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Environmental Impact Statement – Chapter 3: Strategic justification and Project need

Warragamba Dam Raising

Reference No. 30012078
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Contents

List of Tables

List of Figures

3 Strategic justification and Project need

This chapter outlines the NSW strategic planning framework relevant to the Project. It identifies the need for the Project for reducing and managing the flood risk in the Hawkesbury-Nepean Valley and the Project objectives. A statement of strategic need and justification concludes the section. The relevant Secretary's Environmental Assessment Requirements (SEARs) are shown in Table 3-1.

Table 3-1. Secretary's Environmental Assessment Requirements: justification and need

Desired performance outcomes	Secretary's Environmental Assessment Requirements[1]	Where addressed
2. Environmental impact statement The project is described in sufficient detail to enable clear understanding that the project has been developed through an iterative process of impact identification and assessment and project refinement to avoid, minimise or offset impacts so that the project, on balance, has the least adverse environmental, social and economic impact, including its cumulative impacts.	The EIS must include, but not necessarily be limited to, the following: (c) a statement of the objective(s) of the project;	This chapter, Section 3.3
	(d) a summary of the strategic need for the project with regard to its critical State significance and relevant State Government policy;	This chapter

1 Note: this chapter specifically addresses SEARs 2(c) and 2(d) in addition to those general requirements of the SEARs applicable to all chapters and as identified as such in Chapter 1 (Section 1.5, Table 1-1).

3.1 NSW and regional strategic planning and policy framework

3.1.1 Hawkesbury-Nepean Valley Flood Risk Management Strategy

Resilient Valley, Resilient Communities, *Hawkesbury-Nepean Valley Flood Risk Management Strategy* (the Flood Strategy) (Infrastructure NSW (INSW) 2017) is a comprehensive long-term framework for the NSW Government, local councils, businesses and the community to work together to reduce and manage flood risk in the Hawkesbury-Nepean Valley. The Flood Strategy, released in May 2017, was coordinated by Infrastructure NSW and was based upon the 2013 Hawkesbury-Nepean Valley flood management review and work undertaken by the Hawkesbury-Nepean Valley Flood Management Taskforce (the Taskforce).

The NSW Government established the Taskforce in early 2014, which was independently chaired and included senior representatives from:

- Infrastructure NSW
- Department of Premier and Cabinet
- Department of Primary Industries (Water)
- WaterNSW (previously Sydney Catchment Authority)
- NSW State Emergency Service
- Office of Emergency Management (now Resilience NSW)
- Department of Planning and Environment (now Department of Planning, Industry and Environment, DPIE)
- Office of Environment and Heritage (now part of DPIE)
- NSW Treasury
- NSW Public Works Advisory (part of Department of Finance, Services and Innovation)
- Roads and Maritime Services (now Transport for NSW).

The Flood Strategy is the result of the Taskforce's comprehensive assessment of flood mitigation options. The Taskforce developed the following methodology to select the best mix of infrastructure and non-infrastructure measures to reduce flood risk for inclusion in the Flood Strategy:

1. Understanding the current population and asset distribution.

2. Establishing the different levels of urban development (population) that could occur in the valley by 2041 under current planning arrangements.
3. Assessing current and future flood risk in terms of flood damages and risk to life, including consideration of climate change.
4. Further investigating infrastructure and non-infrastructure options identified in the 2013 review to create a shortlist for final evaluation.
5. Evaluating infrastructure and non-infrastructure options for the development of the Flood Strategy.

The Flood Strategy identified nine outcomes to reduce flood risk and impacts, and actions for each of those outcomes. One of the outcomes was to reduce flood risk in the Hawkesbury-Nepean Valley by raising Warragamba Dam. The Taskforce found that raising Warragamba Dam and creating a flood mitigation zone (FMZ) of around 14 metres provided the highest net benefit for reducing flood damages and risk to life compared to other alternatives considered. All alternatives are described and assessed in Chapter 4 (Project development and alternatives). Further information on the Project need is presented in Section 3.2.

The actions the Taskforce identified to progress the Project were:

- complete concept design and costing for the Project to create an FMZ of around 14 metres for flood mitigation
- prepare an environmental impact statement (EIS) — this will include community consultation and detailed assessment of the potential environmental impacts from construction and ongoing operation
- submit environmental and planning approvals — the environmental and planning approval for the Project would also be referred to the Commonwealth Government under the *Environment Protection and Biodiversity Conservation Act 1999*
- submit a final business case for the Project to the NSW Government by 2020.

Another outcome of the Flood Strategy was for coordinated flood risk management across the valley now and in the future. A new Hawkesbury-Nepean Valley Flood Risk Management Directorate (the Directorate), based initially within Infrastructure NSW was established to oversee implementation of the Flood Strategy.

As the dam raising would mitigate but not eliminate flood risk entirely, the Flood Strategy includes approaches to make sure future land use will be carefully managed and better integrated with road and emergency planning. If the dam is raised the current minimum flood planning level would be retained in conjunction with a new Regional Land Use Planning Framework being developed by DPIE. The framework will ensure the cumulative impacts of planning decisions are considered, and flood risk to life and property is not increased, by limiting new growth to those areas where people can be safely evacuated in a severe flood.

3.1.2 NSW State Infrastructure Strategy 2012-2032

Flooding in Queensland in 2011 renewed concern about flood risk in the Hawkesbury-Nepean Valley. In developing the *State Infrastructure Strategy 2012-2032* (Infrastructure NSW 2012), INSW commissioned new modelling to provide up-to-date data on flood impact from both a flood damages and an economic impact perspective so that it could provide advice to the NSW Government (Molino Stewart 2012). The new modelling found that exposure to flooding in the Hawkesbury-Nepean Valley had increased since earlier assessments and was projected to increase further.

The *State Infrastructure Strategy 2012-2032* recommended that the NSW Government review all available major flood mitigation options, including raising Warragamba Dam wall, to significantly reduce the potential economic and social impact of flooding in the Hawkesbury-Nepean Valley.

3.1.3 NSW State Infrastructure Strategy 2018-2038: Building momentum

There was an update to the NSW State Infrastructure Strategy in March 2018. One of the key elements of the NSW *State Infrastructure Strategy 2018-2038* (Infrastructure NSW 2018) is the implementation of the Flood Strategy which includes the construction and operation of the Project.

3.1.4 Greater Sydney Region Plan and Western City District Plan

The Greater Sydney Commission (GSC) was established in 2015, with the aim to coordinate and align the planning to shape the future of Greater Sydney. In 2018 the GSC released the *Greater Sydney Region Plan,* A *Metropolis of Three Cities* (Greater Sydney Plan) (GSC 2018).

The Greater Sydney Plan:

- sets a 40-year vision (to 2056) and establishes a 20-year plan to manage growth and change for greater Sydney in the context of social, economic and environmental matters
- informs district and local plans and the assessment of planning proposals
- assists infrastructure agencies to plan and deliver for growth and change and to align their infrastructure plans to place-based outcomes
- informs the private sector and the wider community of the growth management and infrastructure investment intentions of government.

The Greater Sydney Plan also identifies detailed objectives and strategies to achieve the plan's vision. Flooding risks in the Hawkesbury-Nepean Valley are specifically noted in the Greater Sydney Plan and strategy 37.1 of that plan proposes that the NSW Government:

> *Respond to the direction for managing flood risk in the Hawkesbury-Nepean Valley as set out in Resilient Valley, Resilient Communities – Hawkesbury-Nepean Valley Flood Risk Management Strategy.* (GSC 2017, p. 154)

Draft district plans were developed for five subregions in the greater Sydney region. These plans contained more detailed strategies and actions. The Western City District Plan, which includes the Hawkesbury-Nepean Valley, reiterated the commitment of implementing the Hawkesbury-Nepean Valley flood risk management strategy (GSC 2018).

3.2 Project need

3.2.1 Flood risk in the Hawkesbury Nepean valley

3.2.1.1 Topography

The Hawkesbury-Nepean Valley consists of 425 square kilometres of floodplain, as shown on Figure 3-1. The extent of the floodplain is based on the largest possible flood event (probable maximum flood or PMF). The key areas of the Hawkesbury-Nepean Valley floodplain are at Wallacia, Penrith, Richmond-Windsor, and small pockets downstream of Sackville. The Hawkesbury-Nepean Valley floodplain also includes the backwater effects (areas that are unable to drain due to high levels of water in the main river) of flooding from the Hawkesbury-Nepean River, and tributaries such as South Creek and Eastern Creek.

The Hawkesbury-Nepean Valley floodplain falls mainly within four Local Government Areas (LGAs) — Penrith, Hawkesbury, The Hills Shire, and Blacktown — and includes the key population centres of Penrith, Richmond and Windsor, and many surrounding suburbs. Downstream of Warragamba Dam, areas of the Liverpool, Hornsby, Northern Beaches, Wollondilly, and Central Coast LGAs are also within the Valley floodplain, but have lower flood risk. Upstream, areas of Wingecarribee and Wollondilly LGAs are affected.

The combination of large upstream catchments and narrow downstream sandstone gorges results in floodwaters backing up behind natural choke points in the Hawkesbury-Nepean Valley. The Hawkesbury-Nepean Valley has been described as a bathtub, with five main taps (being the main tributaries) but only one drain outlet, the Sackville Gorge (Figure 3-1). As a result, floodwaters back up and rise rapidly, causing significant flooding both in terms of area and depth. This bathtub effect is unusual as most coastal river valleys tend to widen as they approach the coast, which is not the case in the Hawkesbury-Nepean Valley.

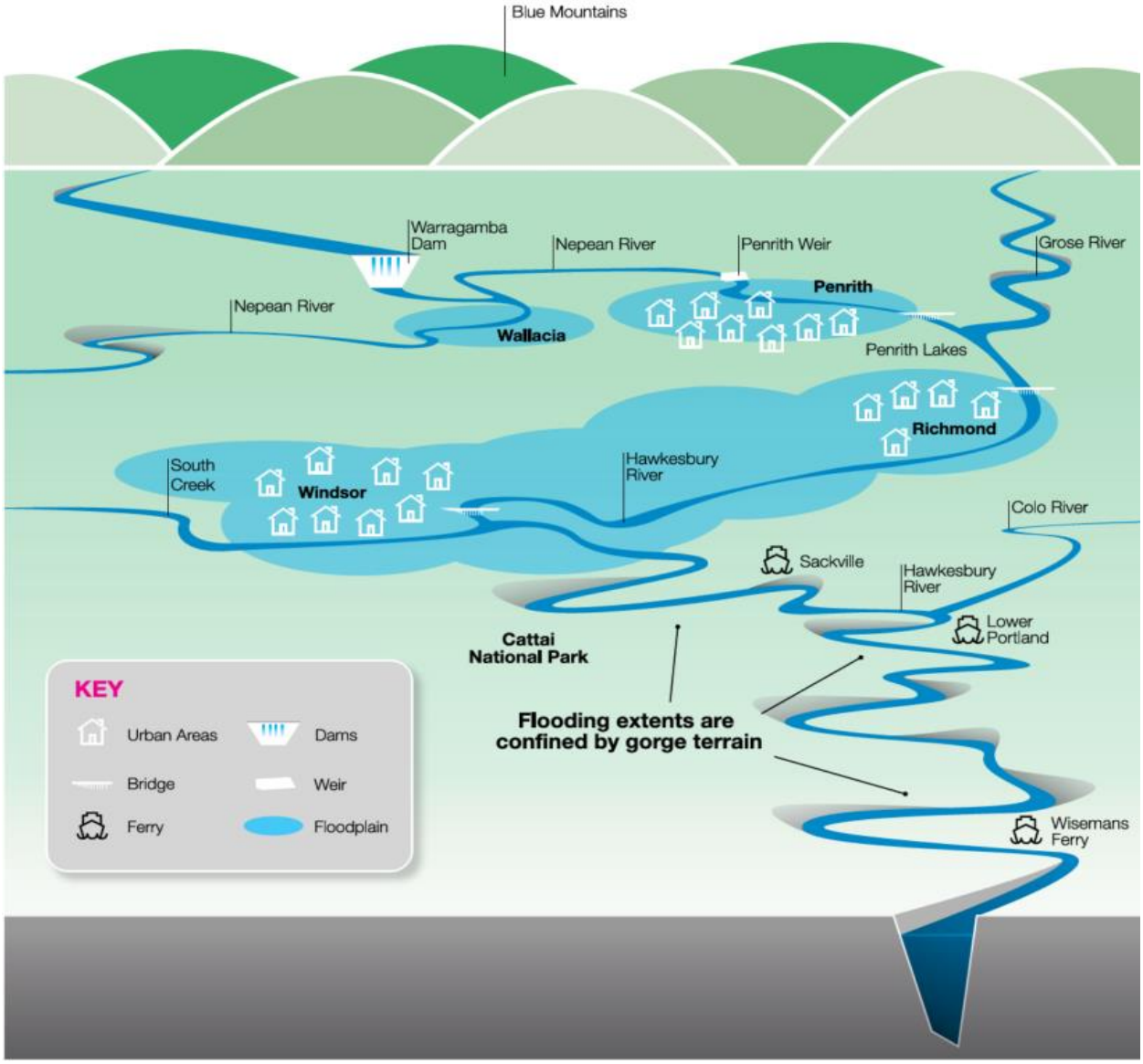
There are two main areas of flooding caused by two specific topographical features of the Hawkesbury-Nepean Valley. The Castlereagh Gorge, located just upstream of the Grose River inflow, restricts flood flows resulting in flooding of the Penrith area. The Sackville Gorge substantially restricts flood flows and causes extensive flooding of Windsor and Richmond, and the South Creek catchment.

3.2.1.2 Sources of flood waters

The floodwaters flowing into the Hawkesbury-Nepean Valley come from several different river catchments. The largest of these, representing 80 percent of the catchment at Penrith and 70 percent of the catchment at Windsor, is the catchment of Warragamba Dam.

Warragamba Dam is located about 65 kilometres west of Sydney in a narrow gorge on the lower section of the Warragamba River, 3.3 kilometres before it joins the Nepean River. The Nepean River then becomes the Hawkesbury River at the junction of the Grose River at Yarramundi. This entire river is referred to as the Hawkesbury-Nepean River.

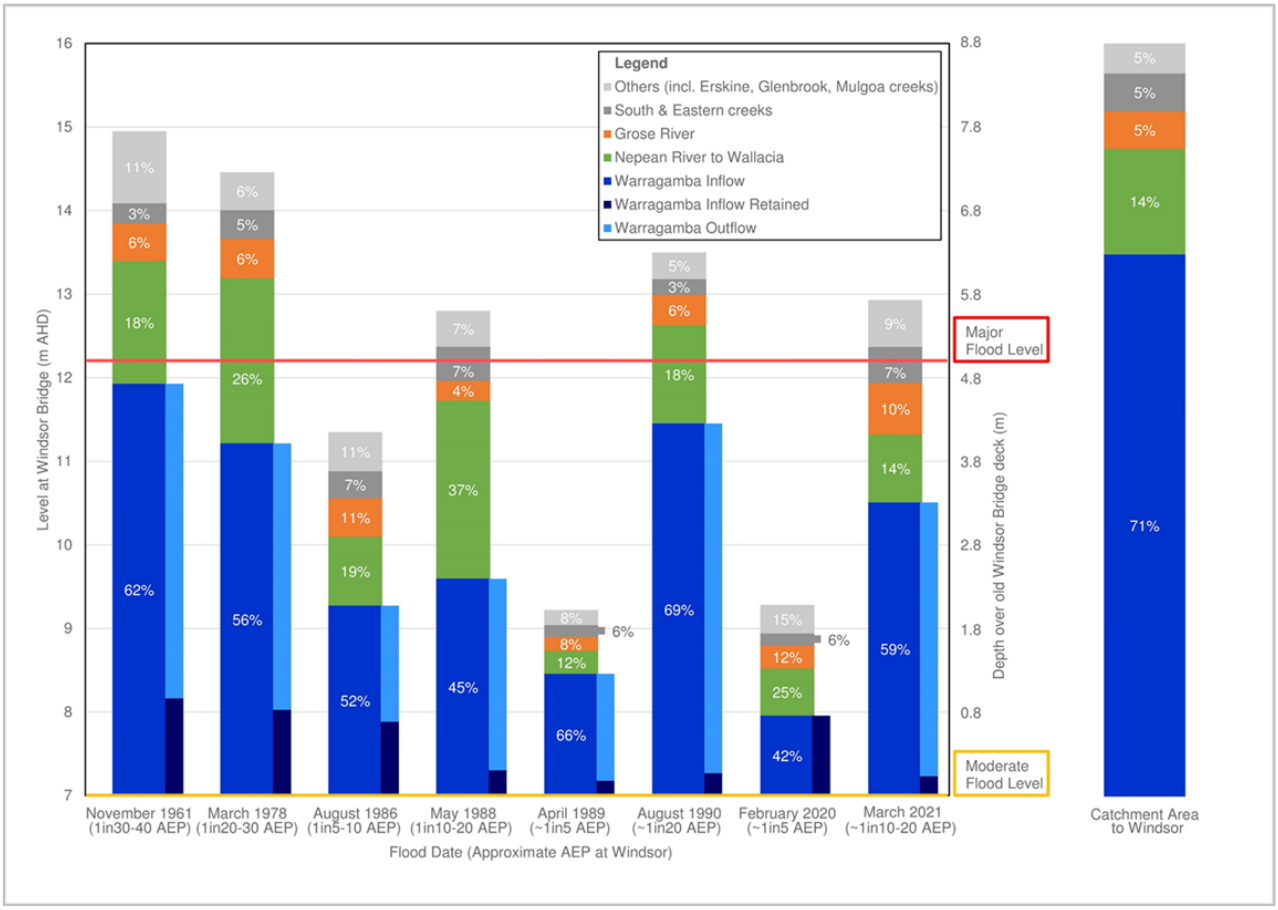
Figure 3-1. Topography and features of the Hawkesbury-Nepean Valley



Source: INSW (2017).

Further inflows into the Hawkesbury-Nepean Valley can come from the Nepean River, the Grose River, South Creek, Colo River, and others. While floods can occur without contribution from the Warragamba Dam catchment, the most significant floods (above the 1 in 100 chance in a year flood) would necessarily include significant flood inflows from the Warragamba Dam catchment. However, each flood event is unique due to the timing of rainfall across the Hawkesbury-Nepean Valley catchment. Figure 3-2 shows how the contributions from various river catchments have varied for previous floods in the Hawkesbury-Nepean Valley.

Figure 3-2. Relative contribution different river catchments in range of Hawkesbury-Nepean Valley floods



Source: INSW (2021)
Notes: AEP (annual exceedance probability) = chance in a year

The February 2020 event was about a 1 in 5 chance in a year flood, with Warragamba catchment modelled to contribute 42 percent of the total volume at Windsor. The dam storage level was low at the start of the event and captured all flows from the Warragamba catchment. However, had the dam been full, downstream flood levels would have been around three metres higher, or equivalent to around a 1 in 20 chance in a year event.

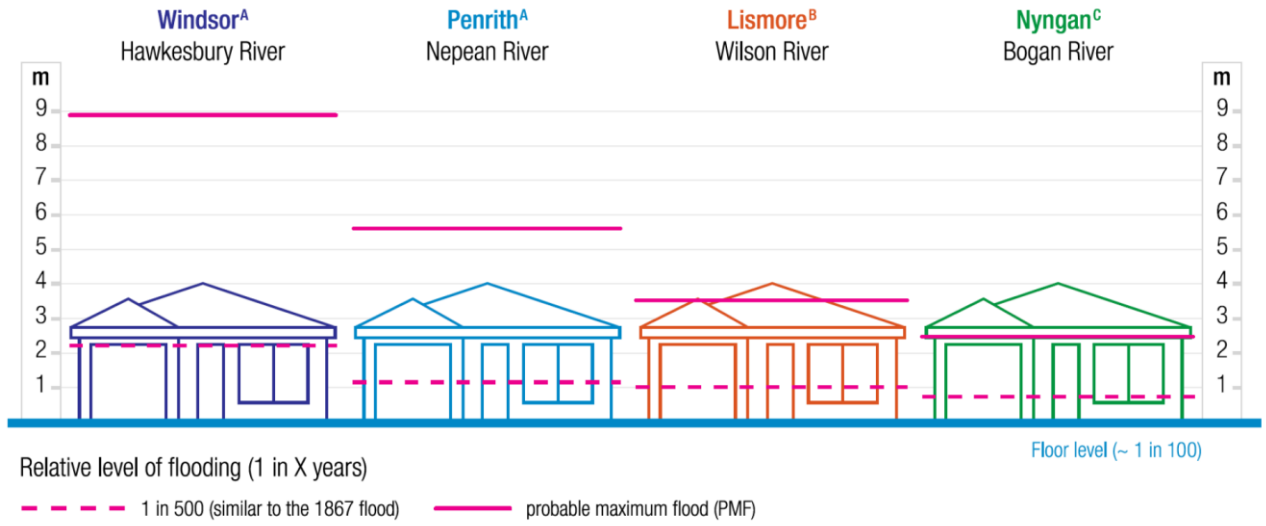
3.2.1.3 Flood extents

The NSW Floodplain Development Manual (DIPNR 2005) requires consideration of all flood events up to the PMF with regard to developing a floodplain risk management plan. The PMF is a hypothetical flood estimate relevant to a specific catchment whose magnitude is such that there is negligible chance of it being exceeded. It represents a notional upper limit of flood magnitude and no attempt is made to assign a probability of exceedance to such an event (Ball *et al*. 2019). The PMF is unlikely to occur in nature given the size of the Warragamba Dam catchment.

The 1 in 100 chance in a year flood level with 0.5 metres of freeboard has been the default flood level for land use planning in NSW. The significant scale of inundation of urban areas at Emu Plains, Penrith, Richmond, Windsor, Bligh Park, McGraths Hill and Marsden Park reflects a number of factors. First, some development dates from the 1800s, when the new settlers had limited knowledge of flooding. Second, much development pre-dates the significant advances in flood modelling techniques in the 1990s, which are the basis of today's flood planning levels. Third, in the Hawkesbury-Nepean Valley, the large potential depths of flooding above the 1 in 100 chance in a year flood planning level cause many more urban areas to be at risk of inundation.

In most NSW rivers, the difference in the flood depth between the 1 in 100 chance in a year flood level and the PMF is about two to three metres (see Figure 3-3). In the Richmond-Windsor region, the PMF is up to nine metres above the 1 in 100 chance in a year flood level. The relatively large potential flood depth along with the rapidly rising floodwaters (as discussed in Section 3.2.1.1) greatly increases the risk to life and property.

Figure 3-3. Comparison of the differences in flood levels and flood risk between the Hawkesbury-Nepean River and other floodplains



Source: (INSW 2019)

3.2.1.4 Flood impacts

Although large flood events are infrequent, they have high economic and social consequences that increase with population growth. Given the large differences in flood depths between a 1 in 100 chance in a year flood and the PMF in the Hawkesbury-Nepean Valley, minimising flood risk in the area below the 1 in 100 chance in a year flood level (that is, the current flood planning level) does not adequately address the Hawkesbury-Nepean flood risk.

The Hawkesbury-Nepean Valley is changing from a semi-rural landscape to an urban landscape. Up to 134,000 people live and work on the floodplain and could require evacuation. Over 25,000 residential properties and two million square metres of commercial space are currently subject to flood risk. These numbers would increase over the next 30 years.

If a 1 in 100 chance in a year flood was to occur today (similar to the Brisbane 2011 flood) the Taskforce estimated that:

- 7,600 residential properties would be impacted
- there would be approximately $3 billion in damages
- 55,000 people would need to be evacuated.

If a 1 in 500 chance in a year flood was to occur today (similar to the highest recorded flood in European history, in 1867) the Taskforce estimated that:

- 15,500 residential properties would be impacted
- there would be approximately $8 billion in damages
- 90,000 people would need to be evacuated.

Given the forecast increase in population within the Hawkesbury-Nepean Valley, if a flood similar to the largest flood since European settlement was to occur in 2041 the Taskforce estimated that:

- 26,000 residential properties would be impacted
- there would be approximately $12 billion in damages
- 135,000 people would need to be evacuated.

3.2.1.5 Evacuation

Evacuating people from flood-affected areas is the primary method of reducing the risk to life during a flood event. In the Hawkesbury-Nepean Valley, the NSW State Emergency Service identifies mass self-evacuation by private motor vehicles as the primary method for evacuation because other transport options are highly vulnerable to floods or have limited capacity. The major regional evacuation road routes are shown in Figure 3-4. Currently, there is insufficient

road capacity to safely evacuate the whole population in time, with multiple communities relying on common, constrained and congested road links as their means of evacuation.

The undulating topography of the Hawkesbury-Nepean Valley results in many key evacuation routes becoming flooded at low points long before population centres are inundated, creating flood islands. Many of the significant urban centres such as McGraths Hill, Windsor, Richmond, and Bligh Park are located on flood islands that can become fully submerged in large flood events, that is, a greater than a 1 in 500 chance in a year event.

Reliable and timely flood forecasts and warnings are critical for evacuation. Currently, the Bureau of Meteorology Service Level Specification (BoM 2015) has a 15-hour flood peak forecast target for large flood events at Windsor. However, the NSW State Emergency Service requires more than 15 hours to evacuate some flood islands in the Hawkesbury-Nepean Valley during large flood events. This could force the NSW State Emergency Service to make evacuation orders based on uncertain flood predictions. If the flood exceeds the prediction, lives could be at risk. Alternatively, if the flood does not reach the predicted level, large numbers of people could be evacuated unnecessarily, which could mean people may be reluctant to follow future evacuation orders.

3.2.1.6 Climate change

The Hawkesbury-Nepean Valley's high flood hazard is forecast to increase in the future due to climate change. Climate change has the potential to alter the frequency and severity of rainfall extremes, change rainfall patterns and increase the likelihood of flooding in the Hawkesbury-Nepean Valley.

In 2016, the Australian Government updated the 1987 edition of *Australian Rainfall and Runoff* (AR&R) (Ball *et al*. 2016), the national guideline for estimating flood characteristics in Australia, with a further update following in 2019 (Ball *et al*. 2019). AR&R indicates that there is likely to be increased rainfall intensity with an associated increase in flooding in Australia generally and in the Hawkesbury-Nepean Valley due to climate change. For example, a 2 °C increase in temperature would result in a 10 percent increase in rainfall intensity.

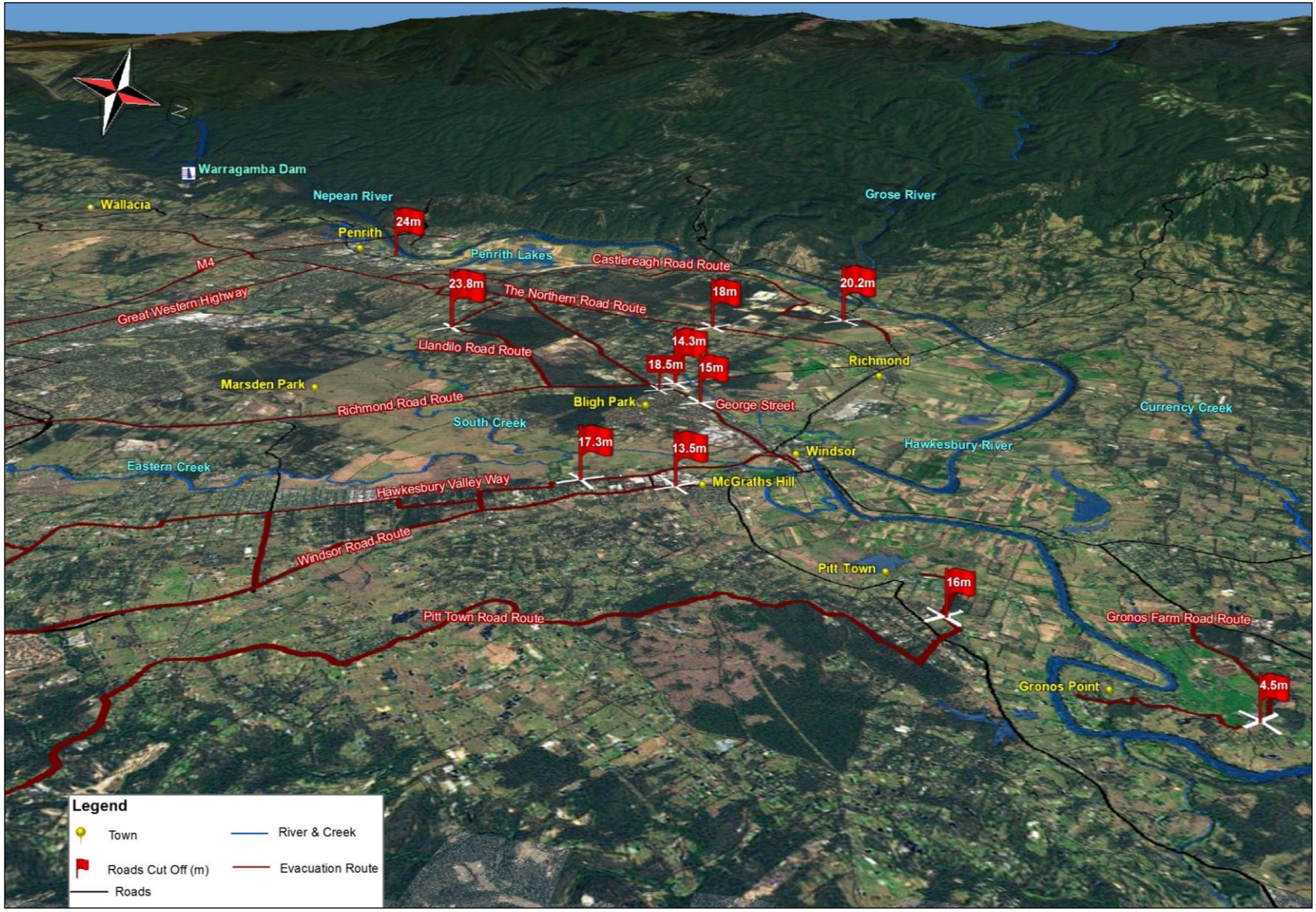
In coastal NSW, including the Hawkesbury-Nepean Valley, flash flooding, river flooding, hail, wind, and coastal erosion due to rough seas are often associated with low-pressure systems off the Australian east coast. These weather systems are called east coast lows (ECLs) and occur on average 10 times each year. Floods in the Hawkesbury-Nepean Valley are usually associated with ECLs, as are most floods in coastal south-eastern Australia.

The eastern seaboard climate change initiative – east coast lows (ESCCI-ECL) program is a research cooperative led by the former NSW Office of Environment and Heritage that provides information on future possible changes in the frequency and intensity of ECLs due to climate change. It has found that while there may be a decrease in the number of small to moderate ECLs in the cool season with little change in these storms during the warm season, extreme ECLs in the warmer months may increase in number, further increasing the flood risk.

Patterns of the El Niño–Southern Oscillation (ENSO) cycle and other climatic influences may also be affected by climate change, leading to increased flooding. Although large uncertainties exist about the future pattern, El Niño years experienced in NSW are likely to continue to result in lower than average rainfall and become hotter. By comparison, La Niña years are expected to continue to result in higher than average rainfall and become warmer, with storms producing heavy downpours likely to become more frequent, and flooding increasing during these years.

In recognition of the potential impacts of climate change, the Directorate has undertaken additional climate and hydrological modelling to assess potential future flooding impacts for a range of climate change scenarios. The results clearly show that the existing flood risk is set to increase with climate change. Under a medium climate change projection, by 2090 the 1 in 100 chance in a year flood level is forecast to increase by around 1.1 metres at Windsor and 0.7 metres at Penrith (WMAwater 2017). For a flood similar to the Brisbane 2011 floods (1 in 100 chance in a year flood) the Taskforce estimated only 2,500 residential properties would be impacted compared to 7,600 properties if the Project were not to proceed. In a flood similar to the largest flood since European settlement (1867 flood – 1 in 500 chance in a year flood), 5,000 residential properties would be impacted, compared to 15,500 if the Project were not to proceed.

Figure 3-4. Flood evacuation routes and low points



Source: DPI (2014a)

3.2.1.7 Summary of flood risks

The Hawkesbury-Nepean Valley has a high flood hazard, with both historical and geological evidence of rapid widespread flooding across the Valley.

There is also a high level of flood exposure as the floodplain is in the western Sydney region, an area with a large and growing population. It is one of Australia's most significant and diverse economies with an annual gross regional product of about $137 billion in 2019 (economy.id 2020).

Population growth in the Hawkesbury-Nepean Valley means that flood exposure will increase in the future. Climate change may further increase flood risk as it has the potential to increase the severity and frequency of the flood hazard in the Hawkesbury-Nepean Valley.

The Flood Strategy (Section 3.1.1) concluded that the significant risks to life and property from flooding in the Hawkesbury-Nepean Valley warranted a comprehensive and coordinated response to reducing impacts and risks. The Flood Strategy developed nine key outcomes to address impacts and risks, which were:

- Outcome 1 - coordinated flood risk management across the Hawkesbury-Nepean Valley now and in the future
- **Outcome 2 - reduced flood risk in the Hawkesbury-Nepean Valley by raising Warragamba Dam (the preferred infrastructure solution)**
- Outcome 3 - strategic and integrated land use and road planning
- Outcome 4 - accessible contemporary flood risk information
- Outcome 5 - an aware, prepared and responsive community
- Outcome 6 - improved weather and flood predictions
- Outcome 7 - best practice emergency response and recovery
- Outcome 8 - adequate local roads for evacuation
- Outcome 9 - ongoing monitoring and evaluation, reporting and improvement of the Flood Strategy.

3.2.2 Warragamba Dam raising

The Warragamba Dam Raising Project was identified in the Flood Strategy as one of the key outcomes and the primary infrastructure option to reduce flooding risk and impacts in the Hawkesbury-Nepean Valley. The options and alternatives considered before selecting the Warragamba Dam Raising Project as a key outcome are described in Chapter 4 (Project development and alternatives).

Warragamba Dam is a water supply dam and provides around 80 percent of Sydney's water supply. It is currently not designed or operated for flood mitigation. Previous recent works at the dam including raising the dam wall by five metres in the 1990s and constructing the auxiliary spillway in early 2000s were to improve the dam's safety and did not increase its capacity of storage for water supply or flood mitigation capabilities.

Options were investigated to raise the height of the existing Warragamba Dam to temporarily store floodwaters upstream of the wall. This would reduce flood risk by temporarily holding back and slowly releasing floodwaters coming from the Warragamba Dam catchment and decreasing the depth and extent of the flood downstream. Raising Warragamba Dam to create an FMZ of around 14 metres was determined to have the highest net benefit. While creating an FMZ of greater than 14 metres would provide additional flood mitigation, the upstream impacts and construction costs would increase, therefore the additional benefits would not exceed the incremental costs.

However, based upon additional climate change and hydrological modelling, to provide similar current flood mitigation benefit as the 14-metre FMZ, in 2090 the dam spillways may need to be raised to create an FMZ of 17 metres. For all raising options considered, the full supply level would not change.

Raising Warragamba Dam to create an FMZ of around 14 metres would result in a significant reduction in the number of properties flooded and in flood damage costs. For a flood similar to the Brisbane 2011 floods (1 in 100 chance in a year flood) only 2,500 residential properties would be impacted compared to 7,600 properties if the Project were not to proceed. In a flood similar to the largest flood since European settlement (1867 flood – 1 in 500 chance in a year flood), 5,000 residential properties would be impacted, compared to 15,500 if the Project were not to proceed.

3.3 Project objective

The objective of the Project is to:

'Reduce risk to life and property damage downstream in the Valley by raising Warragamba Dam wall'

Chapter 15 (Flooding and hydrology) and Chapter 21 (Socio-economic, land use and property) demonstrate that the Project would meet this objective.

Considerations in meeting this objective include:

- reducing peak flood heights and reducing the flood rate of rise (or delaying the flood peak) downstream
- minimising upstream environmental, cultural and social impacts from increased temporary inundation within the catchment of Lake Burragorang
- minimising downstream environmental, social and economic impacts from changes in water releases from the dam
- minimising construction impacts
- maintaining the primary role of Warragamba Dam for water supply
- ensuring the upgrade meets dam safety requirements
- delivering a scheme that has the greatest net benefit for current and future conditions.

Based on the Taskforce Options Assessment Report (INSW 2019) and subsequent investigations, the Project would significantly reduce the risk to life and scale of evacuations during critical flood events. By reducing the depth and extent of flooding, it would also reduce damages to people's homes and communities by on average around 75 percent over the long term.

The major benefits would be experienced in the Wallacia, Penrith/Emu Plains, Richmond/Windsor, and South Creek/ Eastern Creek areas of the floodplain, and to a lesser extent in the Lower Hawkesbury.

3.4 Statement of project justification

The Warragamba Dam Raising Project is required to reduce flooding impacts on downstream communities and urban development in the Hawkesbury-Nepean Valley. The unique topography of the Hawkesbury-Nepean Valley results in extensive and damaging floods, especially for flood events greater than the 1 in 100 chance in a year flood. The current number of people affected by a 1 in 100 chance in a year flood is 55,000. The risk would increase as the number of people, properties and businesses in the catchment increases over time. Also, because of the limited capacity and flood prone evacuation routes from developed areas of the floodplain, there is a risk of the loss of human life when significant flood events occur. A detailed and comprehensive Hawkesbury-Nepean Valley flood risk management strategy was developed by a multi-agency Taskforce to investigate alternatives and options to reduce the risks and impacts of significant flood events in the Hawkesbury-Nepean Valley. No other infrastructure alternative or option (and their combinations) investigated by the Taskforce was as effective and viable in reducing flood risks as the Project. Other alternatives and options are described and assessed in Chapter 4 (Project development and alternatives).

The Warragamba Dam Raising Project is one of nine outcomes identified by the Taskforce to address flooding impacts. As the Warragamba Dam catchment contributes up to 70 percent of the floodwaters in the affected downstream floodplain and there is an existing dam, viable flood mitigation options were considered for Warragamba Dam. As Warragamba Dam was designed for and is operated as a water supply dam, there is no dedicated capacity for flood mitigation. Increasing the capacity behind the dam wall to provide an FMZ of around 14 metres was identified as the highest net benefit out of all the alternatives considered. The Project would substantially reduce the extent of flooding in the Hawkesbury-Nepean Valley.

Peer reviewed climate change research found that by 2090 it is likely an additional three metres of spillway height would be required to provide similar flood mitigation outcomes as the current flood mitigation proposal. Raising the dam side walls and roadway by an additional three metres may not be feasible in the future, both in terms of engineering constraints and cost. The current design includes raising the dam side walls and roadway by 17 metres now to enable adaptation to projected climate change. Any consideration of raising spillway heights is unlikely before the mid to late 21st century and would be subject to a separate planning approval process.

The Warragamba Dam Raising Project in combination with the other outcomes identified in the Hawkesbury-Nepean Valley flood risk management strategy would significantly reduce the extent and period of flooding as well as damages and risk to human life from flooding.

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