Flood Impact and Risk Assessment

Ulladulla High School Upgrade

Prepared for NSW Department of Education

24 March 2025

232045

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Your Partner in Engineering

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Rev	Date	Prepared By	Approved By	Remarks
1	17/01/2025	LC	EC	Draft
2	14/03/2025	LC	EC	Updated per Urbis and SI comments
3	19/03/2025	LC	EC	Updated per Urbis and SI comments
4	24/03/2025	LC	EC	Updated site plan

Glossary and Abbreviations

Annual Exceedance Probability	AEP	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage
Australian Height Datum	AHD	A common national surface level datum often used as a referenced level for ground, flood and flood levels, approximately corresponding to mean sea level.
Average Recurrence Interval	ARI	The long-term average number of years between the occurrence of a flood equal to or larger in size than the selected event. ARI is the historical way of describing a flood event. AEP is generally the preferred terminology.
Bureau of Meteorology	BoM	An executive agency of the Australian Government responsible for providing weather services to Australia and surrounding areas.
Development Control Plan	DCP	A Development Control Plan is a document prepared by the Council which provides detailed guidelines which assist a person proposing to undertake a development. A DCP must be consistent with the provisions and objectives of a Local Environmental Plan (LEP).
Finished Floor Level	FFL	The level, or height, at which the floor of a building or structure (including alterations and additions) is proposed to be built.
Flood hazard		A source of potential harm or a situation with a potential to cause loss of life, injury and economic loss due to flooding. Flood hazard is defined as a function of the relationship between flood depth and velocity.
Flood Planning Level	FPL	The combination of the flood level from the defined flood event and freeboard selected for flood risk management purposes.
Freeboard		A factor of safety typically used in relation to the setting of floor levels or levee crest levels. Freeboard provides a factor of safety to compensate for uncertainties in the estimation of flood levels across the floodplain, such as wave action, localised hydraulic behaviour etc.
Local Environmental Plan	LEP	LEPs provide a framework that guides planning decisions for local government areas through zoning and development controls. Zoning determines how land can be used (for example, for housing, industry, or recreation).
New South Wales State Emergency Service	NSW SES	The NSW SES is an agency of the Government of New South Wales, is an emergency and rescue service dedicated to assisting the community in times of natural and man-made disasters.
Probable Maximum Flood	PMF	The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain.
Representative Concentration Pathways	RCP	RCPs make predictions of how concentrations of greenhouse gases in the atmosphere will change in future as a result of human activities. The four RCPs range from very high (RCP8.5) through to very low (RCP2.6) future concentrations.
Severe Weather Warning		The Bureau of Meteorology issues Severe Weather Warnings whenever severe weather is occurring in an area or is expected to develop or move into an area. Severe Weather Warnings are issued for: • Sustained winds of gale force (63 km/h) or more

- Wind gusts of 90 km/h or more (100 km/h or more in Tasmania)
- Very heavy rain that may lead to flash flooding
- Widespread blizzards in Alpine areas
- Very large waves and high tides expected to cause unusually damaging or dangerous conditions on the coast

Executive Summary

This Flood Impact and Risk Assessment has been prepared by TTW to support a Review of Environmental Factors (REF) for the NSW Department of Education (DoE) for the Ulladulla High School upgrade, located at 55 South Street, Ulladulla, NSW, 2539 (the site). The site is legally referred to as Lot 1 DP 595313.

The site is unaffected by riverine flows in any modelled flood event, up to and including the Probable Maximum Flood (PMF). However, the site is impacted by local overland flooding when the stormwater system reaches capacity, overtopping onto the site from South Street.

Following consultation with Shoalhaven City Council on the 21st of October, it was confirmed that the controls set out in Shoalhaven City Council Development Control Plan (DCP) 2014 do not apply to the site, given that it is unaffected by riverine flows in the 1% AEP event. Although Finished Floor Levels of the new building do not need to be set at the PMF level, Council requires the floor level to be raised 300mm from the surrounding ground surface given the sensitive nature of the site as an educational facility. The purpose of the 300mm fall away from the building is to ensure surface runoff and minor overland flow paths are directed away from building entrances, in accordance with stormwater standards.

Review of the civil design levels from Meinhardt shows the current design is compliant with this requirement. In addition, the proposed building complies with the NSW Department of Education's guidelines for educational site selection, meeting the following advisory guidelines:

i. Proposed building is located above the 1-in-200-year (0.5% AEP) flood level;
ii. Proposed building has flood free access for pedestrians and vehicles;
iii. Proposed building is located on land above the Flood Prone Land Contour (i.e., land susceptible to flooding in the PMF).

The extent and nature of potential impacts are low and will not have significant impact on the locality, community and/or the environment. This report concludes that the proposed activity is suitable, will not result in unacceptable impact, and warrants approval subject to implementation of the following flood mitigation measures:

Project Stage	Mitigation Measures	Reason for Mitigation Measure	Report Section
Operation	Preparation and implementation of a Flood Emergency Response Plan (FERP)	To identify the most appropriate flood emergency response strategy for the site based on an assessment of the time to inundation and recession	See TTW's FERP submitted alongside this report.

Following the implementation of the above mitigation measures, any impacts are deemed to be acceptable and appropriate.

1.0 Introduction

This Flood Impact and Risk Assessment has been prepared to support a Review of Environmental Factors (REF) for the NSW Department of Education (DoE) for Ulladulla High School upgrade (the activity).

The purpose of the REF is to assess the potential environmental impacts of the activity prescribed by *State Environmental Planning Policy (Transport and Infrastructure) 2021* (T&I SEPP) as "development permitted without consent" on land carried out by or on behalf of a public authority under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The activity is to be undertaken pursuant to Chapter 3, Part 3.4, Section 3.37 of the T&I SEPP.

This document has been prepared in accordance with the *Guidelines for Division 5.1 assessments* (the Guidelines) by the Department of Planning, Housing and Infrastructure (DPHI) as well as the *Addendum Division 5.1 guidelines for schools*. The purpose of this report is to determine the existing constraints of flooding and overland flow paths at the school site, alongside the likely impact of the proposed new building on flood behaviour. The details of this report are based on currently available information at the time of writing.

1.1 Reference Documents

This report has been prepared with reference to the following documents and guidelines:

- Australian Institute of Disaster Resilience (AIDR) Guideline 7-3: Flood Hazard (2017)
- Department of Planning and Environment (2021) Considering Flooding in Land Use Planning Guideline
- Department of Planning and Environment (2023) Flood Impact and Risk Assessment – Flood Risk Management Guide LU01
- FloodSafe guidelines and the relative FloodSafe Tool Kits
- NSW Department of Planning and Environment (2023) Flood Risk Management Manual (https://www.environment.nsw.gov.au/topics/water/floodplains/floodplain-manual\)
- NSW Department of Education – School Infrastructure NSW (2020) School Site Selection and Development, A guideline for determining appropriate school sites (https://www.schoolinfrastructure.nsw.gov.au/news/2021/03/guidelines-for-school-site-selection-and-master-planning-.html)
- NSW Environment and Heritage (2021) Millards Creek – Physical data (https://www.environment.nsw.gov.au/topics/water/estuaries/estuaries-of-nsw/millards-creek)
- NSW Maps Viewer (Spatial Collaboration Portal - Map Viewers (nsw.gov.au))
- NSW Planning Portal Spatial Viewer (https://www.planningportal.nsw.gov.au/spatialviewer/)
- NSW SES (2022) Shoalhaven City Flood Emergency Sub Plan – A Sub Plan of the Local Emergency Management Plan (EMPLAN) (https://www.ses.nsw.gov.au/media/5902/shoalhaven-city-local-flood-emergency-sub-plan-oct-2022.pdf)
- NSW State Emergency Service (SES) Guidelines
- Shoalhaven City Council (2014) Shoalhaven Local Environmental Plan (SLEP)
- Shoalhaven City Council (2021) Millards Creek Flood Study – Final Study Report, prepared by Water Modelling Solutions
- Shoalhaven Development Control Plan (2014) – Chapter G9: Development on Flood Prone Land, Part 5.1: General controls
- Shoalhaven Development Control Plan (2014) – Dictionary
- Shoalhaven Flood Maps (https://maps.shoalhaven.nsw.gov.au/SCCViewer/index.html?Viewer=extSLEP)
- TTW (2025) Flood Emergency Response Plan, dated 24 March 2025

2.0 Site Description

Ulladulla High School is located at 55 South Street, Ulladulla, NSW, 2539 and is legally referred to as Lot 1 in Deposited Plan 595313. The site is located within the Shoalhaven Local Government Area (LGA) and has an approximate area of 6.5 hectares. An aerial photograph of the site is provided at Figure 1**.**

The site is zoned SP2 Educational Establishment and existing development comprises various buildings, a car park, landscaping, sports fields and sports courts associated with Ulladulla High School. Ulladulla High School currently comprises 61 Permanent Teaching Spaces (PTS) and 8 Demountable Teaching Spaces (DTS). Playing fields are located in the north western portion of the site.

The site is largely rectangular in shape, however, is indented in the north east corner where an early learning centre is situated outside of the site boundary on the corner of Green Street and St Vincent Street. The primary frontage to the school is along St Vincent Street to the east, with two vehicular access points to at-grade carparking areas.

Dense vegetation is located in the central and eastern portion of the site, separating the school buildings from the early learning centre. Vegetation is also concentrated along the site boundaries and around the playing fields. The surrounding locality is primarily residential to the west and south. Ulladulla Town Centre is located to the east of the site. Ulladulla Public School is located to the north of site opposite Green Street.

Figure 1: Aerial Photograph of the Site (Source: Urbis, January 2024)

3.0 Proposed Activity Description

The proposed activity relates to upgrades to Ulladulla High School. Specifically, the proposed activity comprises the following:

- Construction of a new two-storey home base building.
- Construction of new stairs and covered walkways.
- Upgrade works to existing internal pedestrian pathways.
- Installation of solar panels.
- External landscape works.

Any works relating to the existing demountables or associated with substations will be undertaken via a separate planning pathway. Figure 2 provides an extract of the proposed site plan.

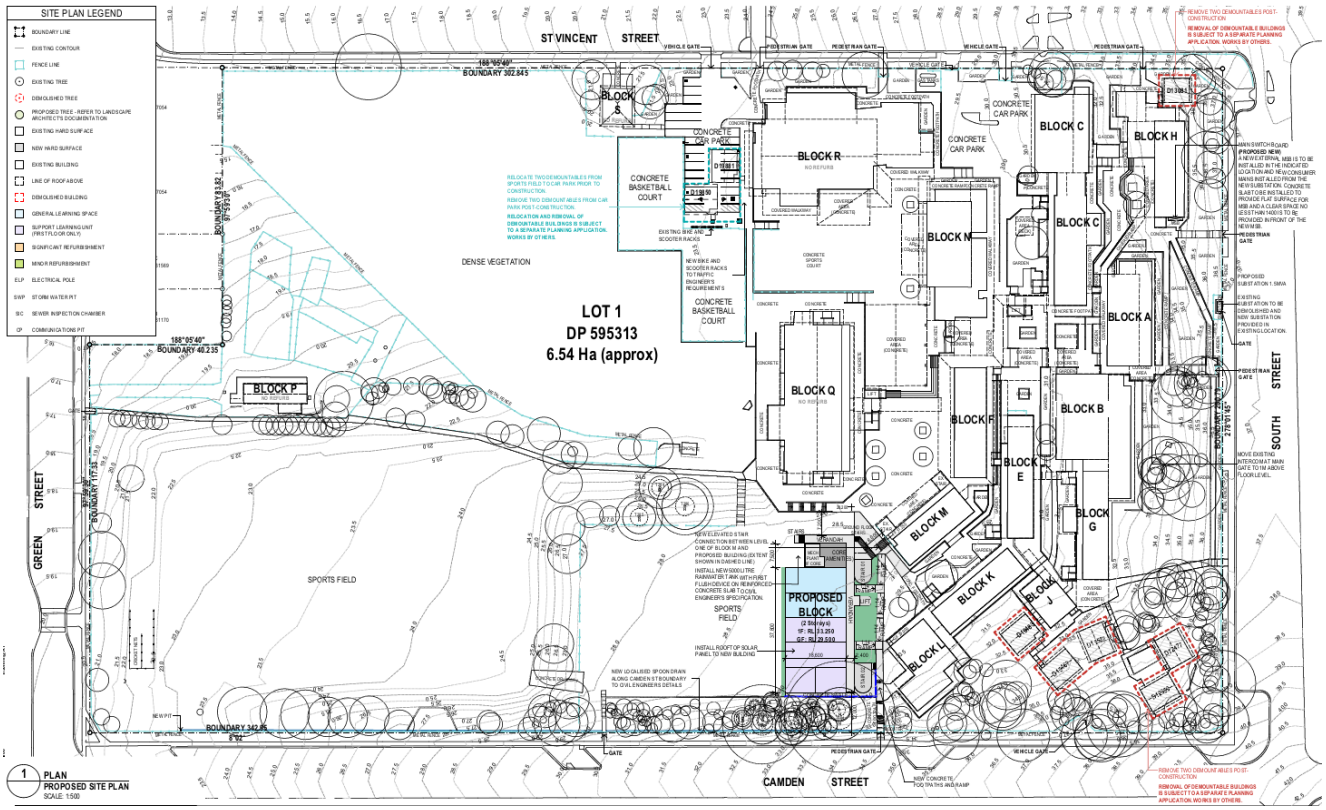


Figure 2: Site Plam (Source: Fulton Trotter, dated March 2025)

4.0 Hydrological Context

4.1 Topography

The site is located a suitable distance from Millards Creek (250m north of the site), preventing any impacts from creek flow at the site. However, the site is situated within a natural depression that forms a drainage path and is consequently vulnerable to overland flooding from the local upstream stormwater catchment.

As part of a desktop study of the site, elevation data for the site was obtained from ELVIS (Elevation Information System) with a spatial resolution of 1m, dated May 2011. The site is situated on the lower northeastern flank of a local hill, with ground surface across the site varying from a low of 13.9m AHD at the northeast corner of the site to a high of 39.7m AHD in the southwest corner. This is depicted in the Digital Elevation Model (DEM) of the site in Figure 3, with a predominant slope from the South Street frontage towards the natural gully to the northeast. The presence of the gully alongside the steep terrain is expected to convey overland sheet flow across the site.

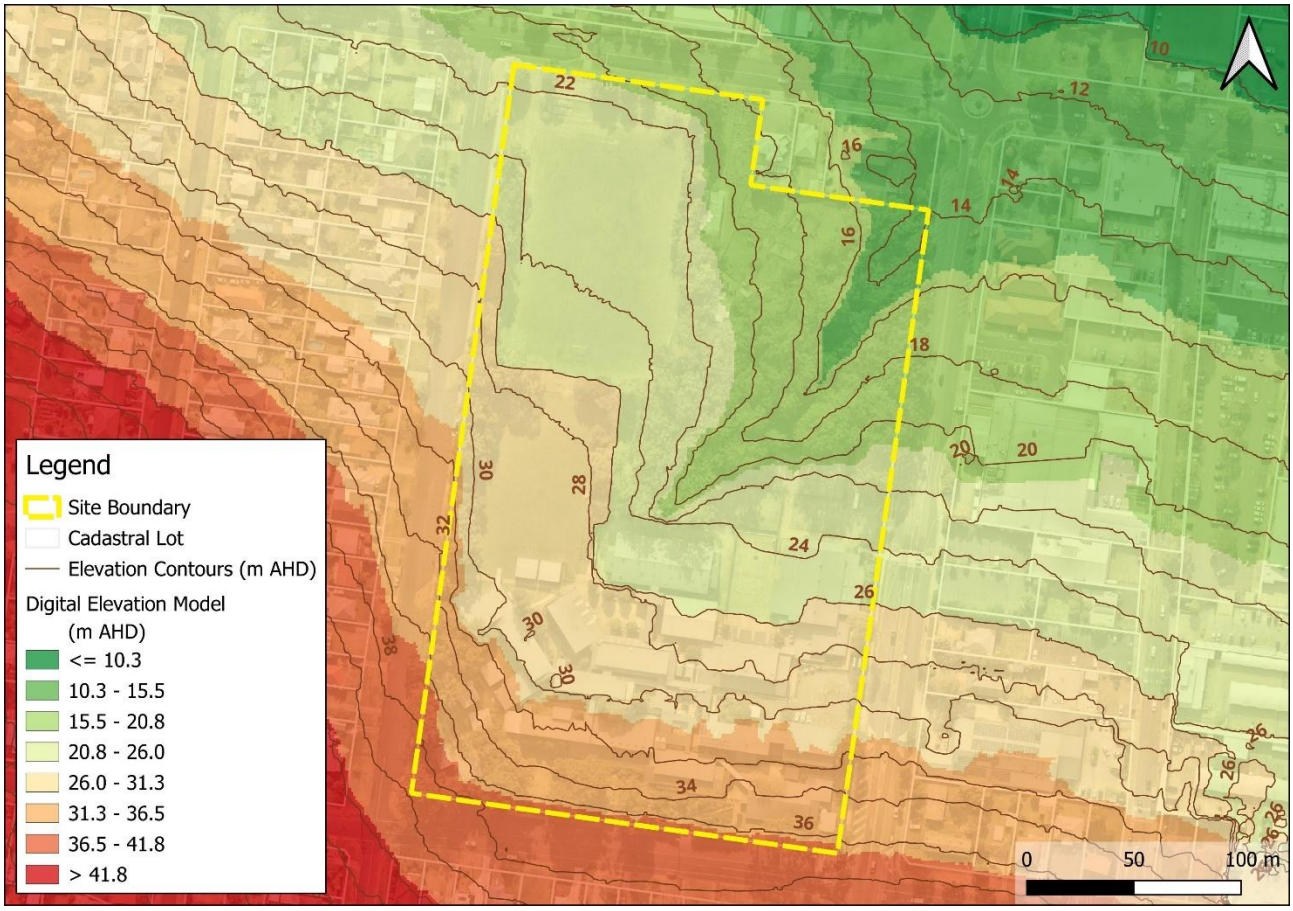


Figure 3: Topography of the site and surrounding area (Source: DEM obtained from ELVIS, 2011)

4.2 Catchment Description

The site is located within the steep, urbanised Millards Creek catchment, which is approximately 5.1 km^2 in area. The creek itself discharges through Ulladulla Harbour and into the Tasman Sea. Over 70% of the Millards Creek catchment is taken up by the urban centre of Ulladulla, with forested areas forming only 15% of the land use (NSW Environment and Heritage, 2021). Given the urban environment of Ulladulla town centre, it has been necessary to review the risks associated with stormwater and overland flow within the site. In addition to the urbanisation of the Millards Creek catchment, the catchment is also steep, resulting in minimal flood storage and increased runoff (NSW SES, 2022).

The creek itself is the major drainage feature relative to the Ulladulla, and the gully situated within the site is

conveyed under St Vincent Street into the creek via a culverted pipe system at its downstream extent. The watercourses surrounding the site are shown in Figure 4, with reference to the Stahler Stream Order. This provides a measure of the relative size of streams, with the smallest tributaries referred to as first-order streams. As they have no upstream tributary, first-order streams typically originate from rainfall or springs, and have a low overall volume of water.

As depicted in Figure 4, the gully onsite is a first-order stream, collecting water from a relatively small area.

Figure 4: Watercourses in the surrounding area of Ulladulla High School (Source: SixMaps, 2024)

5.0 Flood Planning Requirements

TTW requested a Flood Certificate from Shoalhaven City Council on the 17th of October 2024 based on preliminary site plans dated the 4th of October 2024, provided by Fulton Trotter. In their email response, Council advised that the proposed building location is not impacted by riverine flooding in the 1% AEP event, and hence the flood related development controls outlined in the Shoalhaven Development Control Plan (DCP) do not apply for this proposed activity. They also advised that a Flood Certificate is not required for the site.

According to Schedule 1 (Land Use Categories) of the Shoalhaven DCP (2014), schools are regarded as a Category H development ("Buildings and activities requiring special evacuation consideration") and Finished Floor Levels should be built to the Probable Maximum Flood (PMF) level.

Given that Council's initial advice appeared contrary to the above terms of the DCP, TTW sought further clarification from Shoalhaven City Council on the 21st of October via email to confirm that the proposal will not have to comply with the DCP. In this email, TTW confirmed that the site is a school, and included a screenshot of Council's flood model results demonstrating a significant overland flow path across the site in the PMF event, and queried whether flood controls would still not apply.

In their email response, Council then advised that given the site is a Category H development, they require the floor level to be raised 300mm from the surrounding ground surface, but that there is no requirement for the floor level to be raised to the PMF level. Email correspondence with Council is attached in Appendix A.

As such, the controls set out in Shoalhaven DCP (2014) do not apply. Section 10.0 provides an assessment of the compliance of the design with the 300mm freeboard requirement recommended by Council.

6.0 Available Flood Information

6.1 Flood Type and Extent

Shoalhaven City Council commissioned Water Modelling Solutions to complete the Millards Creek Flood Study in 2021, which assessed flood behaviour and impacts in the area. The study considered not only mainstream flooding from Millards Creek and its tributaries, but also the impacts of urban stormwater flooding and overland flows.

The flood study found that the heavily urbanised catchment has numerous overland flow paths, which develop along roads leading towards Millards Creek, including St Vincent Street, and in areas where upstream catchment flows are obstructed by development. The study found that overland flow is the primary source of flooding in the catchment. Despite a few low-lying crossings being overtopped, Millards Creek remains mostly within its main channel up to and including the 1% AEP event.

6.2 Flood Function

The Flood Risk Management Guideline FB02 identifies the hydraulic categorisation (or 'flood function') of flows as an important constraint to consider in the use and development of land. Floodplains have three natural hydraulic functions, defined in the Flood Risk Management Manual (2023) as follows:

- **Floodways** are areas which convey a significant portion of water during floods and are particularly sensitive to changes that impact flow conveyance. They often align with naturally defined channels.
- **Flood storage areas** store a significant proportion of the volume of water and where flood behaviour is sensitive to changes that impact on the storage of water during a flood.
- **Flood fringe areas** are areas within the extent of flooding for the event, but which are outside floodways and flood storage areas. Flood fringe areas are not sensitive to changes in either flow conveyance or storage.

Filling and development in floodways or flood storage areas can alter flood behaviour, potentially to the detriment of the existing community. The Millards Creek Flood Study included an assessment of the flood function of flows in the catchment. Although there is no technical definition of hydraulic categorisation, the assessment was based on the following criteria:

- **Floodway** is defined as areas where:
  - the peak value of velocity multiplied by depth (V x D) > 0.25 m^2/s **AND** peak velocity > 0.25 m/s, **OR**
  - peak velocity > 0.6 m/s AND peak depth > 0.3 m OR
  - defined channels (from bank to bank) on creeks or tributary flow paths
- **Flood Storage** = areas outside the floodway where peak depth > 0.5 m; and
- **Flood Fringe** = areas outside the floodway where peak depth < 0.5 m.

Figure 5 presents the flood function of flows surrounding the site, taken from the Millards Creek Flood Study results. As shown in the figure, the Millards Creek catchment is steep, resulting in minimal flood storage areas. The main creek and overland flow paths are classified as floodways, including St Vincent Street and some parts of Green Street. At the Ulladulla High School site, the natural depression through the centre of the site forms a drainage path that is regarded as a floodway. Aside from this channel, flows are largely regarded as flood fringe areas.

The proposed building is situated outside the 1% AEP extent, and consequently is not located within any floodways, flood storage areas, or flood fringe areas in this event.

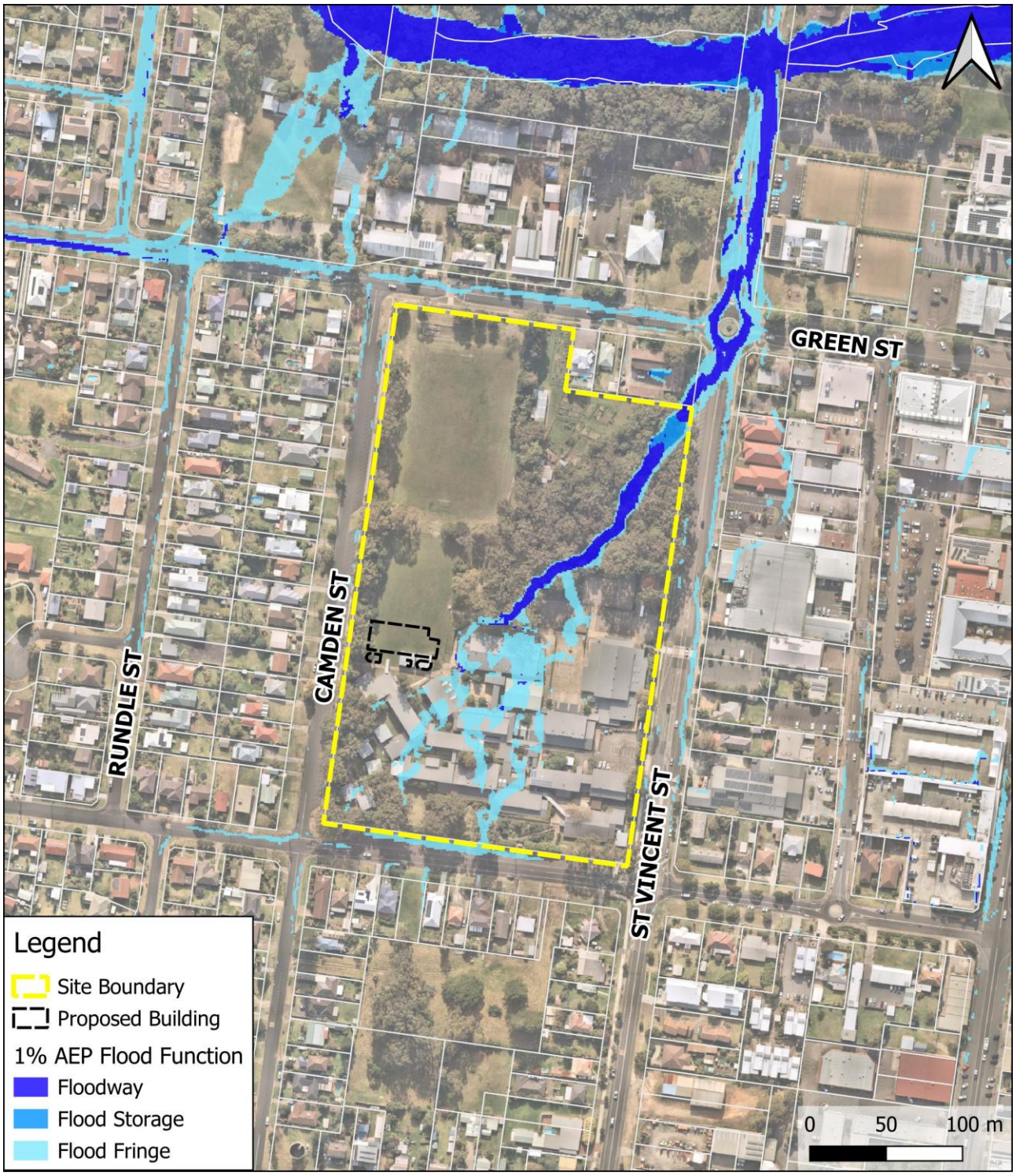


Figure 5: Flood function of flows during the 1% AEP event (Source: Millards Creek Flood Study, 2021)

7.0 Hydraulic Model Setup

7.1 Millards Creek Flood Study (2021)

TTW obtained Shoalhaven City Council's DRAINS and TUFLOW model files for the Millards Creek Flood Study. In the study, DRAINS software was utilised to conceptually model rainfall concentration (including runoff from roof drainage systems, gutters, etc.). These runoff hydrographs then provided hydrological input for the TUFLOW model. Both models are based on the Australian Rainfall and Runoff 1987 (ARR1987).

The general Council TUFLOW model configurations are as follows:

1. 2m cell size
2. TUFLOW release 2013-12-AB _iDP_w64
3. Council's DRAINS hydrographs were used as input to the model.

This model represents the most comprehensive data available for the area at the time of writing and was utilised for this study. Minor updates were made to Council's model (summarised in Section 7.3), with all other inputs and parameters kept consistent.

7.2 2D Model Domain

The TUFLOW model boundary used in the MRE Flood Study (WMA Water, 2019) was retained in TTW's model, and is shown in Figure 6. A square 2m x 2m grid was utilised for the study. As TUFLOW samples elevation points at the cell centres, mid-sides and corners, surface elevations are sampled every 1m. This 2m grid size is therefore sufficient in representing topographical variations within the study area.

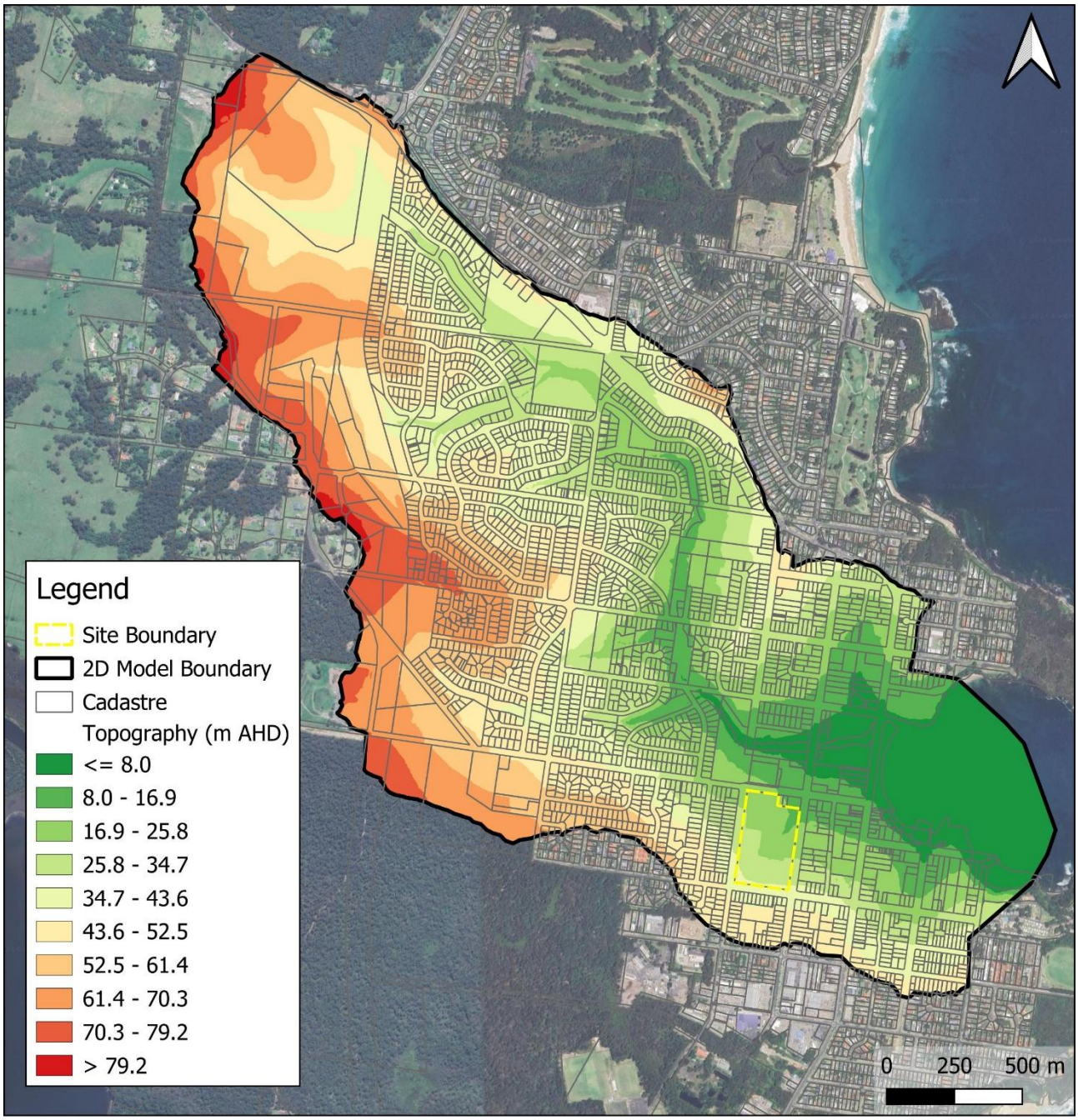


Figure 6: Millards Creek Flood Study model extent

7.3 TTW Model Updates

7.3.1 Site Survey

TTW obtained Shoalhaven City Council's TUFLOW model developed for the Millards Creek Flood Study (2021). For the existing scenario, the model was updated to incorporate new site survey information at a finer spatial resolution. The survey was conducted on the 27th–29th October 2023 by CMS Surveyors. The site survey information is shown in Figure 7. Additional detailed survey was also provided for the adjacent Ulladulla Public School and added into the model.

Figure 7: Detailed site survey information for Ulladulla High School (Source: CMS Surveyors, October 2023)

7.3.2 Building Representation

The Millards Creek Flood Study model represents buildings via an increase in hydraulic roughness (or Manning's 'n' values) within the model. Individual buildings were not represented in the roughness map, but urban areas were assigned a roughness value of 0.1.

This approach allows overland flow to travel through buildings and consequently may not provide an accurate depiction of overland flows paths in all cases. TTW updated the model to block out buildings from the 2D domain, preventing floodwaters from flowing through the buildings. This approach was adopted for buildings within the school boundary and in the immediate surrounding area (including the overland flow path southwest of the school). The remaining buildings within the model domain were represented via a roughness value of 0.1, in line with Council's approach. This had a notable impact on flow distribution and flood behaviour at the site, demonstrated in the comparison presented in Appendix B.

The existing building footprints were based on the site survey from October 2023, presented in Figure 7. Although they were included in the survey data, the demountable buildings were not represented in the model, as these are not permanent structures (and may not withstand severe floods) and will not be present in the developed case.

7.4 1D Model Domain

The stormwater information within the Millards Creek model was reviewed and retained. The drainage pipe network includes a 375mm pipe along South Street. This connects to a 900mm pipe that is diverted through the Ulladulla High School site before discharging into the watercourse onsite. Additional stormwater drainage infrastructure data within the site itself was obtained from site survey data from October 2023. However, the existing drainage system onsite is likely to run at capacity in large storm events and they are unlikely to have any impact in the rare event flood modelling. No additional pipes were therefore incorporated into the model.

7.5 Flood Hazard Assessment

The relative vulnerability of the community to flood hazard has been assessed by using the flood hazard vulnerability curves set out in '*Handbook 7 – Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*' of the Australian Disaster Resilience Handbook Collection (2017).

These curves assess the vulnerability of people, vehicles and buildings to flooding based on the velocity and depth of flood flows. The flood hazard categories are outlined in Figure 8, ranging from a level of H1 (generally safe for people, vehicles and buildings) to H6 (unsafe for vehicles and people, with all buildings considered vulnerable to failure).

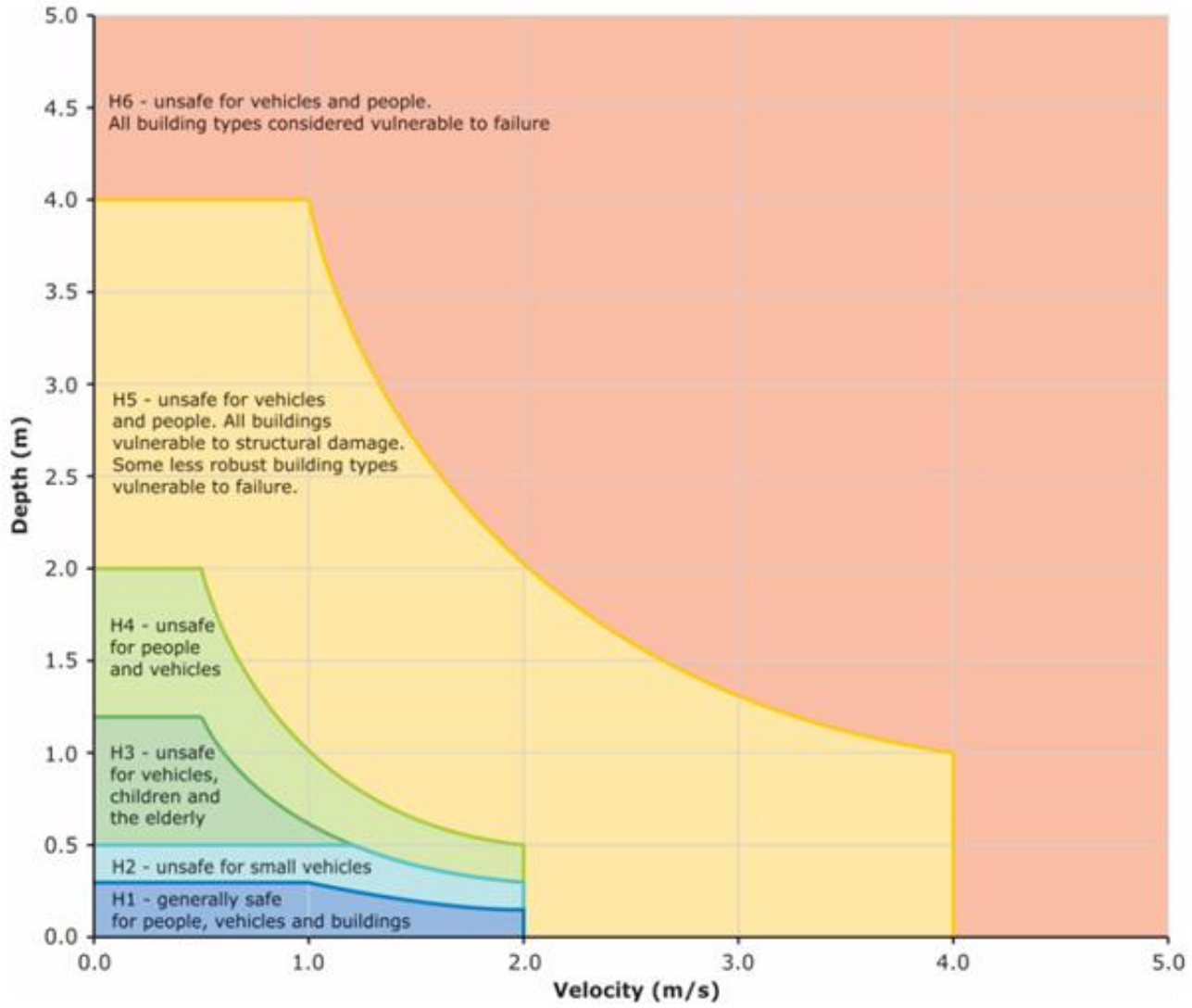


Figure 8: Flood hazard vulnerability curve (Source: Flood Risk Management Guide FB03 - Flood Hazard, NSW Department of Planning and Environment, 2022)

8.0 Flood Model Results

8.1 Critical Storm Durations

The model was run for a range of storm durations from 15 minutes to 360 minutes to identify the critical storms in relation to the site. Table 1 outlines the model runs completed for each event, alongside the critical duration and median temporal pattern identified for the site.

Table 1: Critical durations and median temporal patterns identified for each design event

Event	Storm Durations Assessed (mins)	Critical Duration	Median TP
10% AEP	30, 45, 60, 90, 120, 180, 270, 360	90 minutes	TP09
1% AEP	30, 45, 60, 90, 120, 180, 270, 360	45 minutes	TP02
0.5% AEP	30, 45, 60, 90, 120, 180, 270, 360	45 minutes	TP02
0.2% AEP	30, 45, 60	45 minutes	TP02
PMF	15, 30, 45, 60, 90, 120, 180, 270, 360	30 minutes	TP01

8.2 Existing Flood Conditions

The peak flood levels, depths, velocities, and hazard categories in the critical duration 1% AEP event for the existing site conditions are shown in Figure 9, Figure 10 and Figure 11, respectively. Figure 12, Figure 13 and Figure 14 illustrate the PMF depths, velocity, and hazard information under existing conditions. Flood depth and level maps for the 10%, 0.5% and 0.2% AEP events are attached in Appendix C.

The site is impacted by overland flows when South Street's stormwater system exceeds capacity and is affected by events as frequent as the 10% AEP event. The following observations have been made:

- Runoff overflows onto the site from the south, and generally travel in a north-northeastern direction toward the natural gully onsite.
- Depths within this channel reach a maximum of 1.10m in the 1% AEP event, upstream of the culvert at the northeast of the site. In the PMF, depths here reach a maximum of 1.65m.
- The existing buildings obstruct a notable portion of flows from reaching the gully, resulting in ponding between the structures, particularly to the south of the existing buildings.
- The proposed activity area (northwest of the existing buildings) is largely unaffected by overland flows in the 1% AEP event, although there are some flows around the demountable buildings with a depth of 300m. In the PMF, the proposed activity area is impacted by flows generally less than 100m deep, although the flow path just south of the demountables reaches 370mm.
- Flow velocities within the gully reach a maximum of 2.1 m/s in the 1% AEP event and exceed 3.0 m/s in the PMF. Across the proposed activity area, flow velocities generally lie between 0.5-1.0 m/s in the PMF.
- Flows in the 1% AEP event are typically categorised as low hazard (H1) over the site, although some flood hazards are as high as H3 to H5 in isolated areas south of several existing buildings. In the PMF event, the west of the site (including the proposed activity area) is primarily impacted by low hazard (H1) flows, however there are pockets of high hazard flows (H4-H5) around the demountable buildings. Camden Street, which marks the western border of the site, is primarily impacted by low hazard flows in the PMF, while St Vincent Street to the east is impacted by high hazard flows, reaching a H5 hazard level.

Figure 9: 1% AEP flood depths and levels at the Ulladulla High School under existing conditions

Figure 10: 1% AEP flood velocities at the Ulladulla High School under existing conditions

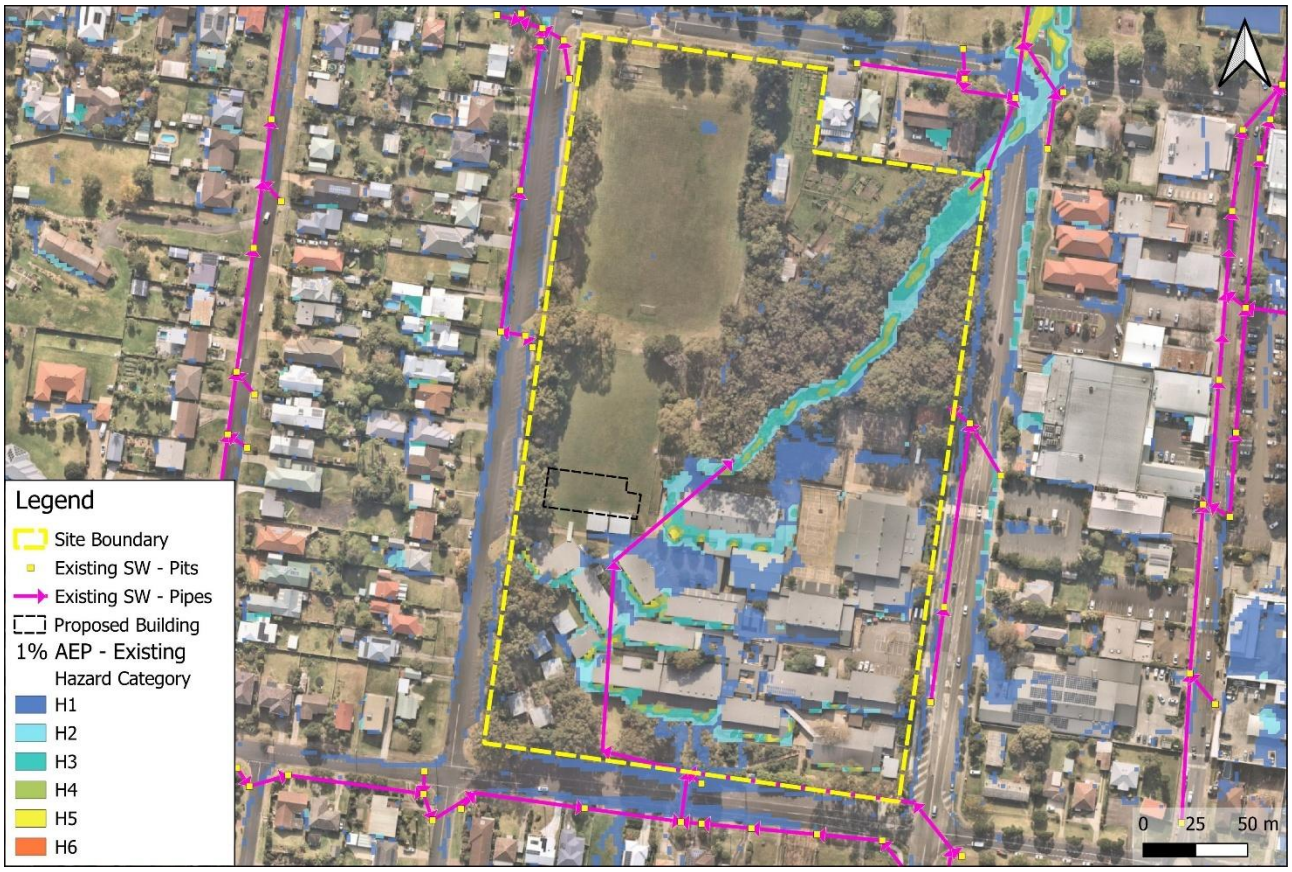


Figure 11: 1% AEP flood hazard levels at the Ulladulla High School under existing conditions

Figure 12: PMF depths and levels at the Ulladulla High School under existing conditions

Figure 13: PMF velocities at the Ulladulla High School under existing conditions

Figure 14: PMF hazard levels at the Ulladulla High School under existing conditions

8.3 Post-Construction Flood Conditions

8.3.1 Model Updates

The existing conditions flood model was updated to create a post-construction flood model based on the 50% Schematic Design information:

- The proposed buildings were incorporated into the model based on the building footprints in the site plan shown in Figure 2.
- The site grading and levels were updated based on the 50% Schematic Design TIN provided by Meinhardt, dated 5 December 2024.

The proposed building is located at the northwestern extent of the existing building cluster. As with the current design of the school, the proposed activity includes terracing, with a sunken landscaped area immediately south of the building. This is presented in the perspective view of the proposal, presented in Figure 15.

A number of measures have been incorporated into the design to mitigate impacts from overland flows, including a wall surrounding the southwest of the proposed building, as demonstrated in the perspective view. Between the wall and the building, a swale has been incorporated into the civil design along the western border of the building. This will limit ponding and direct any flows from the southwest of the sunken landscaped area to the north of the building, away from any openings.

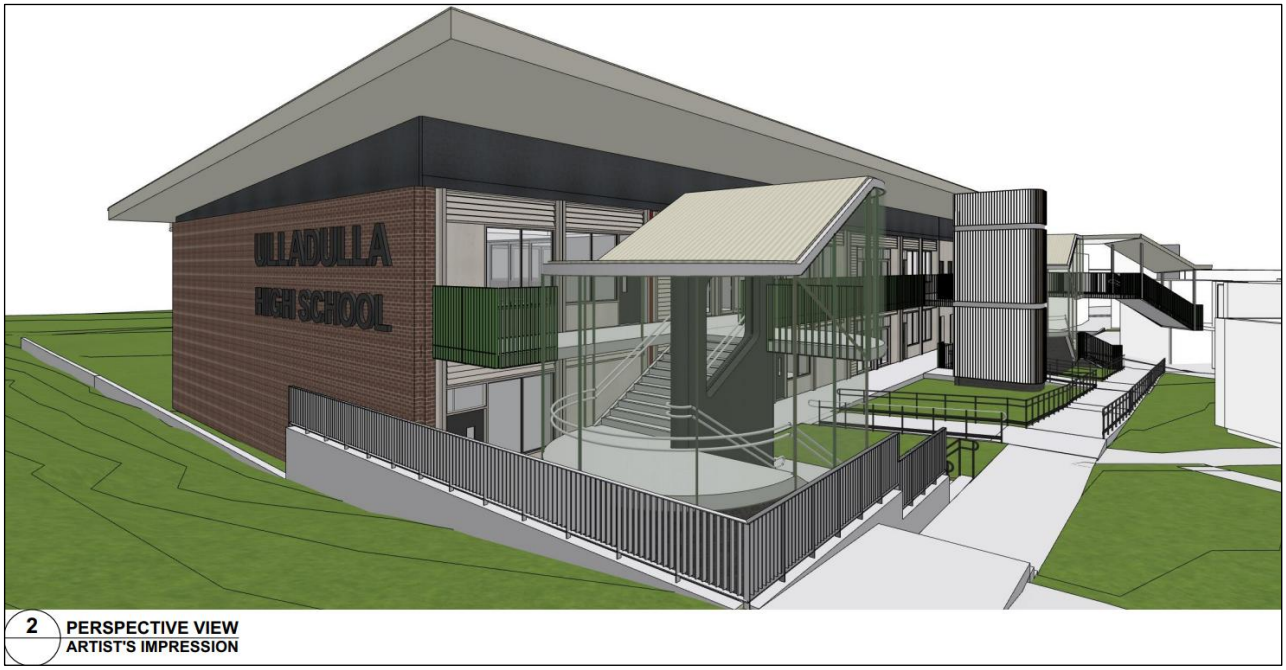


Figure 15: Perspective view of the proposed building, viewed from the southwest (Source: Fulton Trotter, dated 12 December 2024)

8.3.2 Model Limitations

The spatial resolution of the model grid (with a cell size of 2m x 2m) limits the ability of the model to represent small-scale detail within the design surface, in particular the vertical drop into the sunken landscaped garden and the swale adjacent to the wall.

In addition, the proposed stormwater network has not been incorporated into the model (nor has the existing stormwater network within the site). The current design includes stormwater pipes with a diameter of 225-300mm. These would reach full capacity in severe flood events and not impact on the results of the modelling to a significant degree.

8.3.3 Post-Construction Scenario Results

Figure 16, Figure 17 and Figure 18 illustrate peak flood depths and levels, flow velocity, and hazard categorisation at the site under post-construction conditions in the 1% AEP event. PMF depth, level, velocity and hazard results are presented in Figure 19, Figure 20 and Figure 21, respectively. Additional flood mapping for the 10%, 0.5% and 0.2% AEP events is attached in Appendix D.

The following observations have been made:

- The extent of overland flows surrounding the proposed building footprint has increased, owing to the sunken landscaped garden, with isolated ponding in this area. Depths within this sunken garden reaches a maximum of 350mm in the 1% AEP event, and 500mm in the PMF event. However, the site grading directs flows away from the proposed building, and flows do not reach the openings in the 1% AEP event.
- Table 2 outlines the flood levels at three points along the veranda adjacent to the doorways, which are all located along the southern side of the building. The point locations are presented in Figure 22. In the PMF event, flood levels peak at 29.59m AHD at Point B, 90mm higher than the current proposed FFL of 29.50m AHD.
- However, the 2m grid used in the hydraulic model does not fully capture the mitigation measures implemented into the civil design, owing to the interpolation of elevation data between cells. As a result, the vertical drop into the sunken garden and the swale to the west of the building are not accurately represented. The model therefore underestimates flood storage and provides a conservative indication of flood levels. In reality, it is believed that the flood levels along the veranda would be below 29.50m AHD in all events, including the PMF.

- The site's stormwater pits and pipes are not included in the flood model, which shows conservative ponding in the sunken garden that would not occur in reality.
- In terms of flood hazard, flows to the south of the new building are categorised as H1 hazard level in the 1% AEP event (generally safe for people and children), and H1-H2 hazard level in the PMF. To the southeast of the new building, flows are regarded as high hazard (peaking at a hazard level of H5) in the PMF, due to flow velocity exceeding 2.0m/s in this region. This can be attributed to the high velocity of flows as they are directed down to the lower terrace. Note that this area is impacted by high hazard flows in existing conditions (up to H5), and hence the proposed activity does not worsen the existing flood risk or change the flood emergency management strategy for the existing school. For the proposed building, flood-free access is available to the west, onto Camden Street via the pedestrian access point, allowing safe egress from the site.
- More detailed comparison between pre- and post-construction flood levels is presented in Section 11.0.

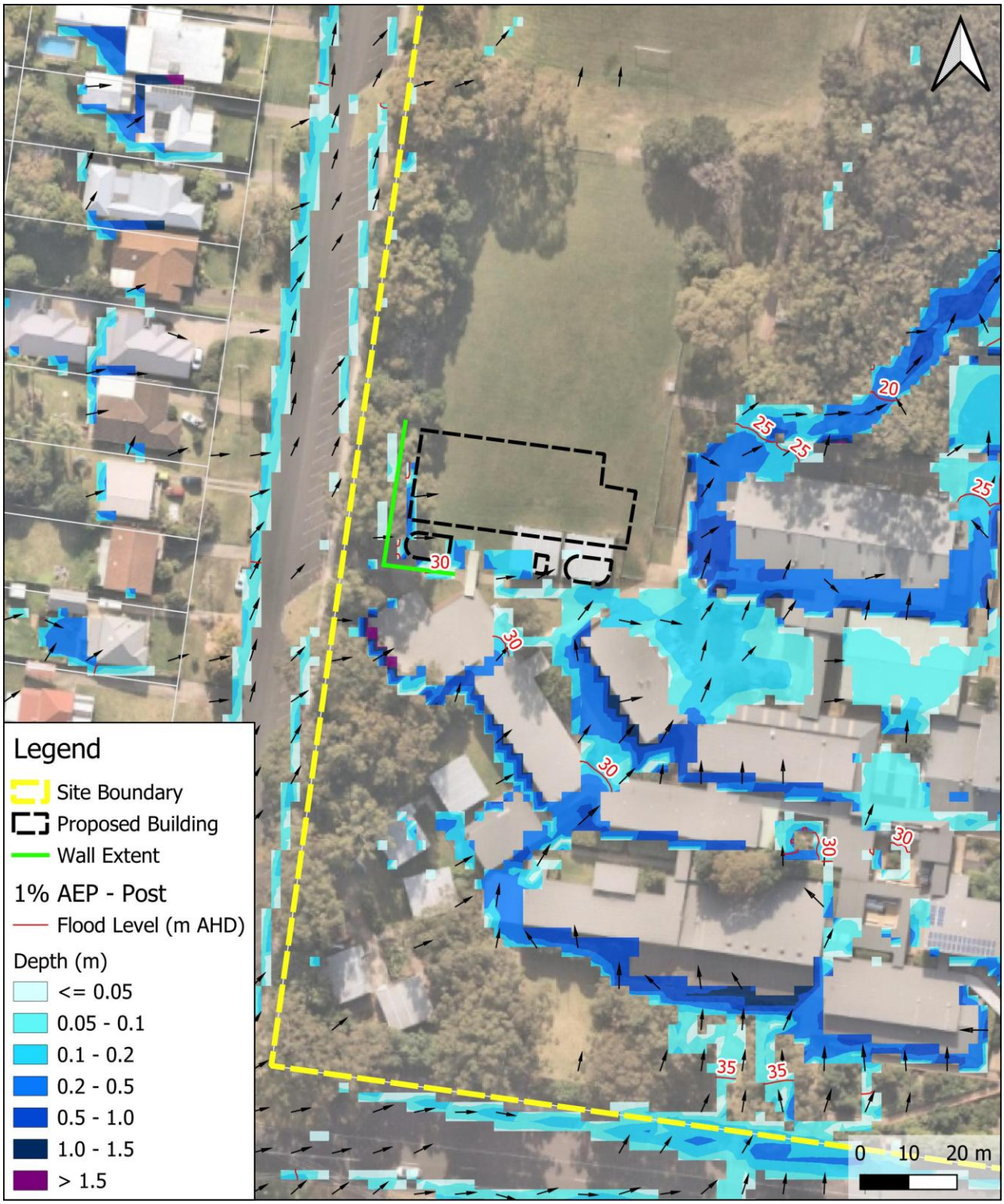


Figure 16: 1% AEP flood depths and levels at Ulladulla High School under post-construction conditions

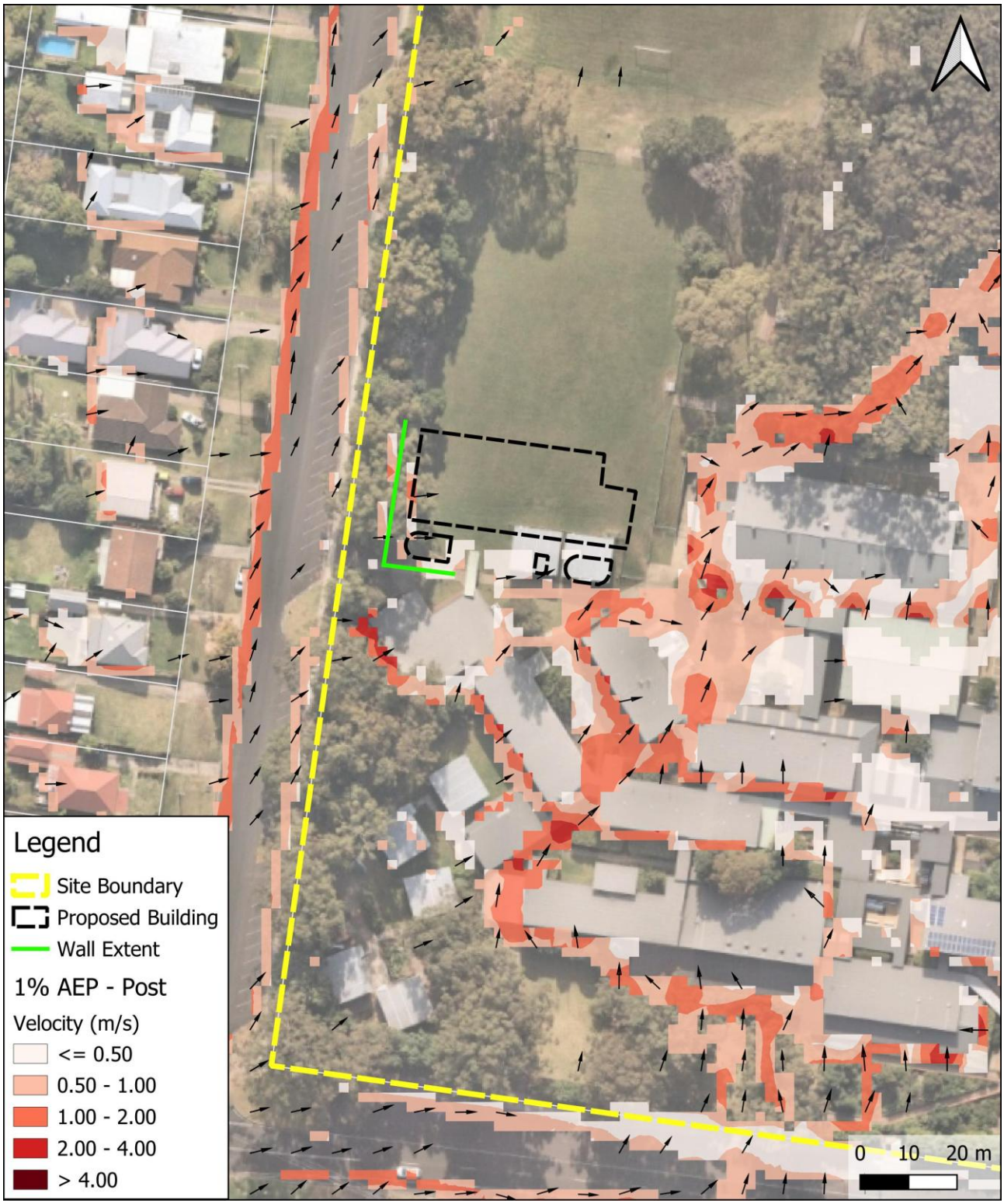


Figure 17: 1% AEP flood velocities at Ulladulla High School under post-construction conditions

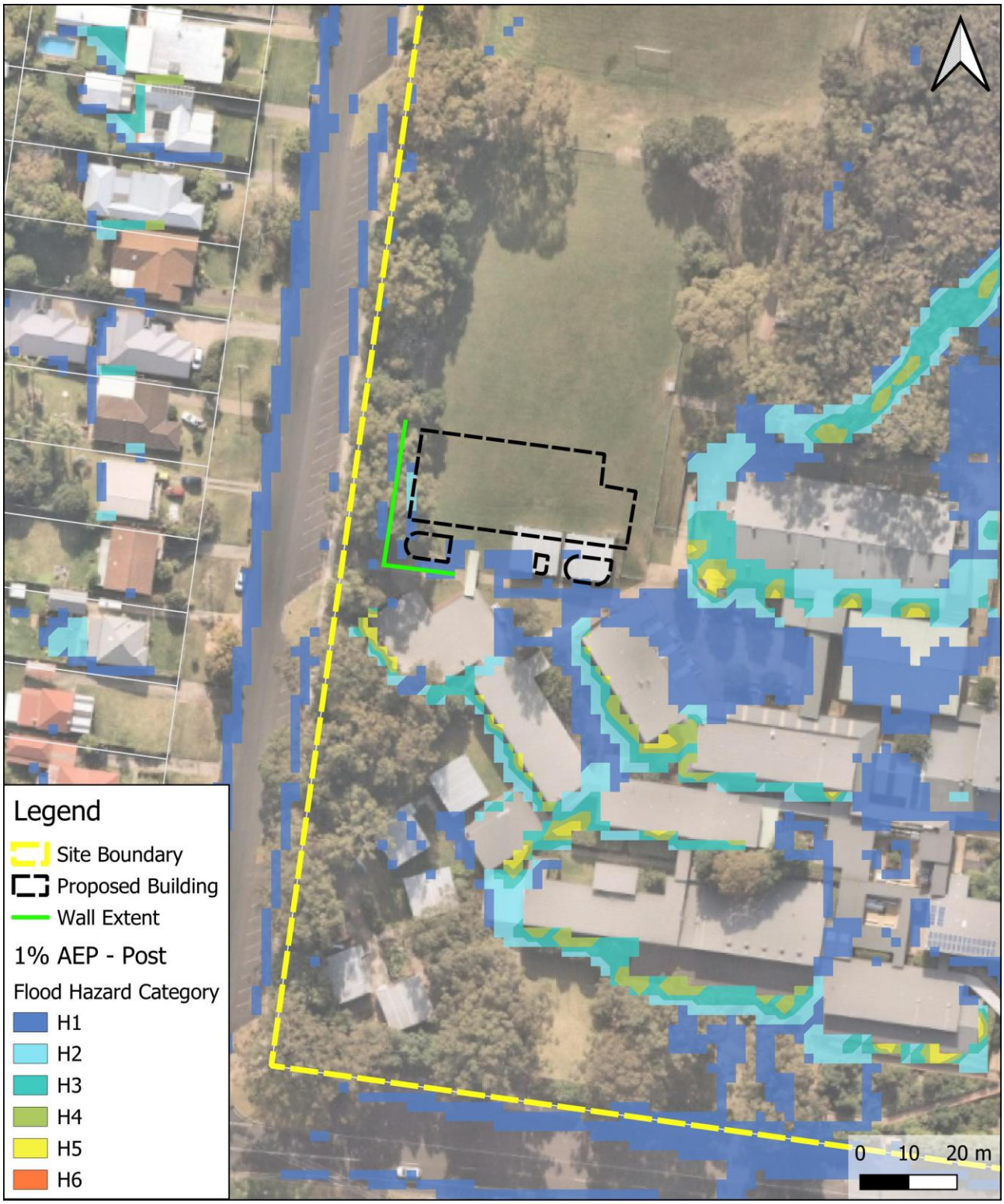


Figure 18: 1% AEP flood hazard levels at the Ulladulla High School under post-construction conditions

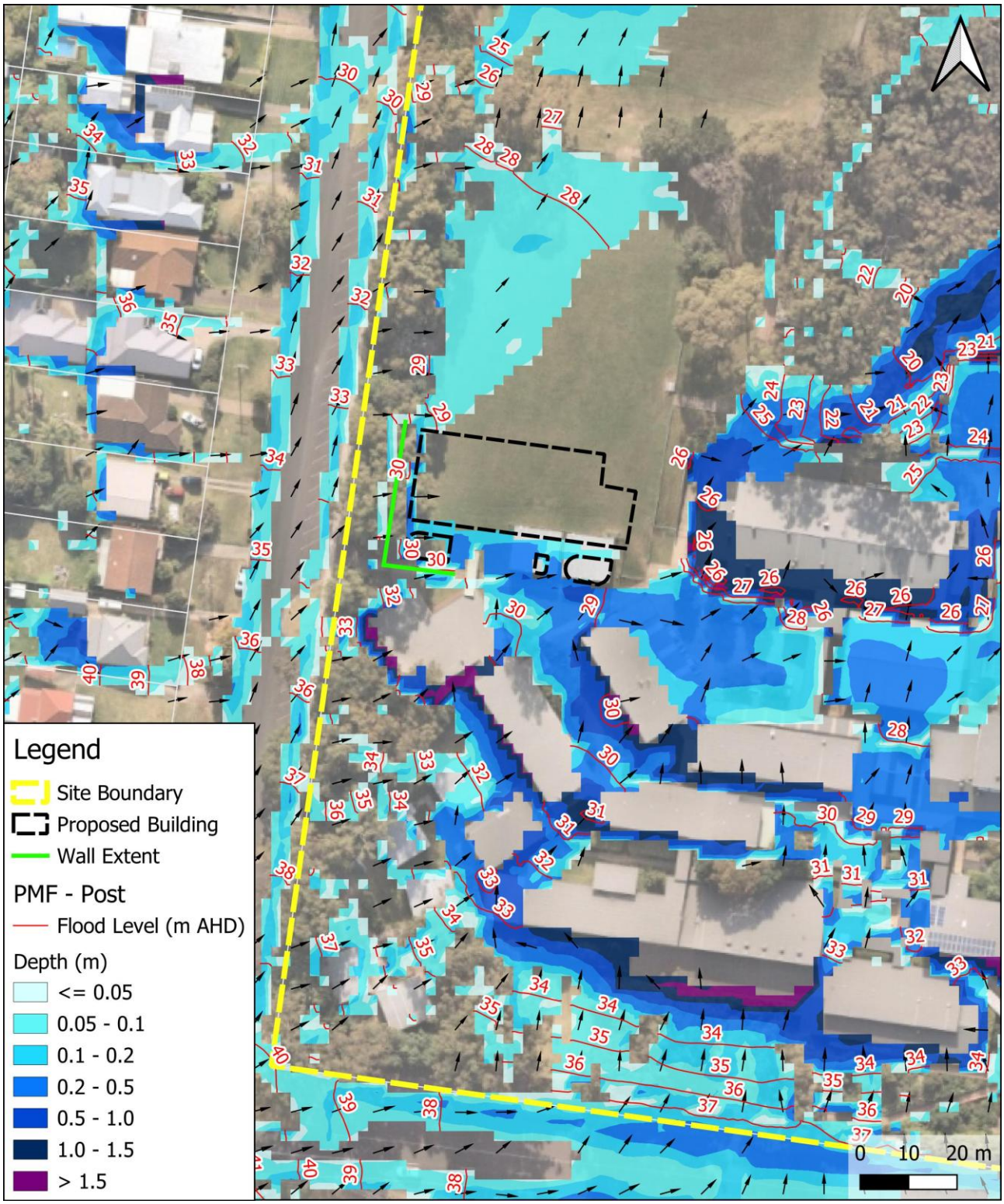


Figure 19: PMF depths and levels at Ulladulla High School under post-construction conditions

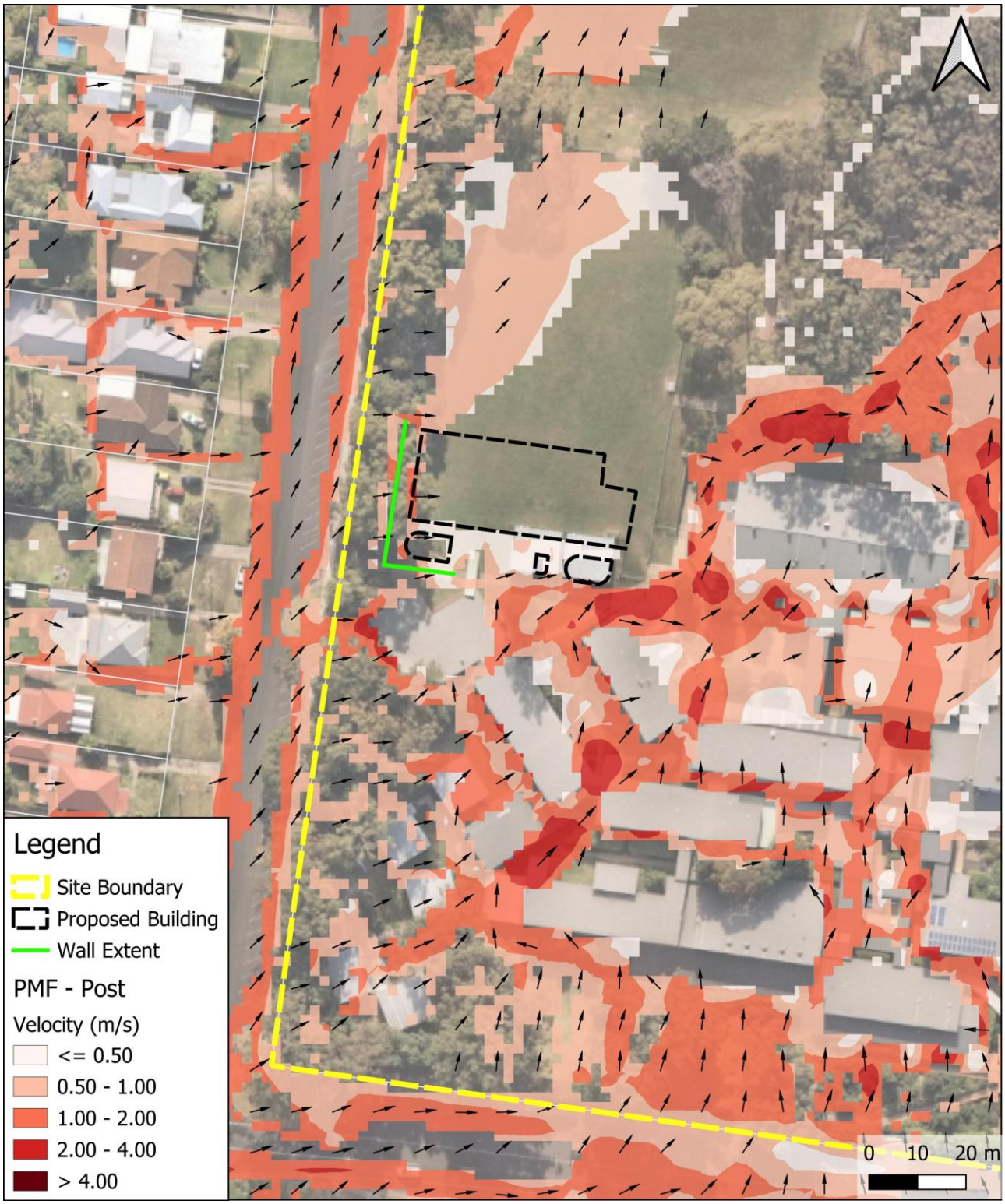


Figure 20: PMF velocities at Ulladulla High School under post-construction conditions

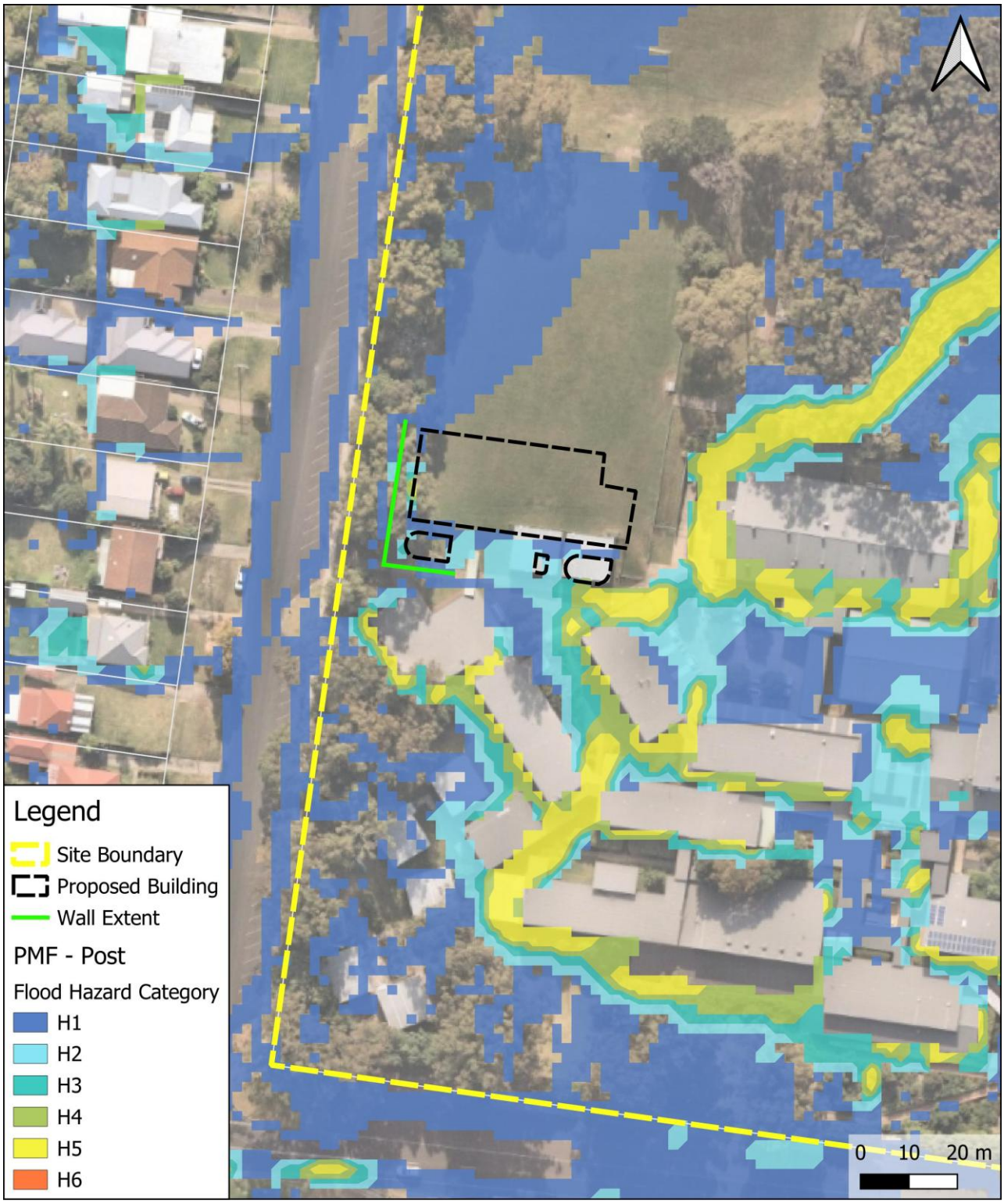


Figure 21: PMF hazard levels at Ulladulla High School under post-construction conditions

Table 2: Modelled flood levels surrounding the proposed acitivty site. Refer to Figure 22 for point locations.

Point	Existing Flood Level (m AHD)					Post-Construction Flood Level (m AHD)						
	10%	1%	0.5%	0.2%	PMF	10%	1%	1% CC 2050	1% CC 2100	0.5%	0.2%	PMF
A	N/A					N/A		29.52	29.54	29.51	29.52	29.58
B	N/A					N/A		29.41	29.44	29.40	29.41	29.59
C	N/A				29.19	N/A						29.56

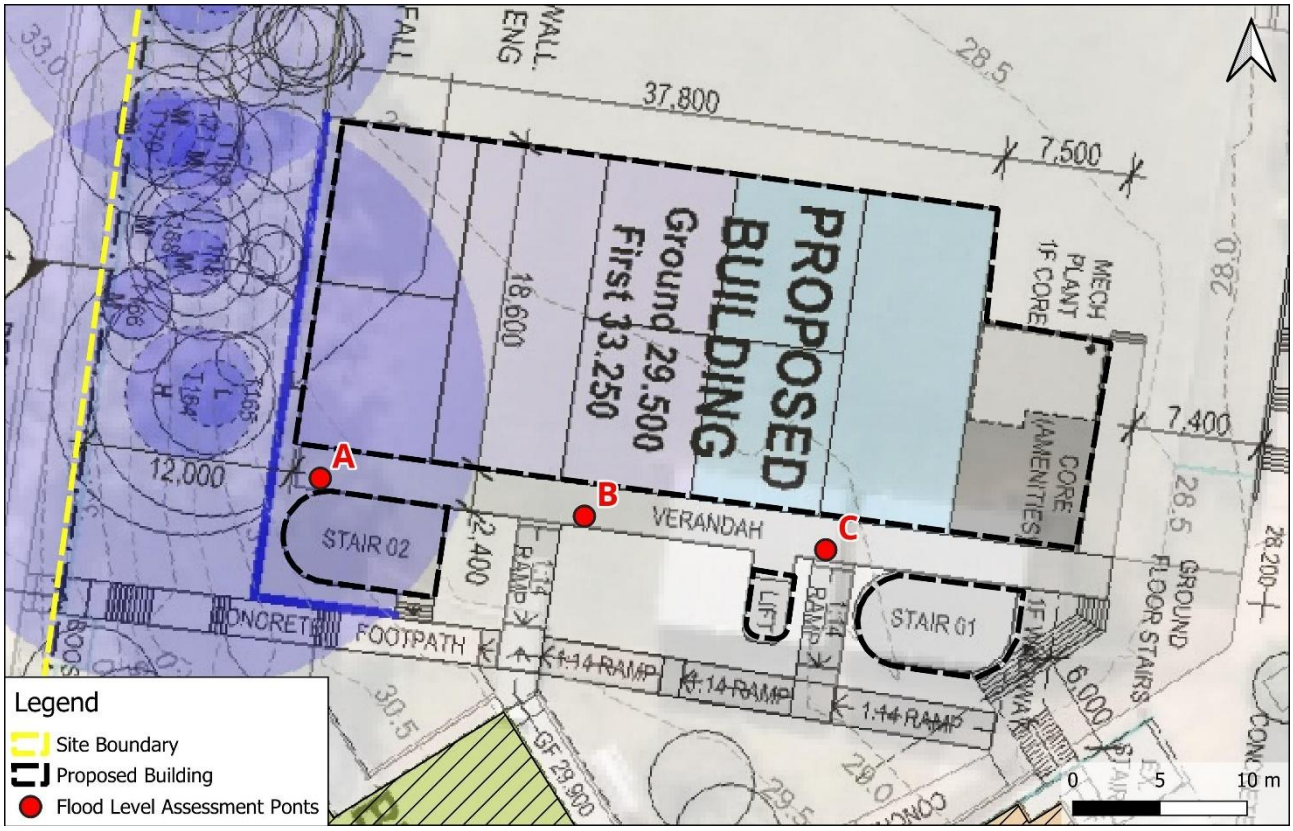


Figure 22: Flood level assessment locations. Refer to Table 2 for levels

9.0 Sensitivity Assessment

The sensitivity of the model to varying model parameters has been assessed in the following section. The sensitivity of flood levels to climate change is analysed in Section 9.1, while the impact of pit blockage is outlined in Section 9.2. The increase in flood levels is assessed for 2 locations within the site, and 2 offsite locations on St Vincent Street and South Street. These are labelled in Figure 23.

Figure 23: Point locations where flood level sensitivity has been assessed

9.1 Climate Change

Climate change is expected to have an adverse impact on rainfall intensities, which has the potential to have significant impact on flood behaviour at specific locations.

The Millards Creek Flood Study included an assessment of flood behaviour in 2050 and 2100 based on data obtained from the CSIRO Climate Futures Tool. For rainfall intensity, this equated to an increase of 7.3% under RCP 8.5 in 2050, and 16.3% in 2100. However, the ARR2019 guidelines were updated on 27th August 2024 with new guidance on how to consider climate change when planning for future floods, which includes variable rainfall adjustments based on storm duration. The projected increase in rainfall during short-duration events is significantly higher than the estimates provided in CSIRO. For this study, a sensitivity analysis has been carried out to determine the impact of climate change on local flood conditions under the Shared Socioeconomic Pathway (SSP) 3-7.0. SSP3-7.0 is a medium to high reference scenario that assumes that CO_2 emissions will double by 2100.

Similarly, in terms of sea-level rise, the 2100 scenario was based on a projected increase of 360mm. Updated findings from the Intergovernmental Panel on Climate Change (IPCC) indicate that sea levels may rise by up to 850mm in 2100. This higher projection was applied to tidal levels in the model to ensure a more accurate representation of levels under future climate change.

Two combined climate change scenarios have been assessed:

- Projected 2050 (CC2050): Sea-level rise of 230 mm and rainfall increase of 29%
- Projected 2100 (CC2100): Sea-level rise of 850 mm and rainfall increase of 66%

These climate change factors were applied to the 1% AEP, 0.5% AEP and 0.2% AEP event rainfall. Table 3 provides a summary of the flood level increase at four locations within and surrounding the site. Figure 24 and Figure 25 demonstrate the flood level afflux in the 1% AEP event in the CC2050 and CC2100 scenarios, respectively.

The results indicate that for the majority of the site, flood levels are expected to increase by 30-50mm in the 1% AEP event under the CC2050 scenario, and 50-70mm in the CC2100 scenario. Based on the flood assessment locations, the largest increase in flood level is anticipated at Point C, south of the existing Building Q, with a 117mm increase under the 1% AEP CC2050 scenario and a 244mm increase under the CC2100 scenario.

Table 3: Climate change sensitivity at four locations within and surrounding the site. Refer to Figure 23 for locations.

	Flood Level (m AHD) Increase Due to Climate Change								
	1% AEP			0.5% AEP			0.2% AEP		
	Flood Level	CC2050	CC2100	Flood Level	CC2050	CC2100	Flood Level	CC2050	CC2100
A	12.80	+56mm	+112mm	12.82	+56mm	+113mm	12.85	+58mm	+120mm
B	29.33	+58mm	+111mm	29.37	+39mm	+92mm	29.39	+54mm	+105mm
C	25.38	+117mm	+244mm	25.42	+129mm	+255mm	25.48	+131mm	+283mm
D	37.04	+20mm	+41mm	37.05	+20mm	+41mm	37.06	+21mm	+43mm

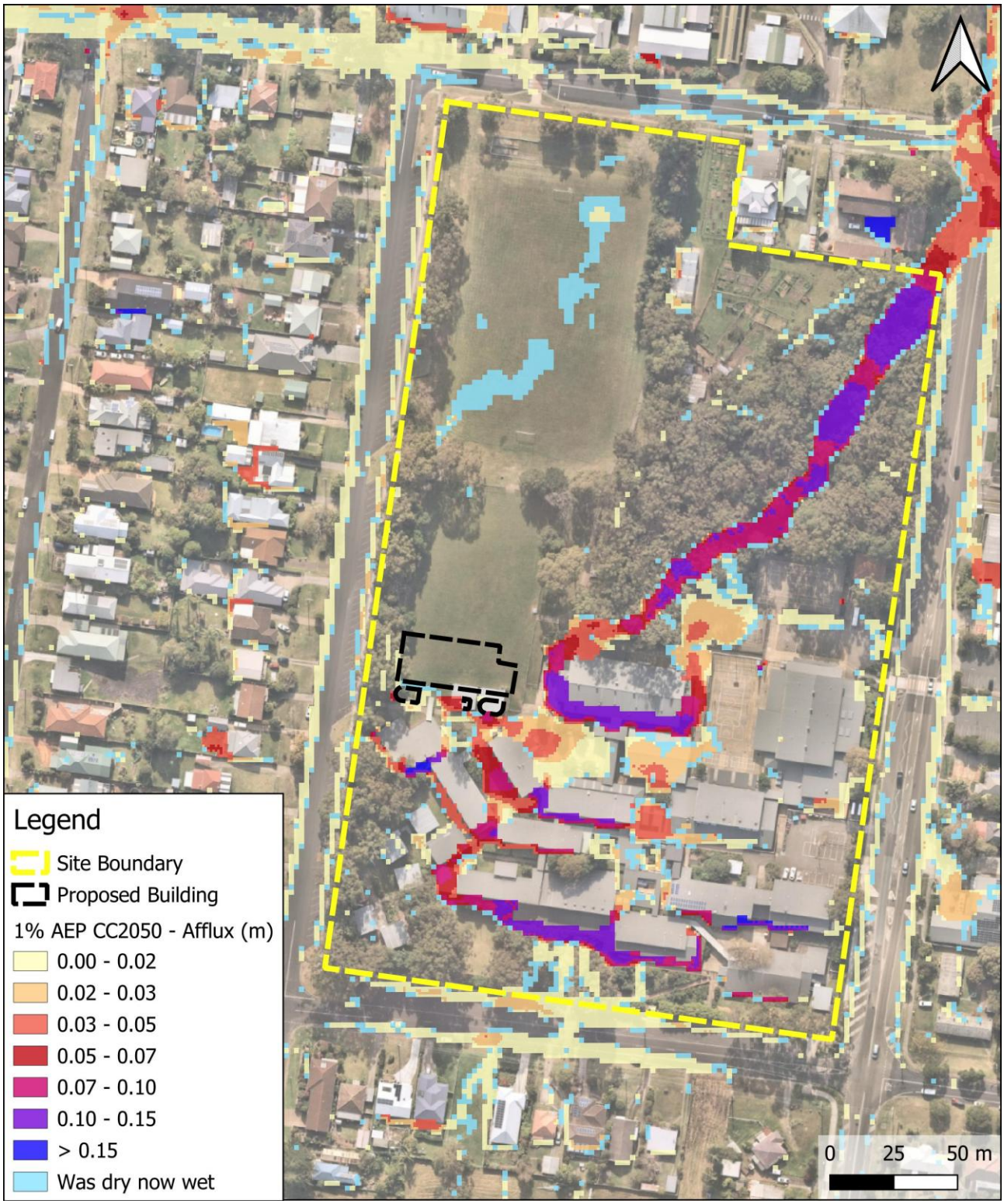


Figure 24: Flood level afflux (m) under the 1% AEP CC2050 scenario

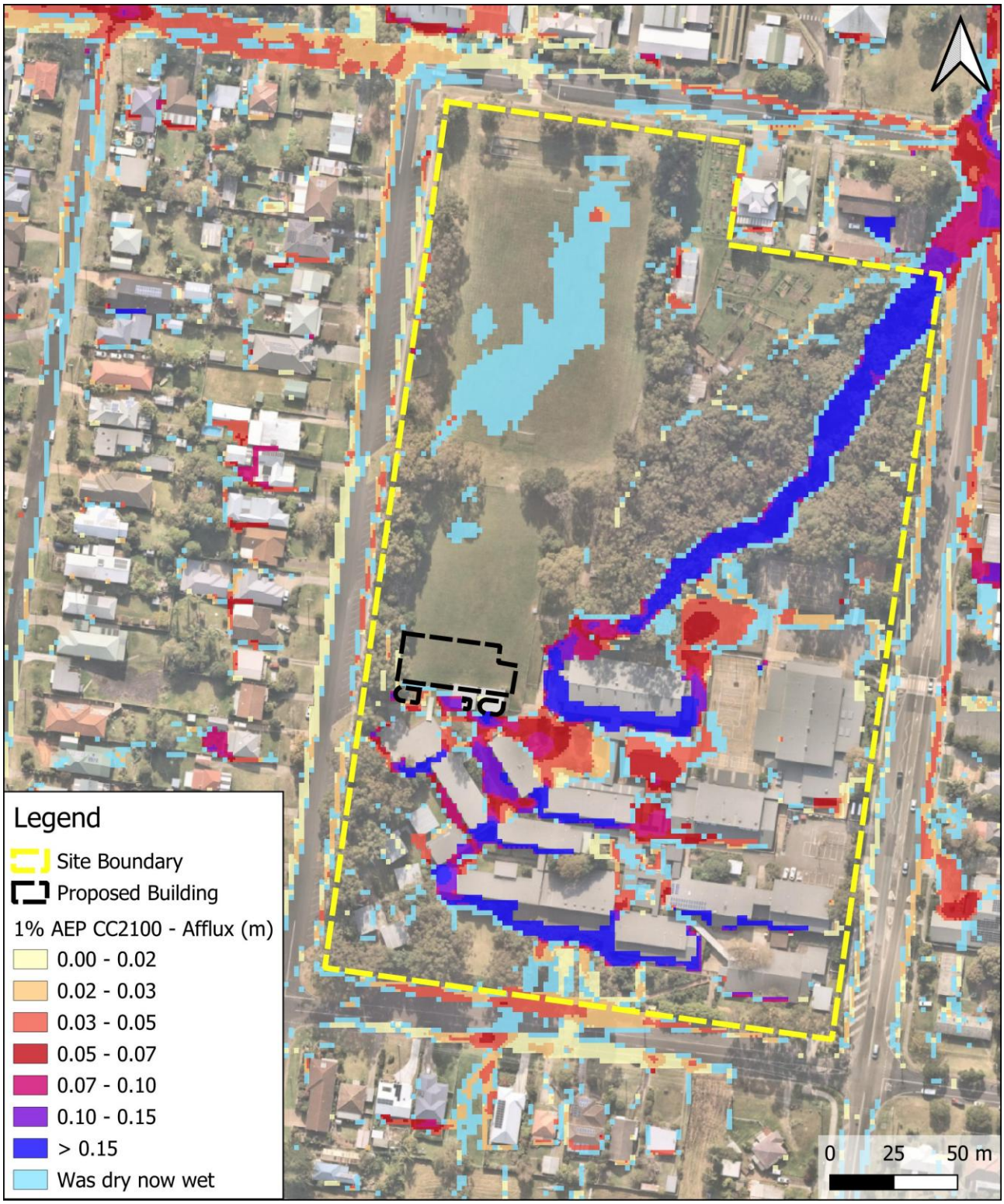


Figure 25: Flood level afflux (m) under the 1% AEP CC2100 scenario

9.2 Blockage Assessment

The Shoalhaven City Council DCP states that modelling should include a 50% and 100% blockage analysis of existing drainage structures. For the purpose of this study, these blockage factors were applied to all of Council's existing stormwater pits.

Table 4 outlines the flood level increase from a 50% and 100% blockage in the post-construction scenario at Points A-D. Within the site boundary, the largest increase in flood level under the 100% blockage scenario is

observed around Point C, south of the existing Building Q. At this location, flood level increases by 23mm in this scenario. For the majority of the site, however, flood level increases are below 10mm.

Table 4: Pit blockage sensitivity at four locations surrounding the site. Refer to Figure 23 for locations.

	Flood Level Increase		
	1% AEP Flood Level (m AHD)	**50% Blockage**	**100% Blockage**
Point A	12.80	+8 mm	+21 mm
Point B	29.33	0 mm	+2 mm
Point C	25.38	+3 mm	+23 mm
Point D	37.04	0 mm	+2 mm

10.0 Compliance with Flood Planning Controls

10.1 Council Requirements

As discussed in Section 5.0, Council have advised that the proposed activity is not subject to any specific flood controls outlined in the Shoalhaven DCP, given that it is unaffected by mainstream flooding. However, they recommended that the FFL of the proposed building is set to 300mm above the surrounding ground level. The purpose of the 300mm fall away from the building is to ensure surface runoff, and minor overland flow paths are directed away from building entrances in accordance with stormwater standards.

The principal of levels falling away from the building floor level have been met, as shown in Figure 26, which presents contours of the design levels at the site, extracted from the 50% Schematic Design TIN provided by Meinhardt, dated 5th December 2024. This markup is also attached in Appendix E.

In order to ensure a smooth connection to the existing footpath, the pathway to the new building does not have 300mm fall away from the building. It ramps down from 29.90m AHD at the connecting footpath, to 29.50m AHD adjacent to the building. However, there is a cross fall along this ramp that will shed water to the landscaped areas to the east of the path, directing flows away from the building and building openings.

In terms of flood risk, the design is regarded as acceptable by TTW, given that the civil and stormwater design has incorporated a number of measures (including a swale, an overflow pipe and site grading considerations) to mitigate overland flows.

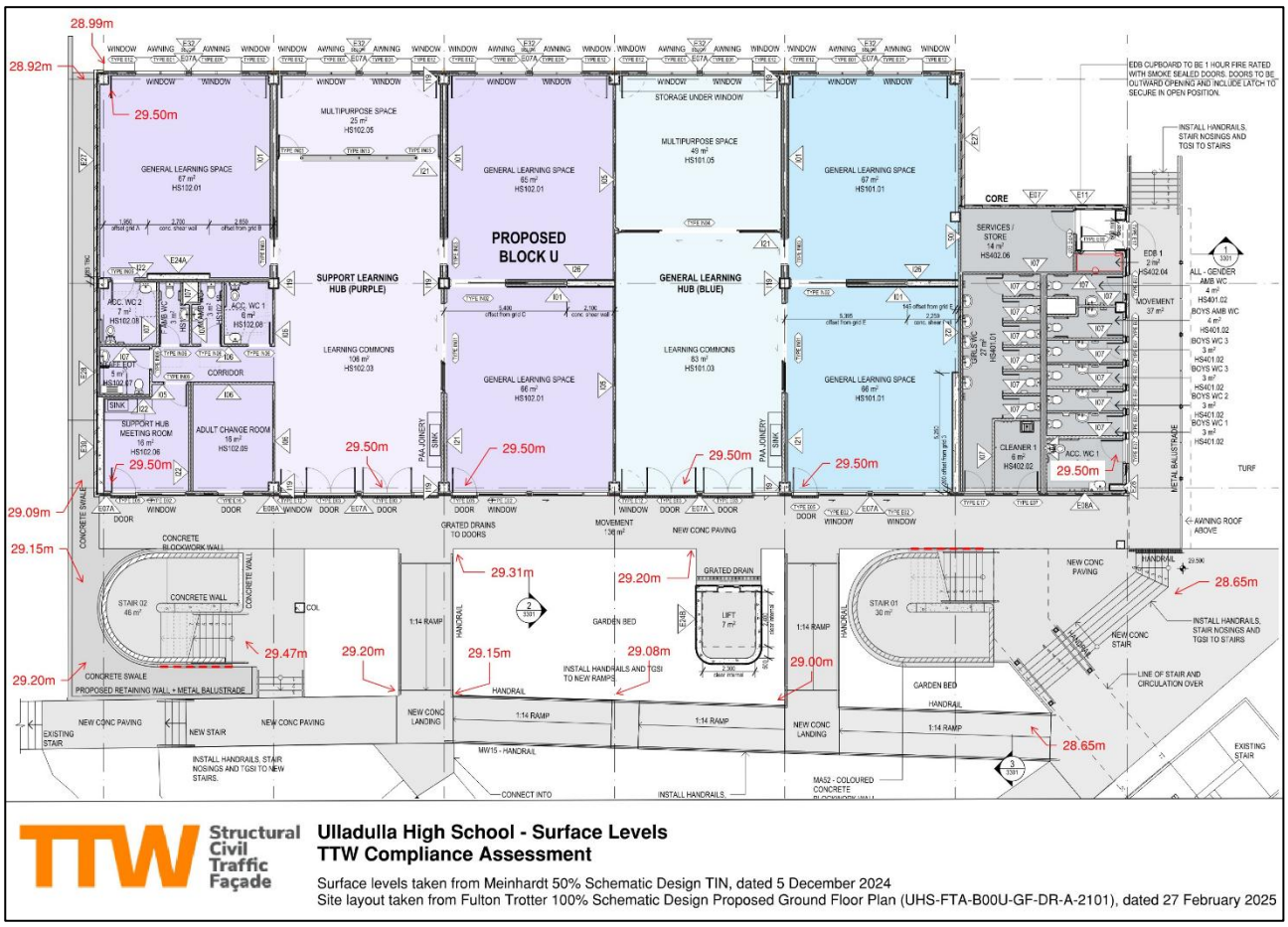


Figure 26: Design ground levels surrounding the proposed building (Source: levels taken from Meinhardt design TIN, dated 5 December 2024; ground floor site plan obtained from Fulton Trotter, UHS-FTA-B00U-GF-DR-A-2101, 27 February 2025)

10.2 NSW Department of Education Guidelines

NSW Department of Education (DoE) have their own framework and guidelines for educational site selection and development. Whilst Ulladulla High School is an existing school site, these guidelines should be considered to determine whether the proposed activity is appropriate. For flooding, the framework provides the following recommendations:

iv. Site should be located above the 1-in-200-year (0.5% AEP) flood level;

v. Site should provide flood free access for pedestrians and vehicles (in particular, emergency vehicles during a flood event);

vi. Buildings must be located on land above the Flood Prone Land Contour (i.e., land susceptible to flooding in the PMF) where possible.

Item i: The 0.5% AEP flood levels across the proposed veranda are summarised in Table 2 (Section 8.3.3), peaking at 29.51m AHD, 10mm above the current FFL of 29.50m AHD. It should be noted that this is regarded as isolated ponding, not flooding, and it does not form an overland flow path. In addition, it is believed that the model outputs provide a conservative estimation of flood levels onsite (see Section 8.3.2 and 8.3.3 for discussion), and in reality, the flood level here would be below 29.50m AHD in all events.

Item ii: In terms of site access, Figure 27 presents the flood hazard categorisation of flows during the 1% AEP event. Access to and from the site is available via two vehicular entry points on St Vincent Street, labelled in the figure, alongside a pedestrian access point onto Camden Street. The pedestrian access point onto Camden Street is the closest egress point for the proposed building, affected only by low hazard (H1 flows) that are contained within the gutter.

There are some isolated areas along St Vincent Street adjacent to Exit “A” with flows categorised as H3 hazard (unsafe for vehicles, children and the elderly), but these are contained within the gutter, and the central portion of the road is trafficable during the critical duration 1% AEP event for vehicles travelling on the southbound lane. Onward travel is possible via low hazard roads onto Deering Street, which is largely free from overland flows in the 1% AEP event. Northbound travel on St Vincent Street is not recommended, given that the roundabout is impacted by flows with a hazard classification of H5, which is regarded as unsafe for vehicles. Further consideration of site access in the PMF event and flood emergency response strategies is provided in TTW’s Flood Emergency Response Plan for the site, dated 24 March 2025.

Item iii: The steep banks of the Millards Creek means the watercourse does not overtop onto the site in any event, including the PMF. As the site is unaffected by mainstream flooding in all events, the site is above the flood prone land contour.

The proposed building is therefore deemed compliant with the DoE guidelines for educational site selection.

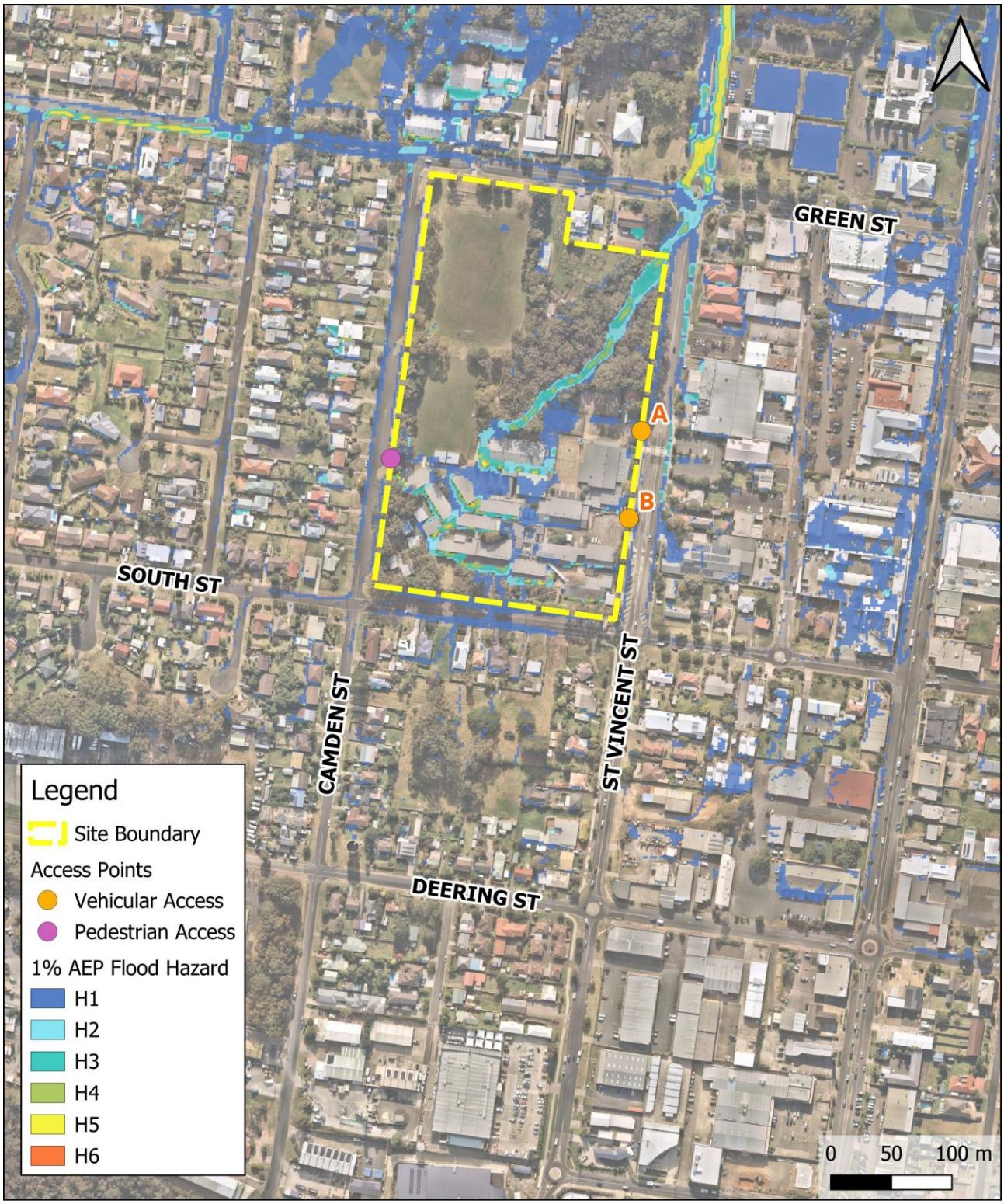


Figure 27: 1% AEP event flood hazard categorisation for the surrounding area

11.0 Mitigation Measures

Mitigation measures identified as necessary are outlined in Table 5. Following the implementation of these measures, any impacts are deemed to be acceptable and appropriate.

Table 5: Mitigation Measures

Project Stage	Mitigation Measures	Reason for Mitigation Measure	Report Section
Design	To ensure the impact of overland flows is mitigated, the proposed activity must be constructed in accordance with the civil plans prepared by Meinhardt, dated 5 December 2024, including a 300mm fall away from the proposed building	To ensure surface runoff and minor overland flow paths are directed away from building entrances	Section 8.3, Section 10.0
Operation	Preparation and implementation of a Flood Emergency Response Plan (FERP)	To identify the most appropriate flood emergency response strategy for the site based on an assessment of the time to inundation and recession	See TTW's FERP submitted alongside this report.

12.0 Evaluation of Environmental Impacts

It is necessary to review any potential adverse offsite impacts to neighbouring properties or changes to flood behaviour as a result of the proposed activity. A flood impact assessment has been carried out to ensure the proposed activity would not result in worsening of the flood conditions over neighbouring properties. The flood level impact map is shown in Figure 28.

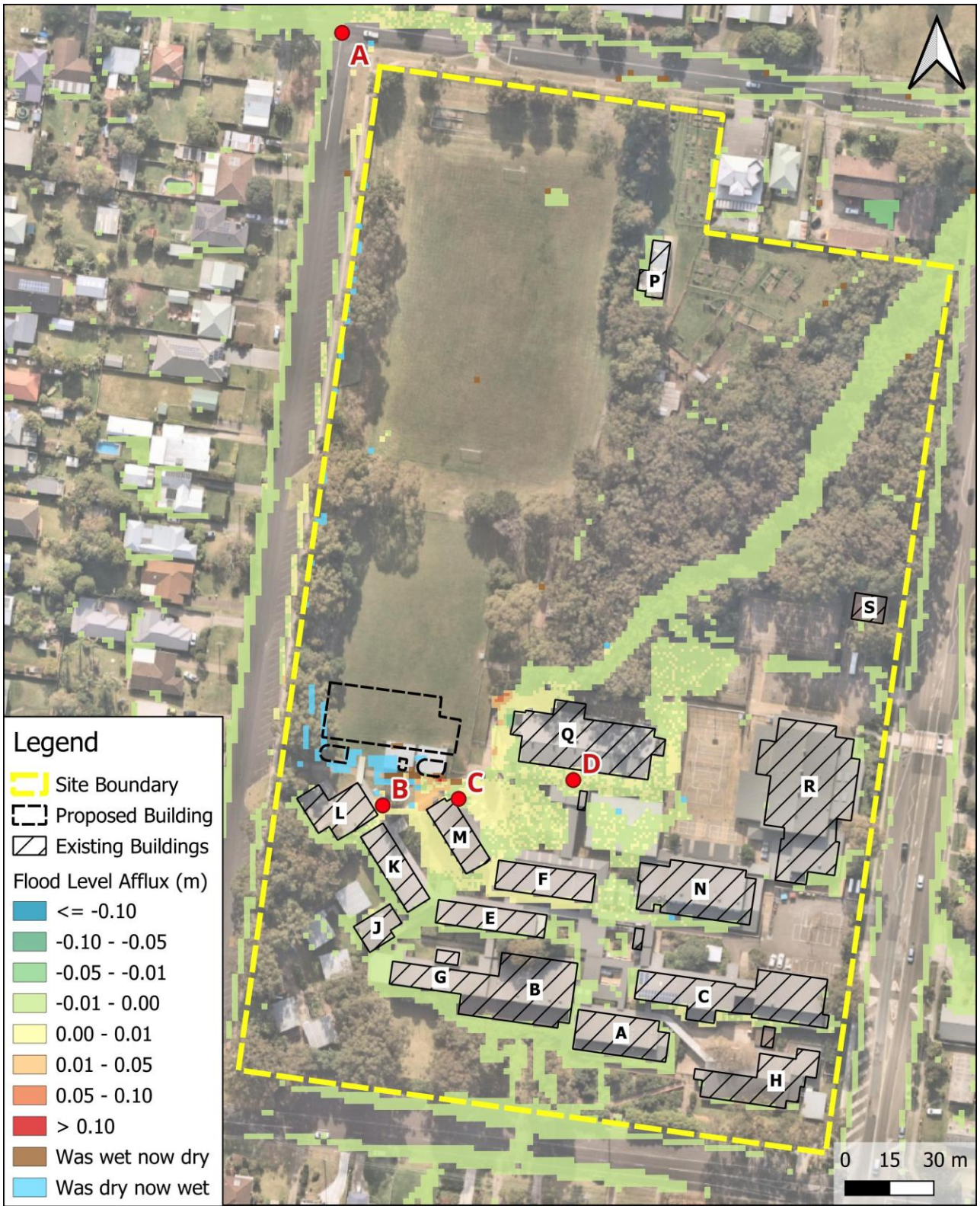


Figure 28: Flood level afflux – Impact of proposed activity on flood levels in the 1% AEP event

Table 6 summarises the flood level afflux in the 1% and PMF events at the four points labelled in this figure. The impact assessment demonstrates no change to flood levels over neighbouring properties, and negligible increases across the adjacent footpath and road. The proposed activity therefore has no notable offsite impacts. Within the site, the proposed building obstructs flows, which are redirected further east. This impacts existing buildings to some extent, namely, Building L, M and Q (labelled in Figure 28).

Table 7 provides a summary of the FFL of each of these buildings (taken from as-built drawings and site survey data), alongside the 1% AEP and PMF levels in both existing and post-construction conditions. Review of these flood levels demonstrates the impact of the proposed building. At all locations, where the flood level exceeds the ground floor FFL, there was already potential inundation under existing conditions. The proposal therefore has no impact on any existing emergency response strategy for these buildings.

The extent and nature of potential impacts are low and will not have significant impact on the locality, community and/or the environment. Potential impacts can be appropriately mitigated or managed to ensure that there is minimal impact on the locality, community and/or the environment.

Table 6: Difference in flood levels at four points surrounding the proposed activity (see Figure 28 for point locations)

Point	Adjacent Building	Difference in Post-construction vs Existing Flood Level (m)	
		1% AEP	PMF
A	Offsite – Camden St / Green St Junction	+1 mm	+4 mm
B	Building L	+11 mm	+23 mm
C	Building M	-4 mm	+57 mm
D	Building Q	0 mm	+75mm

Table 7: FFLs and existing vs post-construction flood levels for Buildings L, M and Q

Point	Adjacent Building	FFL	Flood Level (m AHD)			
			Existing		Post-construction	
			1% AEP	PMF	1% AEP	PMF
B	Building L	30.00	29.95	30.06	29.97	30.08
C	Building M	28.50	28.53	28.66	28.53	28.72
D	Building Q	25.00	25.37	26.02	25.37	26.09

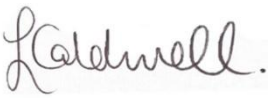
13.0 Conclusion

TTW updated Council's Millards Creek Flood Study model to investigate the impact of the proposed activity on flood behaviour and assess the suitability of the site for further activity. Analysis of hydraulic modelling carried out concluded that:

- The wider Ulladulla High School site is impacted by overland flows in all modelled design events, including the 10% AEP event. The proposed building footprint is situated outside the 1% AEP flood extent, with flows directed to the sunken gardens.
- The hydraulic model of the site provides a conservative estimate of flood behaviour, due to the model resolution, which underestimates flood storage available and flow conveyance through the swale. Model outputs indicate a PMF level of 29.59m AHD, 90mm above the current FFL. However, it is believed that in reality, due to the conservative nature of the modelling, the building is likely to be flood-free in this event. This has no overall impact on the project, as the activity meets the flood planning requirements and provides a suitable emergency response in extreme flood events.
- As the site is not impacted by mainstream flooding, Council have advised that the flood controls outlined in Shoalhaven DCP do not apply, and there is no requirement for the FFL of the proposed building to be set above the PMF level. They recommend the FFL is set 300mm above the surrounding ground. The current design complies with this requirement. The civil design includes other mitigation measures, including site grading and overflow pipes to direct flows away from the building.
- The proposed activity has no significant offsite impact on flood behaviour or flood hazard in the 1% AEP event. Review of flood levels in existing versus post-construction conditions shows that the proposed activity has no offsite impacts on adjacent properties or roads in both the 1% AEP and PMF events. Within the site, localised flood level increases can be attributed to changes in site grading, which alter the existing overland flow paths. It is noted that existing floor levels of some existing blocks are already prone to inundation during the 1% and PMF events and that the proposed building does not change these levels significantly.
- The potential impact of climate change has been considered, with the CC2100 scenario including 850mm of sea level rise, and a 66% increase in rainfall. In the 1% AEP event, flood levels to the south of the proposed building increase by 111mm under the CC2100 scenario, equating to a level of 29.33m AHD.
- Additional sensitivity testing of pit blockages has also been assessed, with negligible onsite impacts.
- A Flood Emergency Response Plan has been prepared by TTW and submitted alongside this report.

The findings in this report are based on currently available information, regulations and correspondence undertaken at the time of writing.

Prepared by
TTW (NSW) PTY LTD



LAURA CALDWELL
Civil Flood Modeller

Authorised By
TTW (NSW) PTY LTD

EIRIAN CRABBE
Associate Director

Appendix A – Council Email Correspondence

From: Simon Slater <Simon.Slater@shoalhaven.nsw.gov.au>
Sent: Wednesday, 9 October 2024 11:29 AM
To: Laura Caldwell <laura.caldwell@ttw.com.au>
Subject: Flood Certificate Request - 241 Green St & 55 South St, ULLADULLA

You don't often get email from simon.slater@shoalhaven.nsw.gov.au. Learn why this is important

[External Email]: Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello,

Thank you for taking the time to request a flood certificate for the 241 Green St & 55 South St, ULLADULLA properties.

In accordance with Council's *Millards Creek Flood Study (2021)*, the property is identified to range from flood prone land, to flood free land. Further information regarding the proposed development is required for Council to assess if a flood certificate is required.

If details regarding the proposal, including scale and location, can be provided to Council, an assessment into the flood certificate and potential development controls requirements can be conducted.

Please reach out if you have any further questions.

Regards,

Shoalhaven City Council

Simon Slater
Floodplain Project Officer

+61 2 4429 3237 | +61 498 090 273
Bridge Road (PO Box 42) Nowra NSW 2541
shoalhaven.nsw.gov.au

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From: Laura Caldwell <laura.caldwell@ttw.com.au>
Sent: Thursday, 17 October 2024 9:23 AM
To: Simon Slater <Simon.Slater@shoalhaven.nsw.gov.au>
Cc: Jamie Marshall <jamie.marshall@ttw.com.au>
Subject: RE: Flood Certificate Request - 241 Green St & 55 South St, ULLADULLA

EXTERNAL: Be cautious opening links or attachments.

Hi Simon,

Apologies for the delay in getting back to you – I have now received approval to share initial site plans for both school sites. Please let me know if you need any other information.

Kind regards,
Laura

TTW

Laura Caldwell | Civil Flood Modeller
+61 2 9439 7288 | | laura.caldwell@ttw.com.au
TTW Engineers | Sydney
Read our latest news here

From: Simon Slater <Simon.Slater@shoalhaven.nsw.gov.au>
Sent: Friday, 18 October 2024 10:04 AM
To: Laura Caldwell <laura.caldwell@ttw.com.au>
Cc: Jamie Marshall <jamie.marshall@ttw.com.au>; Alexander Aronsson <Alexander.Aronsson@shoalhaven.nsw.gov.au>
Subject: RE: Flood Certificate Request - 241 Green St & 55 South St, ULLADULLA

You don't often get email from simon.slater@shoalhaven.nsw.gov.au. Learn why this is important

[External Email]: Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Laura,

Council has reviewed the provided plans against flood data from Council's adopted *Millards Creek Flood Study (2021).*

To assist with your application Council can provide the following flood specific advice:

Option 1 (55 South St, ULLADULLA - Lot 1 DP 595313):
The proposed building location ***is not*** impacted by riverine flood in a 1% AEP event. No flood certificate will be required for this option. Please note, even though the properties are outside the riverine 1%, during heavy rainfall periods overland flow may still occur across the properties as water cannot absorb quickly enough into the ground.

In accordance with DCP Chapter G9, there would be no flood related development controls for this development.

If proceeding with this option, please include this email in any development application you may make for the property in lieu of a flood certificate if required.

Option 2 (227 Green St, ULLADULLA - Lot 1 DP 529425):
The proposed building location ***is*** impacted by riverine flooding in a 1% AEP event. As such, a flood certificate will be required for this proposal. Please inform Council if you wish to proceed in obtaining this flood certificate.

To determine what development controls apply to this property, flood information provided should be used in conjunction with Council's relevant *Shoalhaven DCP Generic Chapter G9* or *G10*. A link to the Shoalhaven DCP is below.

http://dcp2014.shoalhaven.nsw.gov.au/main-category/generic-chapters

Please reach out if you have any further questions, and I will be happy to assist.

Regards,

Shoalhaven City Council
Simon Slater
Floodplain Project Officer
+61 2 4429 3237 | +61 498 090 273
Bridge Road (PO Box 42) Nowra NSW 2541
shoalhaven.nsw.gov.au

RESPECT | INTEGRITY | ADAPTABILITY | COLLABORATION

From: Laura Caldwell <laura.caldwell@ttw.com.au>
Sent: Monday, 21 October 2024 12:29 PM
To: Simon Slater <Simon.Slater@shoalhaven.nsw.gov.au>
Cc: Jamie Marshall <jamie.marshall@ttw.com.au>; Alexander Aronsson <Alexander.Aronsson@shoalhaven.nsw.gov.au>
Subject: RE: Flood Certificate Request - 241 Green St & 55 South St, ULLADULLA

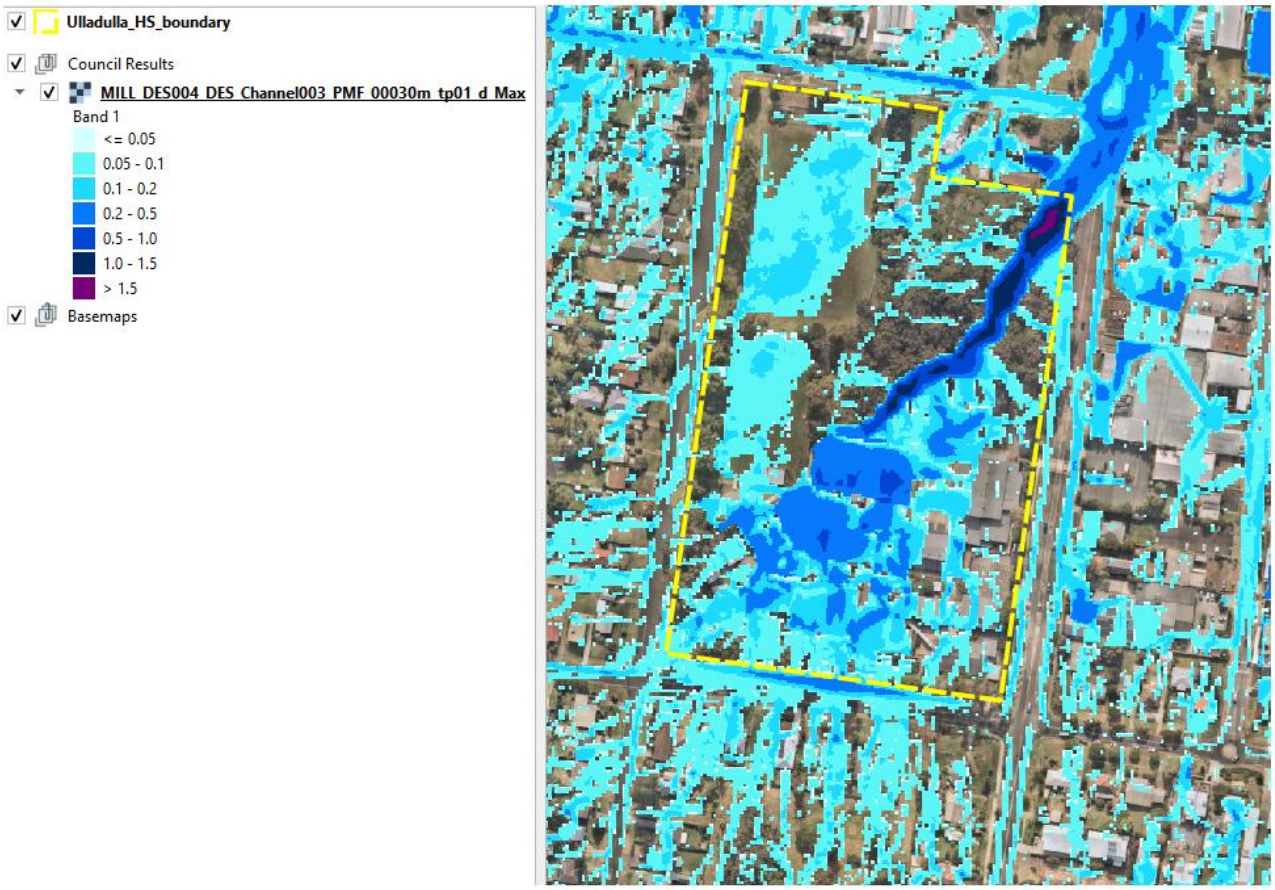
EXTERNAL: Be cautious opening links or attachments.

Hi Simon,

Thank you for the advice. We would like to obtain a flood certificate for 227 Green St (Lot 1 DP 529425), if you could please let me know how we can proceed with this.

With regards to Ulladulla High School (55 South Street), the proposed new building is situated within the PMF extent (from overland sources). I have attached a screenshot of Council's PMF 30min design results below (from the Millards Creek Flood Study). To confirm, do the flood controls outlined in the Shoalhaven DCP still not apply to this site, with no requirement for the FFLs to be built to the PMF levels?

Thanks,
Laura



Laura Caldwell | Civil Flood Modeller
+61 2 9439 7288 | | laura.caldwell@ttw.com.au
TTW Engineers | Sydney
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From: Simon Slater <Simon.Slater@shoalhaven.nsw.gov.au>
Sent: Monday, 21 October 2024 2:19 PM
To: Laura Caldwell <laura.caldwell@ttw.com.au>
Cc: Jamie Marshall <jamie.marshall@ttw.com.au>; Alexander Aronsson <Alexander.Aronsson@shoalhaven.nsw.gov.au>
Subject: RE: Flood Certificate Request - 241 Green St & 55 South St, ULLADULLA

[External Email]: Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Laura,

Please find attached the invoice for the flood certificate request for the 227 Green St, ULLADULLA - Lot 1 DP 529425 property.

Once payment has been received, the flood certificate will be completed within 10 working days. You don't need to email me payment confirmations; Council receives a notification when a payment has been made.

Furthermore, regarding Ulladulla High School - 55 South Street, Council's Development Control Plan does not impose flood related development constraints on residential development outside the FPL. However, additional considerations are required for buildings and activities requiring special evacuation consideration. Due to the nature of this site, Council would require the floor level to be raised 300mm from the ground surface. There will be no requirement for the floor level to match the PMF level. Again, if proceeding with this option, please include this email in any development application you may make for the property in lieu of a flood certificate if required.

Regards,

Shoalhaven City Council

Simon Slater
Floodplain Project Officer

+61 2 4429 3237 | +61 498 090 273
Bridge Road (PO Box 42) Nowra NSW 2541
shoalhaven.nsw.gov.au

RESPECT | INTEGRITY | ADAPTABILITY | COLLABORATION

From: Laura Caldwell <laura.caldwell@ttw.com.au>
Sent: Monday, 21 October 2024 5:11 PM
To: Simon Slater <Simon.Slater@shoalhaven.nsw.gov.au>
Cc: Jamie Marshall <jamie.marshall@ttw.com.au>; Alexander Aronsson <Alexander.Aronsson@shoalhaven.nsw.gov.au>
Subject: RE: Flood Certificate Request - 241 Green St & 55 South St, ULLADULLA

EXTERNAL: Be cautious opening links or attachments.

Hi Simon,

Thank you for confirming. To clarify, the proposed building is situated on a slope, varying between RL 28.7 – 30.0 – when looking at the 300mm freeboard, would this be on top of the ground level adjacent to the openings as opposed to the maximum ground level around the building footprint?

It would also be useful to know if the implementation of other mitigation measures (e.g. retaining walls) would be regarded as an acceptable alternative to raising the floor levels 300mm above the ground surface?

Any information is greatly appreciated – thanks again for your help with this.

Kind regards,
Laura

TTW

Laura Caldwell | Civil Flood Modeller
+61 2 9439 7288 | | laura.caldwell@ttw.com.au
TTW Engineers | Sydney
Read our latest news here

From: Simon Slater <Simon.Slater@shoalhaven.nsw.gov.au>
Sent: Tuesday, 22 October 2024 1:48 PM
To: Laura Caldwell <laura.caldwell@ttw.com.au>
Cc: Jamie Marshall <jamie.marshall@ttw.com.au>; Alexander Aronsson <Alexander.Aronsson@shoalhaven.nsw.gov.au>
Subject: RE: Flood Certificate Request - 241 Green St & 55 South St, ULLADULLA

[External Email]: Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Laura,

No issues, as we are happy to assist. Regarding the 300mm freeboard, you are correct in assuming that this is applied adjacent to building doorways, as opposed to the maximum ground level within the building footprint.

Regarding other potential mitigation measures, Council can accept alternative approaches, provided that it can be demonstrated that there are no adverse impacts on neighbouring properties. However, the principle behind implementing a 300mm freeboard is to ensure that overland flows are diverted around the building and do not enter the structure. Please note, it is difficult to provide specific feedback at this stage without further plans.

Regards,

Simon Slater
Floodplain Project Officer

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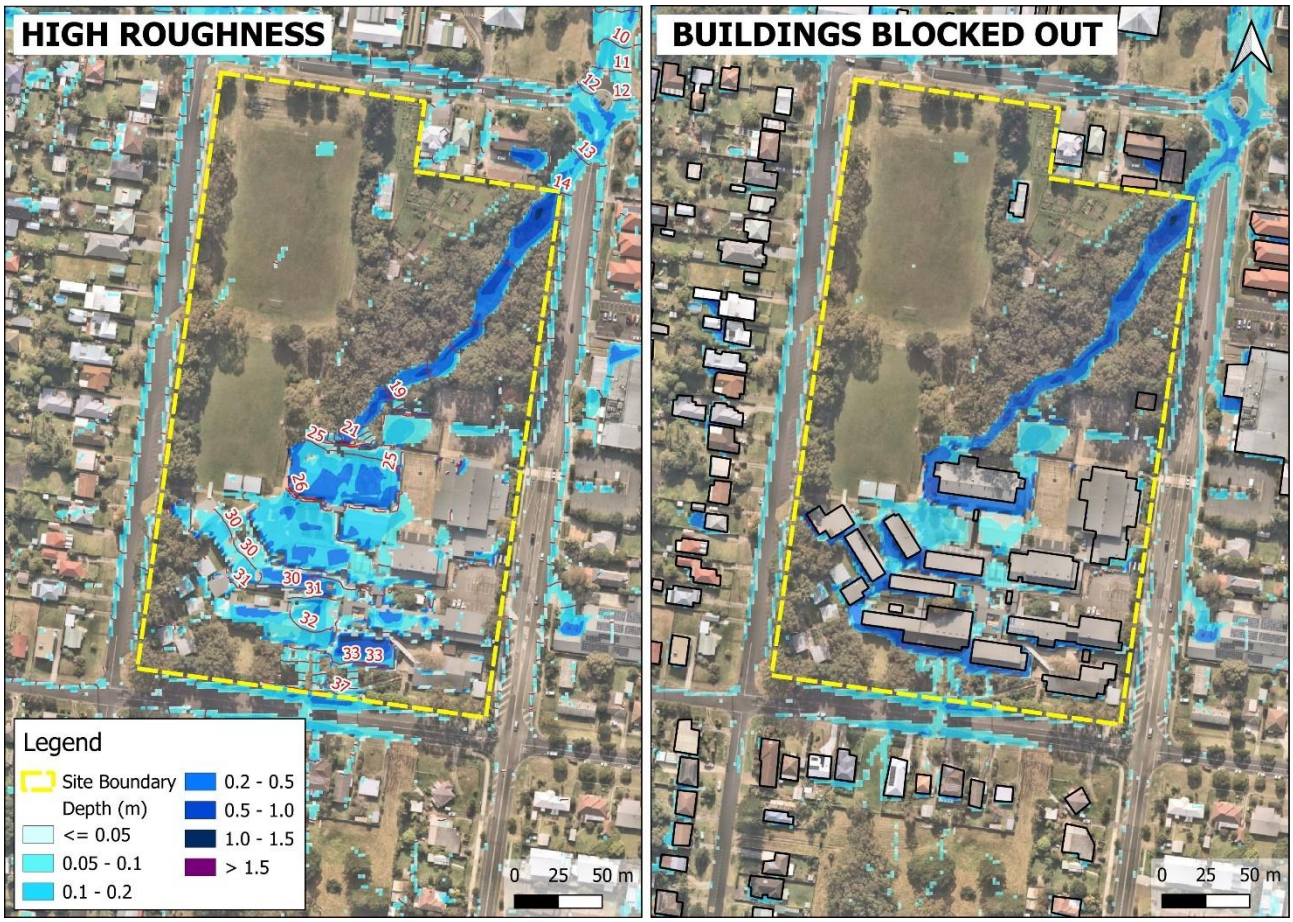
shoalhaven.nsw.gov.au

RESPECT | INTEGRITY | ADAPTABILITY | COLLABORATION

Appendix B – Building Representation



Appendix A 1: Comparison of 1% AEP flood levels and depths when buildings are represented through a high roughness value, in line with Council's approach (left), versus when they are blocked out of the model domain (right)

Appendix C – Additional Existing Scenario Maps

10% AEP Event

Appendix B 1: 10% AEP flood depths and levels at Ulladulla High School under existing conditions

Appendix C 1: 10% AEP flood velocities at Ulladulla High School under existing conditions

Appendix C 2: 10% AEP flood hazard levels at Ulladulla High School under existing conditions

0.5% AEP Event

Appendix B 2: 0.5% AEP flood depths and levels at Ulladulla High School under existing conditions

Appendix C 3: 0.5% AEP flood velocities at Ulladulla High School under existing conditions

Appendix C 4: 0.5% AEP flood hazard levels at Ulladulla High School under existing conditions

0.2% AEP Event

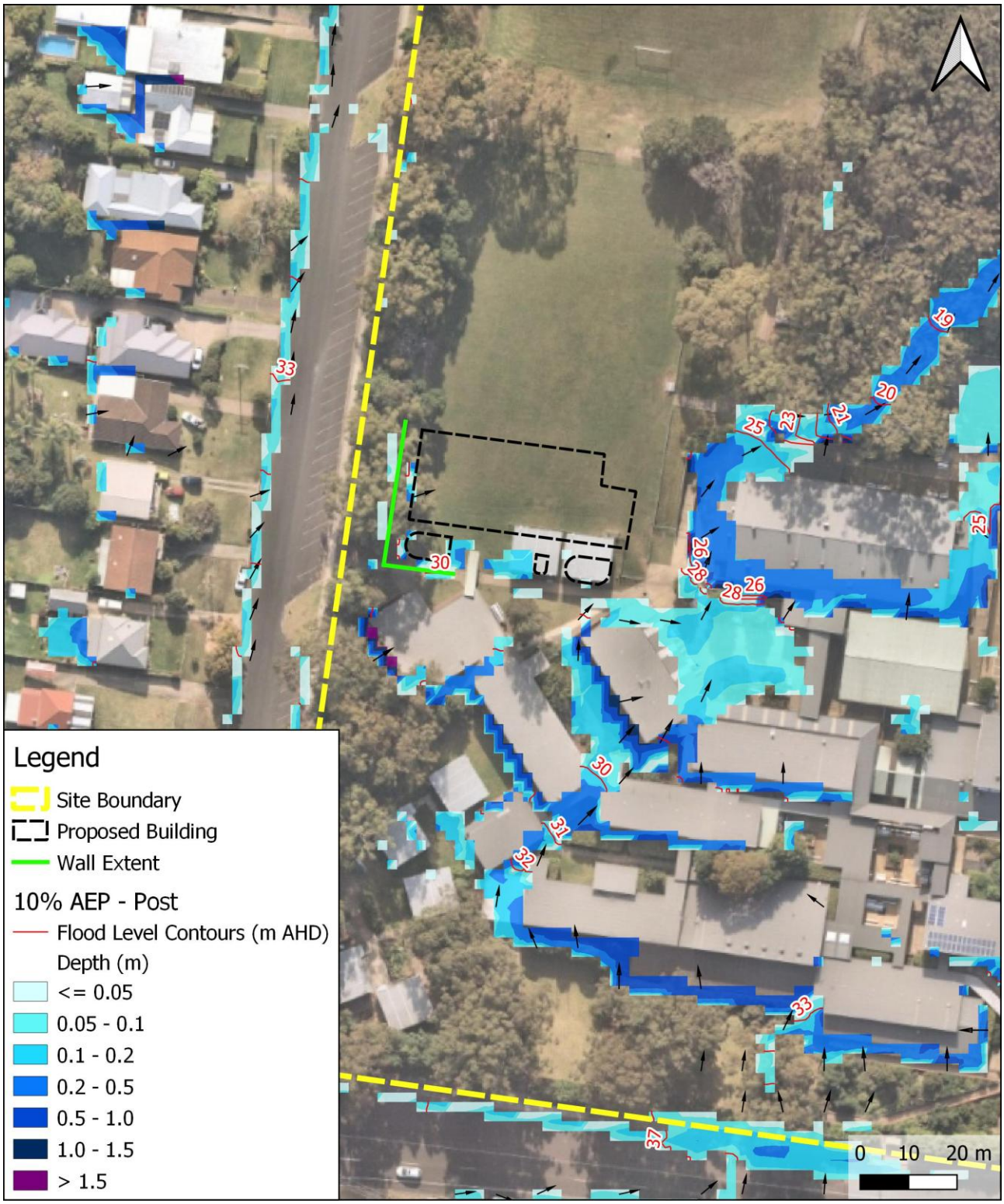
Appendix C 5: 0.2% AEP flood depths and levels at Ulladulla High School under existing conditions

Appendix C 6: 0.2% AEP flood velocities at Ulladulla High School under existing conditions

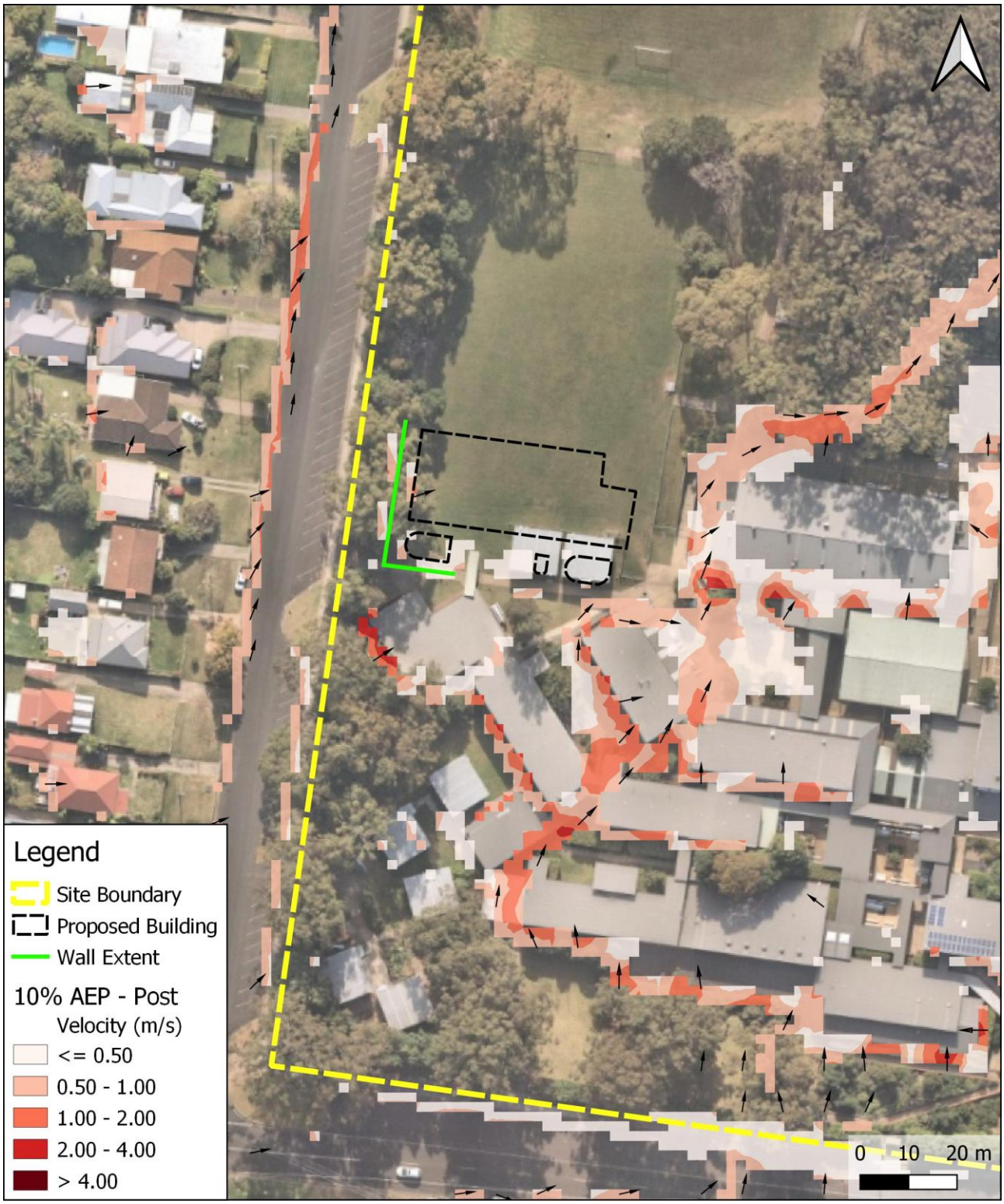
Appendix C 7: 0.5% AEP flood hazard levels at Ulladulla High School under existing conditions

Appendix D – Additional Post-construction Scenario Maps

10% AEP Event



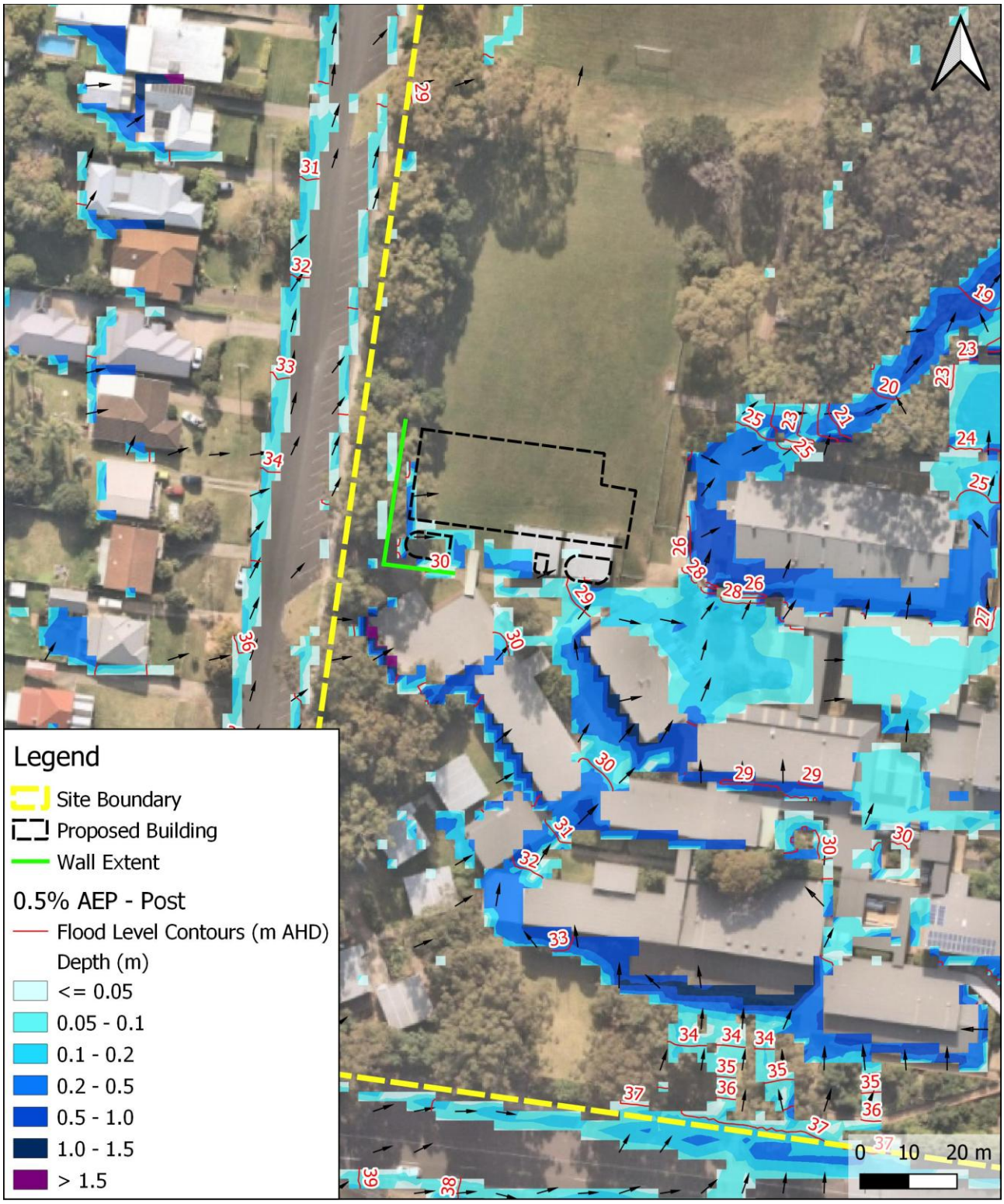
Appendix D 1: 10% AEP flood depths and levels at Ulladulla High School under post-construction conditions



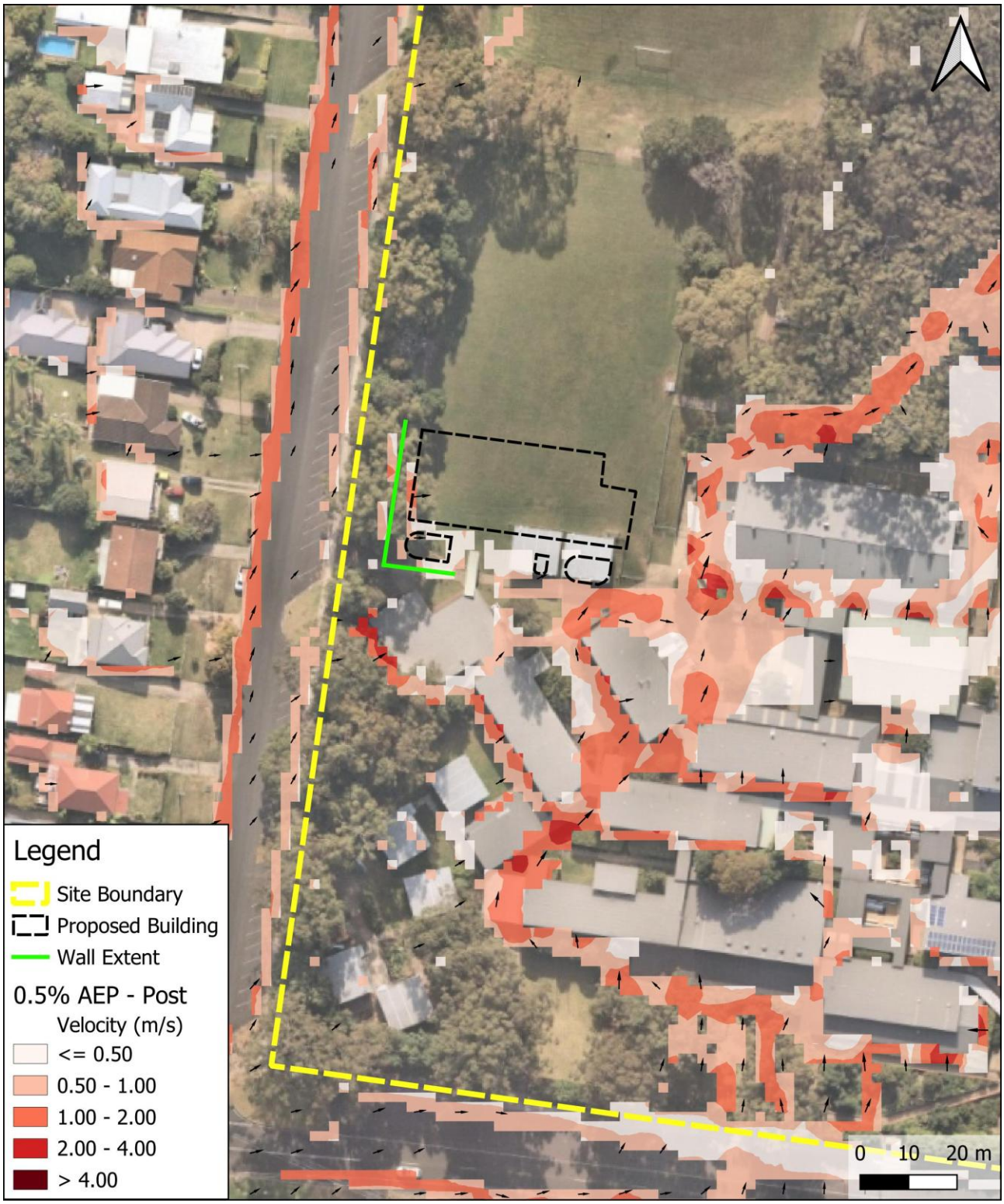
Appendix D 2: 10% AEP flood velocities at Ulladulla High School under post-construction conditions

Appendix D 3: 10% AEP flood hazard levels at Ulladulla High School under post-construction conditions

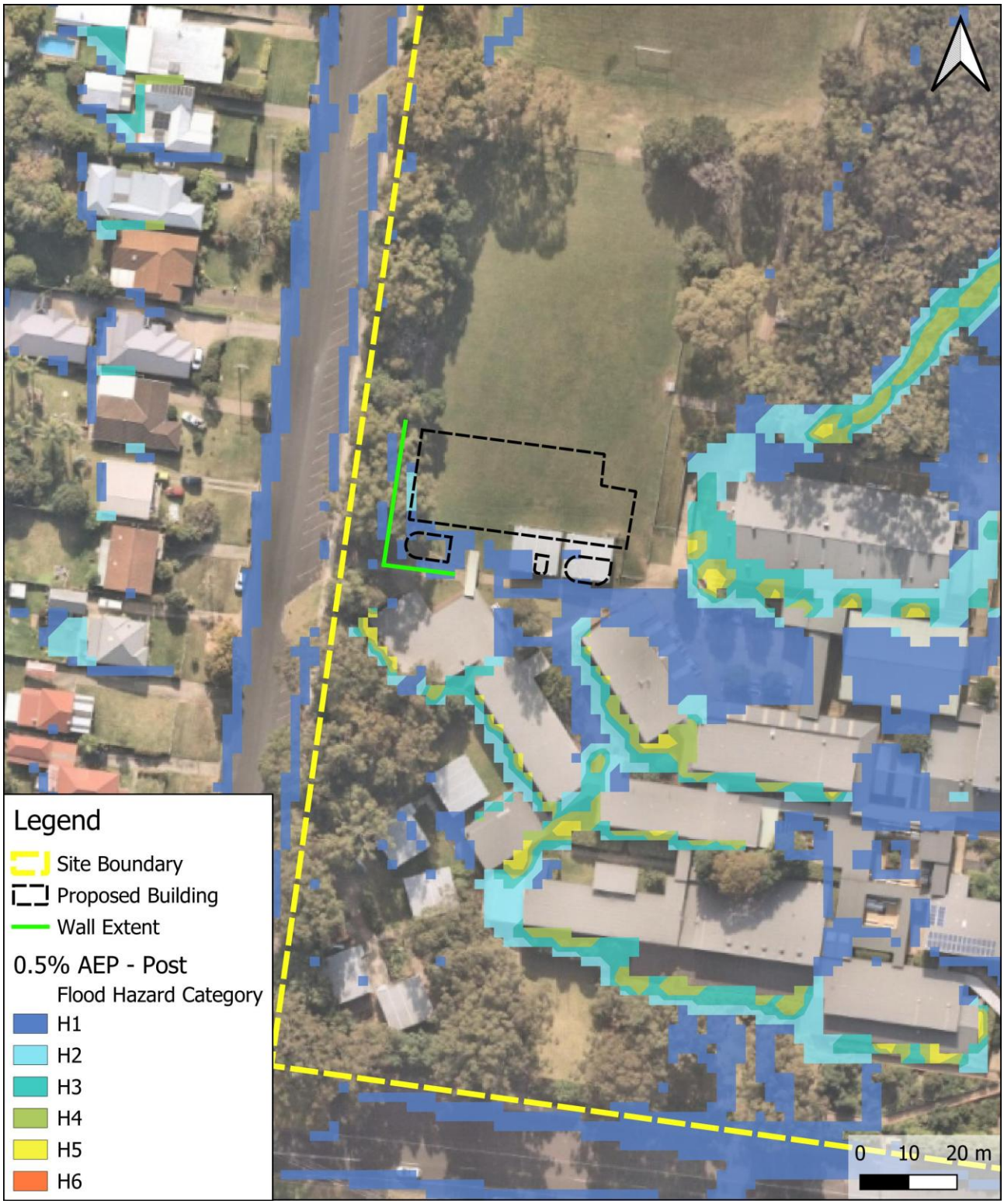
0.5% AEP Event



Appendix D 4: 0.5% AEP flood depths and levels at Ulladulla High School under post-construction conditions

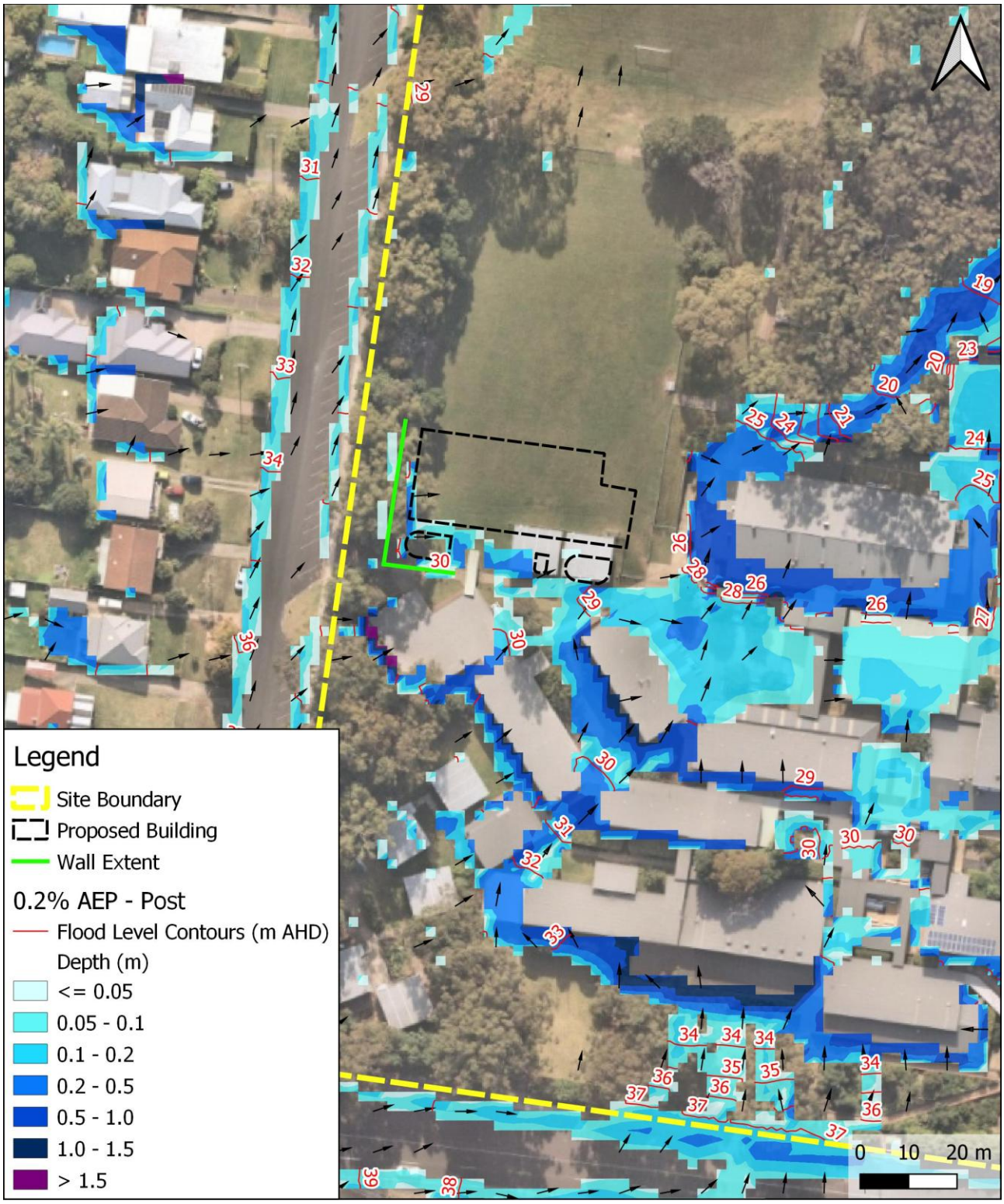


Appendix D 5: 0.5% AEP flood velocities at Ulladulla High School under post-construction conditions

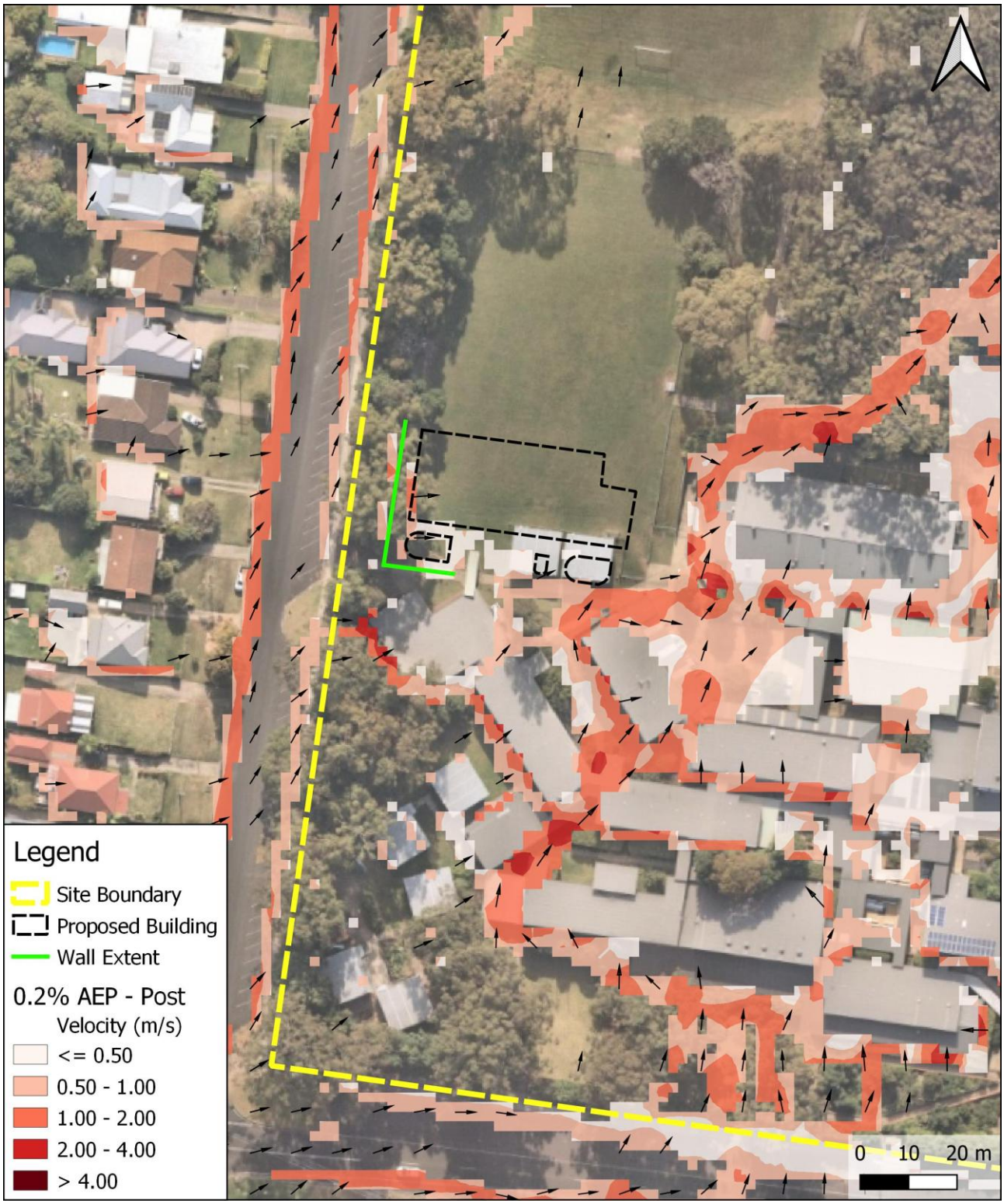


Appendix D 6: 0.5% AEP flood depths and levels at Ulladulla High School under post-construction conditions

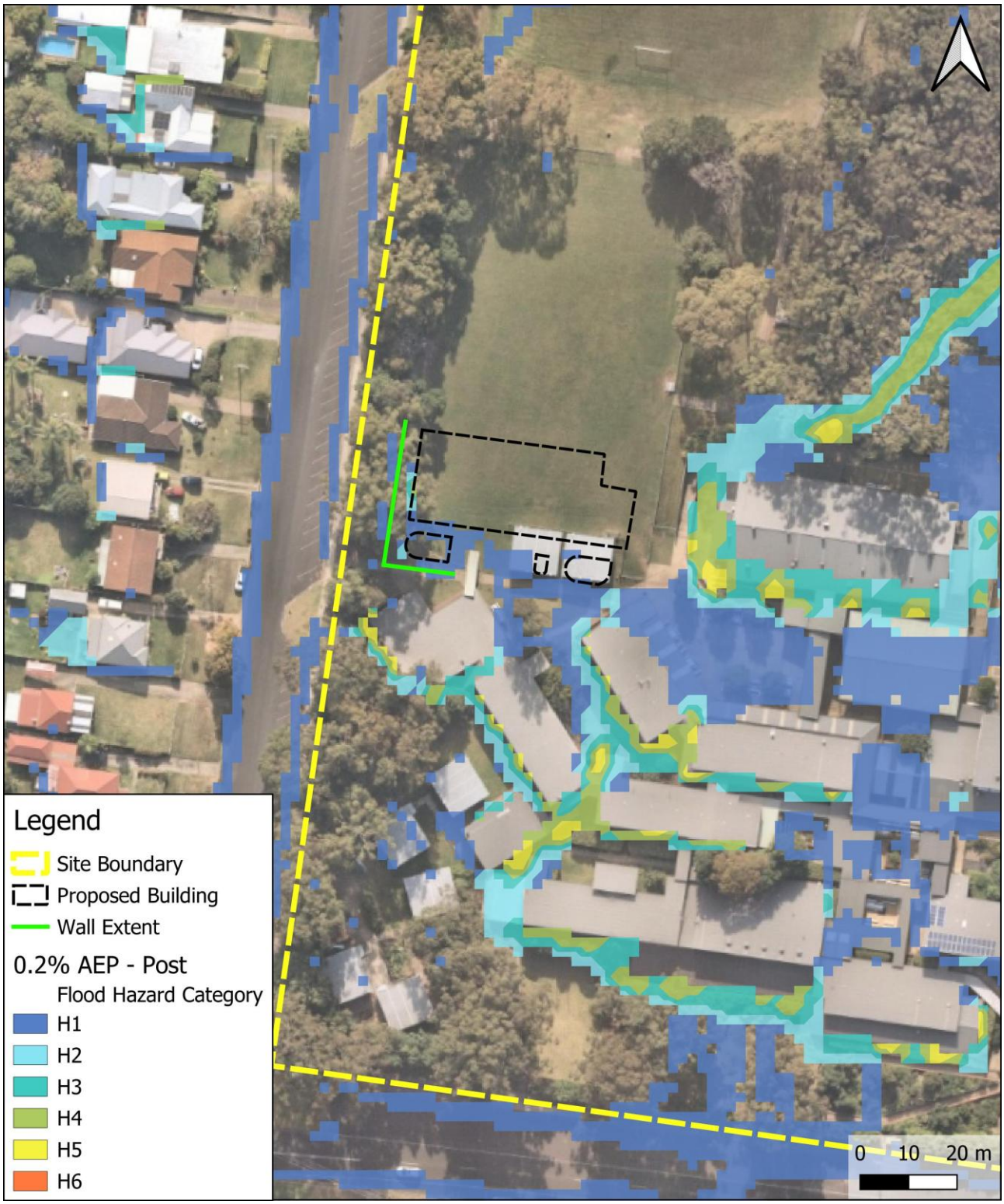
0.2% AEP Event



Appendix D 7: 0.2% AEP flood depths and levels at Ulladulla High School under post-construction conditions

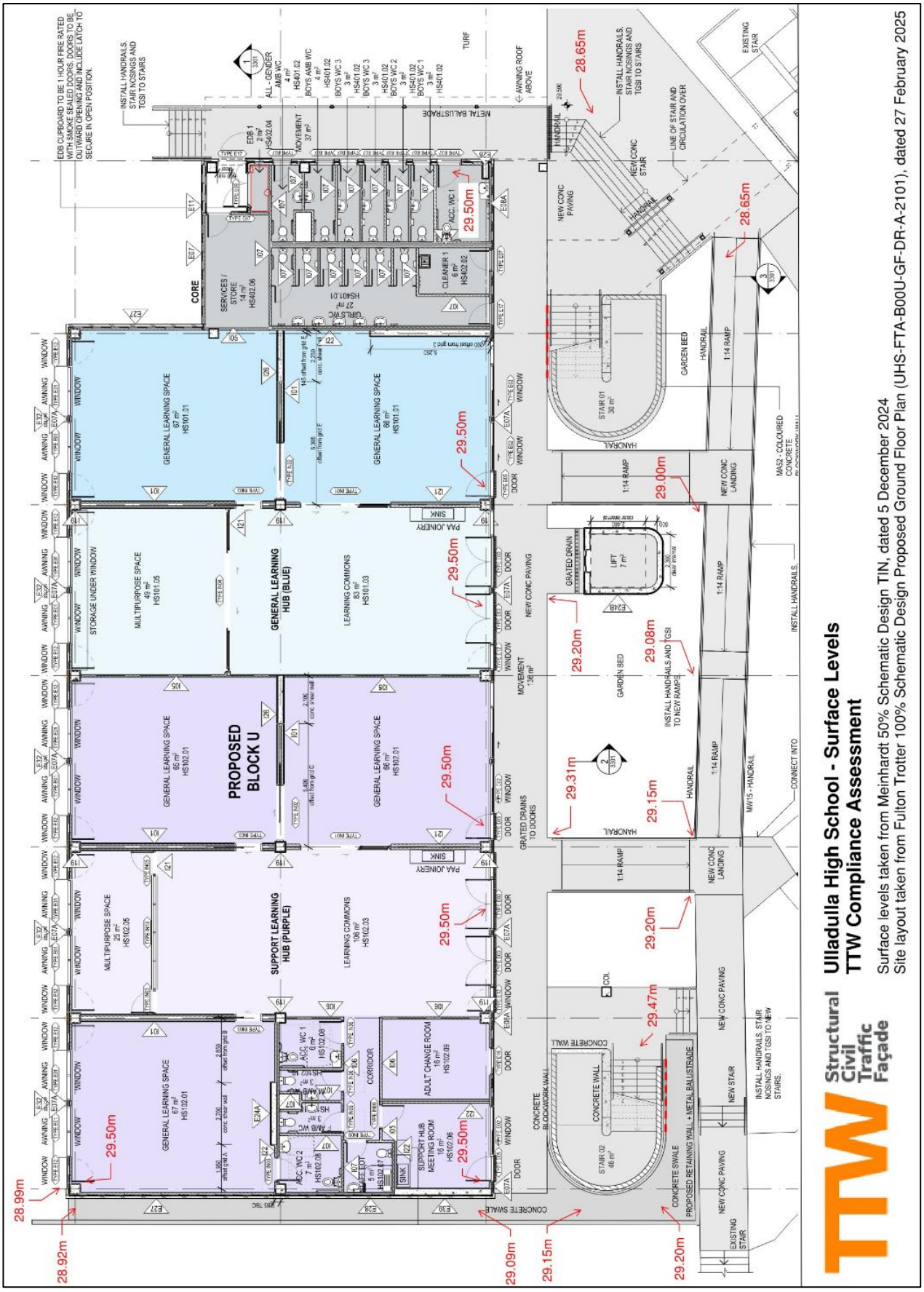


Appendix D 8: 0.2% AEP flood velocities at Ulladulla High School under post-construction conditions



Appendix D 9: 0.2% AEP flood depths and levels at Ulladulla High School under post-construction conditions

Appendix E – Design Level Compliance Assessment



Appendix E 1: Design Levels - TTW Markup and Compliance Assessment