weather and flooding. This can cause issues when relying on the gauge/s to trigger evacuation at a specific site. In addition, it is unclear as to who will be responsible for installing,

maintaining, and managing the proposed onsite gauge/s and warnings associated with the gauge/s. Gauges that are not maintained properly can cause significant issues.

Please feel free to contact Elspeth O'Shannessy via email at rra@ses.nsw.gov.au should you wish to discuss any of the matters raised in this correspondence. The NSW SES would also be interested in receiving future correspondence regarding the outcome of this referral via this email address.

Yours Sincerely

A handwritten signature in black ink, appearing to be 'Elspeth O'Shannessy', written over a horizontal line.

Elspeth O'Shannessy
Planning Coordinator, Emergency Risk Management
NSW State Emergency Service

Annex C Council Responses to Proposed FERP

Nathan Cheah

From: Phillip Townsend <Phillip.Townsend@cessnock.nsw.gov.au>
Sent: Thursday, 14 July 2022 3:19 PM
To: Nathan Cheah; Jules Bosco
Cc: Kieran Smith; Netsanet Shiferaw
Subject: RE: [External] Flood evacuation plan

Hi Nathan,

Thank you for your contact & opportunity to review the plan. I think BMT have developed a very robust plan.

Please find some high level comments & suggestions for your consideration:

- References are made to various flood extents, e.g. 1% AEP, 5% AEP, 10% AEP (evacuation), 20% AEP (flood warning system activation) etc – suggest inundation mapping be included for some of these more common events to inform the emergency response
- Suggest to clearly identify who invokes this plan – it appears to be via existing (AS3745) ECO arrangements
- Where does this plan fit in terms of other site based emergency plans & is there any crossover or conflict with existing AS3745 evacuation arrangements?
- The recommendation to install a future site based flood warning system is an excellent idea
- Until a FWS is installed, is it worthwhile (where practicable) physically marking various critical flood extent levels within the college grounds to refer to in the plan?
- Due to the size of the Cessnock LGA & the location of the headwaters of the different creek/riverine systems within the LGA, the Cessnock Airport BoM rain gauge might be more appropriate to inform of potential flooding events rather than relying on Wollombi Brook water level gauge data – note that Council is about to install some new water level gauges at a number of locations in the Cessnock Urban Area - this data may not appear on the BoM website but the SES will have access to this information & the data can/will also be used for future flood model calibration

As you could probably appreciate, it might be a little while yet until the SES can respond due to their current operational workload.

Regards,

Phillip Townsend



Phillip Townsend | Stormwater Engineer
62-78 Vincent St | PO Box 152 | Cessnock NSW 2325
p 02 4993 4109
www.cessnock.nsw.gov.au



Integrity, Respect, Teamwork, Accountability and Excellence

From: Nathan Cheah <nathan.cheah@bmtglobal.com>

Sent: Thursday, 14 July 2022 11:39 AM

To: Phillip Townsend <Phillip.Townsend@cessnock.nsw.gov.au>; Jules Bosco <Jules.Bosco@cessnock.nsw.gov.au>

Cc: Kieran Smith <Kieran.Smith@bmtglobal.com>; Netsanet Shiferaw <Netsanet.Shiferaw@bmtglobal.com>

Subject: RE: [External] Flood evacuation plan

Thanks @Jules

Hi Phillip,

To help with our enquiry, attached are the draft FERP which we have developed for the SPCC development at Nulkaba and the powerpoint slides which summarise the FERP. DPE has requested that the FERP be developed in consultation with Council and SES and we are hoping to obtain some feedback from Council re: FERP. We have also contacted SES recently but still waiting for the local representative to return our call.

If it suits, we can organise a Teams meeting to go through the FERP with you and our client (SPCC) in attendance. Please let us know.

Thanks for your help.

Regards,

Nathan

Dr Nathan Cheah
Associate Principal Engineer

Direct: +61 (02) 9195 1502
Tel: +61 (02) 8960 7755
Fax: +61 (02) 8960 7745
Web: www.bmt.org



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Registered in Australia, Registered no. 010 830 421, Registered office Level 5, 348 Edward Street, Brisbane QLD 4000, Australia.

From: Jules Bosco <Jules.Bosco@cessnock.nsw.gov.au>

Sent: Thursday, 14 July 2022 10:59 AM

To: Phillip Townsend <Phillip.Townsend@cessnock.nsw.gov.au>

Cc: Nathan Cheah <nathan.cheah@bmtglobal.com>

Subject: [External] Flood evacuation plan

Hi Phillip,

There is a regional planning application for additional development at St Phillip Christian college, Nulkaba and the applicant is requested to compile a flood evacuation plan as part of the application. Nathan would like some guidance on the requirements which also require SES input.

Please could you contact Nathan on 02 9195 1502 or the above email.

Regards

Jules Bosco Principal Development Engineer

BEng. Grad.Dip EngSc. MEngSc. MIAust CPEng NER

62-78 Vincent St | PO Box 152 | Cessnock NSW 2325

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Annex D BMT Responses to SES and Council

Table D.1. BMT Responses to SES Feedback

SES Comments	BMT Responses
<i>It is the preference of NSW SES that all schools follow the application of sound land use planning and flood risk management. This includes site design and stormwater management measures that minimise any risk to the community. Furthermore, schools or sections of schools that are at known risk of flooding or isolation are closed prior to flooding commencing and when there is an indication that flooding is likely, for example, when there is a flood warning.</i>	The BMT (2021) FIA which was undertaken to support the SSDA of the proposed development demonstrates how flood risks are managed on-site (e.g. with finished floor levels above the flood planning level). Section 5.3 of the FERP describes the procedures for school closure due to a flood event.
<i>The NSW SES has reviewed the proposed FERP and the flood risk information (e.g. Local Flood Plan, Flood Studies etc.) available to the NSW SES, noting the proposed development is at risk of flooding in a and the adjacent roads may be cut by floodwaters. In accordance with sections 3.6, A-5, L-5, L-6.9.6 and N-7 of the NSW Floodplain Development Manual, 2005 (the Manual), the NSW SES is opposed to the imposition of development consent conditions requiring private flood evacuation plans rather than the application of sound land use planning and flood risk management. The NSW SES also does not have statutory authority to endorse or approve flood emergency response plans, which is referred to in the Manual (particularly section N7)</i>	The BMT (2021) FIA which was undertaken to support the SSDA of the proposed development demonstrates how flood risks are managed on-site (e.g. with finished floor levels above the flood planning level). The residual flood risks up to the PMF extreme event are managed as part of the FERP prepared for the proposed development.
<i>The Flood Impact Assessment should consider the full range of flooding, including events up to the Probable Maximum Flood (PMF). It is noted that the site itself is prone to flooding from Black Creek (page 4 of the Draft FERP and Black Creek Floodplain Risk Management Study and Plan 2015), with high depth and hazard in a PMF (1.2 to 2.5 metres depth). This is unsafe for children, and therefore they must not be exposed to the floods. The Black Creek Floodplain Risk Management Study and Plan does indicate earlier flooding at this site and Wine Country Drive than the 0.2% cited in the FERP. It is recommended that advice is sought from Council regarding any updated flood information available for this site.</i>	The BMT (2021) FIA which was undertaken to support the SSDA of the proposed development has considered events up to the PMF. The FERP for the proposed development has been prepared based on the results from the BMT (2021) FIA, which is included as Annex A. Discrepancy in the flood results is discussed in the BMT (2021) FIA report.
<i>Risk assessment should have regard to flood warning and evacuation demand on existing and future access/egress routes. Consideration should also be given to the impacts of localised flooding on evacuation routes. The local and regional road network is prone frequent flooding and would require caregivers to ensure they have adequate time to collect the children prior to</i>	The impact on existing traffic due to the proposed development is documented in the <i>St Philip's Christian College, Cessnock - Transport and Accessibility Impact Assessment</i> (Stantec, 2022). Discussion on timing and the feasibility of the evacuation period are presented in Section 5.3 of the FERP, along

SES Comments	BMT Responses
<i>the roads becoming flooded. As this age group of students are largely unable to self-evacuate, the evacuation time would require additional travel time required for caregivers to reach the building prior to access becoming affected and proceed to safety. Evacuation must not require people to drive or walk through flood water. Therefore, ideally the school would be closed prior to the impact of flooding on the evacuation routes as indicated in the FERP, and preferably prior to the commencement of school for that day.</i>	with procedures for school closure due to a flood event. The FERP does not recommend driving through floodwaters.
<i>Development strategies relying on deliberate isolation or sheltering in buildings surrounded by flood water are not equivalent, in risk management terms, to evacuation. Sheltering in a building within the flood extent is not safe, as proposed in of the FERP (section 4.3.2 of the FERP). Sheltering in buildings where entrances and exits may become flooded in the larger floods may result in isolating the children potentially without food or water for several hours or more depending on the weather system/s. Isolation also increases the risk of fire or medical emergencies and likelihood of caregivers entering floodwater to get to their children. It is unrealistic to assume parents or caregivers will not attend the school to pick up children in circumstances of flooding.</i>	Additional comments included in Section 4.1 of the FERP outlining SES response and confirming a shelter-in-place strategy is not suitable for any event except where it cannot be avoided due to unexpected changes in conditions which either made evacuation impossible or provided inadequate warning time (such as in the PMF extreme event).
<i>Development strategies relying on an assumption that mass rescue may be possible where evacuation either fails or is not implemented are not acceptable to the NSW SES. This may occur if caregivers are unable to safely reach the children during a flood.</i>	The principal flood emergency management strategy as outlined in the FERP is school evacuation prior to evacuation routes and buildings becoming flooded. Additional comments included in Section 4.1 of the FERP outlining SES response and confirming a shelter-in-place strategy is not suitable for any event except where it cannot be avoided due to unexpected changes in conditions which either made evacuation impossible or provided inadequate warning time (such as in the PMF extreme event).
<i>It should be noted that gauges can go offline or become damaged or destroyed in severe weather and flooding. This can cause issues when relying on the gauge/s to trigger evacuation at a specific site. In addition, it is unclear as to who will be responsible for installing, maintaining, and managing the proposed onsite gauge/s and warnings associated with the gauge/s. Gauges that are not maintained properly can cause significant issues.</i>	Section 5.2 of the FERP describes the need for redundancy in the system as well as current practice of observing Lomas Lane as the trigger of evacuation (fallback option should the warning system fails). It is recommended that the supplier be responsible for the installation and maintenance of the system, whilst the warnings would be relayed to the flood wardens during a flood emergency.

Table D.2. BMT Responses to Council Feedback

Council Comments	BMT Responses
<i>References are made to various flood extents, e.g. 1% AEP, 5% AEP, 10% AEP (evacuation), 20% AEP (flood warning system activation) etc – suggest inundation mapping be included for some of these more common events to inform the emergency response</i>	A reference to the BMT (2021) FIA document is provided in Section 2.3. The FIA is now included as Annex A.
<i>Suggest to clearly identify who invokes this plan – it appears to be via existing (AS3745) ECO arrangements</i>	Chapter 5 of the FERP outlines the personnel and responsibilities in carrying out the FERP.
<i>Where does this plan fit in terms of other site based emergency plans & is there any crossover or conflict with existing AS3745 evacuation arrangements?</i>	The latest FERP will supersede the previous FERP prepared by SMEC (2011). Following recommendation by SES, Council and the Department of Planning, an off-site evacuation strategy is recommended in the latest FERP, which is a change from the shelter-in-place strategy recommended in the previous FERP.
<i>The recommendation to install a future site based flood warning system is an excellent idea</i>	Added note to Section 5.2.1 indicating Council support.
<i>Until a FWS is installed, is it worthwhile (where practicable) physically marking various critical flood extent levels within the college grounds to refer to in the plan?</i>	Added note to Section 5.2 regarding addition of manually read flood markers at the NE Access on Lomas Lane
<i>Due to the size of the Cessnock LGA & the location of the headwaters of the different creek/riverine systems within the LGA, the Cessnock Airport BoM rain gauge might be more appropriate to inform of potential flooding events rather than relying on Wollombi Brook water level gauge data – note that Council is about to install some new water level gauges at a number of locations in the Cessnock Urban Area - this data may not appear on the BoM website but the SES will have access to this information & the data can/will also be used for future flood model calibration</i>	Added reference to gauge in Section 5.2.2. Added observation of gauge to Section 6.2.

Annex E Traffic Engineer Review of FERP

Nathan Cheah

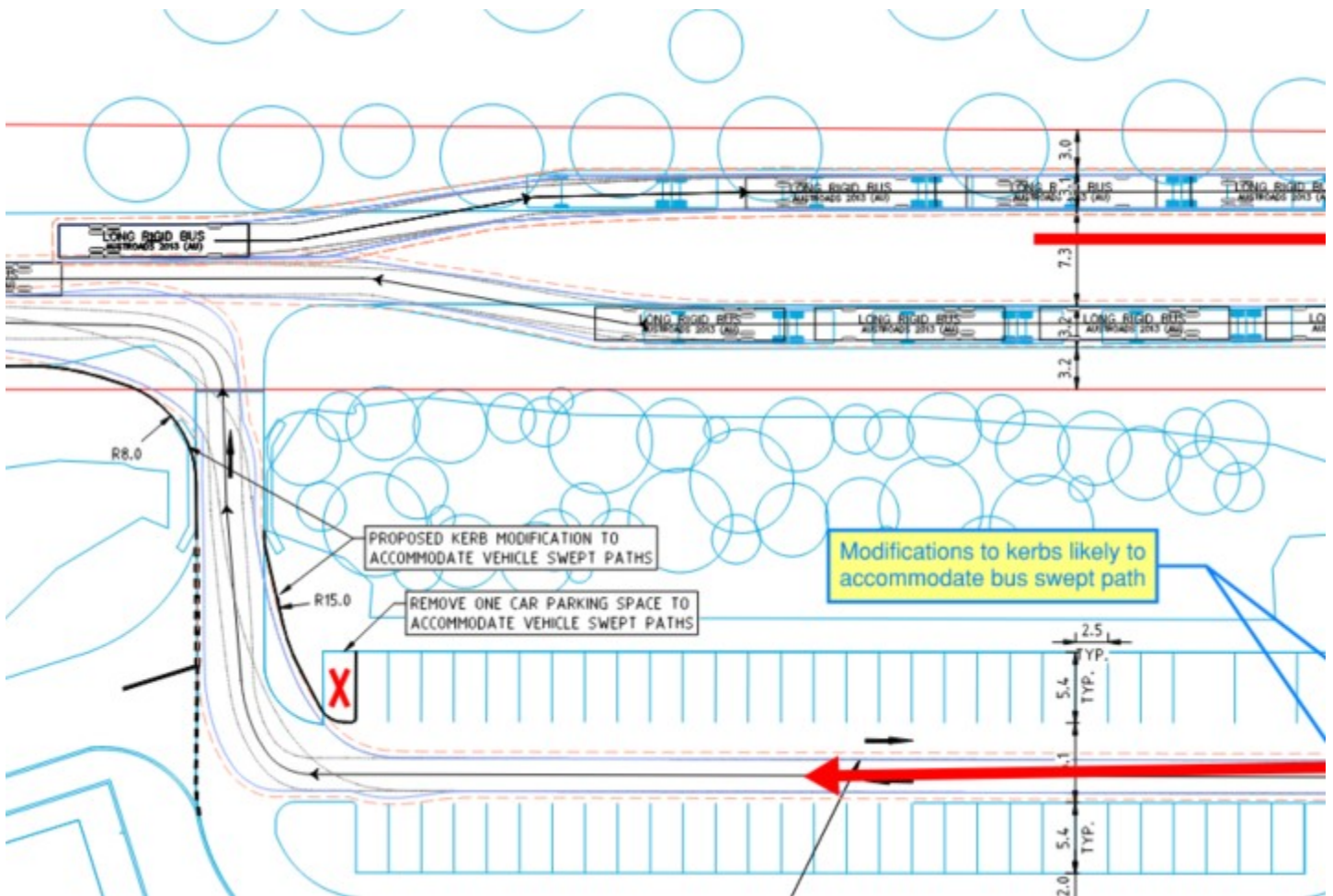
From: Hazell, Rhys <rhys.hazell@stantec.com>
Sent: Friday, 15 July 2022 4:31 PM
To: Rebecca Johnston; Bradley, Carla
Cc: David Price; Katrina Walker; Nathan Cheah
Subject: [External] RE: SPCC Cessnock - Flood Emergency Management Plan - Stantec comments

Hi Rebecca,

Following review of the Flood Emergency Response Plan, we have the following comments from a traffic perspective:

- Minor modifications will be required for the central access to allow buses to turn around, with the bus loop to the east anticipated to be flooded.
 - Subject to swept paths, kerbs to be amended and may potentially result in the loss of one parking space and the marked crossing would likely need to be extended – refer below bus route in red.
 - If buses are part of the FERP, pick-up can be facilitated in the car park – to be managed during evacuation, some cars may be held/block to allow safe passage for pedestrians.
- Bus access can already be accommodated at the WCD access with any pick-up to occur in the car park near the senior school.
- A flood evacuation period of 5 hours is considered adequate to accommodate full evacuation, with the first two hours able to accommodate access and entry via Lomas Lane.
 - With five hours before WCD access/egress is cut off, flood trigger would need to occur before 1pm (assuming after school care finishes at 6pm) otherwise all students would have a planned departure during the evacuation period anyway.

Overall, we are comfortable with the FERP and support from a traffic perspective.



Regards

Rhys Hazell

Senior Principal Transportation Planner

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From: Rebecca Johnston <rjohnston@barrplanning.com.au>

Sent: 15 July 2022 15:47

To: Hazell, Rhys <rhys.hazell@stantec.com>; Bradley, Carla <carla.bradley@stantec.com>

Cc: David Price <david@spcc.nsw.edu.au>; Katrina Walker <kwalker@barrplanning.com.au>; Nathan Cheah <nathan.cheah@bmtglobal.com>

Subject: FW: SPCC Cessnock - Flood Emergency Management Plan

HI Rhys

Just chasing an update this task for SPCC Cessnock and info needed to finalise the Flood Emergency Evac Plan.

If you could please liaise directly with Nathan Cheah at BTM nathan.cheah@bmtglobal.com, that would be great.

Dr Nathan Cheah
Associate Principal Engineer

Direct: +61 (02) 9195 1502

Regards

REBECCA JOHNSTON
PARTNER & PLANNING MANAGER



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REBECCA JOHNSTON



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THE FUTURE

From: Rebecca Johnston

Sent: Thursday, 7 July 2022 4:49 PM

To: Hazell, Rhys <rhys.hazell@stantec.com>

Cc: David Price <david@spcc.nsw.edu.au>

Subject: SPCC Cessnock - Flood Emergency Management Plan [Filed 07 Jul 2022 16:51]

Hi Rhys

Sorry to have missed your call earlier today.

As discussed, a today's meeting with BMT on the Flood Emergency Management Plan, your input to test the assumptions made by BMT on the evacuation timeframes is required. If you could please provide some analysis based on the known split of travel modes for staff and students, this would assist.

If you could please provide to me by early next week this would be appreciated.

Regards

REBECCA JOHNSTON

PARTNER & PLANNING MANAGER



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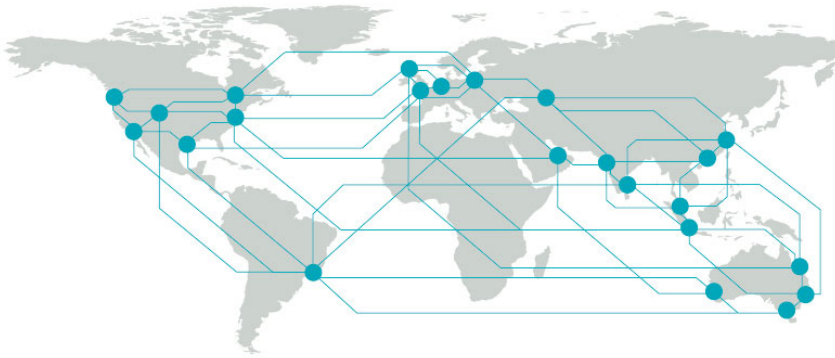
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REBECCA JOHNSTON



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