TTW Structural Civil Traffic Façade

Flood Emergency Response Plan

Ulladulla High School Upgrade

Prepared for NSW Department of Education / 5 June 2025

232045

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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
5	30/05/2025	LC	EC	Response to comments
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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

1.0 Introduction

This Flood Emergency Response Plan (FERP) 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 outline the flood behaviour at the site, including the time to inundation and recession over key access roads, and to determine the most appropriate emergency response strategy for the proposed building. 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
- 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 Planning and Environment (2023) Support for Emergency Management Guideline, Flood Risk Management Guideline EM01 (https://www.environment.nsw.gov.au/research-and-publications/publications-search/support-for-emergency-management-planning)
- NSW Department of Planning and Environment (2025) Shelter-in-place guideline for flash flooding (https://pp.planningportal.nsw.gov.au/draftplans/made-and-finalised/shelter-place-guideline-flash-flooding);
- NSW Department of Planning, Housing and Infrastructure – Planning Circular PS 24-001, Update on addressing flood risk in planning decisions, 1st March 2024
- NSW Environment and Heritage (2021) Millards Creek – Physical data (https://www.environment.nsw.gov.au/topics/water/estuaries/estuaries-of-nsw/millards-creek)
- 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
- TTW (2025) Flood Impact and Risk Assessment, dated 5 June 2025.

2.0 NSW SES Comments

Following the public exhibition phase, NSW SES provided comments for consideration on 13 May 2025. A direct response to flood planning matters raised by NSW SES has been provided within Table 1.

Table 1: Response to NSW SES Comments

Item	NSW SES Comment/Submission	TTW Response
Existing flood risk		
1.1	It is understood that the site is not affected by mainstream flooding from Millards Creek, however, it is impacted by overland flooding. There is a gully onsite from a first-order stream, which is conveyed under St Vincent Street into Millards Creek via a culverted pipe system at its downstream extent.	Millards Creek Flood Study Model adopts a "direct rainfall' or "rainfall on grid" (ROG) hydrology approach, in which rainfall is applied to each active cell in the 2D mesh. Hydrologic losses and runoff are therefore calculated for each cell and routed through downstream cells to evaluate flood depths and velocities. As a result, the ROG method is typically associated with substantial shallow sheet flow, a large portion of which is generated within the site itself, as opposed to offsite.
1.2	The site is affected by overland flows when South Street's stormwater system exceeds capacity, as frequently as the 10% Annual Exceedance Probability (AEP) events. Flows within the gully, that crosses the northeastern part of the site, are regarded as a floodway and can reach up to 1.1 metres depth in the 1% AEP event, and 1.65 metres in a Probable Maximum Flood (PMF).	The majority of flows in the 10% and 1% AEP event are generated within the site itself and are not sourced from offsite – as shown in Figure 9 and Appendix C1 of TTW's FIRA report, flows within both Camden Street and St Vincent Street do not overtop into the site. Minor overflows from South Street are below 50mm in the 10% AEP event and are considered shallow sheet flows. In this instance, this is an internal stormwater management issue rather than a flood concern. It should also be noted that TTW's flood modelling did not involve incorporating any additional internal stormwater network across the site, nor any proposed stormwater infrastructure from Meinhardt's design. It consequently represents a conservative estimation of overland flows and ponding onsite.
1.3	"*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*", with a flood hazard level up to H5 around the existing buildings in events as frequent as the 10% AEP. A H5 hazard level is unsafe for vehicles and people, and all buildings are vulnerable to structural damage. Some less robust building types are vulnerable to failure.	As presented in Appendix C3 of TTW's FIRA report, the majority of flows across the site in the 10% AEP event are low hazard (H1-H2). The isolated areas of H5 hazard flows can be attributed to the rainfall on grid methodology and the ponding around the buildings, which would in reality be

	We note however, that the proposed new building itself is outside the 1% AEP flood extent.	managed by the internal stormwater network in the 10% AEP event.
1.4	In a PMF event flooding further encroaches onto the site, including at the location of the proposed building with flood depths 0.2 metres here; however, parts of the broader site, including areas east and south of the proposed new building can see flood depths up to 1- 1.5 metres and H5 hazard level.	This summary is correct.
Proposed development		
2.1	It is understood that the proposed activity includes terracing, with a sunken landscaped area immediately south of the building, and a wall surrounding the southwest of the proposed building. Between the wall and the building, a swale has been incorporated into the civil design along the western border of the building to limit ponding and direct any flows from the southwest of the sunken landscaped area to the north of the building.	This summary is correct.
2.2	The new building's ground floor levels are set at 29.5 m AHD, with flood levels along the verandah (at the southern side of the building) close to 29.6m AHD in a PMF, which could result in minor over-floor flooding. In post-development conditions, "*the extent of overland flows surrounding the proposed building footprint has increased, owing to the sunken landscaped garden. Depths within this sunken garden reaches a maximum of 350mm in the 1% AEP event, and 500mm in the PMF event*." While site grading directs flows away from the proposed building, preventing flood water from reaching the building openings in the 1% AEP event, we note that the areas at the entry to the stairways and ramps leading up to the building are at a lower level (for example the ground level for the stairs and ramp in the southeastern corner of the building is at 28.65m AHD), which could result in people getting isolated within the new building during flooding events.	This summary is correct – site grading prevents excess runoff reaching building openings. Flows over the ramps are low hazard (H1-H2), which are regarded as safe for people and children. However, the emergency response strategy for the proposed building is either to pre-emptively close the school, or to shelter in place with no outdoor access, ensuring staff and students are away from any floodwaters. Section 5.3 of this FERP provides an assessment of the maximum period of isolation.
2.3	We also note there is an increase in the extent of the H5 hazard level impacted area between the proposed building (southeastern corner) and building M in a post-development PMF scenario. Also, the flood assessment considered flooding impacts on the surrounding buildings (limited to buildings L, M and Q) and notes that existing floor levels of these blocks are already prone to inundation during the 1% and/or PMF events, with modelling showing increases up to 75mm at building Q, which even in existing conditions is subject to over 1 metre of over floor flooding in a PMF event.	It should be noted that H5 hazard already existed at this building (Building M), and so the minor increase in high hazard flows does not change the existing emergency response for that building.

Access/egress – emergency management considerations		
3.1	The proposed new building (located at the western part of the site) appears to be cut from vehicular access even in fairly frequent events (such as the 10% AEP) due to flooding within the site (between the buildings) of H2 – H5 hazard level, and the vehicular access points being on the opposite side (eastern part of the site), on St Vincent Street. In a 10% AEP event there is also flooding up to 0.5 metres in areas around the base of the proposed stairs, ramps and lift of the proposed building.	"Flooding" between the buildings in the 10% AEP event can be attributed to the rainfall on grid modelling approach adopted, which applies rainfall to every active cell. Excess runoff generated within the site would be managed via the internal stormwater infrastructure. There is flood free access to the vehicular entry from the proposed building in the 10% AEP event. In the 10% AEP event, flows reach a maximum depth of 220mm in the sunken gardens (not 500mm). However, this is a conservative estimation of depths given that the proposed stormwater infrastructure has not been modelled.
3.2	"*Flows typically inundate the surrounding access roads rapidly, cutting off portions of St Vincent Street (at the crossing over Millards Creek) and the western extent of Green Street within 15–45 minutes*." In a PMF event, the entire site appears to be isolated with flooding on surrounding roads peaking at H5 hazard level and a duration of isolation up to 5 hours and 15 minutes for the longer duration events, however noting that isolation time would be reduced for shorter duration events.	As discussed in Section 5.3 of this FERP report, the maximum period of isolation is 1 hour 45 minutes. Access via St Vincent Street may be cut off for up to 5 hours 15 minutes in longer duration events, but alternative access to the site is possible via Camden Street. Pre-emptive closure of the school is the preferred flood emergency strategy for the school site where advanced warning of a major storm event is forecast. However, shelter-in-place (SIP) guidance published by the NSW Department of Planning, Housing and Infrastructure (DPHI) in January 2025 states that SIP is an appropriate emergency management response when the flood warning time and flood duration are both **less than six hours**.
3.3	"*Both the Milton-Ulladulla hospital and the Ulladulla Fire Station are located north of Millards Creek, with implications for site access during significant flood events given the impact to St Vincent Street Bridge in events as frequent as 2-5% AEP*." The Princes Highway bridge over Millards Creek also gets cut in rarer events, between 0.5% AEP – 0.2% AEP. In a 1% AEP event, the northern part of St Vincent Street (north of its intersection with Green Street) becomes a high hazard floodway. In a PMF event, flooding north and east of the site, along Green Street and St Vincent Street, including at their intersection, is categorised as a floodway.	As detailed within the FERP, the proposed development does not require private flood evacuation plans. Where there is enough warning prior to school opening hours, the school should be closed in advance of the flood event so children and staff can remain safe at home and parents do not have to drive through roads that could become hazardous due to flooding (outlined in Section 6.1 of this FERP). This approach is supported by NSW SES. Where there is not enough warning time, the secondary response is to shelter-in-

	The FERP proposes an alternative route that is, however, "*not flood-free, is cut off by high hazard flows in the PMF event, and should only be used by emergency personnel in the event of a secondary emergency*." We would like to emphasise that development proposals should not rely on emergency management strategies that would put emergency services personnel at risk (e.g. to traverse high hazard flows) to respond to such events.	place. The route presented in Section 5.3 of this FERP is for use in secondary emergencies only (e.g. a medical emergency or a coincident event, including a fire).
3.4	It is understood that the Flood Emergency Response Plan (FERP) proposes pre-emptive closure of the site when advanced notice of extreme rainfall is available ahead of the school day, and the shelter-in-place strategy in the event of flooding during school hours. Noting that the areas adjacent to the proposed development site (to its southeast), the broader site and the surrounding roadways are subject to high hazard flooding (including floodways and high hazard areas), we recommend ensuring consistency with the Shelter in Place Guideline for Flash Flooding.	The SIP Guideline notes that the development must not be subject to high hazard flooding (e.g. floodways, high hazard H5 or H6 areas), and surrounding roadways should not be subject to high hazard flooding. While a portion of the roads adjacent to the site are subject to high hazard floodwaters (St Vincent Street in particular), it is deemed more hazardous to attempt to evacuate the site once a severe storm event has already commenced, as this would involve moving vulnerable site users from safe refuge into roads of high hazard.
3.5	In summary, we note that movement within the site, even in existing conditions, is significantly constrained during flooding events due to the existing buildings obstructing overland flows, resulting in flooding H2 – H5 flood hazard level between the buildings at the site in events as frequent as 10% AEP, which impacts on people's ability to evacuate. We recommend considering the suitability to further develop this site in its current flood risk context, particularly considering the sensitive uses of the site.	Flooding" between the buildings in the 10% AEP event can be attributed to the rainfall on grid modelling approach adopted, which applies rainfall to every active cell. In reality, excess runoff generated within the site would be managed via the internal stormwater infrastructure. There is flood free access to the vehicular entry from the proposed building in the 10% AEP event. TTW emphasise that the site is not subject to major flooding. The primary risk to the site is excess stormwater runoff.
3.6	The flood impact assessment suggests "*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*". We would like to emphasise that pedestrian evacuation is not appropriate primary flood risk management strategy. However, while noting the flooding constrains within the site, we recommend investigating site design and stormwater management options that could enable safe evacuation off-site, such as considering vehicular access via the proposed flood-free access onto Camden Road and mitigation measures to provide a safe access/egress route within the site. Also,	As detailed in Section 6.1 of TTW's FERP, pre-emptive closure of the school is the preferred flood emergency strategy for the school site where advanced warning of a major storm event is forecast. Where there is not enough warning time, the secondary response is to shelter-in-place (Section 6.2).

	consideration of the impact of flooding on the roadways should go beyond the area immediately adjacent to the site fully understand the isolation risks and evacuation constraints.	
Recommendations and requests		
4.1	We request further information on the expected population increase (if any) at the site (students and staff) following the upgrades, and recommend considering cumulative impacts of this proposal on risk to life, the existing and future community, and emergency service resources in the future, particularly noting that the high school is adjacent to other sensitive uses sites - Ulladulla Public School and an early education centre.	There is no proposed increase in student population following the upgrades. The proposed building is situated within a lower risk area within the overall site, and ultimately provides a safer space than the existing buildings, reducing risk to life.
4.2	Recommend considering that if the new building is not intended to be evacuated, the building must be located with floor levels above the PMF level, noting that the proposed design levels are below the PMF.	Note that the adopted emergency response strategy is pre-emptive closure of the site before the onset of the storm. Where this is not possible, the secondary response is to shelter-in-place. As discussed in Section 8.3.2 of TTW's FIRA report, the model limitations (including the 2m x 2m grid size) result in an underestimation of flood storage and provides a conservative indication of flood levels. In reality, the proposed building is believed to have very low risk of any above-floor flows, including during the PMF.
4.3	Recommend investigating site design and stormwater management options to reduce risk to life at the site, particularly considering the flash flooding risk and sensitive uses of the site. Any improvements that can be made will benefit the community.	The risk to life has been reduced by providing additional space above the PMF – the existing buildings onsite are not all suitable for shelter-in-place.
4.4	Recommend consulting with the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) regarding the impact of the proposed development on flood behaviour at the site and adjacent areas, particularly considering the flash flooding environment and obstructed overland flows.	TTW have consulted with Council on their requirements. There is no impact on adjacent areas, as discussed in Section 12 of TTW's FIRA report.
4.5	Recommend ensuring people at the site (including staff, students, parents/carers and workers - during the construction phase) are made aware and kept updated in relation to the flood risk for the lifespan of the development.	This is included in this FERP – see Section 9.0.
4.6	Recommend reviewing and updating the school's Emergency Management and Evacuation Plan specific to a flood emergency event and align with the above considerations / advice provided herein.	This has been included in Section 12.0 of TTW's updated FERP report.

4.7	In relation to the Flood Emergency Response Plan (FERP), we support, as the primary flood emergency management strategy, pre-emptive closure of the school site prior to the start of the school day if there is an expectation of flooding. The most appropriate form of advice for flash flooding environments are Severe Weather/Severe Thunderstorm Warnings.	The NSW SES severe weather warnings are included in Section 7.2 of this FERP.
4.8	We note flood warnings are not issued for Ulladulla by BoM and therefore flood warnings are not likely to be issued by the NSW SES. In addition, there are no formal flash flooding warning systems available for this area, therefore it is unlikely to have any prediction of "flood heights and timings" or any confirmation of "flooding event being anticipated/not anticipated" (page 23) at the site. Neither the NSW SES nor the Bureau of Meteorology can undertake to provide special individual flood warning or advice services for each business site, particularly during operational events when resources are in high demand.	This is noted.
4.9	We note that the Flood Warning products currently available under the AWS being issued by the NSW SES are for riverine flooding events.	The NSW SES severe weather warnings are included in Section 7.2 of this FERP.
4.10	We note that "flash flooding is reported in the media / via visual observation" is an indication that flooding has already occurred, and dangerous conditions could already be present at the site and surrounding roads, which is too late to implement as a trigger for taking protective action. The aim of warning triggers is to enable people to take action and move to safety prior to the onset of flooding, before they are exposed to hazardous conditions	Visual observation intended as a last resort where there is no pre-warning. In some cases this will represent the earliest opportunity to trigger SIP actions. Note that this refers to visual observation of flows over adjacent roads or across the wider site before they reach the new building. Flows at proposed building are only ever low H1-H2 hazard, which are not regarded as dangerous conditions.

3.0 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)

4.0 Proposed Activity Description

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

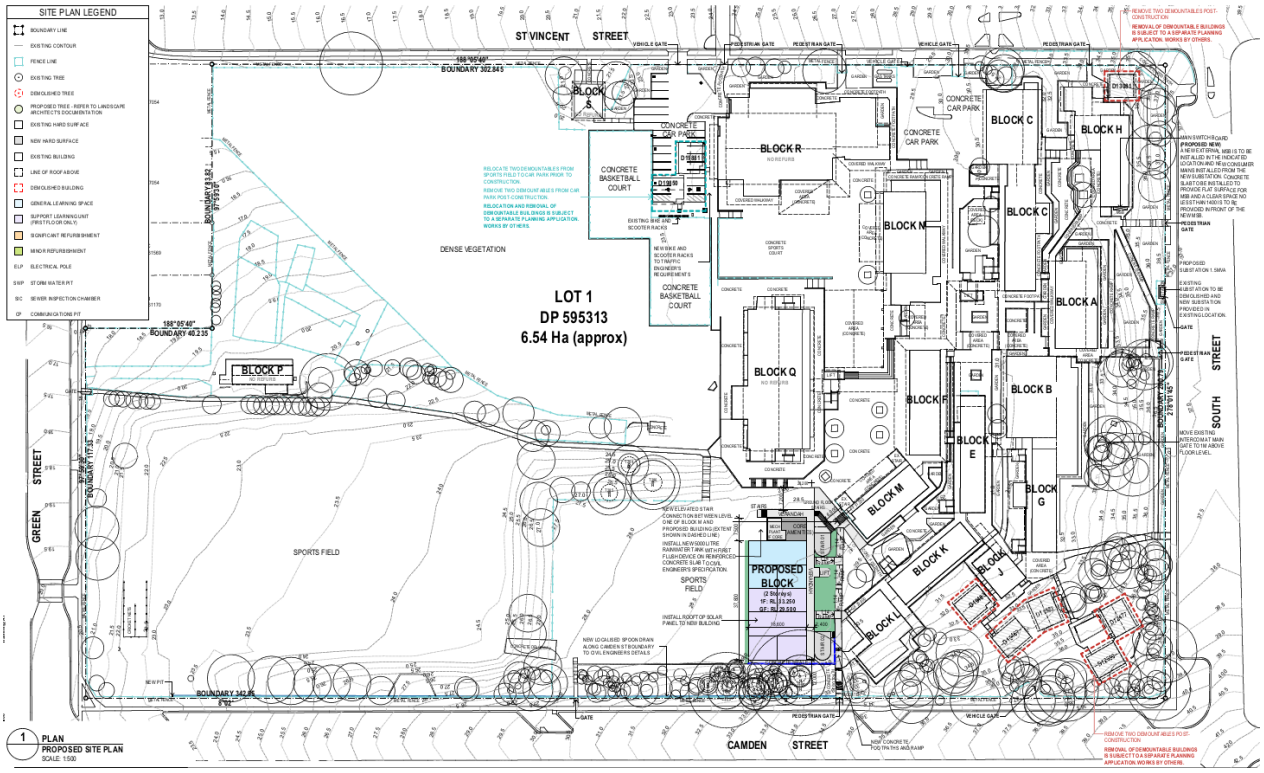

Figure 2: Site Plam (Source: Fulton Trotter, dated March 2025)

5.0 Flood Behaviour

TTW obtained Shoalhaven City Council's DRAINS and TUFLOW model (developed by Water Modelling Solutions for the Millards Creek Flood Study, 2021) in order to determine the flood behaviour in the area.

The model was updated to incorporate detailed site survey information alongside the post-development design levels alongside the new building, located at the existing car park. For the Probable Maximum Flood (PMF), a range of storm durations from the 15-minute storm up to the 360-minute storm were run. Although the 30-minute storm is critical for the site, this FERP includes an analysis of longer duration events to determine the maximum potential impact time for the site.

5.1 Flood Depths and Levels

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. Figure 3 and Figure 4 present flood depths and levels at the site in the 1% AEP and PMF events, respectively.

The school site is located within a natural depression that forms a gully across the site, conveying overland sheet flows across the site. Runoff overtops onto the site from South Street once the stormwater system reaches capacity, and generally travels in a north-northeasterly direction towards the gully.

The proposed building is located to the northwest of the existing building cluster, and southwest of the gully. As with the current design of the school, the development proposal includes terracing, with a sunken landscaped area immediately south of the building, directing flows away from building openings. In significant storm events, isolated ponding occurs within these sunken gardens, with depths reaching a maximum of 350mm in the 1% AEP event, and 500mm in the PMF event.

In the PMF event, flood levels peak at 29.59m AHD, 90mm higher than the currently proposed FFL of 29.50m AHD. However, the 2m grid size of the hydraulic model does not fully capture the vertical drop into the sunken garden, nor the swale located along the western boundary of the proposed building. In addition, the site's internal 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. As a result, flood storage surrounding the building is underestimated, and in reality, the flood levels would likely fall below 29.50m AHD in all events. More detail is provided in TTW's Flood Impact and Risk Assessment report submitted alongside this FERP.

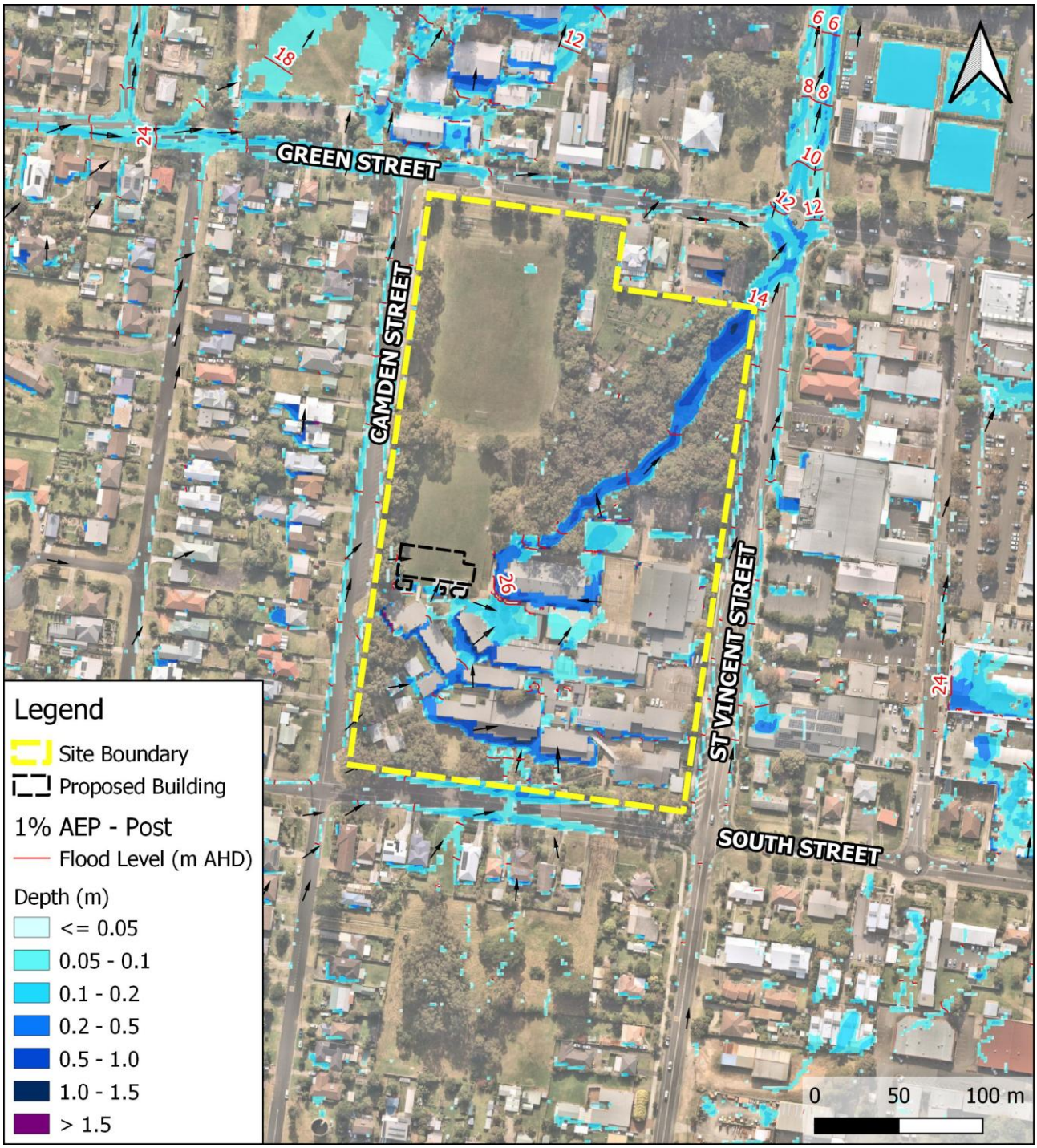

Figure 3: Flood levels and depths (1% AEP event)

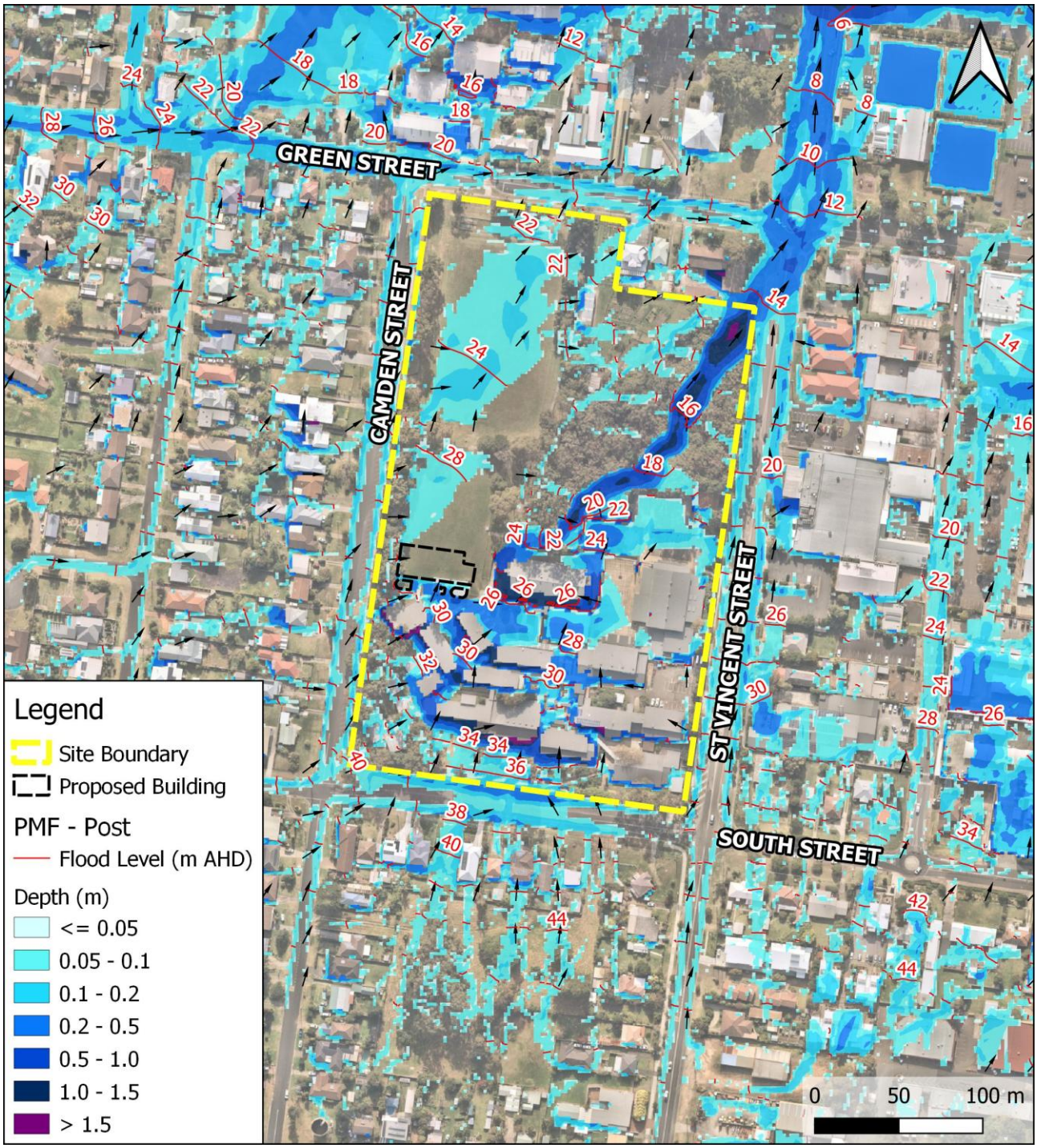

Figure 4: Flood levels and depths (PMF event)

5.2 Flood Hazard

A hazard assessment was conducted 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 5, 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).

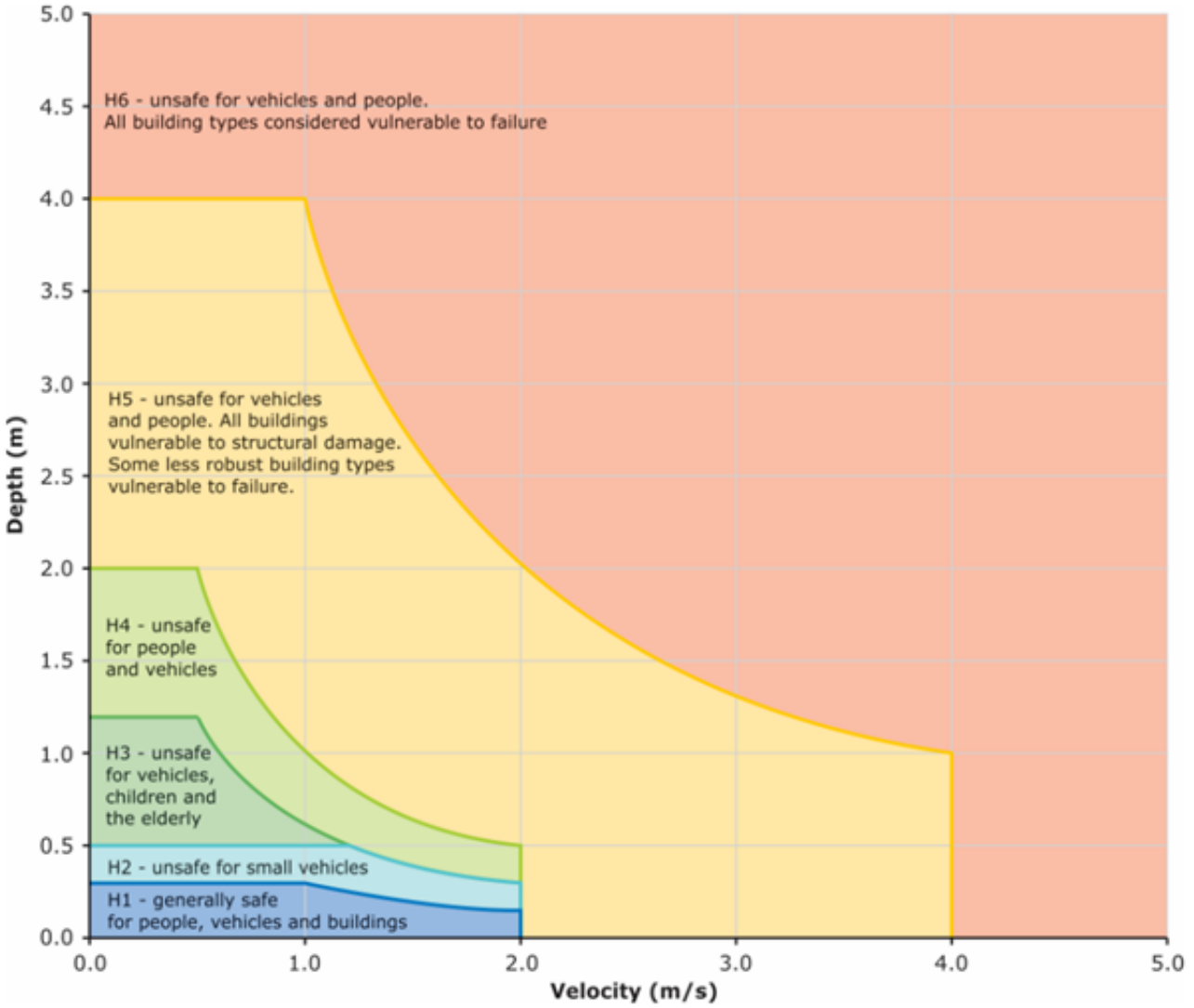

Figure 5: Flood hazard vulnerability curve (Source: Flood Risk Management Guide FB03 - Flood Hazard, NSW Department of Planning and Environment, 2022)

Figure 6 and Figure 7 present the flood hazard categorisation around the site in post-development conditions in the 1% AEP and PMF events, respectively.

Flows to the south of the proposed 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 2.0 m/s in this region.

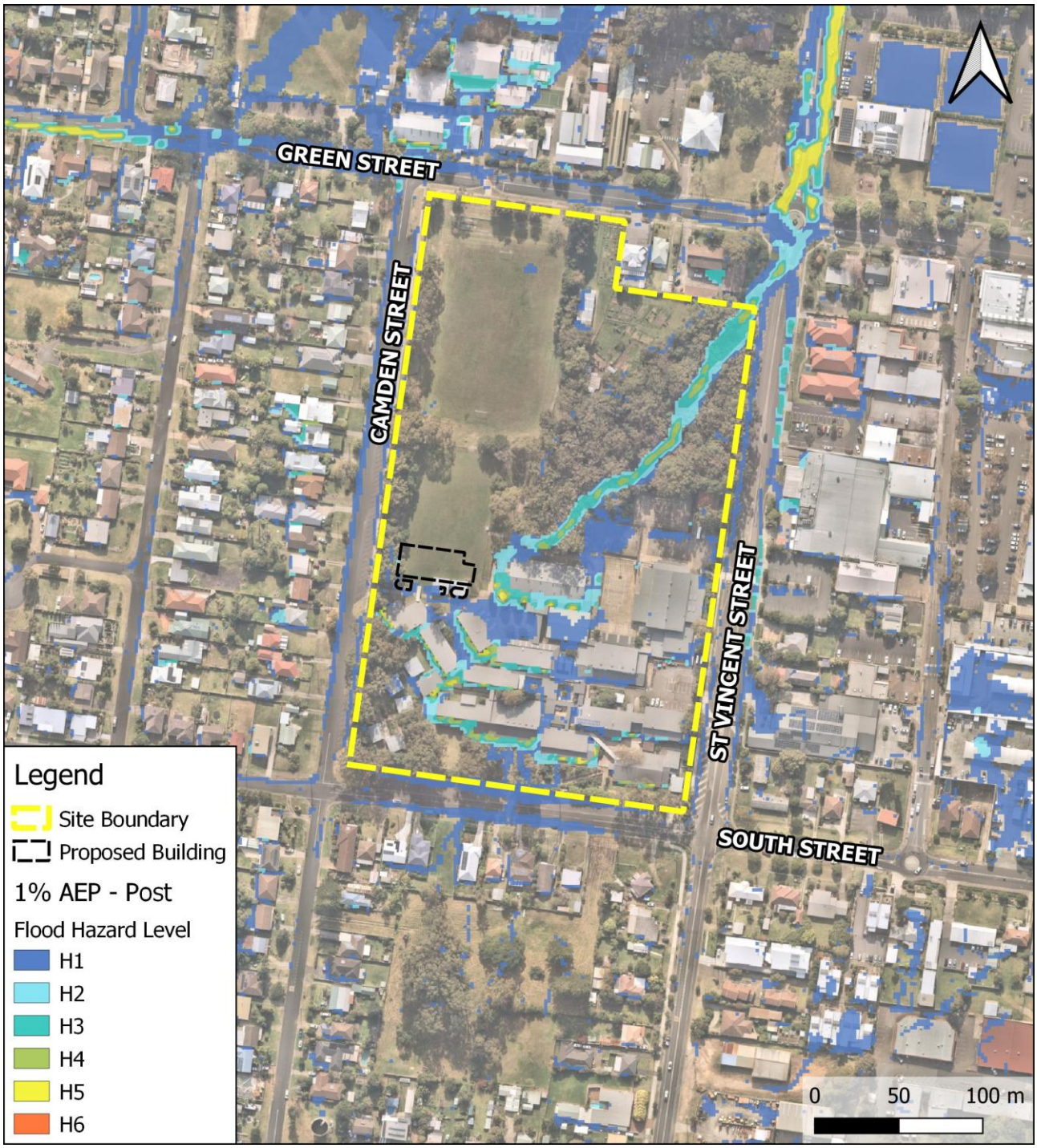

Figure 6: Flood hazards (1% AEP event)

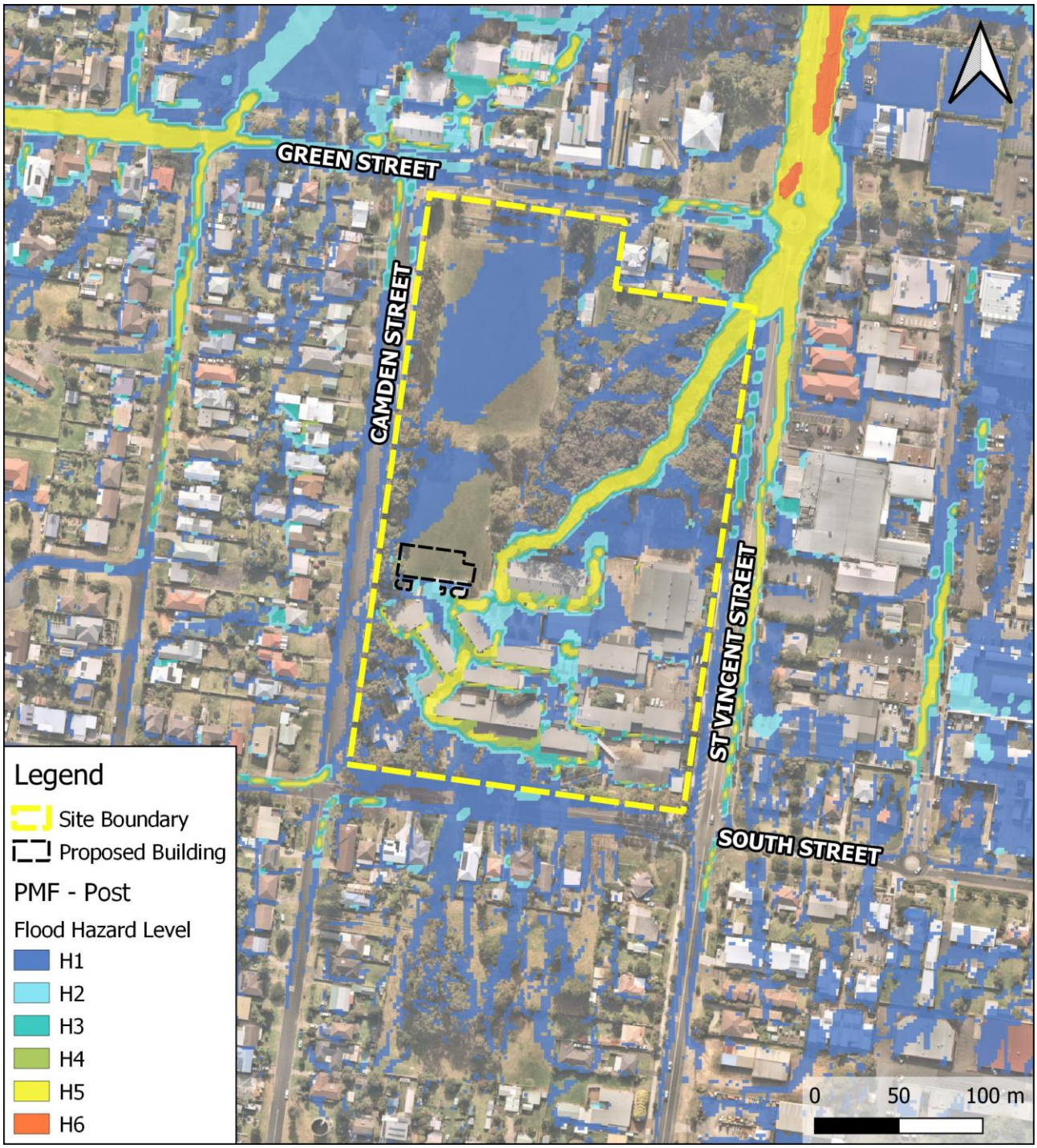

Figure 7: Flood hazards (PMF event)

5.3 Inundation and Recession Times

Table 2 presents a summary of the inundation and recession times for a range of storm events and durations. In all modelled events and storm durations, Camden Street is the first access road to return to flood free conditions. Review of model outputs indicate that the 2-hour PMF storm event is critical in terms of isolation, with a total isolation period of 1hr 45 minutes before flood-free access is possible via Camden Street.

St Vincent Street, the key access route to the northern side of the creek, has a more prolonged period of impact, with a recession time of up to 5 hrs and 15 minutes during the 6-hour duration PMF storm.

In terms of time to inundation, flows typically inundate the surrounding access roads rapidly, cutting off portions of St Vincent Street (at the crossing over Millards Creek) and the western extent of Green Street within 15–45 minutes.

Table 2: Time to inundation and recession at the site

Event + Duration	Time to Inundation	Recession Time		
		Proposed Building	Camden St	St Vincent St
1% AEP 45 minutes	< 45 minutes until the northern portion of St Vincent St (including the roundabout onto Green St) and the western extent of Green St are cut off by high hazard flows	Flood free access via Camden St pedestrian access for the duration of the storm event	Flood free for duration of this event	Flood free 1hr 15 minutes following the onset of the storm
PMF 30 minutes	< 15 minutes until St Vincent St & western Green St are cut off. On Camden St, hazardous flows are contained within the gutter	Flood free access into and out of the proposed building via pedestrian access onto Camden St is possible 45 minutes following the onset of the storm	Flows largely contained within the kerb and gutter for the duration of the storm, and completely flood free after 45mins	Flood free approximately 1hr 15 minutes following the onset of the storm
PMF 1 hr	< 30 minutes until St Vincent St and the western extent of Green St (northeast of the site) are impacted by high hazard flows (H5), cutting off these access routes	Flood free access into and out of the proposed building via pedestrian access onto Camden St is possible 60 minutes following the onset of the storm	Flows contained within kerb and gutter for the duration of the storm. Flood free 1hr after onset of storm	South of St Vincent St is flood free 1hr after onset of the storm. The roundabout and bridge are flood free after 1hr 30 mins
PMF 2 hrs	< 15 minutes until St Vincent St and the western extent of Green St (northeast of the site) are impacted by high hazard flows (H5)	Flood free access into and out of the proposed building via the pedestrian access onto Camden St is possible after 1hr 45 minutes	Flows contained within the kerb and gutter system throughout the storm, and flood free after 1hr 45 minutes	Flows at the St Vincent St bridge recede fully 2hrs 45 minutes following the onset of the storm
PMF 4.5 hrs	< 45 minutes until St Vincent St is impacted by high hazard flows (up to H5). One lane of the western portion of Green St is impacted by high hazard flows	Flood free access to the proposed building is possible 1hr 45 minutes following the onset of the storm via the pedestrian access onto Camden St	Flood free for duration of this event	St Vincent St bridge returns to flood free conditions approx. 4 hrs 45 minutes after the onset of the storm
PMF 6 hrs	< 45 minutes until St Vincent St is impacted by high hazard flows (up to H5). One lane of the western portion of Green St is impacted by high hazard flows	Flood free access via Camden St pedestrian access for the duration of the storm event	Flood free for duration of this event	Flood free approximately 5 hrs 15 mins after the onset of the storm

6.0 Flood Response Strategy

6.1 Pre-Emptive Closure

Although flash flood events are characterised by minimal warning times, there would be advanced notice of the extreme rainfall experienced in a 1% AEP or PMF event. Where there is enough warning prior to school opening hours, the school should be closed in advance of the flood event so children can be safe at home and parents do not have to drive though roads that could become hazardous.

An SMS should be sent to parents at the earliest opportunity (once the severe weather warning is issued by BOM) to advise of the school closure.

6.2 Shelter-in-Place

Shelter-in-place (SIP) guidance published by the NSW Department of Planning, Housing and Infrastructure (DPHI) in January 2025 provides considerations that can inform whether SIP is an appropriate response strategy in a flash flood environment, alongside design considerations that should be met. Table 3 outlines some of the factors that must be considered when proposing SIP, alongside a review of whether the Ulladulla High School site meets these requirements.

Based on this assessment, where there is not advanced notice of severe weather, and staff and students are already in the school, the secondary flood management strategy for the site is to shelter-in-place. It should be noted that the new building is not expected to experience above-floor inundation in the PMF. As a result, the building is safe to shelter in, and has adequate facilities to support SIP, including ambulant toilets and staff and student toilets, as per the design criteria outlined in the DPHI's SIP guideline.

Table 3: DPHI SIP Guidelines

SIP Guideline	Response
Floor Levels	
PMF levels are critical given that sufficient space above the PMF is a requirement outlined within the NSW shelter-in-place guidelines: "Shelter in place is the internal movement of a building's occupants to **an area within the building above the probable maximum flood** (PMF) level before their property becomes inundated by flood waters".	As outlined in TTW's FIRA report, the proposed building has a very low risk of above-floor flows in any event, including the PMF. In addition, vertical evacuation to upper levels (well above the PMF level) is also available.
Capacity	
The DPHI's shelter-in-place guideline recommends a minimum floor space of 2m^2 per person	Based on current site plans, the overall building floor area is approx. 1,465m^2, with a 'usable' floor area of 895 m^2 to shelter within (when excluding toilet and storage facilities, alongside a further 30% reduction to account for furniture). The proposed building therefore has capacity to shelter 447 people. During the shelter-in-place orders, all staff and students are to remain indoors.
Further Assessment Criteria	
Detailed assessment of evacuation off-site (the primary emergency management strategy) must	Given the site is impacted by flash flooding, there is little warning time to implement evacuation offsite.

be completed to determine that evacuation off-site is not achievable	NSW SES state that evacuation of a site must not require people to drive or walk through floodwaters. It is therefore recommended that the school is prepared for a shelter-in-place strategy in the event that there is not sufficient time to pre-emptively close the school in advance of a severe flood event.
Must assess the flood behaviour at the site, with assessment of the potential maximum duration of isolation up to and including the PMF to identify that: a) flash flooding is the only flood risk present at the site, whether it be from overland flooding, local creek or riverine flooding, and	Flash flooding is the only flood risk at the site. Peak flood levels at the site in the 1% AEP and PMF events are produced in the 45-minute and 30-minute storm events, respectively.
b) the flooding occurs within less than 6 hours from the commencement of causative rain and the duration of shelter in place due to isolation by floodwaters is less than 12 hours from the commencement of rainfall	In the 30-minute PMF event, there is less than 15 minutes from the onset of the storm until flows over Green Street and St Vincent Street become hazardous. The roads return to flood-free conditions after approximately 1 hour. In longer duration events, flows over these roads take up to 5 hrs 15 minutes to fully recede, however the overall risk to the site is lower, given that other routes (via Camden Street and South Street) provide alternative access to the site. Given this, it is expected that the maximum isolation period is 1hr 45 minutes.
c) the development is not subject to high hazard flooding (e.g. floodways, high hazard H5 or H6 areas) or surrounding roadways are not subject to high hazard flooding.[3] [3] Flood Risk Management Guideline FB03 Flood Hazard, DCCEEW, 2023.	While a portion of the roads adjacent to the site are subject to high hazard floodwaters in the PMF event (St Vincent Street in particular), it is deemed more hazardous to attempt to evacuate the site once a severe storm event has already commenced, as this would involve moving vulnerable site users from safe refuge into roads of high hazard.

6.3 Secondary Risks

Although shelter-in-place is the preferred emergency response strategy should a severe event begin without sufficient warning, any decision to shelter-in-place must consider secondary risks, including medical emergencies and building fire. Both the Milton-Ulladulla hospital and the Ulladulla Fire Station are located north of Millards Creek, with implications for site access during significant flood events given the impact to St Vincent Street Bridge in events as frequent as 2-5% AEP.

While there is no passage to the north of the creek that is flood-free or low hazard in all events (up to the PMF), Figure 8 presents an alternative route from the site onto Princes Highway that avoids St Vincent Street by travelling west on South Street and Green Street. It should be noted that **this route is not flood-free, is cut off by high hazard flows in the PMF event, and should only be used by emergency personnel** in the event of a secondary emergency.

Caution must be taken when driving across Green Street. In the PMF, this area is cut off by high hazard (H5) flows. In the 0.2% AEP event, the centre of the roadway is affected by flows with a maximum hazard level of H2, with H5 flows towards the gutter. The route is as follows:

- Egress from site from southern driveway onto St Vincent St, turning right (travelling south).
- At the junction, turn right onto South Street, travelling west for approximately 950m.

- Turn right onto Warden Street. At the junction onto Green Street, turn left, travelling west for approximately 660m.
- Turn right onto Pirralea Road, travelling northwest.
- Continue onto Slaughterhouse Road until the junction with Princes Highway.

This route leads onto Princes Highway, with access into Milton and Milton-Ulladulla Hospital to the northwest. In the event of a fire, emergency personnel should avoid southbound travel on the Princes Highway, given that the Princes Highway Bridge over Millards Creek is inundated in the 2-1% AEP event. The school should be accessed via the route outlined in Figure 8, if deemed safe.

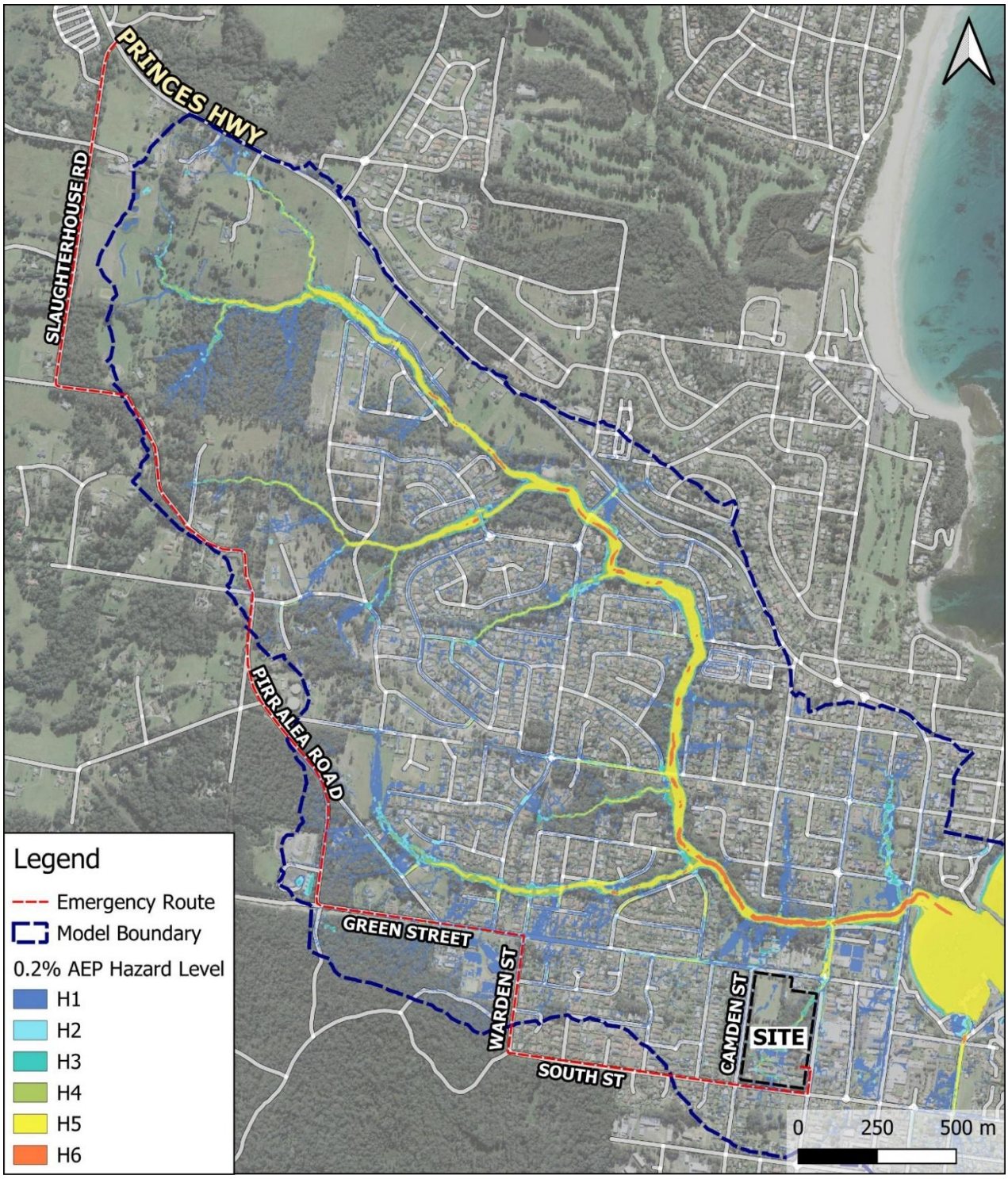

Figure 8: Route for emergency personnel in the event of a secondary emergency (shown against 0.2% AEP hazard levels)

7.0 Flood Warnings and Notifications

7.1 Bureau of Meteorology

Severe weather and thunderstorm warnings are issued by the Bureau of Meteorology (BoM). These warnings are continually updated with descriptions of the likely conditions, including predicted extreme rainfall depths. Flood warnings are issued by the BoM when flooding is occurring or is expected to occur in an area. Warnings may include specific predictions of flood depths dependent on real-time rainfall and river level data. These warnings are distributed by BoM to councils, police and the relevant local SES, as well as being available on the BoM website.

- A ***Flood watch*** is issued by the BoM up to four days prior to a flood event. A watch is generally updated daily and may be issued before, during, or after rainfall has occurred.

- ***Flood warnings*** are issued by the BoM when flooding is occurring or expected to occur in a particular area. Warnings may include specific predictions of flood depths dependent on real-time rainfall and river level data. These warnings are distributed to Council, Police, and the relevant local SES, as well as being available on the BoM website, through telephone weather warnings and radio broadcasts.

However, flood warnings are not issued for Ulladulla by BoM, and therefore flood warnings are not likely to be issued by the NSW SES. In addition, there are no formal flash flooding warning systems available for this area. Triggers should consequently focus on severe weather and thunderstorm warnings.

7.2 NSW SES Australian Warning System

NSW SES has recently implemented the Australian Warning System (AWS) which replaces their previous evacuation orders and warnings system. The AWS is a new national approach to information and 'Calls to Actions' for hazards including severe thunderstorm events. The System uses a nationally consistent set of icons, with three warning levels: Advice, Watch and Act, and Emergency Warning. The severe weather warnings are depicted in Figure 9.

Figure 9: Australian Warning System - Three Warning Levels

The NSW SES utilises a range of sources to build detailed flood intelligence within local communities, including information from flood studies and historical flood data. As part of the transition to the Australian Warning System, the NSW SES has increased flexibility to tailor warnings at the community level, based on the expected consequences of severe weather events.

The Chief Warden is responsible for monitoring information from the AWS. Impacted communities will continue to receive warnings through the NSW SES website, NSW SES social media channels and by listening to local ABC radio stations. The NSW SES has also developed an all-hazards warning platform, Hazard Watch, to provide an additional channel for communities to access important warning information.

Each warning has three components:

1) **Location and hazard**: The location and the type of hazard impacting the community.
2) **Action statement**: For each warning level there are a range of action statements to guide protective action by the community. These statements evolve as the warning levels increase in severity. Statements range from ‘prepare now’ at the Advice level, to ‘avoid the area’ at the Watch and Act level, to ‘seek shelter now’ in the Emergency Warning level. As the situation changes and the threat is reduced, the level of warning will decrease accordingly.
3) **The warning level**: The severity of the natural hazard event based on the consequence to the community.

7.3 Triggers

It should be noted that the flashy nature of flooding at the site (and the inherently limited warning time associated with this type of flooding) limits the capacity of both the BoM and NSW SES to issue warnings and flood notifications with sufficient lead time. It is important to note that the warnings outlined above may not be available or occur with sufficient advanced warning.

Alternative triggers are required for the school to ensure adequate response time, primarily involving continued monitoring of severe weather warnings, media updates via local radio stations and social media alongside visual observation of flows across the site and over St Vincent Street (if safe to do so). While the Chief Warden is responsible for monitoring information from the AWS, NSW SES recommend that all site users (namely, all staff members and wardens) refer to the HazardWatch website and the Hazards Near Me app.

7.4 Emergency Signals

The site should have a Public Announcement (PA) system that can be used by the Chief Warden to inform all staff of the chosen response strategy in the event of a flood emergency. This ensures that staff with key responsibilities in the Plan can begin to fulfil their duties without delay.

The PA system should be used alongside SMS and email updates to staff and parents to inform them of any severe weather or flood warnings covering the site or key access routes.

8.0 Flood Response Team

8.1 Staff Responsibilities

In the event of a severe flood, various staff members will be responsible for specific tasks as detailed in Table 4. Before the site is in operation, these roles must be delegated to specific staff members.

Table 4: Staff Flood Responsibilities

Role	Responsibilities
Chief Warden	- Decide if pre-emptive closure can occur if warnings are received prior to school opening hours or with several hours' notice - Monitor notifications from BoM and AWS - Monitor BoM weather warnings in the area of the site - Inform staff and students/parents of flood risk - Coordinate flood SIP drills
First Aid Officer	- Coordinate assistance for less able students and staff - Prepare a Flood Emergency Kit that includes a portable radio, torch, spare batteries, first aid materials, emergency contact numbers, candles, waterproof matches, waterproof bags and required medications
Staff	- Check visitor log and student registers so all site users can be accounted for - Report missing students or site visitors to Chief Warden

8.2 Key Contact Details

In the event of a severe flood, key telephone numbers have been listed in Table 5 below.

Table 5: Key Contact Numbers

IMPORTANT TELEPHONE NUMBERS	
Chief Warden	tba
Deputy Principal	tba
Safety/First Aid Officer	tba
External Contacts	
Police/Ambulance	000
NSW State Emergency Services (SES)	132 500
Fire & Rescue NSW – Ulladulla	02 4478 4977
Ulladulla Police Station	02 4454 8599
Milton Ulladulla Hospital	02 4454 9100

9.0 Preparation for Flood Response

9.1 Education

As part of the preparation for a flood event, all staff and students will be made aware and advised of the flood risks present on site and the flood protocols & procedures via signage. All staff on site will be made aware of the flood risk (including their management responsibilities) via briefing and signage. This will form part of the mandatory site inductions that all staff must undertake prior to commencing work. A copy of this FERP which includes emergency response procedures will be made available at communal areas within the site as well as the main office. This FERP must be regularly reviewed by the Chief Warden, or in the event of any staff restructure or other significant change, to ensure it is up to date.

It is recommended that students and frequent users of the site are educated on the potential flood risk and actions that will be undertaken during a flood event. Lessons should also be held that address flood risks and highlight dangerous behaviour during a flood event. Materials available on the NSW SES website have been tailored for students of various ages.

9.2 Signage

It is important that the site has adequate signage for flood warning, similar to those in Figure 10. Flood warning signs should be positioned around the site to identify areas affected by Category H3 hazard and higher in the critical PMF event, in accordance with the Flood Hazard Flood Risk Management Guide FB03, NSW Department of Planning and Environment. Refer to Figure 7 for hazard categorisation of flows in this event.

If time permits, temporary signage should also be placed at the driveway onto St Vincent Street, highlighting the flood risk to users travelling north on this road.

Figure 10: Signage and Gauges

9.3 Flood Drills

To reduce human behaviour risks, this plan should be regularly exercised, in a similar manner to that of fire evacuation drills. It is recommended that flood drills be held annually to ensure all staff are familiar with the sound of the alert and their subsequent flood response actions. It is the responsibility of the Chief Warden to ensure that drills are organised and that any issues with these drills are attended to, and if necessary,

procedures adjusted and drills rerun.

These drills are required to test the suitability of the plan, identify gaps and to provide staff the opportunity to put into practice their specific responsibilities. If issues arise, this plan should be reviewed and updated. The Chief Warden will also ensure that all site drills are recorded in an appropriate records book and any non-conformities reported and responded to.

9.4 Flood Emergency Kit

A Flood Emergency Kit should be prepared prior to a flood event taking place and regularly checked to ensure that supplies within the kit are sufficient and in working condition. This check could occur after the flood drill takes place to provide a regular schedule. The Kit should include:

- Radio with spare batteries;
- Torch with spare batteries;
- First aid kit and other medicines;
- Waterproof bags;
- A copy of the Site Emergency Management Plan; and
- Emergency contact numbers.

This Emergency Kit should be stored in a waterproof container, and it is the responsibility of the First Aid Officer to make sure that this kit is maintained and available during an emergency.

Other items for self-sufficiency should be stored, maintained and regularly updated in an accessible location within the proposed building in the event that shelter-in-place actions are deemed necessary. This would include sufficient drinking water and food as well as fire extinguishers.

10.0 Flood Response Actions

Flood Emergency Response Plan	
Flood Warning and Notification Procedures	**Protocols**
1) Weather forecast predicts significant rainfall event in the area or BoM issues a **FLOOD WATCH** or NSW SES issue a yellow "**ADVICE**" warning 	The following actions must be undertaken: 1) Ensure the emergency kit is ready to use, and there is sufficient drinking water and food in an accessible location within the proposed building. 2) Listen to the local radio station for updates on forecasted rainfall intensity, flood heights and timings. If onsite, Chief Warden is to conduct visual assessment of conditions onsite and at the Green St driveway. Listen to the local radio station for updates on forecasted flood heights and timings, though this may not be available with sufficient lead time. Monitor updates on social media and NSW SES platform Hazard Watch. 3) Call NSW SES or local police for an update and advice. 4) Notify all staff and students of the potential for flash flooding and confirm availability of staff to assist with emergency actions if required. 5) Ensure staff are familiar with the flood emergency strategy If a significant storm is forecast with advanced warning (>6 hrs), the **Chief Warden** should pre-emptively close the school. Notify parents and staff via SMS and email.
2) Flash flooding is reported in the media / via visual observation or BoM issues a **FLOOD WARNING** or NSW SES issue an amber "**WATCH AND ACT**" or red "**ACT NOW**" warning 	If the flood event is not anticipated to impact the site, the **Chief Warden** is to continue hourly check-ins and postpone high risk activities (e.g. outdoor activities). If flood event is anticipated to impact the site, the **Chief Warden** must undertake the following actions: **Outside of School Hours:** Close down the school. If the flood is expected to continue into school hours, notify students and staff of the temporary closure of the school via SMS and email. **During School Hours**: • **For life-threatening emergencies phone 000 immediately.** • Contact NSW SES on 132500 to confirm response strategy. • A warning message should be broadcast over the PA system confirming a significant flood event. Occupants within the proposed building will be advised to remain where they are, and not to leave the building. Within classrooms, teachers should conduct a headcount to ensure all students are accounted for. • The Chief Warden should ensure that no one is outdoors. Once everyone is indoors, access to the exits should be closed off with temporary signage advising site users of the flood risk outside. • Send SMS to parents to inform them of shelter-in-place procedures. The SMS should remind parents not to drive through floodwaters or to try collect their children. • If time permits, the Chief Warden should coordinate asset protection, including power shutdown and relocation of assets, prior to the onset of the storm. • The Chief Warden is to follow any action statements provided via NSW SES. **NOTE: Avoid driving or walking through floodwaters. These are the main causes of death during flooding. Although the school ground may not be flooded, safe travel arrangements for students to go home may be disrupted by flooding and/or road closures.**
3) Visual observation shows flood is receding or the alert has been downgraded by the relevant authorities and any flood event that occurred has passed.	Once it has been confirmed that the water level has reduced to a suitable level, and if determined safe, the **Chief Warden** may announce that classes can resume as normal. An additional SMS should be sent to parents advising them that they may collect their children if preferred. Staff must review a hard copy of the class list and record student release.

11.0 Mitigation Measures

Mitigation measures identified as necessary are outlined in Table 6.

Table 6: Mitigation Measures

Project Stage	Mitigation Measures	Reason for Mitigation	Report Section
Design	This FERP is based on the 50% Schematic Design information for the proposed site, and must be reviewed (and if necessary, updated) following the detailed design stage, prior to the site becoming operational.	To ensure the information in this FERP is still relevant	N/A
Operation	Delegate staff responsibilities	To ensure all staff are aware of their specific roles and flood reponse actions.	Section 7.1, Section 9.0
Operation	Education and signage. Depth markers can also be implemented on external building walls to demonstate the estimated 1% AEP and PMF depths so site users are aware of the potential risks of flooding at the site.	To ensure all staff and students are aware of the flood risks present onsite and the flood protocols and procedures via signage.	Section 8.1, Section 8.2
Operation	Flood drills	To ensure staff and students are familiar with the sound of the alert and their flood reponse actions.	Section 8.3
Operation	Flood emergency kit should be prepared and regularly checked	To ensure that supplies are in working condition	Section 8.4

12.0 Limitations and Revision of the FERP

This FERP only addresses the emergency response strategies during extreme flooding events for staff and students within the proposed building, not the wider school, and is considered a guide only. It does not cover staff and student safe travel arrangements to the site or when their safe travel arrangements may be disrupted by flooding and/or road closures.

In addition, this FERP is based on the currently available information for the proposed site, and must be updated following the detailed design stage, prior to the site becoming operational. The school's existing Emergency Management and Evacuation Plan should be reviewed and updated to consider a specific flood emergency event and align with the above considerations / advice provided herein.

13.0 Evaluation of Environmental Impacts

Based on the identification of potential issues, and an assessment of the nature and extent of the impacts of the proposed development, it is determined that:

- The proposed development is considered to result in low flood risks to people present at the school during a flood event and will not have significant adverse effects on the locality, community or environment (refer to TTW's Flood Impact and Risk Assessment report for Ulladulla High School submitted alongside this report);
- The construction of the proposed building reduces flood risk to site users by providing additional safe space above the PMF level for temporary shelter. In addition, the building has close access to the site's Camden Street pedestrian access, offering more efficient egress and limiting exposure of staff and students to potentially severe weather conditions or hazardous flows.
- Potential impacts can be mitigated and/or managed to ensure that there is minimal impact on the locality, community and/or the environment.

Prepared by
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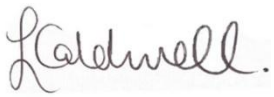

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