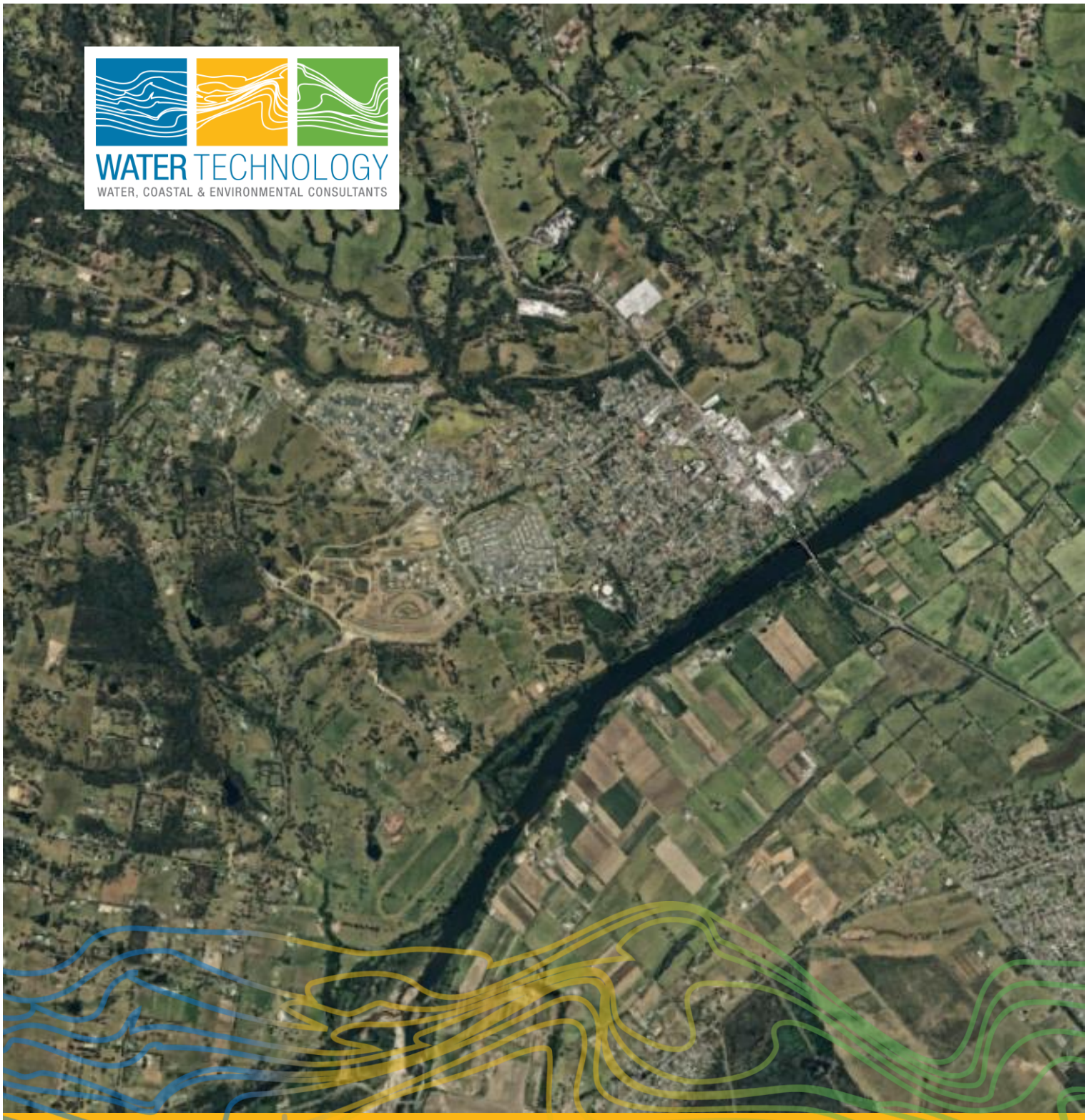

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

Report

Redbank Expansion Area Flood and Bushfire Safety Evaluation

Redbank Communities

18 February 2025

Document Status

Version	Doc type	Reviewed by	Approved by	Date issued
V01	Draft	S Molino	S Molino	05/02/25
V01a	Final	S Molino	S Molino	18/02/25

Project Details

Project Name	Redbank Expansion Area Flood and Bushfire Safety Evaluation
Client	Redbank Communities
Client Project Manager	Mark Regent
Water Technology Project Manager	Steven Molino
Water Technology Project Director	Filippo Dall'Osso
Authors	Steven Molino, Vanesa Posada
Document Number	25050118_R01V01a_ Redbank Expansion Area Flood and Bushfire Safety Evaluation

Suite 3, Level 1, 20 Wentworth Street
Parramatta NSW 2150
Telephone (02) 9354 0300
ACN 093 377 283
ABN 60 093 377 283

ACKNOWLEDGEMENT OF COUNTRY

The Board and employees of Water Technology acknowledge and respect the Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of Country throughout Australia. We specifically acknowledge the Traditional Custodians of the land on which our offices reside and where we undertake our work.

We respect the knowledge, skills and lived experiences of Aboriginal and Torres Strait Islander Peoples, who we continue to learn from and collaborate with. We also extend our respect to all First Nations Peoples, their cultures and to their Elders, past and present.

Artwork by Maurice Goolagong 2023. This piece was commissioned by Water Technology and visualises the important connections we have to water, and the cultural significance of journeys taken by traditional custodians of our land to meeting places, where communities connect with each other around waterways.

The symbolism in the artwork includes:

- *Seven circles representing each of the States and Territories in Australia where we do our work*
- *Blue dots between each circle representing the waterways that connect us*
- *The animals that rely on healthy waterways for their home*
- *Black and white dots representing all the different communities that we visit in our work*
- *Hands that are for the people we help on our journey*

18 February 2025

Mark Regent
Project Director
Redbank Communities
76 Arthur Phillip Drive, North Richmond
NSW 2754

Via email: markregent@redbankcommunities.com.au

Dear Mark

Redbank Expansion Area Flood and Bushfire Safety Evaluation

This document presents the Redbank Expansion Area Flood and Bushfire Safety Evaluation on behalf of Redbank Communities. It has been prepared and submitted in response to Hawkesbury City Council Resolution 238, documented in the minutes of 10 December 2024, which requires the 2009 North Richmond Release Area Flood and Bushfire Safety Report to be updated for the rezoning of the land identified as Kemsley Park.

Yours sincerely

Steven Molino
Project Manager
steven.molino@watertech.com.au
WATER TECHNOLOGY PTY LTD

CONTENTS

APPENDICES

LIST OF FIGURES

1 BACKGROUND

Redbank Communities has prepared a Planning Proposal to expand the existing Redbank development to include an area east of Grose Vale Road (Kemsley Park). This proposal seeks to facilitate sustainable urban growth while ensuring appropriate land use for Kemsley Park and contributing to the 2029 housing completion target for the Hawkesbury Local Government Area, as set by the Department of Planning, Housing and Infrastructure.

The original North Richmond Release Area Flood and Bushfire Safety Evaluation Report, prepared by Molino Stewart (now Water Technology) in 2009, assessed evacuation provisions for the Redbank development generally as well as the proposed seniors housing development under the State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004. It examined broader urban development potential in the Hawkesbury-Nepean Valley, providing key insights into floodplain management and bushfire risk mitigation to support the feasibility of proposed developments.

In 2024, Hawkesbury City Council resolved to proceed with the rezoning of Kemsley Park, as documented in Resolution 238 of the Council minutes of 10 December. This resolution requires an updated evaluation of flood and bushfire risks to reflect current environmental, regulatory, and infrastructure conditions.

To support the Redbank Communities proposal, this report assesses the adequacy of evacuation infrastructure during flood and bushfire events and updates the findings of the 2009 *North Richmond Release Area Flood and Bushfire Safety Evaluation* to align with the rezoning process. Accordingly, this report considers the provisions of Planning for Bushfire Protection 2019 and the Flood Risk Management Manual 2023 and associated guidelines. It also takes into account the most recently published bushfire hazard mapping, flood modelling and flood evacuation modelling.

This report has been prepared by Steven Molino, who has extensive experience in floodplain and bushfire management, particularly in the Hawkesbury Nepean Valley. Steven also prepared the 2009 North Richmond Release Area Flood and Bushfire Safety Evaluation report. A copy of Steven's curriculum vitae can be found in Appendix A.

2 PROJECT DESCRIPTION

2.1 The Site

The site, located at 322 Grose Vale Road, Grose Vale, lies in the southwestern corner of the Hawkesbury Local Government Area (LGA) and is bordered on three sides by the existing Redbank development (see Figure 2-1). Known historically as 'Kemsley Park,' it spans 35.41 hectares and is legally described as Lot 260 in DP123271.

The site has a 590 metre frontage on Grose Vale Road to the southwest, with primary access via a centrally located driveway and a secondary entry through the adjoining property, part of the emerging Redbank Estate. It has been used predominantly for rural residential and agricultural purposes since its original land grants. The site contains a single-story dwelling, a detached garage, a machinery shed, three earthen dams, timber fencing, and cleared land with a long driveway leading to Grose Vale Road.

The land slopes from 86 meters AHD in the southwest to 46 meters AHD in the north directing water into two dams north of the current driveway. These dams are on an intermittent stream which is a tributary of Redbank Creek. The land slopes down to the south from the current driveway and drains into another dam which overflows into an existing dam within the Redbank estate. Vegetation includes patches of Cumberland Plain Woodland, planted natives along the driveway, and exotic species around the dwelling, with most of the site cleared for grazing.

Figure 2-1 Aerial view of the site

2.2 Proposed Urban Development

The proposal outlines the natural and logical expansion of the Redbank Estate, classified as infill development due to the site being largely surrounded by urban-zoned lands within an urban release area. It aims to enhance the existing open space network and extend the modified grid road pattern characteristic of Redbank. The

master plan has been thoughtfully designed, considering the site's topography, native vegetation, bushfire risks, available services, housing diversity, and the heritage value of the Yobarnie Keyline system.

The master plan outlines the following key aspects:

- A responsive development footprint that respects significant terrestrial biodiversity areas along the southwestern edge and through the Site's central spine.
- Capacity for approximately 300 to 350 residential lots offering a variety of housing options, including:
  - Predominantly R2 Low-Density Residential lots,
  - R5 Large Lot Residential lots along the western boundary, and
  - Affordable housing delivered in collaboration with a Community Housing Provider, utilising dual-occupancy typologies.
- A local road network aligned with the adjoining Redbank development, providing three new access points via local roads while avoiding additional access to Grose Vale Road.
- An open space network designed to support active and passive recreation needs of the community, with contributions to higher-order recreational facilities off-site.
- Strategic placement of open spaces to showcase the Site's landform and scenic views.
- Tree canopy enhancement opportunities through future street tree planting, open space embellishments, and drainage corridor improvements.
- Bushfire planning measures integrated into road positions and lot depths.
- Utilisation of planned infrastructure capacity for water, sewer, and power networks.

This masterplan has been used to determine the proposed land use zoning in a manner that is consistent with the existing Redbank community.

This compares to:

- 2,553 dwellings in the 2021 census for the suburb of North Richmond which for census purposes extends north east to Wire Lane and Kurmond Road and encompasses the Redbank estate.
- 480 completed dwellings in Redbank in August 2021
- 1,399 approved dwellings for Redbank

There was an average of 3.2 people per dwelling and 3.2 vehicles per dwelling in the North Richmond according to the census.

3 FLOODING

3.1 Nature of Flooding in the Area

3.2 Riverine Flooding

The Hawkesbury River has a catchment of about 11,000 square kilometres upstream of Windsor in the Hawkesbury Local Government Area. The normal river level is only 0.5m above sea level at this point but is 100km from the ocean. Downstream of Windsor the river enters a deep sandstone gorge at Sackville.

When flood waters reach the gorge at Sackville the lack of elevation and the constriction in the river means that the water flows downstream much more slowly than it is entering the floodplain upstream. This causes the river to rise to considerable depths such that the 1% Annual Exceedance Probability (AEP) flood is 17.5m above sea level and the probable maximum flood (PMF) is 30.6m above sea level at North Richmond. The largest flood recorded in the valley occurred in 1867 and reached 19.5m at Windsor (about 19.7m at North Richmond), nearly six metres higher than the July 2022 flood. There is sedimentary evidence that a flood exceeded 20m at some time under current climatic conditions. These floods cover a floodplain with an area of about 400 square kilometres.

The more frequent floods in the river would cover the Richmond bridge for up to three days while floods as big as the 1867 flood or larger would be above the bridge level for five or six days.

The extent of the 1% AEP and PMF floods in the Hawkesbury Nepean Floodplain are illustrated in Figure 3-1 and in the North Richmond area in Figure 3-2. This shows that the subject site is above the 1% AEP and PMF levels and therefore is not directly at risk from riverine flooding under any foreseeable flood events. However, the locality does get isolated from Richmond during floods due to the closure of the North Richmond bridge.

3.3 Creek Flooding

Redbank Creek along the northern boundary of the Redbank Estate, as well as several other ephemeral water courses which cross the land, can also flood. Hawkesbury City Council placed the Draft Redbank Creek Flood Study (MHL, 2024) on public exhibition in December 2024. The extent and depth of the 1% AEP and PMF flood levels west of North Richmond, including Kemsley Park, are shown in Figure 3-3 and Figure 3-4 respectively.

Flooding in these creeks would rise and fall over the space of a few hours and the maximum depth of flooding, besides that occurring in the dams, is less than one metre deep and is confined to a small area within tens of metres of the creek bank.

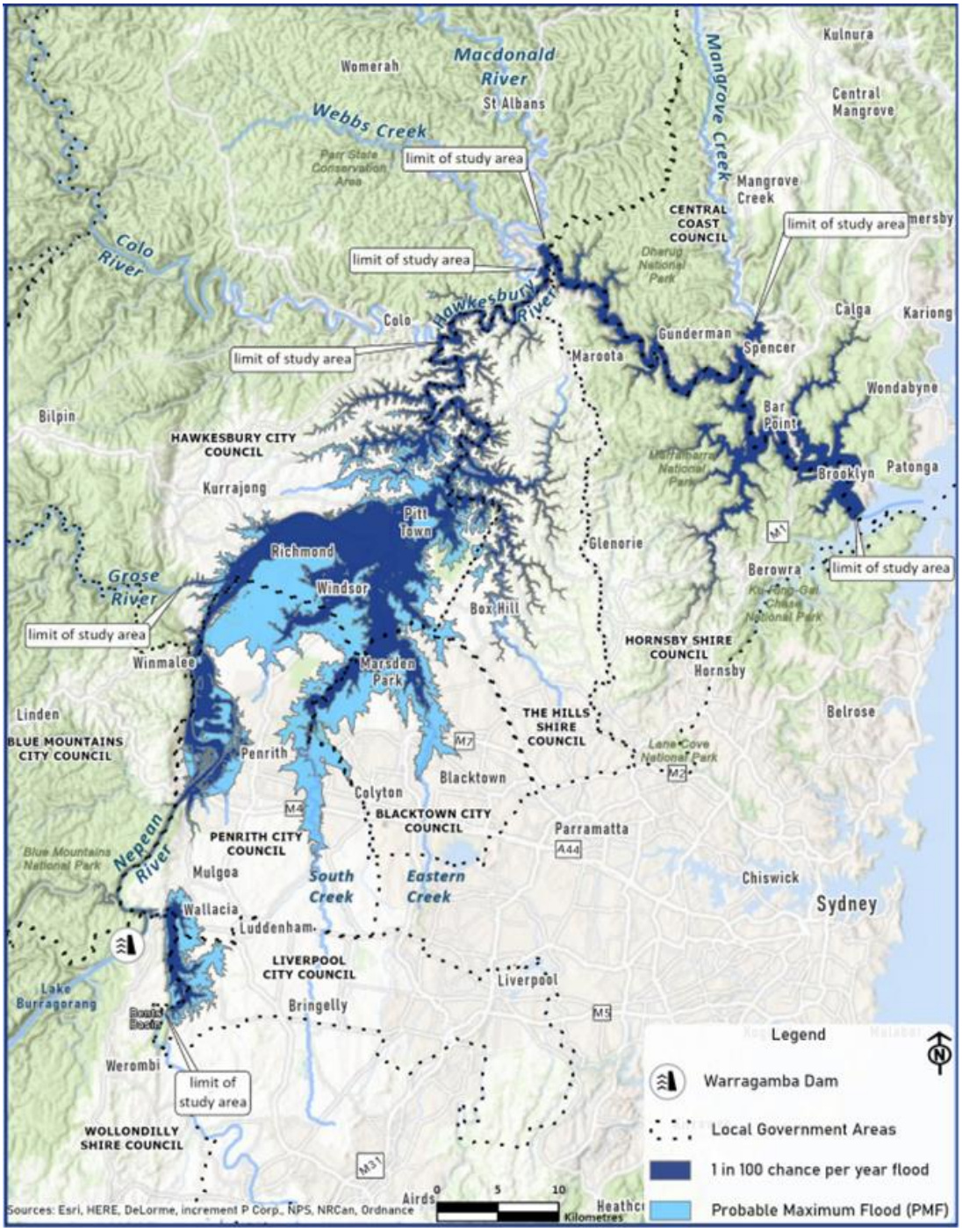

Figure 3-1 Hawkesbury Nepean Flood Extents (NSWRA, 2024)

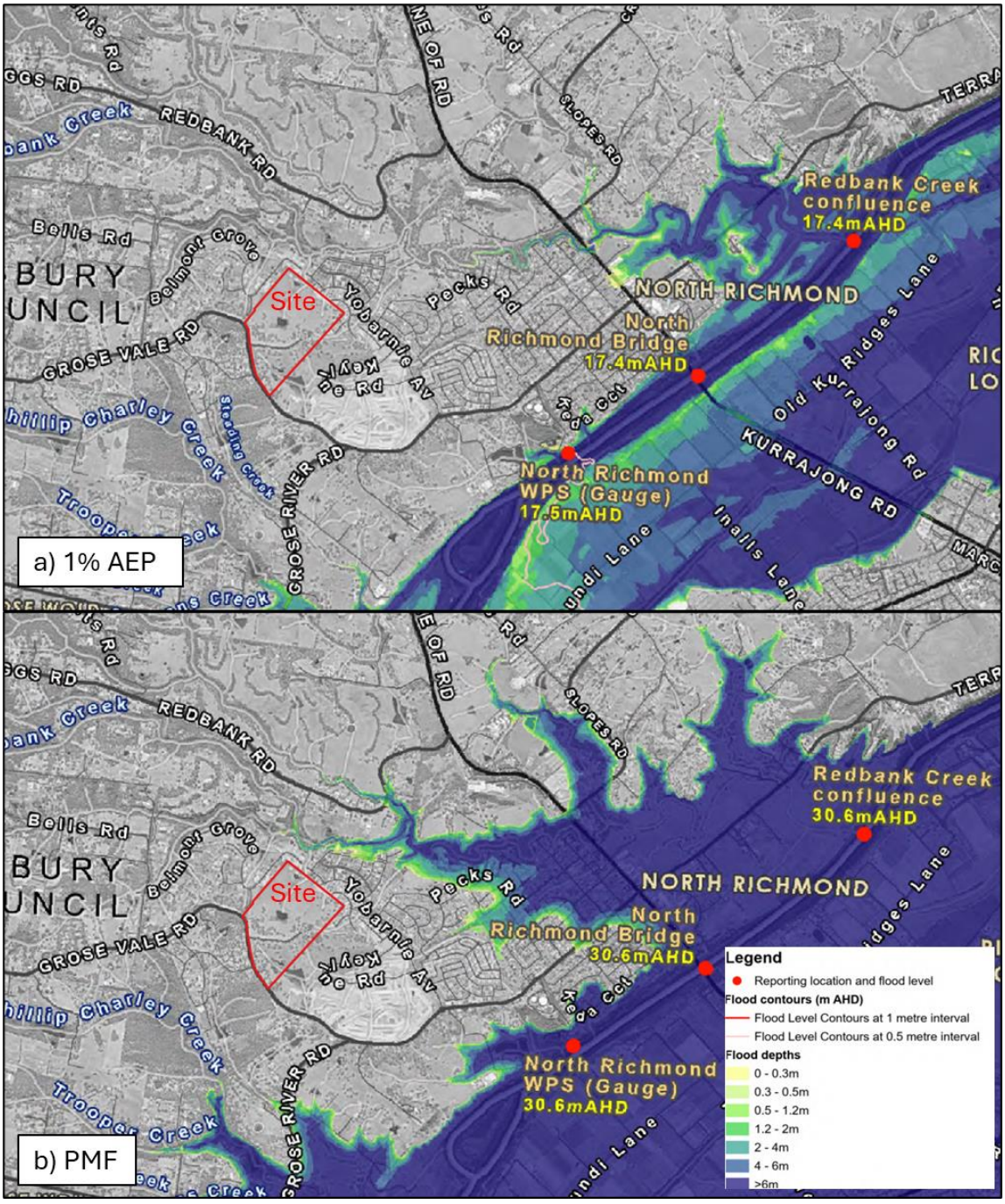

Figure 3-2 1% AEP and PMF flood extents (NSWRA, 2024)

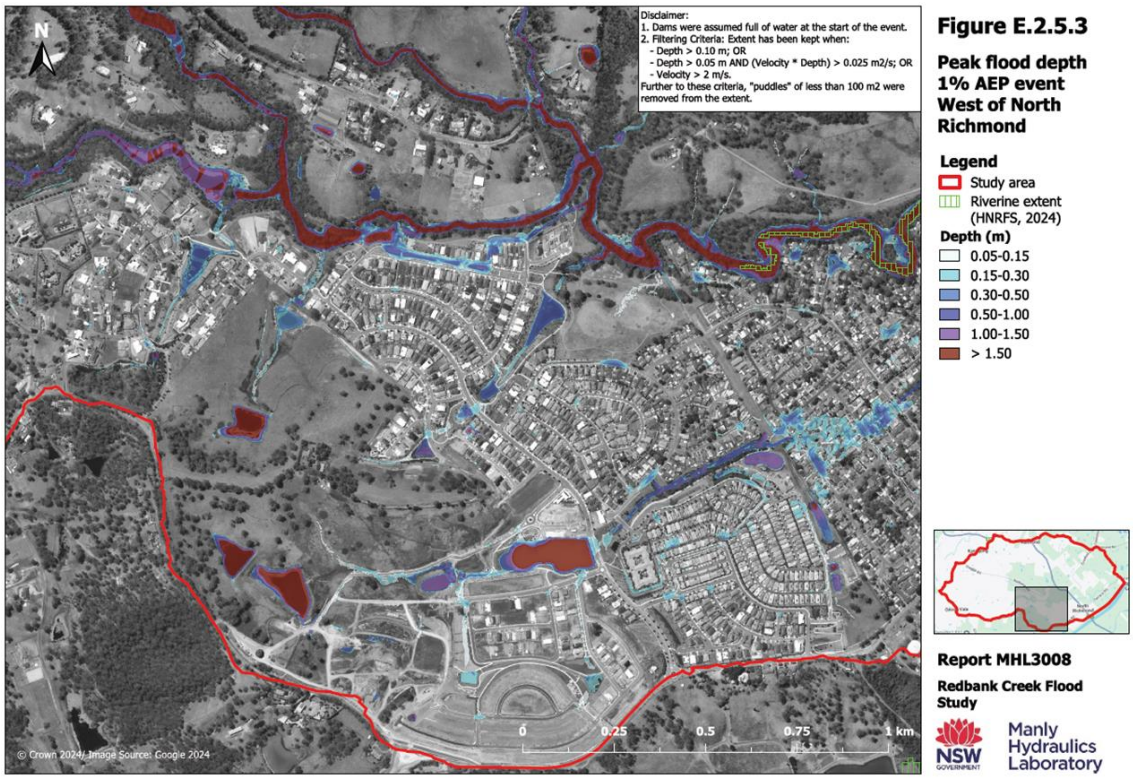

Figure 3-3 Peak flood depth 1% AEP event West of North Richmond

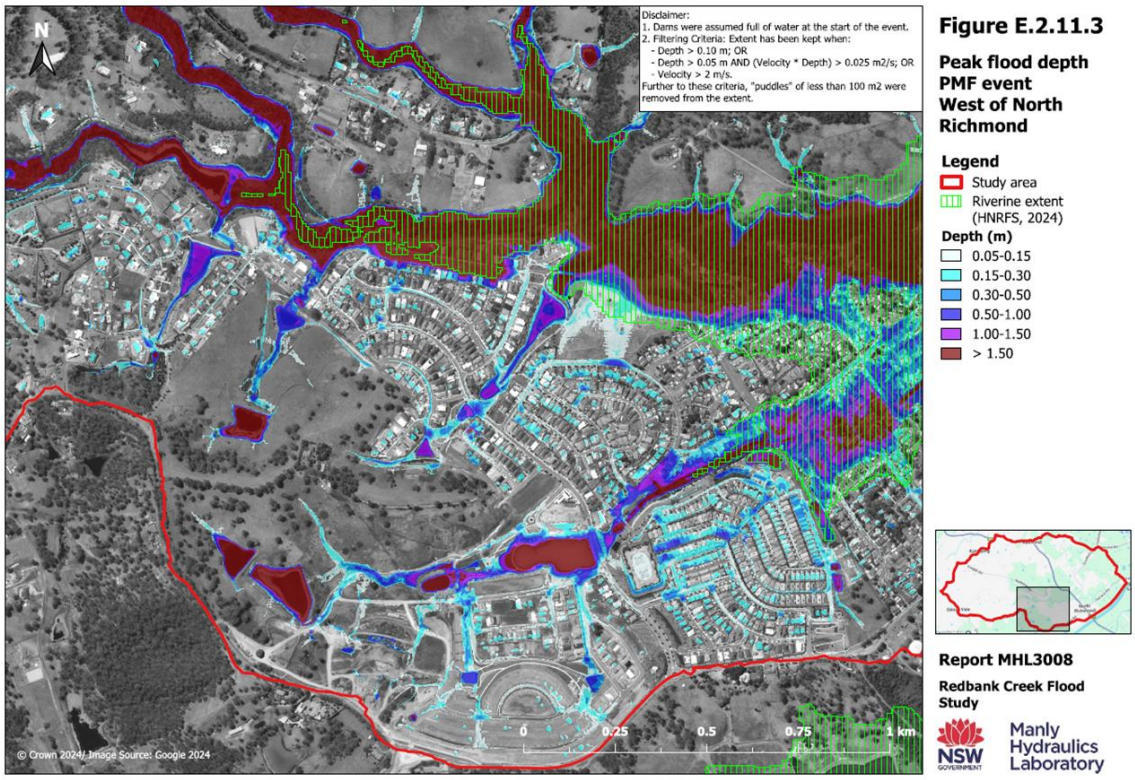

Figure 3-4 Peak flood depth PMF event West of North Richmond

3.4 Government Policy

3.4.1 Department of Climate Change, Energy, the Environment and Water

The Flood Risk Management Manual 2023 sets out guidelines for development in floodplains including best practice processes for the rezoning of land by local government.

The Manual advocates a merits based approach to floodplain development with consideration of the consequences of flooding up to the PMF. This includes consideration of the consequences for property and people. The Manual generally recommends residential floors levels to be set at the 1% AEP level plus an allowance for freeboard (typically 0.5 m). This is referred to as the flood planning level (FPL).

3.4.2 Department of Planning Housing and Industry

Since 14 July 2021, an updated flood-prone land package has been applicable, including the following documents:

3.4.2.1 Considering Flooding in Land Use Planning Guideline 2021

It advises councils on flood-related land use planning and the areas where flood-related development controls should apply. These are:

- Flood Planning Areas (FPAs): Areas of land at or below the FPL
- Special Flood Considerations (SFCs): Areas outside the FPA but subject to risks from extreme flood events, such as the PMF. It requires additional consideration for sensitive uses (e.g., hospitals, childcare facilities, and senior housing) and hazardous industries.

Since the proposed Redbank Expansion Area is located above the 1% AEP and PMF levels, none of these controls should apply.

3.4.2.2 Local Planning Directions under Section 9.1(2) of the Environmental Planning and Assessment Act 1979.

It directs that:

- '(4) A planning proposal must include provisions that give effect to and are consistent with:

  (a) the NSW Flood Prone Land Policy,

  (b) the principles of the Floodplain Development Manual 2005 (now The Flood Risk Management Manual 2023),

  (c) the Considering flooding in land use planning guideline 2021, and

  (d) any adopted flood study and/or floodplain risk management plan prepared in accordance with the principles of the Manual and adopted by the relevant.
- '(5) 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.

The Planning Proposal aims to rezone the land from Primary Production Small Lots to Low-Density Residential, Large Lot Residential, and Public Recreation in an area located outside the Flood Planning Area.

3.4.2.3 Flood Risk Management Guideline FB01

This guideline advocates limiting growth in flood risk through land use planning. It states that development assessment considerations should link to the requirements of the consent authority, which may be outlined in

the relevant State Environment Planning Policy (SEPP), LEP, DCP or policies. These requirements depend on factors such as development type, location, flood behaviour, risks, and available flood information.

These requirements may also identify the need for a Flood Impact and Risk Assessment (FIRA) to support the assessment of the impacts of a development proposal. A FIRA is often necessary for:

- subdivisions or new developments in existing zoned areas
- supporting new developments through rezoning processes
- addressing consent authority concerns about flood impacts, risks to the community, and new developments.

FIRAs must align with council objectives and flood-related requirements in LEPs, DCPs, and policies, providing flood data, impact assessments, and risk mitigation strategies.

3.4.2.4 Resilient Valley Resilient Communities from Hawkesbury-Nepean Valley Flood Risk Management Strategy (HNVFRMS)

This document which was published in 2017 proposes nine outcomes for reducing flood risk. Outcome 3 advocates that a regional planning framework be developed to integrate land use and road planning, adapting to and managing flood risks in the Hawkesbury-Nepean Valley. Outcome 8 advocates adequate local roads for evacuation. The report states that new restrictions may be applied in higher-risk areas, and land use and road planning must consider the cumulative impact of population growth on road evacuation capacity.

Actions to be taken include:

- Improving Flood Risk Information:
  - Conduct a regional flood study with a modern, accessible model.
  - Develop a regional evacuation model to identify capacity constraints.
  - Assess asset damages across the Valley.
- Integrating Land Use and Road Planning:
  - Create a Regional Evacuation Road Master Plan for a cohesive evacuation network and flood-resilient road design standards.
  - Develop a Regional Land Use Planning Framework to align policies with flood management goals.
  - Establish a land use planning response to preserve the benefits of the dam wall raising.

Since 2017 the NSW Reconstruction Authority (NSWRA) completed a new flood study (NSWRA, 2024) and Infrastructure NSW (INSW) published the results of a valley-wide flood evacuation modelling investigation (INSW, 2023). In late 2024, Hawkesbury City Council (HCC) placed on public exhibition a draft floodplain risk management plan (HCC, 2024) which included proposed changes to flood planning controls.

3.4.2.5 Hawkesbury-Nepean Valley Flood Evacuation Modelling

INSW in collaboration with NSWSES published this report in 2023 to inform flood risk management planning. It sets out flood evacuation constraints in the valley to guide future urban planning decisions. The evacuation modelling accounted for future residential development in North Richmond and other areas. It is noted from this report that, under a 2041 committed and potential development scenario, there would be no people in North Richmond unable to evacuate within 12 hours in a 1 in 1,000 (0.1% AEP) chance per year flood event.

As Redbank was committed development, and Kemsley Park planned development at the time the report was written, this indicates that increasing the population in North Richmond through the development of Kemsley Park would not compromise the evacuation of anyone in the area.

However, when considering mid-century climate change (a 9% increase in rainfall intensity) the number of people unable to evacuate from committed development alone during a 0.1% AEP flood in North Richmond could be between 51 and 100. Research undertaken for HNVFRMS indicates a 9% climate change related increase in rainfall intensity by mid-century (~2060) would increase the 1% AEP flood level by 0.7m at North Richmond and the rates of rise are predicted to increase with floods peaking earlier. This will mean the 0.1% flood will impact more homes, more quickly in North Richmond which is why some of them might not be able to evacuate within 12 hours. None of the homes in Kemsley Park would be affected by even a PMF with climate change.

3.4.3 Hawkesbury City Council

3.4.3.1 Flood Policy 2020

This Policy provides development controls to be applied to all Development Applications for any development in the Hawkesbury City Council LGA on land located within the FPA. This Policy does not apply in the circumstances of local overland flooding or local drainage inundation as defined in the Floodplain Development Manual and determined by Council.

3.4.3.2 Hawkesbury Local Environmental Plan 2012

The HCC LEP states that a development consent for land within a FPA can only be granted if the proposal is compatible with the flood function and behaviour of the land and does not increase flood risks to other properties. The development must ensure safe occupation, efficient evacuation, and incorporate measures to manage life risks during floods. Additionally, it must avoid adverse environmental impacts, including erosion, siltation, and damage to riparian vegetation or riverbanks.

When assessing such developments, the consent authority must consider the potential impact of climate change on flood behaviour, the design and scale of proposed buildings, measures to minimise life risks and ensure evacuation safety, and the ability to modify, relocate, or remove structures if flooding or coastal erosion affects the area. Terms used align with the Considering Flooding in Land Use Planning Guideline, unless otherwise specified.

3.4.3.3 Draft Hawkesbury Floodplain Risk Management Study and Plan 2025

Currently Hawkesbury City Council's FPL is the 1 in 100 level without an allowance for freeboard.

Section 8.4.4 (Building and Development Controls) of this study mentions that, based on the flood range and climate risk, it is recommended that the Council adopt the 0.5% AEP (1 in 200 AEP) as the defined flood event, with an additional 0.5m freeboard for the Flood Planning Level. It proposes that Council's planning documents be updated accordingly and climate change considerations be incorporated into the planning levels.

The Hawkesbury-Nepean River Flood Study 2024 includes regional flooding and does not include local catchment flooding, which may produce higher flood levels in the upper reaches of tributaries. Hawkesbury Council's draft Redbank Creek Flood Study was placed on public exhibition in December 2024. The flood planning levels from this local flood study would also need to be considered where they exceed the levels determined for the Hawkesbury-Nepean River.

3.4.4 State Emergency Service

3.4.4.1 Hawkesbury-Nepean flood emergency sub plan 2020

According to this plan, Redbank and Kemsley Park are within the Grose Wold subsector just south of the North Richmond sub sector which itself is south of the North Richmond Lowlands subsector.

North Richmond Lowlands is classified as a low flood island where Terrace Road is first cut at 20% AEP event at 11.5m AHD near Redbank Creek and then it is cut near Beamont Ave in a 0.2% AEP year event at 19.3m AHD. North Richmond subsector has rising road access but its evacuation route is not affected until the river reaches 17.6m AHD. Grose Wold subsector is also classified as rising road access but its roads are not affected by any floods up to the PMF level.

While Kemsley Park and the wider Redbank development are not isolated by flooding, once the North Richmond Bridge is closed, they must drive west along the Bells Line of Road, onto the Darling Causeway at Bell and then east on the Great Western Highway at Mount Victoria to be able to cross the river at Penrith. This detour takes about 2 hours in normal driving conditions.

In 2024 Hawkesbury City Council approved construction of a road bridge over the Grose River at Yarramundi. Once this bridge is completed it will provide a shorter alternative route south from North Richmond to the Great Western Highway via Springwood Road which will be able to be used by Kemsley Park residents. The lowest points on this route are where it crosses Lynch Creek and Mahons Creek which both get cut by a 5% AEP flood on the Hawkesbury Nepean River (BD Infrastructure, 2024). This compares to the deck of the North Richmond Bridge which is at 8.4m AHD and closed at even lower river levels due to structural stability concerns. The most frequent flood modelled for the Hawkesbury Nepean River is the 20% AEP event which is 12.3m AHD at North Richmond Bridge. Therefore, once the new bridge is complete, the frequency with which residents of Kemsley Park, Redbank and North Richmond will need to go via Bells Line of Road to cross the river will be greatly reduced.

There is no policy to evacuate any residents/houses located above the PMF level west of the Hawkesbury River. These residents are safe to remain in place but, if required, can travel west of the river and cross the river by one of the routes previously described.

3.5 Regional Flood Impacts

3.5.1 Overview

As indicated in Figure 3-1, a large proportion of Richmond, Windsor, Penrith and adjoining areas would be under water in a major flood. The more frequent floods in the river would cover the North Richmond bridge for up to three days while floods as big as the 1867 flood or larger would be above the bridge level for five or six days. These floods would likely cause major damage to property and infrastructure on the floodplain and place human life in the area at significant risk, leading to mandatory evacuation for extended periods.

By contrast most of Redbank, including Kemsley Park, will remain above floodwater level, even in the PMF event and so would not suffer any significant direct damage to property nor direct risk to human life. However, the PMF event would cover a significant proportion of North Richmond Bridge as well as a few properties in Pansy Crescent and on the northern side of Flannery Drive which back onto Redbank Creek. A maximum of about 20 properties may be affected with some dwellings likely to experience above floor flooding (Figure 3-5).

3.5.2 Comparison to Other Development Sites

Figure 3-6 is taken from *Hawkesbury-Nepean Valley flood evacuation modelling to inform flood risk management planning - Hawkesbury-Nepean Valley Flood Risk Management Strategy* (INSW, 2023) and shows that for 2041 committed development, multiple subsectors in the Penrith and Richmond/Windsor floodplains would have a significant number of people unable to evacuate within 12 hours for a 1 in 1000 chance per year (0.1% AEP) flood. It is worth noting that the people at risk are concentrated in the Richmond and Windsor town centre and don't include the North Richmond community because it is not significantly impacted in this event.

While significant areas of North Richmond may be impacted in a PMF, the area has rising road access for evacuees and would evacuate west along Bells Line of Road and not converge with any of the other evacuation

traffic from the rest of the floodplain. Therefore, even in the most extreme event evacuation from North Richmond is not constrained in the same way as it is on the broader floodplain.

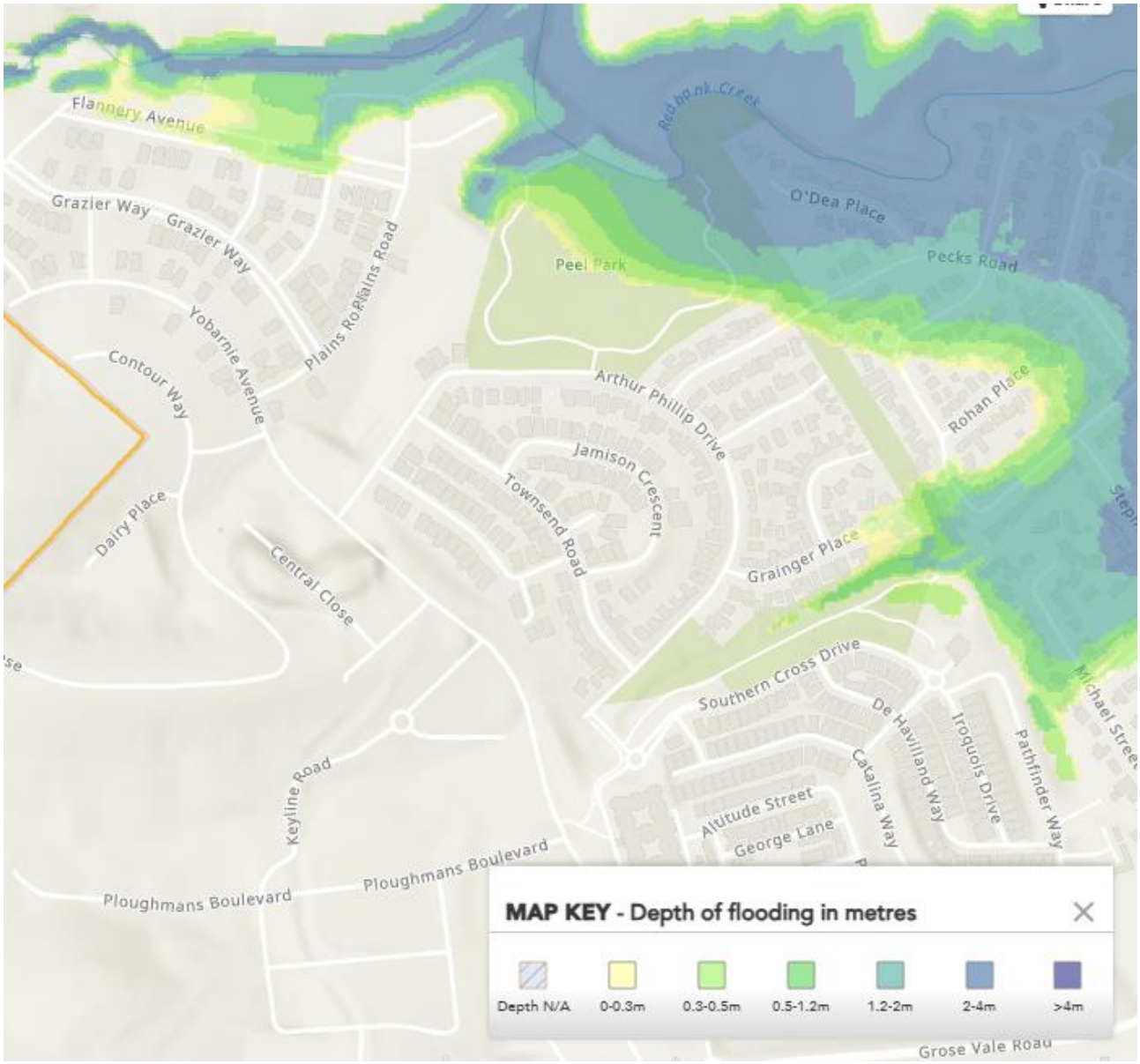

Figure 3-5 PMF flood depth in area of interest (SES, 2024)

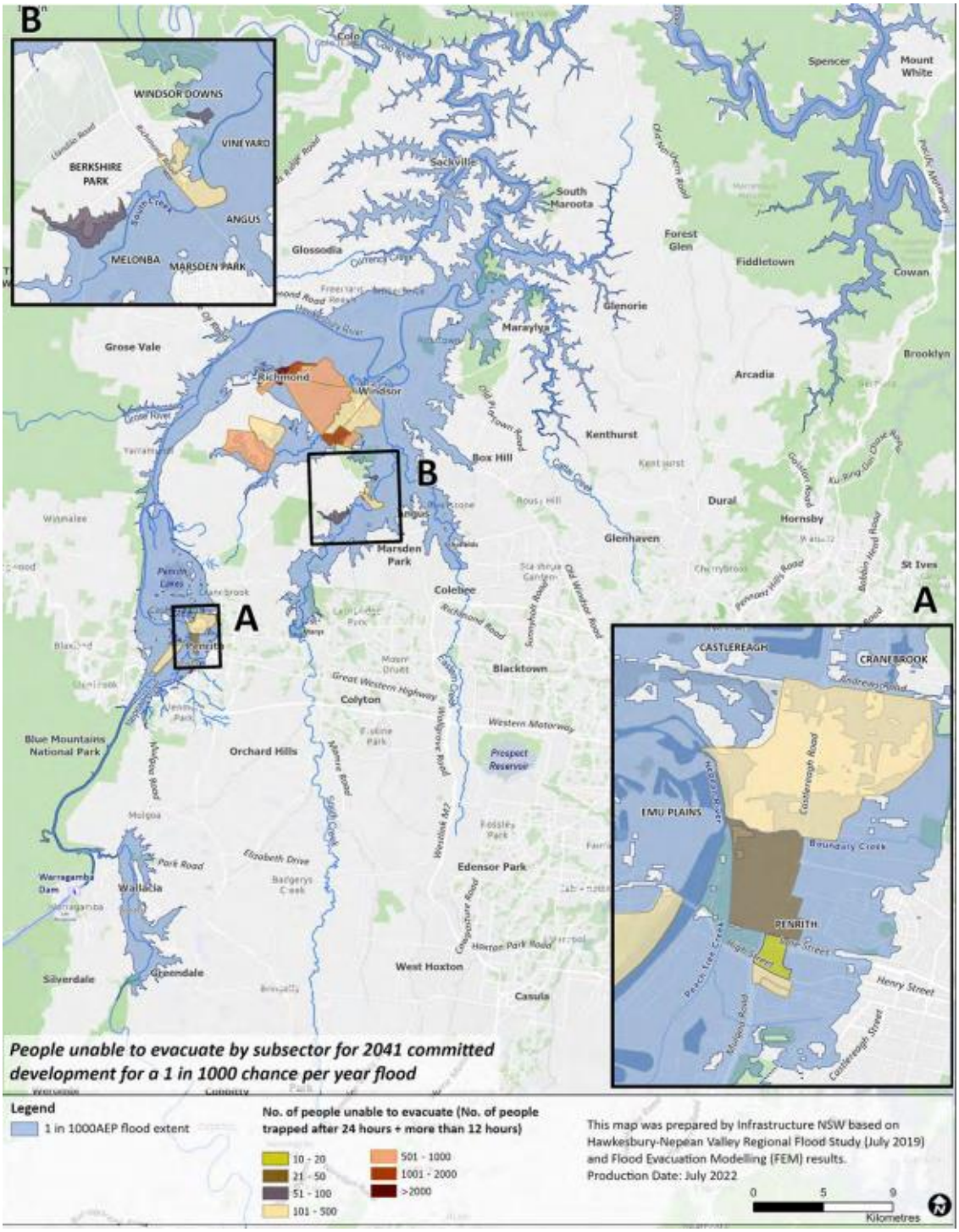

Figure 3-6 People unable to evacuate by subsector for 2041 committed development for a 1 in 1000 chance per year flood (0.1% AEP) (State of NSW, HNVFRMS 2023)

3.6 Site Flood Impacts

3.6.1 Direct

3.6.1.1 Riverine Flooding

None of Kemsley Park is below the PMF level (30.6m AHD). Therefore flooding on the Hawkesbury Nepean River will not directly impact on any of the proposed development.

3.6.1.2 Local Flooding

The ephemeral water courses through Kemsley Park will flood from time to time but as shown in Figure 3-3 and Figure 3-4, floodwaters are confined to the dams and close to the creek banks. As riparian corridors will be provided along these creek lines in the subdivision in accordance with NSW Government guidelines, the 1% AEP and most of the PMF will be confined to open space areas.

As this is a greenfield urban development, it will be possible to subdivision layouts and building footprints so that no dwellings experience above floor flooding.

3.6.2 Indirect

3.6.2.1 Riverine Flooding

The Hawkesbury Nepean Flood Emergency Sub Plan has been prepared by the NSW State Emergency Service (SES) to set out a plan of action in preparation for and response to major floods in the Hawkesbury Nepean Valley (SES 2020).

For the purposes of the plan, each sector in the valley is classified into categories based on the impact of flooding on the community as one of the following:

- Flood Islands (Low or High);
- Trapped Perimeters (Low or High);
- Areas with Overland Access;
- Areas with Rising Road Access; and
- Indirectly Affected areas.

In the Plan, North Richmond is classified by the SES as a Low Flow Island. The response strategy options that apply to this classification are partial evacuation, complete evacuation, resupply and rescue.

The Incident Controller will develop a response strategy tailored to address the anticipated flood impacts in each sector and will consult with the NSW SES State Controller regarding these plans. Since the impact may differ between sectors, multiple strategies may need to be chosen and applied throughout the operational area. The choice of strategy for each sector will largely depend on the Bureau's ability to provide a reliable assessment of the maximum expected flooding extent.

However, it is noted that the whole of Kemsley Park and most of Redbank is above the PMF. This flood free area would therefore fall into the indirectly affected area categories. That is, it will not be directly affected by riverine flooding but utilities and services may be lost due to flooding.

The following explains how floods on the Hawkesbury Nepean could indirectly affect development on the subject site.

3.6.2.1.1 Road Access

North Richmond and Windsor bridges will close when the river reaches about 8.4m AHD or less at North Richmond. This would cut the most direct and second most direct access across the river for North Richmond residents.

The duration of such a disruption would vary (SWC 1995). In a 1 in 5 flood the bridges would be under water for 2.5 days, in a 1 in 20 flood for 3.5 days, in a 1 in 100 flood for 4.5 days and in a PMF for 6 days or more. This assumes that the bridge and approach roads are intact after the flood.

When the North Richmond Bridge is closed, residents can cross the river using the Great Western Highway or the M4 Motorway Bridge, requiring a detour of approximately 130 km via Bells Line of Road though Bell - Mount Victoria. However, it is important to note that these alternative routes are also vulnerable to flooding. The M4 Motorway may close at a level of 32.8 m AHD and potentially at 28.5 m AHD at South Creek. Similarly, the Great Western Highway may become inaccessible at 25.2 m AHD at South Creek.

In the event of a PMF, none of these crossings will be usable. The proposed Grose River Bridge, once completed, will provide an additional access route for North Richmond residents via Springwood Road. While the bridge is designed to sit above the 1 in 100 year flood level, other bridges on Springwood Road will get cut by a 5% AEP flood on the Hawkesbury Nepean. Therefore the new bridge will improve connectivity and significantly reduce travel times during flood events below this threshold.

It is likely that in a 1 in 100 flood or bigger the North Richmond and Windsor bridges could be severely damaged or even washed away and roads across the floodplain around Richmond would be scoured. In these more extreme events the reality is likely to be that the alternative access would be needed to be used for months.

Of course that would also depend on the purpose that people had for crossing the river. If it were simply for regular food supplies then the shops in North Richmond would be able to provide those supplies although they would have to be restocked more regularly by deliveries approaching from the west.

If the purpose of crossing the river was to visit a destination on the floodplain, then that destination would probably be damaged or vacated as a result of a flood big enough to damage the bridge so an alternative destination would have to be found in any case. Lithgow or Katoomba which are both within one hour's drive would probably have suitable alternatives.

If the purpose was to reach a destination on the other side of the floodplain, then the detour would need to be taken until the access across the entire floodplain was restored.

Given the low probability of this occurring, and the more urgent needs of those directly affected by flooding, it is unlikely that this inconvenience in any flood would be sufficient to warrant the SES to call for the evacuation of North Richmond.

3.6.2.1.2 Electricity

Endeavor Energy is responsible for electricity distribution throughout the Hawkesbury LGA. North Richmond is supplied out of the Hawkesbury Transmission Substation as is most of the Hawkesbury LGA.

Communities can be without power for several days to months. For flood levels exceeding 14.5m, all electricity supply west of the Hawkesbury River is likely to be shut off. North Richmond, along with many other communities, would most likely be affected (NSW SES, 2020).

Providing the lines and substation are not damaged by flooding, the power would be able to be restored soon after the water dropped below this level. In these circumstances North Richmond could be without power for a few days.

When flooding exceeds about 20m AHD at Windsor (about a 1 in 500 flood) the Hawkesbury Transmission Substation would be damaged and it could take weeks or even months to restore power not only to North Richmond but other communities in the region that are dependent on that power. It would also include almost every property which is above the PMF level west and north of the Hawkesbury River between Yarramundi and the McDonald River.

Many residents in the new Redbank Estate already have solar panel systems and some of these have battery storage. Such use of these renewable energy options may generate sufficient emergency power for some households at Kemsley Park, Redbank and North Richmond.

Given that flooding is only one of many ways in which power supply could be interrupted, it is unlikely that loss of power through flooding would be sufficient a trigger to require the evacuation of the proposed Kemsley Park development nor the rest of Redbank of North Richmond.

3.6.2.1.3 Telecommunications

Mobile base stations typically have 4–8 hours of battery backup to maintain functionality during power outages. However, if mains electricity is not restored within this period, these base stations will fail, resulting in the loss of mobile telephone services.

Similarly, landline voice and data services in North Richmond are at risk during power outages or flooding. Telecommunications roadside cabinets, which are crucial for these services, can fail if they lose mains power or become inundated.

Telecommunications exchanges, which serve as critical hubs for maintaining connectivity, rely on backup power generators and on-site batteries during power failures. While these systems can sustain operations for several hours, they require refuelling to function beyond the 4–8 hour threshold. In extreme weather or flooding, telecommunication maintenance crews may need assistance from the NSW State Emergency Services (SES) to access these sites and refuel the generators, ensuring uninterrupted service.

Given the low probability of flooding completely cutting off access to critical telecommunications infrastructure for an extended period, it is unlikely that the loss of telecommunications alone would justify the evacuation of North Richmond, Redbank or Kemsley Park. While such disruptions could create temporary communication challenges, these impacts can be managed and would not pose an immediate threat to public safety, provided other critical systems remain operational.

3.6.2.1.4 Water Supply

North Richmond Water Treatment Plant treats and supplies reticulated drinking water to North Richmond. While some of the sludge lagoons at the plant would be submerged in floods exceeding 18m AHD, this would not affect the operation of the plant and even a PMF would not directly impact on the plant's function.

Loss of electricity supply poses a greater threat to the plant's operation with the plant having to shut down due to loss of power when the flood level exceeds 13m AHD. Power supply to key pumping stations would also be cut off at about this level. This would not prevent water being supplied to customers as water stored in elevated tanks within the system could be stretched out to as long as two weeks if severe water restrictions were imposed.

Any properties on the floodplain east of the river which were not evacuated would have similar risks of loss of water supply because they get their water from North Richmond Water Treatment Plant although should the North Richmond bridge or its approaches be damaged by floodwaters, the pipeline supplying east of the river could be cut.

Two high level reservoirs have been built at Redbank providing gravity water to supply Redbank, Kemsley Park and greater North Richmond. While these are supplied from North Richmond Water Treatment Plant,

they store about 24 hours of supply at normal usages rates and longer on restricted supply. These therefore could provide some temporary water supply should the treatment plant cease to operate. Furthermore, all new homes will be fitted with rainwater tanks to meet BASIX requirements. Given the prevailing weather conditions which will cause flooding, these tanks are likely to be full. Therefore, the need to evacuate due to lack of drinking water is highly unlikely.

3.6.2.1.5 Gas Supply

North Richmond does not have reticulated a gas supply.

3.6.2.1.6 Sewerage

A gravity wastewater main near Redbank Creek is planned to support the development, enabling connection to existing sewer infrastructure at Redbank. Wastewater will eventually be transferred to Richmond through a pipeline to be constructed by Sydney Water, which is expected to be operational by 2026.

Meanwhile, the North Richmond Sewage Treatment Plant is undergoing refurbishment and reconfiguration to redirect flows to the Richmond Sewage Treatment Plant via a new sewer main. This system will include a pump installed well above the 1:100 flood level to ensure reliable operation during extreme weather events.

There can be a very low risk of sewage treatment failure due to flooding and were it to occur it is unlikely to necessitate the evacuation of the entire development.

3.6.2.1.7 Medical Services

North Richmond has pharmacies, doctors, and dentists, ensuring that the loss of road access due to flooding will not cause significant disruptions in accessing these essential medical services.

There are four hospitals within reasonable proximity to the site:

- Hawkesbury District Hospital/Windsor Hospital, Windsor – Approx 8km east of the site A 127 bed private hospital, services include emergency services, surgical services, 24 hour medical centre (bulk billing), community nursing.
- Nepean District Hospital, Penrith - Approx 20km south of the site. This is a 420-bed major referral hospital.
- Lithgow Hospital, Lithgow - Approx 75km west of the site. This consists of a 46 bed public hospital, 14 bed private hospital, 13 bed nursing home, 31 hostel type units and a comprehensive community health centre. 24 hour emergency services operate.
- Blue Mountains Hospital, Katoomba – Approx 50km southwest of the site. This is an 86-bed general hospital

Flooding would cut off all access from North Richmond to the hospital at Windsor because Windsor effectively becomes an island. In floods exceeding 16m AHD the hospital itself would be directly impacted by flooding but would be reliant upon emergency power supplies before that occurred. Although not specified in the *Hawkesbury-Nepean Valley Flood Emergency Sub Plan* (NSW SES, 2020), it has been observed that during the floods from 2020 to 2024, medical support was deployed west of the river including medical personnel, ambulances and medical helicopter support when required.

All of the other hospitals would not be directly or indirectly affected by flooding of the Hawkesbury Nepean River. Loss of road access directly across the river will increase the travel time to Nepean Hospital to close to two hours in 5% AEP floods and larger, while the travel time to Lithgow and Katoomba hospitals would remain at the current one hour.

This increased travel time is only likely to be an issue for medical emergencies.

3.6.2.2 Local Flooding

Local flooding is only likely to affect internal roads to the development and then only in the more extreme rainfall events and for less than one hour.

3.7 Flood Evacuation

The preceding analysis shows that neither riverine flooding nor local flooding would pose a direct threat to the proposed development at Kemsley Park.

The indirect impacts of either type of flooding are unlikely to trigger the mass evacuation of North Richmond, Redbank and Kemsley Park although some parts of North Richmond may need to be evacuated ahead of an extremely rare flood on the Hawkesbury River.

However, should it be decided, either by the occupants or the SES, that restricted access or reduced services made staying in North Richmond untenable, there would remain a safe, flood free access route by which people could leave at any time.

This would mean that there would be no urgency to evacuate and the SES could time the evacuation so that it did not coincide with urgent evacuations from life threatening floodwaters.

The NSW SES bases its flood evacuation planning on an estimated vehicle evacuation rate of 600 vehicles per hour, per lane of outbound traffic (NSW SES, 2020). As mentioned in Section 2.2, the 2021 Census recorded 2,553 dwellings in the suburb of North Richmond. With the full development of Redbank and the development of Kemsley Park. This would increase the total number of dwellings in the North Richmond Census suburb to 3,822. With 3.2 vehicles per dwelling recorded in the Census, this would mean about 12,230 vehicles would need to evacuate.

This would take a bit over 20 hours to evacuate. The evacuation of all of the urban residential areas in North Richmond could therefore be evacuated in one day.

4 BUSHFIRE

4.1 Bushfire Risk Categories

Bushfire risk is defined as the chance of a bushfire igniting, spreading and causing damage to assets of value to the community. Risk may be rated as being extreme, major, moderate, minor or insignificant and is related to the vulnerability of the asset.

Assets which are exposed to an extreme/major bushfire risk are those that are located in an area of high bushfire hazard containing large areas of unmanaged bushland, remote from the safety provided by existing development. These assets require early relocation of the occupants when a bushfire event occurs that could cut evacuation routes and which could breach fire safety measures implemented in the design of a development.

Assets which are exposed to a moderate bushfire risk are those that are located in an area of moderate bushfire hazard, usually within an area that contains existing development and some unmanaged bushland/grassland which is exposed to periodic bushfire events. The bushfire risk to these assets is mitigated by the provision of bushfire protection measures such as the maintenance of Asset Protection Zones and construction standards to buildings.

Evacuation of properly prepared assets within a moderate bushfire risk area is not normally required for moderate to extreme bushfire events however exposure to a catastrophic fire event may require relocation of the residents to a safe refuge remote from the potential fire path.

Assets which are exposed to a minor/insignificant bushfire risk are those that are located within an existing urban area or rural residential precinct which provides minimum combustible fuels for fires to burn across and are located nominally 100 metres from the bushfire hazard interface. Evacuation of assets occupied by the frail/aged or people with respiratory illnesses may be required due to the potential for smoke impact.

4.2 Bushfire Risks

4.2.1 Existing Site

Hawkesbury City Council's Bushfire Prone Land Map (Figure 4-1) shows most of the existing site as being Category 3 vegetation which is Grasslands, freshwater wetlands, semi-arid woodlands, alpine complex and arid shrublands. It is classified as vegetation with a medium bushfire risk.

The site is actually managed grassland with some scattered shade trees and narrow vegetated creek lines. This means that it has a lower bushfire hazard than suggested by its classification on Council's maps.

The Bushfire Prone Land Map indicates that the area to the east of the site is classified as non-bushfire prone land, offering some level of mitigation from this side. In contrast, some sections to the southwest and along Redbank Creek are designated as Category 1 Bushfire Prone Vegetation, which poses a higher fire risk. The site is bordered to the northwest by a rural residential area that contains managed grassland vegetation, which presents a low to moderate bushfire risk to these portions of the site.

4.2.2 Future Site

Urban development on the land will result in the removal of some of the scattered trees and remove much of the grassland which will theoretically reduce the already low to moderate bushfire hazard over most of the site.

However, there is likely to be a requirement for all ephemeral watercourses to have vegetated buffer zones extending from the top of each bank. These riparian corridors themselves can become bushfire prone land with a fire hazard greater than the existing grass land or even the current open woodland categorisation should they be quite wide. Fire protection measures will therefore be required to address this potential risk.

According to the planning proposal, the site can accommodate appropriate Asset Protection Zones (APZ) within its boundaries. The proposal assumes that the retained vegetation on the site and the function of Grose Vale Road as a perimeter road will facilitate firefighting operations in response to bushfire threats from the rural-zoned lands to the west. The APZs can partially extend into the road reserve outside the site, with encroachments at the southwestern and southeastern corners, which the masterplan envisions being located within the rear setbacks of residential lots.

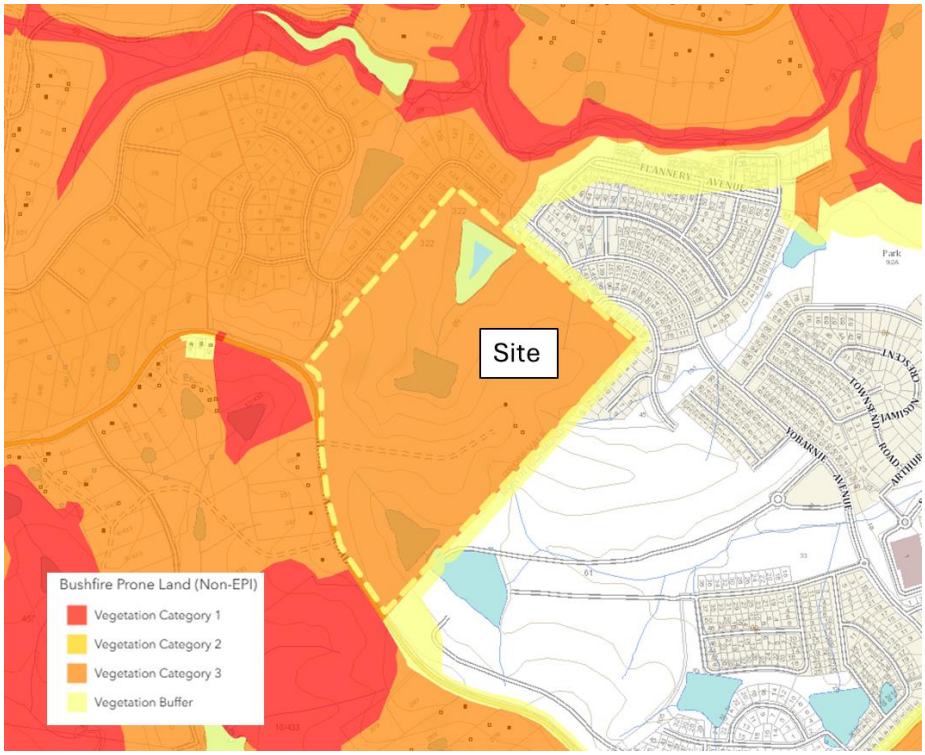

Figure 4-1 Bushfire Prone Land Map (NSW Planning Portal Spatial Viewer, 2024)

4.2.3 Indirect

To the northwest, west and southwest of the existing development within the Kurrajong, Grose Vale and Grose Wold districts are large tracts of undisturbed bushland within the Blue Mountains National Park. Large, intense bushfires occur at frequent intervals within this bushland.

Fires burning in the National Park will not, due to the separation provided by the existing development in the district, pose a direct risk to lives or property on the subject site but the smoke and embers from those areas could deposit onto the North Richmond area and create local fire ignitions of unmanaged vegetation and inconvenience to all and health impacts on those with respiratory illnesses or weak respiratory systems.

Furthermore, high winds that accompany severe fires can damage above ground infrastructure such as overhead electricity supplies. In the case of North Richmond any above ground electricity supplies coming into the area which pass through high wind areas and areas with a risk of bushfire could be susceptible.

4.3 Managing Bushfire Risks

4.3.1 Direct

There are five ways in which direct bushfire threat can be reduced:

1. Provide an asset protection zone between the buildings and bushfire prone vegetation;
2. Design and build buildings to resist the impacts of bushfire;
3. Provide appropriate access for emergency services to undertake fire fighting
4. Provide adequate water supplies for fire fighting
5. Manage the residual vegetation to reduce bushfire risks

It will be possible to design the future subdivision layout and construction of the built structures in accordance with the requirements of Planning for Bushfire Protection 2019 (RFS,2019) such that all of the statutory requirements for the above mitigation measures can be met.

4.3.2 Indirect – Smoke and Ember Attack

With regard to the indirect effects of bushfire on people there are basically two ways in which they can be dealt with:

4.3.2.1 Smoke

1. Seal buildings and stay indoors until the smoke has abated; or
2. Evacuate the area until the smoke has abated.

Either option would be available to most of the residents of North Richmond, including those in the proposed residential development on the site.

Buildings could be designed with features that allow them to be easily and effectively sealed to minimise smoke infiltration. Incorporating air conditioning systems with advanced air filtration technology would further improve indoor air quality and maintain comfortable temperatures, ensuring that occupants have a safe and controlled environment during smoke events.

4.3.2.2 Ember Attack:

1. Plant and maintain appropriate landscaping close to buildings;
2. Minimise the accumulation of dry, combustible fuels within the subdivision;
3. Provide protection to buildings to minimise the accumulation of combustible fuels in roof gutters and valleys.

The risk of ignition of vegetation/buildings can be minimised with appropriate management of fuels and construction standards to the buildings.

4.3.3 Evacuation Planning

Under Section 44 of the Rural Fires Act 1997, the Commissioner of the NSW Rural Fire Service (NSW RFS) is responsible for managing bushfire operations and implementing necessary measures to control or suppress bushfires. This includes relocating (evacuating) individuals at risk.

The Commissioner typically delegates the decision to evacuate an area or facility to the appointed Incident Controller. Under Section 24 of the Act, authorised officers, including firefighters and police, may issue directions as part of the emergency response. These directions can include instructing individuals to leave dangerous areas or restricting access to unsafe zones.

Decisions to undertake planned evacuations/relocations will be made by the Incident Controller and where possible, in consultation with the NSW Police Force (NSWPF) and/or relevant Emergency Operations Controller (EOCON). The actual activity is co-ordinated by the NSWPF and/or EOCON. In emergencies, the NSWPF may independently undertake evacuations under Section 60L of the State Emergency and Rescue Management Act 1989. The NSWPF will notify the Incident Controller as soon as possible to ensure a coordinated approach and the safety of residents (NSWRFS, 2023).

If additional support is required, such as evacuation centres or animal care, the Incident Controller will alert the EOCON to organise these arrangements. Potential evacuation centres include Richmond Air Force Base, Richmond High School, or the University of Western Sydney Hawkesbury Campus. Individuals requiring medical assistance may be relocated to Windsor Hospital or Nepean Hospital in Penrith.

Bushfire risk is higher along the Bells Line of Road to the west of North Richmond, while routes to the east and across the floodplain to Richmond are considered low risk. Currently, there is no dedicated bushfire evacuation plan for North Richmond nor is there a bushfire preparation map or bushfire survival map. The closest location with such maps is Bowen Mountain, 10km to the west. The Bowen Mountain bushfire preparation map shows North Richmond as the destination for early evacuation. The RFS has not identified any Neighbourhood Safer Places in North Richmond or surrounding areas. All of this points to the RFS not considering the urban areas of North Richmond to have a high bushfire risk. Kemsley Park would be an extension of these urban areas and so would likewise be considered to be low risk and unlikely to require evacuation.

Nevertheless, were an evacuation order to be issued for some reason, residents are expected to be able to leave safely, relocating to Richmond. The time required is not expected to exceed the 20 hours designated for flood evacuation.

While evacuation orders can be made by authorities, individuals are encouraged to have their own Bush Fire Survival Plan in line with the guidelines provided by the NSW Rural Fire Service (RFS). The RFS offers resources to help individuals and families develop personalised plans tailored to their circumstances. Residents can evacuate early if they feel unsafe, even in the absence of an official order.

In the event of a bushfire, the NSW RFS provides real-time updates and information through platforms like the Hazards Near Me app and their website. These tools offer details on current fire incidents, alert levels, and any evacuation advisories pertinent to the area.

5 CONCLUSIONS

The Kemsley Park site can be considered to be:

- Free of any direct risk of flooding from the Hawkesbury Nepean River;
- Free from any direct threat of a major bushfire;
- At risk of minor local floods and low intensity bushfires along riparian corridors on site.

It will be possible to manage the impacts of localised floods and bushfires by:

- Incorporating mitigation measures in the design and management of the riparian corridors; and
- Adopting current best practices in flood and fire safety in the designs of subdivisions, roads, bridges and buildings.

Major to extreme floods on the Hawkesbury Nepean River:

- will cut North Richmond's most direct road access across the river
- will cut grid electricity supplies to much of the Hawkesbury LGA including North Richmond
- will cut telephone communication to much of the Hawkesbury LGA including North Richmond
- will reduce the amount of treated drinking water to North Richmond
- will cut access to Hawkesbury Hospital at Windsor and increase travelling time to Nepean Hospital at Penrith by about 1.6 hours via Bell - Mount Victoria. Having the Grose River Bridge would avoid this disruption during floods no greater than the 5% AEP event.

These indirect effects of flooding will be able to be mitigated by:

- deferring trips across the river, travelling to similar destinations in North Richmond, Katoomba or Lithgow or detouring through Katoomba and Penrith
- including renewable energy supplies, energy efficiency measures and emergency power generation in parts or all of the proposed development
- including rainwater harvesting and water efficiency measures in the proposed development

These indirect flood impacts will be no worse, and in many cases less severe, than the impacts on areas on the floodplain east of the river.

Major bushfires in the bushland to the northwest, west and southwest of North Richmond, within the Blue Mountains National Park, could create smoke concentrations which may cause breathing difficulties for people particularly if they have a pre-existing respiratory complaint. This indirect bushfire impact can be mitigated by:

- people evacuating Kemsley Park until the smoke has abated
- people staying indoors with the building sealed until the smoke has abated
- While it is unlikely that either bushfire or flood would require the evacuation of the proposed development, it is recognised that in the most extreme events many people may voluntarily choose to leave or may be instructed to do so by the SES in floods or the NSW Rural Fire Service via the Police during bushfires.

Were this to be the case, the entire existing population of North Richmond as well as those in the new development could be evacuated to an unaffected location within 20 hours although there would be no urgency requiring it to be done this quickly.

6 REFERENCES

BD Infrastructure (2024) *Grose River Road – Road link and Bridge, Grose Wold and Yarramundi Review of Environmental Factors*

GLN Panning (2024) *Planning Proposal Redbank Expansion Area (Kemsley Park)*

NSW Reconstruction Authority (2024) *Hawkesbury-Nepean River Flood Study*

Department of Planning and Environment (2023) *Flood risk management manual*

Department of Planning and Environment (2021) *Local Planning Direction - Section 9.1(2) of the Environmental Planning and Assessment Act 1979*

Department of Planning, Industry and Environment (2021) *Considering flooding in land use planning Guideline.*

Department of Planning and Environment (2023*) Understanding and managing flood risk - Flood risk management guideline FB01*

Infrastructure NSW (2017) *Resilient Valley, Resilient Communities Hawkesbury-Nepean Valley Flood Risk Management Strategy*

Infrastructure NSW, (2023) *Hawkesbury-Nepean Valley flood evacuation modelling to inform flood risk management planning - Hawkesbury-Nepean Valley Flood Risk Management Strategy*

NSW SES (2020) *Hawkesbury-Nepean Valley Flood Emergency Sub Plan*

WMAwater, *(2024) Draft Hawkesbury Floodplain Risk Management Study and Plan 2025*

Hawkesbury City Council (2021) *Hawkesbury City Council Policy, Flood Policy*

Hawkesbury City Council (2012) *Hawkesbury Local Environmental Plan*

Hawkesbury City Council *(*2024*) Draft Redbank Creek Flood Study*

NSW Rural Fire Service (2019*) Planning for Bush Fire Protection - A guide for councils, planners, fire authorities and developers*

NSW Rural Fire Service (2023) *State Bush Fire Plan - a Sub Plan of the NSW Emergency Management Plan*

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

APPENDIX A
STEVEN MOLINO CV

STEVEN MOLINO

steven.molino@watertech.com.au
Phone: 1300 198 413 | 0402 305 799

Director

BSc, BE (Civil) (Hons)

MIEAust, CPEng, NPER, RPEQ

QUALIFICATIONS

- Bachelor of Science (Physical Geography and Environmental Chemistry), UNSW, NSW, Australia
- Bachelor of Engineering (Hons) (Civil), UNSW, NSW, Australia
- Certificate IV in Assessment & Workplace Training
- Certified Lead Environmental Auditor (Exemplar Global 13515)

AFFILIATIONS

- Member, Institution of Engineers, Australia
- Registered Professional Engineer NPER 3 Civil and Environmental (1053737)
- Registered Professional Engineer Queensland (12936)

SUMMARY

Steven has been working in floodplain management since 1991 including in the highest risk floodplains in Australia. Having researched and developed methodologies for flood damage assessment, he has estimated flood damages using databases of more than 20,000 properties. His expertise in flood warning, emergency planning and evacuation analysis is recognised internationally, and he helped the NSW SES refine and implement its evacuation timeline model which he has used for populations of up to 75,000. Steven has developed flood emergency response plans numerous premises and developed the Business FloodSafe toolkit used by the NSW and Victoria SES.

Steven transferred these skills to the assessment of bushfire risks and has been undertaking strategic bushfire risk assessments since 2007. Since 2019 he has been apply these skills to coastal hazards including storm surge and rising sea levels.

He has also assessed and prioritised natural hazard risk management for multiple hazards in 10 Pacific Island nations for the United Nations.

Steven has evaluated several flood warnings and evacuations in NSW and Victoria and independently reviewed implementation of the recommendations from the 2009 Victorian Bushfire Commission of Inquiry.

His technical expertise, analytical skills and ability to communicate technical concepts have been used to good effect in natural hazard management, option evaluation and expert testimony in Queensland, New South Wales and Victoria.

PROFESSIONAL HISTORY

2022 – Present	Director	Water Technology Pty Ltd
1995 – 2022	Principal	Molino Stewart
1990 – 1994	Senior Project Manager	ERM Mitchell McCotter
1986 – 1990	Environmental Engineer	NSW Electricity Commission
1985	Civil Construction Engineer	NSW Electricity Commission
1984	Civil Design Engineer	NSW Electricity Commission
1979 – 1983	Cadet Engineer	NSW Electricity Commission

SPECIALIST AREA OF EXPERTISE

- Natural hazards management
- Evacuation modelling
- Warning systems
- Emergency response plans
- Expert testimony

MAJOR PROJECTS: *this list is not exhaustive*

Child Centred Risk Assessments (UNICEF)

The United Nations Children's Emergency Fund (UNICEF) provides long term humanitarian and developmental assistance to children and mothers in developing countries. To better target its spending on disaster risk reduction, UNICEF engaged Molino Stewart to prepare risk maps for 10 Pacific Island nations which identified areas of high risk for children exposed to floods, tsunami, cyclones, drought, earthquakes and volcanic activity. Created a spatial presentation of results using GIS tools and created summary reports for each country highlighting the areas with the greatest risk and the most significant contributors to vulnerability in each of those areas.

Newcastle Floodplain Risk Management Plan (Newcastle City Council)

Newcastle City Council prepared a floodplain risk management plan for ocean, river and flash flooding which affects more than a third of the City's 60,000 properties. Many of the residents and businesses had strong expectations about improving the preparedness and response to the flooding in light of the devastating 2007 event. Integrated modelling results from three creeks, the Hunter River and oceanic flooding, taking into consideration climate change

Hawkesbury-Nepean Flood Damages Assessments (Infrastructure NSW)

As part of the 20 Year Sydney Infrastructure Strategy, Infrastructure NSW investigated the flooding impacts in the Hawkesbury Nepean Valley and the potential for these to be reduced through construction of mitigation infrastructure. Estimated the potential flood damages and the benefits of various mitigation options. This included creating a database of about 30,000 buildings and liaising with infrastructure owners to obtain updates on previous work undertaken by Steven about how these would be affected by flooding. Compiled aggregated damages and economic analyses across 400km^2 of floodplain, along 150km of river, for 13 asset classes for 11 flood frequencies for 13 different mitigation options for existing and future development scenarios

Ingleside Planning Precinct Regional Bushfire Assessment (Sunland Group and Mirvac)

Ingleside in Sydney's Northern Beaches had been investigated for rezoning from a mostly rural residential area into an urban area. Investigations had taken many years and by the time a planning proposal had been placed on public exhibition a draft revision of Planning for Bushfire Protection has been published which foreshadowed the need for bushfire risks, including evacuation risks to be considered at a regional scale during the planning proposal process.

The Department of Planning Industry and Environment (DPIE) had engaged a consultant to prepare a regional bushfire risk report, the first of its type to be prepared. The report found that no development could take place in the area because of bushfire risks. Two major landowners in the area wanted to investigate the commercial implications of bushfire for its investments, and wanted to better understand whether there was scope for managing bushfire risks associated with its sites which would satisfy Council and NSW DPIE concerns in relation to risk to property and risk to life. They commissioned Molino Stewart to critique the DPIE report and produced an alternative bushfire assessment and evacuation analysis if warranted.

Review Of Community Bushfire Warnings (Victorian Fire Services Commissioner).

Designed a review plan in consultation with the client to meet the requirements of the recommendations from the Victorian Bushfires Royal Commission. Conducted interviews with Incident Controllers, Information Officers and other stakeholders involved in recent bushfires in Victoria. Analysed interview responses and relevant documentation in relation to the review plan. Related findings to learnings about warnings from other jurisdictions and emergencies. Wrote a detailed report covering review findings, discussion of issues and achievements, and suggested improvements. Report published on Fire Services Commissioner website: **http://www.firecommissioner.vic.gov.au/our-work/review/2011-review-of-community-bushfire-warnings-2/**

Canley Corridor Floodplain Risk Management Study and Plan (Fairfield City Council)

Floodplain Risk Management Study and Draft Floodplain Risk Management Plan for a catchment subject to overland flows. This was the first for overland flows in the LGA and set planning policy and explored mitigation options not previously considered.

Bushfire Safety Audits of Essential Energy High Voltage Sites (Multiple Clients)

To comply with IPART requirements, Essential Energy required its high voltage customers to demonstrate that their privately owned and maintained high voltage electricity assets were appropriately managed, commensurate with their bushfire risk. Molino Stewart was engaged by several organisations to independently audit the bushfire risk assessment and bush fire risk management of their assets. This involved a desktop review and, where there was a potential bushfire risk, a site inspection to assess compliance against Essential Energy specified audit criteria. The audits covered a variety of high voltage arrangements and industry including substations and high voltage power lines for mines, defence facilities, food processing factories, manufacturing plants and bulk water pumping stations.

Future Natural Hazards Risks (NSW DECCW)

Worked with Risk Frontiers at Macquarie University to assess the impact of climate change on future natural hazards risks across NSW.

Review of Floodplain Risk Management Plans (Toowoomba Regional Council)

Conducted technical and strategic review of Floodplain Risk Management Plans developed by other consultants for six townships in The Toowoomba LGA. This included review of methodologies and plan content for damage assessment, emergency management, mitigation options and community consultation. Review comments were provided to Toowoomba Regional Council and the consultants throughout the project.

Bow Bowing Bunbury Curran Creek Floodplain Risk Management Study and Plan (Campbelltown City Council)

The Bow Bowing Bunbury Curran Creek catchment (90km^2) is located in the City of Campbelltown (population 150,000), 53km south west of the Sydney CBD. The catchment is a mixture of rural, residential, commercial, industrial and open space land use. It is predominantly residential land use with large areas of open space. There are significant localised industrial areas at both Minto and Ingleburn. The main commercial hubs are in Campbelltown/Macarthur and Ingleburn. Prepared a floodplain risk management study and plan for the whole of the catchment.

Three Tributaries Floodplain Risk Management Study and Plan (Fairfield City Council)

Engaged by Fairfield Council to undertake the Floodplain Risk Management Study and the development of a Draft Floodplain Risk Management Plan for the three major tributaries of Prospect Creek within the Fairfield LGA, NSW. The Project addresses the flooding, environmental and planning issues associated with the management of flood prone land within the catchment areas of the tributaries, as well as assessing the status of the detention basins within the catchment.

Duck River Floodplain Risk Management Study and Plan (Parramatta City Council)

Producing study and plan for 40 square kilometres, fully developed urban catchment in western Sydney where the 1% flood affects more than 1,000 properties across four local government areas. Many parts of the remaining open space within the floodplain have high biodiversity values and the communities are culturally and linguistically diverse.

Regional Floodplain Database Study Advisory Group (Moreton Bay Regional Council)

Providing expert advice on flooding issues as a member of this study group whose role it is to gain a comprehensive knowledge of flood behaviour across the Moreton Bay Region and develop strategies for the management of any flooding problems identified.

Parramatta River City Plan (Parramatta City Council)

Council has a bold plan to redevelop the river channel, public open space along the river corridor and guide redevelopment of buildings along the river banks to create a vibrant reinvigorated section of the CBD in the style of many European Cities. This includes the provision of recreational infrastructure and food outlets below the 1% flood level. Provided a risk-based framework for the master planning, detailed design and flood emergency response management of the precinct. This included design guidelines to ensure assets would survive inundation in a 1% flood and more than 50,000 people would be able to safely evacuate from major events were flash flooding to occur.

Parramatta CBD Floodplain Risk Management Plans (Parramatta City Council)

As Sydney's second CBD, Parramatta has been earmarked by the State Government and Parramatta City Council for major redevelopment including expansion of the CBD footprint, increased height limits on buildings and an increase in residential high-rise buildings in the city centre. This will be accompanied by revitalisation of public open spaces including the Parramatta River corridor. All these areas are flood prone and guidance was required to ensure that development was compatible with the flood risk to lives and property. Molino Stewart assisted Parramatta City Council to update its flood policy, update it floodplain risk management plans and provide planning guidelines for residential and commercial redevelopment throughout the CBD.

North West Sector Flood Evacuation Analysis (NSW Department of Planning)

Developed an evacuation model and produced an analysis for the North West Sector, which forms part of the NSW Department of Planning's "City of Cities" Sydney Metropolitan Strategy. Analysed the evacuation capacity and cumulative constraints of current and possible future evacuation routes under a range of developmental scenarios to 2031, the results of which would inform SES evacuation plans and DOP developmental guidelines in the future.

Penrith Lakes Development (Planning NSW)

Provided expert advice on evacuation strategies, life and property protection and flood planning levels for a proposed 5,000 dwelling development on a rehabilitated mining site on a Nepean River floodplain.

West Dapto Flood Access (Growth Centres Commission)

Evaluated the impacts of flooding on accessibility for various road network upgrade options for future development of a 14,000-lot growth centre.

Grafton Evacuation Review (Clarence Valley Council)

Evaluated the flood evacuation plans for 12,000 people from Grafton.

Comparative Evaluation of Warning Technologies (State Emergency Service)

Investigated and compared old, new and emerging technologies for disseminating flood and tsunami alerts and warnings.

Planning Infrastructure for Flood Hazards (Hawkesbury Nepean Floodplain Management Steering Committee)

Consulted with major infrastructure owners and managers to determine their level of awareness of flooding and the strategies which they had in place to protect or replace assets and to maintain or restore service in the event of a flood. Developed briefing papers to guide and assist service providers develop response and recovery programs.

Lane Cove Bushfire Safety Planning (Hyecorp)

Questions had been raised about the suitability of an area in northern Sydney for multi-storey unit development because of its proximity to urban bushland and the associated bushfire risks. This study involved mapping of the precinct bushfire risks, development controls and road hierarchy to determine which areas were not suitable for urban consolidation because of bushfire, which were unconstrained by the bushfire risk, which could be readily redeveloped with appropriate bushfire management measures, and which were marginal because of the impact of bushfire controls and development controls of the developable property envelope.

Orchard Hills Rezoning Proposal- Bushfire Assessment (Construction Consultants Pty Ltd)

Prepared a bushfire assessment for a developer who was in the process of purchasing lots on a 300ha proportion of land in Orchard Hills (Penrith LGA) across the M4 and east of the Northern road, who intended to submit a rezoning application for the whole area.

North Richmond Flood and Bushfire Emergency Response Planning (Buildev)

Evaluated the bushfire and flood risks and evacuation planning requirements for a proposed 2,000 lot development including aged care facilities over 200ha.

Springwood Schools Bushfire Management Plan (Catholic Education Office)

I was responsible for overseeing the development of a combined bushfire and biodiversity management plan for the Catholic Education Office's large land holdings in Springwood. These needed to find a careful balance between biodiversity conservation, asset protection, protection of lives, protection of neighbouring houses and maintenance costs. There are a high school and primary school on the site, an isolated access road, residential properties immediately to the east and endangered ecological communities within the APZs.

Victorian Emergency Management Reform White Paper (Department of Environment and Primary Industries)

Reviewed all proposed hazards planning arrangements in Victoria and advised on how existing arrangements can be integrated under the one system given the significant differences in regulation and responsibilities between the two principal hazards: bushfire and flood and the proposal to apply the Integrated Fire Management Planning framework to all hazards. This project involved researching the relevant legislation and government policies which set out the roles and responsibilities within all three tiers of government and the private sector and consulting with representatives of each of the government agencies involved to identify the similarities and differences in flood and bushfire management and provide a critique setting out the advantages and disadvantages of adapting the Integrated Fire Management Planning framework to floods.

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

Melbourne

15 Business Park Drive
Notting Hill VIC 3168
Telephone (03) 8526 0800

Sydney

Suite 3, Level 1, 20 Wentworth Street
Parramatta NSW 2150
Telephone (02) 9354 0300

Brisbane

Level 5, 43 Peel Street
South Brisbane QLD 4101
Telephone (07) 3105 1460

Adelaide

1/198 Greenhill Road
Eastwood SA 5063
Telephone (08) 8378 8000

Perth

Level 1, 21 Adelaide Street
Fremantle WA 6160
Telephone (08) 6555 0105

New Zealand

7/3 Empire Street
Cambridge New Zealand 3434
Telephone +64 27 777 0989

Wangaratta

First Floor, 40 Rowan Street
Wangaratta VIC 3677
Telephone (03) 5721 2650

Geelong

51 Little Fyans Street
Geelong VIC 3220
Telephone (03) 8526 0800

Wimmera

597 Joel South Road
Stawell VIC 3380
Telephone 0438 510 240

Gold Coast

Suite 37, Level 4, 194 Varsity Parade
Varsity Lakes QLD 4227
Telephone (07) 5676 7602

watertech.com.au