MOTT MACDONALD

The Timberyards by RTL Co.

State Significant Development Application (SSDA)
Flood Impact and Risk Assessment

January 2025

Acknowledgment of Country

On behalf of Mott MacDonald, we would like to begin by acknowledging the Traditional Custodians of the land on which we meet today, and pay our respects to their Elders past and present.

We recognise and respect their cultural heritage, beliefs, continued connection to the land and water and commit to building a brighter future together.

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Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	07 Nov 24	D Chick	D Fettell	A Tarshan	Draft issue for peer-review
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Contents

Tables

Figures

Photos

Executive summary

This Flood Risk and Impact Assessment has been prepared on behalf of Varsity Assets Management Pty Ltd (Developer) on behalf of RTL Investments 2 Pty Ltd as trustee for RTL Marrickville Property Trust ('RTL Co.') (the Applicant) to support a State Significant Development Application (SSDA) for the proposed *The Timberyards by RTL Co*. development (The Timberyards). The SSDA (SSD-76927247) seeks consent for a diverse rental housing precinct comprising build-to-rent (BTR), co-living and affordable housing. The precinct development comprises seven buildings ranging from eight to thirteen storeys, with open space that includes a pocket park, through site links and communal open spaces. Specifically, consent is sought for the following:

- Site preparation (including remediation), demolition and bulk excavation for basement parking;
- Residential accommodation (shop top housing, residential flat buildings and mixed use buildings) that includes BTR, co-living and affordable housing;
- Retail premises on the ground floor within the MU1 zoned land and extending up to 25m into the R4 zoned land;
- Publicly accessible recreation area (pocket park) and through site links;
- Neighbourhood shop (within the R4 zoned land);
- Associated landscaping and public domain works; and
- Augmentation of, and connection to, existing utilities as required.

A detailed description of the proposal is provided in the Environmental Impact assessment (EIS) by Ethos Urban. The development is declared State Significant by virtue of being a BTR development on land in Greater Sydney with an Estimated Development Cost (EDC) of greater than $50 million, with the tenanted component representing greater than 60% of the EDC (Schedule 1, State Environmental Planning Policy (Planning Systems) 2021).

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. Whilst the Flood Risk SEAR requests a FIRA for the site (Table 1.2) the Timberyards does not fall within land identified by the Inner West LEP Flood Planning Area or Marrickville DCP Flood Liable Land Map. As such the standard LEP clauses related to flooding do not apply. However, 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 that the residual flood risk could be also reduced by complying with the Marrickville DCP 2011 and Victoria Road DCP 2019. Compliance can be achieved without negatively affected existing flood risk to the surrounding areas.

To summarise the outcome of the design:

- 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
- Flood Planning Level requirements and other Development Controls,
  - the Upper Ground level and all first floor storeys would be above the PMF level in most instances
  - all basement ingress points achieve the Flood Planning Level (1% AEP + 500 mm freeboard) as a minimum, as described by Marrickville DCP 2011
  - 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)
  - the Timberyards SEARs do not require establishing a FERP, however, the establishment of a FERP should be completed prior to the Occupation Certificate being issued, with the obligation falling on the building owner or Body Corporate
  - a FERP for new multi-storey development can 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.

The flood emergency management (EM) strategy for the Timberyards 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.

Based on this FIRA and the *Marrickville Valley Flood Risk Management Study and Plan* (2017), a shelter in place policy during a flood emergency is the most logical EM approach to protect life, given the following constraints:

- the site is 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. 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 other 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 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

1 Introduction

1.1 Project Description

This Flood Impact and Risk Assessment (FIRA) has been prepared on behalf of Varsity Assets Management Pty Ltd (Developer) on behalf of RTL Investments 2 Pty Ltd as trustee for RTL Marrickville Property Trust ('RTL Co.') (**the Applicant**) to support a State Significant Development Application (SSDA) for the proposed *The Timberyards by RTL Co.* development. The SSDA (SSD-76927247) seeks consent for a diverse rental housing precinct comprising build-to-rent (BTR), co-living and affordable housing. The precinct development comprises seven buildings ranging from eight to thirteen storeys, with open space that includes a pocket park, through site links and communal open spaces. Specifically, consent is sought for the following:

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1.2 Project Vision

RTL Co. aim to deliver Sydney's premier neo-industrial residential neighbourhood - a global benchmark for imaginative urbanism. The Timberyards by RTL Co. aims to seamlessly integrate diverse residential offerings into the distinctive character of Marrickville, fostering a sense of pride among residents and the local community. The project will deliver a wide range of rental living solutions, complemented by recreation spaces and local retail, all underpinned by Connection to Country and environmentally sustainable design principles.

1.3 Site Description

The Timberyards by RTL Co. (The Timberyards) is located in Marrickville within the Inner West Local Government Area (LGA). The site comprises 39 lots with legal identification listed in Table 1.1 below, and has a total area of 22,770m^2 or, for the purpose of calculation of floor space, an area of 22,564m^2 (excluding the SP2-zoned Victoria Road widening land, which is within the site boundary). The site is located within Precinct 47: Victoria Road in the *Marrickville Development Control Plan 2011* (MDCP 2011).

The site is approximately 700m walking distance to the newly opened Sydenham Metro Station, with 7-minute travel time to the Sydney CBD.

The site currently comprises primarily industrial and light industrial uses, with residential dwellings to a minor portion of the site on Farr Street (western boundary) and Victoria Road (eastern boundary). The site also has frontage to Sydenham Road to the south and Mitchell Street to the north (and encompassing a small lane off Mitchell Street). An aerial map is provided in Figure 1.1.

Table 1.1: The Timberyards legal identification

Lot/DP	Property Address	Lot/DP	Property Address	Lot/DP	Property Address
1/724487	119A Sydenham Rd	1/572829	35 Farr St	3/252507	19 Farr St
1/972534	121 Sydenham Rd	12/4590	14 Mitchell St	4/252507	21 Farr St
B/439802	129 Sydenham Rd	13/4590	10 Mitchell St	5/252507	23 Farr St
A/439802	131 Sydenham Rd	14/4590	8 Mitchell St	6/252507	25 Farr St
D/377270	133 Sydenham Rd	15/4590	183 Victoria Rd	7/252507	27 Farr St
1/700223	135 Sydenham Rd	16/4590	4 Mitchell St	8/252507	29 Farr St
B/343286	7 Farr St	17/4590	2 Mitchell St	9/252507	31 Farr St
A/304426	9 Farr St	3/4590	165 Victoria Rd	1/583801	33 Farr St
A/304426	11 Farr St	2/4590	167 Victoria Rd	C/301985	175 Victoria Rd
1/78883	13 Farr St	1/4590	169 Victoria Rd	D/301985	183 Victoria Rd
1/252507	15 Farr St	A/301985	171 Victoria Rd	E/301985	175 Victoria Rd
2/252507	17 Farr St	B/301985	173 Victoria Rd	A/166330	183 Victoria Rd
345/587262	191 Victoria Rd	1/315293	183 Victoria Rd	20/667441	183 Victoria Rd

Figure 1.1: The Timberyards by RTL Co. – Aerial Site Map

Source: Nearmap, Ethos Urban

1.4 Purpose

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, with specific SEAR(s) identified in Table 1.2 below.

Table 1.2: Relevant SEARs

SEAR	SEAR description	Report name or report section
16. Flood Risk	Identify the flood planning level as set out in the relevant council LEP or SEPP and identify any: • flood risks on site having regard to adopted flood studies • the potential effects of climate change, and • any relevant provisions of the NSW Flood Risk Management Manual	The Timberyards site falls outside the Flood Liable Land and Flood Risk Planning areas identified by the Inner West LEP 2022 and the Marrickville DCP 2011. Therefore, the site is considered at low risk from flooding.
	A flood impact and risk assessment (FIRA) must be prepared having regard to the *Flood Impact and Risk Assessment Guideline - LU01* (FIRA guide). When determining the scope and category of the FIRA the requirements outlined in the FIRA guide must be considered. The FIRA must: • identify and describe existing flood behaviour and flood constraints on the site and its surrounding areas for the	The Timberyards by RTL Co. by RTL Co. Flood Impact and Risk Assessment (FIRA) 10% AEP has been assessed in lieu of the 5% AEP storm as the hydrology

SEAR	SEAR description	Report name or report section
	full range of events, including 5% AEP, 1% AEP, PMF and 0.5% AEP or 0.2% AEP and provide an assessment of the compatibility of the development and its users with flood behaviour. • determine and describe changes in post development flood behaviour, impacts of flooding on existing community and on the development and its future community for full range of events, 5% AEP, 1% AEP, PMF and 0.5% AEP or 0.2% AEP. • consider impacts of climate change due to any increase in rainfall intensities. The 0.5% AEP or 0.2% AEP events can be used to provide an understanding of the scale of change of flood behaviour relative to the 1% AEP event.	was not available in the received Council flood model.

The aim of the FIRA is to support design of the Timberyards where specific elements of the design may influence existing flood behaviour or introduce additional flood risk. The report aims to identify and analyse:

- existing flooding constraints around the site,
- the 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 assessment describes the nature of flooding that impacts the subject site and outlines planning requirements related to flooding that currently apply to the Timberyards.

The Timberyards SEARs do not require establishing a Flood Emergency Response Plan (FERP); however, one will be required prior to the Occupation Certificate being issued, with the obligation falling on the building owner or Body Corporate.

1.5 FIRA Requirements

The 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 the Timberyards FIRA to meet the desired aims of the, it requires an understanding of:

- a range of flood risk examining major and extreme storm events (10% Annual Exceedance Probability (AEP), 1% Annual Exceedance Probability (AEP) and Probable Maximum Flood (PMF)),
- the constraints that flooding 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

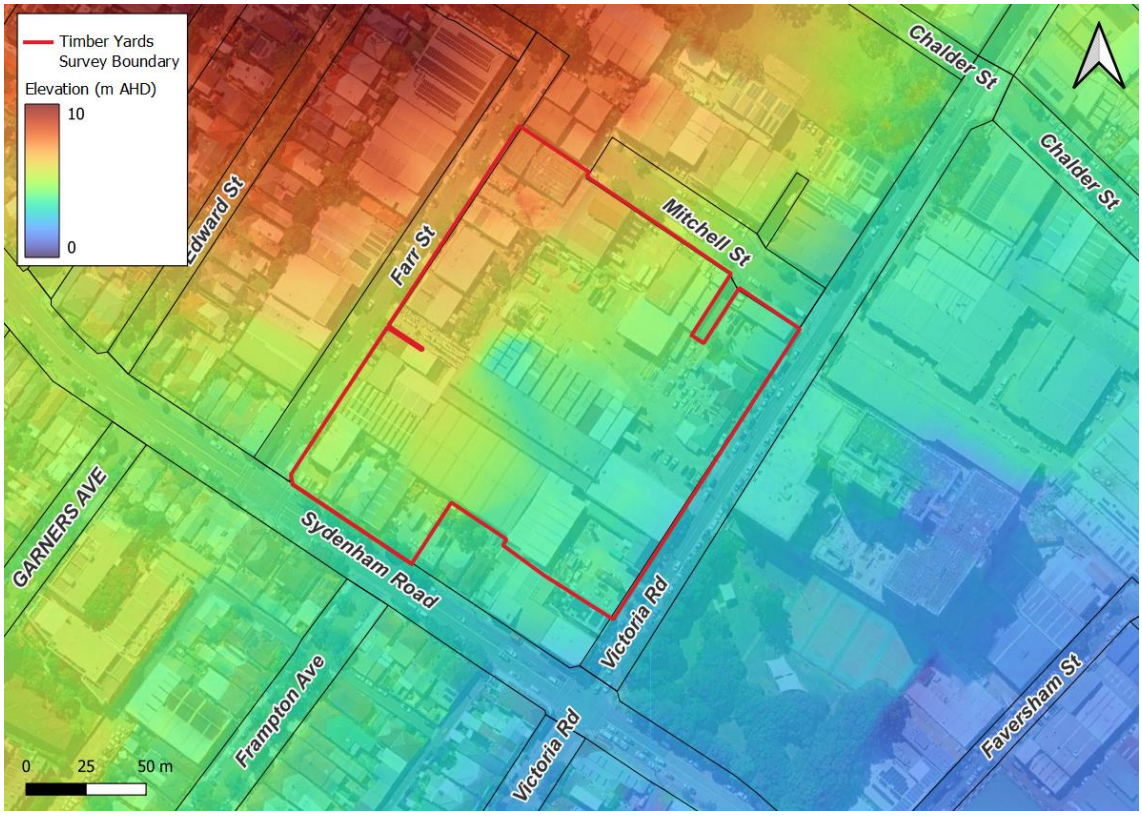
2.1 Study Area

The subject site boundary is identified in Figure 1.1 and Figure 2.1 and is approximately 2.2 hectares. It is located in Marrickville, NSW. Marrickville forms part of the Inner West Council Local Government Area (LGA), southwest of Sydney CBD.

The site is bounded by roads on all four sides: Farr Street and Sydenham Road to the west and south and Victoria Road and Mitchell Street to the east and north. The site is predominantly occupied by Danias Timber with a mixture of residential, retail and light industrial buildings along the interfaces with the surrounding roads.

The area around the Timberyards has relatively gentle slopes from north-west to south-east towards Sydenham station. The area around Sydenham station is very low-lying, with typical elevations between 1 m and 2 m AHD. Elevations across the Timberyards site range from 7.4 m AHD in the north to 3.5 m AHD in the south.

Figure 2.1: The Timberyards - Site Boundary Location and Topography



2.2 Flood Context and Behaviour

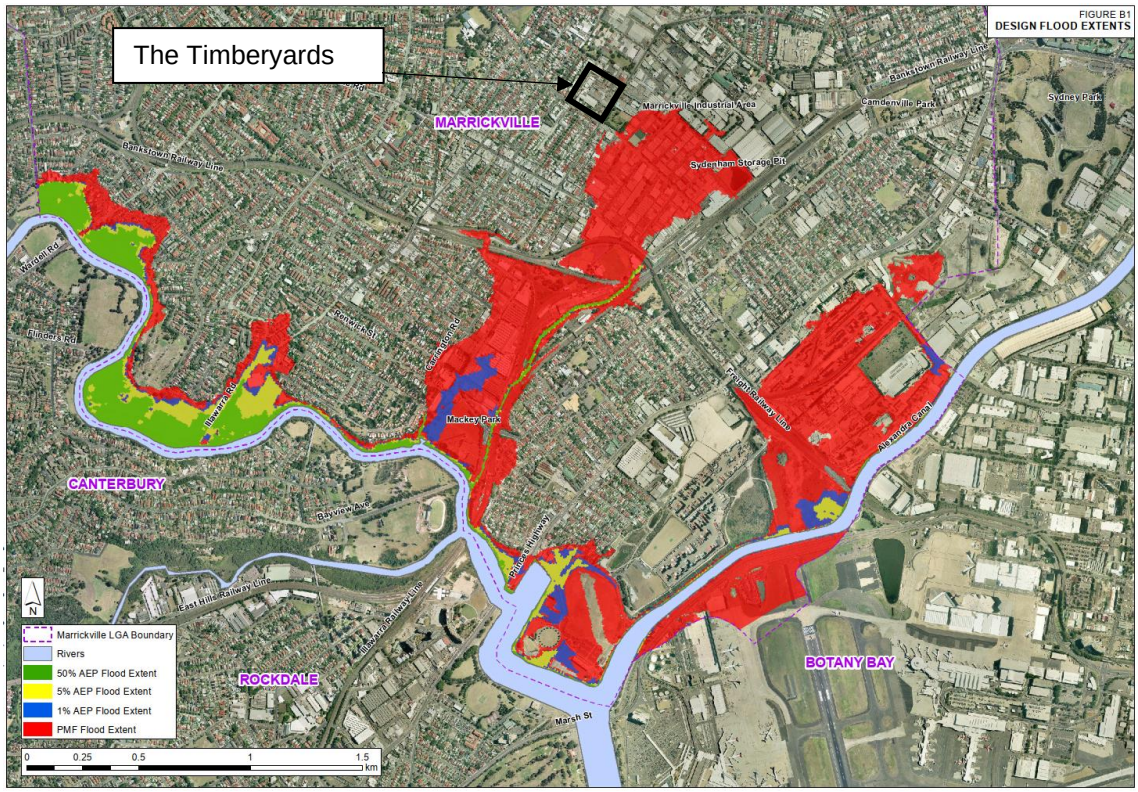
The Marrickville Valley is subject to two sources of flood risk; mainstream flooding from Cooks River and overland flow from intense storms that exceed the capacity of the local stormwater drainage networks.

2.2.1 Mainstream Flooding

The *Cooks River Floodplain Risk Management Plan* (2015 FRMP) was prepared in February 2015 to provide the basis for future management of the floodplain of the Cooks River within the Inner West Council LGA. The 2015 FRMP study does not include management of overland flow areas upstream of the Cooks River flood extent.

Outputs from the study (Figure 2.2) show the Timberyards is not affected by mainstream flooding from Cooks River, including the PMF event.

Figure 2.2: Cooks River FRMP – Design Flood Extents

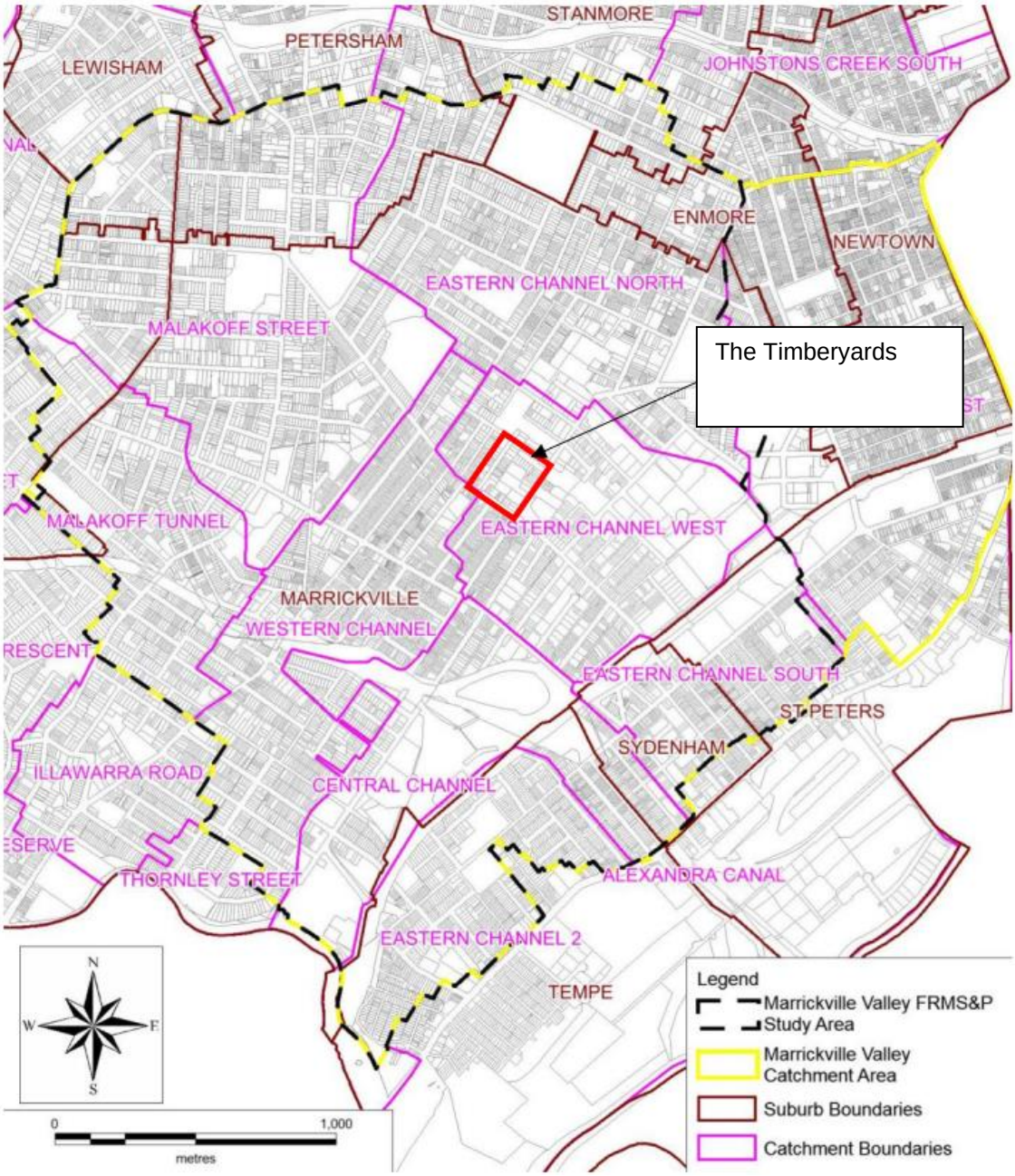


2.2.2 Overland Flow

The *Marrickville Valley Floodplain Risk Management Study and Plan* (2017 FRMSP) is a comprehensive study of the overland flow flood risk affecting the Marrickville Valley. The study defines the existing flooding behaviour and associated hazards related to extreme storms. The Timberyards is only subject to overland flow, as established in Section 2.2.1.

The Marrickville Valley catchment is a 7.9km^2 stormwater catchment that drains into Cooks River via four large outfalls; Eastern Channel, Central Channel, Western Channel and Malakoff Tunnel. The Timberyards is located within the Eastern Channel West sub-catchment (Figure 2.3).

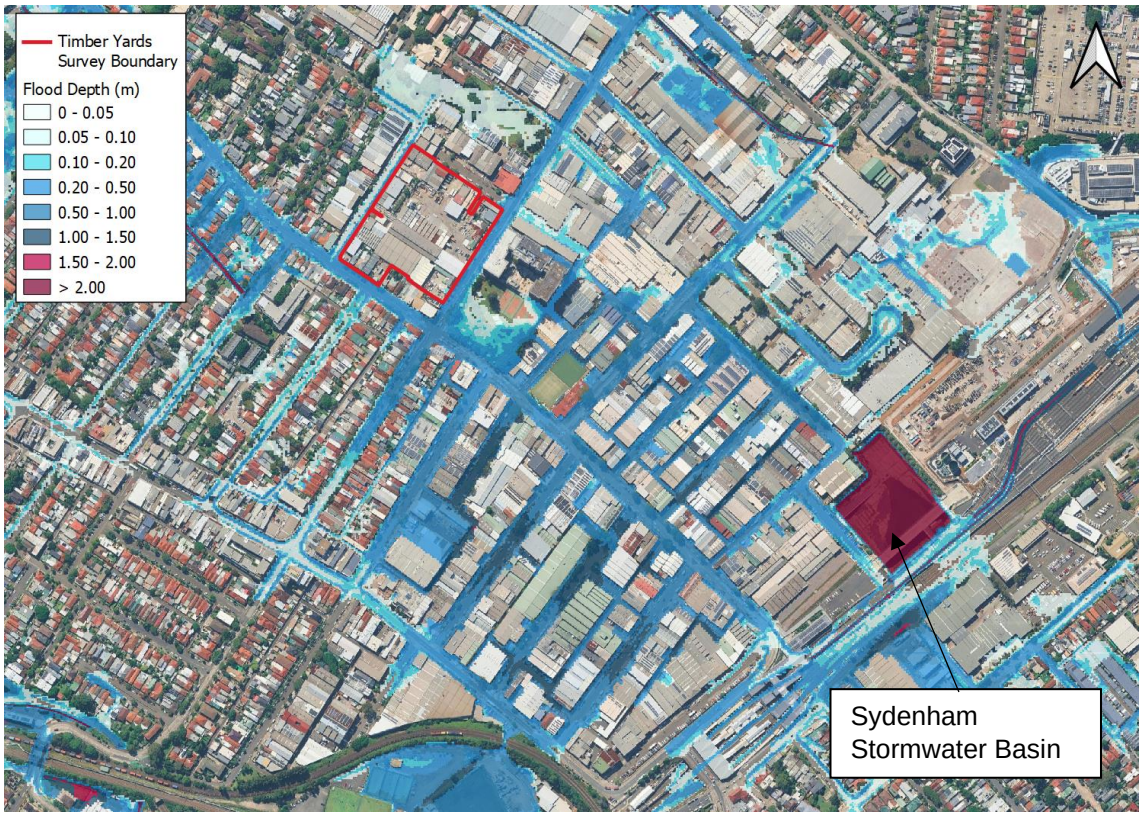
Figure 2.3: Marrickville Valley Stormwater Sub-catchments



Source – Marrickville Valley Floodplain Risk Management Study and Plan (September 2017)

The Eastern, Central and Western stormwater channels have relatively low capacity (typically less than 10% AEP) with excess flows being conveyed along adjacent roads to the lowest part of the catchment near Sydenham station. This includes flow routes along Sydenham Road and Victoria Road converging at the southeastern corner of the Timberyards site. 1% AEP flood depths in the vicinity of the Timberyards typically range from 300 and 500 mm along Sydenham Road and Victoria Road and are shown in Figure 2.4.

Figure 2.4: 1% AEP Overland Flow Flood Depths and Extents



The low-lying area surrounding the Sydenham Stormwater Basin (Marrickville Industrial Area) is subject to deep ponding of flood water, being the natural low point of the catchment. 1% AEP water depths exceed 1 m in a number of locations and most roads are impassable. The Timberyards is located on the fringe of this area, shown in Figure 2.4, however, it should be noted that flooding from overland flow is confined to the road corridors and does not inundate the Timberyards site itself.

2.3 Flood History

The low-lying land in the centre of the Marrickville Valley was previously part of the Gumbramorra swamp which has had a long history of flooding. The size of the freshwater swamp varied depending on the season and rainfall and could double in size during wet periods.

Stormwater is conveyed from surrounding areas into the old swamp basin via a number of stormwater channels eventually being discharged to Cooks River.

2.3.1 1880s

Flooding in Marrickville has been recorded since the 1880s with several flooding incidents between 1884 and 1889.

The Great Marrickville Flood of 1889 was caused by an intense period of rainfall over the course of five days, with 508mm falling during that time (408mm fell during a three day period). According to the Bureau of Meteorology (BoM) IFD for Marrickville, this is in excess of the 1% AEP event. Newspapers reported that all of Tram Vale (the original subdivision over Gumbramorra swamp, now Marrickville Industrial Area) from Victoria Road to Sydenham railway line was covered in water. *"Water also covered all the ground from Sydenham Road to Cooks*

River at the eastern end of Marrickville Road". Reports put the depth at between 2 to 3 metres. The lower parts of Chapel Street, Victoria Road, Sydenham Road, Marrickville Road and Meeks Road (now Carrington Road) "*could not be seen for water*"[1].

Three brick channels were built in Marrickville (Eastern, Central and Western Channels) running into Cooks River to improve drainage of storm water. These channels are key feature of the present day management of stormwater in Marrickville.

2.3.2 1930s

Flooding remained a problem until the 1930s, despite the stormwater channels. It resulted in the construction of the Sydenham Stormwater Basin (Sydenham Pit), a large 9 m deep detention structure adjacent to Sydenham Station with a capacity of 100 ML. Drainage channels convey water to the basin where it is stored and then pumped into the Eastern Channel and discharged to Cooks River.

2.3.3 2020s

Severe storms in February 2022 saw flash flooding in Marrickville. Flooding was observed on low-lying streets around the LGA such as Renwick Street shown in Photo 2.1 however, no recent evidence of flooding has been found in the vicinity of the Timberyards or Victoria Road Precinct.

Photo 2.1: Flooding at Renwick Street, February 2022

Source – ABC News https://www.abc.net.au/news/2022-02-23/sydney-weather-flash-flooding-ses-rescue-22-people/100852830

[1] https://marrickvilleheritage.org.au/2022/03/04/marrickville-floods

2.4 Existing Emergency Management

In June 2015, the SES released the *Marrickville Flood Emergency Sub Plan* to support the local community during a flood event.

In terms of key personnel and their responsibilities the Local Flood Plan outlines the following:

- SES Marrickville Local Controller is responsible for co-ordinating flood emergency response for the local area,
- An Incident Controller for the local area is to be identified by the Local Controller to manage the response in the event of flooding occurring,
- Inner West Council has a number of responsibilities at all stages of emergency
  - Preparedness: Council is to manage the Floodplain Risk Management Process,
  - Response: At the request of the incident controller deploy personnel and resources, close and re-open Council roads notifying SES of road status, assist in protecting residents' properties with sandbagging,
  - Recovery: Management of health hazards including removal of debris and waste, as well as ensuring premises are safe for re-occupation and storage of evacuee's furniture

The following local features within the Marrickville Valley are identified within the sub-plan.

- The SES Marrickville Operations Centre is located at 3-5 Railway Lane, Sydenham
- Supporting operation centres are located at:
  - Marrickville Emergency Operations Centre Marrickville Council Depot Building A, First Floor, 15 Unwins Bridge Road, St Peters
- There are five active reconnaissance areas:
  - Riverside Ave, Dibble Ave, Pilgrim Ave, Tennyson St and Wardell Rd Bridge gauge, Dulwich Hill, downstream side,
  - Illawarra Rd, Cahill Pl, Wharf St, Hill St and Illawarra Rd Bridge gauge, Marrickville, downstream side,
  - Thornley St and Thornley St gauge, Marrickville, down walkway, upstream side,
  - Bay St, Holbeach Ave and Holbeach Ave gauge, Tempe, on Motorboat Club Wharf,
  - Carrington Road, Carey Street, Richardson's Crescent, Renwick Street, Myrtle St, Warren Road and Mackey Park levee.
- No evacuation centres are identified to shelter evacuated residents. The primary advice to evacuated residents is to stay with friends or relatives, or else go to the nearest accessible evacuation centre, to be identified by the SES incident controller.

3 Design Controls

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 for overland flow.

3.1 Inner West Council Documents

3.1.1 Local Environment Plan 2022 (LEP)

Clause 5.21 Flood Planning and *Clause 5.22 Special flood considerations* of the Inner West LEP 2022 outline controls and objectives for land within the Flood Planning Area (FPA). The objectives of this section are:

- To minimise the flood risk to life and property associated with the use of land,
- To allow development on land that is compatible with the land's flood hazard, taking into consideration projected changes as a result of climate change,
- To avoid significant adverse impacts on flood behaviour and the environment.

The FPA identifies land likley to be affected by the 1% AEP flood.

3.1.1.1 Flood Planning Area

Whilst the Flood Risk SEAR requests a FIRA for the site (Table 1.2) The Timberyards does not fall within land identified by the FPA, established by the 2017 FRMSP (Appendix A). As such the standard LEP *Clause 5.21* does not apply.

The lack of inclusion in the FPA is explicable considering the 1% AEP flood map for the site, derived from the 2017 study, which shows overland flow in Sydenham Road and Victoria Road adjacent to the Site, but no actual flooding of the site itself.

3.1.2 Marrickville Development Control Plan 2011 (MDCP 2011)

There are two sections of the Marrickville DCP 2011 which contain development controls relevant to flood risk, both within Part 2 – Generic Provisions

- *Part 2.22 – Flood Management* - This section recognises that there are some flooding risks that require development controls and guidelines in order to reduce or eliminate their impacts,
- *Part 2.25 – Stormwater Management* - This section relates to stormwater drainage for all development types. The flow of stormwater from developments needs to be managed so as to negate or reduce to an acceptable frequency the possibility of flooding buildings and/or the danger to life at any location, through the storage of stormwater where appropriate in developments and the control of major development drainage systems.

While the stormwater section of the DCP does identify some development controls that are relevant to flood management, the majority of flood related controls are identified in the flood management section.

3.1.2.1 Flood Liable Land

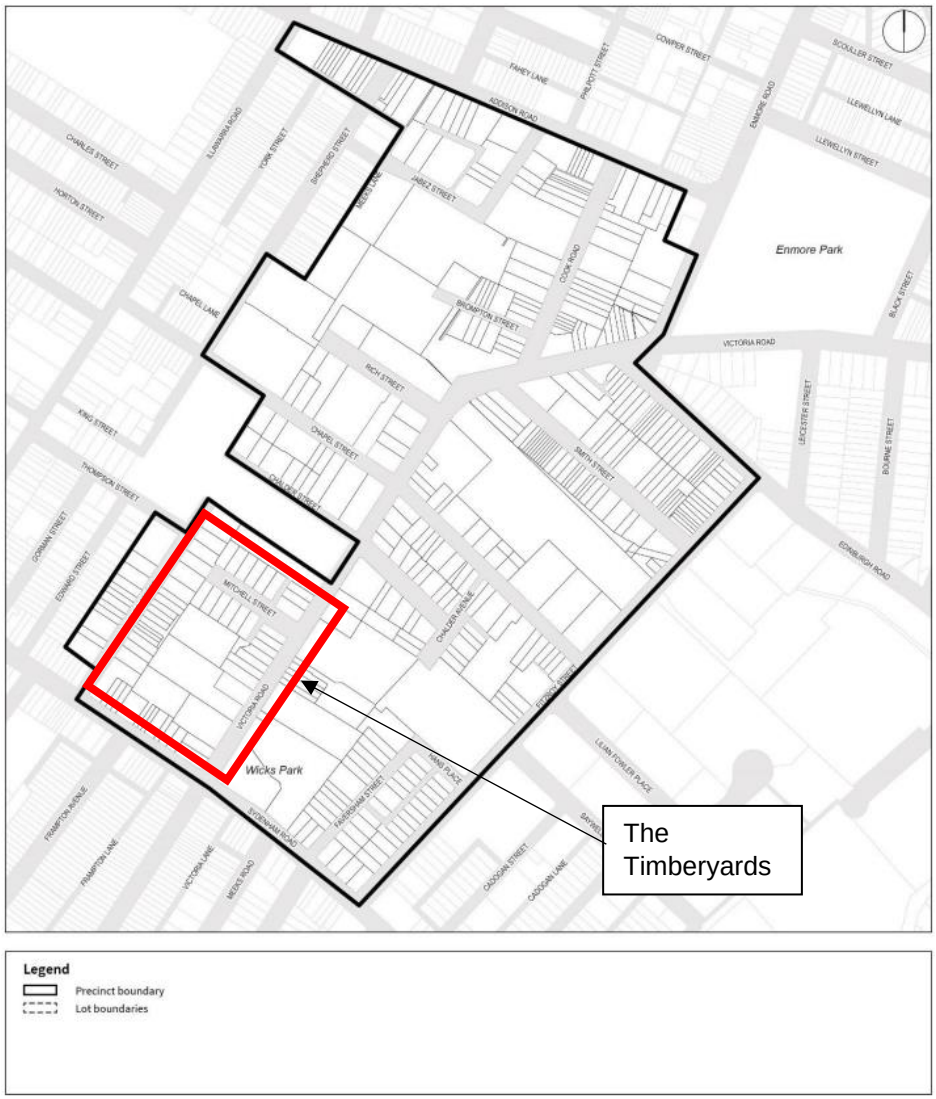
MDCP 2011 identifies flood liable land via the Flood Liable Land Map. Areas considered flood liable are a combination of the FPA (3.1.1.1) and additional areas that are likley to be affected by the Probable Maximum Flood (PMF) of the Cooks River (Figure 2.2).

The Timberyards does not fall within land identified as flood liable by the Flood Liable Land Map (Appendix B).

3.1.3 Victoria Road Precinct (Precinct 47) Control Plan 2019 (VRDCP 2019)

The Victoria Road DCP 2019 establishes a framework to guide development in Precinct 47 – Victoria Road. Part of the Victoria Road Precinct was rezoned by the NSW Government on 1 December 2017 allowing new multi-unit residential, mixed use and business development uses, significantly increasing development potential within the Precinct. This section of the DCP applied to development within the boundary of the precinct as shown in Figure 3.1. The Timberyards fall entirely within this precinct.

Figure 3.1: Victoria Road (Precinct 47) Land Application



This section forms and additional part of the MDCP 2011. It sets out specific controls to guide the future development of the Victoria Road precinct. Development within the precinct will need to have regards to both DCPs.

Specific objectives within Victoria Road DCP 2019 include:

- Stormwater management is integrated within the layout and design of the precinct without compromising the visual attractiveness of the public domain,
- Streets and public open spaces perform a secondary stormwater management function in a manner that does not compromise their core functions for movement and recreation,
- To ensure that stormwater management is appropriate to the site and to the proposed development,
- Stormwater management effectively treats and disposes of stormwater and protects property from flooding.

These are enacted by the following controls:

- Proposed development within the precinct is to be in accordance with *Section 2.17 Water Sensitive Urban Design*, *Section 2.22 Flood Management* and *Section 2.25 Stormwater Management* of the MDCP 2011.

3.1.4 Development Controls - Flood Planning

Inner West Council adopts a Flood Planning Level. By default, the Flood Planning Level is the 1% AEP flood level plus freeboard. The application of freeboard is 500 mm unless an exception is described with a specific development control. The follow relevant controls apply to the Timberyards.

3.1.4.1 Controls for New Residential Development

- ***C5*** - Floor levels of habitable rooms must be a minimum of 500 mm above the 1% AEP flood level at that location. For areas of minor overland flow (a depth of 300mm or less or overland flow of 2m^3/s or less) a lower freeboard of 300 mm may be considered on its merits
- ***C6*** – Any portion of buildings below the Flood Planning Level) must be constructed from flood compatible materials
- ***C7*** - Flood free access must be provided where practicable

3.1.4.2 Controls for New Non-Residential Development

- ***C11*** - All flood sensitive equipment must be located above the Flood Planning Level at that location
- ***C12*** - Any portion of buildings below the Flood Planning Level must be built from flood compatible materials
- ***C13*** - Floor levels (except for access-ways) must be at least 500 mm above the 1% AEP flood level, or the buildings must be flood-proofed to at least 500 mm above the 1% AEP flood level. For areas of minor overland flow (a depth of 300 mm or less or overland flow of 2m^3/s or less) a lower freeboard of 300 mm may be considered on its merits
- ***C14*** - Flood-free access must be provided where practicable

3.1.4.3 Controls for Garages, Carports, Open Car parks and Basement Garages

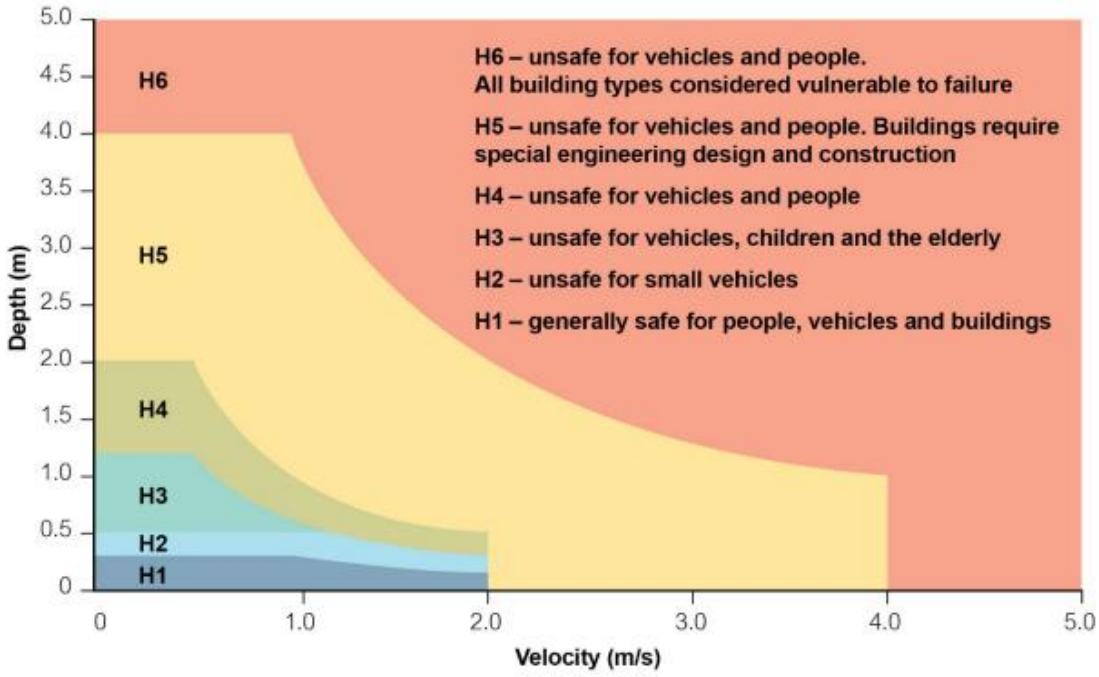
- ***C27*** - On properties with a low flood hazard classification, basement (below natural ground level) car parking must have all access and potential water entry points above the Flood Planning Level, and a clearly signposted flood free pedestrian evacuation route provided from the basement area separate to the vehicular access ramps. For basement car parking in properties affected by High Hazard flooding further considerations will apply
- ***C28*** - Basement garages must include adequate flood warning systems, signage and exits must be available to allow safe and orderly evacuation without increased reliance upon the SES or other authorised emergency services personnel
- ***C29*** - For parking areas servicing more than two parking spaces, reliable access for pedestrians must be provided from all parking areas to a safe haven which is above the PMF

3.2 NSW Flood Risk Management Manual (2023)

The NSW Government's manual supersedes the previous *NSW Floodplain Development Manual* (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 has been developed by Australian Emergency Management Institute Handbook 7 in 2014 (*Managing the floodplain: Best practice in flood risk management in Australia* (AEMI 2013), defining hazard into six categories. The categories relate to the flood vulnerability curves shown in Figure 3.2.

Figure 3.2: General Flood Hazard Vulnerability Curve – Australian Emergency Management Institute (2014)



Source: Figure 6 AIDR 2017b

Categories H1 to H4 are equivalent to low hazard and H5 to H6 are equivalent to high hazard in the 2005 Floodplain Development Manual.

3.3 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 Hydraulic Modelling

4.1 Overview

The flood modelling methodology and approach can be found in Appendix C.

4.2 Model Results

4.2.1 Existing Flood Behaviour (Base Case)

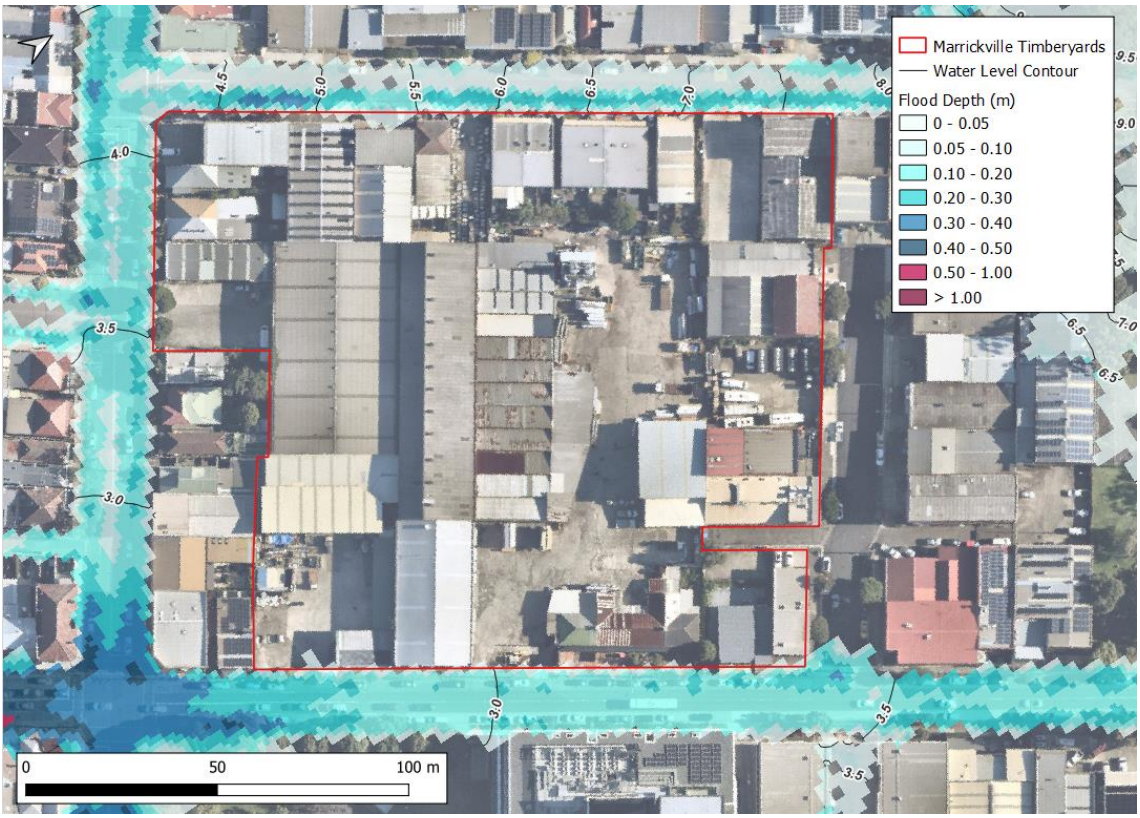
4.2.1.1 10% AEP Storm (1 in 10-year)

Flood Depths and Extents

The received Council flood model does not have a design storm for the 5% AEP required by the SEARs. Therefore, the 10% AEP storm has been used to represent a minor storm event. While 'minor' in the context of flood risk, the 10% AEP storm has an average annual recurrence of 1 in 10-years and is still considered uncommon.

During a 10% AEP storm, shallow flooding is present in the roads surrounding the Timberyards site with the greatest depth predicted in Sydenham Road / Victoria Road intersection, shown in Figure 4.1. There is no flooding across the Timberyards site itself.

Figure 4.1: 10% AEP Flood Depth, Level and Extent (Base Case)



Farr Street

Flood depths along Farr Street are relatively shallow with the greatest depths predicted in the gutters, with water reaching up to 0.22 m.

Sydenham Road

Flood depths along the Timberyards interface at Sydenham Road are generally shallow ranging between 0.10 m and 0.20 m. Greater flooding depths (> 0.30 m) are predicted at the Victoria Road intersection, however, this area does not interface the Timberyards site.

Victoria Road

Victoria Road is relatively flat, highlighted by the spacing of the water level contours in Figure 4.4. Water depths are typically 0.16 m along Victoria Road, with the same deeper ponding at the Sydenham Road intersection described previously.

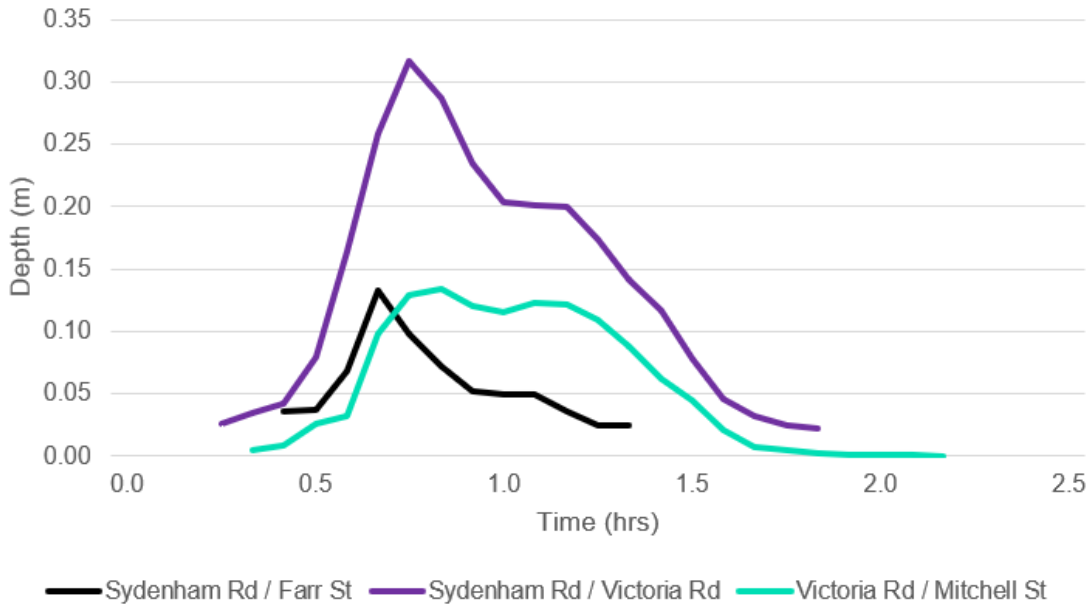
Mitchell Street

Mitchell Street is predicted to be free from inundation during the 10% AEP event.

Inundation Onset and Duration

10% AEP depth plots are shown in the figure below for a range of locations. These are based on key locations where flooding is predicted. The hydrographs show the rate of rise is fast, reaching a maximum depth after 45 minutes. After 1.5 hours, the water depth has typically receded.

Figure 4.2: 10% AEP Water Depths

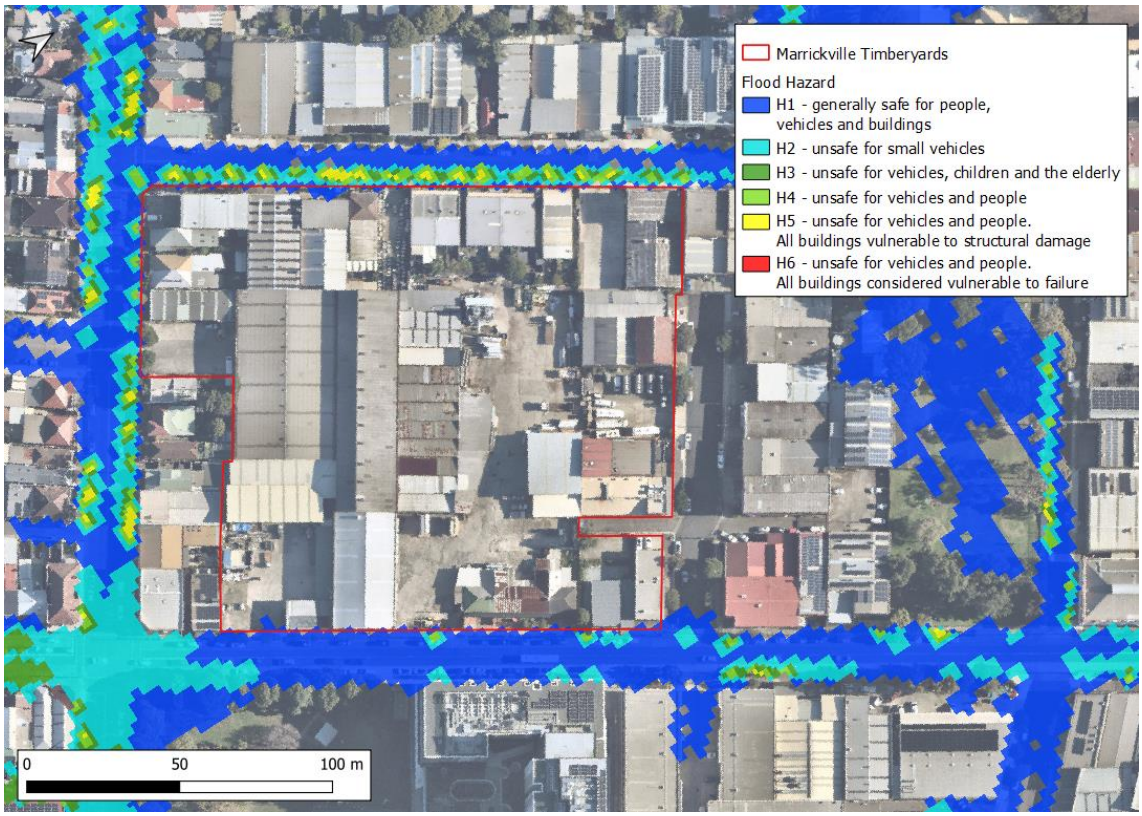


Flood Hazard

10% AEP flood hazard is shown in Figure 4.3. Category H1 to H4 is considered low hazard, while H5 and H6 are considered high hazard.

The model predicts low flood hazard surrounding the Timberyards site (< H4). There are some isolated high hazards due to high velocities in the road gutters.

Figure 4.3: 10% AEP Flood Hazard



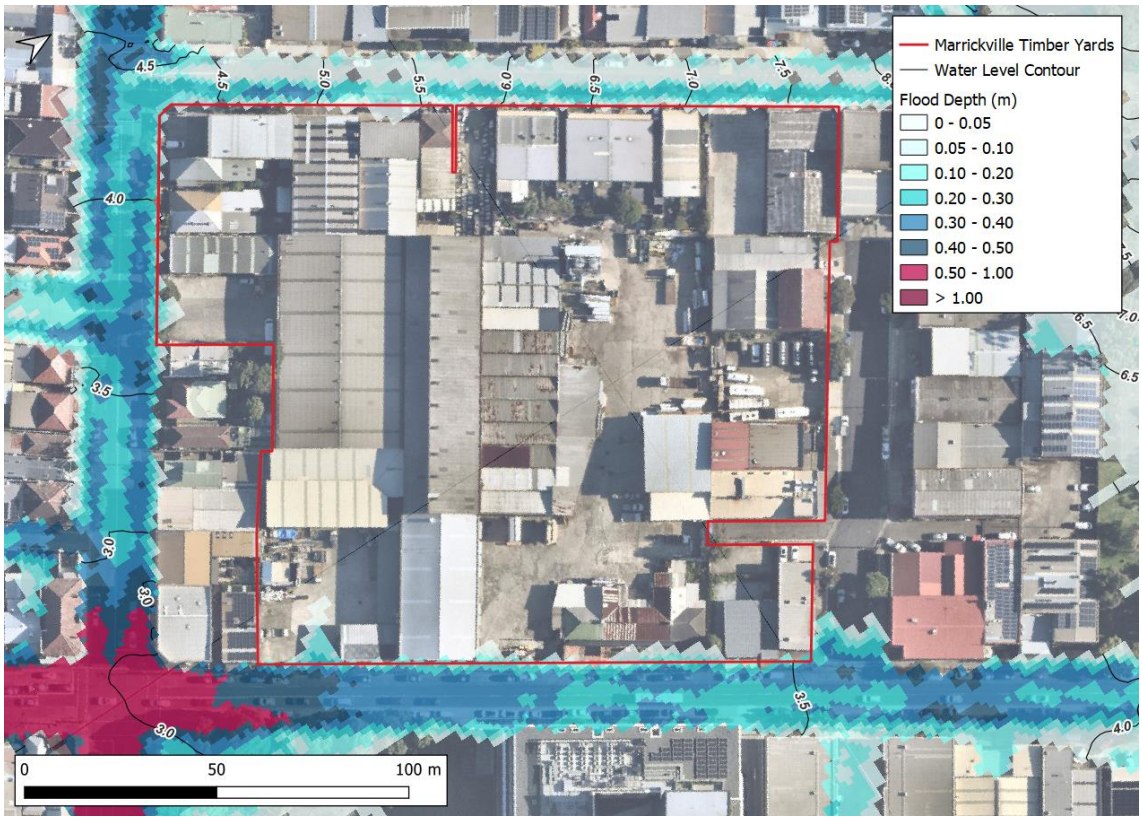
4.2.1.2 1% AEP Storm (1 in 100-year)

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.

Flood Depths and Extents

Flooding is present in the roads surrounding the Timberyards site with the greatest depths predicted in Sydenham Road and Victoria Road, shown in Figure 4.4. There is no flooding across the Timberyards site itself. This is consistent with the Inner West LEP 2022 Flood Planning Area and MDCP 2011 Flood Liable Land mapping (Appendix A and Appendix B).

Figure 4.4: 1% AEP Flood Depth, Level and Extent (Base Case)



Farr Street

Flood depths along Farr Street are relatively shallow as the road falls towards Sydenham Road. The greatest depths are predicted in the gutters, with water reaching up to 0.22 m.

Sydenham Road

Sydenham Road is the most flood affected road that interfaces the Timberyards as it conveys flows from the north of the catchment towards the Sydenham Detention Basin. Flood depths along the interface at Farr Street are generally between 0.25 m and 0.35 m. Greater flooding depths are predicted at the Victoria Road intersection, however, this area does not interface the Timberyards site.

Victoria Road

Victoria Road is relatively flat, highlighted by the spacing of the water level contours in Figure 4.4. Water depths vary along Victoria Road, ranging from 0.30 m at the intersection with Mitchell Street to 0.45 m at the intersection with Sydenham Road.

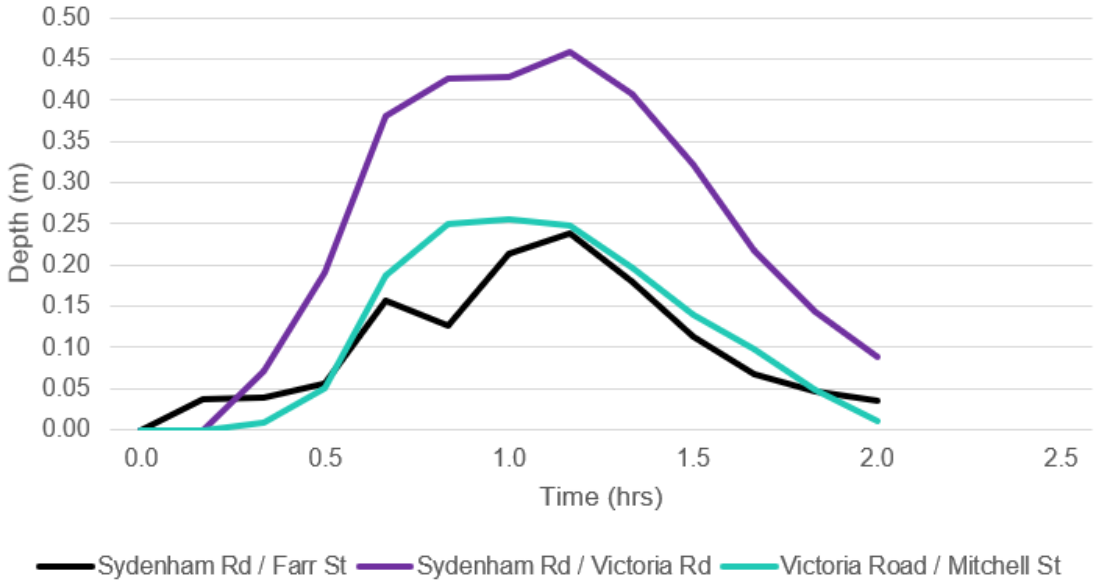
Mitchell Street

Mitchell Street is predicted to be free from inundation during the 1% AEP event.

Inundation Onset and Duration

1% AEP depth plots are shown in the figure below for a range of locations. These are based on key locations where flooding is predicted. The hydrographs show the rate of rise is fast, reaching a maximum depth after 30 minutes. After 2.0 hours, the water depth has typically receded.

Figure 4.5: 1% AEP Water Depths



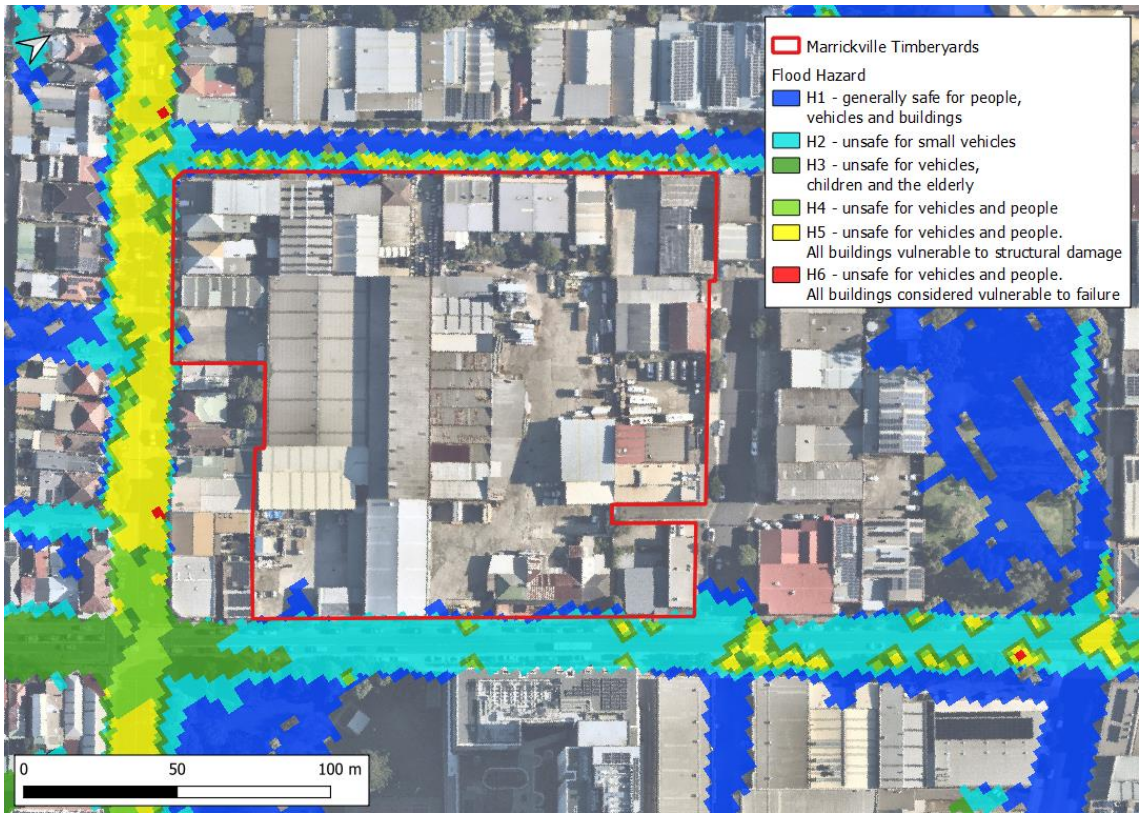
Flood Hazard

1% AEP flood hazard is shown in Figure 4.6. Category H1 to H4 are considered low hazard, while H5 and H6 are considered high hazard.

The model predicts the highest area of hazard along Sydenham Road (H5), where a combination of deeper flow and higher velocity lead to potentially unsafe conditions. However, the flood hazard is only high (> H4) for 30 minutes during the peak of the storm.

Flows along Farr Street typically generate low hazard flooding, with some isolated high hazards due to high velocities in the gutters. Flood hazard on Victoria Road is typically low (< H4) and Mitchell street is free from flooding (< H1).

Figure 4.6: 1% AEP Maximum Flood Hazard



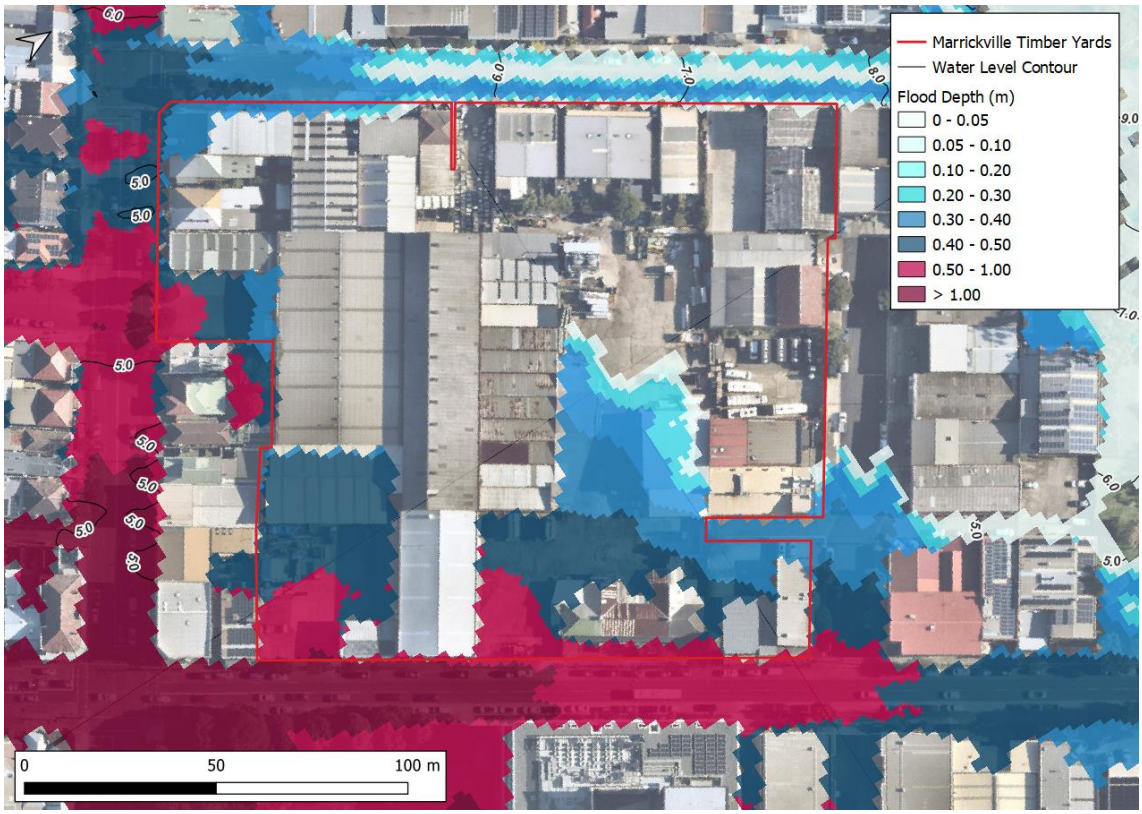
4.2.1.3 Probable Maximum Flood (PMF)

PMF results are provided for flood planning requirements but do not form part of the flood impact assessment. The PMF is a theoretical maximum flood that can occur at a location with a probability of occurring between 1 in 100,000 and 1 in 10,000,000 in any year.

Flood Depths and Extents

The area around the Timberyards is subject to very deep ponding during the PMF as the low-lying area around the Sydenham Detention Basin fills with water, acting like a large bathtub. Flood depths, levels and extents are shown in Figure 4.7.

Figure 4.7: PMF Depth, Level and Extent (Base Case)



Farr Street

PMF depths along much of Farr Street are relatively shallow as the road falls towards Sydenham Road with the deepest flows typically confined to the gutter. Backwater from Sydenham Road causes deeper ponding at the intersection with depths reaching up to 1.00 m.

Sydenham Road and Victoria Road

As shown in Figure 4.7, there is very deep ponding of flood water along much of Sydenham Road and Victoria Road with PMF depths ranging between 1.50 m and 2.50 m. This presents a significant challenge for emergency management in this location.

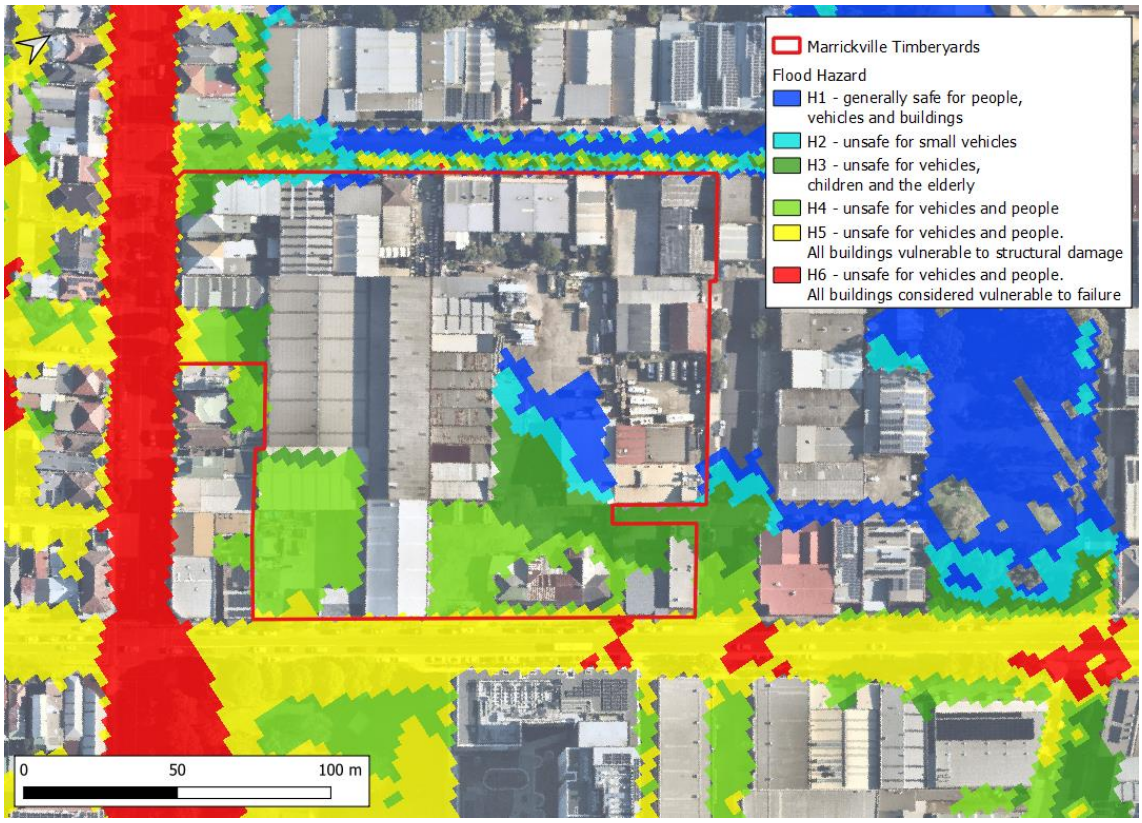
Mitchell Street

The western half of Mitchell Street is predicted to be free from inundation during the PMF event. The eastern half is subject to deeper ponding, reaching up to 1.50 m at the intersection with Victoria Road.

Flood Hazard

PMF hazard is shown in Figure 4.8. The model predicts high hazard along Sydenham Road and Victoria Road where a combination of deeper flow and high velocity create unsafe conditions. Flows along Farr Street typically generate low hazard flooding, with some areas of intermediate and high hazard due to high velocities. Much of Mitchell Street is free from flooding in the PMF.

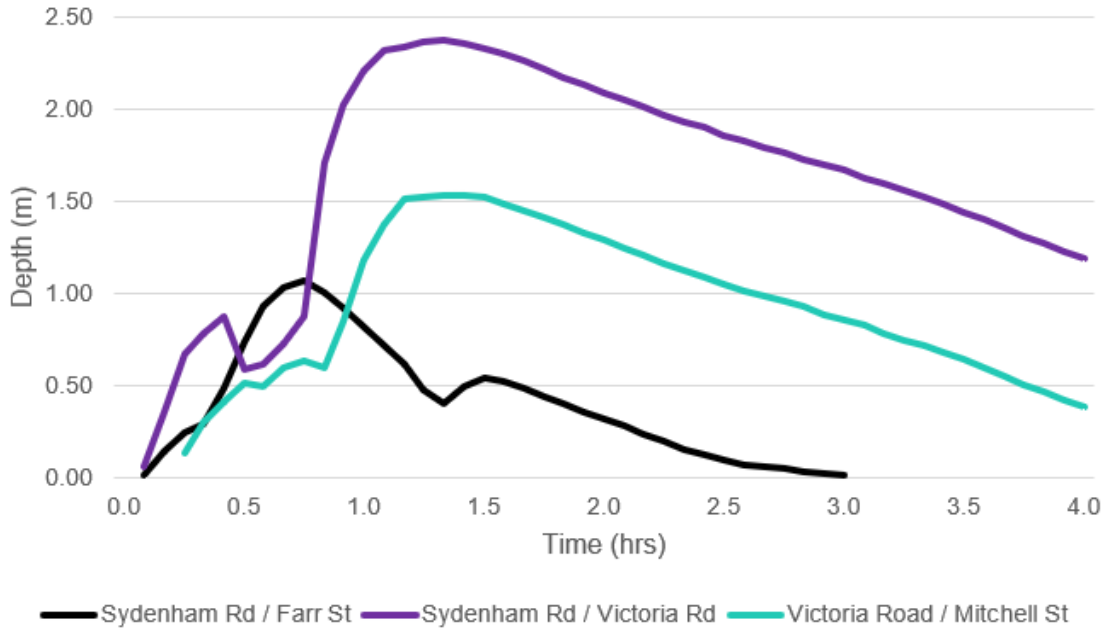
Figure 4.8: PMF Hazard



Inundation Onset and Duration

PMF depth plots are shown in the figure below for a range of locations. These are based on key locations where flooding is predicted. The hydrographs shown the rate of rise is fast, reaching a maximum depth after 1.0 hour. The flood water takes a number of hours to recede, particularly from the deeper area of ponding at the Sydenham Road / Victoria Road intersection and areas to the southeast. However, the northwestern direction of Sydenham Road should be free from flooding after 3.0 hours providing access away from the development site.

Figure 4.9: PMF Water Depths



4.2.2 Post Development Flood Behaviour (Design Case)

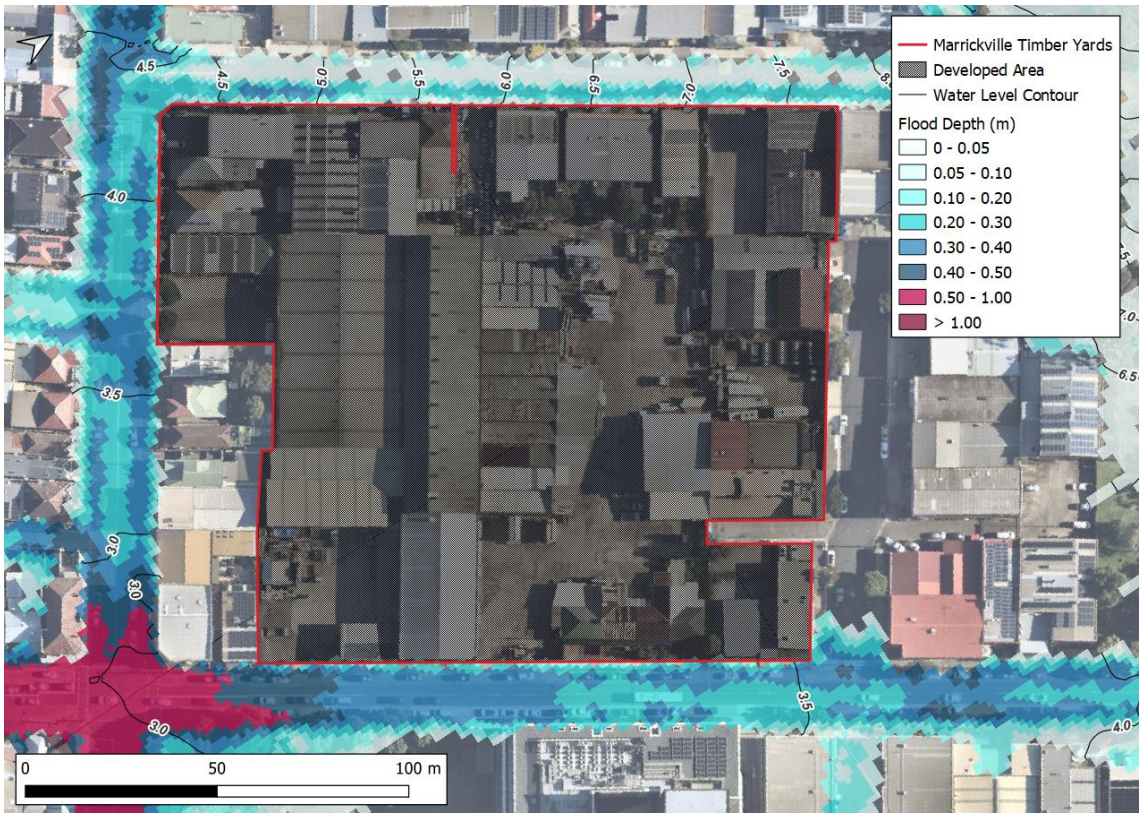
To represent the Timberyards post development case, a new building block out was included in the model covering the proposed site. This assumes that the site will be immune from flooding in the 1% AEP storm by adopting the Council Flood Planning Level (1% AEP + 500 mm freeboard), preventing any water ingress to the site itself.

4.2.2.1 1% AEP Storm (1 in 100-year)

Flood Depths and Extents

The design case 1% AEP flood risk shows no change from the base case with flooding present in the roads surrounding the Timberyards. (Figure 4.10).

Figure 4.10: 1% AEP Flood Depth, Level and Extent (Design Case)



The inclusion of the Timberyards development is not predicted to cause adverse changes in flooding, as indicated by the water level difference map in Figure 4.11. There is no flooding across the Timberyards site itself.

Figure 4.11: The Timberyards – Water Level Difference and Peak Flow Sampling

The mapping shows some flood model sensitivity along Sydenham Road, with patches of increase and decrease water level predicted. A sensitivity test on the flood model was undertaken by reducing the computational timestep but retaining all other geometry and stormwater network features. The sensitivity test determined that the patchy afflux is being caused by poor computation performance related to the model timestep, the grid dimension and high velocity flow and not a result of the development of the Timberyards site.

To support this conclusion, comparative peak flows have been extracted at key locations around the development site (flows have been rounded to the nearest 0.1 m/s). These show the difference between to two scenarios is negligible.

Table 4.1: Comparison of Peak Flows

Sample Point	Location	Base Case Peak Flow (m/s)	Design Case Peak Flow (m/s)	Difference (m/s)
A	Farr St	1.1	1.1	0.0
B	Sydenham Rd (u/s Farr St)	22.9	22.9	0.0
C	Sydenham Rd (d/s Frampton Ave)	21.0	20.9	-0.1
D	Sydenham Rd (@ Wicks Park)	23.9	23.7	-0.2
E	Victoria Rd (@ Wicks Park)	5.9	6.0	+0.1
F	Victoria Rd (d/s Mitchell St)	7.3	7.3	0.0
G	Frampton Ave	0.8	0.8	0.0
H	Sydenham Rd (d/s Farr St)	20.0	20.0	0.0

Inundation Onset and Duration

Inundation onset and duration is unchanged and is consistent with the existing condition; refer to Figure 4.5.

Flood Hazard

There is no change in flood hazard compared to the existing condition. Refer to the 1% AEP flood hazard is shown in Figure 4.6.

4.2.2.2 PMF

Flood Depths and Extents

The design case PMF risk is relatively unchanged from the base case with very deep flooding present in the roads surrounding the Timberyards.

Inundation Onset and Duration

Inundation onset and duration is unchanged and is consistent with the existing condition; refer to Figure 4.9.

4.2.2.3 Post Development Flood Impacts

The flood impact assessment has identified that there is no material change in flood risk around the Timberyards site, even with the conservative approach of using building block-outs.

The key parameters of the flood assessment are summarised below:

- Changes in peak 1% AEP water level
  - the changes in peak water level as a consequence of the development do not exceed the recommended thresholds for habitable buildings or residential zoned land
  - no cumulative impacts predicted
  - no new areas of flood inundation
- 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 timeframes
- Change in 1% AEP flood velocity
  - flood water velocities are not significantly 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 changes in flood hazard outside the site boundary

4.3 Climate Change

Several climate change scenarios were modelled for the 1% AEP flood event as part of the Marrickville Valley FRMSP. The flood study adopted the following 1% AEP scenarios to assess the sensitivity to climate change:

- 0.4m rise in tailwater level in the Cooks River
- 0.9m rise in tailwater level in the Cooks River
- 10% increase in design rainfall intensity
- 20% increase in design rainfall intensity

- 30% increase in design rainfall intensity
- Combinations of the above

The results concluded that for the Marrickville Valley only the downstream edge of the catchment near Mackey Park is impacted by sea level rise. This does not affect the Timberyards.

The impacts of rainfall increase on flood behaviour shows a general increase in flood levels across the entire catchment when rainfall intensity is increased. A 10% increase in design rainfalls results in approximately a 0.10 m maximum increase in peak levels, a 20% rainfall increase a 0.20 m maximum increase in peak levels and a 30% rainfall increase a 0.30 m maximum increase in peak levels.

4.4 Managing Flood Risks

The area around the Victoria Road (Precinct 47) is significantly flood affected with reginal flooding issues identified by the flood model. It is beyond the scope of this development to alleviate these flooding issues, however, the overall intent behind the design is to make the Timberyards as resilient to flooding as is practicable.

It is situated in a unique location where PMF depths along the eastern aspects are many times greater than the 1% AEP depth which limit opportunities to prevent water ingress into the basement via lift shafts. The MDCP and VRDCP allow basement openings along Victoria Road to be at the Flood Planning Level (1% AEP + 500 mm freeboard) as the 1% AEP flood hazard is generally low (< H4), however, this would permit entry of water in a PMF event. This approach has also been adopted by the adjacent Wicks Place development which was designed in 2019[2] with construction completed in 2024.

Inner West Council support using the Flood Planning Level along Victoria Road so long as emergency access can be achieved from Farr Street.

The design of the site has located basement car park ramps at the most suitable locations on Farr Street and Mitchell Street which are not subject to such extreme PMF depths and low flood hazard. The MDCP notes: *"Flood free access must be provided where practicable"*, however, roads around the site are flood affected, so there is limited flood free access available. The proposed the Timberyards is not flood affected, therefore, the safest course of action for users should be to remain in place in a flood event and wait for flood waters to recede.

The Upper Ground level interfacing Farr Street is entirely above the level of the PMF and it is expected that all storeys above the ground floor on the Lower Ground level interfacing Victoria Road would be above the PMF level. The ground floor units on this side of the development will all be retail.

The new multi-storey building will be stable during flooding up to the PMF and all non-ground floor residents in multi-storey residential development would be only exposed to an indirect flood risk.

4.4.1 Flood Detention

Building / Lot-Based Detention Options

Through the coordinated civil design of open spaces, storage volumes can be achieved through lowering ground levels within landscaped areas and recreational areas that do not serve a flood

[2] 182-198 Victoria Road and 28-30 Faversham Street, Marrickville Mixed Use Development. Civil DA Report (prepared from Toga Wicks Park Developments Pty Ltd) 07 November 2019

emergency management function, such as the pocket parks and recreational areas within the precinct.

Additional flood storage is also created through integrating soft Water Sensitive Urban Design (WSUD) features which typically sit below the adjacent ground level such that these features are fed runoff water from the precinct ground level via gravity. This serves to create flood storage volumes in addition to their primary function in treating runoff water quality.

4.4.2 Water Sensitive Urban Design (WSUD)

A dedicated stormwater management will effectively manage nuisance flooding around the Timberyards by introducing new stormwater network, above ground detention and/or WSUD features that can detain or convey shallow surface water flows. Some examples of soft WSUD features include:

Vegetated Swales

Vegetated swales are linear features that convey stormwater along the surface within a wide, shallow channel, typically at gentle longitudinal grades (<5%). The linear form of swales makes them ideally suited to a linear environment in both rural and urban areas, as well as locations without defined drainage systems.

Bioretention / Raingardens

Bioretention basins are non-linear features that do not convey stormwater but they may be designed to provide a detention function. The basins can be a range of scales and shapes and therefore flexible in their design and location. They have the advantage of being able to be distributed throughout the precinct at regular intervals.

Permeable Pavements

Porous and permeable pavements promote infiltration through the pavement surface itself to a subsurface collection system or to the subsoil. Porous pavements allow for infiltration through the internal structure of the material itself. Porous and permeable pavements are generally only suitable under light traffic loads but can be included in many locations such as car park and pedestrian thoroughfares.

Green Roofs

Providing green roofs will aid in reducing surface water runoff. Not only do they provide additional water storage capacity which helps reduce flood risk, but they also have other benefits such as filtering out pollutants from stormwater runoff and improving air quality in urban environments.

4.4.3 Overland Flow Conveyance

Setbacks of the buildings and streetscape obstructions to overland flow adjacent to the road reserves, where overland flow occurs, can serve to calm the flood behaviour by widening the flow path available. For an existing road reserve that experiences overland flow, by widening the flow path the depth of flow is generally reduced which contributes to a safer resulting condition for people and vehicles. Conversely a larger flow capacity of the road reserve is afforded when a wider cross section adopted.

5 Design Recommendations

5.1 Flood Planning Levels

The Flood Planning Level is to be greater than or equal to the 1% AEP flood level + 500 mm freeboard according to the MDCP 2011 and VRDCP 2019 respectively.

Site specific Flood Planning Levels are listed in Table 5.1 with ID locations shown below in Figure 5.1 and Figure 5.2.

Table 5.1: Site Specific Flood Planning Levels

Location ID	Description	1% AEP Flood Hazard	1% AEP Water Level (m AHD)	PMF Water Level (m AHD)	Flood Planning Level (1% AEP + 0.5m) (M AHD)	Adopted Level (mAHD)
A – Farr Street	Overland flow route into the Timberyards and Lower Ground level open spaces	Low	4.84	5.40	5.34	5.34
B – Farr Street	Lift lobbies (to basement)	Low	5.21	5.41	5.71	8.74
C – Farr Street	Overland flow route into the Timberyards and Lower Ground level open spaces	Low	5.92	5.97	6.42	6.42
D – Farr Street	Lift lobbies (to basement)	Low	6.25	6.26	6.75	7.40
E – Farr Street	Basement car park ramp	Low	6.46	6.48	6.96	6.96
F – Farr Street	Lift lobbies (to basement)	Low	7.34	7.39	7.84	7.84
G – Mitchell Road	Overland flow route into Upper Ground open spaces	N/A	N/A	N/A	N/A	7.84
H – Mitchell Road	Lift lobbies (to basement)	N/A	N/A	N/A	N/A	7.84
I – Mitchell Road	Through link	N/A	N/A	N/A	N/A	5.30
J – Mitchell Road	At-grade car park entry	Low	3.55	4.84	4.05	4.35*
K – Victoria Road	Lift lobbies (to basement)	Low	3.36	4.84	3.86	3.86*
L – Victoria Road	Basement stairs	Low	3.31	4.85	3.81	3.81*
M – Victoria Road	Lift lobby	Low	3.13	4.85	3.63	3.63*
N – Victoria Road	Lift lobby	Low	3.05	4.86	3.55	3.55*
O – Sydenham Road	Lift lobby	High	3.74	5.46	4.23	4.66*
P – Sydenham Road	Lift lobby	High	4.15	5.28	4.65	4.66*

*the adopted Flood Planning Level in these locations is below the level of the PMF. This is permitted by the VRDCP 2019 which states that *"on properties with a low flood hazard classification for the 1% AEP flood event, basement car parking must have all access and potential water entry points above the Flood Planning Level (1% AEP flood level plus*

0.5m freeboard". 1% AEP flood hazard along Victoria Road is classified as Low (Figure 4.6) and this approach has been adopted and accepted by Council for the adjacent Wicks Park development.

Figure 5.1: Upper Ground Level – Farr Street

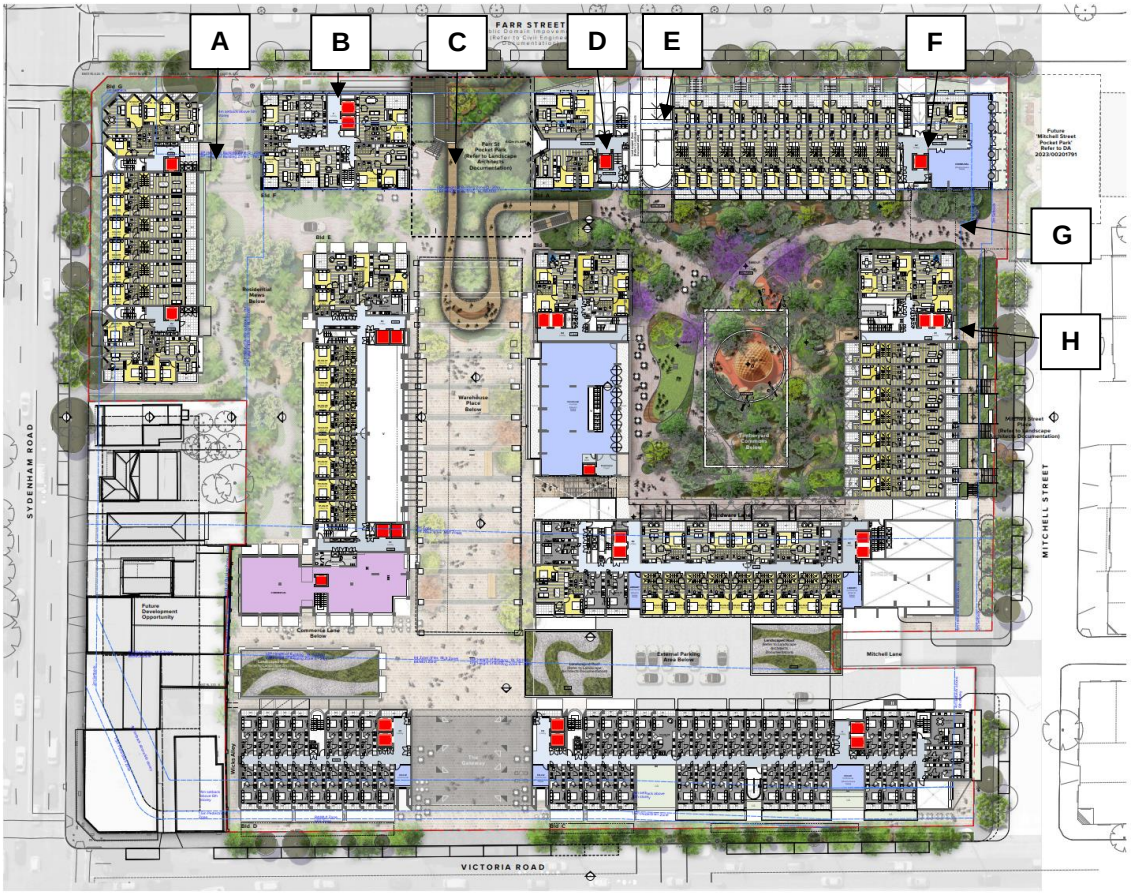
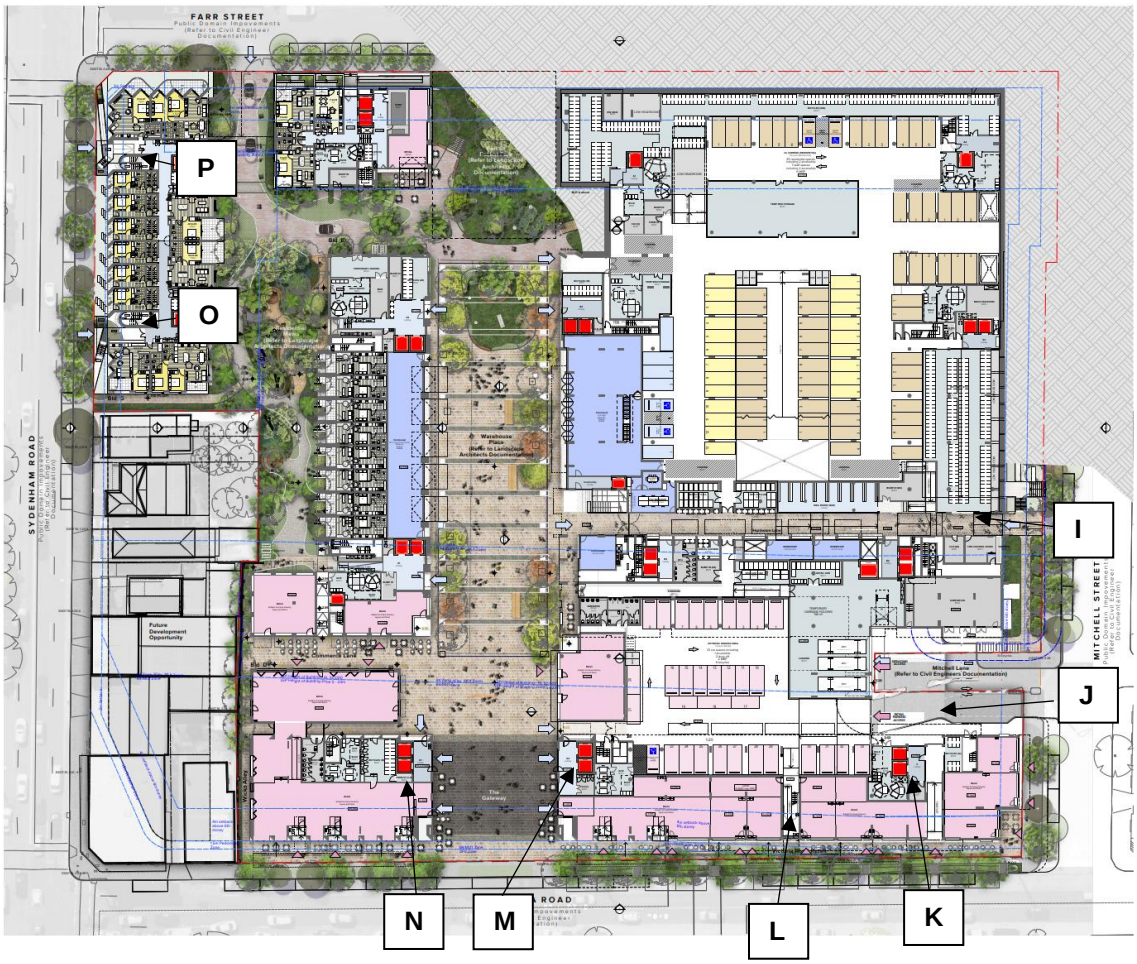


Figure 5.2: Lower Ground Level – Victoria Road



5.1.1 Habitable Floor Levels

Habitable floor levels have been set at a minimum of the Flood Planning Level as per C5 of MDCP 2011.

5.1.2 Non-habitable Floor Levels (Retail)

C13 of MDCP 2011 states *"Floor levels (except for access-ways) must be at least 500mm above the 1% AEP flood level, or the buildings must be flood-proofed to at least 500mm above the 1% AEP flood level".* However, other, relevant DCPs in the area allow a more flexible approach to retail with planning levels ranging from the 5% AEP to the 1% AEP to achieve the best outcome for street level activation. As retail units present a lower flood risk than habitable floor, a more reasoned approach is recommended for the Timberyards SSDA and has proven successful in previous SSDAs.

To activate the street along Victoria Road, it is proposed to have retail floor levels at (or above) the adjacent 1% AEP water level to prevent a disconnection between the street and the unit by incorporating ramped entry points. Ramps limit access from the street and reduce the available footprint within the unit itself. It is then proposed to have a back of house location within each retail unit set to the Flood Planning Level to allow the locating of more sensitive features (such as kitchens or storerooms) above the adjacent 1% AEP flood level.

5.1.3 Basement Entry Points

The Timberyards has a single basement car park to cater for residential parking with an entry located on Farr Street (location E, Figure 5.1). Retail parking is at grade with an entry located on Mitchell Street (location J, Figure 5.2).

There are two primary means for water to enter the basement car park; via the vehicular entry ramp or via lift shafts that link the basement to the ground floor level (other features such as air vents may also be present in the future design, however, these have not been factored into the design at this stage).

All potential water entry points to the basement have been set to the Flood Planning Level (1% AEP + 0.5m). This is deemed acceptable to Council who noted "*the basements must be protected from flooding to the PMF level (Refer to C33 of Part 9.47 of the site specific DCP) and vehicles access shall be located so as to minimise impacts of flooding and allow for satisfactory emergency evacuation.* ***If emergency access can be provided to Farr Street from all basement car parks, then flood protection to the basements can be reduced to the Flood Planning Level (1% AEP storm plus 500 mm freeboard)****".*

As the site has a single basement with an entry on Farr Street providing emergency access / egress, this requirement has been achieved.

5.2 Flood Emergency Management

The flood emergency management (EM) strategy for the Timberyards has been assessed following advice provided in *Flood risk management guideline EM01 - Support for emergency management planning* (DPE 2023), relevant plans from the NSW SES and the Marrickville Valley Floodplain Risk Management Study.

The EM01 guideline provides advice on how the flood risk management (FRM) framework and process described in the *Flood risk management manual: the policy and manual for the management of flood liable land* (DPE 2023) can consider and support flood EM.

Emergency Management in NSW is run at three levels of scale, at a state-wide level, at a regional level, and a local level. Each subsequent level provides additional local detail in emergency management.

5.2.1 Regional EMPLAN

Marrickville is located within the Sydney Metropolitan Emergency Management Region (SMEMR). This region encompasses seven Local Government Areas of Sydney bounded by Randwick to the east and Sutherland Shire to the southwest.

This plan details arrangements for prevention, preparation, response and recovery to emergencies within the SMEMR. The objectives of this plan are to:

- Support Local Emergency Management Plans and augment them when required
- Identify trigger points for regional level activation, escalation and demobilisation
- 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
- Detail arrangements for the acquisition and co-ordination of resources at the regional level

The NSW SES leads flood EM planning and have 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 act 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 becomes 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

5.3 The Timberyards Emergency Planning

It has been established that roads around the Timberyards are at risk of flash flooding as critical storm durations are less than 6 hours (Appendix C, Section C.2.4). 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 no 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 Timberyards 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

5.3.1.1 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.

There are no evacuation centres identified within the *Marrickville Flood Emergency Sub Plan*. It is recommended that evacuation centres for flood events be reviewed and updated for the whole of the Inner West Council area and centres be rationalised for all types of emergencies.

The Marrickville Valley Floodplain Risk Management Study identifies locations that may be suitable to function as evacuation centres during and following a flood event:

- Marrickville Town Hall
- Petersham Town Hall
- St Peters Town Hall
- Annette Kellerman Aquatic Centre

In this instance evacuation to Sydenham Road or Victoria Road is logical while the surrounding road networks are free from flooding. These roads provide access to:

- Marrickville Town Hall (via Victoria Road and Marrickville Road)
- Petersham Town Hall (via Sydenham Road, Illawarra Road, Addison Road and Shaw Street)
- St Peters Town Hall (via Sydenham Road and Railway Parade)

- Annette Kellerman Aquatic Centre (via Victoria Road)

In addition to these suggested evacuation centres, the following arterial roads can be accessed:

- A36 Princes Highway to the south (including access to M8 Motorway (WestConnex). Tunnel portals are located above the higher of 1% AEP + 500 mm or the PMF)
- A34 New Canterbury Road to the north

These arterial roads provide means of moving to safer locations, whether that is the nominated evacuation centre or away from a forecasted storm area, if possible. However, it should be noted that evacuation centres are set up at the discretion of the SES incident controller 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
  - enact a site-specific Flood Emergency Response Plan (FERP). A FERP serves as a guide for building occupants, outlining the suitable actions during a flood emergency
    - a site-specific FERP for the Timberyards should be completed prior to the Occupation Certificate being issued
- 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 Timberyards then it is likely too late to safely evacuate before the storm arrives
  - the *Marrickville Valley Floodplain Risk Management Study* recommends a minimum of 2.5 hours is required to safely evacuate the Marrickville Valley, with assistance from SES. This is based on the SES evacuation timeline model. Therefore, it is likley too late to evacuate once a Detailed Severe Thunderstorm Warning has been issued for the area

5.3.1.2 Emergency Management Strategy – Evacuation During a Storm

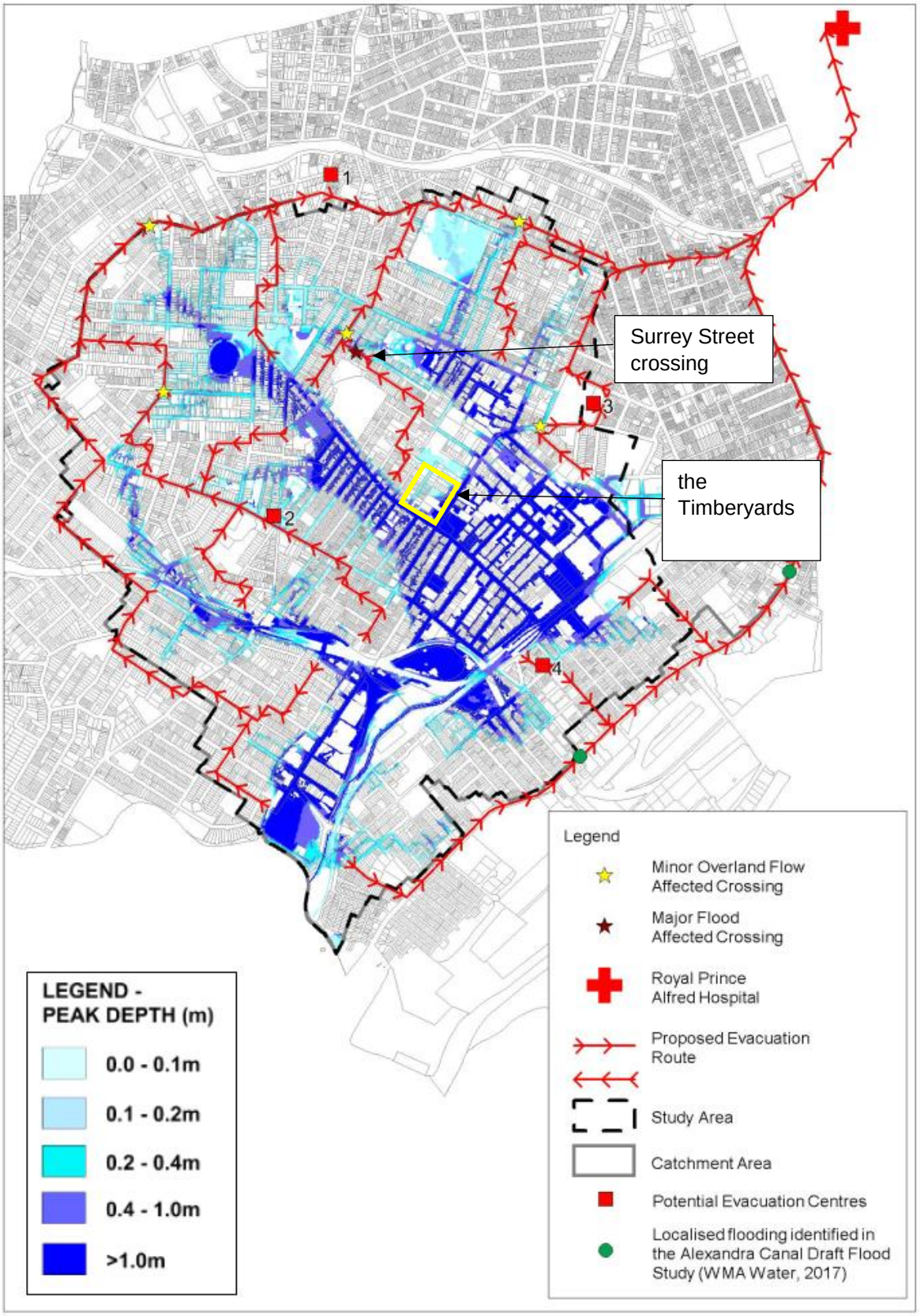
According to the *Marrickville Valley Floodplain Risk Management Study* the majority of the Marrickville Valley can access regional evacuation routes via a range of local road routes throughout the valley which are predominantly flood free (Figure 5.3).

The exception is communities surrounded by Eastern Channel to the north and Sydenham Road to the south which includes the Victoria Road Precinct and the Timberyards. This route requires crossing Surrey Street which has flood affectation, with up to 1.0 m peak flood depths for the 1% AEP and PMF events. These flood depths mean the crossing cannot be traversed at the peak of either design storm.

The duration of flooding at this Surrey Street crossing is likely to be less than 2.5 hours even in the PMF event as it is located in the upper catchment. High flood hazard (> H4) is only predicted for a short period of time (< 30 minutes).

Therefore, the risk to life associated with the isolation of this Marrickville community during this short time of isolation is assumed to be minor.

Figure 5.3: Evacuation Routes to RPA Hospital and Suggested Evacuation Centres



Source – Marrickville Valley Floodplain Risk Management Study and Plan (September 2017)

The Timberyards is located on the fringe of the Marrickville Industrial Area which is an area of concern. It is noted that the rate of rise, resulting flood depths and the size of the floodplain would make it unsafe to evacuate during a storm.

Therefore, evacuation by either vehicle or on foot from this area will be incredibly difficult for affected occupants. SES and emergency access to the Marrickville Industrial Area during flooding will also be nearly impossible as it is the area of the floodplain with the most significant flood depths. Due to these problems special shelter-in-place provisions should be provided.

Considering the points summarised above, the safest flood strategy is during a storm is to remain in place, given the Timberyards has a high level of flood protection achieved through the design process. To enact remaining on site, the following is required:

- each building will nominate a designated evacuation warden to consult with relevant authorities and coordinate assembly points,
- it is proposed that an onsite safe muster point be The Mews and Timberyards Common within the Upper Ground portion of the development:
  - finished levels for this area will be between 7.30 and 7.60 m which are higher than the adjacent PMF water levels, particularly on Sydenham Road and Victoria Road
  - Flood Planning Levels based on water levels in Farr Street ensure that The Mews and Timberyards Common would remain free from external sources of flooding
  - communal areas in Building A and Building B can be used as locations to shelter safely as they are above the PMF water level
  - the time period for sheltering will be short as critical storm durations do not exceed two to three hours
- based on the surrounding flood hazards, evacuation away from the precinct during a severe storm is not deemed to be safe as there are no flood free or low hazard routes available between the precinct and the nearest evacuation centres. Evacuating during a storm would pose a greater risk than remaining in place. This approach supports the SES StormSafe advice, detailed below

5.3.1.3 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.

Table 11 in EM01 describes Shelter in Place (SIP) is an appropriate strategy to be considered when existing zoned areas are being redeveloped, as is the case at the Timberyards. *EMA Manual 20 – Flood Preparedness* states that SIP is to be preferred over evacuation if *“evacuation is likely to be more dangerous than sheltering”.*

The site is embedded within an extensive 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.

The *Draft Shelter-in-place Guideline* (DPE 2023) suggests that SIP is appropriate when the onset of flooding and flood duration are both less than six hours as is the case at the Timberyards. The onset and duration of flooding around the precinct is typically between 1 and

3 hours, depending on storm duration. The time required to evacuate vertically within a building to a level higher than the PMF could be several minutes only.

With SIP as a consideration, utilising the Upper Ground level and first floors of the development ensure occupants can have a safe refuge above the PMF water level.

The buildings should be designed to resist flood impacts up to the PMF, resulting in a flood free and structurally sound conditions within all structures on site and therefore will not create a situation where a burden is placed on the SES to provide any emergency evacuation coordination.

5.3.1.4 Emergency Management Strategy - Decision Making Summary

The points raised above can be summarised against the *EM01 Section D4.2* flow chart considering emergency management in greenfield developments, rezoning and creating new communities, recreated as Figure 5.4 below. Residential development is compatible in the existing zoning as the zoning of site will remain as residential but allow a greater density and mix of housing types including residential flats.

Figure 5.4: Considering emergency management in greenfield developments, rezoning and creating new communities

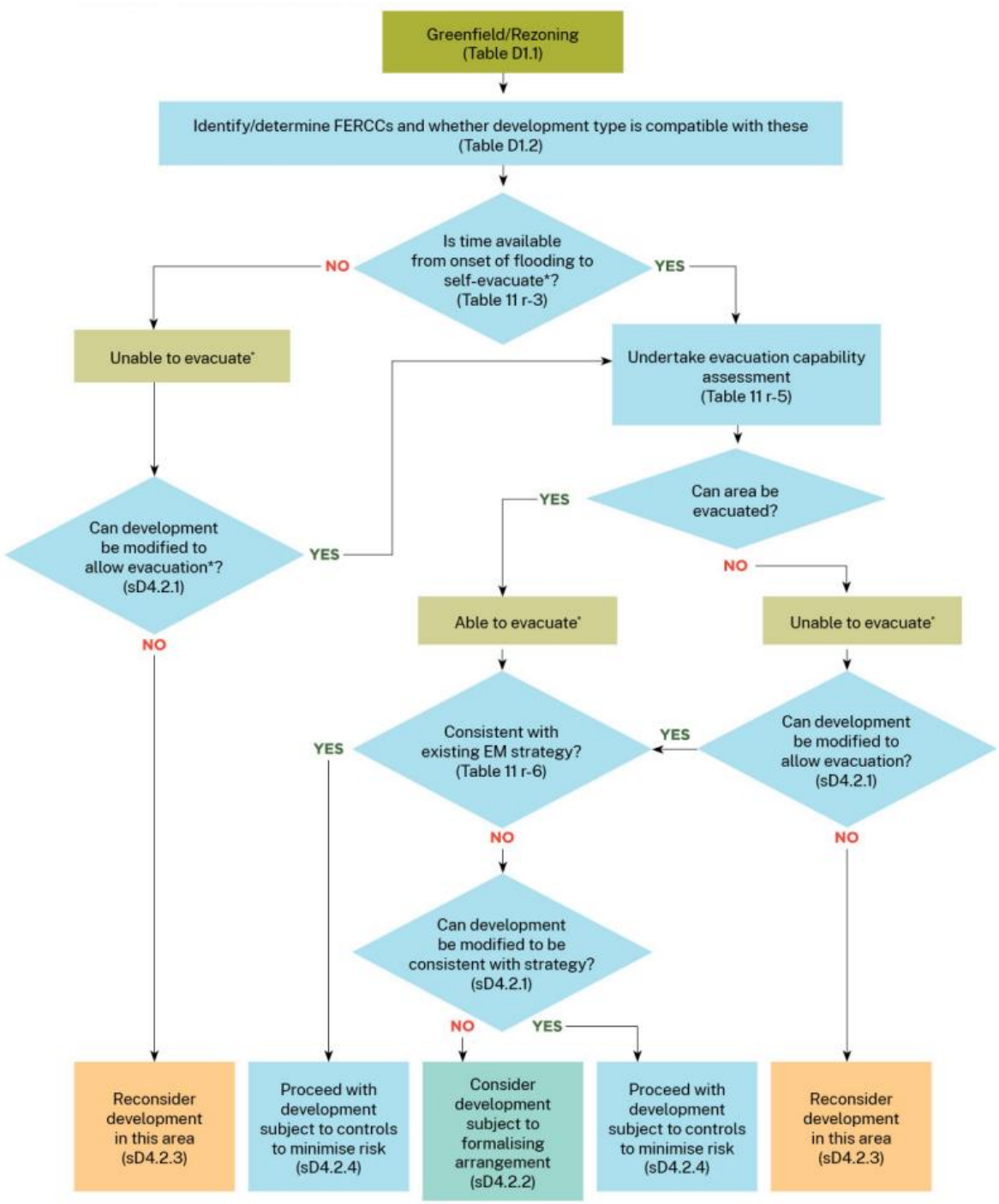


Table 5.2: Emergency Management Considerations

	Decision	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 in the catchment 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	Section C.2.4	Unable to evacuate
Can development be modified to allow evacuation?	No	There are no proposals to alter the existing Council road layout or stormwater drainage system which are primarily source of ponding flood water around the Timberyards.	Section 5.3.1.2	Reconsider development Consider development controls
Is time of isolation short?	Yes	The period of worst-case inundation (PMF) is less than 6 hours	Section 4.2	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	Section 5.1	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	Section 5.1 Section 5.3.1.5	Consider development types and apply controls

5.3.1.5 Emergency Management Strategy – Residual Risks

Table 12 of EM01 provides a summary of residual risks to consider in order to support the EM decision-making process, specifically with regards to redevelopment in existing zoned areas. The following relevant strategies are identified for the Timberyards and this FIRA recommends are implemented for the precinct, once building massing and finished floor levels have been finalised.

Flood Emergency Response Plan (FERP)

The establishment of a Flood Emergency Response Plan (FERP) should be completed prior to the Occupation Certificate being issued, with the obligation falling on the building owner or Body Corporate. The FERP serves as a guide for building occupants, outlining the suitable actions during a flood emergency. This could include a warning system, response triggers, emergency

contacts, designated SIP refuge, and the risks involved in sheltering in place. It is the legal duty of the building owner or body corporate to ensure that the FERP is not only set up but also regularly practiced, maintained, and updated.

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. Building managers 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.

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.

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

5.4 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 site is not identified by the Inner West LEP 2022 FPA Map or the MDCP 2011 Flood Liable Land Map, therefore, relevant Council flood management clauses do not apply
- 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 at in Marrickville is required to accommodate the additional residents in Sydney over the next 20 years. 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 FERP for new multi-storey development can 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

5.5 Summary of Flood Emergency Management

Section 5.3 outlines the relative flood risk that the Timberyards is exposed to. The site is affected by flash flooding which is inherently more dangerous than riverine flooding or coastal inundation, largely due to the short timeframes 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 very 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.

Sheltering in place is an appropriate response when the flood warning time and flood duration are both less than six hours, as is the case for the Timberyards. Flooding at Surrey Street also

limits the horizontal evacuation potential for the Marrickville Industrial Area, though it is short-lived (less than 2.5 hours).

The lack of pre-determined evacuation locations and the rapid onset of flooding in the catchment leads to sheltering being the safest means of emergency management, supported by *EMA Manual 20 – Flood Preparedness* which states that sheltering in place is to be preferred over evacuation if "*evacuation is likely to be more dangerous than sheltering"*.

6 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 *Marrickville Valley Flood Risk Management Study* was made available for this flood impact and risk assessment. The model was developed using TUFLOW in 2013 / 2017 by WMAwater for Inner West Council and received by Mott MacDonald. It is the current Council adopted model for the catchment.

Whilst the Flood Risk SEAR requests a FIRA for the site (Table 1.2) the Timberyards does not fall within land identified by the Inner West LEP 2022 Flood Planning Area or Marrickville DCP 2011 Flood Liable Land Map. As such the standard LEP clauses related to flooding do not apply. However, to ensure a robust design, this FIRA has been development 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 the Timberyards 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 10% AEP, 1% AEP and PMF have been assessed as they relate to the MDCP 2011 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 Marrickville Valley. The stormwater networks have relatively low capacity (typically less than 10% AEP) with excess flows being conveyed along adjacent roads to the lowest part of the catchment near Sydenham Station. This includes main flow routes along Sydenham Road and Victoria Road converging at the southeastern corner of the Timberyards site. 1% AEP flood depths in the vicinity of the Timberyards are typically between 100 and 300 mm in Sydenham Road and Victoria Road.

To represent the Timberyards post development 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).

The flood model highlights the following:

- Changes in peak 1% AEP water level
  - the changes in peak water level as a consequence 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 timeframes
- Change in 1% AEP flood velocity
  - flood water velocities are not significantly 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 changes in flood hazard outside the site boundary

The flood emergency management (EM) strategy for the Timberyards 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.

Based on this FIRA and the *Marrickville Valley Flood Risk Management Study*, a shelter in place policy during a flood emergency is the most logical EM approach 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. 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 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

A. Inner West LEP 2022 Flood Planning Area

B. Marrickville DCP 2011 Flood Liable Land

C. Flood Modelling Methodology and Approach

C.1 Modelling Approach

C.1.1 Basis of Flood Model

The Marrickville Valley Floodplain Risk Management Study flood model was used as the basis for this evaluation. The model was developed using TUFLOW in 2013 by WMAwater with subsequent updates undertaken in 2017. The model was received by Mott MacDonald to use for this FIRA. It is the current Council adopted model for the catchment.

C.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.

C.1.3 Modelling Scenarios

Flood model scenarios for the Timberyards were based on the following:

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

C.2 Hydraulic Modelling

C.2.1 Flood Model Development

TUFLOW models for Marrickville Valley catchment were based on the following:

- Existing conditions
  - an assessment of the current flooding conditions based on existing survey of the site with present-day building layouts
- Design conditions with mitigation measures

The following storm Annual Exceedance Probabilities (AEP) have been assessed in relation to the proposed development site

- 1% AEP (1 in 100-year storm) – analysis of emergency management, flood impacts and alignment with MDCP 2011 Flood Planning Levels
- Probable Maximum Flood (PMF) – analysis of emergency management and definition of flood planning levels. The PMF is the largest flood that could conceivably occur at a location and defines the maximum extent of flood-prone land

C.2.2 Digital Terrain Model

Model topography is based Airborne Laser Survey (ALS) data, modified where building interference has occurred to ensure the surface is hydraulically correct. Comparisons to ground survey and other LiDAR datasets show that the data used in the TUFLOW model is generally accurate.

C.2.3 Modifications to the Existing Council Model

The following updates were made to the received flood model.

C.2.3.1 Stormwater Pit and Pipe Network

The model adopts the stormwater network data from the Marrickville Valley flood model, which includes the large channels of the WSSS. This was reviewed against site-specific information and found to be a good representative of the networks around the Timberyards.

Due to the age of the original flood model (2013), it was necessary to make some minor adjustments to some of the open stormwater channels represented in the model, which were causing the model to crash during the PMF storm. Affected channels were updated from TUFLOW ‘S’ (gradient / slope) type channels to ‘SN’ (non-inertial) type channels which are less susceptible to causing instabilities due to high velocities. The affected stormwater channels have a low hydraulic capacity and do not the Timberyards; therefore, these adjustments have no bearing on the model results at the subject site.

C.2.3.2 Topographic Survey Data

Topographic survey of the surrounding roads was undertaken for this study and used to supplement the existing data in the hydraulic model. The topographic survey was incorporated in the model and used to update the following:

- Road crown elevations along Farr Street, Sydenham Road, Victoria Road and Mitchell Street,
- Road gutter invert elevations along Farr Street and Mitchell Street,
- Back of pavement elevations along Farr Street (the elevation at which water would overtop the pavement and flow into the Timberyards site.

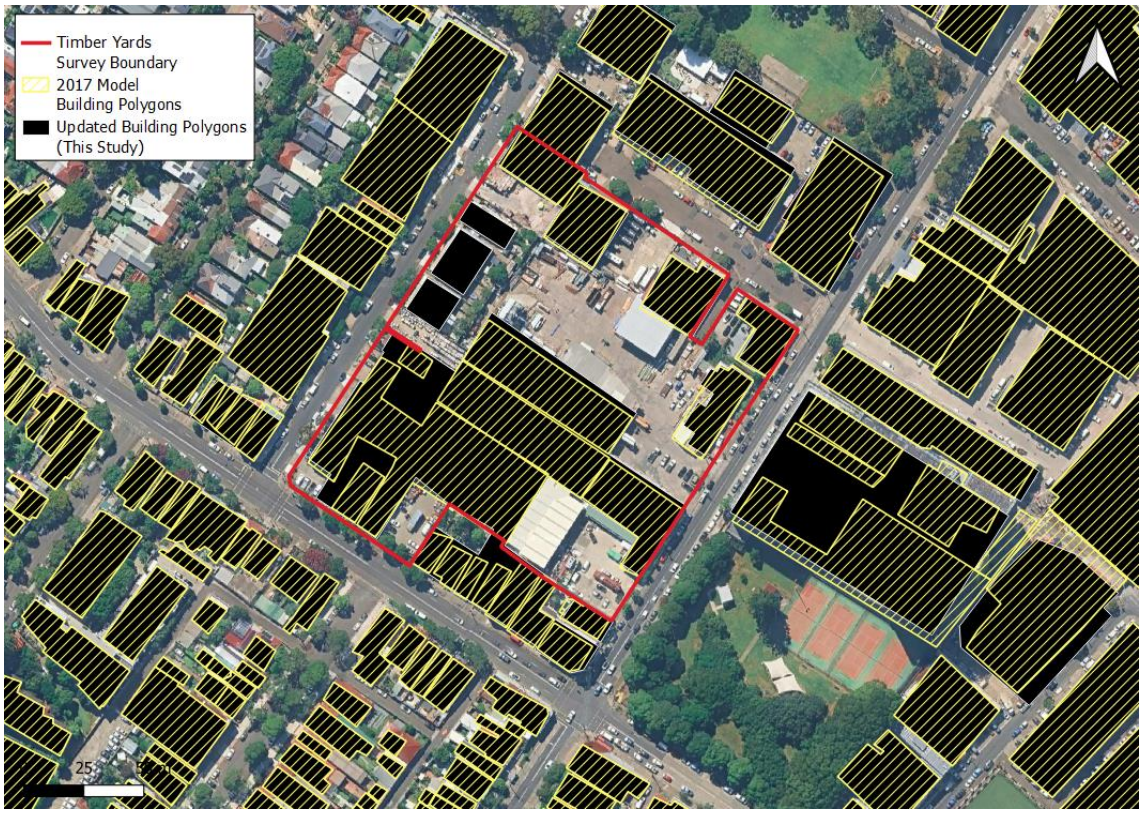
Figure C.1: Topographic Updates

C.2.3.3 Building Footprints

The flood model adopts the method of 'blocking out' buildings by applying an inactive layer over building footprints present in the model. This deactivates the area from the hydraulic calculations. This approach is adopted by many Councils across Sydney as it gives a more conservative estimate of flooding in local roads.

Building footprints were reviewed against the latest aerial images around the Timberyards and subsequently updated to represent the latest layouts. A comparison is shown in. The most notable inclusion is a block of terrace housing along Farr Street that were not included in the original model, despite being present at the time of its development in 2012 / 2013.

Figure C.2: Comparison of Building Representation (Received vs Updated Model)



C.2.4 Critical Storm Durations

An important consideration in defining the flood behaviour of an area is an assessment of the timing of flooding which is a key factor in assessing flood risk. If the rate of rise of floodwaters is fast then the opportunity for emergency response is limited and the risk to life may be higher, while if there is a long duration of inundation then the risk may increase due to extended periods of isolation for flood affected residents.

The 1% AEP critical duration is 2 hours, with the peak flooding occurring within 1 hour of the onset of rainfall. For the PMF, the critical storm duration is 60 minutes with the peak of flooding occurring less than 30 minutes after the onset of rainfall. These fast times to peak flooding mean that flooding in the Marrickville Valley is flash flooding.

It should be noted that the hydrological files received with the Council flood model do not include longer duration storms, other than the critical durations identified.

D. Flood Maps