

2022 Flood Inquiry

Volume Two: Full report

29 July 2022

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2022 Flood Inquiry

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Acronyms

AASFA	Agriculture and Animal Services Functional Area
ACCC	Australian Competition and Consumer Commission
ADF	Australian Defence Force
AEP	Annual exceedance probability
AFAC	Australian and New Zealand National Council for Fire and Emergency Services
AHD	Australian Height Datum
ANZLIC	Australia and New Zealand Spatial Information Council
ARI	Average recurrence interval
BNHCRC	Bushfire and Natural Hazard Cooperative Research Centre
Bureau	Bureau of Meteorology
CAD	Computer Aided Dispatch
CBAA	Community Broadcasting Association of Australia
CERA	Canterbury Earthquake Recovery Authority
CLEX	Australian Research Council Centre of Excellence for Climate Extremes
CSG	Customer Service Guarantee
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DACC	Defence Assistance to the Civil Community
DCJ	Department of Communities and Justice
DCP	Development Control Plan
DCS	Department of Customer Service
DFE	Defined Flood Events
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
DRFA	Disaster Recovery Funding Arrangements
EMA	Emergency Management Australia
EMC	Emergency Management Committee
EMPLAN	State Emergency Management Plan
ENSO	El Niño-Southern Oscillation
EOC	Emergency Operations Centre
EOCON	Emergency Operations Controller
EPA	Environment Protection Authority
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPI	Environmental Planning Instrument
ERC	NSW Cabinet Expenditure Review Committee

ESO	Emergency Services Organisation
EUSFA	Energy and Utility Services Functional Area
FLARE	Flash Flood Advisory Resource
FPA	Flood Planning Area
FPL	Flood Planning Level
FRAO	Flood Rescue Area of Operations
FRNSW	Fire and Rescue NSW
GSAC	Goonellabah Sports and Aquatic Centre
ICC	Incident Control Centres
IFD	Intensity, Frequency and Duration
IMS	Incident Management Structure
IMT	Incident Management Team
INSW	Infrastructure NSW
IOD	Indian Ocean Dipole
LEMC	Local Emergency Management Committee
LEMO	Local Emergency Management Officer
LEOCON	Local Emergency Management Operations Controller
LEP	Local Environment Plan
LGA	Local Government Area
MoU	Memorandum of Understanding
MSD	Mass Service Disruptions
NBN	National Broadband Network
NCEN	NSW Climate Extremes Network
NEMRRA	National Emergency Management, Resilience and Recovery Agency
NOCC	Network Operations and Control Centres
NRRA	National Recovery and Resilience Agency
NRRC	Northern Rivers Recovery Corporation
NRSC	National Resource Sharing Centre
NSSN	NSW Smart Sensing Network
NSWPF	NSW Police Force
NSWRA	NSW Reconstruction Authority (proposed in this report)
SES	NSW State Emergency Service
NSW VRA	NSW Volunteer Rescue Association
OEM	Office of Emergency Management
PIFAC	Public Information Functional Coordinator

PMF	Probable maximum flood
PSN	Public Safety Network
PWA	Public Works Authority
QRA	Queensland Reconstruction Authority
REMC	Regional Emergency Management Committee
REMO	Regional Emergency Management Officer
REOCON	Regional Emergency Operations Controller
RFS	NSW Rural Fire Service
RPAS	Remotely Piloted Aircraft Systems
SAM	Southern Annular Mode
SARA	State Archives and Records Authority
SCC	SES State Command Centre
SEMC	State Emergency Management Committee
SEOC	State Emergency Operations Centre
SEOCON	State Emergency Operations Controller
SEPP	State Environmental Planning Policy
SERCON	State Emergency Recovery Coordinator
SERM Act	<i>State Emergency and Rescue Management Act 1989</i>
SES Act	<i>State Emergency Service Act 1989</i>
SHQ	State Headquarters
SLSNSW	Surf Life Saving NSW
SRB	State Rescue Board
STP	Sewage Treatment Plant
TELCOFA	Telecommunications Services Functional Area
TEMU	Telecommunications Emergency Management Unit
TSFA	Transport Services Functional Area
UAV	Uncrewed Aerial Vehicle
UNDR	United Nations Office for Disaster Risk Reduction
VBRRA	Victorian Bushfire Reconstruction and Recovery Authority
WELFAC	Welfare Services Functional Area Coordinator
WHS Act	<i>Work Health and Safety Act 2011</i>

Chapter

1

1. Introduction and context

1.1. Introduction

Flood Inquiry established

NSW experienced major flooding in February, March and, most recently, July 2022. In March 2022, the NSW Premier established this Flood Inquiry which was announced by the Acting Premier on 21 March 2022. Its Terms of Reference are included in Volume One.

This chapter describes the approach adopted and processes undertaken by the Inquiry to understand these flood events and to make recommendations for future improvements. It includes detail on consultation with expert, government and industry stakeholders. It also provides an overview of community consultation and participation, and the analysis of such. In addition, it provides some historical context for the major flooding that occurred.

Process and approach of this Inquiry

The Inquiry's initial timeframe was to provide a report to the NSW Premier on causation and land use planning by 30 June, and on all other matters by 30 September 2022. However, early consultations made it clear that flood-affected communities across NSW need certainty of direction and support. It also became apparent that causation, planning and emergency management considerations are all integrally linked. For these reasons, the Inquiry sought approval to deliver a single and complete report by the end of July. This accelerated the Inquiry's final timeline but, importantly, did not inhibit deep consultation and analysis.

The Inquiry met with a wide range of individuals and organisations to ensure diverse perspectives were heard and considered. Given the scale of the floods, the Inquiry prioritised hearing from affected communities. Public submissions were invited, and community town halls held to ensure the Inquiry heard from as many community members as possible.

In total, about 150 consultation meetings were held with individuals, communities and community representatives, government stakeholders, researchers, emergency services agencies, experts and others. All participants were invited to speak at these meetings, and their contributions were of great value to the Inquiry.

The Inquiry drew on a wide range of source material to understand the climate factors which led to the 2022 floods, and how these floods were prepared for and responded to. This material included research literature and journal articles, operational guidelines, NSW Government policies and procedures, media reports and publications from experts in the field.

Indeed, although the Terms of Reference for the Inquiry are quite broad, it became apparent that an expanded overview of disaster preparedness and response was required. Consequently, the Inquiry has endeavoured to take an 'all-hazards' approach to its report with the intention of reducing, to the best extent possible, loss of life and damage to property from all types of future disasters.

Given the breadth of the Inquiry's Terms of Reference and the fact that floods are an incredibly complex issue across NSW and Australia, the Inquiry covered a lot of important matters. But it could not cover all of them –many additional issues will require further consideration and consultation with stakeholders.

Site visits

Meeting with flood-affected community members and hearing their direct experiences was a key priority of the Inquiry. Over its truncated 4-month duration, the Inquiry Co-leads and members of the Secretariat visited the Northern Rivers region 5 times to witness firsthand the impacts of the floods. This included an early visit 3-5 April when the co-leads accompanied the Premier, Deputy Premier, the Minister for Education and Early Learning, local Members of Parliament and other community leaders to Lismore, Wardell, Cabbage Tree and Woodburn, including a visit to local NSW State Emergency Service (SES) facilities and a flyover of the Northern Rivers floods.

Members of the Inquiry team also travelled to Broken Hill to understand in person its unique challenges in responding to flash flooding.

The Inquiry was eager to visit as many flood-affected communities as possible, but was limited by its short reporting timelines and the ongoing concerns and impacts of the COVID-19 pandemic.



Photos 1-1: L-R: Michael Barnes and Ashley Jones from Rotorwings Helicopter Services with Inquiry Co-lead, Mick Fuller. Lisa and Brent Simons from Woodburn Marine with Inquiry Co-lead, Mick Fuller. Source: Inquiry Secretariat.

Media

The Inquiry Co-leads did a range of print, radio and television interviews during the course of the Inquiry, particularly with Northern Rivers media outlets.

Community consultation and participation

Hearing from those who have been directly affected by the floods is critical in understanding the nature of the floods' impact on people and communities, so community consultation was a cornerstone of the Inquiry's approach. The Inquiry thanks the community members who donated their time to attend meetings or made a submission.

Town Halls

The Inquiry moved quickly to organise a number of town hall meetings, in person and online, to offer flood-affected communities easy and convenient ways to share their experiences and

concerns, noting that many had lost access to technology and transport modes in the floods. Three face-to-face community town hall meetings were held at:

- Lismore (511 attendees in person, 91 online)
- Tumbulgum (278 attendees in person)
- Mullumbimby (273 attendees in person).

Two virtual community town hall meetings were also held for Clarence River (15 people online) and the Hawkesbury-Nepean Valley (16 people online). In total, 1,184 people from flood-affected communities attended these meetings, with 83 people or families choosing to share their experiences with the Inquiry.

Submissions

Submissions to the Inquiry opened on 4 April. Submissions were initially set to close on 20 May, but were extended to 24 June, helping to ensure that flood-affected residents had maximum opportunity to contribute to the Inquiry. The Inquiry also made clear it would accept submissions from those who were flood-affected at any time, so submissions continued to be received until the very end of the Inquiry's reporting period on 31 July, though were not included for the analysis reported below. Submissions could be submitted online, via email or post, in person at a Service NSW Service Centre or Mobile Service Centre, or by hard copy presentation to the Inquiry Secretariat at the town halls referred to above.

In total, 1,498 written submissions were received by 26 July 2022 from about 125 postcodes across NSW, with over half of these coming from the Northern Rivers region – 32% of submissions were from postcode 2480 (Lismore area), followed by 9% from 2472 (Broadwater, Woodburn), 6% from 2487 (Kingscliff, Chinderah and surrounds), 6% from 2482 (Mullumbimby) and 4% from 2477 (Alstonville).

As shown in Figure 1-1, most written submissions (66%) were made as 'a resident in a flood-affected area', followed by 'other' (13%) and 'a member of the general public' (9%).

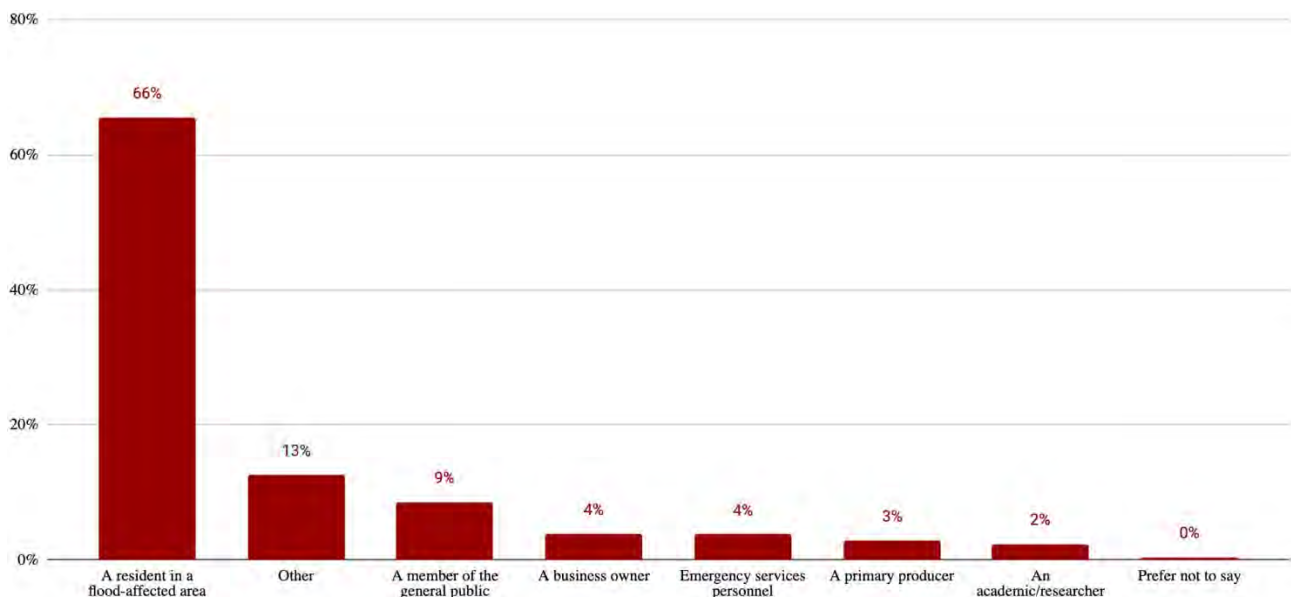


Figure 1-1: Topic modelling. Source: League of Scholars (2022).

Analysis of community views

Early on, the Inquiry commissioned League of Scholars to assist with a thorough analysis of community views. League of Scholars is a data science analytics and consulting firm with deep

expertise and experience in various areas of advanced computational social science. League of Scholars completed three streams of analysis:

- submissions analysis based on a processed form of the raw data from 1,498 written submissions to the Inquiry via webform, email and 83 via community meetings – with 1,450 unique submissions
- search traffic analysis based on bespoke data collection of relevant web search traffic data curated and collected
- social media analysis based on analysis of a corpus of related and relevant social media posts curated and collected.

A summary of this analysis, including key findings, is included in Volume Three.

Submissions analysis

Key themes raised in submissions are illustrated in Figure 1-2. Most submissions relate to 3 main topics, namely: **Topic A: homes and family** (698 submissions), **Topic B: water engineering** (414 submissions) and **Topic C: emergency services** (191 submissions). Other main topic areas were **Topic D: planning in light of climate change** (78 submissions), **Topic E: recovery** (54 submissions) and **Topic F: environment** (15 submissions).

The number of submissions under Topic A shows how many people shared stories about their family and communities, and how the floods affected their lives and homes. This is reflected in distinctive themes of the topic, which included home-related phrases such as 'living room', 'gas cooktop' and 'wardrobe'; family-related terms such as 'elderly parents', 'grandchildren'; and community-related terms such as 'neighbours', 'community', 'old' or 'elderly'.

Topic B concerned all water and water infrastructure matters such as rainfall, stormwater, drainage, rivers and canals. Many submissions spoke about past processes and activities which reduced the impact of flooding, and made suggestions on what should be done now to improve water infrastructure to reduce flooding.

Under Topic C, many submissions provided feedback on how SES responded to the event, their own flood rescue experiences, and community and government response efforts. These submissions were generally quite in-depth and detailed. Distinctive themes included response and recovery efforts, reflections on the telecommunications network, landslides, road repairs, flood rescues and emergency accommodation.

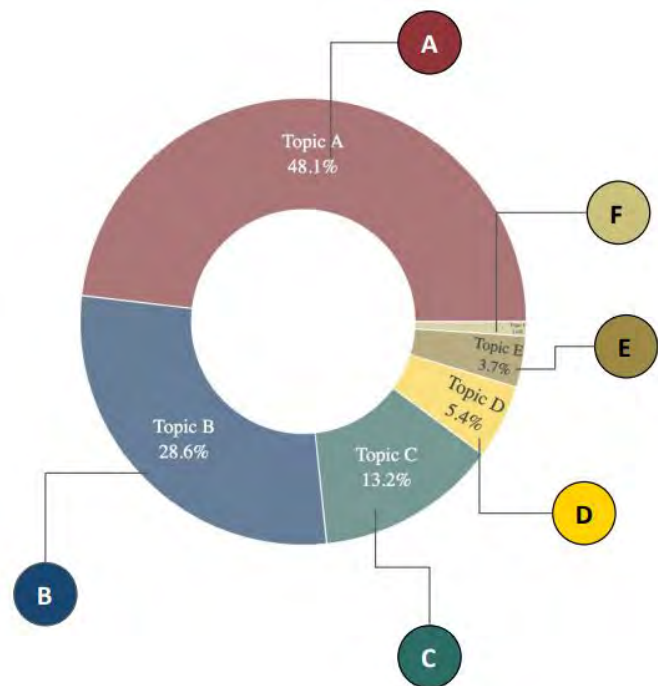


Figure 1-2: Topic modelling. Source: League of Scholars (2022).

The majority of submissions in Topics A, B, C and D came from individuals, whereas submissions in topics E and F came mostly from organisations. In topic A most submissions were from people who identified as female. Submissions in other topic areas were more evenly split on gender lines.

[Geographic analysis](#) indicated that most submissions in Topics A and B were from the Northern Rivers, with other topics more concentrated within the Sydney area.

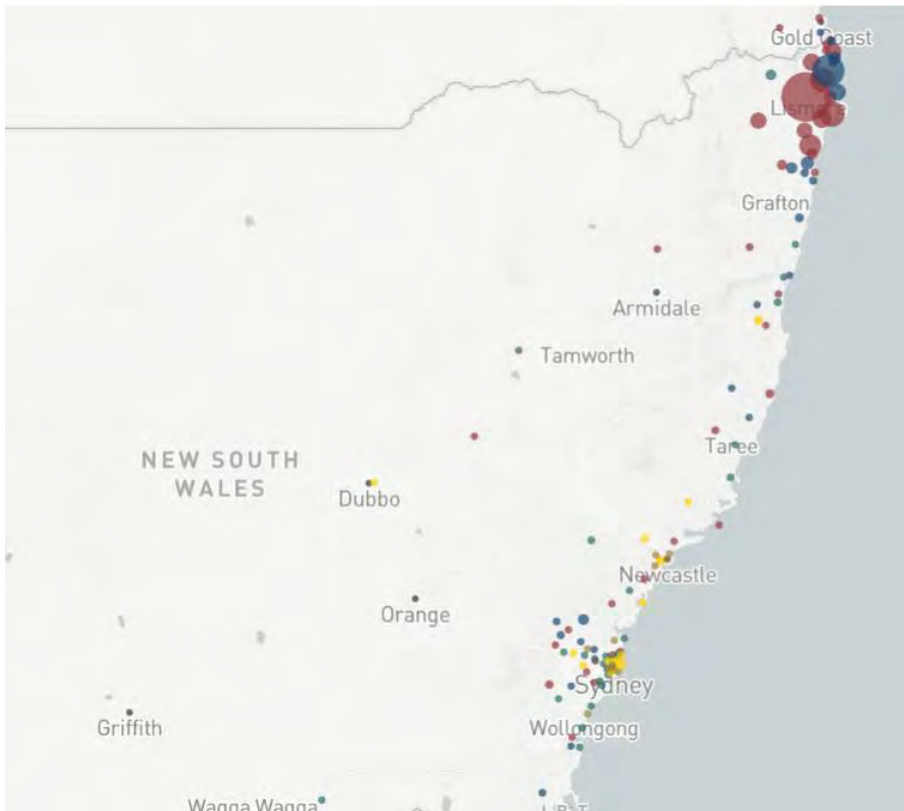


Figure 1-3: Geographic analysis.
Source: League of Scholars (2022).

Search traffic and social media analysis

It is estimated that between January and April, 300,000 flood-related Google searches per day were made. The Sydney floods in early July corresponded with over 100,000 Google searches in one day alone (Sunday 3 July). Postcode analysis showed that the most flood-related searches on Google came from the Northern Rivers, being postcodes 2478 (Ballina area), 2480 (Lismore area), 2486 (Tweed area/Banora Point), 2477 (Alstonville and Wardell area) and the Clarence River, 2463 (Macleans area).

In general, an analysis of historical Google trends data in NSW revealed that search activity grew significantly after the first major flood event, and that it correlated with a combined Northern Rivers/Sydney region rainfall index between February and April 2022.¹

Search trends also revealed other areas of concern linked to floods. For example, volumes of some correlated search terms such as 'insurer', 'severe thunderstorm', and 'flash flooding' peaked in the lead up to the peak rainfall while others such as 'levee', 'dams' and 'floods' spiked during the peak rainfall. Some peak searches were evident in the days and weeks following rainfall, revealing the sequence and timing of aftershocks, clean up and rebuilding.

Social media analysis was based on a corpus of 915,983 words and phrases used in 55,000 NSW flood-related public social media posts to Twitter from over 18,000 different accounts between February and April.

Topic modelling of the text used in these tweets revealed 5 topics. Four were **election and politics**, **specific local problems and solutions**, **causes and consequences** and **locals take charge**. The fifth topic was removed as it was deemed to be spam. Subset tweets within each topic allowed League of Scholars to create a Geo-Map, and revealed that 2 topics had a

¹ The rainfall index is an index to represent rain in metropolitan areas (average daily rainfall data at Collaroy and Sydney) as well as rain in the Northern Rivers area (average daily rainfall data at Byron Bay and Mullumbimby) for comparison with statewide data on search term volumes.

geographic concentration; **locals take charge** (Northern Rivers) and **causes and consequences** (Sydney area) whereas the 2 other themes were spread out across the state and nation.

Importantly, volumes of daily NSW flood-related web search activity and NSW flood-related social media activity are highly correlated. For example, the number of Google searches in NSW for emergency services from January to April correlates strongly with the number of daily mentions of NSW SES on Twitter for the same period.

This is important as it shows that the 2 sources are largely coherent and can be used to complement each other for insights into people's interests, challenges and behaviours in the lead up to, during and after the floods.

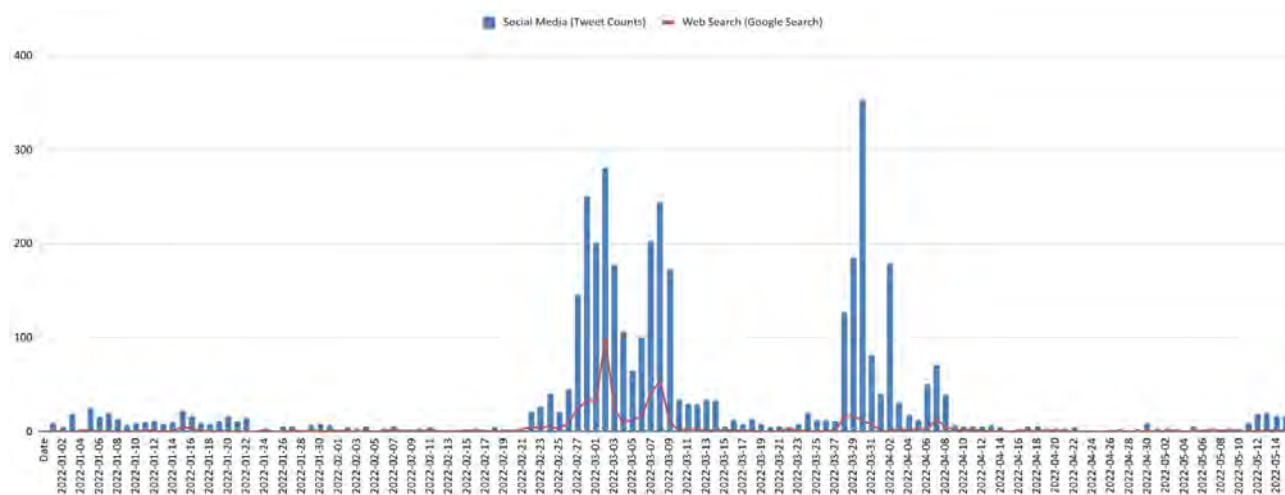


Figure 1-4: Daily search and social media activity related to the NSW State Emergency Services, January-May 2022, are highly correlated. Source: League of Scholars (2022).

Photo and video submissions

Many submissions had photos attached which provided an insight into people's personal experiences of the floods. Some of these have been included in Volume One and throughout the report. Photos and videos received from individuals have also been included to illustrate a cross-section of the community experience, but specific details of their location and source are not provided to protect privacy. Many photos also were confronting and distressing and included destroyed homes and deceased cattle. The Inquiry has chosen not to publish these, but they did give the Inquiry an insight into the pain and trauma felt by individuals and communities.

All the photos are a powerful reminder of the extensive impact of the 2022 floods in NSW. Given the importance of this photographic record, the Inquiry has liaised with the State Archives and Records Authority (SARA) to share the photos received during the submissions process. SARA has advised that, once the Inquiry's records are transferred to the State Archives Collection, work will begin to arrange an online display of a selection of photos to share with the community.

Climate, weather and technology experts

In addition to hearing directly from those affected by the floods, the Inquiry consulted with a number of flood and technology experts. To understand the causes and contributing factors influencing the floods, the Inquiry met with Professor Andy Pitman AO, Director of the Australian Research Council Centre of Excellence for Climate Extremes (CLEX), which NSW is fortunate to host at the University of NSW. Professor Pitman's climate expertise and that of his colleagues in CLEX has informed the final report of this Inquiry. The Inquiry also met with representatives and researchers from research companies including Risk Frontiers.

The Inquiry drew on material and met with the Director, meteorologists and climate experts from the Bureau of Meteorology on 4 occasions with further supplementary material provided by the

Bureau following each meeting. The Inquiry also received and utilised material prepared by Dr Mel Taylor from the Bushfire and Natural Hazards Cooperative Research Centre.

The Inquiry met with a number of academics including Professor Alexander ‘Sandy’ McFarlane AO on 20 June to discuss mental health issues and Professor Seth Westra on 19 May and 7 June to discuss flood modelling matters. Representatives from the Inquiry also attended a Flood Recovery and Resilience: Research Experience and Collaboration Workshop run by the University of Sydney on 16 May and received advice from the NSW Smart Sensing Network through its Director, Professor Benjamin Eggleton.

Government agencies and other organisations

A full list of meetings held is included in Volume Three of this report, though the Inquiry points out that numerous phone calls and informal meetings were also held which provided valuable information.

Industry consultations and roundtables

In order to facilitate the Inquiry’s deeper understanding of key issues, and to hear views from a range of stakeholder groups, the Inquiry also held a number of face-to-face and virtual roundtable discussions. These included:

- Sydney development and industry associations roundtable
- a Lismore women’s roundtable including representatives from the Country Women’s Association
- property developers roundtable organised by Urban Taskforce
- Northern Rivers property developers roundtable
- building industry and associations roundtable
- agriculture roundtable.

The inquiry also met with the Paul Ramsey Foundation on 9 June and Bunnings on 30 June.

Indigenous consultation

The Inquiry sought to understand the stories and perspectives from the Indigenous community in the Northern Rivers. A roundtable with 19 Indigenous leaders from a range of local Aboriginal Land Councils and Indigenous housing, health and welfare organisations was held at the end of June in Lismore. An overview of the key themes discussed at this meeting include:

- due to the history of flooding in the region, Indigenous communities and organisations have always had a sense of self-preparedness based on information given at the time. However, the lack of warning and information from emergency services affected the ability and capacity to communicate to tenants, communities and staff
- poor local knowledge on how to support and rescue isolated Indigenous communities meant there was a severe lack of emergency transport and evacuation centres for these communities
- there are generations of Indigenous knowledge and history about the crucial role of landscapes and river systems which need to be considered and listened to, and it is important to add an Indigenous lens to land management practices
- support for Indigenous communities, particularly those which are isolated, has all come from within their own communities. These communities have the capacity and knowledge to give support, and this capacity should be considered in terms of how recovery and relief is provided. There is a need for money and resources, but red tape and policy prevents it being provided.

The Inquiry thanks the community members who attended this roundtable meeting. Incredible stories were told, with many great recommendations on how to empower and support Indigenous communities in all phases of a natural disaster event.

Caveat

The Inquiry did not have powers to compel witnesses to attend interviews or to require agencies to produce documents. All meetings were carried out in an open and cooperative way. In some cases, agencies and stakeholders were asked to provide written information and answer specific questions and, where needed, further information or clarification was sought.

Case studies and commissioned works

Works commissioned by or provided to the Inquiry are included in Volume Three of this report. Each of these works has informed the Inquiry's final report and recommendations.

The commissioned works include a paper on the background and causes of the extreme rainfall and flooding in NSW in 2022 prepared by the ARC Centre of Excellence for Climate Extremes (CLEX), a summary of a preliminary Cost Benefit Analysis Framework prepared by NSW Treasury, and a piece on restoring the environment from Bundjalung man, Mr Oliver Costello. The League of Scholars was also commissioned to complete social media, search and submissions analytics.

Further, to ensure the Inquiry was informed by a deep understanding of the flood impacts in Lismore and the Hawkesbury-Nepean Valley, 3 case studies were commissioned: one on flooding and land use planning in Lismore and the Northern Rivers, one on emergency management during the 2022 flood events in Lismore, and one on flooding and planning issues in the Hawkesbury-Nepean Valley.

Previous reviews and inquiries

The Inquiry considered a selection of previous reviews and noted many common themes, most of which strongly resonated with 2022 flood experiences and key findings in this report. Common themes include:

- a need for improved warnings (including for flash flooding), better communications and increased use of real time data
- recommendations for Bureau of Meteorology expertise to be embedded within the SES
- a need for increased information sharing and coordination between all levels of government
- a need for increased support for local government, including to ensure maintenance of roads and other assets
- a need for greater training, resourcing and up to date planning
- a need for flooding and emergency management expert input into land use planning
- greater investment in mitigation
- recommendations on the importance of business continuity plans and the protection of critical infrastructure to minimise disruption to essential services.

This Inquiry found it difficult to establish from publicly available information if and how recommendations from previous inquiries had been implemented.

The Inquiry noted that an April 2021 NSW Audit Office Performance Audit report *on Addressing public inquiry recommendations – Emergency response agencies* found that two-thirds of recommendations reviewed in the audit could not be verified as being implemented as intended, and in line with the outcomes sought. The audit also found that agencies did not always nominate milestone dates or priority rankings for accepted recommendations, and so could not demonstrate if they were managing or monitoring them effectively.²

² Audit Office of NSW. (2021). Addressing public inquiry recommendations – emergency response agencies. Retrieved from <https://www.audit.nsw.gov.au/our-work/reports/addressing-public-inquiry-recommendations---emergency-response-agencies>

The Inquiry heard a deep sense of frustration from many flood-affected residents and community members over a lack of implementation and change over time, despite multiple previous reviews. Many were sceptical that this Inquiry would succeed in effecting significant change. Similar findings on implementation (or lack thereof) were made in the 2020 NSW Independent Bushfire Inquiry, which recommended that a central accountability mechanism be established to track implementation of the report.

1.2. Context

Australia, including NSW, is disaster and flood prone. Although Australia is probably more famous for drought, it is flooding which is the most damaging natural disaster in the country. Floods cause the most damage to land and property and have been responsible for over 2,500 deaths nationwide since 1790.³ This section provides a brief overview of recent natural disasters, including a flood event that took place in March 2021 and several major historical floods.

Australia, including NSW, is disaster prone

Australia is an expansive island continent that features a wide range of climatic zones, from the tropical regions of the north, through the arid expanses of the interior, to the temperate regions of the south.⁴ As a result of its varied climate, environment and geography, Australia experiences many of nature's more extreme weather phenomena and hazards, including droughts, tropical cyclones, severe storms, east coast lows, floods, landslides, heatwaves and bushfires.⁵ Australia can also suffer from geological-driven hazards including earthquakes and tsunamis, and biosecurity threats such as COVID-19 and Hendra virus.

It is important to note that natural hazards are not on their own disasters. A disaster occurs when natural hazards intersect with people and things of value, and when the impacts of hazards exceed the community's ability to avoid, cope or recover from them.⁶

To illustrate NSW's susceptibility to just two hazards – fire and flood – Figures 1-5, 1-6 and 1-7 overlay NSW's probable maximum flood extent against the NSW Rural Fire Services' mapping of bushfire prone land. As can be seen, there is very little of the state, particularly on the east coast where most people live, that is not susceptible in some way.

³ Rural Assistance Authority. (2022). Declared natural disasters. [Natural disasters | State Library of New South Wales \(nsw.gov.au\)](https://www.nsw.gov.au/natural-disasters)

⁴ Australian Bureau of Statistics. (2012). Year Book 2012. Retrieved from [1301.0 - Year Book Australia, 2012 \(abs.gov.au\)](https://www.abs.gov.au/1301.0-Year-Book-Australia-2012)

⁵ Ibid.

⁶ Commonwealth of Australia. (2020). Royal Commission into National Natural Disaster Arrangements. Retrieved from <https://naturaldisaster.royalcommission.gov.au/system/files/2020-11/Royal%20Commission%20into%20National%20Natural%20Disaster%20Arrangements%20-%20Report%20%20%5Baccessible%5D.pdf> .

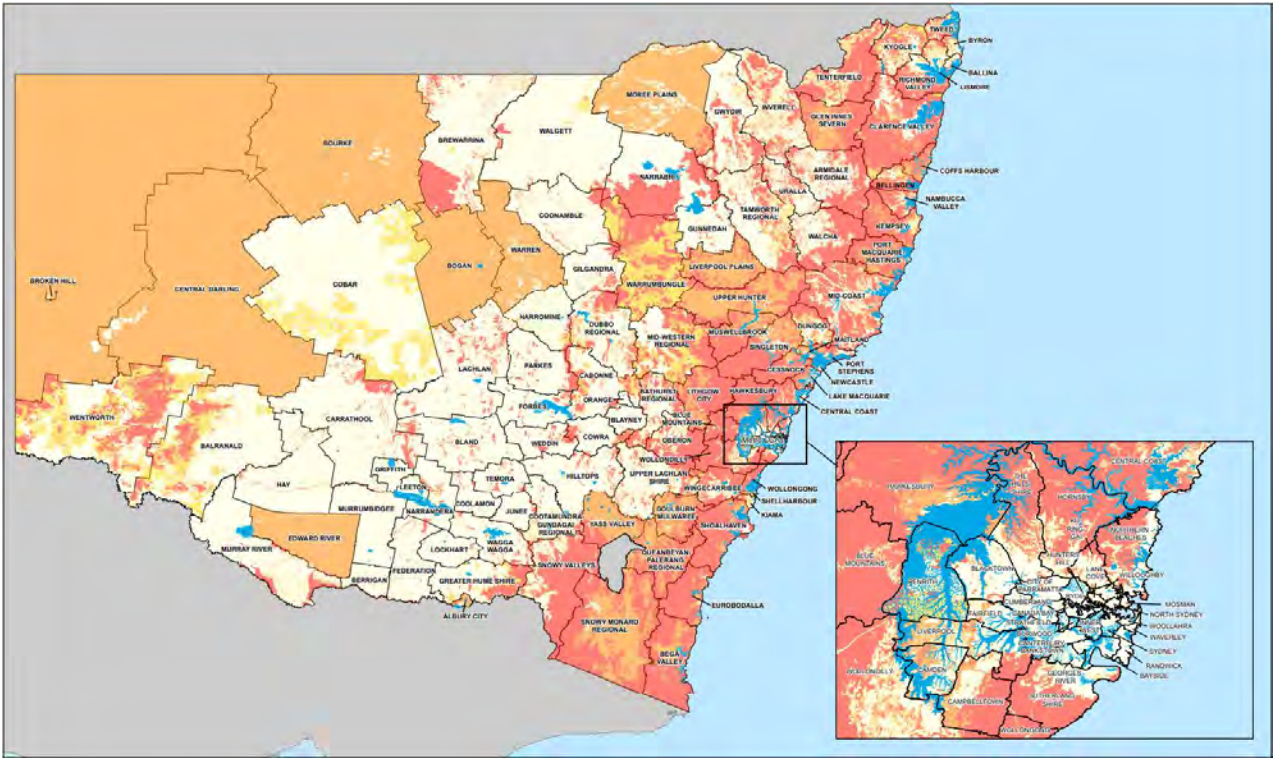


Figure 1-5: PMF flood extent and RFS Bushfire prone land by LGA across NSW. Source: Prepared by the Department of Planning and Environment (2022).

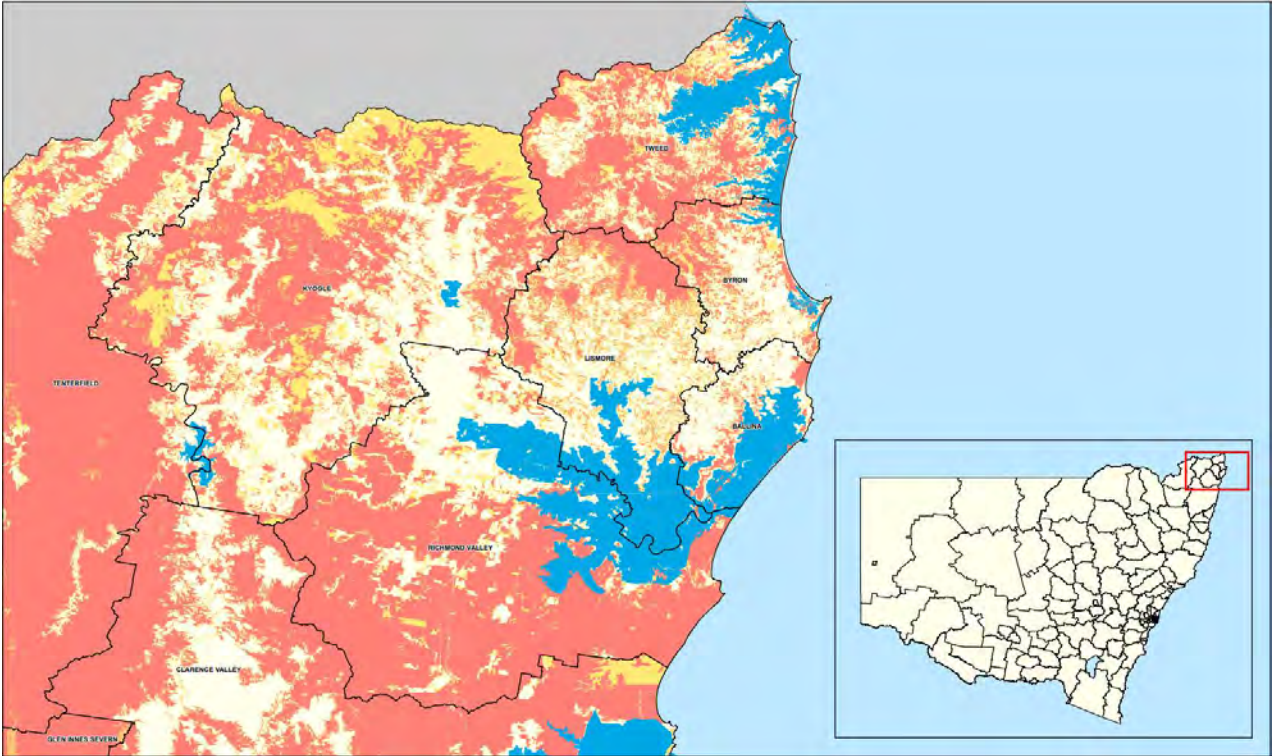


Figure 1-6: PMF flood extent and RFS Bushfire prone land by LGA across the Northern Rivers. Source: Prepared by the Department of Planning and Environment (2022).

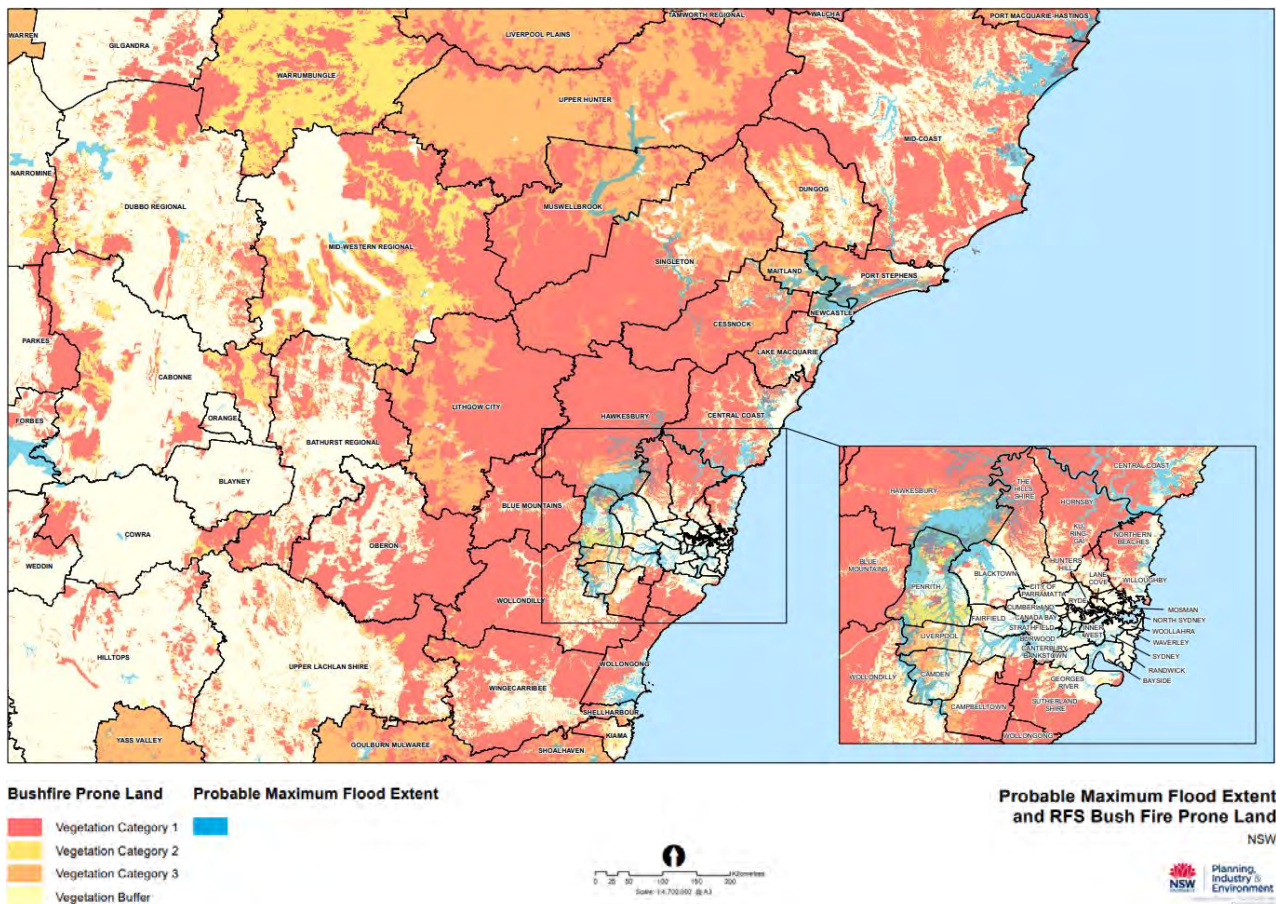


Figure 1-7: PMF flood extent and RFS Bushfire prone land by LGA across the Hawkesbury-Nepean. Source: Prepared by the Department of Planning and Environment (2022).

Note, Vegetation category 1 is considered to be the highest risk for bushfire, and is represented in red. This vegetation category has the highest combustibility and likelihood of forming fully developed fires, including heavy ember production. Vegetation category 2 is considered to be a lower bush fire risk than Category 1 and Category 3 but higher than the excluded areas. It is represented as light orange. This vegetation category has lower combustibility and/or limited potential fire size due to the vegetation area shape and size, land geography and management practices. Vegetation Category 3 is considered to be medium bush fire risk vegetation. It is higher in bush fire risk than category 2 (and the excluded areas) but lower than Category 1. It is represented as dark orange.

Recent, successive disasters illustrate our vulnerability

The flood events in February, March and July 2022 occurred within a year of a prior declared flood event (March 2021), and within 2 years of a major storm event (February-March 2020) and the worst ever forest fires. The 2019–20 Black Summer fires were preceded by a crippling drought that affecting the whole of NSW. These successive disasters occurred at the same time that communities across Australia were grappling with the devastating impacts of the COVID-19 pandemic.

Cumulatively, these events have disrupted almost every aspect of Australian society and the economy. The recent floods affected many communities across NSW still dealing with and recovering from the impacts of these previous natural and health disasters. Many submissions to the Inquiry described the compounding effects of these successive disasters, with little time for recovery between each.

A summary of recent disasters is outlined below to highlight their cumulative impact on NSW communities.

The 2017-2019 drought

Following a predominantly wet winter and spring in 2016 over much of Australia, conditions turned dry in 2017. From January 2017 to December 2019, rainfall was the lowest on record. The 2017, 2018, 2019 and 2020 calendar years were among the warmest on record.⁷ The most extreme rainfall deficiencies over multi-year periods occurred in the northern half of NSW.⁸

Most cities and towns across NSW had significant water restrictions in place during the drought. In December 2019, the NSW Department of Primary Industries Combined Drought Indicator (CDI) showed 100% of NSW in one of the 3 drought categories (drought-affected, drought, intense drought).⁹ Intense drought conditions continued in far western and north-eastern NSW and expanded throughout central and south-east NSW during December 2019.¹⁰

The prolonged drought contributed to significant economic impacts: it was estimated that the drought cost the NSW economy \$5.7 billion of Gross State Product in 2018–19. The financial hardship experienced by primary producers contributed to a decline in regional spending, undermining the sustainability of local businesses.¹¹ Over a third of regional businesses surveyed in August 2018 by the NSW Business Chamber indicated their business viability was at risk due to the drought. Stock had to be destroyed and communities suffered from loss of livelihoods, financial stress and declining regional economies. A study by Wittwer (2020) estimated NSW job losses due to drought were around 0.55% or 17,500 FTE jobs in 2017–18, and more than 1% or 34,000 jobs in 2018–19.¹²

The sustained, hot conditions further combined with the dry landscape and strong winds to produce dangerous fire weather conditions leading into summer 2019.¹³

Black Summer 2019–2020

The Black Summer of 2019–2020 was unprecedented in its intensity and scale. It showed that bushfire behaviour is becoming more extreme and less predictable.¹⁴ These were the worst forest fires ever seen. A key challenge was the large number and size of bushfires running simultaneously, the length of the fire season, and the unprecedented number of fire-generated (or pyrocumulonimbus) thunderstorms that occurred.

The losses from these fires were extensive. Twenty-six people were killed, including 3 NSW RFS members and 3 international aerial firefighting crew. The fire burnt over 5.52 million hectares of

⁷ NSW Government. (2022). Drought stages and measures implemented during the 2017-20 drought. Retrieved from [Drought stages and measures implemented during the 2017-20 drought - Water in New South Wales \(nsw.gov.au\)](https://www.nsw.gov.au/our-government/our-portfolio/primary-industries/drought-stages-and-measures-implemented-during-the-2017-20-drought-water-in-new-south-wales)

⁸ Bureau of Meteorology. (2022). Special climate statement 70. Retrieved from <http://www.bom.gov.au/climate/current/statements/scs70.pdf>

⁹ DPI (NSW Department of Primary Industries). (2019). The NSW Combined Drought Indicator (CDI). Retrieved from <https://www.dpi.nsw.gov.au/dpi/climate/seasonal-conditions-and-drought/key-research/features-of-the-nsw-state-seasonal-update/features-of-the-combined-drought-indicator>

¹⁰ DPI (NSW Department of Primary Industries). (2019). NSW State Seasonal Update - December 2019. Retrieved from [NSW State Seasonal Update - December 2019](https://www.dpi.nsw.gov.au/dpi/climate/seasonal-conditions-and-drought/nsw-state-seasonal-update/december-2019)

¹¹ NSW Government. (2019). Support for drought affected communities in NSW. Retrieved from [Submission 25 - NSW Government.pdf](https://www.nsw.gov.au/our-government/our-portfolio/primary-industries/support-for-drought-affected-communities-in-nsw)

¹² Wittwer, Glyn. (2020). Estimating the Regional Economic Impacts of the 2017 to 2019 Drought on NSW and the Rest of Australia. Centre of Policy Studies/IMPACT Centre Working Papers g-297, Victoria University, Centre of Policy Studies/IMPACT Centre. Retrieved from <https://ideas.repec.org/p/cop/wpaper/g-297.html>

¹³ Bureau of Meteorology. (2022). Previous Droughts. Retrieved from <http://www.bom.gov.au/climate/drought/knowledge-centre/previous-droughts.shtml>

¹⁴ NSW Independent Bushfire Inquiry. (2020). Final Report of the NSW Bushfire Inquiry. Retrieved from <https://www.nsw.gov.au/nsw-government/projects-and-initiatives/nsw-bushfire-inquiry>

land, destroyed 2,476 houses, 3 schools, 284 facilities and 5,559 outbuildings.¹⁵ In its *Insurance Catastrophe Resilience Report: 2020–21*, the Insurance Council of Australia reported 304,359 claims lodged and \$5.74 billion damages incurred; with 91% of claims closed.¹⁶

The 2019–20 bushfire season ran for 8 months – between 1 July 2019 and 31 March 2020. The last fires were extinguished on 2 March 2020 after 240 consecutive days of burning.¹⁷

Severe storms and flooding in March 2021

In March 2021, sustained, heavy rainfall was experienced over much of eastern Australia and led to widespread flooding across regions from the Queensland border down to the Sydney metropolitan area, parts of the South Coast and multiple locations in inland NSW.

The heavy rain fell against a backdrop of relatively wet antecedent conditions across most of the affected regions, associated with a La Niña which developed in the second half of 2020. Soils became more saturated during 2020 and water storage levels generally increased. This contributed to flooding being more widespread and severe than had been the case during a broadly comparable rain event in February 2020.¹⁸

Across NSW catchments, as rainfall records were broken, record flood levels were observed. The community impacts were significant: at one stage flood warnings covered an area of NSW that included a population of 6 million people. Across the event over 25,500 NSW residents were subject to evacuation orders.¹⁹ A total of 4,460 homes were damaged, 1,196 homes were rendered uninhabitable and \$400 million in joint NSW and Australian Government funding was provided.²⁰

There were 2 flood-related fatalities during this event.²¹ As at March 2022, the Insurance Council of Australia reported 59,000 claims lodged and \$618 million damages incurred; with 87% of claims closed.²²

NSW is flood prone

The March 2021 floods and the more recent floods are not unusual or extraordinary.

Many towns across NSW have been settled on the banks and bends of rivers – increasing the state’s exposure to flood risk. NSW’s history of European settlement along the coast and on floodplains, together with its climate and topography, means NSW is extremely flood prone.

¹⁵ Ibid.

¹⁶ Insurance Council of Australia. (2021). *Insurance Catastrophe Resilience Report:2020-21*. Retrieved from https://insurancecouncil.com.au/wp-content/uploads/2021/09/ICA008_CatastropheReport_6.5_FA1_online.pdf

¹⁷ NSW Independent Bushfire Inquiry. (2020). *Final Report of the NSW Bushfire Inquiry*. Retrieved from <https://www.nsw.gov.au/nsw-government/projects-and-initiatives/nsw-bushfire-inquiry>

¹⁸ Australian Disaster Resilience Knowledge Hub. Accessed via: [New South Wales Flood, 2021 \(aidr.org.au\)](https://www.aidr.org.au/news/new-south-wales-flood-2021)

¹⁹ AFAC (Australasian Fire and Emergency Service Authorities Council). (2021). *Independent review into 2021 NSW flooding*. Retrieved from <https://www.ses.nsw.gov.au/media/5448/review-nsw-flooding-final.pdf>

²⁰ Resilience NSW. (2022). *Advice provided to the Inquiry on 21 June 2022*.

²¹ Insurance Council of Australia. (2022). *Catastrophe report 6.5*. Retrieved from https://insurancecouncil.com.au/wp-content/uploads/2021/09/ICA008_CatastropheReport_6.5_FA1_online.pdf

²² Insurance Council of Australia. (2022). *Catastrophe 212*. Retrieved from <https://insurancecouncil.com.au/news-hub/current-catastrophes/catastrophe-212-march-floods-nsw-and-se-queensland/>

As such, NSW has a long history of flooding. Oral traditions include many references to Indigenous people living with floods and other weather extremes. European records of floods began in the late 1700s. This section recounts only a few of NSW's most notable major floods.

Gundagai 1852

The flood of Gundagai in 1852 remains Australia's deadliest flood, with 89 people being thought to have lost their lives. Local Wiradjuri men saved close to 70 people using bark canoes and rowboats. The entire settlement was destroyed, leaving just 3 houses standing. The Sydney Morning Herald reported:

*One of the most fearful catastrophes which it has ever been our lot to record ... the village of Gundagai has been almost entirely destroyed.*²³

The town was later rebuilt on higher ground on the slopes of Mount Parnassus, through land swaps facilitated by the Government.²⁴

Hawkesbury-Nepean Valley 1867

In the Hawkesbury-Nepean Valley, a series of floods occurred between 1800 and 1810.

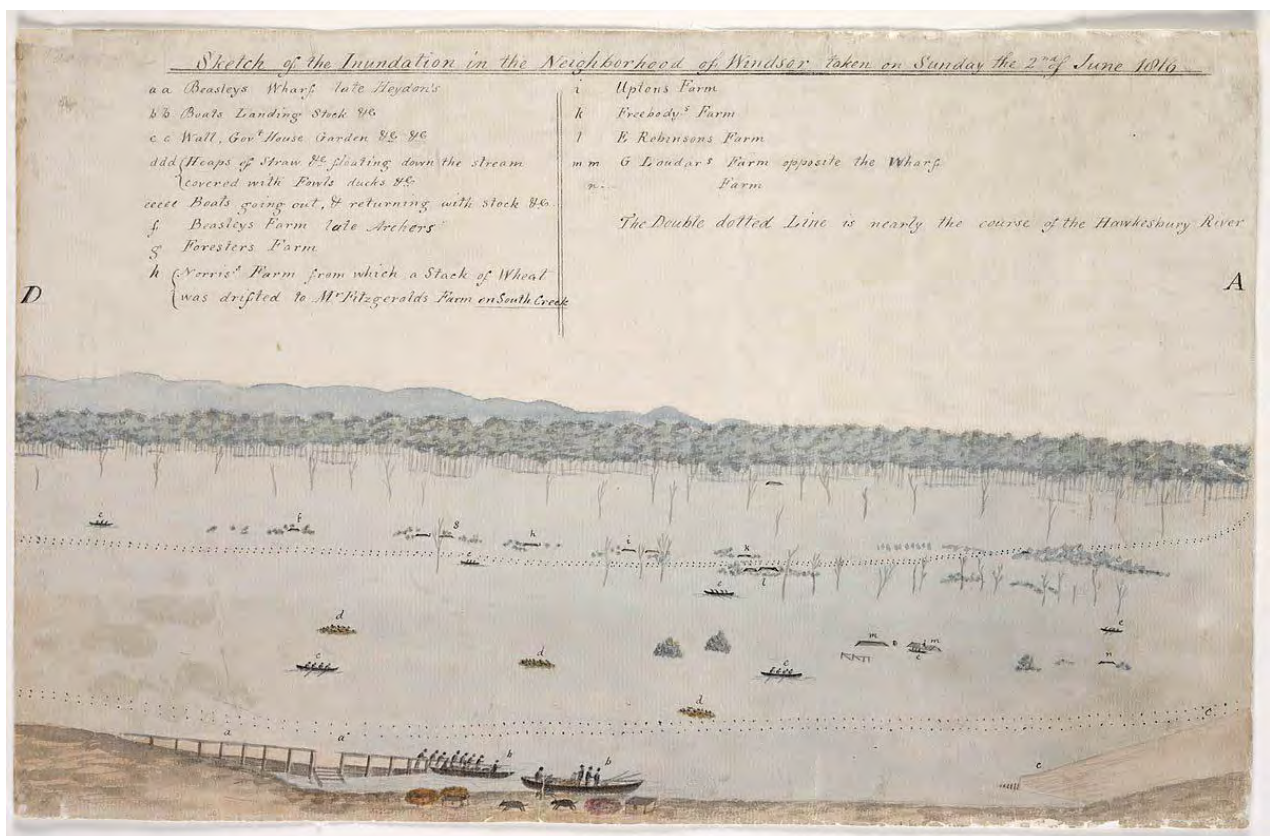


Photo 1-2: A sketch of the inundation in the neighbourhood of Windsor, taken Sunday 2 June 1816. The double dotted line is nearly the course of the Hawkesbury River. Source: NSW State Library.

But the largest flood in the Valley since European settlement occurred in June 1867. The river reached 19 m above normal river height at Windsor, and about 20 people lost their lives.

This flood was described as

²³ National Museum Australia. (2022). Gundagai flood. Retrieved from [Gundagai flood | National Museum of Australia \(nma.gov.au\)](https://www.nma.gov.au/gundagai-flood)

²⁴ Ibid.

a huge 'inland sea' with waves up to two metres high. The flood stretched from Pitt Town to Kurrajong and from Riverstone to the Blue Mountains. Windsor, Richmond and Pitt Town became small 'flood islands'.²⁵

This flood is estimated to have been a 1 in 500 event. If a flood similar to the 1867 flood occurred today, the impacts would be catastrophic.

Hunter Valley 1955

Following heavy rainfall in February 1955, flooding caused widespread damage across the Hunter Valley, with more than 40,000 people evacuated from more than 40 towns. A total of 15,000 residents were evacuated from the Singleton and Maitland regions, 5,200 homes were flooded and 58 homes were destroyed or washed away.²⁶ There were 14 deaths recorded as a result of the flood.²⁷ In response to the floods, the NSW State Emergency Service (SES) was established – the first dedicated emergency service in Australia. The flood also led to the establishment of the Hunter Valley Flood Mitigation Scheme and the *Hunter Valley Flood Mitigation Act 1956*.



Photos 1-3: L-R: A Railway station flooded at Maitland, New South Wales, February 1955; 2UE Relief Fund - Flood fund, 28 February 1955. Photographs by Ron Iredale. Source: NSW State Library.

As can be seen, major floods with extensive loss of lives, homes and businesses are not new to NSW.

²⁵ AFAC. (2017). Challenges and mitigation: the inevitable Hawkesbury-Nepean flood. Retrieved from afac.com.au/insight/operations/article/current/challenges-and-mitigation-the-inevitable-hawkesbury-nepean-flood

²⁶ NSW Government. (2020). Hunter Valley Flood Mitigation Scheme fact sheet. Retrieved from [Hunter Valley Flood Mitigation Scheme \(nsw.gov.au\)](https://www.nsw.gov.au/hunter-valley-flood-mitigation-scheme)

²⁷ Ibid.

Chapter

2

2. Flood causes and contributing factors

This chapter examines “the causes of, and factors contributing to, the frequency, intensity, timing and location of floods in NSW in the 2022 catastrophic flood events, including consideration of any role of weather, climate change, and human activity” (Term of Reference 1a). It explores the causal and contributing factors of the extreme rainfall and resultant flooding with a view both to informing community understanding of these factors (including what is not known about them) and, as discussed in later chapters, to inform practice in preparing for, responding to and recovering from events of this kind. It also explores how to harness research and new technologies so that floods and the weather associated with them can be better measured to improve flood warning and recovery systems.

Following a very wet spring in 2021, there was significant flooding across NSW in the summer of 2021–22 which extended into autumn and winter of 2022. The most notable floods affected various areas in the:

- Northern Rivers including Lismore, Tumbulgum, Murwillumbah, Coraki, Woodburn, Grafton, Ulmarra and Maclean
- Hawkesbury-Nepean Valley including at Upper Nepean, North Richmond, Wisemans Ferry, Menangle Bridge, Wallacia Weir, Windsor, Sackville and Lower Portland
- central to north coasts including along the Manning, Macleay and Hunter Rivers, in addition to Wollombi Brook.

The Northern Rivers floods were particularly bad with Lismore experiencing its highest flood on record since European settlement. The floods were associated with intense and sustained rainfall, resulting from a series of concurrent and successive weather systems, described in section 2.3. Seven-day average rainfall records were broken in Tweed, Brunswick, Richmond and Wilsons River catchments, with the highest 7-day total of 1,346 mm recorded at Uki on the Tweed River.²⁸

Submissions to the Inquiry described both the rain and the floods. The rain was a “river [which] fell from the sky”,²⁹ “drenching” and “sheeting down vertically”³⁰ with “unrelenting”³¹ intensity. The rain-bearing weather systems were labelled slow moving or said to have simply stalled in place. The latter is a phenomenon that the Inquiry learnt can amplify not only intense or heavy rainfall by dumping massive amounts of rain over the same location to cause flooding, but can also amplify average rainfall which, by stalling or lingering in place can inundate a catchment and cause flooding. The 2022 floods themselves were described as a “tsunami, there were waves and surges of water smashing the streets”³² and “not like any other flood we’ve seen”³³.

²⁸ Bureau of Meteorology. (2022). New South Wales in February 2022: Very wet end to the month for the Northern Rivers. Retrieved from <http://www.Bureau.gov.au/climate/current/month/nsw/archive/202202.summary.shtml>.

²⁹ Marlene Crompton, submission to the Inquiry.

³⁰ Northern Rivers Business Roundtable on 3 May 2022.

³¹ Anne Schillmoller, submission to the Inquiry.

³² Anonymous, submission to the Inquiry.

³³ Anonymous, submission to the Inquiry.

In the Hawkesbury-Nepean Valley, floods were generally worse than those experienced in March 2021, and comparable to those of 1978.³⁴ Most flooding in the Valley was classified major, and because of the Valley's population density, the floods caused significant damage to property.

Many people have assumed such bad flooding was due to climate change, particularly with the memory of 2017–2019's bad drought and the 2019–20 catastrophic bushfire season still fresh. To understand the weather and climate issues, the Inquiry drew on extensive consultation with the Bureau of Meteorology³⁵ (Bureau) and the Australian Research Council Centre of Excellence for Climate Extremes³⁶ (CLEX) and its Director, Professor Andy Pitman AO FAA from the University of NSW. These discussions were supplemented with a set of formal questions submitted to CLEX, the detailed answers to which can be found in Volume Three of the Inquiry Report.

To understand the on-ground phenomena associated with floods, the Inquiry consulted informed community groups including the Lismore Citizens Flood Review,³⁷ Indigenous leaders, several local and state government agencies including Infrastructure NSW (INSW), the Department of Planning and Environment (DPE), Water NSW, the State Emergency Service (SES), Resilience NSW, the Insurance Council of Australia, and consulting and research organisations.

As both CLEX and the Bureau explained to the Inquiry, climate change is fundamentally affecting our weather. We know that the earth has warmed, with global surface temperatures 1.09°C higher in the period 2011–2020 than in 1850–1900.³⁸ To quote CLEX:

*The detection of trends in many weather and climate variables, and the attribution of those trends to increasing greenhouse gases in the atmosphere is well established and not controversial.*³⁹

However, it is not known with any great certainty precisely how rainfall patterns at a local scale are changing with climate change. And there is also no great certainty about how flood risk, existing and future, is shifting with climate change. As explained in Johnson, White, Van Dijk, Evans, Jakob, Kiem, Leonard, Rouillard and Westra (2015):⁴⁰

Although changes to rainfall extremes are expected in most locations, it is not clear how these changes translate into flood risk due to the potential additional feedback of altered catchment characteristics (e.g., storage volumes, soil moisture, vegetation cover and fire disturbance) on runoff due to the changing climate and/or direct human-led changes.

Flood damages have increased over the instrumental period in Australia, but it is not known if this is due to changes in population densities, increased infrastructure in flood prone locations (the exposure), improved reporting or actual changes in the occurrence of flood-producing meteorological events (the hazard).

³⁴ Bureau of Meteorology. (2022) Special Climate Statement 76 – Extreme rainfall and flooding in south-eastern Queensland and eastern New South Wales. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs76.pdf>.

³⁵ Meeting with the Bureau of Meteorology on 14 April 2022.

³⁶ Meeting with Professor Andy Pitman on 25 March 2022.

³⁷ Meeting with Beth and Richard Trevan, Lismore Citizens Flood Review, on 23 May 2022.

³⁸ IPCC. (2019). Summary for Policymakers. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Retrieved from <https://www.ipcc.ch/srccl/>.

³⁹ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 7 June 2022.

⁴⁰ Johnson, F, White, C J, Van Dijk, A, Evans, J P, Jakob, D, Kiem, A S, Leonard, M, Rouillard, A, & Westra, S. (2015). How and why are floods changing in Australia? In 36th Hydrology and Water Resources Symposium, 1-8. Retrieved from <https://research-repository.uwa.edu.au/en/publications/how-and-why-are-floods-changing-in-australia>.

This chapter attempts to provide perspective on the full range of causes of, and factors contributing to, the 2022 flood events.

2.1. What is a flood? Terms and definitions

A flood is an overflow of water beyond the normal limits of a watercourse.⁴¹ The NSW Floodplain Development Manual⁴² notes 3 types of floods:

- riverine flooding – where flooding results from relatively high stream flow that overtops the natural or artificial banks of any part of a stream, river, estuary, lake or dam
- local overland flow – also known as flash flooding – which results primarily from drainage in urban areas
- coastal or oceanic inundation – resulting from elevated ocean levels, including from storm surge, or from sea level rise.

All 3 types of flood can occur within the one event as happened on 8-9 June 2007 during the Pasha Bulker Storm, named after the 76,000-tonne bulk carrier MV *Pasha Bulker* which grounded on Nobbys Beach, Newcastle. As a result of an east coast low augmented by a high tide, the Hunter, Central Coast and Sydney saw major riverine flooding, flash flooding, beach erosion and gale force winds. The system resulted in 9 fatalities, huge swells of up to 14 m and insurance costs of approximately \$1.35 billion.⁴³

Riverine flooding can be caused by dam release or failure, or through excess water introduced to a catchment by way of a king tide, storm surge, snow melt or heavy rainfall.⁴⁴ Depending on where it occurs, in a significant event it can:

- cause inundation of properties which disrupts people's lives and destroys homes and business premises
- contain fast flowing, high velocity elements which create a risk to life
- rise quickly causing specific areas to become isolated
- create challenges for evacuating people safely
- create standing or slow-moving water that lasts for days to weeks (e.g. the Hawkesbury-Nepean Valley)
- cause infrastructure to malfunction further contributing to community scale disruption (e.g. water and sewer systems not functioning, power supply interrupted, road pavements damaged, land slips, etc.)
- cause environmental health issues due to contaminated water from overflowing sewers/septic tanks, and floating debris including animal carcasses

⁴¹ Bureau (Bureau of Meteorology). (2022). Understanding floods. Retrieved from <http://www.Bureau.gov.au/australia/flood/knowledge-centre/understanding.shtml>.

⁴² The primary technical document for flood management in NSW is the 2005 Floodplain Development Manual ([Floodplain Development Manual \(nsw.gov.au\)](http://www.nsw.gov.au/floodplain-development-manual)). It is due to be replaced by the draft 2022 Flood Risk Management Manual ([Flood Risk Management Manual \(nsw.gov.au\)](http://www.nsw.gov.au/flood-risk-management-manual)).

⁴³ Verdon-Kidd, D, Kiem, A S, Willgoose, G & Haines, P. (2010). East Coast Lows and the Newcastle/Central Coast Pasha Bulker storm. National Climate Change Adaptation Research Facility, Gold Coast. Retrieved from https://knowledge.aidr.org.au/media/1925/verdon-kidd_2010_east_coast_lows_pasha_bulker_storm.pdf

⁴⁴ Bureau (Bureau of Meteorology). (2022). Understanding floods. Retrieved from <http://www.Bureau.gov.au/australia/flood/knowledge-centre/understanding.shtml>.

- cause dangerous situations for rescuers when large floodplains are inundated and the floodwaters create their own weather systems – for example wind waves can be generated across a water body with a large fetch, and in an extreme event a seiche⁴⁵ can occur.

Riverine flooding does not just mean flooding from larger river systems. Smaller creek systems can become blocked, overtop and create localised evacuation issues. For example, flooding in Dungog in 2015 was caused by an intense east coast low that resulted in run off that backed up into the local creek system, Myall Creek.

Local overland flooding, or **flash flooding**, occurs within 6 hours of rain falling and can happen after a short burst of heavy rain such as from a thunderstorm.⁴⁶ It is generally short in duration but can be dangerous, as high intensity rainfall events can lead to high velocity floods. These can result in safety issues as there is often little warning of such floods because gauges, which are typically placed in river systems, may not pick up localised drainage issues. The problems caused by flash flooding can sometimes be mitigated through upgrading engineering works to improve drainage capacity or by installing bespoke monitoring and warning systems. Flash flooding, though of concern, does not create the same level of ongoing challenges that extensive riverine flooding represents.

Coastal flooding, or coastal inundation, is typically caused by elevated ocean levels, including from storm surge associated with tropical cyclones and tsunamis, or from sea level rise.⁴⁷ The impacts of coastal inundation are often exacerbated by the tidal cycle. More substantial impacts can occur if a coastal or ocean inundation event coincides with riverine flooding on coastal floodplains. The rate of fall of floodwaters will slow considerably and back-flooding of areas can also occur, where floodwaters in an area previously inundated could rise again with the high tide.

Each type of flood was observed during the summer of 2021–2022 and autumn and winter of 2022. Though riverine and flash flooding caused by excess water from heavy rainfall is most relevant in an analysis of the 2021–2022 flood events, the Inquiry notes that storm surges and coastal inundation also contributed to flooding in parts of Northern NSW, and the overtopping of Warragamba dam contributed to flooding in the Hawkesbury-Nepean. Flash flooding caused a serious flood in Broken Hill in March 2022 causing one fatality.

How rainfall contributes to flooding – the statistics

When rain falls over an area of land, some is absorbed into the ground, while the rest becomes runoff and flows downhill. It follows that the statistics of rainfall itself are an obvious marker of flooding. There are 4 key temporal and spatial properties, or ‘statistics’, of rainfall that contribute to ‘flooding’ rains:

- intensity (the rate at which the rain falls)
- duration (the period over which rain falls)
- volume (how much rain falls)
- spatial pattern (where the rain falls).

Each of these properties can vary widely, and consequently any resultant runoff and flood can also vary widely. The nature and properties of the rainfall – whether it is “short and sharp” or “long and sustained” – and exactly what kind of flood results is catchment specific. As the Inquiry heard repeatedly, “every flood is different”.

⁴⁵ A seiche is a standing wave that oscillates in a body of water creating localised impacts with waves up to 5 metres in height (see [What is a seiche? \(noaa.gov\)](https://www.noaa.gov/what-is-a-seiche/)).

⁴⁶ Bureau of Meteorology. (2022). Understanding floods. Retrieved from <http://www.Bureau.gov.au/australia/flood/knowledge-centre/understanding.shtml>.

⁴⁷ Ibid.

What happens when rainfall hits the ground?

Put simply, flood is the outcome of water falling as rain at a rate that is faster than a catchment can absorb or drain. As discussed by Johnson et al. (2016), this simple definition hides considerable complexity because the key driver of a flood is time.⁴⁸

Beyond the statistics of the rainfall itself, if the time it takes for rainfall runoff to flow through the catchment⁴⁹ and appear at a specific point in the river or drainage system is slow, there is a chance the river or system will have capacity to accommodate the excess water.⁵⁰ But if all the water falling in a catchment flows very quickly downstream, there is a risk that it will all reach a specific point in the river or drainage system at the same time, exceeding capacity and creating a flood.⁵¹

Slowing water as it flows through a catchment depends on many factors, like the landscape itself and the geometry of a catchment including its size and slope. In some steep, hilly catchments, an extraordinary amount of intense rain on a saturated catchment is required to cause a flood because the slope moves the water very quickly. In some larger, more lowland catchments, flooding can occur gradually following many days of less intense rainfall because the lower gradients mean the water cannot be moved out of the catchment quickly enough.

Other factors that influence the speed of water moving through a catchment include its saturation levels and catchment management. For example, if the soil is relatively dry, some of the rainfall will be absorbed and retained in the soil. It follows that a saturated catchment is at a higher risk of flood than a dry catchment. Further, forests, vegetation and deep soils tend to slow the flow of water through a catchment whereas urbanisation creates impermeable surfaces and hastens the flow. Without efficient storm water management and drainage, heavy rainfall and storm water can move very quickly towards a location at risk of flooding.

As discussed in Section 2.3 below, the long, wet spring in NSW in 2021 led to most catchments already being saturated by summer with little capacity to absorb subsequent rainfall. The catchments in which the rain fell are also described in Section 2.3, and the movement of rainfall through these catchments as it is influenced by catchment management and land use planning is discussed in Chapter 7.

Flood size and magnitude

Floods are usually measured as height above the Australian Height Datum (AHD), which is approximately equal to mean sea level.⁵² The height above sea level is one indicator of flood magnitude and is important when determining the impact of a flood. By using key locations in the floodplain, it is possible to compare the heights of different flood events. The flood peak is the highest height observed during a flood event at a specified site on the river or floodplain.

The Bureau classifies flooding as minor, moderate or major at key river height stations. Each classification is defined by the water level that causes certain impacts upstream and downstream of the station.⁵³ These river heights are determined based on standard descriptions of flood effects

⁴⁸ Johnson et al. (2016). Natural hazards in Australia: floods. *Climatic Change*, 139, 21-25. doi: 10.1007/s10584-016-1689-y.

⁴⁹ The area of land that contributes runoff to a particular point is called the catchment.

⁵⁰ Professor Andy Pitman. (2022). Advice to the Inquiry provided 28 April 2022.

⁵¹ Ibid.

⁵² GeoScience Australia. (2022). Australian Height Datum. Retrieved from <https://www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/ahdgm/ahd>.

⁵³ Bureau of Meteorology. (2022). Flood Warning Services. Retrieved from <http://www.Bureau.gov.au/water/floods/floodWarningServices.shtml>.

(see Table 2-1 below), historical data and relevant local information.⁵⁴ The classifications are revised from time to time by the NSW SES, in consultation with the Bureau, local government and other members of the NSW Flood Warning Consultative Committee.⁵⁵

As at May 2022, the classifications used are:

Minor flooding	Causes inconvenience. Low-lying areas next to water courses are inundated. Minor roads may be closed and low-level bridges submerged. In urban areas inundation may affect some backyards and buildings below the floor level as well as bicycle and pedestrian paths. In rural areas removal of stock and equipment may be required.
Moderate flooding	In addition to the above, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood affected areas may be required. In rural areas removal of stock is required.
Major flooding	In addition to the above, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood affected areas may be required. Utility services may be impacted.

Table 2-1: Minor, moderate and major flood classifications used by the Bureau of Meteorology. Source: Bureau of Meteorology.

In addition to flood height, other flood properties that contribute to the magnitude or severity of a flood event include:

- volume (the total amount of water in the flood – this contributes to both the height and duration of flooding)
- rate of rise (how fast the flood rises – the faster a flood rises the less time there is for adequate warning and evacuation)
- velocity (how fast the water is flowing – higher velocity flow causes a higher risk to human life, as well as a higher risk of erosion, and damage to infrastructure)
- duration (how long the flood lasts – a longer flood causes greater disruption to transport, business and personal networks)
- extent (how much area the flood covers – smaller floods may affect a single catchment, whereas larger floods may affect several catchments and have more widespread impact).

Consequences of flooding

Floods affect both individuals and communities, and have social, economic and environmental consequences. Floods are the most expensive type of natural disaster⁵⁶ and the second most deadly natural disaster after heatwaves.⁵⁷ The environmental effects of flood can be both positive and negative. For example, floods can replenish landscape nutrients whilst affecting water quality, soil erosion, animal habitat and cultural heritage.

Generally, small/minor floods occur more frequently and have lower economic, social and environmental consequences compared to larger/major floods that are less common but often have greater consequences. The impact of a flood event varies depending on flood properties

⁵⁴ Ibid.

⁵⁵ NSW SES (State Emergency Service). (2018). Provision of and requirements for flood warning. Retrieved from <https://www.ses.nsw.gov.au/media/2655/gauges-and-warnings.pdf>.

⁵⁶ Insurance Council of Australia. (2022). Advice to the Inquiry provided 22 April 2022.

⁵⁷ Bureau of Meteorology. (2022). Understanding floods. Retrieved from <http://www.Bureau.gov.au/australia/flood/knowledge-centre/understanding.shtml>.

described above (height, volume, rate of rise, velocity, duration and extent), in addition to the exposure and vulnerability of the affected environment.

Exposure is a measure of the number of people or things that may be affected by a flood while vulnerability is a measure of the potential of people or things to be harmed. For instance, the impact of a flood in an area with very few people (low exposure) who can evacuate easily (low vulnerability) would be less severe than in an area with lots of people (high exposure) who cannot evacuate easily (high vulnerability).

Flood risk and probability – what makes a ‘bad’ flood?

A bad flood is inherently subjective. A bad flood according to a hydrologist might be one that lasts a long time, but to a resident or community member, a long-lasting flood might not be bad if it does not inundate their property.

The largest flood that could occur at a particular place is called the probable maximum flood (PMF).⁵⁸ Flood risk can be described as a combination of the consequences if a flood were to occur and the probability or chance of a flood event occurring.⁵⁹

Determining the probability of a flood event

The chance of different sized floods occurring is calculated using 2 primary methods: statistical analysis of long-term flood records (flood frequency analysis) or statistical analysis of rainfall and runoff. Both methods result in predictions for peak water flows at key locations in rivers which are then input into floodplain hydraulic models.

Floodplain hydraulic models are calculated representations of rivers and their surrounding floodplain. These models consider river size, ground levels, surrounding development (like roads), ridges and embankments to estimate predicted flows. The output of the models includes predicted flood levels and water flow speeds.

Describing the probability of a flood event – what does a ‘1 in 100 year flood’ really mean?

Often floods are referred to using the likelihood or chance (or estimated likelihood or chance) of different sized floods occurring in any one year. This can be expressed as an annual exceedance probability (AEP) or an average recurrence interval (ARI). An AEP is the chance that a flood of a given or larger size will occur in any one year, expressed as a percentage. For example, a 1% AEP is a flood that has a 1% chance of being equalled or exceeded in any one year.

Alternately, an ARI is expressed as the long-term average number of years between the occurrence of a flood of a given size or larger. So, a ‘1 in 100 year’ event refers to a flood level or peak that has a one in a hundred, or 1% AEP, chance of being equalled or exceeded in any one year. Throughout this Report, the Inquiry utilises AEP to describe the chance of a flood event. However, in practice, the terms are used interchangeably and the terms often lead to confusion about what exactly they refer to.

The chance of experiencing different sized flood events in any given period of time can be estimated mathematically, as shown in Table 2-2 below.

⁵⁸ NSW SES (State Emergency Service). (2018). New South Wales State Flood Plan Glossary. Retrieved from <https://www.ses.nsw.gov.au/media/2650/glossary.pdf>.

⁵⁹ Queensland Government. (2011). Understanding floods: Questions & Answers. Retrieved from https://www.chiefscientist.qld.gov.au/data/assets/pdf_file/0022/49801/understanding-floods_full_colour.pdf.

Annual exceedance probability (%)	Annual recurrence interval (1 in X years)	Chance of experiencing in an 80 year period	
		At least once (%)	At least twice (%)
20	5	100	100
10	10	99.9	99.8
5	20	98.4	91.4
2	50	80.1	47.7
1	100	55.3	19.08
0.5	200	33.0	6.11
0.2	500	14.8	1.14
0.1	1,000	7.69	0.30
0.01	10,000	0.80	0.003

Table 2-2: Probabilities of experiencing a given size flood once or more in 80 years. Source: Draft 2022 Floodplain Risk Management Manual.

In Table 2-2, over a period of 80 years, a given location has a 55% chance of experiencing a 1:100 year flood event at least once, and a 19% chance of experiencing a 1:100 year flood event at least twice.

It is important to note that one flood event does not affect or influence the chance of a subsequent flood occurring. Floods are a random natural occurrence. A 1 in 100 chance per year flood could occur several years in a row (for example, in Kempsey, NSW, major floods approaching the 1% AEP level occurred in 1949 and again a year later in 1950) or it could be more than 100 years before a flood of that size occurs again.

It is also important to note that the calculation of the probability of a flood event is an estimation, and it can be just as important to consider the uncertainty associated with the estimated number as the number itself. As Nathan, Jordan, Scolah, Lang, Kuczera, Schaefer, Weinmann (2016) note:⁶⁰

The estimation of exceedance probabilities of extreme events that lie beyond the observed record is a vexing area of hydrology as it necessarily involves making extrapolations that have a high degree of uncertainty. Nevertheless, owners of high hazard infrastructure have an ongoing responsibility to manage their assets in a risk-informed manner, and they require estimates of extreme hydrologic risks to assist them with their decision making.

Flood probabilities are used in decision-making about the management of floods, including emergency management. They also are used in flood risk assessment in the land-use planning system particularly in the estimation of the flood planning level. This is discussed in more detail in Chapter 7.

2.2. Scale of the 2022 floods

The key characteristics that made these flood events so serious were:

- the saturated catchment, due to its being pre-soaked by prior flooding in March 2021 and a wetter-than-average spring (back-to-back La Niña) in 2021

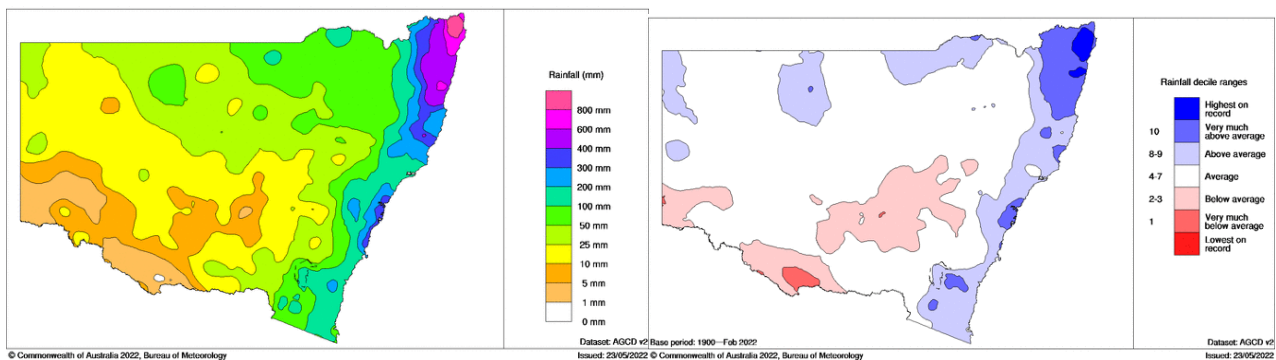
⁶⁰Nathan, R, Jordan, P, Scolah, M, Lang, S, Kuczera, G, Schaefer, M, Weinmann, E. (2016). Estimating the exceedance probability of extreme rainfalls up to the probable maximum precipitation. *Journal of Hydrology*, 543, 706 -720. doi:[10.1016/j.jhydrol.2016.10.044](https://doi.org/10.1016/j.jhydrol.2016.10.044).

- the sustained, extreme rainfall that lingered in place, dumping massive amounts of rain over the same locations
- the extremely large scale of the area that flooded across NSW, both simultaneously and in succession
- the intensity and magnitude of the floods in some areas, including the rapid rate of rise.

This section gives details of the two most prominent features of the 2022 NSW flood events: the record-breaking rainfall and the magnitude of the areas which flooded. It also includes comparisons with earlier major floods, and details on rate of rise. While there is an obvious connection between the extreme rainfall and the subsequent floods, other factors also contributed. These, together with explanations of why these factors occurred, are discussed in Section 2.3.

Record breaking rainfall

The intense rainfall that occurred across areas of south-eastern Queensland and north-east NSW during February, March and into April was some of the most significant on record. Figures 2-1 and 2-2 below show rainfall totals (top) and deciles (bottom) for February and March 2022.



Figures 2-1: NSW total rainfall (mm) and rainfall deciles in February 2022. Source: Bureau of Meteorology (2022).

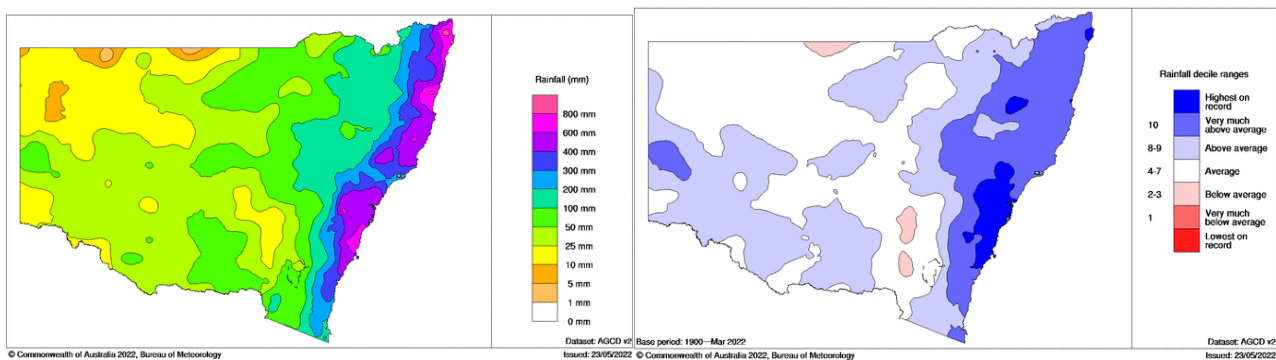


Figure 2-2: NSW total rainfall (mm) and rainfall deciles in March 2022. Source: Bureau of Meteorology (2022).

Across south-eastern Queensland and north-east NSW, rainfall in the last week of February was 2.5 to more than 5 times the monthly average (based on the 1961–1990 period). More than 50 sites in south-eastern Queensland and north-east NSW recorded more than 1 metre (1,000 mm) of rain in the week ending 1 March.⁶¹

Initially affecting greater Brisbane and particularly Gympie in mid-February, the rainfall extended and intensified into north-east NSW on 27 and 28 February. For the 7-day period ending 1 March, the Bureau's Upper North Coast rainfall district, which covers the Northern Rivers region, had its wettest week since at least 1900, with an area-averaged rainfall total of 642.8 mm, exceeding the

⁶¹ Bureau of Meteorology. (2022). Special Climate Statement 76 – Extreme rainfall and flooding in south-eastern Queensland and eastern New South Wales. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs76.pdf>.

previous record set in March 1974 of 480.3 mm.⁶² In fact, on 28 February, 701.8 mm of rain was recorded at Rosebank (Upper Coopers Creek) which is the highest daily total in the Bureau's NSW rain gauge network since 1954, in Australia since 1998, and the third-highest on record for the state.⁶³

The Tweed, Brunswick, Richmond and Wilsons River catchments had 7-day average rainfalls that were 37 to 61% above previous records. The highest 7-day total recorded in eastern NSW was 1,346 mm at Uki on the Tweed River. The weekly rainfall totals in parts of north-east New South Wales were more than 60% of the average annual total rainfall (based on the 1961-1990 period), with a broader region receiving more than 40% of the average annual total rainfall.⁶⁴

The NSW central and southern coasts, including Sydney, experienced persistent rain during the 2 weeks ending 9 March. The most intense rain fell during the week commencing 3-March, and some areas also received more than 300 mm in the week before.⁶⁵ Individual daily rainfall totals were substantial in some areas, but it was the multi-day and multi-week nature of the intense rainfall that had the greatest impacts. For example, the 7-day period commencing 2 March was comparable to the wettest 7-day period on record (since 1900) for the Hawkesbury-Nepean catchment average rainfall, set in February 2020.⁶⁶ Fourteen-day totals were even more significant, with the Hawkesbury-Nepean, Upper Nepean, Georges-Sydney Coast and Wollongong Coast catchments all setting records (since 1900) by substantial margins.

Daily rainfall totals of more than 150 mm were recorded at locations from the Hunter Valley to south of Sydney from 3 to 9 March. Several sites recorded more than 200 mm in a single day including:⁶⁷

- Carey's Peak, 214.2 mm, 4 March
- Ulladulla AWS 217.0 mm, 8 March
- Beaumont 249.0 mm, 7 March.

On 9 March, Sydney (Observatory Hill) had recorded 872.4 mm since the start of the year, making it the wettest start to the year since records began in 1859.⁶⁸

⁶² Ibid.

⁶³ Bureau of Meteorology. (2022). New South Wales in February 2022: Very wet end to the month for the Northern Rivers. Retrieved from <http://www.Bureau.gov.au/climate/current/month/nsw/archive/202202.summary.shtml>.

⁶⁴ Ibid.

⁶⁵ Bureau of Meteorology. (2022). Special Climate Statement 76 – Extreme rainfall and flooding in south-eastern Queensland and eastern New South Wales. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs76.pdf>.

⁶⁶ Ibid.

⁶⁷ Ibid.

⁶⁸ Bureau of Meteorology. (2022). New South Wales in March 2022: Very wet along most of the coast. Retrieved from <http://www.Bureau.gov.au/climate/current/month/nsw/archive/202203.summary.shtml>.

On 15 and 16 March, heavy rain fell on western parts of the state (see Photo 2-1). At Broken Hill, more than 60 mm of rain was recorded at the airport in under 4 hours on 16 March.⁶⁹



Photo 2-1: Rain over Broken Hill 15 March 2022
 (Source: The Flying Doctor Service via Barrier Police District, NSW Police).

Rainfall/flooding lag

Mostly peak river heights lag peak rainfall by up to a day. However, sometimes they appear to correlate with rainfall. The relationship between rainfall in February and March and subsequent flooding is shown in below series of Figures (2-3, 2-4 and 2-5) for:

- Bungawalbin, on the Richmond River
- Gloucester, on the Manning River
- Windsor, on the Hawkesbury River
- Denman, on the Hunter River.

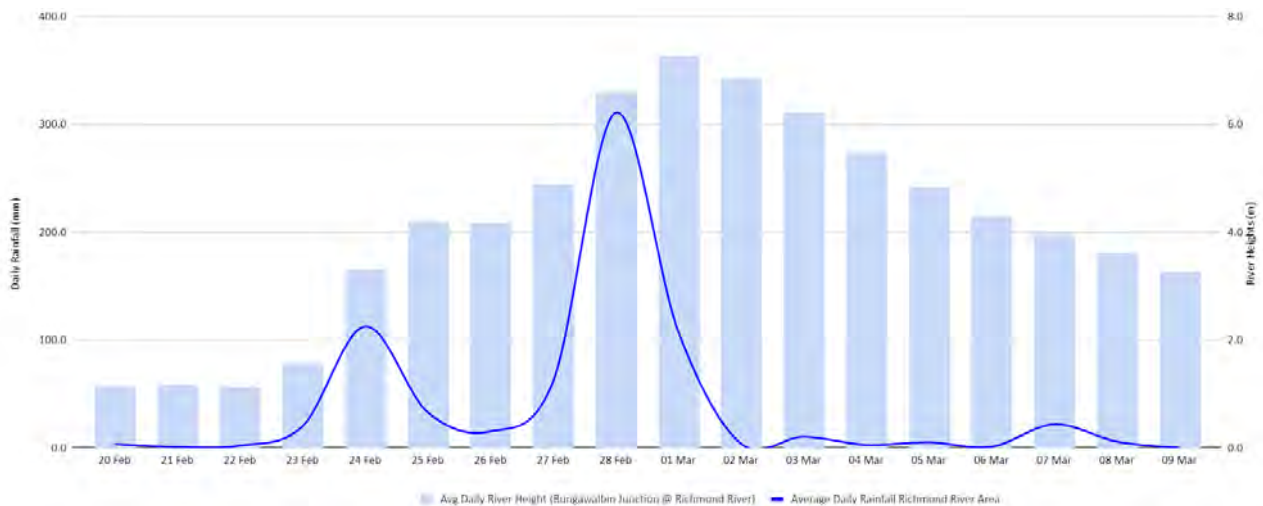


Figure 2-3: Relationship between rainfall and subsequent flooding at Bungawalbin, on the Richmond River. Source: League of Scholars (2022).

⁶⁹ Ibid.

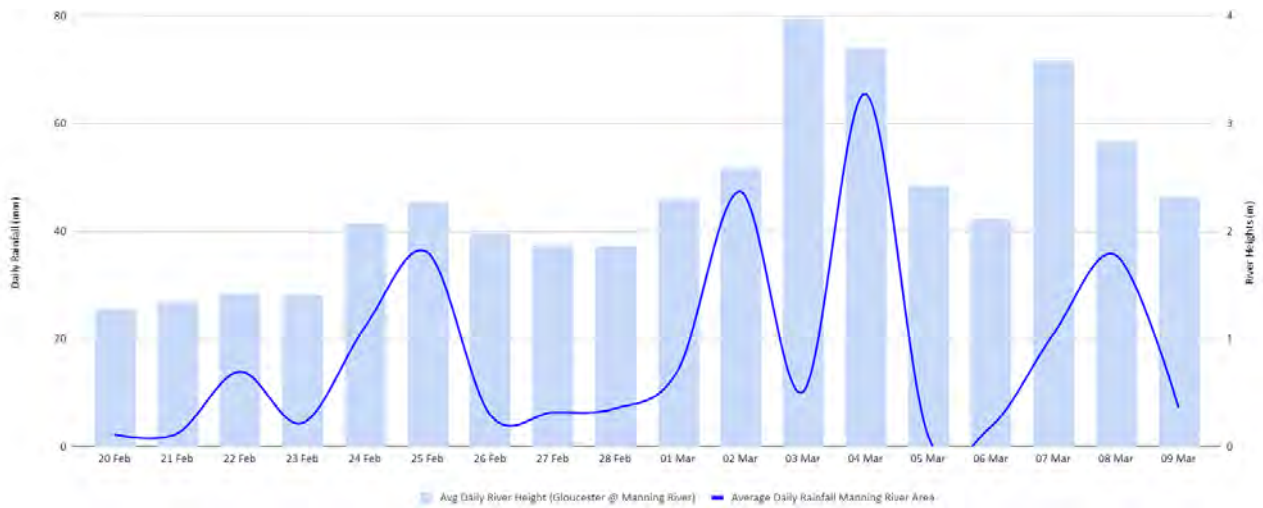


Figure 2-4: Relationship between rainfall and subsequent flooding at Gloucester, on the Manning River. Source: League of Scholars (2022).

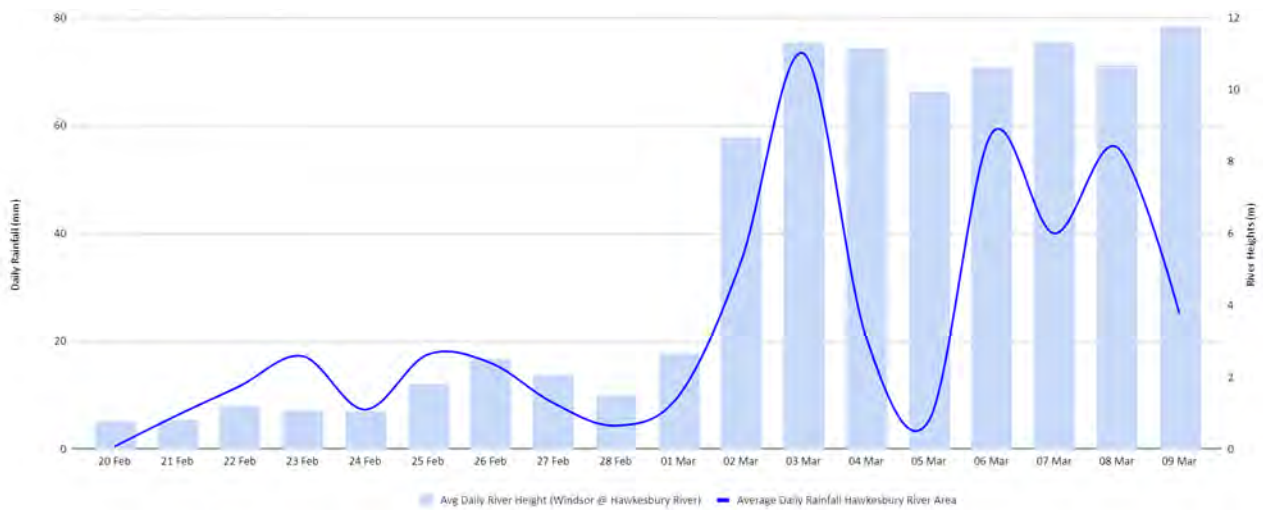


Figure 2-5: Relationship between rainfall and subsequent flooding at Windsor, on the Hawkesbury River. Source: League of Scholars (2022).

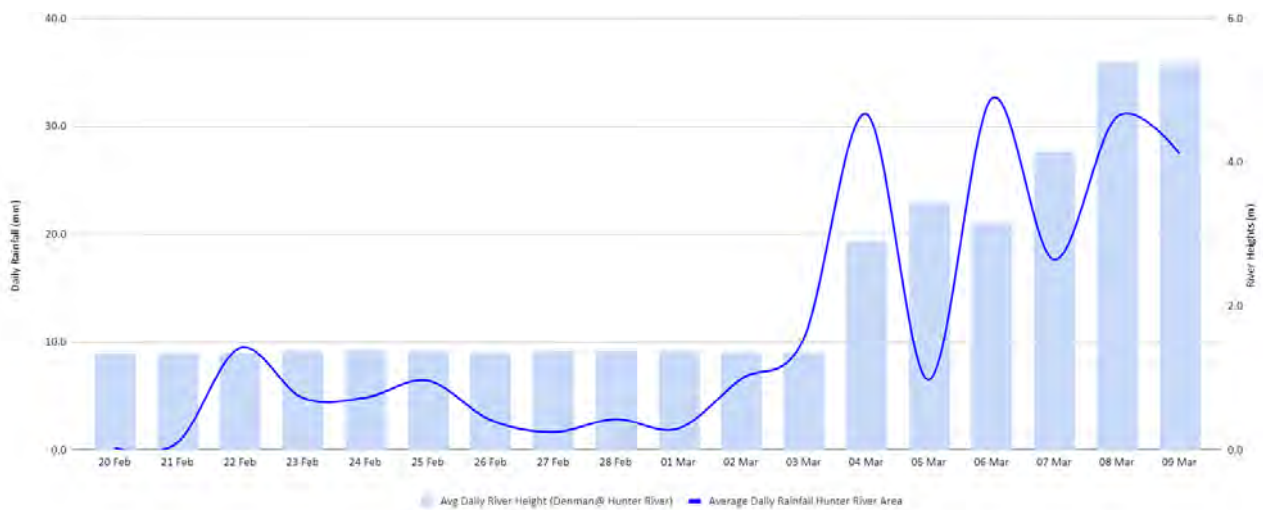


Figure 2-6: Relationship between rainfall and subsequent flooding at Denman, on the Hunter River. Source: League of Scholars (2022).

Magnitude of the flooded areas across the east coast of NSW

Following the record-breaking rainfall, record-breaking floods (based on the available history of river level records) occurred in north-east NSW and inundated major towns and regional areas between late February and early April.

Along the **Richmond** and **Wilson's Rivers** (plus Coopers and Leycester creeks) there was devastating flooding, particularly for the town of Lismore (Wilson's River) on 28 February, and Coraki and Woodburn (Richmond River) on 1 March, as shown in Figure 2-7.⁷⁰ Lismore was then affected by a second major flood on 30 March.

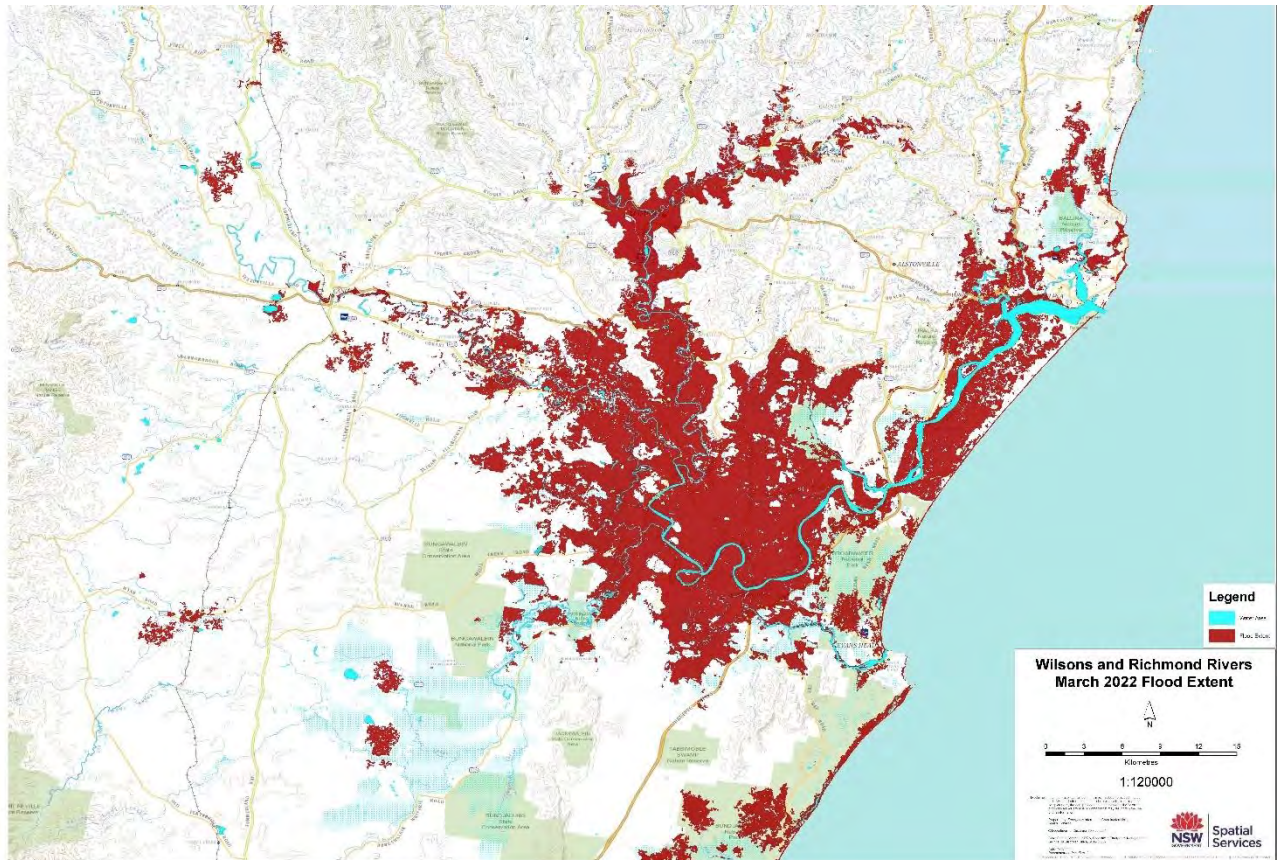


Figure 2-7: Extent of the March 2022 flooding at Wilsons and Richmond rivers. Source: NSW Department of Customer Services, Spatial Services.

⁷⁰ Bureau of Meteorology. (2022). Special Climate Statement 76 – Extreme rainfall and flooding in south-eastern Queensland and eastern New South Wales. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs76.pdfz>.

On the **Tweed River**, major flooding affected Murwillumbah and Tumbulgum on 28 February (see Figure 2-8).

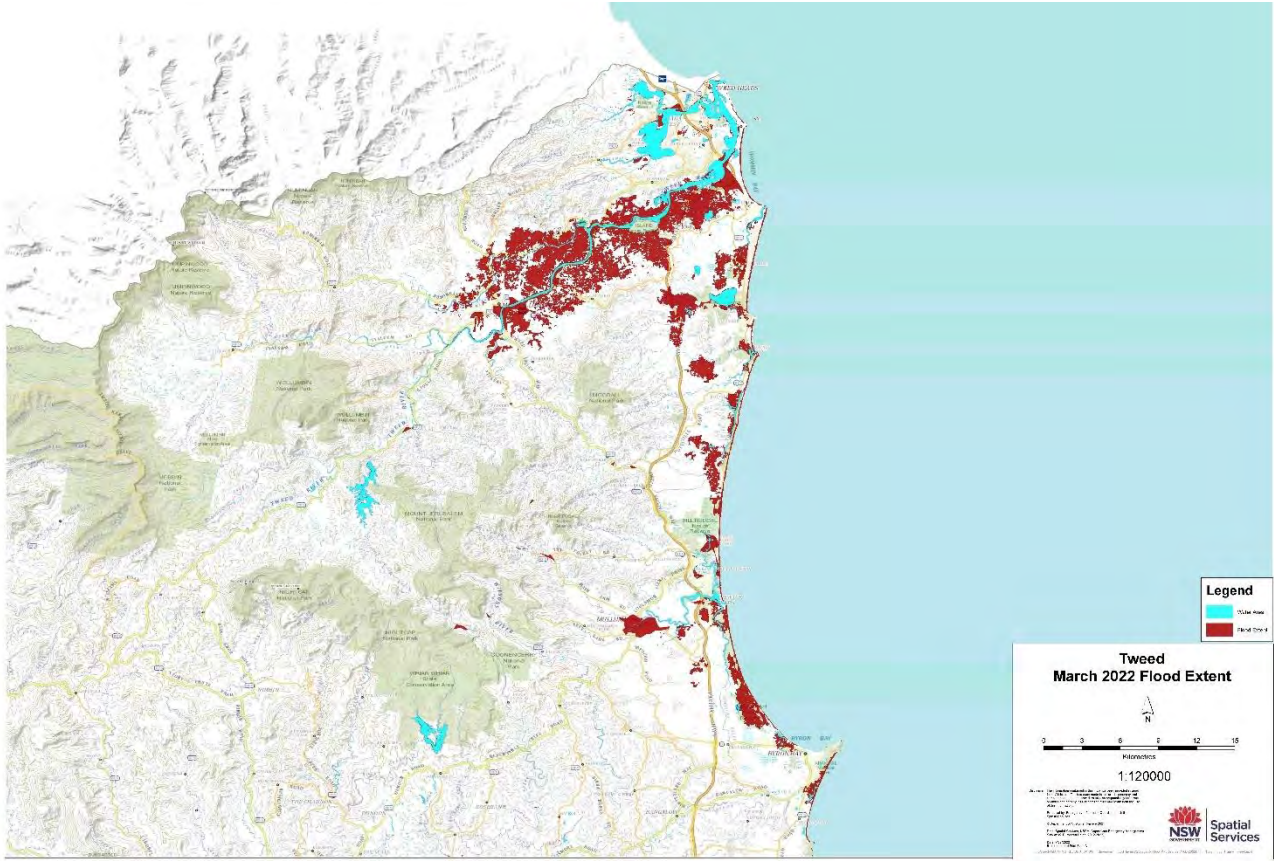


Figure 2-8: Extent of 2022 flooding at Tweed. Source: NSW Department of Customer Services, Spatial Services.

Along the **Clarence River**, on 28 February major flooding occurred in Grafton, with Ulmarra and Maclean also flooding on 1 March (Figure 2-9).⁷¹

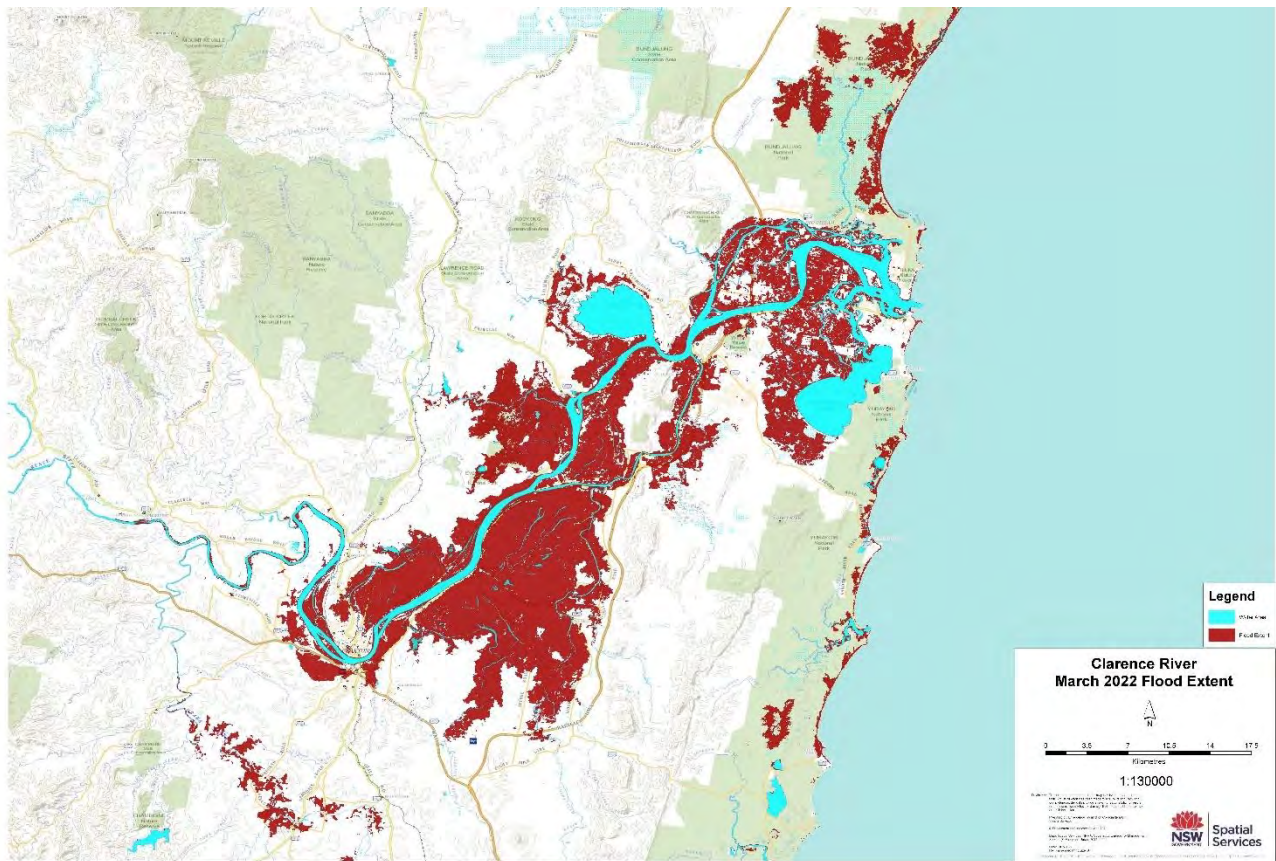


Figure 2-9: Extent of the March 2022 floods on the Clarence River. Source: NSW Department of Customer Services, Spatial Services.

⁷¹ Ibid.

The **Hawkesbury-Nepean Valley** saw moderate to major flooding recorded along the Upper Nepean, North Richmond, Wisemans Ferry, Menangle Bridge, Wallacia Weir, Windsor, Sackville and Lower Portland during early March (see Figure 2-10).⁷²

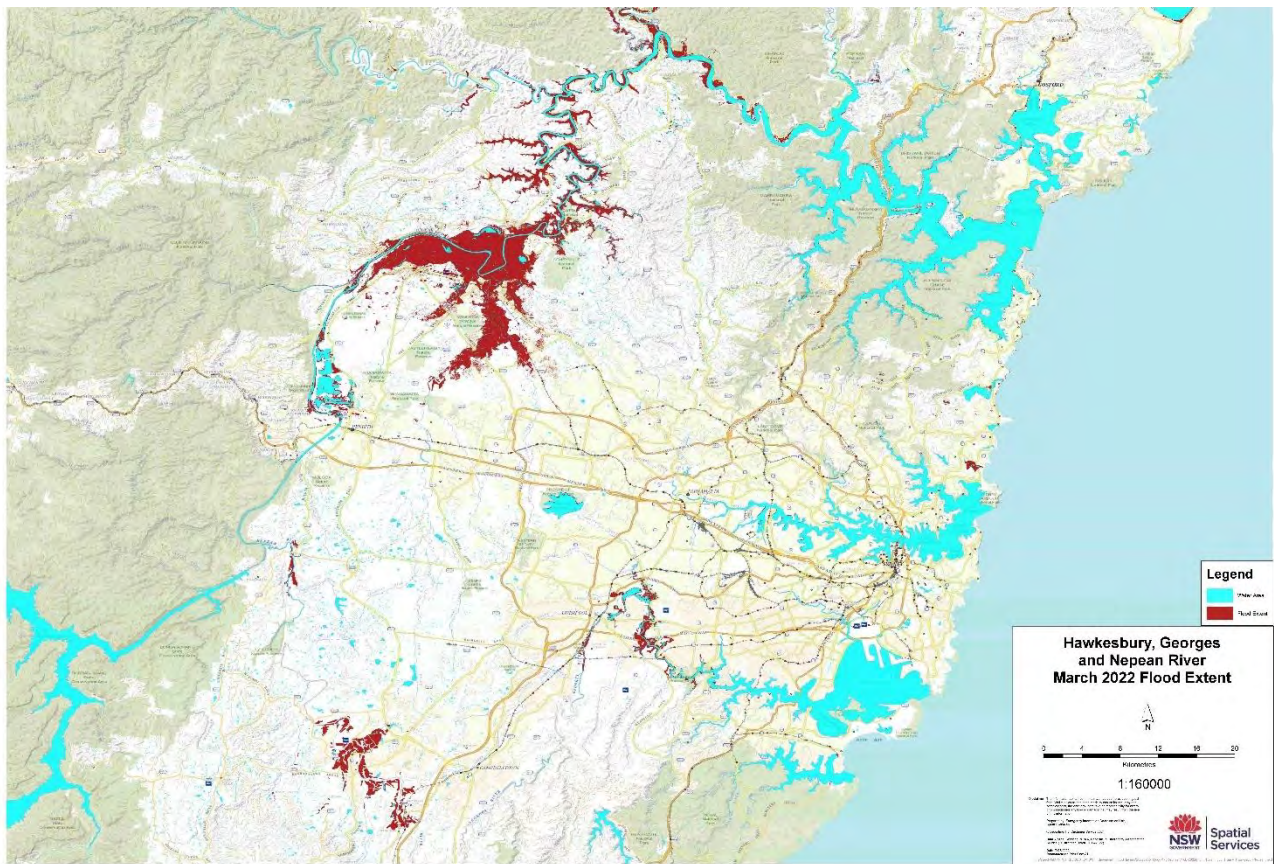


Figure 2-10: Extent of the March 2022 floods on the Hawkesbury-Nepean, Georges and Nepean Rivers. Source: NSW Department of Customer Services, Spatial Services.

⁷² Ibid.

There was also significant flooding from the central to the north coast of NSW along the **Manning**, **Macleay** and **Hunter** rivers. Moderate to major flooding occurred in the Hunter River catchment. At Bulga on Wollombi Brook, prolonged major flooding occurred from 7 to 11 March. At Singleton on the Hunter River, a major flood was recorded on 9 March, caused by the floodwaters coming from Wollombi Brook (Figure 2-11).⁷³

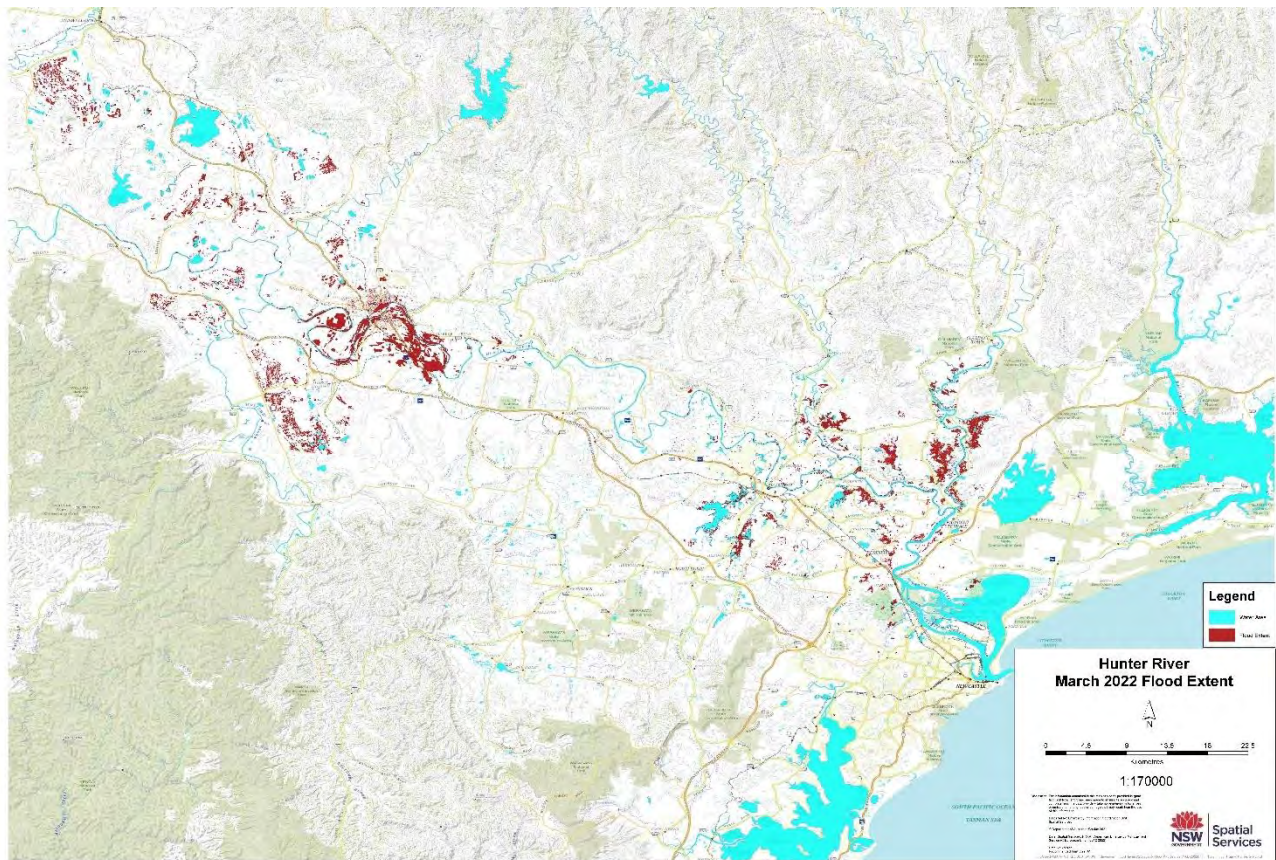


Figure 2-11. Extent of the March 2022 floods on the Hunter River. Source: NSW Department of Customer Services, Spatial Services.

Significant flash flooding also took place across NSW. In mid-March, there was flash flooding at **Broken Hill**,⁷⁴ and an event that affected **Byron Shire** on 1 April was largely driven by flash flooding.

Flood waters – rate of rise and velocity

Rates of rise will vary across a flood event, depending on the specific time period in question, and also depending on the catchment characteristics and intensity of rainfall.

In Table 2-3 below, rates of rise in metres/hour (m/hr) have been calculated for various forecast locations and include the rates for:

- minor flood threshold to moderate flood threshold
- moderate flood threshold to the flood peak
- moderate flood threshold to major flood threshold
- major flood threshold to the flood peak

⁷³ Ibid.

⁷⁴ Bureau of Meteorology. (2022). New South Wales in March 2022: Very wet along most of the coast. Retrieved from <http://www.Bureau.gov.au/climate/current/month/nsw/archive/202203.summary.shtml>.

- minor flood threshold to the flood peak (where major flooding occurred)

As can be seen, the rates of rise for these events varied significantly, but in some cases were very rapid and driven by rainfall rates intensifying – for example at Lismore in the Northern Rivers, the river level rose by an average 0.37 m/hr from exceeding the major flood threshold to reaching its peak. At North Richmond in the Hawkesbury-Nepean, the river rose by an average 0.69 m/hr between the moderate and major flood thresholds.⁷⁵

	Rate of rise (threshold m/hr)				
	<i>Minor to moderate</i>	<i>Moderate to flood peak</i>	<i>Moderate to major</i>	<i>Major to flood peak</i>	<i>Minor to flood peak</i>
Tweed River					
Chinderah	0.04	0.07	0.11	0.06	0.06
Tumbulgum	0.07	0.07	0.04	0.09	0.07
North Murwillumbah	0.19	0.12	0.18	0.11	0.14
Marshalls Creek					
Billinudgel	0.67	0.14	0.13	0.14	0.18
Brunswick River					
Mullumbimby	0.09	0.22	0.21	0.25	0.14
Wilson's River					
Lismore	0.15	0.09	0.04	0.37	0.10
Richmond River					
Wiangaree	n/a	n/a	n/a	n/a	n/a
Casino	0.32	0.12	n/a	n/a	n/a
Coraki	0.02	0.08	0.10	0.07	0.04
Woodburn	0.05	0.07	0.03	0.09	0.07
Clarence River					
Macleay	0.02	0.03	0.12	0.02	0.03
Ulmarra	0.02	0.07	0.09	0.05	0.04
Grafton	0.12	0.05	0.03	0.12	0.06
Upper Nepean River					
Camden Weir	0.39	0.22	n/a	n/a	n/a
Wallacia Weir	0.21	0.17	0.21	0.07	0.19
Penrith	0.08	0.06	n/a	n/a	n/a
Hawkesbury and Lower Nepean Rivers					
North Richmond (WPS)	0.34	0.04	0.69	0.02	0.06
Windsor (PWD)	0.69	0.04	0.04	0.06	0.05
Sackville	0.13	0.02	0.02	0.05	0.04
Lower Portland	0.07	0.02	0.02	0.05	0.03
Georges River					
Liverpool	0.27	0.01	0.01	n/a	0.02
Hunter River					

⁷⁵ Bureau of Meteorology. (2022). Advice to the Inquiry provided 19 July 2022.

Camden Weir	0.06	0.02	0.00	0.00	n/a
Wallacia Weir	0.16	0.08	0.10	0.02	0.10
Wollombi Brook					
Bulga	0.04	0.04	0.02	0.07	0.04
Wollombi	0.29	0.24	n/a	n/a	n/a

Table 2-3: Flood rates of rise between minor, moderate, major and flood peak thresholds during March 2022 event. Source: Bureau of Meteorology (2022).

The Inquiry notes it is common for rates of rise from minor to moderate to be faster than moderate to major and major to flood peak. This is because flooding at lower thresholds is typically more contained within the banks of rivers, rather than spreading across the floodplain.

Anecdotally, the Inquiry was told flood waters in various parts of the state were incredibly powerful and fast moving. For example, a wind gauge at Lismore is alleged to have been submerged by flood waters, and to have recorded flood water velocity at 26km/h.

How did the 2022 floods compare with classification peaks and previous major floods?

Most, but not all, 2022 flood events well exceeded the river height to be classified as a major flood

As stated in Section 2.1 above, the Bureau of Meteorology uses a three-tiered classification scheme that defines flooding as minor, moderate or major at key river height stations.

Table 2-4 below shows how the 2022 flood peaks compare to the river heights for each category of flooding in the **Northern Rivers** region. At almost all station locations on each river, the flood peaks far exceeded the level for classification as major flooding.

	Flood classification (water level (m))			February/March 2022 flood	
	Minor	Moderate	Major	Peak (m)	Classification
Tweed River					
Chinderah	1.30	1.70	2.00	2.98	Major
Tumbulgum	1.40	1.80	2.50	4.77	Major
North Murwillumbah	3.00	4.00	4.80	6.51	Major
Marshalls Creek					
Billinudgel	2.50	3.00	3.50	4.30	Major
Brunswick River					
Mullumbimby	2.50	3.50	4.50	4.98	Major
Wilson's River					
Lismore	4.20	7.20	9.70	14.40	Major
Richmond River					
Wiangaree	11.00	15.50	n/a	14.68	Minor
Casino	11.90	14.90	17.70	16.49	Moderate
Coraki	3.40	5.00	5.70	6.65	Major
Woodburn	3.20	3.70	4.20	7.17	Major
Clarence River					

Maclean	1.60	2.20	2.50	3.37	Major
Ulmarra	2.10	3.40	4.90	6.03	Major
Grafton	2.10	3.60	5.40	7.67	Major

Table 2-4: Flood heights and classification on North Coast Rivers during March 2022 event. Source: Bureau of Meteorology (2022).

In Lismore particularly, major flood river heights were exceeded by almost 5 m. The hydrograph below (Figure 2-12) shows the Lismore flood peak not only exceeding the major flood level, but also approaching the Probable Maximum Flood (PMF – see Section 2.1).

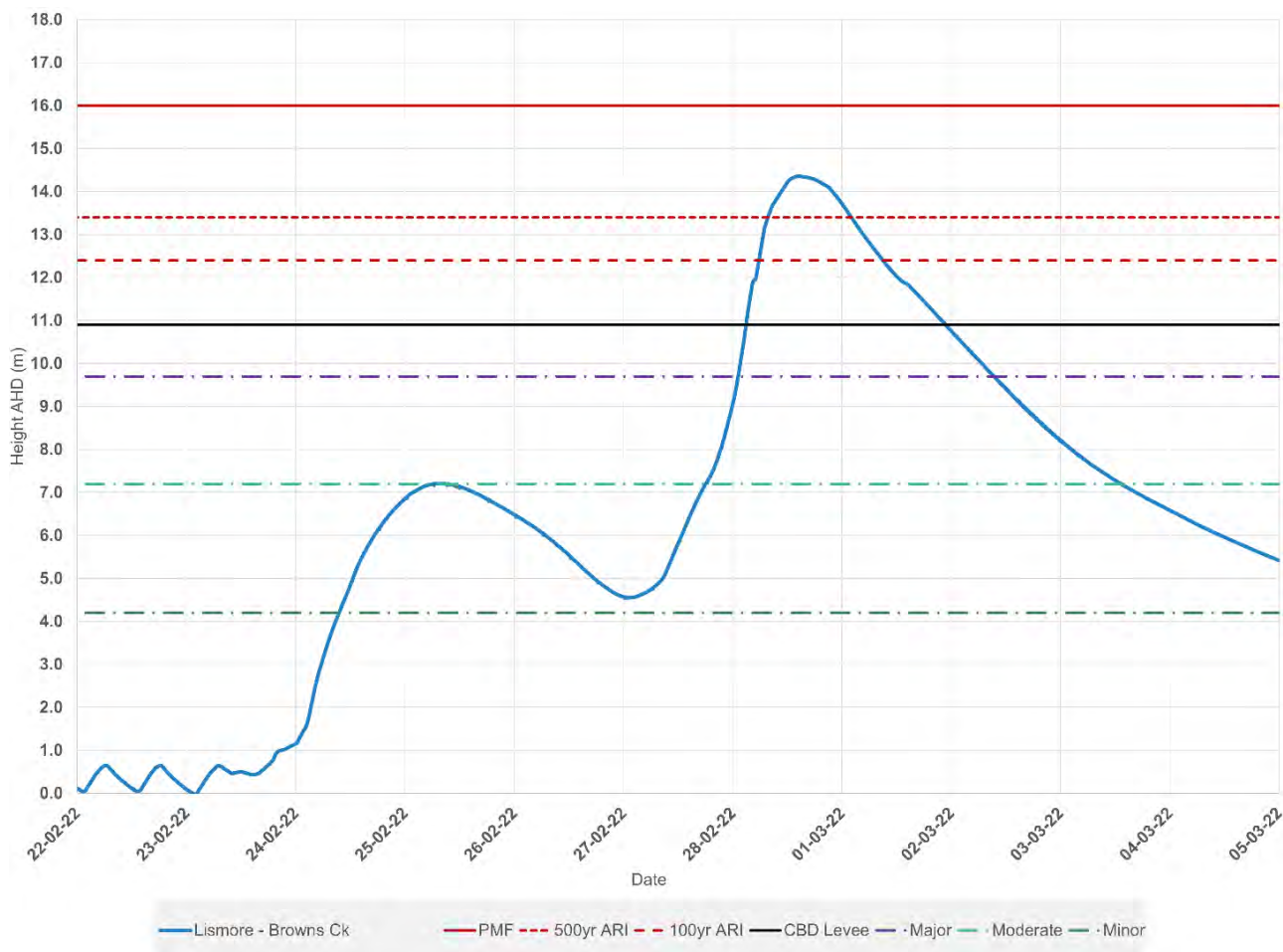


Figure 2-12: Hydrograph of flooding at Lismore. Source: Adapted from Manly Hydraulics Lab.

Table 2-5 below shows how the 2022 flood peaks in the **Hawkesbury-Nepean** and **Georges Rivers** compare to the river heights for each category of flooding. This table also shows that flooding on that river at most locations exceeded major flood levels, though by a lesser margin than was seen in the Northern Rivers.

	Flood classification (water level (m))			March 2022 flood	
	Minor	Moderate	Major	Peak (m)	Classification
Upper Nepean River					
Camden Weir	6.80	8.30	13.80	12.05	Moderate
Wallacia Weir	5.00	8.70	11.00	11.35	Major
Penrith	3.90	7.90	10.40	8.33	Moderate
Hawkesbury and Lower Nepean Rivers					

North Richmond (WPS)	3.80	7.90	10.50	14.09	Major
Windsor (PWD)	5.80	7.00	12.20	13.80	Major
Sackville	4.60	7.30	9.70	10.58	Major
Lower Portland	4.60	6.10	7.60	8.64	Major
Georges River					
Liverpool	2.00	3.00	4.50	4.46	Moderate

Table 2-5: Flood heights and classification on the Hawkesbury-Nepean and Georges Rivers during March 2022 event. Source: Bureau of Meteorology (2022).

Flood peaks across the **Hunter, Williams and Paterson Rivers** and **Wollombi Brook** also reached major in some locations, as shown in Table 2-6.

	Flood classification (water level (m))			March 2022 flood	
	Minor	Moderate	Major	Peak (m)	Classification
Hunter River					
Maitland Belmore Bridge	5.90	8.90	10.50	9.36	Moderate
Singleton	10.00	11.50	13.00	13.15	Major
Wollombi Brook					
Bulga	3.00	3.70	4.60	7.37	Major
Wollombi	6.70	8.60	12.20	11.25	Moderate
Williams River					
Dungog	4.90	7.60	8.50	7.73	Moderate
Paterson River					
Gostwyck Bridge	9.10	10.70	12.20	13.17	Major

Table 2-6: Flood heights and classification on the Hunter River and Wollombi Brook during March 2022 event. Source: Bureau of Meteorology (2022).

Most but not all the 2022 floods exceeded the flood peaks of March 2021

Eastern Australia and NSW particularly have experienced multiple severe flood events, some of which have been explored above in Chapter 1.

During and after the 2022 events, there has been robust discussion on defining the severity of the storm cluster and resultant flooding. Various media outlets published unverified ARIs between 1 in 50 years and 1 in 3,500 years,⁷⁶ particularly with respect to the flooding that affected Lismore. Many stakeholders, including media and researchers, have also attempted to identify analogous storm events – largely based on rainfall intensities, but also in terms of flood peaks – and the impact of recent events has been compared to those of February 1893, March 1955, March 1974 and January 2011.⁷⁷

As noted in Chapter 1, a significant flooding event took place in March 2021, affecting many of the same communities as in the flood events that are the subject of this Inquiry.

⁷⁶ Risk Frontiers. (2022). The Weather behind the Eastern Australian floods – the storm cluster from 23rd February to 2nd of April, 2022. Retrieved from <https://riskfrontiers.com/insights/eastern-australian-floods-february-april-2022/>.

⁷⁷ Ibid.

Table 2-7 compares flood peaks between the 2 recent events at select locations in the Hawkesbury-Nepean and Hunter and Clarence Valleys and shows that in, almost all locations, the flood peaks in the 2022 floods exceeded those of March 2021.

Location	March 2021 peak (m)	March 2022 peak (m)	Note
Hawkesbury-Nepean			
Menangle Bridge	12.85 on 23 March	15.92 on 8 March	Also peak of 16.83 m on 7 April 2022
Wallacia Weir	8.57 on 21 March	11.35 on 8 March	
North Richmond	14.38 on 21 March	14.09 on 8 March	
Windsor	12.93 on 24 March	13.80 on 9 March	March 2022 level around 0.7 m below 1978
Sackville	9.71 on 21 March	10.58 on 9 March	
Lower Portland	7.84 on 24 March	8.64 on 8 March	March 2022 around 1 m higher than 1978 and 1964
Wisemans Ferry	4.36 on 24 March	5.18 on 9 March	
Hunter River			
Singleton	12.20 on 25 March	13.15 on 9 March	
Maitland	7.56 on 26 March	9.36 on 11 March	
Wollombi Brook			
Bulga	6.63 on 23 March	7.37 on 9 March	
Wollombi	7.95 on 22 March	11.25 on 9 March	
Clarence River			
Grafton	6.56 on 24 March	7.67 on 28 February	
Ulmarra	5.13 on 24 March	6.03 on 1 March	
Macleay	2.66 on 25 March	3.37 on 1 March	

Table 2-7: Selected locations in the Hawkesbury-Nepean, Clarence and Hunter Valleys where the peak flood level in March 2022 exceeded that of the March 2021 floods. Source: Bureau of Meteorology (2022).

2.3. What caused the floods, and why were they so bad?

A number of stakeholders told the Inquiry that no two floods are the same, and that “every flood is different”. Measurements of rainfall, river heights and area flooded can quantify flood magnitude. To understand fully why *these* floods happened at the scale they did, and assist with planning for the future, it is important to take an in-depth look at the causes of and contributing factors to these floods.

In general terms, they involved large-scale weather systems combining with small-scale weather systems operating within the context of large-scale modes of climate variability – all interacting on multiple timescales.⁷⁸

⁷⁸ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 7 June 2022.

As Professor Pitman explained to the Inquiry, the worst floods are typically due to multi-day high rainfall events that occur when rain-bearing weather systems stall over a region.⁷⁹ Importantly, the worst flooding is associated with a temporally compounding event. Such an event occurs when a series of hazard events affect the same region, intensifying the impact of any individual event. In relation to flooding, it is reasonable to define a temporally compounding event as one where heavy rainfall events occur too rapidly in succession for a catchment to dry in between.⁸⁰

The extreme rainfall between 23 February and 2 April 2022 acted as a temporally compounding event, whereby each successive storm intensified the impact of the previous storms. The intensity of the resultant flooding event was amplified because the rain fell in a saturated catchment and in locations with terrain and landscape characteristics conducive to flooding.

No one yet knows everything about the extreme rainfall events that took place, or the subsequent flooding. We understand the meteorology of the event well enough; we have as much data as we can from observations. But this huge amount of data must be examined in detail before there can be a thorough understanding of exactly what happened, and how what happened varied across the state and throughout the season – and there is difficulty in projecting coincident extremes in each of the compounding variables that contribute to record-breaking floods (or any weather extreme for that matter).

To understand the role of climate change (which is potentially a contributing factor, but not the cause of the event), formal scientific process with hypotheses, experimentation, analyses and interpretation is required – research that may take one to 2 years, perhaps longer. The Inquiry notes this research is underway in CLEX, CSIRO, the Bureau and other groups, and it is anticipated that this research will modify or add detail to some of the explanations provided below. This research is critical to improving the state's ability to imagine and predict what may happen in the future.

The extremely wet spring/early summer of 2021–2022 saturated catchments

The long and sustained season of rainfall throughout spring 2021 led to most catchments being saturated by December 2021, with record soil moisture and negligible spare water storage capacity.

But the rain did not stop to allow saturation levels to drop. Rainfall in December was above average for much of eastern NSW,⁸¹ and January rainfall was 30% above average for Australia as a whole.⁸² Many sites in NSW, including some with long-standing records, had their highest total January rainfall on record or their highest total January rainfall for at least 20 years.⁸³

Consequently, the landscape had limited ability to absorb rain in February, March and April 2022, when long-range forecasts for summer 2021–2022 pointed to wetter than average conditions along the east coast of Australia.⁸⁴

⁷⁹ Professor Andy Pitman. (2022). Advice to the Inquiry provided 28 April 2022.

⁸⁰ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 7 June 2022.

⁸¹ Bureau of Meteorology. (2021). Monthly Weather Review Australia December 2021. Retrieved from <http://www.Bureau.gov.au/climate/mwr/aus/mwr-aus-202112.pdf>.

⁸² Bureau of Meteorology. (2022). Monthly Weather Review Australia January 2022. Retrieved from <http://www.Bureau.gov.au/climate/mwr/aus/mwr-aus-202201.pdf>.

⁸³ Bureau of Meteorology. (2022). New South Wales in January 2022: Warm nights, wetter than average. Retrieved from <http://www.Bureau.gov.au/climate/current/month/nsw/archive/202201.summary.shtml>.

⁸⁴ Bureau of Meteorology. (2021). Outlook issued 2 December 2021. Retrieved from <http://www.Bureau.gov.au/climate/outlooks/#/overview/summary/>.

The above average rainfall was due to the alignment of large-scale drivers of climate variability

Conditions are generally very favourable for heavy rain along the NSW coast because of its location in the sub-tropics, the East Australia Current which acts as a source of warm moist air, and the Great Dividing Range which provides an added source for uplift (the steepness of which also primes the coastline for fast responding floods).⁸⁵

This does not mean there are not droughts. For some parts of northern inland NSW, 2019 was the driest year on record by a substantial margin. Yet 2 years later, 2021 was one of the wettest years on record.⁸⁶

In 2021, Australia's nationally averaged annual rainfall was 9% above the 1961–1990 average,⁸⁷ and November 2021 was Australia's wettest November since national records began in 1900.⁸⁸ Rainfall through spring 2021 was above average across almost all of NSW and very much above average in large regions of NSW.⁸⁹ Across spring/summer 2021–2022, rainfall in NSW was the highest on record for the 6-month period from 1 November 2021 across large areas of coastal NSW, and very much above average for most of NSW.⁹⁰

As the Bureau and CLEX informed the Inquiry, several large-scale climate variables increased the chances of above average rainfall and the risk of bad flooding. Two phenomena – or modes of climate variability – in particular have been highlighted as key contributors that increased the risk of very wet conditions over 2021 and the broad pattern of high rainfall in the 6 months prior to March 2022: the La Niña phase of the El Niño-Southern Oscillation (ENSO)⁹¹ coupled with the negative Indian Ocean Dipole (IOD).⁹² More detail of these drivers is provided in the CLEX report at Volume Three.

Following a weak-to-moderate La Niña event over the summer of 2020–21, the Pacific Ocean returned to neutral ENSO conditions by March.⁹³ However, cooling of surface waters resumed from

⁸⁵ Meeting with the Bureau of Meteorology on 14 April 2022.

⁸⁶ Bureau of Meteorology. (2022). Special Climate Statement 75 – Australia's wettest November on record. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs75.pdf?20220214>.

⁸⁷ Bureau of Meteorology. (2022). Special Climate Statement 76 – Extreme rainfall and flooding in south-eastern Queensland and eastern New South Wales. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs76.pdf>.

⁸⁸ Bureau of Meteorology. (2022). Special Climate Statement 75 – Australia's wettest November on record. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs75.pdf?20220214>.

⁸⁹ Bureau of Meteorology. (2022). Climate maps. Retrieved from <http://www.Bureau.gov.au/climate/maps/>.

⁹⁰ Ibid.

⁹¹ ENSO is monitored in the atmosphere via the Southern Oscillation Index (SOI), a measure of atmospheric circulation that takes the difference of atmospheric pressure between Darwin and Tahiti. In the ocean, ENSO is most commonly monitored through observed sea surface temperatures within a region of the central and eastern tropical Pacific." La Niña, a phase of ENSO, is associated with cooler surface waters in the Pacific Ocean causing increased rainfall and cloudiness in the western Pacific and usually means above-average winter/spring rainfall for the east and north of Australia. Bureau of Meteorology (2022). Retrieved from <http://www.Bureau.gov.au/climate/updates/articles/a020.shtml>.

⁹² The IOD is an index that measures the difference in sea surface temperatures on either side of the tropical Indian Ocean. The more negative the IOD value, the more likelihood that moisture-laden air will flow towards south-eastern Australia and promote rainfall. Bureau of Meteorology (2022). Retrieved from <http://www.bom.gov.au/climate/enso/history/ln-2010-12/IOD-what.shtml>.

⁹³ Bureau of Meteorology. (2022). Special Climate Statement 75 – Australia's wettest November on record. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs75.pdf?20220214>.

mid-year, and La Niña WATCH was issued in September.⁹⁴ The WATCH moved to ALERT in October, before being declared by the Bureau on 23 November 2021.⁹⁵

The Bureau reported that by June 2021, the chances of a negative IOD event had risen considerably, before being declared in July 2021 – for the first time in five years (the prior being declared in 2016, between June and September)⁹⁶. The IOD was in a weak negative mode for most of the period to October, before weakening in November, as is typical at that time of year.⁹⁷ However, waters in the region between Indonesia and northern Western Australia, near the eastern node of the IOD, were still significantly warmer than usual in November.

A third climate driver is the Southern Annular Mode (SAM).⁹⁸ This was positive for most of October and November,⁹⁹ resulting in easterly wind anomalies over southern Australia which transported moisture from oceans into the coast and ensured there was a sustained flow of moisture. This persistent and strong positive phase of the SAM continued into summer 2021–2022,¹⁰⁰ resulting in record extent, duration and frequency of easterly winds. There were almost no westerlies across eastern Australia for many months.¹⁰¹ On top of this, warm oceans surrounding northern Australia and several active phases of another climate driver, the Madden Julian Oscillation,¹⁰² also contributed to the development and maintenance of wetter conditions over 2021 and into summer 2021–2022.¹⁰³

It is not uncommon for a negative IOD and La Niña to be ‘in phase’ – that is, coincidentally occurring and favouring rainfall over eastern Australia. It is less common for each of the drivers to be both in phase and extreme, but such conditions have occurred in the past.¹⁰⁴ In 1974, an extreme La Niña phase led to periods of significant and widespread rainfall and flooding. Similarly, one of the strongest La Niña events on record was observed in the lead up to the Brisbane floods of 2011, following a moderate strength negative Indian Ocean Dipole (IOD) in 2010. The La Niña and negative IOD of 2010 marked the end of the millennium drought. Flooding in 2017 was preceded by a strong negative IOD in 2016. However, at the time of the Lismore floods the El Niño-Southern Oscillation status was at El Niño watch.¹⁰⁵

⁹⁴ Ibid.

⁹⁵ Meeting with the Bureau of Meteorology on 14 April 2022.

⁹⁶ Ibid.

⁹⁷ Bureau of Meteorology. (2022). Special Climate Statement 75 – Australia's wettest November on record. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs75.pdf?20220214>.

⁹⁸ The SAM refers to “the (non-seasonal) north-south movement of the strong westerly winds that blow almost continuously in the mid- to high-latitudes of the southern hemisphere. This belt of westerly winds is also associated with storms and cold fronts that move from west to east, bringing rainfall to southern Australia”. Bureau of Meteorology (2022). Retrieved from <http://www.Bureau.gov.au/climate/sam/>.

⁹⁹ Bureau of Meteorology. (2022). Special Climate Statement 75 – Australia's wettest November on record. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs75.pdf?20220214>.

¹⁰⁰ Meeting with the Bureau of Meteorology on 14 April 2022.

¹⁰¹ Ibid.

¹⁰² The Madden Julian Oscillation is “the major fluctuation in tropical weather on weekly to monthly timescales. The MJO can be characterised as an eastward moving ‘pulse’ of cloud and rainfall near the equator that typically recurs every 30 to 60 days.” Bureau of Meteorology (2022). Retrieved from <http://www.Bureau.gov.au/climate/mjo/#tabs=Phase>.

¹⁰³ Bureau of Meteorology. (2022). Special Climate Statement 76 – Extreme rainfall and flooding in south-eastern Queensland and eastern New South Wales. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs76.pdf>.

¹⁰⁴ Bureau of Meteorology. (2022). Advice to the Inquiry provided 21 July 2022.

¹⁰⁵ Ibid.

Catchments were saturated, as shown by all hydrological indicators

Any rain that falls on the ground can enter a catchment, be it the soil or other ground surface, water storage (for example dams) or streams. Due to the amount of rainfall in the previous 2 years, the storages were almost full and soils were already wet, so most of the rain in the later part of the period contributed directly to streamflow, runoff and flood generation.¹⁰⁶

Soil moisture

At the start of the Black Summer in December 2019, soils were extremely dry. But in February 2020, there was a rapid and widespread increase in soil moisture following significant rainfall across eastern NSW. By the start of November 2021, root-zone soil moisture (soil moisture in the top 100 cm) was already above average (highest 30% in 1911–2021) over large areas of inland NSW and southern Queensland (Figure 2-13).¹⁰⁷

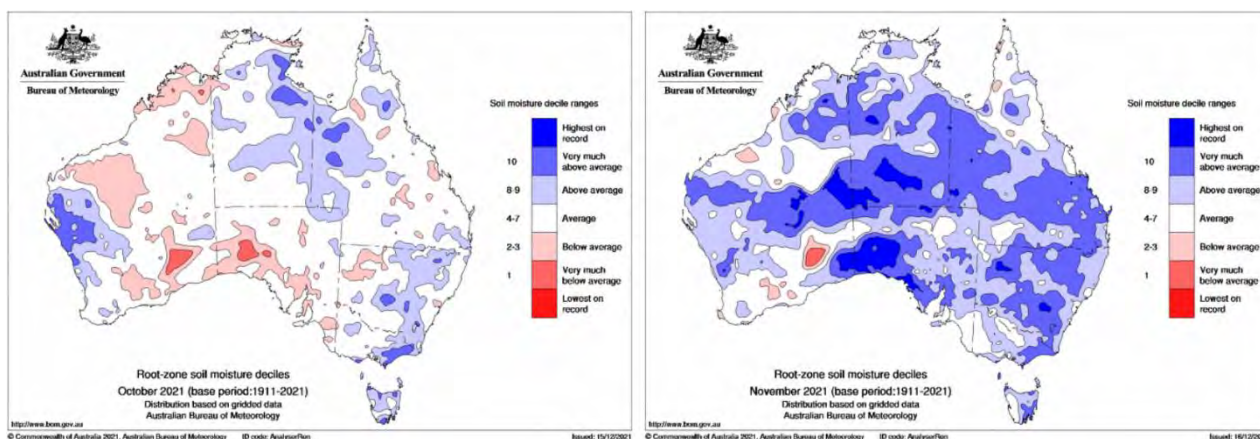


Figure 2-13: AWRA-L root zone soil moisture (top 100 cm of the soil profile) deciles for October and November 2021. Deciles relative to 1911–2021. Source: Bureau of Meteorology.

Following the sustained rainfall throughout late winter and particularly spring 2021, soil moisture was very much above average by December 2021 (highest 10% in 1911–2021) across eastern areas of NSW and Queensland including the Hunter, Namoi and Border Rivers catchments, with some record high soil moisture in the upper Lachlan catchment and north of Canberra.¹⁰⁸ The very high soil moisture, in conjunction with the heavy rainfall, resulted in large inflows into water storages and high baseline runoff in affected catchments.

Water storage

Again, due to the multiple rain events across NSW in 2021 and 2022, catchments across the state were wet and water storage capacity was limited.¹⁰⁹ Figure 2-14 shows 4 out of 6 eligible storage systems in NSW were 81-100% full in September 2021, increasing to 5 in January 2022.

¹⁰⁶ Meeting with the Bureau of Meteorology on 14 April 2022.

¹⁰⁷ Bureau of Meteorology. (2022). Special Climate Statement 75 – Australia's wettest November on record. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs75.pdf?20220214>.

¹⁰⁸ Bureau of Meteorology. (2022). AWRA-L root zone soil moisture (top 100 cm of the soil profile) deciles. Deciles relative to 1911–2021. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs75.pdf?20220214>.

¹⁰⁹ Department of Planning and Environment, Water Group and Environment and Heritage Group (Biodiversity, Conservation and Science). (2022). Advice to the Inquiry provided 30 May 2022.

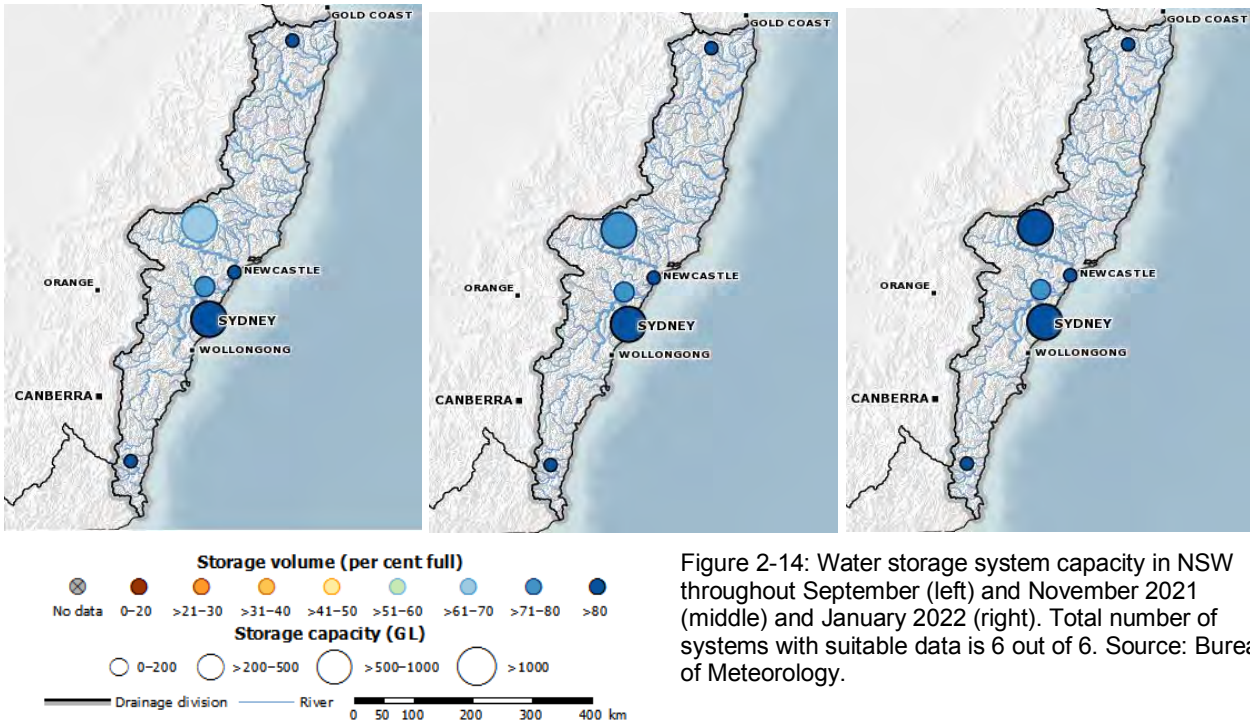


Figure 2-14: Water storage system capacity in NSW throughout September (left) and November 2021 (middle) and January 2022 (right). Total number of systems with suitable data is 6 out of 6. Source: Bureau of Meteorology.

Figure 2-15 below shows a graph of storage levels within Water NSW’s supply system from 2016 to 2022.

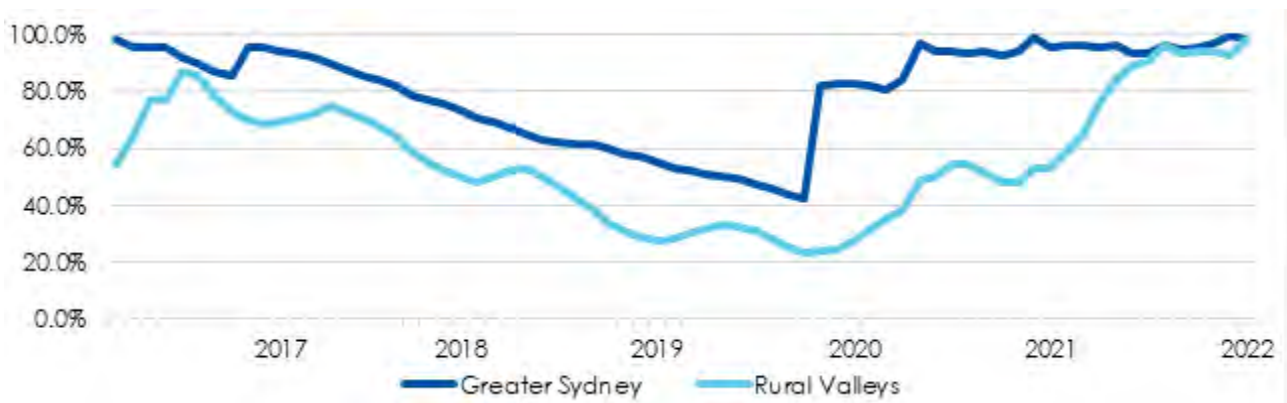


Figure 2-15: Water NSW water storage levels - July 2016 to April 2022. Source: Water NSW (2022).

Water NSW reported to the Inquiry that most storages for Greater Sydney had been full or approaching full supply level since the end of 2020. As a result, there was minimal airspace available in the dams to capture inflows during this period. In the Hawkesbury River region, Warragamba Dam, which sits at the headwaters of the Hawkesbury River system and is the largest water storage in the region at over 2 million megalitres, was already at 98% capacity on 22-February.¹¹⁰

¹¹⁰ Bureau of Meteorology. (2022). Special Climate Statement 76 – Extreme rainfall and flooding in south-eastern Queensland and eastern New South Wales. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs76.pdf>.

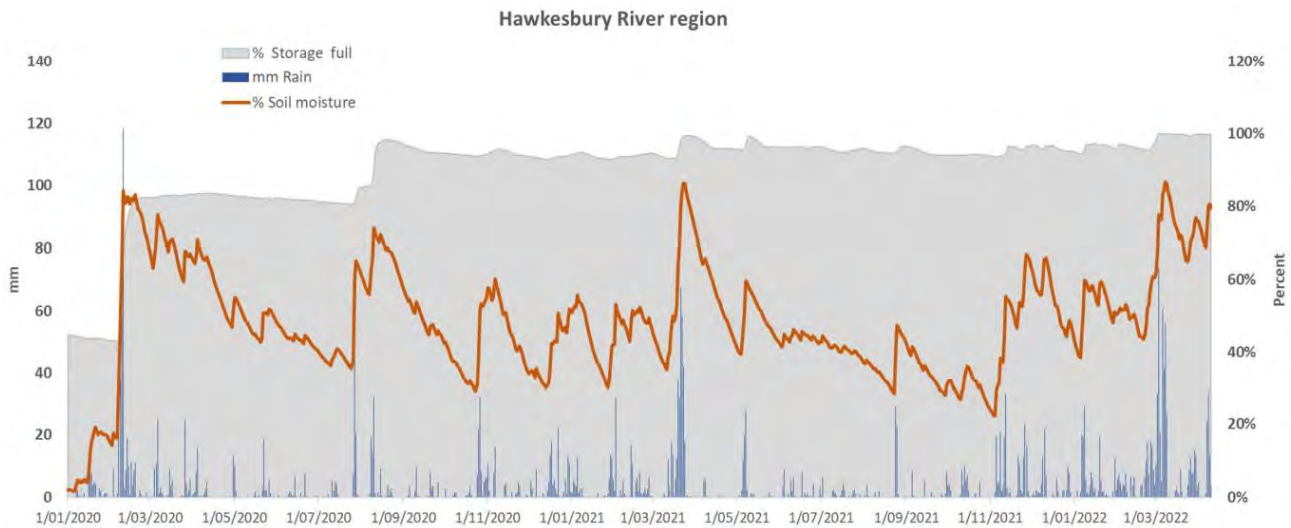


Figure 2-16: Water storage capacity in the Hawkesbury-Nepean. Source: Bureau of Meteorology.

Streamflow conditions

Streamflow is the flow or movement of water in streams, rivers and other channels. In response to the very wet conditions, above average streamflow conditions were observed across the south-east coast in the months preceding November 2021. In September 2021, above average streamflow was observed in 16% of sites across the east coast of NSW (Figure 2-17, left) and by October 2021, 65% of sites were observed to be above average or very much above average (Figure 2-17, middle). In November, highest on record streamflow was observed in 32% of sites across NSW coastal rivers including the Clarence, Richmond, Hunter and Shoalhaven (Figure 2-17, right).¹¹¹

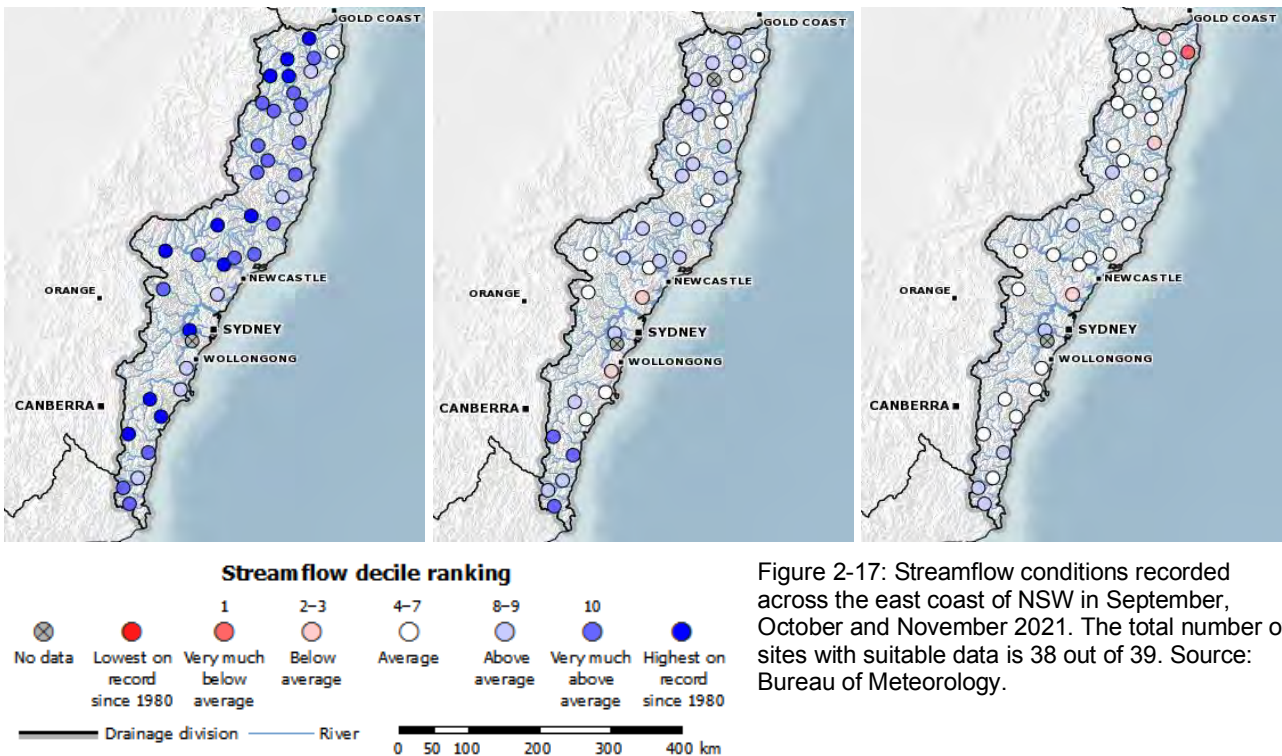


Figure 2-17: Streamflow conditions recorded across the east coast of NSW in September, October and November 2021. The total number of sites with suitable data is 38 out of 39. Source: Bureau of Meteorology.

¹¹¹ Bureau (Bureau of Meteorology). (2022). Special Climate Statement 75 – Australia's wettest November on record. Retrieved from <http://www.Bureau.gov.au/climate/current/statements/scs75.pdf?20220214>.

Further heavy rainfall events in late summer/early autumn 2022 fell on saturated catchments

Clearly, by mid-summer 2021–22, the catchments were saturated. But, as summarised by Professor Pitman in the CLEX report at Volume Three, “conditions were conducive for serious flooding *if, and only if* an extreme rainfall event occurred”.¹¹²

The chances of a heavy or extreme rainfall event falling on a saturated catchment is very often influenced by the large-scale weather patterns associated with La Niña and a negative phase of the IOD. Notably, the presence of back-to-back La Niña events increases the chances of bad flooding, compared with the occurrence of a La Niña in a single year only. This is because there is a higher chance that soils are already very wet or saturated leading into the second, successive La Niña event. Although these conditions do not mean that flooding should be expected, it does weight the dice to above average rainfall, and raise the probability of flooding if extreme rainfall occurs.¹¹³

In this case, further flooding rains did come, in late summer and early autumn of 2022.

Various weather systems and mechanisms interacted to create repeated, sustained and/or stalled heavy rainfall events

Outside the tropics, weather is mainly driven by Rossby waves which are undulations in the jet stream. The jet stream is a band of strong winds in the upper atmosphere that extend around the earth. When these winds are displaced to the north or south by mountains or weather systems, they can force part of the jet stream out of its normal position and create a Rossby wave.¹¹⁴ Rossby waves usually then move east, steered by the jet stream. Just like waves on the ocean shore, Rossby waves can amplify and break.¹¹⁵

When a Rossby wave breaks, a region of high-pressure air can form at ground level and may stay in one place for some time. This high-pressure region can in turn cause other weather systems (such as low-pressure systems bearing rain) to stall over one location. As the name suggests, stalled weather systems stay put for a long time and can lead to prolonged downpours, but also to lengthy heat waves or bouts of cold weather.¹¹⁶

In February 2022, an amplifying Rossby wave formed a blocking high-pressure system over New Zealand and aided the development of a series of slow-moving low-pressure systems within a trough that fed an atmospheric river – a large volume of warm, moist air – from the Coral and Tasman seas into eastern Australia.¹¹⁷ The trough stalled and failed to move east due to the blocking high pressure system. An east coast low formed to bring heavier rainfall to the central NSW coast in early March, followed by a second east coast low in late March.

These concurrent and successive systems delivered intense rain to east and south-east NSW. Following 2 years of La Niña conditions, the rain fell on catchments that were already wet, with full water storages and high river levels. Each of these key weather events is described below.

¹¹² CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 7 June 2022.

¹¹³ Ibid.

¹¹⁴ Parker, T, & Barnes, M. (2022). Planetary waves, cut-off lows and blocking highs: what's behind record floods across the Southern Hemisphere? Retrieved from <https://theconversation.com/planetary-waves-cut-off-lows-and-blocking-highs-whats-behind-record-floods-across-the-southern-hemisphere-183632>.

¹¹⁵ Ibid.

¹¹⁶ Ibid.

¹¹⁷ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 7 June 2022.

A hybrid tropical dip and subtropical low 23 to 28 February 2022 resulted in extreme rainfall over south-east Queensland and the Northern Rivers region of NSW

Tropical dips are a summer climate feature. The storm that occurred between 23 and 28 February was a hybrid because a tropical dip at the surface was superimposed and offset to the west by a mid to upper-level cut-off subtropical low that is a typical climate feature of mid-late autumn to spring.¹¹⁸ Cut-off lows are associated with sustained, and often heavy, rainfall.¹¹⁹ They are low pressure systems which have broken away, or are 'cut-off', from steering westerlies and the main belt of low pressure which lies to the south of Australia.¹²⁰

A cut-off low may develop when a low-pressure system forms on an active cold front. Alternatively, one can form in an unstable easterly flow north of a slow moving or blocking high. This dual system is sometimes referred to as a blocking pair.¹²¹ Individually, cut-off lows usually last for only a few days. But, when formed as part of a blocking pair, they can continue for up to a week.

The combination of the tropical dip and cut-off subtropical low drew in warm, moist surface air flow through strong north-east to easterly winds which mixed with the mid-level pool of cold air, resulting in extreme precipitation and thunderstorm activity. The synoptic situation was maintained by trade winds at the surface and the tropical low over New Caledonia, whilst a Rossby wave – which spread eastwards from tropical cyclone activity in the central and western Indian Ocean – strengthened the cold air pool above. What was highly irregular in this instance was that the wave spread eastwards in the subtropics, merging with the cold air pool over south-east Queensland rather than tracking south-east over the Indian Ocean to interact with weather systems over the Southern Ocean. This was due to the blocking high south of Australia. If this had not occurred, then the tropical dip and subtropical low would not have formed as a blocking pair and would have dissipated much faster.¹²² Importantly, this type of blocking is not unusual. It is a typical feature of climate in this region, and is driven by the land, sea topographical pattern. What was uncommon was how stationary this system was over a very specific small region.¹²³ Typically, the weather system would have moved away to the south or southeast, meaning that multi-day totals in any given location would have been much lower.¹²⁴ Further, a major feature of the trough was that it basically steered the atmospheric flow over very warm water and then persistently into south-east Queensland and north-east NSW.¹²⁵

The hybrid tropical dip and subtropical low delivered the highest February total rainfall on record at many sites across south-east Queensland and the Northern Rivers region of NSW. This rainfall event led to the record 14.4 m flooding at Lismore, exceeding the previous Lismore record flood peak of 12.11 m from March 1974.¹²⁶

¹¹⁸ Risk Frontiers. (2022). The Weather behind the Eastern Australian floods – the storm cluster from 23rd February to 2nd of April, 2022. Retrieved from <https://riskfrontiers.com/insights/eastern-australian-floods-february-april-2022/>.

¹¹⁹ Bureau of Meteorology. (2022). Cut off low. Retrieved from <http://www.Bureau.gov.au/climate/about/?bookmark=cutofflow&msclkid=d9465e07cf7c11eca5dfd0cf8b1d9550>.

¹²⁰ Ibid.

¹²¹ Ibid.

¹²² Risk Frontiers. (2022). The Weather behind the Eastern Australian floods – the storm cluster from 23rd February to 2nd of April, 2022. Retrieved from <https://riskfrontiers.com/insights/eastern-australian-floods-february-april-2022/>

¹²³ Bureau of Meteorology. (2022). Advice to the Inquiry provided 20 July 2022.

¹²⁴ Ibid.

¹²⁵ Ibid.

¹²⁶ Lismore City Council. (2022). History of Lismore flood events 1870 -2022. Retrieved from <https://lismore.nsw.gov.au/files/2022-033-2022-.pdf>.

The extreme rainfall in the Northern Rivers was a rare occurrence

Above in Section 2.1, it was noted that rainfall statistics include intensity (the rate at which rain falls) and duration (the period over which rain falls). Countless stakeholders told the Inquiry that the rain in Lismore and surrounds was unusual and extreme in both intensity and duration. To understand just how unusual this rainfall was, or if it was typical rainfall amplified by other factors, the Inquiry sought advice on daily and sub-daily rainfall averages from the Bureau.

The Bureau explained that rainfall intensity, frequency and duration (IFD) data is provided as part of the Bureau's design rainfall service, and is the basis for estimating annual recurrence intervals, or return periods commonly communicated – for example an AEP. Events are then classified as very frequent, frequent, infrequent or rare with an associated AEP. An infrequent event is one with an AEP between 1% and 10%, and a rare event is one with an AEP less than 1%.

The ability to determine the IFD of a rainfall event, and its subsequent AEP, is heavily influenced by the data available, in particular, whether the stations report sub-daily observations. The Bureau updated its design rainfalls in 2016 using historical data from the Bureau's observing network as well as a significant amount of third-party data. The 2016 update was aimed at providing better estimates of the 2% and 1% AEP design rainfalls. A caveat to using these data is that the observational data at some locations cover limited time periods, and hence the sampling of rare, heavy rainfall events may be limited. Additionally, the IFD estimates do not include climate projections of changes to heavy rainfall. Being based solely on historical data, it is likely that estimates of the probability of very heavy rainfall in the existing ARR are not reflective of current and future climate.¹²⁷

During the recent floods, weather stations in the upper catchment of the Wilson River and at Lismore recorded sub-daily rainfall information, allowing a comparison to be made between the recent rainfall event and historical rainfall IFD.

For the 7 days ending 28 February, rainfall in the Northern Rivers upper catchments sat at an AEP around 1% (in the infrequent category) from 1 hour to 3-6 hours. But, beyond 6 hours, and from 18 hours to 2-3 days there was not a lot of drop off in intensity. For example, at Doon Doon (Figure 2-18) the rainfall total over 24 hours is almost double that over 12 hours. This sustained, intense rainfall saw the storm envelope AEP fall far below 1% (rare category). The storm envelope AEP at Uki (Figure 2-19, bottom) similarly sat well outside design rainfall, and less than 1%.

¹²⁷ Bureau of Meteorology. (2022). Advice to the Inquiry provided 20 July 2022.

DOON DOON (MCCABES ROAD) storm envelope compared to design IFD
 Station number: 058019 Location: 28.5314°S 153.3151°E Data source: accumulations
 Design grid point: 28.5375°S 153.3125°E

Bureau of Meteorology

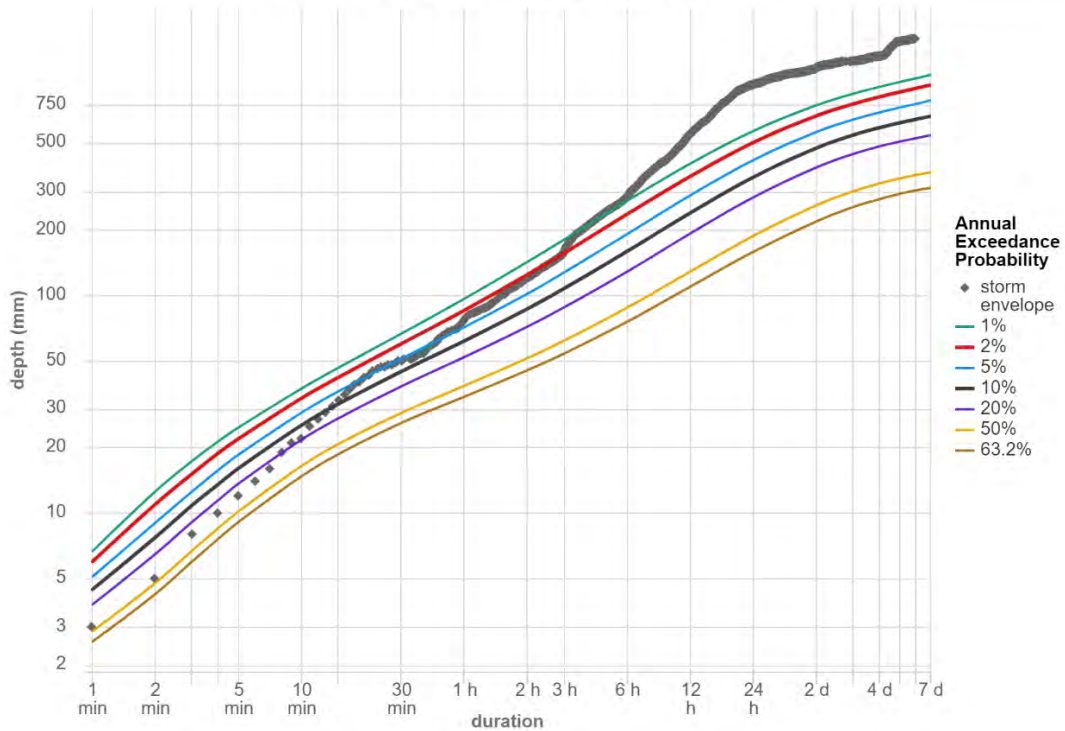


Figure 2-18: Intensity-Frequency-Distribution (IFD) analysis of rainfall in Lismore's upper-catchment at Doon Doon for the week ending 28 February 2022. Source: Bureau of Meteorology (2022).

UKI (TWEED RIVER) storm envelope compared to design IFD
 Station number: 058167 Location: 28.4147°S 153.3339°E Data source: accumulations
 Design grid point: 28.4125°S 153.3375°E

Bureau of Meteorology

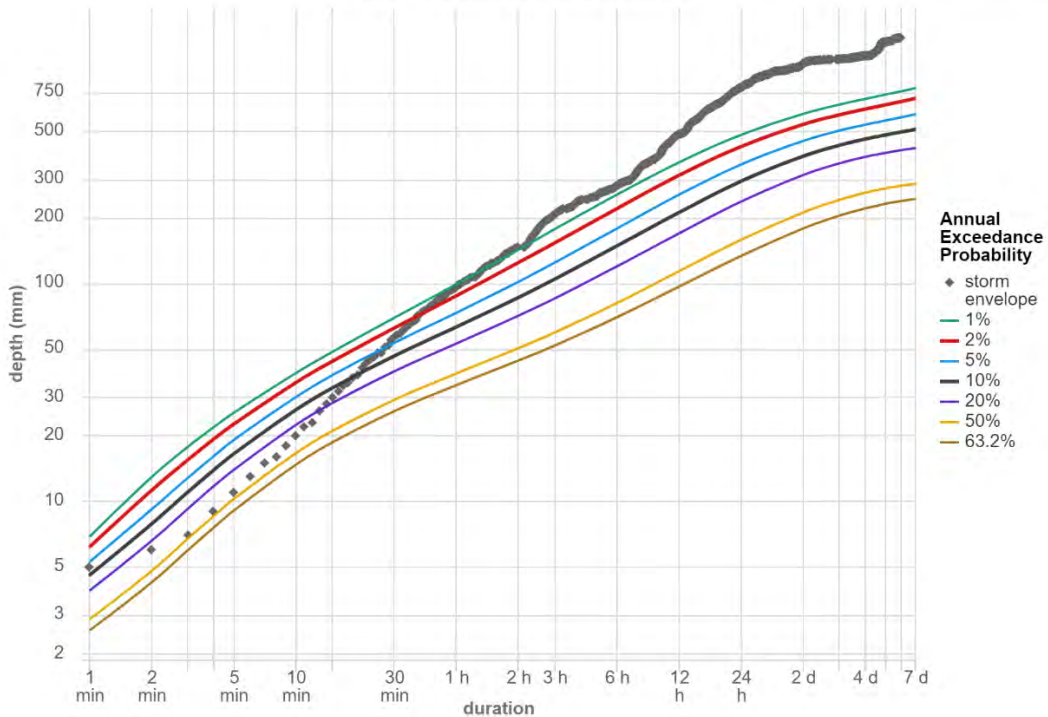


Figure 2-19: Intensity-Frequency-Distribution (IFD) analysis of rainfall in Lismore's upper-catchment at Uki for the week ending 28 February 2022. Source: Bureau of Meteorology (2022).

Similarly, in Lismore itself, the rainfall AEP sat around 1% at timescales of 2-3 hours, but less than 1% (within the rare category) on all timescales beyond 6 hours (see Figures 2-20 and 2-21).

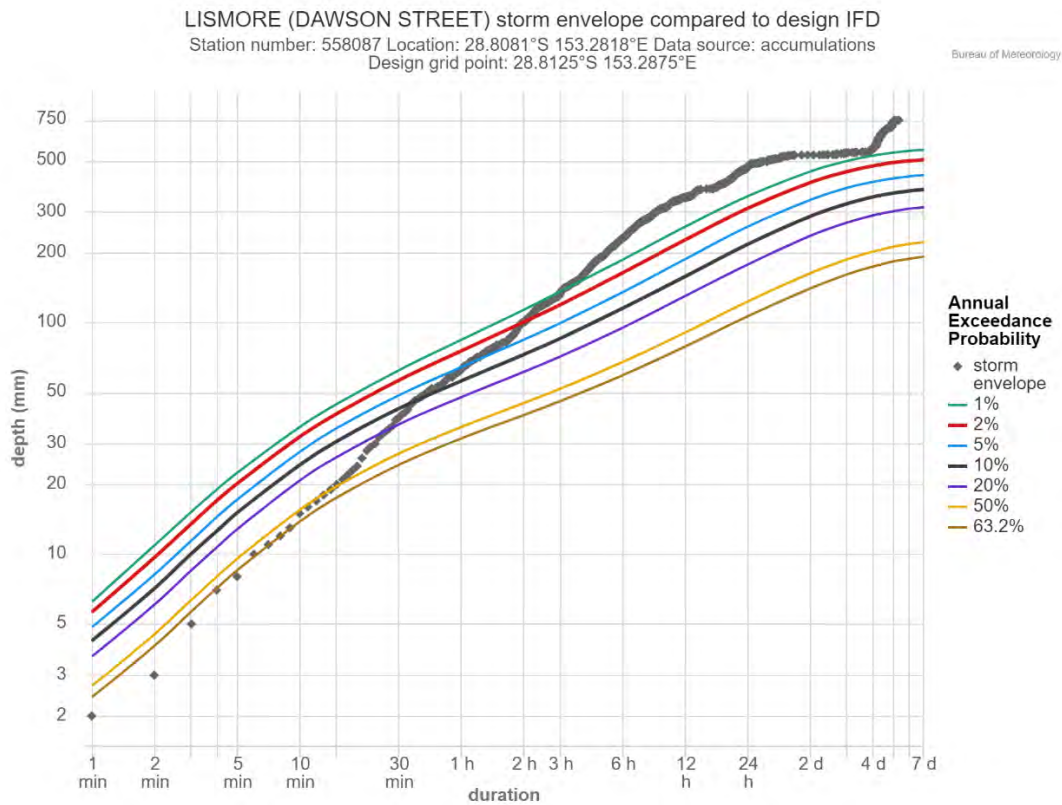


Figure 2-20: Intensity-Frequency-Distribution (IFD) analysis of rainfall in Lismore at Dawson Street for the week ending 28 February 2022. Source: Bureau of Meteorology (2022).

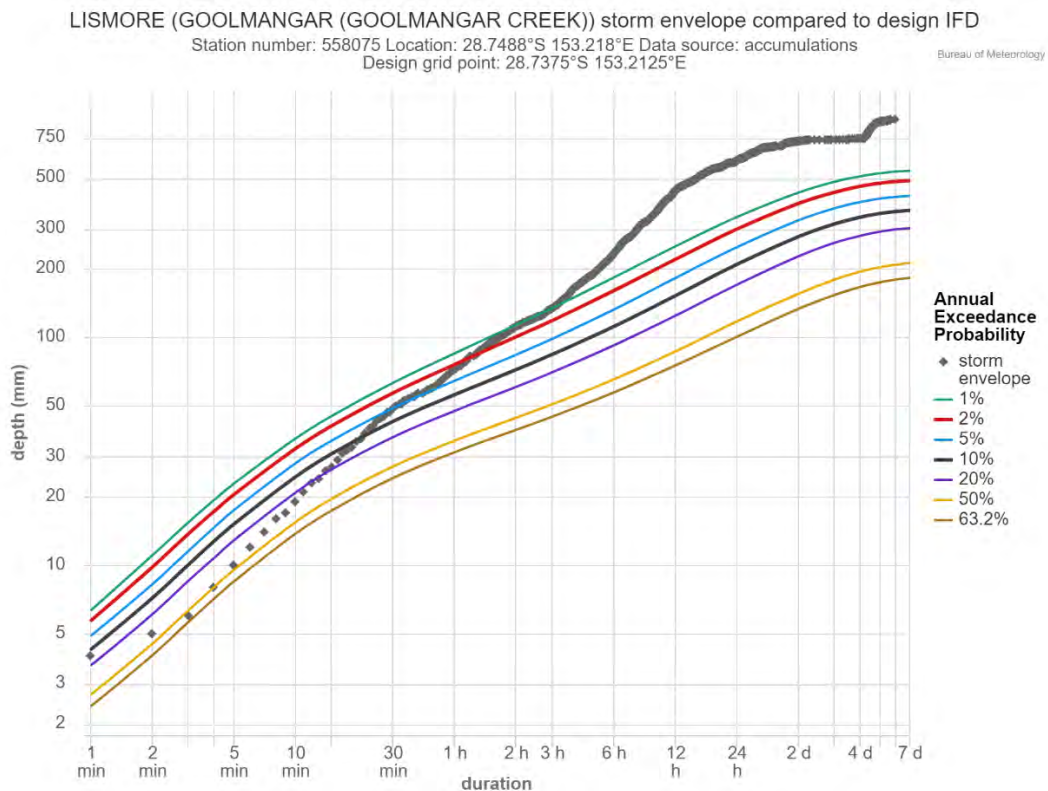


Figure 2-21: Intensity-Frequency-Distribution (IFD) analysis of rainfall in Lismore at Goolmangar Creek for the week ending 28 February 2022. Source: Bureau of Meteorology (2022).

An east coast low 28 February to 9 March resulted in heavy rainfall over the Mid-North Coast, Central Coast and Illawarra

East coast lows are intense low-pressure systems which occur on average several times each year off the eastern coast of Australia, in particular southern Queensland, NSW and eastern Victoria. East coast lows will often rapidly intensify overnight making them one of the more dangerous weather systems to affect the south-east Australian coast.¹²⁸ East coast lows are typically associated with strong and gusty winds, sustained heavy rainfall and high seas. They can cause widespread damage over a very short period.

Five east coast lows in succession are rare, but not unprecedented, with other notable years including 1950, 1974 and 2007 – all of which saw record rainfall across NSW. The Pasha Bulker Storm on 8 June 2007, referred to in Section 2.1, was caused by a low-pressure system which moved southward from the northern Tasman Sea and was centred off Newcastle. It caused widespread damage in the coastal parts of the Hunter, Central Coast and Sydney Metropolitan areas of NSW, due to sustained heavy rain, strong winds and large ocean waves and swell. The system led to 9 fatalities, major flooding in the Hunter Valley, gale force winds and flash flooding in Newcastle and the Central Coast and erosion at many Sydney beaches. This system also saw Cremorne Wharf collapse into Sydney Harbour, as well the running aground of the 76,000-tonne bulk carrier MV *Pasha Bulker* on Nobbys Beach, Newcastle.¹²⁹

The development of the east coast low experienced between 28 February and 9 March 2022 was typical of the evolution of inland trough systems to generate an easterly trough low over a warm northern Tasman Sea. The intensity of the system was determined by the formation of a cut-off low which formed further south over the Tasman Sea as the blocking-high near New Zealand contracted.¹³⁰

The resultant, deep east coast low tracked southwards and parallel to the eastern seaboard, producing constant onshore airflow and orographic (mountain-related) rainfall over the mid north coast, then the central to Illawarra coast (between 2 and 8 March).¹³¹ The east coast low produced flooding of the Macleay River at Kempsey and flash flooding in the Central Coast, Sydney and the Illawarra. Sustained orographic rainfall over 3-4 days caused flooding in the Georges River and Hawkesbury-Nepean River system that was intensified by near-capacity dam storage.¹³² The east coast low then tracked to the south of New Zealand's South Island.¹³³

An east coast low 28 March to 2 April resulted in heavy rainfall over the Northern Rivers, Mid-North Coast, Sydney, and Illawarra

A second east coast low formed off south-east Queensland and the Northern Rivers region of NSW on 29 March, evolving from a weak tropical low at the juncture of two trough lines in the Coral Sea.¹³⁴ Though technically an easterly trough low also, the formation of this system over the Coral Sea in a dip was quite different from the prior east coast low experienced between 28 February and 9-March which developed in an inland trough over Queensland. Yet, much like the prior

¹²⁸ Bureau (Bureau of Meteorology). (2022). East Coast Lows. Retrieved from <http://www.Bureau.gov.au/climate/about/?bookmark=eastcoastlow>.

¹²⁹ Ibid.

¹³⁰ Risk Frontiers. (2022). The Weather behind the Eastern Australian floods – the storm cluster from 23rd February to 2nd of April, 2022. Retrieved from <https://riskfrontiers.com/insights/eastern-australian-floods-february-april-2022/>.

¹³¹ Ibid.

¹³² Ibid.

¹³³ Ibid.

¹³⁴ Ibid.

system, this east coast low intensified due to the formation of a mid to upper-level cut-off low, cold air pool and the passage of a cold front.

Like the hybrid tropical dip and prior east coast low, strong blocking highs over the Tasman Sea maintained a robust warm subtropical humid air mass along the NSW coast. Though not unusual for early autumn, this east coast low delivered another extreme weather event with unusually high rainfall intensity and daily totals to the Bellingen-Dorrigo region and then over the mid north coast, Sydney and the Illawarra regions. Unfortunately, the Northern Rivers was again the focus of maximum rainfall anomalies, resulting in a compound flood event.

From 31 March to 2 April, the slow-moving east coast low intensified off the NSW Central Coast with a gale force south-easterly wind over the western Tasman Sea. Powerful swell caused large, sustained waves at beaches from the Illawarra to the Central Coast. This saw severe beach erosion at the northern ends of beaches and localised inundation because of wave energy which transferred into coastal lagoons at Wamberal, Avoca, Narrabeen and Queenscliff.¹³⁵

These weather systems occurred concurrently and consecutively – why?

Extreme rainfall events are influenced by 2 main factors.¹³⁶ First, the atmosphere must contain a significant supply of moisture, which is replenished in some way if rainfall is to be sustained at a specific location. Second, there must be vertical ascent (uplift) within the atmosphere which can be due to orography (i.e. elevated terrain, including mountains and, by extension, hills) or a particular variety of weather system. In scientific literature, the first factor is referred to as the thermodynamic process, and the second factor as the dynamic process.

At Appendix A in Volume Three, CLEX summarises the situation as follows: “climate change influences both the thermodynamic and dynamic processes, but in very different ways”. To explain the extreme rainfall of February and March 2022, on the thermodynamic side, there would have been more moisture in the atmosphere due to the warming of the atmosphere. It is known that global warming heats the atmosphere. A warmer atmosphere can hold more moisture – about 7% more per 1°C of warming – and more available moisture can increase the intensity of extreme rainfall events. For example, hourly extreme rainfall intensities increased by 10-20% in many Australian locations between 1966–1989 and 1990–2013.¹³⁷ Daily rainfall associated with thunderstorms increased 13-24% from 1979 to 2016, particularly in northern Australia.¹³⁸ From this it could be predicted that an event occurring in 2022 would, on average, have more moisture associated with it than the same event in 1900.

However, it does not necessarily follow that this led to more rainfall in the recent events, and it would be simplistic to argue the warmer world and atmosphere holding more moisture made these specific events more intense. This is because the rainfall bearing systems cannot be reliably explained by the thermodynamical response alone.¹³⁹ As outlined by CLEX in Volume Three, the conditions for the extreme rainfall were set by large-scale weather systems and modes of variability, particularly La Niña. These were connected to a very active upper troposphere with

¹³⁵ Ibid.

¹³⁶ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 7 June 2022.

¹³⁷ CSIRO (Commonwealth Scientific and Industrial Research Organisation). (2022). Understanding the causes and impacts of flooding. Retrieved from <https://www.csiro.au/en/research/natural-disasters/floods/Causes-and-impacts>.

¹³⁸ Ibid.

¹³⁹ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 7 June 2022.

mechanisms, like Rossby waves, that can be explained dynamically. As explained by Parker and Barnes (2022):¹⁴⁰

At present, different climate models show different things about what climate change means for Rossby waves and wave breaking. The models don't yet have high enough resolution to explicitly include some of the detailed physical processes related to rainfall, jet streams and Rossby waves.

While the models agree that climate change will alter the position and speed of the jet stream winds, they disagree about what will happen to Rossby waves.

It is possible that changes in climate shifted, influenced or organised those circumstances to occur at the same time and location that led to the extreme rainfall.¹⁴¹ But, it is also possible to explain the extreme rainfall through natural variability and 'just bad luck', or the way land is used and developed – or a combination of the three.

To determine the specific contribution of climate change on these systems and processes is extremely challenging for the Inquiry, because it requires climate change to be superimposed upon Australia's large-scale natural climate variability in an event attribution study. Though various Australian attribution studies have been published for extreme temperature events, extreme rainfall events and extreme fire events,¹⁴² it is probable that a full-scale analysis and event attribution study for this event might be beyond the research community's technical capabilities at this time.

Could this extreme rainfall have been predicted in advance?

The Bureau provides rainfall forecasts for a range of 'lead times'. In general, rainfall forecasts for the hours and days ahead, up to 7 days in advance, are deterministic forecasts,¹⁴³ where predictions aim to provide rainfall totals, locations and timing to a high degree of accuracy. These forecasts have their highest skill for shorter lead times, of 48 hours or less, and particularly for extreme rainfall events.¹⁴⁴

Extended or long-range forecasts are also provided by the Bureau. These are not presented as deterministic, but rather as probabilistic forecasts – whereby the chances of receiving rainfall above or below historical percentiles are provided. These forecasts are provided by the Bureau for multi-week to 3-month lead times. Over even longer lead times of 3 to 9 months, the Bureau also provides extended probabilistic forecasts of climate drivers such as ENSO and the IOD. While extended probabilistic prediction has limitations, it can provide useful foresight and intelligence, especially if used appropriately.¹⁴⁵

Improvements in the weather models used to provide extended range forecasts have enhanced the ability to provide probabilistic forecasts of extreme rainfall for Australia. But, unlike a weather

¹⁴⁰ Parker, T & Barnes, M. (2022). Planetary waves, cut-off lows and blocking highs: what's behind record floods across the Southern Hemisphere? Retrieved from <https://theconversation.com/planetary-waves-cut-off-lows-and-blocking-highs-whats-behind-record-floods-across-the-southern-hemisphere-183632>.

¹⁴¹ Professor Andy Pitman. (2022). Advice to the Inquiry provided 28 April 2022.

¹⁴² CSIRO (Commonwealth Scientific and Industrial Research Organisation). (2019). Climate change and extreme events – quantifying the changing odds. Retrieved from <https://ecos.csiro.au/climate-change-and-extreme-events-quantifying-the-changing-odds/>.

¹⁴³ "When a model runs once at the highest possible resolution – which means it uses all of the available computing power to create the forecast, the forecast produced is known as a **deterministic forecast**. This type of forecast represents atmospheric processes in the finest possible detail, and thus generates a relatively detailed forecast. But, because of the uncertainty of the initial conditions, the deterministic forecast is only one possible future outcome of an infinite number of possibilities." Source: World Climate Service. The Difference Between Deterministic and Ensemble Forecasts. (2021). Retrieved from [The Difference Between Deterministic and Ensemble Forecasts - World Climate Service](#).

¹⁴⁴ Bureau of Meteorology. (2022). Advice to the Inquiry provided 20 July 2022.

¹⁴⁵ Ibid.

forecast for, say, 25 mm of rainfall in 2 days' time, which is easily understood by most people, a probabilistic rainfall forecast requires interpretation to lead to actionable decisions. In general, extended probabilistic rainfall forecasts should be used to increase preparedness for the risk of flooding or drought, over a suitably broad region, and within a suitably broad time window.¹⁴⁶

On the other hand, extended prediction is much more difficult for extreme rainfall falling over a very specific location, and within a very specific time window.¹⁴⁷

Long- and short-range prediction are therefore best suited to being used as appropriate for different decisions across the timescale of preparedness (many months ahead) to warning and response (hours to days).¹⁴⁸

For this specific event, the Bureau explained that a number of factors reduced the predictability of extreme rainfall at longer lead times. This was mostly due to the unusually slow movement of the system, which led to record breaking multi-day rainfall totals at many locations.

The predictability of subsequent flooding is further diminished by factors such as uncertainty in the precise location of the most extreme rainfall, and the topography of catchments in the region. For example, if extreme rainfall happens to fall in a particular part of the catchment, it can greatly increase the runoff and flooding response downstream. As explained by Professor Pitman at Appendix A in Volume Three:¹⁴⁹

The nature of weather forecasting would suggest that a forecaster determining very heavy rainfall 4 km north of where it ends up occurring is an outstanding forecast. It is one model grid point wrong. This is at the limits of predictive skill in circumstances of extreme rainfall, often with super-cell thunderstorms embedded within other highly active systems. However, 4 km north of a point on the land might forecast the rain landing in one catchment north of where a town is located. Thus, an error of 4 km might be wholly acceptable in forecasting, and be at the limits of what is possible, and yet be a catastrophically bad forecast in the context of flood forecasting.

What this means for the recent events is that the antecedent conditions and climate phenomena like La Niña and the negative IOD increased the risk of flooding, but for the risk to be realised, extreme rainfall over particular catchments was necessary – and that is not accurately predictable in terms of magnitude and landfall location beyond a few days in advance.

The heavy rain fell in locations with terrain and landscape characteristics conducive to flooding

As stated in Section 2.1 above, what happens when rainfall hits the ground is a key driver of flooding. Each of the locations that flooded between February and April 2022 possesses unique terrain and landscape characteristics that make it prone to flood, particularly when exposed to sustained, heavy rainfall over an already saturated catchment.

For example, Lismore's deep bowl shape has seen the town nicknamed 'the bowl' or 'the wok'. The case study in Volume Three describes Lismore's position in the Richmond River catchment, the rivers that feed into this catchment and what happens when heavy rain falls over the floodplain and surrounds. Box 2-1 below provides an excerpt of this description.

¹⁴⁶ Ibid.

¹⁴⁷ Ibid.

¹⁴⁸ Ibid.

¹⁴⁹ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 7 June 2022.

Box 2-1: Lismore catchment characteristics – excerpt from case study

The Wilsons River catchment forms part of the larger Richmond River catchment of northern NSW and it drains to the sea at Ballina. The Wilsons River joins with Leicester Creek at Lismore before joining the Richmond River at Coraki. The total upstream catchment area for the Wilsons River upstream of Lismore is over 550 km². Inclusive of the water catchment areas for the tidal pool upstream of Lismore (including Leicester Creek catchment), the total catchment area exceeds 1,400 km². During heavy rain, rainfall from the high surrounding hills comes down the steep creeks and rivers meeting at Lismore, then slowing down and spreading across the floodplain before moving out to sea.

Following the sustained, intense rain that fell in the upper catchment, fast moving water rushed through the rivers and creeks to meet in Lismore and was topped up by the sustained and intense rainfall over Lismore, or ‘the bowl’ itself.

Similarly, many stakeholders described the ‘bathtub effect’ of the Hawkesbury-Nepean to the Inquiry. The case study of the Hawkesbury-Nepean in Volume Three provides a summary of catchment characteristics for the Hawkesbury-Nepean, with an excerpt in Box 2-2 below.

Box 2-2: Hawkesbury-Nepean catchment characteristics – excerpt from case study

The unique ‘bathtub’ effect of the floodplain also contributes to the extent and depth of flooding; the Valley has five tributaries but only one ‘plug hole’ at Sackville Gorge. Narrow downstream sandstone gorges between Sackville and Brooklyn create natural choke points and can contribute to fast-flowing water. Floodwaters back up and rise rapidly, causing deep and widespread flooding across the floodplain. River rises can begin as quickly as 6-12 hrs after heavy rain begins, particularly if the catchment is already saturated.¹⁵⁰ Floodwaters in the Valley can also sit for long periods of time before the water can dissipate; in the largest recorded flood in the Valley in 1867, water levels at Windsor exceeded 13.5 metres above normal river level for nearly 4 days.¹⁵¹

Though the rainfall in the Hawkesbury-Nepean was not as intense as that experienced in Lismore, the high saturation in the catchment and the shape of the floodplain meant that water backed up and resulted in flooding.

Many other towns in eastern NSW, including but not limited to Wollongong and the Tweed area, also have landscape characteristics conducive to flash flooding. Bounded on one side by escarpment and the other side by the ocean, flash flooding happens as water travels down escarpments towards the ocean.¹⁵²

Chapter 7 explores the development characteristics and planning decisions in particular catchments that also contribute to flood risk and exposure.

Could these floods have been worse?

There are several scenarios in which the floods experienced during early 2022 could have been worse. For instance, there was every chance, given the antecedent conditions and dynamic weather systems present, that Tweed could have experienced major flooding at the exact same

¹⁵⁰ NSW SES (NSW State Emergency Service). (2016). Camden Flood Emergency Sub Plan. Retrieved from <https://www.ses.nsw.gov.au/media/1600/plan-camden-lfp-mar-2016-endorsed.pdf>.

¹⁵¹ Yeo, S, Bewsher, D, Robinson, J, & Cinque, P. (2017). The June 1867 floods in NSW: causes, characteristics, impacts and lessons. Floodplain Management Australia National Conference. Newcastle, NSW.

¹⁵² Wollongong City Council. (2022). Floods and Stormwater. Retrieved from [Floods and Stormwater | Wollongong City Council \(nsw.gov.au\)](https://www.wollongong.nsw.gov.au/floods-and-stormwater).

time as Lismore – further stretching emergency services capability and resources in the Northern Rivers. Similarly, the events in the Hawkesbury-Nepean could have been much worse had that area been hit with more intense rainfall (as was seen in Lismore), or an east coast low with heavy rain and wild winds, resulting in a flood comparable to that seen in 1867.

Further, at the end of May, the 2021–22 La Niña event continued to weaken, with oceanic indicators mostly at neutral levels.¹⁵³ However, atmospheric indicators remained above La Niña thresholds, meaning La Niña's influence continued.¹⁵⁴

Climate settings continued to be favourable for wet conditions in the weeks and months following the February and March flooding event. It is entirely possible that a further major rainfall event could have occurred over affected regions a few days later, further compounding the impact of flooding in February-April. For instance, Cyclone Debbie occurred in late-March, and East Coast Lows are most common in autumn and winter. Hence, there was a tangible risk that Lismore could have experienced another flood shortly after the first flood event in late February/early March. In fact, based on the Bureau's current long-range outlook, the risk of flooding remains elevated through to October (the limit of the current forecast period).¹⁵⁵

Internationally, and around the same period, Brazil experienced 4 major flood events in the 5 months to May 2022. Despite being in drought for most of 2021, heavy rains have hit the country several times since the end of that year with around 32,000 families living in areas at risk of landslide or flooding in the state of Pernambuco alone.¹⁵⁶ The flood events in Brazil were due to a similar combination of weather systems: a cut-off low over the coast, pinned in place by a blocking high out to sea,¹⁵⁷ and the resultant heavy rain, land slides and flooding tragically killed more than 200 people.

Could extreme rainfall as was seen in the Northern Rivers happen in the Hawkesbury-Nepean Valley?

Similar rainfall rates to the Northern Rivers could be recorded in the Hawkesbury-Nepean Valley, although the chance of these rainfalls occurring is lower. For example, a 5% AEP in 60 minutes of rainfall at Lismore is around 65 mm whereas this is a 1% AEP in the Hawkesbury-Nepean Valley.¹⁵⁸

In early February 2020, a trough with embedded low-pressure circulations hovered off the NSW coast, generating significant rainfall over the Hawkesbury-Nepean catchments from 6-13 February 2020. Some locations recorded more than 500 mm, with the most intense rainfall over 12 hours on 9 February 2020.¹⁵⁹ Figures 2-22 and 2-23 show the recorded storm event at Faulconbridge and Robertson at less than 1% and 1-2% respectively.

¹⁵³ Bureau of Meteorology. (2022). Outlook issued end of May. Retrieved from <http://www.Bureau.gov.au/climate/outlooks/#/overview/summary/>

¹⁵⁴ Ibid.

¹⁵⁵ Bureau of Meteorology. (2022). Advice to the Inquiry provided 20 July 2022.

¹⁵⁶ ABC (Australian Broadcasting Corporation). (2022). Drone images show the magnitude of destruction caused by heavy rains in Brazil. Retrieved from <https://www.abc.net.au/news/2022-05-29/drone-footage-destruction-heavy-rain-brazil-flood-landslide/101108300>.

¹⁵⁷ Parker, T & Barnes, M. (2022) Planetary waves, cut-off lows and blocking highs: what's behind record floods across the Southern Hemisphere? Retrieved from <https://theconversation.com/planetary-waves-cut-off-lows-and-blocking-highs-whats-behind-record-floods-across-the-southern-hemisphere-183632>

¹⁵⁸ Bureau (Bureau of Meteorology). (2022). Advice to the Inquiry provided 20 July 2022.

¹⁵⁹ NSW Government. (2020). February 2020 Flood Hawkesbury-Nepean Valley 20 June 2020 presentation to Legislative Council Select Committee. Retrieved from <https://www.parliament.nsw.gov.au/lcdocs/other/13410/Presentation%20-%20Infrastructure%20NSW%20-%202030%20June%202020.pdf>.

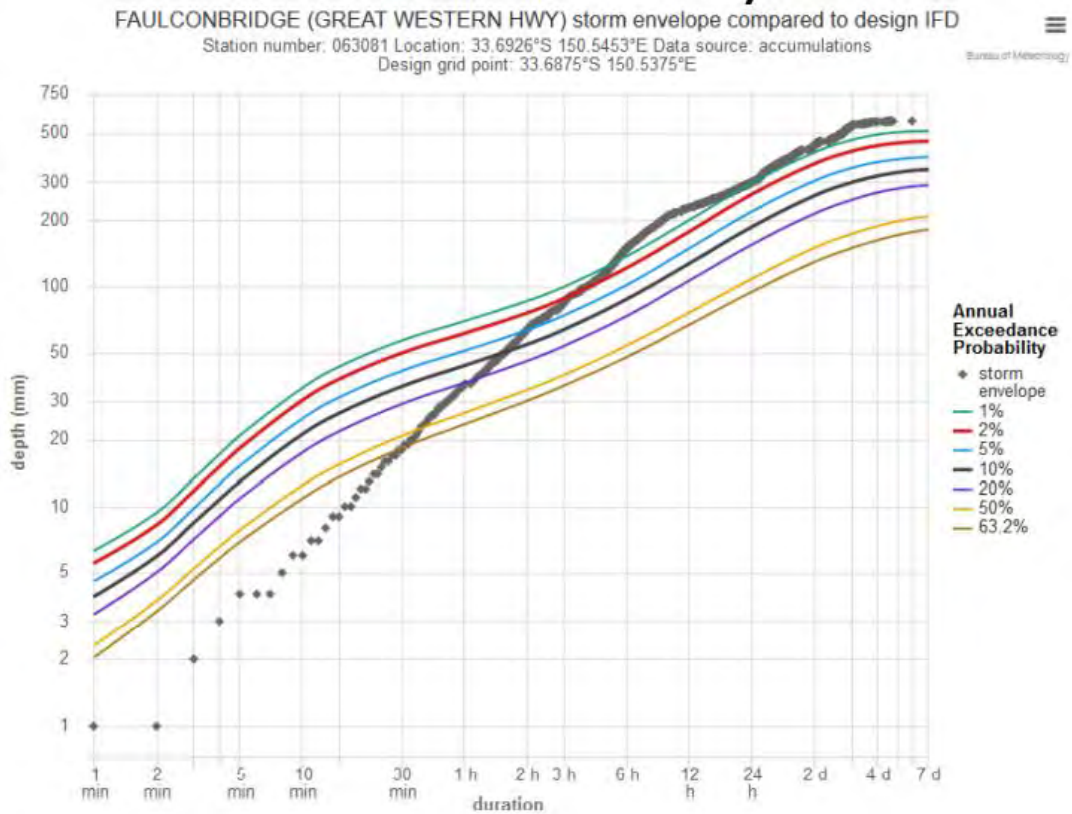


Figure 2-22: Intensity-Frequency-Distribution (IFD) analysis of rainfall at Faulconbridge for the week ending 10 February 2020. Source: Bureau of Meteorology (2022).

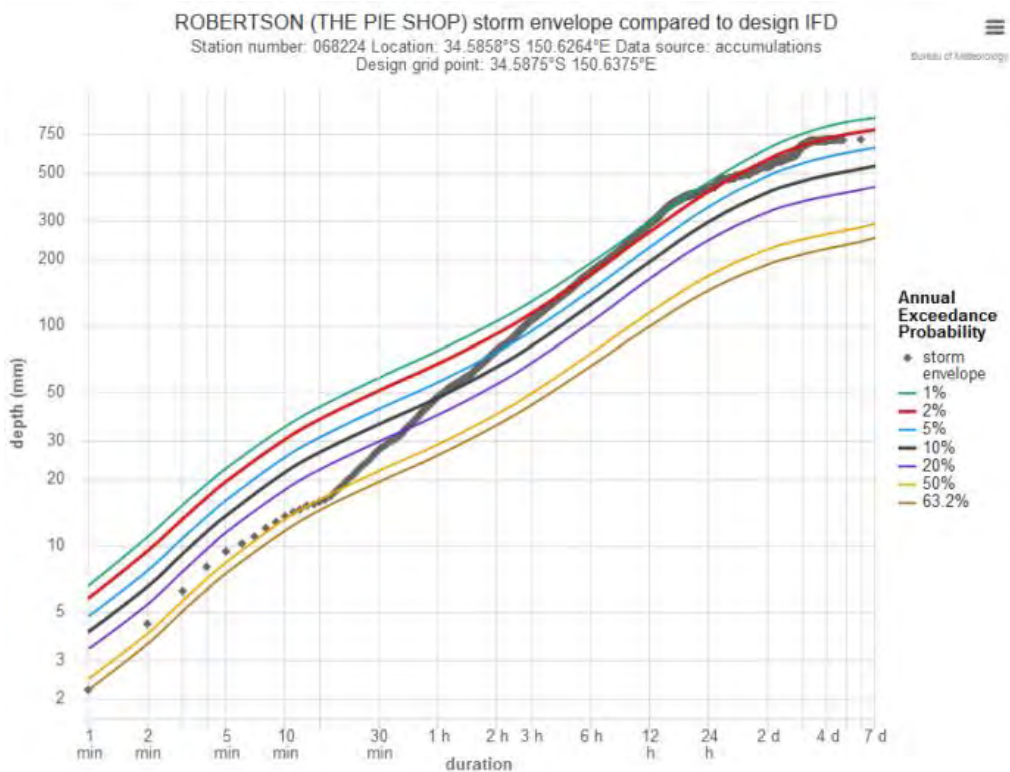


Figure 2-23: Intensity-Frequency-Distribution (IFD) analysis of rainfall at Robertson for the week ending 10 February 2020. Source: Bureau of Meteorology (2022).

This rainfall led to minor/moderate flooding, noting that catchments were relatively dry following prolonged drought. Further, Warragamba was 43% full at the beginning of the rainfall event and captured all inflows.¹⁶⁰

An additional factor is that, due to the size of the Hawkesbury-Nepean catchment, large floods, particularly in the Hawkesbury and lower Nepean Rivers are driven more by extreme multi-day rainfall events than extremely intense rainfall over several hours.¹⁶¹ Larger floods than the floods of 2021 and 2022 are certainly possible – both the historic record and flood studies show that these floods were large, but much larger events are possible.¹⁶²

Further rainfall and flooding in early July 2022

Further to the February/April flood events, and despite the La Niña having been declared over by the Bureau earlier in July 2022, at the time of writing a coastal region from approximately the Hunter to Jervis Bay and inland including the Blue Mountains received further heavy rainfall in early July (see Figure 2-24).

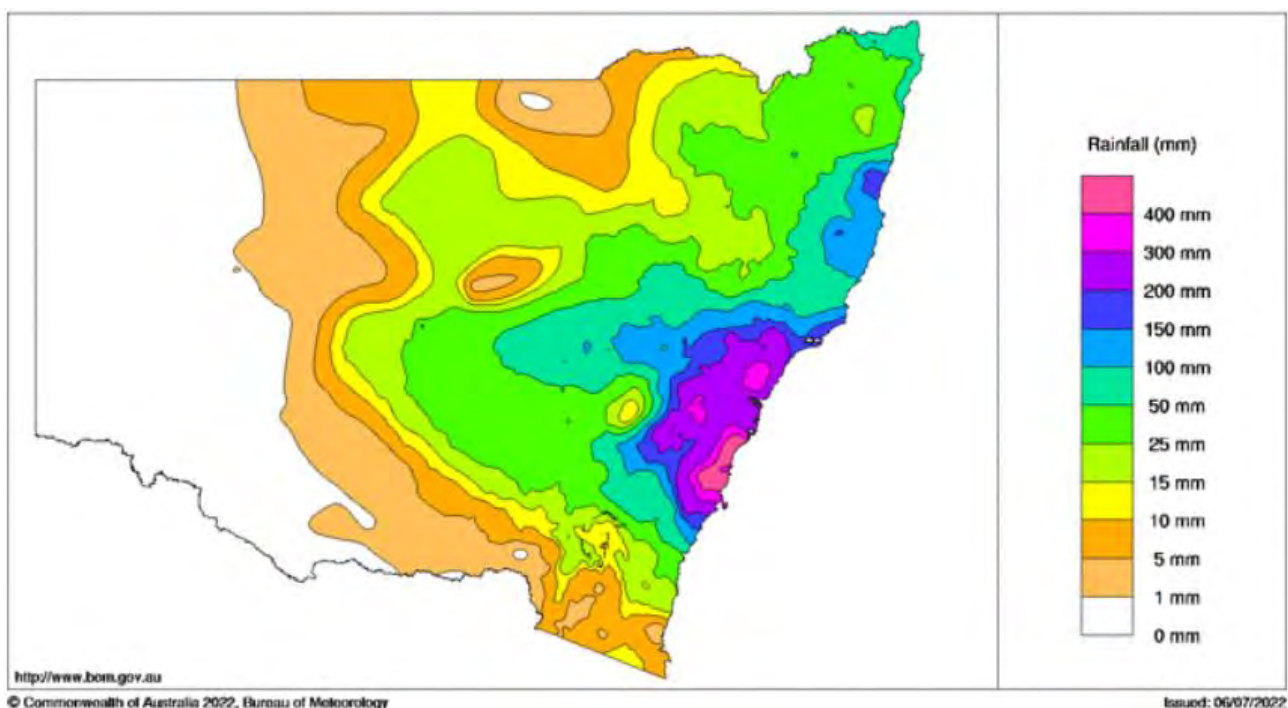


Figure 2-24: NSW Rainfall totals (mm) week ending 6 July 2022. Source: Bureau of Meteorology (2022).

Parts of Greater Sydney, including the Hawkesbury-Nepean valley but also the Hunter and Illawarra, flooded, with some areas (including Lower Portland, North Richmond WPS, Sackville, Windsor PWD, Maitland Belmore Bridge, Singleton, Camden Weir, Penrith, Wallacia Weir, Bulga and Wollombi) exceeding March 2022 flood peaks (see Table 2-8 below).

¹⁶⁰ Ibid.

¹⁶¹ Bureau of Meteorology. (2022). *Advice to the Inquiry provided 20 July 2022*.

¹⁶² Ibid.

	Flood classification (water level (m))			July 2022 flood	
	Minor	Moderate	Major	Peak (m)	Classification
Georges River					
Liverpool	2.00	3.00	4.50	4.28	Moderate
Milperra	2.00	3.30	4.20	4.16	Moderate
Picnic Point	2.00	n/a	n/a	2.33	Minor
Hawkesbury and Lower Nepean					
Lower Portland	4.60	6.10	7.60	8.98	Major
North Richmond WPS	3.80	7.90	10.50	14.19	Major
Sackville	4.60	7.30	9.70	10.91	Major
Upper Colo	5.10	8.60	14.30	15.00	Major
Windsor PWD	5.80	7.00	12.20	13.93	Major
Wisemans Ferry	n/a	3.50	4.20	5.78	Major
Hunter River					
Aberdeen	7.20	9.80	10.00	Below Minor	Below Minor
Denman	6.50	7.90	9.00	Below Minor	Below Minor
Maitland Belmore Bridge	5.90	8.90	10.50	10.41	Moderate
Muswellbrook	7.20	8.00	10.00	Below Minor	Below Minor
Raymond Terrace	2.50	3.10	3.50	2.91	Minor
Singleton	10.00	11.50	13.00	13.71	Major
Upper Nepean					
Camden Weir	6.80	8.30	13.80	12.72	Moderate
Menangle Bridge	5.20	9.20	12.20	16.61	Major
Penrith	3.90	7.90	10.40	9.52	Moderate
Wallacia Weir	5.00	8.70	11.00	13.85	Major
Williams River					
Dungog	4.90	7.60	8.50	6.81	Minor
Mill Dam Falls	6.10	7.60	9.10	7.43	Minor
Wollombi Brook					
Bulga	3.00	3.70	4.60	9.11	Major
Wollombi	6.70	8.60	12.20	14.21	Major
Shoalhaven River					
Nowra Boat Shed	2.30	3.30	4.30	3.03	Minor
Terara	2.20	3.00	3.90	2.89	Minor

St Georges Basin					
Island Point Road	1.20	1.50	1.80	1.31	Minor
Sussex Inlet	0.90	1.20	1.80	1.08	Minor

Table 2-8: Flood heights and classification during July 2022 event. Source: Bureau of Meteorology (2022).

Natural disaster was declared for 37 affected LGAs: Bayside, Blacktown, Blue Mountains, Camden, Canterbury Bankstown, Cumberland, Campbelltown, Central Coast, Cessnock, Dungog, Fairfield, Georges River, Hawkesbury, Hornsby, Kiama, Lake Macquarie, Lithgow, Liverpool, Maitland, Mid Coast, Muswellbrook, Nambucca, Newcastle, Northern Beaches, Penrith, Port Stephens, Randwick, Shellharbour, Shoalhaven, Singleton, Sutherland, The Hills, Upper Lachlan, Warren, Wingecarribee, Wollondilly, Wollongong.¹⁶³

In response to this further event, the Inquiry sought supplementary advice from CLEX, to understand the climate signals:¹⁶⁴

This event was associated with an east coast low which channelled significant moisture on-shore. Roughly ten events occur annually, affecting the east coast, but only about one of these develops into a significant weather event. There is no observed trend in the frequency of east coast lows.

The event that occurred in July 2022 occurred after around 2 weeks of relatively dry weather. However, in mid-winter, evaporation rates across the Hawkesbury-Nepean [and Georges River and Illawarra] catchment are small and are likely around 1 mm per day. The “drying” of these catchments, even if around 14 mm over the 2 weeks, is unlikely to have had much impact on the flooding and the catchments are very likely still close to their maximum capacity to store water. Consequently, the more than 100 mm of rain is rapidly transferred out of the catchment in the form of river flow, on timescales of a day or two.

In short, the flooding that affected Sydney and near-by regions is associated with

- a. A relatively common east coast low,*
- b. Quite high daily rainfall totals, co-located with specific catchments,*
- c. Saturated catchments, as a consequence of previous weather events.*

It is impossible to determine the degree to which there is a climate change signal in this event. There are possible links (the sea surface temperatures are relatively warm off New South Wales which tends to increase the amount of water evaporated from the ocean) but whether this affected the east coast low is unknown. In the absence of evidence to the contrary, the best assessment possible at this time is that there is no significant climate change signal in the July 2022 flooding event.

Once more, the Inquiry notes that the number of significant or unusual events experienced in the last year does not itself amount to a climate signal – sometimes records are broken simply because historical records and rainfall observations are not long enough to include all possible events. It means we cannot exclude climate change as a contributing factor, but we cannot demonstrate that it is the causal factor in this event.¹⁶⁵

¹⁶³ NSW Government. (2022). Natural disaster declarations. Retrieved from <https://www.nsw.gov.au/disaster-recovery/natural-disaster-declarations>.

¹⁶⁴ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 4 July 2022.

¹⁶⁵ Ibid.

A third La Niña?

As at 5 July 2022, due to the persistence of some La Niña-like signals, the ENSO Outlook continues at La Niña ‘watch’. This means there is around a 50% chance of La Niña forming later in 2022, and is double the normal likelihood.¹⁶⁶ Four of 7 models indicate La Niña could return in spring with the remainder maintaining ENSO-neutral until the end of 2022.¹⁶⁷ If a La Niña were to develop later this year, it would be the third consecutive La Niña.

A third La Niña could increase the chances of rain over an already saturated east coast, and it follows that any further floods as a result could be worse the third time around.¹⁶⁸ A triple La Niña has only occurred 3 times before, in 1954-57, 1973-76 and most recently in 1998-2001.¹⁶⁹

The Inquiry notes that projections from climate models need to be interpreted with care. As climatologists continue to monitor conditions, and the science continues to develop, governments, industries and communities will be provided further information to prepare for the future.

2.4. What can we expect in future?

The flood events during the summer of 2021–2022 were unusual, but should not have been wholly unexpected given historical weather and climate patterns, in addition to other antecedent conditions explored above (including the particularly wet spring leading into summer 2021–2022, and the particular locations in which the rain fell, and the terrain and landscape characteristics of those locations).

Flood events in NSW have happened before and will happen again, and it is clear that community perception and experience of hazards is changing. It is also clear that the flood planning level on the map is not static – it is changing seasonally and generationally. But, because flood events are influenced by several elements and factors, it is difficult to state confidently, based on the current science, that, overall, extreme flood events in NSW and across Australia will increase in intensity or frequency as a result of climate change.

So, what can we expect in future? Though the role of climate change is not yet well understood, and climate change alone is insufficient to explain the extreme rainfall events experienced in February, March, April and July 2022, there is evidence to support the hypothesis that climate change is contributing to an accelerated and more intense hydrological cycle. It can and has been argued that climate change is making us experience extreme weather events more often, and that other decisions (i.e. development) are also making us feel them more intensely.

This section explores some of these issues in detail to inform what we might expect in future and how we can better adapt in planning and preparing for, responding to and recovering from events of this kind.

¹⁶⁶ Bureau of Meteorology. (2022). ENSO outlook. Retrieved from [ENSO Outlook – an alert system for the El Niño–Southern Oscillation \(Bureau.gov.au\)](#)

¹⁶⁷ Ibid.

¹⁶⁸ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Concerns over a third possible La Niña for Australian spring 2022. Retrieved from [The ARC Centre of Excellence for Climate Extremes | Concerns over a third possible La Niña for Australian spring 2022 - The ARC Centre of Excellence for Climate Extremes](#)

¹⁶⁹ ABC (Australian Broadcasting Corporation). (2022). La Niña officially over, but Bureau of Meteorology says it might be back in spring. Retrieved from [La Niña officially over, but Bureau of Meteorology says it might be back in spring - ABC News](#)

Are flood events likely to become more frequent and more intense?

The Inquiry has learned, as explained by CLEX, that the evidence supporting any long-term trend towards more wet seasons of the kind just experienced is very limited. Springs and summers as wet as 2021–2022 are rare and are likely to remain so in the future.¹⁷⁰ It is not yet known what effect climate change is having on rainfall frequency or spatial distribution. However, it is known that the chances of flash flooding are increasing due to an increase in short-term, intense rainfall events, though long-term trends suggest cool season rainfall is declining.¹⁷¹ Further, increased coastal inundation from rising sea-levels combined with high tide events can be expected.¹⁷²

The Inquiry also learned that there is evidence slowly emerging that major dynamic systems are stalling or becoming ‘stuck’ in place.¹⁷³ What this means for the future is that, regardless of rainfall intensity, systems may stall and affect a location for a longer period, dumping rain over the same spot for days. It is not yet understood why these sorts of events apparently stall, and the dynamics of stalling generally are still largely unknown. The Inquiry notes that CLEX intends to undertake further research in this area.¹⁷⁴

Trends and projections of extreme rainfall

In the CLEX report at Volume Three, Professor Pitman describes the current state of play with regard to projections of future extreme conditions and rainfall, noting:

*There are several sources of data for projections of future rainfall. None are robust at the spatial detail required to make sound predictions of future extreme conditions. In NSW, the NARCLiM project was used to provide projections for the north coast of NSW.*¹⁷⁵

The NARCLiM product has advantages over global climate models in that it has higher spatial detail and resolves fine spatial details of the coastline and topography. The NARCLiM projections suggest little change in summer rainfall in the next 20 years, but higher rainfall later in the century (Figure 9). However, the changes in very wet days, and consecutive wet days do not hint at a significant trend towards more events of the kind experienced this summer. High uncertainty and strong differences in model projections mean that we cannot rule out an increased occurrence of wet summers characterised by extreme wet spells as the world warms. The nature of the NARCLiM product means it is partly reliant on the large-scale simulations of global climate models and the degree to which these models capture the detailed processes required to project summer rainfall extremes with accuracy is not clear.

¹⁷⁰ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 7 June 2022.

¹⁷¹ Bureau of Meteorology. (2020). State of the Climate 2020. Retrieved from <http://www.Bureau.gov.au/state-of-the-climate/>.

¹⁷² Professor Andy Pitman. (2022). Advice to the Inquiry provided 28 April 2022; CSIRO (Commonwealth Scientific and Industrial Research Organisation). (2022). Understanding the causes and impacts of flooding. Retrieved from <https://www.csiro.au/en/research/natural-disasters/floods/Causes-and-impacts>; Queensland Government. (2011). Understanding floods: Questions & Answers. Retrieved from https://www.chiefscientist.qld.gov.au/_data/assets/pdf_file/0022/49801/understanding-floods_full_colour.pdf.

¹⁷³ Professor Andy Pitman. (2022) Advice to the Inquiry provided 17 May 2022.

¹⁷⁴ Ibid.

¹⁷⁵ Office of Environment & Heritage. (2014). North Coast Climate change snapshot. Retrieved from <https://www.climatechange.environment.nsw.gov.au/sites/default/files/2021-06/North%20Coast%20climate%20change%20snapshot.pdf>.

However, there is clear evidence of rain intensifying at daily and sub-daily scales. Observations show that the intensity of short duration, or hourly, extreme rainfall events has increased by around 10% or more in some regions in recent decades, with larger increases typically observed in the north of Australia.¹⁷⁶ As the climate warms, heavy rainfall events are expected to continue to become more intense. A warmer atmosphere can hold more water vapour than a cooler atmosphere and, in theory, rain should intensify 6.5-7% per degree of warming.¹⁷⁷ Evidence also shows that at shorter timescales, rain is intensifying much more than that.¹⁷⁸ For example, the intensity of daily rainfall with 5% AEP may increase 4-10% by 2050 for a low emission scenario and 8-20% by 2050 for a high emission scenario.¹⁷⁹

It is expected that long-term climate change will result in greater climate variability with more intense, extreme events than in the past. Various research studies have shown a relationship between increasing greenhouse gas concentrations in the atmosphere and more frequent, strong El Niño and La Niña events.¹⁸⁰ There is agreement among the better climate models of enhanced ENSO variability, meaning that in the future, when La Niña occur, there is an increasing risk of rainfall that would have been unusual in the observed historical record.¹⁸¹ There is also limited but consistent evidence that, under La Niña conditions, elevated ocean temperatures can lead to more rainfall than would have otherwise occurred.¹⁸²

Finally, the Inquiry was also told that tropical expansion cannot be discounted in a discussion of future rainfall variability. The tropics wrap around Earth's middle like a warm, wet belt, and are characterised by high average temperatures and heavy rainfall.¹⁸³ Tropical expansion describes the process by which the tropics grow, or expand, towards the poles.¹⁸⁴ A recent study found tropical expansion is occurring at a rate of around 150 to 300 km per 25 years, and is driven primarily by ocean warming caused by climate change.¹⁸⁵ What this expansion means in terms of rainfall statistics requires further analysis.

Projections of coastal inundation

The *State of the Climate* report released by CSIRO and the Bureau in 2020 found that the global mean sea level has risen by around 25 cm since 1880, with half of this rise having occurred since

¹⁷⁶ Bureau of Meteorology. (2020). State of the Climate 2020. Retrieved from <http://www.Bureau.gov.au/state-of-the-climate/>.

¹⁷⁷ Professor Andy Pitman. (2022). Advice to the Inquiry provided 28 April 2022.

¹⁷⁸ Guerreiro, S B, Fowler, H J, Barbero, R, Westra, S, Lenderink, G, Blenkinsop, S, Lewis, E, & Li, X. (2018). Detection of continental-scale intensification of hourly rainfall extremes. *Nature Clim Change* 8, 803–807. doi: <https://doi.org/10.1038/s41558-018-0245-3>. Retrieved from <https://www.nature.com/articles/s41558-018-0245-3>

¹⁷⁹ CSIRO (Commonwealth Scientific and Industrial Research Organisation). (2020). Why don't our cities cope with heavy rain? Retrieved from <https://ecos.csiro.au/city-planning-for-heavy-rain/> .

¹⁸⁰ CSIRO (Commonwealth Scientific and Industrial Research Organisation). (2022). Understanding the causes and impacts of flooding. Retrieved from <https://www.csiro.au/en/research/natural-disasters/floods/Causes-and-impacts>.

¹⁸¹ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 4 July 2022.

¹⁸² Ibid.

¹⁸³ American Geophysical Union. (2020). The tropics are expanding. Retrieved from <https://www.sciencedaily.com/releases/2020/08/200818094013.htm>

¹⁸⁴ Ibid.

¹⁸⁵ Yang, H, Lohmann, G, Lu, J, Evan, J Gowan, S, Jiping, L, Qiang, W. (2020). Tropical Expansion Driven by Poleward Advancing Midlatitude Meridional Temperature Gradients. *Journal of Geophysical Research: Atmospheres*, 125. Retrieved from <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2020JD033158>

1970.¹⁸⁶ Rates of sea level rise vary across Australia, due to natural climate variability and the effect of climate drivers including the ENSO. However, the rates of rise in the north and south-east of Australia are significantly higher than the global average.¹⁸⁷ The report projected that Australia would experience ongoing sea level rise (likely at an accelerated rate) and coastal inundation through more frequent, extreme sea levels.¹⁸⁸

As a result, CSIRO and the Bureau found that rising sea levels around Australia, combined with more frequent high tide events, are increasing flood risks by increasing the risk of inundation and damage to coastal infrastructure and communities.¹⁸⁹

Increased flood risk due to increasing coastal inundation may be further exacerbated by the increase in population choosing to live on the coast, and associated development pressures. Chapter 7 explores these themes in more detail.

Is there a pattern of more extreme wet, flooding summers (and hot dry, bushfire summers) emerging?

As discussed in Sections 2.1 and 2.3, there are several factors that contribute to flood risk. The Inquiry has established that flood risk can be heightened by the presence of large-scale climate variables (for example back-to-back La Niña leading to wetter antecedent conditions), local weather systems, or changes in catchment management (including the removal of vegetation, urbanisation and changes in water management strategies).

It is incredibly challenging to identify trends and patterns in flood events due to complexities in pinpointing the causes of, and interplay between, these factors. Further, quantitative data across regions of NSW for each of these factors individually – let alone in concert – are not robust enough to conclude if there is a trend towards flooding. Critically, and as was observed in the recent flood events, flooding can be caused by local weather systems co-occurring within a catchment or catchments that are saturated due to prior events. As a result, evidence of trends in climate driven flooding is virtually non-existent.¹⁹⁰

In its report in Volume Three, CLEX describes the localised nature of flood risk in contrast to climate driven, hot dry summers and risk of fire:

For a truly extreme fire season to occur requires a very dry landscape. This is unlikely to occur over a single dry year (while a catchment can change from very dry to totally saturated in a few days of very high rainfall). Thus, the extreme dryness required for extreme fires take several years to develop and is almost inevitably at a regional scale or larger. One typically cannot have extreme dryness, requiring years of very low rainfall, in one catchment and wet conditions in a neighbouring catchment. Extreme dryness is often (but not always) associated with very long periods (multi-year) without La Niña or a negative phase of the Indian Ocean Dipole. King et al. (2020)¹⁹¹ explored the conditions associated with the extreme dryness over parts of Australia in 2019 and

¹⁸⁶ Bureau of Meteorology. (2020). State of the Climate 2020. Retrieved from <http://www.Bureau.gov.au/state-of-the-climate/>

¹⁸⁷ Ibid.

¹⁸⁸ Ibid.

¹⁸⁹ Ibid.

¹⁹⁰ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 7 June 2022.

¹⁹¹ King, A D, Pitman, A J, Henley, B J, Ukkola, A M, & Brown, J R. (2020). The role of climate variability in Australian drought. *Nature Climate Change*, 10: 177-179. doi: 10.1038/s41558-020-0718-z. Retrieved from <https://www.nature.com/articles/s41558-020-0718-z>

demonstrated that such events were often associated with a very long period without a La Niña and without a negative phase of the Indian Ocean Dipole.

Following the Black Summer of 2019–2020, the NSW Independent Bushfire Inquiry explored future trends relating to extreme bushfire seasons, including reduced cool season rainfall and drought, projections of more heatwaves, and worsening fire danger and longer seasons. That Inquiry explained that long-term trends show a 10-15% decrease in rainfall in recent decades in south-eastern Australia. It also noted that temperatures are likely to increase further and this increase could be extreme under high-emissions scenarios, dramatically increasing the risk of heatwaves and fire risk. Fire seasons themselves were observed to be worsening in a few dimensions with trends towards more days with higher fire risk and fire seasons starting earlier in the year and becoming longer.

Overall, that Inquiry concluded that:¹⁹²

...the weight of evidence indicates that it is likely that we will see extreme fire conditions again when the risk factors combine in the right way. Extreme fires and fire seasons are likely to become more frequent.

In summary, the evidence that Australian summers are exhibiting a pattern of more frequent wet, flooding summers and hot dry, bushfire summers is mixed.¹⁹³ As outlined above, evidence to support widespread trends in sustained periods of extreme rainfall is limited. Conversely, evidence that Australian summers are becoming hotter, longer and more intense is extensive.¹⁹⁴

A. Findings – causation

- NSW is flood prone and has a lot of people living in the flood plain. Floods will continue to be a major risk for NSW.
- It is incredibly challenging to identify trends and patterns in flood events due to complexities in pinpointing the causes of, and interplay between, the various factors that lead to flood. Based on the current science, it is difficult to state confidently that, overall, extreme flood events in NSW and across Australia will increase in intensity or frequency as a result of climate change. Springs and summers as wet as 2021–2022 are rare and are likely to remain so in the future.
- However, there is clear evidence of the tropics expanding towards the poles, in addition to rain intensifying at daily and sub-daily scales. Observations show that the intensity of short duration, or hourly, extreme rainfall events has increased. As the climate warms, heavy rainfall events are expected to continue to become more intense with consequent increased chances of flash flooding. There will also be increased coastal inundation from sea-level rise.

¹⁹² NSW Independent Bushfire Inquiry. (2020). Final Report of the NSW Bushfire Inquiry. Retrieved from <https://www.nsw.gov.au/nsw-government/projects-and-initiatives/nsw-bushfire-inquiry>.

¹⁹³ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 7 June 2022.

¹⁹⁴ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 4 July 2022.

2.5. Knowledge resources to support flood prediction and risk management – data, technology and research

References to the current capabilities to monitor flood risk in real time have been made earlier in this chapter. This section looks at the technology and techniques, including remote sensing, available to and used by Government agencies in the recent floods. It discusses learnings from the use of this technology and looks at opportunities to adopt and deploy this technology to enable better monitoring and assessment of flood risk, better action on flood threat, and better recovery from the impact of flood events in the future.

This chapter has also identified the need for more research to gain a better understanding of the mechanisms driving climate change, extreme rainfall and subsequent flood risk. This section concludes there is a need to extend NSW's current research, monitoring, prediction and modelling capabilities to enable new and innovative ways to plan for, prepare for and respond to flood events in NSW.

Sensing technology and data fusion techniques – current uses in, and future opportunities for, flood management

Remote sensing technology and data, the various forms of which allow the acquisition of spatial and sensory information, is an invaluable knowledge resource to manage flood and other disaster. The NSW Bushfire Inquiry Report provided a summary of how remote sensing and data fusion can be used in fire management:¹⁹⁵

Relevant data can be collected from sensors mounted on different infrastructure at various platforms or heights – ranging from space, atmospheric altitudes, to aerial and ground level. Depending on the particular need or purpose, sensors are commonly mounted on ground-based infrastructure such as towers, or aerial assets like high-altitude platforms, drones and aircraft – both planes (fixed-wing) and helicopters (rotary wing), balloons at high and low altitudes, and satellites in orbit (low-medium earth orbit and geosynchronous/geostationary) each of these can provide different levels of coverage, resolution, frequency, ease of use, cost, and complexity.

Once collected, the data require processing, analysis and, often, fusion with data from other sources before outputs can be delivered to users to inform decision making. Some systems offer on-board processing and can immediately broadcast outputs in a ready-to-use form. Typically, though, a more complete picture is obtained by bringing data from many sources together (data fusion), as the greatest use of remote sensing inputs generally comes when data inputs from various sources are integrated and overlaid against relevant background information in supporting systems. This data integration, fusion and analysis is either done automatically, or by various agencies at federal, state and local levels, or commercially for a fee... In an ongoing sense, remote sensing data from satellites, radar, balloons, and weather stations are used for short and long-term weather prediction and for climate forecasts.

This summary is equally applicable to flood, as remote sensing technology in flood management also functions to collect, process and deliver sensory data and spatial information with a view to providing a real-time and accurate assessment of flood risk, conditions, extent, behaviour and

¹⁹⁵ NSW Independent Bushfire Inquiry. (2020). Final Report of the NSW Bushfire Inquiry. Retrieved from <https://www.nsw.gov.au/nsw-government/projects-and-initiatives/nsw-bushfire-inquiry>.

impact.¹⁹⁶ Remote sensing technology data can also be usefully fused with data from rain and river gauge networks, which provide the backbone of flood data particularly for riverine floods.

Sensing technology and data fusion techniques can be used in various ways at various times during floods

Prior to a flood event, it is essential that the baseline environment is monitored in real-time to assess flood risk and threat, and to inform adequate preparations for any potential flood events. During a flood event, meteorological, spatial and sensory information is used to assess flood risk and threat, to trigger – with as much notice as possible – warning of an emergency and to elicit appropriate action from emergency services and communities. Following a flood, fast collection of information and data is critical to verify flood extents and impacts, and to enable timely damage assessments and priority clean-up. It is also at this stage that any necessary improvements to predictive tools and gaps in sensing technology are assessed, in order to prepare better for future floods.

Figure 2-25 below summarises the use of remote sensing technology and data fusion techniques across each phase of a flood.

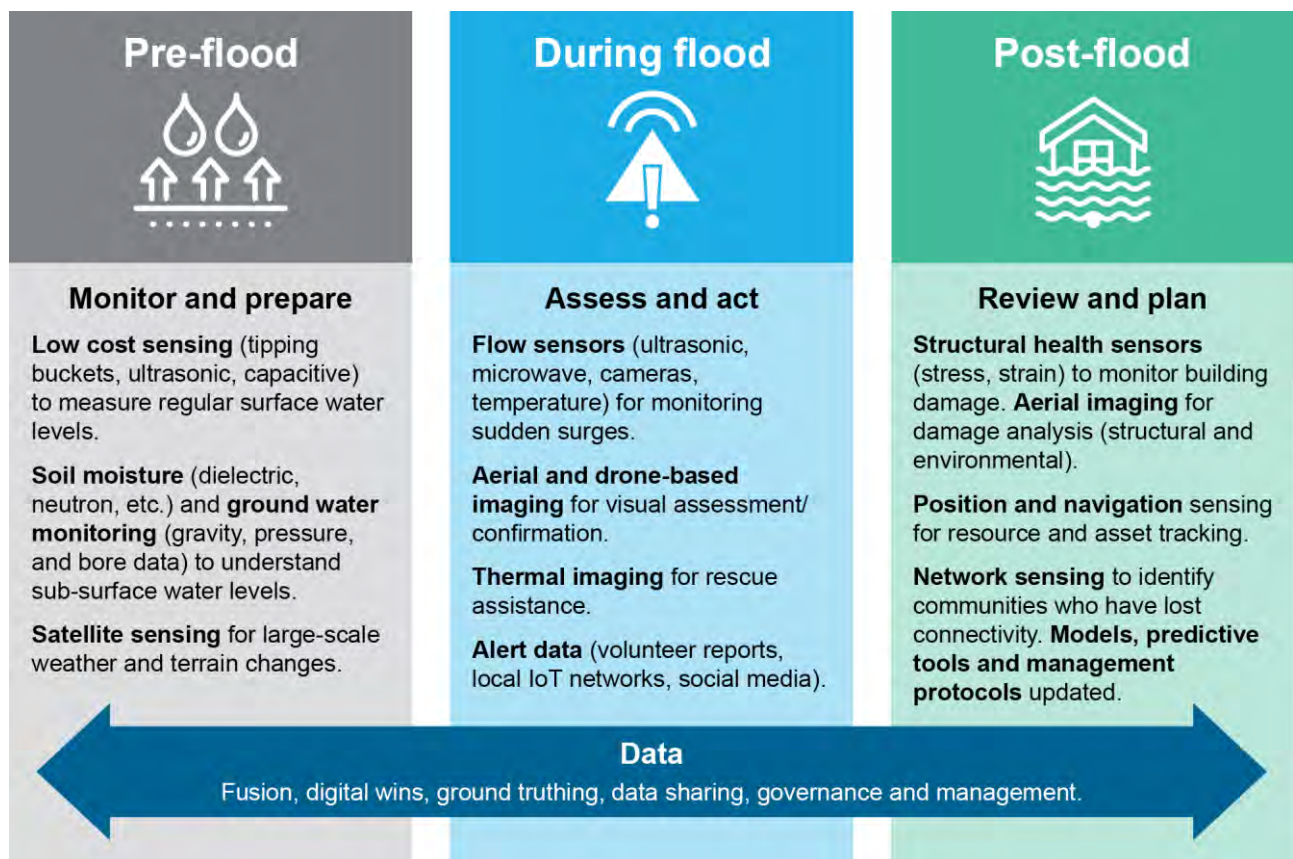


Figure 2-25: The use of remote sensing technology and data fusion techniques, pre-during and post flood. Source: NSW Smart Sensing Network.

Uses and limitations in the 2022 floods

The Inquiry heard that a number of government departments and agencies support flood preparedness, response, recovery and resilience outcomes through these technologies and data fusion techniques. Box 2-3 includes some examples reported to the Inquiry.

¹⁹⁶ Ibid.

Box 2-3: Use of sensing technology and data fusion techniques in the 2022 floods

Uses by NSW Government departments and agencies during the recent floods included:

- The Department of Customer Service (DCS) and Infrastructure NSW (iNSW) supported emergency management operations by deploying drones to verify flood heights and calibrate flood modelling
- Water NSW¹⁹⁷ and Sydney Water¹⁹⁸ utilised various technologies to monitor NSW's riverine environment including rain and river gauges, as well as cameras, infrared imagery, water velocity and flow sensors, presented via online dashboards¹⁹⁹
- iNSW drew on Nearmap imagery (under licence) to identify flood extents and understand riverbank impacts²⁰⁰
- DCS and NSW Environment Protection Authority (EPA) conducted plane and helicopter flyovers to provide aerial imagery and spatial analysis to assess flood extents and damage, including riverbank erosion risks, and to identify high priority areas for treatment²⁰¹
- DCS compared river gauge data with data from previous flood events to determine severity, analysis of land use and titles within flood extents of affected Local Government Areas (LGAs) to assist Service NSW in determining grant eligibility²⁰²
- DCS fast-tracked cadastral upgrades in areas such as Lismore, Richmond Valley, The Hills, Byron, Central Coast, Clarence Valley, Hawkesbury and Hornsby where flood damage was most destructive to infrastructure, including buildings, connecting roads and houses, to assist further damage assessments and support grant eligibility determinations.²⁰³

Machine Learning and Artificial intelligence techniques allowed for the data collected to be processed rapidly and made available to emergency services and other relevant Government stakeholders through NSW's Spatial Portal and Spatial Digital Twin.²⁰⁴

The Inquiry also heard of some of the difficulties in using remote sensing technology during the floods. One of the key challenges described was the growing need for scalable, bespoke, remote flood forecast and monitoring systems with a reliable communications network to enable timely warnings.²⁰⁵ This is a particular concern for flash flooding which was a major problem in the 2022 floods.

Floods are hard to forecast and predict due to their highly localised nature and given the complicated interplay of casual factors described in sections above. Warnings of severe storm rainfall events range from 1-24 hours ahead, and flash flooding can occur within hours of a rainfall event. This makes appropriately configured rain radars and reliable rain and river gauge

¹⁹⁷ Water NSW. (2022). Real-time Data. Retrieved from www.waternsw.com.au/waterinsights/real-time-data.

¹⁹⁸ Sydney Water. (2022). Managing Stormwater. Retrieved from <https://www.sydneywater.com.au/water-the-environment/what-we-are-doing/current-projects/managingstormwater.html>.

¹⁹⁹ Ibid.

²⁰⁰ iNSW (Infrastructure NSW). (2022). Advice to the Inquiry provided 10 June 2022.

²⁰¹ Ibid; DCS (Department of Customer Service). (2022). Advice to the Inquiry provided 30 May 2022.

²⁰² DCS (Department of Customer Service). (2022). Advice to the Inquiry provided 30 May 2022.

²⁰³ Ibid.

²⁰⁴ Ibid.

²⁰⁵ NSSN (NSW Smart Sensing Network). (2022). Advice to the Inquiry provided 2 May 2022.

information critical to support timely and accurate flood forecasts, as radars provide estimates of rainfall over large areas, supported by real-time rainfall and river heights from gauges.²⁰⁶

The Inquiry heard that there are significant gaps in radar coverage, particularly over the Mid-Coast, and more redundancy in the system is needed in case of outage.²⁰⁷ It was also told that government water monitoring assets and technology, including gauges, are often installed as part of an isolated project, such as large, fixed monitoring stations centred around key assets, rather than being implemented as part of an integrated network for the primary purpose of robust flood monitoring.²⁰⁸ For example, Water NSW told the Inquiry that its 5,000-plus monitoring stations primarily measure the quality and quantity of water in NSW rivers, streams, groundwater bores and dams for water licensing or water sharing plan compliance.²⁰⁹ With some tweaking, this resource of a large network of monitoring stations can also be pressed into service to assist with the provision of timely and accurate flood warnings.

Another example where better integration would provide a significant flood data boon concerns the location, ownership, management and maintenance of rain and river gauges. The Inquiry heard that NSW Government rain and river gauges sit alongside and yet largely separate from Australian Government and local government gauges. Multiple stakeholders described NSW's, and Australia's, rain and river gauge network as a "patchwork"²¹⁰ and commented on the varied capacity of councils to maintain their gauges satisfactorily – leaving key gaps in the gauge network. As stated by Janelle Saffin MP, Member for Lismore:²¹¹

Flood gauges are unreliable and in and poor condition. There is confusion as to the jurisdiction for the installation and maintenance flood gauges whether it be the NSW Government, Australian Government or Local Government, or a mix of them.

The Bureau doesn't own or control any river gauges in some high-risk catchments, and some current owners do not have capacity to undertake appropriate maintenance. The river gauge network covering NSW needs to be significantly enhanced and appropriately maintained, preferably under leadership and coordination from the Bureau. Gauges and data from the Bureau must also be augmented with much better local flash flooding sensor intelligence.

During the floods, weather affected the collection of aerial and satellite imagery. Cloud associated with heavy rainfall is in most cases impenetrable, and when aircraft can get under cloud it is at significantly higher cost.²¹² In some cases, imagery was obscured by cloud shadow, reflective sunlight or blurred by rain, and the time lag in acquiring high resolution aerial photography and data meant it was not always best suited for immediate disaster response.²¹³

There were also difficulties in acquiring data post-flood. DCS Spatial Services told the Inquiry that the extent and scale of the floods created challenges in landing and refuelling planes, which hampered efforts to collect and download aerial imagery of flood extents and impact.²¹⁴

²⁰⁶ Bureau of Meteorology. (2022). Advice to the Inquiry provided 24 June 2022.

²⁰⁷ Ibid.

²⁰⁸ NSSN (NSW Smart Sensing Network). (2022). Advice to the Inquiry provided 2 May 2022.

²⁰⁹ Water NSW. (2022). Water monitoring network. Retrieved from [WaterNSWhttps://www.watarnsw.com.au/supply/regional-nsw/water-monitoring](https://www.watarnsw.com.au/supply/regional-nsw/water-monitoring).

²¹⁰ Meetings with Water NSW on 28 April 2022; Bureau of Meteorology on 25 May 2022; Department of Planning and Environment on 6 May 2022.

²¹¹ Janelle Saffin MP, Member for Lismore, submission to the Inquiry.

²¹² Meeting with Stephen Jacoby on 25 May 2022.

²¹³ Ibid.

²¹⁴ Meeting with Department of Customer Service, NSW Telco Authority on 3 June 2022.

The capability is there – but is not used to its fullest extent

Australia's, including NSW's, strong capability in remote sensing both commercially and in the public sector was noted by the 2020 NSW Independent Bushfire Inquiry, which commented:²¹⁵

NSW, and Australia more generally... has been active in this field since the late 1970s. The Department of Customer Service (DCS) through Spatial Services is the key spatial data agency in NSW and the State has a long history of developing and using remote sensing and spatial expertise (and various NSW government agencies were members and associate members of the Cooperative Research Centre for Spatial Information, CRC SI, throughout its existence 2003-18 as were several companies based in NSW). Spatial Services coordinates NSW government access to a wide variety of remote sensing data sources including State-wide imagery from more than 100 satellites orbiting Earth. But many other State agencies also have strong spatial information capabilities including DPIE, Transport for NSW, Infrastructure NSW and Regional NSW.

NSW coordination with other Australian governments and the government of New Zealand on remote sensing and spatial matters more broadly is coordinated through the Australia and New Zealand Spatial Information Council (ANZLIC) which is the peak intergovernmental organisation providing leadership on all aspects, including the collection, management and use, of spatial information. ANZLIC was a key player in promoting the greater integration of spatial data with other built and natural environment information with a view to, among other things, reducing natural disaster and climate impacts on people, property and the environment.

This Inquiry would add the NSW Smart Sensing Network (NSSN), which recently celebrated its 6th anniversary and, as a consortium of 8 universities across NSW and the Australian Capital Territory, has a proven track record in delivering innovative smart sensing solutions. The NSSN was invited by the Inquiry to provide advice outlining the current and prospective significance of smart sensing to the issue of flood prediction, preparation, response and mitigation and this advice has informed the Inquiry's findings in this area.

The NSW Independent Bushfire Inquiry went on to describe the various ways in which remote sensing technology was used in the 2019–2020 bushfires. It concluded:²¹⁶

The Inquiry was impressed with how NSW RFS worked at great speed to use quite a diverse array of remote sensing imagery and information to infer the characteristics of the big fires in the 2019-20 season, but the Inquiry and several of the remote sensing agencies and companies it consulted were surprised that more sophisticated data fusion and automatic decision-making tools were not available to assist NSW RFS with this task, given Australia's capabilities in this field.

Again, this Inquiry cannot help but draw parallels. Though remote sensing technology and data fusion techniques were used reasonably well in the recent flood events, as the NSSN summarised in its advice to the Inquiry:²¹⁷

There is currently no system in place that allows for high-resolution mapping of the water system specific to each local authority. There is an over reliance on in-person validation of gauge levels, a fragmented information system from various stakeholders, and a lack of historical and modern data required for accurate flood modelling and prediction.

²¹⁵ NSW Independent Bushfire Inquiry. (2020). Final Report of the NSW Bushfire Inquiry. Retrieved from <https://www.nsw.gov.au/nsw-government/projects-and-initiatives/nsw-bushfire-inquiry>.

²¹⁶ NSW Independent Bushfire Inquiry. (2020). Final Report of the NSW Bushfire Inquiry. Retrieved from <https://www.nsw.gov.au/nsw-government/projects-and-initiatives/nsw-bushfire-inquiry>.

²¹⁷ NSW Independent Bushfire Inquiry. (2020). Final Report of the NSW Bushfire Inquiry. Retrieved from <https://www.nsw.gov.au/nsw-government/projects-and-initiatives/nsw-bushfire-inquiry>.

Most of the challenges and limitations described by the NSSN and in the section above are easily remedied – subject to appropriate investment.

Opportunities to improve and enhance our capability

Sensing technologies are critical enablers of data-driven preparation, response and recovery initiatives, and the state need always to be looking at how it can harness all available and emerging technology in this area – by both optimising use of existing technologies and developing new and innovative solutions.

As a result of prior natural disasters, including the worst fires ever in the Black Summer of 2019–2020, emergency services, climate and land management agencies at state and national level have strong remote sensing capability and this technology provided useful information during the planning, preparation, response and recovery phases of the 2022 flood events.

However, more is needed to push the state's and nation's capability and use this technology to its fullest extent. This includes optimising and increasing adoption of all available sensing technologies, in addition to greater investment in developing technologies and related data fusion methods. As a matter of principle, increasing investment in, development of and use of this technology should not just be done to improve the way we plan, prepare, respond to and recover from disaster events, but also to improve business-as-usual or every-day use (including catchment monitoring, mine rehabilitation and general work health and safety).

The Inquiry notes that DCS Spatial Services is in the process of acquiring 2 new sensors with cloud-based auto-imagery processing capability,²¹⁸ and that there has been recent Government investment in remote sensing technology following the recommendations of the 2020 Independent Bushfire Inquiry. This includes \$57 million in technology and IT systems to strengthen emergency fire services across the state. Among the new technology were 30 drones which can be deployed to live-stream thermal imaging, providing information on fire extents to crews on the ground, in addition to fire trucks with radio, 4G and satellite connectivity.²¹⁹ The Inquiry was also told that the NSW Rural Fire Service, working with the University of Sydney robotics laboratory, is also designing smart drones tethered to fire trucks,²²⁰ assets that can also be harnessed to provide flood intelligence.

Further, given that technology has developed to be more powerful, cheaper and better connected, there is no reason not to have remote sensing technology that is spatially and temporally marked in high-risk catchments to provide reliable, real-time monitoring and risk assessment information. Government should utilise the capability and expertise of organisations like the NSSN and other companies to develop and build new warning systems.

To improve the reliability of existing flood forecast, monitoring and warning infrastructure, Government, in collaboration with the Australian Government, should identify gaps in the NSW's gauge network and negotiate the planned upgrade (increasing automation) of assets to ensure continuous real-time data is available to flood forecasters, emergency responders and communities. Further, network ownership must be consolidated to ensure fitness-for-purpose and to enhance network resilience through frequent, consistent maintenance.

Government must also upgrade NSW's radar capability and invest in fixed radar, particularly over high-risk areas. Additionally, and though existing overlaps in radar coverage provide a measure of redundancy in the event of radar outage, devoted back-up radars would more effectively reduce

²¹⁸ Meeting with Department of Customer Service, NSW Telco Authority on 3 June 2022.

²¹⁹ Lai, S. (2021). Fireball-dropping drones part of new technology upgrades for NSW firefighters. Retrieved from [NSW bushfires: Fireball-dropping drones part of new technology upgrades for firefighters \(9news.com.au\)](https://www.9news.com.au/news/nsw-bushfires-fireball-dropping-drones-part-of-new-technology-upgrades-for-firefighters/9news.com.au)

²²⁰ Meeting with NSW RFS Commissioner on 16 May 2022.

the risk associated with radar outages occurring in the lead up to, and during, floods. Mobile radar would also provide coverage where fixed radar cannot be maintained.

At base level, the fundamental flood data relies on a full coverage by a properly located network of rain and river gauges and sufficient radar capability. The Bureau has investigated what is needed in this regard and developed a New Policy Proposal. Funding this would lead to a significant improvement in available flood data.

Finally, the Inquiry echoes and extends the sentiment of the NSW Independent Bushfire Inquiry which determined:²²¹

... it is also essential that Government advocate at a national level to push existing technology as far as possible, including via acquiring expensive infrastructure items such as high altitude platforms owned nationally, and encourage new technological innovation by developing a plan for effective and innovative fire management using remote sensing technology.

High-altitude platforms positioned over the east coast would have many applications beyond fire, flood and other disaster management, including monitoring for mine rehabilitation.

B. Findings – knowledge resources to support flood management

- The design of the current rain and river gauge network is not fit for purpose. There are issues around gauge location, ownership and maintenance, and there is a lack of leadership and coordination of the gauge network. The river gauge network covering NSW needs to be significantly enhanced and appropriately maintained, preferably under leadership from the Bureau of Meteorology.
- NSW has strong capabilities and systems in sensor research and technologies but needs to harness this further to provide more flood monitoring information and warning systems, especially for flash flooding.
- Radar coverage over NSW requires upgrading to improve gaps in the existing network, and enhanced redundancy to ensure reliability of forecast and warning services is available for at-risk catchments, particularly in cases of radar outages in the lead up to and during floods.

1. Recommendation – knowledge resources to support flood management

That, to provide more accurate and complete data for flood threat identification, warning and modelling systems, Government through the proposed new NSW Reconstruction Authority (NSWRA) work with the Australian Government to:

- improve the rain and river gauge network by:
 - implementing the Bureau's proposed New Policy Proposal for rain and river gauges in NSW
 - working to transfer ownership and maintenance responsibility for as many of the river and rain gauges as possible in NSW to the Bureau

²²¹ NSW Independent Bushfire Inquiry. (2020). Final Report of the NSW Bushfire Inquiry. Retrieved from <https://www.nsw.gov.au/nsw-government/projects-and-initiatives/nsw-bushfire-inquiry>.

of Meteorology

– upgrading and ensuring there is a maintenance program across NSW for those gauges that remain in state and local government ownership

- upgrade radar capability in NSW to ensure overlapping coverage and some redundancy, through upgrades to existing fixed radars, and investment in new fixed and mobile radars.

Also that the Government through the NSWRA:

- ensure that all relevant state entities and local councils implement the Bureau flash flooding guidelines for all watercourses for which they have flood warning responsibility, drawing on the state's significant expertise in remote sensing to implement effective monitoring and warning systems that send warnings to all residents and businesses in affected areas
- make real-time flood warnings and information – both raw information from gauges and processed information from models – available publicly via a smartphone app (ideally part of a state disaster information app) that also allows citizens to provide information during a flood to help authorities and community. This information could include flood imagery and local knowledge observations in the lead into, during, and immediately after flood events.

Climate and weather research

New South Wales is exposed to a range of climate risks and extreme weather events. Though research cannot prevent extreme events from happening, it can help to inform processes that protect people from the effects – before, during and after a disaster event.

Critically, and as explored above, while existing science can tell of the increasing risks of some extreme events, accurate information is lacking for specific and local risk assessment and a lot is still unknown about climate and rainfall producing weather events.

Gaps in current understanding and capability widen when taking into account the largely unknown effect of climate change. This adds an extra risk factor that needs to be included when planning for the longer term.

State expertise needs to be supported

Emerging evidence hints at changes in climate that are regionally specific and potentially catastrophic, such as the stalling of intense rainfall systems over coastal NSW. Different industries and sectors need different information, and the same is true for regional locations. Without region-specific knowledge of these changes and capacity to identify emerging threats at a state and regional level, there is a risk that Government investment in mitigation or adaptation measures may fail to protect from future events – or may be targeted at events that never materialise.

To date, NSW Government has accessed many of its fundamental science needs and emerging climate risk requirements from the internationally recognised ARC Centre of Excellence for Climate Extremes headquartered at UNSW Sydney (CLEX), and this Inquiry was fortunate also to be able to draw on CLEX's expertise in preparing this report.

CLEX is subject to the funding rules of the Australian Research Council and will close in 2024.²²² The Inquiry was told that CLEX plans to relocate its activities to Monash University, pending the success of a new funding request. CLEX's relocation would leave a major research capability gap in NSW and no significant science foundation to identify and assess emerging climate risks to the state, nor to support short-term and long-term state-specific priorities. It would also mean that connections to national research, and the ability to leverage such, would almost entirely be contained within Victoria.

As such, the Inquiry strongly suggests Government commit to maintain the research capability of CLEX in NSW.

Further to this investment, the Inquiry suggests that CLEX and UNSW establish a long-term partnership with Government to inform targeted measures to mitigate climate change through an increased understanding of specific risks and local impacts of climate change in NSW.

Collaboration at a national and international scale

Rather obviously, climate and weather do not stop at state borders. But, as Professor Pitman explained to the Inquiry, at a national scale, climate research remains disconnected. Excellent research undertaken by the university sector, CSIRO and the Bureau is not captured in a way that leads to a well-developed national program.²²³ It is critical that Australia resolve the disconnect between research and operational requirements, through a national strategy for climate and weather research.

Australia, and NSW, as a global centre for disaster research and technology

Australia is fortunate to have had the Bushfire and Natural Hazards Cooperative Research Centre (BNHCRC) which, for almost 2 decades, has acted as a coordinating body for research nationally in bushfire and other disaster-related topics.

Following the 2019–2020 bushfires, the Australian Government invested \$88.1 million to extend and scale up critical research into bushfires and other natural hazards, creating Natural Hazards Research Australia, a new, national research centre for natural hazard resilience and disaster risk reduction,²²⁴ as a scaled-up successor to BNHCRC.

The Inquiry notes that this transition is in its infancy and that the success of this centre is critical to deliver evidence-based research to support the needs of emergency services and communities across Australia to mitigate climate and disaster risks, and prepare for, respond to and recover from future natural disasters.

The Inquiry also notes that the NSW Independent Bushfire Inquiry recommended:²²⁵

²²² The ARC Centre of Excellence for Climate Extremes (CLEX) is financially supported via a Major Investment Grant (CE170100023) from the Australian Research Council. The Centre is financed and hosted by the University of New South Wales. Collaborating partners are Monash University, the University of Melbourne, the Australian National University and the University of Tasmania. They provide significant financial and in-kind support. The Centre also receives financial support from the NSW Research Attraction and Acceleration Program, the NSW Department of Planning and Environment and the Bureau of Meteorology. ARC Centre of Excellence for Climate Extremes. (2021). 2021 Annual Report. Retrieved from <https://climateextremes.org.au/annual-report-2021/>

²²³ CLEX (The ARC Centre of Excellence for Climate Extremes). (2022). Advice to the Inquiry provided 7 June 2022.

²²⁴ Hon. David Littleproud MP & Hon. Karen Andrews MP. (2020). \$88.1 million for new world class disaster research centre. Retrieved from [Joint media release with the Hon. Karen Andrews MP - \\$88.1 million for new world class disaster research centre \(homeaffairs.gov.au\)](https://www.homeaffairs.gov.au/joint-media-release-with-the-hon-karen-andrews-mp-88.1-million-for-new-world-class-disaster-research-centre).

²²⁵ NSW Independent Bushfire Inquiry. (2020). Final Report of the NSW Bushfire Inquiry. Retrieved from <https://www.nsw.gov.au/nsw-government/projects-and-initiatives/nsw-bushfire-inquiry>.

that 'Government establish NSW as a major world centre of bush fire research, and technology development and commercialisation'.

This Inquiry now takes that recommendation a step further.

NSW's research, development and commercialisation capabilities must also be extended to include more on flood and other disasters, so that NSW too can become a global centre for understanding, monitoring and responding to all disasters. Continuing to strengthen our understanding of flood-producing weather phenomena and harnessing all available and emerging technology at a state level will enable more effective, targeted and timely:

- resource deployment during heavy rainfall and flood events, for example, earlier targeting of incidents that are likely to escalate
- warnings to communities and emergency services on the ground about the likelihood of very dangerous conditions
- mitigation measures.

2. Recommendation – climate and weather research

That, to enable effective mitigation and adaptation measures in response to changing climate risks, Government establish NSW as a world centre of disaster research and technology development. This should include:

- maintaining and enhancing climate and weather research capability in NSW through establishing a long-term research funding network/partnership (the NSW Climate Extremes Network – NCEN – modelled on other successful research networks such as NSSF) with the state's universities, coordinated and led through the ARC Centre of Excellence in Climate Extremes (with funding renewed based on performance every 5 years) to ensure leading-edge climate change research and modelling capabilities are available to government agencies and NSW businesses and communities. The funding will enable NCEN to hire researchers and build training programs for students and researchers to enrich the research environment, and the impact of the research in decision making within NSW
- commissioning further research and technology development (through NCEN working as appropriate with the Bureau of Meteorology, Natural Hazards Research Australia, CSIRO and research organisations worldwide, as well as the ARC Centre of Excellence in Climate Extremes) to understand the weather patterns conducive to extreme rainfall (including more detailed rainfall event attribution studies) with a view to increasing rainfall forecasting accuracy in time and location.

Chapter

3

3. Emergency management and response

This chapter reports on the following Term of Reference for the Inquiry:

1.c.responses to floods, particularly measures to protect life, property and the environment, including:

- i) immediate management, including the issuing and response to public warnings*
- ii) resourcing, coordination and deployment*
- iii) equipment and communication systems*

1.d. the transition from incident response to recovery, including the roles, structures and procedures of agencies, government, other entities and the community

2.a. safety of emergency services and community first responders

2.d. impact on essential services, including electricity supply, water supply and telecommunications

2.g.coordination and collaboration between the NSW Government and the Australian Government

2.h.coordination and collaboration by the NSW Government with other state and territory governments and local governments

2.i. public communication and advice systems and strategies.

The chapter provides an overview of the response to the 2022 flood events and an assessment of its effectiveness, as well as opportunities for improvement in the future. In particular, this chapter examines the:

- current legislative framework and emergency management arrangements
- coordination and deployment of local, interstate and Australian Government agencies
- effectiveness of public warning systems
- power of community initiatives
- role of evacuation centres
- impacts on essential infrastructure and services including telecommunications, water and roads
- transition from incident response to recovery.

Overall, the state response to the February, March and April 2022 floods highlighted strengths and weaknesses within NSW's emergency management arrangements, and exposed significant capability gaps, particularly in the NSW State Emergency Service (SES). This was particularly evident in the Northern Rivers where, if it wasn't for community action, loss of life would have been significantly higher. The chapter looks at some of the lessons learnt and makes recommendations for change.

The Inquiry looked particularly at the emergency response to the flooding events earlier in the year, and while it has made some observations about the response to the July 2022 floods, it has not examined this in detail. At the time of writing, the after-action reports for the July floods have not been completed.

3.1. Emergency management arrangements in NSW and how they were applied

This section describes the NSW emergency management legislative framework which underpins the entire emergency management response process, and the way emergency management arrangements are applied.

It details the actual contributions from many agencies and organisations to the management of the 2022 flood events. The scale and complexity of the events and the responses they required meant that the assistance of additional emergency services from other state, interstate and national agencies was sought. It also became clear overall that despite the huge logistical input from multiple agencies, capability gaps were exposed, with members of the community stepping up to fill them.

What is a disaster?

NSW is vulnerable to a variety of hazards, of which floods and bushfires are well-known ones to the community.²²⁶ But, as the 2020 Commonwealth Royal Commission into National Natural Disaster Arrangements stated,²²⁷

hazards on their own are not disasters... Disaster occurs when natural hazards intersect with people and things of value, and when impacts of hazards exceed our ability to prevent, respond or recover from them.

This is, in turn, coupled with the significant effect that natural hazards have on the natural environment.

Box 3-1: A comment on Emergency Declaration Powers under the *State Emergency and Rescue Management Act 1989* (SERM Act)

The Premier can declare a state of emergency in NSW under the SERM Act if satisfied that particular circumstances exist. These circumstances can be paraphrased as an actual or imminent event (such as fire or flood) which threatens people, animals, property or essential services.²²⁸

A declaration enables extraordinary powers to apply for the duration of the state of emergency. The Minister of Emergency Services and Resilience may for example:

- direct any government agency to take action or exercise a function
- order evacuations and o take other safety measures such as stopping traffic or shutting off power or water
- take possession and make use of any person's property for the purposes of responding to an emergency.

Apart from legislation dealing with more specific types of emergencies (such as power supply), all other legislation which enables special action to be taken in a general state of emergency relies upon a declaration being made separately under the SERM Act.

²²⁶ Meeting with Risk Frontiers on 22 April 2022.

²²⁷ Commonwealth of Australia. (2020) Royal Commission into National Natural Disaster Arrangements Report. Retrieved from <https://naturaldisaster.royalcommission.gov.au/system/files/2020-11/Royal%20Commission%20into%20National%20Natural%20Disaster%20Arrangements%20-%20Report%20%20%5Baccessible%5D.pdf>.

²²⁸ *State Emergency and Rescue Management Act 1989*, Division 4, Part 2.

Other legislation that operates in emergency situations does not require the declaration of a state of emergency, but requires particular circumstances to exist before the relevant powers can be exercised. For example, under the *State Emergency Service Act 1989* (SES Act) the emergency powers may be exercised where a flood, storm, or tsunami occurs without the need for any declaration.

The Inquiry notes that each combat agency has strong powers under legislation. During the 2019–20 bushfires the RFS asked the Premier 3 times to exercise a state of emergency. As far as the Inquiry is aware, the SES did not make any requests in the 2022 flood season.

What is emergency management?

For the purposes of emergency management at state level, an emergency is defined as:²²⁹

an actual or imminent occurrence (such as fire, flood, storm, earthquake, explosion, terrorist act, accident, epidemic or warlike action) – which a) endangers, or threatens to endanger, the safety or health of persons or animals in the State, or b) destroys or damages, or threatens to destroy or damage, property in the State, or c) causes a failure of, or a significant disruption to, an essential service or infrastructure, being an emergency which requires a significant and co-ordinated response.

Emergency management incorporates “a range of measures to manage risks to communities and the environment; the organisation and management of resources for dealing with all aspects of emergencies.”²³⁰ This involves the “plans, structures and arrangements which bring together the normal endeavours of government, voluntary and private agencies in a coordinated way to deal with the whole spectrum of emergency needs including prevention, response, and recovery”.²³¹ Without effective emergency management arrangements, a disaster, while short lived, can have a long lasting effect on individuals and the community.

The framework for emergency management arrangements is contained in legislation and covers policy, training and the exercise of management functions by a range of agencies, functional areas, government and the community. The framework is applicable to all phases of an emergency – before, during and after. NSW’s emergency management arrangements, when actioned properly, are very effective.

At its core, emergency management needs to instil and maintain public confidence and trust and meet community needs. Good emergency management requires strong leadership, communication and coordination across all levels of government, between government and the community, and within communities. It also requires good decision making that is evidence-based but employs common sense that meets community expectations.

Effective emergency management is a network of activities and relationships. At times these networks are formal arrangements, at other times they are more organic. Emergency management is not single purpose, nor is it solely concentrated in government agencies. Activities do not always need to be led by Government, as the Inquiry witnessed in the Northern Rivers, but they do need to be supported or coordinated by Government. A feature of Australian culture in emergencies is that members of the community will often step up to fill the gaps until others who may be better placed (or better qualified) can perform the necessary tasks. This certainly occurred in the Northern Rivers, and the Inquiry commends the community for their efforts. Government therefore

²²⁹ *State Emergency and Rescue Management Act 1989*, s4.

²³⁰ Australian Institute for Disaster Resilience. (2020). Australian Emergency Management Arrangements. Retrieved from https://www.aidr.org.au/media/1764/aidr_handbookcollection_australian-emergency-management-arrangement_web_2019-08-22_v11.pdf.

²³¹ Council of Australian of Governments. (2011). National Strategy for Disaster Resilience. Retrieved from <https://knowledge.aidr.org.au/media/2153/nationalstrategyfordisasterresilience.pdf>.

needs to support community-led initiatives in a phased approach, so people know what to do before, during and after an emergency, particularly in high risk areas.

There were numerous other examples during the 2022 flood events of individuals responding to local community needs, including Adam, Lisa and Brent in Woodburn who coordinated civilian flood rescues, Michael from Rotorwings Helicopters, Lismore, who conducted helicopter rescues, and Karina and David from Broadwater who coordinated immediate recovery and longer-term transition back to normal arrangements, to name but a few. The Inquiry was very impressed with the spirit, tenacity, courage and attitude of all community members who helped during these disasters.

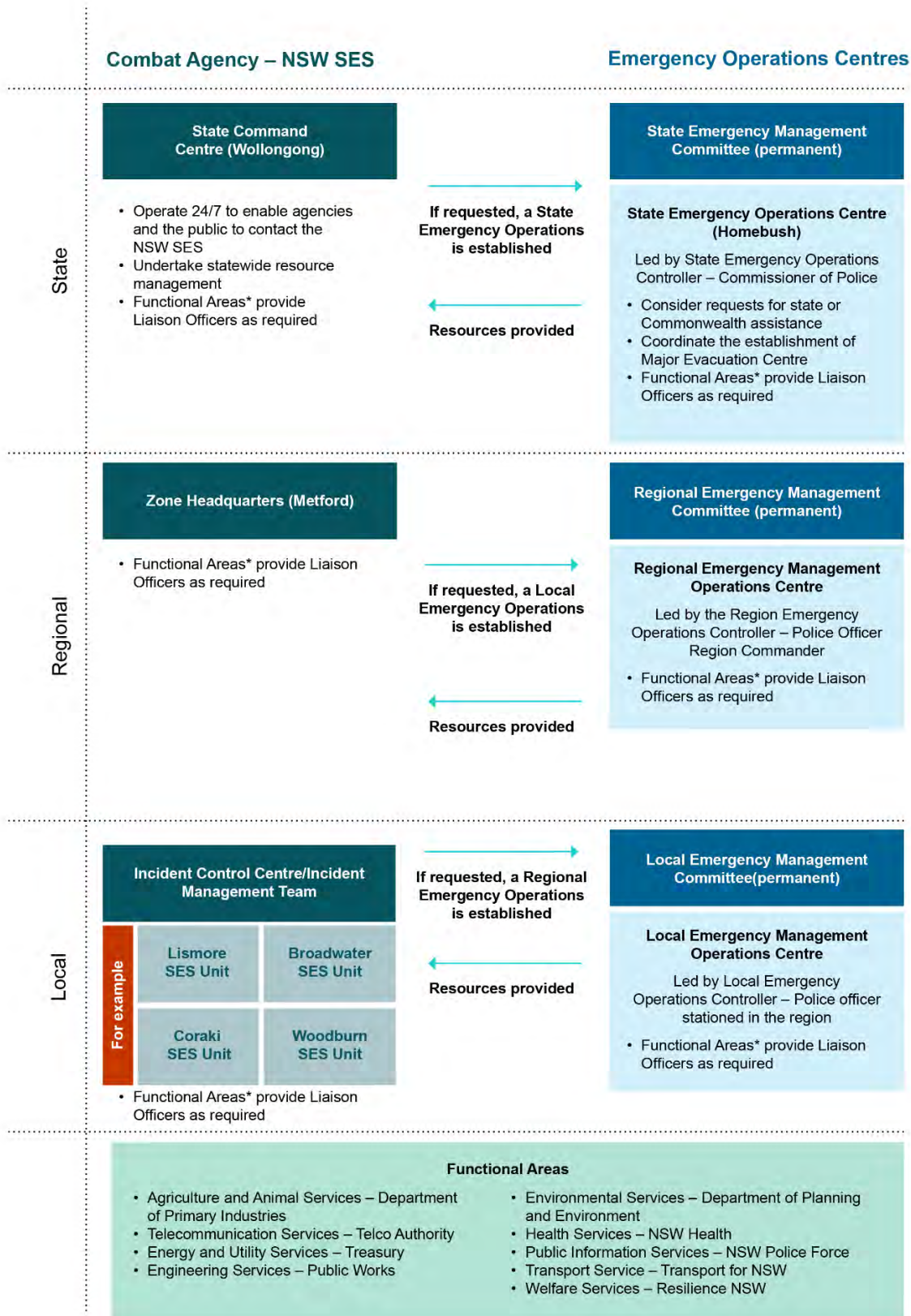


Figure 3-1: Illustration of how the NSW emergency management arrangements work together during an event.

State Emergency and Rescue Management (SERM) Act

Introduction of SERM Act

The *State Emergency and Rescue Management Act 1989* (SERM Act) was introduced following a review by Major General Ron Grey and the Premier's Department specifically about the State Emergency Service.²³² The review was established due to Government's concerns about:

- the lack of control and coordination of rescue and emergency services
- the duplication of rescue roles and resources, and
- the absence of a comprehensive, all agency state disaster plan.²³³

The SERM Act established an emergency management structure and organisation to develop and deliver a state disaster plan. It also established the State Rescue and Emergency Services Board whose main function is to control and coordinate rescue agencies and maintain efficient and effective rescue services.²³⁴

Recent amendments

Since its introduction, the SERM Act has been amended 9 times. A summary of major changes is provided in Table 3-1 below:²³⁵

Year	Key changes
1994	Employment protection provisions for volunteer members of emergency service agencies following reports that volunteers had been threatened with dismissal if they were absent from work carrying out emergency operations.
1995	Provisions to enable: <ul style="list-style-type: none">• the closure of any street, thoroughfare or any other public or private place• the shutting off of gas, water and electricity• the taking possession of, or removal or destruction of, any material or thing that may be dangerous to life or property or that may interfere with the response of emergency services to an emergency• the power to enter premises to comply with these directions.
2000	Provisions to clarify: <ul style="list-style-type: none">• that a combat agency has primary responsibility for controlling the response to a particular emergency• that the EOCON takes control or coordinates support at the request of the combat agency• that if an EOCON at any level is concerned about the control of a particular operation, they can raise the issue with the SECON• the term 'emergency' also applies to events that endanger the safety and health of animals, the environment and property.
2005	Two new offences relating to the unauthorised manufacture or using/displaying of an emergency services uniform with the intention to impersonate an officer of an emergency service organisation.

²³² Second Reading Speech. State Emergency and Rescue Management Bill. (1989). Full day Hansard transcript, Legislative Assembly, Thursday November 30, 1989. Retrieved from <https://www.parliament.nsw.gov.au/hansard/pages/home.aspx?tab=Browse&s=1>.

²³³ Ibid.

²³⁴ Ibid.

²³⁵ Resilience NSW. (2022). *Advice to the Inquiry provided 24 June 2022*.

2009	Provisions to establish the State Emergency Recovery Coordinator and its Deputy positions and their roles and responsibilities in relation to recovery processes including planning, management and accountability.
2010	Miscellaneous amendments in response to the strategic review of the SERM Act including: <ul style="list-style-type: none"> • enabling police to be assisted when taking safety measures in danger areas affected by an emergency • clarifying the ex officio nature of the positions of SEOCON and SERCON and Deputy positions • updating State Emergency Management Committee responsibilities to remove any duplication with technology or combat agency participation.
2018	A range of amendments was introduced to improve the quality and efficiency of emergency response including clarifying the definition of 'emergency' to include a failure of, or significant disruption to, an essential service or infrastructure.
2020	Amendments introduced that provided the State Emergency Management Committee with enhanced responsibility to act on findings from Inquiries, After Action Reviews and other lessons arising from the review of events.

Table 3-1: Summary of changes to the *State Emergency and Rescue Management Act 1989*

The Inquiry was informed that further amendments to the SERM Act are planned to establish a NSW Critical Infrastructure Asset Register and framework to create new obligations for critical infrastructure asset owners/operators to provide data to government about critical assets. The Register would be held by DCS and be subject to appropriate data security controls. This initiative is in response to a recommendation of the 2020 NSW Independent Bushfire Inquiry.²³⁶

Structure of current Act

The SERM Act has 2 main parts:

- part 2 – dealing with state emergency management
- part 3 – dealing with state rescue management.

The interconnectedness of the 2 parts was very much to the fore during the 2022 flood events. Although the SERM Act states that Part 3 applies to a rescue operation whether it relates to a single incident or an emergency, the SERM Act also states that Part 2 prevails if a rescue operation relates to an emergency.

Key features of the SERM Act include:

- definition of the stages of an emergency
- establishment of emergency management committees, at state, regional and local level
- establishment of emergency operations controllers (EOCONs), at state, regional and local level
- requirement for a State Emergency Plan
- establishment of a State Rescue Board.

Stages of an emergency

The emergency management arrangements are governed at a state, regional and local level through the SERM Act. The Minister for Regional New South Wales and the Minister for Emergency Services and Resilience are jointly responsible for the SERM Act.

The SERM Act, s 5, defines the stages of an emergency (known as the comprehensive approach), as follows:

²³⁶ Ibid.

(a) prevention in relation to an emergency includes the identification of hazards, the assessment of threats to life and property and the taking of measures to reduce potential loss to life or property, and

(b) preparation in relation to an emergency includes arrangements or plans to deal with an emergency or the effects of an emergency, and

(c) response in relation to an emergency includes the process of combating an emergency and of providing immediate relief for persons affected by an emergency, and

(d) recovery in relation to an emergency includes the process of returning an affected community to its proper level of functioning after an emergency.²³⁷

Emergency Management Committees (EMCs)

The arrangements divide activities into state, regional and local with each having a corresponding Emergency Management Committee (EMC). Regional activities correspond to a cluster of local government areas (LGAs). Local activities correspond generally to a single LGA (though may have more).

Ideally, in a disaster event all the arrangements should work together as a ‘badge off’ approach, i.e. all agencies work collectively and in a coordinated way towards the common goal of protecting life and property. Fundamentally, every emergency is likely to be multi-agency. At the end of an emergency the state needs to ask: ‘Did we as a state do everything we could?’²³⁸ Figure 3-1 provides an illustration of how this should work.

At **state level**, the State Emergency Management Committee (SEMC) develops emergency management policy and oversees emergency management in NSW. During imminent or occurring emergencies, the SEMC convenes, briefs, and ensures situation awareness of, its members.

The roles and functions of the SEMC are translated at **regional level** through Region Emergency Management Committees (REMC) and at **local level** through Local Emergency Management Committees (LEMC).

Role of local councils

Arguably, the LEMCs have the greatest interface with the communities affected by the emergency. A LEMC is responsible for the preparation and review of emergency management plans to prevent, prepare for, respond to and recover from emergencies within the LGA for which it is constituted, and is chaired by the council’s General Manager or Chief Executive Officer.²³⁹ Its membership includes representation from emergency service agencies in the LGA, and from service providers in functional areas as determined by the local council.

The role of local councils extends over all phases of a natural disaster, as set out in Table 3-2.

Emergency management phase	Council role in supporting emergency response agencies
Prevention	Participation in Local Emergency Management Committees (LEMCs)
	Participation in local emergency training exercises
Preparation	Carry out preparation activities as directed by combat agency
	Monitor and improve asset resilience

²³⁷ State Emergency Management Act 1989.

²³⁸ Meeting with NSW RFS on 16 May 2022.

²³⁹ Audit Office of NSW. (2022). Local government business and service continuity arrangements for natural disasters. Retrieved from <https://www.audit.nsw.gov.au/our-work/reports/local-government-business-and-service-continuity-arrangements-for-natural-disasters>.

Response	Executive support to the EOC
	Incident management
	Carry out directed emergency management activities from emergency controllers
	Support first responders
	Where requested, supply plant equipment to the LEMC
Recovery	Communication on behalf of the EOC
	Participate in recovery committees
	Participation in lessons learned activities
	Coordinate or pass on state or national support or recovery grants

Table 3-2: Overview of council's role during and after natural disasters.

During recovery, councils repair or rebuild damaged council infrastructure and assets, and provide services to clean up waste and debris. The Inquiry heard that recently, in part due to more severe and long-lasting natural disasters, councils have begun recovery activities before the response has finished.

Each council also provides a Local Emergency Management Officer (LEMO), a staff member with specific emergency management planning and preparation responsibilities, and administrative support to the LEMC.

This reflects the fact that councils are well-positioned to drive a community's disaster preparedness through their closeness to their communities. Through the LEMO, they can develop a series of tools and resources to drive continuous improvement and learning.

The importance of the LEMO position became apparent throughout the Inquiry's engagement with local government. The LEMO performs a critical function across a variety of hazards. These positions are often held as additional responsibilities or 'passion projects' by council staff on top of their ongoing duties involving the delivery of core services to their community.

Box 3-2: The importance of a valuing Local Emergency Management network – Sutherland Shire Council

During the Inquiry's meeting with Sutherland Shire Council, council officers provided information about the LEMO role. Council officers identified a business continuity risk in only having a single LEMO with corporate knowledge and experience of emergency management.

To mitigate this risk, Sutherland Shire Council has established a 'LEMO Team', in which a single lead rotates out of the LEMO position and is supported by assistant LEMOs. As all positions are part time, this improves engagement in emergency management planning and preparedness, while establishing business continuity. Furthermore, a team-based approach to the LEMO role has built a collaborative environment through the crisis management that builds continuous improvement and a learning culture.

Sutherland Shire Council LEMC Team		
LEMO Group	Role	Availability
LEMO (PT responsibility)	Direct coordination and liaison with emergency service agencies and government organisation during an emergency incident LEMC Chair, facilitates effective communication networks and planning across LEMC membership Liaison Officer to BCP Mentor Assistant LEMO's.	24 hours 7 days

Deputy LEMO (PT responsibility)	Alternate LEMO	24 hours 7 days (back up)
Assistance LEMO x2 (PT responsibility)	Acts as a second to LEMO assisting in providing exec support, facilitates for LEMC in response to emergency events and preparation of plans Development of LEMO role.	Normal business hours
Business & Emergency Management Officer	Provides EM Business Support Provides LEMC with corporate support Administers DFRA claims.	50%
Operations Controller (Temp appointment)	Facilitates coordination of operational unit responses Appointed within an emergency as required Assists lead/agency/agencies as required.	As required during incidents
Recovery Coordinator (Temp appointment)	Project manages community recovery activities Appointed within an emergency as required Assists lead/agency/agencies as required.	As required during incidents

The LEMO team is supported by a Business and Emergency Management Officer who provides administrative support, ensuring operational roles can focus on operational responsibilities and fully participate in LEMC meetings. The team is also supported by an operations controller and recovery coordinator as required.

Though applicable across a range of emergency situations, a team-based approach to the LEMO role would be a valuable initiative in high risk and flood prone communities across the state.

Emergency operations controllers (EOCONs)

At **state level**, the State Emergency Operations Controller (SEOCON) is a member of the NSW Police Force Senior Executive.²⁴⁰ The SEOCON is a member of, but does not chair, the SEMC. The SEOCON's responsibilities during an emergency include (but are not limited to):

- establishing and controlling a State Emergency Operations Centre (SEOC), a central hub that brings officers from all NSW Government response agencies under one roof to ensure a coordinated emergency response
- controlling and coordinating emergency response operations at state level if the SEOCON is the designated controller or if no alternative agency has been designated as the lead agency (combat agency) – or supporting the combat agency if one has been designated
- providing advice to the Minister about emergencies, including the need to declare a 'State of Emergency'
- ensuring 'Initial Impact Assessments' are completed following an emergency to inform recovery arrangements.

At the **regional level**, the Region Commander of Police for each Emergency Management Region is appointed as the Region Emergency Operations Controller (REOCON). There are 11 Emergency Management Regions across the State, each consisting of several LGAs. The REOCON has very similar responsibilities to the SEOCON at a regional level, and also chairs the Regional Emergency Management Committee (REMC).

²⁴⁰ NSW Government. (2018). New South Wales State Emergency Management Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-emergency-management-plan-emplan.pdf>.

At the **local level**, the Local Emergency Operations Controller (LEOCON) is a senior police officer stationed within the LGA with experience in emergency management. Once the LEOCON is activated, the LEOCON's responsibilities are to set up local emergency operation centres (LEOCs). Activation might occur when there is no designated lead agency (in which case the LEOCON is responsible for coordinating a response to an emergency) or in support of a lead agency (such as the SES when there is a flood event – see below for more details). The LEOCON is a member of the Local Emergency Management Committee (LEMC), but not the chair.

Figure 3-2 shows the cascade of emergency management roles and functions through the three tiers:

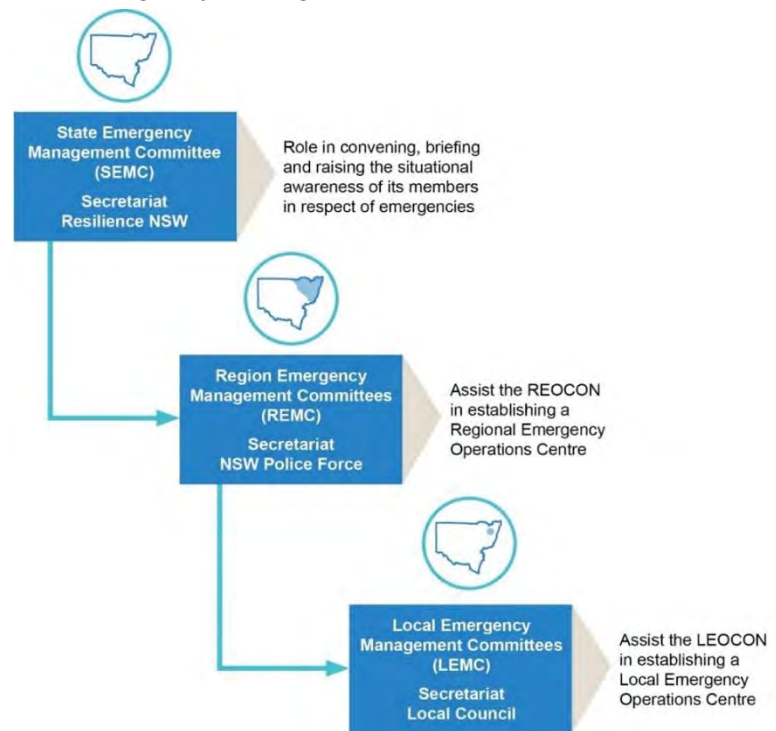


Figure 3-2: The translation of roles and functions of the SEMC into the REMC and LEMC.

State Emergency Plan

The SERM Act requires a *State Emergency Management Plan* (EMPLAN) to ensure a coordinated approach to emergency management by specifying the governance and coordination arrangements and roles and responsibilities of agencies.²⁴¹ The Act stipulates that hazard-specific sub plans and functional area supporting plans should also be drafted.²⁴² The tiered structure already referred to for emergency management means policy and planning is also defined in more detail at a local and regional level. In total there are 11 emergency management regions across the state, each with their own emergency management plan.²⁴³ There are 128 LGAs through which local emergency management planning is coordinated. Some councils may share a local emergency management plan, and some councils may have hazard or event specific local sub-plans, such as for floods, fires or storms.

NSW has 10 state emergency management supporting plans which govern how state agencies or functional areas will operationalise their responsibilities during an emergency. The supporting plans cover areas including but not limited to energy and utilities, engineering, health, telecommunications and transport.²⁴⁴ In addition, the State also has 'sub plans', which outline a series of actions to be implemented for specific hazards or events. For example, the *NSW State Flood Plan* is a sub plan to the *State Emergency Management Plan*. There are 24 sub plans to the State EMPLAN, covering issues such as energy and technology, environmental (e.g. hazardous

²⁴¹ NSW Government. (2018). New South Wales State Emergency Management Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-emergency-management-plan-emplan.pdf>.

²⁴² Ibid.

²⁴³ NSW Government. (2022). Regional plans and management. Retrieved from <https://www.nsw.gov.au/rescue-and-emergency-management/regions>.

²⁴⁴ NSW Government. (2022). State emergency management supporting plans. Retrieved from: <https://www.nsw.gov.au/rescue-and-emergency-management/supporting-plans>.

materials), specific precincts (e.g. the Hawkesbury-Nepean flood emergency sub plan), biosecurity, terrorism and pandemics.²⁴⁵

Principles in the EMPLAN include continuous improvement, co-ordination and information sharing, local capability, community and stakeholder engagement, roles and responsibility, emergency risk management and disaster resilience.

The principles also include:

All Hazards approach – based on the principle that those systems and methods of operation which work for one hazard (e.g. bush fire) are most likely to work for other hazards (e.g. floods). It does not, however, prevent the development of specific plans and arrangements for hazards that require specialised approaches.

All Agencies approach – recognises that no one agency can address all the impacts of a particular hazard, either in a proactive or reactive sense. It is necessary for a combat (lead) agency to co-ordinate the activities of the large number of organisations and agencies that are involved. These can be drawn from across all levels of government and non-government and private sectors.²⁴⁶

For some identified hazards, the EMPLAN identifies a specific ‘combat agency’ as having primary responsibility for controlling the response to a particular emergency (i.e. being the lead agency). In the case of floods, storm and tsunamis, the SES is designated the combat agency by s 8(1) of the SERM Act.

NSW State Flood Plan

The *NSW State Flood Plan*, a sub-plan of the State EMPLAN, sets out the state level multi-agency arrangements for the emergency management of flooding in NSW (including Lord Howe Island).²⁴⁷ The plan was endorsed by the NSW State Emergency Management Committee (SEMC), and the NSW SES Commissioner is responsible for ensuring it is maintained. The plan defines flood:

*as a relatively high-water level which overtops the natural or artificial banks in any part of a stream, river, estuary, lake, or dam, and/or local overland flooding associated with drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves (including tsunami) overtopping coastline defences.*²⁴⁸

The plan states that the primary goals for flood emergency management in NSW are:

- *protection and preservation of life*
- *establishment and operation of flood warning systems*
- *issuing of community information and community warnings*
- *coordination of evacuation and welfare of affected communities*
- *protection of critical infrastructure and community assets essential to community survival during an emergency incident*
- *protection of residential property*
- *protection of assets and infrastructure that support individual and community financial sustainability and aid assisting a community to recover from an incident*

²⁴⁵ Ibid.

²⁴⁶ NSW Government. (2018). NSW State Emergency Management Plan. Retrieved from <https://www.nsw.gov.au/rescue-and-emergency-management/state-emergency-management-plan-emplan>

²⁴⁷ SEMC (State Emergency Management Committee). (2021.) New South Wales State Flood Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2022-01/NSW%20State%20Flood%20Plan.pdf>.

²⁴⁸ NSW Government. (2021). New South Wales State Flood Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2022-01/NSW%20State%20Flood%20Plan.pdf>.

- *protection of the environment and conservation values considering the cultural, biodiversity and social values of the environment.*

The 2 key principles underpinning the plan are:

- *the protection and preservation of human life (including the lives of responders and the community) is the highest priority*
- *evacuation is the primary response strategy for people affected by flooding.*²⁴⁹

In an emergency, other combat agencies will utilise the capacity of supporting agencies to conduct evacuations, focusing their attention on the core objective of controlling the response.

State Rescue Board and State Rescue Policy

Separate from the EMPLAN and the *NSW State Flood Plan* is the *State Rescue Policy*. This is developed by the State Rescue Board of NSW (the SRB), which is constituted under s 42, Part 3, of the SERM Act. Its principal function is to 'ensure the maintenance of efficient and effective rescue services throughout the state'.²⁵⁰ Other responsibilities include:

- developing and promulgating rescue policy, and setting, promulgating and monitoring standards of training
- providing advice on equipment levels for all rescue units in the state
- recommending to the Minister for Emergency Services and Resilience the accreditation of units to undertake those forms of rescue for which the Board has decided that accreditation is required.²⁵¹

Membership of the Board includes:

- the State Emergency Operations Controller
- a member of the NSW Police Force Senior Executive Service
- Chief Executive Officer, NSW Ambulance
- Commissioner, Fire & Rescue NSW
- Commissioner, NSW State Emergency Service
- Commissioner, NSW Rural Fire Service
- Commissioner, NSW Volunteer Rescue Association Inc.
- Commissioner, Marine Rescue NSW, and
- the heads of other volunteer rescue agencies approved by the Minister (this may vary depending on agency priorities).²⁵²

The Chair is appointed by the Minister from one of the members of the board.²⁵³

The *State Rescue Policy*, which is approved by the Minister for Emergency Services, covers many types of rescues such as general land rescue, marine rescue, road crash rescue and vertical rescue, among others. Of particular relevance to this Inquiry is flood rescue, which is defined as:

all rescue activities in a relatively high water level which overtops the natural or artificial banks of any part of a stream, river, estuary, or dam, and/or local overland flooding associated with drainage before entering a water course, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline deficiencies. Any vehicle or pedestrian

²⁴⁹ Ibid.

²⁵⁰ *State Emergency and Rescue Management Act 1989*. s47.

²⁵¹ Ibid. s48.

²⁵² NSW Government. (2021). *NSW State Rescue Policy*, 4th Edition. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-rescue-policy.pdf>.

²⁵³ *State Emergency and Rescue Management Act 1989*.

*access way is deemed to be an artificial bank. There are five levels of flood rescue: Flood rescue awareness, land based, on water, in water and over water.*²⁵⁴

Under this policy, the SES can establish a Flood Rescue Area of Operations (FRAO), giving it the authority to coordinate and control flood rescues. When an FRAO is established, the SES must notify the NSW Police Force Radio Operations Group (operating as Police VKG) before its commencement.²⁵⁵ The Inquiry notes this requirement was not always adhered to during the 2022 flood events. The Inquiry is of the opinion that it would save lives if the Police Radio Operations Group coordinated flood rescue like all other rescues (this is discussed further in section 3.8) and has recommended that the NSW State Rescue Board commences a review into flood rescue to bring it into line with all other rescues (Recommendation 4).

The Inquiry notes an FRAO was not declared for the first flood event in Lismore. In any geographic area where an FRAO is *not* declared, or in any geographic area outside an established FRAO, the NSW Police Force is responsible for coordinating flood rescue response and determining priorities for action in flood rescue operations. See Figure 3-3 below taken from the *NSW State Rescue Policy 4th Edition*.

The emphasis of the *NSW State Flood Plan* is on emergency management; the emphasis of the *State Rescue Policy* is on rescues. Clearly, there is overlap but their purposes are different.

²⁵⁴ NSW Government. (2021). NSW State Rescue Policy, 4th Edition. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-rescue-policy.pdf>.

²⁵⁵ Ibid.

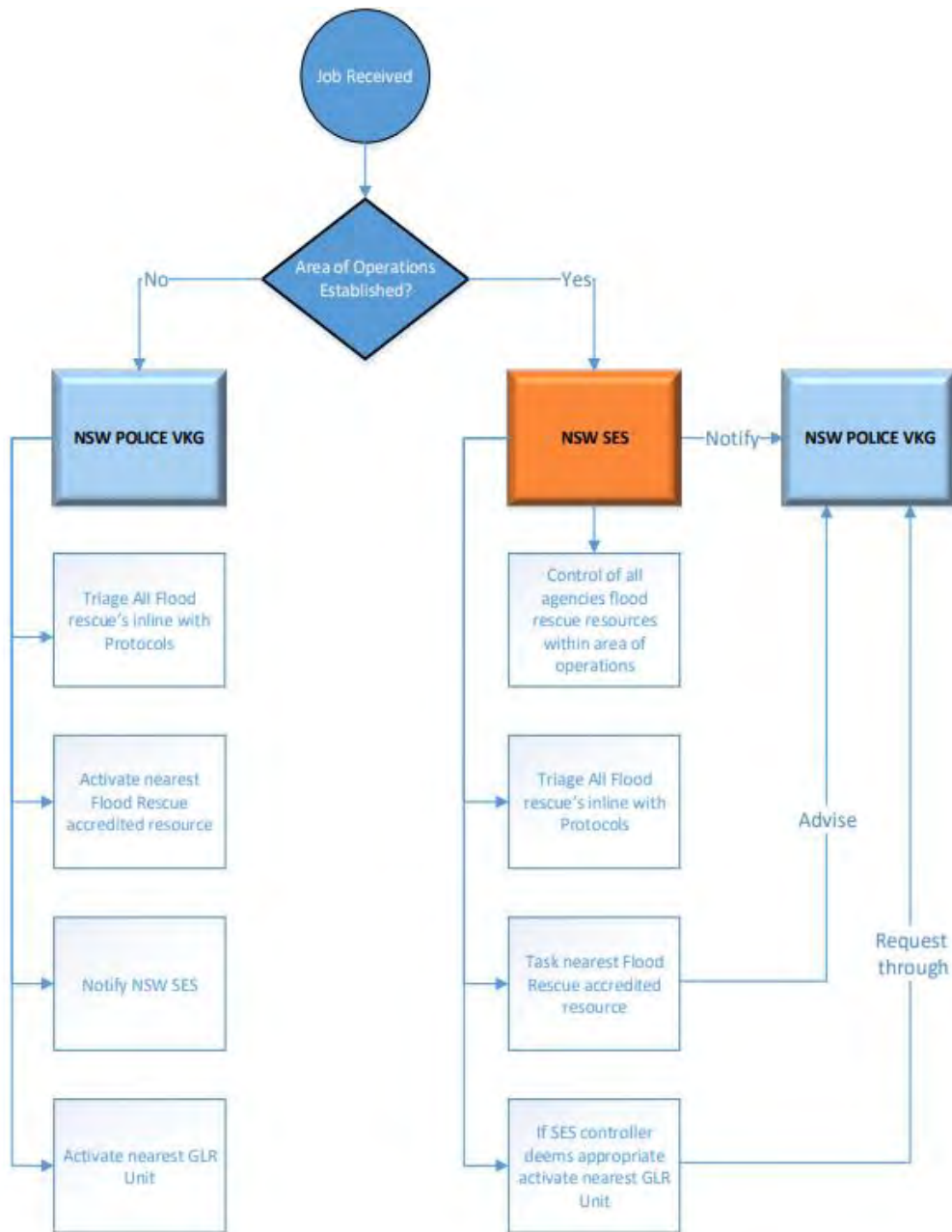


Figure 3-3: Flood Rescue Activation Process.²⁵⁶

3.2. What is an emergency response?

As stated in the EMPLAN “response encompasses actions to reduce the threat to life, property and the environment following the onset of an emergency. This can include the pre-onset mobilisation and related activity. Response activity is usually based on pre-existing sub and supporting plans which are scalable and flexible.”²⁵⁷

²⁵⁶ NSW Government. (2021). NSW State Rescue Policy, 4th Edition, page 55. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-rescue-policy.pdf>.

²⁵⁷ NSW Government. (2018). New South Wales State Emergency Management Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-emergency-management-plan-emplan.pdf>.

An emergency response involves taking actions in anticipation of, during and immediately after an emergency to minimise impacts of the emergency, and ensure people affected are given immediate relief and support. First and foremost, response is about the protection of life and property.²⁵⁸

A successful response is where no lives are lost, clear information and warnings are provided to empower community action to minimise risk, and emergency services and community work together to minimise both risk and the effect of the disaster. The more the effect of the disaster is reduced, the more the community's sense of public trust, confidence and support grows, and the less likely that the community experiences trauma.

The role of the Incident Management Team

Just before and during an emergency, the combat agency (in the case of flooding and storm events the SES), usually establishes an Incident Management Team (IMT) to determine strategies, priorities and actions required in the response. The IMT is responsible for keeping relevant stakeholders informed and works with both the Emergency Operations Controller and the relevant Emergency Management Committee to ensure a co-ordinated approach.

The role of Emergency Operation Centres

Emergency operation centres are the focal point for NSW Government activities, similar to those conducted at the SEOC, and are responsible for the coordination of regional and local resources from respective combat agencies, functional areas and the government as required.²⁵⁹

Support from functional areas

A functional area is defined in the SERM Act as a category of service involved in the prevention of, preparation for, response to or recovery from an emergency. These are business units within NSW Government agencies that, consistent with the scope of their portfolio, perform specific emergency management functions. This may be to support combat agencies or provide emergency risk management leadership within a sector.

The functional areas involved in the flooding events of 2022 included:

Functional Area	Flood Event	Liaison Officer Location
Agricultural and Animal Services (Department of Primary Industries)	February/March	State Control Centre; then transitioned to State Emergency Operations Centre
	March/April	State Emergency Operations Centre
	July	State Emergency Operations Centre
Energy and Utility Services (Treasury NSW)	February/March	State Control Centre; then transitioned to State Emergency Operations Centre
	March/April	State Emergency Operations Centre
	July	State Emergency Operations Centre
	February/March	State Emergency Operations Centre
	March/April	State Emergency Operations Centre

²⁵⁸ Australian Institute for Disaster Resilience. (2019). Australian Emergency Management Arrangements. Third Edition. Retrieved from: [aidr_handbookcollection_australian-emergency-management-arrangement_web_2019-08-22_v11.pdf](http://aidr.handbookcollection.australian-emergency-management-arrangement_web_2019-08-22_v11.pdf).

²⁵⁹ NSW Government. (2018). NSW State Emergency Management Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-emergency-management-plan-emplan.pdf>.

Engineering Services (NSW Public Works Authority)	July	State Emergency Operations Centre
Environmental Services (Dept. Planning & Environment)	February/March	State Emergency Operations Centre
	March/April	State Emergency Operations Centre
	July	State Emergency Operations Centre
Health Services (NSW Health)	February/March	State Emergency Operations Centre
Public Information Services (NSW Police Force)	February/March	State Emergency Operations Centre
	March/April	State Emergency Operations Centre
	July	State Emergency Operations Centre
Telecommunications Services (NSW Telco Authority)	February/March	State Control Centre and transitioned to State Emergency Operations Centre
	March/April	State Emergency Operations Centre
	July	State Emergency Operations Centre
Transport Services (Transport for NSW)	February/March	State Control Centre and transitioned to State Emergency Operations Centre
	March/April	State Emergency Operations Centre
	July	State Emergency Operations Centre
Welfare Services (Resilience NSW)	February/March	State Control Centre and transitioned to State Emergency Operations Centre
	March/April	State Emergency Operations Centre
	July	State Emergency Operations Centre

Table 3-3: Functional areas involved in the 2022 Floods.²⁶⁰

3.3. State agencies involved

Many NSW agencies were involved in the emergency response. In a flood event, all agencies can be called upon by the SES, as the combat (lead) agency, to support operations, including evacuations, rescues and resupply. This is the basis for an all-agency response.²⁶¹ While many agencies did become involved, the Inquiry heard they were often engaged too late to enhance the SES capability.

In the 2022 flood emergencies, as the span of control became more complex and/or the area of operation expanded, the SES' own focus should have narrowed to flood evacuation and rescue. Consequently it was essential that it call on support from other NSW Government agencies at local, regional, and state level, as well as Australian Government and non-government agencies.

This sub-section describes the general nature of the responsibilities of each agency in an emergency flood event, and provides statistics of the actual involvement of each agency in the 2022 floods, where that information has been provided to the Inquiry.

²⁶⁰ NSW Police Force. (2022). *Advice to the Inquiry provided on 12 July 2022*.

²⁶¹ NSW Government. (2018). NSW State Emergency Management Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-emergency-management-plan-emplan.pdf>.

NSW SES

The State Emergency Service Act 1989

The SES is a volunteer-based organisation responsible for flood, storm and tsunami.²⁶² It is established by the *State Emergency Service Act 1989* (SES Act).²⁶³ All SES roles, including volunteers, are subject to the control and direction of the Minister for Emergency Services and Resilience. The SES functions established by s 8(a) of the SES Act include:

(aa) to protect persons from dangers to their safety and health, and to protect property from destruction or damage arising from floods, storms and tsunamis

(a) to act as the combat agency for dealing with floods (including the establishment of flood warning systems) and to co-ordinate the evacuation and welfare of affected communities...

The SES Commissioner is also tasked with arranging for 'the collation, assessment and public dissemination of information relating to floods, storms and tsunamis'.²⁶⁴

The SES must carry out its functions in accordance with the SERM Act, requirements under the EMPLAN or any state of emergency under the SERM Act. Subject to the SERM Act, the SES:

- has overall control of operations in response to an emergency relating to a flood, storm or tsunami
- carries out rescue operations allocated by the State Rescue Board using accredited units
- may also assist the State Emergency Operations Controller to carry out emergency management functions including prevention, preparation and response, and to carry out recovery functions in emergencies.

Box 3-3: A comment on the 'take charge' power in bushfire emergencies

The Inquiry notes there is no equivalent provision in the SES Act to s 44 of the *Rural Fires Act 1997*. This section gives the NSW Rural Fire Service Commissioner authority to 'take charge of bush firefighting operations and bush fire prevention measures and to take such measures as the Commissioner considers necessary to control or suppress any bush fire in any part of the State' in certain circumstances. When a s 44 declaration is made, the Commissioner is 'is not subject to the control and direction of the Bush Fire Co-ordinating Committee'.

The Inquiry is not seeking a similar change to the SES Act, given the overarching powers of the SERM Act, the Premier's State of Emergency powers under s 33 of the SERM Act, and the proposed Task Force 'Hawk' initiative in Recommendation 11. Task Force 'Hawk' will bring together decision makers including Cabinet Ministers, Secretaries of relevant departments and Emergency Service Commissioners to drive continuous improvement in response to any emergency event.

The Inquiry is of the view that the SES Act is adequate and does not require any strengthening amendments. Some consequential changes may be required to implement the Inquiry's flood rescue recommendation.

²⁶² NSW SES (NSW State Emergency Services). (2022). Retrieved from <https://www.ses.nsw.gov.au/about-us/>.

²⁶³ *State Emergency Service Act 1989*, s 7.

²⁶⁴ *State Emergency Service Act 1989*, s. 12(3).

SES activities in the 2022 floods

As the combat agency, SES was responsible for controlling the response to the flood events. Its responsibilities included working closely with the Emergency Management Committees and Functional Areas as required (see Figure 3-1 above). The following information was provided to the Inquiry by the SES and has not been independently verified. During the 2022 flood events, more than 800 SES staff were deployed in the State Command Centre (SCC), Metro Sydney Incident Management Team and the Northern Zone Incident Management Teams. As an example, the Northern Zone (covering the Northern Rivers including Lismore, Coraki, Broadwater and Ballina) IMTs included over 400 SES staff.²⁶⁵ Between 22 February and 14 March across the Northern Rivers, Sydney Metro and Hunter regions, the SES:

- had 2,539 members providing support, equating to more than 220,000 personnel hours
- received 25,870 requests for assistance
- conducted 2,082 flood rescues
- issued 1,084 Flood Bulletins and Flood Watches
- processed more than 1,500 requests for assistance generated from Service NSW for resupply
- issued 113 evacuation orders.²⁶⁶

Between 14 March and 8 April across the Northern Rivers and Sydney Metro, the SES:

- received 4,687 requests for assistance
- conducted 142 flood rescues
- issued 306 Flood Bulletins and Flood Watches
- issued 30 evacuation orders.²⁶⁷

However, the Inquiry was told that in Lismore alone, the SES lost up to 3,000 calls of assistance. The Inquiry was told that Beacon, the SES's operational management software system, was turned off during the first flood event as the system was overwhelmed. Beacon is a web-based program used to record requests for assistance (RFAs), manage the operational tasking of teams and collate data about members' activities. The Inquiry did not hear evidence of calls lost during the July 2022 floods. From 27 June 2022 to 12 July, the SES advised that:²⁶⁸

- it received more than 9,000 requests for assistance
- it conducted more than 454 flood rescues
- it deployed more than 2,600 SES members
- it issued more than 160 evacuation products (orders, warnings)
- damage assessments have been completed on more than 7,000 properties
- more than 2,000 properties were inundated, and damage assessments are still ongoing
- 37 LGAs are included in the natural disaster declarations for this weather event.

²⁶⁵ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 11 May 2022*. NB: these numbers do not include the SES call centre, command teams in the field or volunteers, members and supporting agencies responding in the field.

²⁶⁶ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 11 May 2022*.

²⁶⁷ Ibid.

²⁶⁸ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 12 July 2022*.



Photo 3-1: SES 125 Hastings Road, Bogangar. Source: John O'Brien, submission to the Inquiry.

NSW Police Force

The NSW Police Force runs the Emergency Operations Committees at state, region and local level. The State Emergency Operations Controller (SEOCN) is the Commissioner of Police or their delegate and is responsible for controlling an emergency which covers multiple regions. At a state level, the SEOCN is responsible for establishing the State Emergency Operations Centre and for the provision of state level support to the combat (lead) agency.

The role of an Emergency Operations Controller is also replicated at the regional (REOCN) and local (LEOCN) levels. Again, these positions are held by officers of the NSW Police Force and oversee the relevant Emergency Operations Committee. They are tasked with supporting the combat agency at the relevant level with resources and coordination across functional and supporting areas.

The relevant EOCON will assist the SES (as the combat agency in a flood emergency) by monitoring flood operations, considering requests for other state or Australian Government assistance, coordinating the establishment of a Major Evacuation Centre and, if requested, coordinating support to the SES and/or other agencies.

Recommendation 3 calls for the establishment of a permanent SEOCN to be supported by the establishment of permanent emergency management positions within NSW Police. The Inquiry met with the various emergency service unions throughout its engagement, including the Police Association of NSW which, in its submission to the Inquiry, supported the creation of a permanent, appropriately resourced SEOCN.²⁶⁹

²⁶⁹ Police Association of NSW, submission to the Inquiry.

Marine Rescue NSW

Marine Rescue NSW is a volunteer marine rescue service established in 2009 through the merger of the Royal Volunteer Coastal Patrol, Australian Volunteer Coast Guard Association and NSW Volunteer Rescue Association marine fleet.²⁷⁰ Marine Rescue provides 24/7 emergency search and rescue, log on and vessel tracking service for recreational boating, monitoring of marine radio for distress calls along the NSW coastline and boating safety education and advocacy including licence and radio courses.²⁷¹

Marine Rescue NSW has indicated that it wishes to improve its training capabilities for flood rescue. The Inquiry notes and supports the bid intended for consideration by the current NSW Expenditure Review Cabinet Committee for a flood rescue training facility that would be an all agency asset for the state.

During the 2022 February/March flood events, Marine Rescue NSW deployed 150 members (across both flood operations), either self-initiated or at SES request. The majority of deployments were self-response and located in Evans Head.²⁷²

Volunteer Rescue Association NSW

The Volunteer Rescue Association NSW (VRA) was established in 1969 and has about 1,200 members across 42 General Land Rescue Squads, 2 specialist rescue squads including Alpine and Cave Rescue, and 8 support squads including communications, grief and loss support, aerial patrols and First Aid.²⁷³ The VRA responds to incidents including motor vehicle, industrial, cave rescue, cliff/vertical rescue, body recoveries, animal rescues etc. It also helps other NSW Emergency Services such as the SES, NSW Rural Fire Services (RFS), Fire and Rescue NSW (FRNSW), NSW Ambulance Service and NSW Police Force. The RFS provides training administration, purchasing support and communications support. The VRA informed the Inquiry that its members are rescue specialists, and members “know their backyards, and have a massive amount of local knowledge”.²⁷⁴

Fire and Rescue NSW

Fire and Rescue NSW (FRNSW) is responsible for fire, rescue and hazmat services in cities and towns within designated fire districts across NSW. It currently has 3,507 permanent firefighters, 3,249 on-call firefighters, 4,875 community fire unit volunteers, 535 administrative and trades staff and 198 senior officers – incident management skillset. Specifically, for flood rescue FRNSW has:

- 5 in-water flood rescue stations
- 27 land based flood rescue stations
- approximately 150 in-water flood rescue operators
- 673 land-based flood rescue technicians.²⁷⁵

During the 2022 flood events, FRNSW deployed 3,390 operational personnel and 1,912 Incident Management Team and operational support personnel, provided in-water flood rescue, Hytrans - high volume water pumping, logistics, hazmat, remotely piloted aircraft systems (RPAS)

²⁷⁰ Marine Rescue NSW. (2019). Our History. Retrieved from <https://www.marinerescuensw.com.au/our-story/our-history/>.

²⁷¹ Ibid.

²⁷² Meeting with Marine Rescue NSW on 31 May 2022.

²⁷³ Meeting with Volunteer Agencies on 1 June 2022; and NSW VRA (Volunteer Rescue Association NSW). (2019). About the VRA. Retrieved from <https://www.rescue.org.au/about>.

²⁷⁴ Meeting with Volunteer Agencies on 1 June 2022.

²⁷⁵ FRNSW (Fire and Rescue NSW). (2022). *Advice to the Inquiry provided 27 June 2022*.

intelligence, damage assessments, recovery efforts including wash out and clean-up, major structural collapse response to landslips, deployment centres, community liaison, media and provision of IMTs.²⁷⁶

NSW Rural Fire Service

The NSW Rural Fire Service (RFS) is the combat agency for all fires occurring within 44 Rural Fire Districts across the state and has responsibility for structural fire fighting in more than 1,200 towns and villages. The RFS comprises 1,993 rural fire brigades with a total membership of 79,656.

During the 2022 flood events (excluding the most recent July floods), more than 6,200 RFS fire fighters and 595 incident management personnel were deployed across the state to support internal, SES and Resilience NSW operations.²⁷⁷

The State Air Desk

The RFS contracts and engages aviation resources on behalf of various government agencies and facilitates coordinated dispatch arrangements through the State Air Desk.

During the 2022 flood events, between 24 February and 14 April, the Air Desk received 55 requests with 53 taskings confirmed. The remaining 2 requests were actioned with NSW Ambulance and NSW Police Force confirming capability.

Six RFS aircraft and 21 contract aircraft from 13 operators were dispatched by the State Air Desk during this emergency. These aircraft were tasked following requests from the SES, NSW Department of Primary Industries and Resilience NSW.

Aircraft operated by some agencies including NSW Police Force, NSW Ambulance, Australian Defence Force (ADF) and Westpac Lifesaver Helicopter are not directly engaged by the Air Desk. Despite this, liaison officers from NSW Police Force, NSW Ambulance, ADF and Surf Life Saving NSW operated from the Air Desk to ensure timely communication and co-ordination of aviation resources.

During these events, RFS aircraft completed 202 missions including rescue, transport, reconnaissance and resupply. Of note, RFS helicopters successfully rescued 77 people from floodwaters and returned them to safety during this event.²⁷⁸

Observations were made to the Inquiry that there was confusion around air rescue during the 2022 flood events. The Air Desk was established to coordinate bushfire response, not coordinate aviation rescue. To address this confusion the Inquiry has made Recommendation 4, that aviation rescue is coordinated by NSW Rescue Coordinator (RAO), and that the RFS maintains control for firefighting operations.

Transport for NSW – NSW Maritime

NSW Maritime is a support agency to the SES under the Flood Sub Plan, which falls under the State Emergency Management arrangements. This enables NSW Maritime to provide operational support to SES as the combat agency. NSW Maritime is itself the combat agency for marine oil or chemical spills, and maritime incidents such as groundings, collisions, disabled vessel or fire on a vessel that could result in an oil or chemical spill into the state waters of NSW.

²⁷⁶ FRNSW (Fire and Rescue NSW). (2022). *Advice to the Inquiry provided 3 June 2022*.

²⁷⁷ NSW RFS (NSW Rural Fire Service). (2022). *Advice to the Inquiry provided 17 May 2022*.

²⁷⁸ Ibid.

During the 2022 flood events, NSW Maritime assistance was coordinated through representatives located in regional and local emergency operations centres. This was in addition to specific tasking at a local level by SES units on the Clarence River.

On-water assistance taskings included:

- evacuation of communities
- medical transport of paramedics and patients
- delivery of essential medicines
- movement of supplies, such as fuel and equipment
- transportation of injured wildlife.

Between 1 March and 10 March:

- 131 people were evacuated
- there were 86 on-water tasks (including vessel salvages)
- there were 14 logistical support calls for supplying medical supplies, generators, and fuel.

NSW Maritime also attended to vessels that had sunk, broken from moorings or were at risk of causing a marine incident. In some cases this involved engaging directly with private contractors to complete salvage operations, or working with vessel owners. Specialist NSW Maritime Aerial Observers assisted the Environmental Protection Agency (EPA) to complete debris mapping across all affected waterways.

NSW Maritime assigned dedicated staff (4 Boating Safety Officers and 2 vessels) to the north of NSW on 2 March, to join NSW Maritime North Region's operations team and provide on-water support.

NSW Maritime issued a Marine Notice for navigation hazards from the Far North to Mid North Coast, due to substantial flooding of tributaries into the Tweed, Brunswick, Richmond, Evans, Clarence, Woolli, Bellinger, Nambucca, Macleay and Hastings Rivers on 28 February. The large number of navigation hazards on these waterways included trees and submerged and floating debris. Additionally, NSW Maritime issued a Marine Notice for navigation hazards on the Hawkesbury River upstream of the town of Spencer. NSW Maritime staff directed persons in the vicinity of all these waterways to comply with any directions given by Boating Safety Officers for marine safety.

Surf Life Saving NSW

Surf Life Saving NSW (SLSNSW) is the peak coastal water safety, drowning prevention and rescue organisation in NSW with 76,000 members (more than 30,000 of these are part of 'Nippers', a program for children aged 5-14),²⁷⁹ 21,000 active frontline responders and over 650 fulltime and casual staff across NSW.²⁸⁰ These professional entities operate coastal uncrewed aerial vehicle (UAV) surveillance programs, offering a unique and responsive surge capacity to its volunteer lifesavers during major events.

SLSNSW has the largest operational capability of any emergency service involved in aquatic (coastal and inland) responses. During the 2022 flood events, SLSNSW was involved from 28 February to 11 March. It advised the Inquiry that:

- 17 specialist personnel were in the field within 24 hours of first being activated, which was later scaled to over 100 operational members
- at its peak, 232 members were active in the field on a single day

²⁷⁹ SLSNSW (Surf Life Saving NSW). (2022). Join Nippers. Retrieved from <https://www.surflifesaving.com.au/nippers/>

²⁸⁰ SLSNSW (Surf Life Saving NSW), submission to the Inquiry.

- the total number of members deployed across this period was 1,084.

Across the state, SLSNSW provided personnel and/or assets to 29 separate geographic locations, many for multiple days.

Overall, SLSNSW received 224 requests for assistance, with rescues and evacuations resulting. Formal records indicate that 880 members of the public were assisted by SLSNSW personnel in the field, but SLSNSW advised that this number could have been much higher due to many not being recorded.

Many of the requests to SLSNSW were from the SES, which advised the Inquiry that SLSNSW members' involvement provided immediate and tangible benefit to rescues, due to the lack of SES assets in the field.

Resilience NSW

Resilience NSW was established as an executive agency of the Department of Premier and Cabinet on 1 May 2020 to be responsible for all aspects of disaster recovery and building community resilience to future disasters when the Office of Emergency Management (OEM) was disbanded. It has a role in the NSW Recovery Plan and played a role in response to the 2022 floods.

Further discussion of Resilience NSW's role in the 2022 floods and the Inquiry's recommendations is at Section 3.8.

NSW Department of Primary Industries

The NSW Department of Primary Industries (DPI) is responsible for leading the Agriculture and Animal Services Functional Area (AASFA), which in turn, is responsible for the emergency control and coordination arrangements in support of agriculture and animal resources during a flood. AASFA was activated during the 2022 flood events, which included activating the Agriculture and Animal Services hotline on 1 March 2022.²⁸¹ The hotline received over 3,400 calls.²⁸² As at 14 April 2022, 2,011 requests for assistance to the hotline had been received and completed across both flood events.²⁸³ A total of 395 AASFA personnel were also deployed to the State Coordination Centre in Orange and 4 supporting Local Control Centres in the North Coast, Hunter, Sydney and South-East regions.²⁸⁴

The Inquiry heard that 8-10,000 livestock were estimated to have been lost during the floods,²⁸⁵ and that 363 wildlife were euthanised or died in care, 1,715 animal carcasses were disposed of by the AASFA and one livestock was euthanised by AASFA.²⁸⁶ The Inquiry further heard that there were delays in AASFA providing on-ground support for animals affected by the floods, specifically in Northern NSW. The preliminary economic loss for the primary industries sector as a result of the February/March 2022 flood events is estimated to have exceeded \$500 million, with more than 30 industries affected.²⁸⁷

²⁸¹ Department of Regional NSW. (2022). *Advice to the Inquiry provided 27 May 2022*.

²⁸² Ibid.

²⁸³ Ibid.

²⁸⁴ Ibid.

²⁸⁵ NSW Farmers, submission to the Inquiry.

²⁸⁶ Department of Regional NSW. (2022). *Advice to the Inquiry provided 27 May 2022*.

²⁸⁷ Department of Primary Industries. (2022). *Advice to the Inquiry provided 22 June 2022*.



Photo 3-2: Cattle in floodwaters. Source: Emi Cataldi, submission to the Inquiry.

The AAFSA had exclusive access to 3 helicopters and also made use of other aviation assets to assign tasking, which included aerial fodder delivery, aerial observations and access for veterinarians to isolated animals.²⁸⁸ AASFA provided the following services in support of animals and their welfare:

- provided fodder to more than 72,000 head of livestock
- directly rehomed nearly 1,000 head of cattle displaced by floodwaters
- worked with local stock and station agents and sale yard operators to rehome approximately another 5,000 head of cattle
- treated 96 animals
- onboarded 72 private vet clinics between Grafton and the Queensland border.²⁸⁹

The Inquiry heard, however, that some vets who wanted to volunteer were unable to.²⁹⁰

Box 3-4: The approval process for building livestock flood mounds is unclear

In coastal floodplains, an artificial land mound known as a ‘flood mound’ can provide temporary refuge for livestock and is an important part of flood preparedness for primary producers. The size of flood mounds can vary depending on their use, for example for dairy

²⁸⁸ Ibid.

²⁸⁹ Ibid.

²⁹⁰ Lismore Town Hall 3 May 2022, retrieved from <https://www.nsw.gov.au/sites/default/files/2022-05/lismore-community-meeting-transcript-20220503.pdf>

herds it is recommended the holding space be 9 m² per head, whereas for horses it is recommended at 40 m² per head.

Several primary producers raised concerns with the Inquiry that Tweed Shire Council has provided inconsistent advice about the construction of flood mounds on rural properties. The Inquiry heard that in some cases a development application (DA) to construct a flood mound has not been required, whereas in other cases council has advised it is required.

Tweed Shire Council advised the Inquiry it tries to avoid unnecessary DAs for flood mounds, acknowledging the cost and time it takes to prepare a DA for proponents for a development that typically is low impact. Under the NSW planning system there are a number of considerations council is required to address in its determination.

Other NSW agencies

The following NSW agencies also provided support during the floods:

- National Parks and Wildlife Services
- Ambulance Service NSW
- Transport for NSW
- Department of Customer Service
- NSW Health
- Department of Communities and Justice.

3.4. Interstate agencies involved

The SES advised the Inquiry that it requested interstate resources on 28 February and began to receive support on 1 March. Interstate resources were managed through the AFAC (National Council for Fire and Emergency Services) National Resource Sharing Centre (NRSC) and coordinated by the SES State Command Centre where the interstate Liaison Unit was established.

A total of 742 interstate resources were provided, including: storm crews, incident management team personnel, peer support, community liaison officers and flood rescue personnel. Assistance was provided from:

- South Australia (State Emergency Service and Metropolitan Fire Service)
- Victoria (State Emergency Service, Fire Rescue, Country Fire Authority, Forest Fire Management and Victoria Police)
- Western Australia (Department of Fire and Emergency Services)
- Tasmania (State Emergency Service, Fire Service, Health Department and Surf Life Saving)
- Queensland (Queensland Fire and Emergency Services)
- Northern Territory (State Emergency Service)
- ACT (State Emergency Service and Emergency Services Agency).

The Inquiry was provided with the following information from the NRSC which breaks down the resources deployed in the 2022 flood response. A 'deployment' is one person deploying for a continuous period of days (typically 3-5). As some personnel may have undertaken more than one deployment, the number of unique individuals who deployed may be somewhat smaller than the total number of deployments.

The below information demonstrates the significant capability gaps of the lead combat agency, the SES, when required to deploy flood rescue and incident management capability in large scale and complex flood emergencies, like the 2022 flood events.

Resource type	VIC	ACT	NT	QLD	SA	TAS	WA	Total
Swift Water Rescue	15	-	-	42	30	-	-	87
Flood Boat Crews	21	-	-	-	-	-	-	21
Incident Management	56	5	6	7	59	10	43	186
Storm Damage Crews	124	33	8	41	56	9	21	292
Community Liaison Crews	80	-	-	-	36	-	12	128
Liaison Officers	12	-	-	3	7	-	6	28
Total	308	38	14	93	188	19	82	742

Table 3-4: Total interstate deployments during 2022 Floods.²⁹¹

3.5. Australian Government agencies involved

Australian Defence Force

The Australian Defence Force (ADF) does not have a defined role as a flood event and rescue combat agency, but its assistance can be requested in response to a natural disaster. Requests for assistance from a state or territory to the ADF are made under the *Defence Assistance to the Civil Community (DACC)* arrangements for which there are 6 categories:

- DACC 1 – localised, short-term emergency responses
- DACC 2 – significant crisis response or relief assistance
- DACC 3 – significant recovery assistance
- DACC 4 – local, small-scale non-emergency support
- DACC 5 – general, significant non-emergency support
- DACC 6 – support to law enforcement – no use of force (including no intrusive or coercive acts).²⁹²

A request for ADF assistance is made by an authorised state official, such as the SEOCON, after consultation with a combat or government agency, to Emergency Management Australia (EMA), the Australian Government entity responsible for emergency management coordination within the Department of Home Affairs. Such requests are commenced through the Joint Operations Support Staff office. DACC 1 requests can be done at the local level by SES unit commander.

The ADF has provided assistance in other natural disasters. For example, during the 2019–20 bushfires, there were 32 requests for emergency assistance under the DACC framework. They ranged from aviation support, and the provision of accommodation and logistic support for firefighting crews, to the establishment and renewal of joint taskforce arrangements. Some of the more significant tasks and activities were deploying first aid, food and water to remote communities. As identified by Mr Gary Worboys in the 2019–20 fires, “it would be fair to say that they [ADF] provided hope to many people who would not have seen or had contact with traditional agencies for some time.”²⁹³

²⁹¹ NRSC (National Resource Sharing Centre). (2022). *Advice to the Inquiry provided 15 July 2022*.

²⁹² Australian Government Defence. (2022). Support to the Australian Community. Retrieved from <https://www.defence.gov.au/programs-initiatives/support-australian-community>.

²⁹³ Final Report of the NSW Bushfire Inquiry. (2020), page 350. Retrieved from <https://www.dpc.nsw.gov.au/assets/dpc-nsw-gov-au/publications/NSW-Bushfire-Inquiry-1630/Final-Report-of-the-NSW-Bushfire-Inquiry.pdf>.

Similar to the 2019–20 bushfires, in the 2022 flooding events of February, March and April, the ADF provided assistance across the state, in particular for the Northern Rivers. On 27 February, the SES made a local DACC 1 request for the Lismore area. The local ADF supported the north coast Incident Management Team with doorknocking, sandbagging and use of their vehicles. On 28 February, the SES submitted a DACC 2 request for the following ADF assistance:

- Rotary Wing Support with 24-hour search and rescue capability with winch capability and surveillance support
- high clearance vehicles
- evacuation duties, including general duties support and sandbagging in Lismore.

On 4 March, the SES submitted a further DACC 2 request for the provision of assistance from personnel and equipment to support a range of response, relief and clean-up activities. This included, but was not limited to, continued aviation support and support for search and rescue, evacuation operations, road clearance, removal of debris, clearing access to critical infrastructure, damage assessments and essential services.²⁹⁴

During the second weather event, the ADF remained deployed in the Northern Rivers supporting both response and recovery operations. The ADF had deployed aviation assets, high clearance vehicles and personnel to assist with general duties.

ADF's assistance was well received in the Northern Rivers, with the majority of comments to the Inquiry positive about its role in helping recovery efforts in the immediate aftermath of the disaster.

*The presence of Defence members gave reassurance and relief to many folk so that was a positive.*²⁹⁵

*The Australian Defence Force personnel who eventually responded were super efficient, extremely polite, sympathetic, and above all, happy and willing in their work. The arrival of their personnel and equipment into the local town was comforting and a huge relief. Please pass on this very grateful persons response to the ADF.*²⁹⁶

*Our town and area could not have coped had it not been for the huge number of ADF personnel.*²⁹⁷

Some concerns were raised with the Inquiry about the delay in deployment of ADF. The Inquiry understands this delay was not due to any lack of preparedness by the ADF, but that it was not called in earlier.

*The ADF arriving earlier to help with the clean up recovery would be beneficial. By the time they arrived at our place, we had done the hard physical work.*²⁹⁸

*ADF deployment - FAR FAR too late. Should have been immediate. This inaction has caused an indescribable amount of angst and trouble for people locally.*²⁹⁹

The Inquiry notes that learnings from the recent bushfire and flooding events of the Hawkesbury-Nepean Valley and the mid north coast are likely to lead to the ADF playing a role in most emergency management events of scale. The ADF, however, must be notified immediately to enable it to assess and deploy quickly and accurately.

²⁹⁴ Ibid.

²⁹⁵ Anonymous, submission to the Inquiry.

²⁹⁶ Anonymous, submission to the Inquiry.

²⁹⁷ Helen Robinson, submission to the Inquiry.

²⁹⁸ Kristy Elks, submission to the Inquiry.

²⁹⁹ Victoria King, submission to the Inquiry.

Box 3-5: Lessons identified by the ADF

The ADF shared with the Inquiry its recent lessons identified from its experience helping NSW with its disaster response. Some of the observations made are good points for consideration by NSW combat agencies, including providing

*a clear understanding of the state... command and control arrangements in a crisis is vital to ensure it is clear where the ADF 'plugs in' at state, regional and local levels' and that 'planning for the transition from the response phase to the recovery phase should include the withdrawal of any ADF support.'*³⁰⁰

Bureau of Meteorology

The Bureau of Meteorology (the Bureau) is responsible, in accordance with an Intergovernmental Agreement,³⁰¹ for weather forecasts, warnings and observations in Australia at a range of timescales. Warnings are issued for extreme weather, including cyclones, storms and heatwaves, and provide information to the community, government and emergency services to allow planning and preparation.

In the case of flood warnings, the Bureau issues weather warnings of conditions likely to cause flood, and provides a forecasting and warning service for floods, particularly riverine flooding.³⁰² The Bureau's main role relates to catchment monitoring and river height predictions, as well as issuing and publishing specific warning and data products.³⁰³

This is done in accordance with the Bureau's *Service Level Specification for Flood Forecasting and Warning Services for New South Wales and the Australian Capital Territory* (SLA), which documents and describes the flood forecasting and warning services provided to NSW by the Bureau.³⁰⁴ It includes specifications about times and accuracy, and is produced in consultation with the NSW and ACT Flood Warning Consultative Committee, an advisory body which reports to the Bureau and participating state and local government agencies as required. Its membership includes SES, Department of Planning and Environment, Floodplain Management Australia, WaterNSW, Sydney Water and ACT SES.

The Bureau's role during a flood event is to:

- provide critical intelligence for preparation and response activities, working within state level response teams
- provide advice, data, forecasts, weather and flood warnings and alerts
- support response agencies to maintain their situational awareness in relation to climate, weather and water.

³⁰⁰ Australian Defence Force. (ADF). (2022). *Advice to the Inquiry provided 21 July 2022*.

³⁰¹ Council of Australian Governments. (2018). *The Intergovernmental Agreement on the Provision of Bureau of Meteorology Hazard Services to the States and Territories*. Retrieved from https://federation.gov.au/sites/default/files/about/agreements/intergovernmental-agreement-provision-bureau-meteorology_0.pdf.

³⁰² Meeting with the Bureau of Meteorology on 14 April 2022.

³⁰³ The Bureau of Meteorology. (2013). *Service Level Specification for Flood Forecasting and Warning Services for New South Wales and the Australian Capital Territory – Version 3.13*. Retrieved from http://www.bom.gov.au/nsw/NSW_SLS_Current.pdf.

³⁰⁴ Ibid.

To assist state and local government agencies when local flash flooding warning systems are needed, the Bureau provides technical assistance through its Flash Flood Advisory Resource (FLARE) website and advisory service.³⁰⁵

Outside of its response role, the Bureau also partners and collaborates in projects to improve prevention, preparedness, response and recovery at all time scales.³⁰⁶

Emergency Management Australia

Emergency Management Australia (EMA) is the lead organisation for Australian Government disaster response, preparedness and transition to recovery.³⁰⁷ The EMA's responsibility is to develop capability through exercising, national planning and coordination of requests for Australian Government assistance and, where appropriate, international assistance.³⁰⁸

The EMA undertakes key tasks as dictated by the Australian Government Disaster Response Plan (COMDISPLAN) and is particularly focused on preparation and planning at the national level. The EMA provides a single source of truth for situational awareness to inform strategic planning of Australian Government agencies.

The Inquiry notes that the EMA continues to work with the telecommunications industry and supports efforts to improve the delivery of emergency telecommunications capability. The Inquiry encourages the EMA to continue this work with the NSW Telco Authority and national partners, especially as the loss of telecommunications during the February/March 2022 flood events was so distressing for affected communities.

The Inquiry is also aware that the EMA is working with states and territories on further integration of a common joint operating picture through liaison arrangements.³⁰⁹ During the February/March flood events, the EMA worked through the National Resource Sharing Centre (NRSC) and its Liaison Officers to deploy Australian Government resources. This is highlighted in Table 3-4 above.

The National Resilience and Recovery Agency (NRRRA) is an Australian Government agency established in 2021.³¹⁰ The NRRRA provides financial assistance through the Disaster Recovery Funding Arrangements to states and territories, to assist with costs associated with providing certain disaster relief and recovery assistance.³¹¹ Australian Government emergency responses are led by EMA, not the NRRRA:

Once the event transitioned from the response to recovery phase from a Commonwealth perspective on 16 March 2022, the NRRRA took over management of the event from Emergency Management Australia.³¹²

³⁰⁵ NSW SES (NSW State Emergency Service). (2019). Provision and Requirements for Flood Warning in New South Wales. Retrieved from <https://www.ses.nsw.gov.au/media/3463/provision-and-requirements-for-flood-warning-in-nsw-november-2019.pdf>.

³⁰⁶ Meeting with the Bureau of Meteorology on 25 May 2022.

³⁰⁷ Meeting with the EMA (Emergency Management Australia) on 20 July 2022.

³⁰⁸ Ibid.

³⁰⁹ Ibid.

³¹⁰ Australian Government Department of Prime Minister and Cabinet. (2021). Media Release, National Recovery and Resilience Agency Announced. Retrieved from, <https://www.pmc.gov.au/news-centre/domestic-policy/national-recovery-and-resilience-agency-announced>.

³¹¹ NRRRA (National Recovery and Resilience Agency), submission to the Inquiry.

³¹² Ibid.

After taking over coordination of the national response, the NRRRA was responsible for chairing the Australian Government Crisis and Recovery Committee, which comprises relevant Australian Government agencies.³¹³

From 1 September, the NRRRA and EMA will merge to form a new organisation, the National Emergency Management, Resilience and Recovery Agency (NEMRRA), which will combine the functions of both agencies.³¹⁴

3.6. Community involvement

It is clear from personal accounts provided to the Inquiry that community members took on a critical role in both the emergency response and the transition to recovery. Particularly for the Northern Rivers, the Inquiry heard:

*The Community did not aid in the rescue effort – they led it, forced into emergency response roles and then left to deal with the trauma it has caused.*³¹⁵

When the SES's Beacon system failed, the digital coordination efforts within the community, mainly via social media, filled gaps in emergency services provided by government agencies.³¹⁶ The Inquiry heard that the SES put a call out to the community for boats to respond before rescinding the call due to SES Commissioner concerns about responder work, health and safety risks.³¹⁷

Despite the many tales of community heroics, care and support across all communities in the Northern Rivers, the Inquiry notes that there is no formal record of the community's involvement in the rescue effort. This is disappointing, as community members played such a key role in responding to the February/March and April flooding events. During these events, there was no handover into emergency service systems, such as Beacon, volunteers were not de-briefed, and there was no follow up with volunteers for wellbeing checks.³¹⁸ This is why the Inquiry has recommended the NSW Government develop a 'Community First Responder's program' (Recommendation 6).

The Inquiry heard of the personal toll when people were told they could not assist in the rescue efforts:

*Telling the volunteers not to get in the water leaves people with a lot of guilt and people are quite upset that this happened.*³¹⁹

³¹³ Ibid.

³¹⁴ Australian Government National Recovery and Resilience Agency. (NRRRA). (2022). About us. Retrieved from <https://recovery.gov.au/about-us>.

³¹⁵ Flood Diaries, submission to the Inquiry.

³¹⁶ Ibid.

³¹⁷ Ibid.

³¹⁸ Ibid.

³¹⁹ Ibid.



Photo 3-3: Broadwater. Source: Dominique Opdam, submission to the Inquiry.

The Mayor of Lismore, Mr Steve Krieg, also put a call out to community requesting the assistance of individuals who had access to boats on his Facebook page and continued helping coordinate rescues via social media.³²⁰

The volunteer effort continued from 28 February until 7 March and provided invaluable assistance in Ballina, Broadwater, Brunswick Heads, Bungawalbin, Coraki, Doonbah, Dungarubba, East Lismore, Gunurimba, Lismore, Monaltrie, New Brighton, Northern Lismore, Patches Beach, South Ballina, South Golden Beach, South Lismore, Wardell and Woodburn.

The majority of respondents used their own boats to participate in the rescue and some borrowed boats and surf boards.³²¹ Most of these responders self-identified that they have years of boating experience with some certification/qualifications in boating. Many of the rescuers did so at great personal risk. This risk came from powerlines, rising flood waters, hidden hazards and floating debris.³²²

As the Inquiry was told, in the Northern Rivers:

*Without community action on Monday the 28th this would have been without doubt a mass casualty event.*³²³

³²⁰ Steve Krieg, Mayor of Lismore (2022). Facebook. Retrieved from <https://www.facebook.com/Steve4Lismore>.

³²¹ Ibid.

³²² Flood Diaries, submission to the Inquiry.

³²³ Ibid.

Box 3-6: Lismore's Boatie Brigade

The 'Boatie Brigade' was a collective of citizen-led rescuers operating in the Northern Rivers during the February/March floods. The Inquiry heard that the actions undertaken by community rescuers was effective in saving hundreds of lives. This response is perhaps best reflected in submissions from the Flood Diaries, a survey of 43 local citizens who participated in the citizen-led response. The project identified that 43 citizen rescuers likely provided over 500 volunteer hours and rescued approximately 1,079 people. Many more led rescues of pets, livestock and other animals. Rescues were coordinate via phone calls, Beacon (SES), local knowledge, community coordinators, chat groups and social media.

Submissions received by the Inquiry estimated the 'Boatie Brigade' to be approximately 50 civilian rescuers.

By this time the Boatie Brigade was in full force. The locals had somehow organised themselves with an ad-hoc system, those with boats able to cross to South Lismore were performing rescues ad off boarding those to the [Ballina Street] bridge, the people then crossed the bridge to again board in boats who could then transport them to safety

I found people in need of rescue through Facebook posts and phone calls from my wife who was helping coordinate civilians.

Box 3-7: Adam's account of the first flooding event in Woodburn³²⁴

Woodburn is a town in the Northern Rivers region, with a local SES unit of 19 members. However, due to the floods, 11 SES members were isolated and could not attend the town. Woodburn residents Lisa and Adam worked together to co-ordinate hundreds of flood rescue during the first flooding event.

From about 11pm on Monday calls for assistance started to come in with members of the public stuck or in need of rescuing. Many from North Woodburn were stuck on the Woodburn Bridge. By the early hours of Tuesday morning the sheer scale of the event was becoming clear. Lisa and I worked together to co-ordinate who needed rescuing and from where. From the early hours of Tuesday morning members of the community in personal boats conducted rescue after rescue. This continued as day broke Lisa and others were using social media as we attempted to prioritise where boats needed to go based on how urgent each situation was. The Woodburn SES Unit did not have a boat operator available or able to conduct any rescues in this initial period. I sent a member of the public whom I knew was an experienced boat operator out in SES boat to assist.

From Tuesday morning there must have been 20 to 30 local boats and fishermen from Woodburn and Evans Head on the water assisting with these recues. Over a period of time, I would say they rescued between 300-400 people during the peak of the flood when it was very dangerous. People were being rescued from the roofs and balconies of second story homes. Boat operators were having to duck under power lines as they approached to evacuation centres makeshift boat ramp. As the day went on phone and internet service all but dropped out. By the days end I think there could have been about 500 to 600 people and hundreds of pets at the evacuation centre. It was crazy. The Woodburn and Evans Head community did an amazing job to rescue everyone.

The flooding event was that bad and the water that high from what I saw I personally expected there to be a number [of] fatalities in the Coraki, Woodburn, and Broadwater areas. I just couldn't see that everyone would [have] been able to get out safely.

³²⁴ Adam Bailey, submission to the Inquiry.

3.7. How were the emergency management responses activated?

As discussed in Chapter 2, the 2022 flood season began with record breaking rainfall into already saturated catchments leading to large scale, simultaneous flooding across many parts of the state. The NSW Government and its emergency service agencies had received pre briefings from the Bureau in late 2021 about the high likelihood of above average rainfall and the heightened flooding risk along the length of the east coast of NSW.

The weather conditions meant that emergency services would be more likely to be engaged early in 2022 in response to flooding. However, it is not clear to the Inquiry that in the months following this seasonal briefing there was a state of readiness within emergency services agencies that was equal to the threat. This is further explored in Chapter 4.

From an emergency management perspective, there were 2 big weather events: 22 February–15 March 2022 and 24 March–8 April 2022. The activation responses are set out below.

First weather event: 22 February to 15 March 2022

On 23 February the SES activated its State Command Centre (SCC) to facilitate planning, resourcing, intelligence and support of zone-based Incident Management Teams (IMTs).³²⁵ The SCC continued to operate throughout the event.

Liaison Officers were in place at the SCC from the RFS, NSW Police Force, FRNSW, Ambulance NSW, SLSNSW and Marine Rescue NSW. On 28 February, the State Emergency Operations Centre (SEOC) was established at Homebush.³²⁶ From 1 March, functional area Liaison Officers transitioned to the SEOC. By Thursday 3 March, Liaison Officers from Resilience NSW were in place and an interstate Liaison Unit was established to work alongside the SCC and National Resource Sharing Centre (NRSC) partners to coordinate interstate deployments.

The State Emergency Operations Controller (SEOCN) continued to operate until the event was handed over to Resilience NSW as the State Recovery Controller (SERCON). This occurred progressively across LGAs of the state as follows:³²⁷

- **8 March:** Lismore CBD, Lismore South and Lismore North
- **9 March:** Ballina, Bellingen, Byron, Clarence Valley, Kyogle, Lismore (The Channon & Nimbin), Richmond Valley (Coraki, Casino, Woodburn, Broadwater, Wardell and Bungawalbin), and Tweed
- **14 March:** The Central Coast, Liverpool, Northern Beaches, Penrith, Port Stephens, and Singleton
- **15 March:** Blacktown, Camden, Canterbury Bankstown, Hawkesbury, Sutherland and the Hills.

A total of 5 IMTs were activated across the state, operating from Incident Control Centres (ICC) at Goonellabah (Northern Zone), Metford (Northern Zone), Rhodes (Metro Zone), Dubbo (Western Zone) and Goulburn (South-eastern Zone). ICCs at Grafton (Northern Zone) and Metford (Northern Zone) operated in support of the Goonellabah ICC.

³²⁵ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 26 May 2022*.

³²⁶ Ibid.

³²⁷ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 5 May 2022*.

Second weather event: 24 March to 8 April 2022

On 24 March, operations for the second weather event commenced. The SEOC was still operational in support of the recovery operation from the earlier event. It paused recovery and resumed response operations on Tuesday 29 March. The SEOC established response at the SEOC on 29 March and continued to operate until the event handed over to Resilience NSW as the State Recovery Controller (SERCON) on 7 April for the LGAs of Clarence Valley, Ballina, Byron, Lismore, Tweed and Bellingen.

Third weather event: 2 to 22 July 2022

The Inquiry was told that on 2 July, Liaison Officers from SEOC and other agencies were present at Wollongong State Command Centre in support of SES's flood response operations. The SEOC became operational on 3 July at RFS Headquarters at Sydney Olympic Park. Rapid Cleanup teams led by NSW Police began work mid response and stood down operations on 22 July.³²⁸

3.8. Weaknesses in 2022 flood emergency management response

Existing state emergency management arrangements are sound, and can be effectively implemented to ensure a timely and coordinated approach, provided there is good training and clear practices.³²⁹ The arrangements clearly define which agency is responsible for the prevention, preparation, response and initial recovery for any emergency or natural hazard that may be experienced across the state. In addition, the arrangements are designed to ensure that no agency is left wanting or overwhelmed, regardless of the scale of the emergency. At their core, the emergency arrangements have an all-hazards, all-agency approach, and this is detailed in the *State Emergency Management Plan*.

During the 2022 flood events, the process for seeking interstate assistance and Australian Government support worked well, as evidenced by the timely arrival of additional resources, once requested. The process appeared to work better than during the 2019–20 bushfires.

Failings in the response by emergency agencies did occur, particularly in the Northern Rivers. In both the first and second flood events, there were deviations from the formal emergency management arrangements that agencies are trained to operate within. In particular, in the case of resources requested by the SES, the Inquiry was told the requests were made too late. Interoperability between agencies and the community was also identified as a challenge.

Community safety is the basic principle of emergency management arrangements. It relies on the participation of all emergency services in the response, regardless of the hazard, as well as a commitment to continuous improvement and learnings.

Unfortunately, an agency's embracing of the principles of emergency arrangements is only as good as the culture present in that agency. The Inquiry notes that, while some agencies were proactive in responding to the need for resources, the primary responsibility was on the combat agency, namely the SES, to ask for resources, rather than on other agencies to be prepared with resources and ready to deploy when asked. This issue can mostly be managed through stronger all-agency training and adhering to the formal arrangements in the exercise of emergency management.

³²⁸ NSW Police Force (2022). *Advice to the Inquiry provided 26 July 2022*.

³²⁹ Meetings with; Volunteers Agencies on 1 June 2022, NSW Ambulance on 8 June 2022, FRNSW Meeting on 19 May 2022, NSW RFS on 16 May 2022.

Poor organisational culture will consume good emergency management arrangements, as evidenced in previous SES reviews – of which many recommendations are still unactioned.

There has been a clear failure by the emergency management sector to appropriately adopt lessons learnt from previous disasters, especially floods experienced in NSW. This is further discussed in Section 3.13 of the report.

Capability gaps in the SES operational response

The Inquiry received very positive feedback about the actions and commitment displayed by SES volunteers during the 2022 flood emergency. Some SES units worked tirelessly, with volunteers risking their lives to help communities across the state. There were, however, criticisms of the decision-making processes employed by SES head office, and the lack of support provided to local units, particularly during the peak February, March and April weather events.

The capability gaps in the operational response overseen by the SES were particularly evident in the Northern Rivers. The Inquiry heard a number of criticisms, including:

- personnel structure not fit for purpose
- approach to resource deployment reactive not proactive
- SES response centres inappropriately located
- flood warnings inadequate
- emergency calls not answered
- general preparation lacking.

Personnel

The Inquiry noted that the SES has fewer permanent staff and a much smaller volunteer base compared to other emergency services. This greatly affects its ability to execute its duties adequately, particularly during widespread and time-critical emergencies involving flood rescue. For example, the SES relies on volunteer Unit Controllers to perform the role of Incident Controllers during flood emergencies. During bushfires, this role is performed by a full-time experienced and qualified RFS staff member. Given the complexities of emergencies and the accountabilities of those responsible for making key decisions, this places SES volunteers, who are, by definition, less well trained, exercised and prepared, in an often-difficult position.

Resource deployment

The forward leaning approach that allows pre-positioning and resource readiness was not evident during the 2022 floods. The Inquiry heard the proposition of 'planning for the worst and going big early' was not in the minds of the SES leaders. Many stakeholders were frustrated that requests for assistance were delayed as effects were occurring. Requests seemed to be reactive rather than proactive, which affected the timing of personnel and mobilisation of resources. There was sometimes a reluctance at various levels of SES management to call on the full capacity of other agencies as an emergency neared or descended upon a community.

Location of response centres

The SES State Control Centre (SCC) was located and operated from Wollongong during this event, with the State Emergency Operations Centre (SEOC) located at the RFS headquarters in Sydney Olympic Park. The SCC focused on response strategies, whereas the SEOC worked to support the SES and deal with community-related effects. This was problematic at times, given inconsistent interaction between the 2 centres and a lack of understanding about the strategic intent. The Minister for Emergency Services and Resilience and government officials based

themselves at the SEOC. Media outlets also used the facilities at the SEOC rather than travelling to Wollongong.

The Northern Rivers flood response was partly managed between 2 sites – Goonellabah and Metford – then by the SCC and, the Inquiry heard, often without any local knowledge or input.

Warnings

Many submissions to the Inquiry strongly rebuked the SES about the issuing of flood warnings and evacuation orders. These were often issued with little time to spare, giving residents very little time to prepare and get to higher ground. It is clearly in everyone's interests for warnings to be timely and for orders to be issued as a public safety direction rather than as a last-minute call that danger has arrived and to 'get out quick'. The Inquiry firmly believes that evacuation orders are the frontline of public safety and should not be used to signal the commencement of rescues.

Failure to respond to emergency calls

The Inquiry was told that the SES was overwhelmed by the number of calls received, and that the volume of calls exceeded its ability to respond. The SES does not use a Computer Aided Dispatch (CAD) system (as used by NSW Police Force, FRNSW and RFS) which would greatly assist in processing urgent and non-urgent calls for assistance. The SES's Beacon system used to log and record requests for assistance from members of the public was not fit for purpose and did not allow for jobs to be adequately tracked and actioned. This led to duplication of resources, with potentially multiple services attending to the call, and uncertainty of the safety of the callers.

The Inquiry understands the SES use contingent labour to provide surge capacity during complex events.³³⁰ The Inquiry notes that this should be facilitated through Police Radio VKG, FRNSW or RFS personnel in line with a 'badge off' approach to emergency response.

General lack of preparation

While the Inquiry acknowledges that COVID-19 may have affected community engagement activities across flood-prone communities over the past 2 years, it nevertheless appears that limited attention has been given to engaging community to build disaster preparedness. A core element of disaster preparedness is an understanding of emergency arrangements and the responsibilities of individuals and organisations during an emergency.

As previously noted, the *State Rescue Policy* authorises the SES to establish a Flood Rescue Area of Operations (FRAO), which in turn allows for the closest available flood rescue resource to be activated initially by the appointed SES Incident Controller, with flood rescues triaged and prioritised in accordance with the SES flood rescue management protocols. In any geographic area where an FRAO is not declared, or in any geographic area outside an established FRAO, it is a NSW Police responsibility to activate the nearest accredited flood rescue unit to a flood rescue. The Inquiry found that the State Rescue Policy is not always implemented or well understood.

In summary, the SES at all levels of management requires comprehensive incident management training to ensure all personnel are skilled in managing large scale events such as the 2022 floods. There is an opportunity now for the SES to integrate better with other services to ensure the best possible management and support is provided to communities in need in major events.

The Inquiry notes that none of the issues raised are new – they are recurring issues noted in previous inquiries, reviews, coronial inquests and exercises.

³³⁰ Meeting with NSW SES on 17 May 2022.

Failures in coordination of flood rescue

Volunteers and community feedback indicated that there is confusion about the most appropriate number to call (whether 132 500 or Triple Zero) and inconsistent advice provided during the call. Further complications arose with tasking incoming jobs to available assets via Beacon, with little or no visibility of rescue assets in affected areas. As a result, up to 3,000 calls for assistance were lost by the SES and advice to some individuals in the Northern Rivers was to climb into roof cavities, where they became trapped with rising floodwaters, further complicating rescue activities.

The SES advised the Inquiry that during the 'First Event', which commenced on 22 February, it did not declare a Flood Rescue Area of Operations (FRAO) in the Northern Zone due to how quickly the situation deteriorated and to maintain continuity of coordination of resources. All tasking should have remained with the NSW Police Force out of the NSW Police Radio Operations Group Centre (VKG).³³¹ However, this did not occur and further led to confusion around flood rescues. This led to the digital coordination efforts by members of the community discussed earlier in this chapter.

SES volunteers provided feedback about the lack of FRAO declarations in the first Lismore flood event – such a declaration is required before the SES can assume command of flood rescue. The absence of a FRAO declaration indicates a poor understanding by the SES about the process of taking command, and created confusion in the triaging and tasking arrangements.³³²

Box 3-8: Community views on flood rescues

The Inquiry heard dissatisfaction from the community that the SES would not undertake night-time rescues due to health and safety concerns for members, despite community rescuers doing so themselves. This matter should be reviewed by the SES to establish if night-time flood rescues can be undertaken while ensuring the safety of members and the community.

During Town Hall meetings the Inquiry heard community frustration that NSW Maritime would not launch its vessels or undertake flood rescues because 'insurance wouldn't cover them' and its boats sat unused in the flood rescue response. It is understood this is because NSW Maritime is not an accredited rescue agency, and its staff, while experienced mariners are not trained in swiftwater rescues and that its vessels are not designed to work in swiftwater.

³³¹ NSW SES (NSW State Emergency Service). (2022) *Advice to the Inquiry provided 26 May 2022*.

³³² NSW SES Volunteers Association, submission to the Inquiry.



Photo 3-4: Lismore. Source: Mark Graham, submission to the Inquiry.

C. Findings – operational response

- The NSW State Emergency Services (SES) failed to use many of the resources that were available to it through direct assistance or by other agencies.
- The SES failed to adhere to current emergency management arrangements as outlined in the NSW State Rescue Policy and Emergency Management Plan (EMPLAN).
- The lack of appropriate training and exercising across all combat and relevant government agencies meant some did not understand their roles and responsibilities under the emergency management arrangements, and this affected the protection of life and property in the flood response.
- In previous disasters, the Government and community have turned to senior police to take a lead role in disaster management regardless of the combat agency.
- Appointment of a full time State Emergency Management Operations Coordinator (SEOCN) as a fifth Deputy Commissioner of Police was most recently trialled in 2021 during the COVID-19 pandemic, with Deputy Commissioner Gary Worboys providing leadership and decision making that assisted in protecting life and building community confidence. The Inquiry finds this can work to significantly improve implementation of emergency management arrangements across the full suite of emergencies, including floods.

3. Recommendation – permanent SEOCON

That, to improve NSW's ability to prepare and respond to floods and other disasters, Government establish a new Deputy Commissioner of NSW Police Force to take on permanently the SEOCON role. This role, in addition to current SEOCON functions, would be responsible for:

- chairing the State Emergency Management Committee (SEMC)
- facilitating collaborative risk management and compliance activities working with local and regional emergency management committees, communities, local government, state government agencies, particularly the proposed NSWRA, and the Australian Government
- working with relevant state government agencies to improve their operational readiness and preparedness for emergencies including, but not limited to, training, education, and ensuring proactive understanding of the location and condition of assets available to the combat agency in the event of an emergency, rather than this information being sought during an emergency, with agencies being required to report on implementation and progress through the SEMC
- ownership of a state capability framework to ensure combat agencies can resource a catastrophic event (so, for example, that during a flood emergency SES deploys all available assets, not just assets owned by SES)
- leading training standards across combat agencies, local government, NGOs and essential service providers.
- establishing funded permanent emergency management police positions (at sergeant or senior sergeant level) focussed on local emergency management service delivery for the SEOCON across all 27 police districts in regional NSW, and the 3 police metropolitan regions in Sydney, with priority given to identified high risk-catchments
- supporting existing interstate connectivity
- State Emergency Recovery Controller (SERCON) responsibilities, which could be delegated to a recovery coordinator/s as deemed appropriate
- leading the proposed new agency, Recovery NSW.

That, to support the Deputy Police Commissioner, SEOCON, a full-time secretariat office led by a Deputy Secretary for Emergency Management be established within, though functionally separate from, NSW Police to drive policy development and implementation. This office should be well-trained to ensure the effective chairing of, and secretariat support for, the SEMC.

D. Findings – flood rescue

- The Inquiry found that flood rescue in the 2022 flood events was not conducted in line with the current NSW State Rescue Policy.
- The SES did not have the operational ability to coordinate multiple flood rescues.
- The Inquiry found that SES members and their deployment system (Beacon) was overwhelmed during the flood events of February and

March 2022. The Inquiry heard evidence that Beacon systems were purportedly turned off or ignored by overwhelmed local SES because of the extraordinary number of calls for service, and that in one location up to 3,000 calls for service were never actioned by the SES.

- The Inquiry also heard calls directed from Triple Zero (000) to SES were not taken and often went through to a recorded voice message.
- The Inquiry found there was no redundancy built in for this number of calls for service. Other full-time agencies have redundancy built in for large number of calls, including Fire and Rescue NSW, Rural Fire Service and NSW Police Force.
- All other types of rescues under the State Rescue Policy – General Land Rescue, Industrial Domestic Rescue, Land Search and Rescue, and Marine Rescue – are coordinated by the rescue coordinator, being the NSW Police Force. This is well trained for and exercised, and culturally accepted as an all-agency approach focussed on saving lives.
- It is anomalous that flood rescue is treated differently. The Inquiry found no compelling reasoning for this type of rescue to operate differently to other forms of rescue.
- The Inquiry also found that NSW does not have enough people trained in flood rescue. In part, this forced the community to step up and fill the gaps.

4. Recommendation – flood rescue capability

That, to help improve the protection of life across NSW in flood events:

- the NSW State Rescue Board enforce adherence with current functions for flood rescue as specified in its current NSW State Rescue Policy
- the NSW State Rescue Board commences a review into flood rescue to bring it into line with all other rescues. All other rescues are currently coordinated through Triple Zero VKG NSW Police in an agreement with all other emergency services agencies. The Inquiry heard from the heads of combat agencies and aligning unions on this matter and found a consensus that the coordination of and response to flood rescue must change. The Inquiry acknowledges that this will necessitate implementation activities for a number of agencies
- aviation rescue is coordinated, in line with all other types of rescue, by NSW Rescue Coordinator (RAO), acknowledging RFS will maintain an Air Desk for firefighting activities
- the Flood Inquiry Secretariat remain in place to:
 - conduct an independent audit of NSW rescue capability across the state to inform which agency is best placed to respond to individual flood rescue requests
 - facilitate the transition from Resilience NSW to Recovery NSW. This scope of work could take up to 12 months.

Further, to support effective flood rescue capabilities, appropriate training facilities are required. Accordingly, the Inquiry would support the NSW Cabinet Expenditure Review Committee:

- considering the NSW Marine Rescue bid to enhance the Cronulla Marine Rescue Centre to include a Flood Rescue Operational Centre
- approving funding for a NSW state multi agency 'Flood Rescue Training Academy' in a regional location to support and enhance the multi-agency response needed for large scale events.

The performance of Resilience NSW

The Office of Emergency Management (OEM) was the state's lead agency for recovery prior to the establishment of Resilience NSW. During the 2019–20 bushfires, it became apparent that OEM did not have the capability to mobilise large scale state-wide recovery operations. Consequently, the NSW Government transferred lead bushfire recovery accountabilities to the NSW Police Force through the SEOCON.

The SEOCON then appointed a Recovery Coordinator, at that time Assistant Police Commissioner Mick Willing. The Recovery Coordinator, working closely with the then Deputy Premier, was able to cut through red tape, fast track clean-up activities and better coordinate the management of evacuation and recovery centres, particularly in the badly affected southern parts of the state.

While bushfire recovery operations were underway, the Government commenced the commissioning of a new agency to better deal with all aspects of recovery. This resulted in the formation of Resilience NSW.

As mentioned earlier, Resilience NSW was established as an executive agency of the Department of Premier and Cabinet on 1 May 2020 to be responsible for all aspects of disaster recovery and building community resilience to future disasters. This includes overseeing and coordinating emergency management policy and service delivery and leading all aspects of disaster and emergency recovery at a state, national and international level.

Resilience NSW's role under the NSW Recovery Plan

Under the *NSW Recovery Plan*,³³³ Resilience NSW is responsible for providing support to the Minister for Emergency Services and Resilience and the State Emergency Recovery Coordinator (SERCON) by:

- providing senior leadership to facilitate whole-of-government coordination
- coordinating formal recovery processes at the direction of the SERCON. Coordination should prioritise locally led recovery but may include coordination at the regional or state level
- developing and maintaining recovery policies, plans and arrangements
- resourcing one or more Recovery Coordinator positions. (Recovery Coordinators will be identified by the SERCON as required and will ordinarily be drawn from within Resilience NSW and supported by Resilience NSW staff)
- providing recovery management and operational expertise to Local and Regional Recovery Committees
- maintaining operational oversight and disseminating operational reports to key stakeholders
- preparing progress and other reports associated with recovery operations
- coordinating the analysis of impact and recovery needs assessment data to inform operational and non-operational recovery planning
- monitoring and evaluating state-funded recovery programs
- implementing a lessons learnt management process at the end of a recovery operation

³³³ Resilience NSW. (2021). NSW Recovery Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/Supporting-Plan-Recovery.pdf>

- providing a point of contact for Australian Government agencies in relation to recovery issues and requests. (These Australian Government counterparts include, but not be limited to, the National Recovery and Resilience Agency and Emergency Management Australia).

Recovery Coordinators role and functions

As outlined in the NSW Recovery Plan, recovery coordinators are nominated by the SERCON and drawn from the ranks of Resilience NSW. Their role is to coordinate recovery operations on behalf of the NSW Government in an affected area. The Recovery Coordinator's functions are to:

- in consultation with the lead agency, establish and develop a plan to transition from combat operations and immediate recovery matters to formal recovery
- establish and maintain an effective relationship with local councils to facilitate locally led recovery
- chair the Local Recovery Committee when required
- chair the Regional Recovery Committee
- oversee the implementation of recovery needs assessments
- support Resilience NSW to maintain an operational picture of the emergency's impact and keep the Local/Regional Recovery Committee informed
- communicate key messages in accordance with the agreed public information strategy
- establish regular dialogue with key stakeholders to ensure their participation in, and awareness of, the intended recovery process
- assist with the facilitation and coordination of non-government and private sector services insofar as those services are involved in the recovery process
- monitoring and evaluating state-funded recovery programs
- identifying areas where existing policy provisions are unlikely to be sufficient to achieve the requisite level of recovery and providing advice to the SERCON
- at the conclusion of the official recovery phase, providing a report to the SERCON detailing actions taken, lessons identified and recommended mitigation measures.³³⁴

Resilience NSW's response to the 2022 flood events

In practice, the role of Resilience NSW in response to the 2022 flood events included:

- supporting the SEOC
- leading the Welfare Services Functional Area, including responsibility for the management of evacuation centres
- supporting evacuation centres and providing immediate assistance to affected individuals.³³⁵

Resilience also plays a role in recovery from flood events including:

- leading the State Recovery Committee
- hosting the role of SERCON
- undertaking recovery operations under direction of the SERCON
- administering the Disaster Relief Account (reimbursement of extraordinary costs incurred by NSW Government agencies to deliver disaster assistance)
- brokering funding support from Australian Government, private, not-for-profit partners.³³⁶

³³⁴ Ibid.

³³⁵ Resilience NSW. (2022). *Advice to the Inquiry provided 3 June 2022*.

³³⁶ Ibid.

Feedback on Resilience NSW's performance

The Inquiry received many submissions raising concerns and issues with Resilience NSW and its performance during the 2022 floods. These showed that Resilience NSW did not always perform in line with its remit as described above. There was a widespread view that Resilience NSW failed in leadership and planning:

Multiple agency representatives described the Resilience NSW performance as 'chaotic', 'shambolic', 'disorganised'.³³⁷

[Resilience NSW] was never prepared for a disaster this big and needs to be looked at to see whether they are relevant at all.³³⁸

Resilience NSW's involvement during the emergency response phase to this event often proved a hindrance to protecting the community.³³⁹

In particular, criticisms of Resilience NSW focussed on its role and functions in evacuation and recovery centres, transition to recovery, delivery of grants and overall confusion that the agency caused in the emergency management arrangements:

Transition to Recovery ... was not led confidently and proactively by Resilience NSW.³⁴⁰

All the agencies such as Health, Red Cross, NRRRA etc. had staff and counsellors ready for action, but no progression was made by Resilience NSW during the 48-hour hiatus period. Resilience NSW did not operate as the lead agency for Recovery. Resilience NSW's internal cohesion was low.³⁴¹

Both large and community based not-for-profit organisations raised issues with Resilience NSW's approach to recovery centres. For example:

- the Australian Red Cross found that “general operation of the recovery centres has been extremely challenging for staff and volunteers present”³⁴² and that Resilience NSW, being a relatively new lead agency, “had a major effect on the way Red Cross and other agencies have transitioned into recovery”.³⁴³ It said the agency's approach was slow and often inconsistent, and this had led, amongst other things, to the delayed establishment of mobile recovery centres, which were crucial for smaller communities who were otherwise unable to access recovery centres.
- the St Vincent de Paul Society found that “people were not informed about how long they would need to wait and what they could expect [from Resilience NSW], and there were breaches of confidentiality”³⁴⁴ which added to the stress and confusion some people experienced.

For local councils, the performance of Resilience NSW raised particular concerns. Faced with inadequate performance by Resilience NSW, local council staff stepped in to fill the gap, taking on more tasks in the evacuation and recovery centres, with many staff volunteering and working through the nights.

³³⁷ Lismore Citizens Flood Review Group, submission to the Inquiry.

³³⁸ Melinda Kent, submission to the Inquiry.

³³⁹ Fire Brigade Employee's Union, submission to the Inquiry.

³⁴⁰ Anonymous, submission to the Inquiry.

³⁴¹ Lismore Citizens Flood Review Group, submission to the Inquiry.

³⁴² Australian Red Cross, submission to the Inquiry.

³⁴³ Ibid.

³⁴⁴ St Vincent de Paul Society, submission to the Inquiry.

Many local councils felt that poor understanding of the agency's remit confused processes and delayed recovery times. For example:

- Narrabri Shire Council found that Resilience NSW created a significant “muddying of waters”, particularly around what the community expects to be “council’s function and role as part of the emergency and disaster management cycle”.³⁴⁵
- Central Coast Council said that a “lack of clarity around exactly what role they [Resilience NSW] play and what support and resources are to be provided resulted in confusion and delays in putting in place forward steps toward recovery”.³⁴⁶
- MidCoast Council said that it “needs a clear understanding of the role of Resilience NSW in recovery and what this looks like on the ground and how they support community and local government during and following an eve”.³⁴⁷
- Ballina Shire Council said that the lack of clarity around Resilience NSW’s role as a relatively new organisation contributed to the confusion.³⁴⁸

Many smaller community-led organisations felt that engagement and communication by Resilience NSW was inadequate. One such organisation in Mullumbimby said it received a request from Resilience NSW and Byron Shire Council “to move out of the civic hall with 24 hours’ notice with no adequate venue to move into,” with Resilience NSW and the council then purportedly ceasing all communications with that community organisation.³⁴⁹

Funding from Resilience NSW for smaller community-based organisations was also slow and unresponsive: “Every time our organisation... has asked for things to be paid, or a hub to be set up to help feed people, that request has not been actioned speedily,” causing financial strain for the business and reduced services to people in need.³⁵⁰

To address these issues, the Inquiry is recommending that Resilience NSW be disbanded and Recovery NSW be established.

E. Findings – Resilience NSW and recovery

- The Inquiry notes that many Resilience NSW staff were dedicated and did their best in trying circumstances.
- However, during the 2022 flood events Resilience NSW did not perform as intended, primarily due to the size and scope of its remit.
- The Inquiry notes that a majority of submissions which mentioned Resilience NSW and the role it played in the 2022 floods were critical of it.
- The main criticisms were directed at Resilience NSW’s slowness and unresponsiveness in respect of evacuation and recovery centres, clean up, restoring essential services and issuing of grant funding to affected communities and businesses, all of which exacerbated the stresses resulting from the disaster.
- Resilience NSW is the lead agency tasked with maintenance and implementation of the NSW Recovery Plan. It is clear there was inadequate focus on the agency’s ‘on the ground’ operational response

³⁴⁵ Narrabri Shire Council, submission to the Inquiry.

³⁴⁶ Central Coast Council, submission to the Inquiry.

³⁴⁷ MidCoast Council, submission to the Inquiry.

³⁴⁸ Ballina Shire Council, submission to the Inquiry.

³⁴⁹ NSW Flood Inquiry. (2022). Mullumbimby Town Hall Meeting on 6 June 2022.

³⁵⁰ Louise Somerville, submission to the Inquiry.

in helping people in need, delivering grants, leading the clean-up and restoring access to essential services. There was a widespread view of a failure in leadership and planning by Resilience NSW.

- The Inquiry found that Resilience NSW caused confusion in emergency management arrangements during the operational response and recovery. This stemmed from its lack of preparedness and inadequate engagement and communication about its role and functions.
- This was exposed in the evidence the Inquiry heard about the confusion and chaos at evacuation centres, where basic welfare support and other services were not available. In particular, the Inquiry heard that decision making at evacuation centres was often unclear, due to a blurring of the roles of Resilience NSW and the Department of Communities and Justice. Other performance issues included inadequate engagement and communication, and breaches of confidentiality which increased the stress of an already traumatic situation for affected people.
- The performance of Resilience NSW raised particular concerns at the local council level. The Inquiry found that, faced with inadequate performance by Resilience NSW, local council staff stepped in to fill the gap, taking on more tasks in the evacuation and recovery centres, with many staff volunteering and working through the nights. Many councils felt that poor understanding of the agency's remit confused processes and delayed recovery times.
- The Inquiry found that Resilience NSW's approach to recovery centres was slow and often inconsistent. Among other things, there was a delay in establishing mobile recovery centres, which were crucial for smaller communities. Both large and community-based not-for-profit organisations raised these issues.
- Funding from Resilience NSW for smaller community-based organisations was also slow and unresponsiveness causing financial strain for businesses and reduced services to people in need.

5. Recommendation – Resilience NSW and recovery

That, in order to enhance NSW disaster preparedness, response and recovery, and meet the needs of the people of NSW prior to, during and after a disaster, and provide clarity on agency roles and responsibilities, Resilience NSW be reshaped to 'Recovery NSW'. The new agency will be more streamlined and agile to drive recovery in the first 100 days post disaster. To achieve this, Resilience NSW's functions should be reallocated as follows:

- disaster preparedness and support, and disaster emergency management policy and service delivery to the newly created Deputy Commissioner of Police responsible for the SEOCON [Recovery NSW]
- community engagement and public education on disaster risk and preparations to DCS/NSWRA

- disaster recovery and renewal management and coordination to the newly created NSWRA
- evacuation centre management and coordination to the Department of Communities and Justice (DCJ), which includes support for self-styled community evacuation centres. Many of DCJ's current functions deal with people in crisis, therefore the Inquiry finds it best placed to perform the role of evacuation centre lead. The Inquiry notes the importance of a police or security presence in evacuation centres, particularly in the early days of the establishment of the evacuation centres
- welfare services functional area (WELFAC) to the DCJ
- grants administration to the Department of Customer Service (DCS)/Service NSW for immediate relief and the NSWRA for longer term recovery and reconstruction.

There should also be a renewed focus on agency, local and state government training.

3.9. A 'Community First Responder' program is required to empower community led initiatives

The Inquiry acknowledges all NSW citizens who helped defend and support their communities through the 2022 floods and recognises the important contribution they made in response to the 2022 flood events. They are a testament to the incredible resilience and strength of communities across NSW.

NSW has a strong culture of volunteerism, people who are willing to give up their time and energy to protect their communities without monetary compensation. However, volunteers necessarily have competing demands on their time that can affect their availability and ability to participate in emergency response activities. As the expectations and demands placed on volunteers in formal emergency agencies are increasing, due to longer and more intense disaster seasons, formal volunteerism is also declining. In its place, more informal, spontaneous networks are developing, not just to deal with disasters as they occur, but before and after as well.

In the case of the 2022 flood events, there were three key drivers behind community involvement:

- the SES has insufficient 'active' members to deal with large scale weather/flood events
- even in a best-case scenario, the SES will never have enough trained volunteers (or trained permanent staff) to respond to multiple flood rescue calls for assistance as experienced in the Northern Rivers in 2022
- the community will always fill the gaps when government agencies fail, or are stretched beyond capacity, no matter what the disaster.

The SES has the authority to request or can ask the SEOCAN to facilitate a request for any asset or resource, public or private, whether accredited, trained or not, to assist in flood operations, as per the *NSW State Rescue Policy*.³⁵¹ This was put into practice early on the morning of 28 February when civilians commenced launching private vessels to conduct flood rescues in Lismore. The Inquiry heard that this was in response to a call out from an SES spokesperson on media channels for residents to volunteer themselves and their vessel to the nearest SES station if

³⁵¹ NSW Government. (2021). *NSW State Rescue Policy* 4th Edition, page 31. Retrieved from www.nsw.gov.au/sites/default/files/2021-04/state-rescue-policy.pdf.

it was safe to travel.³⁵² However, that call-to-arms was cancelled when the situation became too dangerous.³⁵³ The Inquiry heard that community members continued to undertake flood rescues despite the dangerous conditions.

The Inquiry looked closely at the ‘second tier’ volunteer class that was active during the floods. It has met and taken evidence from community members who protected life and property during the floods. These heroic individuals used boats, jet skis, canoes, private helicopters and anything that would float to rescue complete strangers. This was despite evidence that the community knew the SES had issued warnings that it was too dangerous for members of the public to assist with flood rescues.

*The flotilla of community owned boats and jet skis saved many hundreds of lives despite SES HQ initially hampering the effort with ‘do not enter the water’ request.*³⁵⁴

*I wish the SES did more on the day, I can understand they didn’t want people just out on the water but it was an emergency. People were literally clinging to life, and the SES said no don’t go to the water... that was the saddest moment. I’m glad the people in boats didn’t listen.*³⁵⁵

*The SES put a call out for boats to respond before rescinding the call due to ‘insurance issues’*³⁵⁶

Many civilian rescuers also said that conditions were dangerous, but it did not stop them from being involved in the emergency rescues. Factors that placed rescuers at risk included “underwater obstacles”, “the speed and force of the water”, “rising flood water at a fast increasing rate”, and “powerlines”.³⁵⁷

Box 3-9: Maritime Rescues – Law of the Sea

Whether trained or not, the 2022 floods saw a diversity of the community’s bravest participate in a community-led response to rescue thousands in need of assistance. Under international Maritime Law, a longstanding convention exists through which a shipmaster is obligated to render assistance to other vessels in distress. This is outlined in the International Convention on Maritime Search and Rescue and enshrined in Australian law through the *Australian Maritime Safety Authority Act 1990*.³⁵⁸

For example, the Tasmanian *Marine Search and Rescue Act 1971*³⁵⁹ establishes the obligation to render assistance if another vessel is in danger, in need of assistance or if those on board are suffering from illness or injury. Under such circumstances, it is an offence not to respond with all speed.

³⁵² Sky News. (2022). SES call on Lismore residents with boats to assist in evacuation as town’s levee inundate homes, roads and isolate areas. 28 February. Retrieved from <https://www.skynews.com.au/australia-news/ses-call-on-lismore-residents-with-boats-to-assist-in-evacuation-as-towns-levee-inundate-homes-roads-and-isolate-areas/news-story/5a755918e37428a9301ce7994261b0cd>.

³⁵³ ABC News. (2022). Lismore flood emergency sees people stranded on roofs, evacuation warning issued for entire NSW Northern Rivers. 28 February. Retrieved from <https://www.abc.net.au/news/2022-02-28/lismore-flood-emergency-levee-breaks-largest-on-record/100866296>.

³⁵⁴ Lismore Citizens Flood Review Group, submission to the Inquiry.

³⁵⁵ Anonymous, submission to the Inquiry.

³⁵⁶ Flood Diaries, submission to the Inquiry.

³⁵⁷ Ibid.

³⁵⁸ *Australian Maritime Safety Authority Act 1990* (Cth).

³⁵⁹ *Marine Search and Rescue Act 1971* (Tas). Part 6.

This convention highlights the importance of first responders rendering assistance in times of crisis. This is a longstanding tradition on the seas and should apply on Australia's river system and floodplains.



Photo 3-5: Local Boaters Woodburn. Source: Lisa Symonds, submission to the Inquiry.

The Inquiry heard that, where possible, some SES units provided life jackets to community members offering their assistance and arranged for at least one SES member, either a Flood Boat Operator or an In Water Flood Rescue Operator, to come aboard private vessels to help guide private citizens. This was due to the unit not having enough vessels to respond to the event.

The Inquiry also heard that, in some instances, local SES units turned community members away if their vessel did not appear to be safe or appropriate. Some SES units appeared reluctant to accept the assistance of community members and in some instances, turned community members away due to concern about potential liability and work, health and safety risks to untrained community members.

Informal and formal volunteers also established evacuation centres and temporary mini supermarkets to house and feed the thousands of individuals in need.

Ahead of the next flood season it is imperative that the SES establish a process through which more community volunteers can be accredited to assist in the coordination of flood rescue operations.

By definition this informal network of volunteers cannot be formalised. Consequently, they are without the legislative, policy and training protections that the formal volunteer-based agencies provide. The state cannot encourage its citizens to be reckless of their own safety when attempting to help others. However, support and recognition of these informal networks must be provided by the state as these networks will continue to proliferate.

The Inquiry acknowledges that volunteerism comes in many forms. The tightly regulated combat and supporting agencies are not always a good fit for would be volunteers in current times. There is however a need to empower local communities, particularly in 'high risk catchments' and 'high risk fire locations'.

The SEOCAN (and the proposed NSWRA – see Chapter 6) need to fund local initiatives that adequately prepare 'high risk communities' to plan, prepare, respond and recover in a coordinated and safe manner through a Government-funded 'Community First Responder' program. If appropriately supported through funding initiatives by government, the Inquiry is of the opinion that community can be an effective 'first responder' in disasters. Funding in the form of grants could support:

- provision of rescue and medical equipment
- establishment and management of evacuation and recovery centres,
- delivery of psychological first aid and other initiatives to help protect life and property, and
- create opportunities for ongoing training.

The Inquiry notes that this program should be informed by a review of volunteerism in NSW, acknowledging its essential place in the state's emergency management arrangements, especially in response. The review should identify how emergency volunteer agencies might respond to declining formal volunteerism and how to make better use of community first responders.

F. Findings – community led initiatives

- The Inquiry acknowledges all the efforts of all NSW citizens who helped defend their communities and recognises the important contribution they made in responding to and recovering from the 2022 flood season. Those efforts are a testament to the incredible resilience and strength of communities across NSW who were threatened by floods and storms.
- The Inquiry notes volunteers today increasingly have competing demands that affect their availability and ability to participate in emergency response activities. Indicative of this is declining recruitment and retention rates and a decline in the number of active volunteer members, particularly for the SES.
- Greater expectations and demands are being placed on volunteers as disaster seasons become longer and more intense. The Inquiry heard that formal volunteerism is declining, and instead more informal, spontaneous networks are developing prior to, during and after a disaster.
- The Inquiry found that during disasters, particularly when Government capability is exceeded, community was often more effective at saving community than Government.
- During the 2022 flood events, multiple communities, especially in the Northern Rivers, felt abandoned by Government. Communities want to feel supported by Government, but do not want government to run or

interfere in community led initiatives that work well.

- The Inquiry found that, if properly supported through grant initiatives by Government, community can be an effective 'first responder' in disasters. This grant funding could support the establishment and management of evacuation and recovery centres, delivery of psychological first aid and other initiatives to help protect life and property. Ongoing training opportunities must be part of this initiative.
- While Government has a role in sustaining a community response to a disaster, it should also aim for, wherever possible, transitioning from a community to an agency response.
- This Inquiry was told that for Indigenous people, the act of evacuating can be particularly distressing due to the intergenerational trauma of forced removal from family and Country. This was further amplified for some by the presence of security at evacuation centres.
- Indigenous communities understand cultural safety, know each other, and are embedded in networks. An Indigenous first responder program would help address the needs of Indigenous people in disasters, including when evacuating and in the design and management of evacuation centres.
- To assist in the Indigenous first responder program, Aboriginal Community Liaison Officers (ACLOs) should be involved in emergency management arrangements. ACLOs work closely with Indigenous communities, Aboriginal community organisations and other service providers in their day-to-day activities. The ACLO encourages positive working relationships and partnerships between the NSW Police Force and Aboriginal people as well as promoting an awareness of Indigenous issues to Police.

6. Recommendation – the Community First Responders Program

That, to better coordinate community efforts to save life and property during a disaster, Government create a 'Community First Responders Program', funding appropriate community equipment and training, particularly in high-risk catchments along the east coast of NSW. This training would be delivered by combat and/or other appropriate government agencies. This program could support and empower community led initiatives such as disaster response, evacuation centres and the provision of services such as psychological first aid.

To plan for volunteerism into the future, the State Emergency Management Committee (SEMC) commission a review of volunteerism in NSW, acknowledging it is essential to the state's emergency response to protect life and property. This review needs to recommend a way forward for emergency volunteer agencies to respond to declining formal volunteerism and to make better use of Community First Responders.

Further, to ensure Indigenous communities are included in emergency planning and preparation, emergency management processes incorporate the needs of Indigenous communities including for evacuation procedures and centres by:

- developing an Indigenous first responders program working with Aboriginal communities in flood affected regions to understand what is needed, and resourcing this program appropriately, and
- ensuring Aboriginal Community Liaison Officers (ACLO) form part of the Local Emergency Management Committees and are present at evacuation centres during a disaster to better serve Indigenous communities.

3.10. Public warnings

Timely warnings and public information play an important role in community safety by empowering people to make informed and timely decisions about protective action for themselves and family (e.g. evacuating), and for property (e.g. moving valued items to higher levels, securing large items). Warning systems are in place to inform communities of possible riverine, flash flooding, and flooding downstream of dams.³⁶⁰ However, not all of these systems are timely or have the intended results.

The Intergovernmental Agreement between the Bureau and NSW (referred to in Section 3.5 above) sets out responsibilities for meteorological forecasting and warning services for riverine and flash flooding. However, the responsibility for developing and issuing public warnings, and disseminating warnings, is shared across all levels of government.³⁶¹ The *Provision and Requirements for Flood Warning in NSW* supplements the State Flood Plan and outlines the roles and responsibilities for operating and maintaining warning systems and disseminating warnings and advice; the types of warnings to be issued, and the location of flood warnings and issued local flood advice.³⁶²

Under *the State Emergency Service Act 1989*, SES is responsible for establishing flood warning systems. In practice, the SES works with the Bureau and councils to develop warning systems and ensure consistent warning products and messaging across the state. SES informed the Inquiry that it uses gauge information to prepare flood intelligence, issue warnings and respond to flooding. However, there are many assets, such as flood and weather gauges, which are owned by the community, private organisations and government agencies, that are currently not used by the SES to inform public warnings.

The different types of warnings are known as ‘warning products’. The Bureau, SES and councils all issue different warning products.³⁶³

Warning Product	Who issues	Description
Severe Thunderstorm Warnings	Bureau	Severe Thunderstorm Warnings range in character from short-lived events to systems producing widespread damage across broader areas. Weather phenomena accompanying these storms include any combination of large hail, damaging or destructive winds, tornadoes and intense rainfall leading to local flash flooding.

³⁶⁰ NSW SES (NSW State Emergency Service). (2019). Provision and Requirements for Flood Warning in New South Wales. Retrieved from <https://www.ses.nsw.gov.au/media/3463/provision-and-requirements-for-flood-warning-in-nsw-november-2019.pdf>

³⁶¹ Ibid.

³⁶² Ibid.

³⁶³ Ibid.

Regional Severe Thunderstorm Warnings	Bureau	Regional Severe Thunderstorm Warnings are issued when severe thunderstorms are expected to develop within or move into a specified area. The warnings describe the area under threat and the particular hazards likely to be associated with the thunderstorms.
Detailed Severe Thunderstorm Warnings	Bureau	Detailed Severe Thunderstorm Warnings are issued when severe thunderstorms are already occurring, or are expected to develop within or move into the heavily populated regions around Sydney, Newcastle and Wollongong.
Severe Weather Warnings	Bureau	Severe Weather Warnings are issued when severe weather is expected to affect land-based communities and Lord Howe Island within the next 24-36 hours.
Flood Watches	Bureau	Flood Watches are an early advice of increased flood risk over a catchment up to four days in advance of large-scale weather systems that have the potential to cause flooding.
Flood Warnings	Bureau	Flood Warnings provide advance notice that a flood may occur in the near future at a certain location or in a certain river basin or catchment.
Livestock and Equipment Warnings	SES	Livestock and Equipment Warnings are issued when there is evidence of significant rises in stream levels below minor flood heights.
Local Flood Advices	SES and/or councils	Local Flood Advices are issued based on localised valley watch information for locations in which the Bureau does not issue Flood Warnings.
Flood Bulletins	SES	Flood Bulletins are issued by SES to inform the public of what is expected during a flooding event. Flood Bulletins contain information on the flood consequences that are likely to occur and what actions must be taken to protect persons and property. They include what the predicted height means in terms of areas likely to be flooded and the depth and nature of the expected flooding and areas of danger to be avoided.
Evacuation Warnings	SES	Evacuation Warnings are messages advising the community to prepare for a likely evacuation. Evacuation Warnings provide advice on how to prepare and what the public should take with them.
Evacuation Orders	SES	Evacuation Orders communicate the need for a community (or parts of a community) to evacuate by a specified time in response to an imminent threat. An Evacuation Order also provides advice on where to go and the best evacuation route to take.

Table 3-5: Warning products.

What is the process for a public warning?

The SES provided the Inquiry with a snapshot of the process for public warnings.³⁶⁴

³⁶⁴ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 11 May 2022*.

Box 3-10: Process for public warnings

1. The Bureau releases a Flood Warning for a nominated river. The Flood Warning sets out predicted river heights at nominated locations.
2. The Intelligence and Public Information areas of the relevant Information Management Team compare the predicted heights with consequence data in Flood Intelligence Cards.
3. The Public Information area drafts a Flood Bulletin outlining consequence data and action statements for members of the public based on the Bureau predictions.
4. Where consequence data is a 'trigger' in an area for evacuation warning or order, the Public Information team will draft the relevant evacuation product in consultation with the Intelligence area. Triggers are often identified by the Intelligence area and Intelligence may identify a need for a product based on trends in flood gauge heights.
5. A Bulletin/Evacuation product is approved by the Incident Controller based on local knowledge, intelligence and other stakeholder discussions.
6. If it is an Evacuation product, it also requires the approval of the State Duty Commander.
7. The Bulletin/Evacuation product is then distributed by the Public Information team through:
 - MyPortal – a distribution platform which directly emails the product to pre identified stakeholders in the affected area (news outlets, LEMO, REMO, Council).
 - website – uploaded to the SES website
 - social media – uploaded to local and state SES pages. When there is a high number and frequency of products, a summarised list is published every 12 hours
 - common Operating Picture – the common operating picture displays an updated list of evacuation products and during complex events this is displayed at the State Command Centre, the SEOC and is provided to supporting agencies
 - media – the Media Unit organise interviews with broadcast media to provide updated information and warnings throughout an event
 - doorknocking
 - call trees or matrixes
 - emergency alert.

The preparation of products is a manual process, using pre-populated word templates which are emailed or sent to the Incident Management Gateway on Microsoft Sharepoint.

How is this information disseminated to the community?

The SES informed the Inquiry that the SES website provides up to date advice on evacuation orders, evacuation warnings, flood bulletins and evacuation centres.³⁶⁵ In addition, the *Provision and Requirements for Flood Warning in NSW* document outlines how the SES may deliver flood warning information directly to the public including any combination of the below:

- mobile and fixed public address systems
- two-way radio

³⁶⁵ Ibid.

- emergency alert
- telephone/fax
- doorknocking
- mobile and fixed sirens
- variable message signs
- community notices in identified hubs
- distribution through established community liaison networks/partnerships
- internet – including authorised social media and the official SES website.³⁶⁶

The Inquiry recognises there is a generational shift in how information is both disseminated and received, and that children, parents and grandparents may use different mechanisms to receive information.

MoU exists with the ABC for emergency information broadcast

The ABC works across Australia with emergency services agencies to deliver warnings, alerts, information and news about disasters and emergencies on TV, radio, online and on mobile. Local stations seek to deliver timely, accurate and relevant information to affected communities.³⁶⁷ In NSW, the ABC has committed, in a Memorandum of Understanding (MoU) with the NSW Government, to broadcasting warnings on the radio, social media and online as soon as possible after being told of a threat being posed to the community.³⁶⁸

The SES advised that, while other media outlets do not have an MoU outlining broadcast responsibilities for emergency warning, they often share this information as it is relevant to their audiences. Incident Management Teams recognise that all sources of reliable information are beneficial to the community.³⁶⁹

PIFAC should play a role in coordinating release of reliable information

The role of the Public Information Functional Area Coordinator (PIFAC) is outlined in the NSW Public Information Services Functional Area Supporting Plan.³⁷⁰ The plan states that all agencies are entitled to release information without the express approval of the PIFAC. However, when agencies need to ensure that their agency-specific messages do not conflict with PIFAC messages, agencies may need to consult the PIFAC before the release of any information.

The Inquiry was told that during the COVID-19 pandemic, DCS took a greater role in public messaging and sentiment gathering as it had the resources and expertise to do so. In the 2022 flooding events, the media was leveraged by event controllers and agencies including the SES. The PIFAC function as it is designed under the SERM Act was notably absent.

The role of social media

There has been a notable shift in recent years in how people access information: they proactively seek it through apps, social media and websites as well as more traditional channels such as TV,

³⁶⁶ NSW SES (NSW State Emergency Service). (2019). Provision and Requirements for Flood Warning in New South Wales. Retrieved from <https://www.ses.nsw.gov.au/media/3463/provision-and-requirements-for-flood-warning-in-nsw-november-2019.pdf>

³⁶⁷ ABC (Australian Broadcasting Corporation). (2021). ABC Emergency Broadcasting. 19 November. Retrieved from <https://about.abc.net.au/press-releases/abc-emergency-broadcasting/>

³⁶⁸ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided on 26 May 2022*.

³⁶⁹ Ibid.

³⁷⁰ NSW Police Force. (2019). Public Information Services Functional Area Supporting Plan. Retrieved from <https://www.emergency.nsw.gov.au/Documents/plans/supporting-plans/SupportingPlan-Public-Information.pdf>.

radio and print media. Correspondingly, there has been an increase in the use of technology and social media to distribute information and warnings. Social media is now an important communication tool which enables real time communication and played a critical role in the 2022 floods.

During this event emergency services and supporting agencies posted and shared vital information regarding weather updates, flood warnings and evacuation orders. Social media will continue to be a tool at the disposal of emergency services across the prevention, preparedness, response and recovery spectrum. Submissions received by the Inquiry demonstrate this point for example:

As we were receiving very little information from official sources we had to rely upon media and social media to get an understanding of what was happening around us.³⁷¹

If we stayed following the SES reports I'm positive [sic] we all would not have survived. It was instinct and reports from locals upstream via social media that saved us.³⁷²

Social media and search traffic analysis shows that during the 2022 floods, many people turned to social media (Twitter) and Google for the sharing and receiving of flood event information. NSW flood-related 'tweets' peaked between 28 February and the first week of March 2022 (see Figure 3-4). Top domains linked to unique flood related posts in Twitter between February and April 2022, included the guardian.com, abc.net.au and news.com.au. Very few people had linked to the SES as a source of information (see Figure 3-5).

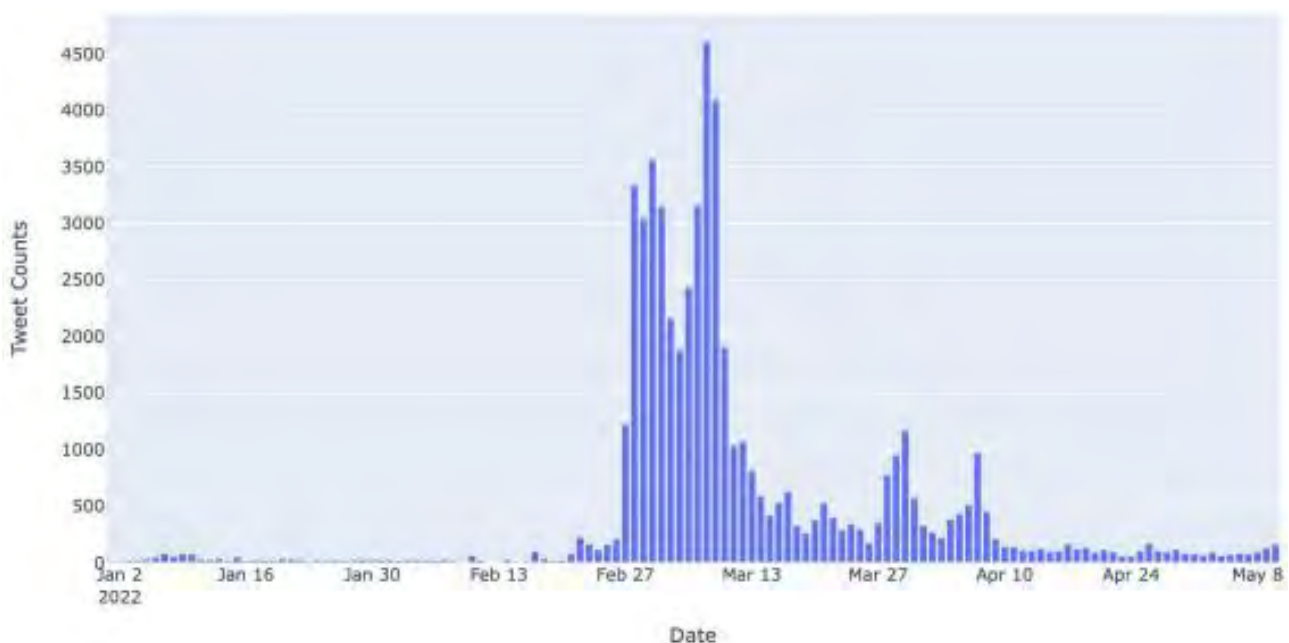


Figure 3-4: flood related social media volumes during first and second flood events.

³⁷¹ Stephen Bocking, submission to the Inquiry.

³⁷² Craig Greaves, submission to the Inquiry.

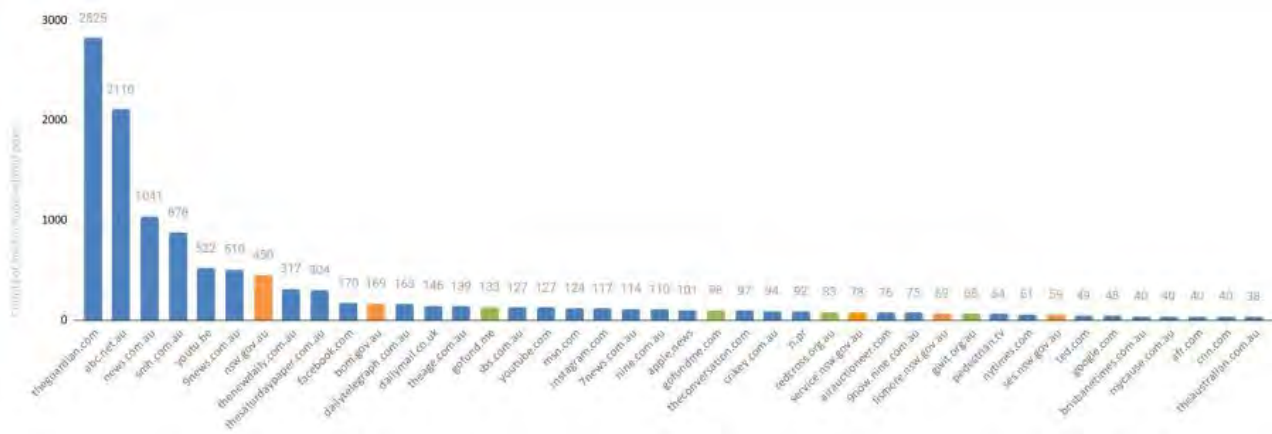


Figure 3-5: Key media sources for flood-related information.

How were communities warned about the 2022 floods?

The Inquiry appreciates that the safety of people in flood-affected communities is influenced by their awareness, preparedness, responses and decision making and, critically, by public warning systems. To this extent, in early October 2021, the Bureau released its outlook for the 2021–22 severe weather season, which included the risk of above average flooding for eastern and northern regions of Australia. The Premier and senior officials were briefed in early November 2021 of the increased risk of major flooding along the eastern seaboard for NSW.³⁷³

The SES advised the Inquiry that between June and December 2021, it undertook numerous community engagement activities including social media, print and in-place media advertising. In particular, the SES held community meetings in Lismore in the lead up to February 2022 to discuss flood risk and preparedness.

On 27 February 2022, a press conference was held with the Bureau, NSW Premier, Minister for Emergency Services and Resilience and the SES Commissioner that communicated the following:

- multiple major flood warnings remain current for north-eastern New South Wales.
- there is a risk of dangerous and potentially life-threatening flooding at Tumbulgum, Lismore, Grafton, Coutts Crossing, Kyogle and Coraki, similar to what was seen in south-east Queensland
- heavy rain continued overnight and is likely to continue
- dangerous and life-threatening flash flooding is expected over the Northern Rivers, Mid North Coast and Northern Tablelands throughout the day and possibly into Monday
- communities should be prepared for flood impacts and are encouraged to keep up to date with the latest forecasts and warnings on the Bureau's website and weather app, and to follow the advice of emergency services.

The SES advised the Inquiry that before and during the 2022 flooding events, it shared information with the SEOC and other state and Australian Government agencies through daily operational briefs, weather updates, situational awareness reports, operational update reports, state overview reports, and common operating pictures.³⁷⁴

Once the flooding commenced, the SES used a number of methods to inform and warn communities about the potential flooding. These included broadcast media, social media, door knocking, SMS and the SES and the Bureau websites and emergency alerts.³⁷⁵

³⁷³ Meeting with the Bureau of Meteorology on 14 April 2022.

³⁷⁴ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 11 May 2022*.

³⁷⁵ Ibid.

Between 22 February and 15 March across the Northern Rivers, Sydney Metro and Hunter regions the SES issued 1,620 flood bulletins and flood watches, issued 173 evacuation orders, and received 3,778,577 website hits.³⁷⁶ Over the course of the flood events, the SES published 193 tweets and issued 383 Facebook posts from the official SES Facebook page. The SES advised that tweets were liked or shared 2,816,700 (total impressions) times, and Facebook posts were liked or shared 1,888,710 times. The SES also gained over 31,645 new Facebook followers.

The Inquiry observed for the July 2022 floods that the community was more aware of the flooding risks due to recent lived experience and often didn't wait for official warnings before taking preventative and protective action.

Were the warnings effective? Did the warnings trigger action?

The Inquiry heard anecdotal evidence that the community ignored SES warnings to evacuate, especially in the Northern Rivers during both flood events. This was exacerbated by mixed messaging from the SES, particularly during the first flood event at Lismore.

It is difficult for the Inquiry to establish if the public warnings were effective across the state, as different areas had different experiences and to varying degrees of severity. The Inquiry found that the effectiveness of the warnings was disparate due to factors such as location, type of flooding event and severity of flooding event. For example, flooding is characteristic of Lismore and part of its residents lived experience. Overall, however, more work is needed to ensure messaging (and corresponding action) of warnings is improved.

As previously discussed, warnings and public information are critical to enhancing public safety, as the provision of timely and relevant information helps community members make informed decisions.

Across the State and Metropolitan Sydney

2022 saw flooding events across NSW. While there has been a focus on the Northern Rivers and Hawkesbury-Nepean regions, other parts of Metropolitan Sydney, the Central Coast, Far West (Broken Hill) and the Hunter also experienced flooding events.

Sydney and the Central Coast experienced persistent intense rainfall in the week of 3 to 9 March that caused widespread flash flooding and major riverine flooding especially in the Hawkesbury-Nepean Valley (explored further below). This rainfall quickly overwhelmed local stormwater and drainage systems, resulting in significant flash flooding across Metropolitan Sydney as well as along the Central Coast. Severe weather and major flood warnings were issued, and thousands of people were evacuated from the affected areas.³⁷⁷

Central Coast

Following a Severe Thunderstorm Warning on 22 February, the Central Coast was one of the first areas to be affected, with 3 flood rescues requested in the Gosford area and flash flooding closing parts of the Central Coast Highway at West Gosford. On 25 February, severe weather hit the Central Coast, again causing flash flooding and requiring flood rescues. One flood-related death was recorded.³⁷⁸

³⁷⁶ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 11 May 2022. and 27 May 2022*

³⁷⁷ The Bureau (the Bureau of Meteorology). (2022). *Advice to the Inquiry provided 20 May 2022.*

³⁷⁸ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 11 May 2022.*

From 3 March 2022, flooding was experienced in the Tuggerah Lakes area of the Central Coast. This led to numerous SES requests for assistance and evacuation warnings and orders. A significant multi-agency door-knocking and sandbagging operation was undertaken to alert and prepare affected properties (87 properties based on the projected flood height of 1.6 m.³⁷⁹ An evacuation order was issued. The evacuation orders appear to have been relatively successful with only 19 flood rescues being requested during the flood event.

In its submission to the Inquiry, the Central Coast Council advised that flood prediction and forecasting improvement opportunities exist. Central Coast Council's flood team has been developing flood modelling over the past years that is proving to be extremely accurate. Opportunities exist to share this modelling with the Bureau of Meteorology and improve flood predictions and community notifications about evacuations. Council is willing and open to sharing this information to bolster preparedness and response across the state³⁸⁰ and this is encouraged by the Inquiry.

Hunter

From 6 March, there was widespread riverine flooding across the Hunter with major flooding projected in catchments including the Lower Hunter and Wollombi Brook, Goulburn and Upper Hunter, Paterson and Williams Rivers and Karuah River. Ultimately the worst flood predictions for the Hunter were not seen, with the weather system shifting the heaviest rainfall onto Metropolitan Sydney. However, major flooding was still observed on Wollombi Brook at Bulga where floodwaters exceeded March 2021 levels and the community was isolated, and at Singleton where the New England Highway was cut. Minor to moderate riverine flooding was also observed throughout the region, affecting mainly rural properties with localised isolations.³⁸¹

Flooding occurred across all major river systems in the Hunter Region. The areas greatest affected were Singleton, Spencer, and Hinton:

- the Wollombi Brook at Wollombi peaked at 11.24 m at around 8:08 pm on 9 March 2022
- the Wollombi Brook at Bulga peaked at 7.37 m at around 12:45 pm on 9 March 2022, with major flooding above the March 2021 flood level
- the Hunter River at Singleton peaked at 13.16 m at around 7:00 pm on 9 March closing the New England Highway.³⁸²

Communities were kept advised throughout the event via multiple platforms, including the SES website, social media, radio, and television.³⁸³ The SES issued 5 evacuation orders and 5 evacuation warnings during the flood event.³⁸⁴ The warnings and orders appear to have been successful with only 5 known requests for flood rescue.

Clarence Valley

The Clarence Valley experienced 3 flood events during February/March 2022, with the second flood being the largest. The second flood in Maclean was the highest flood recorded since completion of the Clarence River Levee in 1976.³⁸⁵ In its submission to the Inquiry, Clarence Valley Council advised that on 4 occasions during the floods, SES disseminated incorrect information in evacuation orders including advertising evacuation centres that had already closed, had not been

³⁷⁹ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 9 March 2022*.

³⁸⁰ Central Coast Council, submission to Inquiry.

³⁸¹ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 9 March 2022*.

³⁸² *Ibid.*

³⁸³ *Ibid.*

³⁸⁴ *Ibid.*

³⁸⁵ Clarence Valley Council, submission to Inquiry.

authorised for use during the flood event by the Clarence Valley LEOCON, or that were inaccessible as the evacuation route was already inundated and closed. Council found push notifications, app updates and social media posts to be insufficient for those located in areas with poor or no phone reception or during events that significantly affect telecommunications.³⁸⁶

Other areas of Metropolitan Sydney

On 8 March, the Northern Beaches experienced a flooding event, with the Manly Lagoon recording its highest water level since records commenced in the 1940s:

*The 8 March event was the most significant in a number of storm and coastal erosion events throughout February and March with over 170mm falling in a 6hr period which was substantially higher than all available forecasts for the area.*³⁸⁷

Despite the heavy rain fall, no official evacuation warning or order from SES Headquarters was issued for the Manly Lagoon flooding. A few social media updates by the local SES units were posted.

Broken Hill

Broken Hill had a flash flooding event on 15 March. Over 140 mm of rain fell within an hour, which broke the previous record of 129-139 mm recorded in 1989. Barrier and Silvercity Highways and Menindee Road were closed due to flash flooding. There was one death on Menindee Road.³⁸⁸ The Inquiry was told that rain events in Broken Hill often occur very quickly and at such an intensity that the streets are underwater in less than an hour. However, as quickly as the streets are inundated, within 2 hours the flooding has receded. For this March event, there was no warning prior to the event and there is no Doppler radar coverage for Broken Hill.³⁸⁹ One of the biggest issues in Broken Hill is that there is no drainage in the city. After a rain event has finished, residents may use their cars to go and observe the water phenomenon. This can cause washback of the water into the streets and onto houses and shops, causing more damage.³⁹⁰ In this case, warnings need to be targeted to discourage driving through flood waters.

Hawkesbury-Nepean

In the Hawkesbury-Nepean, in the March and April floods, a total of 576 flood bulletins were issued, 438 in March and 138 in April, with the Bureau issuing its first Flood Watch for the Hawkesbury-Nepean system on 1 March. From what the Inquiry observed and has been advised, overall, the warnings in the Hawkesbury-Nepean area had the desired effect, with nearly 40,000 people affected by an evacuation order or warning and only 182 flood rescues carried out.³⁹¹ The majority of those affected by the floods were successfully evacuated prior to, or stayed in place safely during, the flooding event. While this was the case for the majority, the Inquiry received a submission that a few locations near the Hawkesbury-Nepean did not receive any evacuation warnings or orders.

On the 2nd of March this year it was quite obvious to me that, you know, with the Bureau and SES declarations of where were flood and by roughly much and the various warnings it was quite obvious that Rickabys Creek, South Creek and Eastern Creek would also be inundated

³⁸⁶ Ibid.

³⁸⁷ Northern Beaches Council, submission to the Inquiry.

³⁸⁸ Meeting with Broken Hill Police on 22 June 2022.

³⁸⁹ Meeting with Broken Hill Police on 22 June 2022; and Broken Hill Council LEMO 22 June 2022.

³⁹⁰ Meeting with Broken Hill Council LEMO 22 June 2022.

³⁹¹ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 9 March 2022.*

by floodwater. There was no warnings for those areas. Warnings came after the water came.

³⁹²

Ms Robyn Preston MP, Member for Hawkesbury, told the Inquiry that she felt the community was better prepared for the floods this year and that they evacuated well in advance.³⁹³

Councillor Glenn Gardiner, of Penrith City Council, advised that no flood warnings were issued in advance of the flooding for Rickabys Creek, South Creek and Eastern Creek. The warning came after the flood waters arrived, requiring one resident to be rescued by helicopter from Werrington.³⁹⁴

Why were the warnings more successful in the Hawkesbury-Nepean?

Some success can be attributed to the timeliness and effectiveness of the warnings, but there are other contributing factors. The Hawkesbury-Nepean Flood Risk Management Directorate within Infrastructure NSW has done extensive flood modelling for the Hawkesbury-Nepean Valley. This is complemented by the monitoring of Warragamba catchment and in particular Warragamba Dam. There is extensive monitoring and modelling of the rainfall in and around the Warragamba catchment, and how that affects the dam and subsequent overflows (noting that floodwaters flowing into the valley come from several different river catchments – in previous floods, the Warragamba catchment has contributed 40-70% of floodwaters in the valley).³⁹⁵

The Inquiry heard that the emergency management agencies were more assertive and willing to take affirmative action (i.e. 'go early' on evacuations) compared to other areas of the state. It is noted, however, that a conservative approach is generally taken in the Hawkesbury-Nepean due to the risk factors of a flooding event, namely the size of the population living in the floodplain; the 'bathtub' effect whereby floodwaters tend to rise fast, be deep, and remain for days; the fact that there are a number of critical roads that get flooded early and therefore cannot be used for evacuations; and the heavy reliance on the road network for vehicle-based evacuations given limited rail and air transport options. It is also noted that the Hawkesbury-Nepean catchment had a more sophisticated preparedness campaign than other areas of the state, so this may have contributed to the community's overall willingness to act on the warnings.

More importantly, however, while these flood events contributed to loss of life and significant property damage, they were relatively small compared to the scale of historic floods experienced in this area.³⁹⁶ As noted in Chapter 1, the largest flood in the valley since European settlement was in June 1867, when the river reached around 19 m above normal river height at Windsor. This flood was described as 'a huge 'inland sea' with waves up to 2 m high. The flood stretched from Pitt Town to Kurrajong and from Riverstone to the Blue Mountains. Windsor, Richmond, and Pitt Town

³⁹² Hawkesbury-Nepean Community Town Hall 16 June 2022, retrieved from <https://www.nsw.gov.au/sites/default/files/2022-07/Hawkesbury-Nepean-community-meeting-transcript-16-June-2022.pdf>.

³⁹³ Ibid.

³⁹⁴ Ibid.

³⁹⁵ INSW (Infrastructure NSW). (2017). Resilient Valley. Resilient Communities Hawkesbury-Nepean Valley Flood Risk Management Strategy. Retrieved from <https://www.infrastructure.nsw.gov.au/media/2855/infrastructure-nsw-resilient-valley-resilient-communities-2017-jan.pdf>.

³⁹⁶ The Bureau of Meteorology. (2022). *Special Climate Statement 76 – Extreme rainfall and flooding in south-eastern Queensland and eastern New South Wales*, page 3. Retrieved from <http://www.bom.gov.au/climate/current/statements/scs76.pdf?20220525>.

became small ‘flood islands’.³⁹⁷ It is estimated to have been a ‘1 in 500’ year flood event.³⁹⁸ Sediment analysis in the Nepean Gorge indicates there may have been a ‘1 in 1,000’ year flood event before European settlement. In comparison, the March 2022 flood has been classified as a ‘1 in 20 year’ flood at Windsor. Floods experienced in the region in July 2022 were broadly comparable to the March 2022 floods. The Inquiry notes that it is often the ‘lived experience’ that the community relies upon in its comprehension of the flood danger and decision to evacuate.

Given that these floods were relatively small in comparison to what can occur in this region, the emergency management arrangements and services were not stretched nor tested in this event as in other parts of the state.

The Inquiry also notes that the Hawkesbury-Nepean’s location close to Sydney provided more alternative housing options for evacuees, including with family and friends not affected by the flooding, and more emergency personnel and resources from the Sydney area.

Northern Rivers

As explained in Chapter 2, the Northern Rivers Region experienced 2 separate flooding events on 28 February and 30 March. Both events resulted in many residents requiring rescue from the roofs of their houses, or more concerningly inside their roof which were often tin or Colorbond, which trapped community members with rising floodwaters. This resulted in community first responders having to cut them out of their roofs. The second event, while less severe in terms of maximum flood height, still caused a lot of destruction due to severe weather and flooding.

First flooding event

The Bureau issued 46 Flood Warnings between 24 February and 6 March for the Wilson’s River. It issued a major flood warning on 26 February and first forecast the overtop of the levee via a flood warning on 27 February at 2:15 pm.

In total, the Bureau issued 3 Flood Watches for the Wilsons River between 23 and 27 February. The highest forecast flood level included in this product was major, with this level of severity first issued on 26 February. The Bureau issued three Flood Scenario Outlooks for the Wilsons River, commencing 23 February and concluding 27 February. The highest forecast flood level was major, with this level of severity first issued on 26 February. The first time the levee was forecast to be overtopped by the Bureau as part of a Flood Scenario Outlook was 26 February at about 2:00 pm.

The Bureau issued 52 Flood Warnings between 24 February and 11 March for the Richmond River, including a major flood warning on 26 February. In total, 3 flood watches and 3 flood scenario outlooks were issued between 23 and 27 February. As with the Wilsons River, the highest forecast flood level included in this product was major, with this level of severity first issued on 26 February.³⁹⁹

In summary, the Bureau extensively forecast and communicated to Government and the community the risk of severe weather, and identified and communicated the risk of intense localised rain, life threatening flash flooding and potential for rapid river rises. However, the risk of such severe weather was not adequately communicated through the SES Flood Bulletins and other warning products.

³⁹⁷ AFAC (National Council for Fire and Emergency Services). (2017). Challenges and Mitigation: The Inevitable Hawkesbury-Nepean Flood. Retrieved from afac.com.au/insight/operations/article/current/challenges-and-mitigation-the-inevitable-hawkesbury-nepean-flood.

³⁹⁸ See Section 2.1 in Chapter 2 for more on the probability terminology associated with floods.

³⁹⁹ The Bureau (the Bureau of Meteorology). (2022). *Advice to the Inquiry provided 14 April 2022*.

For the first event beginning on 22 February, the Inquiry heard multiple stories of residents early on 28 February waking up to rapidly rising water.⁴⁰⁰ Many people did not evacuate before this flooding event and, as a result, many were left stranded or requiring rescue. As the Inquiry was told, 'when you receive thousands of requests for assistance you know something has gone wrong.'⁴⁰¹

Why were the warnings inadequate in the Northern Rivers?

The inadequate warning of the Northern Rivers region ahead of the 28 February flood was the result of an accumulation of issues, which led to a systemic failure that resulted in the community not having enough time to evacuate, and not understanding the severity of the flood itself. These issues included the SES's failure to look at all the factors, and its lack of a planning and intelligence unit to synthesise all information available, including but not limited to Bureau forecasts. In addition, the SES does not have an ability to 'warn about flash flooding' as it has not fully understood its legislative responsibilities in this area.

The Inquiry heard from numerous sources that community flood plans were based on the highest recorded flood or the most severe flood in living memory. For many this was the 1974 flood which reached a height of 12.11 m in Lismore. This assumption proved destructive and is indicative of a greater flaw within the flood warning system.

In Lismore City Council's submission to the Inquiry advised that:

On Sunday, 28 February 2022, the community started preparing for another possible flood. Initial predictions were that it could possibly hit the heights of the 2017 experience. In activating their flood plans, local vendors removed stock and equipment from their stores, and moved this to higher ground, or to purpose-built shelving onsite so that flood water wouldn't reach it. Most included a buffer of a metre or so above the 2017 flood levels just to be safe. Sandbag stations were set up to stop water entering properties. People in low-lying areas went to stay with family and friends to wait out the weather.

This was simply not enough.

During the course of the evening, as the deluge continued, water rose much faster than expected. By 3am, flood waters yet again topped the levee and rushed into town. At their peak, flood levels reached around 14.4 metres. The height of these floods were unmatched in living memory.

Those three metres made all of the difference.

They meant that people who thought they were safe on their second storey got trapped in their roof cavity as waters rose at terrifying speeds. They spent hours calling for help, climbing through windows, trying to break through roof panels to climb to relative safety.

They meant that people who thought they had 'flood proofed' their place saw all of their belongings placed at height destroyed anyway.

They meant that people who didn't need to evacuate the 2017 flood were caught unawares and found themselves clinging to their roof and waiting for rescue. Many people were sleeping as waters crept up, missing that critical evacuation window.

They meant that the emergency response, which may have been suitable for a 11.59m flood was simply unable to respond to the significance of the event. Rescues were affected by locals in tinnies, kayaks and jetskis.⁴⁰²

In the Northern Rivers, as across the state, warning systems rely heavily on the Bureau and the centralisation of decision making in the SES State Headquarters. As one submission stated,

⁴⁰⁰ Anonymous, submission to the Inquiry.

⁴⁰¹ Meeting with Risk Frontiers on 22 April 2022.

⁴⁰² Lismore City Council, submission to Inquiry.

*the situation in Lismore is different to anywhere in the state and should be considered differently...The system needs to support community. The expertise is within the community, not in Wollongong.*⁴⁰³

The Inquiry was told by Lismore City Council that the Bureau and SES appear unwilling to be 'forward looking' because weather is highly variable. 'However, the lack of specific information about what might be possibly coming contributes to the general approach of many that their reference point is the last flood or the biggest flood they have experienced.'⁴⁰⁴

Messaging that provides a range of possible scenarios would empower community and give them greater capability to make decisions about their own welfare. Lismore City Council has offered an approach which would capture current weather and river conditions to provide a maximum of 3 potential scenarios for the immediate future. However, the council noted that such a warning system would require further development of existing catchment models.

Effective coordination and liaison arrangements between the Incident Management Team and Emergency Operations Centre also created operational barriers, which affected the flow of information between agencies and the timeliness of warnings to community.

In its submission to the Inquiry, Rous County Council advised that evacuation information was poorly delivered to local residents, and that poor decisions were made about giving evacuation and all clear notices. Its examples included:

- giving an all clear to re-enter the Lismore CBD in the early evening, rather than taking a cautious approach and waiting for the morning
- giving an all clear to return to Woodburn when the flood was still coming
- sending people to evacuation centres from which they were physically cut off (e.g. Woodburn residents being sent to Lennox Head when the highway was cut by flooding).⁴⁰⁵

Rous County Council suggested that:

- risk assessments for providing the all clear to return must include an assessment of the safety of evacuating again if the situation changes, and the risk of it changing
- local information and advice along with the previous notices must be investigated before issuing all clears and evacuation orders (e.g. check local road conditions, and river levels)
- decisions on all clears and evacuation orders need to be checked by someone on the ground.⁴⁰⁶

Access to actionable and timely information was not forthcoming and this created significant challenges for both community and supporting agencies.

Planning by SES began on 25 February and pre-emptive warnings were developed by the Incident Management Team (IMT) on the afternoon of 26 February. However, as the flood event expanded, situational reporting by the IMT became more generic, lacking local intelligence of potential flood impact. The scope of the IMTs area of operation and the scale of the event overwhelmed the capability of the SES to provide adequate and detailed warnings.

While situational reporting indicated as early as 24 February that remote communities were becoming isolated because of flood waters, it appears there was no consequential or significant ongoing monitoring of the creeks and tributaries that had led to the isolation.

In addition, the SES issued flood evacuation orders for North Lismore and South Lismore on 27 February at 9:30 pm with advice to evacuate by 10:00 pm, giving only 30 minutes for preparation. A flood evacuation order for the Lismore CBD was issued on 27 February at 9:30 pm

⁴⁰³ Anonymous, submission to Inquiry.

⁴⁰⁴ Lismore City Council, submission to Inquiry.

⁴⁰⁵ Rous County Council, submission to the Inquiry.

⁴⁰⁶ Ibid.

to evacuate by 5 am the following morning. The community reported that no warnings or orders were issued for downstream communities, particularly the badly affected community of Coraki.

Collectively, the intelligence advice from the IMT, Zone and State Operational Centres failed to comprehend the cumulative effect of weather events, climate conditions and resource constraints. This resulted in poorly followed or no evacuation orders, and also affected the capacity of the combat agency to respond.

Second flooding event

While the word 'unprecedented' is often used when referring to the 14.37m flood of 28 February 28 - 1 March, this should not be used as an excuse for the failures of monitoring, warning and communication failures that occurred at that time and again on 30 March.⁴⁰⁷

Similar issues were experienced in the second flooding event, exacerbated by the extensive damage caused by the first flood to the Lismore City flood levee and to the river gauges.

Lismore City Council advised that, during the first flood event, the 4 pump stations associated with the levee system were completely submerged, including electric motors and switchboards. The damage meant that all 4 were non-operational. Sections of the concrete levee wall that protects the Lismore CBD were also superficially damaged. After the council's audit of the levee system after the first flood event, flood gates etc. were cleared of debris and a temporary repair was undertaken to the Browns Creek Pump Station. This pump station was operational for the second flood event on 30 March, but the other 3 pump stations were not. In all other aspects, the levee system was operational by the second event.⁴⁰⁸

The Bureau advised the Inquiry it uses the primary flood level gauge on the Wilsons River at Lismore (Lismore Rowing Club), owned by Lismore City Council, for monitoring and issuing flood warnings for Lismore. This gauge failed at around 1.00 pm on 28 February. Readings taken from the secondary Browns Creek gauge were then used to inform river height forecasts. This gauge is also council-owned and is located in the middle of the town next to the levee gates on the Wilsons River.⁴⁰⁹

The damage to warning infrastructure constrained the ability of emergency services to provide timely flood and evacuation warnings based on accurate data, but this data gap itself should have been a factor in decision making about public warnings, evacuation orders and pre-deployment of resources in the lead up to the second flood.

Messaging of warnings needs to be overhauled

During the 2022 flood events, public information and the dissemination of warnings varied across the state. Initially, information and warnings were somewhat coordinated. As the events became bigger and more serious, the provision of information became more erratic and the advice became more generic and less helpful for communities.

This was particularly evident in the Northern Rivers region. Communication and public warning failures led to increased anxiety in the community and to a disordered emergency response which put lives in danger.

Communication failures

The SES website is a primary source of information to the community, but it crashed during peak demand periods. People were also either unable to get through to the SES hotline on 131 500 or to Triple Zero, or experienced long wait times to be rescued once they had logged their job. These

⁴⁰⁷ Anne Schillmoller, submission to the Inquiry.

⁴⁰⁸ Lismore City Council, submission to the Inquiry.

⁴⁰⁹ The Bureau of Meteorology, submission to the Inquiry.

frustrations led to people, especially in the Northern Rivers region, turning to social media in desperation to understand what was happening and to request urgent flood rescues when they were unable to get an SES response. The Inquiry heard that the SES had difficulty managing rescue requests they did receive, as they were not necessarily captured in the Beacon tasking system. The Inquiry recognises that this was a period of extreme activity, but it did point to a lack of SES preparedness for such a complex event.

This reliance on social media was also problematic as information about Evacuation Warnings and Evacuation Orders was shared inconsistently by the SES on social media pages. Some information was shared a long time after it had been issued, while other information was not posted to social media pages. When the SES website crashed, people were unable to find evacuation information on social media.

The Inquiry also heard that the geotargeting messages issued by the SES were inconsistent and sometimes delayed or provided inconsistent information for the same area. For example, the SES issued the geotargeting SMS for the Lismore Evacuation Order at 12:43 am on 28 February, nearly 4 hours after the Evacuation Order was issued at 9:30 pm. In Lismore, multiple evacuation warnings and orders were issued for the same area but had different evacuation deadlines.

Language, timing and dissemination of warnings was confusing and inconsistent and sometimes dangerous

The Inquiry was told that messaging from various government agencies, including the SES, the Bureau and local councils, as well as the media, was inconsistent despite containing similar information. For example, each agency had different terminology, images and colours for actions (e.g. evacuate) which contributed to a sense of confusion and a lack of coherent approach by government authorities.

Communications and messaging from the lead combat agency was somewhat fragmented and inconsistent making it difficult for Council to reproduce accurate and timely information for the community.⁴¹⁰

The SES locally utilises the term 'nuisance flooding' in a way that is inconsistent with the Bureau or indeed its own terminology and consequently, the community comes to disregard flood messaging from it since it is neither timely or accurate.⁴¹¹

One example involved a Northern Rivers SES social media post advising residents to seek higher ground immediately, which "may include the second storey of your building as well as in or on your roof."⁴¹² This was then reposted on the SES Facebook page for broader distribution. While well meaning, this advice led to many Lismore residents becoming trapped in their roof cavities on 28 February.

It was clear from submissions to the Inquiry, and in community meetings held in the Northern Rivers region, that the lack of clear advice in communications from government agencies worsened the event by creating confusion and contributing to the general sense of chaos.

⁴¹⁰ Central Coast Council, submission to the Inquiry

⁴¹¹ Dr Graham Brewer, submission to the Inquiry

⁴¹² Northern Rivers NSW SES (NSW State Emergency Service) Facebook post 01:24 28/2/22, reposted to NSW SES Facebook page 01:40 28/2/22.

Improving the public warning system

Changing the presentation of forecasts and warnings

The Inquiry was told that the Bureau forecasts are based on river height as measured by gauges, and that most residents are unable to translate this information to their own risk of being flooded.⁴¹³ Straight gauge information is not useful, as it may only reflect the amount of rainfall in a specific location.⁴¹⁴ Existing flood forecasts and warnings that provide users with estimates of river height are not effective in communicating, either to communities or emergency services, when and where flooding is expected. More meaningful presentation of this information, perhaps in a visual form, would improve community responses to and compliance with flood forecasts and warnings. Warnings also need to include both what could happen to water levels, and what action the community needs to take. This would give the community greater capability to make decisions about their own welfare.

Adopting the Australian National Warnings system

The SES advised the Inquiry that it is working on initiatives to improve the development and distribution of public information products.⁴¹⁵ One of these is aligning to the Australian Warning System, which is a nationally consistent hazard-agnostic approach to emergency warnings developed by a Working Group from the Australian and New Zealand National Council for Fire and Emergency Services (AFAC). It is based on the bushfire warning levels (Advice, Watch & Act and Emergency Warning)⁴¹⁶ which have not yet been adopted for other hazards.

The Inquiry is of the view that the SES should prioritise alignment to the Australian National Warning system and test this new system with the community to provide greater consistency in public information and warnings.

Strengthening the PIFAC

Each government agency or functional area has its own media branch or spokesperson.

During a crisis, an officer within the Police Media Unit operates as the Public Information Functional Area Coordinator (PIFAC). They are responsible for coordinating all agencies, making sure all communications can be used and accessed by all communities. The PIFAC becomes the spokesperson for the SEOCON and delivers whole of government, balanced and timely messages as an emergency event develops, throughout the response and into recovery. The PIFAC is also crucial in collecting and understanding public sentiment, and continually improving how to reach out to and provide messaging for diverse, vulnerable and multicultural communities.

As the NSW Government agency specialising in customer services across a range of government functions, DCS is in a stronger position to leverage its technological advantage to deliver the PIFAC function, as per Recommendation 7.

Convening regular government press conferences

A handful of comments to the Inquiry mentioned that people had become accustomed to the regular press conferences with the Premier, the relevant Minister and combat agency during previous emergencies such as the 2019–20 bushfires and the COVID-19 pandemic. These press conferences were effective at providing clear key messages to the community and promoting confidence in the emergency management arrangements. The presence of the Premier with the

⁴¹³ Meeting with the Bureau of Meteorology on 26 May 2022.

⁴¹⁴ Meeting with Steve Jacoby on 25 May 2022.

⁴¹⁵ NSW SES (NSW State Emergency Service) (2022). *Advice to Inquiry provided 26 May 2022*.

⁴¹⁶ NSW Police Force (2022). *Advice to the Inquiry provided 25 June 2022*.

commissioners of the different agencies reflected a united approach, and visually reinforced that the agencies were working together. It also held the Government to account, with media asking questions that were answered by the Government during or after the conference. While fire and pandemic are different types of events from floods, this model could have been drawn on to strengthen messaging earlier in the emergency cycle and could have continued to be used into the recovery effort.

Making better use of community broadcasters

Community broadcasters are community-owned and operated independent radio services. They are often a trusted source of information in communities which are under-represented in mainstream media, including Indigenous communities, culturally and linguistically diverse communities, LGBTQIA+ communities, youth and seniors.

For example, in some non-English speaking communities, community radio is the only source of information which is both in their language and delivered in a culturally appropriate manner.⁴¹⁷ This is also true for Indigenous communities:

*First nations community radio stations and media organisations are also the fastest and most responsive conduits for getting information through to First Nations communities in a way that is culturally appropriate, accessible, in-language and timely.*⁴¹⁸

During the 2022 flood events community broadcasters performed multiple roles as embedded members of the community. The Inquiry heard that some became a coordination point for the voluntary recovery effort.⁴¹⁹ Others endeavoured to keep communities up to date with emergency warnings and information when internet connectivity and phone lines were down.

*Richmond Valley Radio in Coraki shared urgent calls for help from people and families needing to be evacuated by boat who couldn't get through to emergency services. Sydney's 2BACR broadcast emergency information to their Bankstown-Auburn community about the floods of the Georges River. Paradise FM in Ballina shared hourly updates from the SES and connected people with clean up, accommodation and mental health advice.*⁴²⁰

The Inquiry was also provided with examples of community broadcaster involvement in previous emergencies, such as bushfires.

Community broadcasters have a unique foothold within often hard to reach demographics across the state. Their particular strength is providing a 'hyper-local' approach, giving granular detail about street closures and inundation, creek flows and isolated communities. This approach makes use of broadcasters' local knowledge and relationships with local emergency services, and provides a platform for local knowledge and intelligence to inform the community in a timely manner.

The Inquiry heard that the SES's preference for communication via TV and ABC Radio means that information is often out of date or incorrect at the time of broadcast.⁴²¹ Empowering community broadcasters to perform a more active role across the emergency management spectrum would give community an additional trusted source of information from which to prepare and respond during a flood and other natural disasters. It might also form part of the information and intelligence collected by the SES.

The national Community Radio Broadcasting Codes of Practice states that "community broadcasters play a vital role in broadcasting emergency information. Community radio stations with the ability to offer emergency broadcasts will:

⁴¹⁷ Community Broadcasting Association of Australia, submission to the Inquiry.

⁴¹⁸ Ibid, page 2.

⁴¹⁹ Ibid.

⁴²⁰ Ibid, page 3.

⁴²¹ Lismore Citizens Flood Review Group – Emergency Management, submission to the Inquiry.

- have procedures in place to enable appropriate local emergency broadcasts,
- liaise with appropriate emergency and essential service organisations, and
- ensure the accuracy of emergency information”.⁴²²

The Community Broadcasting Association of Australia (CBAA) provides online tools and training to assist broadcasters who wish to become emergency broadcasters.⁴²³ This training details how to develop a community broadcast plan, roles and responsibilities, message construction and other relevant information. CBAA also provides access to more detailed emergency broadcast training via the Community Media Training Organisation.

The NSW emergency arrangements do not currently recognise or incorporate the potential for community radio stations to be engaged as a complement to the ABC and commercial radio in emergency broadcasting. In Victoria, community radio stations can be certified as official emergency broadcasters, formalised through an MoU with Emergency Management Victoria,⁴²⁴ to provide information across response, recovery and assurance and learning domains.

G. Findings – public warnings

- NSW Government must have clear, consistent and effective messaging prior to and during a disaster to ensure all community members understand the risk in all its dimensions including vulnerability, capacity, exposure and hazard characteristics.
- Effective messaging will empower the community to make better decisions in a disaster, particularly around early evacuation.
- During the 2019–20 bushfires and the COVID-19 pandemic, clear and consistent messaging from Government was vital in reaching vulnerable and culturally and religiously diverse communities. This was achieved through strong Public Information Functional Area Coordination (PIFAC) performance driven by the Department of Customer Service (DCS) and its customer-facing operation Service NSW.
- Under current leadership, DCS has delivered a high level of service to the community and the Inquiry saw this same level of service play out during multiple disasters/emergencies.
- PIFAC should be delivered by the subject matter expert for public communication, DCS, which is also well placed to get the traction necessary for whole of government communications.

7. Recommendation – PIFAC function

That, to ensure the community can better understand the threat of flood, storm and tsunami activity, the Department of Customer Service (DCS) be made accountable for PIFAC in all emergencies. This will improve access

⁴²² Community Broadcasting Association of Australia. (2008). Community Radio Broadcasting Codes of Practice., page 9. Retrieved from <https://www.cbaa.org.au/sites/default/files/media/Community%20Radio%20Broadcasting%20Codes%20of%20Practice%20-%20Print%20Friendly%20PDF.pdf>.

⁴²³ Community Broadcasting Association of Australia. (2022). Emergency Broadcasting. Retrieved from <https://www.cbaa.org.au/emergency-broadcasting>.

⁴²⁴ Ibid.

to clear, reliable and consistent messaging prior to and during emergencies. This transfers the PIFAC role from NSW Police Force to Service NSW. Under this PIFAC function, DCS would be responsible for:

- proactively assessing community sentiment and working with agencies to effectively disseminate key disaster information to all communities including vulnerable, culturally, linguistically, and religiously diverse communities
- coordinating clear, consistent, reliable messaging from all government agencies, especially during a disaster
- working with the SEMC, the Bureau of Meteorology, the new NSWRA and SEOCON to provide public statements evaluating the likely risk of flooding and the effectiveness of planning and preparation for the upcoming season. This should be based on sophisticated monitoring of key risk factors and signals for extreme flood events. It should form the basis for clear public communication about these risks on a regional basis and the actions that the Government proposes in preparation.
- working with the NSWRA and SEOCON to deliver a single communication tool for riverine floods, flash floods and dam warnings which uses all available inputs (such as information from the Bureau, real-time river and rain observations data and citizen science data) and provides an assessment of antecedent conditions (such as saturated catchments, soil moisture and water storage capacity). This information should be available to communities and individuals in real-time, on live warning signs in town centres (using satellite connections so they are not reliant on local telecommunications infrastructure)
- recognising that community will revert to social media platforms to self-organise when government is unable to respond, the NSW Government should also consider how to work with social media companies and online communities to ensure consistent messaging during an emergency. This may include directing individual users to Government platforms for updated information.

8. Recommendation – NSW disaster app

That, to improve community confidence in government messaging and warnings, the SEOCON and DCS develop a single 'NSW disaster app'. This:

- will consolidate individual agencies warning apps
- have a simple interface that is accessible via mobile devices
- provide real time flood warnings and information, both raw information from gauges and processed information from publicly available models
- allow citizens to provide information during a flood to help authorities and community, including flood imagery and local knowledge observations in the lead into, during and immediately after flood events.

Further, the SEOCON and DCS develop a single impact assessment tool accessible by DCS/Service NSW to expediate grants for and insurance claims on homes and businesses.

3.11. Evacuation centres

In an emergency, a direction to evacuate is made by the Incident Controller in consultation, where possible, with the NSW Police Force and/or the relevant Local Emergency Operations Controller (LEOCON). A decision to evacuate takes into account the *State Flood Plan*, any relevant regional and local flood plans, *Community Safety and Coordinated Evacuations Policy* and the *Evacuation Management Guidelines*.

Specific evacuation arrangements are developed and recorded within Local Emergency Management Plans (EMPLANs) prepared by Local Emergency Management Committees (LEMCs). These plans cover assessment of the circumstances potentially triggering evacuations, the operational arrangements for managing these, evacuation routes and evacuation centres.

What is an evacuation centre?

An evacuation centre is ‘a centre which provides affected people with basic human needs including accommodation, food and water’⁴²⁵ to which could be added sanitation, basic health care and communications. A centre can also serve as a source of up-to-date emergency information.

The very need for evacuation centres demonstrates that people’s lives have been up ended, so there can be high levels of emotion, exhaustion and strain on both evacuees and those providing the support services in evacuation centres.

How are locations for evacuation centres selected?

A centre may be established prior, during or following a disaster. The identification of appropriate sites for evacuation centres across NSW is the responsibility of Local Emergency Management Committees (LEMCs). Sites are assessed against criteria and should be audited annually to ensure their continued suitability in the case of an emergency.⁴²⁶ Choices are made in consultation with emergency services agencies, and are based on the results of an emergency risk management process to ensure the facility is located outside the potential hazard affected area. As well as evacuation centres, holding areas or facilities for companion animals need to be identified.

The actual running and management of official evacuation centres is currently a multi-agency activity, involving the Department of Communities and Justice, NSW Health, Resilience NSW, NSW Police and other agencies and functional areas on request. However, this process requires a lead agency, as decision-making in times of crisis should be swift in order to support community needs.

Evacuation centres may be located at:

- existing facilities – these generally need little additional infrastructure or goods to accommodate people and provide basic services – examples include registered and/or community clubs, community halls, Office of Sport facilities, schools and universities
- temporary facilities – these require complete assembly and supporting infrastructure
- combined facilities – where existing facilities are supplemented by temporary facilities.⁴²⁷

⁴²⁵ NSW Government. (2014). State Emergency Management Plan – Evacuation Management Guidelines. Retrieved from:

https://media.opengov.nsw.gov.au/pairtree_root/a7/f9/5c/07/7b/46/4c/2a/a8/51/24/cf/8c/52/7d/b6/obj/Guideline_Evacuation_Management.pdf

⁴²⁶ Ibid.

⁴²⁷ Ibid.

How well did the evacuation centres work?

Submissions received by the Inquiry about evacuation centres mainly focused on centres in the Northern Rivers, which were a mix of government and community led. Similar to the role that community performed in rescue operations, unofficial centres (run by community) developed through a need to fill the gap in official centres (run by government agency). The feedback included:

- some centres were overcrowded and did not have appropriate amenities for evacuees and companion animals for the duration of time required
- management of vulnerable persons was not well planned and generally did not meet their needs
- some said that security was not adequate, and they felt unsafe; others said there was too much security, with some Indigenous evacuees finding that the security presence brought back memories of inter-generational trauma
- some centres were not managed or coordinated well by those tasked in charge – there was a lack of clear delegations, responsibilities and escalation pathways, and a lack of clarity about which agencies and organisations were present
- equitable service provision was difficult due to the urgent unplanned nature of requests for assistance
- spontaneous volunteering from individuals and agencies occurred – although well meaning, the consequent lack of formal oversight created risks for the health workforce and the community
- some evacuation centres did not have appropriate registration or discharge processes
- some centres' managers appeared inadequately trained, and this affected already traumatised and vulnerable evacuees
- mental health support and accommodation for staff and volunteers in centres was inadequate, particularly when they were flood affected themselves
- individuals and local community groups were not given power to help in circumstances where it would have benefited evacuees
- some unofficial centres were set up because official ones were not being set up fast enough or with sufficient capacity
- some centres did not have power, technology or an active communication network
- after the floods receded, there were attempts to close some evacuation centres despite the presence of evacuees who had no alternative accommodation available.

The Inquiry notes that some of these issues could have been mitigated if the relevant LEMC had properly exercised its responsibilities before the Lismore event. This goes to the need for proper planning and preparation, which is discussed in more detail in Chapter 4.

While the submissions specifically about evacuation centres were mostly negative, the Inquiry received many comments from evacuees expressing gratitude to all the support staff who were physically present at the centres and tirelessly helped those in need.

It is clear from the submissions that, if it were not for individuals, community and local organisations who provided support at evacuation centres, the physical, mental and emotional toll on the affected community would have been worse. The importance of evacuation centres in assisting with community resilience needs to be taken into account in planning for the future.

Evacuation centres were not all fit for purpose

In accordance with work health and safety laws, evacuation centres, like any other facilities, are required to provide a safe and healthy environment for evacuees and those working in them, so far

as is reasonably practical.⁴²⁸ While this principle was applied in many centres, whether community-led or government agency-led, there were problems, many of which also occurred in the 2019–20 bushfires. There is an urgency to address these before the next disaster occurs.

Some evacuation sites were simply inappropriate for the numbers of people, and did not have the required amenities to meet their occupants' needs. The Inquiry was told that some centres had toilets backed up due to flood waters, no showers, and overcrowding. There were also instances of criminal activity, including petty theft and assaults. One submission to the Inquiry stated:

The tension was so high that people were verbally attacking other people. It was so bad I opted to stay in the back of a friend's car with my 2 dogs and refused to go back in the hall. Not even for food. Then to make matters worse they started bringing in over 100 more people rescued to an already extremely overcrowded centre with limited food and overflowing toilets and no place to shower. Dogs had to be tied to trees they were getting loose and attacking. One lady even ended up in hospital.⁴²⁹

Another said that 'security was provided by a local policeman on his free time which he donated. Apart from that the community tried its best to provide a secure space.'⁴³⁰

The Inquiry also received submissions which raised concerns of safety in evacuation centres, noting that all community members including those that are considered more vulnerable were all in the same evacuation centre.

Whilst the evacuation centre was amazing in what had been created overnight, there were major safety issues - everyone was sleeping in the same area - men, women, children, babies, dogs, this did not seem safe, as there were young single women, women with children, people with mental health issues and possible drug withdrawals all in the same space.⁴³¹

Although my family were fortunate enough not to require accommodation in an evacuation centre, I have heard nothing but horror stories coming out of them. Examples of confronting experiences included children witnessing people openly taking drugs, needles discarded on the floors, people having sex.⁴³²

One submission to the Inquiry stated that "our only security presence for the first week was from a local policeman on his free time which he donated. Apart from that the community tried its best to provide a secure space."⁴³³

Better coordination and communication is needed

In the Northern Rivers, community-run evacuation centres operating on informal arrangements spontaneously sprang up due to the size of the disaster and the lack of support for people in certain geographic locations.

Larger community businesses and groups were often willing to provide space, facilities and shelter for evacuees in their communities. These offers were sometimes met with resistance from state agencies or local council because they did not have formal approval to operate as an official evacuation centre. Noting that the community often trusts organisations that are local and known to them ahead of government run facilities, the Inquiry believes there is scope for formalising the involvement of local groups in decisions about evacuation centre locations.

⁴²⁸ *Work Health and Safety Act 2011* (Cth)

⁴²⁹ Name withheld, submission to the Inquiry.

⁴³⁰ Stephen Bocking, submission to the Inquiry.

⁴³¹ Anonymous, submission to the Inquiry.

⁴³² Anonymous, submission to the Inquiry.

⁴³³ Stephen Bocking, submission to the Inquiry.

For example, an LEMC could take applications or expressions of interest from local groups in providing space, facilities and shelter in the event that formally identified evacuation centres reach capacity. This would facilitate their use, and the staffing of them by appropriate agencies.

A common theme in submissions was that it was unclear who was in charge at evacuation centres. This resulted in sub-optimal decision-making, erosion of trust in Government, communication breakdowns and the duplication and poor tracking of tasks. A lack of communication was a particular source of distress for many people and community organisations, and a missed opportunity to leverage the goodwill of hundreds of volunteers.

The Inquiry was told that, without the donation of time, food, clothing and other essential items by individuals and local community organisations, evacuation centres would have been unable to cope with demand.

Without donations of food and supplies the locals would of had NOTHING to eat and drink as it took government WAY too long to act.⁴³⁴

The people, the community at the evacuation centre were incredible, they had set up a space for sleeping, for groceries, for food, for clothing, massage and acupuncture, counselling, GP clinic, there were people constantly bringing donations of mattresses, clothing, food, cakes, nappies.⁴³⁵

The Inquiry commends the donors for these efforts. However, a downside of this generosity was that many evacuation centres received broken or rotting items, which required valuable volunteer time to sort and dispose of. This suggests there is a low understanding in the community about what constitutes an appropriate donation, and some effort needs to be allocated to publicising the criteria for acceptable gifts.

⁴³⁴ Adam Nabbe, submission to the Inquiry.

⁴³⁵ Anonymous, submission to the Inquiry.



Photo 3-6: Lismore evacuation centre. Source: Southern Cross University, submission to the Inquiry.

Box 3-11: Southern Cross University and Goonellabah evacuation centres

On Sunday evening (27 February 2022), the first evacuation centre was set up at Southern Cross University in Lismore by the Police – a location on high ground with many rooms and spaces. The centre was an indoor basketball court equipped only with plastic chairs and some folding tables. There was, at that stage, little understanding of how many people would arrive.

By all accounts, the Southern Cross Evacuation centre quickly became distressing due primarily to the flood event unfolding but was exacerbated by the lack of a safe or supportive social environment. For many days, services were either overwhelmed or absent. Communication between agencies was difficult, no clear organisational structure was in place and solutions were being invented along the way. There were few DCJ staff present (usually around 1-2 in a centre with hundreds of people) and they themselves had been flood affected.

The Australian Red Cross and Salvation Army volunteers were among the first to arrive to begin registering people. Bedding was only available if people brought it with them. Between 2000-3000 people ended up being delivered over the succeeding days to a centre designed for 200 people.

Many rescued citizens were turning up in just the clothes on their back, grass in their hair, saturated and shaking. Many turned up with pets, presenting an additional challenge. The basketball court reverberated the noise of barking dogs and overcrowding. It was very

*dark due to the power continually being lost...we were registering people by lantern light.*⁴³⁶

At night in the initial week, security guards were the only authority present at SCU Evacuation centre. Many people chose to sleep in their cars or in hallways because they felt safer there. There was no phone coverage, internet or power for many days, so the uncertainty about the whereabouts or wellbeing of loved ones increased the distress of many citizens.

On Wednesday, 1 March 2022 a second evacuation centre was set up by Lismore City Council at the Goonellabah Sports and Aquatic Centre (GSAC). This was handed over to DCJ to run a few days later. The contrast between this centre and the SCU centre was notable – with a more organised system, more communications and more humane conditions including made up beds and other support enabled by community volunteers.

GSAC sought to create space for elderly people and assist where possible, but – like all centres – there was limited forward planning for the myriad of difficult cases being presented to untrained volunteers: children with severe autism; people with disabilities, families with young children and women in centres with their previous abusers.

Staff at all centres carried the burden of making decisions with the limited resources they had. After the initial shock, those who could left to go and stay with friends and families; the people left behind were those without somewhere safe to go or without a network to receive them.

Better support is needed for vulnerable people

No evacuation centre can be expected to be an enjoyable place for anyone escaping a natural disaster. However, vulnerable populations are particularly at risk during disasters. In the case of the Northern Rivers, many vulnerable people live in less resilient accommodation in lower lying flood-affected areas. This group is more likely to be disadvantaged by flood events and their needs should be better considered in the development of emergency management plans. These cohorts are also less likely to have stable friends and families to stay with after an evacuation, so the transition from evacuation centres to alternative accommodation for vulnerable people needs to be particularly considered as part of disaster planning and preparation.

Local emergency management plans for this region during the time of the 2022 floods are primarily logistical in nature, treating the evacuee population as a homogenous group. Given that, in a crisis, there is less time to make decisions in a tiered or nuanced manner, advanced planning is required so that good outcomes for the vulnerable can be achieved.

The Inquiry heard that evacuation centre operations would have been improved if a plan had been developed and tested beforehand to manage the vulnerable populations within the broader cohort. The plan should cover the elderly, the unwell, the mentally ill, disabled people, vulnerable women experiencing domestic violence and other identified vulnerable groups. More forward planning would assist decision makers to provide better support for the safety and wellbeing of these groups, and reduce the later effects of trauma.

Better health coordination is needed

Health was a major issue across flooded communities – not just for the thousands of people who lost access to regular medications, but for those who sustained injury during the flood rescue. Evacuation centres varied in their ability to respond to health issues, and this variation appeared dependent on leadership and the availability of staff and volunteers to procure medications.

⁴³⁶ Name withheld, submission to the Inquiry.

The Inquiry was told that, in some Northern Rivers evacuation centres, there was no coordinated health response for days, and that some evacuees went days without their regular medication. This was especially challenging for those being treated for mental illness, given the stimulating and chaotic environment of an evacuation centre. The Inquiry also was told stories of people with drug dependencies suffering withdrawal symptoms, people going into medical shock, and cuts and abrasions from flood waters being left untreated.

Meanwhile the Dunoon Sports Club had opened up as a temporary evacuation centre. I attended there to volunteer. The donations were coming in thick and fast. By the time I got there in the afternoon there were many climate refugees sitting in shock and despair, one poor man detoxing of methadone and unable to get his script filled.⁴³⁷

In regards to GSAC and SCU Evacuation Centres - At both these centres there were issues with anti-social behaviour, violence and drug use, including syringes lying around, but the situation was much worse at SCU where Support Services were also lacking in the early days. Methadone users were a huge problem at both locations, until their doses were sorted by driving them to the methadone clinic each day. Alcohol was also a problem with alcoholics bringing it in and hiding it to keep drinking⁴³⁸

Many evacuees needed medications for chronic diseases (like heart disease or diabetes). This became a challenge for local GPs, particularly in the Northern Rivers region, as local pharmacies lost stock in floods and stocks in nearby towns were quickly depleted. The health community mobilised and a local volunteer medical workforce assisted at Goonellabah Sports and Aquatic Centre (GSAC) and other evacuation centres. The Inquiry commends the staff who worked long hours to medicate people and assist with flood-related infections. Nearby pharmacies donated thousands of dollars of stock and medical staff volunteered for after-hours work.

This agility and willingness of the local health workforce to respond should be capitalised on in emergency planning. A coordinated, central source of information to allow health practitioners to match resources with need would be useful.

Another positive example involved a group of occupational therapy students on placement who spent time at the Maclean Evacuation Centre to undertake assessments on vulnerable and elderly people. They were then able to access equipment from the local community health centre to assist with mobility and reduce discomfort. Medical students were also eventually sent to the Southern Cross recovery centre to assist.

Better support for Indigenous people is needed

Indigenous communities across the state, especially in the Northern Rivers, were greatly affected by the floods. The Inquiry heard specifically about Indigenous people's experiences, the Inquiry held a roundtable in the Northern Rivers with attendees from Local Aboriginal Land Councils (LALC), housing providers, Aboriginal community organisations and community.⁴³⁹

The Inquiry heard that communities have a good sense of flood preparedness based on the information provided at the time of the event. However, due to the lack of accurate information and up to date warnings, this affected one community's timely evacuation. Jali LALC was asked to evacuate Cabbage Tree Island. Evacuees were taken to Ballina evacuation centre, but soon after had to evacuate again to the Lennox Head evacuation centre. Evacuations through to recovery efforts for Indigenous Communities was largely led by these communities and most felt unsupported by Government.

The Inquiry was told that some Indigenous people felt unwelcome at evacuation centres, and in some cases support services were reluctant to provide immediate relief. These experiences

⁴³⁷ Madeleine Smith, submission to the Inquiry.

⁴³⁸ Lismore Citizens Flood Review Group, submission to the Inquiry.

⁴³⁹ Meeting with Indigenous Roundtable on 20 June 2022.

compounded the trauma they had already experienced as a result of the floods and leaving their homes, and may have put some people at risk due to fear of how they may be treated in evacuation centres.

The Inquiry emphasises that everyone has the right to receive support following a natural disaster, and that discrimination in evacuation centres should not occur under any circumstances. While this was not the case in all centres, it is clear that further work is needed to ensure evacuation support is inclusive and is delivered in a culturally safe way.

The Inquiry makes similar observations to those of the 2020 NSW Bushfire Inquiry. Indigenous communities should be included in emergency planning and preparation to ensure good working relationships are formed ahead of a disaster occurring, and emergency management processes must incorporate the needs of Indigenous communities. All staff delivering services in evacuation centres (both government and non-government) should be culturally competent. In some cases, this may require additional training.

3.12. Effect on critical infrastructure and essential services

What we value and want to preserve in an emergency can vary, depending on our perspective as, say, an individual, a family, a farmer or a business. But, as the NSW Bushfire Inquiry stated in 2020:

All agree on the value of critical infrastructure services – clean water, communications, power, sewerage and roads.⁴⁴⁰

Power, telecommunications, water, water treatment and waste disposal are essential services that the community rely on. These functions depend on each other for effective delivery. The networks that ensure the sustained delivery of power, telecommunications and water treatment involve complex interactions and have strong interdependencies. A failure of any one of these elements can have an inordinate or compounding impact on other vital services.

Sadly, extended disruptions to essential services were common during the flood events, causing considerable hardship and sometimes exacerbating the crises and risks that people faced.

Power and communications

Loss of power – the numbers

The loss of power during the flood events was significant in scale and duration and had a compounding effect on other services. Months later, power continued to remain an issue throughout Northern NSW. A number of residents have told the Inquiry that they experienced a lack of power for a period between 13 days to 3 months, and that some households continue to experience on-going power issues.

Essential Energy⁴⁴¹ informed the Inquiry that its infrastructure sustained extensive flood damage across the network from the Tweed Valley to Coffs Coast.⁴⁴² Its Murwillumbah and Lismore depots both sustained serious structural damage to buildings, electrical infrastructure and stored

⁴⁴⁰ Report of the NSW Bushfire Inquiry. (2020). Page 149. Retrieved from [Final-Report-of-the-NSW-Bushfire-Inquiry.pdf](#).

⁴⁴¹ Essential Energy is a state-owned electricity company, which owns, maintains and operates the electrical distribution for a large part of NSW, covering 95% of the State.

⁴⁴² Essential Energy, submission to the Inquiry.

equipment stored.⁴⁴³ Most significantly, the Lismore depot was completely submerged in flood water during the first flood event in February and flooded again during the second event in March. Essential Energy has identified that the Lismore depot will need to be relocated due to the extent of the damage and the risk of future flooding.⁴⁴⁴ The South Lismore zone substation was also damaged and rendered non-functional. This caused widespread outages to the region because the zone supplies 10 feeders.⁴⁴⁵



Photo 3-7: Essential Energy's Lismore depot on 28 February 2022.

A total of 69,603 Essential Energy customers were affected by power outages. This included 1,408 life-support customers with medical conditions reliant on a continuous supply of electricity to run critical medical equipment.⁴⁴⁶ During and after the flood event, 7,043 properties were de-energised for safety considerations; as of 15 July, 5,521 had been re-energised following a safety inspection.⁴⁴⁷ Most outages were unplanned, so Essential Energy was unable to warn its customers of pending power outages.⁴⁴⁸ As a result, customers had to follow a 3-step process to enable reconnection:

- engage a licensed electrical contractor to inspect their premises for safety and compliance and make any necessary repairs⁴⁴⁹
- wait for the electrical contractor to log a Certificate of Compliance on completion of the inspection
- call Essential Energy to have power restored.⁴⁵⁰

Figure 3-6 below shows the unplanned customer minutes lost across the Essential Energy network. The effects on customers due to the floods, in terms of minutes lost, approached those of the 2019–20 bushfires. Power supply to around 104,000 premises was affected by the 2019–20 bushfires and 69,603 premises had power outages due to the 2022 flood events.⁴⁵¹

⁴⁴³ Ibid.

⁴⁴⁴ Ibid.

⁴⁴⁵ Ibid.

⁴⁴⁶ Ibid.

⁴⁴⁷ Ibid.

⁴⁴⁸ Essential Energy. (2022). *Advice provided to the Inquiry 15 July 2022*.

⁴⁴⁹ Essential Energy, submission to the Inquiry.

⁴⁵⁰ Ibid

⁴⁵¹ Ibid

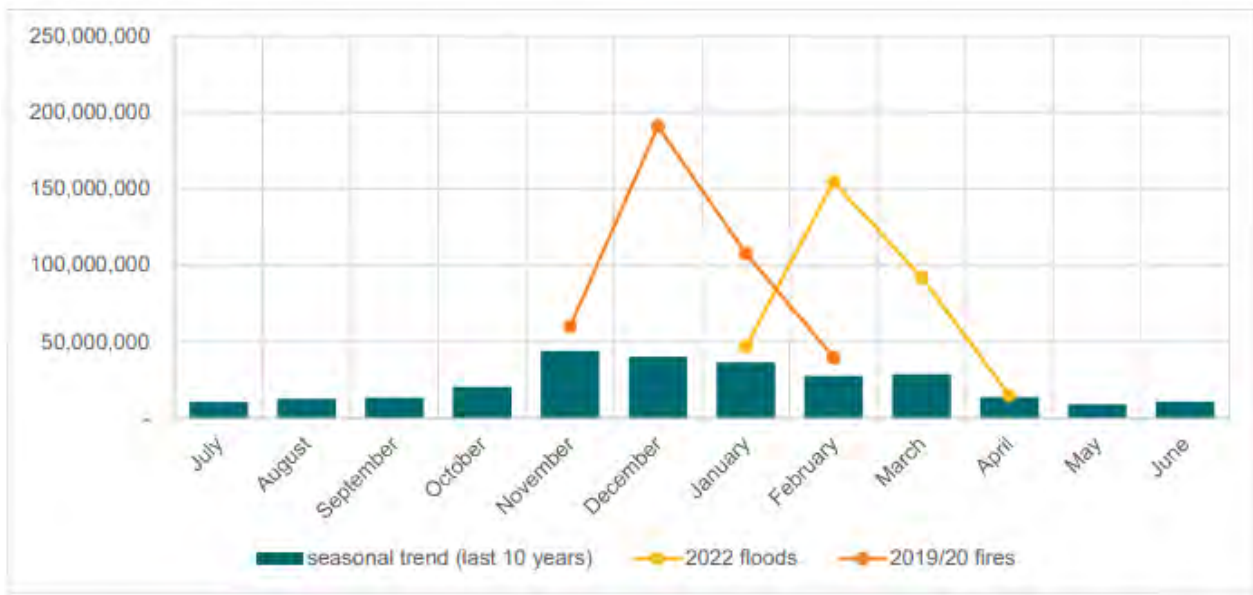


Figure 3-6: Unplanned customer minutes lost across the Essential Energy network.

Loss of power – impact

Widespread power outages created havoc for the recovery efforts and had cascading consequences on other essential services, with ongoing stress for the community.

The loss of power affected:

- emergency services and residents who were unable to send and receive emergency warnings
- the ongoing and effective operation of emergency evacuation centres
- emergency services and residents who were unable to charge their mobile phones, transistor radios and torches
- the operation of water supply and sewerage systems reliant on power to operate
- essential businesses including post offices and banks being unable to operate.

The loss of power meant significant consequences for evacuation and response efforts as weather updates were unable to be communicated, residents could not call for help and the internet was unavailable to find the locations of evacuation centres.⁴⁵² For example, in North Byron, power, phone and internet connections had failed in most areas by 10 am on 28 February at the beginning of the flooding events.⁴⁵³ After the flooding events, the loss of power continued to affect communities, with food spoilage due to loss of refrigeration, lack of fans to dry out homes, and lack of internet to assist with alternative accommodation searches or family communication and support.⁴⁵⁴

The loss of power also affected the operation of evacuation centres. For example, Southern Cross University, which operated as an evacuation centre in Lismore, had no power initially during the flood. The university's back-up generators are designed to power data centres rather than day-to-day activities. It was also difficult to get access to the diesel fuel needed to power the generators as a result of road closures.⁴⁵⁵ The university has identified on campus emergency energy

⁴⁵² Ibid.

⁴⁵³ Anonymous, submission to the Inquiry.

⁴⁵⁴ Ibid.

⁴⁵⁵ NSW Farmers Association, submission to the Inquiry.

generation, fuel bunkering, backup electricity storage and solar generation as immediately necessary to address capacity gaps and act as an insurance mechanism for future events.⁴⁵⁶

Loss of power was seen in multiple other areas of the state. Many parts of Western Sydney suffered loss of power for up to 10 days⁴⁵⁷ which also affected connection to a number of water and sewerage services.⁴⁵⁸

Other areas of the Northern Rivers had extended power outages. The Indigenous community of Cabbage Tree Island was evacuated on 28 February and returned nearly 2 weeks later, but power was not restored for another week.⁴⁵⁹

During the flood events, the Energy and Utility Services Functional Area (EUSFA) team⁴⁶⁰ had a rostered Liaison Officer on shift at the SCC from 28 February and subsequently at the State Emergency Operations Centre in Homebush from 1 March to 10 April.⁴⁶¹ EUSFA advised the Inquiry, that during the flood events, liaison officers:

- sourced river height forecast information from SES/Bureau to enable planning of work for electricity and water companies to minimise loss of power, drinking water and sewage treatment
- ensured electricity safety messages were communicated to all organisations in the SEOC
- coordinated fuel data (inventories, delivery schedules, etc) from oil companies in affected areas and ensured fuel availability remained in Emergency Services
- facilitated fuel deliveries for outboard motors during the initial flood rescues
- coordinated electricity restoration and prioritisation for telecommunication sites, evacuation centres and other critical infrastructure
- ensured water chemical deliveries were prioritised
- undertook routine reporting of electricity outage information to executives
- helped coordinate generators for some key sites
- contributed to the water/waste-water recovery team
- co-chaired the Water and Wastewater Working Group which was set up to manage mutual aid, resource sharing and prioritisation of recovery activities.⁴⁶² This served to provide a focal point for interaction between electricity, gas, liquid fuels and water industries with government agencies such as the emergency services, Resilience NSW and other Functional Areas.

Telecommunications losses – the numbers

Telecommunication carriers advised that the widespread scale of outages was due to loss of power, flood damage and sites being inaccessible.⁴⁶³ The services affected included mobile phone networks and fixed networks including landlines and the internet.

⁴⁵⁶ Southern Cross University, submission to the Inquiry.

⁴⁵⁷ WSROC (Western Sydney Regional Organisation of Councils), submission to the Inquiry.

⁴⁵⁸ Ibid.

⁴⁵⁹ Ms Tamara Smith MP, Member for Ballina, submission to the Inquiry.

⁴⁶⁰ The EUSFA (Energy and Utility Services Functional Area) is established under the Energy and Utility Services Functional Area Supporting Plan, a supporting plan of the state EMPLAN. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/Supporting-Plan-Energy-utilities.pdf>

⁴⁶¹ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 9 March 2022*.

⁴⁶² EUSFA (Energy and Utility Services Functional Area). (2022). *Advice to the Inquiry provided 13 July 2022*.

⁴⁶³ NSW Government. (2022). NSW Government submission, Select Committee's Inquiry into the flood response to major flooding across NSW in 2022. Retrieved from <https://www.parliament.nsw.gov.au/lcdocs/submissions/78931/057%20NSW%20Government.pdf>.

Telstra advised the Inquiry that the flood events resulted in substantial damage to telecommunications infrastructure and the power grid, causing mass disruptions to their customers' mobile and fixed services.⁴⁶⁴

Telecommunications providers reported to the NSW Telecommunications Services Functional Area (TELCOFA) that 802 commercial network impacts during the flood events, with most site outages being restored within 2 weeks once it was safe to do so.⁴⁶⁵ During the peak of the floods, 18 communities across NSW had no telecommunications access.⁴⁶⁶ Telstra advised that it restored mobile communications to these communities within 13 days.⁴⁶⁷

When mass outages occur during extreme weather conditions, telecommunication providers declare Mass Service Disruptions (MSDs) which "indicate that there are circumstances outside the provider's control that result in a delay in conducting repair activities to restore services".⁴⁶⁸ Telstra declared an MSD for North-East NSW from 28 February to 21 March inclusive, and for Sydney from 4 March to 18 March inclusive.⁴⁶⁹



Photo 3-8: Damaged fire duct alongside a washed-out bridge, NSW/QLD Border region⁴⁷⁰

The declaration of an MSD exempts the service provider from complying with the Customer Service Guarantee (CSG) performance standards outlined in the *Telecommunications (Customer Service Guarantee) Standard 2011* for the duration of the MSD and waives the service provider's obligation to pay damages for contravention of a service standard under s 116 of the *Telecommunications (Consumer Protection and Service Standards) Act 1999*. The CSG only applies to standard telephone services.

In the initial days of flooding, Telstra network facility disruptions were largely due to loss of mains power.⁴⁷¹ However, once floodwaters receded, Telstra advised it could restore power to many locations reasonably quickly and enable services to be brought back online, with the exception of locations where network facilities had been affected.⁴⁷² Damage to telecommunication network infrastructure included damage to optic fibres, equipment damage and mains power.⁴⁷³ In these situations, back-up power solutions such as power generators were not of any practical use as equipment had to be replaced and infrastructure rebuilt.

⁴⁶⁴ Telstra, submission to the Inquiry.

⁴⁶⁵ Ibid.

⁴⁶⁶ Ibid.

⁴⁶⁷ Ibid.

⁴⁶⁸ Ibid.

⁴⁶⁹ Ibid.

⁴⁷⁰ Telstra, submission to the Inquiry.

⁴⁷¹ Ibid.

⁴⁷² Ibid.

⁴⁷³ Ibid.

The floods also meant that road and facility access was often restricted or limited, specifically where it took considerable time for flood water to recede. Without access roads, telecommunication carriers are unable to assess damage, undertake necessary remediation or restoration activities or deploy temporary facilities. Telstra identified that road closures and other challenges delayed access to sites and service restoration in some instances. The Inquiry recognises that fixing essential services is not reliant on technical expertise only, and that access is a major factor.

Telecommunications losses – impact

The large-scale loss of communications during the flood significantly affected:

- people’s ability to call for help
- people’s ability to know whether they were directly threatened by flood
- people’s ability to make decisions about preparing properties, whether to evacuate, and evacuation options (such as knowing the safest evacuation route and which roads are open)
- people’s contact with family and friends
- flood recovery efforts, for example, operation centres losing contact with flood teams on the ground, outages to operations centres, and distribution of warnings to the public.

During an emergency event, people rely on the telecommunications network to seek emergency assistance via Triple Zero and other emergency numbers, to communicate with family and neighbours, and to receive warnings via emergency alert services. The widespread loss of power significantly affected this, and lives were put at risk as a consequence.

The Inquiry heard overwhelmingly that many residents in Northern NSW were unable to reach Triple Zero or the SES, or to receive timely warning systems:⁴⁷⁴

*I tried to ring the SES 3 times at 6:15 am, but the line was constantly engaged.*⁴⁷⁵

*By the time we got an evacuation order we were already trapped called the SES no answer they called us back 3 days later if I wasn't for locals we would still be on the roof.*⁴⁷⁶

*Once on the roof we saw nothing but water, every direction to the horizon, no land. We called 000 several times who told us they knew where we were and would get to us as soon as possible, we could not get through to the SES. We spent 5 hours on our roof, in the rain, waiting to be rescued, yelling, screaming, whistling at passing boats - watching the water continue to rise.*⁴⁷⁷

*I called Police and SES multiple times as the landslide was occurring, however the SES no. would repeatedly drop out while I was waiting to connect. Police weren't able to respond until midnight and by then we had already evacuated ourselves and our pets to a family members address on the Gold Coast.*⁴⁷⁸

In Ballina, telecommunications including landlines, mobile phone and the internet went down across the region from 3 to 10 March.⁴⁷⁹ The communities unable to call Triple Zero included Mullumbimby, Jiggi, Uki, Koonorigan, Ocean Shores, Stokers Siding, The Channon, Main Arm,

⁴⁷⁴ Ms Tamara Smith MP, Member for Ballina, submission to the Inquiry.

⁴⁷⁵ Rita-ann Spek, submission to the Inquiry.

⁴⁷⁶ Jesse Flanagan, submission to the Inquiry.

⁴⁷⁷ Breanne Cottam, submission to the Inquiry.

⁴⁷⁸ Alee Whiteman, submission to the Inquiry.

⁴⁷⁹ Ms Tamara Smith MP, Member for Ballina, submission to the Inquiry.

Kyogle, Modanville, Homeleigh, Pillar Valley, Eden Creek, Ulmarra, Tucabia, Wooli, Duranbah, Kingscliff, Whian Whian and Doubtful Creek.⁴⁸⁰

The Inquiry heard that many residents did not get evacuation texts from the SES. A total of 30 evacuation orders affecting 59,000 people in the Northern Rivers were declared on 2 March, but many were not accessed by residents.⁴⁸¹

*By 12 o'clock at night the water was knee deep surrounding our house, this was now larger than the '2017' flood and the rain was continuing to fall extremely hard. We started to run round to our neighbours to make sure they got their cars out and they were starting to prepare to leave. Still no message from SES or anyone on our phones.*⁴⁸²

*Not that it was possible at this stage, but there was no evacuation order from the SES. I'd seen one earlier at 5am for South Golden but not for our area. But even if there was, where would we go, and how would we get there?*⁴⁸³

*On the 3rd of March (approx.) NSW SES put on their Facebook page that we were to be evacuated, no text message was received. At 1am police came door knocking asking who was at home. We never received a safe to return order however there was no water in the street at that stage. The second rise hit around the 8th of March. No evacuation warning on Facebook or text message was received. We were stuck in our house by flood waters for 2 days.*⁴⁸⁴

*This flood came within 24 hours with no official warning received for Broadwater about possible heights. Of the 35 flood warning issued from the SES in relation to the Richmond River none mentioned Broadwater.*⁴⁸⁵

In its submission to the Inquiry the Nimbin Community Response and Recovery Team⁴⁸⁶ advised that little or no communication technologies were working in the Nimbin catchment area from 28 February to 10 March.⁴⁸⁷ Mobile phone signal in the area was limited and NBN, landlines and ADSL were all down.⁴⁸⁸ This affected the time taken to locate missing people, with community members relying on word of mouth and physically walking to check in on residents.⁴⁸⁹ Only a limited number of people, including within the SES, had access to satellite phones. The Nimbin Community Response and Recovery Team advised that the only place in town with reliable communications was the Nimbin Hospital which had its own mini NBN tower relaying a signal from the Lismore Base Hospital.⁴⁹⁰

In the days and weeks after the flood events, telecommunications continued to be disrupted. The Mullumbimby township had no phone communication, no internet and no EFTPOS for about one week following the flood.⁴⁹¹ There were many stories of communities across the North Coast being without mobile phone services and internet in the weeks following the flood. This also affected the

⁴⁸⁰ Ibid.

⁴⁸¹ Ibid.

⁴⁸² Anonymous, submission to the Inquiry.

⁴⁸³ Anonymous, submission to the Inquiry.

⁴⁸⁴ Emma Davies, submission to the Inquiry.

⁴⁸⁵ Daniel Ainsworth, submission to the Inquiry.

⁴⁸⁶ Nimbin Community Response and Recovery Team includes representatives from Nimbin Neighbourhood and Information Centre, Nimbin A&I Society, Nimbin Branch of the CWA, Nimbin Brigade RFS and a number of community volunteers.

⁴⁸⁷ Nimbin Community Response and Recovery Team, submission to the Inquiry.

⁴⁸⁸ Ibid.

⁴⁸⁹ Ibid.

⁴⁹⁰ Ibid.

⁴⁹¹ Byron Shire Council, submission to the Inquiry.

ability of residents to make grant applications for government funding in the aftermath of the flood events, causing another source of frustration and stress for residents in the recovery phase.

The disruptions to the telecommunications network also created enormous difficulties for emergency response personnel. The Inquiry heard in Ballina that personnel had to drive between evacuation centres due to a lack of phone coverage, and in some cases had to drive outside of the region towards Queensland to be able to access reliable communications.⁴⁹² SES members on the ground in Ballina advised their only means of communicating was with walkie talkies.⁴⁹³ A similar story was heard in the Northern Rivers, where disrupted telecommunications hindered the SES's ability to provide early warning messages.

On the positive side, the Public Safety Network⁴⁹⁴ from February to April maintained availability at 99.92 %, managing around 4.3 million calls.⁴⁹⁵ The Inquiry was advised that the Public Safety Network uses a combination of technologies to provide power in the event of an outage. Currently, on-site battery power for most sites will last for 15 hours. Several remote sites also rely on solar power to provide both primary and secondary backup power.

Telecommunications outages also created issues for ongoing recovery efforts. The Nimbin Health and Wellbeing Association advised the Inquiry that its lack of access to communications in the weeks following the flood was frightening for many elderly and vulnerable community members.⁴⁹⁶ Many members rely on the association for daily support and for meal delivery. With telecommunication outages, they were isolated with no form of contact for a number of days. As the association stated, "Imagine being 78 years old, on your own with limited mobility and not knowing if anyone was coming to bring you anything to eat".⁴⁹⁷ People who rely on life alert buttons in the event of a fall or other medical issue were also left unable to contact emergency services.⁴⁹⁸

Essential Energy advised that a number of challenges caused reconnection delays. For example, it could not commence repairs to underground infrastructure in Lismore CBD until the water had receded.⁴⁹⁹ Access to sites was difficult due to floodwater, landslides and damaged roads.⁵⁰⁰ Essential Energy used helicopters and drones to assist with restringing powerlines in many rural areas, but helicopters were hampered for some time due to weather conditions and visibility.⁵⁰¹ The second flooding incident on much of the North Coast and Mid North Coast also caused further delays in restoring power supply in some areas.

Outages to the communications network created reconnection challenges and made it difficult to inform customers about restoration times. For example, in Lismore, the main telephone exchange was inundated and needed repair, so Essential Energy crews were forced to rely upon radio networks.⁵⁰² Deploying resources was further hampered by the lack of accommodation options for employees.⁵⁰³ Essential Energy advised that:

⁴⁹² Ballina Shire Council, submission to the Inquiry.

⁴⁹³ Ibid.

⁴⁹⁴ The Public Safety Network is radiocommunications network used by emergency service agencies and government agencies to coordinate responses to disasters and emergencies.

⁴⁹⁵ NSW Government. (2022). NSW Government submission, Select Committee's Inquiry into the flood response to major flooding across NSW in 2022. Retrieved from <https://www.parliament.nsw.gov.au/lcdocs/submissions/78931/057%20NSW%20Government.pdf>.

⁴⁹⁶ Nimbin Health and Wellbeing Association, submission to the Inquiry.

⁴⁹⁷ Ibid.

⁴⁹⁸ Ibid.

⁴⁹⁹ Ibid.

⁵⁰⁰ Ibid.

⁵⁰¹ Ibid.

⁵⁰² Ibid.

⁵⁰³ Ibid.

*The sheer geographical scale of these floods and the extent of households and businesses affected, as well as the challenge of getting access to many premises, meant that some delays to the reconnection process were unavoidable.*⁵⁰⁴

NSW Government response

During a declared flood emergency, the NSW Telco Authority's Telecommunications Emergency Management Unit (TEMU) is responsible for leading the Telecommunications Services Functional Area (TELCOFA). TELCOFA "coordinates the response to significant and widespread telecommunications outages that endanger the safety of the public or emergency responders".⁵⁰⁵

TELCOFA also provides information on hazards to telecommunications carriers, and assists them to access critical infrastructure, for example by arranging air transport for NSW Police, SES or NSW RFS or, under appropriate protocols, ADF escorts. Carriers, in turn, assist the TEMU with the deployment of emergency communication services and information on network outages caused by natural hazards.

To aid in the recovery, TEMU deployed 12 officers to liaise between the telecommunication carriers' network operations and control centres (NOCCs) and emergency services to identify risks to critical assets.⁵⁰⁶ TEMU facilitated meetings between these bodies to provide a platform for all carriers to share network impacts and areas of focus, mitigate duplication efforts when coordinating technicians' access to critical sites, and estimate repair timeframes. Between February and April, TELCOFA facilitated 20 meetings with carriers including Telstra, Optus, Vodafone/TPG and NBN.

Cross-carrier roaming arrangements

Currently, national roaming arrangements between carriers allow Triple Zero calls to be made regardless of the caller's contracted carrier. However, as identified in the Final Report of the NSW Bushfire Inquiry, there are currently no national roaming agreements between carriers enabling people to make calls, send SMS or access data during an emergency. The Inquiry understands that this is primarily due to commercial considerations rather than practical issues. National roaming agreements in emergency events would help maintain a level of telecommunications coverage for affected communities when there is reduced coverage due to telecommunication asset damage.

In July 2020, the Final Report of the NSW Bushfire Inquiry recommended:

*That, in order to minimise communication outages and extend basic communication coverage during bushfires, the NSW Government work directly, or together with other Australian governments and/or their relevant power and telecommunications regulatory, policy and market bodies, to facilitate cross-carrier roaming arrangements between carriers and the public for basic text, voice and data during the period of emergency in areas directly affected by fire.*⁵⁰⁷

This recommendation has not been implemented but is in progress. While the *Telecommunications Act 1997* (Cth) does not mandate domestic standard roaming arrangements between carriers for the public during emergencies, the NSW Telco Authority has advised the Inquiry that it fully supports this recommendation and is working with Regional NSW on a submission to the current

⁵⁰⁴ Ibid.

⁵⁰⁵ NSW State Telecommunications Services Functional Area. (2018). NSW Telecommunications Services Functional Area Supporting Plan (Telco Plan), page 5. This is a supporting plan of the state EMPLAN. Retrieved from <https://www.emergency.nsw.gov.au/Documents/plans/supporting-plans/Supporting-PlanTelecommunications.PDF>.

⁵⁰⁶ NSW Telco Authority. (2022). *Advice to the Inquiry provided 20 June 2022*.

⁵⁰⁷ NSW Government. (2020). Final Report of the NSW Bushfire Inquiry – Recommendation 30. Retrieved from <https://www.dpc.nsw.gov.au/assets/dpc-nsw-gov-au/publications/NSW-Bushfire-Inquiry-1630/Final-Report-of-the-NSW-Bushfire-Inquiry.pdf>

Australian Competition and Consumer Commission (ACCC) inquiry – *Telecommunications Inquiry into Access to Regional Towers and Associated Infrastructure) Direction 2022*. This Inquiry commenced on 1 July 2022 and will report its findings within 12 months.⁵⁰⁸

This Inquiry urges the NSW Telco Authority to continue to promote this outcome in its engagements with the Commonwealth Department of Infrastructure, Transport, Regional Development, Communications and the Arts. It suggests that, as a matter of urgency, given the significant effect of the loss of communications during the 2019–20 bushfire season and now the 2022 flood events, this recommendation be implemented to ensure that telecommunication networks can support – not hamper – future disaster response and recovery arrangements.

Water supply and sewerage systems

Water supply and sewerage systems were also heavily affected by the flood events. The Water Group in the Department of Planning and Environment (DPE) estimate that \$145 million worth of damage was caused to water and wastewater infrastructure.⁵⁰⁹

Waste water system failures

Several wastewater systems failed in the North Coast region due to infrastructure flooding, which damaged equipment, broke sewers and caused a loss of power to pumping stations.⁵¹⁰ The Inquiry received advice from the DPE that, while some infrastructure and systems became operational within a couple of days, some are still not functioning properly.⁵¹¹

The East Lismore Sewage Treatment Plant (STP) was the most heavily affected, being completely flooded, and all the electrical equipment onsite was destroyed, making the plant inoperable. NSW Public Works and Lismore City Council worked together to restore operations, and successfully repaired key components of the treatment process; however, repair work remains ongoing.⁵¹² The DPE Water Group, working closely with Public Works and the Northern Rivers Recovery Corporation, has advised it will take up to 5 years and \$55 million to reconstruct the East Lismore STP.⁵¹³

McGraths Hill STP was also partially flooded, and the entire plant was offline for 6 days, as was South Windsor STP, with power off for one day and the plant compromised for an additional 4. Both McGraths Hill and South Windsor STPs are back operating normally.

The Inquiry heard that sewage pump stations transferring sewage to the South Lismore STP were also affected.⁵¹⁴ All of Lismore CBD, North and South Lismore, Lismore Heights and parts of Girards Hill rely on the pumps to dispose of sewage to the South Lismore STP.⁵¹⁵ The 12 pump stations located in these areas all sustained severe damage and none were functioning post the floods.⁵¹⁶

⁵⁰⁸ NSW Telco Authority. (2022). *Advice to the Inquiry provided 20 July 2022*.

⁵⁰⁹ Department of Planning and Environment. (2022). *Advice to the Inquiry provided 31 May 2022*.

⁵¹⁰ *Ibid.*

⁵¹¹ *Ibid.*

⁵¹² *Ibid.*

⁵¹³ *Ibid.*

⁵¹⁴ Lismore City Council, submission to the Inquiry.

⁵¹⁵ *Ibid.*

⁵¹⁶ *Ibid.*

As outlined in the previous section, the loss of power has flow on effects for other essential services. In the case of sewerage systems, loss of power meant the systems were unable to operate. This was further compounded by loss of mobile phone coverage and communications more generally, which made it difficult to coordinate the restoration of services.⁵¹⁷ Richmond Valley Council advised the Inquiry that it was unable to establish the status of sewerage systems, meaning it had no reliable data to let it know whether sewerage pump systems were overflowing.⁵¹⁸

Sewerage and septic systems often become overloaded during flood events, resulting in the release of raw sewage into flood waters. This can create serious human health risks.⁵¹⁹ The Mullumbimby Neighbourhood Centre advised the Inquiry that raw sewage mixed with floodwater resulted in many health issues among residents, including hospitalisation.⁵²⁰ The Department of Planning and Environment also advised that there were several reported cases of illness in residents exposed to flood waters during and immediately after the floods.⁵²¹



Photo 3-9: East Lismore STP damage. Source: Public Works Authority.

Water supplies at risk

Across NSW several water systems failed or were put at risk because of flooding to infrastructure, broken pipes, loss of power to pumping stations and treatment works, dirty source water or chemical supply issues.⁵²² This affected both access to and the quality of water, particularly in parts of Northern NSW. This occurred in the context of recent and unprecedented effects on water security in regional NSW due to drought and bushfires.⁵²³

In Nimbin, a section of destroyed watermain resulted in the water supply for the township being limited to the DE Williams Dam, which only has a supply of 60 days.⁵²⁴ Consequently, the township was placed on water restrictions and 80 properties, which had been directly connected to the destroyed supply main, no longer had access to water.⁵²⁵ The critical nature of this issue led to Lismore City Council, with the Australian Defence Force, constructing a new access road, with 4 km of poly pipe laid to restore water security to the Nimbin township.⁵²⁶

⁵¹⁷ Water Directorate, submission to the Inquiry.

⁵¹⁸ Richmond Valley Council, submission the Inquiry.

⁵¹⁹ Department of Planning and Environment. (2022). *Advice to the Inquiry provided 31 May 2022*.

⁵²⁰ Mullumbimby Neighbourhood Centre, submission to the Inquiry.

⁵²¹ Department of Planning and Environment. (2022). *Advice to the Inquiry provided 31 May 2022*.

⁵²² Ibid.

⁵²³ Water Directorate, submission to the Inquiry.

⁵²⁴ Lismore City Council, submission to the Inquiry.

⁵²⁵ Ibid.

⁵²⁶ Ibid.

Due to water supply issues in Mullumbimby from 1 March, Byron Shire Council requested that residents delay cleaning their properties.⁵²⁷ It took 4 days for the water network to be repaired and residents given permission to begin cleaning.⁵²⁸

Water supply was also affected in the Tweed Shire Council area, with emergency water supply restrictions put in place across the shire from 28 February to 3 March.⁵²⁹ The Inquiry was advised that the shire also came close to running out of water.⁵³⁰ Some reservoirs were completely drained so the council had to switch to others, leading to complaints of dirty water and low pressure in some areas. Vulnerable water customers who rely on supply of water for medical purposes, such as home haemodialysis patients and hospitals, had to be individually contacted by phone.⁵³¹

The Inquiry heard that there was a shortage of the chemicals required for water treatment plants and that some treatment plants came within days of running out.⁵³² DPE advised the Inquiry that this chemical supply issue came close to affecting 2 plants serving over 100,000 people. If this had eventuated, it could have led to a widespread declaration that water supplies were not drinkable and the issuing of a large-scale boil water alert.⁵³³ However, any such alert may well have been impossible to implement, given the large-scale loss of power in many regions. This would have led directly to a lack of safe, drinkable water.

Waste disposal

The volume of waste resulting from the floods, and the damage to waste infrastructure caused by the floods, led to significant waste management problems.

The huge volume of flood waste was beyond the capabilities of local tips. Richmond Valley Council estimated 80,000 tonnes of waste was collected after the floods, equivalent to 6 times the community's annual contribution to landfill.⁵³⁴ Byron Shire Council advised that the local waste transfer station was overwhelmed with waste in the first week after the first flood and had to close to the public.⁵³⁵

The Inquiry heard positive feedback that Public Works Advisory (PWA) and the Environment Protection Authority (EPA) worked effectively to coordinate waste collection in the Northern Rivers region.⁵³⁶ This included establishing temporary transfer stations and arranging for the transfer of waste to large facilities in Queensland, thus avoiding the capacity limits in local tips.⁵³⁷ Lismore City Council noted that this had been a council responsibility in previous events, which was problematic and logistically challenging, and it appreciated the model adopted for this event.⁵³⁸

The efficient removal of waste enabled businesses and communities to begin the process of recovery. In Casino CBD, affected businesses were able to reopen within 48 hours of the flood and

⁵²⁷ Tweed Shire Council, submission to the Inquiry.

⁵²⁸ *Ibid.*

⁵²⁹ *Ibid.*

⁵³⁰ *Ibid.*

⁵³¹ *Ibid.*

⁵³² Water Directorate, submission to the Inquiry.

⁵³³ *Ibid.*

⁵³⁴ Richmond Valley Council, submission to the Inquiry.

⁵³⁵ Byron Shire Council, submission to the Inquiry.

⁵³⁶ Ballina Shire Council, submission to the Inquiry.

⁵³⁷ Lismore City Council, submission to the Inquiry.

⁵³⁸ *Ibid.*

continue to offer essential local supplies to support their communities.⁵³⁹ More broadly, the efficient removal of waste helped to support community recovery and confidence.⁵⁴⁰

On the other hand, Northern Beaches Council advised the Inquiry that it had to manage its flood waste unaided, because it was told that PWA had no further capacity to provide waste management support.⁵⁴¹ The council removed over 430 tonnes of flood waste from about 1,430 private properties.⁵⁴² This placed significant pressure on internal and contractor resources, on top of trying to maintain the demands of business-as-usual waste services.⁵⁴³

The Inquiry was also told of issues with waste sorting, including the disposal of hazardous material such as asbestos. Byron Shire Council advised that there was a lack of timely direction about the management of hazardous waste, and a lack of landfill sites available within the region capable of accepting volumes of asbestos.⁵⁴⁴ There were also issues with kerbside waste sorting. Once the floodwaters subsided, many residents began immediately cleaning out premises affected by the floods, placing all waste, unsorted, at kerbside for collection.⁵⁴⁵ Consequently, many otherwise recoverable materials went to landfill, resulting in more landfill than was necessary. Community led groups wanted to assist with this problem but had no available mechanisms.⁵⁴⁶ Further recovery arrangements need to ensure that local and state governments have standing contracts, with local businesses were possible, for clean up, so this can be activated as quickly as possible after a flooding event.

Local waste transfer stations were overwhelmed

The Inquiry heard that local waste transfer stations were overwhelmed and not equipped to take the large volumes of waste following the flood events in February/March 2022.^{547,548,549} As well as spatial constraints, waste storage facilities and local waste transfer stations also have volume limits on the amount of waste they can accept annually.⁵⁵⁰ These facilities must operate throughout the year on the basis that they won't exceed their annual limit.⁵⁵¹

There are processes in place to divert waste to other locations following a natural disaster to ensure that facilities can manage their annual limits. Under the Environmental Services Functional Area, PWA is responsible for procuring the services of waste contractors to divert waste to other areas.⁵⁵²

PWA advised the Inquiry they assist local councils in disposal of waste to commercial facilities to ensure local waste facilities are not overloaded.⁵⁵³ The majority of the waste from the Northern

⁵³⁹ Richmond Valley Council, submission to the Inquiry.

⁵⁴⁰ Ibid.

⁵⁴¹ Northern Beach Council, submission to the Inquiry.

⁵⁴² Ibid.

⁵⁴³ Ibid.

⁵⁴⁴ Byron Shire Council, submission to the Inquiry.

⁵⁴⁵ Lismore City Council, submission to the Inquiry.

⁵⁴⁶ Byron Shire Council, submission to the Inquiry.

⁵⁴⁷ Waste transfer stations serve as a link between a community's solid waste collection program and a final waste disposal facility.

⁵⁴⁸ Lismore City Council, submission to the Inquiry.

⁵⁴⁹ Byron Shire Council, submission to the Inquiry.

⁵⁵⁰ Meeting with the NSW Environment Protection Authority on 15 July 2022.

⁵⁵¹ Ibid.

⁵⁵² Department of Regional NSW. (2022). *Advice to the Inquiry provided 27 May 2022*.

⁵⁵³ Meeting with Public Works Advisory on 21 July 2022.

Rivers was transported to commercial facilities in South-East Queensland.⁵⁵⁴ It is estimated that more than 220,000 tonnes of flood waste was removed from communities across the state as a result of the 2022 floods.⁵⁵⁵ Temporary waste transfer stations were also established, and by 7 March 17 temporary waste transfer stations had been established in the Northern Rivers region.⁵⁵⁶

H. Findings – impact to essential services

- The loss of power during the flood events was significant in terms of scale, duration and its compounding effect on other services including telecommunication, sewerage system plants and water supply systems.
- Similar to the 2019–20 bushfires, the loss of telecommunications services caused the most distress to communities because it affected their ability to request flood rescues, communicate with family and friends, provide warnings and access post-emergency information.
- National roaming agreements in emergency events should be implemented to help maintain a level of telecommunications coverage for affected communities when there is reduced coverage due to telecommunication asset damage.
- Attendance of essential service personnel at local emergency management committees was varied across the state, and when there was poor attendance, this hampered emergency arrangements during the 2022 floods.

9. Recommendation – impact to essential services

That, to minimise disruption to essential services, including outages which compromise basic communication coverage, and to ensure access to safe water supply and power during flood events, Government work directly or together with the Australian and other state governments and/or their relevant power and telecommunications regulatory, policy and market bodies to:

- ensure there are sufficient redundancy options known and made available (for example, backup diesel generators, deployed temporary telecommunications facilities, etc.) to supply power to essential telecommunication infrastructure, alternative telecommunications infrastructure and water treatment facilities.
- ensure that the telecommunication entities, electricity network providers and water treatment managers are using up to the minute, whole of catchment models to inform business continuity planning in the event of flooding
- facilitate cross carrier roaming arrangements between carriers and the public for basic text, voice and data during the period of emergency in areas directly affected by flood

⁵⁵⁴ Department of Regional NSW. (2022). *Advice to the Inquiry provided 22 July 2022*.

⁵⁵⁵ Ibid.

⁵⁵⁶ Department of Regional NSW. (2022). *Advice to the Inquiry provided 27 May 2022*.

- ensure all essential services are mandatory members of the Emergency Management Committees at state, regional and local levels
- ensure the state understands essential services redundancies and what emergency redundancy options are available from Australian Government agencies
- ensure, given the heavy reliance on essential services by community and government during a disaster, essential services loss, redundancy and build back better principles are exercised through emergency management committee processes annually.

3.13. Transition from incident response to recovery

What is recovery?

Under the SERM Act, recovery is the fourth and final stage of an emergency which “includes the process of returning an affected community to its proper level of functioning after an emergency”.⁵⁵⁷ Emergency services, functional areas and supporting agencies share a collective responsibility to aid in a community’s recovery and, while returning a community to “its proper level” encompasses a legal responsibility, there is also a moral obligation to ensure that recovery results in a better prepared and resourced community to respond to future threats.

Recovery is not simply about what happens after an emergency but includes pre-planning and continuous improvement. It is “the coordinated efforts and processes to bring about the immediate, medium-term and long-term holistic regeneration of a community following a civil defence emergency”.⁵⁵⁸ Recovery is people-centric and, as explained by Peter Wilding, should be treated as an inseparable component of the state’s emergency response if the core objective is to reduce the effect of an emergency on the community.⁵⁵⁹

Recovery centre establishment

The state’s approach to emergency planning, including recovery, is set out in the *State Emergency Management Plan* (EMPLAN),⁵⁶⁰ and a series of supporting plans that sit underneath it. These supporting plans include:

- the *NSW Recovery Plan* setting out the responsibilities, authorities and mechanisms for disaster recovery in NSW⁵⁶¹
- the *Welfare Services Functional Area Supporting Plan* (WSFA) setting out the responsibilities, authorities and mechanisms for coordinating key welfare services during an emergency.⁵⁶²

⁵⁵⁷ *State Emergency and Rescue Management Act 1989*. s5.

⁵⁵⁸ AFAC (Australasian Fire and Emergency Services Authorities Council). (2021). Recovery: what is it? Retrieved from <https://www.afac.com.au/auxiliary/publications/newsletter/article/recovery-what-is-it>

⁵⁵⁹ Ibid.

⁵⁶⁰ NSW Government. (2018). New South Wales State Emergency Management Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-emergency-management-plan-emplan.pdf>

⁵⁶¹ Resilience NSW. (2021). NSW Recovery Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/Supporting-Plan-Recovery.pdf>.

⁵⁶² NSW Government. (2018). Welfare Services Functional Area Supporting Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/Supporting-Plan-Welfare-Services-Functional-Area.pdf>.

Under the *NSW Recovery Plan*, the decision to establish a Recovery Centre is made by the SERCON in consultation with the SEOCAN.⁵⁶³ However, the Local Recovery Committee, a strategic decision-making body for local recovery, assesses the need for a recovery centre and recommends it to the SERCON.

The SERCON is “responsible for the overall interagency coordination and management of recovery centre functions”.⁵⁶⁴ A Recovery Centre Coordinator, currently drawn from Resilience NSW staff, is deployed in the flood-affected regions to coordinate recovery operations and resources across government agencies. The coordinator and their team facilitate the establishment and management of recovery centres, mobile recovery services and community recovery access points, with the aim to get people, communities and businesses back on their feet.

Each recovery centre includes representatives of a range of government agencies, local councils, not-for-profit organisations and some businesses such as insurance companies, all with the aim of providing support to affected residents and businesses.

Some not-for-profit organisations such as The Salvation Army and the Australian Red Cross are specifically listed as participating organisations in the WSFA Supporting Plan,⁵⁶⁵ indicating that they are willing to provide key welfare services and commit resources in the management of emergencies, once formally requested. For example, the Salvation Army’s role is to “provide and coordinate emergency catering services to disaster affected people and WSFA members”.⁵⁶⁶ From the Salvation Army’s experience:

*regardless of what is set out in the EMPLAN, there is an expectation that trusted community organisations, including The Salvation Army, will be present at evacuation and recovery centres. We often stand in the gap, providing financial, emotional and material support before community members can access government relief funding and insurance payouts.*⁵⁶⁷

However, as this more general role in recovery centres (and evacuation centres) is not specified in the EMPLAN or the WSFA Supporting Plan, the actual services such agencies provide may end up being limited due to their own funding and human resource limitations.

As of 31 May, Resilience NSW had established 63 recovery centres and assistance points in areas that required community support, providing services for over 41,000 people, as follows.⁵⁶⁸

- 26 in North Coast
- 11 in Sydney which includes Hawkesbury, The Hills, Camden, Blacktown
- 9 in Mid North Coast
- 5 in the Hunter
- 4 in New England
- 4 in South Coast
- 3 in Central Coast
- 1 in Southern Highlands.⁵⁶⁹

⁵⁶³ NSW Government. (2018). New South Wales State Emergency Management Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-emergency-management-plan-emplan.pdf>

⁵⁶⁴ NSW Government. (2018). Welfare Services Functional Area Supporting Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/Supporting-Plan-Welfare-Services-Functional-Area.pdf>.

⁵⁶⁵ Ibid.

⁵⁶⁶ Ibid. page 11.

⁵⁶⁷ The Salvation Army, submission to the Inquiry.

⁵⁶⁸ Resilience NSW. (2022). *Advice to the Inquiry provided 6 June 2022*.

⁵⁶⁹ Resilience NSW (2022). *Advice to the Inquiry provided 30 June 2022*.

Additionally, 2 Service NSW Mobile Service Centres were set up to assist with flood recovery, one in Lismore and the other in Murwillumbah. Twenty-nine Mobile Recovery Services also visited the regions offering additional support to flood and storm affected communities.

Recovery centres set up by government agencies under state plans were generally located in areas that were accessible and in town centre settings. Smaller communities that were isolated due to floodwaters, landslips or damaged roads established their own community evacuation and recovery centres, also referred to as 'community hubs.' Early into the emergency, these communities realised that government support was unable to reach or fully service their communities, so they began to self-organise. As they transitioned to the recovery phase, the hubs took on broader duties, including the provision of medical services, shopping facilities, meeting places and places to go for 'accidental counselling'.

How well did recovery centres work?

Evacuation centres and recovery centres perform different roles at different stages of disaster and emergency efforts. As previously highlighted in Section 3.11, an evacuation centre's purpose is to provide primary care and short-term accommodation for evacuees. A recovery centre's purpose is to provide more comprehensive support to community and individuals as the recovery progresses.

Recovery centres should be a 'one-stop-shop' that provides a single point of face-to-face contact for information and assistance to affected individuals and businesses, with the aim of minimising inconvenience and the need for travel. The centres also provide a point of focus and belonging, especially for those dislocated from their community environment.

The assistance given included information, support and help with grant applications. One recovery centre attendee said:

*the recovery centre that was set up was a wonderful help. They knew our brains were not functioning from the trauma and lack of sleep.*⁵⁷⁰

Many people told the Inquiry that the staff providing support in recovery centres did their best. But the Inquiry was informed that some attendees found the recovery centres overwhelming, a feeling which was amplified by the complexity of government processes. People had to navigate through the complex

*requirements for making claims [which] is overwhelming for many distressed and traumatised flood victims. This is compounded by the release of new grants, and by agency back offices not processing claims in the expected time, resulting in multiple returns to a Centre.*⁵⁷¹

The Inquiry was also told that many people were slow to claim financial assistance, with some only finding out that recovery help was available in late May.⁵⁷²

Another submission said they attended the recovery centre multiple times and found it overwhelming to be in the same place as many other traumatised people and that this made their situation worse. They also "felt frustrated with having to complete long government questionnaires, only to have to complete the exact same ones a few weeks later over the phone".⁵⁷³

In Lismore, Southern Cross University was both an evacuation centre and, on its lower levels, a recovery centre. This placed additional burdens on the university's resources, but may also have added to the feelings of being overwhelmed as reported above.

One particular issue highlighted to the Inquiry was the lack of a centralised system to ensure that people at evacuation centres tell their story once only. Instead, people are asked to provide the

⁵⁷⁰ Leesa Hallahan, submission to Inquiry.

⁵⁷¹ Anonymous, submission to the Inquiry.

⁵⁷² Anonymous, submission to the Inquiry.

⁵⁷³ Anonymous, submission to the Inquiry.

same information multiple times, by local councils, state government agencies, Australian Government agencies and NGOs, and there is no mechanism to allow people to authorise the sharing of their information to reduce this burden.

A more human-centric model to support and track an individual's journey through recovery could be implemented by using customer relationship management (CRM) technology.⁵⁷⁴ A 'tell us once' approach to data collection at evacuation centres would greatly assist evacuees and reduce the risk of retraumatising individuals. One of the first things a person wants after being rescued is some form of personal identification.⁵⁷⁵ Ideally, replacement of personal identification lost during an emergency would be readily available through the Service NSW App – enabling individuals easily to prove their identity, commence their recovery and access much needed resources.

At present, it appears that the importance of the first 72 hours of an emergency is not well understood by government employees and volunteers. When support services are not done well, the community helps themselves in whatever way it can.⁵⁷⁶ Ultimately, government agencies must work collectively to ensure that a community's immediate needs are met.

Lessons learned in recovering from previous disasters

During an emergency and in the immediate aftermath, individuals require a diversity of services that support their wellbeing, health and safety. As seen above, they require access to telecommunications and energy, and resources such as shelter, clothing, food and water. They want to know what has happened to their family, friends, neighbours and the broader community. A void in information and access to services may well exacerbate the trauma an individual may already be experiencing. Much like recovery in general, the transition period must be human-centric and provide a sense of connectivity to community and services. In an emergency, people require government agencies to have actively planned for their needs and to expedite the delivery of services through evacuation and recovery centres.

Disasters are not new to NSW, nor are they new to Australia yet the Inquiry observed that recovery is still a vexed issue that governments continually struggle to get right. There is a real failure of the system to build on past experiences and learn lessons from previous disasters to inform the response to the current.⁵⁷⁷ The Inquiry heard that part of this failure is due to a culture of exceptionalism: both 'our state is different' and 'we know what we are doing'⁵⁷⁸ when experience tells us this is not always the case.

The 2 most common concerns expressed to the Inquiry about recovery were people having to retell their story multiple times to multiple government agencies and authorities, and the slowness with which grants were processed and allocated.

The Inquiry observed that recovery has a different set of requirements from response. Recovery should be more individualised and led by locals, with less of the command-and-control culture that applies in the response phase.⁵⁷⁹

Some of the most successful transitions to recovery were community led, such as in Broadwater, where Karina and David set up and ran the Broadwater Community recovery centre. Being run by locals and for locals, this centre was able to respond to the needs of the community throughout the immediate to longer-term recovery process. For example, initially it provided free goods and services but this was then scaled back to ensure money and economic activity was flowing into the

⁵⁷⁴ Meeting with the Department of Customer Service on 27 May 2022.

⁵⁷⁵ Ibid.

⁵⁷⁶ Ibid.

⁵⁷⁷ Meeting with Prof McFarlane on 20 June 2022.

⁵⁷⁸ Meeting with Ben Hubbard on 17 June 2022.

⁵⁷⁹ Ibid.

community e.g. “you don’t want to be handing out free sandwiches when you’ve got a bakery that is trying to get back onto its feet”.⁵⁸⁰ The key aspect of recovery is getting people back to business as usual as quickly as possible.⁵⁸¹

Queensland has a good model of setting up recovery at the same time as response and this helps get quick wins on the ground. From a Queensland perspective, the Inquiry was told that, no matter what the disaster is, there must be constant communication with the community and the presence of all emergency services on the streets and in the disaster zones to build confidence that the Queensland Government is supporting the community and its recovery efforts.⁵⁸²

10. Recommendation – transition initiatives

That, to improve the community’s experience during immediate disaster recovery phase, Government through the SEOCON, NSWRA, DCS/Service NSW and other state agencies as required provide greater support (financial, health [including mental health], temporary accommodation, administrative and other support services) to affected communities by:

- minimising the number of times a person is required to relive their trauma by providing evidence or narrative of their disaster impact (for the purposes of accessing relief and support services). This includes consistent and effective referral pathways and follow up mechanisms
- looking at information sharing arrangements with the Australian Government to streamline grant identification and delivery
- partnering with affected communities and individuals to navigate and access support as soon as possible during or immediately following disaster events
- where possible, merging evacuation and recovery centres for the first 30 days post disaster. Where co location is not possible, DCS/Service NSW must have a representative present at both evacuation and recovery centres.

The Inquiry notes that clear transition initiatives are required dependent on the phase of recovery and lead agency associated – for example, the transition between the SEOCON (including DCS/Service NSW) in the immediate recovery phase to the NSWRA for the longer-term recovery. Functions that may require transition include, but are not limited to, administering grants and funding, and managing infrastructure and housing projects.

⁵⁸⁰ Meeting with Broadwater Community Recovery Centre on 1 May 2022.

⁵⁸¹ Meeting with Nicole Scurrah on 8 June 2022.

⁵⁸² Meeting with Queensland Police Commissioner, Katrina Carroll and Deputy Commissioner Steve Gollschewski on 26 May 2022.

Chapter

4

4. Emergency planning and preparedness

This chapter reports on the following Term of Reference for the Inquiry:

1.b. The preparation and planning by agencies, government, other entities and the community for floods in NSW, including the accuracy and timing of weather forecasts, current laws, emergency management plans, practices and mitigation strategies, their application and effort

2.a. Safety of emergency services and community first responders

2.b. Preparation and planning for future flood threats and risks.

Flooding is one of the biggest causes of insured losses in NSW. Widescale floods have occurred throughout NSW history and they will happen again, possibly more frequently as discussed in Chapter 2.

Consequently, the state needs to ensure that all agencies and communities are prepared for floods and other natural hazards, and that the emergency management system embodies a continuous improvement approach to preparedness measures. This is all the more necessary as the community's expectations of government and emergency service agency responses increase significantly with each event, and there is greater public scrutiny of the response and recovery phases.

This chapter examines the preparations by government agencies, mainly the SES, ahead of the 2022 flood season, and whether the preparation and planning was appropriate, particularly in light of what was already known in late 2021 about the heightened flood risk over the following months.

Critical to flood preparedness is the community itself, and this chapter examines whether there were sufficient measures in place to support community preparedness ahead of the 2022 flood season.

In addition, the chapter provides an overview of capability and resourcing for local governments, NSW emergency management agencies, addresses the safety of first responders, and sets out some requirements for improved planning and preparation for future flood risks.

4.1. Weaknesses in planning and preparation

This section examines the weaknesses in the planning and preparation for the 2022 floods. In summary, the SES is the lead agency for planning and preparation for floods in NSW. This responsibility includes raising the level of community awareness and preparedness, providing adequate training equal to the threat posed by floods – particularly in high-risk catchments – and approaching flood risk through an all-agency paradigm.

Preparations did not appropriately reflect the risk to community posed by antecedent weather conditions which were known well in advance of the flood events. In particular, engagement was not effective in generating a clear understanding of communities' flood risks in different parts of the state. The Inquiry observed that appropriate reviews and exercising of existing flood plans at a state, regional and local level did not occur. This was particularly concentrated in high-risk catchments, where training and exercising was also insufficient to prepare for the severity of the floods.

The SES was not sufficiently aware of the assets that were available to it from other emergency services, interstate partners and from the Australian Government, which affected its ability to pre-deploy assets in preparation for the event.

The COVID-19 pandemic affected the delivery of training and exercising during 2020–22. However, other emergency services were more agile in adapting to the challenges of the pandemic. COVID-19 was not appropriately planned for in evacuation centres.

Being ready for future disasters will require continuous improvement across all agencies. Senior Ministerial and Departmental leaders also have a role to play in fostering community confidence through appropriate governance, accountability and engagement.

Responsibilities for planning and preparation

Emergency planning and preparation is about the process of establishing and documenting agreements about the roles and responsibilities of relevant people and organisations when emergency management is required.⁵⁸³ It is also about ensuring that those who have been allocated emergency management responsibilities have the capacity and capability to discharge those responsibilities effectively when a disaster occurs.⁵⁸⁴

Of the many emergency management documents at state, regional and local levels that feed into the state emergency management system, the *State Emergency Management Plan* (EMPLAN) and its sub plans are among the most critical. One of the sub plans is the *State Flood Plan*. As the SES is the designated combat agency for floods,⁵⁸⁵ it has extensive roles and responsibilities under this plan, including flood emergency planning, intelligence systems, warning systems, briefing, training and exercising, and community resilience to flooding.⁵⁸⁶ Like other emergency service agencies, the SES is also expected, as part of its preparation activities, to:

- understand its resourcing gaps and requirements and work to address these
- review previous responses and lessons learned
- identify any technological improvements
- identify any learnings from previous events, and other agencies.⁵⁸⁷

This is intended to ensure that the agency has resources, staff and volunteers to respond at the best possible level to any upcoming disaster.⁵⁸⁸

In respect of community preparation, the SES is expected to take the lead in working with other agencies and the community to raise the level of community preparation for floods. This includes building confidence in messaging and increasing understanding and awareness of upcoming risks. It also includes identifying and publicising the preparations the community can make to minimise the risk and effect of any disaster – in the case of floods, this includes encouraging community members to have an escape plan, know when to evacuate and where to go, store valuables in alternative safe locations and not drive through flood waters.

At a governance level, the tiered emergency management committees (EMCs) at state, regional and local level also have functions that focus on the planning and preparation stage. For example, the functions of a Local EMC include:

⁵⁸³ Australian Institute for Disaster Resilience. (2020). Emergency Planning. Retrieved from https://www.aidr.org.au/media/8313/aidr_handbookcollection_emergencyplanning_2020.

⁵⁸⁴ Australian Government. (2020). Royal Commission into National Natural Disaster Arrangements Final Report. Retrieved from <https://naturaldisaster.royalcommission.gov.au/publications/html-report/chapter-11>.

⁵⁸⁵ *State Emergency Service Act 1989*, s 8(1).

⁵⁸⁶ NSW Government. (2021). NSW State Flood Plan. Retrieved from <https://www.nsw.gov.au/sites/default/files/2022-01/NSW%20State%20Flood%20Plan.pdf>.

⁵⁸⁷ Mr Gary Worboys, former SEOCON (2022). *Advice to the Inquiry provided 30 May 2022*.

⁵⁸⁸ Ibid.

(b) review and prepare plans in respect of the relevant local government area that are, or are proposed to be, subplans or supporting plans established under the State Emergency Management Plan, and

(c) make recommendations about and assist in the co-ordination of training in relation to emergency management in the relevant local government area, and

(d) develop, conduct and evaluate local emergency management training exercises, and

(e) facilitate local level emergency management capability through inter-agency co-ordination, co-operation and information sharing arrangements⁵⁸⁹

While not commenting further on the role of EMCs, the Inquiry formed the view that EMCs need to play a stronger role in ensuring a whole-of-government approach to disaster readiness, and be pro-active in reviewing plans and monitoring the preparation activities of the emergency service agencies within their area of responsibility.

At the highest levels of governance, appropriate planning and preparation dictates that Government Ministers and Departmental Secretaries have a high degree of situational awareness and at all times are prepared for an emergency.

Preparations not ramped up despite known risks

The 2022 floods were preceded by the antecedent conditions of a saturated catchment, full dams and pre-briefings from the Bureau in late 2021 which indicated the high likelihood of above average rainfall contributing to a heightened flooding risk across the east coast of NSW.

The SES provided emergency service organisations and partner agencies on the State Emergency Management Committee (SEMC) with a seasonal briefing in October 2021, when the Bureau declared a La Niña weather system. This briefing covered the potential for flooding across the state during the coming storm season, from 1 October to 31 March. It is clear to the Inquiry that individual Cabinet Ministers and Departmental Secretaries were at times engaged when the weather events were on. However, to achieve a heightened state of readiness and improve situational awareness, a cohesive arrangement that brings together these key leaders prior to the weather events occurring is required.

Between 1 November 2021 and 28 February 2022, the SES issued 24 Weather Briefing packs that were available to all emergency management agencies and held regular briefings to disseminate information to the SEMC and emergency management partners via the State Emergency Operations Centre (SEOC) as required.⁵⁹⁰

Nevertheless, the Inquiry found no evidence of any extraordinary preparation or planning undertaken by NSW government agencies in line with this identified heightened risk and likely consequences.

In the case of the SES, which is the combat agency for floods, storms and tsunamis in NSW, it appears to the Inquiry that the SES was actually unprepared for events of the scale, severity and complexity seen in 2022.

This was demonstrated by the many failures to give timely public warnings which led to the need for a high number of rescues, especially in the Northern Rivers, where community rescues significantly outnumbered SES rescues. In general, the Inquiry found that the combat agency and supporting agencies were focussed on the response to the emergency, with limited emphasis on mitigation as would be commonplace if an appropriate emergency planning culture was in place.⁵⁹¹

⁵⁸⁹ *State Emergency and Rescue Management Act 1989*. s29 (1A).

⁵⁹⁰ NSW Police Force. (2022). *Advice to the Inquiry provided 25 June 2022*.

⁵⁹¹ Meeting with Risk Frontiers on 22 April 2022.

It was suggested by the SES to the Inquiry that its poor preparation and response was due to unreliable forecasts, i.e. there was more rainfall than was predicted. It is the Inquiry's view that NSW cannot predict its way out of flooding events. While the 2020 floods were described by some as 'unprecedented', especially those in the Northern Rivers, 'unprecedented' does not absolve government agencies of responsibility to provide an effective response, or to plan and prepare appropriately for events, or to learn lessons to improve for the next event.⁵⁹²

Appropriate preparation and planning is essential to ensure that flood risks are mitigated and the severity of the consequences reduced.

What were the failures in preparation?

Lack of review of existing flood plans

The *State Flood Plan* and local flood plans stipulate a requirement that the SES review flood plans after a flood event.⁵⁹³ In the case of Lismore City, it does not appear that the endorsed local flood plan was reviewed following the 2021 floods in the Northern Rivers area which resulted in evacuation warnings and orders affecting at least 800 people and isolating 16 communities.

The responsibility for this lies with both the SES Commissioner and the Local SES Controller, and both need to be more proactive in ensuring that the learnings from past floods inform future ones.

The Inquiry notes that local flood plans often entail detailed and complex information that, although important, can obscure vital information needed in an emergency. Local flood plans should clearly outline a set of procedures or actions to be taken before, during and after an emergency. These should be readily available for practical use.

Lack of training and conduct of exercises

As mentioned, an important part of preparation and planning is documenting a range of emergency management and hazard specific plans at state, regional and local levels. However, such plans cannot be static: they require regular testing through training and exercises, both to ensure the plans themselves are comprehensive and effective, and to ensure those charged with implementing them have the skills to do so. This is not only good practice, but also a requirement under the *State Flood Plan*.⁵⁹⁴

The last multi-agency flood exercise, called Exercise Deerubbin, was conducted in 2019 and tested command and control, consequence management and recovery arrangements arising from hypothetical catastrophic flooding of the Hawkesbury-Nepean River system.⁵⁹⁵ This exercise was focussed on metropolitan areas, and would not have provided appropriate insight to inform a flood event in the Northern Rivers.

In respect of the Northern Rivers, the Inquiry was advised of desktop exercises in 2022 and field exercises in 2018, though these did not relate to floods or flood rescues. The Inquiry understands the SES conducted a small-scale flood exercise in 2018.⁵⁹⁶

The Inquiry was told of concerns by SES volunteers that they lack training and re-certifications, in particular for flood rescue,⁵⁹⁷ and that desktop-only training is not sufficient. For example:

⁵⁹² Meeting with Professor Sandy McFarlane on 20 June 2022.

⁵⁹³ NSW Government. (2021). *NSW State Flood Plan*. Retrieved from: <https://www.nsw.gov.au/sites/default/files/2022-01/NSW%20State%20Flood%20Plan.pdf>.

⁵⁹⁴ *Ibid.*

⁵⁹⁵ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 5 July 2022*.

⁵⁹⁶ Lismore City Council. (2022). *Advice to the Inquiry provided 24 June 2022*.

⁵⁹⁷ NSW SES Volunteers Association (2022), submission to the Inquiry.

The Drive Operational Vehicles course is a desktop-based course only, with no physical component including vehicle behaviour and/or driving in hazardous conditions. The structure of this course, and the potential time distance between activations for response driving put volunteers at risk as does the very nature of working in flooded communities increase the likelihood that volunteers, while undertaking their roles within the NSW SES, will indeed come across and potentially be required to transit across flood water- be it for their own safety or to undertake flood rescue roles. Despite no specific training being offered to members regarding driving in or around flood water, members are nevertheless being placed by the Service in a flooded or likely to be flooded location.⁵⁹⁸

Feedback from volunteers has indicated a concern regarding the lack of flood rescue training and recertifications that have occurred. Volunteers provided anecdotal evidence to the Association that while other agencies appear to have been able to conduct flood rescue training, the NSW SES has fallen behind. 'Failures in training and recertifications in recent years led to a shortage of operators'.⁵⁹⁹

Members advised they felt SES volunteers were ill-equipped and lacked the necessary training, experience and ultimately confidence, to make major decisions of public communication, particularly in relation to evacuation orders.⁶⁰⁰

Adequate training and resources are needed to enable [sic] effective NSW SES Capability, particularly in the Northern Rivers...The Training System needs to be adequately resourced and funded for full time and part-time employees providing timely Training and Development delivered to SES workers.⁶⁰¹

The Inquiry found that training and the conduct of exercises in the SES was insufficient to prepare SES members to deal with large scale flooding events.

Lack of knowledge by SES of resources available to it

The SES told the Inquiry that, at a state level, it was not aware of all the resources that were available for it to call on, before or during the flooding events.⁶⁰² Consequently, resources that could have been called on for assistance early in the event were not called. This was especially relevant to Australian Government resources, such as the Australian Defence Force. During the Northern Rivers flood event, the Volunteer Rescue Association NSW (VRA) was not fully utilised by the SES State Command Centre, despite being a significant contributor to the response.⁶⁰³

Following meetings with local SES units, it was clear to the Inquiry that these units did not know what resources were available to them from other emergency service agencies, such as the RFS and FRNSW, or the local council. Nor did they know that many community members had boats or jet skis that could assist with flood rescues.

On the Monday, I was sent a text message to prepare for tasking. I then waited all day and no tasking came through...

I was fully prepared to go to evacuation centres, pack sand bags, make sandwiches or other ground based action, but instead I waited all day to be tasked. My skills and experience, which could have been used to save one of the four lives lost that day, went squandered...

On the Tuesday, I decoupled from agency, borrowed a boat and was part of the rescue effort which extracted 400 citizens of Woodburn to Evans Head. I drove my tinny in moderate conditions,

⁵⁹⁸ Ibid.

⁵⁹⁹ Ibid.

⁶⁰⁰ FBEU (Fire Brigade Employees Union), submission to the Inquiry.

⁶⁰¹ Paul Copeland, submission to the Inquiry.

⁶⁰² Meeting with NSW SES (NSW State Emergency Service) on 13 April 2022.

⁶⁰³ VRA (Volunteer Rescue Association). (2022). *Advice to the Inquiry provided 29 June 2022.*

performing risk assessments as appropriate and got between 30 and 40 people out with the help of my crew on board. She was also a Marine Rescue member and appalled by the lack of tasking on the Monday...

*The Ballina Marine Rescue boats did nothing the entire event while there were 300+ people sitting in the Coraki evacuation centre for 7 days... and could have been performing medical evacuations food and supply drops and other needs based assistance.*⁶⁰⁴

This is a big failure in being prepared in an area that is prone to large scale flooding events.

Ineffective community engagement

The SES advised the Inquiry that ahead of and during the event it undertook community awareness and engagement campaigns in areas identified as at greatest risk. This included the Northern Rivers, Hawkesbury-Nepean and the Central Coast. Specifically, separate website pages were created for the Georges River and Northern Rivers catchments with localised information about flood risk and preparedness activities, and links to other relevant information such as local council emergency dashboards and the Bureau, as well as in-language resources for culturally and linguistically diverse (CALD) communities. Community engagement activities were largely digital and print-based as a result of COVID-19 restrictions. They included a range of social media, print, presentations, displays and in-place media advertising. In the Northern Rivers, SES held community meetings in Lismore in the lead-up to February 2022.

In the Hawkesbury-Nepean, a preparedness campaign targeting residents was jointly delivered by Infrastructure NSW, Resilience NSW and SES. The campaign, which ran from October to December 2021, encouraged community members to recognise the early signs of potential flooding and have a plan in place to respond. The campaign was delivered through social media and in print advertising, and recently won the national Emergency Media and Public Affairs award for 'Excellence in Readiness & Resilience', with the outcomes of the campaign informing future campaigns in the Northern Rivers and Central Coast.⁶⁰⁵

Despite the award, it is not clear to the Inquiry that the SES understood its audience, or the need to tailor its engagement activities to a diverse community to ensure its messaging achieved maximum reach. A recent survey by Infrastructure NSW of Hawkesbury-Nepean Valley residents found that only 18% even knew they lived in a high-risk flood area, and that about 80% had done nothing to prepare for floods.⁶⁰⁶

In the Northern Rivers, the Inquiry heard that some local community members anticipated major flooding due to their generational knowledge of flood behaviour. Local indigenous community members also read the landscape and understood the potential severity of the floods to come. However, community awareness of flooding was generally about lived experience and lacked any consideration of the potential for the flood to exceed historical heights. For much of the community, their preparation was to wait for clear instructions to evacuate from the SES, many of which came too late.

The Inquiry points out that community engagement is not a tick in the box activity, but a foundation for saving lives.

⁶⁰⁴ Kerewin Hartland, submission to the Inquiry.

⁶⁰⁵ Infrastructure NSW (2022). Hawkesbury-Nepean Valley Flood Preparedness Campaign Wins National Award. Retrieved from: <https://www.infrastructure.nsw.gov.au/news/2022/may/18/hawkesbury-nepean-valley-flood-preparedness-campaign-wins-national-award/#:~:text=wins%20national%20award-,Hawkesbury%2DNepean%20Valley%20flood%20preparedness%20campaign%20wins%20national%20award,Excellence%20in%20Readiness%20%26%20Resilience>.

⁶⁰⁶ NSW Government. (2019). Submission to the Parliamentary Inquiry on the Proposal to Raise the Warragamba Dam Wall. Retrieved from <https://www.parliament.nsw.gov.au/lcdocs/submissions/65299/0237%20NSW%20Government.pdf>.

Lack of planning for impact of COVID 19 on preparations

Across the state the preparation for, response to and recovery from the 2022 floods occurred in an environment in which COVID-19 remained a threat to the wellbeing of community and the safety of emergency service personnel. There is no doubt that COVID-19 affected face to face training, the conduct of exercises and networking, all aspects that are critical in effective emergency management preparations and planning.

The SES acknowledged that COVID-19 restrictions affected the delivery of training over 2020–22.⁶⁰⁷ Emergency management training shifted online, with webinars and web-based courses provided to volunteers to maintain proficiency and obtain new accreditations. Across all emergency services agencies, the lack of face-to-face, scenario-based training affected operational capabilities and reduced the opportunity for emergency service personnel to exercise interoperability, test emergency management arrangements and develop the relationships which are relied on during an emergency event.

COVID-19 also presented some unexpected opportunities for some emergency management committees. The Inquiry heard that the state border closures pushed local emergency management committees together, especially in the Murray and Wentworth regions, enabling them to cement networks between and within local emergency management committees.⁶⁰⁸ This strengthened emergency arrangements, and provided a foundation for relationships to “not be starting from a standing start”.⁶⁰⁹

COVID-19 vaccine mandates negatively affected both recruitment of some new volunteers and retention of existing ones in the SES. As one person in Mullumbimby told the Inquiry:

*We are still a relatively under-vaccinated community. There are a lot of younger people in our community who would join the SES but one of the conditions is they have to be vaccinated. So I wonder if that's really a need ... I'm wondering if that's really something that needs to exist or whether that could be removed as a requirement because we'd have lots more hands, helping hands if there wasn't that mandate.*⁶¹⁰

The vaccine mandate resulted in the closure of at least 3 SES units across the state.⁶¹¹ It is concerning that the RFS, the natural partner of these units, was not informed of the resulting capability gap. The RFS set up a rigorous campaign of Rapid Antigen Testing (RAT) and vaccination for its members; it is not clear whether the same process was undertaken within the SES.

COVID-19 also had other consequences on the general preparedness of the SES. For example, the Inquiry was told that the SES fleet replacement program was impacted by global logistics and supply constraints, limiting the manufacture and delivery of new vehicles throughout the 202–21 financial year.

The Inquiry observed that the SES did not seem to take into account the impacts of COVID-19 in its preparations for an emergency response. For example, the Inquiry was not informed of any plans by the SES for managing the number of volunteers and staff who needed to isolate as a result of a positive COVID-19 result for themselves or a close contact. The SES advised that, at the time of the floods, it had a state-wide total of 144 volunteers, 22 staff (and 9 individuals who were both volunteer and staff) on leave as a result of COVID-19.⁶¹²

⁶⁰⁷ Meeting with NSW State Emergency Service on 17 May 2022.

⁶⁰⁸ Meeting with NSW Police Broken Hill on 21 June 2022.

⁶⁰⁹ Ibid.

⁶¹⁰ Mullumbimby Town Hall on 6 June 2022, retrieved from <https://www.nsw.gov.au/sites/default/files/2022-07/Mullumbimby-community-meeting-transcript20220606.pdf>.

⁶¹¹ Workshop with Volunteer Associations on 1 June 2022.

⁶¹² NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 20 June 2022*.

It also appears that there was little planning for the effect COVID-19 would have on evacuation centres. The Lismore Citizen's Flood Review Group observed that "initially COVID was of little concern, but it quickly became a problem because of the very crowded situation with no COVID precautions being taken".⁶¹³ The Inquiry heard that:

*the Local Health District involvement at many evacuation centres was initially limited to the supply of RATs for COVID-19 testing. At Alstonville Evacuation Centre, this arrived on Wednesday 9th March (nine days after flood), after an outbreak had occurred at SCU evacuation centre.*⁶¹⁴

The community has learnt to live with the challenges of COVID-19 over the past 2 years. The issues of RAT testing at evacuation centres such as Alstonville should have been known and resolved more efficiently.

A new focus on planning and preparation is required

Despite preparation and planning being a feature of the NSW emergency management arrangements, the Inquiry found that many essential preparation and planning activities were underdone and under-resourced in the lead up to the 2022 flood events, especially by the SES.

Of course, the effectiveness of preparations varied across NSW depending on the location and scale of the flood, the nature of the local SES unit and local governance arrangements. In the Hawkesbury-Nepean, emergency management arrangements appeared to work better and be more effective, although the flood in the Valley was a much smaller event than in the Northern Rivers.

It is quite clear to the Inquiry that, in the Northern Rivers region, preparations were insufficient to address the systemic lack of planning, training, resourcing, equipment and community awareness that contributed, with a range of other factors, to the devastating impacts of the February and March floods. The SES simply lacked the capacity to coordinate a response to an event of this scale.

One of the key messages consistently heard by the Inquiry from other combat agencies such as RFS, FRNSW and NSW Police Force was the philosophy to 'go big and go early'. This philosophy is reflected in their preparation, and their early response to other disasters such as fire and search and rescue. This approach needs to be broadly adopted by all emergency management agencies in responding to a crisis, and particularly the SES.

At the time of writing, the east coast of NSW has just concluded a La Niña period – one of the key contributors to the extensive rainfall leading to the 2022 floods – but a further La Niña weather event may commence in spring 2022. It is critical that emergency services, all levels of government, the non-government sector and communities across the state work in partnership to address gaps in flood preparedness, prevention, response and recovery. Each agency, including the SES, must use its time away from active operations to future proof and modernise its resourcing, planning and response activities.

Readiness for future disasters – whether flood, bushfire or pandemic – requires continuous improvement across all agencies. The community's confidence in Government's ability to manage an emergency will grow through improved situational awareness and a commitment to interoperability at all levels of the arrangements. Government Ministers and Departmental Secretaries are integral to this process and will drive a whole of government approach to planning and preparation through exercising of the arrangements.

⁶¹³ Lismore Citizens Flood Review Group, submission to the Inquiry.

⁶¹⁴ Mr Wolfgang Smith, submission to the Inquiry.

I. Findings – emergency management planning and preparation

- The Inquiry found that NSW needs improved governance arrangements to drive a cohesive, whole of government approach to disaster preparedness, planning and emergency management.
- The Civil Contingencies Committee (COBRA) in the United Kingdom provides a great example of a high-level coordination and decision-making committee ready for activation in the event of major emergencies. The committee is a mixture of Ministers, officials and agency personnel from departments closely involved in emergency management. This structure seems to work well to boost, encourage and facilitate action.

11. Recommendation – Task Force Hawk

That, to ensure disaster readiness, Government establish a high-level Government standing committee, Task Force ‘Hawk’, comprising key Cabinet Ministers, Secretaries and Commissioners that meets, trains and exercises to ensure Government is prepared to respond to any emergency. Task Force ‘Hawk’ should resonate with the community in difficult times to ensure the highest level of confidence in Government’s response.

Further, to improve the preparation for and timely response to disasters, and to ensure the emergency management systems and plans are fit for purpose, effective and appropriate, within 12 months Government, via the SEOCN, ensure all emergency management processes and plans have been updated and implemented.

4.2. Resourcing of emergency management

This section examines resourcing of emergency management. In summary, local councils can and should be leveraged to improve planning for natural disasters. Particular attention should be given to improving the participation of Local Emergency Management Officers in Local Emergency Management Committees. Local Government has expressed a strong need for increased funding into mitigation of flood risks. The Inquiry agrees that improved investment in mitigation across all levels of government will save money spent in recovery.

The SES did not have sufficient flood rescue technicians or incident management personnel to adequately service those areas within high-risk catchments at the height of the emergency. Assistance was sought and offered by NSW and interstate agencies where shortcomings were identified. However, the timing and scale was reactive and should have adopted a ‘go hard, go early’ approach.

Unlike most other jurisdictions, NSW has an abundance of personnel and resources that can be engaged during an emergency response. However, the SES lacks the ability to engage, co-ordinate and deploy these assets in a planned and timely fashion. The RFS is better resourced with a bigger footprint across the state than the SES. Appropriate resourcing has seen it develop into a mature, professional volunteer combat agency with strong support systems able to lead large-scale, complex events and support its volunteer base through robust training and exercising arrangements.

How well is local government funded for emergency management?

As the level of government closest to community, local councils are well placed to facilitate community preparedness through engagement, resourcing, plan development and emergency risk management. Although local involvement in preparedness is critical, the Inquiry has heard “the roles of local government under the current NSW emergency arrangements are unclear, unfunded, and as a result, fail to integrate local context”.⁶¹⁵

Historically, the SES derived most of its funding from local councils, and councils continue to supply the SES with land and buildings for local units.⁶¹⁶ However, this supply arrangement has not guaranteed the ongoing improvement of the assets themselves to the standard required to keep the community safe.

In 2022 alone, 32% of east coast councils (approximately 90) have been affected by flooding. One third of councils in Victoria and Queensland also have been affected. Many councils operate with significant financial pressures and are required to undertake emergency management and flood mitigation activities without government grants.⁶¹⁷ The costs of response and recovery from natural disaster add to fiscal pressures.

It has been pointed out to the Inquiry that the 2020 Royal Commission into National Natural Disaster Arrangements found local governments require further resourcing to fulfill their emergency management obligations across all hazards.⁶¹⁸ Although local government is an active participant in local emergency management arrangements, additional work is required to integrate the needs and risks of local government into Emergency Management Plans.

Councils need improved resourcing to ensure they can fully participate in their respective LEMCs. The Inquiry heard that “while local government plays a critical grassroots role in emergency management, most Local Emergency Management Officers (LEMOs) are part time positions that require support”.⁶¹⁹ Often these are dual roles within council and picked up as secondary responsibilities because of resourcing constraints.

Under the Queensland model, full time disaster coordinators are employed by each council. An alternative approach is illustrated by the Sutherland Shire Council which operationalised a ‘LEMO Team’ through which multiple council staff members participate in local emergency management planning, preparation, response and recovery.⁶²⁰ This approach has been successful in improving council’s engagement in local emergency management arrangements.

Apart from the LEMO roles, an increasing number of council staff, including communications officers, facilities managers, community development staff, waste managers and civil works staff, are now undertaking essential roles in disaster preparedness, response and recovery.⁶²¹

Councils also provide flood information to the SES to improve flood intelligence and assist in the dissemination of warnings to communities. While the Bureau and SES work in partnership to warn the community about riverine flooding, local governments, in partnership with the state, are

⁶¹⁵ WSROC (Western Sydney Regional Organisation of Councils), submission to the Inquiry.

⁶¹⁶ Meeting with NSW SES (NSW State Emergency Service) on 17 May 2022.

⁶¹⁷ Linda Scott, President, Australian Local Government Association (2022). *Advice to the Inquiry provided 16 June 2022*.

⁶¹⁸ WSROC (Western Sydney Regional Organisation of Councils), submission to the Inquiry.

⁶¹⁹ Ibid.

⁶²⁰ Meeting with Sutherland Shire Council on 28 June 2022.

⁶²¹ WSROC (Western Sydney Regional Organisation of Councils), submission to the Inquiry.

responsible for flash flood warnings. Councils may operate flood gauges or warning systems to assist in this process.⁶²²

It is essential that planning for natural disasters incorporate an increased focus on mitigation and adaptation measures. The Local Government Association of NSW told the Inquiry that, while the severity and frequency of natural disasters is likely to increase, most funding is spent on recovery (97%) not preparation (3%).⁶²³

The Inquiry was pleased to see the National Recovery and Resilience Agency (NRRRA) announce an annual \$200 million mitigation fund. The contrast with the cost of recovery is stark: in the Northern Rivers alone, the cost of repairs to local road infrastructure following the 2022 floods is expected to exceed \$1 billion.⁶²⁴ The cumulative damage bill of this and future events will greatly exceed the capacity of local government to manage. Every dollar invested into mitigation across all levels of government saves money spent in recovery.

The Inquiry understands the NRRRA is currently developing the second *National Action Plan* under the National Disaster Risk Framework, and the Inquiry urges it to give appropriate attention to mitigation strategies.



Photo 4-1: Hytrans high-capacity pump in Lismore.

How are NSW emergency management agencies funded?

The NSW Government is responsible for funding emergency service agencies. This funding has never been tested against capability.

⁶²² NSW Government. (2021). NSW State Flood Plan. Retrieved from: <https://www.nsw.gov.au/sites/default/files/2022-01/NSW%20State%20Flood%20Plan.pdf>

⁶²³ LGNSW (Local Government NSW), submission to the Inquiry.

⁶²⁴ Ibid.

NSW emergency management agencies are primarily funded through the NSW Budget. These costs are partially offset by revenue contributions collected from insurers and local government under the *Emergency Services Levy Act 2017*. Emergency management agencies also receive some funding from grants and donations.

The table below provides an overview of the resourcing and funding of key emergency management agencies in 2021–22.⁶²⁵ The 2022–23 NSW Budget increased funding for all agencies listed below, but the SES's budget remains the smallest of the emergency management agencies.

Agency	Staff	Volunteers	2021-22 Budget	2022-23 Budget
SES	333	10,214 ⁶²⁶	Budgeted Expenses: \$193.1 million Revised Expenditure: \$178.3 million Budgeted Capital Expenditure: \$47.3 million Revised Capital Expenditure: \$22.3 million	Expenses: \$197.6 million Capital Expenditure: \$40.3 million
RFS	1,079	75,354	Budgeted Expenses: \$656.4 million Revised Expenditure: \$551.3 million Budgeted Capital Expenditure: 29.7 million Revised Capital Expenditure: \$22.3 million	Expenses: \$786.5 million Capital Expenditure: \$51.2 million
FRNSW	7,407	5,075	Budgeted Expenses: \$847.1 million Revised Expenditure: \$918.9 million Budgeted Capital Expenditure: \$82.6 million Revised Capital Expenditure: \$67.2 million	Expenses: \$862.0 million Capital Expenditure: \$105.6 million
NSW Ambulance	6,710	342	Budgeted Expenses: \$1,171.5 million Revised Expenditure: \$1,249.5 million Budgeted Capital Expenditure: \$458.5 million Revised Capital Expenditure: \$293.9 million	Expenses: \$1,423.2 million Capital Expenditure: \$296.2 million
Resilience NSW	245	N/A	Budgeted Expenses: \$777.4 million Revised Expenditure: \$1,034.7 million Budgeted Capital Expenditure: \$11.7 million Revised Capital Expenditure: \$1.7 million	Expenses: \$2,061.0 million Capital Expenditure: \$58.6 million

⁶²⁵ NSW Treasury. (2022). *Advice to the Inquiry provided 3 June 2022*.

⁶²⁶ The Inquiry has been told that the number of active volunteers is much lower than this.

VRA	1126		Resilience NSW provides grant funding to the VRA under a funding agreement, they provide Resilience with reporting regarding that agreement, however there is no oversight of VRA's entire recurrent/capital budget as they are a separate non-govt entity.	Resilience NSW provides grant funding to the VRA under a funding agreement: <ul style="list-style-type: none"> \$6 million
NSW Police Force	17,727	N/A	Budgeted Expenses: \$ 4,272 million Revised Expenditure: \$ 4,725.6 million Budgeted Capital Expenditure: \$389.4 million Revised Capital Expenditure: 235.3 million	Expenses: \$5,000.7 million Capital Expenditure: \$507 million

Table 4-1: 2021-22 Resourcing and funding for key NSW Emergency Management Agencies.

Were NSW emergency management agencies able to provide what was needed to manage the 2022 floods?

The SES was the combat agency (i.e. lead agency) responsible for overall management of the 2022 flood emergency. At the height of this emergency, it did not have sufficient flood rescue technicians or incident management personnel to adequately service all areas within the flooding footprint. One of its responsibilities was to call on, engage, coordinate and deploy assistance from other emergency management agencies to fill its own shortfall. While it did do this, much of it was too narrowly focused and too late. The timing and scale of its requests tended to be reactive to immediate emergencies, and not in anticipation of likely threats.

For example, FRNSW received its first request for assistance from the SES on 23 February, deploying an in-water flood rescue team and a Hytrans high capacity pump.⁶²⁷ The Inquiry heard that FRNSW scaled up its deployment throughout the event in support of the SES, with a peak daily deployment response of 242 operational field personnel in the Northern Rivers and Hawkesbury-Nepean.⁶²⁸

The Inquiry also heard that NSW Ambulance wasn't initially included within IMT arrangements, being told it wasn't required.⁶²⁹ In addition, liaison arrangements from the RFS were not requested for the Northern Rivers IMT until 28 February, 6 days after the flood emergency began.⁶³⁰ The Inquiry was told that the capabilities of Surf Life Saving NSW (SLSNSW) were also under-utilised.⁶³¹

NSW has an abundance of personnel and resources that can be engaged during an emergency response, namely staff and volunteers in emergency service agencies, other state and Australian government agencies and community groups that have been referred to throughout this report.

The SES's overall response fell short because it did not have the ability to engage, co-ordinate and deploy these assets in a planned and timely fashion. Overwhelmingly, the Inquiry was told by all other emergency service agencies and some community volunteers that the SES should have

⁶²⁷ FRNSW. (Fire and Rescue NSW). (2022). *Advice to the Inquiry provided 15 June 2022*.

⁶²⁸ Ibid.

⁶²⁹ Meeting with NSW Ambulance on 8 June 2022.

⁶³⁰ NSW RFS. (NSW Rural Fire Service). (2022). *Advice to the Inquiry provided 17 May 2022*.

⁶³¹ Meeting with Surf Lifesaving NSW on 13 July 2022.

followed those agencies' philosophy of 'go early and go big'. In other words, throw as many resources as possible at the disaster and if there is redundancy, that is a good outcome. The Inquiry agrees.

Box 4-1: Aviation rescue assets are vital in flood prone catchments

The RFS State Air Desk co-ordinated aviation support at the request of the SES, including aircraft with search and rescue capabilities. With the exception of an NSW Ambulance contracted helicopter (Westpac) at Lismore, there are limited aviation rescue assets in the flood prone Northern Rivers region. The RFS currently owns 6 helicopters equipped for bushfire and flood support, as well as search and rescue. These aircraft are available for use by all emergency services for winch insertion/extraction, aviation rescue, transport and surveillance. The aircraft are also fitted with state-of-the-art technology allowing agencies to view real time high-definition footage. This capability is regularly used by the SES during flood operations.

The NSW Government announced the regionalisation of the RFS helicopter fleet in November 2021, confirming aircraft would be based at Coffs Harbour, Dubbo and Tumut. The Inquiry noted concerns raised by the Northern NSW community about the availability of helicopters for use by the emergency services in the region, particularly given the high risk of bushfires and flooding.

The placement of additional aviation assets in the Northern Rivers region would allow the aircraft to provide multi-agency, multi-hazard support year-round. This capability could also be used for rapid deployment of flood rescue personnel from FRNSW and the NSW Police Force, as well as rescue equipment for the SES.



Photo 4-2: RFS Helicopter at Wisemans Ferry. Source: NSW RFS Twitter.

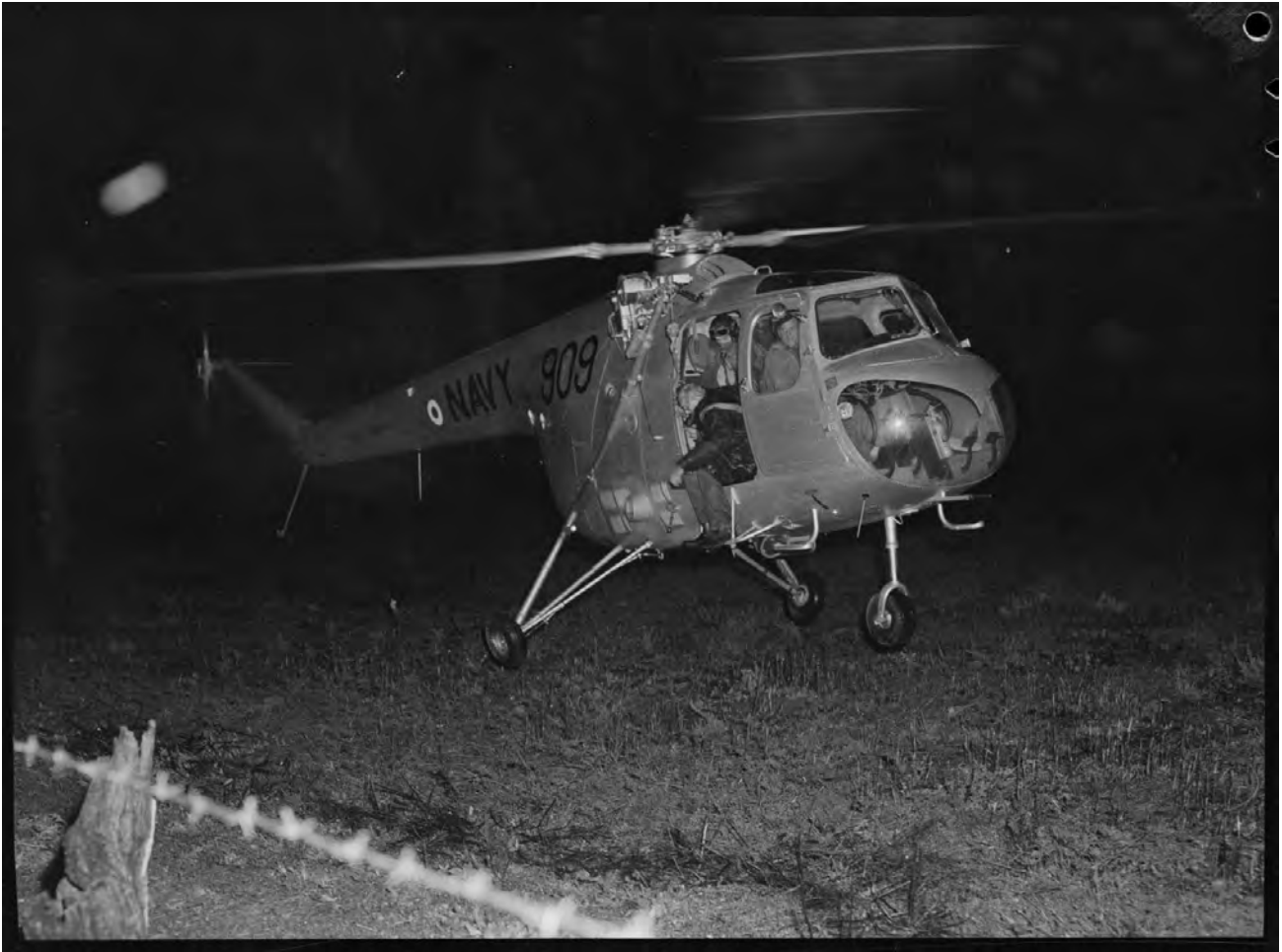


Photo 4-3: Navy Helicopter during the 1955 Warren Floods. Source: NSW State Library.

SES resourcing in focus

The SES is a volunteer-based organisation with a small component of salaried staff.

Across the State, the SES has 10,000 volunteers (although active membership is believed to be much lower) supported by approximately 327 salaried staff, though only 27 of the salaried staff are full time operational. There are 259 units located across 5 zones.⁶³²

Zone	HQ Location	Staff (includes permanent and full time)	Volunteers
State Headquarters	Wollongong	207	N/A
Metro	Rhodes	23	4,034
Northern	Metford	26	2,460
Western	Dubbo	18	1,438
Southern	Wagga Wagga	14	755
South-Eastern	Goulburn	15	1,094

Table 4-2: SES zones, staff and volunteers.

Over the past 5 years, the number of full time staff has fluctuated in response to restructures and budget constraints, but its volunteer base has steadily increased. There is some conjecture,

⁶³² NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 11 May 2022*.

however, about the number of active volunteers, with the Inquiry hearing from a number of sources that the number of active SES volunteers is inflated. The SES advised the Inquiry that, since the 2022 flood events, it has received more than 4,300 new volunteer applications.

Year	Full time equivalent salaried staff	Volunteers	Recurrent expenses	Capital expenses
2016–17	325 ⁶³³	8,235	\$109.3 million	\$36.8 million
2017–18	325 ⁶³⁴	9,110	\$106.433 million	\$2.303 million
2018/19	352 ⁶³⁵	9,493	\$100.814 million	\$24.312 million
2019–20	328 ⁶³⁶	10,260	\$100.936 million	\$15.916 million
2020–21	333 ⁶³⁷	10,214	\$158.8 million	\$42.7 million
2021–22	333 ⁶³⁸	10,214	\$193.1 million	\$47.3 million
2022–23	TBC	TBC	\$197.6 million	\$40.3 million

Table 4-3: SES resourcing and funding from 2016-23.

In the latest NSW Government budget (2022–23), the SES received an additional \$132.7 million to boost its capability through investing in infrastructure, resources, and staffing.⁶³⁹ In particular, the \$132.7 million includes:

- \$58.7 million to upgrade 18 critical-priority unit facilities across the State
- \$43 million to split the existing Northern Zone into 2 new zones, and split the existing Western Zone into 2 new zones
- \$11.7 million to establish Zone Headquarters in the 2 new zones with Level 3 Incident Control Centre capabilities
- \$18 million to upgrade existing Zone Headquarters to Level 3 Incident Control Centres
- \$1.3 million to develop a Facility Strategy and complete further detailed business cases to address the remainder of the recommendations from the 2021 independent review.⁶⁴⁰

While the Inquiry has focused on the overall performance of the SES, particularly fulltime staff, it is important to reflect on what the SES is funded to achieve. In comparison with the RFS and other combat agencies, the SES profiles as a part-time, funded agency with a small, but active volunteer base. Under its current structure and funding base, it does not have the ability to command and control a response to a large-scale weather event or long campaign.

⁶³³ NSW SES (NSW State Emergency Service). (2017). NSW SES Annual Report 2016-2017. Retrieved from <https://www.ses.nsw.gov.au/about-us/publications-and-reports/>.

⁶³⁴ NSW SES (NSW State Emergency Service). (2018). NSW SES Annual Report 2017-2018. Retrieved from <https://www.ses.nsw.gov.au/about-us/publications-and-reports/>.

⁶³⁵ NSW SES (NSW State Emergency Service). (2019). NSW SES Annual Report 2018-2019. Retrieved from <https://www.ses.nsw.gov.au/about-us/publications-and-reports/>.

⁶³⁶ NSW SES (NSW State Emergency Service). (2020). NSW SES Annual Report 2019-2020. Retrieved from <https://www.ses.nsw.gov.au/about-us/publications-and-reports/>.

⁶³⁷ NSW SES (NSW State Emergency Service). (2021). NSW SES Annual Report 2020-2021. Retrieved from <https://www.ses.nsw.gov.au/about-us/publications-and-reports/>.

⁶³⁸ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 26 May 2022*.

⁶³⁹ The Premier, Deputy Premier, Treasurer, Minister for Emergency Services and Resilience (2022). \$132 million record investment to future-proof the NSW SES Media release. Retrieved from <https://www.nsw.gov.au/media-releases/132-million-record-investment-to-future-proof-nsw-ses#:~:text=The%20NSW%20Government%20is%20making,priority%20Unit%20facilities%20across%20NSW.>

⁶⁴⁰ Ibid.

The Inquiry has seen the value of the SES, its proud history and the need for the agency to strengthen its operational skills and capability. However, additional funding needs to be in conjunction with an increase in operational capability (training, systems and personnel) for the SES to improve its response to flood events. The Inquiry has identified the opportunity for the NSW Government to leverage the 20-year development of the RFS to greatly improve the operational response of the SES.

The RFS receives almost 4 times the funding of the SES, has 5 times as many staff and has immeasurably more volunteers at its disposal. Its corporate services have matured to match the larger fulltime combat agencies, such as NSW Police Force and FRNSW. The Inquiry notes that there is great value in harnessing the strength of the RFS in the areas of training, capital investment, intelligence, planning and preparation and communication to supercharge the SES's operational capability before the next storm season. This would see a significant improvement in the number of SES volunteers who are 'event ready', while also expediting the maturity of the SES's corporate systems, including Beacon.

Comparison of SES with the RFS

The RFS is also a volunteer-based organisation supported by salaried staff. Across the State, the RFS has over 78,000 volunteers supported by approximately 1,070 salaried staff. There are 1,993 Rural Fire Brigades located across 44 Districts that report to 7 area commands.⁶⁴¹

Area Command	Total Districts	Staff (includes permanent and full time)	Volunteers
Greater Sydney	9	190	15,485
Hunter	5	133	9,550
North Eastern	6	108	7,484
North Western	5	82	7,685
South Eastern	7	126	12,916
South Western	6	75	10,946
Western	6	119	15,590

Table 4-4: RFS area command, districts, staff and volunteers.⁶⁴²

Over the past 5 years, the number of full-time staff and volunteers has increased, particularly since the 2019–20 bushfire season.

Year	Full time equivalent salaried staff	Volunteers	Recurrent expenses	Capital expenses
2016/17	878	73,223	\$693.2 million	\$47 million
2017/18	911	72,491	\$709.6 million	\$52 million
2018/19	936	71,234	\$729 million	\$74.9 million
2019/20	998	76,319	\$774.3 million	\$51.9 million
2020/21	1079	75,354	\$672.5 million	\$29.2 million
2021/22	1155	75,354	\$656.4 million	\$29.7 million
2022/23	TBC	TBC	\$786.5 million	\$51.2 million

Table 4-5: RFS resourcing and funding from 2016-23.⁶⁴³

⁶⁴¹ NSW RFS (NSW Rural Fire Service). (2022). *Advice to the Inquiry provided 17 May 2022*.

⁶⁴² Ibid.

⁶⁴³ NSW Treasury. (2022). NSW Budget Papers: 2016 to 2023. Retrieved from <https://www.budget.nsw.gov.au/budget-papers>.

The original RFS budget for 2019–20 was \$524.3 million. The 2019–20 summer bushfires led to a significantly higher Natural Disaster Response and Recovery expenditure, with a significant portion within the RFS. Compared with the 2019–20 budget, the RFS budget has increased by \$148.2 million in 2020–21.⁶⁴⁴

In the latest budget (2022–23), the RFS received:

- \$191 million in response to the NSW Bushfire Inquiry, including:
 - \$105.6 million to replace or retrofit fire trucks
 - \$75.4 million to expand the number of mitigation crews
 - \$10 million to enhance strategic fire trails
- \$56.5 million to construct 6 new fire control centres.⁶⁴⁵

It is clear that the RFS is much better resourced than the SES and has a much bigger footprint across the state.



Photo 4-4: SES and RFS personnel. Source: NSW RFS, advice to the Inquiry.

Appropriate resourcing leads to a mature combat agency

The Inquiry often heard the adage that the ‘SES was the poor cousin of the RFS’. The above section shows a clear difference in funding arrangements between the 2 volunteer agencies. During this Inquiry, comparisons between the RFS and the SES were often made as both are volunteer organisations with strong histories and full time capabilities.

⁶⁴⁴ Ibid.

⁶⁴⁵ NSW Government (2022). NSW Budget 2022-2023 Media Release, 21 June. Retrieved from <https://www.nsw.gov.au/media-releases/record-investment-emergency-services#:~:text=%2456.5%20million%20for%20the%20RFS%20to%20construct%20six,gender-separation%20provisions%2C%20equipment-cleaning%20facilities%20and%20contamination%20management%3B%20and>.

The RFS, through 3 Commissioners, successive disasters, inquiries, government funding and strong organisational leadership, has developed into a mature, professional volunteer combat agency with strong support systems that enable it to lead a large scale, complex event and support its volunteer base through robust training and exercising arrangements.

The RFS takes an all-hazards, all-agency approach to any emergency. As an incident gets bigger, RFS's remit becomes smaller and more focussed on fighting the fires. For example, many local emergency committees told the Inquiry that, during a fire incident, the RFS often tasks the NSW Police Force to perform evacuations to free up RFS resources to fight the fire. Its mode is "whoever is closest and able to do it – doesn't matter what badge you send – to stop it getting out of hand".⁶⁴⁶

This organisational maturity is also reflected in the RFS's volunteer retention and training and exercising philosophy. RFS Commissioner Rob Rogers told the Inquiry that volunteers must be kept busy and have a purpose to be kept interested.⁶⁴⁷ RFS often has big campaign events, and a fire season that can last 8 months. Day to day, the RFS uses dozens of incidents to test and exercise its training arrangements, including preparation for upcoming fire seasons with hazard reduction burns.⁶⁴⁸

Surf Life Saving NSW is another volunteer organisation that successfully retains its volunteers. From an early age through 'nippers', surf lifesaving clubs foster a culture of volunteerism, surf rescue, safety and community leadership. The competitive, sporting element is a further attraction, and Surf Lifesaving NSW retains approximately 21,000 frontline volunteers.⁶⁴⁹

Rosters and ongoing work for volunteers are also important to keep volunteers engaged with a sense of purpose.⁶⁵⁰

Conversely, SES activity is often sporadic, and the Inquiry identified resentment from local units about SES's head office being located in Wollongong. As identified in this and the previous chapter, SES's organisational immaturity and failings were displayed through its response to the 2022 flood events.

Volunteers told the Inquiry that, as the complexity of the 2022 events grew, communication with the upper echelons of the SES reduced. Local units stated that they often felt abandoned by head office and ill-supported during the events, but also criticised the limited contact they had with head office before events in respect of preparation and planning, and community engagement activities.

The Inquiry observed a notable difference between the SES and the RFS in their approaches to recruiting, retaining, training and exercising.

4.3. Training

This section examines the training for flood rescue. In summary, the 2022 flood season demonstrated the need for exponential growth in the number of trained flood rescue personnel. Only 6% of the SES volunteer base is accredited to perform either In Water and/or On Water flood rescues.

Training timeframes within the SES have been affected by the dilution of regionally based training and a lack of training facilitators. The RFS has greater capacity to facilitate training for new

⁶⁴⁶ Meeting with NSW RFS (NSW Rural Fire Service) on 16 May 2022.

⁶⁴⁷ Ibid.

⁶⁴⁸ Ibid.

⁶⁴⁹ Meeting with Surf Lifesaving NSW on 13 July 2022.

⁶⁵⁰ Meeting with NSW RFS (NSW Rural Fire Service) on 16 May 2022; Meeting with Surf Life Saving NSW on 13 July 2022.

volunteers and is much faster in training its volunteers to be 'truck ready'. Merging the backend functions of the RFS and SES would result in improved timeliness of core training elements and additional facilitators able to train SES volunteers.

The SES need to review its recruitment and retention plan to ensure new members are not lost because of unrealistic training and attendance criteria. There is a fundamental need for the SES to improve its volunteer management systems to better understand operational capability and develop more targeted recruitment and training programs to address gaps in skills.

Training time for volunteers to be event-ready

All SES members and volunteers are trained in Flood Rescue Awareness within 3 to 6 months of joining the service. Once they have completed foundational training, members can choose which additional training pathways to pursue. The options may depend to a degree on the focus of their local unit. Training pathways include Flood Rescue, Storm, Land Rescue, Land Search and Support.

On average it can take 3 to 6 months depending on the SES unit to get volunteers 'truck ready', i.e. ready to deploy for a storm event.⁶⁵¹ During that time, SES volunteers will undertake about 6 courses including hazard identification, safety, storm related roles and Beacon, and may participate in rescue operations and some nationally accredited training competencies.⁶⁵² If a prospective volunteer's application is successful, they are a probationary member for a minimum of 3 months.⁶⁵³

In contrast, a basic fire fighter course for the RFS is undertaken over 2 weekends, with theory on one weekend and practical/assessment on the other. This allows the volunteer to be on the truck with an understanding of basic safety and fire behaviour principles quite quickly.⁶⁵⁴ More information about the training journey is provided below.

Comparing training pathways

At a fundamental level, volunteer training outcomes for both the SES and the RFS are similar. In both pathways, volunteers undertake workplace safety, operational and organisational training courses. Both will undertake introductory training into hazard management, covering the core accountabilities of each combat agency. Both agencies are Registered Training Organisations and require national units of competency to be completed prior to being 'on truck' ready.

Where the 2 agencies' training diverges is in the level of sophistication for hazard-based training at a foundation level. Figure 4-1 indicates that incoming SES volunteers receive competency across a range of unit functions.

⁶⁵¹ Meeting with NSW SES (NSW State Emergency Service) on 17 May 2022.

⁶⁵² Ibid.

⁶⁵³ NSW SES (NSW State Emergency Service). (2022). What NSW SES Volunteers Do. Retrieved from <https://www.ses.nsw.gov.au/get-involved/volunteer/unit-volunteers/#:~:text=If%20your%20application%20for%20membership,accepted%20as%20a%20Unit%20Member>.

⁶⁵⁴ Meeting with NSW RFS (NSW Rural Fire Service) on 16 May 2022.

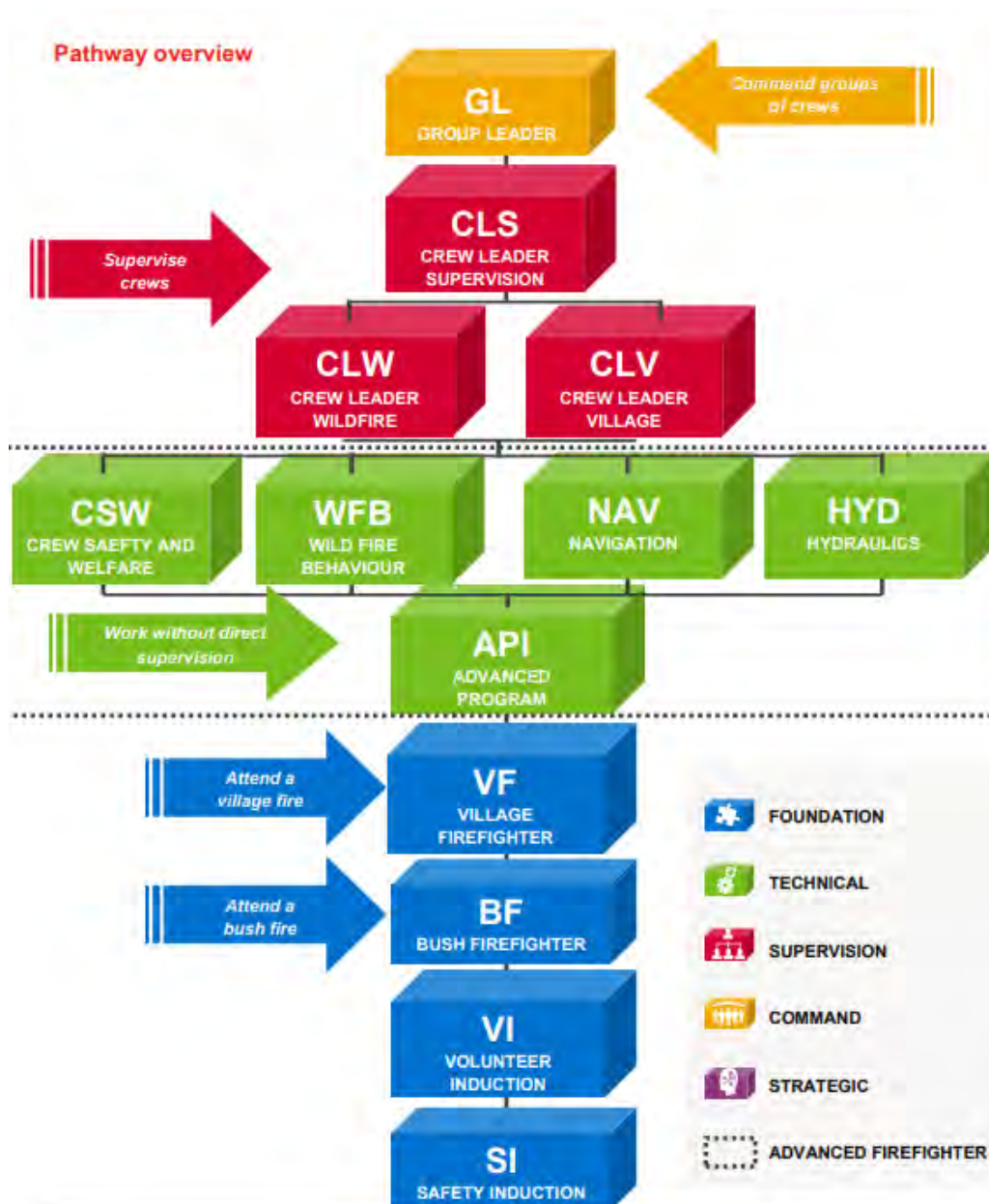


Figure 4-2: RFS training pathway.⁶⁵⁷

It is clear to the Inquiry that the RFS has better capacity to facilitate training for new volunteers, which is delivered through a series of online, brigade and district resources. The SES on the other hand delivers most of its foundational training through local units, with rescue training facilitated through zones or specialist trainers.⁶⁵⁸ Training timeframes within the SES have also been affected by the dilution of regionally based training and a lack of training facilitators.⁶⁵⁹ SES training courses may also be delivered by external training providers including partner agencies such as Resilience NSW and the RFS or commercial vendors.⁶⁶⁰ The SES needs to review its recruitment and retention plan to ensure new members are not lost because of unrealistic training and attendance criteria.

⁶⁵⁷ NSW RFS (NSW Rural Fire Service). (2022). Training Information Booklet. Retrieved from: https://www.rfs.nsw.gov.au/_data/assets/pdf_file/0013/71401/Training-Information-Booklet.pdf

⁶⁵⁸ Meeting with the NSW State Emergency Service on 17 May 2022.

⁶⁵⁹ Ibid.

⁶⁶⁰ Ibid.

Emergency Service	Training	Timeframe
SES ^{661,662}	<p>Foundational training to be 'on truck' ready includes: First Aid Operate Communications Equipment Beacon Familiarisation Introduction to AIIMS Field Core Skills Job Ready Induction and Workshop Flood Rescue Awareness.</p> <p>Further technical training pathways are available for storm, flood rescue, land rescue, land search and support once foundational training is completed.</p>	3 to 6 months dependent on the unit conducting the training.
RFS ^{663,664,665}	<p>Foundational training to be 'on truck' ready includes: safety induction (WHS, Risk Management, Hazards, Health and Safety Incidents) volunteer induction (RFS Structure, brigade information, expectations and responsibilities, health and wellbeing, local familiarisation) Bush Firefighter (Firefighter safety principles, Basic principles of fire, First attack firefighting, Bush fire behaviour factors, Bush fire development, Examples of bush fires, Hazards and precautions, Hand tools, knapsacks, ropes and ladders, Hoses and small gear, Water supply and equipment, Bush firefighting techniques, Bush fire hazard reduction, Bush firefighting teamwork and Radio communications)</p>	Can be completed in approximately 2 weekends.

Table 4-6: Time it takes to be trained operator in SES and RFS.

As the Inquiry has already identified, the SES could make significant leaps in operational readiness ahead of the next flood season by entering into a shared corporate functions agreement with the SES. An alignment of foundational training products, where appropriate, is one area in which the SES should explore stronger integration with the RFS. A merging of the backend functions of the RFS and SES has the potential to result in improved timeliness of core training elements and result in additional facilitators through which the SES volunteers can receive training.

Flood rescue training and accreditation

To attain accreditation as a Flood Rescue Operator, SES members must successfully complete both a swim and fitness test. They are required to complete physical accreditation at least every 3 years in addition to ongoing training and attainment of specified competencies.⁶⁶⁶ All SES members involved in flood rescue are trained to a minimum of flood rescue awareness, which provides a basic understanding of generic flood water hazards, risks when working near flood water and how to assist those in need without entering flood waters. However, flood rescue awareness is not an accreditation.

⁶⁶¹ Ibid.

⁶⁶² NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 18 May 2022*.

⁶⁶³ Meeting with the NSW RFS (NSW Rural Fire Service) on 16 May 2022.

⁶⁶⁴ NSW RFS (NSW Rural Fire Service). (2022). Training Information Booklet. Retrieved from: https://www.rfs.nsw.gov.au/_data/assets/pdf_file/0013/71401/Training-Information-Booklet.pdf.

⁶⁶⁵ NSW RFS (NSW Rural Fire Service). (2019). Service Standard 6.1.3 – Training in the NSW Rural Fire Service. Retrieved from [6.1.3-Training-in-the-NSW-RFS.pdf](#).

⁶⁶⁶ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 26 May 2022*.

In line with the *NSW State Rescue Policy* only accredited SES Units perform flood rescue, where training and equipment is suitable, and a risk assessment has indicated that the risk to rescuers is acceptable. To be accredited a SES Unit must have successfully met accreditation requirements specified in the *NSW State Rescue Policy*, including:

- satisfactorily equipped facility/ies.
- evidence of qualified Flood Rescue operators relevant to the accreditation requested (personnel) to staff the Unit and operate in the field
- evidence of suitable flood rescue vessel/vehicle/s
- evidence that equipment is sufficient and appropriate to the types of rescues for which the unit is to be accredited
- confirmation that agency operating procedures, including activation protocols are in place in support of flood rescue.

SES priorities and budget constraints determine which courses are offered and/or developed. Swift water rescue training is conducted at Penrith and members need to travel to Sydney from regional areas to attend the training. The Inquiry heard that some SES members reported having difficulty booking into training courses.⁶⁶⁷

*There were not enough courses scheduled and run at Penrith Whitewater Stadium or Manly Hydraulic to meet the burden of recertification and attrition of members (new operators trained to fill gaps).*⁶⁶⁸

SES training for flood rescue

Under the *NSW State Flood Plan*, the SES performs flood rescue in situations where there is suitable training and equipment and a risk assessment has indicated that the risk to rescuers is acceptable. Flood rescue operations will be conducted in accordance with the State Rescue Board *Land Rescue Policy* and the *NSW State Rescue Board Flood Policy*.

The *NSW State Rescue Policy* defines Flood Rescue as:

*all rescue activities in a relatively high-water level which overtops the natural or artificial banks of any part of a stream, river, estuary, or dam, and/or local overland flooding associated with drainage before entering a water course, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline deficiencies.*⁶⁶⁹

The policy sets out 5 levels of flood rescue.⁶⁷⁰ Each level has differing levels of responsibility, training competencies and qualifications and minimum equipment lists:

- **Flood Rescue Awareness** – ‘a basic understanding and awareness of generic flood water hazards and associated risks and simple actions which can be taken to assist the victim without entering flood waters’.⁶⁷¹ SES training but no accreditation required
- **Land Based Flood Rescue** – ‘undertaken from the shore, including reaching to the victim with a ladder or throwing a connected object such as a rope or portable flotation device’.⁶⁷² SES training but no accreditation required, provides support to On Water and In Water Flood Rescue operations

⁶⁶⁷ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 26 May 2022*.

⁶⁶⁸ NSW SES VA (NSW State Emergency Service Volunteers Association), submission to the Inquiry.

⁶⁶⁹ NSW Government (2021). *NSW State Rescue Policy, Version 4.1*. 5 July. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-rescue-policy.pdf>.

⁶⁷⁰ Ibid.

⁶⁷¹ Ibid.

⁶⁷² Ibid.

- **On Water** – ‘involves reaching the victim by powered vessel where there is a low likelihood of the operator entering the water’.⁶⁷³ Accreditation required.
- **In Water** (includes swift water rescue) - involves ‘the operator entering the flood waters to reach the person by swimming or using a raft or unpowered vessel to reach the victim’.⁶⁷⁴ Accreditation required.
- **Over Water** - professional helicopter crews ‘rescue person/s from flood water ... at the direction of the NSW Police Force Radio Operations Group Rescue Coordinator (ROG RCO) or SES Incident Controller’.⁶⁷⁵

Rescue units are defined as a unit (comprising a group of persons) which carries out rescue operations.⁶⁷⁶ A rescue unit comprises four elements:

- *Registered Crew – competent and current rescue operators*
- *Rescue Vehicle/Vessel – an appropriate and clearly marked rescue vehicle/vessel*
- *Rescue Equipment – sufficient and appropriate to the tasks for which the unit has been accredited*
- *Operating Procedures – procedures for call-out, response, operation and training.*⁶⁷⁷

Flood Rescue Units are endorsed by the Minister “as meeting current State Rescue Board accreditation standards for In Water and/or On Water Flood Rescue”.⁶⁷⁸ They are considered “the most appropriate flood rescue resource to carry out In Water or On Water Flood Rescue (in accordance with their accreditation)”.⁶⁷⁹ Flood Rescue Units must:

- have suitable flood rescue vessel/vehicle/s including access to a powered vessel or inflatable raft⁶⁸⁰
- be equipped to a standard to facilitate all aspects of flood rescue and have satisfactorily equipped facility/ies and evidence that equipment is sufficient and appropriate to the types of rescues for which the unit is to be accredited
- have evidence of qualified Flood Rescue operators relevant to the accreditation requested (personnel) to staff the Unit and operate in the field, and have available a minimum of 2 trained operators at all times⁶⁸¹
- provide confirmation that agency operating procedures, including activation protocols are in place in support of flood rescue.

Not all SES members are qualified to perform all levels of Flood Rescue and this affects the SES’s resourcing and ability to respond to requests for flood rescue. The SES had 265 units in total as at 30 June 2021,⁶⁸² including:

- 74 accredited Flood Rescue (In Water) Units (i.e. units that can perform flood rescues by entering flood waters to reach the person by swimming or using a raft or unpowered vessel to reach the victim)

⁶⁷³ Ibid.

⁶⁷⁴ Ibid.

⁶⁷⁵ Ibid.

⁶⁷⁶ *State Emergency and Rescue Management Act 1989*. s 52.

⁶⁷⁷ NSW Government (2021). NSW State Rescue Policy, Version 4.1. 5 July. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-rescue-policy.pdf>.

⁶⁷⁸ Ibid.

⁶⁷⁹ Ibid.

⁶⁸⁰ Ibid.

⁶⁸¹ Ibid.

⁶⁸² NSW SES (NSW State Emergency Service). (2021). NSW SES Annual Report 2020-2021. Retrieved from <https://www.ses.nsw.gov.au/about-us/publications-and-reports/>.

- 96 accredited Flood Rescue (On Water) Units (i.e. units that can perform flood rescues by reaching the victim by powered vessel where there is a low likelihood of the operator entering the water).⁶⁸³

Of the SES's approximately 10,000 volunteer members (with the active number of volunteers understood to be much lower), based on advice received, the Inquiry estimates that only 215 members are accredited In Water Operators and 426 members are On Water Operators – that's around 6% of the SES's volunteer base. The table below represents the number of SES members who have completed training related to flood rescue per year.

	FY18–19	FY19–20	FY20–21	FY21–22
Flood Rescue Awareness	790	1355	868	910 ⁶⁸⁴
Land Based Flood Rescue Course	183	95	181	35 (as of 18 May 2022)
Flood boat Course	86	41	136	74
In Water Flood Rescue Course	49	49	41	23 (plus 18 to be trained in June 2022)

Table 4-7: SES members trained in flood rescue.

The Inquiry also heard concerns that training of volunteers for Incident Management Teams is limited in the Northern Zone, creating significant gaps in operational knowledge and capability. This demonstrates a fundamental need for the SES to improve its volunteer management systems to better understand operational capability and develop more targeted recruitment and training programs to address gaps in skills. The NSW SES Volunteers Association submission expressed frustration that volunteers lacked training. It suggested that multi-agency desktop exercises be run bi-annually and in real time with real challenges. The submission states that “failures in training and recertifications in recent years led to a shortage of operators”.⁶⁸⁵ This was demonstrated at the Coraki SES Unit, where the Inquiry heard that only 3 of its members were accredited flood boat operators and, despite the significant flood risk, there is no swift water rescue capability.⁶⁸⁶

Overall, the 2022 flood season demonstrated the need for more trained rescue personnel in the SES.

⁶⁸³ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 26 May 2022*.

⁶⁸⁴ All SES members involved in flood rescue are required to have completed flood rescue awareness training. However, this is not an accreditation and does not enable a volunteer to conduct flood rescues.

⁶⁸⁵ NSW SES Volunteers Association, submission to the Inquiry.

⁶⁸⁶ Meeting with Coraki NSW SES Unit on 1 May 2022.



Photo 4-5: SES Personnel undertake flood rescue training in 2019. Source: NSW SES Website.

Other agencies training for flood rescue

Training for all hazards across all agencies is essential to improve community safety and confidence in the emergency response. It was made clear to the Inquiry that the SES response was supplemented by a substantial deployment of flood rescue operators from other agencies. The failure to mobilise that capability in a timely and co-ordinated way is a concern for the combat agency and government. Ultimately, the community does not care what colour the uniform is or what patch is on a shoulder in an emergency.

The RFS and FRNSW have developed on land, in water and swift water rescue capabilities. This capability is primarily designed to support the SES as the flood combat agency with in-water flood rescue technicians and associated equipment. However, the NSW Police Force has responsibility for swift water rescue when an area of operation has not been determined by the SES.

The RFS commenced developing its flood rescue capability in 2001, particularly for flood prone regions within a limited emergency service presence. Despite ongoing training to develop a sophisticated flood rescue capability, the greatest contribution the RFS makes in flood events is through its aviation rescue capability.



Photo 4-6: FRNSW flood rescue operators. Source: FRNSW advice to the Inquiry.

FRNSW has approximately 150 in-water flood rescue operators who staff 5 flood rescue stations and deploy with surge capacity resources when needed. A total of 670 firefighters are trained in land-based flood rescue. When FRNSW responds to an in-water flood rescue, it will deploy a minimum of 2 firefighters qualified for land-based flood rescue and 2 firefighters qualified for in-water flood rescue. When deploying to large scale flood events, FRNSW provides self-sufficient strike teams with their own command structure, transport and equipment.⁶⁸⁷

While the RFS and FRNSW have a notable role in supporting the SES as the lead combat agency for floods, the Inquiry heard that the flood rescue capability of the SES itself is significantly constrained. As mentioned earlier in this chapter, submissions to the Inquiry expressed concern at the lack of flood rescue training and recertification of flood rescue operators.⁶⁸⁸ This includes the ongoing professional development of volunteers to gain advanced skills in flood rescues, such as working around electricity.

⁶⁸⁷ FRNSW (Fire and Rescue NSW). (2022). *Advice to the Inquiry provided 3 June 2022*.

⁶⁸⁸ NSW State Emergency Service Volunteers Association, submission to the Inquiry.



Photo 4-7: Flood rescue by FRNSW team Alpha 1 in Ballina. Source: FRNSW advice to the Inquiry.

The Inquiry was informed that in smaller towns without SES or FRNSW units, emergency RFS volunteers will step in and perform rescues when there is a flood, even though they are untrained in this form of rescue. This could endanger the volunteers' safety, so the RFS is looking to expand its training to include flood rescue to manage this risk, and has strong support from its volunteers to do so.⁶⁸⁹

Box 4-2: FRNSW surge capacity is critical for supporting communities in metropolitan high-risk catchments

The SES is critically reliant on the surge capacity of other emergency services during state-wide flood events. For the 2022 floods, it was clear that FRNSW was the first point of contact for surge capacity, with 3,390 operational personnel deployed to assist the SES during the 2022 NSW floods, and 150 officers trained as in-water flood rescue.⁶⁹⁰

This is supported by 670 firefighters trained in land-based flood rescue operations. FRNSW personnel are also professional, full time officers, with training and capability across a range of hazards.⁶⁹¹ FRNSW maintains 5 State Rescue Board accredited in-water flood rescue stations and 8 additional in-water caches of equipment to support surge capacity.⁶⁹²

The Inquiry supports ongoing investment in developing the in-water flood rescue capability of FRNSW, expanding the number of flood rescue stations and in-water resource caches. The focus should be predominately on metropolitan, high-risk catchments, where FRNSW already has a significant presence in the community. This investment will support the SES and provide added surge capacity during complex flood events.

⁶⁸⁹ Meeting with the NSW RFS (NSW Rural Fire Service) on 16 May 2022.

⁶⁹⁰ FRNSW (Fire and Rescue NSW). (2022). *Advice to the Inquiry provided 3 June 2022*.

⁶⁹¹ Ibid.

⁶⁹² Ibid.

The Inquiry suggests that the VRA's training model be considered. The VRA approached the RFS a decade ago to seek greater alignment between the training of both agencies. The VRA now uses the RFS's Registered Training Organisation for its own training, resulting in not only improved and more consistent training standards, but cost savings as well.⁶⁹³ The VRA's integration of training with the RFS is a successful example of merged backend functions. The SES would find significant value in aligning its backend functions with the RFS in a similar way to the VRA. This would also deepen the all-hazards and all-agency approach to emergency response.

J. Findings – flood training and accreditation

- The SES is a volunteer-based organisation made up of approximately 300 salaried staff, with only 27 of these staff in full-time operational roles. At best, it has limited capacity, operational command and training facilities or organisational capability to plan, prepare and respond to large scale disasters and emergencies.
- The \$132.7 million given to the SES in the 2022–23 budget is a welcome first step to boost its capability and improve operational performance.
- There are existing models of shared services for volunteer agencies that have enhanced operational performance through improved training and exercising. For example, the Rural Fire Service (RFS) is the current registered training organisation (RTO) for the Volunteer Rescue Association (VRA). Fire and Rescue NSW (FRNSW) is responsible for the receipt of fire and emergency calls and related information for RFS via the Triple Zero (000) network. There has been no loss of agency identity or mandate under these shared service arrangements.
- The maturity of the RFS as an emergency management agency has evolved in large part through its response to previous findings of Coronial Inquests, Royal Commissions and other inquiries. The RFS now has a mature, all hazards approach to emergency management, is a professionalised volunteer agency with over 79,000 volunteer members, and has a highly capable corporate support function with a strong ethos around training and exercising. Merging RFS and SES corporate services provides an opportunity to professionalise the SES and improve operational performance through enhanced training and exercising capability.
- If this recommendation is implemented, corporate services functions could be partly run out of Wollongong, the existing SES headquarters, with SES operational functions run out of the current Homebush site that houses RFS, SEOCAN and Resilience NSW. This will consolidate many of the volunteer agencies in a single operational location for the proposed Task Force 'Hawk' (Recommendation 11).

⁶⁹³ VRA (Volunteer Rescue Association). (2022). *Advice to the Inquiry provided 30 June 2022*.

12. Recommendation – SES and RFS back-office merger

That, to help protect life and property across NSW in storm and flood events, and to improve resourcing and NSW State Emergency Service (SES) frontline capability, Government implement, before the next storm season, a merger of the SES and NSW Rural Fire Services (RFS) back-office and corporate service functions, while maintaining their separate legislative identity, brand, uniform and volunteer membership. This ‘joined-up’ RFS/SES corporate support structure would be under the command of the RFS given its corporate and operational maturity and would be responsible for:

- placing risk at the centre of all decision making and planning for catastrophic disasters
- establishing a dedicated intelligence unit that synthesises the wealth of intelligence available to inform critical decision making, particularly for flash flooding
- establishing a planning unit to help better prepare communities, NSW combat and other agencies, and local governments about upcoming flood and storm seasons
- establishing a fulltime SES position for each high-risk catchment to ensure flood identification, response assets and supporting infrastructure is serviced, operational and ready to deploy
- designing and implementing a workforce plan to identify any capacity and capability gaps in frontline emergency staff, now and into the future
- improving the hiring standards of frontline full-time staff in operational decision-making positions
- improving the support, training and retention of both frontline staff and volunteers
- improving media protocols and identifying a designated media spokesperson during a disaster

The newly merged model should be reviewed in 12 months’ time by the SEMC.

4.4. Empowering the community to be prepared for floods

The Inquiry found that members of the community plan for floods in accordance with their own lived experience, and more broadly to collective memory. They plan for what they know has happened in the past, rather than what is the worst that could happen.

This was seen in the Northern Rivers, especially in Lismore, where some businesses and people did prepare for the serious flood they thought was coming, but not the one that came which was much bigger than anyone expected. The scale and complexity of this 2022 flood event exceeded the expectations of even the most experienced of locals who were well-versed in emergency management. Preparedness activities included putting equipment and belongings above the 1975 and 2017 flood planning level, evacuating children and pets, and preparing to shelter in place. In

the Northern Rivers there is an established culture of sheltering in place during flooding events.⁶⁹⁴ As one community member put it there is “something about being used to floods, as [we] have lived through a number of them”.

*We are no strangers to flooding, regularly moving cars to higher ground, moving belongings upstairs etc etc. Since the house was built in the 50's flood water has never breached the floorboards, not even close, so when text message warnings of 10, 10.5, 11 metres started coming in no one was that concerned. We moved our stuff, stocked up on food and that was that. I am a nurse at our local hospital and went to stay elsewhere on Sunday the 27/2 as I didn't want to get cut off from work.*⁶⁹⁵

*On the day the flood happened I watched carefully the warnings from BOM and the SES. In North Lismore we have always prepared well for flooding, and most people in my street stayed home to protect their home. In 2017 floods a lot of rubbish from other places floated and landed in our backyards, so it's good to be there to start clean up straight away. I helped other people pack up their business and get cars to safety up in Lismore Heights. I thought my only possession at risk was the car, so I moved it to a spot up behind the cemetery, about 750 m from my place. When I waded back to the house, the car was empty except for my spare glasses. So I was prepared. I had food and clean water stored, cat food and litter, even my makeshift toilet for when the water goes off. The gas bottles were tied up and turned off. So I waited.*⁶⁹⁶

*We began the process of moving all items to the upper level to prevent inundation damage of belongings. By 6am we had decided that once the belongings of ourselves and the home owners (who were still in the process of moving out) had been moved upstairs we would leave town with our four children and two dogs as we had not been in a flood before. Everyone in town felt confident that they had prepared well as always (we were in what was considered a high point in town, other than the only hill which has the school and retirement village perched on top).*⁶⁹⁷

The Inquiry notes that the SES has access to further evidence including community intelligence of local rivers and tributaries in addition to the information that it receives from the Bureau. The SES is the primary conduit of such information to the wider community and, as discussed in Chapter 3, it has a responsibility to ensure this information is appropriately disseminated to empower the community to plan for worst case scenarios. Failing to do so is indicative of the failures in community engagement, as discussed earlier in this chapter.

The Inquiry heard that, when discussions about potential floods arose, especially in Lismore, there was confidence that infrastructure such as the Lismore levee would ‘prevent’ a flood. However, infrastructure can fail.⁶⁹⁸ Overreliance on it can result in people not taking the safer and more effective flood survival strategy, namely evacuating.⁶⁹⁹ The potential for such overconfidence in infrastructure solutions must be taken into account in community engagement activities.

The more knowledge and information about their risk, and how to prepare for it, the more likely the community will actually be prepared when a flood event occurs. Communities must be engaged in the development of local emergency plans to promote understanding of the hazards they face,

⁶⁹⁴ Tofa, M, Haynes, K., Avci, A, van Leeuwen, J, Roche, K., Coates, L & Gissing, A (2018) Exploring the experiences of those who shelter in place during severe flooding. Melbourne: Bushfire and Natural Hazards CRC. Retrieved from <https://www.bnhcrc.com.au/publications/biblio/bnh-5200>.

⁶⁹⁵ Emily Green, submission to the Inquiry.

⁶⁹⁶ Meaghan Vosz, submission to the Inquiry.

⁶⁹⁷ Elyse McMaster, submission to the Inquiry.

⁶⁹⁸ Meeting with Insurance Council of Australia on 22 April 2022.

⁶⁹⁹ Meeting with Risk Frontiers on 22 April 2022; meeting with Insurance Council of Australia on 22 April 2022.

input local knowledge and participate in exercising. As outlined in the State EMPLAN, communities are a vital part of emergency management arrangements.⁷⁰⁰

Communities cannot be expected to understand and manage flood risks, develop household flood response plans, receive flood information, contribute to flood intelligence, and identify needs of high-risk individuals, without the support of the emergency support agencies, in particular the SES. If the engagement between government agencies and the community is right, it is much easier for the community to play its role in disasters. It is an interdependent system.

The SES provides resources to individuals, households, businesses and community organisations to plan for flood emergencies. It uses a range of media to disseminate these, but it is not clear that it fully recognises the way different generations use different communication platforms. Figure 4-3 is an example of the online resource provided by the SES to develop a home emergency plan.

GET READY FOR FLOODS
WITH THE FOLLOWING 5 STEPS

1. Know your flood risk
2. Plan now for what you will do
3. Prepare your home and business
4. Be aware
5. Look out for each other

Together it's simple to Get Ready for floods

GET READY

SES
NEW STATE EMERGENCY SERVICE

Principal Partner

NEMA
INSURANCE

Figure 4-3: SES Community preparedness information. Source: NSW SES Website.

⁷⁰⁰ NSW Government. (2018). NSW State Emergency Management Plan. Retrieved from <https://www.nsw.gov.au/rescue-and-emergency-management/state-emergency-management-plan-emplan>.

Figure 4-4: SES Home Emergency Planning Tool. Source: NSW SES Website.

The Inquiry notes that the digitisation of learning tools and the shift to web-based community engagement shifts the onus of responsibility onto community and away from emergency services in knowing risk, planning and being prepared. This occurs through reduced oversight of engagement activities that would otherwise have been conducted in person. It also reduces opportunities for relationship building between community and local SES Units. Web-based learning should occur in conjunction with other forms of community engagement including in-person events.

The SES told the Inquiry that investment in local resources to build awareness and risk understanding needs to be increased and accompanied by further investment in engagement campaigns in high-risk flood areas.

The Inquiry notes that sound engagement requires a participatory model. As Webber Gissing, Dufty and Bird (2017) have advocated, top-down or one-way approaches to communication treat

community as a homogenous group of individuals.⁷⁰¹ Good community engagement should reflect the diversity of community interests, values and localised knowledge.

The National Strategy for Disaster Resilience has offered a community engagement model for emergency management in which multiple types of engagement can be utilised depending on the context and nuances of the community.⁷⁰² Different types of engagement will enable various members of the community to involve themselves according to how advanced is their knowledge of emergency management, the risks of flooding and disaster resilience.

Webber et al. studied a pilot project with the SES, using participatory-based approaches to community engagement, in the communities of Narrabri, Burringbar/Mooball and Chipping Norton. The project showed positive impacts, included improved relationships between community and the SES, a wider appreciation within community of flood risks, and improved awareness of local flood plans.⁷⁰³

Combining participatory-based methodologies alongside other engagement practices through a community safety approach may improve community resilience in future flood events. Different engagement models may be needed to ensure that traditionally hard to reach members of the community, including culturally and linguistically diverse people, the vulnerable and children and young people, are involved.

The Inquiry heard that during a disaster children and young people have reported feeling invisible, forgotten, helpless and unable to influence events around them.⁷⁰⁴ In its submission to the Inquiry, the Advocate for Children and Young People reflected on their consultations:

*Children and young people spoke about the importance of having opportunities to share their stories with peers and the broader community. Creating these mechanisms either through Youth Liaison Officers within local government or platforms utilising technology such as Facebook Live are easy but effective ways to ensure the voice of children of young people is heard. Alternatively, organisations with the relevant skills and experience to safety and meaningfully engage with children and young people post disaster events, should be funded to carry out this task as a regular aspect of disaster recovery.*⁷⁰⁵

This level of engagement is true across the PPRR spectrum. The Inquiry believes more should be done by the SES to empower communities' preparedness and planning for future floods, including hard to reach parts of the community. An option could be to make better use of the local government network, including Aboriginal and youth liaison officers, or the regional networks of councils. Engagement processes do not always need to reinvent governance to be effective, but can leverage existing relationships to improve emergency preparedness.

4.5. Safety of first responders

A key principle of the *NSW State Flood Plan* is the protection and preservation of human life, including the lives of first responders and the community during floods.

⁷⁰¹ Webber, D, Gissing, A, Dufty, N, & Bird, D. 2017. Community Participation in Emergency Planning: NSW State Emergency Service Case Study. Retrieved from <https://ajem.infoservices.com.au/items/AJEM-32-02-15>.

⁷⁰² Australian Institute for Disaster Resilience. (2013). Australian Disaster Resilience Handbook 6: National Strategy for Disaster Resilience: Community Engagement Framework. Retrieved from <https://knowledge.aidr.org.au/media/1761/handbook-6-national-strategy-for-disaster-resilience-kh-final.pdf>

⁷⁰³ Webber, D, et al. 2017. *Community Participation in Emergency Planning: NSW State Emergency Service Case Study*. Page 31.

⁷⁰⁴ Advocate for Children and Young People, submission to the Inquiry.

⁷⁰⁵ Ibid.

There are many factors that contribute to the safety of first responders and the community during flood events including: undertaking community awareness campaigns, appropriate resourcing, training, fit for purpose facilities and equipment, effective emergency incident management and governance, and appropriate operational management and risk assessments. The combination of these elements contributes to the safety of both first responders and the community during a flood.

Work, Health, and safety obligations of Emergency Services

All agencies, including agencies managing emergencies, must comply with the *Work Health and Safety Act 2011* (WHS Act). The main object of the Act is to provide a consistent framework to secure the health and safety of workers and workplaces. The Act imposes a primary duty on agencies, such as the SES and RFS, to ensure the health and safety of their workers.⁷⁰⁶

Under the Act, an individual is considered a worker if that person carries out work in any capacity for the SES, including as a volunteer.⁷⁰⁷ In most cases, a volunteer would be considered a ‘worker’ as they undertake specific duties for the SES. The Inquiry understands that if a ‘worker’ is untrained or performs activities on an irregular or ad hoc basis, this does not preclude their activities from being considered as ‘work’ under the Act.⁷⁰⁸

*the fact that a volunteer operates in a high-risk environment does not in any way reduce the RFS’s and SES’s obligation under the WHS Act. To the contrary, that a volunteer operates in a high hazard environment places a greater onus on the person conducting a business or undertaking to ensure as far as is reasonably practicable, the health and safety of the volunteer.*⁷⁰⁹

It is therefore critical that the SES and other emergency services provide expedient and regular training to new and ongoing volunteers. The Inquiry would strongly advise that appropriate training for the consequences of floods, storms and tsunamis forms the basis of the SES’s work, health and safety obligations to its members. Any gaps in the ability to provide such training in a timely manner would be a significant risk and should be addressed urgently.

Compliance with the NSW State Rescue Policy

The NSW State Rescue Policy stipulates that in order to undertake flood rescue operations all agencies must be authorised/accredited in accordance with State Rescue Board (SRB) requirements, as prescribed by the SES.⁷¹⁰ Compliance with the policy is a core component of ensuring the safety of respondents. The policy states that “only appropriately trained agency personnel should perform at the functional levels whether it is at the ‘land based’, ‘on water based’ and ‘in water based’ flood rescue operations”.⁷¹¹

The Policy notes that agencies are required to ensure training and resourcing is appropriate to the level of flood risk outlined in a local flood plan. Advanced positioning of flood rescue resources will be directed by the SES where it has established a Flood Area of Operations (FRAO) or is preparing to do so.⁷¹² The Inquiry notes that a FRAO was not declared by the SES prior to the first flood events in 2022 and that the pre-positioning, training and allocation of resources was not equal to the level of risk to communities, particularly in the Northern Rivers.

⁷⁰⁶ Crown Solicitor’s Office. (2022). *Advice to the Inquiry provided 20 July 2022*.

⁷⁰⁷ Ibid.

⁷⁰⁸ Ibid.

⁷⁰⁹ Ibid.

⁷¹⁰ NSW Government (2021). NSW State Rescue Policy, Version 4.1. 5 July. Retrieved from <https://www.nsw.gov.au/sites/default/files/2021-04/state-rescue-policy.pdf>.

⁷¹¹ Ibid.

⁷¹² Ibid.

The State Rescue Policy establishes the minimum amount of Personal Protective Equipment and flood rescue equipment for both On Water and In Water Flood Rescue. The Inquiry heard reports of SES members not having appropriate equipment for the conditions, for example:

- SES members and vessels are not equipped with Emergency Position Indicating Radio Beacons or tracking devices when responding to requests for assistance (these should be waterproof)⁷¹³
- some members reported waterproof GPS, iPads and mobile phones for navigation became waterlogged and unusable in the wet conditions⁷¹⁴
- lack of a waterproof system to record details of doorknocking and evacuations⁷¹⁵
- lack of waterproof bags for storing equipment and documents (e.g. evacuation maps and registers)⁷¹⁶
- some SES members reported being trapped inside flood-affected housing without breathing apparatus for themselves or the community members they were rescuing⁷¹⁷
- some Lismore City SES Members reported wearing the same (wet) uniform and boots for up to 36 hours.⁷¹⁸

The Inquiry notes that the response of SES volunteers was materially affected by deficiencies in training, equipment and resources. All were limited and stretched to capacity.

4.6. Lessons learned from previous events

An important part of the preparation phase is consideration and implementation of lessons learnt from previous events to ensure continuous improvement within an agency. Lessons learnt must be attainable and have short term goals, with longer-term goals such as cultural change and infrastructure investment covered in strategic plans.

In NSW there is a framework for emergency management agencies to capture the learnings from previous seasons and events and make recommendations for improvements for future seasons. The Lessons Management Framework for the NSW Emergency Management sector provides a foundation for implementing lessons management capability across the sector.⁷¹⁹ It was endorsed by the State Emergency Management Committee (SEMC) in March 2019, and a final report was endorsed in February 2022 identifying additional learnings from the COVID-19 pandemic and other disasters.⁷²⁰

The Lessons Management Framework identifies 5 essential elements to support the implementation of a lessons management lifecycle:

- governance
- leadership and culture
- roles, responsibilities and accountabilities
- standard definitions
- a clearly defined lessons management process for identifying, sharing and learning lessons.

⁷¹³ NSW SES Lismore Unit. (2022). *Advice to the Inquiry provided 2 May 2022.*

⁷¹⁴ Ibid.

⁷¹⁵ Ibid.

⁷¹⁶ Ibid.

⁷¹⁷ Ibid.

⁷¹⁸ Ibid.

⁷¹⁹ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 20 June 2022.*

⁷²⁰ Resilience NSW (2022). *Advice to the Inquiry provided 24 June 2022.*

Applied together, the elements support and sustain a consistent approach to lessons management across the sector. The framework acknowledges the good work already being done by many organisations and provides a way for organisations to develop and build on existing levels of maturity in lessons management. This sits alongside formal reviews such as independent inquiries and royal commissions. Some examples of outputs of the Lessons Management Framework include the 2020 State Lessons Report endorsed by the SEMC, as well as individual agency examples from Resilience NSW and the SES.

The NSW Government (Resilience NSW) also informed the Inquiry that it is working to implement initiatives in response to findings and recommendations of previous natural disaster related Inquiries and Royal Commissions including the *Final Report of the NSW Bushfire Inquiry into the 2019-20 bushfire season* and the *Royal Commission into National Natural Disaster Arrangements*.

Like the NSW Bushfire Inquiry, this Inquiry found it difficult, from publicly available information, to establish whether and how recommendations from previous inquiries have been implemented. The Inquiry notes that, since the NSW Bushfire Inquiry, the NSW Parliament has legislated that the Minister for Emergency Services and Resilience provide updates on all recommendations from that inquiry every 3 months.⁷²¹ It suggests that a similar mechanism be employed for this flood Inquiry. A Flood Inquiry Implementation and Evaluation Unit will assist the Government in ensuring that lessons are learnt from this disaster, and that any Inquiry recommendations accepted by Cabinet are implemented efficiently and effectively in advance of the next flood season.

The Inquiry notes that the 2021 NSW Auditor General's Report *Addressing public inquiry recommendations - Emergency response agencies* concluded as follows:

The arrangements used by NSW emergency response agencies to address public inquiry recommendations have important and consistent gaps.

For two thirds of the recommendations reviewed as part of this audit, the agencies did not sufficiently verify that they had been implemented as intended, and in line with the outcomes sought. This exposes risks that gaps in disaster responses are not addressed in a complete or timely way and persist or recur in the future'.

Two thirds of the recommendations reviewed as part of this audit had also not been allocated milestone dates or priority rankings, and as such the audited 'agencies are less accountable'⁷²²

In the 2022 flood events, the lack of applying past lessons was evident in Lismore. Some of the key lessons from the 2017 Lismore flooding event was that there was a lack of evacuation compliance, with most residents opting to shelter in a higher storey of their home as flood waters rose, leading to a corresponding rescue demand; poor insurance coverage; and overconfidence in the CBD levee.⁷²³ After the 2017 floods it was clear that people would still stay in their homes and shelter in place during a flood event.⁷²⁴ The issues raised in 2017 were repeated in 2022, including confusion around warnings and information, residents being caught off guard by the scale and speed at which the flood occurred, lack of appropriate resourcing, training and experience for SES volunteers, and issues with flood rescues.

⁷²¹ NSW Auditor General. (2021). *Addressing public inquiry recommendations – Emergency response agencies*. Retrieved from <https://www.audit.nsw.gov.au/sites/default/files/documents/FINAL%20REPORT%20-%20APIR%20-%20ERA.pdf>.

⁷²² Ibid.

⁷²³ Meeting with Risk Frontiers on 22 April 2022.

⁷²⁴ Tofa, M, Haynes, K, Avci, A, van Leeuwen, J, Roche, K, Coates, L. & Gissing, A. (2018) *Exploring the experiences of those who shelter in place during severe flooding*. Melbourne: Bushfire and Natural Hazards CRC. Retrieved from <https://www.bnhcrc.com.au/publications/biblio/bnh-5200> and meeting with Risk Frontiers 22 April 2022.

Previous reviews into the SES have also found issues with communication and flood warnings, poor resourcing including insufficient staff and improper equipment, poor planning, insufficient training and overworking of volunteers, out of date flood plans, and poor organisational culture. These reviews identified issues both in response and planning and preparedness.⁷²⁵

Furthermore, anecdotal evidence presented to the Inquiry was damning about the implementation of recommendations from previous reviews, with some estimating that only a handful of hundreds of recommendations have been made and 'accepted' or 'supported' by successive governments.⁷²⁶

*This submission is not about this thesis, but about the whole system of emergency management in Australia and its appropriateness for the emerging challenges confronting this nation. In the last decade literally millions of thoughtful, experience- and evidence-based words have been written in submissions to various national and state inquiries, and as a result of CRC-initiated natural hazards research, but largely appear to have fallen on deaf ears.*⁷²⁷

*There have been reviews and inquiries into floods previously, where findings and recommendations have been made public and yet no action has occurred.*⁷²⁸

Looking at these previous inquiries, and seeing similar issues arise in the review of the 2022 flooding events, the Inquiry concludes that the SES has a poor organisational culture and is ill-equipped to implement change. This in part is due to the numerous leadership changes, restructures and realignments the organisation has undergone since 2014. This disrupted history has seen the value of continuous improvement lost along with leadership and innovation. The Inquiry heard from many SES volunteers that Wollongong (SES headquarters) is its own worst enemy in attracting and retaining volunteers.

SES volunteers told the Inquiry that the changes in the SES have impacted negatively. They have experienced barriers to service due to processes and burdens placed on them by headquarters leadership and this has affected the retention and attraction of volunteers. The feedback included:

- increased bureaucracy
- increased focus on management of volunteers rather than 'supporting' volunteers
- no practical support to volunteers
- increased workloads, increased administration burden, less support from understaffing in Zones and an attitude of 'Not My Job' from Zone staff; and no knowledge of 'who does what' at State Headquarters
- constant staff turnover at executive level, critically reducing organisation knowledge and experience at decision-making levels
- volunteers increasingly being removed from the management space [and receiving] no Incident Management training, no people management training and no ongoing support in their Unit/Local Command roles.⁷²⁹

In addition, volunteers have expressed concern that a lack of training and integration into incident management has meant that local units have largely been left out of the decision-making process. The centralisation of decision making within State Headquarters has resulted in an increase in non-local incident controllers who, once an event has concluded, leave local units as the public face of the organisation to deal with the consequences of their decision making.

⁷²⁵ AFAC (Australasian Fire and Emergency Services Authorities Council). (2021). Independent Review into 2021 NSW Flooding. Retrieved from <https://www.ses.nsw.gov.au/media/5448/review-nsw-flooding-final.pdf>

⁷²⁶ Meeting with Janelle Saffin, MP, Member for Lismore on 17 May 2022.

⁷²⁷ Bill Calcutt, submission to the Inquiry.

⁷²⁸ NSW State Emergency Service Volunteers Association, submission to the Inquiry.

⁷²⁹ Ibid.

4.7. Evolution of the NSW State Emergency Service

Numerous restructures badly affected the SES's leadership and organisation culture

One driver for some SES restructures has been to improve organisational culture, with the 2021 SES Facilities Review emphasising corporate management deficiencies that had been identified by the Public Service Commission, the Office of the NSW Ombudsman and the NSW Audit Office.⁷³⁰ The SES Facilities Review was commissioned by the Deputy Commissioner of Corporate services to examine whether the SES's current zone and unit facilities were able to meet the organisation's intended purpose. The review identified a number of deficiencies in Unit and Zone Operational Facilities and made recommendations for immediate remediation and long term strategic asset planning. As a result of such internal challenges, the SES observed:

*trust among volunteers and the service declined, resulting in a loss of operational focus which led to decreased operational capability and significant loss of volunteer confidence in the Service management.*⁷³¹

This sentiment was shared by the Lismore Citizens Flood Review Group, which noted that the SES has had a total of 7 acting or permanent Commissioners appointed in a period of 10 years. It further noted that the restructures of the SES resulted in an 'extra layer of bureaucracy' with 5 layers of hierarchy between community and Commissioner. The high turnover of senior staff within the SES was also viewed as problematic as it resulted in a loss of corporate knowledge.⁷³² As a result, the community has viewed the internal restructures of the SES as of being of no direct benefit.

*In the past 18 months the major focus of the SES organisation appears to have been inwards whereas the needs of the local units and the welfare of the community should be paramount. From reports received, this institutional failing was clearly demonstrated during the February 28 event where the focus of the Incident Management Team appeared to be upwards to HQ not downwards supporting the units as the primary aim. The core pillar of the organisation should be responding to and following up on requests for support from the units and the community.*⁷³³

Organisational restructures throughout the last decade and intensively over the previous 18 months have resulted in cultural, leadership and hierarchy challenges. In particular, and though not consistently felt across the state, the relationship between volunteers and headquarters has also been affected by ongoing change. This has most acutely been felt in high-risk communities such as the Northern Rivers.

In the 2019–20 budget the NSW Government underwent a process of efficiency dividends in which agencies were allocated savings targets. The Inquiry has heard from the SES that these savings affected the ability of the agency to deliver core services and support volunteers, with a specific bearing on planning and preparedness functions.

The agency underwent a restructure in 2019 to achieve part of its assigned savings target. The Inquiry heard that through this process the SES became a response agency instead of a preparation and prevention agency. Large gaps in the planning, prevention and resilience building

⁷³⁰ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 29 March 2022*.

⁷³¹ Ibid.

⁷³² Lismore Citizens Flood Review, submission to the Inquiry.

⁷³³ Ibid.

areas of the agency emerged as a result of significant FTE losses across planning, strategic policy and community engagement.⁷³⁴

The recent history of the SES has been characterised by significant challenges for its leadership. Trust and cultural issues of not asking for help from other emergency service agencies have emerged as a result of successive leadership changes and are barriers to implementation of effective incident management systems. Organisational change was decoupled from asset and infrastructure funding, resulting in a combat agency capable of managing low risk, smaller incidents, but challenged in managing complex, large and fast-evolving emergencies. This was demonstrated in the 2022 flood season.

The Inquiry failed to establish the purpose of the previous restructures. However, it appears there has been no improvement in SES performance during large scale complex weather events.

The history of the NSW SES

The origins of the SES can be attributed to the establishment of Civil Defence in NSW during the Second World War in which the voluntary National Emergency Service was created. Although the National Emergency Services dissolved with the conclusion of the war, some of its functions remained a component of the Chief Secretary's Department. With the advent of the Cold War the desire for civil defence capabilities once again became a critical need.

The need for a civil defence capability coincided with several significant flood events across the Hunter Valley, North Coast and northern inland regions of the state during the late 1940s and early 1950s. These floods resulted in considerable loss of life, damage to public and private property, and infrastructure. As a result, in April of 1955, the NSW Cabinet decided to create the State Emergency Service and Civil Defence Organisation, coupling the need to provide a consistent response to flood events and establish civil defence capability.⁷³⁵

The focus of the State Emergency Service and Civil Defence Organisation was to involve communities in the planning for and response to flood emergencies.⁷³⁶ However, this responsibility was ill defined and interpreted to be reactive to floods as they occurred. The organisation coordinated community response to flood threats, led training, provided flood warnings, and acted to protect and sustain communities during and after floods via rescue and resupply.⁷³⁷

The Modern SES was formalised by legislation through the introduction of the *State Emergency Service Act 1989*. The Act codified in law the responsibilities of the SES to be the combat agency dealing with floods and to coordinate warnings, evacuations and welfare for affected communities. The Act also designated the SES as the combat agency for storms and tsunami, and since then its responsibilities have developed into various support roles that have become a core component of their services. SES volunteers have a proud history and have undertaken a strong role throughout numerous weather events and local incidents. As members of the community themselves, volunteers should be recognised for the responsibility they have in protecting their communities during natural disasters.

⁷³⁴ Meeting with NSW SES (NSW State Emergency Service) on 17 May 2022.

⁷³⁵ NSW SES (NSW State Emergency Service). (2006). NSW SES Annual Report 2005/2006. Retrieved from https://www.ses.nsw.gov.au/media/1172/nswses_annual_report_2005_06_5mb.pdf.

⁷³⁶ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 29 March 2022*.

⁷³⁷ Pfister, N, & Rutledge, A, (2002). The role of the New South Wales State Emergency Service in Flood Management. Retrieved from https://www.ses.nsw.gov.au/media/2558/the_role_of_the_nsw_state_emergency_service_in_flood_management.pdf.



Photo 4-8: NSW Police and Army Personnel during 1954 Northern NSW Floods. Source: NSW State Library.

SES has undergone significant transformations

The SES has undergone a number of reviews and internal restructures since 2014 to improve the organisation's ability to manage emergencies and remain fit-for-purpose. Best practice dictates that each major flood event necessitates reflection to identify key observations and learning opportunities to inform continuous improvement. The most recent and significant transformation commenced in 2014 when the SES planned to modernise its service delivery, which began in 2017 as the 'Organisational Transformation Program'.

This program replaced 17 regional headquarters with 5 zones significantly changing service delivery. The change was intended to prioritise resourcing for flood risk areas and be accompanied by funding for facility upgrades and resourcing.⁷³⁸ Though all ongoing staff were assigned a role within the new structure, a substantial number of staff were assigned to roles for which they had limited or no experience.⁷³⁹

This reorganisation of the SES inadvertently concentrated decision-making power. A smaller number of regional zones, coupled with under resourcing of former regional headquarters, limited the decision-making capability of local IMTs in response to local factors during large scale events. The span of control over the 5-zone model is outside the capability of the SES particularly in large scale events. Zones are too large to be able to command and control the response to large scale weather events. This was very evident in the Northern Rivers in 2022.

Transition from regions to zones affected the SES response

The creation of zones covering significant areas of the state affected the SES's ability to manage the 2022 floods. In particular, the resourcing challenges of units, zones and the State Headquarters (SHQ) challenged the chain of command and the ability of the SES to manage concurrent emergencies across the state at the lowest effective level. Where individual IMTs across the state should have been empowered to manage the complexities of the evolving

⁷³⁸ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 29 March 2022*.

⁷³⁹ NSW SES (NSW State Emergency Service) (2022). *Advice to the Inquiry provided 26 May 2022*.

situation in partnership with their respective EOC, the centralisation of decision-making within the SHQ eroded this critical function.

It is clear from advice provided to the Inquiry that local communities in high risk and flood prone areas across the state place great credibility on local leadership and knowledge. Using such expertise supports the relationship between community and emergency services, which ultimately improves community resilience to floods.



Figure 4-5: The SES Former Regional Headquarters. Source: NSW SES Facilities Review.



Figure 4-6: The SES Current Zones. Source: NSW SES Facilities Review.

Regional and unit infrastructure was insufficient to respond to the 2022 floods in high-risk communities

The Inquiry heard that when the Regional Headquarter buildings were constructed they were equipped as incident control centres (ICC) with the ability to manage Level 2 incidents. It is noted that these facilities continue to operate as ICCs during large scale events but are unable to accommodate additional emergency service organisations.

As current zone headquarters are not located in high risk or flood prone communities it is likely that former regional headquarters will continued to be relied upon to house IMTs during large scale events. This creates considerable risk to the community as the facilities are not fit for purpose.

The current zones as highlighted in Figure 4-7 do not reflect the needs of flood prone or high-risk communities. This was evident in the 2022 floods where the Northern Rivers emergency was managed by a combination of an IMT at Goonellabah and the Zone HQ at Metford. The Northern Zone is approximately 630 km in length and too large to be effectively managed through a single ICC.

The Inquiry heard that many of the SES's local units still occupy facilities constructed in the 1990s. These facilities are not large enough to house core functions with other stakeholders, such as liaison officers. The Inquiry further heard that it would not be unusual for liaison officers to be forced to work from kitchens or carparks and away from real time information and crucial updates.⁷⁴⁰

⁷⁴⁰ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 29 March 2022*.

This siloed arrangement is something NSW SES has struggled with since the introduction of AIIMS, however the 2018 restructure, creating five Zone HQs, has meant that continuing to work in separation within small, outdated facilities has become hazardous. For example, disjointed coordination could lead to poor operational response, field incidents, or failure to effectively manage an emergency.⁷⁴¹

Such issues had a material effect on the response to the 2022 floods. The inquiry heard from multiple emergency management stakeholders that communication was disjointed, cooperation was difficult and management of the emergency was beyond the control of the IMT.

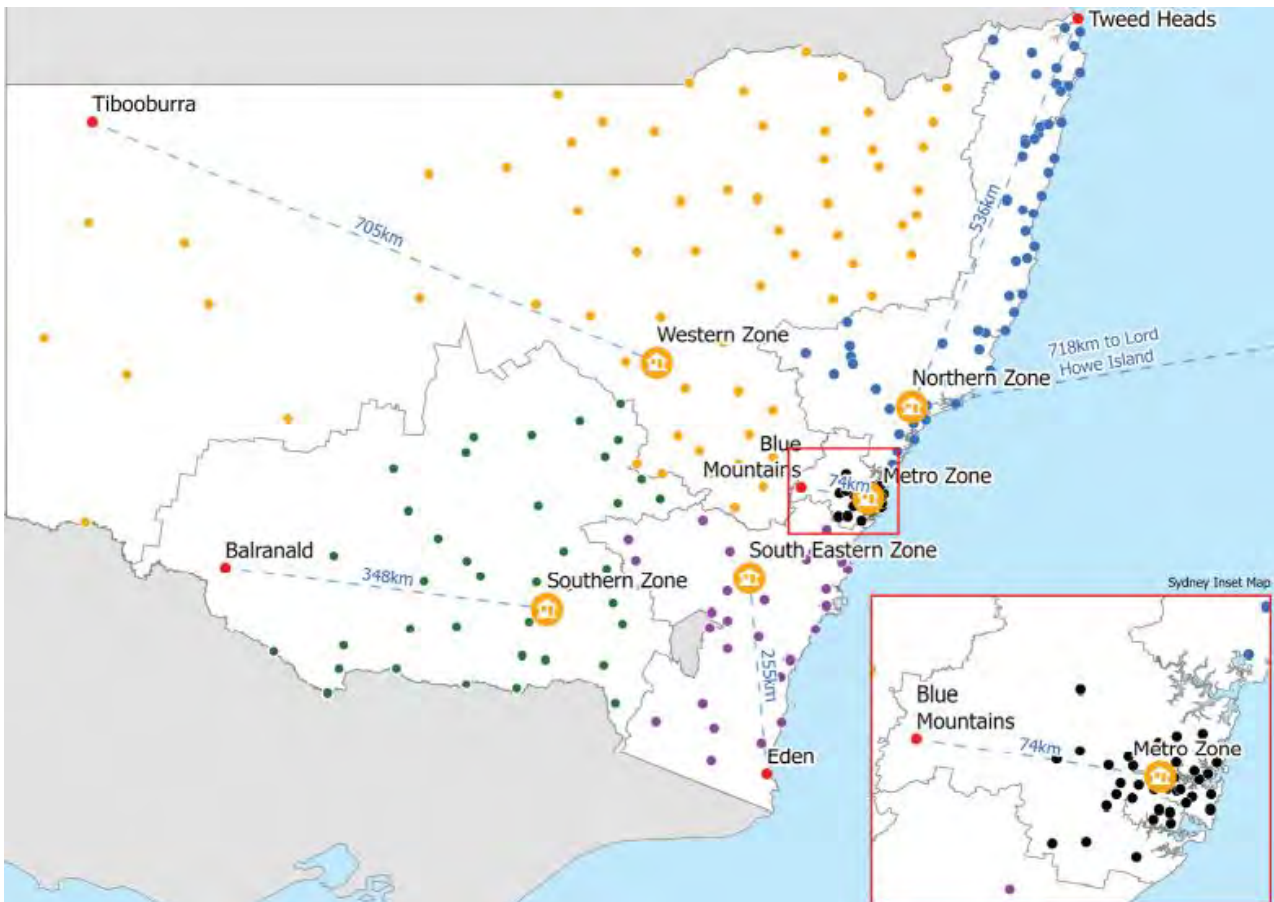


Figure 4-7: SES Zone Distances.

The SES Facilities Review further identified that there is insufficient staff to cover Incident Management positions. In an emergency it is common practice that non-operational staff will be operationalised to assist with emergency management. If zones are unable to maintain 24 hour a day operation, then control will be shifted to the State Command Centre. During the 2022 floods in the Northern Rivers, the Inquiry heard that incident operations were managed through a combination of resources from Metford and Goonellabah to maintain 24-hour operational capability.

The 5 SES zones require risk-based funding to be able to manage a flood emergency at the lowest effective level. The organisational transformation which resulted in the creation of zone headquarters was decoupled from adequate funding, meaning that facilities were unable to meet the needs of the zone's populations. The current model was designed to establish a hierarchy through which incident management could scale in response to an emergency. However, the current Zone Headquarters are not fit for purpose, do not meet the requirements of a Level 3 incident and are insufficient to respond to complex incidents.

⁷⁴¹ Ibid.

The SES has outlined what is required for a Level 3 incident control centre to manage major emergencies:

A facility used to accommodate an Incident Management Team (IMT) and an expanded Incident Management Structure (IMS) during preparation for, or response to large complex incidents. Have facilities and services to support the inclusion of Liaison Officers from other agencies (ESO) and supporting functional areas. Where possible, be at a pre-defined location that allows an appropriate level of communication with personnel at incidents within its 'footprint'. Must be well linked to neighbouring ICCs, L/REOC's, other agency coordination centres, Division/Sector Command Points, Staging Areas, and airbases.⁷⁴²

Further investment is required across all zones to ensure ICCs can facilitate effective control over complex, large scale and evolving emergencies, such as the 2022 floods.

SES capability, assets and facilities need to be fit for purpose

The SES requires fit for purpose Unit and Zone Headquarters, located off flood prone land, to appropriately prepare for and respond to the risk of future flood events. The Inquiry heard that during the Northern Rivers floods, the IMT was crowded, the bandwidth inadequate to meet the needs of IMT members and electrical systems failed.⁷⁴³ Zone operational facilities were constructed in the 1990s and designed to meet the operational requirements of the organisation at the time. The complexity and frequency of flood emergencies require investment in fit-for-purpose facilities.

The SES Facilities Review conducted in 2021 identified that Regional Zones Headquarters were no longer fit-for-purpose, fall significantly short of the needs of the organisation and should be upgraded to meet the specifications of a fit-for-purpose Incident Control Centre Level 3. In addition, further internal reviews have highlighted that the operating environment has not kept pace with the requirements of service delivery and does not effectively support modern response operations.⁷⁴⁴

The current facilities are too small and do not have the required footprint or technology to meet ICC 3 specifications. The metre sq. standard from NSW Property and Development is 10m² per person (this may increase in an operational setting). The number of personnel required to function in a level 3 ICC is approximately 100-110 people.⁷⁴⁵

The Inquiry was told that it was common for IMT liaison staff to be located in kitchens, or other areas away from real time information and crucial updates.

SES Unit and Zone facility management needs to be sorted

Under current arrangements councils own and fund maintenance of SES Units, and Property NSW, in the Department of Planning and Environment (DPE), owns and leases back Zone Headquarters to the SES. This process, under which external entities manage the essential asset of an emergency service, creates an operational risk for the SES as it has reduced control of capital investment and management of the lifecycle of its assets.

Various zone headquarters across the state have been reviewed for their operational effectiveness. For example, the 2021 SES Facilities Review identified the Metro Zone Headquarters in Rhodes and the Bankstown warehouse as being at high risk due to their private ownership and pending dates of contract expiry. The Review recommended that the SES

⁷⁴² Ibid.

⁷⁴³ Lismore Citizens Flood Review Group, submission to the Inquiry.

⁷⁴⁴ NSW SES (NSW State Emergency Service). (2022). *Advice to the Inquiry provided 29 March 2022*.

⁷⁴⁵ Ibid.

commence discussions with DPE, stagger contracts to mitigate future risk, and communicate its future asset requirements.⁷⁴⁶

The Review further recommended that the SES collaborate with Property and Development NSW to “co-create a SES Facility Strategy to develop modern Incident Control Centres and align with the NSW Government’s Regionalisation Plan”.⁷⁴⁷ The Inquiry supports this endeavour to develop a long-term strategy for the organisation’s facility requirements.

The Inquiry understands that PDNSW has established governance through the Property Strategy Collaboration Committee and has tools at its disposal – including Land iQ – to identify and facilitate the transfer of government-owned land and assets. Such systems should and will continue to perform an important role in enabling the SES to identify fit for purpose sites so that it can provide a high-quality service to the community.

The Inquiry notes that the NSW Government has provided funding to address the need for fit for purpose facilities in high-risk catchments, such as the Northern Rivers. The Inquiry supports the SES continuing to work with its partners in local and state government to identify appropriate mechanisms to address facility requirements for local units and zone headquarters.

The benefits of shared facilities should be looked at

In following up the matters discussed above in this chapter, it would be prudent for the SES to seek opportunities to collocate with other emergency service agencies.

At its meeting with Sutherland Shire Council, the Inquiry observed how effectively a collocated facility can perform. The Inquiry saw firsthand a model through which the RFS and an SES IMT can share facilities to improve interoperability. It notes that this approach requires enough space for all services to operate effectively.

Shared facilities between the RFS and SES can benefit the performance of IMTs, reduce operational costs, heighten situational awareness during an emergency and facilitate improved compliance with the principles of AIIMS. The Inquiry considers it best practice wherever possible to collocate RFS and SES operational centres and assets. While not suitable in all locations, there may be particular benefit for metropolitan-based units, where land value is higher and access to appropriate facilities is restricted.

Emergency management precincts create a strong visual representation of the importance of emergency services to the community. They can facilitate training, meetings and operations, and be a focus for community outreach, but require mature agencies and long-term strategic planning and investment in infrastructure to be successful.

Collocation between a combat agency and an EOC has worked well in past emergencies. Collocation does not require the combat agency and EOC to physically be in the same room; it is about proximity. Both must have enough space to acquit their duties properly.

⁷⁴⁶ Ibid.

⁷⁴⁷ Ibid.



Photo 4-9: Sutherland Shire Emergency Service Centre. Source: Flood Inquiry Secretariat.

Whole of catchment approach to flood risks needed

Effective mitigation of flood risks requires coherent planning and preparedness at a catchment level. Currently, the emergency management arrangements rely on an interwoven system of shared resources, personnel and assets to respond to hazards. As such, resources from a single emergency service or multiple services may be called upon during an emergency to facilitate warnings, evacuations or rescues.

In the case of floods, what occurs in higher points of a catchment (creeks, tributaries or upstream) will have consequences for downstream communities. A catchment-based approach to information sharing, intelligence, planning and the dissemination of public warnings is critical. As noted in the Lismore Citizens Flood Review Group submission:

Throughout the Richmond catchment, from the time flood rain starts falling on the northern border ranges, accurate information is critical as the emergency management implementation timeframe is short. Major flooding can occur in many towns, and villages in the catchment within 8-12 hours. Rural residents and farmers need time to shift cattle and equipment to higher ground and urban residents and businesses need as much time as possible to pack up and move assets.⁷⁴⁸

Transitioning to a whole of catchment approach to flood risks would support future planning for flood risks, collaboration across LGAs, emergency service resource preparedness and general community disaster resilience. Any changes to SES Unit and Zone structures need to take this into account.

⁷⁴⁸ Ibid.

Chapter

5

5. Understanding flood (disaster) risk and acting on threat

Much of this report focuses on being prepared. Earlier sections cover emergency management planning and preparedness, and later sections will cover land management planning and preparations. But an important component of preparing for, and building resilience against, flood and other disaster is personal preparedness. Failure to prepare at a personal level makes preparations at the state and wider community level much harder and more expensive.

This section explores the importance of everyone getting a handle on risk. It discusses how risk may be understood, and how this understanding does, or does not, translate to action and effective decision-making at both an individual and community level and in broader government policy-making. It includes Inquiry observations on people's understanding of flood risk with a particular focus on anticipation before the event, response to flood warning and alert information during the event, and attitudes to relocation in known, high-risk areas following the event. This section does not make a recommendation about whether or not to move specific towns. Rather, it explores the related issues that arise in a discussion of relocation and resettlement, and the factors that weigh on individual and community decision-making with respect to these options. Ultimately, it concludes that more can be done to empower people and communities to undertake proactive decision-making for an unknowable and uncertain future. As summarised by Janelle Saffin MP, Member for Lismore:⁷⁴⁹

Floods will happen again but preparedness is key. We need to now create a model of adaptation to disaster preparedness that addresses risk, structure and cognition that guides preparedness.

5.1. Observations on human perception and management of flood (and other disaster) risk

Reflecting on recent disasters generally, the Inquiry observed that perceptions of, and reactions to, different risks and hazards are incredibly varied. Fire tends to invoke fearful, immediate and, more often than not, proactive responses, whereas perception of flood risk appears to be reluctantly cautious, with actions to manage flood risk often coming too late or not at all.

In this sense, and though still quite dissimilar, flood draws a closer analogue to drought than fire. Both drought and flood seem to be considered insidious disasters: disasters that have a longer lead time and are often 'slow' to develop.⁷⁵⁰ As was explored in Chapter 2, and in greater detail at Chapter 7, flood risk is – to a degree – predictable. Though extended prediction is difficult for extreme rainfall falling over a very specific location, and within a very specific time window, the flow of water through a catchment can be modelled. This means we should have a rough idea of different sized floods and their severity if they were to occur – and the ability to anticipate, prepare and respond to flood events.

⁷⁴⁹ Janelle Saffin MP, Member for Lismore, submission to the Inquiry.

⁷⁵⁰ The obvious caveat is flash flooding, which by its very nature occurs swiftly and often without warning.

Some people had trouble anticipating, and preparing for, the scale of the floods (and other bad disasters)

As is summarised in Section 1.2, in the past 3 years alone, NSW has experienced drought, heatwaves and bushfires, severe storms, flooding and a health pandemic. Throughout Inquiry consultations, many stakeholders described each disaster as serving to compound the impact of the last, and as further testing the resilience, strength and fortitude of communities across NSW. Yet, despite concurrent and consecutive natural and health disaster events increasing stress on exposed and vulnerable communities, most people in NSW (and elsewhere) had trouble anticipating the scale of the bad floods (or any natural disaster) and, in turn, understanding and managing their risk. In 2020, the NSW Independent Bushfire Inquiry noted that:

...while most stakeholders involved in fire fighting, land management and emergency response said they expected it would be a bad season, the scale took many by surprise.

And continued:

The Inquiry observed many people seemed to be aware in a general way that the conditions (fuel, weather, drought, etc.) were bad up and down the State and in neighbouring states and territories. It heard from residents of the South Coast that they knew it would be a bad season when the forested hills turned brown through winter. But the Inquiry also observed that this awareness of wide-scale and elevated risk did not necessarily lead to everyone being well-prepared, and there did not appear to be a general understanding in the community, even in high bush fire risk areas, of what could be coming.

This Inquiry cannot help but make the same observation, albeit 2 years later. People were generally conscious of conditions being prime for flooding along the east coast of Australia, including NSW, at the beginning of 2022. Yet again, despite preconditions being favourable for flooding and being armed with the knowledge of various scenarios based on flood modelling, the Inquiry observed that community and emergency services awareness did not necessarily translate into adequate preparation. Even in areas frequently affected by floods, there did not seem to be overall understanding of the 'worst case scenario' or scale of what could be coming.

For example, most stakeholders in Lismore, including community members, businesses and emergency services, told the Inquiry that they believed they were truly ready. People had moved belongings to higher ground, prepared their houses and packed cars. Lismore Business Chamber, SES and others reported to the Inquiry how impressed they had been with business preparedness and community camaraderie in the lead up to the floods. However, all these preparations were premised on the assumption that floods would not exceed prior flood levels even as incredibly heavy rainfall hit the upper catchment and CBD in the hours before the flood peaked at 14.4 m. Perhaps the best example of preparing for what is known but not preparing for the worst is evidenced by some river gauges in Lismore, which stop at 12.11 m (the height of the 1974 flood, or the prior highest flood on record), despite the probable maximum flood (PMF) for the area being 16-16.5 m.

Similarly, the Inquiry observed that some stakeholders in the Hawkesbury-Nepean Valley misunderstood their potential risk or what a 'bad' event might look like. For example, many community members described the floods experienced there as much more significant than it was in reality. The Inquiry heard 'it's not 1 [in] 100 anymore, we had 2 [1] in 100s in the last 12 months',⁷⁵¹ when in actual fact, the recent floods were not even close to that level or magnitude.

⁷⁵¹ NSW Independent Flood Inquiry Hawkesbury-Nepean Virtual Town Hall held on 16 June 2022.

The way people processed alert and warning information during the flood was complex and multi-faceted

For flood warnings and alerts to be effective, people need to process the risk information. Simply, this involves receiving, interpreting, responding and reviewing relevant information.⁷⁵² Across these stages, the Inquiry observed many reasons why people may, or may not, have acted on flood warnings or alerts.

The current systems, processes and communication channels used to distribute risk communications, and the effectiveness of these communications, are included in Chapter 3 of this report. The loss of energy and communication infrastructure during the floods, particularly mobile reception, impeded community receipt of warnings. The Inquiry was told that 802 commercial telecommunications sites were affected during the flood events,⁷⁵³ and that at the height of the floods, 18 communities across NSW had no telecommunications access.⁷⁵⁴ As in the 2019–2020 bushfires, flood-affected people without reliable mobile phone coverage reported feeling helpless as they had no means of calling SES or Triple Zero for help, receiving emergency alerts or contacting loved ones.

The Inquiry heard that, following receipt of warning or alert information and before taking action, people would generally seek to confirm or contextualise this information to understand its personal relevance and potential consequences at the household level.⁷⁵⁵ For example, community members reported monitoring rainfall, looking at rising floodwater or reviewing multiple sources of information. Here, the Inquiry observed an overreliance on apps and social media as a source of dynamic truth. Many people described dutifully following the Bureau app weather forecasts and predicted flood heights, and expressed frustration that these live measures were revised ‘too late’:

*I rang my mum in Melbourne and told her there's no way out and it's not looking very good as no one was coming to help/save us. By 3am and trying to constantly watch the bom app which was only updating every few hours. The water was now rushing up under the car, the wheel wells in the car we full of water it was almost half way up the car.*⁷⁵⁶

*I called my mum in Melbourne in the morning when we still had service and got her to check the BOM and forecasts - no more rains she said, just a few mm. I have a screen shot of the BOM app for Mullumbimby for that day attached. Within fifteen minutes the rains were back however, in full force and the water was once again rising in the house.*⁷⁵⁷

*On a technical note the BOM river gauges [sic] in the Marshals catchment froze about 12am and didn't recommence river [sic] readings for about a week depending on what happened to them or the signal. That said looking at the Floods near me Public Works advisory river levels kept functioning at proper levels. I assume its the same gauge [sic] but the bureau numbers stopped working. If someone was at home wondering to evacuate they would not have dependent on what channel they got this data through. I didn't believe the bureau figures so checked another source and the public works one was fully functional and correct.*⁷⁵⁸

But, by their very nature, these apps are reliant on information and data that is constantly changing – as was explored in Chapter 1, prediction is difficult for extreme rainfall falling over a very specific location, and within a very specific time window – meaning these sources may never reflect the

⁷⁵² Dr Mel Taylor, Natural Hazards Research Australia. (2022). Background briefing paper: Disaster Psychology. Submitted to the Inquiry 6 June 2022.

⁷⁵³ Telstra. Submission to the Inquiry.

⁷⁵⁴ Ibid.

⁷⁵⁵ Ibid.

⁷⁵⁶ Eleesha Hughes, submission to the Inquiry.

⁷⁵⁷ Svea Pitman, submission to the Inquiry.

⁷⁵⁸ Duncan Fowler, submission to the Inquiry.

event in actuality. The Inquiry notes that the Bureau places caveats on its radar, warnings and forecast information. However, people tend not to pay attention.

The Inquiry also heard that, if situational cues were in conflict with the formal instruction or warning, it created uncertainty about the right action to take, and the urgency with which to take it.⁷⁵⁹ For example, evacuation orders were undermined by people checking social media and seeing images of people recreating or playing in flood waters or partying while sheltering in place. Similarly, media reports showed reporters standing knee-deep in floodwater or footage of vehicles driving through floodwaters whilst talking about the dangers of doing just that.⁷⁶⁰

Many individuals, particularly in flood prone areas or who had experienced the recent March 2021 floods, also referenced their experience of prior flood events and/or knowledge of local conditions, including their property (for example floor heights) and their surroundings in describing to the Inquiry their initial assessment of whether the risk was relevant to them. Some locals told the Inquiry they knew that the floods would be bad:

I knew 12 hours beforehand because when my back drain overflows Lismore floods. Six hours before Lismore flooded, I knew it was going to be really, really bad.

This 'risk appraisal' involves an assessment of how likely people perceive the threat to be, how vulnerable they feel to it, and how serious the consequences might be if the threat were realised.⁷⁶¹ A person will then balance this against their perceived ability to cope with the threat, whether they are able to take action and how effective they think the recommended action might be.⁷⁶² The Inquiry observed that if the information received was not interpreted as personally relevant, it was unlikely to engender further engagement and subsequent action.

How people choose effective responses and act in a timely way, particularly in conditions of uncertainty, is subject to a range of factors including biases in decision-making, as Dr Mel Taylor explained to the Inquiry:⁷⁶³

...heuristics and biases speed up decision making but can introduce errors. For example, we tend to use information that comes to mind quickly when making decisions about the future. As an example, if someone receives a warning to consider evacuating but can recall an occasion when they, or neighbours, sheltered in place and nothing happened, they may put more emphasis on that recollection, discount the warning, and fail to act. Similarly, uncertainty associated with a natural hazard event, i.e., whether it will happen, whether it will affect the person or their property, mean that resources may be redirected to more certain events.

As described by Tim Harford (2020), other biases and heuristics also contribute, whether for better or worse, to individual decision-making. Harford explains that people are social animals and thus engage in normalcy bias, or 'herd mentality', taking their cues from what others are doing.⁷⁶⁴ Or, even if people understand the risk and know someone will be affected, they might exhibit optimism bias and assume it will affect someone else.⁷⁶⁵ People are also quite good at engaging in wishful thinking, and find reasons to justify ignoring risks.⁷⁶⁶ Perhaps most interestingly, Harford surmises

⁷⁵⁹ Bushfire and Natural Hazards CRC. (2020). Addressing Conflicting Cues During Natural Hazards: Lessons From Emergency Agencies, Hazard Note, Issue 72. Retrieved from <https://www.bnhcrc.com.au/hazardnotes/72>.

⁷⁶⁰ See [NSW floods update: Driver under investigation after bus driven through flood waters in Sydney | Sunrise \(7news.com.au\)](#) and [Northern NSW Besieged Under Record Flood Waters - Bing video](#).

⁷⁶¹ Dr Taylor (2022).

⁷⁶² Ibid.

⁷⁶³ Ibid.

⁷⁶⁴ Harford, Tim. (2020). Why we fail to prepare for disasters, Financial Times. Retrieved from <https://on.ft.com/36PGKNF>.

⁷⁶⁵ Ibid.

⁷⁶⁶ Ibid.

that people are inherently short-sighted, and are particularly bad at understanding risks that have an exponential driver.⁷⁶⁷

There is also a broad range of demographic, socioeconomic, social, and situational factors that influence the effectiveness of warnings and understanding of risk. This includes cultural heritage, age, household composition, dependent others, health status, animal ownership, availability of and access to transport, and behaviours of others/social norms.⁷⁶⁸ Many of these demographic factors, and their implications for flood risk management at an individual and community level, are described in the Hawkesbury-Nepean Valley case-study in Volume Three.

When considering relocation of high-risk areas, people are confronted with an array of economic, emotional, risk and social challenges

It is natural that following disasters of a certain scale, or recurrent disasters, the question 'should people live here?' arises. The answers to this question are numerous and varied and include 'this is where we have always lived', 'these are our homes' or 'we can't do this again'. More often than not, however, the question inspires further questions, such as 'where else will we go', 'how much will it cost' and 'who is going to pay'. The options that float to the top inevitably include building back, or voluntary relocation and resettlement. Regarding the latter, King, Bird, Haynes, Boon, Cottrell, Millar and Thomas (2014) explain:⁷⁶⁹

...relocating people and communities out of hazard zones, through voluntary relocation, buy-back schemes and rezoning of hazard-prone areas is not new in Australia. Gundagai in New South Wales and Clermont in Queensland provide two historical examples of township that were relocated after flood as both towns experienced severe loss of life. In Gundagai, 89 people out of a population of 250 drowned in May 1851 (Australia's worst-ever flood in terms of loss of life) and 64 people drowned in Clermont on 28 December 1916...

Another more recent example can be found at Grantham, Queensland. Following devastating flash floods in January 2011 that resulted in the death of 12 people, the local council implemented a voluntary land-swap scheme to relocate residents from the floodplain to higher ground.⁷⁷⁰

The work of this Inquiry has taken place during a broader discussion of relocating some parts of towns in NSW, primarily in Lismore and surrounds.⁷⁷¹ As such, the Inquiry has observed various attitudes to relocation ranging from staunch resistance to full support. Within a month of the recent floods, several major employers in Lismore had decided to move their operations to avoid future devastation. Lismore City Council has recommended a 'planned retreat of residential dwellings' from areas of highest flood risk,⁷⁷² and neighbouring Tweed Shire Council is strongly advocating

⁷⁶⁷ Ibid.

⁷⁶⁸ Dr Taylor (2022).

⁷⁶⁹ King, D, Bird, D, Haynes, K, Boon, H, Cottrell, A, Millar, J, & Thomas, M. (2014). Voluntary relocation as an adaptation strategy to extreme weather events. *International Journal of Disaster Risk Reduction*, 8, 83-90. doi:10.1016/j.ijdrr.2014.02.006.

⁷⁷⁰ Ibid.

⁷⁷¹ For example, see: [After two devastating floods in five years, what's next for Lismore? - ABC News](#); [Environmental Engineer Jamie Simmonds says he can help Lismore recover from flood | Newcastle Herald | Newcastle, NSW](#); [It's time to come clean on Lismore's future. People and businesses have to relocate away from the floodplains \(theconversation.com\)](#); and [Is it time to talk about Lismore's future? | Architecture & Design \(architectureanddesign.com.au\)](#).

⁷⁷² Lismore City Council, submission to the Inquiry.

for a voluntary house purchase scheme.⁷⁷³ Community submissions on the matter are mixed, though most appeared to support such schemes:

We need to consider buy back schemes, how many more times can you keep rebuilding a city before we actually do something. The cost while great would surely be better than rebuilding constantly.⁷⁷⁴ A buy-back system is good, but it doesn't prevent people from re-buying land that in a few years might be facing the same prospects as they are now.⁷⁷⁵

Every single person except one, and that's a lot of people, when I've asked "what do you think should be done" has responded, "move to higher ground" or something similar... The residents are willing indeed keen to have their homes moved to higher ground, or to live in different homes, opinions vary on this one.⁷⁷⁶

Lismore is our home & community & I want to rebuild.⁷⁷⁷

I adore Lismore and this region generally and believe that it is truly unique and I cannot imagine wanting to live anywhere else but within the broader community here. They have carried me through extremely difficult times with creativity, much laughter and incredible love & generosity and I feel that I have an important place & role here within the Northern Rivers which I do not wish to lose.⁷⁷⁸

There has been very little research on the long-term success or human impact of relocation initiatives in Australia, though it has been shown that relocation can reduce exposure to natural hazards.⁷⁷⁹ However, in an ongoing discussion about future options, and when communities are faced with decisions about resettlement or voluntary relocation, the Inquiry notes that affected residents are confronted with great uncertainty and are forced to consider profound changes to their everyday lives. Many related issues are raised where the costs are more than financial, and studies have explored the emotional, risk and social dimensions underpinning household decisions to accept or decline buyouts in voluntary schemes or resettlement.⁷⁸⁰

For instance, negative risk appraisal – including traumatic memories of the event and perceived ability to cope with a future event – is identified as an influencing factor and major catalyst for considering relocation after disaster.⁷⁸¹

Following the recent floods, many community members said they feel bleak about their ability to cope with any further disaster events, and have expressed their desire to relocate. Yet, for many of these people, the potential 'benefits' of lower risk and more affordable insurance, are outweighed by a range of limitations, chief among them financial commitments like renting or home ownership.⁷⁸² These issues were raised by community members in submissions to the Inquiry:

We need to move the town but there's no housing and no incentive. People need a land swap to build elsewhere, and there are about 20,000 people homeless and sheltering in a room or balcony or garage or storage shed.⁷⁸³

⁷⁷³ Meeting with Tweed Shire Council on 4 May 2022.

⁷⁷⁴ Samantha Brown, submission to the Inquiry.

⁷⁷⁵ Anonymous, submission to the Inquiry.

⁷⁷⁶ Helen Robinson, submission to the Inquiry

⁷⁷⁷ Anonymous, submission to the Inquiry.

⁷⁷⁸ Anonymous, submission to the Inquiry.

⁷⁷⁹ Seebauer, S., & Winkler, C. (2020). Should I stay or should I go? Factors in household decisions for or against relocation from a flood risk area. *Global Environmental Change*, 60
doi:10.1016/j.gloenvcha.2019.102018.

⁷⁸⁰ Ibid; King et al (2014).

⁷⁸¹ Dr Taylor (2022)..

⁷⁸² Ibid.

⁷⁸³ Meaghan Vosz, submission to the Inquiry.

*We are hoping that the government will look at buy backs for our area, otherwise we will have to stay and face this situation again. We now feel economically trapped in our home.*⁷⁸⁴

Many of these factors were also described by Okada, Haynes, Bird, van den Honert and King (2014) as swaying individual decision makers in choosing not to participate in moving the town of Grantham:⁷⁸⁵

...some impacted residents who initially decided to participate in the project have chosen to opt out and there are others who chose not to participate from the start. Some of these residents have left the community, others plan to leave while some have chosen to stay and repair their existing home. Potential reasons for not participating are financial constraints. For example, residents who cannot afford to demolish their existing house in the original location and/or cannot build a new home in the resettlement site after land-swapping may choose to stay and repair their damaged houses.

Other factors considered in deciding whether to accept or decline voluntary buy-out or resettlement include livelihood opportunities, family commitments, and emotional ties or attachment to place.⁷⁸⁶ The structure and administration of programs for relocation can also highlight social justice issues,⁷⁸⁷ as well as trust in authorities. Many submissions to the Inquiry were critical of the level of government support being offered, commenting on community freedom of choice and lack of agency in the discussion, whilst similarly criticising timing (the perceived delay in making a decision), and general framing of the issue by external media (and politics) within and external to the community. For example:

*The announcement of the Northern Rivers Reconstruction Corporation is welcome but its value will depend on the results achieved, how communities are directly assisted and respectfully engaged, and the time it takes for the Corporation to start to make a difference.*⁷⁸⁸

*Announcements of State and Federal Government financial assistance packages do not always become a realistic practical experience. These announcements sound great in the media, but are often unattainable.*⁷⁸⁹

*The magnitude of this disaster is difficult to convey... This has allowed the government and the insurance industry to delay making any commitment to the future of Lismore.*⁷⁹⁰

5.2. The ways in which we perceive and respond to risk affects our ability to recover from, and build resilience to, flood (and other natural disaster)

Throughout Inquiry consultations, various stakeholders would often note that in the immediate aftermath of a disaster, there is a high level of community and government engagement in the risk. Resources are made available, and there is a strong commitment to disaster risk reduction and

⁷⁸⁴ Vicki Findlay, submission to the Inquiry.

⁷⁸⁵ Okada, T., Haynes, K., Bird, D., van den Honert, R., & King, D. (2014). Recovery and resettlement following the 2011 flash flooding in the Lockyer valley. *International Journal of Disaster Risk Reduction*, 8, 20-31. doi:10.1016/j.ijdr.2014.01.001.

⁷⁸⁶ Ibid.

⁷⁸⁷ Frost, L., & Miller, F. (2021). Planning for social justice, anticipating sea level rise: the case of Lake Macquarie, Australia, *Australian Geographer*, 52:2, 171-190, doi: 10.1080/00049182.2021.1917327.

⁷⁸⁸ Anonymous, submission to the Inquiry.

⁷⁸⁹ Fiona Wagner, submission to the Inquiry.

⁷⁹⁰ Anonymous, submission to the Inquiry.

readiness activities. However, sustaining this level of interest in risk management activities can be challenging in the absence of a recent disaster event or an elevated threat.

It is the Inquiry's observation that it is not uncommon for the 'long tail' of disasters to enable a sort of 'collective amnesia', which in turn makes a collective volte-face possible – leaving behind those most affected. The news cycle enables this forgetting as it moves onto the next spectacle, by which time transient populations and intergenerational changes further erode remembering. This collective amnesia following a disaster event promotes inertia and inhibits decisive and necessary action in preparing for and building resilience against future events. It also fosters dangerous assumptions in disaster preparations, for example, the inherent assumption in evacuation modelling that everyone will heed alerts and warnings uniformly and respond in the intended and desired way – which is not the case as explored above.

Another salient example of waning interest in disaster preparedness on 'good-weather days' is our failure to prioritise resilience over efficiency. People who have a low income may not take a long-term approach to resilience as they are living day-to-day. But the Inquiry has also observed that the uncertainty associated with a flood or natural hazard event (whether it will happen, what its impact may be, and what areas will be affected) means that when resources are available, they may be redirected to more certain events, and that the cost of being fully prepared for flood can be more than people are willing to pay. This is true at an individual and collective level. Within the logic of day-to-day efficiency, it is not easy to justify household investment in flood mitigation when there are more immediate or pressing needs, like school expenses or household repairs. And at government level, it is similarly difficult to justify investment in research or emergency capacity that may never be called upon. As was explored in greater detail in Section 1.1, the Inquiry notes that a number of recommendations from previous inquiries and reviews into flood and disaster have not been implemented or delivered.

People, communities and governments are constantly juggling competing priorities for their time, mental resources and money. As posited by Professor Alexander (Sandy) McFarlane AO, former Director of The University of Adelaide's Centre for Traumatic Stress Studies, the issue becomes "how do you create narrative and discourse that keeps these issues alive in a reasoned way?".⁷⁹¹

Different people may experience a range of mental health issues at different stages in the long tail of a disaster

During, and in the immediate wake of, a flood or disaster, many people experience varied and intense emotional reactions. Adrenaline fuelled rescues and a short 'honeymoon' period following survival may coincide with, or dissolve into, fear, exhaustion and acute stress. Chapter 3 above briefly explores this 'cognitive overload'⁷⁹² in the immediate response to a disaster event. Though many people will generally recover in the weeks and months following an event and are able to maintain a healthy level of function, some people will experience mental health conditions in the months and even years following the initial event.

As Professor McFarlane explained to the Inquiry, this is because there are two primary dimensions by which people are affected by disaster – those for whom the trauma is imprinted upon them and whose future experiences are then looked at through the lens of the disaster event, and those for whom the trauma is challenging to process and who become intensely avoidant of the event and any reminders.⁷⁹³

Each dimension can bring with it associated mental health effects. These effects may present quickly and endure over an extended period. For example, delays in support due to unsafe conditions, geographical barriers and/or loss of essential services post-disaster can prolong trauma

⁷⁹¹ Meeting with Professor Sandy McFarlane on 20 June 2022.

⁷⁹² Meeting with NSW Ambulance on 8 June 2022.

⁷⁹³ Meeting with Professor Sandy McFarlane on 20 June 2022.

and exacerbate emotional distress.⁷⁹⁴ But the mental health effects of disaster may also lie dormant and present sometime after the disaster event itself. Long-term mental health issues are linked to ongoing stressors post disaster, such as social disruption and/or the practical challenges of rebuilding (including access to housing, insurance and securing financial assistance).⁷⁹⁵

As a result, natural disasters give rise to increased rates of depression, anxiety, post-traumatic stress disorder (PTSD), alcohol and substance abuse, anger and violence, poor sleep quality and complicated grief.⁷⁹⁶ A study by Alderman, Turner and Tong (2013) examined the impacts of the 2011 Brisbane floods, and found people affected by the floods were 1.9 times more likely to report psychological distress, 2.3 times more likely to report poor sleep quality, and 2.3 times more likely to develop PTSD than the general population.⁷⁹⁷

There has also been an observed correlation between severe earthquakes, floods and other natural disasters and increased suicide rates,⁷⁹⁸ and stakeholders told the Inquiry that the 6 months post-disaster is critical for people experiencing heightened suicidal risk.⁷⁹⁹

In addition to the various stages at which people experience the mental health effects of disaster, various groups within a community are more susceptible to such effects. Vulnerable people, including the elderly, women, disabled people, people with existing mental health conditions or from low-socioeconomic backgrounds, in addition to those most exposed to and/or affected by the disaster, are at higher-risk of post-disaster mental health issues.⁸⁰⁰ Importantly, children are particularly vulnerable to ongoing mental health effects post-disaster, which can result in a sense of instability, danger and poorer educational outcomes.⁸⁰¹

K. Finding – compound mental health studies

Despite the many studies which examine the mental health effects of natural disaster, very few have explored the impact of compound events, or the effects of consecutive disasters on individual or community mental health and resilience.

13. Recommendation – compound mental health studies

That, to inform Government policies and programs for mental health and disasters, Government commission a longitudinal study on the effect of consecutive disasters on community mental health.

⁷⁹⁴ The Royal Australian and New Zealand College of Psychiatrists. (2020). Addressing the Mental Health Impacts of Natural Disasters and Climate Change-Related Weather Events. Retrieved from <https://www.ranzcp.org/newspolicy/policy-and-advocacy/position-statements/addressing-the-mental-health-impacts-of-natural-di>.

⁷⁹⁵ Black Dog Institute. (2020). Mental Health Interventions following disasters. Retrieved from [mental-health-interventions-following-disasters-black-dog-institute-february-2020.pdf \(blackdoginstitute.org.au\)](https://www.blackdoginstitute.org.au/mental-health-interventions-following-disasters-black-dog-institute-february-2020.pdf)

⁷⁹⁶ Goldmann E, & Galea S. (2014). Mental health consequences of disasters. *Annu Rev Public Health*; 35: 169-83.

⁷⁹⁷ Alderman, K, Turner, L and Tong, S. (2013). Assessment of the Health Impacts of the 2011 Summer Floods in Brisbane. *Disaster Med Public Health Prep* 7(4). 380–386.

⁷⁹⁸ Krug, EG, Kresnow, M, Peddicord, JP, Dahlberg LL, Powell KE, Crosby, AE, & Annest JL. (1999). Suicide after natural disasters. *N Engl J Med*. Jan 14;340(2):148-9. doi: 10.1056/NEJM199901143400213.

⁷⁹⁹ Meeting with Nicole Scurrah on 8 June 2022.

⁸⁰⁰ Meeting with Professor Sandy McFarlane on 20 June 2022.

⁸⁰¹ Goldmann E et al (2014).

A note on community resilience

In line with the various stages at which individuals recover, Mr Ben Hubbard, former Chief Executive Officer of the Victorian Bushfire Reconstruction and Recovery Authority, told the Inquiry that communities within communities also recover and build resilience at variable speed.⁸⁰² Though we typically conceptualise communities affected by natural disaster based on groups bounded by geography, these geographic groups are made up of smaller communities bonded by common interests and affiliations, such as culture, religion, sport, schools etc.⁸⁰³ This can mean that, within an affected location, different communities will follow a range of different trajectories during recovery and may therefore be at different stages at any given time.⁸⁰⁴

To build community resilience, these stages need to be recognised and accommodated,⁸⁰⁵ and it follows that community resilience is hard to operationalise.⁸⁰⁶ Because of this, some communities may never 'recover', with limited ability to adapt and transform after disasters, and may be left more vulnerable.⁸⁰⁷

The Grantham example – striking while the iron is hot

Above, the report explores community resilience and the difficulty in operationalising this due to the many stages of individual and community recovery. Key in this discussion has been timing, with delay being shown to generally exacerbate and aggravate trauma and mental health effects and hinder recovery and resilience.

The Inquiry notes there is a balance between striking while the iron is hot and moving with speed, not haste. In relation to relocation particularly, a significant barrier to effective relocation is timing and social factors – where fast, top-down, decision-making is based on desultory planning, and limited or no consultation.⁸⁰⁸ Reflecting on the relocation of Grantham following devastating flooding on 10 January 2011, Okada et al (2014) describe the fast decision-making process of Lockyer Valley Regional Council (LVRC) in moving Grantham.⁸⁰⁹

On the morning following the flood, it was clear that parts of Grantham had been destroyed and what remained was severely damaged. After witnessing the destruction, the LVRC Mayor recalled thinking "If you're ever going to make a change, now's the time to do it". This was the stimulus for action by the LVRC, who immediately set about discussing better options before rebuilding in flood affected areas commenced.

"So within days, this discussion immediately started... We felt really strongly that it's ridiculous to build this thing back in the position where this may happen. Well, this may be 1 in 2000 years, may be... 1 in 10,000 years, we don't know. But the reality is 'it has happened before'... we know it happened in our lifetime, we need to look for something better."

...the LVRC made a critical decision to act quickly, finding a non-flood prone land parcel for community resettlement close by. They wished to provide certainty quickly and establish a clear vision of the future for the community. It was supported by a number of residents, who were faced with difficulties such as declining land values and a lack of existing flood-free

⁸⁰² Meeting with Ben Hubbard on 17 June 2022.

⁸⁰³ Dr Taylor (2022)..

⁸⁰⁴ Norris FH, Tracy M, & Galea S. (2009). Looking for resilience: understanding the longitudinal trajectories of responses to stress. *Soc Sci Med.* Jun;68(12):2190-8. doi: 10.1016/j.socscimed.2009.03.043.

⁸⁰⁵ Meeting with Professor Sandy McFarlane on 20 June 2022.

⁸⁰⁶ Dr Taylor (2022); Mayer B. (2019). A Review of the Literature on Community Resilience and Disaster Recovery. *Curr Environ Health Rep.* Sep;6(3):167-173. doi: 10.1007/s40572-019-00239-3.

⁸⁰⁷ Ibid.

⁸⁰⁸ Okada et al (2014).

⁸⁰⁹ Ibid.

residential lots. The LVRC decided on eliminating the risk of future flooding, rather than simply mitigating it.

Key to realising LVRC's vision was the Queensland Reconstruction Authority (QRA). A new development area was purchased by the LVRC in April, during which time Grantham was also declared a Reconstruction Area through the *Queensland Reconstruction Authority Regulation 2011*. This enabled works to commence and be fast-tracked. A Master Plan prepared by LVRC was released 4 May 2011 following extensive input from community, and on 11 May 2011 the QRA released the Proposed Development Scheme for the Grantham Reconstruction Area. This provided the regulatory framework to support the delivery of the Master Plan. By mid-2011, the Development scheme took effect.⁸¹⁰

Close collaboration between the community, QRA and LVRC enabled the town to be moved in just 11 months, at a cost of \$18 million to the national and Queensland governments.⁸¹¹

Many stakeholders commented to the Inquiry that the Grantham experience was a good example of local, state and national governments working with community to 'strike while the iron was hot'⁸¹², whereby fast, consultative decision-making took advantage of appropriate opportunities as they presented.

The importance of collaboration between all sectors, as well as strong community engagement and participation in any proposed relocation or resettlement program, is also a key finding of Okada et al (2014).⁸¹³

5.3. What can be learnt for future disasters?

In summary, the flood or disaster itself – though devastating – is quite straightforward and we know that there are going to be more of them. It is not a matter of if but when (and the when could be sooner than expected). However, human behaviour, individually and collectively, in anticipation of and responding to disaster risk is always going to be complex and multi-faceted. The challenge for Government is accommodating this complexity in decision-making at all levels prior to, during and following a disaster event in order to nurture broader resilience. As summarised by the Productivity Commission's 2015 Report on Disaster Funding:⁸¹⁴

Governments can do better in terms of policies that enable people to understand natural disaster risks and also to give them the incentive to manage the risks effectively.

The Inquiry notes that information on hazard and risk exposure has improved significantly in recent years, and there are good examples globally and interstate of systemic solutions and approaches to understanding risk. For example, the first priority of the United Nations Office for Disaster Risk Reduction (UNDRR) Sendai Framework for Disaster Risk Reduction is 'Understanding Risk'. The UNDRR states:⁸¹⁵

UNDRR wants to break the cycle of disaster > response > recovery > repeat...

At the heart of UNDRR's approach is the idea of reducing risk, not just preventing disasters; building resilience and making risk-informed investment – social, economic and environmental

⁸¹⁰ Queensland Reconstruction Authority. (2022). Case Study: Rebuilding Grantham Together in 2011. Retrieved from [rebuilding-grantham-full.pdf \(qra.qld.gov.au\)](https://www.qra.qld.gov.au/rebuilding-grantham-full.pdf).

⁸¹¹ Okada et al. (2014).

⁸¹² Meeting with QRA on 23 May 2022.

⁸¹³ Okada et al (2014).

⁸¹⁴ Productivity Commission. (2015). Natural Disaster Funding Arrangements. Retrieved from [Inquiry report - Natural Disaster Funding - Productivity Commission \(pc.gov.au\)](https://www.pc.gov.au/inquiry-report-natural-disaster-funding).

⁸¹⁵ United Nations Office for Disaster Risk Reduction. (2022). Retrieved from [UNDRR Understanding Risk](https://www.unisdr.org/we/information/publications-and-reports/2022/01/undrr-understanding-risk)

– the norm. It recognizes that resilience is not just about bouncing back, and that investment is not just about building back better. Radical transformation is needed. Political momentum and commitment to act must transcend election cycles. It means that the private sector must be brought on board, not despite their profit-making agenda, but because of it, in the interest of sustainability. It means that the most vulnerable must drive change, rather than be the recipients of it.

Within Australia, the QRA coordinates the ‘Get Ready Queensland’ program – a year-round, all hazards, resilience building initiative.⁸¹⁶ This program is increasing community resilience and preparations through its public website which provides resources on alerts and warnings, understanding risk, preparation activities, phases of disaster and relevant news. The program is supported by \$2 million in state government funding, to support local government in improving their resilience. QRA administers the funding, supported by guidelines, templates and acquittal processes.⁸¹⁷ Councils are further able to access the Get Ready Queensland Council Hub for downloadable resources and funding information.⁸¹⁸

And, at a campaign level, communications are becoming increasingly user-centred, consequence-based and designed to encourage action.⁸¹⁹ Warnings include advice on what action to take rather than identifying or emphasising the severity of the risk. For example, messages about driving through flood water have shifted from ‘if it’s flooded, forget it’ to ‘back it up and turn around’⁸²⁰.

The intent and effect of each of these initiatives is to increase community awareness of hazards and perception of risk before or as the risk materialises, and to drive decisive action when and if action is required.

But more must be done to ensure people are informed about hazards and to develop personal agency and capacity to deal with risk, before, during and after a disaster event – thus, building community capacity to also deal with risk in a proactive way. There are immediate opportunities to improve risk information sharing, communication, consistency and education.

To build intergenerational resilience and sustain disaster discourse in a reasonable way, it is critical that we build intergenerational understanding of disaster risk – with a particular focus on young people and children. As summarised by the UNDRR:⁸²¹

Children and youth under age 30 currently make up more than half the world’s population. They are the ones who will benefit most from reducing disaster risk and impacts, curtailing climate chaos ... their contributions are already making a difference for more inclusive DRR [Disaster Risk Reduction] and resilience-building policies, more prepared households, healthier children and youth, and safer communities. However more can, and must, be done to support and engage children and youth around the world in DRR ...

The Advocate for Children and Young People in its submission to the Inquiry identified school education as a mechanism to build an understanding of risk.⁸²²

⁸¹⁶ QRA. (2020). Get Ready Queensland. Retrieved from [Get Ready Queensland | Queensland Reconstruction Authority \(qra.qld.gov.au\)](https://www.qra.qld.gov.au/).

⁸¹⁷ Ibid.

⁸¹⁸ Ibid.

⁸¹⁹ Dr Taylor (2022).

⁸²⁰ Hamilton, K., Peden, A. E., Keech, J. J., & Hagger, M. S. (2018). Changing people's attitudes and beliefs toward driving through floodwaters: Evaluation of a video infographic. *Transportation Research Part F: Traffic Psychology and Behaviour*, 53, 50-60. doi:10.1016/j.trf.2017.12.012.

⁸²¹ UNDRR. (2020). Words into Action guidelines: Engaging children and youth in disaster risk reduction and resilience building. Retrieved from [Words into Action guidelines: Engaging children and youth in disaster risk reduction and resilience building | UNDRR](https://www.undrr.org/publications/words-into-action-guidelines-engaging-children-and-youth-in-disaster-risk-reduction-and-resilience-building/).

⁸²² Advocate for Children and Young People, submission to the Inquiry.

In our consultations, many children and young people discussed the need to learn about different disasters and what to do in disaster situations. They agreed that school was an ideal setting for this to occur. Children and young people reported that this education would not only assist them with knowing what they should do; it would also help them remain calm when faced with a disaster situation: “They could just educate them. So it’s not so scary. You just know how bad it can be and what to do.”

L. Findings – flood risk management at all levels

- Broad community memory of disaster is negligible, though sympathy at the time of the event is significant. Collective amnesia in the long tail following a disaster event promotes inertia and inhibits decisive and necessary action in preparing for, responding to, recovering from and building resilience against future events.
- Individuals, community and Government need to prepare and invest in disaster management proactively not reactively – and be as disaster ready as possible in an environment of uncertainty (knowing that disasters will recur but not when, where or how). And decision-makers need to accommodate the complexity of human behaviour.
- Government must promote personal agency and capacity through consistent communications and education to create more resilient communities, and to enable better flood (and other disaster) risk management at all levels (individual, community and government). Effective risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure, hazard characteristics and the environment, and should be used to inform decision making across all phases of disaster management, including risk assessment, prevention, mitigation, preparedness and response.

14. Recommendation – flood education

That, to build disaster resilience in future generations as floods and other natural disasters are a fact of Australian life, the Department of Education should design, implement and deliver an evidence-based, targeted education campaign (like sun exposure) in schools (new disaster curriculum).

Chapter

6

6. Building back better – reconstruction

In the aftermath of a flood or other natural disaster, recovery and reconstruction create heightened uncertainty in the community. The primary goal of any recovery and reconstruction process should be to reduce this collective uncertainty and restore and renew communities as quickly and collaboratively as possible.

If done well, post-disaster recovery processes offer an opportunity to address legacy or long-standing issues – breaking the cycle of impact and loss and strengthening the resilience of a city or region. But if executed poorly and slowly, the process and management of reconstruction and recovery following a disaster can affect the intensity and duration of the experience, heighten uncertainty, and prolong trauma and suffering.

The Inquiry consulted with various established coordinating organisations whose purpose is to achieve renewed and more resilient communities in the wake of catastrophic disaster events in Australia and around the world. The Inquiry also undertook its own research. This chapter discusses the common challenges faced by reconstruction authorities, but also why they are seen to be effective mechanisms to get people back on their feet.

The Inquiry notes the strong advocacy of Ms Janelle Saffin MP, Member for Lismore, who has called for the creation of such an entity,⁸²³ and the establishment of the Northern Rivers Reconstruction Corporation on 1 July 2022. The Inquiry suggests there is opportunity to extend the scope of that entity not only to build back from the recent floods, but also to help the state prepare for the next flood or other disaster – wherever in the state that may be. To this end, this chapter also discusses what is needed to enable and support an effective, state-wide, all-disaster reconstruction authority in NSW.

6.1. What is needed to manage reconstruction effectively

Floods cause significant damage, leaving properties wrecked and communities torn apart. The cost to replace property can be in the billions, and the social cost of adverse mental and physical health effects, as well as disruption to livelihoods and education, equally great.

For governments the general imperative is to ensure that people affected by floods are stabilised, rehoused and successfully functioning socially and economically as quickly as possible. This involves many challenges including the following:

- marshalling, managing and acquitting the finances needed to manage temporary arrangements and then restoring or constructing infrastructure and housing
- ensuring all relevant agencies (and levels of government) work together to support those affected while establishing and managing the processes involved in rebuilding and reconstruction
- doing all this at speed, and trying to be flexible about the application of regulations and the ‘usual arrangements’ (e.g. the planning system)
- making decisions on whether and what to fix or rebuild; and, if the damage is great and the area is highly flood prone, whether to build back in a new less risky location. This latter option

⁸²³ Janelle Saffin MP, Member for Lismore, submission to the Inquiry.

requires balancing possible community resistance to relocation with the recurrent cost of such flooding recurring – which includes the continued drain on the public purse, the risk of a recurrence of flood trauma to flood victims, and the ability for house-owners to obtain building insurance

- keeping affected communities involved, informed and functioning at least to some degree through the rebuilding process.

As Johnson and Olshansky (2013) note:

*... governments tasked with post-disaster reconstruction face an extraordinary set of management challenges. The first is the compression of activities in time, focused in space, as cities built over the course of decades if not centuries are destroyed or damaged suddenly and must be rebuilt in a fraction of the time it took to construct them. From this tension develops a second challenge: a keen tension between speed and deliberation, as the various recovery actors in stricken communities move with urgency while aiming to make thoughtful and deliberate decisions, to ensure optimal long-term recovery. From both these phenomena a third challenge arises: the need for immediate access to a deep wealth of money and information—the two currencies of the post-disaster recovery environment.*⁸²⁴

And they go on:⁸²⁵

... to meet these demands, governments in every country after every large disaster create new relief agencies or significantly rearrange existing organizations. The most common reason for these post-disaster governance transformations is lack of capacity. Governments still need to attend to their normal daily affairs while they coordinate the reconstruction or reinvention of impacted communities, so they appoint an entity that can focus daily attention on rebuilding while coordinating the recovery-related activities of multiple government agencies. Commonly designed to serve a variety of purposes and governmental settings, these recovery agencies provide a range of substantive functions as they rebuild infrastructure, housing, and economic activity. They differ depending on the type and scale of coordination they provide; the scope of their authority, especially regarding the flow of money and information; and the level of government they serve—at either the national, state, or intergovernmental level.

Examples of disaster recovery/reconstruction agencies include:

- Queensland Reconstruction Authority (QRA), established as a temporary body in 2011 in response to unprecedented natural disasters that struck Queensland over the summer of 2010–11, and to deal with the rebuild of Grantham, and made a permanent body in 2015
- Canterbury Earthquake Recovery Authority (CERA), also established in 2011 to lead and coordinate the New Zealand Government's response and recovery efforts following the earthquakes of 2010 and 2011 in Canterbury. CERA was disestablished in April 2016
- Victorian Bushfire Reconstruction and Recovery Authority (VBRRA), established in 2009 to coordinate the recovery of communities affected by the 2009 Black Saturday bushfires
- Nepal Reconstruction Authority established following the 2015 Nepal earthquake
- Louisiana Recovery Authority created following Hurricanes Katrina and Rita.

The Inquiry also notes the work of the United Nations Office for Disaster Risk Reduction, which has developed the *Sendai Framework for Disaster Risk Reduction 2015–2030*. This Framework advocates for “the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses,

⁸²⁴ Johnson, A & Olshansky, R B. (2013). The road to recovery: Governing post-disaster reconstruction. Retrieved from: <https://www.lincolnst.edu/publications/articles/road-recovery>.

⁸²⁵ Ibid.

communities and countries” and provides member states with concrete actions to protect development gains from the risk of disaster.⁸²⁶

The Inquiry consulted in detail with those involved in establishing and running the QRA, consulted some of those involved with CERA and VBRRRA, and studied literature on responding to and rebuilding post disasters. From this work, the Inquiry echoes Johnson and Olshansky’s (2013) statement that “the key to governing large-scale crises effectively is the mastery of money, information, collaboration, and time”. It would add that the relevant reconstruction agency also needs highly proactive leadership at the political and executive levels, with a strong focus on delivery along with excellent convening and consultation skills.

NSW currently covers this space somewhat differently. Its nearest match to QRA, the VBRRRA or CERA is some of the recovery responsibilities of Resilience NSW in conjunction with the Northern Rivers Reconstruction Corporation which only commenced on 1 July 2022.

The question for Government is whether this responsibility structure is sufficient to respond to the major disaster that is the 2022 floods, or whether a different type of authority is needed. Is now the time to take the opportunity to build back from these disasters while preparing for the next through the creation of a permanent reconstruction authority covering all types of disasters? The question is particularly relevant given that the extreme forest fires last seen in 2019–20 are highly likely to recur and that floods are again likely in vulnerable areas with dense population, including the Northern Rivers region and the Hawkesbury-Nepean Valley as explained in the Inquiry’s case studies.

To help tease this issue out it is worth examining the key characteristics of successful reconstruction/recovery authorities provided in the Johnson and Olshansky (2013) study:⁸²⁷

1. Managing Money: Sourcing and distributing recovery funding efficiently, effectively, and equitably.

When large amounts of public funds are involved in a disaster cleanup, the true power over the recovery resides with the level of government that controls the flow of money and how it is acquired, allocated, disbursed, and audited. Sometimes, the recovery organization assumes all or some of these powers, and sometimes all funding authority continues to reside where it did before the disaster, in the same legislative and administrative branches. Important functions in the post-disaster environment include setting policies and priorities for allocating large sums of recovery funding and establishing accounting systems that allow for timely disbursement of critical financing while also providing transparency and minimizing corruption.

2. Increasing Information Flows: Effectively gathering, integrating, and disseminating information to enhance decision making and actions by all recovery actors.

A critical demand is to accelerate and broaden the flows of information among recovery actors about the dynamics of reconstruction actions and emergent opportunities. This challenge includes the planning and public engagement processes that provide information to citizens and institutions involved in the recovery, facilitate communication and innovations among recovery actors, and convey citizen concerns to government agencies and NGOs in a timely manner. It also includes providing information between both governmental and nongovernmental organizations and establishing forums to facilitate coordination. ...

A critical function appropriately provided by a government-supported agency is the acquisition, synthesis, and distribution of basic information on damage, reconstruction activities, population,

⁸²⁶ UNDRR (United Nations Office for Disaster Risk Reduction). (2022). What is the Sendai Framework for Disaster Risk Reduction. Retrieved from: <https://www.undrr.org/implementing-sendai-framework/what-sendai-framework>.

⁸²⁷ Johnson & Olshansky (2013).

social and economic issues, and various recovery indicators. Such agencies issue regular progress reports and monitor recovery indicators.

3. Supporting Collaboration: Building sustainable capacity and capability for long-term recovery through genuine collaboration and coordination, both horizontally among local groups and vertically among different levels of government.

Vertically organized, hierarchical agencies—with clear organizational charts and streamlined channels of communication—are usually not well suited to manage disaster recovery, because the lack of “connecting flow” across vertical hierarchies limits collaboration as well as the flow of new and updated information among organizations. U.S. national agencies involved in recovery, for example, are more adept at administering individual programs than they are at solving complex problems that cut across governmental institutional boundaries. ...

By contrast, horizontally organized agencies can promote interagency coordination and information sharing, allowing individual groups to adapt to new contexts and information while remaining responsible to their parent organization. If multiple states or local jurisdictions are involved, cooperation among multiple jurisdictions is essential. Technical assistance and capacity building for the key recovery actors is also important for building local capabilities to sustain long-term recovery. ...

Because they carried the authority of state leaders, India’s GSMDA and Queensland Australia’s reconstruction authority were able to successfully coordinate the activities of other state agencies. ...

This trend strongly suggests that governments should resist the urge to manage the details of reconstruction and act less as managers and more as coordinators and facilitators of the process.

4. Balancing Time Constraints: Effectively meeting the immediate and pressing local needs of recovery while also successfully capitalizing on opportunities for longterm[isic] betterment.

Governments face a balancing act as they confront the tensions between speed and deliberation, and between restoration and betterment. The most fundamental way to address these challenges is to increase information flows, as described above. But recovery agencies have found several other specific ways to attain both speed and improvement. To hasten reconstruction, there are often opportunities to streamline normal bureaucratic processes of decision making, especially regarding construction permits, without compromising quality. Because such processes often involve multiple agencies, a recovery agency can be helpful to the extent that it can facilitate or compel line agencies to cooperate more effectively.” ...

Most recovery agencies include disaster risk reduction in their reconstruction policies. A common recovery slogan is “build back better.” The slogan of the Louisiana Recovery Authority was “Safer, Stronger, Smarter.” The easiest form of post-disaster betterment is to adopt disaster-resistant building standards. The incorporation of new structural standards need not slow down the rebuilding process, but land use improvements such as relocating neighborhoods or entire communities can require considerable time for planning and land acquisition. These projects involve difficult tradeoffs between speed, design quality, and public involvement. ...

One way to manage these goals simultaneously is to support participatory planning processes to create long-term betterment while also trying to meet immediate needs. In many cases, professional planners worked with neighborhoods—in Japan, Chile, New Orleans, and Bhuj, India, for example—but each project also involved difficult compromises in order to meet time constraints. Victoria and Queensland’s creation of local recovery planning committees, however, are great examples of state and national support systems that helped build local capacity to carry forward the rebuilding processes over time.

And the Inquiry would add two more:

5. Not letting the perfect be the enemy of the good

Many of those consulted on reconstruction from disaster emphasised the need to keep the focus on getting affected communities back to functioning as successful and coherent entities as quickly as possible. This can require the making of early calls, hard choices and compromises on issues such as design, location and funding. These ‘no-regrets’ decisions will be contested, but so long as consultation and collaboration with those affected and their representatives occur, the ultimate outcomes are more likely to be broadly accepted.

6. Leading special disaster-avoidance projects

As noted above, many reconstruction bodies also have disaster prevention and avoidance activities in their remit. Sometimes the reconstruction authority’s focus is on getting projects scoped and started and then checking on completion and maintenance. Sometimes the authority owns the project on an ongoing basis. While many special projects are about infrastructure, some may be on other aspects of prevention or avoidance. For example, QRA has a significant education role, running the Get Ready campaign each year.

These 6 characteristics were all emphasised as important features of QRA, CERA and the VBRRA.

With the partial exception of the Northern Rivers Reconstruction Corporation, NSW has no one body which has these 6 characteristics and uses them to get communities back on their feet quickly and effectively; and which works to minimise the harm from highly likely future disasters. Without such a body, reconstruction activities inevitably gear up slowly, and little is done at state level to prepare for the impact of an even bigger disaster, for example the disaster that would happen were a saturated Hawkesbury-Nepean Valley to receive rainfall of the scale that occurred in the Northern Rivers region in February-March 2022.

M. Finding – permanent reconstruction agency

NSW is at significant risk of yet more major disasters. These will be challenging and expensive to prevent and to respond to. The state would benefit from having a permanent reconstruction agency which begins the reconstruction process as the disaster strikes and thus works to ameliorate community devastation and, better still, provides education and infrastructure before a disaster strikes that minimises the harm from a disaster.

15. Recommendation – NSW Reconstruction Authority

That, to provide rapid and effective recovery from floods (and other disasters) and to provide maximum mitigation of the impacts of future floods (and other disasters), Government establish a permanent state-wide agency, the NSW Reconstruction Authority (NSWRA) dedicated to disaster recovery, reconstruction and preparedness. The NSWRA should:

- source and acquit reconstruction funding from state, Australian Government and philanthropic sources and ensure it is distributed and spent efficiently, effectively, and equitably to get the affected communities functioning again successfully in minimum time. A disaster-preparedness funding envelope should be a permanent feature of the state’s budget (NSW Adaptation Fund) with specific drawdown

arrangements negotiated as soon as a disaster occurs

- work with appropriate agencies to ensure disaster relief grants schemes are put into place quickly and ensure rapid and effective distribution of disaster relief grants
- be the clear lead agency responsible for managing and coordinating Government's program of housing and infrastructure renewal and recovery within disaster-affected communities, with a focus on working with community, business, state and local government partners (particularly planning, infrastructure, water and roads agencies and utilities) to deliver best practice and rapid effective expenditure of public reconstruction funds. For this it should be given appropriate authority to accelerate or override planning arrangements (in particular, local government planning, environmental and land management controls, provisions and regulations) in affected and high-risk areas and, as necessary, compulsorily acquire or subdivide land
- ensure there is appropriate project management, monitoring, evaluation and reporting of recovery implementation and associated civil engineering and public works at both a state and local level
- develop effective information flow and consultation mechanisms which ensure a clear voice in crisis but also a broader engagement process during the rebuilding phase, so all those affected in a disaster are supported, consulted and informed throughout the recovery and reconstruction process
- in line with the Government's vision to build a more disaster-robust state, be the state's lead agency responsible for disaster prevention. In this role, NSWRA would work collaboratively with key stakeholders (at risk communities, local government and the private, research and philanthropic sectors) to improve risk reduction and disaster adaptation particularly in high-risk areas. In particular, it should work with disaster-prone communities, local government and agencies across state government to develop a State Disaster Mitigation Plan and scope, source funding for and lead special disaster-prevention and mitigation projects identified in that Plan
- contribute to Government's objectives for the community – creating jobs, homes and a strong economy, especially in the regions, protecting the environment and building safe, caring and connected communities by:
 - administering funding under disaster recovery funding arrangements and assisting local governments to achieve value for money outcomes in their reconstruction programs
 - providing advice and support to local governments to maximise the effectiveness of their disaster preparedness and reconstruction programs
 - coordinating disaster recovery activities that help communities recover from disasters and build their preparedness for future events.

Further, it is recommended that the NSW Reconstruction Authority be established and function under dedicated legislation [*the NSW Disaster Reconstruction Act*] that is modelled on the Queensland Reconstruction Authority Act. This legislation should include that:

- the Authority be allocated to a senior portfolio to maximise its convening power and its ability to respond rapidly when disaster strikes
- its CEO be a statutory appointment and be supported by an Advisory Board (maximum 7 members) comprising community, government and industry leaders with appropriate expertise and experience related to disaster response
- Special Projects be formal constructs with appropriate links to all other relevant agencies
- transition provisions transfer the activities and assets of the Northern Rivers Reconstruction Corporation with immediate effect.

6.2. Enabling and supporting the NSWRA

As noted above, the NSW Reconstruction Authority would ideally be established and function under dedicated legislation.

The Inquiry consistently heard that the *Queensland Reconstruction Authority Act 2011* (QRA Act) was a good example of fit for purpose and effective legislation. The Act gives the QRA broad powers in defined circumstances. These include the ability to compel decisions and to ‘step in’ and assume the functions of planning authorities, both in creating plans (like NSW’s Local Environment Plans (LEPs) and State Environmental Planning Policies (SEPPs)) and in determining development applications as a consent authority. It also establishes the QRA’s main functions as they relate to planning, under ‘notices’ and ‘development schemes’ – both of which are triggered by Ministerial declaration. Other powers of the QRA, which do not directly intersect with the planning system but are still relevant, include the power to impose a ‘duty to cooperate’ with the QRA or other Queensland Government entities, and the power to compel any government entity or person to provide any information (other than personal information) reasonably required for the effective and efficient carrying out of the QRA’s functions.

The Inquiry recommends that the NSW Government use the QRA Act as a model for any cognate NSW legislation for the following reasons:

- **the QRA works – and works well**

In a 2011 Performance Management Systems audit, the Auditor-General of Queensland examined the QRA (as it existed at that time) in order to assess whether Queensland had systems in place to ensure it was fulfilling its role under the National Partnership Agreement for Natural Disaster Reconstruction and Recovery.⁸²⁸ The Auditor-General found, *inter alia*, that:

- the QRA was able to set up its functions rapidly through means including “the use of established policies and procedures from organisations with similar functions”⁸²⁹ – a suggestion consistent with NSW using the QRA Act as a model for its own legislation
- the QRA “is responding to the community’s needs through good planning and the application of relevant expertise. The diversity of activities, required to cover all aspects of

⁸²⁸ Auditor-General of Queensland. (2011). Performance Management Systems Audit. Report to Parliament No. 7 for 2011. National Partnership Agreement for Natural Disaster Reconstruction and Recovery. Retrieved from:

https://www.gao.qld.gov.au/sites/default/files/reports/rtp_national_partnership_agreement_for_natural_disaster_reconstruction_and_recovery.pdf

⁸²⁹ *Ibid*, p 2.

the disasters, has been well-managed. This has been acknowledged by the International Bank for Reconstruction and Development, a part of the World Bank Group⁸³⁰

- in administering funding, the QRA’s use of “highly experienced and skilled officers to process applications ensures a high quality of assessment of applications against the Determination. Value for money documents ... appear logical and sufficient to guide officers in a consistent manner for processing submissions”⁸³¹
- the QRA, at the time of the Auditor-General’s audit, “has met key planned milestones while continually improving processes where gaps or roadblocks appear”⁸³²

The former CEO of the Victorian Bushfire and Recovery Reconstruction Authority, Mr Ben Hubbard, who was interviewed by the Inquiry, also expressed the view that the QRA works well.

- **no unprecedented expansion of government powers involved**

Using the QRA Act as a model for cognate legislation in NSW would not involve the grant of any fundamentally novel powers to a NSW Government agency.

Every material function of the QRA has either a precedent or an analogue in NSW legislation. For example, under the now-repealed *Nation Building and Jobs Plan (State Infrastructure Delivery) Act 2009*, the Co-ordinator General had functions to compel co-operation, to carry out development and to override the provisions of the *Environmental Planning and Assessment Act 1979* – all functions with equivalents under the QRA Act which the Inquiry recommends be instituted in a NSW Reconstruction Authority.

Legislation establishing the NSWRA

The legislation establishing a NSW Reconstruction Authority would necessarily involve the following elements in order to support the findings and recommendations of the Inquiry as set out above.

Objects of the Act

Any legislation requires a robust and clear series of objects. The 4 characteristics of successful reconstruction authorities outlined above, as well as the Inquiry’s 2 additional characteristics, should form the basis of those objects in the new Act. Specifically, the objects must address:

- managing money – see below for how the object can be addressed in the legislation
- increasing information flows
- supporting collaboration
- balancing time constraints
- not letting the perfect be the enemy of the good – which in practice would involve an object prioritising rapid responses and potentially also provisions shielding certain decisions of the authority (particularly time sensitive decisions) from certain types of review (e.g. merits appeal in the courts)
- leading special disaster avoidance projects, including mitigating the impacts of disasters through appropriate evacuation planning.

The legislation would also benefit from provisions analogous to section 3 of the QRA Act, which sets out how the main purpose of the QRA Act is to be achieved. This will provide a high level “how” to correspond to the “why” set out in the objects.

⁸³⁰ Ibid, p 3.

⁸³¹ Ibid, p 2.

⁸³² Ibid, p 2.

An administratively stable, permanent agency with authority and well-defined limits

One of the principal benefits of the QRA model is that it is – to the extent possible – administratively stable and less likely to be subject to machinery of government changes than a model vesting functions in a subsidiary division of an existing department or agency.

The benefit of permanence through the creation of a separate agency was highlighted in the Inquiry's interviews with Mr Ben Hubbard, former CEO of the Victorian Reconstruction Authority (as it was by Johnson and Olshansky (2013)⁸³³).

A balancing consideration is that the authority must have well-defined limits. When circumstances render it appropriate to devolve certain decision-making, plan-making or other functions of the Authority to local government or elsewhere, the legislation must be drafted in a manner to permit this.

To protect the administrative stability of the authority and minimise the risk of administrative dependency on any other part of Government, the legislation must include detailed provisions about the constitution and internal administration of the Agency.⁸³⁴ This would include the CEO appointment being a statutory appointment.

In a major disaster the agency must be able to act decisively and at speed with sufficient resources. As Ben Hubbard said:⁸³⁵

You need 3 things to do recovery well:

1. *mission – your job not anyone else's*
2. *mandate – I'm allowed to go and get stuff done*
3. *resources – need flexibility of resources, because stuff just happens. Bureaucratic delay stuff is horrendous.*

To ensure appropriate support is provided, the agency needs to report to a senior Minister.

Financial powers and obligations

As set out at characteristic 1 above, managing money will be a primary function of the authority recommended by the Inquiry. This management function must be supported by the following elements:

- a mandate for collecting monies: in practice this will involve permanent vertical integration with the Australian Government and local government, as well as permanent functions to receive philanthropic donations – the permanence being necessary in order to have frameworks in place to account for income in emergency situations. This function may also include a consolidation and rationalisation of existing revenue streams and funds within the NSW Government – to reduce administrative redundancy
- best practice reporting requirements: it goes without saying that the mandate for collecting monies must be linked with superior transparency and reporting requirements. The books of the authority should be open to ongoing scrutiny by the public, with all monies received or spent appropriately accounted for
- permanent mechanisms for dispersing money quickly, with an emphasis on helping those most in need, value and probity. In interviews with the QRA, the Inquiry heard that one of the principal benefits of the QRA structure has been achieving value for money compared to pre-existing mechanisms for spending on disaster preparedness and recovery. This must involve

⁸³³ Johnson & Olshansky (2013).

⁸³⁴ See *Queensland Reconstruction Authority Act 2011*, Part 2.

⁸³⁵ Meeting with Ben Hubbard on 17 June 2022.

placing reliance on the expertise of authority staff to determine where and how those monies would best be spent – including determining in what circumstances other government entities (especially local government) would be better placed to manage those expenditures. The high volume and speed of monies being spent in disaster situations is also a high-risk environment for exploitation – so an overriding emphasis on probity is absolutely necessary.

In practice, some or even most of this function may be best addressed by regulation or the authority's own policies or procedures, but the emphasis on being a proper custodian of public monies should be reflected in the legislation establishing the authority.

Convening functions

The third of the characteristics of a successful reconstruction authority outlined by Johnson and Olshansky (2013) is

Supporting Collaboration: Building sustainable capacity and capability for long-term recovery through genuine collaboration and coordination.

Mechanisms that the QRA Act uses to achieve this goal, which should be adopted in the NSW legislation, are:

- absolute clarity about when and where the authority's functions are able to be exercised, in order to provide an unambiguous mandate and avoid duplication or diffusion of responsibility. The QRA Act achieves this by requiring a Ministerial declaration by Gazette notice – either of an area or of a project – to activate the QRA's jurisdiction to exercise key functions.⁸³⁶ The QRA Act provides that the Minister may make the declaration on the Minister's own initiative or at the request of the relevant local government entity⁸³⁷ – NSW legislation should adopt a similar approach. The critical point is that the decision is made at Ministerial level, to reflect government priorities about the allocation of the authority's resources
- a duty to cooperate with the authority imposed on other government agencies.⁸³⁸ In practice, the mere imposition of a duty to cooperate with an authority is unlikely to – in and of itself – foster the necessarily collaborative approach. It is nonetheless useful, supported by other relevant tools, to establish the authority as the peak body in exercising the relevant disaster preparation and reconstruction functions. The duty to cooperate with the authority is particularly important in circumstances where the authority steps in to exercise the functions of another government entity. In such cases, the authority will require the support of that other government entity in providing assessment and recommendations – in a manner similar to the Planning Secretary exercising certain assessment functions on behalf of the separate and Independent Planning Commission of NSW
- an advisory board assisting with setting strategy, with membership comprising the SEOCAN, secretaries of relevant departments, representatives of local government⁸³⁹ and community and philanthropic organisations, with an independent chair.

We note that the QRA has rarely had to invoke its convening powers as it has been very deliberate in building close working relationships with other agencies, using a leadership board, chaired by the Director General of Premier and Cabinet and including other departmental secretaries, as a coordinating and reporting mechanism.⁸⁴⁰

⁸³⁶ *Queensland Reconstruction Authority Act 2011*, Part 4.

⁸³⁷ *Queensland Reconstruction Authority Act 2011*, s. 42(5).

⁸³⁸ As in the *Queensland Reconstruction Authority Act 2011*, s. 126.

⁸³⁹ See *Queensland Reconstruction Authority Act 2011*, s. 30.

⁸⁴⁰ Meeting with QRA on 24 May 2022.

Expediting and overriding existing processes that cause unnecessary delay

The fourth characteristic of a successful reconstruction authority identified by Johnson and Olshansky (2013)⁸⁴¹ is

Balancing Time Constraints: Effectively meeting the immediate and pressing local needs of recovery while also successful capitalising on opportunities for long-term betterment.

By design, development controls under the NSW planning regime constrain fast development, because the Government considers it in the community's interest that development plans be exhibited, assessed and deliberated on by a consent authority. In order to prepare for a disaster or to re-establish communities and services in the wake of a disaster, immediate action may be required. It can be argued that the circumstances associated with disaster outweigh those of more 'standard' development approval processes. Consequently, the authority requires the ability to expedite development decisions.

The QRA Act sets up a regime under which the QRA can compel decisions within stipulated periods of time. If those stipulated periods are not met, the QRA can then step in and make the decision in the shoes of the original decision-maker.⁸⁴² This is a tool of some sophistication. It can only be triggered if the original decision-maker has been given an opportunity to make the decision in a timely manner itself, with the QRA having jurisdiction to step in only if the delay continues. A NSW Reconstruction Authority must have the same powers to compel timely decisions from NSW government entities – including but not limited to consent authorities for development – in circumstances of urgency. Note that the QRA power can only be initiated in circumstances where the Minister has made a declaration by notice in the Gazette, thus providing accountability in the exercise of the power.

A repository and disseminator of the best information and expertise

The second characteristic of a successful reconstruction authority identified by Johnson and Olshansky (2013)⁸⁴³ is

Increasing Information Flows: Effectively gathering, integrating, and disseminating information to enhance decision making and actions by all recovery actors.

This characteristic overlaps with the convening functions of the authority identified above. An authority that functions in a healthy, collaborative environment with other governments and government entities is one that necessarily shares information where appropriate.

To encourage this, the authority must have the benefit of legislative provisions which adequately support information *gathering* and information *dissemination*. The former is straightforward; the latter involves some finesse in order to be successfully grafted onto existing government processes, particularly within the planning system.

To enable the authority to gather the best available information and expertise, the NSW legislation should include a power for the authority to:

- requisition staff with necessary expertise from elsewhere in government⁸⁴⁴
- compel the provision of relevant information necessary for carrying out the authority's functions.⁸⁴⁵

⁸⁴¹ Johnson & Olshansky (2013).

⁸⁴² *Queensland Reconstruction Authority Act 2011*, Part 5.

⁸⁴³ Johnson & Olshansky (2013).

⁸⁴⁴ See *Queensland Reconstruction Authority Act 2011*, s.27.

⁸⁴⁵ See *Queensland Reconstruction Authority Act 2011*, Part 10, Division 1.

For the purposes of the legislative drafting required to facilitate these information dissemination functions, the functions can be conceptualised as 2 types, rhetorically styled ‘soft’ and ‘hard’ dissemination:

- the ‘soft’ functions relate to the authority making information available and encouraging a culture of awareness among other government agencies, industry and the community. No sophisticated legislative drafting is likely to be required to support this function, as it is unilateral on the authority’s part. This can adequately be addressed by the processes and procedures of the authority once established
- the ‘hard’ information dissemination functions relate to circumstances and processes external to the authority and for which information from the authority must form a part. These could be functions related to land use planning – in which case the authority’s information would be a mandatory consideration for consent authorities. In practice, this could be achieved by a provision of a State Environmental Planning Policy (potentially in a streamlining of the existing Resilience and Hazards SEPP) which, by virtue of s 3.28(1) of the *Environmental Planning and Assessment Act 1979*, could prevail over the standard flood planning clause 5.21 of NSW Local Environmental Plans.

Plan making functions

To facilitate preparedness and reconstruction, the authority would need a power to make development schemes.⁸⁴⁶ In Queensland, a development scheme is a statutory instrument that may provide for any matter the QRA considers will “promote the proper and orderly planning, development and management” of a project or area declared by the Minister.⁸⁴⁷ Such development schemes are analogous to Environmental Planning Instruments under the *Environmental Planning and Assessment Act 1979* (NSW).

The plan-making function of the NSWRA will be a tool that is capable of fixing deficiencies in existing NSW Environmental Planning Instruments (or other statutory instruments). It will allow other government agencies to have the benefit of the authority’s expertise in establishing controls, while still retaining their own decision-making functions. This will be particularly useful in facilitating the transfer of decision-making authority for designated areas or projects to other government entities at the appropriate time, under the auspices of the authority’s plans. The plan-making functions must be capable not only of addressing disaster recovery but also preparedness – including appropriate planning for evacuation routes.

A statutory property developer

A new NSWRA will also need the power to undertake works, acquire land (including easements and easements in gross), deal with roads and exercise all the powers of an individual (including to enter into contracts and dispose of property).⁸⁴⁸

Among other things, these functions are integral to facilitating the wholesale relocation of communities and facilitating evacuation through improved road capacity, and will be practically supported by the plan-making functions of the authority set out above. To foster a culture of accountability at the authority, these powers can and should be constrained by reference to Ministerial authorisation in some cases and – in all cases – by what is necessary and expedient to achieve the authority’s functions.

⁸⁴⁶ See *Queensland Reconstruction Authority Act 2011*, Part 6.

⁸⁴⁷ See *Queensland Reconstruction Authority Act 2011*, s. 62.

⁸⁴⁸ See *Queensland Reconstruction Authority Act 2011*, s. 11 and Part 7.

Special projects – disaster mitigation

NSW needs disaster mitigation, most notably due to the high potential for more major flooding and extreme forest fires across the state. Because this is such an issue for NSW it needs to be addressed in the proposed Act.

By their nature, special projects are difficult to legislate for. In this case, the scope and terms of such projects will depend on the priorities determined by the authority in the course of its information gathering and disaster preparedness activities. It is proposed that the authority be required to develop a State Disaster Mitigation Plan for annual review and endorsement by the NSW Government. This plan may address matters as varied as building standards, development opportunities (including to facilitate evacuation) and early warning mechanisms. A wide discretion is necessary, but one that is appropriately constrained by accountability mechanisms. The Inquiry considers that the new legislation should include a permanent feedback loop with government: i.e. there should be a formal structure for the authority to advise government on priority special projects (the draft annual update to the State Disaster Mitigation Plan), with the NSW Government then being accountable for providing the resources and approval (with conditions, if appropriate) to proceed.

Disaster cost benefit framework

To support the activities of the new NSWRA, and of other agencies responding to flood (and other disasters), it is important to have methods of estimating costs and benefits associated with response to disasters. Early on, the Inquiry sought NSW Treasury's advice on the financial tipping point at which various flood mitigation and response measures become appropriate for consideration. NSW Treasury suggested the best way to consider the issue was in a formal cost benefit analysis framework, and subsequently developed a preliminary framework for provision to the Inquiry. The Inquiry considers the preliminary framework, a summary of which is included in Volume Three, to be a very useful piece of work that should be further developed.

16. Recommendation – cost benefit framework

That, to enable a more systematic prioritisation of investment options in risk mitigation before, during and immediately following a natural disaster event, Government adopt and utilise a Disaster Cost Benefit Framework. This Framework will enable Government to estimate the investment required for any given disaster, starting with flood events, and will enable the fast allocation of funding based on detailed and rapid analysis of flood and property modification, mitigation, preparation, response and finance related options including:

- i. flood modification measures/flood defence (including dams/ water management; levees; waterway or floodplain modifications; etc)
- property modification measures/flood risk mitigation (including land filling; flood proofing; house raising; optimum zoning; removal of development (buy back schemes/relocation))
- response modification measures/flood preparation (including flood warnings; upgrading evacuation routes; evacuation planning; emergency response and education programs; flood data collection and sharing; etc)
- finance related options (including building standard reforms; restructure and reduction of stamp duty; direct subsidies; government reinsurance pools; etc)

The Framework should build on the preliminary version developed by NSW Treasury and provided to this Inquiry. To support this Framework, Government should also use the NSW Adaptation Fund that can be drawn on during or immediately following a flood event.

Transition arrangements

As noted above, the Queensland Reconstruction Authority was originally established as a temporary body before legislative amendment came into effect in 2015 to make it a permanent Queensland Government agency. The Inquiry recommends that the proposed NSWRA similarly transition from and leverage the initial work of the Northern Rivers Reconstruction Corporation, but with broadened state-wide and all-disaster scope.

NSW Parliamentary Counsel should be requested to commence drafting dedicated legislation to be introduced, considered and passed as soon as possible. The legislation should include provisions for the immediate transfer of the activities and assets of the Northern Rivers Reconstruction Corporation to the new NSWRA. This would include the CEO, who should transit as Acting CEO, and all personnel of the corporation.

Until such time as this legislation is enacted, the Northern Rivers Reconstruction Corporation should continue with its activities to rebuild affected communities within Ballina, Byron, Clarence Valley, Lismore, Richmond Valley, Tweed and Kyogle Local Government Areas.

Chapter

7

7. Living with flood (disaster) risk in the natural and built environment

7.1. Introduction

The recent devastation caused by the 2022 flood events is a reminder of the ever-present risk of natural disasters in NSW. The Insurance Council of Australia estimates that, since records began in 1970, the total incurred claim costs from flooding are more than \$21.3 billion, with the 2022 February-March events across NSW and South-East Queensland alone costing over \$3.35 billion.⁸⁴⁹ These costs are likely to grow with climate change. The *NSW 2021–22 Intergenerational Report* outlines a scenario in which a 2.2°C increase in temperature would yield an indicative 12% increased risk of flood in NSW, though not necessarily uniformly across the state.⁸⁵⁰

Many people live on floodplains in NSW, and many of these are in known high risk areas.

If a 19 m flood (like the 1867 record flood)⁸⁵¹ happened in the Hawkesbury-Nepean Valley now, more than 90,000 people would need to be evacuated and more than 15,500 homes would be affected by floodwater.⁸⁵² There is also evidence that some people in the Valley (e.g. at McGrath's Hill) would not be able to get out safely if a mass evacuation were ordered. Although the July 2022 floods in this area were bad, with over 9,000 people under evacuation orders, the situation could have been a lot worse.

One of the roles of the NSW planning system is to mitigate disaster risk including risk of flooding. Any successful planning system should ensure that flood risk management goes hand-in-hand with the economic and social aspirations of the community, particularly the provision of more affordable housing, and that communities are assisted to adapt the places they value to reduce the risk. Critically, a successful planning system will underpin the relocating or safe rebuilding of homes and communities already, or likely to be, devastated by catastrophic floods.

In all development considerations there is an over-riding obligation to keep people safe. At minimum, development should only occur where it is possible to ensure residents' lives are saved through safe and effective evacuation processes. Protecting property is a secondary but still important obligation.

According to the Productivity Commission's 2015 Report into *Natural Disaster Funding Arrangements*,⁸⁵³

⁸⁴⁹ Insurance Council of Australia, submission to the Inquiry.

⁸⁵⁰ NSW Treasury. (2021). NSW Intergenerational Report. Retrieved from [2021-22 NSW Intergenerational Report](#).

⁸⁵¹ Cinque, Peter. (2017, 6 September). Challenges and mitigation: the Inevitable Hawkesbury-Nepean Flood, AFAC Conference Paper. Retrieved from [afac.com.au/insight/operations/article/current/challenges-and-mitigation-the-inevitable-hawkesbury-nepean-flood](#)

⁸⁵² Infrastructure NSW, Advice to the Inquiry 2 May 2022

⁸⁵³ Productivity Commission. (2015). Natural Disaster Funding Arrangements. Retrieved from <https://www.pc.gov.au/inquiries/completed/disaster-funding/report>.

regulations affecting the built environment have a significant influence on the exposure and vulnerability of communities to natural hazards. While building regulations have generally been effective, there is a need to transparently incorporate natural disaster risk management into land use planning.

In the worst flood or natural disaster, no level of emergency response can fix poor land planning and land use decisions or lack of preparedness by people living on the floodplain.

The framework for floodplain planning in NSW has been modified to address flooding several times over the last 70 years. While major floods have led to repeated policy assertions that a risk-based approach is needed to calculate the appropriate flood planning level, the need for land developments to house a growing population has led to guidance which tends repeatedly to establish a flood planning level of 1% AEP. This, coupled with the increasing frequency and severity of rainfall events exacerbated by climate change, has contributed to thousands being displaced in recent major floods.

Despite recent improvements, particularly the 2021 *Flood Prone Land Package*,⁸⁵⁴ the history of floodplain planning in NSW shows that the planning system does not yet adequately take into account key issues associated with floodplain development. These include legacy risks, the capacity to rehome flood-affected communities promptly, and quality catchment-scale modelling across the state. Floodplain planning relies on strategic clarity coupled with good guidance and data to inform future land use decisions, provide quality control on the actions of local government, and make judgements about whether flood mitigation strategies are appropriate.

Adoption and implementation of a more robust risk-based approach to new developments is needed to ensure that flood risk from new developments is minimised.

Key elements of such an approach include:

- a comprehensive and up to date understanding of risks on a catchment-wide scale informed by modelling that is relevant now and into the future
- a well-developed and clearly understood line of sight between relevant strategic planning instruments that inform decisions on the ground
- a system where anyone seeking to develop new areas is provided with greater clarity and early advice to plan flood-resilient communities
- a credible evacuation strategy if required, with decision makers able to integrate this into decisions at the strategic planning and development level
- flexibility to adapt and change course in establishing as yet unbuilt towns and suburbs, in order to mitigate risk.

It will take innovative and challenging approaches to replan communities to reduce the growing risk of flood. However, with sufficient strategic clarity, clear integration of flood risk, and broadscale mobilisation of private sector finance for mitigation shepherded and amplified by an innovative Government, legacy risks can be better addressed, and communities better fortified for the challenges ahead.

In complying with the *NSW Climate Change Adaptation Strategy*⁸⁵⁵ released recently, the planning system will inevitably face some difficulties in addressing the legacy of past decisions, finding a different way of treating new developments, and embracing a more flood-resilient way of increasing housing supply for growing communities.

This chapter discusses best practice floodplain planning at a conceptual level, provides an overview of the development of floodplain planning in NSW and its progression towards

⁸⁵⁴ Department of Planning and Environment. (2021). Flood prone land package. Retrieved from <https://pp.planningportal.nsw.gov.au/flood-prone-land-package>.

⁸⁵⁵ NSW Treasury Office of Energy and Climate Change. (2022). NSW Climate Change Adaptation Strategy. Retrieved from <https://www.climatechange.environment.nsw.gov.au/nsw-climate-change-adaptation-strategy>.

consistency, and then examines areas of challenge and opportunity across the NSW planning system for achieving best practice. Finally, it addresses some broader matters related to the built and natural environment which are required to achieve cost-effective mitigation.

7.2. Floodplain planning: a best-practice framework

A proactive approach to risk

Internationally, floodplain planning has moved away from a *reactive* approach to managing the impacts of flood events towards a *proactive* process which seeks to study, understand and anticipate risks. Whilst floods have often catalysed community conversation and government action to make ad hoc changes to existing floodplain management approaches, holistic floodplain planning aims to address risk proactively by framing a series of decisions or judgements around the right balance of risk and reward from activities in floodplains.

Floodplains are resources. They are a natural source of capital and environmental value. They are also a form of infrastructure which may underpin the industries, land use and social and cultural values embedded in or near them. The very characteristics and natural processes of floodplains help sustain economic, environmental and social activities, but poor judgements about how best to make use of them can create unacceptable or unnecessary risk and cost to the human community and the environment.

Due to the risks created by past decisions and activities, planning now needs to account for *existing risks* associated with existing settlements, infrastructure and practices. Because human settlements and practices are not fixed in time, and past decisions continue to play out in changing land use and ecology, planning should also factor in *anticipated future risks*. Anticipated risks can include changes due to other actions, such as land use planning and new infrastructure. One critical risk to anticipate is changing natural processes and, in particular, climate change which is changing flood behaviour in many locations through changed rainfall patterns and rising sea levels, exacerbated by changes to the capacity of the floodplain to absorb or manage the flow of water. Finally, land planning should highlight transparently, as well as account for, the *residual risks* that are not fully addressed by the strategy and how they will be managed, monitored or addressed iteratively.

A plan within a hierarchy of plans

Floodplain planning needs to be consistent with principles governing the use of floodplains and sit within at least two (ideally connected) hierarchies of plans – for emergency management planning and for land use planning. It should *inform* broader strategies and be *integrated* into local strategies across the range of activities that affect the floodplain, whilst still advancing such strategic state-wide aims as the provision of infrastructure and housing, development to improve community amenities and placemaking, the application of environmental and catchment management policies, and emergency management, as well as more general economic and social improvement.

As a matter of principle, the aspirations and concerns of local communities should inform broader, regional strategies. Local aspirations, however, must also align with community-wide standards, and be in accordance with the broader economic and social aims of the state. Therefore, local planning decisions which affect floodplains should not unduly affect other communities of interest without broader strategic consideration.

This means that risk must be accounted for at a catchment scale – for the very simple reason that floodplains can operate beyond the spatial bounds of a community of interest, a local government body or a planning authority. Depending on the structure of communities and organisations within a

floodplain, this may require a stronger role for regional planning in order to achieve a balanced risk outcome.

As floodplain planning sits within a hierarchy of plans, it should both respond to and inform the contents of other plans to ensure that floodplain risk management is integrated. This ensures that floodplain planning is *iterative*, with periodic review establishing an effective feedback loop within that hierarchy of plans.

Having a floodplain planning process means the adequacy of risk management across all strategies can be brought into a single space and considered. It can highlight inadequacies with other plans and create new tasks to undertake in reviewing those local plans, but also integrate aspirations from outside the floodplain planning process. An example is the way that aspirations around restoring natural capital have not just been integrated into floodplain planning, but have emerged as a strategic tool to reduce risk in some floodplains.

This planning hierarchy can be seen in the United Kingdom's Thames Estuary, where the *TE2100 Flood Risk Management Plan*⁸⁵⁶ was the first plan to be established under the *National Flood and Coastal Erosion Risk Management Strategy for England*, whose long-term vision is for "a nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100".⁸⁵⁷ The strategy's three long-term ambitions are:

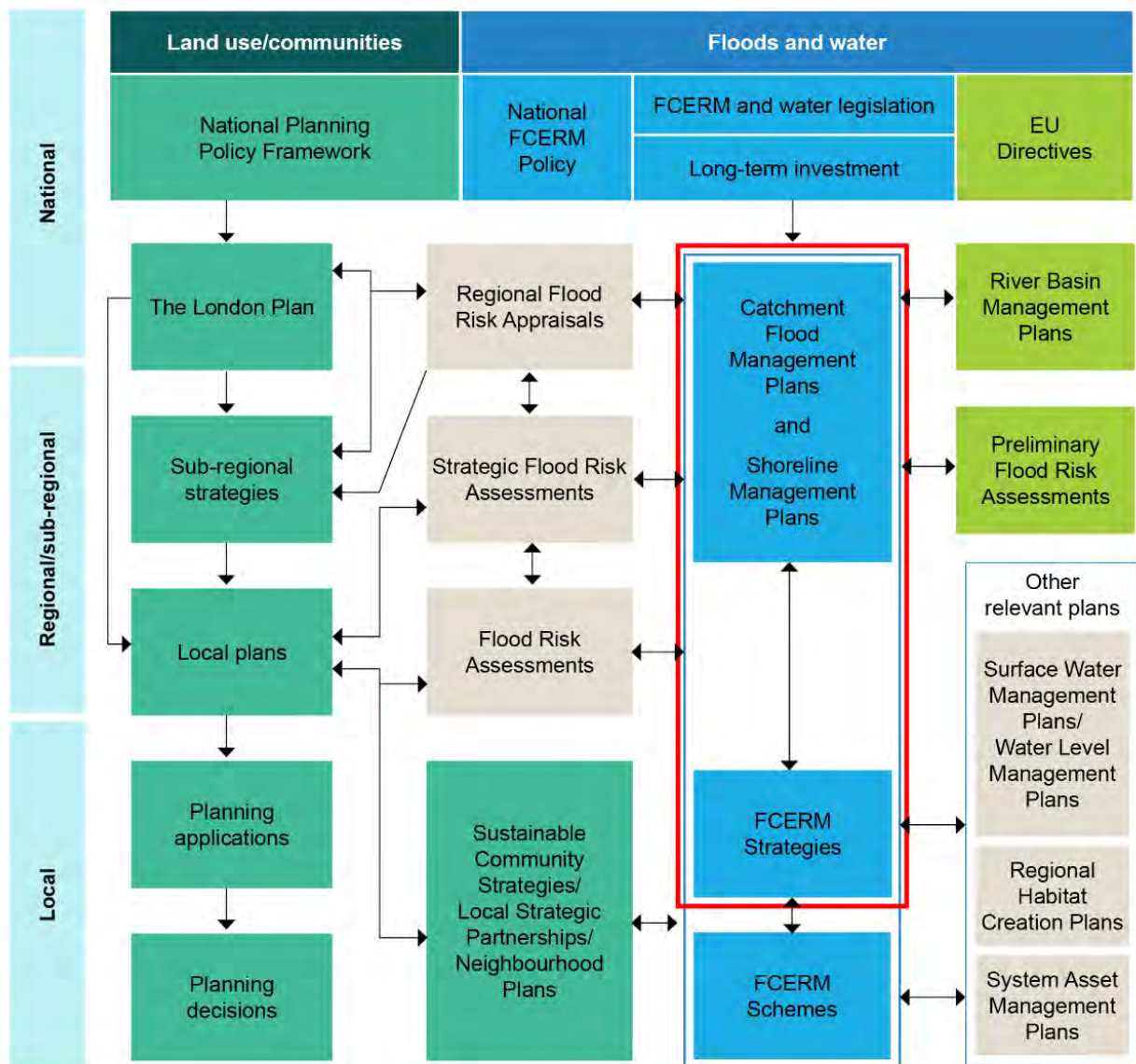
- *Climate resilient places ...*
- *Today's growth and infrastructure resilient in tomorrow's climate ...*
- *A nation ready to respond and adapt to flooding and coastal change.*⁸⁵⁸

These aims are in broad alignment with climate change policies of the NSW Government.

⁸⁵⁶ United Kingdom Environment Agency. (2021). TE2100 Flood Risk Management Plan. Retrieved from <https://www.gov.uk/government/publications/thames-estuary-2100-te2100/thames-estuary-2100-te2100>.

⁸⁵⁷United Kingdom Environment Agency. (2020). National Flood and Coastal Erosion Risk Management Strategy for England. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/920944/02_3_15482_Environment_agency_digitalAW_Strategy.pdf.

⁸⁵⁸ Ibid.



TE2100 Flood Risk Management Plan sits within this area □

Figure 7-1: Indicative relationship between high level plans, strategies, schemes and other planning initiatives – and how the TE2100 Plan fits into this hierarchy. Source: TE2100 Flood Risk Management Plan (2021).

The Thames Estuary is long-settled and complex, with enormous economic, social, historic and environmental significance. The TE2100 Flood Risk Management Plan is evidence-based, and identifies 10 “key indicators of the changes which will affect flood risk management”,⁸⁵⁹ including the impacts of climate change. It is also iterative:

*These indicators, or “triggers for change” must be monitored throughout the life of the TE2100 Plan The outputs from this monitoring programme will inform the regular reviews and re appraisal of the Plan. Importantly, they will also trigger decision-making if rapid change occurs in one or more of the indicators.*⁸⁶⁰

⁸⁵⁹ United Kingdom Environment Agency. (2021). TE2100 Flood Risk Management Plan, p 36. Retrieved from <https://www.gov.uk/government/publications/thames-estuary-2100-te2100/thames-estuary-2100-te2100>

⁸⁶⁰ Ibid.

Figure 7-1 illustrates how the TE2100 plan interacts with other plans.⁸⁶¹ It directly assists in flood risk appraisals and assessments, but it also creates a two-way relationship with local plans, enabling it both to address the flood impacts identified in local plans and to inform the updating of those plans over time. The larger and more complex is the catchment, the more numerous are the stakeholders to be engaged and the more plans there are with which the risk management process needs to interact. Consequently, stakeholder engagement is crucial – both to ensure that plans have the best possible inputs, and to ensure that stakeholders are informed about flood risk as they engage more broadly in the community.

In NSW, many local communities will have only a small number of plans with which floodplain risk management processes interact. The level of complexity of the intersections within the TE2100 plan is most analogous to the work being undertaken for the Hawkesbury-Nepean Valley. A striking aspect highlighted by scrutiny of the TE2100 plan is the depth of the plans under the UK Government's *Flood and Coastal Erosion Risk Management Policy Statement*,⁸⁶² notably Regional Flood Risk Appraisals informed by Catchment Flood Management Plans.

7.3. Evolution of floodplain planning in NSW

In Australia flood risk management responsibilities lie with the states and territories, with the exact arrangements for risk assessment and management allocated differently between state and local governments in each jurisdiction.

Since early colonial times in NSW there has been a myriad of Government interventions in the form of planning schemes – special infrastructure schemes involving systems of flood mitigation works; government directions; guidance notes; flood mapping programs; acquisition and buyback schemes; and statutory instruments – introduced in response variously to major flood events and their impacts, or population pressures and housing preference. These interventions have fluctuated between, on the one hand, often sophisticated approaches to ensure planning regulations do not allow people to buy houses that are at more than a low risk of flood (these interventions typically are in response to a major and damaging flood) and, on the other hand, approaches encouraging or allowing a more tolerant approach to flood risk in the interests of responding to pressures for more housing near major urban centres (this often reflects a long period of drought).

This section covers, at some length, the history of changes to managing for floods within the planning system over the last 200 years to illustrate the flood protection/housing provision challenge which NSW continues to face, a challenge which morphs from flood to drought. Many of this Inquiry's planning and housing recommendations have been at least partly implemented previously, so there is already a base for their (re-)implementation now.

A note on flood planning levels for development

As just stated, this section discusses the evolution of flood planning in NSW. Before beginning, it is useful to understand the approach to determining flood planning levels (FPLs) in the context of land planning and development on floodplains.

A floodplain is the total area that is likely to be inundated by the largest flood that could conceivably occur at a given location, i.e. the probable maximum flood (PMF). Land within the floodplain is

⁸⁶¹ Ibid. p 24.

⁸⁶² DEFRA (United Kingdom Department for Environment, Food and Rural Affairs). (2020). Retrieved from <https://www.gov.uk/government/publications/flood-and-coastal-erosion-risk-management-policy-statement>

flood prone. The NSW *Flood Prone Land Policy* states that “with few exceptions, it is neither feasible nor socially or economically justifiable to use the PMF as a basis for determining FPLs”.⁸⁶³

If the PMF is not used, then “lesser flood events are typically adopted for planning and development purposes, that is, defined flood events (DFEs)”.⁸⁶⁴ While these are based on understandings of flood behaviours and the associated likelihood and consequences of flooding”,⁸⁶⁵ they also “represent a compromise between the level of protection we can afford and the *risk* we are prepared to take with the consequences of larger floods”.⁸⁶⁶

For residential development, the NSW Flood Prone Land Policy specifies a single DFE as the starting point for the FPL: “Determining the FPL for typical residential development should generally start with a defined flood event (DFE) of the 1% annual exceedance probability [AEP] flood plus an appropriate freeboard (typically 0.5 metres)”.⁸⁶⁷ [Freeboard is “the height above a defined flood level, typically used to provide a factor of safety in, for example, the setting of floor levels and levee crest levels”.⁸⁶⁸]

The history of planning which follows shows that, among other things, the 1% AEP has been a feature of flood planning for a long time. As explained in Chapter 2, an alternative way of describing the 1% AEP is as a ‘1 in 100 year’ flood.

The AEP itself is determined through statistical analysis of long-term flood records and/or rainfall runoff to enable predictions for peak water flows at key locations in rivers, which are translated into flood levels and water flow speeds.

Alternative approaches both to flood modelling and to setting an appropriate flood planning level are discussed later in this chapter.

Early planning responses to flooding

The first major acts of floodplain planning in NSW came after the arrival of Governor Macquarie. A year after arriving in the colony in December 1809, Governor Macquarie established the so-called Macquarie Towns – Castlereagh, Pitt Town, Richmond, Wilberforce and Windsor. The towns were all established on higher ground due to flooding in the previous year.

Frustrated that his earlier direction about the Macquarie Towns had not been followed, in March 1817, Governor Macquarie issued a Government and General Order directing settlers to remove their residences from within the flood marks and move to the townships assigned for them on the highlands. The purpose of the direction was for “the preservation of themselves, their families and their property”.⁸⁶⁹

Government intervention in managing flooding in NSW continued through the 1800s. For instance:

⁸⁶³ DPE (Department of Planning and Environment). (2022). Flood Prone Land Policy, as per DPE Draft Flood Risk Management Manual, p 2. Retrieved from [Flood Risk Management Manual \(nsw.gov.au\)](https://www.nsw.gov.au/flood-risk-management-manual)

⁸⁶⁴ Agriculture and Resource Management Council of Australia and NZ. (2000). Floodplain management in Australia: best practice principles and guidelines. SCARM Report 73.

⁸⁶⁵ AIDR (Australian Institute for Disaster Resilience). (2017). Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia. Retrieved from [adr-handbook-7.pdf \(aidr.org.au\)](https://www.aidr.org.au/adr-handbook-7.pdf).

⁸⁶⁶ Agriculture and Resource Management Council of Australia and NZ. (2000). Floodplain management in Australia: best practice principles and guidelines. SCARM Report 73. P 96.

⁸⁶⁷ DPE (Department of Planning and Environment). (2022). Flood Prone Land Policy, as per DPE Draft Flood Risk Management Manual, p 2. Retrieved from [Flood Risk Management Manual \(nsw.gov.au\)](https://www.nsw.gov.au/flood-risk-management-manual).

⁸⁶⁸ Agriculture and Resource Management Council of Australia and NZ. (2000). Floodplain management in Australia: best practice principles and guidelines. SCARM Report 73.

⁸⁶⁹ Lachlan Macquarie by command of his Excellency, John Thomas Campbell, Secretary. Government and General Order, issued at Government House, Sydney, 5 March 1817 by the Civil Department.

- after the 1852 flood in Gundagai, the Colonial Secretary's office issued a notice of a land swap where owners of flooded allotments in Gundagai could present themselves and be permitted to obtain land elsewhere
- the *Crown Lands Alienation Act 1861*⁸⁷⁰ allowed for the setting aside of land for a public purpose. This provision was carried through to the *Crown Lands Act 1884* and used extensively for managing flood issues
- across the State, directions were issued to “reserve from sale for access in flood time”⁸⁷¹ or “reserve from lease for refuge in flood time”. Specific parcels of Crown land were not able to be sold or leased because they were needed for either access, refuge or stock management during times of flood including in and around Lismore, Casino, Ballina, Windsor, Penrith, Grafton, Taree, Kempsey, Wagga Wagga, Moree, Walgett, Tweed, and Coraki.

Hunter Valley Flood Mitigation Scheme

Following the floods of the 1940s and 1950s, the major focus on reducing impact from flooding was on engineering solutions and construction of flood mitigation works. The largest and most comprehensive flood mitigation scheme in NSW was constructed to protect the town of Maitland following the devastating 1955 flood⁸⁷² when 14 people were killed, 160 homes were destroyed, and approximately 5,000 homes were inundated. The cost of this flood was estimated at over \$100 million.⁸⁷³

Formal development of floodplain management as an integration of infrastructure, land use and emergency planning commenced following the 1955 Maitland floods. The creation of the NSW State Emergency Service and the delivery of the Hunter Valley Flood Mitigation Scheme (the Scheme) demonstrated the integration of emergency response and co-ordinated infrastructure development to address risk from defined flood events.

The scheme has prevented major flooding affecting the town of Maitland on at least 6 occasions. Today, as seen in Figure 7-2, the scheme consists of:

- 185 km of levees and control banks
- 3.8 km of spillways
- 165 km of drainage channels
- 259 floodgates
- 36 km of bank protection works.

From the 1960s, institutional capacity to plan for flood grew through the formation at the Maitland Town Hall in 1961 of the Floodplain Management Association – now Floodplain Management Australia (FMA).

⁸⁷⁰ *Crown Lands Alienation Act 1861* s 4 and *Crown Land Act 1884* s 101 allowed land to be set aside for a public purpose.

⁸⁷¹ NSW Government Gazette (Sydney, NSW: 1832 – 1900). Various issues. Retrieved from [Search - Trove \(nla.gov.au\)](https://nla.gov.au).

⁸⁷² According to Callaghan and Power (2014), this flooding event was attributed to a Tropical Interaction type two – when a deep layered trough system extends well into the tropics and either interacts with a Tropical Cyclone or a Tropical Low.

⁸⁷³ NSW Government. (1986). Floodplain Development Manual.

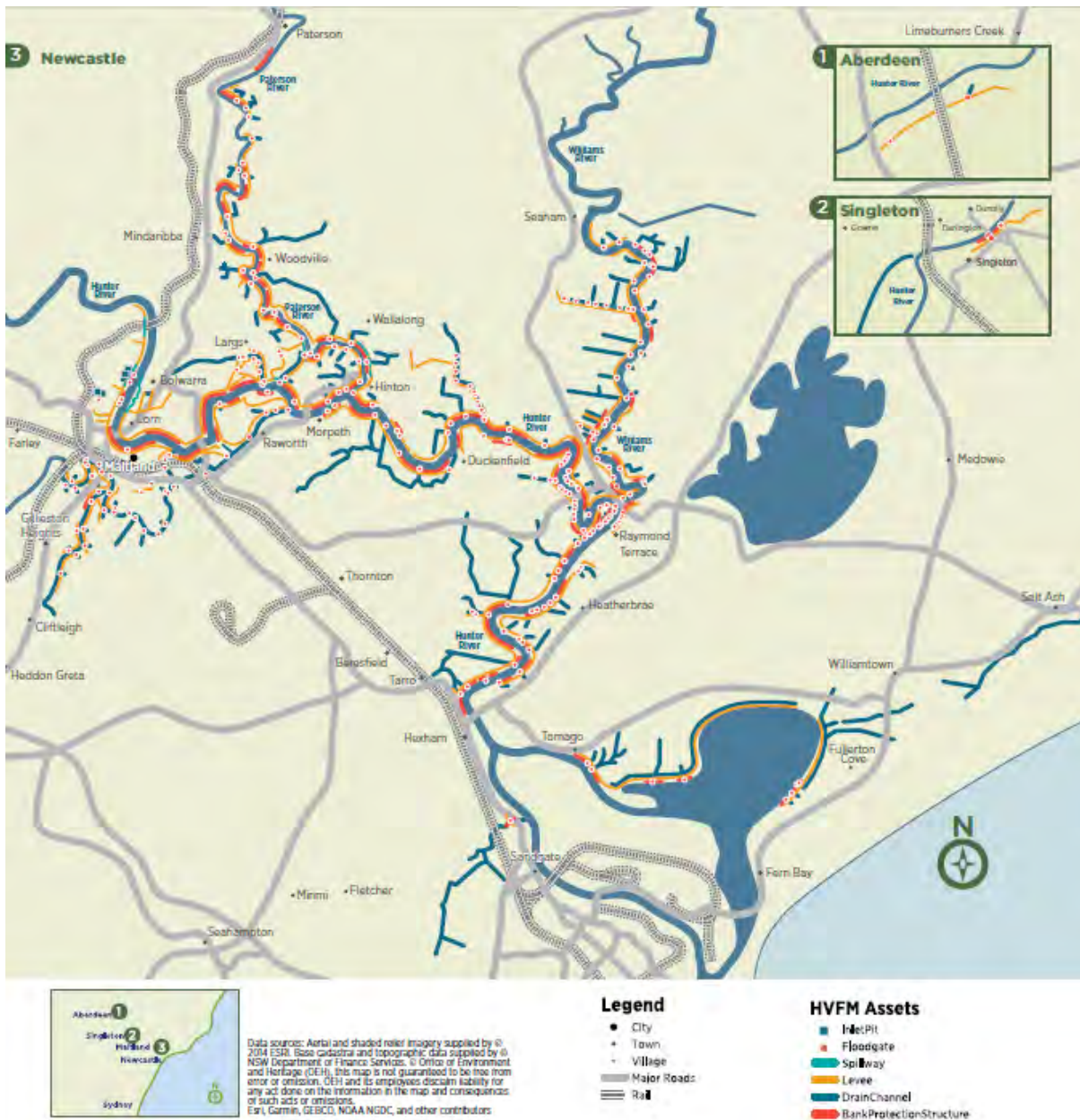


Figure 7-2: Schematic diagram of the Hunter Valley Flood Mitigation Scheme⁸⁷⁴

Flood prone land still released

In 1963 the State Planning Authority was created and, by 1965, thousands of hectares of farmland from the Hawkesbury-Nepean floodplain were released for housing to accommodate population increases from post-war immigration and the baby boom.

⁸⁷⁴ Department of Planning and Environment. (2020). Hunter Valley Flood Mitigation Scheme Fact Sheet released October 2020. Retrieved from <https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Water/Floodplains/hunter-valley-flood-mitigation-scheme-factsheet-200454.pdf>

Improved floodplain planning, particularly in response to the 1970s floods

A series of formal improvements to floodplain planning occurred over the decades leading up to the release of the Flood Prone Land Policy in 1984 and Floodplain Development Manual in 1986. These reflect the evolution of floodplain management as an area of practice informing government policy.

Following the 1955 Maitland floods, in 1957 all government departments were instructed to seek the advice of the Public Works Department or the Water Conservation and Irrigation Commission before constructing infrastructure such as roads, bridges and railways in river flood channels. This was extended to local government through Circular 1981⁸⁷⁵ in January 1958, directing councils to provide for safety of buildings in time of flood and to keep flood channels clear of development.

Between 1971 and 1977, 20 significant floods affected coastal catchments in NSW, with extensive flooding in the Richmond, Tweed, Hastings, Manning, Hawkesbury, Georges, Shoalhaven and Moruya Rivers and Lake Illawarra resulting in 6 deaths.⁸⁷⁶

This led to a heightened focus on floods and, in 1977, Circular 15 from the Planning and Environment Commission was issued to all councils, outlining that it was

*State Government policy to promote the removal of urban development from flood-prone areas where practicable and appropriate and to clear the floodways for New South Wales rivers of unnecessary obstructions to the free flow of floodwater.*⁸⁷⁷

Flood-prone lands were defined as areas covered by a 1 in 100 year flood unless determined otherwise. Floodways were defined as areas inundated on the average of 1 in 20 years.⁸⁷⁸ Government agencies were directed to use flood-free sites for any government-related work or ensure adequate flood proofing in the structure's design.

In 1978, Circular 22 was issued by the Planning and Environment Commission to all councils, NSW government bodies and financial institutions. It set out the rationale for needing a new policy on flood-prone lands, and specifically noted that

*the Government has become increasingly concerned at the loss of life and property caused by flooding and the cost of relieving distress and repairing damage during and after floods. New South Wales Treasury figures indicate that since June 1973 over \$60 million have been spent by the Government as a consequence of the nine major floods in this period.*⁸⁷⁹

The circular noted further that “flood mitigation works and flood control measures in planning schemes and interim development orders have not been entirely successful”, with benefits being offset by new development, and not all flood-prone areas being subject to flood control measures, meaning that “a more positive and far reaching policy ... is needed to control or prevent development in these areas.”

⁸⁷⁵ Circular 1981 (1958), as referenced in Planning and Environment Commission. Circular No 22 Implementation of Circular No 15, Development of Flood-Prone Lands. Issued on 12 April 1978.

⁸⁷⁶ Callaghan, J, and Power, S B. (2014). Major coastal flooding in southeastern Australia 1860 – 2012, associated deaths and weather systems. *Australian Meteorological and Oceanographic Journal* 64:3 September 2014 pp 183-213. Retrieved from [Major coastal flooding in southeastern Australia 1860–2012, associated deaths and weather systems \(bom.gov.au\)](http://www.bom.gov.au/mjo/papers/2014/Callaghan_Power_2014.pdf).

⁸⁷⁷ Planning and Environment Commission Planning Circular No 15 Development of flood-prone lands. Issued 16 August 1977.

⁸⁷⁸ This would equate to 5% AEP.

⁸⁷⁹ Planning and Environment Commission Planning Circular No 22 Implementation of Circular No 15 Development of flood-prone lands. Issued on 12 April 1978.

Councils were advised to modify their existing planning controls to give effect to the policy. They were also directed to use their powers to prevent the erection of buildings on flood prone land and to promote the safety of inhabitants during times of flood.

The policy also highlighted a shift away from hard infrastructure such as levees, indicating that it was better to direct funds in some cases to relocation of existing developments and “for new urban areas to be located, where possible, on high ground”. The policy also pointed to the Rural Bank providing low interest loans of up to \$5,000 for relocation or raising of dwellings.

The policy also provided direction on liability. Specifically, if a council approves development within a flood prone area which is subsequently damaged by flood, it may be liable to legal action for damages on the basis it was negligent in giving the approval. The policy specifically noted that “compensation for injurious affection under s 342AC of the *Local Government Act 1919* would not apply to cases where flood liable land is rezoned to prohibit certain development”. The concept of injurious affection was introduced in the *Local Government (Town and Country Planning) Amendment Act 1945*, where compensation was payable due to provisions in a planning scheme coming into force.

A flood mapping program was introduced for riverine areas to show the limits of the 1 in 20, 1 in 50 and 1 in 100 year floods and information on flood heights and behaviour.

Developed over subsequent years, these flood mapping studies were amongst the first attempts in NSW to utilise hydrological modelling to inform floodplain management, and present data spatially to help understand the issues and communicate them. These studies were prepared on a catchment-wide basis and were completed for all major catchments by the mid-1980s, helping to prioritise areas where more detailed investigations were required. However, there were significant concerns from Government around public release of those studies.

1984 Flood Prone Land Policy and 1986 Flood Planning Manual –responsibility shifts to local government

With the introduction of the *Environmental Planning and Assessment Act 1979* (EP&A Act), the state introduced State Environmental Planning Policies (better known by the acronym ‘SEPP’), prepared Regional Environmental Plans and replaced Interim Development Orders under the *Local Government Act 1919* with Local Environmental Plans. This was an important step in the move towards a hierarchy of plans in which floodplain planning can occur.

In December 1984, a new *Flood Prone Land Policy* was announced. This was a departure from the 1978 ‘command and control’ approach and was significant in that it encouraged councils to establish floodplain management committees with community representation so that “individuals can effectively communicate their aspirations on the management of the flooding problem”, elevating the role of community consultation and education.⁸⁸⁰

It firmly placed the onus for the management of flood prone land on local government, ending the catchment studies program and repositioning the NSW Government’s role as providing technical assistance on all flooding matters and, with the Australian Government, providing financial assistance to subsidise flood mitigation works and voluntary purchase schemes “initiated by councils in significantly hazardous areas”.

Instead of the prescriptive approach of the 1978 policy, it introduced the concept of a merit-based approach to deal with flood-prone land planning, development and building matters “to facilitate development wherever practical”. Development was now to be “normally permitted” in flood fringe areas (outside the floodway) “subject to appropriate flood proofing conditions”.

⁸⁸⁰ In more recent times, floodplain management committees were formally constituted under s355 of the *Local Government Act 1993* as a committee of council with an advisory function to the elected council.

The 1984 policy included an aim of engaging with the insurance industry to provide “reasonable tariffs for flood prone properties” and suggested that ready access to insurance was a benchmark for appropriate risk management.

In terms of a risk-based approach, the policy signalled a move away from one-size fits all definitions of the floodway as a 1 in 20 year event to a definition based on hydraulic, safety and damage potential considerations. It removed the definition of flood prone land as referring to the 1 in 100 year flood (or 1% AEP) definition, and opened it up to councils to determine their own designated flood levels based on standard flood events.

In addition, it introduced the concept of ‘freeboard’ set at 0.5 m to be added to floor levels above the designated flood level, which could be lowered where damage potential was low. This could account both for an additional level of risk, as well as for the impact of local weather on flood waters.

Finally, the policy outlined a commitment to introduce legislation to protect council and other public authorities against claims for damages and enable relief from land tax, council rates and water and sewerage rates where vacant land cannot be developed.⁸⁸¹

To give effect to that commitment, in 1985 further amendments were made to the *Local Government Act 1919* with respect to rates payable on flood liable land and to the liability of councils and others in connection with flood liable land.

The amendments allowed councils to identify “vacant flood liable land” being land that had been determined by the council to be unsuitable for the erection of a building because it is liable to flooding.⁸⁸² In recognition of this, a hierarchy of rating charges was established, where vacant flood liable land had a minimal rate levied.

This Act amendment also marked the introduction of a statutory release from liability providing a council acted in good faith.

Exculpation from liability – flood liable land

582A(1) A council shall not incur any liability in respect of—

- (a) Any advice furnished in good faith by the council relating to the likelihood of any land being flooded or the nature or extent of any such flooding;*
- (b) Anything done or omitted to be done in good faith by the council in so far as it relates to the likelihood of land being flooded or the nature or extent of any such flooding.*

This new section applied to the preparation or making of an environmental planning instrument or development control plan, and the granting or refusing of consent to a development application,⁸⁸³ as well as the granting or refusing of consent to the erection of a building or for subdivision of land, imposing any conditions, providing advice in a planning certificate, and carrying out flood mitigation works.

To demonstrate it had acted in good faith, a council needed to prove that it had acted substantially in accordance with the principles in the relevant manual. The provision was also extended to apply to the Crown, statutory bodies, public servants and any person acting under the direction of a council or the Crown in the same way it applied to council.

⁸⁸¹ The issue of rate relief and relief from water and sewerage charges has been raised by members of the Lismore community, with frustration expressed that there was no flexibility and that councils would still need to levy these charges despite the circumstances faced by many residents.

⁸⁸² The *Local Government (Flood Liable Land) Amendment Act 1985*, assented to on 12 June 1985, included section 126 to be inserted in the amended *Local Government Act 1919*.

⁸⁸³ Development consent was granted under the *Environmental Planning & Assessment Act 1979* while buildings and subdivisions were still regulated under the *Local Government Act 1919*.

An updated version of this provision is found in the present-day *Local Government Act 1993* s 733, which has been tested in several courts, including the High Court.⁸⁸⁴

The first *Floodplain Development Manual* was published in December 1986. It was authored by the former Public Works Department⁸⁸⁵ and published as a whole-of-government document. It noted roles for different agencies:

- Public Works Department and Water Resources Commission – to provide specialist advice regarding hydraulic and engineering matters
- Department of Environment and Planning to provide advice on planning matters
- State Emergency Service regarding planning in the event of natural disasters and emergencies.

It set out a process for local government to follow to understand the impacts of flooding in its local government area, standardised a flood study methodology, set out policy guidance for councils to implement the outcomes, further delineated the floodplain into hydraulic based hazard categories, included a draft flood proofing code, and introduced an option assessment matrix to weigh up various floodplain management options. It also included guidance for councils to develop an interim local policy to deal with flooding issues immediately while they undertook their more detailed studies.

Despite the substantial change in policy towards a merit-based approach and steps towards a risk-based approach between 1978 and 1984, the manual was relatively consistent with previous arrangements in relation to undeveloped areas noting that “Council should maintain existing low development zones over land liable to significant flooding and adopt development strategies which avoid any expectations or demands for development on flood liable land. This can be done where sufficient alternative flood free land is available for development”.

The manual also recommended that, for existing developed areas, the principle of reducing the intensity of development or, at worst, not increasing it should be pursued. It was further noted that where it is necessary to rezone land so as to eliminate any development potential, consideration should be given to its public acquisition.

Rather than a one size fits all approach of managing land to the 1 in 100 year level, suitability of a site for development was to be based on understanding the applicable hydraulic and hazard categories.⁸⁸⁶ The land use tables also indicated the need to consider evacuation and evacuation routes, and provided direction on the ability of vehicles to withstand flood waters.

Guidance was given on flood proofing which included raising habitable floor levels, using fill to raise floor levels, and ensuring habitable areas are on the upper floors. A draft Flood Proofing Code, based on the Australian Government’s *Housing in Flood Prone Areas 1975* was included.

In summary, the 1986 manual was a comprehensive set of options with practical guidance on how to implement the 1984 policy direction.

To support the *Floodplain Development Manual*, a further Planning Circular (C9) was released in 1989. The Circular was accompanied by a Direction under s117(2)⁸⁸⁷ of the *Environmental*

⁸⁸⁴ *Bankstown City Council v Alamo Holdings Pty Ltd* (2005) 223 CLR 660.

⁸⁸⁵ This part of the Public Works Department has been subject to several machinery of government changes since 1995 and is now located in the Environment and Heritage Group of the Department of Planning and Environment.

⁸⁸⁶ New concepts were introduced around a low and high hazard flood fringe, flood storage and floodway with a matrix published with development guidance about appropriate development categories (e.g. infill development, new development, redevelopment, etc) and land use category (residential, commercial, industrial etc).

⁸⁸⁷ S117 directions are now section 9.1 directions under the decimal numbering system in the *Environmental Planning and Assessment Act 1979*.

Planning and Assessment Act 1979 which aimed to encourage local environmental plans to be consistent with the *Flood Prone Land Policy*.

Councils were also directed not to permit a significant increase in the development of flood liable land that was likely to result in government expenditure on flood mitigation, and Direction G25 provided specific direction for not 'upzoning' land to be rezoned, noting that "A draft local environmental plan shall not... rezone flood liable land from a zone described as special uses – flood liable, rural, open space, scenic protection, water catchment or coastal land protection or similar to a zone described as residential, business, industrial, special use, village or similar".

The limitations of the approach of mandating a 1 in 100 year flood planning level without consideration of other factors became starkly clear the following year, highlighting at the same time the need for emergency management plans to be integrated fully into flood planning. In 1990, the flooding of Nyngan by a 1 in 200 to 250 year event, which overtopped its levees, led to one of the largest airlifts in Australia's history. It highlighted the need to consider a range of Defined Flood Events before setting planning levels for infrastructure or development, and the need for emergency management to be able to respond to a range of events through adequate warning systems and effective plans.

In addition, improved contingency planning around the consequences of unlikely structural failure at Warragamba Dam commenced, a process that is continuing today to understand evacuation options and develop flood evacuation plans better, as well as addressing increasing risk due to urban expansion and climate change.

2005 Floodplain Development Manual and 2007 Planning Circular – 1% AEP entrenched as default setting

Since the 1984 Policy and 1986 Manual were released, improved national guidance was being driven by the Australian Government working collaboratively with the states through organisations such as Emergency Management Australia, which in 1999 delivered a notional best-practice floodplain manual *Floodplain Management in Australia*.⁸⁸⁸ This manual is the precursor of Handbook 7 of the Australian Disaster Resilience Handbook Collection, *Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*.⁸⁸⁹

In the 2000s a greater amount of guidance around risk management was made available to assist councils and developers in planning for flood risk. The accompanying state-wide policy,⁸⁹⁰ however, did not lead to the application of these risk-based concepts and was silent on to how to integrate other significant advice from the NSW Government about climate change risk, until specific guidance was developed in 2007.⁸⁹¹

In 2005, the *Floodplain Development Manual* was released, which included principles around floodplain risk management and provided a toolkit for local governments to integrate floodplain risk management in local environmental planning. Many of its key recommended processes and terms are generally accepted as reflecting good practice.

The manual provides an explicit acceptance that a risk-based approach should determine an appropriate flood planning level, addressing the issue with historic approaches. It posits that

⁸⁸⁸ Agriculture and Resource Management Council of Australia and NZ. (2000). Floodplain management in Australia: best practice principles and guidelines. SCARM Report 73.

⁸⁸⁹ AIDR (Australian Institute for Disaster Resilience). (2017). Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia. Retrieved from [adr-handbook-7.pdf \(aidr.org.au\)](#).

⁸⁹⁰ Flood prone land policy, contained within DIPNR. (2005). Floodplain development Manual: the management of flood liable land. Retrieved from [Floodplain Development Manual \(nsw.gov.au\)](#).

⁸⁹¹ DECC (NSW Department of Environment and Climate Change). (2007). Practical consideration of climate change: Floodplain Risk Management Guide. Retrieved from [Practical consideration of climate change \(nsw.gov.au\)](#).

“historic practice in NSW has generally seen the adoption of a single FPL for development control. This tended to focus on the 1% AEP event and resulted in the popular perception that this event defined the limit of flooding. This perception precluded assessment of risk levels associated with rare floods that may be more critical for a particular location”.

Nonetheless, the manual strongly guides those undertaking floodplain risk management towards a flood planning level consistent with then normative practice (1% AEP), noting that “an appropriate FPL for new residential development is generally based upon the 1% AEP flood”⁸⁹² with freeboard of generally 0.5 m. It also identifies that, when determining an FPL, a study may find that previous understanding of a 1% AEP reflected a higher risk than previously understood. In this case, this may warrant an increase to the FPL, additional mitigation, or acceptance of a higher flood exposure.

The release of the 2007 Planning Circular *Guideline for Residential Development on Low Flood Risk Land* expanded on the level of advice and guidance available to councils. However, it sought to restrict the capacity of local governments to restrict or condition development above the 1% AEP by establishing it as a strong default setting, requiring a process of exceptional circumstances to address it.

In response to community concern over notations of planning certificates, the circular directed that councils should adopt the 100-year flood (1% AEP) as the Flood Planning Level for residential development, unless they can demonstrate exceptional circumstances.

In practice, a small number of councils were able to gain approval for inclusion of additional clauses – notably Tweed and Wollongong councils. Not all councils that sought to apply additional development controls for flooding were successful in their requests.

The circular was accompanied by an updated regulation⁸⁹³ which restricted the ability to notify prospective purchasers about the nature of the flood risk on their properties unless flood related development controls applied. This specifically excluded notifying of any risk greater than the 1 in 100 year flood level in residential areas.

The accompanying section 117 direction to councils indicated that no development controls were to apply to residential development above the 1 in 100 year level, but emergency response could be considered for some development types like aged care and critical emergency response and recovery facilities such as evacuation centres.

Some results of floodplain planning as at 2009

In 2009 the then Department of Environment, Climate Change and Water (now Environment and Heritage Group of the Department of Planning & Environment), when developing an indicative understanding of the impacts of climate change on flooding at regional and state-wide scales, carried out some preliminary work on the total number of buildings likely to be flood affected. Data was collated from 200 flood studies and from this it was estimated that there would be approximately:

- 50,200 buildings affected in a 1% AEP flood
- 70,500 buildings affected in a 0.5% AEP flood
- approximately 126,000 buildings affected in extreme floods.

⁸⁹² DIPNR (NSW Department of Infrastructure, Planning and Natural Resources). (2005). Floodplain Development Manual: the management of flood liable land. Retrieved from [Floodplain Development Manual \(nsw.gov.au\)](http://www.nsw.gov.au).

⁸⁹³ The *Environmental Planning and Assessment Amendment (Flood Related Development Controls Information) Regulation 2007* commenced on 16 February 2007.

A preliminary updated assessment compiled by the Environment and Heritage Group of DPE (EHG) in May 2022 using available information gives higher estimates of the numbers of properties that would be affected by flooding, specifically:

- of the order of 290,000 properties (not only buildings) in a 1% AEP flood or historic events where no 1% AEP level has been determined
- of the order of 500,000 properties (not only buildings) in extreme floods (such as the probable maximum flood, PMF).

And it is anticipated that the number of existing buildings at risk of flood impact will increase over time due to the impact of climate change on flood behaviour in certain catchments. This is expected to occur for several reasons – since the height of the 1% AEP is not static and will increase over time, more buildings will eventually be below it; over time more buildings will be built or redeveloped in flood prone areas; and, as sea levels rise, low lying areas will be inundated regularly.

A breakdown of a number of community facilities and vulnerable land use types or asset types from the 2022 DPE EHG work that could be affected by flooding is presented in Table 7-1.

Type	Indicative number of properties with this land use type where land is within the 1% AEP and historical (where no 1%) flood extents	Indicative number of properties with this land use type where land is within extreme floods (the PMF+ historical and within +1% AEP + historical where no PMF available)
Post Office	145	233
Police Station	64	98
Local Government Chambers	37	57
General Hospital	19	39
Community Medical Centre	77	116
Integrated Health Service	4	8
Nursing Home	98	168
Retirement Village	92	152
Community Home	7	8
SES Facility	54	81
Ambulance Station	45	77
Fire Station	50	79
Fire Station – Bush	153	219
Airport	18	28
Transport Interchange	8	10
Community Facility	423	597
Child Care Centre	31	72
Preschool	12	25
Education Facility	5	5
Primary School	182	317
Special School	15	33
Combined Primary-Secondary School	39	53
High School	53	91

Technical College	4	5
TAFE College	28	36
University	5	6
Library	73	100
Museum	50	77
Club	266	378
Cemetery	95	121
Gaol	3	10
Historic Site	46	74
Filtration Plant	30	44
Pumping Station	58	75
Sewerage Works	103	151
Power Station - Fuel Driven	1	2
Gas Facility	4	6
TOTAL	2,397	3,651
Total where cl 5.22 could be applied		1,844 (50%)

Table 7-1: Land use and asset types within the 1% AEP and PMF flood levels across NSW (2022). Source: Unpublished data from Environment and Heritage Group, DPE (2022). Indicative estimates are based on preliminary assessments using available information.

Table 7-1 shows a total of 2,397 vulnerable land uses and assets across the state that are situated below the 1% AEP flood level. These land uses/assets that are below the 1% AEP flood level include nursing homes, retirement villages, cemeteries, community medical centres, libraries, community facilities, clubs, primary school, rural fire stations, post offices and sewerage works.

Further adding to the potential for community disruption, 366 emergency services buildings (e.g. police, ambulance and fire stations, SES headquarters) are located below the 1% AEP flood level, and 554 are above the 1% AEP level but below the PMF level. As happened in Lismore in the February-March 2022 event, when the emergency service buildings were flooded and not available for use, valuable resources for the community may not be available at the time when they are needed the most.

The Hawkesbury-Nepean

An existing major piece of work that does address flood risk quite explicitly is the 2017 study of flooding in the Hawkesbury-Nepean Valley. With its unique geography and long history of settlement, and even longer history of serious flooding, the Hawkesbury-Nepean is well recognised as one of the highest risk floodplains in NSW.

In 1997, the Hawkesbury-Nepean Flood Management Advisory Committee was established by the Government. It recommended that detailed floodplain risk management studies and plans (FRMS&Ps) be developed by each of the 6 major councils in the Valley that undertake land use planning and development consent functions. Subsequently, the state assigned itself an additional planning and development role in this area with the creation of the North-West and South-West Growth Centres.

The Building, Land Use and Subdivision Guidelines⁸⁹⁴ prepared for the Hawkesbury-Nepean Flood Management Advisory Committee were released in 2006, providing a stronger point of reference to embed mitigation up front into new developments: in hard infrastructure in subdivisions, in subdivision layouts, and for individual dwellings.

Those guidelines identify that higher-density built forms can, if appropriately designed, significantly lower flooding risk. They identify a range of benefits from higher density development, including the capacity to reduce property damage, locate more dwellings above or near the PMF, reduce the need for or resilience around evacuation, and better manage local flood impacts. Despite that, only 3 pages of the guidelines are dedicated to higher density precincts and their additional resilience, with the focus largely on improving conventional suburban subdivisions.

In 2017, Infrastructure NSW (INSW) released *Resilient Valley, Resilient Communities - the Hawkesbury-Nepean Valley Flood Risk Management Strategy*⁸⁹⁵ which marked an important development in moving towards a holistic understanding and assessment of the flood risk of the Hawkesbury-Nepean.

This strategy investigated infrastructure and non-infrastructure options to reduce overall flood risk in the Valley, in response to the 2013 Hawkesbury-Nepean Valley Flood Management Review. That Review came about in response to the State Infrastructure Strategy 2012–2032 which noted that the growing awareness in the 1980s of evidence of previous very large floods in the Valley had led, in the 1990s, to major upgrades of Warragamba Dam to prevent dam break during major flooding events.

The *State Infrastructure Strategy* also noted that investments in improved elevated road access had not resolved evacuation issues and that raising the wall of Warragamba Dam would be reconsidered.

That the work undertaken to date has both informed broader strategies and is being integrated into local strategies across the range of activities that affect the floodplain indicates that, as a process of risk assessment, the Hawkesbury-Nepean Strategy is leading to improvements. In fact, the strategy has been reviewed in light of the 2020 and 2021 floods, demonstrating that it can be suitably iterative from the experience of emergency management, allowing testing of its assumptions.

INSW's work is enabling a detailed picture to be built which quantifies the risk to life and property under a range of scenarios in a way that allows government to update a full range of plans better to incorporate flood risk. In particular, it has established an understanding of how that risk is growing due to past land use planning and infrastructure decisions, and the potential impacts of climate change which are an increasing risk in the Valley.

For land use planning, a key outcome of the strategy is to deliver strategic and integrated land use and road planning, with DPE developing a Regional Land Use Planning Framework to establish a new land use and settlement strategy for the Valley, aligned with approaches for evacuation road planning. This is necessary to address the gap between expectations under the frameworks set in the mid 2000s and the better practice sought in the 2021 guidelines, described in the next section.

The challenges identified in this work are already reflected in the Western City District Plan, which notes that "(g)iven the scale of the severity and regional-scale of the risk, more stringent consideration is warranted for areas affected by the probable maximum flood (PMF) as well as the

⁸⁹⁴ Hawkesbury-Nepean Floodplain Management Steering Committee. (2006). Reducing vulnerability of buildings to flood damage: guidance On Building In Flood Prone Areas. Retrieved from: [REDUCING VULNERABILITY OF BUILDINGS TO FLOOD DAMAGE \(nsw.gov.au\)](https://www.nsw.gov.au/infrastructure/infrastructure-planning-and-design/reducing-vulnerability-of-buildings-to-flood-damage)

⁸⁹⁵ INSW (Infrastructure NSW). (2017). Resilient Valley, Resilient Communities – the Hawkesbury-Nepean Valley Floodplain Management Strategy. Retrieved from [Resilient Valley, Resilient Communities \(nsw.gov.au\)](https://www.nsw.gov.au/infrastructure/infrastructure-planning-and-design/resilient-valley-resilient-communities).

1:100 year flood.”⁸⁹⁶ Importantly, the District Plan addresses the way government can achieve multiple priorities by “providing for less intensive development or avoiding certain urban uses in areas of higher risk and allowing more intensive development in areas of lower flood risk, subject to an assessment of the cumulative impact of urban growth on regional evacuation road capacity and operational complexity of emergency management”.

2021 Flood Prone Land Package

Another move to address flood risk more explicitly was the release of the 2021 Flood Prone Land Package which recognised that the guidance and frameworks established in the 2000s were not adequately addressing risk. It identified that floodplain planning processes were failing to mitigate a range of flood events adequately up to the PMF.

A critical change to the 2021 Planning Circular 21-006 *Considering flooding in land use planning: guidance and statutory requirements*, issued 14 July 2021, was the removal of the need to obtain exceptional circumstances to apply different residential development controls. It also stressed that safe and effective evacuation should be a driving consideration in planning for land use. This allowed more flexibility for consideration of *anticipated risks*, such as legacy land use planning decisions and changes due to rising sea levels or climate change impacts upon extreme weather and therefore flooding behaviour.

The key revisions were to delegate greater control to those engaging in floodplain planning by taking steps “to remove the need to obtain exceptional circumstances to apply flood related residential development controls above the 1% Annual Exceedance Probability (AEP) flood event”.

This is more consistent with the guidance of Handbook 7 (*Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*) from the Australian Institute for Disaster Resilience released in 2017, which notes that, whilst the 1% AEP concept is “often used in government guidelines and policy instruments to define the standard up to which general development controls are applied to new standard residential development to limit growth in risk,” there can be locations where “adopting the general standard for development controls may result in a residual risk that is intolerable to the community. In these circumstances, additional localised development constraints may be warranted to reduce residual risk further”.⁸⁹⁷

In a context of heightened awareness of the challenge of evacuation in areas such as the Hawkesbury-Nepean, Planning Circular 21-006 also clarifies the need to plan for an evacuation rather than a shelter-in-place strategy, noting that this “also ensures planning proposals consider the flood risks and do not permit residential accommodation in high hazard areas and other land uses on flood prone land where the development cannot effectively evacuate”.⁸⁹⁸

There is a subtle change in language in terms of defined flood events (DFEs) in the 2021 draft Flood Risk Management Manual. It includes the principle that flood planning levels be based on a merit assessment, and that floodplain planning needs “to consider the risks associated with the full range of flooding, up to and including the probable maximum flood (PMF)” whilst noting that it is rare that the PMF would be the basis for determining an FPL.

The 2005 manual was silent on the matter of climate change. The 2021 manual refers to it, but does not provide clear guidance on how climate change impacts should be factored into mitigation.

⁸⁹⁶ Greater Sydney Commission. (2018). Western City District Plan. Retrieved from [Western City District Plan | Greater Sydney Commission \(greatercities.au\)](#).

⁸⁹⁷ AIDR (Australian Institute for Disaster Resilience). (2017). *Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*. Retrieved from [adr-handbook-7.pdf \(aidr.org.au\)](#).

⁸⁹⁸ DPIE (NSW Department of Planning, Industry and Environment). (2021). *Considering flooding in land use planning: Guidance and statutory requirements*. Planning Circular PS21-006. Retrieved from <https://www.planning.nsw.gov.au/-/media/Files/DPE/Circulars/2021/PS-21-006-Considering-flooding-in-land-use-planning.pdf?la=en>.

As outlined in the 2005 manual, a changing expectation around the real risk of a 1% AEP scenario should lead to either the resetting of the FPL or the application of additional mitigation.

These guidelines represent good practice advice, addressing the main deficiencies of the 2007 policy. But they provide little direct guidance to councils to assess the risk picture more comprehensively and include it in appropriate actions across the breadth of floodplain planning.

As stated previously, best practice floodplain planning sits across a hierarchy of plans. It should identify existing risks, anticipate new risks and transparently account for residual risks. It should both *inform* broader strategies and be *integrated* into local strategies across the range of activities that affect the floodplain, whilst seeking to advance its strategic aims in an iterative process.

The framework established in 2021 by the Government begins to address serious deficiencies with state-wide policy in the mid-2000s, which did not fully encourage a risk-based approach to land use planning in floodplains. The old approach has overly relied on a 1% AEP with insufficient focus on safe evacuation capacity, other cost-effective mitigation, and the changing risk due to climate change.

The Warragamba Dam wall raising conundrum

In recent years there has also been a great deal of work put into a major flood mitigation proposal for the Hawkesbury-Nepean Valley. A proposal to raise the wall height of Warragamba Dam by 14 m is currently with the Government for assessment and determination. It is intended to provide regional flood mitigation benefits for the Hawkesbury-Nepean Valley, noting the dam catchment has historically contributed between 40% and 70% of flood flows.

The \$2 billion proposal has been assessed by Infrastructure NSW as the single most effective flood mitigation option available. Modelling by INSW shows that raising the dam wall has the potential to reduce flood impacts to dwellings and, more importantly, provide improvements in evacuation by delaying the peak of a flood and increasing the time before key roads are closed.

However, the Environmental Impact Statement for raising the dam wall identifies significant likely Aboriginal cultural heritage and biodiversity impacts from increased intermittent flooding of the World Heritage listed upper catchment following the raising of the dam wall. Highly significant Aboriginal sites are present, together with some 88 threatened flora and fauna species.

Other objections to raising the dam wall are concerns that it could lull communities into thinking new developments are safe from a large flood when they are not.⁸⁹⁹

Further discussion of the proposed raising of Warragamba Dam wall can be found in the Hawkesbury-Nepean Valley Case Study in Volume Three.

7.4. How the NSW Planning System measures up in dealing with flood

When evaluating the NSW flood planning approach against the best-practice framework given in Section 7.2 above, the Inquiry noted that many of the desirable features are in place – and several are not.

⁸⁹⁹ Davies, Anne. (2021). Developing a floodplain: how raising a dam wall could create a false sense of security in Sydney's west. Retrieved from <https://www.theguardian.com/australia-news/2021/mar/28/developing-a-flood-plain-how-raising-a-dam-wall-could-create-a-false-sense-of-security-in-sydneys-west>.

Proactive planning for floods needs to be stronger

As detailed in the section on the evolution of flood planning above, the rhetoric of proactive processes (urging a risk-based approach to determining safe places to build) has featured in many of the relevant policy releases over the decades. However, it has been compromised in practice by short-term pragmatism (often enshrined in the guidance documents that accompany policies) associated with the need for speedy release of land for homes and the difficulties of deciding exactly how to determine an appropriate risk-based flood planning level (FPL), especially in the light of climate change.

However, NSW does have a high-quality example of a comprehensive approach that enables proactive planning for floods in one area – the highly problematic Hawkesbury-Nepean Valley. Infrastructure NSW, working closely with other agencies notably the SES, Transport for NSW, DPE, Water NSW and local councils, has produced sophisticated models covering the whole catchment for various likely flood scenarios and evaluations of possible evacuation routes. This work includes examination of legacy risks, and it enables detailed articulation of anticipated risks – most notably climate change but also risks associated with suggested new developments – and what the residual risks would be should these developments proceed. The relevance of this work has been brought into focus by the floods in 2021 followed by the floods in March and July 2022. It is clear that making the details of these studies even more widely available is needed to help community members decide whether or not they are willing to live with the risk associated with this area in the future.

Similar studies are not available yet to enable proactive planning for most other high-risk catchments in the State. At present, it is up to individual councils to decide whether to prioritise understanding flood risk in their local government areas, and to project manage related studies and consultancies for which they may not be well equipped. To help with this, councils generally apply for financial assistance through the Floodplain Management Program operated by DPE. Success in obtaining financial assistance (at a maximum of a 2:1 ratio of state:local funds) depends on the level of demand – both for studies and for flood mitigation works. This funding, even if limited, acts as a ‘carrot’ to incentivise councils to participate. The *Local Government Act 1993* good faith provisions (s 733) act as another ‘carrot’ encouraging participation.

However, there is no equivalent of a ‘stick’ if councils choose not to participate. They do so at their own risk. And there is no easy mechanism at present by which the state can strategically determine that there is a need for better understanding of flood risk in a given location.

In contrast, when floodplain management was first introduced in NSW in the late 1970s, state government agencies commissioned catchment-wide studies. Modelling was completed at a relatively coarse scale across a whole catchment, and therefore often included multiple local government areas. These studies characterised the entire catchment, and identified vulnerable areas, areas requiring further study, and areas where flood mitigation works may be required regardless of the council boundary. After serious flooding in Victoria in 2011, a similar approach was initiated following the Comrie Review,⁹⁰⁰ with that state coordinating broader catchment scale modelling, and local government undertaking more fine scale modelling nested within the broader model and made available on a single platform.⁹⁰¹ Also, in Queensland, after the 2011 Brisbane floods, an approach at 3 different scales has been implemented. Coarse scale interim assessments were completed across the whole state, flood studies at sub-basin levels were

⁹⁰⁰ Comrie AO APM, Neil. (2011). Review of the 2010-11 Flood Warning and Response. Report to the Victorian Government. Retrieved from https://ghcma.vic.gov.au/wp-content/uploads/2017/05/Review_20101011_Flood_Warnings_and_Response_Comrie_Review_Dec2011.pdf.

⁹⁰¹ Meeting with Victorian Department of Environment, Water, Land and Planning on 17 May 2022

conducted at a moderate level for low growth towns, and high-quality sub-basin flood studies were completed for major centres.⁹⁰²

Both Victoria and Queensland have a nested hierarchy of approaches to understand strategically where risk arising from flooding is most acute and where effort should best be directed. NSW needs to move in this direction and to build on its successes in the Hawkesbury-Nepean study to enable more proactive flood planning across the state that results in clearly articulated, well-thought-through statements of existing, anticipated and residual risks. The need to understand existing or legacy risks much better has been brought into sharp focus by the floods in the Northern Rivers and more recently around Sydney and in the Hunter.

Flood modelling informs flood risk management but has limitations

Understanding the likelihood of flood occurrence and its impact is aided by flood modelling and mapping. This section explores problems with flood modelling and flood planning level estimation for use in flood risk management as it is currently done in NSW. It identifies the limitations of using defined flood probabilities and mapped flood levels that don't adequately reflect likely future changes in rainfall characteristics expected as a result of climate change, or likely changes in how a catchment will respond to rainfall as the built and natural environment changes over time. It calls for an enhanced, risk-based planning approach that is informed by more sophisticated modelling of likely future flood risks.

The approach to determining flood planning levels needs to change

Flood planning level estimations inform decision-making for land use planning and development – as well as other plans such as emergency management and mitigation. The general practice in NSW and internationally is to calculate flood levels using a 'standards-based' approach. As explained by Wasko, Westra, Nathan, Orr, Villarini, Villalobos Herrera and Fowler (2021):

*Arguably, the most common approach to decision-making is through a 'standards-based' approach. Flood modelling is used to arrive at a probability-based measure, such as a specified AEP, or a magnitude-based metric, such as the local 'largest historic flood of record' or 'probable maximum flood' (PMF) event. Decision-making is then based on a specified AEP or event magnitude from a regulatory design standard.*⁹⁰³

As discussed in Section 7.3 above, while NSW policy documents have often called for the use of a nuanced, risk-based approach for determining flood planning levels (FPLs) for land use planning and development, in practice the default has been to use (and until recently mandate) the 1% AEP. While the most recent 2021 Government policy update⁹⁰⁴ no longer mandates the use of the 1% AEP and supports a risk-based approach, there has not been a major shift in re-assessing flood planning levels in most LGAs. Increasingly, such measures are seen as not best practice.

However, a deep look at flood planning levels can challenge conventional community thinking and community aspirations, as well as existing plans and strategies.

As long ago as 1953, when significant inundation from the North Sea led to the loss of over 1,800 lives and the flooding of 135,000 hectares of land, the Netherlands initiated a study of what storm

⁹⁰² Queensland Reconstruction Authority. (2011). Planning for stronger, more resilient floodplains. Part 1- Interim Measures to support floodplain management in existing planning schemes and Part 2 – Measures to support floodplain management in future planning schemes.

⁹⁰³ Wasko C, Westra S, Nathan R, Orr HG, Villarini G, Villalobos Herrera R, Fowler H J. (2021). Incorporating climate change in flood estimation guidance. Phil. Trans. R. Soc. A 379: 20190548. <https://doi.org/10.1098/rsta.2019.0548>.

⁹⁰⁴ DPE (Department of Planning and Environment). (2022). Flood Prone Land Package. Retrieved from [Flooding - \(nsw.gov.au\)](https://www.nsw.gov.au/flooding).

surges could be expected on the Dutch coast, whether safety measures were sufficient to protect it and, if not, what measures should be taken. After 8 years, the study determined that the sea defences in the most densely populated part of the country should be able to withstand storm surges with an AEP of 0.001% (i.e. a 1 in 10,000 year flood).⁹⁰⁵ This led to the construction of coastal engineering projects known as the Delta Works (which includes the Oosterscheldekering – or Eastern Scheldt Storm Surge Barrier) to protect the region. The process of looking deep into a range of defined flood events and determining the appropriate levels to plan various flood risk management actions has proven to be resilient 70 years later as new approaches and frameworks are put in place to address new risks and opportunities. The Second Delta Programme inaugurated in 2007 elevates community aspirations around ecological sustainability and habitat restoration and introduces these as integrated tools for flood risk management.

The lesson from the Netherlands is not that a higher AEP should be utilised as a flood planning level, but that the acceptability of the impacts of a particular AEP (or any other relevant defined flood event that is applied) must be considered and transparent judgements about them made as part of the infrastructure and development decision making process.

How is the 1% AEP for flood calculated?

The 2 primary methods for modelling and calculating the chance of different sized floods occurring are statistical analysis of long-term flood records, or rainfall runoff techniques. Each method provides predictions for peak water flows at key locations in rivers, which are translated into flood levels and water flow speeds through the further use of hydraulic models.⁹⁰⁶ The outputs of these models allow estimation of the AEP of different sized flood events, including a 1% AEP, but also the Probable Maximum Flood (PMF).

Statistical analysis of long-term flood record – flood frequency analysis

Flood frequency analysis can provide estimates of flood exceedance probabilities based on data from stream gauging stations and water flow data that show the actual peak and extent of the flood as it sits in the environment.

Flood frequency analysis can only be used where good, long-term flood records are available and catchment conditions can be easily described or remain relatively unchanged.⁹⁰⁷ As previously stated in this report, flood records in NSW are quite limited – there are a few hundred sites at most in NSW where appropriate gauge sites exist⁹⁰⁸ and records at best only go back to the start of European settlement.

Rainfall runoff based models

Given the sparsity of recorded, observed flood data in comparison to the extensive availability of rainfall data, rainfall runoff techniques are more broadly applied in Australia.⁹⁰⁹

Following devastating flooding from December 2010 to January 2011, which affected Western Australia, Victoria, NSW and particularly Queensland, the Queensland Government developed and

⁹⁰⁵ d'Angremond, Kees. (2017). From disaster to delta project: the storm flood of 1953. Retrieved from [25013_Terra&Aqua_No_90 \(iadc-dredging.com\)](https://www.iadc-dredging.com/25013_Terra&Aqua_No_90).

⁹⁰⁶ Queensland Government. (2011). Understanding floods: Questions & Answers. Retrieved from https://www.chiefscientist.qld.gov.au/_data/assets/pdf_file/0022/49801/understanding-floods_full_colour.pdf.

⁹⁰⁷ WMA Water for NSW Department of Planning, Industry and Environment. (2020). Consideration of climate change in flood modelling in NSW. Unpublished report.

⁹⁰⁸ Ibid.

⁹⁰⁹ Ball, J, Babister, M, Nathan, R, Weeks, W, Weinmann, E, Retallick, M, & Testoni, I. (2019). Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia. Retrieved from [Australian Rainfall and Runoff: A Guide to Flood Estimation - Australian Hydrographers Association \(aha.net.au\)](https://www.aha.net.au/Australian-Rainfall-and-Runoff-A-Guide-to-Flood-Estimation-Australian-Hydrographers-Association).

released *Understanding Floods: Questions and Answers*. It states that rainfall runoff modelling techniques:⁹¹⁰

...use statistical analyses of rainfall records, together with computer models based on the geographical characteristics (for example, catchment area, waterway length) of the region being studied, to determine the chance of different sized floods occurring. These models can be set up to take account of changes that affect runoff, such as new dams and urbanisation, but the computer models used to convert rainfall to runoff are not perfect, making rainfall techniques generally less reliable than the use of long-term flood records.

How reliable is the current approach to modelling for flood risk management?

Accurate flood modelling depends on a sound understanding of rainfall patterns across a catchment and a well validated hydrologic model balanced with hydraulic models capable of representing realistic flood flows over the catchment.

Both flood frequency analysis and rainfall runoff techniques rely on available, historic information (the height and flow of floods prior) or 'stationary' assumptions about climate and weather factors that influence the flood hazard (including but not limited to rainfall intensity-frequency-duration).⁹¹¹

In other words, there is an underlying assumption that for any given catchment, the AEP is fixed. However, as it is a function of both rainfall and the characteristics of the catchment it falls in, the AEP needs to be recalculated when either the characteristics of rainfall or the nature of the catchment changes (for example, new development or changing land uses).

Taking into account climate change

The majority of climate change projections used to estimate future flood risk are not 'disaggregated' by individual catchment.⁹¹² Relevant information, including projected changes in mean annual rainfall, maximum daily rainfall and runoff and return periods, are generally aggregated over large regions as shown in Figure 7-3.

⁹¹⁰ Queensland Government. (2011). *Understanding floods: Questions & Answers*. Retrieved from https://www.chiefscientist.qld.gov.au/_data/assets/pdf_file/0022/49801/understanding-floods_full_colour.pdf.

⁹¹¹ Wasko et al (2021).

⁹¹² Bureau of Meteorology. (2022). *Advice to the Inquiry provided 25 May 2022*.

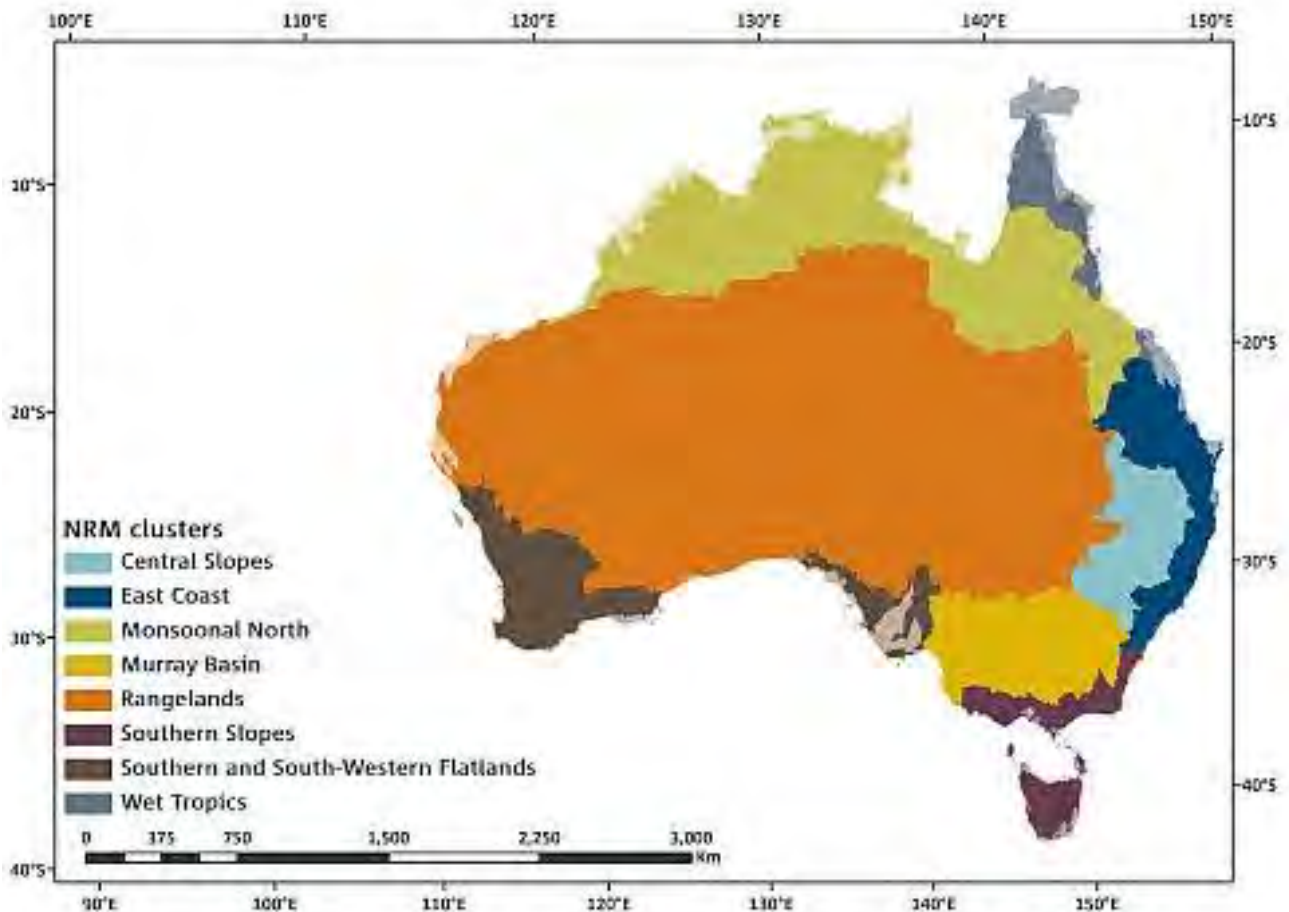


Figure 7-3: Australia's eight natural resource management (NRM) clusters. This was informed by logical groupings of recent past climatic conditions, biophysical factors and expected broad patterns of climate change. Source: Climate change in Australia.

The Government has developed a more refined understanding of the impacts of climate change by region than most jurisdictions around the world with its NARCLiM model.⁹¹³ However, regional climate change projections are not themselves certain. Natural climate variability, the impact of future emissions and concentrations of greenhouse gases and aerosols, and limitations in understanding of the climate system and its representation in models, create inherent uncertainties from the outset.⁹¹⁴

Regardless, and in attempt to account for this uncertainty, climate change projections have been incorporated to some extent in existing NSW flood risk management guidance on flood modelling practice, though the Inquiry was informed that direct data from the NARCLiM model are not used.⁹¹⁵ But advice on consideration of climate change as influencing rainfall producing events is included in the *Floodplain Risk Management Guide*,⁹¹⁶ noting trends derived from current research and

⁹¹³ Department of Planning and Environment. (2022). AdaptNSW. Retrieved from <https://www.climatechange.environment.nsw.gov.au/my-region>.

⁹¹⁴ CSIRO. (Commonwealth Scientific and Industrial Research Organisation). (2021). Climate Change in Australia. Retrieved from https://www.climatechangeinaustralia.gov.au/media/ccia/2.2/cms_page_media/168/CCIA_2015_NRM_TR_C_hapter%206.pdf.

⁹¹⁵ Meetings with Department of Planning and Environment on 10 May and 3 June 2022.

⁹¹⁶ DPIE (NSW Department of Planning, Industry and Environment). (2019). Floodplain Risk Management Guide: Incorporating 2016 Australian Rainfall and Runoff in studies. Retrieved from [Floodplain Risk Management Guide | NSW Environment and Heritage](#)

references to *Australian Rainfall and Runoff 2019*.⁹¹⁷ This guide recommends “a 5% increase in design rainfall intensity per °C of projected warming”.⁹¹⁸ The *Floodplain Risk Management Guide*⁹¹⁹ also notes the possibility of coincidence of coastal inundation, catchment flooding and waterway entrance condition, and provides sea level rise projections to be added depending on the waterway types.⁹²⁰

However, there is evidence to suggest that the 5% scaling factor is conservative.⁹²¹ Rain is intensifying at daily and sub-daily scales and the intensity of short duration, or hourly, extreme rainfall events has increased.⁹²² A study by Guerreiro, Fowler, Barbero, Westra, Lenderink, Blenkinsop, Lewis and Li (2018) found that changes in the magnitude of hourly rainfall extremes in Australia are close to or exceeding double the expected scaling, and exceeding three times the expected scale in the tropics.⁹²³ This study also found that scaling for changes in rainfall based on changes in temperature provides a significant underestimate of observed changes in hourly rainfall extremes in Australia, with implications for assessing the impacts of extreme rainfall.⁹²⁴

As explained by Fowler, Lenderink, Prein, Westra, Allan, Ban, Barbero, Berg, Blenkinsop, Do, Guerreiro, Haerter, Kendon, Lewis, Schaer, Sharma, Villarini, Wasko and Zhang (2021):⁹²⁵

Evidence is emerging that sub-daily rainfall intensification is related to an intensification of flash flooding, at least locally. This intensification will have serious implications for flash flooding globally and requires urgent climate change adaptation measures.

Importantly, intensity is only one aspect of rainfall potentially affected by climate change. As discussed in Section 2.3, the impact of climate change on the frequency, duration, and spatial distribution of rainfall is not yet known with any great certainty.⁹²⁶ In line with this, the guide notes that:⁹²⁷

⁹¹⁷ Ball, J, Babister, M, Nathan, R, Weeks, W, Weinmann, E, Retallick, M, & Testoni, I, (Editors). (2019). *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia. Retrieved from <https://arr.ga.gov.au/>.

⁹¹⁸ WMA Water for NSW Department of Planning, Industry and Environment. (2020). Consideration of climate change in flood modelling in NSW. Unpublished report.

⁹¹⁹ Specifically, the *Floodplain Risk Management Guide: Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways*.

⁹²⁰ Office of Environment and Heritage. (2015). *Floodplain Risk Management Guide: Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways*. Retrieved from <https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Water/Floodplains/modelling-catchment-flooding-oceanic-inundation-150769.pdf?la=en&hash=41092E03528FEF91161826E5FE5D9E5CD2D13598>

⁹²¹ Meeting with Professor Seth Westra on 7 June 2022.

⁹²² Bureau of Meteorology. (2020). *State of the Climate 2020*. Retrieved from <http://www.bom.gov.au/state-of-the-climate/>.

⁹²³ Guerreiro, Selma, Fowler, Hayley, Barbero, Renaud, Westra, Seth, Lenderink, Geert, Blenkinsop, Stephen, Lewis, Elizabeth and Li, Xiao-Feng. (2018). Detection of continental-scale intensification of hourly rainfall extremes. *Nature Climate Change* 8, 803 – 807. <https://doi.org/10.1038/s41558-018-0245-3>.

⁹²⁴ Ibid.

⁹²⁵ Fowler, H. J., Lenderink, G., Prein, A. F., Westra, S., Allan, R. P., Ban, N., Barbero, R., Berg, P., Blenkinsop, S., Do, H. X., Guerreiro, S., Haerter, J. O., Kendon, E. J., Lewis, E., Schaer, C., Sharma, A., Villarini, G., Wasko, C. & Zhang, X. (2021). Anthropogenic intensification of short-duration rainfall extremes. *Nature Reviews Earth and Environment*, 2 (2), pp.107-122. <https://doi.org/10.1038/s43017-020-00128-6>.

⁹²⁶ WMA Water for NSW Department of Planning, Industry and Environment. (2020). Consideration of climate change in flood modelling in NSW. Unpublished report.

⁹²⁷ DPIE (NSW Department of Planning, Industry and Environment). (2019). *Floodplain Risk Management Guide: Incorporating 2016 Australian Rainfall and Runoff in studies*. Retrieved from [Floodplain Risk Management Guide | NSW Environment and Heritage](#)

the scope of the advice on changes in climate ... has been limited to projected changes in rainfall intensity (or equivalent depth) because there is little available information on projected changes in rainfall frequency, duration and temporal patterns, antecedent wetness and baseflow.

Yet, despite this qualifier, a change in other characteristics of rainfall is already being observed. Evidence is emerging that dynamic systems are stalling,⁹²⁸ leading to sustained rainfall of longer duration than otherwise would have occurred over catchments. Take for instance, the duration of the intense rainfall experienced in Lismore and the Northern Rivers during late February and early March 2022, which was longer than seen before in the observed record.⁹²⁹

Whether changing rainfall behaviour is due to the influence of climate change or other factors, any change creates further uncertainty that must be reflected in flood models and the determination of the flood planning level in order to inform flood risk management in NSW.

Taking into account exposure and vulnerability

It is not possible to come up with a range of future risks or assessment of legacy risks (past decisions about where to build have increased population exposure to hazard) without understanding the specific vulnerabilities shaped by past and future decision making. The Bureau of Meteorology explained to the Inquiry that planning and preparing for, and responding to, the consequences of infrequent floods that peak higher and flow faster than in the past will be different to the potential consequences and responses needed if mid-level floods become more frequent.⁹³⁰ For example, to project the highest probable flood in the future, a model would need to capture, at the catchment scale:

- saturated antecedent soil moisture
- highest probable rainfall intensity
- longest plausible duration of weather event weather (stationary systems with multi-day accumulations)
- highest probable coincident storm surge.⁹³¹

As the Bureau noted, to capture the above factors requires ensemble models, whereby thousands of different scenarios are run using machine learning to derive patterns. This requires resource-intensive computation to achieve this at a catchment level across the state and is largely not feasible at present.⁹³² The state's world-leading expertise in quantum computing⁹³³ should help address this in the future, however.

A risk-based approach to flood modelling and planning is required

Flood modelling and estimation, especially for the purposes of knowing where it is safe to live (land use planning), needs to accommodate change or uncertainty – change by way of urbanisation, development and shifting exposure, and uncertainty around the impact of climate change on flood producing events. Instead of using marginal estimations to derive a single defined AEP for contemporary application as the flood planning level, some catchments require a cost-benefit trade-off calculation based on the probability (and consequence) of events to inform design and planning decisions.⁹³⁴

⁹²⁸ Professor Andy Pitman. (2022). Advice to the Inquiry provided 17 May 2022.

⁹²⁹ Bureau of Meteorology. (2022). Advice to the Inquiry provided 7 June 2022.

⁹³⁰ Bureau of Meteorology. (2022). Advice to the Inquiry provided 25 May 2022.

⁹³¹ Ibid.

⁹³² Ibid.

⁹³³ For example, see <https://www.fqt.unsw.edu.au/>.

⁹³⁴ Wasko et al (2021).

Ultimately, any calculation is still just an estimate as climate drivers are not yet fully understood. Therefore, the way flood models are applied in risk management must be treated with caution and the planning decisions that are informed by this modelling must be adaptive and transparent about the assumptions and associated uncertainty.

The Inquiry recommends that government flood modelling be improved, to enable more effective risk-based planning for flood across the state. This would enable better support for engineers, land planners, developers and emergency managers in NSW. This approach should be enacted as a priority in all high-risk catchments in the state, including the Hawkesbury-Nepean, Georges, Wilsons and Tweed rivers, and be extended as soon as possible to other high-risk catchments including the Macleay, Richmond, Hunter, Clarence and Shoalhaven rivers.⁹³⁵

There must also be a mechanism to review and update flood models and data inputs, in order to keep pace with the rate at which climate science is developing.

Flood modelling and hazard identification in NSW is currently the responsibility of local government, so the modelling is done by local government area and not by whole of catchment. This is sub optimal. Furthermore, multiple stakeholders, including some councils, told the Inquiry that councils' capacity to discharge/fulfil this responsibility was highly varied. Some councils were better equipped than others to undertake and regularly update thorough flood modelling.⁹³⁶ Accordingly the Inquiry recommends that flood modelling and flood planning level determination be primarily the responsibility of the NSWRA.

Of course, many design and planning decisions were undertaken before climate change became a necessary consideration. These decisions will need to be revisited to check whether design rainfall and flooding have been underestimated, or conservatively scaled.

Floodplains not treated as resources

The history of flood planning developments makes clear that NSW floodplains have been largely seen as a nuisance that needs to be contained as much as possible in size, consistent with not exposing those living near/on them to excessive flooding risk. Though permissible uses appear in some policy documents, the language is not that of viewing floodplains as valuable resources or assets to be protected and managed. If floodplains were viewed as assets, it would be possible to take a different approach when planning: working out how to maximise simultaneously and harmoniously the value of the asset that is the floodplain at the same time as maximising the value of the very different asset that is the land bordering the floodplain.

How well does flood planning articulate with wider planning and emergency management structures?

As noted above, floodplain planning needs to be consistent with principles governing the use of floodplains and it needs to sit within at least two (ideally connected) hierarchies of plans – for emergency management planning and land planning. It needs to articulate clearly with both sets of plans to enable iteration of floodplain planning improvements to cascade effectively through other parts of the planning system (and vice versa) and for floodplain changes to be picked up in emergency management processes locally.

In NSW, governance and management of flooding and flood response occurs through two sets of plans in the form of two separate legislative frameworks – the planning system legislation, principally through the *Environmental Planning and Assessment Act 1979* (EP&A Act), and the emergency management system legislation, principally through the *State Emergency Rescue and*

⁹³⁵ Note, these rivers have been identified on the basis of a Bureau presentation to the Inquiry (and Insurance Australia Group report) on 25 May 2022.

⁹³⁶ Meeting with Local Government NSW on 5 May 2022.

Management Act 1989 (SERM Act), described in Chapter 3 above. ‘Flood’ is defined as a type of emergency under the SERM Act.⁹³⁷ Sometimes there is overlap in the objectives of these systems, and other times not. This means that coordination of effort between emergency planning and land use planning is required. A good example of such coordination is the close working relationship between INSW, DPE and the SES on the planning for floods in the Hawkesbury-Nepean.

In addition to management of flooding being split across the two frameworks, implementation for both frameworks is split between state and local governments.

The SERM Act establishes 4 stages of an emergency,⁹³⁸ and this is where the crossover with the planning system becomes clear. The 4 stages – referred to as PPRR – are set out in Table 7-2 along with comments on how the planning system contributes to the different stages, and where its contribution could be improved.

Stage	SERM Act requirement	Relationship with planning system
Prevention	The identification of hazards, the assessment of threats to life and property and the taking of measures to reduce potential loss to life or property	Planning system should play a significant role in <i>avoiding</i> placing people and property in harm’s way. <i>This starts with a clear understanding of high-risk catchments and keeping the risk-based calculation of the flood planning level in the catchment up to date.</i>
Preparation	Arrangements or plans to deal with an emergency or the effects of an emergency	Planning system needs to consider evacuation options from existing and newly developed areas at risk to <i>mitigate</i> impacts from flooding. Future development should not occur in areas where satisfactory arrangements for evacuation cannot be implemented. <i>More formal arrangements for evacuation planning are needed within the planning system</i>
Response	The process of combating an emergency and providing immediate relief for person affected by an emergency	Limited to no input from planning system.
Recovery	The process of returning an affected community to its proper level of functioning after an emergency	Not a traditional area of focus for the planning system in NSW but becoming increasingly important as more frequent and more intense disasters affect the State. The planning system has sufficient flexibility to facilitate recovery efforts, but in the rush to recover, needs to be careful to avoid perverse outcomes. Some additional tools will be needed to deal with future challenges and adequately <i>offset</i> impacts on the community from flood events where risk to life and property is unacceptable. <i>The NSWRA has a vital role to play. Its proposed legislative powers will allow it to circumvent standard planning processes when needed.</i>

Table 7-2: Relationship with the planning system during the four stages of an emergency.

The NSW Planning System – a complex system to navigate

The planning system in NSW is effectively divided into two parts – strategic planning and development control, with both parts requiring interaction with state and local governments. This division into two parts is reflected in the name of the overarching legislation, the *Environmental Planning and Assessment Act 1979* (EP&A Act). As a result of the division and the interactions

⁹³⁷ *State Emergency and Rescue Management Act 1989* s4 establishes that the types of events that comprise an emergency include: fire, flood, storm, earthquake, explosion, terrorist act, accident, epidemic or warlike actions.

⁹³⁸ *State Emergency and Rescue Management Act 1989* s5.

with different levels of government, the planning system is complex, making it challenging to address flooding related risks.

Operationally, flooding related decision making is underpinned by the Floodplain Development Manual⁹³⁹ but the decision-making points occur at many different levels of the system and in a variety of contexts.

Strategic planning

Strategic planning is provided for under Division 3.1 of the EP&A Act. It involves government consulting with landowners and the wider public in developing land use plans. Strategic planning documents set an overall intention and vision for an area. They are prepared at both a regional scale (regional and district plans) and at a local scale (local strategic planning statements) in cascading fashion and are required to take various matters into consideration.

Typically, there are overlapping requirements, no continuous line of sight for policy implementation, and fragmentation of responsibility across the 2 levels of government, and different agencies at the state level. Figure 7-3 below gives some insight to the complexity of strategic plan making.

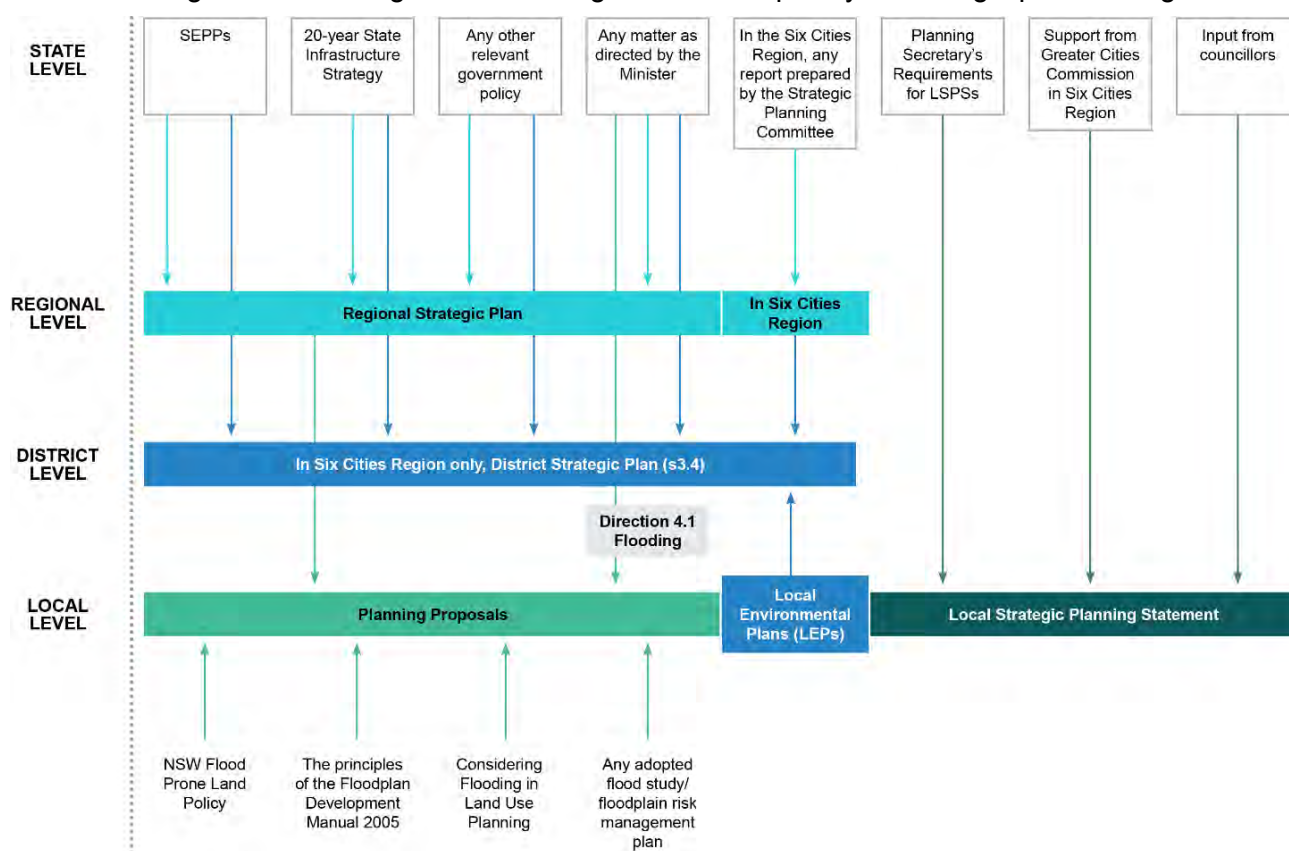


Figure 7-3: Considerations in strategic planning issues.

Strategic plans should be underpinned by robust constraints analysis and mapping (considering flood, bushfire, ecological communities, etc.) undertaken by relevant experts to identify the suitability of different lands for different uses and thereby ensure that appropriate statutory controls are in place to protect the community and the environment from adverse impacts such as flooding. Constraints analysis needs to be updated in strategic plan reviews to take account of land use and

⁹³⁹ DIPNR (NSW Department of Infrastructure, Planning and Natural Resources). (2005). Floodplain Development Manual: the management of flood liable land. Retrieved from [Floodplain Development Manual \(nsw.gov.au\)](http://www.nsw.gov.au).

development changes, and actual and forecast climate change impacts. This helps ensure that strategic plans and development controls are in lock step.

Development control

Development control means that development is to be carried out in accordance with an Environmental Planning Instrument (EPI). EPIs are made under Part 3 of the EP&A Act and include a SEPP or an LEP but do not include a Development Control Plan (DCP).⁹⁴⁰ The Minister is able to issue Directions under s 9.1 of the EP&A Act specifying matters to be taken into account when making EPIs. Direction 4.1 applies to flooding and applies to councils when making LEPs. It requires councils to take flood behaviour into account, but also leaves room for a discretionary decision to not require flood risk to be taken into account.

In relation to flooding, some EPIs used to contain a map known as an 'overlay' which showed which areas are affected by flooding and therefore what standards need to be considered on flood affected land. Since a change to the Standard Instrument LEP in July 2021, LEPs no longer contain a map showing the flood planning area. Instead, councils are instructed to place maps into a development control plan (DCP) or on their websites.

Flooding is also required to be taken into account if development is proposed in the Flood Planning Area (FPA).⁹⁴¹ The FPA reference in turn relies on the Flood Planning Level (FPL).⁹⁴² The development of a FPL requires a council to have made a decision about the Design Flood Event (DFE) it intends to apply for management of flooding, as well as the freeboard it will apply.⁹⁴³ The existence of a FPA is dependent on council having undertaken studies of flood risk in its area. Absent such studies, impacts will not necessarily be taken into consideration when a development assessment decision is made.

To assist in the interpretation of planning controls relating to flooding, the *Considering Flooding in Land Use Planning Guideline* (2021) indicates that all areas where flood-related development controls apply should be mapped, with maps made publicly available in a DCP or on a council website. If maps are not available, then 'risk-based planning controls' can apply to flood-prone land in accordance with the Floodplain Development Manual. The manual does not set out a specific risk-based approach for flood-prone land – instead it notes that, for development requiring consent:

a fundamental principle of floodplain risk management is to assess development applications within the strategic framework of a floodplain risk management plan and not in isolation or individually.

In relation to development of LEPs, the manual notes that:

⁹⁴⁰ *Environmental Planning & Assessment Act 1979* s1.4.

⁹⁴¹ Clause 5.21 in the Standard Instrument LEP specifies this as a compulsory clause to be adopted in all LEPs. The Flood Planning Area (FPA) is defined in both the Floodplain Management Manual 2005 and the *Considering Flooding in Land Use Planning Guideline* (see [Considering Flooding in Land Use Planning Guidelines \(amazonaws.com\)](https://www.amazonaws.com)). The LEP clause refers to the definition in the Floodplain Management Manual 2005 which defines the FPA as 'the area below the Flood Planning Level (FPL)'.

⁹⁴² The definition of the Flood Planning Level (FPL) for the purposes of the LEP clause 5.21 is derived from the *Considering Flooding in Land Use Planning Guideline* (2021) as 'the combination of the flood level from the Design Flood Event (DFE) and freeboard selected for flood risk management purposes. The Design Flood Event is defined as 'the flood event selected as a general standard for the management of flooding to development'.

⁹⁴³ Freeboard is not defined in the *Considering Flooding in Land Use Planning Guideline*. It is defined in the Floodplain Development Manual as 'provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the FPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels etc'.

councils are encouraged to incorporate appropriate planning provisions of floodplain risk management plans into LEPs, DCPs and development control policies.

The manual recommends that LEPs exclude complying development from areas that require flood related development controls.⁹⁴⁴ The Inquiry received submissions indicating that the complying development pathway should not be available for development on flood control lots, that is lots identified as flood constrained on s10.7 Planning Certificates.⁹⁴⁵

Clauses 5.21 and 5.22 were included in the Standard Instrument amendment (July 2021) as a mandatory and optional clause respectively. Clause 5.22 (Special flood considerations), when adopted, applies to a permitted range of “sensitive and hazardous development” on land between the FPA and the PMF in recognition of those uses “having a higher risk to life and warranting the consideration of the impacts of rarer flood events on land located outside the FPA.”⁹⁴⁶ In mid-2021, 32 councils applied to adopt clause 5.22. The resolution of those applications is not yet finalised.

In several parts of Sydney subject to a Precinct SEPP, local planning controls, including clause 5.21 relating to flooding, do not apply, but in some cases, the relevant EPI contains its own flooding considerations.⁹⁴⁷ Precinct SEPPs often contain a flood map, so it is much easier to determine which land development controls and considerations will apply. For remaining areas where LEPs no longer contain maps, it is well established that DCPs do not have statutory weight in relation to development assessment decisions. Through the Direction to have flood maps either in DCPs or on councils’ websites instead of in an EPI, the ability to apply clause 5.21 (and clause 5.22 when it is enacted) is greatly diminished in practice.

A new clause 5.9 was introduced to LEPs following the Black Summer bushfires in 2020, allowing houses in areas affected by any natural disaster (not just bushfires) to be rebuilt without obtaining further consent. However, in relation to flooding, reliance on this clause puts people back into harm’s way without any consideration of mitigation measures (e.g. minimum floor height, relationship to flood planning area, etc.). As a result, standard clause 5.9 of LEPs does not support a ‘build back better’ approach to recovery from all natural disasters. Submissions to the Inquiry have noted that this clause appears to be “somewhat inconsistent” with the NSW Government’s push for resilience.⁹⁴⁸ The Inquiry agrees with that assertion.

As flood related provisions span a number of EPIs and the Standard Instrument, it would be helpful to consolidate them, along with clause 5.9, into a new chapter in the SEPP Resilience and Hazards to aid navigation of the system. This would facilitate a more uniform approach to development assessment.

Integration of evacuation into planning

Since the introduction of the *Floodplain Development Manual*, hundreds of flood studies have been completed at various scales across NSW. The flood studies and floodplain management studies and plans developed are available in static form through the SES Flood Data Portal.⁹⁴⁹ Nearly all

⁹⁴⁴ DIPNR (NSW Department of Infrastructure, Planning and Natural Resources). (2005). Floodplain Development Manual: the management of flood liable land. Retrieved from [Floodplain Development Manual \(nsw.gov.au\)](https://www.planning.nsw.gov.au/-/media/Files/DPE/Circulars/2021/PS-21-006-Considering-flooding-in-land-use-planning.pdf?la=en).

⁹⁴⁵ Shoalhaven Council, submission to the Inquiry.

⁹⁴⁶ DPE (NSW Department of Planning and Environment). (2021). PS 21-006 Considering flooding in land use planning: guidance and statutory requirements. Retrieved from <https://www.planning.nsw.gov.au/-/media/Files/DPE/Circulars/2021/PS-21-006-Considering-flooding-in-land-use-planning.pdf?la=en>.

⁹⁴⁷ In the case of the Central River City precinct, the considerations for flooding do not include evacuation. However, evacuation is one of the key issues within that area.

⁹⁴⁸ Shoalhaven Council, submission to the Inquiry.

⁹⁴⁹ The portal is accessible via the SES website at [Welcome - NSW Flood Data Portal](https://www.ses.nsw.gov.au/).

councils have implemented their own planning controls to give effect to issues raised in flood studies.

Evacuation is now considered to be almost as important as understanding the flood behaviour on a given site, as it is a primary mechanism for reducing the risk to life arising from flooding. Figure 7-4 shows how flood emergency management planning links to information derived from the floodplain management process established in the manual.

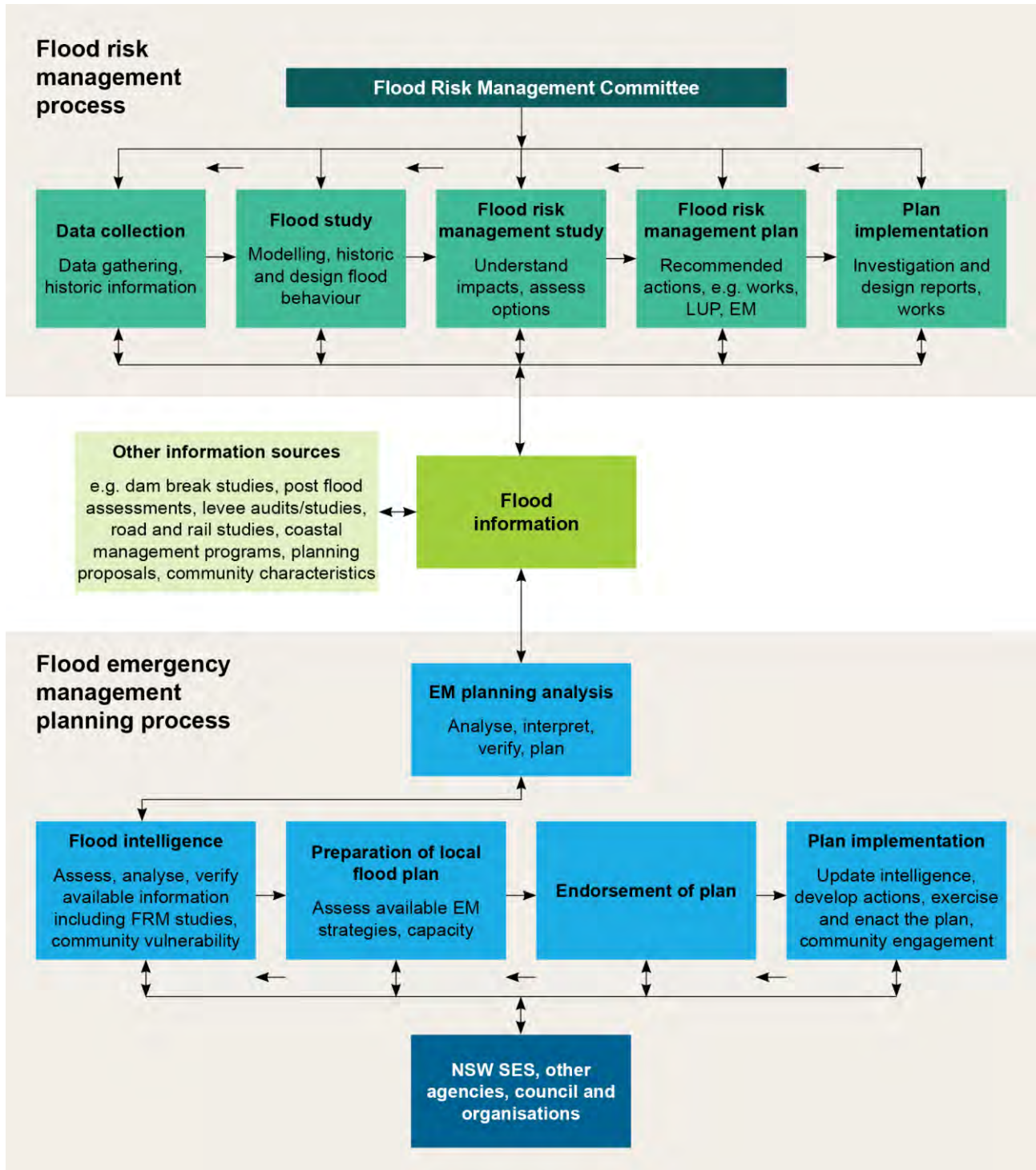


Figure 7-4: Linkages between the floodplain management process and flood emergency management planning process
 Source: Support for Emergency Management Planning guideline – component of the 2022 draft Floodplain Risk Management Manual.

The collaboration between floodplain management experts and the SES has resulted in specific guidance being developed incorporating a Flood Emergency Response Classification.⁹⁵⁰

This classification has specific triggers for when development is suitable to proceed, and when development of an area should be reconsidered. It classifies developments in relation to their mechanism for being cut off from evacuation options as flood levels rise. For example, flood islands and trapped perimeter areas could leave people isolated as flood levels rise unless they have been evacuated early. This creates challenging situations for planners, as these areas may be several kilometres from the river making it difficult for the community to understand why an area is at risk from flooding.

The Inquiry has heard that there is a policy gap around the concept of 'shelter in place' which is sometimes also referred to as 'vertical evacuation'. As there is no formal mechanism for expert advice to be sought in relation to flooding, it is up to the consent authority or the planning proposal authority to make a decision on this.

The emergence of evacuation and emergency management planning as a genuine consideration has also been reflected in the standard flood clause 5.21 which was introduced to all LEPs in July 2021.⁹⁵¹ Specifically:

(2) Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development— ...

(c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and

(d) incorporates appropriate measures to manage risk to life in the event of a flood, and ...

(3) In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters- ...

(c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,

However, unlike bushfire planning considerations, there is no formal requirement to seek advice on the nature of the flood risk including evacuation at any stage in either a strategic planning or development assessment process. This leaves local plan making authorities and consent authorities to make their own decisions without the ability or necessity to access expert technical advice.

In practice, evacuation is not always a short-term consideration. The Inquiry heard that some places were isolated for several days.⁹⁵² For example, Yamba was cut off for 6 days following the March 2022 floods. Concerns were raised about inadequate consideration of flood evacuation options in new development proposals in this area which are aimed at the over-55 demographic. The Inquiry also heard that Brooms Head was isolated from services.⁹⁵³ Other parts of the Clarence Valley were unable to flush toilets in their homes due to the gravity-fed system being flooded and not operating. This means that, if people do not evacuate, they need to be prepared to be isolated for several days with services that may or may not be available.

⁹⁵⁰ Guidance on support for emergency management planning has been updated in 2022 as part of the draft Floodplain Risk Management Manual. It is available at [Support for Emergency Management Planning \(nsw.gov.au\)](https://www.nsw.gov.au/support-for-emergency-management-planning).

⁹⁵¹ The Standard Instrument Local Environmental Plan was amended to introduce a compulsory clause 5.21, and repealed the previous standard flood planning clause that had been introduced by councils progressively to LEPs.

⁹⁵² NSW Independent Flood Inquiry Clarence Valley Virtual Town Hall held on 17 June 2022.

⁹⁵³ Ibid.

Submissions to the Inquiry highlighted the need to review the current Ministerial Direction to councils to ensure that flooding is given appropriate consideration at the rezoning stage, not only at the development assessment stage.⁹⁵⁴ This requirement should be expanded to apply to state-led rezonings also. The Inquiry has heard⁹⁵⁵ that the amendments introduced to the standard LEP clause 5.21 relating to flooding in July 2021 are “ambiguous, subjective and too open to interpretation” in contrast to the Ministerial Direction for rezoning bushfire prone land which:

- sets clearer expectations for rezoning proposals
- requires pre-exhibition consultation with the relevant agency (RFS)
- is underpinned by a specific direction in the recently revised Planning for Bushfire Protection Guidelines.

Simplifying and clarifying planning – the need for a clearer line of sight from strategic planning to development assessment

The complexity of the NSW planning system has meant that over time there is no clear line of sight from strategic planning to land use zoning to development assessment. This makes the tasks of managing for existing risks such as flooding and for emerging risks such as climate change challenging.

In contrast, the United Kingdom’s *Thames River Estuary TE2100 Plan* has an integrated approach that blends the planning system and its outcomes with an understanding of natural hazards through integrating Shoreline Management Plans for coastal issues and Catchment Flood Management Plans for flooding issues.⁹⁵⁶

NSW arguably has an integrated approach for the Hawkesbury-Nepean but not for many other areas. It does not have regional flood risk appraisals but, through the reintroduction of catchment-wide studies, this could be addressed. NSW also does not have strategic flood risk assessments, and its planning framework does not nest as directly as in the UK system. However, it would still be possible to achieve a much more integrated approach within the current legislative framework, with modifications: especially introducing a high-level plan (a disaster adaptation plan) which ties together all the planning instruments relating to disaster prevention for any given town or region.

This would provide the assurance that risks from natural hazards were being considered at the appropriate level at the appropriate time in the planning system, and that decisions were informed by up to date and relevant information.

With the introduction in 2021 of the *Flood Prone Land Policy*, the NSW planning system arguably now has a policy basis which can support best practice floodplain risk planning, subject to a range of operational improvements to determining a risk-based flood planning level for all high-risk catchments. However further improvements are necessary:

- the first aim should be to simplify the various references to management of flood across system, seeking to integrate them into one existing SEPP which will create consistency across the planning system
- the second aim is to clarify how strategic plans flow down to local plans
- the third aim should be to clarify guidance for communities, in particular outlining a clear adaptive management framework for changing flood risk caused by climate change. This

⁹⁵⁴ Shoalhaven Council, submission to the Inquiry.

⁹⁵⁵ Ibid.

⁹⁵⁶ United Kingdom Environment Agency. (2021). Thames Estuary TE2100 Plan. Retrieved from <https://www.gov.uk/government/publications/thames-estuary-2100-te2100/thames-estuary-2100-te2100>.

should improve clarity and build capacity for those undertaking or engaging with floodplain planning to understand how to manage the growing risk of climate change in a proportionate way

- the fourth aim should be explicitly to promote flood resilient towns and cities, especially in the face of the threats from climate change.

7.5. What to do?

This section presents recommendations (and associated findings) that address issues raised in this chapter about how the planning system could address disaster preparedness better.

Given that many people told the Inquiry they had difficulty understanding whether their property, or a property they are considering renting or purchasing, is at risk of flood (or other disaster), Recommendation 17 proposes a mechanism for enabling people to learn what disasters have affected a property, at least since European settlement.

Recommendation 18 firmly endorses a risk-based approach to determining the flood planning level and proposes that this determination be brought back to state level as the responsibility of the new NSWRA; and that the NSWRA re-calculate appropriate flood planning levels for all the state's high-risk catchments, informing these calculations by whole-of catchment studies.

To assist with navigating the planning system, Recommendation 19 calls for all relevant disaster planning and disaster evacuation provisions to be collected within a single disaster adaptation plan to be prepared for each town and region. This will result in there being one document that is the main source of referral for checking all disaster risks (anticipated, legacy, managed, residual) and updating them frequently. These disaster adaptation plans will provide a strong foundation for decisions on both stalled development and development needed to build back in areas which have had to be evacuated because of flood. The recommendation also calls for alternative development in safe areas close to facilities to address the urgent need for more housing, particularly making use of government-owned land.

Recommendation 20 is for floodplains to be treated as assets. To enable this, it calls for the commencement of a process for taking them back into public ownership and re-purposing them to more appropriate uses. Government should progressively move floodplain ownership to government leasehold, with lessees using the land under appropriately specified conditions.

There are many productive possible floodplain uses that would not pose a risk to life during major weather events. Such uses include sporting and recreational activities, garden plots and community gardens (which might in some instances be tied to high-rise developments, so families have access to 'their' garden, even if it is some distance from where they live), agriculture and forestry, renewable energy production, biodiversity offsets, parks and outdoor education activities.

With regard to possible biodiversity uses, state and national environment statutes provide for the generation of biodiversity and carbon credits to be traded in credit markets to offset proposed developments and activities which affect biodiversity values or emit greenhouse gases. This includes at scale housing subdivision proposals and significant public infrastructure projects. In NSW, these credit and offset markets are still maturing. The market for biodiversity offsets remains particularly thin, with demand for offsets outpacing supply. This has priced biodiversity offsets at a level which makes some projects cost prohibitive. The generation of biodiversity and carbon credits should be part of any re-imagining of alternative and valued uses for our floodplains.

Proactive investment in landscape remediation on floodplains through revegetation or other forms of ecosystem restoration can, as well as replacing current high risk land uses (including frequently flood-affected housing), provide a biodiversity and carbon credit income stream to the landowner, generating a store of credits to offset development and activities elsewhere, including the construction of new housing for the flood displaced. Importantly this can enhance natural system

flood mitigation values through improved moisture retention and soil stabilisation. This meshes with Caring for Country by Indigenous people where landscape remediation strengthens cultural connection to Country. It also provides economic opportunities for Indigenous communities when Aboriginal-owned land is used to generate credits or where credits enable development of those lands.

Given the complexity of the planning system and the lack of line of sight from strategic planning to development control, Recommendation 21 in this section addresses simplifying the planning system disaster provisions.

What to do in the Northern Rivers and Hawkesbury-Nepean

The recommendations described can be used to address explicitly the two areas particularly damaged in the 2022 floods – the Northern Rivers region especially Lismore and the Hawkesbury-Nepean Valley. These are the subjects of case studies in Volume Three. The issues for these two areas are summarised here.

The Northern Rivers region especially Lismore

For Northern Rivers, and Lismore in particular, there is a need to move quickly to provide accommodation that is flood-safe and community-connected for the many who have been left homeless. There is also a need to rebuild the economic security of the region. The case study addresses this in detail and calls for a series of actions, all of which fit under the main planning recommendations of this Inquiry. These actions are:

- migration off the floodplain
- re-purpose the floodplain
- develop a land use plan that accommodates and protects some existing uses and heritage
- boost employment and training opportunities in areas of local need for the future – building trades, creative arts, planning, emergency management, environmental and floodplain management
- implement a sustainable transport network of roads, bus routes, cycleways and pedestrian ways to connect villages separated by waterways
- in the Lismore footprint, further develop the health, academic and sporting precincts with related commercial and residential density and diversity of housing, making use of existing zoning mechanisms
- consider CBD residential development in shop top and increased density that is at a level and design off floodplains to bring life into the business district, combined with improved levee and flood mitigation schemes
- engage with the community intensively throughout the reconstruction and new building phase
- consider the area as a sustainable growth centre with a District Commissioner similar to the existing models across Sydney
- have the newly formed Reconstruction Corporation (and then the NSWRA) take a leadership and authority role in developing and implementing the plans and transitioning responsibility back to local government over time.

The Hawkesbury-Nepean

The nature of the Hawkesbury-Nepean's floodplain requires a decision on what is a tolerable level of risk:

- a no risk approach (no risk of property damage and no risk to life) – would see a retreat from existing development footprints

- a risk approach based on no further risk to either lives or property – would see no further development in the PMF area
- a risk approach based on no further loss of life – would see a reduction in development activity in the PMF area and a level of development intensity that can be safely evacuated and managed in a resilient manner.

Continuing to use the existing 1% AEP flood planning level creates a challenge in the Hawkesbury-Nepean as it puts an unacceptable level of risk on human health and safety. This leaves a question about whether to retreat from, halt or manage development in the basin, or some combination of those.

A reduction of development potential in the Hawkesbury-Nepean has a consequential impact on housing supply and economic activity within Greater Sydney. Allowing development, even if managed, also requires long-term funding for infrastructure and services capable of ensuring safe flood evacuation. The strategic planning settings for Greater Sydney incorporate the development of the North West Growth Area and the Penrith CBD as critical contributors to housing affordability.

Implications of policy change recommendations

Planned retreat of development will be expensive and will see the continued loss of heritage as early colonial townships at Windsor and Richmond are reduced in size. The relocation of the populations of Windsor, Richmond, large parts of Penrith and smaller settlements along the river would be cost prohibitive and require extensive new housing to be created. This is not seen as a realistic option to pursue.

Putting a halt to further development in the Hawkesbury-Nepean, even reducing the expected yields, requires a response from Government to find alternative sites for housing, noting:

- there is potential to increase densities within existing urban footprints, recognising there are options for increased density along well serviced transport corridors in the North West, Metro West, Greater West, City and South West metro lines
- other greenfield sites within the Greater Sydney basin could cater for increased densities if investments in public transport services were made, for example the South West, Greater Macarthur and Wilton areas
- investment in faster rail connections to the three ‘outer cities’ of the Six Cities Region,⁹⁵⁷ namely the Hunter, the Central Coast and the Illawarra, could see both jobs and housing relocated to these areas. Broader investment in faster rail beyond the six cities could see development in the Southern Highlands and Tablelands, the Central West and the Mid North Coast as suitable alternatives for housing.

The Greater Cities Commission is updating its regional planning for the Six Cities Region of Greater Sydney and can be tasked with getting an appropriate balance in the housing needed to accommodate a reduction in development potentials.

Rebalancing the greenfield development to infill development proportions, as well as shifting the economic focus for Greater Sydney from a monocentric to a polycentric urban area could be a legacy outcome driven by the need to reshape settlement patterns to respond to flood risk.

Pursuing a strategy in the Hawkesbury-Nepean that contemplates some form of development needs to accommodate a better means of funding infrastructure capability. Improved transport capacity, stronger capability in evacuation management and increased community resilience to disasters, all require assured long-term funding. Building in the capacity to adapt to changing circumstances without the costs and complexity of acquiring land will also be an important consideration.

⁹⁵⁷ The six cities region comprises the Lower Hunter and Greater Newcastle City, Central Coast City, Illawarra-Shoalhaven City, Western Parkland City, Central River City and Eastern Harbour City

As noted above, a potential option for Government to consider, looking at funding and adaptability to change over the long term, is to take floodplains increasingly back into public ownership and then leasing them back (with conditions) under long-term lease arrangements, similar to the ACT.

This approach allows for a shift in the current infrastructure and services funding model, from development contributions to annual lease fees. It also makes it easier to adjust development activity to respond to changing natural disaster risks. In addition, it would require Government to be more actively involved in the development process, acquiring the Torrens Title to development land so it can be converted to leasehold. As landowner, Government would then have greater control over the location, design, development staging and infrastructure funding models for new development, reducing the extent of development risk.

Findings and recommendations – planning

N. Finding – landholders can access information on previous disasters

Most landholders seem to have little idea if their property is at risk of disaster or has ever been affected previously by disaster. Given that house purchase is often an individual or family's single biggest personal investment, it is important that they understand this risk before purchase.

17. Recommendation – landholders can access information on previous disasters

That, to ensure there is a single source of ground truth to prepare for and respond to emergencies, and to provide people with a better understanding of their individual property and community risk exposure, an online visualisation tool be developed to display, for all land parcels (land titles) in NSW, the extent of known disasters that have affected each piece of land in NSW in the past. This information should be made available through the Planning Portal and, particularly in light of climate change, the data involved should be revised and updated at least every two years and after each major natural disaster.

O. Findings – risk-based approach to calculating flood planning level

- Most landholders Using the 1% AEP for calculation of the flood planning level for planning purposes in NSW is not adequate, especially in the light of changing rainfall patterns including the intensification of intra-day rainfall, with the consequent risk of greater flash flooding.
- To understand risk, especially for major flooding events, knowledge of floods at a catchment-wide scale is needed. Councils are generally not adequately resourced or organised to manage either whole-of-catchment models or high quality, risk-based flood planning level estimations. Responsibility for this matter needs to return to the State Government. Re-determining flood planning levels will be relatively straightforward in some cases with the result remaining close to the 1% AEP but will need substantial adjustment in others depending on local rainfall intensities, catchment shape and other risk factors.

18. Recommendation – risk-based approach to calculating flood planning level

That, to take account of greater knowledge of climate change, Government reinforce its adoption of a risk-based approach to calculating the flood planning level for planning purposes and, through the NSWRA, immediately start a process of revising all flood planning level calculations in the state's high-risk catchments. Flood planning level re-determinations for all high-risk catchments should be completed within 3 years. These revised flood planning levels will need to be factored into all development applications (in-progress and new) in those high-risk catchments. The risk profile of high-risk catchments should be revisited at appropriate time intervals to check that levels are current. A review should take place if there has been a significant trigger event (i.e. changed rainfall, development) or at least every 5 years. As well as reviewing the flood planning level, this 5-yearly review should include reviewing any floodplain lease conditions and adjusting them as necessary in the light of better knowledge of climate change impacts. In working out a tolerable, risk-based flood planning level, consideration should be given to the PMF, 1% AEP, 0.02% AEP, existing development, approved but not yet constructed developments, and existing and approved but not yet constructed evacuation routes.

In coordinating this flood planning level re-determination process, NSWRA should work closely with local councils, DPE, communities, state water authorities and state and national engineering and research organisations. In doing so, the NSWRA should also:

- extend and then maintain the DPE state-wide flood database and associated visualisation interface. This database, which should link to LandiQ, would support:
 - monitoring of the flood warning and sensing environment
 - monitoring of trends in rainfall activity and impacts, including timing, cause, extent and intensity
 - tracking trends and identifying patterns in associated weather and climate signals that contribute to severe floods
 - evaluation of the cost and effectiveness of risk mitigation efforts, including land preparation, planning use and management, to enable a better understanding of what works
 - simulation of extreme rainfall events and resultant flooding
 - identification of 'at risk' river and catchment systems for flash flooding
 - rapid and effective deployment of resources during a flash flood event

act as the main coordination point for all NSW hydrological modelling, working with local government, other state agencies, universities, professional bodies (e.g. Engineers Australia) and the Australian Government (especially the Bureau of Meteorology and CSIRO) to improve future NSW flood risk assessment (and hence accuracy and timeliness of flood prediction) by building more formal connections between the extensive existing physical hydrological modelling (done by various NSW agencies) with the Bureau's meteorological and climatological research and riverine flood models

- support local councils to improve modelling of and ensure adequate and appropriate alarm systems for flash flooding.

P. Finding – disaster adaptation plans for all towns

Natural disasters will recur in NSW as we see more extreme climate. NSW will experience more extreme bushfires and larger and more dangerous floods. This means that certain regions and certain areas of cities and towns (notably floodplains associated with major rivers and the parts of cities that are bushfire prone) are increasingly dangerous places to live and will increasingly be a drain on the public purse as people who live there have to be evacuated repeatedly and then re-housed. Particularly good examples include the Hawkesbury-Nepean Valley in the Sydney region, and high-risk flood catchments in regional NSW – notably the Northern Rivers and the Hunter region. The flood risks of these areas are so significant that any further development just increases the burden on current and future communities, and a strategy is needed to adapt to this risk and minimise the number of people who live below the flood planning level.

19. Recommendation – disaster adaptation plans for all towns

That, to establish realistic expectations of safe spaces to live and deliver much needed housing quickly, Government through NSWRA working with local government:

- build a disaster adaptation plan for each city and town, with planning instruments discouraging (and in many cases forbidding) development in disaster-likely areas. These plans should be developed under the NSW Climate Change Adaptation Strategy¹. For towns at high risk, this should be completed within 3 years, with the rest of the state to be completed within 5 years. To develop these plans, it will be necessary to prioritise modelling of the impact of and evacuation possibilities from likely potential disasters as well as modelling the direct impact of the potential disasters themselves. For floods this can be done by continuing and broadening the flood modelling done in INSW to other high-risk catchments. This flood modelling activity should be moved to the NSWRA from the two groups it is currently with (INSW's Hawkesbury-Nepean Valley Flood Risk Management Directorate and the Department of Planning and Environment's Environment and Heritage Group)
- through NSWRA, working with local councils, complete the first sweep of plans including appropriate hazard maps (including but not limited to flood, fire and landslip) and link them to Strategic Plans and LEPs (updating as necessary). An accreditation process should be implemented so local councils with demonstrated capacity can seek accreditation with the NSWRA to maintain their own disaster adaptation plans with oversight (spot audits) by NSWRA
- use the disaster adaptation plans including the disaster/evacuation modelling to resolve existing rezonings currently on hold especially for the North-West corridor of Sydney. Future residential development in the Hawkesbury-Nepean Valley should be increasingly discouraged in favour of rapid development near train stations and other facilities in flood-safe areas

- use the disaster adaptation plans including the disaster/evacuation modelling and the options spelled out in the Northern Rivers case study to inform town planning, relocation options, buy backs and land swaps for the flood affected Northern Rivers region with the NSWRA (and in the lead up to the NSWRA's creation, the Northern Rivers Reconstruction Corporation) urgently commencing a phased program to migrate people off the highest-risk areas of the Lismore floodplain, and other Northern Rivers floodplains, through a significantly expanded land swap and voluntary house purchase scheme, with priority given to our most vulnerable community members
- prioritise and incentivise new development in safe areas, noting this will often mean encouraging first home buyers to choose homes in appropriate density developments, including high-rise developments, through siting such new developments in locations with desirable attributes (near train stations, parkland, shopping centres, etc.) In this regard, Government should focus on redeveloping existing Government land in these locations
- for existing developments which are in disaster-likely areas, ensures evacuation routes are available and of sufficient capacity; the community is well-educated about the risks they face and how and when to evacuate; and any modifications of existing buildings are approved only if they maximally address the relevant risk (e.g. apartment buildings have the first few floors dedicated to parking so residents can shelter in place if necessary) noting that shelter in place only works if the flood waters come up and go down quickly, and if other essential services (water, electricity, sewerage, access to food and medical supplies, etc) are available
- using the Six Cities Region as an inspiration, consider developing another strategic city cluster in NSW, prioritising safety from fire and flood along with affordable housing; new industries offering well-paid employment; living within 30 minutes of the workplace; and offering access to education and training at all levels.

Q. Finding – floodplains as assets

At the moment, there is no coherent or principled approach to proactive, appropriate development of NSW floodplains. Practice to this point has created tensions between the urgent need for more housing and keeping people safe. There is pressure on developers to provide housing, and there is pressure on consent authorities to approve the development, whilst ensuring it is safe and appropriate to do so. Climate change, though not yet fully understood, is increasing this tension. The tension particularly affects those who can't afford to live in suburbs out of the floodplain.

20. Recommendation – floodplains as assets

That, to establish the capacity and maximise the economic, social and environmental potential and consequently unlock the value of NSW floodplains, Government adopt the following guiding principles for floodplain management:

- treat floodplains as an asset, specialising in uses that are productive and minimise risk to life during major weather events. Such uses would include sporting and recreational activities, garden plots and community gardens, agriculture and forestry, renewable energy production, biodiversity offsets, parks and outdoor education activities. Government should progressively move floodplain ownership to Government leasehold with lessees using the land under appropriately specified conditions. The management of the process of conversion to leasehold would be a Special Project of the NSWRA but over time handing the floodplain asset over to management by another government agency. The NSWRA should prioritise rapid conversion to leasehold in cases where houses and businesses are in high-risk areas – this may be accomplished by land swaps or buy backs. In doing so Government achieves early wins for new uses. In other cases, the conversion should occur as a condition of development, of a type that is consistent with safe evacuation or safety in place in the case of flash flooding that recedes rapidly
- treat development of the floodplain in parallel with development of urban structures (houses, businesses and industry) that are built near to the edge of the floodplain. Examples of connection could include high-rise housing developments where apartment owners are granted automatic rights and access to community garden and community recreation facilities. Structures within the floodplain and surrounding development should be connected by a layer of sustainable transport
- favour letting watercourses largely flow naturally rather than implementing engineering barriers such as flood levees and mitigation schemes to stop floods
- communicate the intention to use planning arrangements that will lead to greater safety and community amenity as well as realising a significant state asset. This needs to be communicated in general to the people of NSW, but also to those particularly affected communities at the time of planning, rebuilding and construction.

R. Finding – simplify the planning system disaster provisions

- The new disaster adaptation plans and risk-based approaches to calculating flood planning levels will need to have a clear connection to the development assessment and infrastructure delivery process. It will be critical for new controls to create more resilient buildings to be enforced through development decisions, just as decisions to retreat from high-risk areas require support through public space and other infrastructure funding. Achieving these outcomes needs a clear line of sight between policy imperatives for disaster avoidance and adoption,

the strategic plans that shape settlement decisions, and the operational decisions (like development assessment and spending) that achieve these outcomes. With multiple inputs to the preparation of local planning controls, the line of sight necessary to ensure effective adaptation and resilience to disasters can be obscured. Shifting the responsibility for flood risk management planning to the proposed NSWRA also raises the question of where the development controls for flooding should sit along with the policies that support the inclusion of disaster adaptation plans into strategic planning.

- The division of the planning system into two parts – strategic and development control – and its operation across two levels of government makes it at times challenging in relation to addressing flooding (and natural disasters more generally).

21. Recommendation – simplify the planning system disaster provisions

That, to simplify and improve the state planning processes especially when anticipating and recovering from a disaster, Government:

- ensure there is a clear line of sight directing councils and planning authorities to include disaster response and resilient settlement outcomes in long term strategic plans (Regional and District Plans as well as Local Strategic Planning Statements). This may require more prominence to be given to *Planning for a more resilient NSW: A strategic guide to planning for natural hazards* (Department of Planning, Industry and the Environment) as well as a clear link to the risk-based approach to hazard identification and the disaster adaptation plans
- ensure the NSWRA provides the necessary tools and advice to enable planning authorities to incorporate cumulative impacts of potential natural disasters into strategic plans. These tools should ensure the disaster adaptation plans can be given real effect in strategic plans for settlement and local planning controls
- ensure that Ministerial Directions on hazard and natural disasters (directions 4.1 and 4.6 inclusive) are updated to reflect the new risk-based approach to flood planning levels and deliver the disaster adaptation plans to the zoning process
- create specific flood planning provisions as a new chapter in the SEPP (Resilience and Hazards). These provisions would draw the existing flood planning clauses (5.21 and 5.22 in the standard instrument) up into the SEPP
- put the natural disaster clause (5.9 in the standard instrument) into a new chapter in the SEPP Resilience and Hazards, along with objectives to assist councils to use the clause to build back to more resilient standards
- update planning guidance so that wherever possible community facilities, such as might be used for evacuation centres, are located above the probable maximum flood and essential services are located

above the flood planning level

- ensure that the strategic land use frameworks and related controls permit new developments only in line with the evacuation capacity both individually and cumulatively
- ensure that the strategic land use frameworks enable higher density flood resilient precincts to locate more development at or above the PMF and use a higher flood planning level to avoid catastrophic costs from extreme flooding, as well as deliver cost-effective controls for individual structures.

7.6. Housing

Before the 2022 flood events, much of the State, particularly regional areas, was already under considerable housing stress. Key causes of this included: internal migration patterns, with more people moving from cities to regions and fewer moving from regions to cities, driving up regional house prices and rents; a domestic tourism boom, with long-term rental housing repurposed for short-term accommodation adding to rental shortages; supply chain disruptions and labour shortages inflating building costs and delaying house construction and renovation work; constraints on housing supply caused by poor regional strategic planning, inadequate supporting infrastructure and limited council capacity to assess development proposals; and a reluctance by some developers to commence approved housing projects.

These pressures saw: house prices increase by 24.8% and rents by 12% in regional areas; regional rental vacancy rates fall below 1% – a ‘neutral’ vacancy rate is 2 to 3% – with the Northern Rivers rental vacancy rate at 0.7% before the floods; an increasingly stark trade-off between affordability and location – living on cheaper flood-prone land being the only option for many; and increasing pressure on social and affordable housing and homelessness services.

Housing stress has been exacerbated by the displacement of residents from flood-affected homes. This has disproportionately hit lower income households and has driven yet more demand for social, affordable and market rental properties and has worsened homelessness. The Northern Rivers has been most affected, with more than 4,000 homes uninhabitable and some 10,500 otherwise damaged. At its worst, over 7,000 people were displaced and in need of emergency accommodation.

In addition, intergenerational disadvantage and prejudice continue to create barriers to Aboriginal people accessing rental housing or owning homes; waitlists for social housing remain high and are growing; poor housing diversity characterises the regions, with a prevalence of detached homes and an undersupply of smaller homes close to services to cater for an ageing population; and poor tenure security continues to fuel housing uncertainty for renters.

An effective response demands: prioritising alternative, fit purpose housing for the most vulnerable who continue to reside on high risk floodplains; developing new, resilient, well-connected and attractive social, affordable and market housing supported by appropriate infrastructure – transport, public space, retail, schools – with good access to job opportunities; planning for diverse housing to meet needs and preferences across the housing spectrum, from the homeless, to social housing tenants, to market renters, to aspiring and current homeowners, and for the disabled, the elderly and families; and significant investment by both the public and private sectors.

Building and re-building

Good, safe homes are essential to getting people affected by flood and other natural disaster back on their feet and functioning as quickly as possible. If constructed and maintained properly, they are also critical in minimising the potential damage caused by flood.

But the age of most housing stock in NSW, and the extent of this stock that is in flood-prone areas, means many homes in NSW are ill-equipped to deal with the impact of flood. As has been observed following the recent flood events, damage to homes included mould infestations, compromised electrical, drainage and structural stability. The extent of the damage has left many homes uninhabitable, in need of extensive remediation or requiring a complete rebuild. Further, many of these homes were not insured. As discussed in Chapter 5, delays in rehousing people can prolong trauma following a flood event, and lead to mental health issues.

This section discusses the building and rebuilding of homes in NSW to be more resilient to flood and other natural disaster. It discusses the presence of mould in homes, and for which groups this is a particular concern. It also briefly covers the standards, codes and practices in place across the country and State, and what can be done to improve the speed with which people are rehomed, and the resilience of existing and new homes to mould and other flood damage. In doing so, this section concludes that building back better means building back right.

Mould

The flooding, intense rain and high levels of humidity recently experienced across the east coast of Australia created an incredibly damp environment – one which was optimal for mould growth. Excess moisture and pooled water in many homes affected by the floods saw mould bloom on ceilings and walls within a matter of days and weeks following the flood events. Even communities unaffected by flood reported mould infestation in homes. Submissions to the Inquiry described the mould as causing further deterioration of homes and businesses. Many submissions highlighted people returning to their homes despite the mould, due to lack of crisis accommodation available. A few people have also said that living in mouldy housing has caused them to develop some health issues. For example:

*I know of people living inside of their mould ridden houses because they have nowhere else to go after the flood.*⁹⁵⁸

*I came home to my Damp and mouldy house as I had no other option.*⁹⁵⁹

*We cannot keep the mould at bay and my partner and I are now suffering health wise.*⁹⁶⁰

In addition, various media outlets filed stories highlighting mould as infiltrating homes and a serious health risk.⁹⁶¹

It is important to note that people are exposed to mould spores daily. Mould is present almost everywhere in the environment, both indoors and outdoors,⁹⁶² and people with a normal immune system are unlikely to be affected by it. Though the WHO has concluded that there is sufficient evidence to show that people who occupy damp or mould buildings, both houses and public

⁹⁵⁸ Anonymous, submission to the Inquiry.

⁹⁵⁹ Michelle Anderson, submission to the Inquiry.

⁹⁶⁰ Anonymous, submission to the Inquiry.

⁹⁶¹ See [How to get rid of mould as floods, wet weather and extreme humidity hit NSW and Queensland | NSW and Queensland floods 2022 | The Guardian](#) and [How to deal with mould following the south-east Queensland flooding and rain - ABC News](#).

⁹⁶² NSW Health. (2022). Mould and your health. Retrieved from <https://www.health.nsw.gov.au/environment/factsheets/Pages/mould-and-your-health.aspx>.

buildings, are at increased risk of respiratory infections and exacerbation of asthma,⁹⁶³ this risk is much greater for particular groups of people. For example, the elderly, or people with asthma, allergies or other breathing conditions may be more sensitive to mould. People with weakened immune systems (such as people with HIV infection, cancer patients undertaking chemotherapy or people who have received an organ transplant) and with chronic lung diseases (such as emphysema and Chronic Obstructive Pulmonary Disease) are at greater risk of infection, particularly in their lungs.⁹⁶⁴

The spread of mould can be caused or made worse by inadequate architecture and poor construction practices.⁹⁶⁵ The WHO *Guidelines for indoor air quality, dampness and mould* provide guidance to public health authorities planning or formulating regulations, action and policies to increase safety and ensure healthy conditions of buildings, recognising that “well-designed, well-constructed, well-maintained building envelopes are critical to the prevention and control of excess moisture and microbial growth”.⁹⁶⁶ To this end, section 7.6.3 immediately following discusses building codes, standards and practices as they relate to mould and flood more broadly. Further, poor maintenance practices and other occupant behaviour, such as reduced ventilation from habitually closed windows and doors, can also cause mould to spread.

The Inquiry notes that NSW Health and other authorities provided information on what mould is, how mould can affect human health, and how to reduce the potential hazard associated with mould growth within the home.⁹⁶⁷ Yet the Inquiry recommends Government consolidate and provide consistent, authoritative advice which not only explains how to prevent mould growth, and salvage and restore property affected by mould – but which also explains the various groups at higher risk of health problems caused by exposure to mould, supported by advice to more vulnerable groups on how to manage this risk.

Building standards, codes and practices

The Australian Building Code Board has a Standard for the *Construction of buildings in flood hazard areas* (the Standard). Originally developed in 2012, it was updated in 2019 to reflect the National Construction Code which sets out requirements for all new buildings and structures.⁹⁶⁸

The Standard is only applicable within flood hazard areas, namely “the area (whether or not mapped) encompassing land lower than the flood hazard level (FHL) which has been determined by the appropriate authority”.⁹⁶⁹

The Standard notes that without supporting measures (such as evacuation, planning use planning, emergency response strategies, etc.) it is not possible to guarantee that a building constructed in accordance with the Standard will eliminate the risk of serious injury or fatality. Flood hazard specifically excludes impacts from landslides and areas affected by storm surge or coastal inundation.

⁹⁶³ WHO (World Health Organisation). (2009). WHO guidelines for indoor air quality: dampness and mould. Retrieved from https://www.euro.who.int/_data/assets/pdf_file/0017/43325/E92645.pdf.

⁹⁶⁴ NSW Health. (2022). Mould and your health. Retrieved from [Mould - Fact sheets \(nsw.gov.au\)](https://www.nsw.gov.au/mould-fact-sheets).

⁹⁶⁵ Brambilla, A, & Sangiorgio, A. (2021). Moisture and Buildings: durability issues, health implications and strategies to mitigate the risks. A volume in Woodhead Publishing Series in Civil and Structural Engineering.

⁹⁶⁶ WHO (World Health Organisation). (2009). WHO guidelines for indoor air quality: dampness and mould. Retrieved from https://www.euro.who.int/_data/assets/pdf_file/0017/43325/E92645.pdf.

⁹⁶⁷ NSW Health. (2022). Mould and your health. Retrieved from [Mould - Fact sheets \(nsw.gov.au\)](https://www.nsw.gov.au/mould-fact-sheets)

⁹⁶⁸ The National Construction Code is available at <https://www.abcb.gov.au/sites/default/files/resources/2022/Standard-construction-of-buildings-in-flood-hazard-areas.pdf>.

⁹⁶⁹ Ibid p 6; see also [Understanding the NCC – Building Classifications \(abcb.gov.au\)](https://www.abcb.gov.au/understanding-the-ncc-building-classifications).

A Planning Circular gives effect to the Standard in NSW.⁹⁷⁰

Housing recovery following the flood events

Over 14,500 homes were damaged by the floods, with over 5,000 rendered uninhabitable.⁹⁷¹ Given the extent of the damage, and as the NSW Building Commissioner explained to the Inquiry, consideration should be given to housing recovery in three phases:

1. *Emergency housing with a potential need of up to 2-years*
2. *Remediation of existing housing within the flood affected areas to allow re-occupation, most of which may need relocation in due course*
3. *Rebuilding of new housing away from flood affected areas.*⁹⁷²

The Inquiry notes that DPE is leading a Housing Recovery Taskforce which is focussed on finding suitable locations for emergency housing and amending the planning system as needed to facilitate such,⁹⁷³ and suggests this activity should continue to re-house people as quickly as possible. The Inquiry also notes that much of the emergency and short- or medium-term accommodation will involve the use of prefabrication. However, prefabrication is not currently covered under the *Home Building Act* as it is considered to be a product rather than housing.⁹⁷⁴ The NSW Building Commissioner suggested establishment of a prefabrication compliance working group, tasked with guiding planning and associated legislation to bring these buildings into a regulated asset class.⁹⁷⁵

As explained to the Inquiry by the Commissioner, the average age of housing stock affected by the recent floods is likely to be 25 years or more.⁹⁷⁶ Most of this stock is unlikely to be compliant with current building standards, and it would not be viable to retrofit these homes to meet modern standards.⁹⁷⁷

But, where these homes have been affected by flood but are not located in a floodway or other high hazard area, there is an opportunity to make these homes habitable through minimising potential harms from mould infestation, compromised electrical and drainage and structural stability (for ground subsidence, wind and extreme weather).⁹⁷⁸ However, the Inquiry heard that due to a lack of qualified and experienced trades people, particularly in the Northern Rivers region, many people have commenced 'do it yourself' repairs. Construction works undertaken by unqualified people create a future risk for those carrying out the repairs and the safety of buildings. They also can give rise to immediate safety risks such as hazardous asbestos removal and occupation of buildings with exposed wiring.⁹⁷⁹

Further, when rebuilding homes away from flood affected or flood-prone areas, the Inquiry heard that care must be taken with the quality and construction of new or prefabricated homes. Here, there

⁹⁷⁰ See <https://www.planning.nsw.gov.au/-/media/Files/DPE/Circulars/the-nsw-planning-system-and-the-building-code-of-australia-2013-construction-of-buildings-in-flood-hazard-areas-2013-07-16.pdf?la=en>.

⁹⁷¹ Resilience NSW. Advice to the Inquiry provided July 2022.

⁹⁷² NSW Building Commissioner, submission to the Inquiry.

⁹⁷³ Meetings with DPE (NSW Department of Planning and Environment) on 25 March 2022, 29 March 2022, 21 April 2022, 5 May 2022.

⁹⁷⁴ NSW Building Commissioner, submission to the Inquiry.

⁹⁷⁵ Ibid.

⁹⁷⁶ Ibid.

⁹⁷⁷ Ibid.

⁹⁷⁸ Ibid.

⁹⁷⁹ NSW Independent Flood Inquiry Building Industry Roundtable held on 29 June 2022.

is an opportunity to work with the industry more broadly on improving the standards and compliance with such.⁹⁸⁰

Building back better should mean building back right

The Inquiry was told that making changes to the national codes and process can be very slow, and that NSW could lead the development of its own set of standards that support the rebuilding effort.⁹⁸¹ To this end, the Inquiry suggests that ‘building back right’ underpins works across each of the three phases above – including all remediation works and new construction, including emergency housing and new housing off the floodplain.

All flood-recovery construction initiatives should be supported by assurance that appropriate standards are being met, which requires a more joined up approach from the construction and insurance industries, industry regulators and broader Government. This would provide confidence in the quality of all homes and structures built or remediated during the recovery phase and ensure that flood affected communities can be rehoused as quickly as possible.

Recognising that contemporary construction draws on a global market, the flood recovery challenge provides the NSW construction industry and regulator with an opportunity to work with local suppliers and businesses to upskill and develop flood resilient, environmentally sustainable building practices that account for and can accommodate supply chain disruptions.

Finding and recommendations – housing

S. Finding – housing and rehousing issues

Both metropolitan and regional NSW are in the grip of a housing crisis. House prices and rents rose significantly through the COVID ‘shutdown’, making it more difficult for many to find a place to live. While interest rate rises are easing house price pressures, the rental market remains extremely tight. Rents continue to escalate, and vacancy rates remain low - under 1% for many regions, including the Northern Rivers. The floods made uninhabitable or significantly damaged thousands of homes and forced thousands into emergency accommodation. There are still some 1300 in emergency housing across the Northern Rivers, more than four months after the floods. This is driving more demand for social, affordable and market rental housing and has worsened homelessness. Urgent action is needed to provide fit for purpose, resilient homes for the displaced or those who continue to reside on high-risk floodplains. This includes homes for Indigenous peoples which are respectful of culture and kinship.

22. Recommendation – relocating communities most at risk with good homes and amenities

That, to empower vulnerable people and communities to relocate, Government through the NSWRA:

- identify and prioritise those communities most at risk from future disasters, and for whom relocation may be appropriate or necessary

⁹⁸⁰ NSW Building Commissioner, submission to the Inquiry.

⁹⁸¹ NSW Independent Flood Inquiry Building Industry Roundtable held on 29 June 2022.

- leverage the work done through Government's homes, cities, manufacturing and skills policies, to collaborate and work with these communities in examining, designing, building and installing affordable, attractive and insurable housing options (e.g. locally fabricated high quality modular homes, or utilising local builders to retrofit and/or relocate existing homes to safer ground) and to enable small housing developments with capacity to grow organically over time
- utilise best-practice policy for rapid urbanism and community-building to establish new settlements. This should include:
 - an enquiry-by-design or charrette process led by the Government Architect to ensure that new settlements reflect the aspirations and vernacular of the local community, whilst meeting the technical needs of establishing settlements and delivering infrastructure at low cost. This should also include considering how to repurpose floodplains for community use and benefit, i.e. recreation, sports and energy production as part of the process of returning land below the flood planning level to Government ownership. It should also consider the role of locally manufactured, well-designed and regulated modular housing solutions
 - promoting a sense of community by ensuring appropriate amenity (e.g. schools, shops, and services) is available to relocating people and communities at the time of moving to their new settlements
 - working with the financial and philanthropic sectors to investigate a special purpose fund to provide continuing support for these communities as they transit through re-establishment.

23. Recommendation – housing and development funding options

That, to empower vulnerable people and communities to avoid significant impacts from flood as well as drive broader investment in adaptation, Government through NSWRA:

- consider establishing a NSW Mitigation Fund as a form of secured finance as a lien on title, such as rates-based or utility-based financing, to allow the Government to harness private sector monies to deliver cost-effective flood-resilient retrofits for existing dwellings
- investigate whether trading mechanisms for development rights, renegotiation with developers with existing rights, or uplift value capture to fund buy-outs could reduce existing and anticipated development in areas of greatest flood risks, with an initial focus on the Northern Rivers region and the Hawkesbury-Nepean. In doing so, Government should:
 - ensure that tradeable rights facilitate the construction of additional homes in line with regional plans, in particular the Government's six cities vision developed by the Greater Cities Commission
 - fund voluntary property purchases in identified locations through the issuing of tradeable development rights
- work with the insurance industry to ensure that works are undertaken such that they would improve access to lower cost insurance products,

improving upon existing guidelines from voluntary house raising schemes

- ensure that local delivery partners provide a seamless consumer experience in a cost-effective manner, whilst meeting community expectations for consumer protection and responsible lending
- consider how the NSW Mitigation Fund mechanism can address other adaptation and mitigation opportunities such as improving flood-resilience for structures in areas of extreme risk and reducing emissions and bills whilst improving human health outcomes through energy efficient retrofits and home electrification.

24. Recommendation – housing, especially social housing

That, to ease housing stress in flood prone areas and ensure new development is resilient and community-centred, Government pursue a multi-pronged, decadal strategy through:

- ensuring flood-displaced residents in emergency housing who have no safe return to home options are re-homed in more permanent settlements where community can be re-established, and that emergency housing clusters do not take on de facto permanency
- providing authoritative advice on how to reclaim and restore flood-damaged houses affected by mould. This includes providing detailed advice on who is at risk from living in mould-infected houses (the immunocompromised and those with lung damage plus certain other groups) and what constitutes safe living conditions for this group
- ensuring building standards are adopted for build back after floods so that new housing stock is as flood proof and flood recoverable as possible
- investing additional state, Commonwealth and private sector monies to grow the stock of social and affordable housing
- accelerating investment by the community housing and private sectors in new social and affordable housing projects through a Government run co-contribution grant funding program
- planning for and encouraging collaborative public and private sector investment in innovative mixed-use developments in flood prone regional cities and towns that are built above ground level to be flood resilient, are centrally located, and increase housing diversity by providing smaller social, affordable and market dwellings
- the Government's Expert Housing Advisory Panel providing advice on additional market interventions to improve rental affordability and ease vacancy shortages to reverse homelessness and take pressure off social housing waitlists
- fast-tracking the approval and servicing of new village developments beyond the current footprint of Lismore and other Northern Rivers towns on existing cleared agricultural land above the re-calculated flood planning level, ensuring all infrastructure including transport, retail, schools, public space and other community facilities are in situ prior to

occupation

- fast-tracking planning approvals and the provision of enabling infrastructure to accelerate delivery of Aboriginal housing on Local Aboriginal Land Council land and lands owned by Native Title corporations that respects culture and kinship and supports stable accommodation pathways
- partnering with the development and community housing sectors to relocate flood prone social and affordable housing on the Hawkesbury-Nepean floodplain to new and attractive multi-use, medium density developments within the CBDs of Mount Druitt, Blacktown and other Western Sydney city centres
- under the leadership of the NSW Building Commissioner, developing a code for flood resilient, environmentally sustainable building that accounts for current and likely future supply chain disruptions and extends to modular and manufactured homes
- working with the Greater Cities Commission and regional councils to ensure future local housing strategies factor in the need for natural disaster emergency housing and promote resilient housing systems
- encouraging financial institutions and insurance companies to use pricing structures to incentivise the construction of more safely situated and resilient buildings
- supporting building industry skills growth and making building material supply chains more robust to insulate the economy from future natural disaster and other exogenous shocks
- ensuring building industry occupational health and safety regulations are enforced in the flood-affected areas rebuilding programs.

7.7. Flood risk to caravan parks and manufactured home estates

Caravan parks provide low-cost, short-term accommodation, and are traditionally located near natural assets such as beaches and rivers.⁹⁸² As such, caravan parks are often developed on floodplains, which is considered appropriate due to the temporary and mobile nature of caravans. However, over time, they, along with manufactured home estates, have increasingly become a source of affordable longer-term and permanent accommodation, especially for retirees on constrained incomes, with some parks having transformed into a form of permanent senior housing.⁹⁸³

In 2015 the NSW Government released a *Discussion paper: improving the regulation of manufactured homes, caravan parks, manufactured home estates and camping grounds*.⁹⁸⁴ The discussion paper describes issues in the current regulatory framework and puts forward a number of solutions. The Inquiry recommends that these solutions be implemented as a matter of a priority, to address legacy issues in the planning framework.

⁹⁸² Yeo, S, & Grech, P. (2006). Flood-prone caravan parks in NSW – is the system failing? *Australian Journal of Emergency Management*, Vol 21 No. 3: 12 – 21.

⁹⁸³ Ibid.

⁹⁸⁴ See [Improving the Regulation of Manufactured Homes, Caravan Parks, Manufactured Home Estates & Camping Grounds Discussion Paper November 2015 \(nsw.gov.au\)](https://www.nsw.gov.au/improving-the-regulation-of-manufactured-homes-caravan-parks-manufactured-home-estates-camping-grounds-discussion-paper-november-2015)

In March 2021, during the Hawkesbury-Nepean Valley flood, more than 30 caravan parks were severely affected, with over 1,450 manufactured homes flooded, and reports of some perilous evacuations and rescues.⁹⁸⁵ Numerous submissions to the Inquiry also addressed the significant impact of floods on caravan parks throughout northern NSW. Mr Peter Newton, President of the Kingscliff Ratepayers Association, told the *NSW Parliamentary Select Committee on the Response to Major Flooding across NSW* of more than 1,800 residents at Chinderah Caravan Parks having to be evacuated in the dark by a rapidly formed community emergency rescue effort. The Inquiry has been told that this park is home to some vulnerable communities, including many elderly and frail residents.⁹⁸⁶ Many residents had severe damage to their properties and of the 1,800 evacuated, 1,500 have returned and are living in less than desirable conditions. The Inquiry understands that Tweed is recognised as one of the most unaffordable locations to live in the world⁹⁸⁷ and caravan parks are the most affordable option in the area for many citizens. An anonymous submission to the Inquiry estimated that in North Byron, 90% of homes in caravan parks were lost.⁹⁸⁸

T. Finding – caravan parks and manufactured home estates

Caravan parks and manufactured home estates have been developed in places that are appropriate for tourist purposes but are not always ideal locations for permanent residents. Under the current planning system, there are significant legacy risks which mean that many permanent residents, who are generally older and often infirm, are living at significant flood risk.

25. Recommendation – caravan parks and manufactured home estates

That, to ensure that permanent residents of caravan parks and mobile housing estates are protected from flood, Government:

- prohibit permanent residency in caravan parks and mobile housing estates situated below the risk-based flood planning level. Caravan parks for holiday makers could still be on the floodplain with the provision that, if a flood is imminent, they need to be evacuated
- address the issues raised in the 2015 Discussion Paper (*Improving the regulation of manufactured homes, caravan parks, manufactured home estates and camping grounds*).

⁹⁸⁵ NSW Government. (2021). Hawkesbury-Nepean River March 2021 Flood Review Final Report.

⁹⁸⁶ Tweed Shire Council. (2022). Media release-second recovery centre opens as housing damage unfolds. Retrieved from <https://www.tweed.nsw.gov.au/council/news-updates/latest-news/media-releases/1323408-second-recovery-centre-opens-as-housing-damage-unfolds>

⁹⁸⁷ Tweed Shire Council, submission to the Inquiry.

⁹⁸⁸ Anonymous, submission to the Inquiry.

7.8. Roads and landslips

Roads are critical for safe evacuation from floods

More than 2,000 km of state and local roads sustained damage in the February-March 2022 floods.⁹⁸⁹ As at May 2022, initial estimates indicate the cost of damage to state, regional and local roads, vehicular ferry infrastructure and rail infrastructure is over \$1.5 billion.⁹⁹⁰

Between February and May, more than 50,000 potholes were fixed across regional NSW. As at early June:

- across regional NSW, 70% of repairs to flood damaged roads were complete, 59 of 100 damaged bridges had been repaired, and two-thirds of the 167 landslips had been repaired
- in Greater Sydney, more than 8,400 potholes had been repaired
- more than 330,000 square metres of asphalt on state roads across Greater Sydney had been repaired, the equivalent of nearly 50 full sized soccer fields.

Much of the road damage was due to landslips which occurred in several areas in the February-March floods and again in the July floods. In February-March, extensive media reports indicated that these locations include the upper reaches of the Tweed, Brunswick and Richmond/Wilson Rivers,⁹⁹¹ Illawarra Escarpment,⁹⁹² Newport on the Northern Beaches of Sydney,⁹⁹³ Snowy Mountains Highway at Bemboka,⁹⁹⁴ and Emu Heights in the Blue Mountains.⁹⁹⁵

Further incidences of landslip from the July flooding have been recorded in Richmond Lowlands near the Hawkesbury River,⁹⁹⁶ and the Main Western railway line was closed at Mount Victoria.⁹⁹⁷

The Inquiry heard directly about several instances of landslip, especially in the upper reaches of the Tweed, Brunswick and Richmond/Wilson catchments.⁹⁹⁸ In the Northern Beaches council area, over 200 separate incidents of landslip were reported following the February-March 2022 floods.⁹⁹⁹

The Inquiry also heard that, while a lot of focus in the Northern Rivers has been on the lower parts of the catchment, the impacts in the upper catchment were also extensive. In addition, the areas eroded or subject to landslip in the upper catchment have caused the deposition of sand and silt in the upper reaches of the creeks and rivers, changing the form of the river from having deep pools to being infilled with sand and soil.¹⁰⁰⁰

⁹⁸⁹ Transport for NSW. (2022). Advice to the Inquiry provided 21 July 2022.

⁹⁹⁰ Ibid.

⁹⁹¹ See [‘Next level destruction’: NSW residents detail the moments floods devastated their homes | NSW and Queensland floods 2022 | The Guardian](#), [‘His body was just there’: Mullumbimby volunteers confronted by horrors and chaos of flood aftermath | NSW and Queensland floods 2022 | The Guardian](#), [Landslides - Byron Shire Council \(nsw.gov.au\)](#), [Multiple landslides in Main Arm send house falling down mountainside, residents set up pulley system to deliver supplies - ABC News](#), [NSW Far North Coast & Northern Rivers flood impact research, March 2022 \(riskfrontiers.com\)](#) as well as several submissions made to the NSW Independent Flood Inquiry.

⁹⁹² See [NSW floods cut off towns, roads destroyed across Illawarra and South Coast in week of ferocious storms - ABC News](#).

⁹⁹³ See [Landslides near homes in Emu Heights & Emu Plains | 7NEWS - The Global Herald](#)

⁹⁹⁴ See [NSW weather: Minor flooding, landslide hits south coast with more rain forecast \(willyweather.com.au\)](#)

⁹⁹⁵ See [NSW floods, northern beaches: Landslide narrowly misses Newport family | Northern Beaches Review | Manly, NSW](#)

⁹⁹⁶ See [Sydney floods: Richmond Lowlands house destroyed after Hawkesbury River landslip \(smh.com.au\)](#)

⁹⁹⁷ See [Freight disruptions over Blue Mountains as landslide likely to take weeks to fix - ABC News](#)

⁹⁹⁸ NSW Independent Flood Inquiry Mullumbimby Town Hall held on 6 June 2022 and multiple written submissions.

⁹⁹⁹ Northern Beaches Council, submission to the Inquiry.

¹⁰⁰⁰ Dr Graham Watson, submission to the Inquiry.

In Huonbrook, access to properties has been cut off due to the number of roads and access points washed away. Internet connectivity has also been disrupted,¹⁰⁰¹ further exacerbating isolation. In Nimbin, the Inquiry heard that most access roads were cut due to significant damage from landslides, with people trapped and houses lost due to landslides.¹⁰⁰²



Photos 7-1: L-R: Collapsed home in Moondani; Damage to Tuntable Creek Road between Beardow Road and Rose Road; Landslip at Tuntable Coop. Source: Nimbin Community Response and Recovery Team.

The Inquiry heard from the Tyalgum District Community Association that areas in the upper Tweed catchment have experienced critical subsidence that has completely destroyed a 70 metre section of road making it impassable.¹⁰⁰³



Photos 7-2: Photos of Tyalgum Road (Source: Tyalgum District Community Association¹⁰⁰⁴)

Many parts of the State's rail, bus and ferry network were inoperable for a period during the floods. The rail network in Greater Sydney was not serviceable in March 2022 due to flooding, landslips and damage to power lines, rail tracks, signalling equipment and rail access roads. Approximately 180 kilometres of rail corridor were closed.¹⁰⁰⁵

Access to safe evacuation routes was a common concern raised in submissions to the Inquiry from community members in the Northern Rivers region and the Hawkesbury-Nepean Valley. Concerns were raised about local roads being cut early by floodwaters, preventing safe evacuation, particularly in the Hawkesbury-Nepean Valley. Where roads were not cut by floodwaters, the Inquiry heard that some evacuation routes were poorly lit (if at all), uneven and narrow, giving rise to safety concerns.

¹⁰⁰¹ Anonymous, submission to the Inquiry.

¹⁰⁰² Nimbin Community Response and Recovery Team, submission to the Inquiry.

¹⁰⁰³ Tyalgum District Community Association, submission to the Inquiry.

¹⁰⁰⁴ Ibid.

¹⁰⁰⁵ Transport for NSW. (2022). Advice to the Inquiry provided May 2022.

For those residents who weren't required to evacuate, adequate road access remained critical to their safety and wellbeing. Many reported being isolated from essential services because of roads being cut by flood waters or landslips. A resident in the Hawkesbury-Nepean Valley said:

*During the 2021 floods almost 50% of the Hawkesbury community were isolated by landslides on the Bells Line of Road and the Putty Road; the only evacuation routes available for these residents during the flood. The community were left with inadequate essential services, insufficient food and medical supplies, poor to non-existent communications, sewer failures, no hospital, no police station, no ambulance...*¹⁰⁰⁶

Communities that have experienced successive flooding in recent years noted that, once the flood emergency had passed, delays to the repair of local roads contributed to ongoing social and economic impacts. A Northern Rivers resident said:

*We were unable to run our farming business - unable to receive farm supplies of fertiliser, and fuel as delivery supply trucks are unable to travel the damaged road. There has been a landslide on our public access road that blocked the road to any exit or entry. We were unable to leave the property and emergency services were unable to reach the residents of the road.*¹⁰⁰⁷

Submissions to the Inquiry also highlighted that vehicle damage resulting from unrepaired roads added to the existing financial stress of flood-affected communities.

A State-wide, coordinated view of evacuation roads is required

Key evacuation routes must be identified in advance of a flood, and be well maintained to allow free and easy entry and egress to communities, businesses and emergency services vehicles. When damaged following a flood, they must be promptly repaired for the social and economic wellbeing of communities.

Under the NSW Flood Plan, the SES has responsibility for the planning of evacuation routes within each Local Area Management Committee. The *State Emergency Management Plan Evacuation Management Guidelines* note that evacuation routes must be planned in advance, in consultation with the Transport Services Functional Area (TSFA) and others. Roads critical to evacuation may be owned by state or local governments, as well as private owners, and are maintained and repaired by the relevant owners. This fragmented approach means there is no State-wide, coordinated view or quality control of evacuation routes.

Local government in NSW is responsible for about 90% of the State's roads and bridges.¹⁰⁰⁸ From its Town Hall meetings and submissions, the Inquiry heard concerns about local government's capacity to undertake extensive flood damage repairs to local roads and evacuation routes, noting delays following previous floods.

In submissions to the Inquiry, councils flagged resource constraints and heavy reliance on Disaster Recovery Funding Arrangements (DRFA) to help restore and reconstruct damaged roads and related infrastructure, and noted difficulties complying with the timeframes required for expending funding received.¹⁰⁰⁹

Local Government NSW noted the damage bill for local government roads far exceeds assistance that will be received under the DRFA and is well beyond the financial capacity of the affected councils, and called for additional recovery funding from both the state and national

¹⁰⁰⁶ Carol Edds, submission to the Inquiry.

¹⁰⁰⁷ Debra Van Den Berg, submission to the Inquiry.

¹⁰⁰⁸ Local Government NSW, submission to the Inquiry.

¹⁰⁰⁹ Richmond Valley Council, submission to the Inquiry.

governments.¹⁰¹⁰ Without additional support, councils will need to reprioritise existing funding and resourcing, limiting their ability to deliver existing projects and priorities.

Ballina Shire Council's submission to the Inquiry flagged that its floodplain management planning has identified opportunities to raise certain roads to operate as evacuation routes. However, the cost of the infrastructure upgrades is beyond the council's capacity and it recommended that a funding program be developed for mitigation infrastructure.¹⁰¹¹

Transport for NSW advised the Inquiry that it continues to work closely with local councils to support flood-impact assessments, provide technical expertise, support council access funding for recovery works (including by administering funding under the DRFA), and reinstate key routes that provide connections to the State Road network.¹⁰¹² To date, Transport for NSW has advanced \$65 million in disaster recovery payments to affected local councils for the floods in February and March 2022.¹⁰¹³

Across the State, a coordinated understanding of evacuation routes is required, so they can be suitably repaired, upgraded, maintained and operated to support the safe evacuation of communities in future floods. This work needs to be coordinated by NSWRA to form a strategic, state-wide view of evacuation routes, and to address SES and local government capacity constraints.



Photos 7-3: Flood-damaged roads and bridges in the Northern Rivers Region. Sources: Mrs Debra Van Den Berg, submission to the Inquiry and Mr Daniel Strzina, submission to the Inquiry.

¹⁰¹⁰ Local Government NSW, submission to the Inquiry.

¹⁰¹¹ Ballina Shire Council, submission to the Inquiry.

¹⁰¹² Transport for NSW. (2022). Advice to the Inquiry provided May 2022.

¹⁰¹³ Transport for NSW. (2022). Advice to the Inquiry provided July 2022.

Communication of road closures

Communication of road closures is crucial to ensure communities have the information they need to evacuate safely. The Inquiry heard from Transport for NSW about significant improvements to the Live Traffic NSW website and app in recent years, including the addition of local roads and live camera feeds. Transport for NSW noted that the efficacy of this system in a flood relies on the continued provision of telecommunications services and data from local government authorities. The Inquiry suggests that live traffic information be cross-referenced in the NSW disaster app recommended in Chapter 4, and that continuous improvements be made to enhance the accuracy of information, particularly for small local roads.

Future development depends on adequate road evacuation capacity

As noted above, location of future development must be informed by sound road evacuation modelling to ensure adequate capacity to evacuate current and future populations.

For example, in the Hawkesbury-Nepean Valley, a number of critical roads flooded early and could not be used for evacuation. The capacity of roads to provide safe evacuation routes for residents is a key contributor to flood risk in the Valley, and a key limitation for any future development in the floodplain.

It is noteworthy that, while road upgrades improve evacuation responses and reduce risk to life from a flood emergency, they do not mitigate damage to infrastructure in a flood. They can even contribute to congestion in other parts of the road network given that it operates as one connected system.

Given the large number of low-lying roads in the Hawkesbury-Nepean Valley that can be cut off early in a flood, the cost of potential upgrades and retrofits to elevate these roads would likely be prohibitive. In some areas, road widening cannot occur due to geographic constraints and the level of existing development. This limits the potential for roads alone to be used as a key flood solution in the Hawkesbury-Nepean Valley. However, the *Hawkesbury-Nepean Valley Flood Risk Management Strategy*¹⁰¹⁴ does include actions to maintain and upgrade local evacuation roads to ensure access to major regional evacuation routes as part of a suite of risk mitigation outcomes. These actions are coordinated by Transport for NSW to provide a regional approach to road evacuation, extending beyond local government boundaries.

Road evacuation capacity is also a key factor in the NSW SES's decision to evacuate properties in the Hawkesbury-Nepean Valley early. In the March 2022 floods, over 40,000 residents in the Valley were subject to evacuation orders and warnings.¹⁰¹⁵

This highlights the importance of maintaining existing roads and evacuation routes and ensuring further development does not occur without safe evacuation routes suitable for current and future populations. The Hawkesbury-Nepean Valley Case Study in Volume 2 of this report discusses the challenges of road upgrades further.

Future road design must be more flood resilient

Currently, under the (former) Roads and Maritime Service's *Environment Sustainability Strategy 2019-23*, transport infrastructure proposals are assessed against a range of factors including flood

¹⁰¹⁴ Infrastructure NSW. (2017). Hawkesbury-Nepean Valley Flood Risk Management Strategy. Retrieved from <https://www.infrastructure.nsw.gov.au/expert-advice/hawkesbury-nepean-flood-risk-management-strategy/>.

¹⁰¹⁵ State Emergency Service (SES). 2022. Advice to the Inquiry provided July 2022.

risks, and embedding climate change resilience and adaptability into design and construction.¹⁰¹⁶ However, the extent of flood damage to roads and transport infrastructure across NSW in 2022 highlights their continued vulnerability to floods. When roads fail, or as they come up for renewal, betterment works should be pursued, and new funding found to support this, especially from Australian Government sources.

The Inquiry heard calls from the community for improved consideration of the impact of development and infrastructure on flood behaviour and risk. Many Northern Rivers residents expressed concern that the recent M1 Pacific Highway upgrade failed to cope with flood impacts and risks adequately, and they consider its design may even have contributed to the severity of flooding experienced in Woodburn and surrounding areas by acting like a dam, blocking the escape of floodwaters to the Evans River. Whilst there are pipes under the wall of the motorway, many local residents consider them inadequate for floodwaters.¹⁰¹⁷

The Pacific Highway upgrade was informed by consultation and supported by flood studies in being designed to “maintain a minimum one-in-20 year flood immunity across the major floodplains and one-in-100 years elsewhere”.¹⁰¹⁸ However, flooding in the Northern Rivers region in February and March 2022 has been estimated to be between 1 in 1000-2000 year floods (i.e. an AEP of 0.1% to 0.05%).

The Inquiry notes that Transport for NSW has established a Pacific Highway Flood Impacts Working Group – Woolgoolga to Ballina. The working group will determine if any actions are required based on assessment of afflux and other relevant considerations in the 2022 flood.¹⁰¹⁹

U. Finding – roads and landslips

- Roads are critical in flood evacuations, but the recent floods have highlighted their vulnerability to flood damage and to being cut off by floodwaters and landslips, preventing entry and egress, and isolating communities from essential services.
 - The cost of critical road maintenance and flood-damage repairs, particularly for key evacuation routes, is beyond the capacity of local government and private road owners.
 - Road ownership is fragmented with evacuation routes established at the local level, and no coordinated and state-wide view.
 - Future development must be informed by sound road evacuation modelling to ensure road capacity for population increases.
- Future road design must be more resilient to flood impacts, and must adequately consider the way transport infrastructure can affect the behaviour of floodwaters.

26. Recommendation – roads

That, to improve the planning and protection of road infrastructure and to ensure communities, freight movers, combat agencies and emergency

¹⁰¹⁶ Roads and Maritime Services. (2019). Environmental Sustainability Strategy 2019-2023. Retrieved from [Environmental Sustainability Strategy 2019-2023 \(nsw.gov.au\)](https://www.nsw.gov.au/environmental-sustainability/strategy).

¹⁰¹⁷ Anthony Carusi, submission to the Inquiry.

¹⁰¹⁸ Roads and Maritime Services. (2015). Environmental Sustainability Strategy 2015-2019. Retrieved from [Roads and Maritime Services Environmental Sustainability Strategy 2015-2019 \(nsw.gov.au\)](https://www.nsw.gov.au/environmental-sustainability/strategy).

¹⁰¹⁹ Transport for NSW. (2022). Advice to the Inquiry provided July 2022.

services have appropriate access and egress during and following a flood event, Government, through TfNSW and NSWRA and working with combat agencies and local and federal governments as needed, should:

- develop a state-wide road evacuation plan to establish a coordinated view of evacuation routes to ensure they are well-maintained and, particularly working with the Commonwealth Government, ensure that funding is coordinated and prioritised to target upgrades where it is most needed to increase flood resilience. This plan should be informed by catchment-wide flood risk modelling
- identify and prioritise communities at high risk of flooding where access and egress will be affected (for example rural communities connected by a single road affected by landslips) to coordinate logistics options to sustain communities isolated as a result of flooding.

7.9. Floods and the environment – caring for Country

Australia's environment is well adapted to natural wetting and drying cycles, and in many natural systems, floods are essential to maintain critical biodiversity and ecosystem processes. As the Office of the Queensland Chief Scientist explains:

*[Floods] link the river with the land surrounding it, recharge groundwater systems, fill wetlands, increase the connectivity between aquatic habitats, and move both sediment and nutrients around the landscape, and into the marine environment. For many species, floods trigger breeding events, migration, and dispersal. These natural systems are resilient to the effects of all but the largest floods.*¹⁰²⁰

The Inquiry heard that the Bundjalung Jagun Country of the Northern Rivers has been informed by the flow of waters for millions of years. The Inquiry received a very informative submission from Arabella Douglas which highlights the importance of Indigenous knowledge in preparing for, responding to and recovering from floods. In Volume Three, Mr Oliver Costello, Bundjalung man and founding Director of both the Firesticks Alliance Indigenous Corporation and Jagun Alliance Aboriginal Corporation, recalls the story of Dirawong the Goanna, which teaches how the Evans and Richmond rivers were shaped by a battle between Dirawong and the Great Rainbow Snake. Dirawong headland is a rain making site and when lore's are not followed the big rains and floods will come. This is just one of many Indigenous stories that describe the shaping of Country, the traditions and lore to be followed in caring for Country, and in maintaining balance in dynamic floodplain landscapes.

This balance is fragile. Alteration to the natural flow of rivers, streams, floodplains and wetlands is recognised as a major factor contributing to loss of biological diversity and ecological function in aquatic ecosystems including floodplains.¹⁰²¹ As the Office of the Queensland Chief Scientist stated:¹⁰²²

¹⁰²⁰ Queensland Government. (2011). Understanding floods: questions and answers. Retrieved from <https://www.chiefscientist.qld.gov.au/publications/understanding-floods/flood-consequences>

¹⁰²¹ NSW Scientific Committee final determinations. See [Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands - key threatening process listing | NSW Environment and Heritage](#) listing effective from 31 May 2002.

¹⁰²² Queensland Government. (2011). Understanding floods: questions and answers. Retrieved from <https://www.chiefscientist.qld.gov.au/publications/understanding-floods/flood-consequences>.

Areas that have been highly modified by human activity tend to suffer more deleterious effects from flooding. Floods tend to further degrade already degraded systems. Removal of vegetation in and around rivers, increased channel size, dams, levee bank and catchment clearing all work to degrade the hill-slopes, rivers and floodplains, and increase the erosion and transfer of both sediment and nutrients.

While cycling of sediments and nutrients is essential to a healthy system, too much sediment and nutrient entering a waterway has negative impacts on downstream water quality. Other negative effects include loss of habitat, dispersal of weed species, the release of pollutants, lower fish production, loss of wetlands function, and loss of recreational areas.

Many of our coastal resources, including fish and other forms of marine production, are dependent on the nutrients supplied from the land during floods. The negative effects of floodwaters on coastal marine environments are mainly due to the introduction of excess sediment and nutrients, and pollutants such as chemicals, heavy metals and debris. These can degrade aquatic habitats, lower water quality, reduce coastal production, and contaminate coastal food resources.

This section discusses the impacts of the recent floods on the environment – and how we might, in treating the floodplain as an asset, improve ecological balance and reduce the negative environmental impacts of future floods. In preparing this section, the Inquiry sought to learn from our Indigenous people, to understand what needs to be done to restore and remediate Country.

Significant landscape and water quality impacts following the floods

One of the lasting images of the 2022 flood events is of the debris left behind. Rubbish, vegetation and animals were all moved downstream and deposited in streets and homes within the floodplain, along the banks of rivers or onto adjoining beaches.

Following the March floods there was a lot of erosion and deposition in the Richmond River catchment, particularly upstream from Wardell. Scouring within the channel created deep holes around Empire Vale and Emigrant Creek. The Inquiry was also told of bank erosion and deposition occurring on the Tweed River, and concerns were raised that extensive siltation had also occurred in the lower part of that river.¹⁰²³



Photo 7-4: Drone photo – bank erosion at the confluence of Tweed and Oxley Rivers (left); bank erosion on the Tweed River following the March 2002 flood (right). Source: Submission to the Inquiry from Neil Baker.

Extensive bank erosion was reported to have occurred on the Hawkesbury River, after both the March and July floods, particularly near Cornwallis.¹⁰²⁴

¹⁰²³ Neil Baker, submission to the Inquiry; NSW Independent Flood Inquiry Agricultural Roundtable held on 16 June 2022.

¹⁰²⁴ NSW Independent Flood Inquiry Hawkesbury-Nepean Virtual Town Hall held on 7 June 2022.

Blackwater events also occurred. These are caused when floods wash substantial amounts of organic materials into waterways, or when the sustained presence of water on floodplains causes vegetation to rot. This vegetation and organic material, when consumed by bacteria, leads to a rise in dissolved carbon in the water and a sudden depletion of dissolved oxygen in water – or anoxic water.

The degree of anoxic water across the floodplain depends on factors such as the depth and time of inundation, ambient temperatures and the type/quantity of organic matter available for decomposition.¹⁰²⁵ After the March flood events, the south arm of Clarence River was observed to be completely anoxic and highly sulfidic. The Richmond River catchment in particular has a history of blackwater events following flood, and anoxic water was observed at various locations following the 2022 floods, including at Bungawalbin, West Coraki and Tuckean Swamp.

Ferguson, Lahuerta Pineiro, Call and Maher (2022) undertook water quality observations at Bungawalbin Creek following the floods, describing the various stages of the flood there and its associated water quality impacts. At the flood peak, turbid water dissolved oxygen concentrations started to decline. Then as water levels dropped low enough to allow for drainage, tidal influence became more apparent and there was an influx of anoxic water, coinciding with the first reports of dead fish.¹⁰²⁶



There were also anecdotal reports of fish kills at Ballina, on the Clarence and Hunter Rivers, and at the entrance of the Richmond River including large whiting, bream, flathead and jewfish (one up to 1.1 metres long).¹⁰²⁷

Potential acid sulfate soils are well known on many of the North Coast floodplains where historic drainage activities have been undertaken – this includes the Tweed, Richmond, Clarence and Macleay catchments, as well as around Port Macquarie and in the Manning catchment. On the South Coast, the Shoalhaven floodplain also has acid sulfate soil issues, especially in the Broughton Creek floodplain north of Nowra. Post-event water quality monitoring in March 2022 did not identify any significant acidic discharges. However, this was expected as water levels were still relatively high and there was minimal exchange of groundwater with surface water within the drains.¹⁰²⁸

Photo 7-5: Dead bream observed in North Creek, 10 March 2022. Source: Ferguson et al (2022).

Learning from Indigenous people in land and natural resource management

Much more needs to be done to care for Country to protect the environment against the negative impacts of flood. This includes appropriately utilising the floodplain for purposes resilient to flood so that, when a flood occurs, undesirable debris does not readily flow downstream, and there is

¹⁰²⁵ Ferguson, A, Lahuerta Pineiro, N, Call, M, & Maher, D. (2022). Post-flood water quality and fish kill assessment, Richmond River, Feb-March 2022.

¹⁰²⁶ Ibid.

¹⁰²⁷ Ibid.

¹⁰²⁸ Ibid.

minimal erosion, deposition and siltation. This would also reduce the incidence of subsequent blackwater events and other water quality issues.

The Inquiry heard of good work being done to restore natural balance to NSW's floodplains. For example, approximately 100 volunteers as part of the Wilson River Landcare group have been focussing on urban riverbank regeneration, re-vegetation and stabilisation.¹⁰²⁹ But more can and must be done to unlock natural and cultural resource management knowledge and practices held by our Indigenous people, to improve landscape health and resilience to address climate change and natural hazards.

In Volume Three, Oliver Costello describes Indigenous culture as a keystone to maintaining livelihoods, supporting identity and connection to Country and enabling healthy and regenerative communities to care for Country. He includes a series of recommendations to build community capacity and resilience to mitigate the risk of natural hazards and improve connections to Country. The Inquiry recommends that Government support, sustain and embed engagement with our Indigenous communities in flood risk and hazard management to build resilience in nature and community.

V. Finding – environment

- Floods have positive and negative impacts on the environment.
- Moving to treating floodplains as assets means re-thinking environmental impacts from floods. Indigenous people can lead us all to understand the impacts of these changes and hazards and what needs to be done to restore and remediate Country.

27. Recommendation – environment

That, to maximise protection for the environment in and around floodplains, Government, working with local communities especially Indigenous communities, the NSWRA, other agencies and local councils ensure Indigenous voices are well heard in land use planning and natural resource management by:

- developing an Indigenous led cultural landscape restoration strategy for the Northern Rivers for nature-based flood mitigation and adaptation which would see large-scale native revegetation and wetland restoration across the Richmond River catchment, including the Tuckean swamp
- supporting Indigenous people to engage in cultural stewardship practices to build the resilience of people and Country, including the Jagun Alliance “Healing our River Country for Community and Landscape Resilience” proposal
- establishing a NSW Indigenous Natural Hazards Trust for research into and development of Aboriginal caring for Country and ‘green’ infrastructure to build back resilience in nature and community embedding Indigenous voices and representation in governance structures for the NSW Reconstruction Authority.

¹⁰²⁹ Wilson River Landcare Group, submission to the Inquiry.

7.10. Infrastructure

Protecting essential services infrastructure

Critical infrastructure is essential to life and wellbeing. NSW citizens expect clean drinking water, sewerage services, electricity and telecommunications. These services are never more important than in an emergency. Chapter 3 of this report discusses the prolonged outages experienced in flooded communities, and recommends strategies to minimise disruptions in future floods. The *2022 State Infrastructure Strategy* also makes recommendations to increase infrastructure resilience to a range of risks and hazards, and to embed reliability.¹⁰³⁰

Perhaps the most effective strategy to avoid essential services disruptions in future floods is to ensure that critical infrastructure is located above the flood planning level. This leverages the benefits of current technology and modelling capability. While no two floods are the same, and we are less certain about *when* floods may hit, we do know *where* they will occur. The floodplain is by its very definition land susceptible to flooding. Future strategic land use planning should be informed by whole of catchment flood risk modelling, and must not locate our most valued infrastructure below the appropriate flood planning level.

Table 7-1 in this chapter shows that over 2,000 pieces of essential and community infrastructure are located within the 1% AEP – this includes police stations, fire stations, hospitals, nursing homes, schools, airports, water filtration plants, sewerage works and power stations. Over 3,500 pieces of this type of infrastructure are located below the PMF. This means that, in a flood emergency, some of the most vulnerable members of the community and most important services are placed at risk and may require evacuation.

This occurred in the 2022 floods – Ballina Hospital was evacuated, and the SES offices, Police Station, Ambulance Station and Westpac Rescue Helicopter were flooded in Lismore, affecting their ability to service others in the flood emergency. The Police Station was also flooded in Hawkesbury.

Locating infrastructure above the flood planning level or the PMF is likely to increase upfront costs, but this must be balanced with a community's need to access local services, the more so as flooding impacts increase with climate change.

The Inquiry acknowledges that not all infrastructure can be located above the flood planning level. By necessity, infrastructure like water supply pipes must be located close to the water source. However, critical infrastructure like water treatment plants must be located above the flood planning level, and any infrastructure below the flood planning level must be designed to standards that support immunity from flood impacts.

Consideration must also be given to flood mitigation works and betterment as aging infrastructure comes up for renewal, as the application of appropriate design standards can limit the vulnerability of infrastructure to flood impact, and thereby lessen the disruption experienced by communities.

Floodplain infrastructure

As noted in the Lismore case study and in communication from Public Works Advisory,¹⁰³¹ some important pieces of flood infrastructure (floodgates, levees, drains) were not prepared for and did not function well in the 2022 floods. Indeed, the Inquiry heard from several sources that drains and poor maintenance of drains actually contributed to the February-March floods.

¹⁰³⁰ Infrastructure NSW. (2022). *Staying Ahead: State Infrastructure Strategy 2022-2042*. Retrieved from <https://www.infrastructure.nsw.gov.au/media/3503/state-infrastructure-strategy-2022-2042-full-report.pdf>.

¹⁰³¹ Public Works Advisory. (2022). Advice to the Inquiry provided 9 July 2022.

Many specific locations were identified, particularly in Byron Shire, where drainage was considered to be inadequate, or drains were reported as being blocked, resulting in a substantial overland flow of water during flood events causing inundation of properties.¹⁰³²

Another example was the problem with the operation of Tuckombil Canal which connects the Evans River and Richmond Rivers. Concerns were raised that the replacement of the previous 'fabridam' with a fixed level concrete weir had limited the capacity of the Evans River to channel sufficient water away from the lower Richmond River. Concerns were also raised about the condition of the weir and its ability to catch debris and maintain conveyance capacity.

In the July floods there were problems with the levee system in the Hunter region and with drains in the Hawkesbury-Nepean.

Many of these infrastructure problems seem to stem from lack of resources and lack of clear lead responsibility for maintenance, a matter that needs rectification.

W. Finding – essential services and floodplain infrastructure

- Essential services disruption in the floods was exacerbated by critical infrastructure being situated in low-lying areas and consequently being flooded.
- Many hospitals, medical centres, nursing homes, aged care facilities and police stations are situated below the flood planning level. Several of these were affected in the recent floods.
- Some detrimental impacts of floods come from built structures which are supposed to provide flood mitigation not being maintained and consequently malfunctioning after heavy rain, making floods worse at a local level. Many are the responsibility of several agencies and are maintained by none.

28. Recommendation – essential services and floodplain infrastructure

That, to minimise disruption to essential services (power, communications, water, sewerage) and to ensure flood infrastructure is fully serviceable before flooding, Government ensure:

- essential services infrastructure (communications, water, power and sewerage) is situated as much as possible above the flood planning level. And to minimise disruption to medical services, aged care services and the police, Government ensure hospitals, medical centres, nursing homes, aged care facilities and police stations are situated above the probable maximum flood level
- floodplain infrastructure (drains, levees, flood gates) items are all assigned to an appropriate lead agency which has responsibility for ensuring they are fully maintained and functioning especially when floods are likely.

¹⁰³² NSW Independent Flood Inquiry Mullumbimby Town Hall held on 6 June 2022.

Chapter

8

8. Building a system that works well

The Inquiry has made 28 recommendations for change. This chapter sets out the Inquiry's view of the outcomes that could be achieved if all its recommendations are implemented.

Central to the recommendations is that NSW be always ready for floods and other disasters to strike – and this readiness needs to be primed at all levels of decision-making: government, community and households. Consequently it is necessary to ensure that:

- Government understands flood risk and threat, and is ready to make informed decisions in the public's interest when preparing for, responding to and recovering from floods and other natural disasters
- communities and households are empowered to prepare for flood risk and respond to the threat of flood in a timely and effective way, and are confident in decision-making by government.

With this level of readiness in place, we can minimise the loss of life from floods; we can dramatically reduce the level of property damage; and we can be more assured that affected communities are supported to recover swiftly.

Implementation of the Inquiry's recommendations will put in place the enabling governance structures, administrative tools, new or enhanced systems, and better technology and processes that are necessary to improve the ways in which we plan and prepare for, respond to and recover from floods.

8.1. Disaster preparedness

Disasters will always present challenges for those involved: community, first responders, emergency management agencies and all levels of government. Disaster preparedness does not mean disasters are necessarily less challenging or complicated. However, it should mean that the risk to life and property is reduced, the response and recovery to the disaster is more unified, the community feels supported by government, and those affected by the disaster are more confident they will not be forgotten in the recovery and rebuilding phase.

The Inquiry has recommended that a fifth Deputy Police Commissioner be appointed on a full-time basis as the State Emergency Operations Coordinator (SEOCN). Currently, the role is filled by a senior police executive with other policing tasks to attend to. This will significantly step up the state's disaster preparedness, inculcating a 'full-time' mind set across government when it comes to emergency management. The SEOCN will drive reforms to operational training, education and readiness across NSW's combat agencies. This will include proactive intelligence gathering on the location and condition of assets available to a combat agency in an emergency.

This full-time, heightened disaster preparedness will be reinforced at police region and district levels across the state by the creation of permanent emergency management police positions focussed on local emergency management service delivery. It will be further strengthened by reshaping parts of Resilience NSW to establish a new agency, Recovery NSW, which will support the SEOCN in disaster preparedness and response, and in disaster recovery in the 100-day period after a disaster. This will include auditing emergency management processes and plans to ensure currency.

The Inquiry understands that 'tone' also 'starts at the top' for disaster preparedness. It has recommended the establishment of Task Force 'Hawk', comprising key ministers, departmental

secretaries and emergency management commissioners, to drive a top level, cohesive, whole of government approach to disaster preparedness, planning, response and recovery. Task Force 'Hawk' will convene regularly to exercise preparedness for the next emergency.

8.2. Community responders

The SEOCON will be instrumental in driving a 'community first responders' program using the findings of the Inquiry's recommended review of combat agency volunteerism in NSW. This program will fund community equipment and training in high-risk catchments to assist with emergency response and recovery, including delivery of psychological first aid. It will ensure community first responders and informal community networks are better recognised and supported by emergency services during and after disasters.

The SEOCON will also put in place an Indigenous Australians First Responders Program to embed Indigenous voices in emergency planning and preparation to ensure the needs of Indigenous people are recognised, including respectful consideration of cultural sensitivities when evacuating Indigenous communities. Aboriginal Community Liaison Officers within NSW Police will also become permanent members of local emergency management committees to help improve the Indigenous community experience of disaster response and recovery.

The Inquiry recognises the importance of the community response to flood rescue and recovery. It also understands the damaging psychological impact that floods and other natural disasters can have on communities and individuals, particularly where events are compounded. Effective triaging and psychological first aid capability can reduce community trauma immediately following an event, including suicide rates. The community and Indigenous first responder programs will better equip communities to support their own in the immediate aftermath of a disaster, pending access to formal mental health and other wellbeing services. The Inquiry has recommended that further research be undertaken so that the psychological trauma of disasters can be better anticipated and more effectively responded to, and the role of community in this space better supported.

8.3. Public information and relief funding

As part of this renewed focus on disaster preparedness, and to provide better community support through disasters, the Inquiry has recommended DCS be given accountability for Public Information and Functional Area Coordination (PIFAC) in emergency management. This is based on the effective information dissemination role it performed during the 2019–20 bushfires and COVID-19 pandemic. DCS is well positioned to gauge community sentiment and work across government agencies to ensure public emergency information is fit for purpose and effectively distributed across all communities and households, including the more vulnerable and the culturally, linguistically and religiously diverse. This should include better use of social media by government agencies to avoid the need for communities to self-organise to manage information voids. But it should also extend to supporting communities that do need to self-organise in an emergency with accurate and up-to-date information to inform community-led response and recovery.

The Inquiry was concerned to hear from many about the extraordinary difficulties they encountered in the early recovery phase, especially when they had no identity documents and therefore had trouble accessing immediate disaster relief funding and grants. The Inquiry has recommended that DCS lead the development of a 'one touch' system for the victims of disaster for streamlined access to disaster relief funding which minimises trauma, including that caused by having to tell their stories multiple times.

8.4. Flood rescue capability

Despite best efforts to improve public awareness and warnings, particularly for flash flooding, there will always be those in the community who choose, or who are forced, to shelter in place during floods and need to be rescued. The Inquiry has been clear about the need to improve flood rescue capability across the state. To do this, it has recommended flood rescue be coordinated by the NSW Police Force, rather than by the NSW SES, to align it with all other types of rescues in NSW. This should be backed up by an independent audit of rescue capability across the state to identify the type and location of agency rescue capabilities and, accordingly, which agency is likely to be best placed to respond to a rescue request.

While the Inquiry commends the Government for its recent additional investment in SES capability, more needs to be done to make the SES a sufficiently professional and competent flood rescue combat agency, particularly for the larger scale events experienced in 2022. The Inquiry's recommended merger of the RFS and SES back office and corporate support functions, which would be led by RFS given its operational maturity, will improve the capability of the SES by:

- placing risk at the centre of all decision making and planning for catastrophic disasters, with a 'go big and go hard' philosophy for pre-deployment of resource
- establishing a dedicated intelligence unit to synthesise the wealth of intelligence available to inform critical decision making, particularly for flash flooding
- establishing a planning unit to enable communities, combat and other agencies, and local governments to be better prepared for upcoming flood and storm seasons
- putting in place a workforce plan for frontline emergency staff, including hiring standards and a capacity and capability gap analysis
- improving support, training and retention of frontline staff and volunteers.

This back-office merger will also give the many thousands of RFS volunteers the opportunity for flood rescue training, increasing the number of flood rescue trained specialists across the state.

8.5. Reconstruction

A key recommendation of the Inquiry is for the establishment by legislation of a permanent reconstruction authority, the NSW Reconstruction Authority (NSWRA) which, among other things, will take over the work currently being done by the Northern Rivers Reconstruction Corporation. NSWRA will be the lead Government body for state-wide, all disaster preparation, recovery and reconstruction. It will be supported by an advisory board of community, government and industry leaders and must excel at sourcing and acquitting major funding for reconstruction at scale; ensuring project management and delivery on time and in budget; and maintaining community engagement throughout the reconstruction period, and to a certain extent beyond, to ensure relocated communities are functioning effectively in their new locations.

One critical function of the NSWRA will be to uplift capacity and capability for long-term recovery at all levels of government and across communities. It must prioritise working with other Australian, state and local government agencies to get communities affected by the 2022 floods back on their feet quickly, and functioning successfully socially and economically with a sense of future and purpose. It will have powers to cut through planning red tape to meet local recovery needs and find opportunities for long term betterment. This will involve no-regrets decision making to get people affected by the 2022 floods out of harm's way for the future, and will require the construction of new, affordable and attractive housing and related community and business facilities with amenity and a sense of community and place.

For people and communities affected by the 2022 floods, but for whom relocation is not the solution, the NSWRA may need to look to civil engineering and public works solutions to reduce flood threats, and to help build back better where affected homes and property are to be rebuilt.

The NSWRA will also oversee Special Projects where it takes over responsibility for a task for a limited time to accelerate issues critical to disaster mitigation and preparation. One early such project will be to ensure formal planning processes for safe building near floodplains. This will include identifying all high-risk catchments in the state, checking that appropriate catchment-wide modelling exists or is carried out, and that an appropriate risk-based approach to calculating the flood planning level for the purpose of planning decisions is in place. This may lead to the resettlement of other vulnerable communities in identified, exposed locations, such as caravan parks with permanent residents. Caravan parks for tourists would remain in place if supported by robust evacuation planning.

The NSWRA will also give priority to preparation of a State Disaster Mitigation Plan. This should encompass a requirement for an ongoing maintenance schedule for all flood-related infrastructure including evacuation roads, flood mitigation works (e.g. flood levees and gates, and agricultural drains), dredging programs to augment river depths at key strategic locations, and flood warning systems especially for flash floods and essential services infrastructure.

The Inquiry has recommended that Government disaster mitigation and reconstruction investment decisions be informed by a Cost Benefit Analysis Framework (based on preliminary work completed by NSW Treasury) and supported by an NSW Adaptation Fund to ensure suitable levels of funding are available for when a disaster strikes. This will make more robust and responsive the assessment and allocation of funding for important mitigation and reconstruction projects and will build in consideration of broader community and economic benefits.

8.6. Warning systems

The Inquiry has recommended that Government, in collaboration with the Bureau of Meteorology, invest in upgrades to the rain and river gauge network across NSW. Ownership of assets in the network must be consolidated and supported by a stringent maintenance plan. Joint Australian and state government funding is also required to deliver new mobile radars which enhance redundancy in the event of outages in high-risk areas and which can be rapidly deployed to provide timely and accurate rainfall and flood forecasts.

Investments in weather technology will give better knowledge of rain before and as it falls, but also strengthen communications with community. The data should be made available in real time to the public, in a way that anyone can understand, including through satellite-linked live signs in the town centre of high-risk locations.

The Inquiry has also recommended that the SEOCAN and DCS develop an all-agencies NSW Disaster App. This app would operate a simple interface accessible by mobile devices to consolidate several existing agency emergency services' warning apps. It has the potential to transform the way we collect and share disaster risk and alert and warning information, with quality control mechanisms to ensure communities have reliable information. It would not only draw on government data and up-to-date catchment modelling, but also real-time, quality-assured local flood knowledge and community observations. This will enable information and warnings with local context which better allows communities to determine whether, when and how to act. This should lead to fewer people dying in their homes and cars because they know better what action to take and when, on receipt of warning and alert information.

8.7. Flood and the natural and built environment

A good planning system can do a lot to mitigate disaster risk including from flooding. The NSW planning system is complex and has seen many changes to flood provisions over decades as NSW manages the tension to keep people safe from flood while still making sufficient land available for homes to house a growing population especially in major urban centres in flood prone areas.

The Inquiry makes 5 recommendations addressing how to use the planning system more effectively to develop flood protection that is comprehensive and easier to understand, while at the same time making more housing available on flood-safe lands near facilities such as train stations, schools and medical facilities. The first recommendation is to make it possible to look up for any address what disasters have affected that property since European settlement. The next recommendation is the risk-based recalculation of the flood planning level, to be done by the NSWRA rather than local councils. The third and fifth recommendations address the need for simplifying and strengthening the disaster provisions in planning instruments, including incorporating all such instruments for a town or region in a disaster adaptation plan for that town or region. Such disaster adaptation plans can then be used to inform reconstruction decisions for badly flood damaged regions such as the Northern Rivers, and development decisions for flood affected regions where there are major stalled development proposals such as in the Hawkesbury-Nepean.

Treating floodplains as assets rather than problems is the subject of the fourth planning recommendation which recommends taking floodplains increasingly back into public ownership and using them for suitable activities such as sporting and recreation fields, community gardens, agriculture and forestry, renewable energy production and biodiversity offsets. Instead of building homes and businesses on the floodplain, new housing should be on areas safe from major flood with the people living there having appropriate access to floodplain facilities including garden plots.

The Inquiry also makes 3 major recommendations on housing: to relocate those most at risk of flood with good homes and amenities; to provide affordable mechanisms to make restoring and buying new homes possible after being affected by flood, including dealing with mould and ensuring building standards are maintained; and to provide more social housing especially in flood-damaged areas.

8.8. Infrastructure – roads and essential services

An excellent and well-maintained evacuation road network is vital to enable people to escape an unfolding disaster. Also vital is having processes for rapid repair to evacuation roads if they are affected by the disaster (e.g. from road slips as happened across the Northern Rivers). The recommendation on roads addresses this.

It is also critical to keep essential services functioning though a flood or to get them repaired quickly if they fail. This is best enabled if as much essential services infrastructure as possible is installed above the flood planning level or, even better, the probable maximum flood level. The recommendation on essential services infrastructure addresses this.

8.9. Caring for Country

There is an opportunity to mitigate the impact of storms and flooding by strategically restoring landscapes to reinstate ecosystem functions. The Inquiry suggests that listening to Indigenous voices will lead the way in repairing the natural environment. This is Caring for Country. Repairing

Country rebuilds cultural connection with landscape and makes communities resilient. It also presents economic opportunities for landowners, including farmers and Aboriginal land councils, to generate biodiversity offset and carbon credit income streams in perpetuity, including on high-risk floodplains.

8.10. Education and research

The Inquiry has recommended that more work be done to raise community awareness of the likelihood and risk of flooding and other natural disasters. NSW schools at both primary and secondary levels should introduce flood and other disaster awareness as part of the social studies curriculum. This will permeate through whole families, with children sharing what they learn at school with their parents. It will be particularly beneficial for families where English is not the first language, and in transient populations where people new to an area may not realise their flood or disaster risk.

NSW has the opportunity to build its reputation as a globally leading jurisdiction in disaster risk management, technology and recovery. We can grow our already recognised capability in assessing and understanding flood and fire risk, with funding support from the Australian Government, to improve the accuracy of forecasting of rainfall intensity, time and location. To this end, the Inquiry has recommended the Bureau of Meteorology and the ARC Centre of Excellence in Climate Extremes (CLEX) continue their world-leading research to enhance our understanding of weather patterns conducive to extreme rainfall and other extreme weather events. As well, with CLEX coming to the end of its Australian Government funding period, the Inquiry has recommended the creation of another state research network, the NSW Climate Extremes Network, to be led by the CLEX team but involving all NSW universities which wish to join and linking with other related research organisations nationally and internationally.

8.11. In conclusion

More damaging floods and other natural disasters will come, and NSW must shake off its 'rinse and repeat' disaster thinking. If this state is to be truly well prepared for disasters, it requires a full-time and sustained focus on an all-agencies and all-hazards approach to disaster response. This must be driven from the very top of Government. Because governments at all levels will never be able to meet all needs, either during or in the shadow of disasters, this focus must also recognise and support the central role of communities, which will always step up to help their own when the occasion requires.

Common sense must also prevail when we plan for the use of our floodplains. Our planning needs to lead to fewer risks to life and property, not more. It needs to promote new and valuable alternative uses for our high-risk floodplains. It needs to prioritise relocating homes out of harm's way. It needs to embrace building form and design which is both community-centred and disaster-resilient. And it needs a single-minded focus on rapid and long-lasting post-disaster recovery and reconstruction.

We must also look to repair the natural environment and build back natural mitigants to flooding. Caring for Country and indigenous cultural connection should be at the heart of this repair.

Implementing the recommendations of this Inquiry will give this state the best chance of being in the best position to respond and recover when the next disaster strikes.

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