Flood Impact and Risk Assessment

Ulladulla Public School Upgrade

Prepared for NSW Department of Education

25 March 2025

232045

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Rev	Date	Prepared By	Approved By	Remarks
1	17/01/2025	LC	JM	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	25/03/2025	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 Public School upgrade, located at 241 Green Street, Ulladulla NSW 2539 (the site). The site is legally referred to as Lot 1 DP 122514, Lot 1 DP 529425, and Lot 1, Section 16 DP 759018.

The site is immediately adjacent to Millards Creek, which marks the northern boundary of the site. However, creek flows are contained within the channel along this stretch of the creek, with overland flows acting as the main source of flooding at the site.

The proposed building is situated within the main overland flow path across the west of the site, where excess runoff overtops into the school from Green Street. However, the proposed building includes an undercroft area with staff parking at the ground level, with all habitable floors raised to a minimum level of 22.15m AHD, over 3 metres above the peak Probable Maximum Flood level of 19.02m AHD surrounding the building.

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	N/A – see TTW's FERP submitted alongside this FIRA.

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 Public 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 outline 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
- Department of Planning and Environment (2023) Flood Function – Flood Risk Management Guideline FB02
- 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 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 25 March 2025

2.0 Site Description

Ulladulla Public School is located at 241 Green Street, Ulladulla NSW 2539. The site is located within the Shoalhaven Local Government Area (LGA) and has an approximate area of 3.5 hectares. An aerial photograph of the site is provided at Figure 1. The site is comprised of three lots, legally referred to as follows:

- Lot 1 in Deposited Plan 122514
- Lot 1 in Deposited Plan 529425
- Lot 1 in Section 16 in Deposited Plan 759018

The site is zoned SP2 Educational Establishment and existing development comprises various buildings, a car park, landscaping, a sports field and sports courts associated with Ulladulla Public School. Ulladulla Public School currently comprises 22 Permanent Teaching Spaces (PTS) and 11 Demountable Teaching Spaces (DTS). The western portion of the site contains playing fields, sports courts and parking. Vegetation is interspersed throughout the site.

The site is irregularly shaped with a long frontage to Green Street to the south. Land to the north of the site is zoned RE1 which consists of natural bushland. Low density residential dwellings adjoin the site along the western boundary.

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

3.0 Proposed Activity Description

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

- Construction of a new two-storey home base building over existing car park.
- Alterations to existing car park under new building.
- Construction of new stairs and covered walkways.
- Installation of new fencing.
- External landscape works.
- Installation of solar panels.
- Installation of new pedestrian gate and fire brigade booster.
- Tree removal.

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

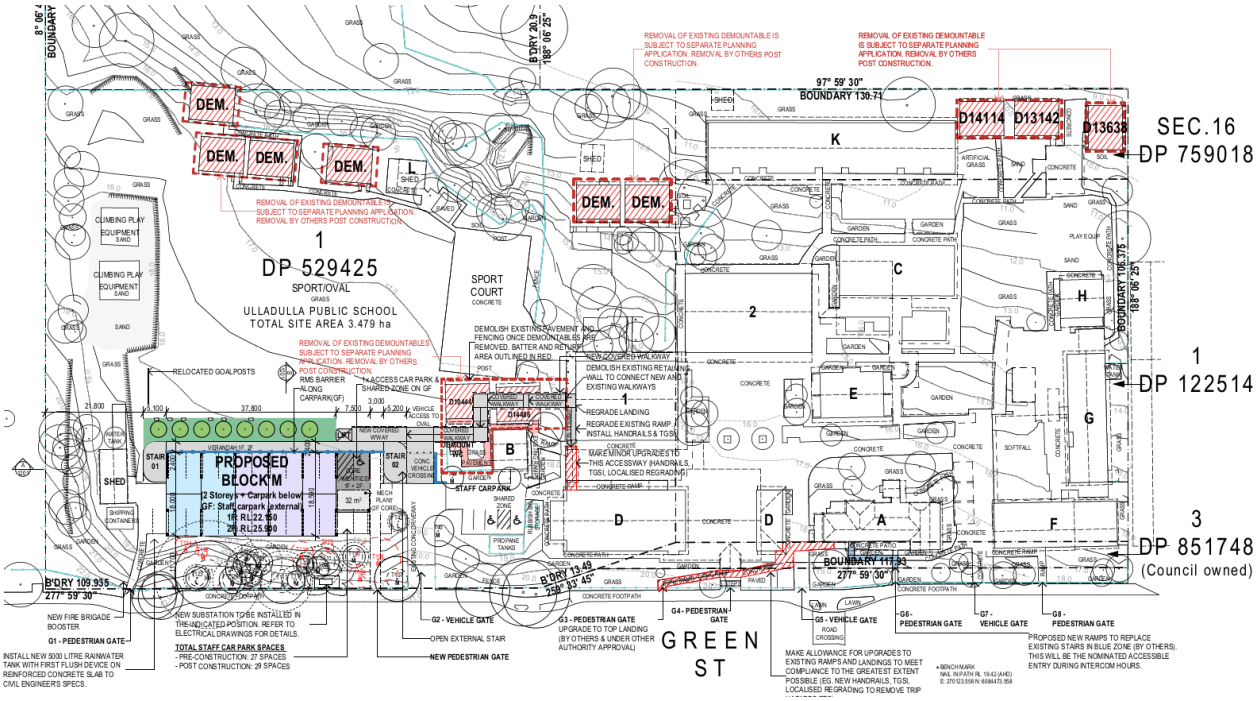


Figure 2: Site Plan (Source: Fulton Trotter, dated March 2025)

4.0 Hydrological Context

4.1 Topography

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 ground surface within the site varies from a low of 5.5m AHD (at the northwest of the site, adjacent to the creek), to a high of 22.6m AHD in the southwest corner of the site. This is depicted in the Digital Elevation Model (DEM) of the site in Figure 3, with a predominant slope from the Green Street frontage to the south of the site towards the creek to the north of the site.

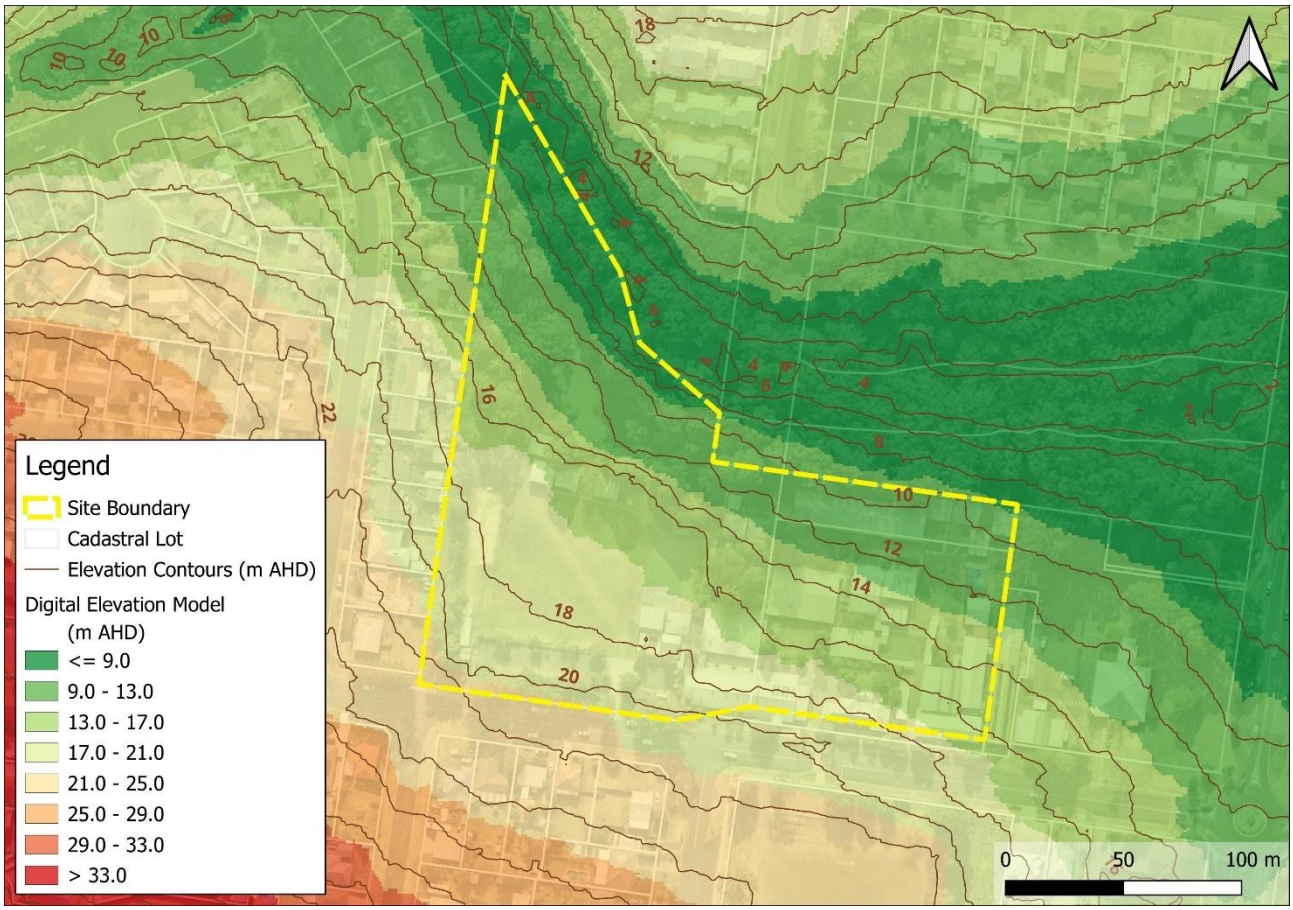


Figure 3: Topography of the site and surrounding area (Source: DEM obtained from ELVIS, 2011)

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 site and is situated just 50m from the existing school buildings. In addition, there are two first order streams to the northwest and southeast of the public school, which drain into the creek. The location of these watercourses is shown in Figure 4.

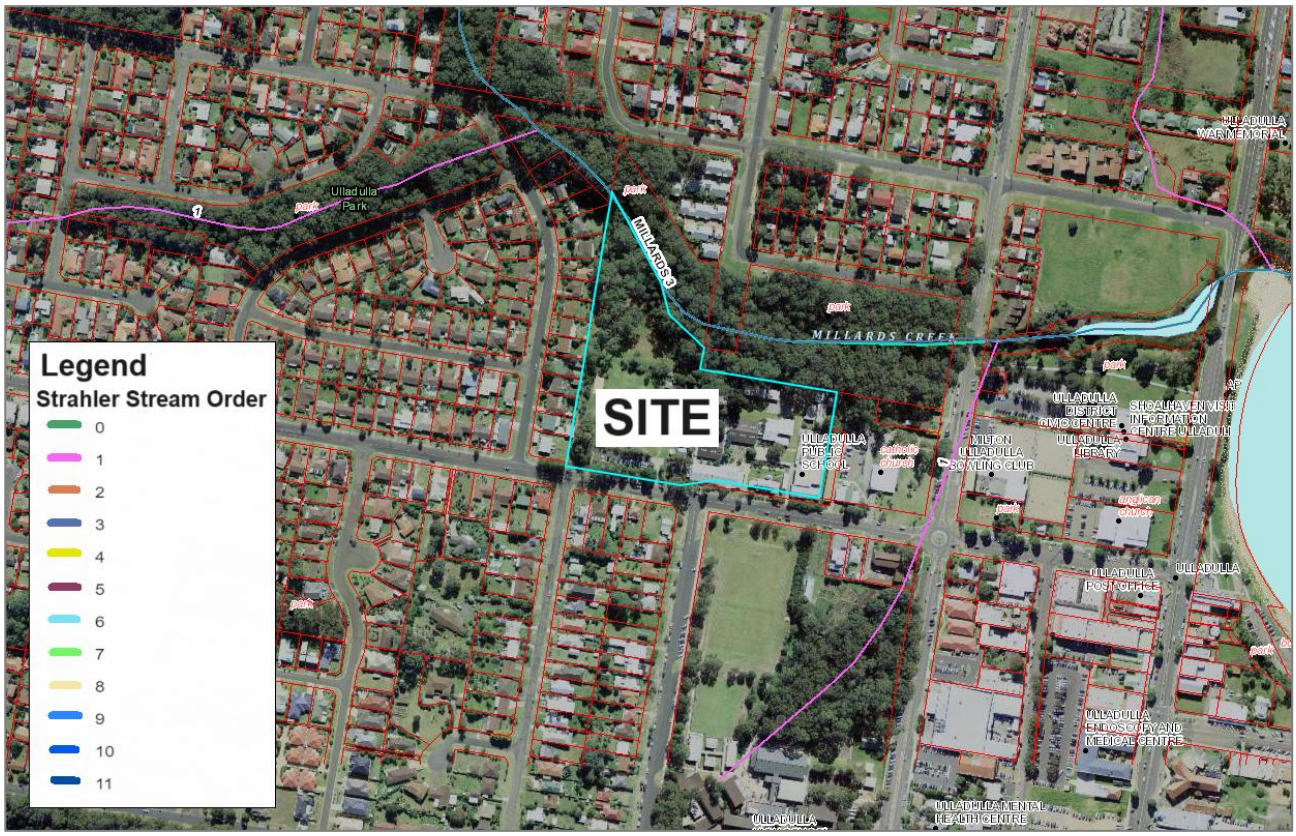


Figure 4: Watercourses in the surrounding area of Ulladulla Public School (Source: SixMaps, 2024)

5.0 Flood Planning Requirements

5.1 Shoalhaven Development Control Plan

The current Development Control Plan (DCP) covering Ulladulla was published in 2014, consolidating Shoalhaven's planning policies into a single DCP covering the entire Shoalhaven LGA. Chapter G9 (Development on Flood Prone Land) of Shoalhaven DCP (2014) provides controls for development on flood prone land and applies to all land susceptible to flooding by the Probable Maximum Flood (PMF). The controls in this Chapter have been transferred from Development Control Plan 106.

The stringency of development controls is dependent on the land use type of the activity alongside the flood hazard categorisation of the site. As per Schedule 1 (Land Use Categories) of the DCP, schools and educational facilities fall within land use Category H, "Buildings and activities requiring special evacuation consideration". As per Schedule 2 (Flood Related Development Controls) of the DCP, Category H land uses are not permitted on high or low hazard floodways, flood storage or flood fringe areas. For Ulladulla Public School, this means that development is unlikely to be permissible within the 1% AEP flood extent without incorporating measures to manage flooding (i.e., diverting flow around new buildings, or elevating structures above overland flow paths).

5.2 DCP Flood Controls

Ideally, any new Category H developments should be situated outside the PMF extent. However, development may be permitted on land below the PMF, subject to the controls highlighted in Table 1. These are outlined in further detail in Table 2. The controls are ultimately dependent on the flood behaviour at the subject site. Section 8.0 of this report outlines the flood behaviour at Ulladulla Public School, and Section 10.0 provides an assessment of the compliance of the proposed activity with the below DCP controls.

Table 1: Shoalhaven DCP flood controls for land below the PMF

Hazard/Hydraulic Category	**Outside Flood Planning Area** (Above the flood planning level but below the PMF)											
Land Use Category (As per schedule 1)	Single Residential / Habitable Buildings	Other Residential / Habitable Buildings	Carparks	Commercial / Industrial / Agricultural Buildings / Retail	Subdivision	Earthworks	Resources Management / Agriculture / Recreational Activities	Critical Infrastructure Assets / Potentially Polluting Activities	Buildings and activities requiring special evacuation consideration	Minor Development	Ancillary Structures	Events
	A(I)	A(II)	B	C	D	E	F	G	H	I	J	K
FLOOR LEVEL*									2			
BUILDING COMPONENTS									1			
STRUCTURAL SOUNDNESS									1			
HYDRAULIC IMPACT									1, 2			
ACCESS									1			
FLOOR EVACUATION PLAN									1			2
MANAGEMENT & DESIGN												

Not suitable for development Not required

Table 2: Shoalhaven DCP Development Controls Matrix Legend

Control	ID	Requirements
Floor Level	2	• Finished Floor Levels (FFLs) must be built to the PMF level.
Building Components	1	• Any portion of the building or structure below the FPL to be built from flood compatible materials (being those materials used in building that are resistant to damage when inundated).
Structural Soundness	1	• Appropriate consulting engineer's report required to confirm that the building can withstand forces of floodwaters including debris and buoyancy forces up to the PMF scenario.
Hydraulic Impact	1	• Appropriate consulting engineer's report for building footprint areas over 250 square metres, a footprint length of more than 20 metres or any development that in the view of Council has the potential to significantly impact on others. The report is to prove that the development will not increase flood hazard or flood damage to other properties or adversely affect flood behaviour for a 5% AEP up to the PMF scenario. • No hydraulic impact report is required if the proposed building is raised on piers allowing free flood flow for a 1% AEP flood event.
	2	• Appropriate consulting engineers report for earthworks of volumes exceeding 250 cubic metres or with a length of more than 20 metres. The report is to prove that the earthworks will not increase flood hazard, flood damage or adversely affect other properties for a 5% AEP up to the PMF scenario.
Access	1	• Reliable emergency vehicle access is required for ambulance, SES, fire brigade, police and other emergency services during a 1% AEP flood event.
Flood Evacuation Plan	1	• Appropriate engineers report demonstrating that permanent, fail-safe, maintenance-free measures are incorporated in the development to ensure that the timely, orderly and safe evacuation of people is possible from the area and that it will not add significant cost and disruption to the community or the SES.

5.3 Council Flood Certificate

TTW requested a Flood Certificate from Shoalhaven City Council via email on 17th October 2024 based on preliminary site plans dated 4th October 2024, provided by Fulton Trotter. The certificate (dated 23rd October 2023) is attached in Appendix A. An excerpt is provided in Table 3, with a maximum PMF event level of 22.7m AHD onsite.

It should be noted that the flood levels provided by Council refer to the maximum PMF event level across the entire lot (Lot 1 DP 529425) and are not specific to the proposed building. As a result, the PMF level quoted below does not represent the minimum required Finished Floor Level for the new building, as this is dependent on the outcome of post-development modelling. This is assessed in further detail in Section 8.3.2.

Table 3: Council flood information for the property (Source: Shoalhaven City Council, 2024)

Year	Existing	Projected 2050	Projected 2100
Flood Planning Level (m AHD)	Not Applicable	22.3**	22.3**
Hazard and Hydraulic Category*	High Hazard Floodway	High Hazard Floodway	High Hazard Floodway
Probable Max Flood Level (m AHD)	22.7	22.7	22.7
1% AEP Flood Level (m AHD)	22.0	22.0	22.0
2% AEP Flood Level (m AHD)	21.9	21.9	21.9
5% AEP Flood Level (m AHD)	21.7	21.7	21.7
10% AEP Flood Level (m AHD)	21.6	21.6	21.6
Velocity (1% AEP flood event) (m/s)	3.3	3.3	3.3

* Refer to Standard Considerations in this Flood Certificate for further details
** 1% AEP + 0.3m freeboard have been applied to determine the FPL in areas exposed to overland flooding

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 contained within its banks up to and including the 1% AEP event.

6.2 Flood Function

The Flood Risk Management Guideline FB02 (Department of Planning and Environment, 2023) 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 , 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. The school site itself is primarily regarded as a flood fringe area, with some isolated areas towards the north of the lot (where there is a steep gradient down to the creek) categorised as floodways.

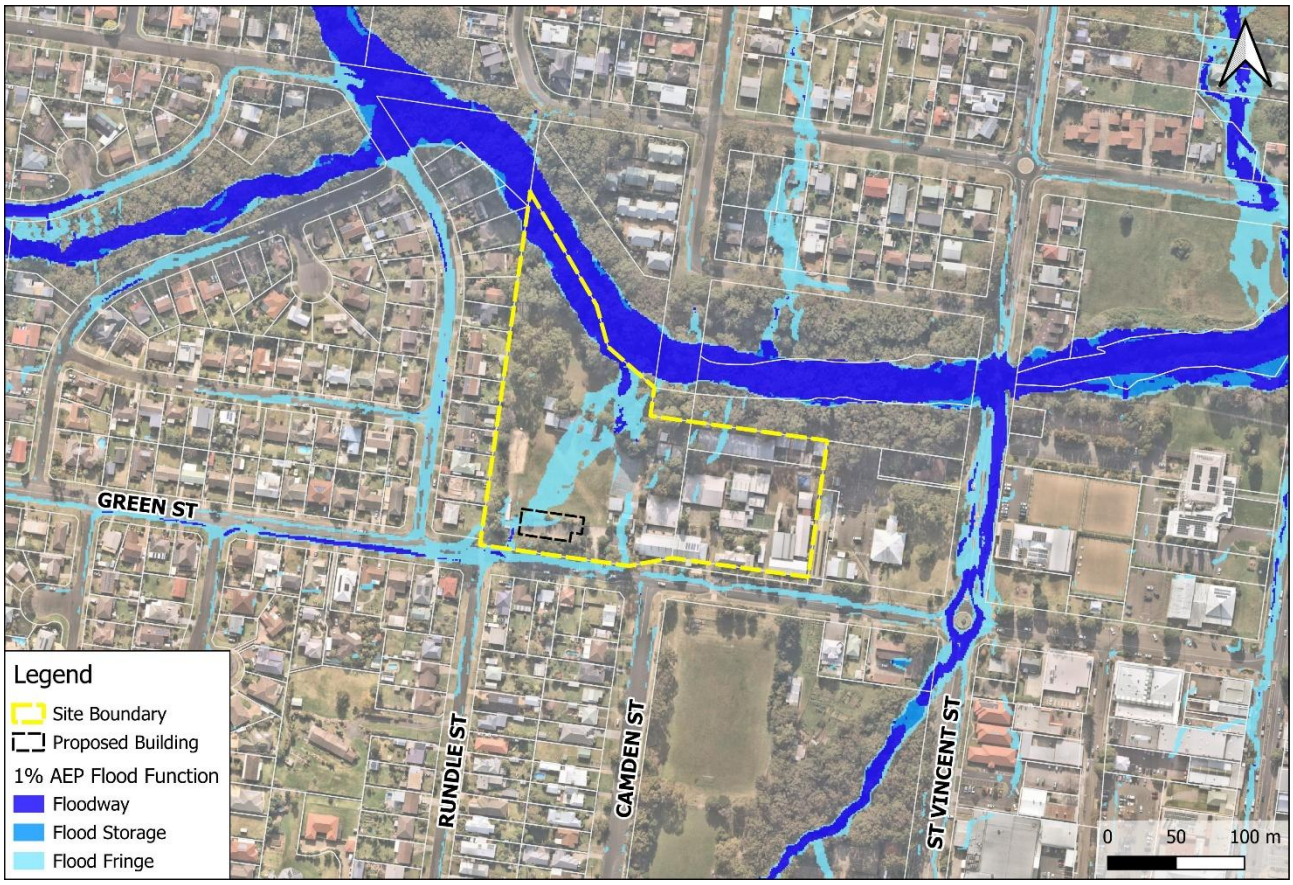


Figure 5: Flood function of flows during the 1% AEP event (Source: Millards Creek Flood Study, 2021)

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/runoff concentrations (including runoff from roof drainage systems, gutters, etc.). These runoff hydrographs provided hydrological inputs to the TUFLOW hydraulic 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.

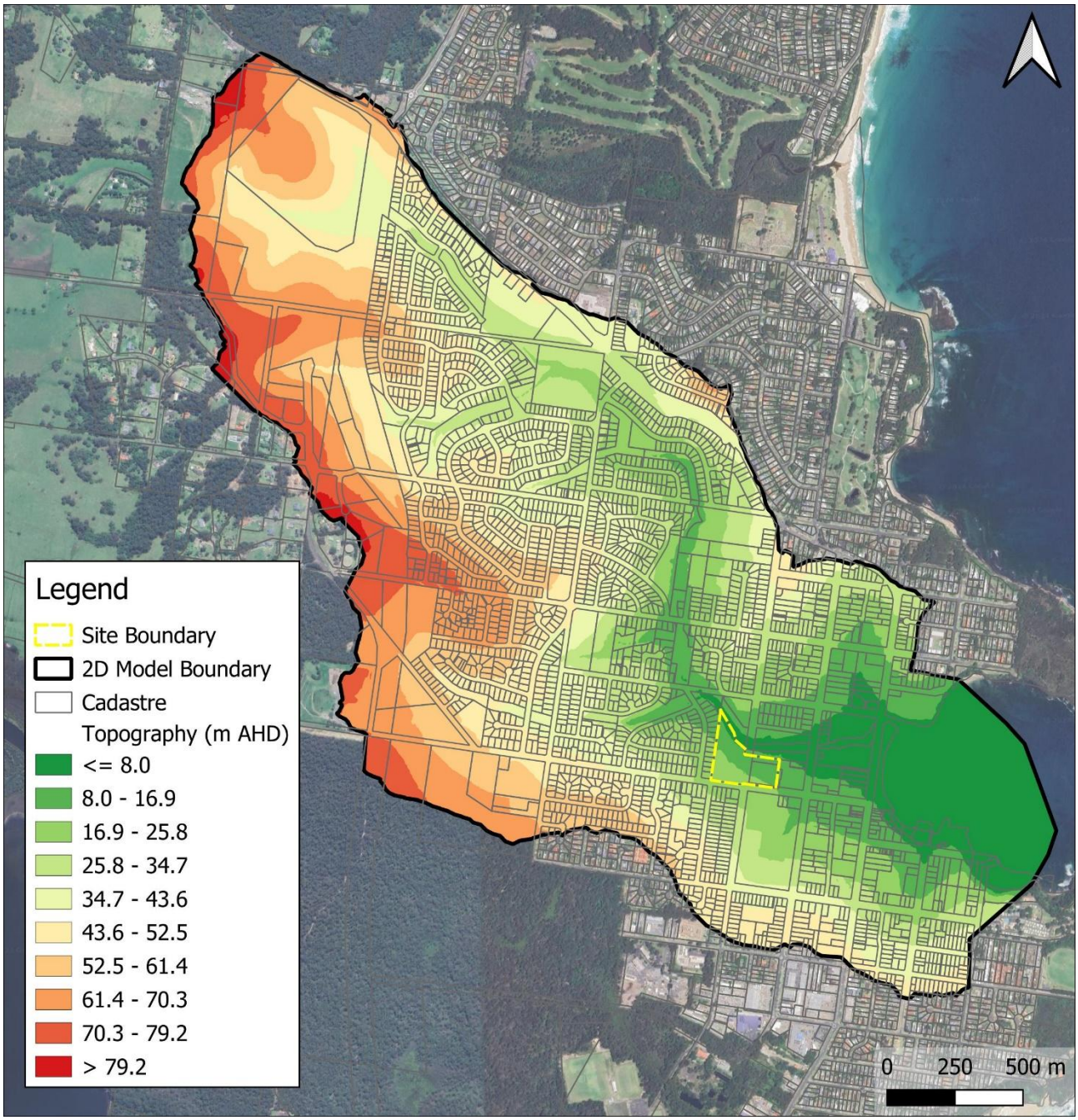


Figure 6: Millards Creek Flood Study model extent

7.3 TTW Model Updates

7.3.1 Site Survey

TTW utilised Shoalhaven City Council's TUFLOW model developed for the Millards Creek Flood Study (2021). For the existing (pre-development) scenario, the model was updated to incorporate new site survey information at a finer spatial resolution. The survey was conducted on the 3rd-6th October 2023 by CMS Surveyors. The site survey information is shown in Figure 7. Additional detailed survey obtained by CMS Surveyors for the adjacent Ulladulla High School was also provided and added into the model.

Figure 7: Detailed site survey information for Ulladulla Public 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 existing 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 comparisons 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 is of a significant size, including a 900mm pipe along Green Street, that is diverted through the site, east of the sports pitch. Additional stormwater drainage infrastructure data within the site itself was obtained from site survey data from October 2023. However, in their survey CMS Surveyors noted that various stormwater pipes are full of debris, and the survey was incomplete, in some areas, as a result. The existing drainage system onsite is likely to run at capacity in large storm events, and therefore most pipes were excluded from the model as they are unlikely to have any impact in the rare event flood modelling. A 1050mm

diameter pipe (located at the fence to the north of the site), was added to 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).

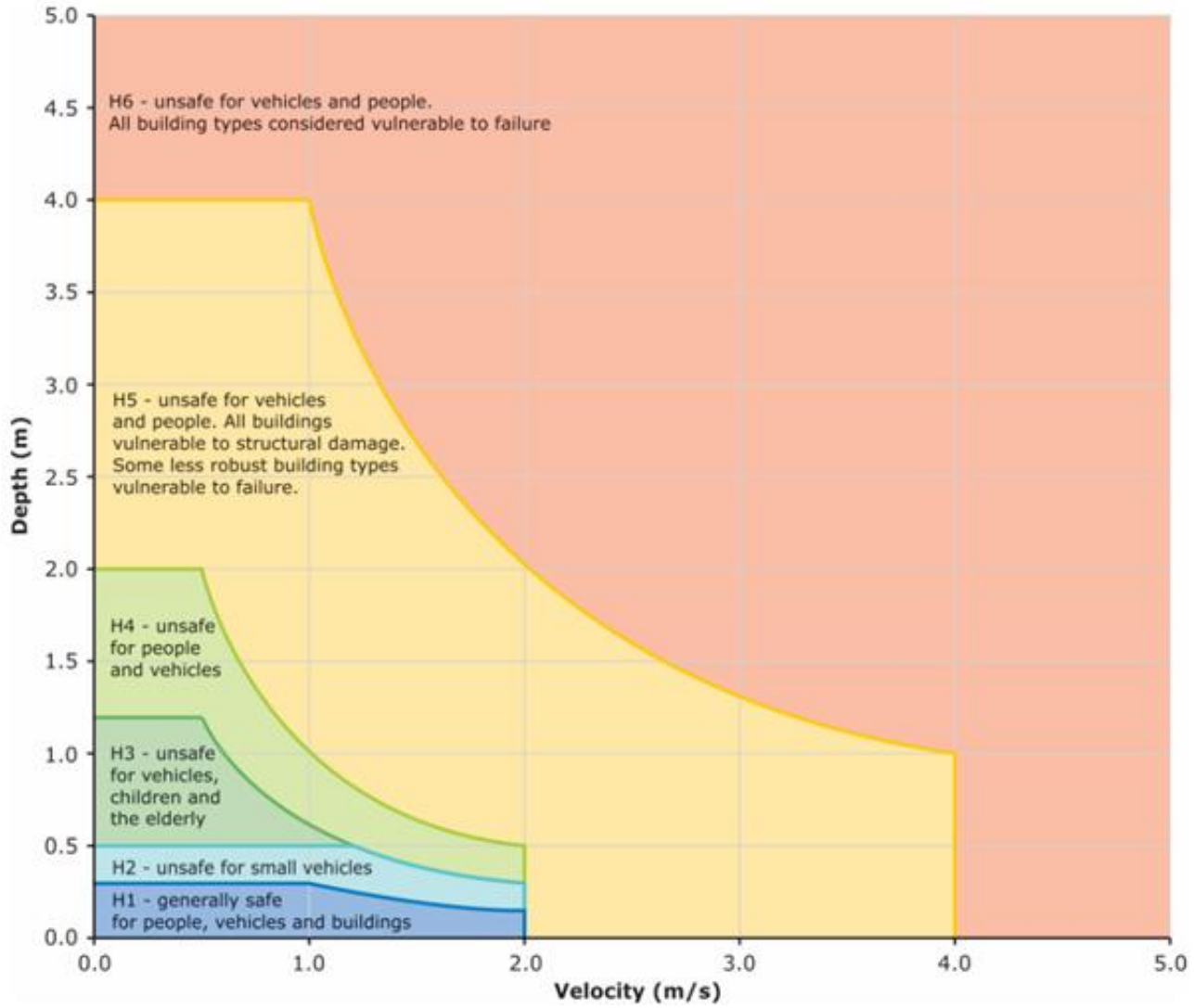


Figure 8: Flood hazard vulnerability curve (Source: Flood Risk Management Guide FB03 - Flood Hazard, NSW Department of Planning and Environment, 2022)

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 4 outlines the model runs completed for each event, alongside the critical duration and median temporal pattern identified for the site.

Table 4: 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 results in the existing scenario. Flood depth and level maps for the 10% AEP, 5% AEP and 0.5% AEP events are attached in Appendix C.

Given the steep and deep banks of Millards Creek, the site is unaffected by mainstream flooding, with flow contained within the channel banks up to and including in the PMF event. Although the site is unaffected by mainstream flooding, it is impacted by overland flows generated upstream of the site. The following observations have been made:

- Overland flow paths form within the site in the 1% AEP event, including within the currently undeveloped land to the west of the site, and is primarily directed towards Millards Creek.
- The existing buildings onsite obstruct overland flows, with floodwaters backing up to the south of numerous school buildings, most significantly Buildings 2, D, C and K. In the 1% AEP event, depths in the region of the proposed development area are typically below 100mm. In the PMF event, depths at these buildings exceed 200mm and reach 350mm to the northwest of the existing car park area.
- Flow velocities are generally highest within the eastern overland flow path, east of Buildings C and K, reaching 1.8 m/s in some areas in the 1% AEP event. Around the proposed development area, flow velocity is typically below 1 m/s in the 1% AEP event, and 1.3-1.5 m/s in the PMF event. In the southwest corner of the site where runoff overflows from Green Street, some flows exceed 2.5 m/s in the PMF event.
- In terms of flood hazard categorisation, flows in the 1% AEP event are typically categorised as low hazard (H1) over the site, although some flood hazards reach as high as H3 to H5 at areas south of the existing buildings. In the PMF event, flows reach a H5 hazard level at the overland flow path, specifically across the west of the car park. In the 1% AEP event, the portion of Green Street directly south of the site is low hazard (H1-H2), although some flows further west along this road are categorised as H5 hazard, unsafe for people and vehicles. In the PMF event, most of the roads surrounding the site are impacted by high hazard flows, including Rundle Street.

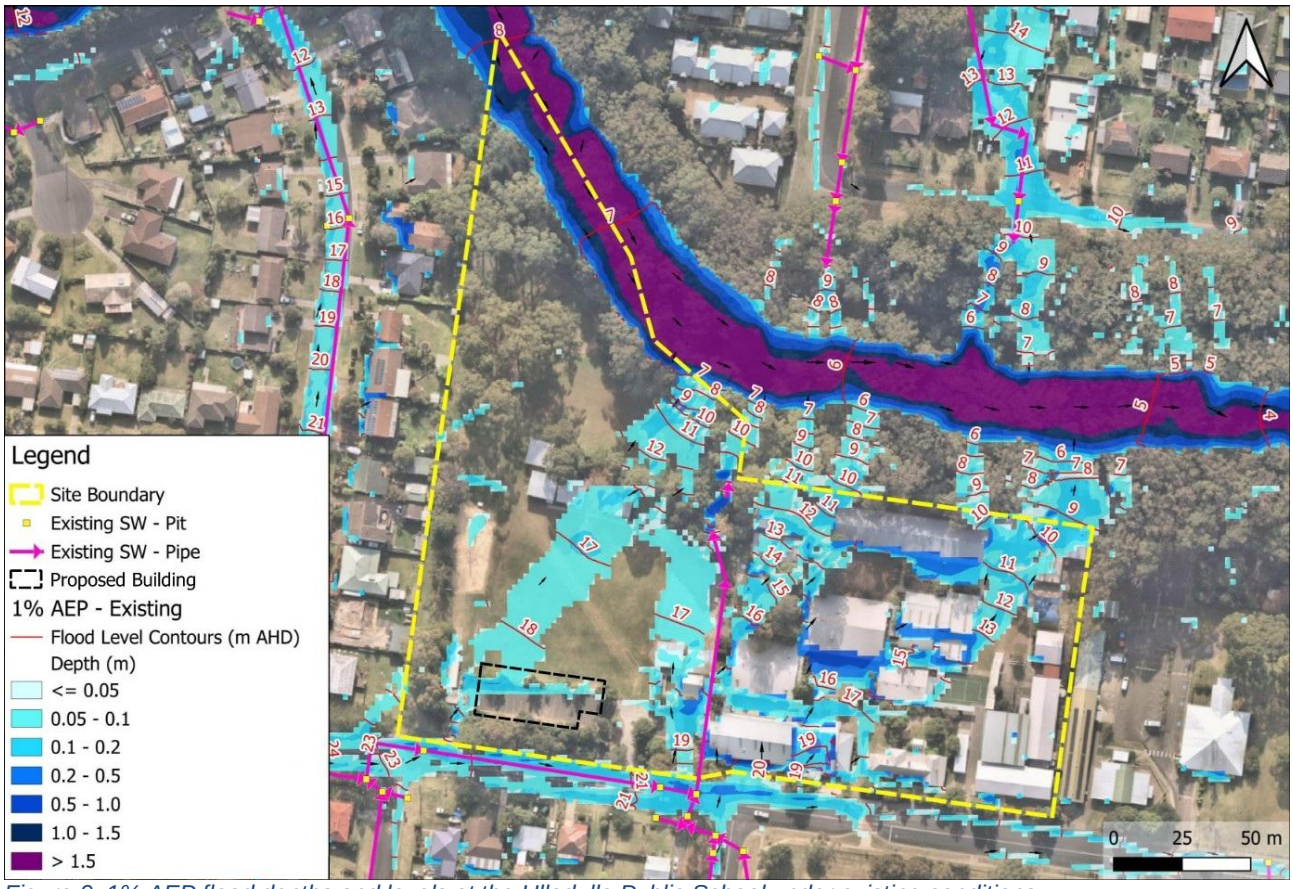


Figure 9: 1% AEP flood depths and levels at the Ulladulla Public School under existing conditions

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

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

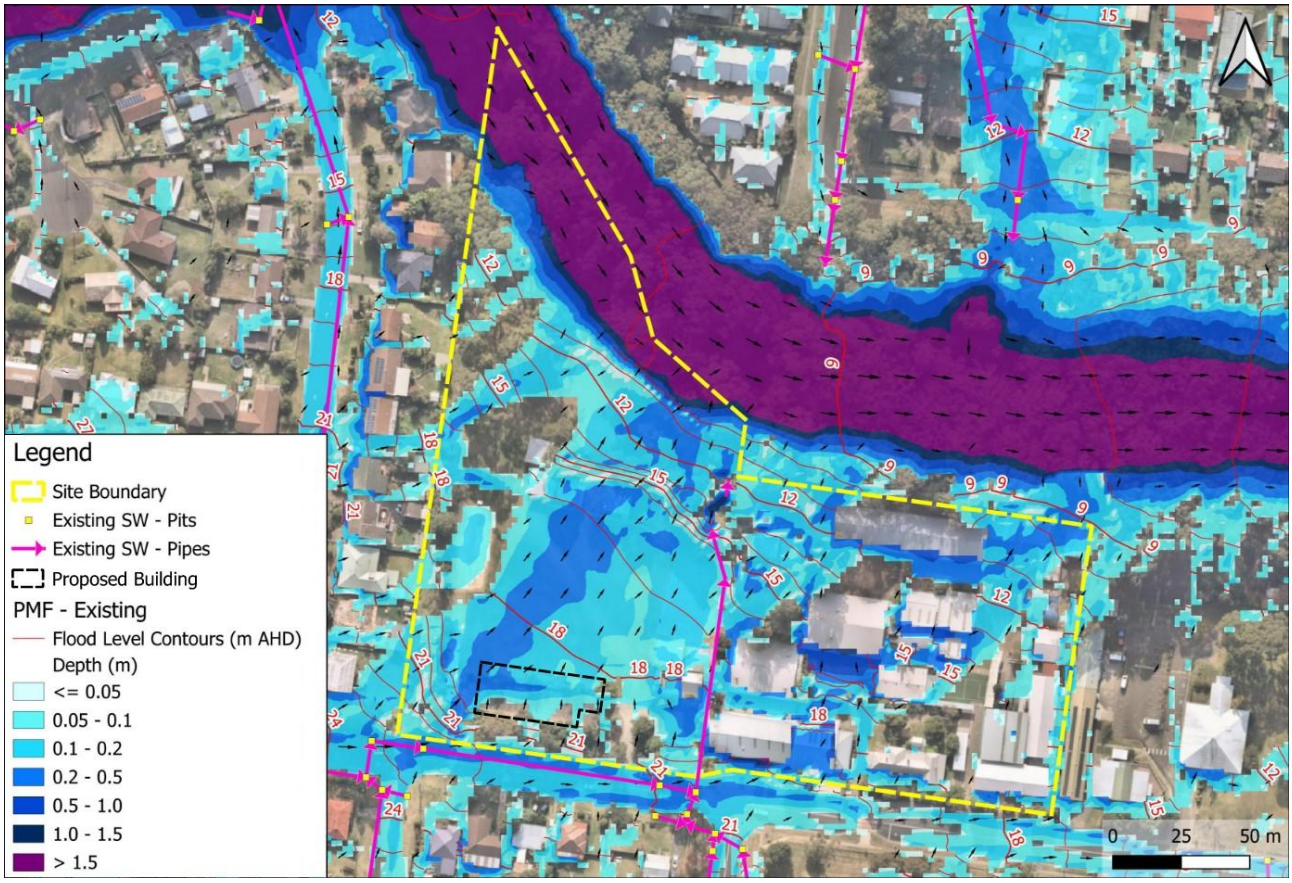


Figure 12: PMF depths and levels at the Ulladulla Public School under existing conditions

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

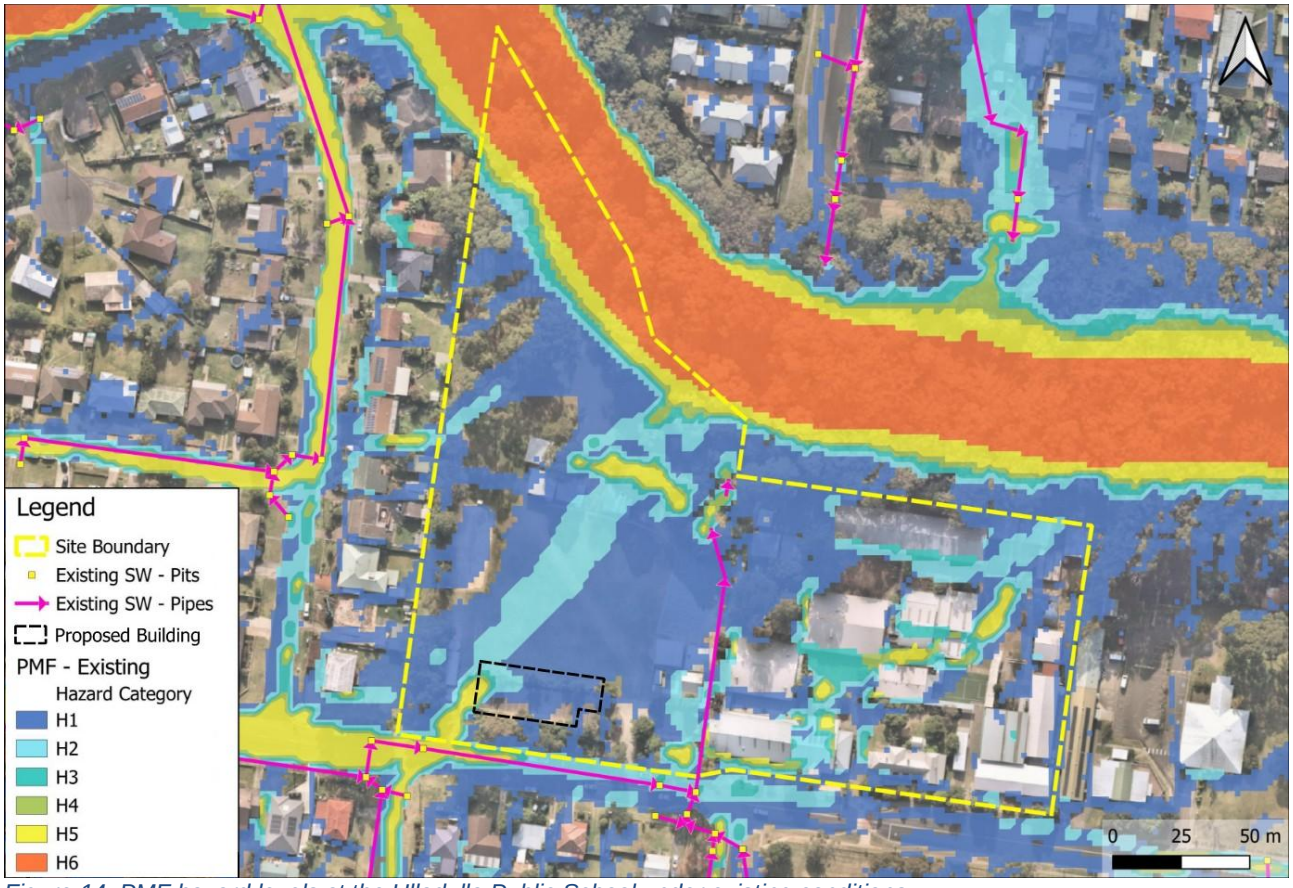


Figure 14: PMF hazard levels at the Ulladulla Public School under existing conditions

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 100% Concept Design information:

- The proposed buildings were incorporated into the model based on the building footprints in the 100% Concept Design site plan.
- The site grading and levels were updated based on the 100% Concept Design TIN provided by Meinhardt, dated 14 November 2024.

The proposed new building is located on the site of the existing car park and is elevated using piers and suspended slabs to maintain the existing flow path beneath. The building was incorporated into the model using Layered Flow Constrictions in TUFLOW to specify the depth-varying form loss of the structures. The lower layer represents the undercroft area, with the obvert level set to 21.75m AHD. Although minimal, the piers within the undercroft area pose a partial obstruction to flow and have been conservatively represented via a 10% blockage in this layer. The upper layer represents the building itself, modelled as a complete flow obstruction.

The proposed stormwater network has not been incorporated into the model as this would reach full capacity in severe flood events and not impact on the results of the modelling to a significant degree.

Figure 15 presents two cross-sectional profiles through the site, demonstrating the difference between existing and design levels at the undercroft area of the proposed building, which will form the proposed staff car park. Between Point A and Point B, design levels at the south are largely consistent with existing levels. To the north of the section, however, the design levels are at a higher elevation. This is also presented in the second section between Point C and D, with the proposed fill likely to pose a partial obstruction to flows being conveyed northwards.

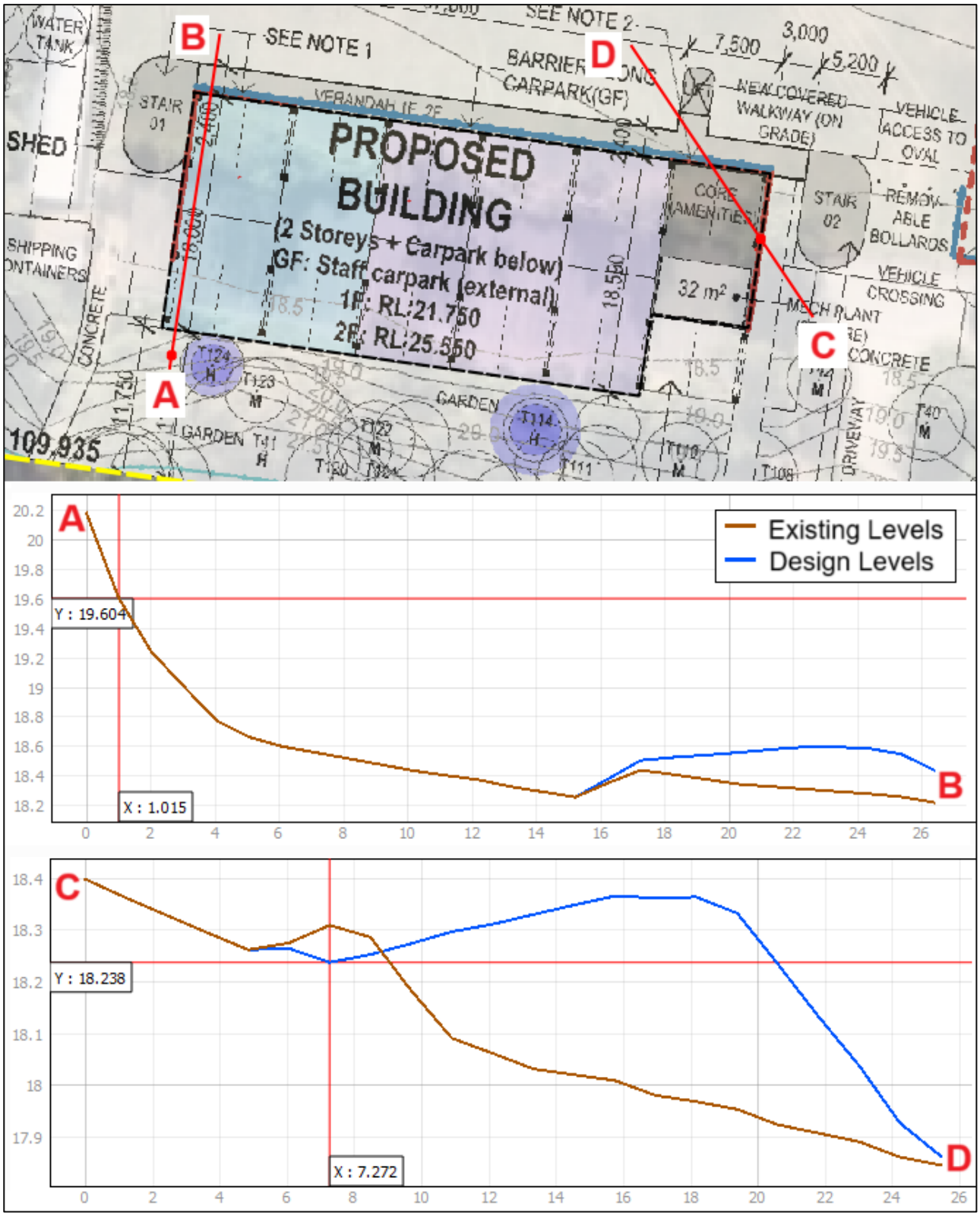


Figure 15: Cross-sectional profiles across the development site showing the difference in existing and design levels

8.3.2 Post-construction Scenario Results

The proposed change in levels at the site has altered the overland flow path across the car park, redirecting flows to the east. This is presented in Figure 16, which illustrates peak flood depths and levels at the site under post-construction conditions in the 1% AEP event. Velocity and hazard maps for the 1% AEP event are depicted in Figure 17 and Figure 18. PMF event 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 the overland flow path across the grassy open space (north of the existing car park) has reduced in post-construction conditions, with flows redirected east, across the redeveloped staff car park. Flood extents and depths over this car park have increased, with depths of up to 300mm in the 1% AEP event, and 470mm in the PMF.
- Table 5 outlines the flood levels at four points within and surrounding the proposed building in post-construction conditions. The point locations are presented in Figure 22. In the PMF event, flood levels surrounding the proposed building peak at 19.02m AHD (Point D, to the southwest of the building). More detailed comparison between pre- and post-construction flood levels is presented in Section 12.0.
- Flow velocities within the undercroft area of the proposed building reach 1.2m/s in the 1% AEP event, and 2.3m/s in the PMF event.
- In terms of flood hazard, flows beneath and surrounding the new building are categorised as H1 hazard level, regarded as safe for people and children. In the PMF, flows to the west of the proposed building are regarded as high hazard, due to flow velocity exceeding 2.0m/s in this region.

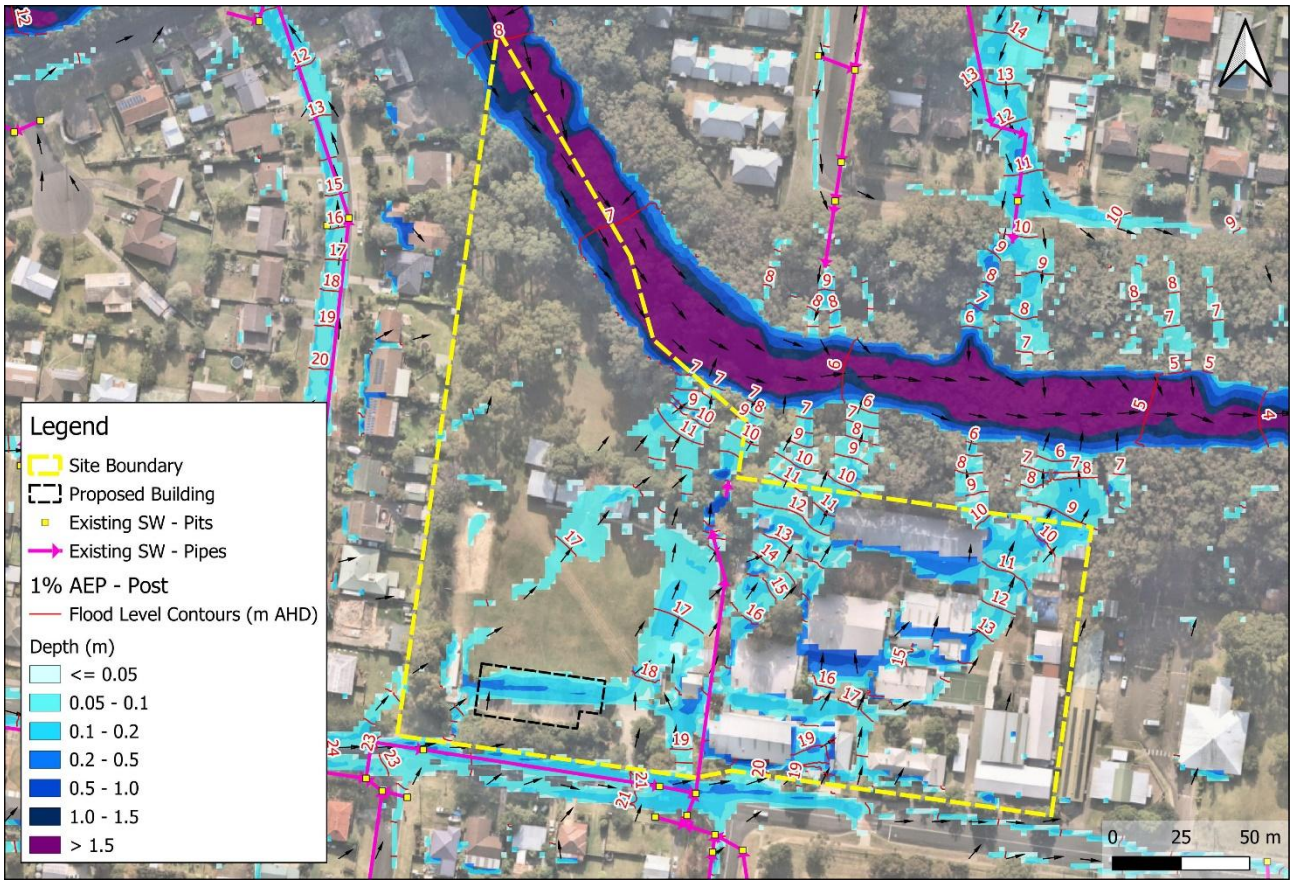


Figure 16: 1% AEP flood depths and levels at the Ulladulla Public School under post-construction conditions

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

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

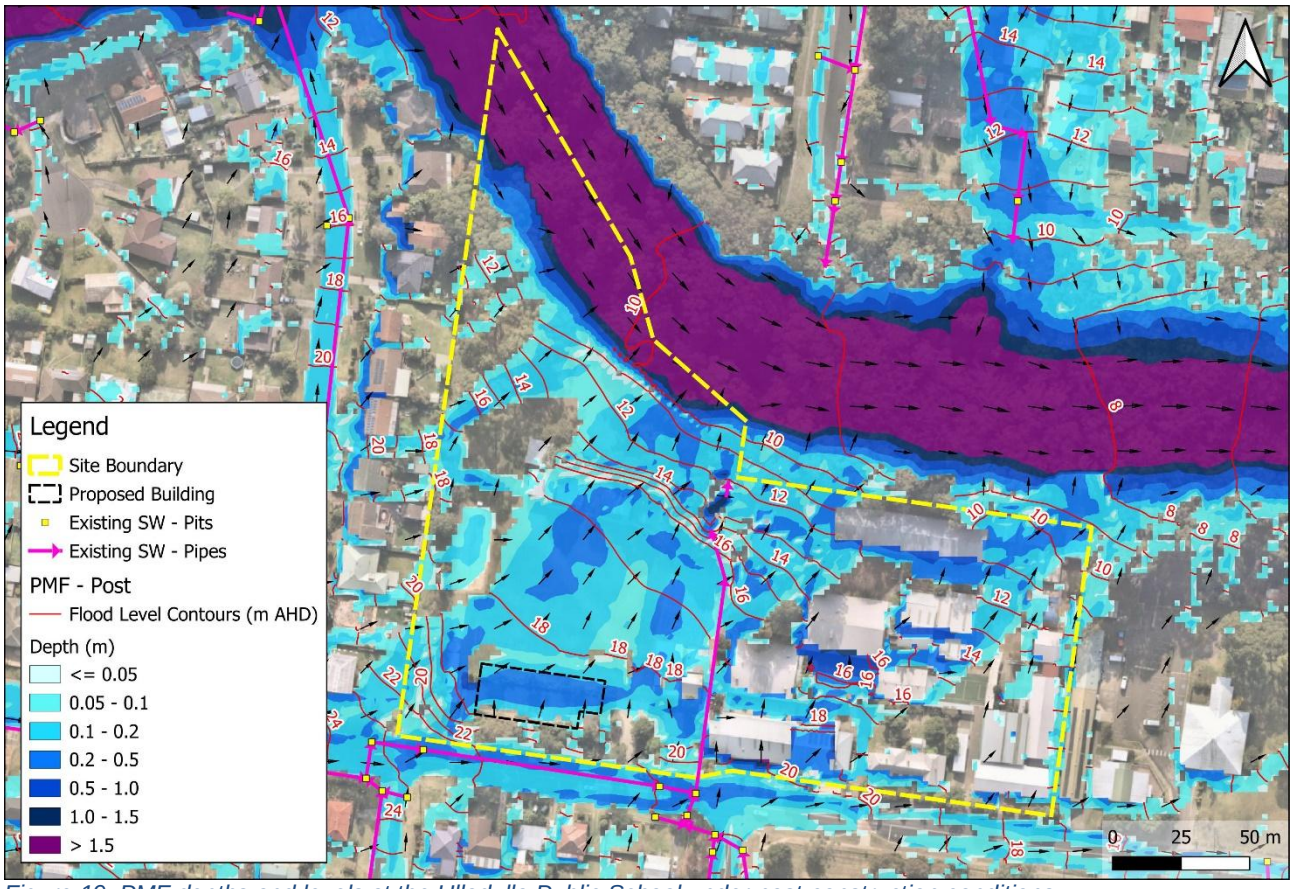


Figure 19: PMF depths and levels at the Ulladulla Public School under post-construction conditions

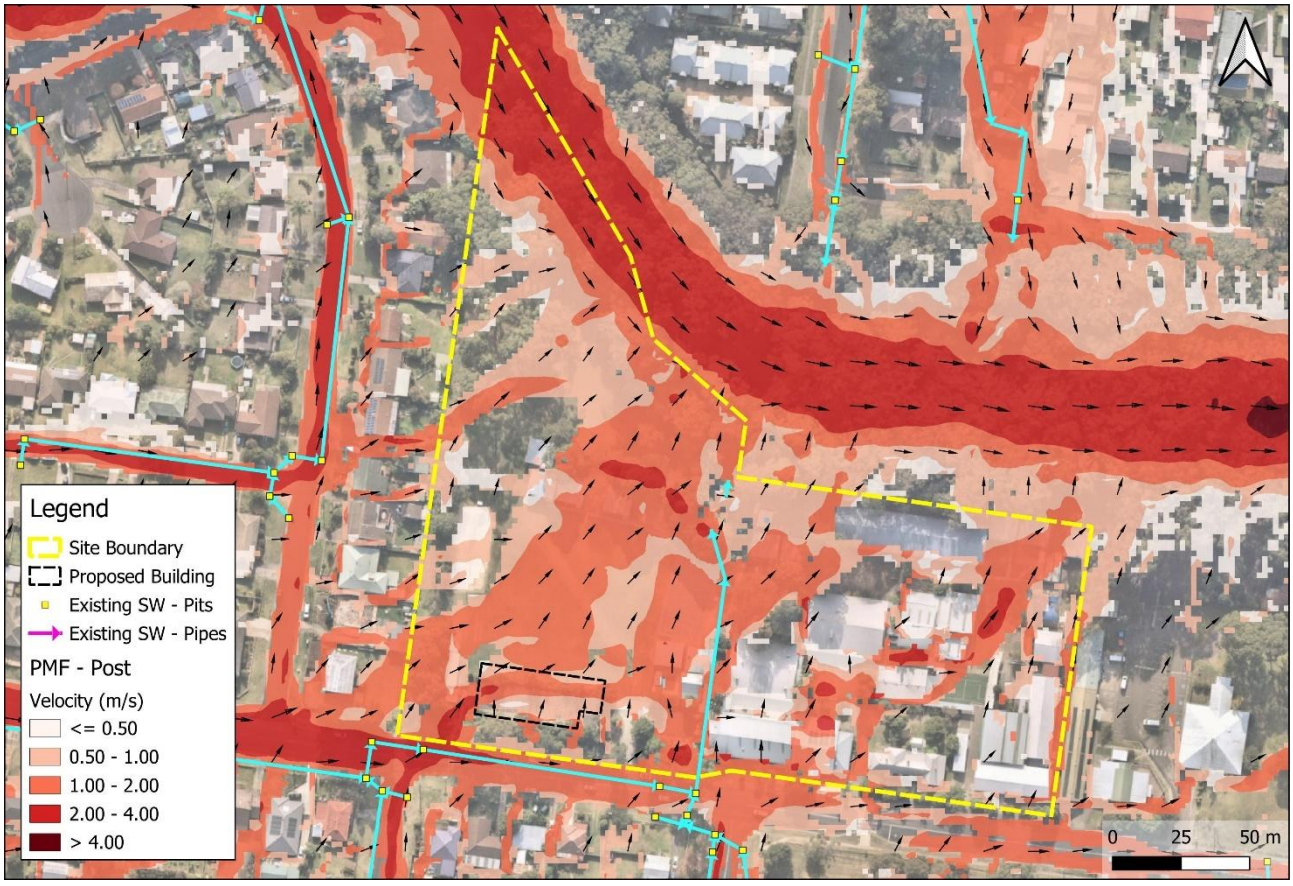


Figure 20: PMF velocities at the Ulladulla Public School under post-construction conditions

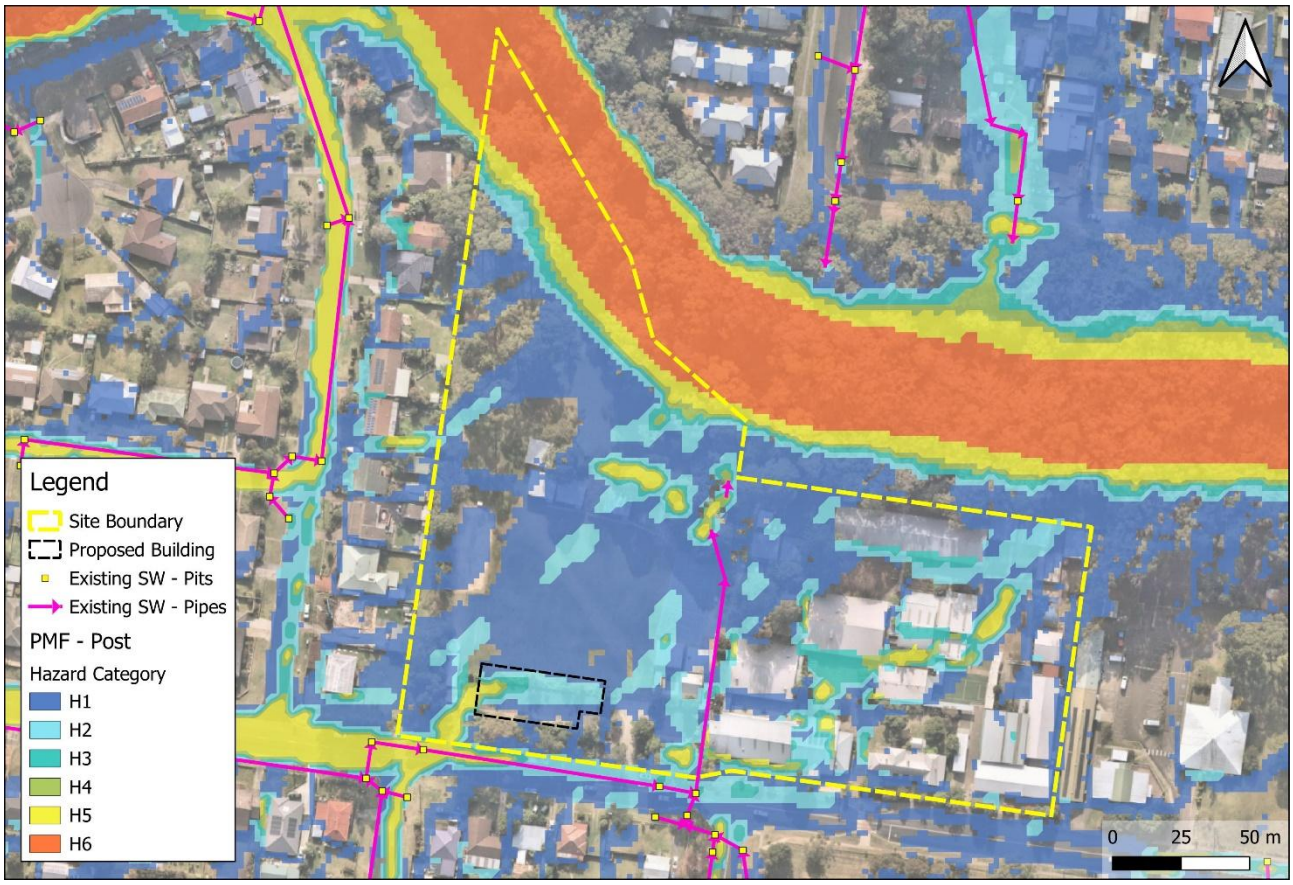


Figure 21: PMF hazard levels at the Ulladulla Public School under post-construction conditions

Table 5: Modelled flood levels surrounding the proposed development site. Refer to Figure 22 for point locations.

Flood Level (m AHD)												
Point	Existing					Post Development						
	10%	1%	0.5%	0.2%	PMF	10%	1%	1% CC 2050	1% CC 2100	0.5%	0.2%	PMF
A	18.42	18.48	18.50	18.52	18.66	18.48	18.57	18.64	18.72	18.61	18.64	18.94
B	18.34	18.38	18.40	18.40	18.50	18.42	18.49	18.52	18.56	18.50	18.52	18.65
C	N/A	N/A	N/A	N/A	18.37	18.35	18.39	18.41	18.43	18.40	18.41	18.49
D	N/A	N/A	N/A	18.86	18.94	N/A	18.88	18.90	18.93	18.89	18.91	19.02

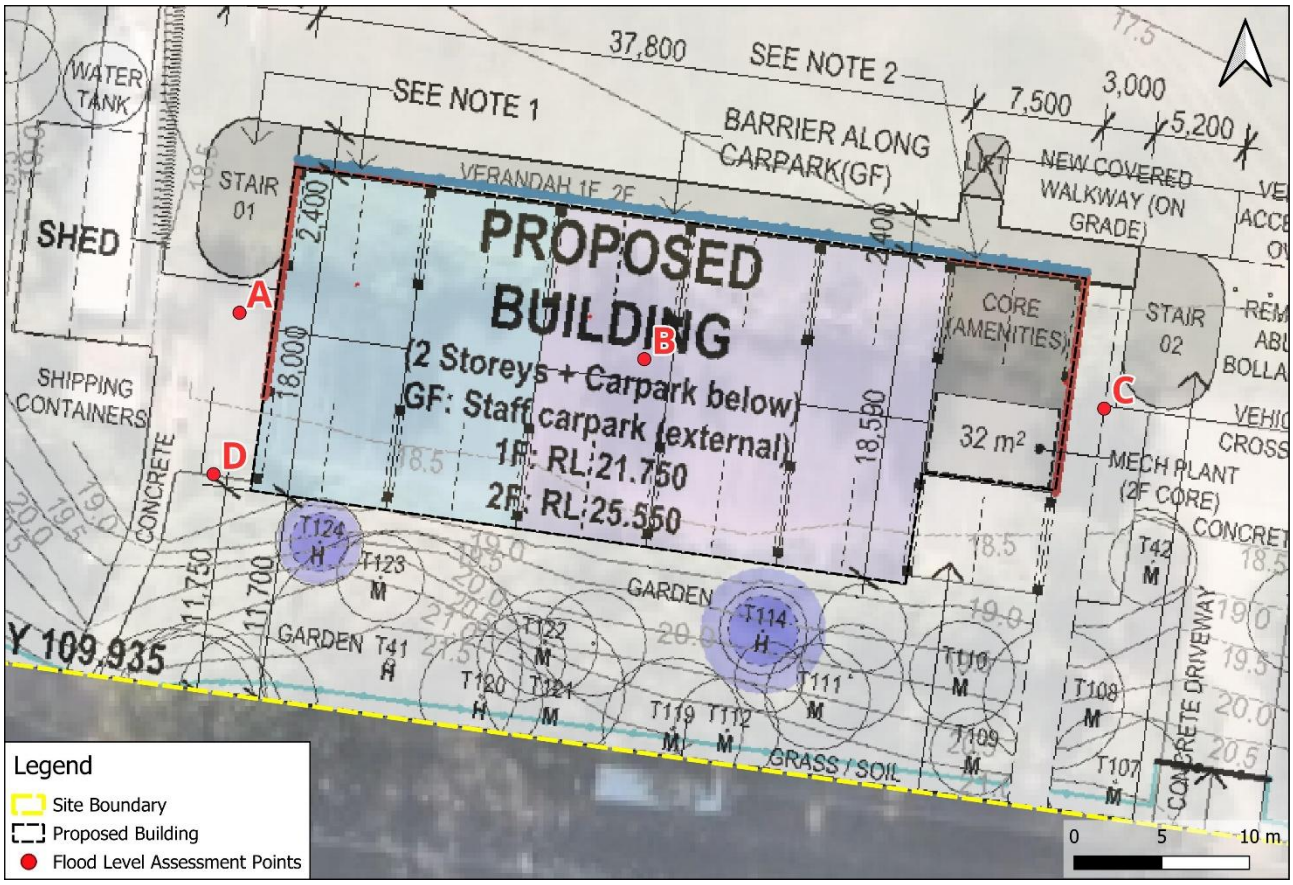


Figure 22: Flood level assessment locations. Refer to Table 5 for levels.

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 two locations onsite at the east and west of the proposed building, and two locations over Green Street. These are labelled in Figure 23. In addition, given that the site is at risk of both riverine flooding from Millards Creek, alongside overland flows from Green Street, a joint probability analysis has been conducted to consider the interaction of these two mechanisms, outlined in Section 9.3.

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. 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 flood levels under future climate change. Two 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 6 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 only expected to increase by 10-20mm in the 1% AEP event under the CC2050 scenario, and 20-50mm in the CC2100 scenario. Based on the flood assessment locations, the largest increase in flood level is anticipated at Point A, west of the proposed building, with a 65mm increase under the CC2050 scenario and a 135mm increase under the CC2100 scenario.

Table 6: 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	18.57	+65mm	+135mm	18.60	+68mm	+138mm	18.63	+69mm	+145mm
B	18.38	+22mm	+44mm	18.39	+22mm	+43mm	18.40	+22mm	+44mm
C	22.38	+57mm	+107mm	22.40	+55mm	+101mm	22.43	+52mm	+95mm
D	20.71	+17mm	+31mm	20.71	+17mm	+31mm	20.72	+14mm	+29mm

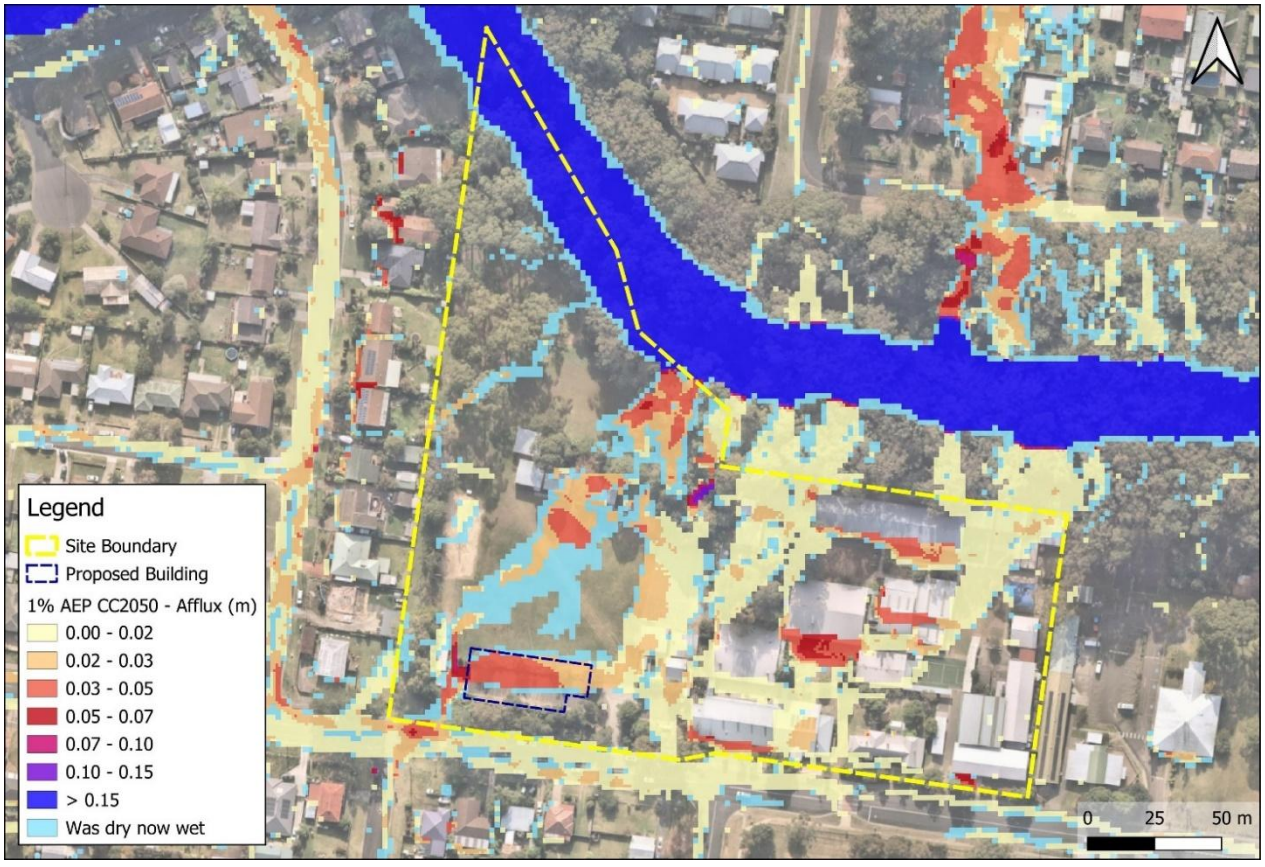


Figure 24: Flood level afflux (m) under the 1% AEP CC2050 scenario

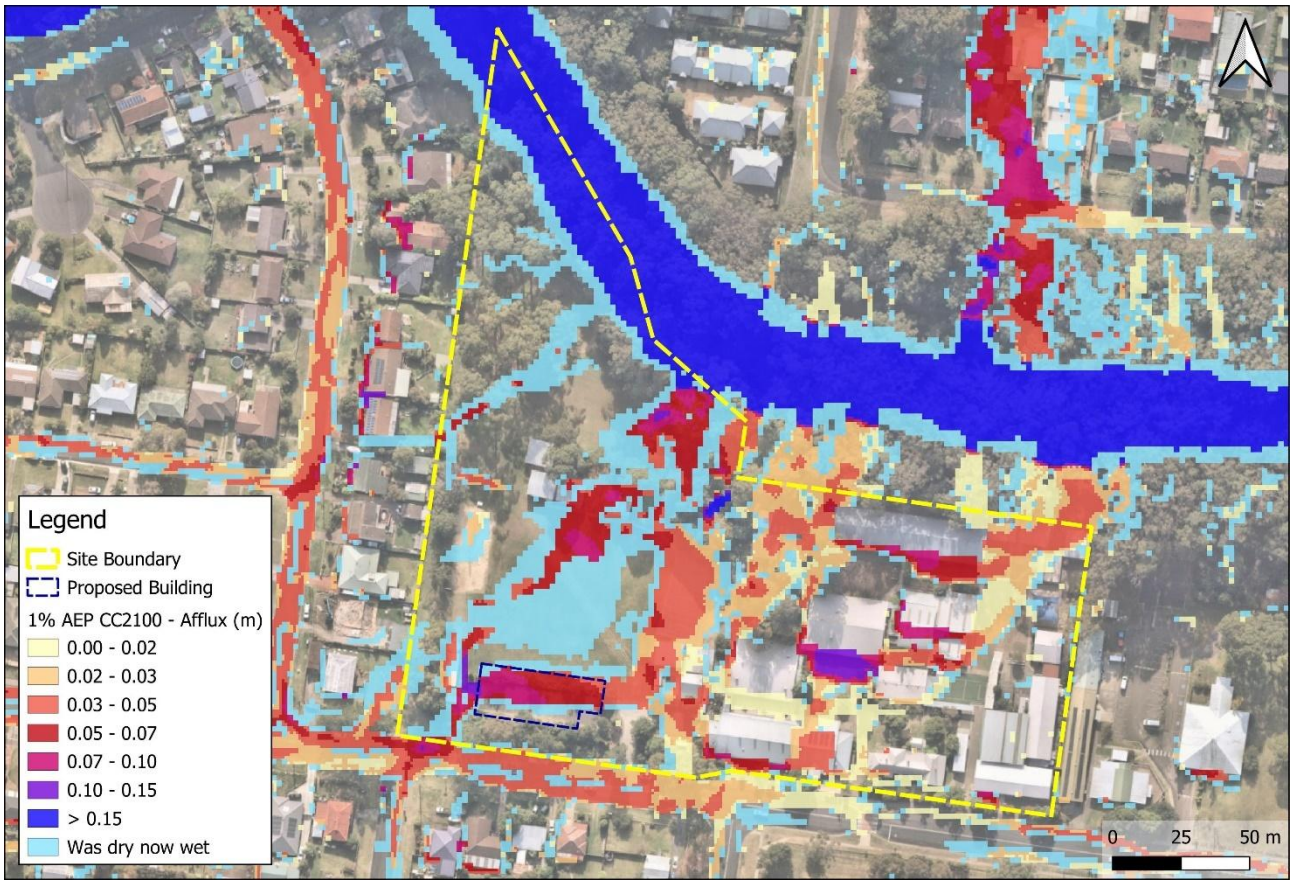


Figure 25: Flood level afflux (m) under the 1% AEP CC2100 scenario

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 7 outlines the flood level increase from a 50% and 100% blockage in the post-construction scenario at Points A to C. Point D is unaffected by pit blockages. Within the site boundary, the largest increase in flood level under the 100% blockage scenario is observed around Point A, west of the proposed building. At this location, flood level increases by 53mm in this scenario. For the majority of the site, however, flood level increases are below 30mm.

Table 7: Pit blockage sensitivity at three locations close to the site. Refer to Figure 23 for locations.

	Flood Level Increase		
	1% AEP Flood Level (m AHD)	**50% Blockage**	**100% Blockage**
Point A	18.57	+15 mm	+53 mm
Point B	18.38	+5 mm	+18 mm
Point C	22.38	+23 mm	+73 mm

9.3 Joint Probability Assessment

In addition to runoff from the catchment, downstream areas can also be influenced by high water levels within the Harbour, which can back up into the creek. Given the site's close proximity to Ulladulla Harbour, a joint probability assessment was completed to determine the impact of coincident flooding from both catchment

runoff and storm surge. The design runs adopt a peak ocean level of 1.40m AHD (based on the 5% AEP event), taken from Millards Creek Flood Study data. For the joint probability assessment, the estimated 1% AEP ocean water level of 1.45m AHD was applied.

As depicted in Figure 26, flows at the site are unaffected, with the St Vincent's Bridge marking the upstream extent of tidal influence.

Figure 26: Joint probability assessment – 1% AEP Flood Level Afflux

10.0 Compliance with Flood Planning Controls

Table 8 summarises the flood controls relevant to the site (as per Shoalhaven DCP, 2014) and identifies the development proposal's compliance or non-compliance with each.

Table 8: Shoalhaven DCP Development Controls Matrix Legend – Compliance Assessment

Control	Requirements	Compliance Assessment
Floor Level	• Finished Floor Levels (FFLs) must be built to the PMF level.	See Section 10.1 for detailed analysis of the floor level requirements for the proposed development.
Building Components	• Any portion of the building or structure below the FPL to be built from flood compatible materials (being those materials used in building that are resistant to damage when inundated).	TTW have provided flood depth and velocity information to the project's structural team to inform the required debris loading calculations. This will ensure the building piers are designed to withstand the forces of floodwaters and debris at detailed design.
Structural Soundness	• Appropriate consulting engineer's report required to confirm that the building can withstand forces of floodwaters including debris and buoyancy forces up to the PMF scenario.	
Hydraulic Impact	• Appropriate consulting engineer's report for building footprint areas over 250 square metres, a footprint length of more than 20 metres or any development that in the view of Council has the potential to significantly impact on others. The report is to prove that the development will not increase flood hazard or flood damage to other properties or adversely affect flood behaviour for a 5% AEP up to the PMF scenario. • No hydraulic impact report is required if the proposed building is raised on piers allowing free flood flow for a 1% AEP flood event. • Appropriate consulting engineers report for earthworks of volumes exceeding 250 cubic metres or with a length of more than 20 metres. The report is to prove that the earthworks will not increase flood hazard, flood damage or adversely affect other properties for a 5% AEP up to the PMF scenario.	Given that the proposed building is situated atop of an overland flow path, it was necessary to incorporate measures into the design to manage flooding and allow unobstructed flow beneath the building. The building is raised on piers, allowing free flow during all flood events up to and including the PMF event. Review of model outputs confirms there is no offsite impact as a result of the development. Localised increases in flood level in the 1% AEP event are due to the change in surface levels over the car park, rerouting overland flows to the east. See impact assessment outlined in Section 12.0 for more detailed analysis.
Access	• Reliable emergency vehicle access is required for ambulance, SES, fire brigade, police and other emergency services during a 1% AEP flood event.	See Section 10.2 for discussion of emergency vehicle access in the 1% AEP event.
Flood Evacuation Plan	• Appropriate engineers report demonstrating that permanent, fail-safe, maintenance-free measures are incorporated in the development to ensure that the timely, orderly and safe evacuation of people is possible from the area and that it will not add significant cost and disruption to the community or the SES.	See TTW's Flood Emergency Response Plan (FERP) submitted alongside this Flood Impact Assessment Report.

10.1 Floor Level Requirements

Given that schools are regarded as a sensitive Category H development, the Finished Floor Levels (FFLs) must be built to the PMF level. Based on current site plans, the FFL for Level 1 is set to 22.15m AHD, elevated over 3 metres above the peak PMF level of 19.02m AHD surrounding the building (taken from Table 5, Point D).

In terms of the staff car park below the building, car parks are classified as Category B developments in Shoalhaven DCP. Floor levels for Category B developments must be high enough to ensure a depth x velocity product of less than 0.3 m^2/s in the 1% AEP flood event. Figure 27 presents the depth x velocity product for the site in this event, with the entire car park area receiving flows of less than 0.3 m^2/s. The proposed development is therefore compliant with the floor level controls set out in the Shoalhaven DCP.

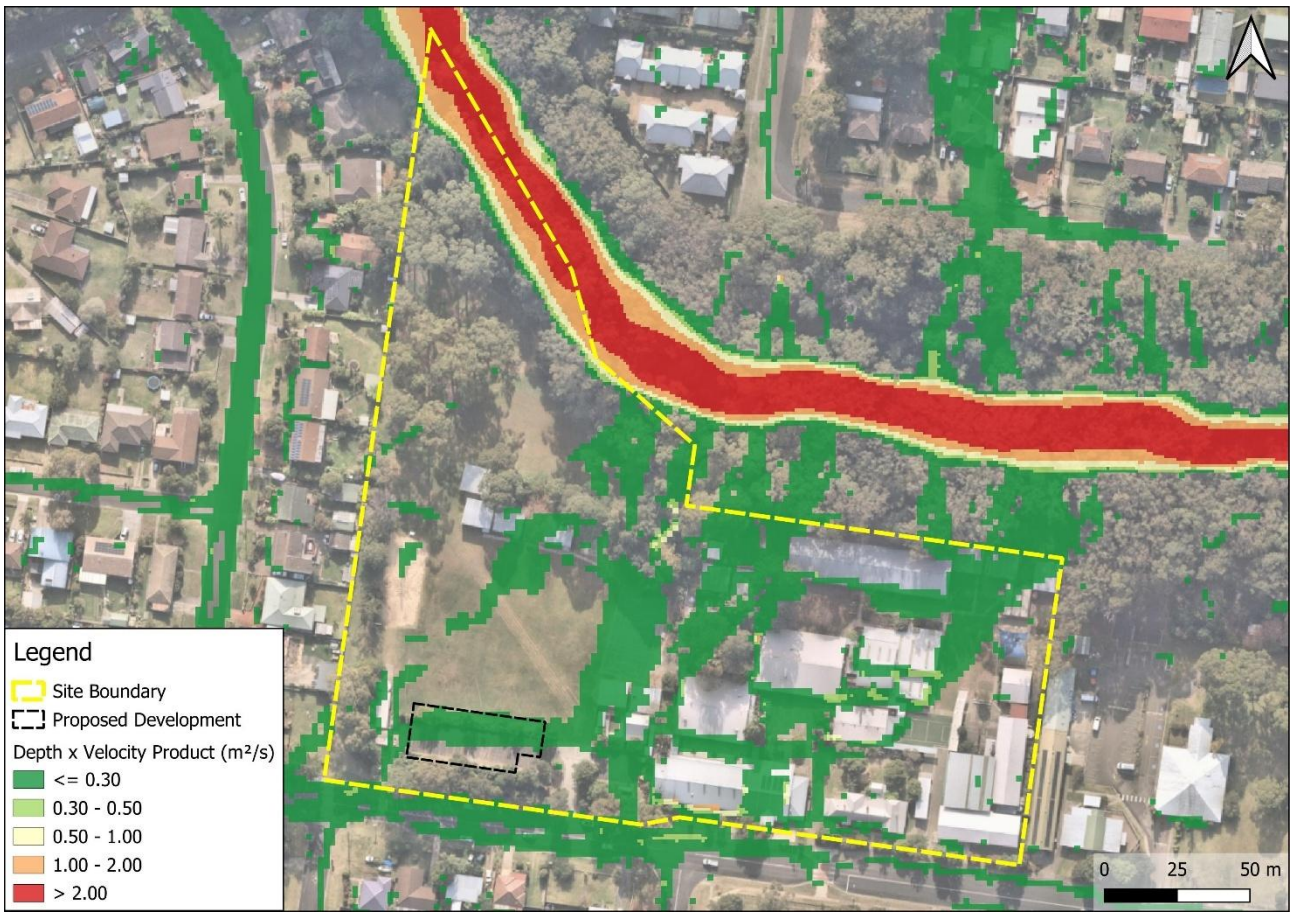


Figure 27: Depth x velocity product in the 1% AEP flood event

10.2 Site Access and Evacuation

In terms of site access, Figure 28 presents the flood hazard categorisation of flows in the 1% AEP event in post-construction conditions. Access to and from the site is available via the Green Street access point, with onward travel possible via the largely flood-free Camden Street, leading onto Deering Street.

Further consideration of site access and flood emergency response strategies is provided in TTW's Flood Emergency Response Plan for the site, dated 25 March 2025.

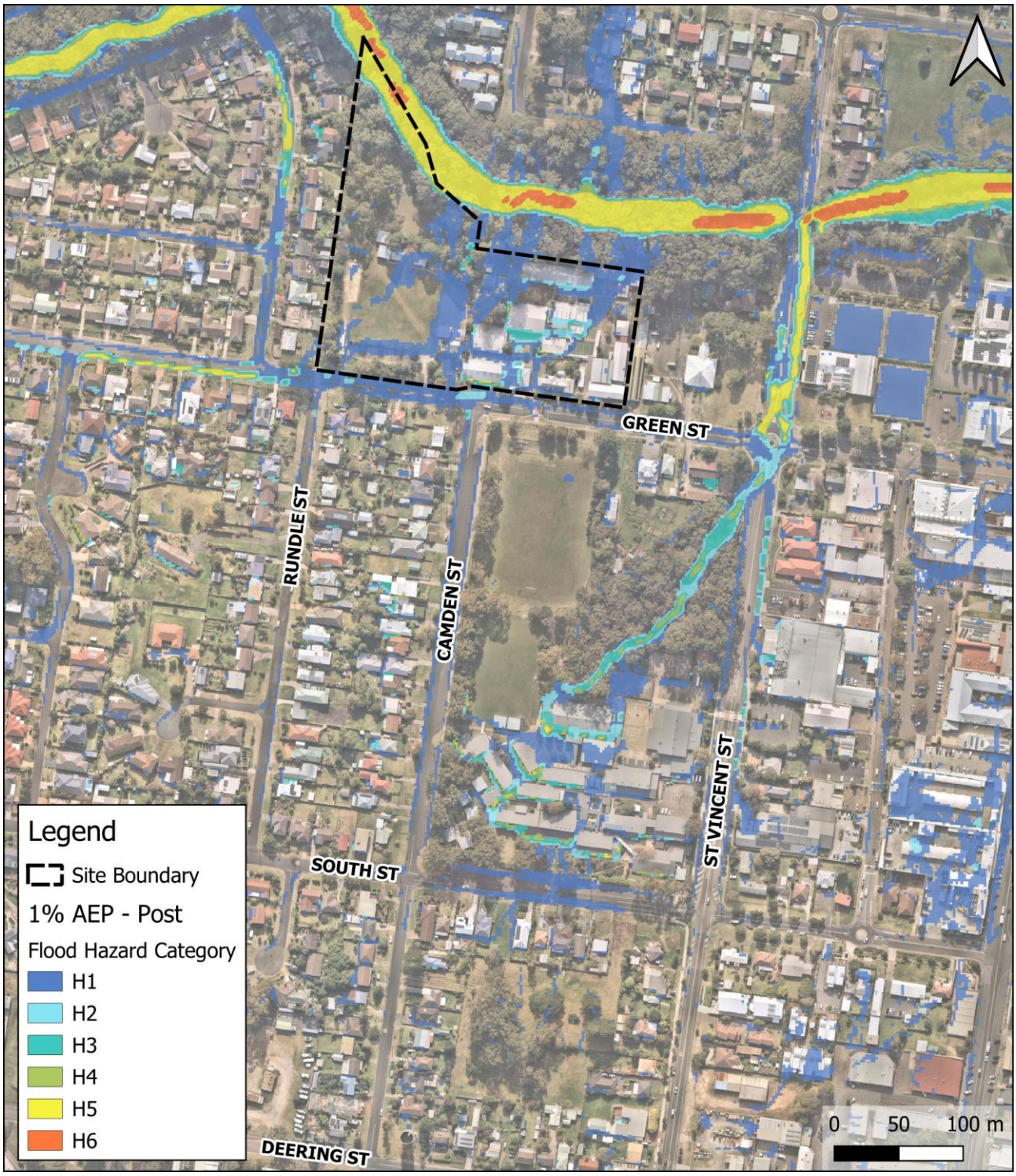


Figure 28: 1% AEP event flood hazard categorisation for the surrounding area

10.3 NSW Department of Education Guidelines

NSW Department of Education (DoE) have their own framework and guidelines for educational site selection and development. Whilst the Ulladulla Public 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:

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

ii. Site should provide flood free access for pedestrians and vehicles (in particular, emergency vehicles during

a flood event);

iii. 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: As aforementioned, the proposed building is elevated at 22.15m AHD, well above the 0.5% AEP flood level of 18.90m AHD, and the PMF level of 19.02m AHD.

Item ii: As discussed in Section 10.2, there is flood free access into and out of the site in the 1% AEP event. 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 19 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 compliant with the DoE guidelines for educational site selection.

11.0 Mitigation Measures

Mitigation measures identified as necessary are outlined in Table 9. Following the implementation of these measures, any impacts are deemed to be acceptable and appropriate.

Table 9: 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	N/A – see TTW's FERP submitted alongside this FIRA.

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 development. A flood impact assessment has been carried out to ensure the proposed development would not result in worsening of the flood conditions over the neighbouring properties in the 1% AEP event. The flood level impact map is shown in Figure 29. Table 10 summarises the flood level afflux in the 1% and PMF events at the six points labelled in the figure.

The impact assessment demonstrates no change to flood levels over neighbouring properties or across the adjacent footpath and road, and therefore the proposed development has no offsite impacts in accordance with Council's DCP. Within the site, flood levels increase by up to 300mm within the onsite staff car park area, which is the result of the change in site grading, redirecting the existing overland flow path. For the majority of the site, flood level afflux is less than 20mm, and less than 10mm adjacent to the existing buildings.

There are some changes in flood level in the PMF event due to the diverted overland flow paths (including an increase of 298mm at Point E). However, this flood level increase is below 10mm adjacent to existing building openings in the PMF event, and therefore is expected to have negligible impact on existing flood emergency planning arrangements 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.

Figure 29: Flood level afflux – Impact of proposed development on flood levels in the 1% AEP event

Table 10: Difference in flood levels at six points surrounding the proposed building (see Figure 29 for point locations)

Point	Difference in Post-Construction vs Existing Flood Level (m)	
	1% AEP	PMF
A	-29 mm	-27 mm
B	+26 mm	+39 mm
C	0 mm	+1 mm
D	+2 mm	+9 mm
E	+98 mm	+298 mm
F	0 mm	+1 mm

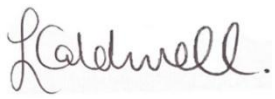
13.0 Conclusion

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. Modelling concluded that:

- The Ulladulla Public School site is impacted by overland flows in all modelled design events, including the 10% AEP event. At the proposed activity area at the existing car park, runoff from Green Street overflows onto the site, forming a flow path across this area. In order to maintain overland flow across this area, the proposed building is elevated on piers, allowing unobstructed flow beneath, within the redeveloped staff car park.
- As a Category H development, the FFL of the proposed building must be elevated to the PMF level. With a current proposed FFL of 22.15m AHD, the building is a minimum of 3m above the peak PMF level of 19.02m AHD. The car park is similarly elevated to a sufficient level to ensure flows in the 1% AEP event are of low hazard with a depth x velocity product of less than 0.3m^2/s, compliant with the controls set out in Shoalhaven DCP.
- The proposed activity has no significant 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 redirect the existing overland flow path.
- 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 west of the proposed building increase by 135mm under the CC2100 scenario, equating to a level of 18.71m AHD. Level 1 of the new building is over 3m above this.
- Additional sensitivity testing of pit blockages and the joint probability of catchment flooding and storm surge have also been assessed, with negligible onsite impacts.
- The proposed activity complies with the relevant flood-related standards and requirements of Shoalhaven City Council and the NSW Floodplain Risk Management Manual, as outlined in Section 7.0 of this report.
- 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 Flood Certificate

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

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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: 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
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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,

Flood Certificate 227 Green St , ULLADULLA , LOT 1 DP 529425 , Land ID- 36019

KB Kate Britton <Kate.Britton@shoalhaven.nsw.gov.au>
To Laura Caldwell

Reply | Reply All | Forward
Thu 24/10/2024 9:20 AM

This sender Kate.Britton@shoalhaven.nsw.gov.au is from outside your organization.

Flood Certificate 227 Green St , ULLADULLA , LOT 1 DP 529425 , Land ID- 36019.pdf
936 KB

You don't often get email from kate.britton@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.

Thank you for your Flood Certificate request. The completed certificate is attached.

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

Regards,

Shoalhaven City Council

Kate Britton
Natural Resources GIS/Flood Modelling Assistant

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RESPECT | INTEGRITY | ADAPTABILITY | COLLABORATION

Shoalhaven City Council

Bridge Rd, Nowra NSW 2541 | **02 4429 3111**
Deering St, Ulladulla NSW 2539 | **02 4429 8999**
Address all correspondence to
The General Manager, PO Box 42, Nowra NSW 2541 Australia
council@shoalhaven.nsw.gov.au | DX5323 Nowra | Fax **02 4422 1816**
shoalhaven.nsw.gov.au

COUNCIL REFERENCE: 28112E (D24/454967)
DATE: 23 Oct 2024

Thank you for your recent inquiry in relation to flood data held by Shoalhaven City Council.

Please find below some general information on flooding, as well as the requested property specific Flood Certificate.

GENERAL FLOOD INFORMATION

Shoalhaven City Council in conjunction with the NSW State Emergency Service has produced site specific flood brochures for Shoalhaven Heads, Nowra / Bomaderry / Terara, Greenwell Point / Orient Point, St Georges Basin, and Sussex Inlet.

These site-specific FloodSafe brochures, as well as general FloodSafe brochures, can be accessed at the below link:

https://www.ses.nsw.gov.au/local-region-information/isr/flood-storm-and-tsunami-guides/

General Flood Information, such as "What to do before, during & after a flood", prepared by Emergency Management Australia is also available online at the below link:

http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf

FLOOD CERTIFICATE

According to the *Millards Creek Flood Study (2021)* this property, 227 Green St, ULLADULLA – LOT 1 DP 529425, Land ID – 36019, comprises Flood Prone Land. This property is located below the Flood Planning Level and is affected by the 1% AEP flood event.

FLOOD INFORMATION

Year	Existing	Projected 2050	Projected 2100
Flood Planning Level (m AHD)	Not Applicable	22.3**	22.3**
Hazard and Hydraulic Category*	High Hazard Floodway	High Hazard Floodway	High Hazard Floodway
Probable Max Flood Level (m AHD)	22.7	22.7	22.7
1% AEP Flood Level (m AHD)	22.0	22.0	22.0
2% AEP Flood Level (m AHD)	21.9	21.9	21.9
5% AEP Flood Level (m AHD)	21.7	21.7	21.7
10% AEP Flood Level (m AHD)	21.6	21.6	21.6
Velocity (1% AEP flood event) (m/s)	3.3	3.3	3.3

* Refer to Standard Considerations in this Flood Certificate for further details
** 1% AEP + 0.3m freeboard have been applied to determine the FPL in areas exposed to overland flooding

SITE SPECIFIC CONSIDERATIONS

1. Current NSW Government legislation requires climate change to be considered as part of this Floodplain Risk Management Study and Plan. Climate change related information evolves with time and it is expected that existing flood behaviour and levels may change in the future.

2. All applications for buildings, and the like, must take into account the projected 2050 flood information. All subdivision and other long-term planning must take into account the projected 2100 flood information.

3. Information provided in this flood certificate uses previous Council sea level rise benchmarks (230mm and 360mm for the 2050 and 2100 horizon's respectively). On 22 April 2024 Council resolved to update previous sea level rise projections to allow consistency with contemporary scientific data as represented by local tidal gauge data and the Intergovernmental Panel on Climate Change (IPCC). The current sea level rise projections for planning purposes are based on a 2030 horizon of 100mm, a 2050 horizon of 230mm and 2100 horizon of 850mm. The new benchmarks will be incorporated into the flood information in future. Until studies incorporating the new benchmarks are undertaken Council will continue to use the best available information.

4. During heavy rainfall events the property is, likely to be subject to significant overland sheet flow, as water cannot absorb quickly enough into the ground.

5. Other hazard and hydraulic categories may affect the property. For more specific information regarding the different hazard and hydraulic categorisations affecting this property please refer to Map 1 and Map 2 below or contact Council on 1300 293 111.

6. The flood information provided is the highest value within the property taken at the southern property boundary. Due to the site topography, lower flood levels will occur towards the northern side of the property.

Map 1: Hazard and Hydraulic Categories for the Projected 2050 Scenario

Map 2: Hazard and Hydraulic Categories for the Projected 2100 Scenario

STANDARD CONSIDERATIONS

Properties below the Flood Planning Level:

Council considers the land in question to be below the Flood Planning Level and therefore subject to flood related development controls. The conditions as set out below will reduce flood risk in flood events up to the Flood Planning Level, however the property may still be subject to flooding at higher levels during rare flood events.

Development controls apply to flood affected properties.

Development conditions will vary depending on flood hazard, hydraulic category as well as the type of development that is proposed. Please refer to the following documents for information on Council's flood related development controls and the NSW State Government's Flood Prone Land Policy. For properties that comprise multiple hazard and hydraulic categories, the development conditions will apply for the highest category that exists within the development footprint.

- Shoalhaven Development Control Plan – Chapter 9: Development on Flood Prone Land http://dcp2014.shoalhaven.nsw.gov.au/main-category/whole-document
- Flood Risk Management Manual 2023: Flood Risk Management Manual | NSW Environment and Heritage

DISCLAIMER

Your enquiry relating to the likelihood of the land specified in the application being flooded has been referred to the Council's Floodplain Engineer.

In responding to your application, the Council seeks to bring to your attention the fact that pursuant to s.733 of the Local Government Act a council does not incur liability in respect of the giving of any advice furnished in good faith by the Council relating to the likelihood of any land being flooded or the nature or extent of any such flooding.

The Council does not have a legal obligation to provide advice to you and to the extent that this reply is giving advice, the Council provides that advice in good faith with the intention of preserving, so far as is legally possible, the Council's immunity from liability pursuant to s.733 of the Local Government Act.

While all reasonable care has been taken to ensure the accuracy of the information given in this reply, its purpose is to provide a general indication of flood risk in the area. Flood lines shown on Council maps indicate the approximate extent of flooding only in relation to the abovementioned land.

The information provided may contain errors or omissions and the accuracy may not suit the purposes of all users. A site survey and further investigation are strongly recommended before commencement of any project based on this data.

The information given is the most current information at the time of the request. It is to be noted, however, that flood information is constantly reviewed and updated and as such, the information contained in this regard is current only on the day of issue.

Before acting upon the information provided in this reply, the Council urges you to obtain separate and independent advice as Council, in giving this information, does not intend it to be relied upon in such a fashion as to impose liability upon the Council.

Should you not be prepared to accept the information contained in this reply upon that basis then you should immediately notify Council.

GLOSSARY

AEP (Annual Exceedance Probability) means the chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage – for example a 1% AEP flood event has a 1% chance of occurring in any one calendar year.

AHD (Australian Height Datum) is a common national surface level datum corresponding approximately to mean sea level.

Flood Fringe is the part of the floodplain remaining after the floodway and flood storage areas have been defined.

Flood Planning Area is any land identified as being flood affected in the 1% AEP flood event plus freeboard.

Flood Planning Level (FPL) is the 1% AEP flood level plus freeboard. The FPL is used for planning purposes, as determined in Floodplain Risk Management Studies and incorporated in Floodplain Risk Management Plans.

Flood Prone Land means any land susceptible to flooding up to the Probable Maximum Flood event (that is, land within the floodplain) as identified in an adopted Council Flood Study or Floodplain Risk Management Study and Plan.

Flood Storage areas are those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood.

Flood Study is a technical investigation of flood behaviour. It defines the nature of flood risk by establishing the extent, level and velocity of floodwaters. The study also provides information on the distribution of flood flows across various sections of the flood plain for the full range of flood events up to and including the PMF.

Floodplain Risk Management Plan is a plan developed in accordance with the principles and guidelines contained in the NSW Government Floodplain Management Manual. Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives.

Floodplain Risk Management Study is a study that identifies and compares various risk management options. This includes an assessment of their social, economic, ecological and cultural impacts, together with opportunities to maintain and enhance river and floodplain environments.

Floodway means those parts of the floodplain where a significant discharge of water occurs during floods. They are often aligned with natural defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.

Freeboard is currently 0.5m for riverine flooding for all catchments in the Shoalhaven LGA. Freeboard is a factor of safety used to set the FPL (i.e. FPL = 1% AEP flood level plus freeboard (0.5m)). Freeboard takes into account uncertainties in flood modelling and climate change predictions, local factors that cannot be included in the flood model or wave action caused by wind, boats or vehicles driving through flood waters.

Hazard Category represents the risk or danger to personal safety, evacuation movements and buildings and structures within the Flood Planning Area during the 1% AEP flood. There are only two possible hazard categories – high or low.

Hydraulic Category describes the function of a specific part of the Flood Planning Area in conveying flood waters during a 1% AEP flood. There are three possible hydraulic categories – floodway, flood storage or flood fringe.

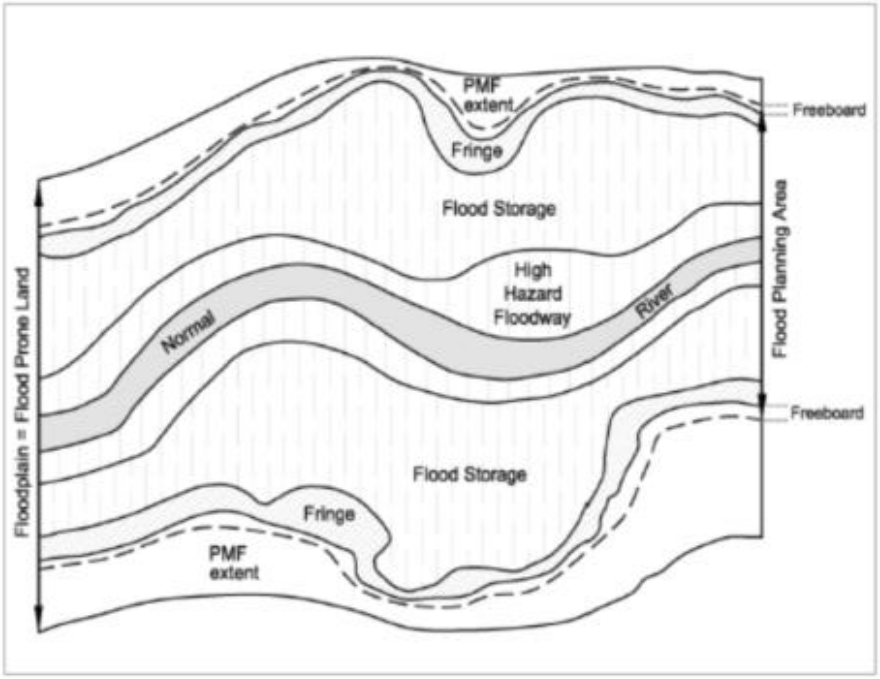


Figure: Floodplain Aerial View

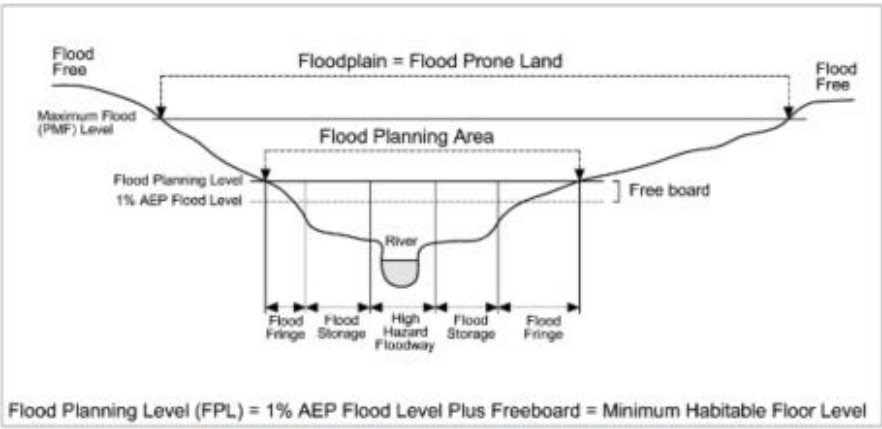
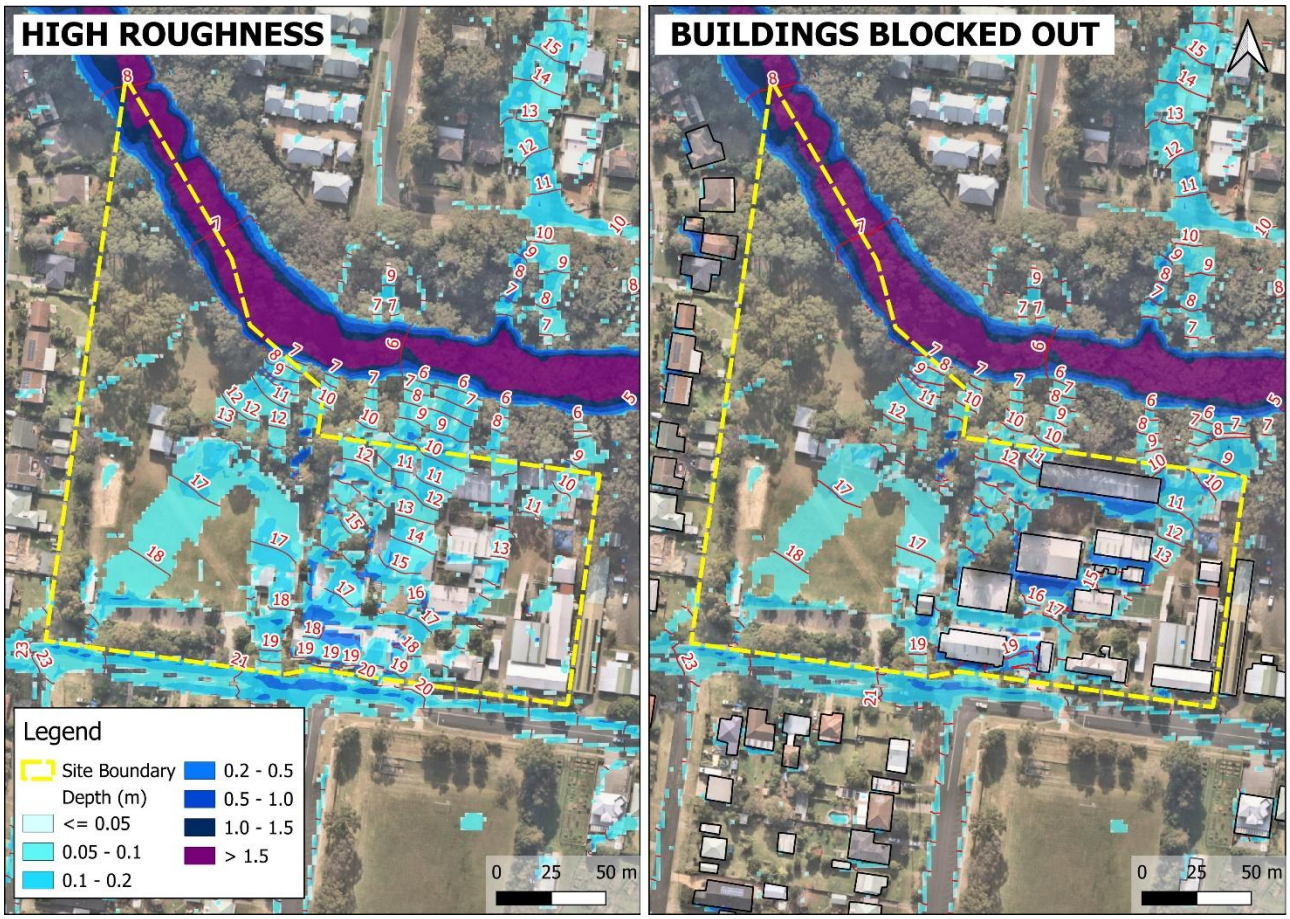


Figure: Cross Section through Floodplain

Probable Maximum Flood (PMF) is 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.

Provisional is used for hazard categories that have been determined in a Flood Study. Hazard categories are provisional until the Floodplain Risk Management Study and Plan has been completed and adopted by Council, as this document considers additions risks, not considered during the Flood Study.

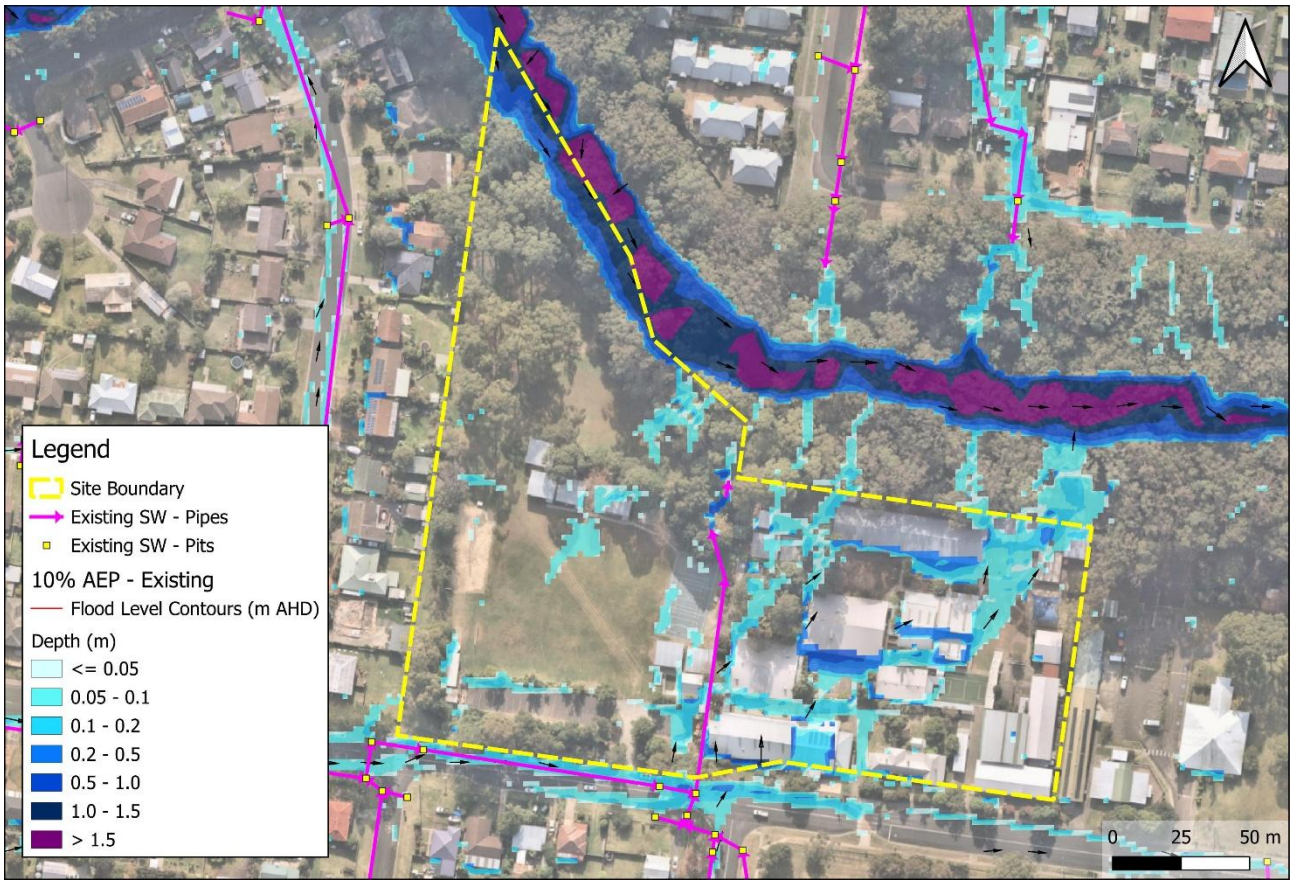
Appendix B – Building Representation



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

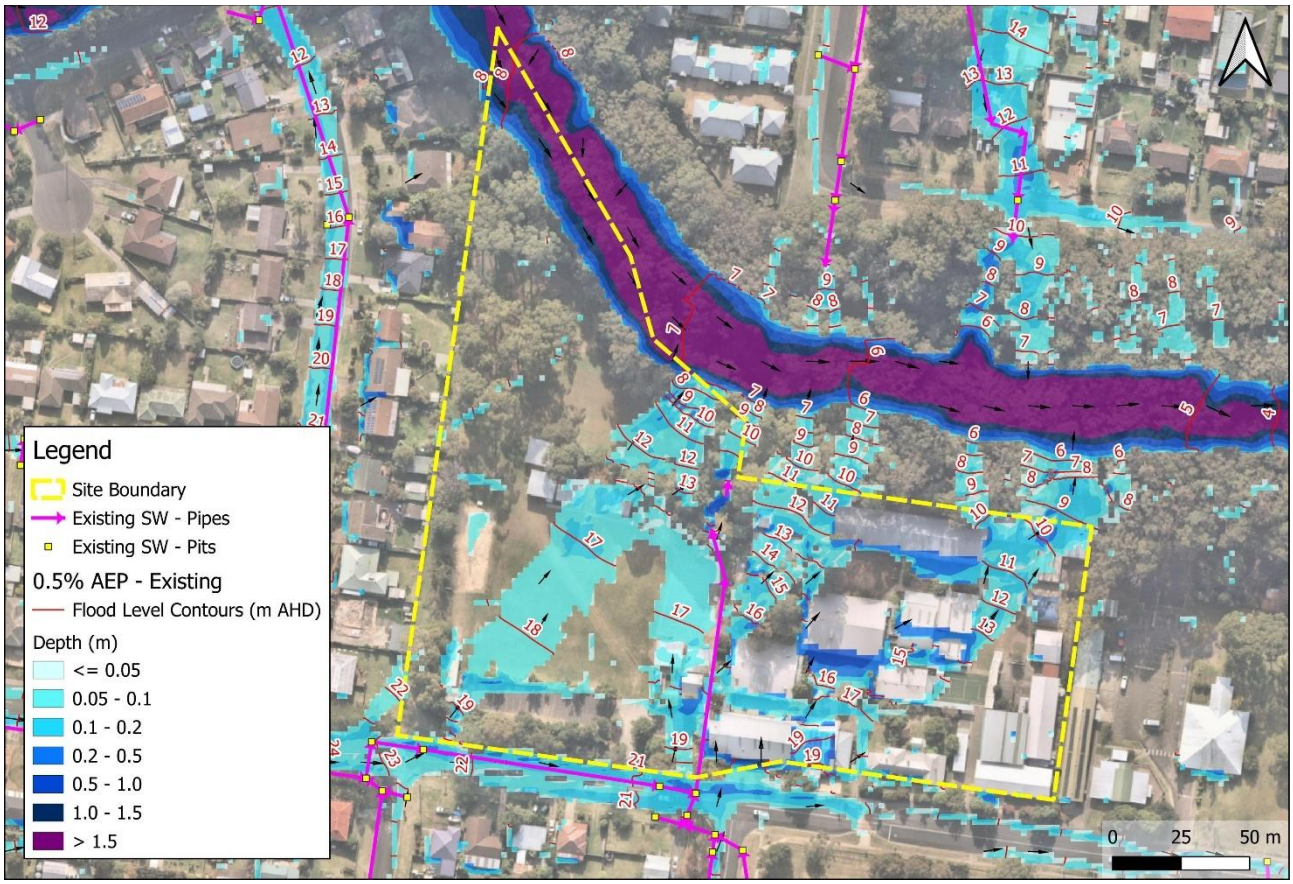


Appendix C 1: 10% AEP flood depths and levels at Ulladulla Public School under existing conditions

Appendix C 2: 10% AEP flood velocities at Ulladulla Public School under existing conditions

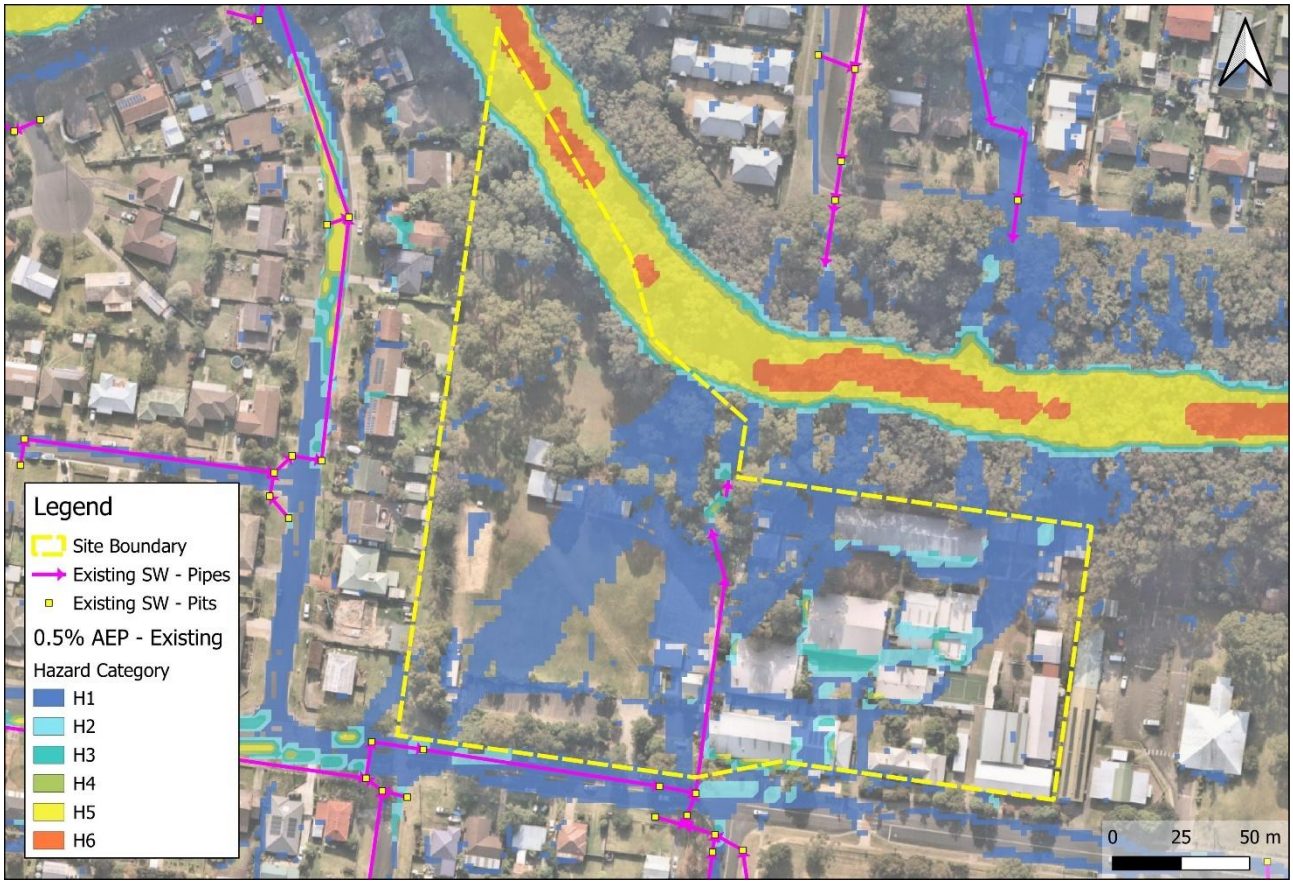
Appendix C 3: 10% AEP flood hazard levels at Ulladulla Public School under existing conditions

0.5% AEP Event



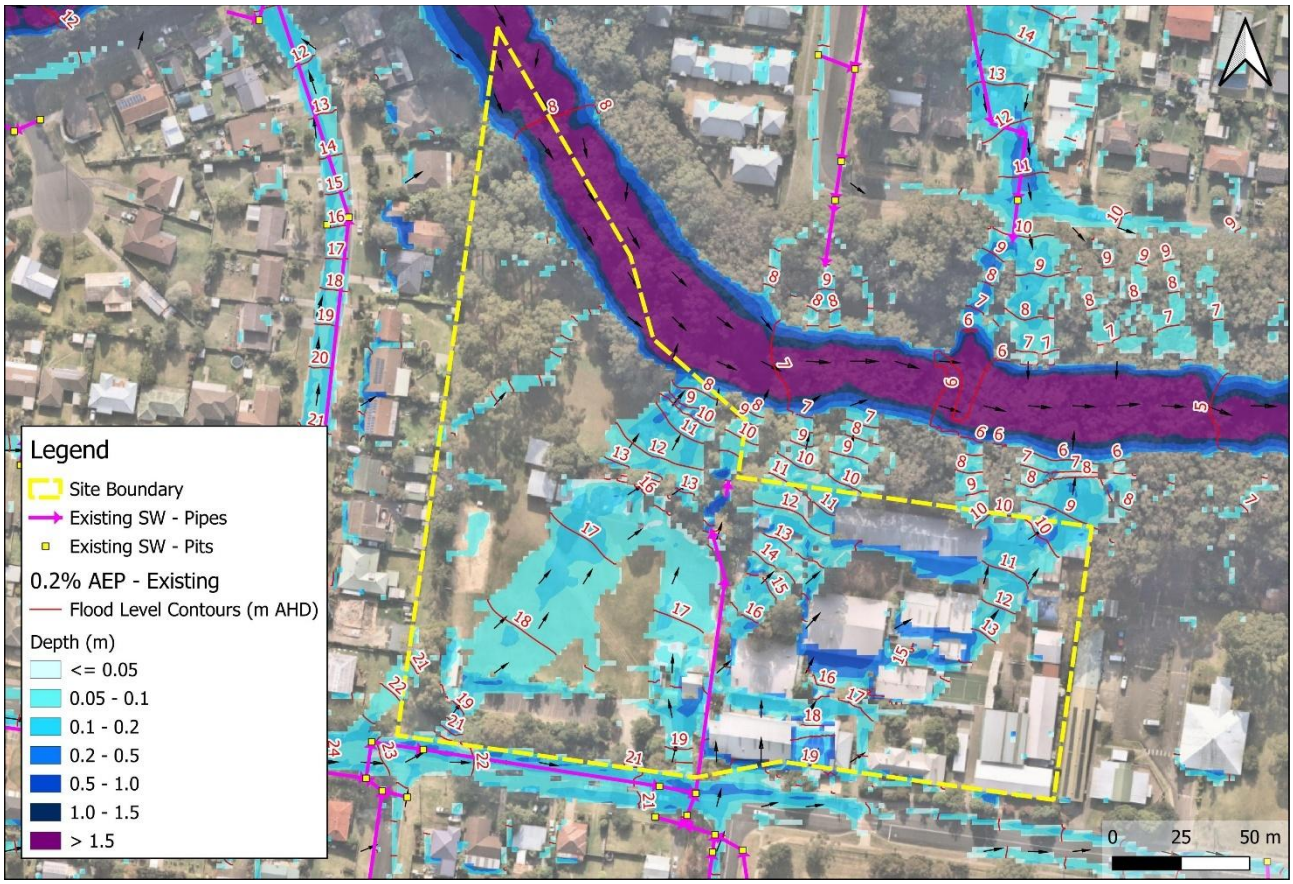
Appendix C 4: 0.5% AEP flood depths and levels at Ulladulla Public School under existing conditions

Appendix C 5: 0.5% AEP flood velocities at Ulladulla Public School under existing conditions



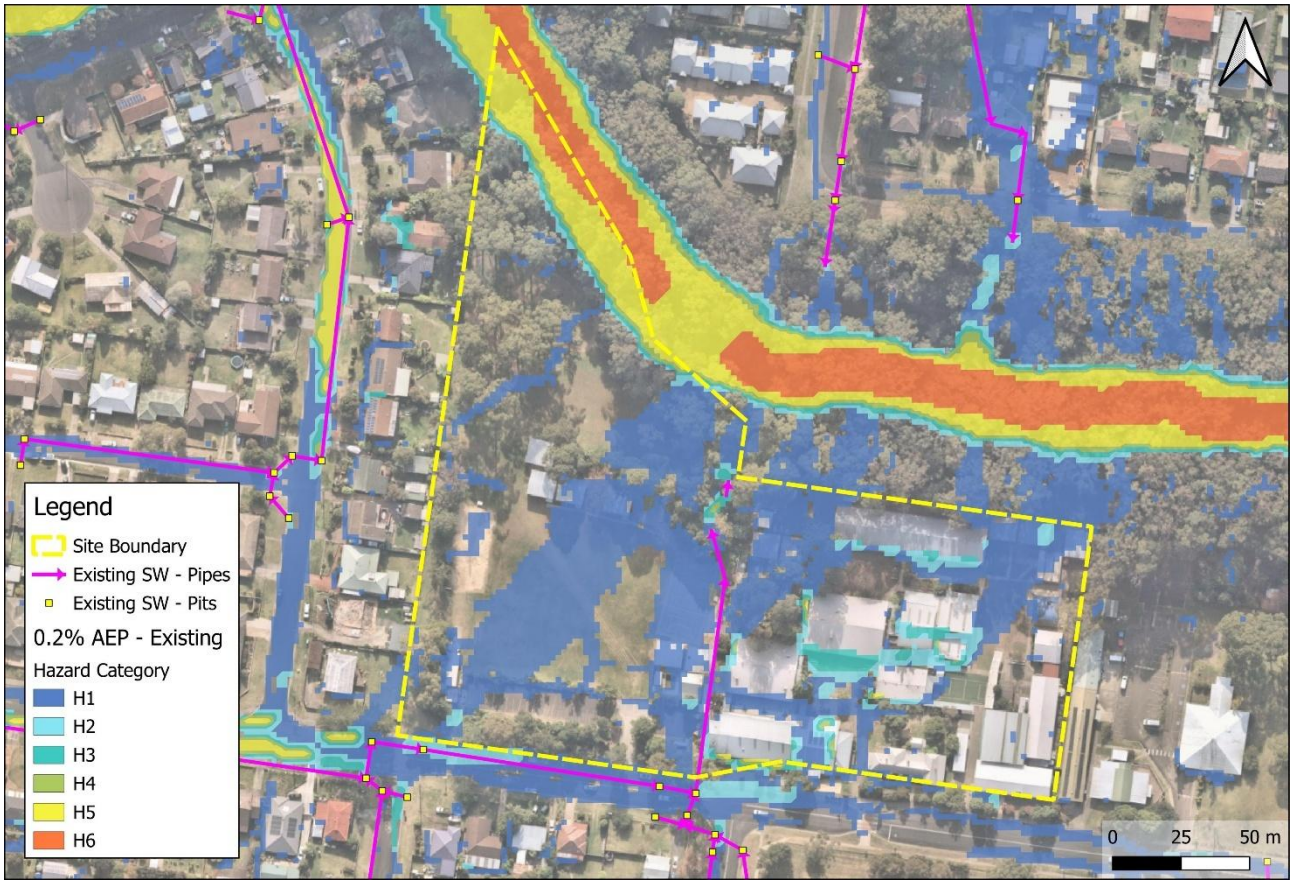
Appendix C 6: 0.5% AEP flood hazard levels at Ulladulla Public School under existing conditions

0.2% AEP Event



Appendix C 7: 0.2% AEP flood depths and levels at Ulladulla Public School under existing conditions

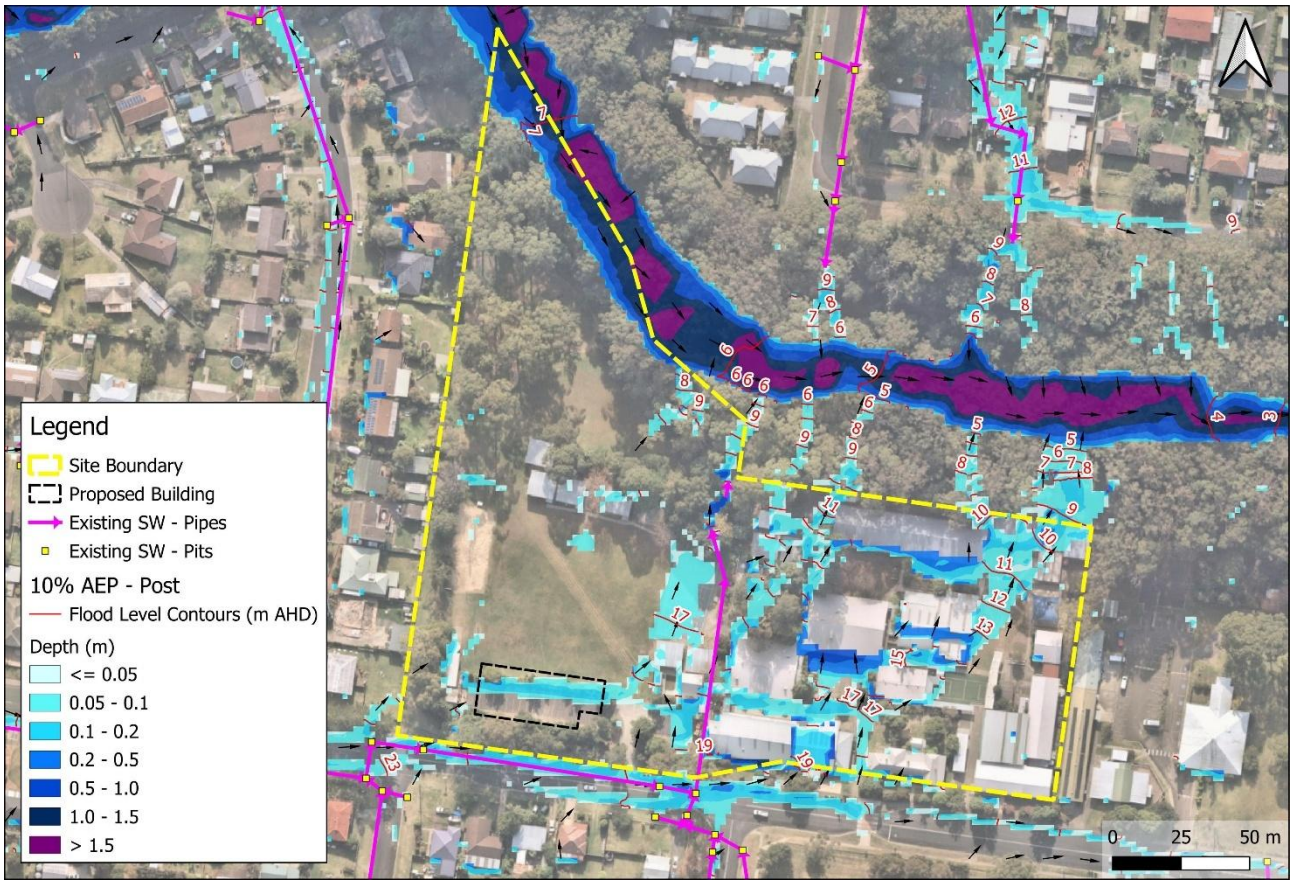
Appendix C 8: 0.2% AEP flood velocities at Ulladulla Public School under existing conditions



Appendix C 9: 0.2% AEP flood hazard levels at Ulladulla Public School under existing conditions

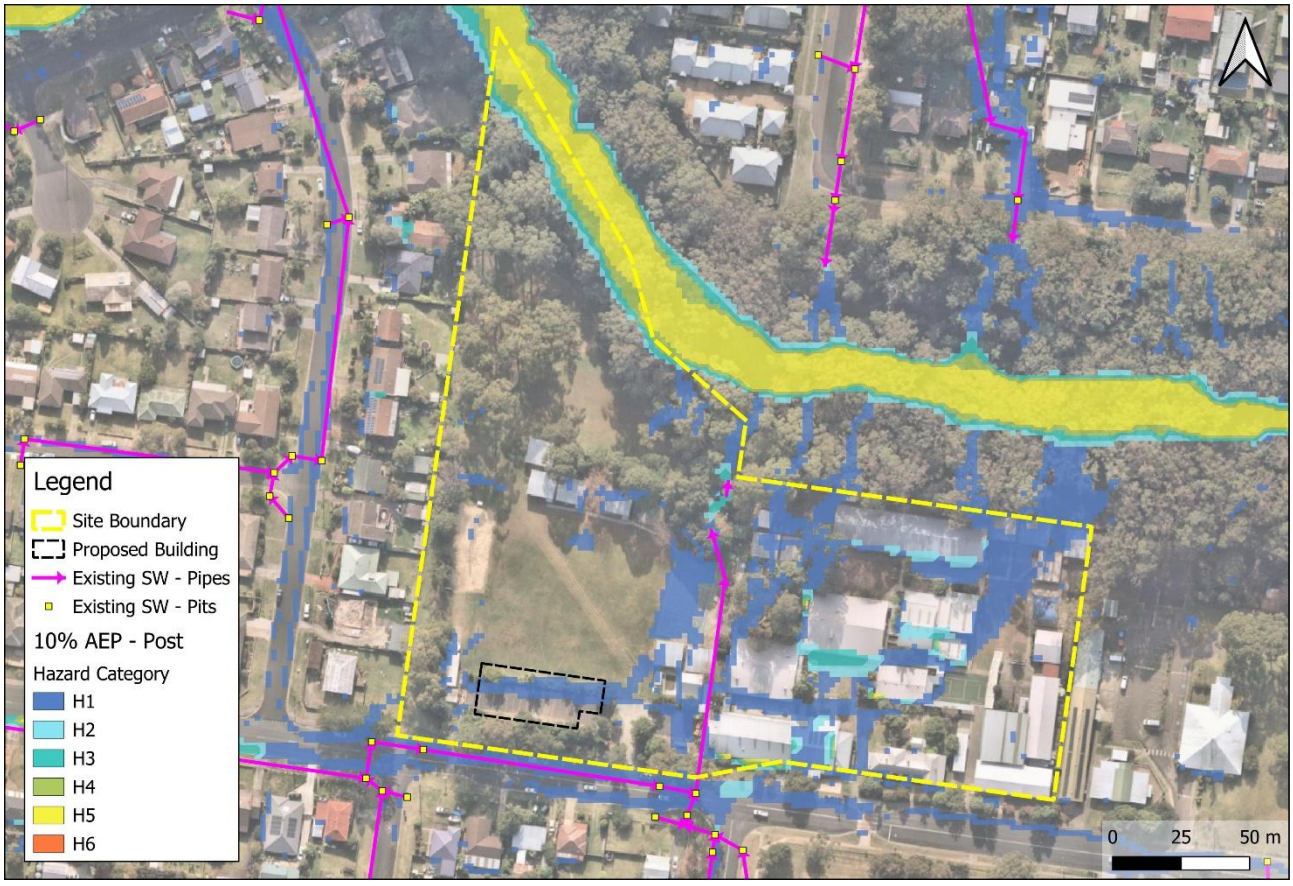
Appendix D – Additional Post-construction Scenario Maps

10% AEP Event



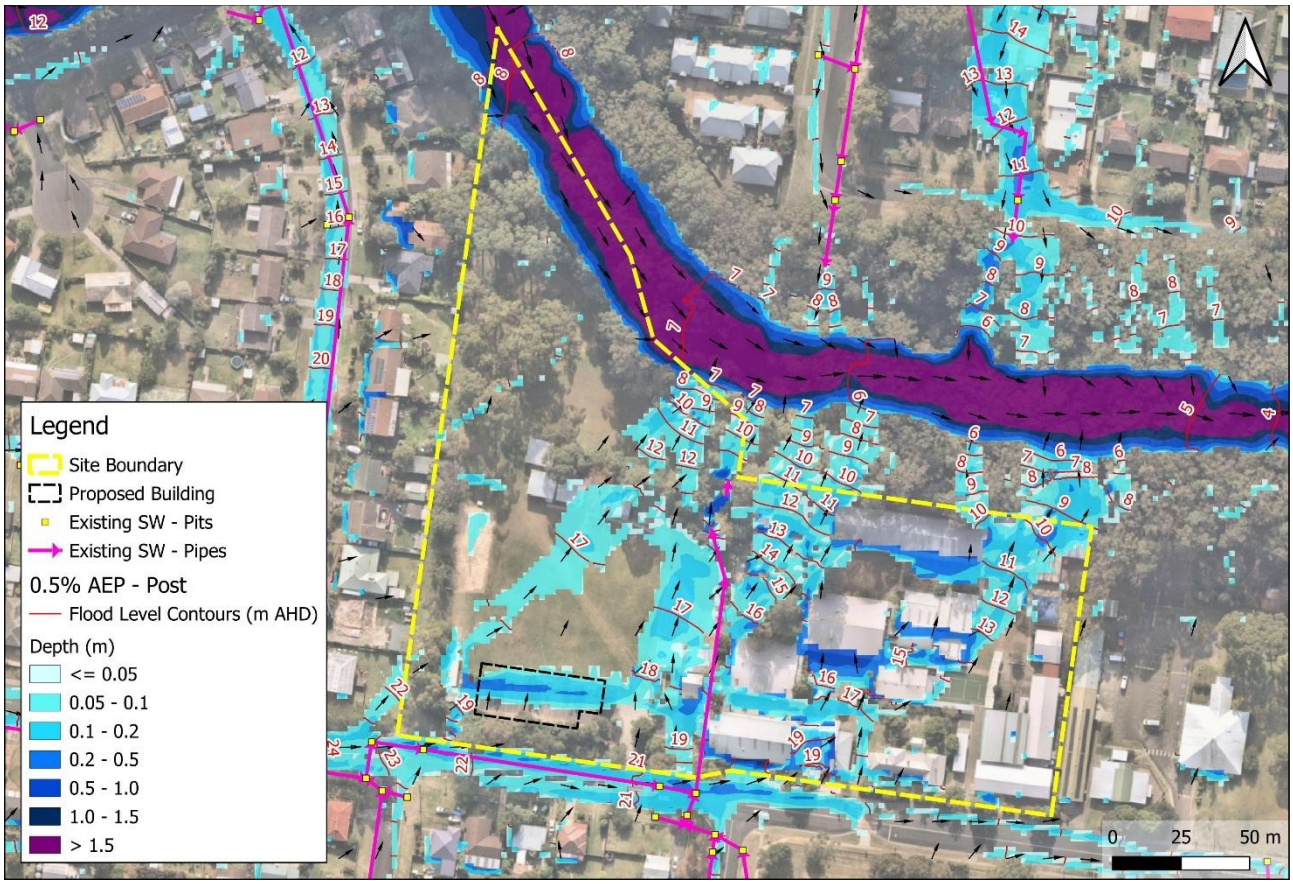
Appendix D 1: 10% AEP flood depths and levels at Ulladulla Public School under post-construction conditions

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



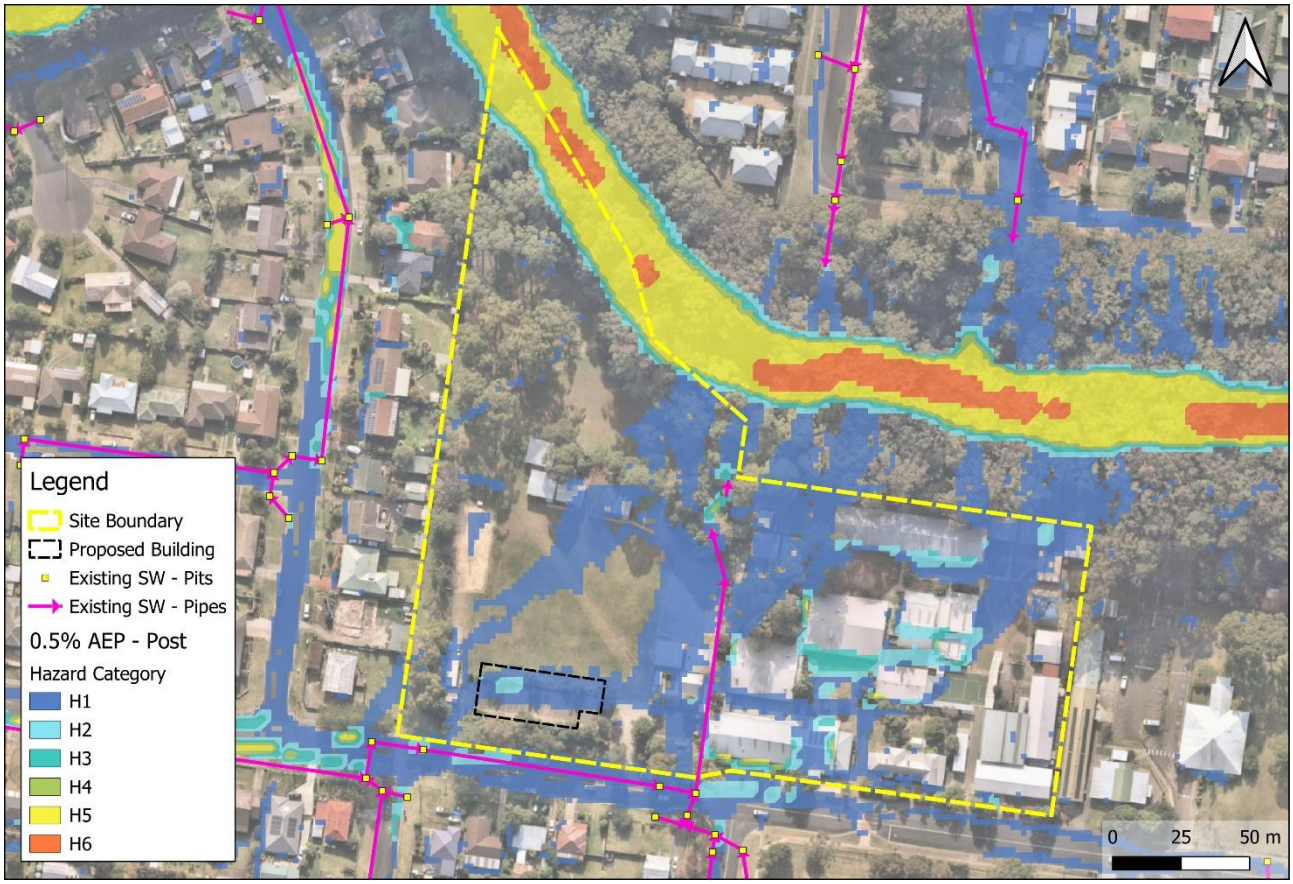
Appendix D 3: 10% AEP flood hazard levels at Ulladulla Public School under post-construction conditions

0.5% AEP Event



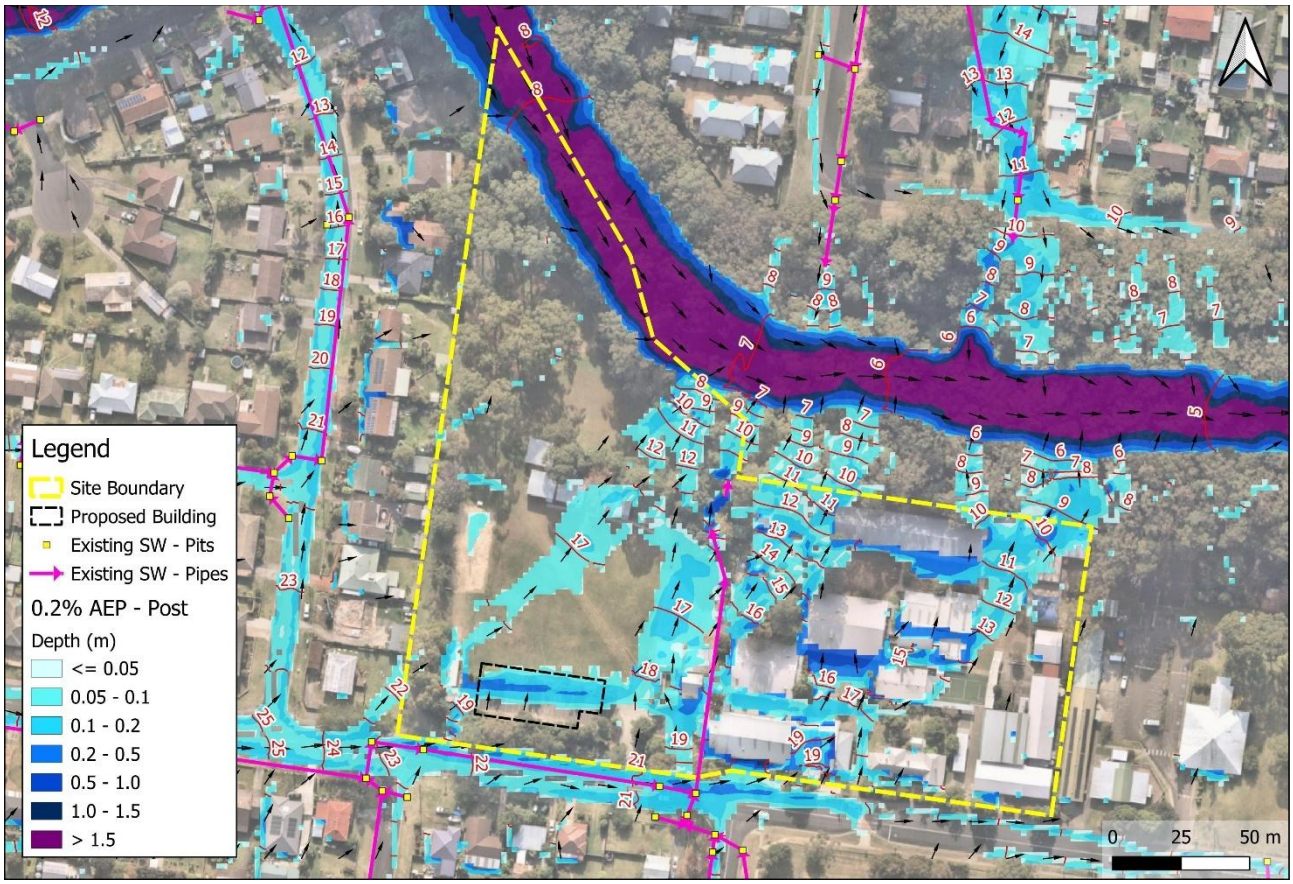
Appendix D 4: 0.5% AEP flood depths and levels at Ulladulla Public School under post-construction conditions

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



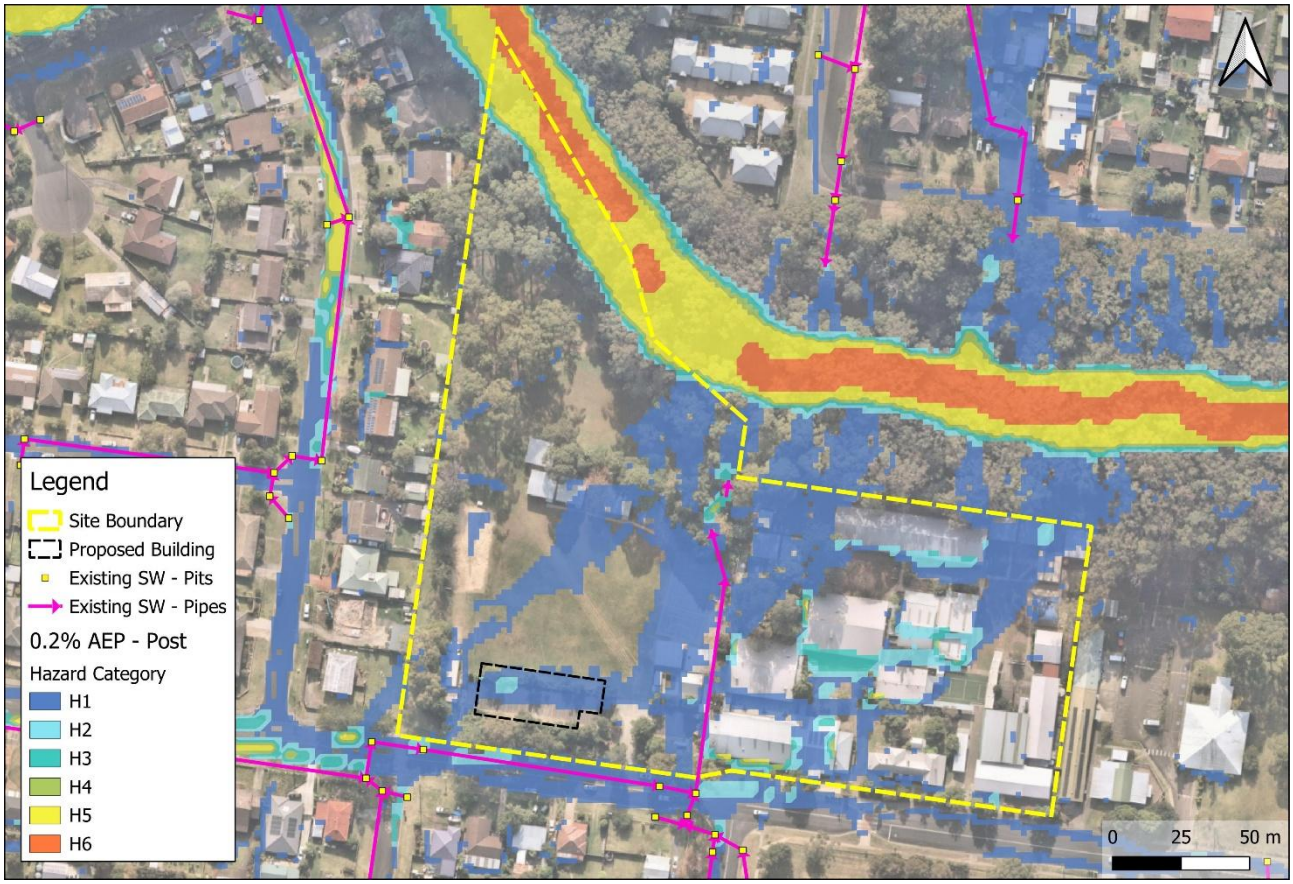
Appendix D 6: 0.5% AEP flood hazard levels at Ulladulla Public School under post-construction conditions

0.2% AEP Event



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

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



Appendix D 9: 0.2% AEP flood hazard levels at Ulladulla Public School under post-construction conditions