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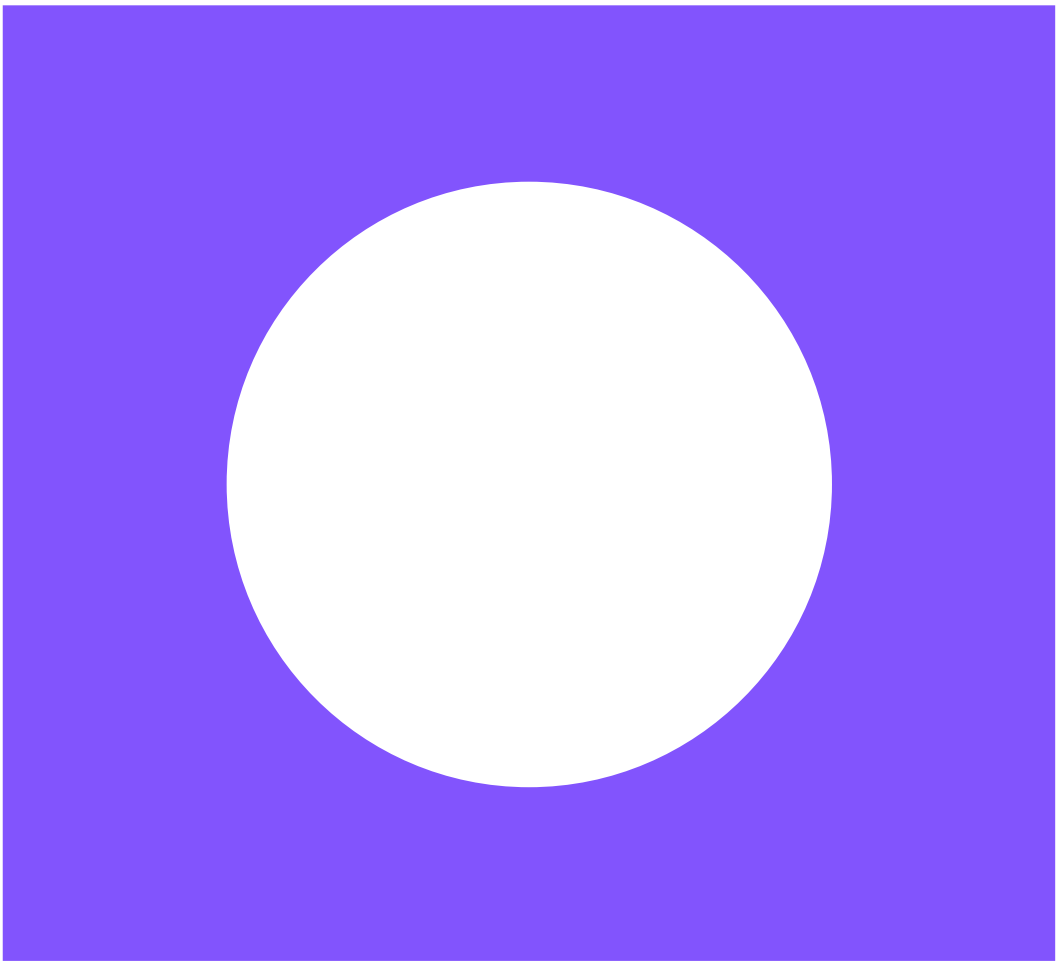

46-52 Nicholson Street & 59-67 Christie Street, St Leonards

Flood Impact and Risk Assessment

September 2025

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Flood Impact and Risk Assessment

September 2025

Issue and Revision Record

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A	12/09/2025	N. McNamara	J. Mail	S. Reilly	Initial Draft
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Executive summary

This Flood Impact and Risk Assessment (FIRA) has been prepared by Mott MacDonald Pty Ltd (Mott MacDonald) on behalf of Coronation for the construction of a new 36-storey residential podium for 541 Build-to-Rent apartments.

The FIRA aims to support the development proposal where specific elements of the design may alter flood behaviour or introduce additional flood risk, to identify and analyse:

- the potential impacts of the proposed development on the flood risk to the existing community
- the impacts and risks of flooding on the development and its users
- how these impacts can be managed to minimise the growth in risk to the community due to the development.

The 1% AEP and probable maximum flood (PMF) have been assessed as they relate to the flood planning levels for the development and inform design for safety and amenity. The PMF is the largest flood that could conceivably occur at a location and defines the maximum extent of flood-prone land. Dry habitable areas above the PMF level are expected to be free from flooding under all scenarios.

Flood Impact Assessment

The key parameters of the flood assessment are summarised below:

- Changes in peak 1% AEP water level:
  - Negligible increases in water level outside the project boundary
  - A negligible increase in peak water level is predicted as a consequence of the development; this is deemed to be acceptable.
- Change in 1% AEP flood velocity
  - Flood water velocities are not significantly changed by the proposed development
- Change in 1% AEP flood hazard
  - There are minimal changes in flood hazard outside the site boundary and flood hazard is limited to H3 within the site boundary

Development Controls

The Lane Cove Environmental Plan (LEP) 2009 outlines flood planning provisions in Clauses 5.21 Flood Planning and 5.22 Special Flood considerations.

The Flood Planning Level (FPL) for dwellings is to be greater than or equal to the 1% AEP flood level + 300mm, or if required, 500 mm freeboard. These are in accordance with Part O – Section 10.5 of the Lane Cove Development Control Plan (DCP) FPLs. Site-specific flood planning levels are listed in Table 6.1 within the body of the report.

This FIRA has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued by the Department of Planning, Housing and Infrastructure (DPHI) for the subject State Significant Development Application (SSDA). Whilst the Flood Risk SEAR requests a FIRA for the site (Table 1.1) the housing development falls within land identified by the Peak flood 1% AEP Design event, meaning the standard LEP clauses related to flooding apply. To ensure a robust design, this FIRA has been developed to support the SSDA as outlined by Flood Risk Management Guideline LU01 (FIRA guide).

By implementing the design recommendations outlined in this report, direct flood risk to any person could be reduced and the residual flood risk could also be reduced by complying with the Lane Cove DCP, 2009. Compliance can be achieved without negatively affected the existing flood risk to the surrounding areas.

To summarise the outcome of the design:

- Flood Planning Level requirements and other Development Controls,
    - The minimum finished floor level of all habitable room(s) is to be at the height of the 100-year Average Recurrence Interval flood level plus 0.3m, or, if required, 0.5 metre freeboard.
    - Basement car parks must be physically protected from inundation by floods equal to or greater than the 1% AEP flood level plus 0.3 freeboard.

The flood emergency management (EM) strategy for the development has been assessed following advice provided in the relevant Willoughby/Lane Cove flood emergency sub-plan from the NSW SES (2023). At the time of writing, there is no dedicated flood study or floodplain risk management study for the area available from NSW Government.

The assessment established that the site is at risk of flash flooding as critical storm durations are less than 6 hours for a high intensity, 1% AEP event. Inundation caused by flash flooding can typically occur with little or no warning and cause a rapid rise in water level over a brief period. Flood events of this nature do not last more than a few hours.

Flood impacts are present in the adjacent streets due to overland flow across all events. The proposed building within the site is identified as being flood-prone from the 1% AEP event, and including events greater than 1% AEP.

Based on the 46-52 Nicholson Street & 59-67 Christie Street, St Leonards FIRA, shelter in place policy during a flood emergency is deemed to be the most logical EM approach to protect life, given the following constraints:

- The site is at risk from flash flooding; the interval between the observable causative event and the flood is less than 6 hours. Consequently, there is insufficient warning time to adequately evacuate the population of the precinct. Additionally:
    - The opportunities for horizontal evacuation during a storm are limited as surrounding streets are subject to high flood hazards that present an unacceptable risk to people. NSW SES advice is not to venture out during a storm or cross any area of flood inundation.
    - The rate of rise and extent of flooding in the most extreme events means that emergency evacuation centres may not get set up and evacuees would generally have to take shelter in private premises.

- The time of isolation is short, based on the duration of flooding around the precinct. A development which is isolated for a few minutes by low-hazard flood water in PMF does not pose a significant risk to life.
- The redevelopment affords a means of creating a safe, on-site shelter above the 1% + 0.5m levels and PMF levels suitable for vertical evacuation
    - redevelopment which caters for sheltering in place can be used to reduce existing risk to life for individuals who currently occupy the floodplain
- additional Development Controls can be imposed which seek to manage the residual secondary risks to life caused by flood isolation to ensure that risks remain tolerable.

1 Introduction

1.1 Aims and Objectives

This Flood Impact and Risk Assessment (FIRA) has been prepared by Mott MacDonald Pty Ltd on behalf of Coronation for a State Significant Development Application (SSD-88113706) for the construction of a new 36-storey build-to-rent housing, providing 541 dwellings, located at 46-52 Nicholson Street & 59-67 Christie Street, St Leonards, NSW.

The purpose of this FIRA is to support the proposed redevelopment where specific elements of the design may alter flood behaviour or introduce additional flood risk and to address the Secretary's Environmental Assessment Requirements (SEARs) for the project issued on 31 July 2025, which identified the following specific assessment requirements:

Table 1.1: Site Specific SEARs

SEAR	SEAR Description	Section of Report where response is provided
19. Flood Risk	• Identify the flood planning area and level as set out in the relevant EPI and other supporting documents to determine. • The flood extent and velocity up to the Probable Maximum Flood and risk on-site having regard to adopted flood studies and, floodplain risk management studies and plans • The site access and egress routes • the potential effects of climate change, • any relevant provisions of the NSW Flood Risk Management Manual, and any other relevant guidelines	1.3 5.2 6.3.1 5.3 4
	• Where the development is occurring on flood prone land a flood impact and risk assessment (FIRA) must be prepared having regard to the Flood Impact and Risk Assessment – Flood Risk Management Guide LU01. When determining the scope and category of the FIRA the requirements outlined in the FIRA guide must be considered. • Detail any flood risk management measures that are to be incorporated as part of the development having regard to relevant guidelines (including any design solutions, flood modification measures, property modification measures, operational procedures or Flood Emergency Response Plan).	6.1 6.2 6.3 6.4

1.2 Background

The proposed development site, located at 46-52 Nicholson Street & 59-67 Christie Street, St Leonards, is owned by Coronation. The location of the site is shown in Figure 1.1. The site is in a well-located area that is serviced by a high level of amenities, services and public transport.

1.3 The Site

The site is located at 46–52 Nicholson Street and 59–67 Christie Street, St Leonards, in the Lane Cove Council local government area (LGA). The site has a total area of 2300 m^2 and has two one street frontages: Nicholson St and Christie St, refer to Figures 1.1 and 1.2. The site aerial imagery shows the site occupied by some former dwellings and a few existing trees. The scheme includes

approximately three basement levels for vehicle and bicycle parking with end-of-trip facilities, vehicular access from Christie Street, and loading dock access from Nicholson Street, along with associated landscaping and public domain works.

Figure 1.1: Site Location

Source: Google Maps, 2025

Figure 1.2: Site Plan

Source: Architectural reference base plan for ground floor – COX Architecture

1.4 FIRA Requirements

This FIRA will demonstrate compatibility of the development with any existing relevant state environmental planning policies (SEPPs), local environmental plans (LEPs), Development Control Plans (DCP) or policies, as well as existing industry guidance, government guidance and reference documents.

For this FIRA, to meet the desired aims of the guidance, it requires an understanding of:

- A range of flood risk examining minor, major and extreme storms events
- The constraints that flood places on the land (floodways, flood storage, flood hazard and emergency response issues)
- The appropriateness of the development or development types for the location based on the flood constraints on the land.
- The adequacy of management measures and controls to:
  - Effectively address these constraints to ensure the flood risks to the proposed development and its users are acceptable.
  - Manage flood and associated emergency management (EM) impacts to the existing community due to the development.

2 Background

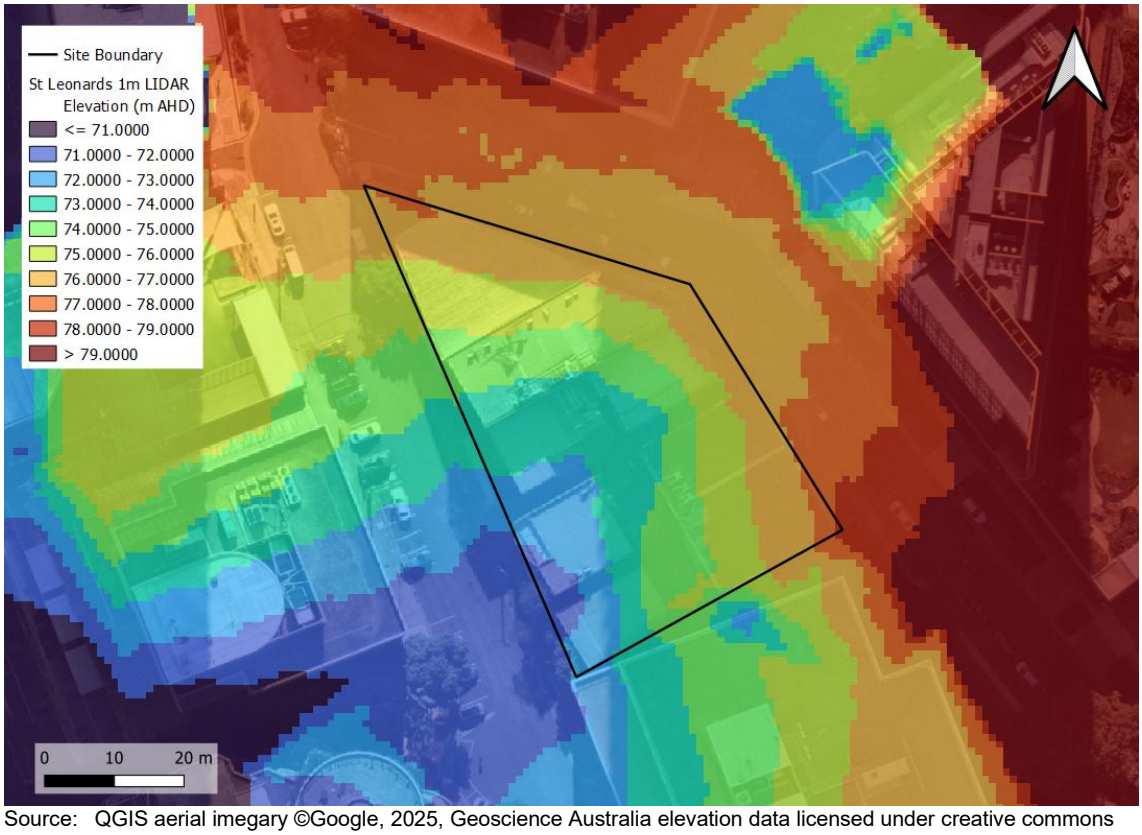
2.1 Study Area

The subject site location is identified in Figure 1.1 and topography in Figure 2.1, located adjacent to Nicholson and Christie road reserves, with an approximate area of 2300m^2.

The area around the site has a slope from North to South slope of around 7 - 8%, with the eastern road levels of Nicholson Street elevated over the site levels, which in turn are elevated above the western Christie Street road levels:

- the area of Christie Street adjacent the site is relatively low lying, within the vicinity of a notable sag point,
- elevations across the site itself ranging from 71.0m AHD in the Southwest of the site, up to levels adjacent Nicholson Street in the range up to 78.00m AHD in the East.
- Nicholson Street also has a sag located in adjacent the site

Figure 2.1: 46–52 Nicholson Street and 59–67 Christie Street, St Leonards, Site Boundary Location and Topography



Source: QGIS aerial imegary ©Google, 2025, Geoscience Australia elevation data licensed under creative commons

2.2 Existing Flood Behaviour

The Nicholson Street development is subject to a single source of flood risk: flooding from rainfall over the local catchment (overland flooding).

2.2.1 Overland Flow

Overland flow occurs when rainfall intensity exceeds the capacity of stormwater systems. It is the most prominent flood scenario around the site area, particularly where flat terrain and drainage of limited capacity lead to ponding and shallow flooding under lower AEP events.

Areas around Christie Street, including the site of development for this study and nearby rail track, are impacted by overland flow paths that develop due to the flat terrain and limited drainage capacity. In a 1% AEP event, the floodplain expands significantly. Floodwaters overtop trunk drainage channels upstream, and the area around Christie Street becomes inundated, resulting in the subject site being impacted by the 1% AEP overland flow flooding.

As the local sag point in Christie Street is overtopped, overland flow progresses west toward the rail corridor. This is a similar pattern of localise overland flow flooding that is observed in the adjacent catchment flood study discussed in section 2.3.

2.3 Flood History

From the Flat Rock Creek Floodplain Risk Management Study and Plan - Report, 2018, it is highlighted that the Council has limited information on flooding from events exceeding the capacity of the drainage network and flooding due to overland flow. Historic newspaper articles, SES reports, the Bureau of Meteorology (BoM) and council websites also indicate minimal historic flooding evidence, although the PMF mapping for the adjacent catchment to the site shows ponding at the adjacent rail track line, see Figure 2.2.

Figure 2.2: PMF - Flat Rock Creek FRMSP

Source: Flat Rock Creek Floodplain Risk Management Study and Plan

3 Methodology Approach

3.1 Available information

No existing Council flood studies or catchment models covered the site, so a site-specific hydraulic model was prepared to accurately assess flood behaviour and establish appropriate design levels.

3.1.1 Basis of Flood Model

A detailed TUFLOW hydraulic model was developed specifically for this assessment, incorporating the latest high-resolution LiDAR topography, surveyed site levels, and the surrounding drainage network. The model simulates overland flow paths and local catchment hydrology under design storm conditions, providing a robust platform for determining flood levels, freeboard requirements and stormwater management measures in accordance with current industry and Council standards.

3.1.2 TUFLOW Software Package

TUFLOW is a one and two-dimensional (1D/2D) hydraulic modelling program that simulates the flow of water across a landscape and through any conveyance structures such as pipes or culverts.

The 2D component of the TUFLOW software package determines overland flow paths by dividing the landscape into a grid of individual cells. The flow of water between cells is then computed repeatedly at regular time steps by solving two-dimensional shallow water equations to estimate the spread and flow of the water. Flows are routed in the direction water that will naturally follow the modelled topography.

The 1D component (called ESTRY) is a separate calculation engine incorporated into TUFLOW to manage flows through structures which cannot be accurately represented with 2d grid cells. ESTRY is a network dynamic flow program suitable for mathematically modelling floods and tides (and/or surges) in a virtually unlimited number of combinations. ESTRY has been developed in conjunction with TUFLOW to resolve complex 1D-2D flows across the floodplain interface.

3.1.3 Modelling Scenarios

3.1.3.1 Existing Flooding Conditions

The 1% AEP and probable maximum flood (PMF) have been assessed as they relate to the flood planning levels for the development and all events from the 1% AEP and greater inundate the site. The PMF is the largest flood that could conceivably occur at a location and defines the maximum extent of flood-prone land.

4 Flood Related Requirements

The following guidelines and standards relate to civil works as they potentially influence flood behaviour and form the basis of engineering decisions regarding stormwater management and the provision of overland flow.

4.1 Australian Rainfall and Runoff (v4.2)

Prepared by the Institution of Engineers, Australian Rainfall, and Runoff – *A Guide to Flood Estimation* was written to provide "*Australian designers with the best available information on design flood estimation.*" It contains procedures for estimating stormwater runoff for a range of catchments and rainfall events as well as design methods for urban stormwater drainage systems. The document has been updated with major revision in the 2016 version (v4.0) with a more refined methodology for hydrological analysis based on the latest hydrological data gathered. Subsequent updates including the previous 2019 version (v4.1) and current revision progress the technical guidance further, in particular with regard to the understanding of climate change effects.

4.2 Lane Cove Council Documents

4.2.1 Lane Cove Council Local Environment Plan (2009)

Lane Cove Local Environmental Plan 2009 outlines the flood planning provisions in accordance with the relevant standard environmental planning instrument under Section 5.21. Additionally Lane Cove Council has not adopted Clause 5.22 *Special Flood Considerations* as part of their LEP 2009.

1. The Objectives of this clause are as follows-
    a. To minimise the flood risk to life and property associated with the use of land,
    b. To allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a results of climate change,
    c. To avoid adverse or cumulative impacts on flood behaviour and the environment,
    d. To enable the safe occupation and efficient evacuation of people in the event of a flood.
2. Development consent must not be granted to development on land the consent authority to be within the flood planning area unless the consent authority is satisfied the development-
    a. Is compatible with the flood function and behaviour on the land, and
    b. Will not adversely affect flood behaviour in a way that results in detrimental increase in the potential flood affectation of other development or properties, and
    c. Will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and
    d. Incorporates appropriate measures to manage risk to life in the event of a flood, and
    e. Will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourse.

3. In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters-
    a. The impact of the development on projected changes to flood behaviour as a result of climate change
    b. The intended design and scale of buildings resulting from the development,
    c. Whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,
    d. The potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flood or coastal erosion.

4.2.2 Lane Cove Council Development Control Plans (2009)

Development control plans (DCP) support the implementation of the objectives of the LEP, providing specific guidance for the design and assessment of proposed developments. Part O of the Lane Cove DCP 2009 addresses flood planning requirements. Clause 10.5 Freeboard includes general flood planning requirements.

Table 4.1: Lane Cove DCP Extracts

DCP Requirement	Required Level (m AHD)	Adopted Level	Compliance
The minimum finished floor level to be at the height of the 100-year Average Recurrence Interval (ARI) flood level plus 0.3 / 0.5 metre freeboard	77.30	77.30	Yes – in combination with the fact that all higher elevation access points are flood protected to the equivalent flood level + 0.3 / 0.5m freeboard

4.2.2.1 10.5 Freeboard

Floor levels of dwellings, including garages, should be at a level that will ensure they are not subject to stormwater inundation or nuisance flooding. To prevent stormwater from entering buildings the finished floor levels must be set at least 150mm above the adjacent ground levels.

The entire outside perimeter of all buildings must have overland escape routes which will protect all finished floor levels from flooding in the event of the complete blockage of the surrounding drainage system.

Where it is proposed to build in an area known to be affected by overland flow, all spaces are to have a minimum freeboard of 300mm (except parking and storage areas which are to have a freeboard of 150mm), above the calculated top water level for the 1 in 100 year ARI storm event.

Freeboard may need to be increased to 500mm or greater where there are high flow rates, high flow depths or low confidence in the accuracy of the flood model.

For this study, it has been assumed that 500mm is the benchmark based on providing a reasonably high level of protection from overland flow rates and associated hazard around the site.

4.3 Crows Nest Transport Oriented Development Precinct Guidance

The Crows Nest Transport Oriented Development (TOD) Precinct Design Guide (Nov 2024), referenced in SEPP (Crows Nest TOD Precinct) 2024, cl. 8.4, sets mandatory design outcomes for proposed development in the precinct.

The key requirements within the Finalisation Report are as follows:

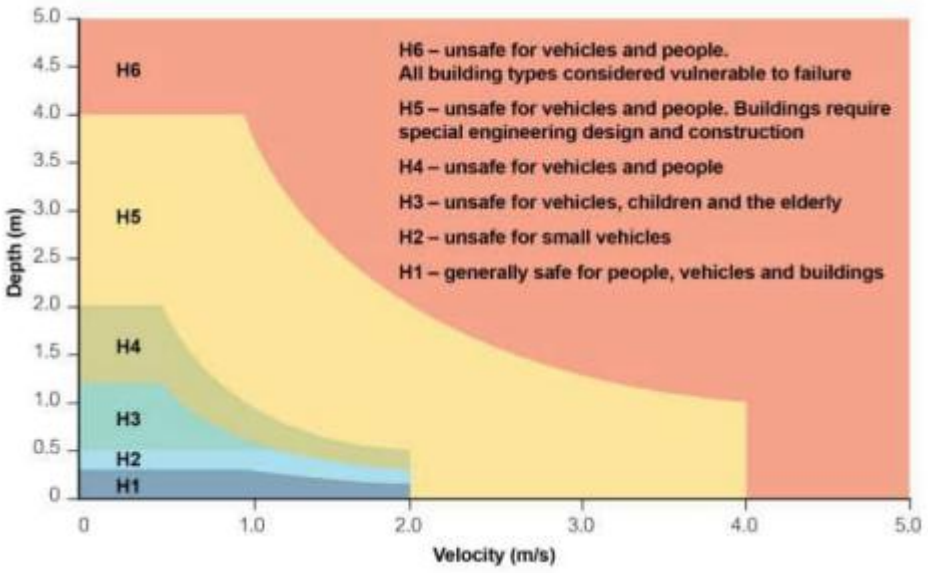
- Set appropriate building floor levels to maintain flood safety.
- Provide flood exclusion measures and basement flood protection.
- Ensure all basement entry points are at least 0.3 m above surrounding ground level.
- Prepare a flood impact assessment that considers gaps in Council flood mapping.
- Demonstrate no increased flood risk to neighbouring properties.
- Adopt shelter-in-place as the default strategy where evacuation is not feasible.
- Incorporate Water Sensitive Urban Design (WSUD) measures into the design.

4.4 NSW Flood Risk Management Manual (June 2023)

The NSW Government's manual supersedes the previous *Floodplain Development Manual – the Management of Flood Liable Land* (2005) and is concerned with the management of the consequences of flooding as they relate to the human occupation of urban and rural developments. The manual outlines the floodplain risk management process and assigns roles and responsibilities for the various stakeholders.

The manual applies to all development and provides additional guidelines for ensuring safe overland flow paths are provided. These guidelines adopt the hazard categorisation which was developed by the Australian Emergency Management Institute in 2014, defining hazards into six categories. The categories relate to the flood vulnerability curves shown in Figure 4.1.

Figure 4.1: General Flood Hazard Vulnerability Curve



Source: Australian Emergency Management Institute (2014)

4.5 Flood Risk Management Guideline LU01 (2023)

Published by the Department of Planning and Environment (DPE), this guideline provides advice on the scope and scale of a flood impact and risk assessment. It does not replace the processes or requirements of the consent authority. It should be read in conjunction with and address any other assessment requirements for the development proposal/application.

It should be read in conjunction with and address any other assessment requirements for the development proposal/application, including those of referral authorities. For example, for state significant development proposals being considered by the NSW Government, this guideline should be read in conjunction with the Planning Secretary's environmental assessment requirements (SEARs) issued for the development.

4.6 Shelter in Place Guideline for Flash Flooding (2025)

Published by the Department of Planning, Housing and Infrastructure (DPHI), this guideline aims to assist consent authorities to undertake site specific, risk-based assessment to assess if shelter in place is a suitable emergency management strategy for development proposed in flash flood environments.

The intent of the guideline is to:

- guide proponents on where shelter in place may be considered in land use planning
- provide consent authorities guidance on matters that may be considered in assessing planning proposals and development applications where shelter in place is proposed
- assist councils when considering the role of shelter in place within their own local guidelines, policies, and development control plans.

The shelter in place guideline defines the following:

- Shelter in place - 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
- Flash flooding – flash flooding is "flooding that occurs within 6 hours of the precipitating weather event, and often involves rapid water level changes and flood water velocity"[1]
- Flood behaviour
  - Flash flooding is the only flood risk present at the site, whether it be from overland flooding, a nearby creek or riverine flooding
  - 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
  - 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[2]

[1] Flash flooding as defined in Emergency Planning and Response to Protect Life in Flash Flood Events (2018) AFAC (Australasian Fire and Emergency Service Authorities Council)

[2] Flood Risk Management Guideline FB03 Flood Hazard, DCCEEW, 2023

5 Hydraulic Modelling

5.1 Existing Flood Behaviour

5.1.1 Design Storm Events

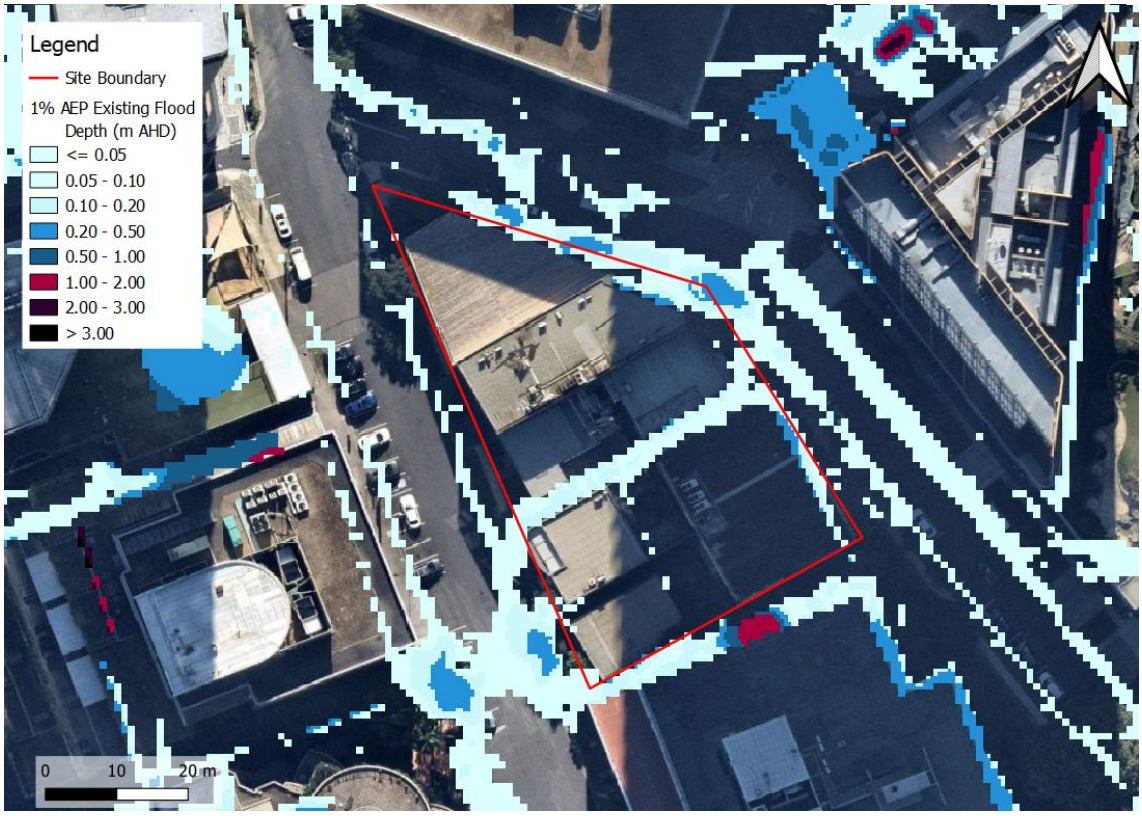
5.1.1.1 1% AEP Storm (1 in 100 year)

The 1% AEP storm forms the basis of Council's flood planning levels. The storm is very rare, having a 1% chance of occurring during any given year. It is equivalent to the 1 in 100-year Average Recurrence Interval (ARI).

The modelling for St Leonards shows significant flooding to the subject site. Flooding occurs on the surrounding land, with the South and Southeast areas experiencing the greatest depths, up to 1.80m within the narrow area between existing buildings, while depths outside this on Christie Street channel rise to 0.35m. Nicholson Street shows generally shallow flooding, from 0.1 m to 0.31 m predicted, to a peak level of 77.70 mAHD, directly adjacent to the South East building and road boundary.

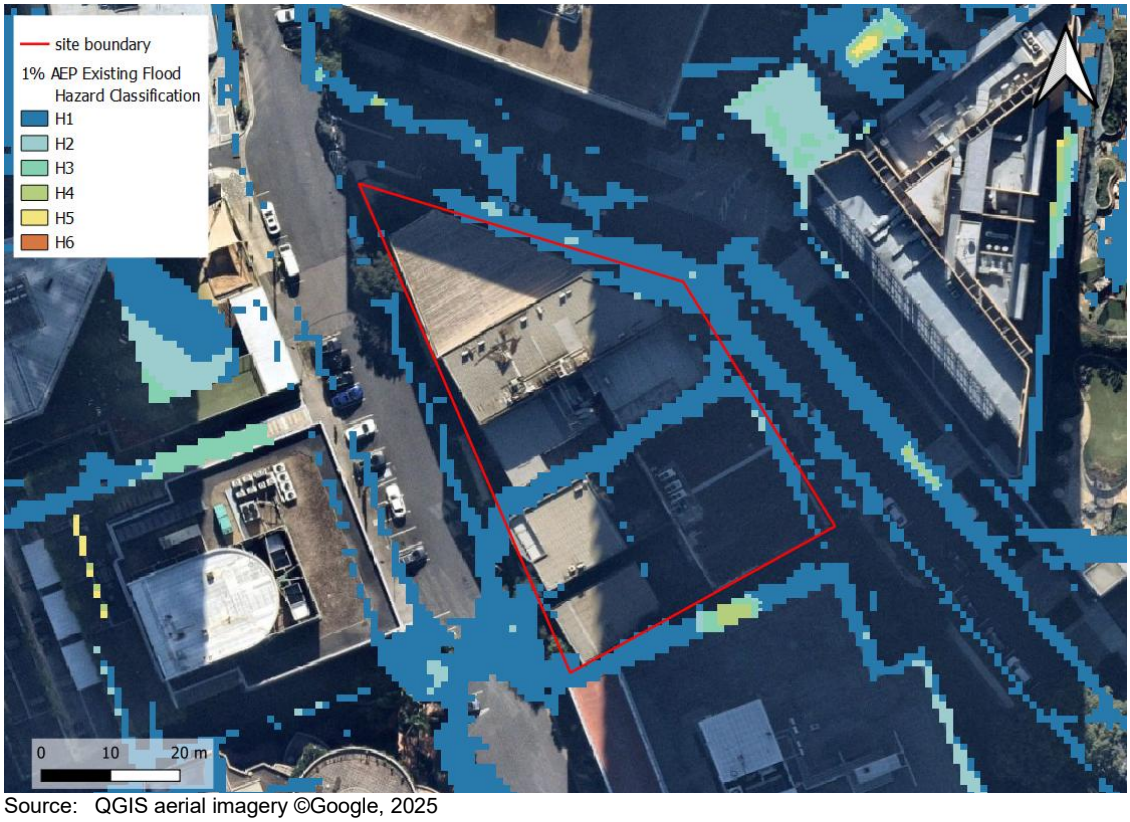
The velocities in the existing scenario are less than 1 m/s across the entire site and velocities in all adjacent roads are less than 2 m/s. Based on both the flood depths and velocities, the resulting provisional hydraulic hazard is shown as H1 – no constraints (Figure 5.2), the narrower sections between buildings indicate up to H4.

Figure 5.1: 1% AEP Storm Flood Depth and Extent



Source: QGIS aerial imagery ©Google, 2025

Figure 5.2: 1% AEP Storm Flood Hazard



Source: QGIS aerial imagery ©Google, 2025

5.2 Design Flood Behaviour

To represent the site post development case, a new building block out was included in the model covering the proposed structure, landscape finished levels introduced and the drainage was upsized to reduce overland flow volumes. This design approach achieves immunity of the structures from flooding in the 1% AEP storm by adopting the Council Flood Planning Level (1% AEP + 500 mm freeboard), preventing any water ingress towards the structure itself.

5.2.1 Design Storm Events

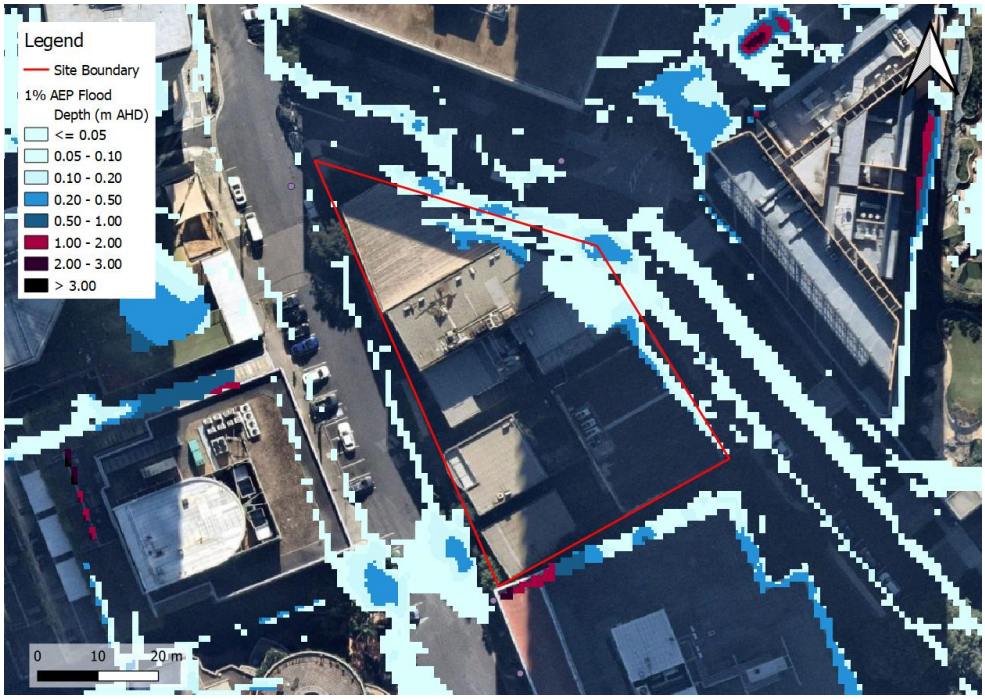
5.2.1.1 1% AEP Storm (1 in 100 year)

The Southern areas, like in the existing flooding scenario, experience the greatest depths, up to 2.5 m within narrow areas between existing buildings, while depths outside this on Christie Street channel rise to 0.34m. Nicholson Street also shows generally shallow flooding, from 0.1 m to 0.35 m to a peak level of 78.09 mAHD, directly adjacent to the building boundary. Within the site boundary, the maximum depth is 0.76m in the area adjacent to the 77.9m raised landscaped area North of the main building.

Based on both the flood depths and velocity, the resulting provisional hydraulic hazard for almost all of the site and the surrounding area is shown as H1 – no constraints (Figure 5.4) and a few minor instances of H2 and H3 – minor flooding hazard. As such, any water within the site should be considered localised nuisance flooding that is inconsequential relative to the surrounding floodway. The only area which shows hazard of concern is the narrow (inaccessible) opening between buildings comprising a 0.5m clear space to the adjacent existing building face at the southern site boundary. A small area of H5 is noted at the narrowest

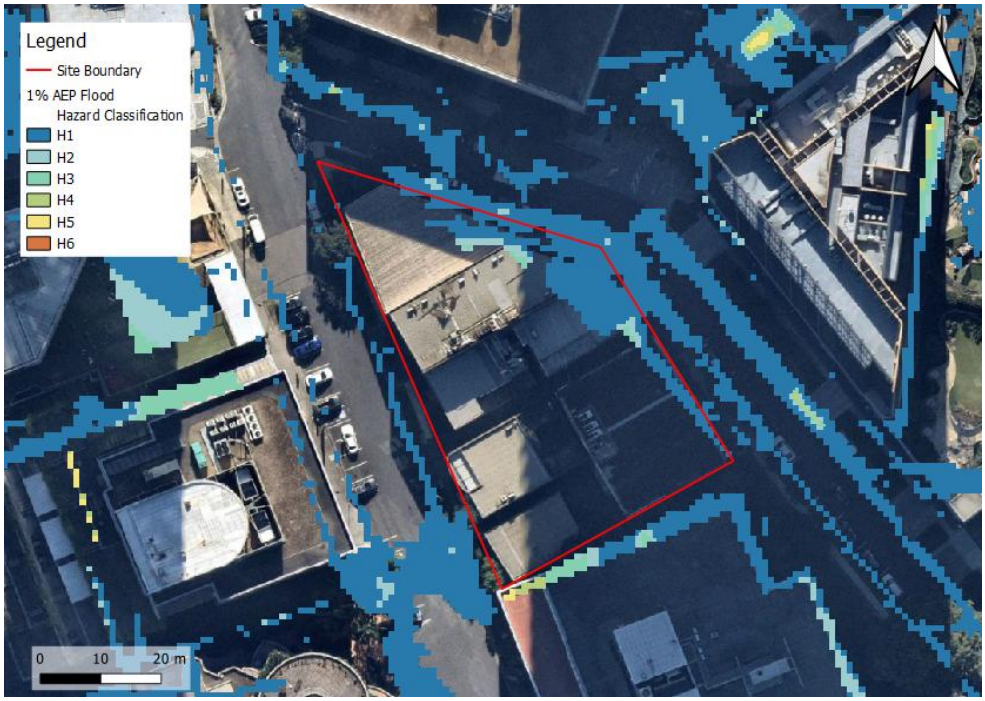
point, relieved by spill into the sag location of the adjacent Christie Street. This clear opening to drain ponded water from against the neighbouring building to the south is the subject of further design refinement in detailed design to lower hazard as much as is practical.

Figure 5.3: 1% AEP Design Storm Flood Depth and Extent



Source: QGIS, 2025

Figure 5.4: 1% AEP Design Storm Flood Hazard

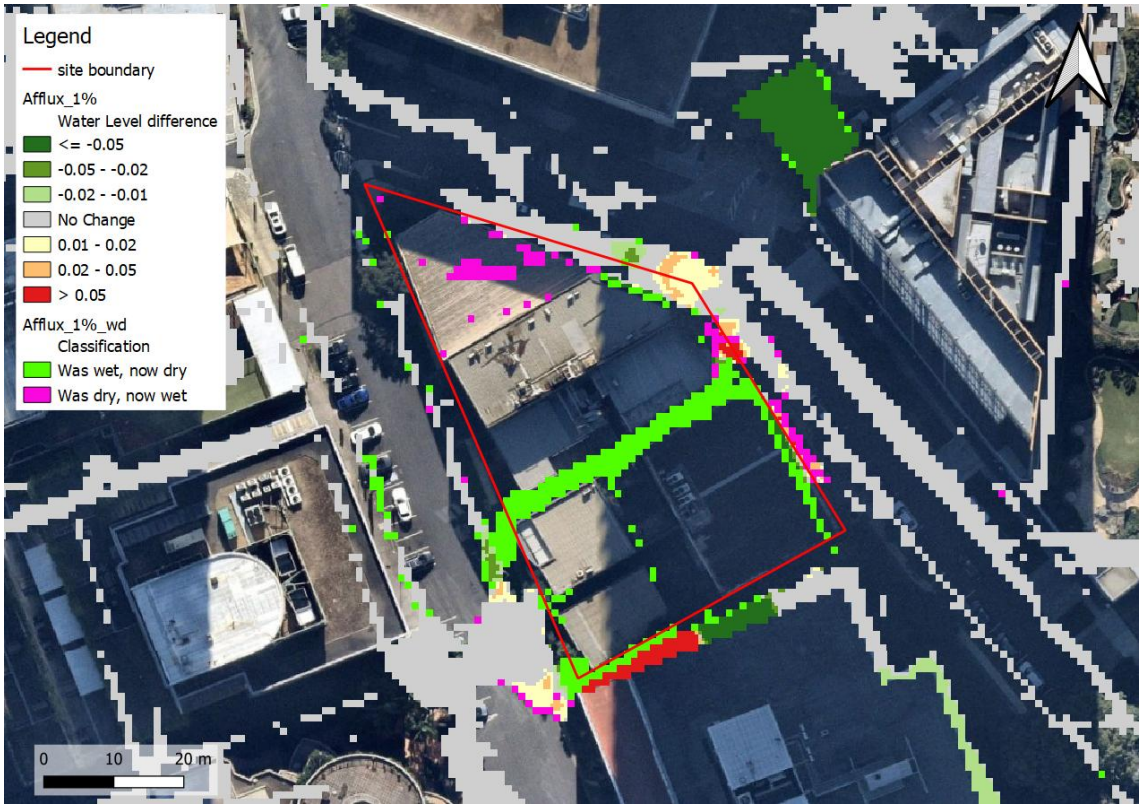


Source: QGIS, 2025

5.2.1.2 1% AEP Flood Afflux

The footprint of the building diverts some area that was wet to dry. Impacts to other areas outside the site footprint are generally minor, with some water level reduction evidenced North of the site, likely due to the upsized pipework providing more volume in the below-ground drainage pipework and removal of the flow path between the two existing buildings that the proposed site will overlay. There is depth addition in the single-narrowed stretch between adjacent building to the south; however, the depth difference is under design consideration to reduce hazard and allow the area to be drained beyond the channel onto Christie Street road reserve.

Figure 5.5: Afflux / Change in Flood Levels at the site



Source: QGIS aerial imagery ©Google, 2025

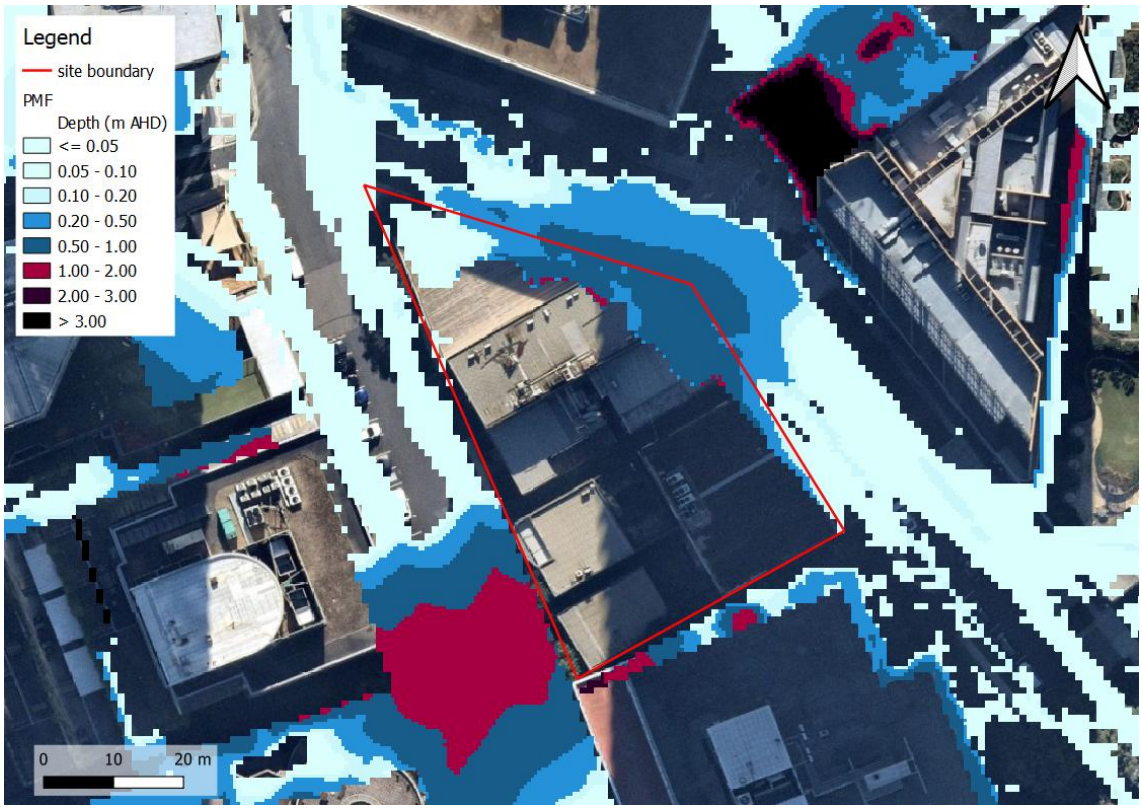
5.2.1.3 Probable Maximum Flood (PMF)

PMF results are provided for flood planning requirements and assessment of flooding changes in the PMF are reviewed to confirm that flooding conditions are not changed that would impart meaningful change in hazard. The PMF is a theoretical maximum flood that can occur at a location with previous studies having approximated a probability of occurring between 1 in 100,000 and 1 in 10,000,000 chance in any year.

Modelling suggests the PMF may cause some inundation to the fringe of the development site and the overland flow route curves round the North of the proposed building from East to West (Figure 5.6). The site is shown to have a depth of up to 2.5m within the narrowed section between buildings previously discussed, whereas within the site boundary, depths peak at 1.15m depth and to a peak water level of 78.08m AHD on the South Eastern corner of the site. Peak velocities within the site lie between 0 to 1.25 m/s and outside the site can exceed 2 m/s

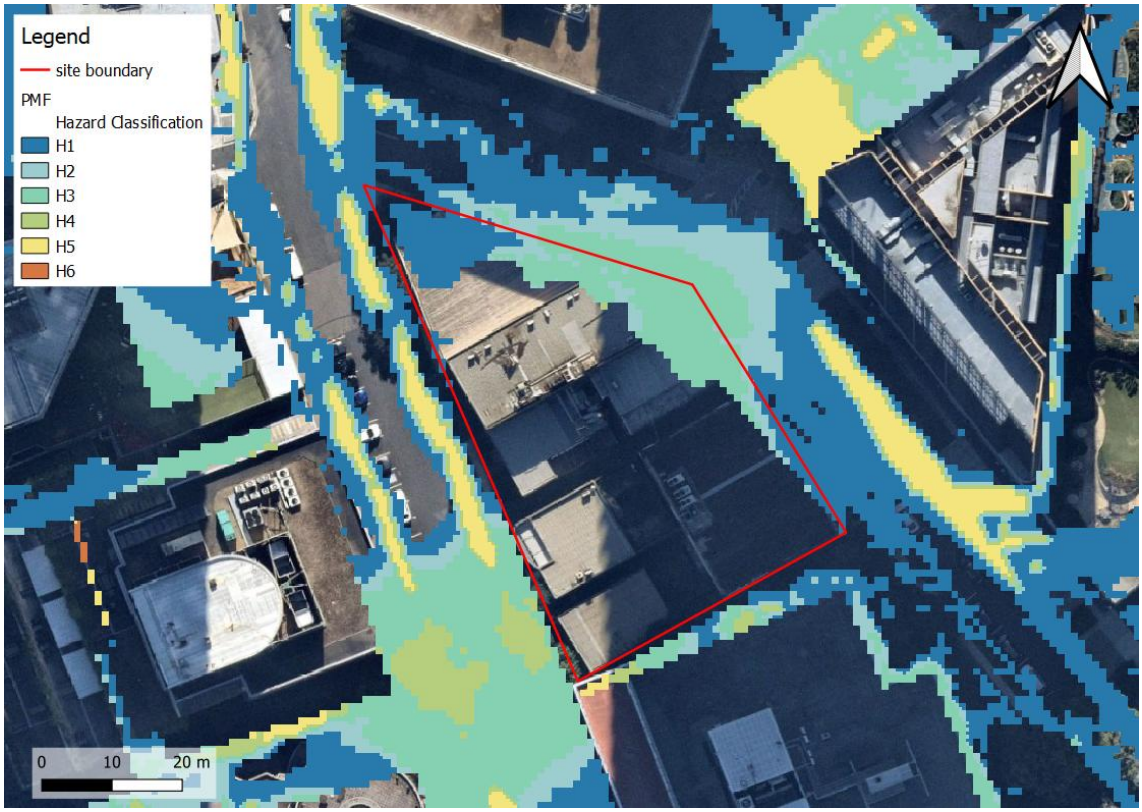
but remain less than 3 m/s. Flood hazards around the site range between H1 and H3, but extend to H5 on adjacent roads in the areas of higher velocities (Figure 5.7)

Figure 5.6: PMF Flood Depth and Extent



Source: QGIS, 2025

Figure 5.7: PMF Design Storm Flood Hazard



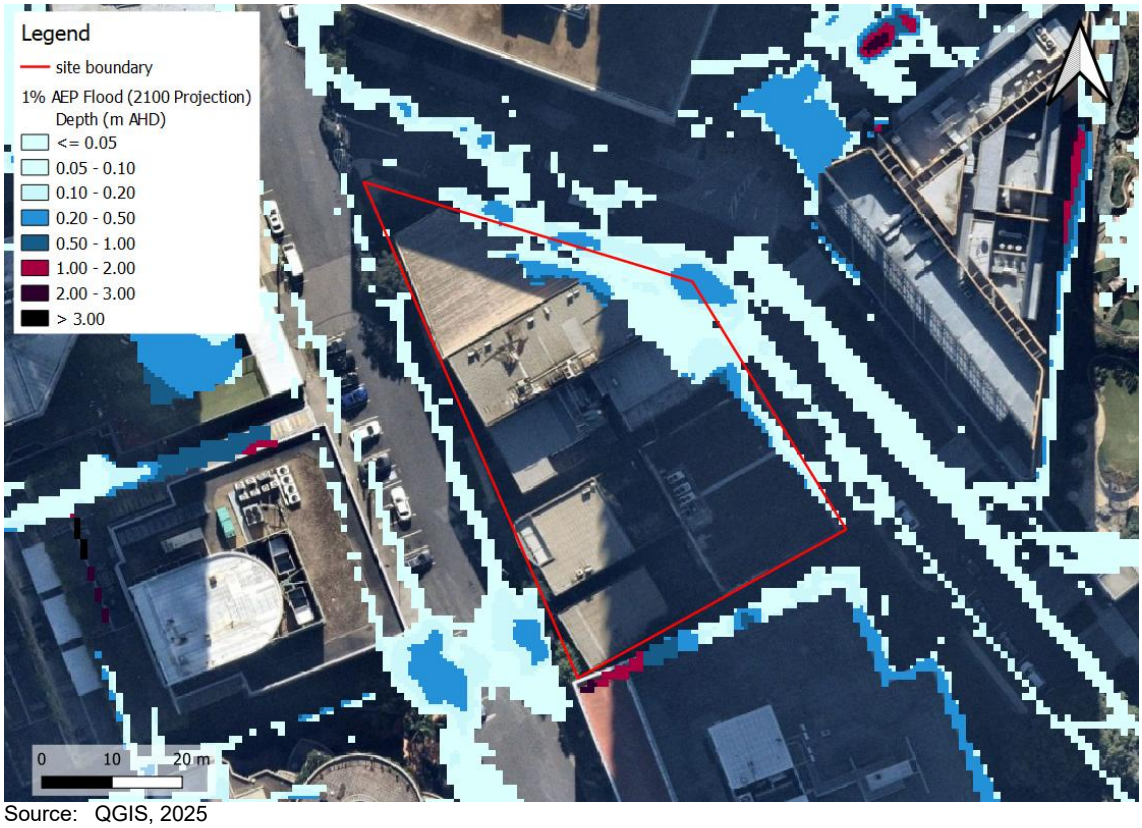
Source: QGIS, 2025

5.3 Climate Change

5.3.1.1 1% AEP Storm (1 in 100 year) under year 2100 projection

The 1% Annual Exceedance Probability (AEP) event was re-simulated under the projected 2100 climate conditions using the Intergovernmental Panel on Climate Change's (IPCC) Assessment Report 6 (AR6) summarised Shared Socioeconomic Pathway (SSP) 4.5 scenario to account for future flow increases. The resulting impacts are illustrated in Figure 5.8, showing a flood depth of 0.80 metres within the site, inundation reaching up to 2.43 metres at the site boundary down the narrow stretch, a peak flood level of 78.10 m AHD and a hazard classification slightly more significant than the today's 1% AEP results, but with the same H1-H3 breakdown within the site.

Figure 5.8: 1% AEP Flood Depth and Extent - 2100 Projection



Source: QGIS, 2025

5.4 Managing Flood Risks

The flood risk does not impact the proposed building footprint significantly; however, it should be advised that, in line with the Australian Disaster Resilience Handbook, Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia, the structure should be designed for flood impacts with suitable water-resistant structural materials up to the PMF level.

5.4.1 Amplification of Existing Stormwater Networks

The formalised pipe and pit drainage network commences along Nicholson Road and Christie Street Parade, converging at the road intersection and continuing to the area where ponding on Christie Street is expected as the drainage network is near capacity. Upgrading the capacity has been incorporated as part of the design, upsizing the pipework from 300mm to 750mm diameter pipework along this network area (See Civil Drawing: 24-1018-CIV-021 for more details).

6 Design Recommendations

6.1 Flood Planning Levels

The Flood Planning Level is to be greater than or equal to the 1% AEP flood level + 500mm freeboard according to the Lane Cove DCP 2009, guidelines and best practice.

Table 6.1: Flood Planning Levels

Location ID	Description	1% AEP Flood Hazard	1% AEP Water Level (mAHD)	PMF Water Level (mAHD)	Flood Planning Level (1% AEP + 0.3m mAHD)	Flood Planning Level (1% AEP + 0.5m mAHD)	Adopted Flood Planning Level (mAHD)	Compliance
A – West access to the courtyard	Route to communal courtyard	Low	75.22	75.28	75.58	75.78	77.30	Yes
B – Northeast Access to Courtyard	Route to communal courtyard	Low	76.52	76.94	76.82	77.02	77.30	Yes
C – East Doorway 1	Building access Doorway	Low	76.57	76.94	76.87	77.07	77.20	Yes
D – East Doorway 2	Building access Doorway	Low	76.65	76.97	76.95	77.15	77.20	Yes
E – Vehicle Access point	Roller Shutter for vehicle basement access	Med	77.28	77.66	77.58	77.78	77.90	Yes
F – Access Southeast corner	Stairway Access	Med	78.10	78.16	78.40	78.60	78.60	Yes
G – Vehicle Access Point	Vehicle basement access	Med	71.52	72.59	71.82	72.02	72.00	Yes
H – Vehicle Access Point	Vehicle basement access	Med	71.49	72.59	71.82	71.99	72.00	Yes

6.1.1 Habitable Floor Levels

All habitable floors are located on the ground floor level of the development or above. Due to the gradient of the site, the building ground floor level varies but generally lies between 77.20 and 77.30. Access points to the building have been cross-checked at different locations across the site to determine the relevant flood levels and impact of flooding. Compliance with the 300mm freeboard requirement in a 1% event is met throughout the building; however, in the Southeast corner, levels suggest that complete 500mm freeboard of the building above the 1%

AEP event will not meet the potential ceiling requirement highlighted in the DCP (of extension of 300mm to 500mm requirement) however given all access points are at a suitable level to prevent ingress into lower floors, this is deemed acceptable. See Figure 6.11 for details on access point locations assessed.

6.1.2 Vehicle entry

The DCP from 2009 specifies a freeboard requirement for parking and storage areas which are to have a freeboard of 150mm.

The basement entry requirements have been specified by the Crows Nest TOD Precinct Design guide, which specifies that all basement entry points are to be set to at least 0.3 m above the surrounding ground level and protected from the effects of flooding.

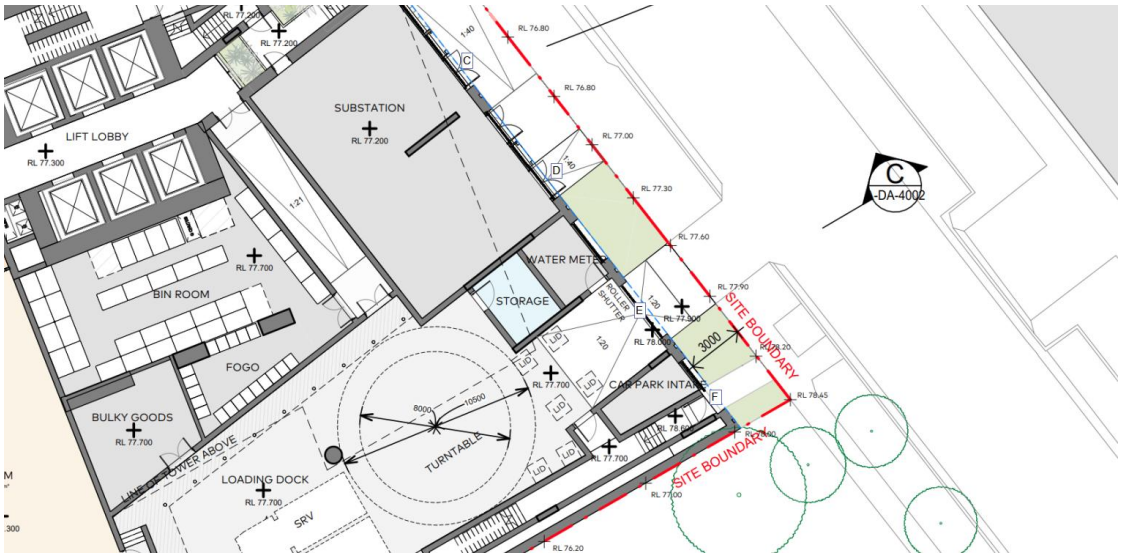
Basement and Loading DockEntry

The roller shutter access point satisfies this (See E within Table 6.1) across Nicholson street (see Figure 66.2), with Christie Street's below ground access requiring at a minimum access level of 72.00 m AHD to fully comply with Council requirements. (Figure 6.3).

Figure 6.11: Plan of Access Locations

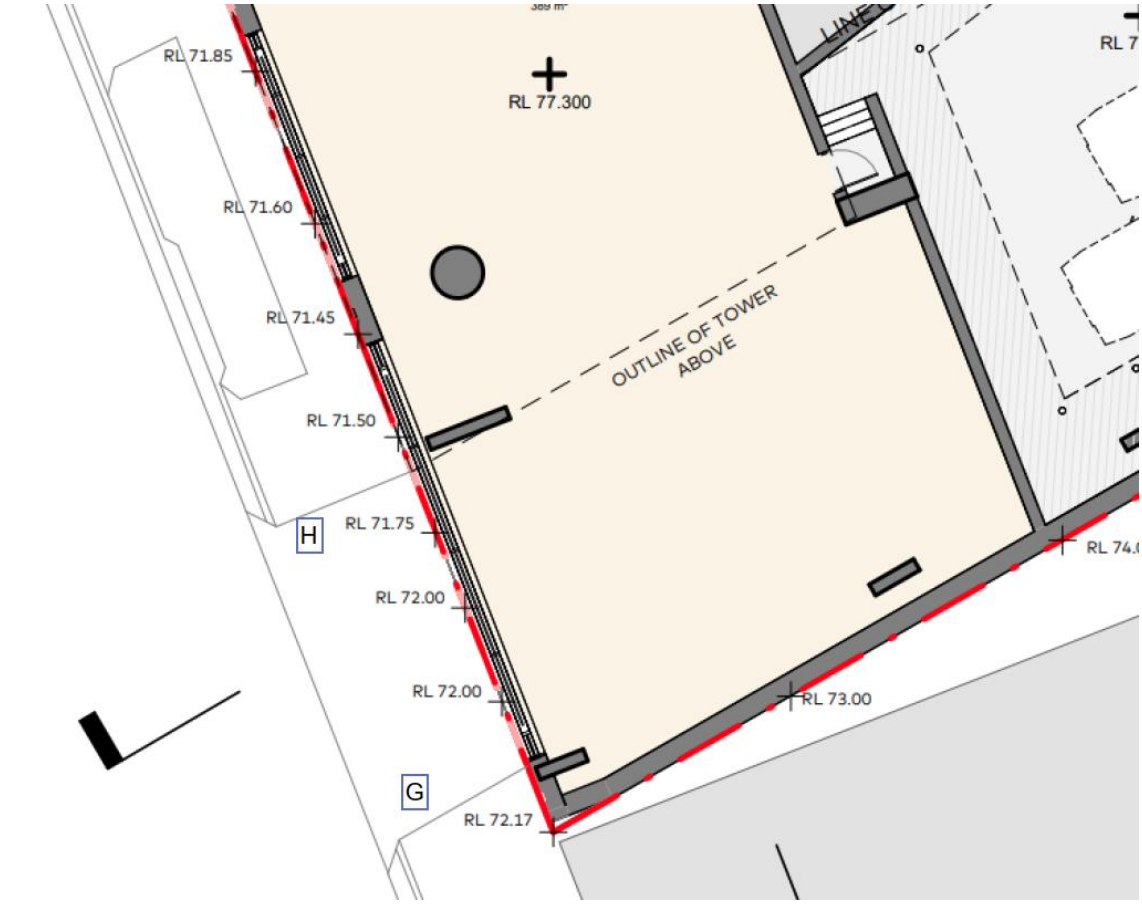
Source: Cox Architecture

Figure 66.22: Key Building Access Locations (Nicholson Street)



Source: Cox Architecture

Figure 6.3: Key Building Access Locations (Christie Street)



Source: COX Architecture

6.2 Flood Emergency Management

The flood emergency management (EM) strategy for the site has been assessed following advice provided in Flood risk management guideline EM01 - Support for emergency management planning (DPE 2023), Lane Cove Local Emergency Management Plan (2021), and Willoughby/Lane Cove Flood Emergency Sub-Plan (2023) from the NSW SES.

The EMPlan details arrangements for prevention, preparation, response and recovery to emergencies within the Lane Cove Emergency Management Region (LCMR). The objectives of this plan are to:

- Support Local Emergency Management Plans (EMPLANs) and augment them when required.
- Identify trigger points for regional level activation, escalation and demobilisation.
- Define participating organisation and Functional Area roles and responsibilities in preparation for, response to and recovery from emergencies.
- Set out the control, co-ordination, support and liaison arrangements at the Regional level.
- Detail activation and alerting arrangements for involved agencies at the regional level; and
- Detail arrangements for the acquisition and coordination of resources at the regional level.

The NSW SES leads flood EM planning and has the following legislative responsibilities in accordance with the State Emergency Service Act 1989:

- To protect persons from dangers to their safety and health, and to protect property from destruction or damage, arising from floods, storms and tsunamis
- to function as the combat agency for dealing with floods (including the establishment of flood warning systems) and to coordinate the evacuation and welfare of affected communities

The role of the NSW SES includes community education, collation of flood intelligence, flood EM planning and flood response, including the evacuation and welfare of affected communities.

To help minimise the flood risk to future occupants, it is important that developments consider flood emergency response. There are two main forms of response that may be adopted:

- Evacuation
  - Horizontal evacuation of occupants from the floodplain before the properties and/or evacuation routes become flooded
- Shelter-in-place
  - Vertical evacuation of occupants in a building to a level higher than the PMF level, who then shelter from the flood until it is safe to return to the ground floor and external areas

6.3 Emergency Planning

It has been established that roads around the site are at risk of flash flooding as critical storm durations cause inundation within less than 6 hours. Inundation caused by flash flooding can occur with little or no warning and cause a rapid rise in water level over a brief period of time. Flood events of this nature do not last more than a few hours.

Severe storms can arrive with little warning or intensify over a short period of time posing a challenge to evacuation as an EM strategy. An EM strategy for the site has been considered for two separate time periods with the emphasis of self-preparation and self-evacuation:

- The period of time prior to the arrival of a storm when surrounding roads are free from flooding
- The period of time during and after the storm when surrounding roads may be inundated

6.3.1 Emergency Management Strategy – Prior to Storm

SES advises that when flash flooding is likely, the best action to take is to leave low-lying homes and businesses (evacuation) well before flooding begins, but only if it is safe to do so. This self-evacuation would need to take place in the hours preceding a predicted storm event before flooding begins to impact the road network.

Evacuation arrangements for the St Leonards area fall under the Willoughby–Lane Cove Local Emergency Management Plan (EMPLAN), which is coordinated by NSW SES and Lane Cove Council. In the event of an emergency, designated evacuation centres are activated based on the scale and location of the incident. The advised evacuation centre for the site is Royal North Shore Hospital, which lies within 500m of the site. However, the surrounding arterial roads do not provide the means of moving to safer locations, whether that is the nominated evacuation centre or away from a forecasted storm area. Evacuation centres are set up at the discretion of the SES incident controller however they may not be operating or may take time to get up and running in the event of a flash flood.

Enacting this strategy would require local monitoring of forecasts issued by Bureau of Meteorology (BoM), including the daily Thunderstorm Forecast and the more specific Regional Severe Thunderstorm Warning and Detailed Severe Thunderstorm Warnings. This could be undertaken by a nominated flood warden for the precinct via the PA system for the buildings.

The forecasts have the following approximate lead times:

- Thunderstorm Forecast
    - 24-48 hours – forecasts likelihood of severe thunderstorms developing across NSW from ‘possible’ through to ‘likely’
    - if the forecast indicates severe thunderstorms are likely then advice should be issued to residents to prepare accordingly. This may entail more active monitoring of BoM forecasts, activating a Home FloodSafe Plan, preparing their property (if located on ground floor) or preparing to self-evacuate

- Regional Severe Thunderstorm Warning
    - 3 hours - forecasts broad areas where severe thunderstorms are occurring or may occur in the next 3 hours
    - the regional warning indicates severe storms are likely, giving less than three hours warning. This time period is the last feasible window where occupants could evacuate to safer areas prior to the storm arriving. However, due to local storm activity and storm tracks, arterial roads surrounding the precinct area may already be affected by flooding
    - a previous state of readiness should allow the rapid mobilisation to evacuate to a nearby hub or to seek shelter in higher parts of the buildings prior to the arrival of a severe storm

- Detailed Severe Thunderstorm Warning
    - less than 60 minutes - detailed warnings are issued when individual severe thunderstorms are within range of the city weather radars
    - they indicate the forecast direction of movement for 60 minutes and immediate Threat Area ahead of the storm
    - if the Detailed Severe Thunderstorm Warning or Threat Area encompasses the site then it is likely too late to safely evacuate before the storm arrives

6.3.2 Emergency Management Strategy – Evacuations during a Storm

The site is located in an area of flooding concern. It is noted that the rate of rise, resulting flood depths and the size of the floodplain would make it unsafe to evacuate through the surrounding roads during a storm. A particular risk is the narrow straight between buildings which shows higher flood depths and velocities, this area should be avoided in a flood event.

Evacuation by either vehicle or on foot from this area will be difficult for affected occupants. SES and emergency access to the site during flooding may also be difficult as it is adjacent to the roads within areas of the floodplain with significant flood depths. Due to these problems special shelter-in-place provisions should be provided as the primary evacuation method if conditions to not allow for safe horizontal evacuation to higher, non-inundated roads.

The short warning time, rapid rate of rise and short duration of flooding in the catchment mean evacuation improvements would have little benefit, and focus should be placed on education and preparedness", reinforcing the need for a shelter in place strategy.

6.3.3 Emergency Management Strategy – Shelter in Place (SIP) during a Storm

NSW SES StormSafe advises the following during a storm:

- never enter or travel through floodwater,
- stay indoors,
- stay clear of creeks, drains, causeways, gutter and streams.

Section 5.1.7 in the NSW State Flood Plan describes Shelter in Place (SIP) is an appropriate strategy to be considered where significant constrains to evacuation exist. Shelter-in-place is determined as a refuge occurring above the PMF level and may occur when there is a risk to public safety and other means of evacuation are not possible.

The site is embedded within an existing road network that was not designed to be free from flooding during extreme storms. It is beyond the scope of the proposal to consider upgrades to local drainage networks to provide flood-free evacuation routes. Consequently, SES advice would preclude evacuating when local roads are flooded as it poses a significant risk to life as entering flood waters is the main cause of death during a flood event.

6.3.4 Compatibility with Shelter in Place Guideline for Flash Flooding

The Shelter in place guideline for flash flooding (DPHI 2025) indicates that SIP is a suitable emergency management strategy for development proposed in flash flood environments. Table 6.1 outlines the decision-making process for the proposed development, based on the advice provided in the Shelter in place guideline for flash flooding.

Table 6.2: Compatibility with Shelter in Place Guideline

Shelter in Place Consideration	Decision	Relevant FIRA Section
Understanding the full range of flood behaviour up to, and including the PMF	A range of storms has been assessed to understand the range of flood behaviour up to 1% AEP and the PMF	5.2
Does shelter in place align with existing emergency management strategies for the area	Yes – There is no formal evacuation procedure or routes identified for the site, other than those proposed in the NSW SES Local Flood Plan (2023)	6.3.1
Has evacuation off-site (the primary emergency management strategy) been investigated and determined to be unachievable	Yes – Access has been investigated and is unachievable in both 1% and PMF events.	6.3.2
Does the development include medical centres, emergency service and community facilities, and	No	6.3.2

Shelter in Place Consideration	Decision	Relevant FIRA Section
sensitive and hazardous land uses, some of which may not be suitable for shelter in place		
Shelter in place for greenfield development is not supported	The site is not a greenfield development	2.1
Whether there is existing government developed flood warning systems that give advanced detailed forecasts of flash flooding to allow sufficient time to evacuate to the proposed refuge locations	Due to the flash flood nature, warning times are limited, especially during rapidly rising events. There is no evidence of sufficient warning time.	6.3.1
Can the community effectively be informed of the risks associated with the emergency management strategy	Yes	6.3.1
Detailed assessment of evacuation off-site to determine that evacuation off-site is not achievable	Yes, the surrounding road networks are not free from flooding.	6.3.1
Flash flooding is the only flood risk present at the site	Yes, critical storm durations are up to 6 hours for the site	5.1

6.3.5 Emergency management strategy – Residual risks

6.3.5.1 Education

Community awareness of flooding is a significant issue within the floodplain due to the infrequency of severe floods and the anticipated depths of these floods in a PMF event. The Precinct Manager need to be aware of the flood risk and their obligation to evacuate the basement car park and ground floor levels when inundation begins to occur. Residents need to be aware of the flood risk and the response requirement during a PMF flood event. As part of this procedure, evacuation drills should be conducted regularly to ensure residents are aware of the procedures for sheltering within the site.r

6.3.5.2 PA System

The building PA system can be used to communicate evacuation directions and safety messages to the population in the lead-up to and during a flood to assist in improving the safety of the community.

6.3.5.3 Medium and high-density residential buildings

Make buildings as safe as possible to occupy during flood events. An area of habitable floor of any residential development should be located above the PMF with the building structurally designed for the likely flood and debris impacts. The buildings should include:

- Alternative power source, with capacity for at least 8h for essential needs
- Automatic fire suppression systems
- Emergency telecommunication system
- Toilet facilities accessible to people with disabilities
- First-aid kit
- Emergency supplies kit
- Shelf-stable food

6.3.6 Emergency Management Considerations

Table 6.3 details key considerations and the advised outcomes related to each flood risk emergency management.

Table 6.3: Emergency Management Considerations

Shelter in Place Consideration	Decision and Evidence	Relevant FIRA Section	Outcome
Is warning time available to onset of flooding?	No - The time to flooding and flood duration are typically very short with minimal warning time. Critical storm durations around the site are less than 6 hours with flood warnings limited to severe weather warnings for the area and no specific advice on local impacts of flash flooding	6.3.1	Unable to evacuate in rapid onset event
Can development be modified to allow evacuation?	No	6.3.2	Stormwater drainage system amendments cannot be improved enough to enable evacuation as the primary advised emergency management solution; the outcome should revolve around safe evacuation either to a communal location outside the floodplain or shelter in place.
Is time of isolation short?	The period of worst-case inundation in the area surrounding the site is within 6 hours.	6.3.1	Consider development types and apply controls
Are occupants able to be safe and self-sufficient for duration of flooding	Yes - FPLs are designed to keep the buildings free from flooding under the most extreme circumstances. Flood-free areas exist within the precinct that could be used as muster points in the event of a flood emergency	6.1	Consider development types and apply controls
Are residual risks associated with SIP tolerable	Yes - Low flood hazard predicted within the precinct during the most extreme storms FPLs are designed to keep the buildings and below ground car parks free from flooding under the most extreme circumstances Flood-free areas located within the precinct could be used as a muster point or shelter location Building PA system can be used to relay emergency information to residents	6.1 6.3.5	Consider development types and apply controls

6.4 Compatibility with Design Controls

The Design Recommendations within this FIRA have been proposed to meet the requirements of the Design Controls applicable to the site. A summary of the site compatibility is presented below:

- The NSW Flood Prone Land 2021 package notes a planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Environmental Protection Zones to a Residential, Business, Industrial or Special Purpose Zones. These land use changes represent an intensification in zoning which could potentially increase flood risk
    - The rezoning does not propose changes to any land zoned as Recreation, Rural, Special Purpose or Environmental Protection Zones
    - The zoning will remain as Residential under which residential flats are permitted in both the existing and the proposed zones. The main purpose of the rezoning is to increase the permissible density of the land.
- This FIRA has been undertaken in accordance with the NSW Government's Flood Prone Land Policy and the principles of the Flood Risk Management Manual

The precinct rezoning enables the increase in density in line with endorsed NSW Government strategies. While the NSW Flood Prone Land 2021 package notes a planning proposal must not permit a significant increase in development density, the proposed intensification of the proposed site at 46-52 Nicholson Street & 59-67 Christie Street is required to accommodate the additional residents in St Leonards over the near future. The proposed intensification will be in the form of vertical development with maximum height and Floor Space Ratio (FSR) increases to accommodate the growing population.

It is possible that direct flood risk to any person could be reduced by implementing the design recommendations and that the residual flood risk could be also reduced. To summarise:

- **Intensification within a brownfield site,**
  - this type of development can elevate the higher risk residential use above the PMF level and can make allowance for shelter-in-place refuge and vertical evacuation which is considered an improvement on the current flood exposure
  - intensified development offers more shelter-in-place opportunities as it will likely provide more floor space for refuge above the PMF level compared to the existing residential dwellings
  - the expected number of persons located on ground floors can be limited to current occupation or increased if the raised ground floor level reduces the risk to future occupants
- **FPL requirements and other Development Controls,**
  - the Upper Ground level and all first-floor storeys would be above the PMF level in most instances
  - it is expected that new multi-storey buildings will be stable during flooding up to the PMF and that all non-ground floor residents in multi-storey residential development would be only exposed to an indirect flood risk

- **Implementation of Flood Emergency Response Plan (FERP),**
  - A developed site specific FERP could address the flood risk faced directly and indirectly by future residents in contrast to the flood risks faced by existing residents in flood affected locations. It is likely most of these properties have no established site-based flood emergency response plan.
  - it is conceivable that a high-rise residential development with an effective flood emergency response plan and vertical evacuation opportunities may have a lower residual flood risk than existing housing limited opportunities for vertical evacuation

6.5 Summary of Flood Emergency Management

Section 6.3 outlines the relative flood risk that the site at 46-52 Nicholson Street & 59-67 Christie Street, St Leonards is exposed to. The site is affected by flash flooding coupled with overland flow. This is largely due to the short times associated with flash flood events, the speeds and depths associated with these events, and difficulties associated with evacuation to a safe location.

In flash flood catchments, the time to flooding and flood duration are typically short with minimal warning time. Warnings to the community are often limited to severe weather warnings or flood watches for the general area. There is often no specific advice available on the local impacts of flash flooding and there may be little time between the start of flood-producing rainfall and flooding of roads, property and potentially buildings.

To help minimise the flood risk to future occupants, the first response that should be adopted in a flood emergency event for 46-52 Nicholson Street & 59-67 Christie Street, St Leonards is shelter in place as the flood warning time and flood duration are both less than six hours for the

site. Flooding along Nicholson Street and Christie Street also limits the horizontal evacuation potential for the area. The lack of pre-determined evacuation locations and the rapid onset of flooding in the catchment led to sheltering being the most suitable means of emergency management.

7 Conclusions

This FIRA has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued by the Department of Planning, Housing and Infrastructure (DPHI) for the subject SSDA.

The Flood Risk SEAR requests a FIRA for the site to support the SSDA in accordance with the principles of the Flood Risk Management Manual and Flood Risk Management Guideline LU01.

Flood model scenarios for 46-52 Nicholson Street & 59-67 Christie Street, St Leonards were based on the following:

- Existing conditions
    - An assessment of the current flooding conditions based on existing survey of the site
- Design conditions with mitigation measures:
    - An amendment to the existing conditions model was built to incorporate the proposed development layout as building block-outs.

The 1% AEP and PMF have been assessed as they relate to the Lane Cove DCP 2009 Flood Planning Levels and emergency management measures for the development. The PMF is the largest flood that could theoretically occur at a location and defines the maximum extent of flood-prone land. Dry areas above the PMF level are expected to be free from flooding under all scenarios.

There is flooding predicted within the site and surrounding roads of 46-52 Nicholson Street & 59-67 Christie Street, St Leonards. The stormwater networks have relatively low capacity with excess flows being conveyed along adjacent roads to the rail corridor West of the site. 1% AEP flood depths in the precinct of the proposed development are typically up to 0.8m with this value increasing between the narrow sections between buildings.

To represent 46-52 Nicholson Street & 59-67 Christie Street, St Leonards design case, a new building block out was included in the model covering the proposed site. This assumes that the site will be immune from flooding in the 1% AEP storm by adopting the Council Flood Planning Level (1% AEP + 500 mm freeboard, selecting the stretch target for freeboard).

The flood model highlights the following:

- Changes in peak 1% AEP water level
    - the changes in peak water level because of the development do not exceed the recommended thresholds for habitable buildings or residential zoned land
    - no cumulative impacts predicted
    - there is no new flooding to existing properties
- Changes in peak 1% AEP flow
    - the changes in peak flow are negligible
- Changes in 1% AEP inundation duration
    - there are no increases in duration of inundation that exceed the recommended times
- Change in 1% AEP flood velocity
    - flood water velocities are insignificantly changed by the proposed development

- there are no changes in flood water velocity outside the site boundary

- Change in 1% AEP flood hazard
  - there are no significant changes in flood hazard outside the site boundary. The flood emergency management (EM) strategy for the site has been assessed following advice provided in Flood Risk Management Guideline EM01 - Support for emergency management planning (DPE 2023) and relevant plans from the NSW SES.

Aspects of this development are required to meet flood related development controls, and the key risks as addressed through design are noted here:

Flood Levels and Appropriate Immunity

The design Flood Levels in Table 6.1 highlight the minimum required floor levels to appease this requirement. According to the development-specific advice and development controls of the Council relating to the habitable rooms, 1% AEP + 0.3m, or if required, 0.5m freeboard is required to meet the Lane Cove Council Flood Policy to enable a level of flood resilience for the residences and provide a reasonable level of flood mitigation. The proposed minimum entrance levels being 77.30 m AHD for the building habitable floor levels and basement car park entrances/stairways. As noted on the architectural drawings, the habitable floor levels of 77.30 m AHD for the Social building would suit the habitable floor levels.

The guidance from the DCP requires a minimum 1% AEP + 300, or if required in high flow cases, 500mm minimum freeboard level for basement car parks and habitable floor levels. This equates floor levels and minimum access as shown in Table 6.1. With the development of drainage in the surrounding site in the next design stage, the development's current proposal follows both Lane Cove Council's LEP 2009 and DCP 2009 and be in line with FIRA guidance that requires consideration of relevant planning instruments and local council standards.

Emergency and potential evacuation during flood events

The required emergency and potential evacuation during flooding events for the site have been considered regarding both the severity of flooding and duration of flooding events. The site is affected by mainstream flooding and there is only risk of extended periods of flood risk that could lead to isolation or a need for prior preparations of flooding provisions in the modelled rare PMF event.

Based on this FIRA, an evacuation strategy and a shelter in place policy during a flood emergency is the most logical EM approaches to protect life, given the following constraints:

- the roads surrounding the site are at risk from flash flooding; flooding that has a relatively high discharge over a short duration – the interval between the observable causative event and the flood is less than six hours. Given the site does not have sufficient warning time to adequately evacuate the population of the building, this should be preferable, however it should be made clear that:
  - the opportunities for horizontal evacuation during a storm are limited as surrounding streets are subject to high flood hazards that present an unacceptable risk to people. NSW SES advice is not to venture out during a storm or cross any area of flood inundation
  - the rate of rise and extent of flooding in the most extreme events means that emergency evacuation centres may not get set up and evacuees would generally have to take shelter in other private premises that may not have robust flood controls
- the time of isolation is short, based on the duration of flooding around the precinct. A development which is isolated for a few hours by flood water in PMF does not pose a significant risk to life

    - redevelopment affords a means of creating a safe, on-site shelter above the PMF – redevelopment which caters for sheltering in place can be used to reduce existing risk to life for individuals who currently occupy the floodplain, but it is likely to increase the number of individuals at risk
- additional Development Controls can be imposed which seek to manage the residual secondary risks to life caused by flood isolation to ensure that risks remain tolerable