Attachment 3 to Item 10.3.4.

Macdonald River, Colo River, Webbs Creek and Greens Creek Flood Risk Management Plan - Final Report

Date of meeting: 29 July 2025
Location: Council Chambers
Time: 6:30pm

Macdonald River, Colo River, Webbs Creek & Greens Creek

Flood Risk Management Plan

Final

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Document Control

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Prepared For: Hawkesbury City Council

Project Name: Combined Macdonald River, Colo River, Webbs Creek & Greens Creek Flood Study and Floodplain Risk Management Study and Plan

Rhelm Reference: J1382

Document Location: RR-04-1382-01 - Combined Rivers FRMP

Cover photo – photo of the Colo River near the Upper Colo Gauge, June 2020.

Report Structure

The reporting for the Combined Catchments of Macdonald River, Colo River, Webbs Creek and Greens Creek River Flood Study and Floodplain Risk Management Study and Plan has been presented in four key documents:

- **Flood Study** – establishes the flood behaviour and risk within the study area.
- **The Flood Risk Management Study** – details the assessments undertaken as part of the study.
- **Flood Risk Management Plan** – presents an implementation strategy for Council to prioritise floodplain management options.
- **Map Compendium** – a set of A3 maps as referenced in the Study and Plan.
- **Map Compendium – Hawkesbury Driven Events**– A set of A3 maps showing flood depth, water level, velocity, and hazard associated with Hawkesbury-Nepean Valley flood events ranging from 2% AEP to the PMF. The modelling also assumes a 10% AEP catchment event for this mapping.

Foreword

The primary objective of the New South Wales (NSW) Government's Flood Prone Land Policy is to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible.

Through the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) and the NSW State Emergency Service (SES), the NSW Government provides specialist technical assistance to local government on all flooding, flood risk management, flood emergency management and land-use planning matters.

The *NSW Flood Risk Management Manual* (NSW Government, 2023a) is provided to assist councils to meet their obligations through the preparation and implementation of floodplain risk management plans, through a staged process. **Figure F1**, taken from this manual, documents the process for plan preparation, implementation and review.

The *NSW Flood Risk Management Manual* (NSW Government, 2023a) is consistent with Australian Emergency Management Handbook 7: *Managing the floodplain: best practice in flood risk management in Australia* (AEM Handbook 7) (AIDR 2017).

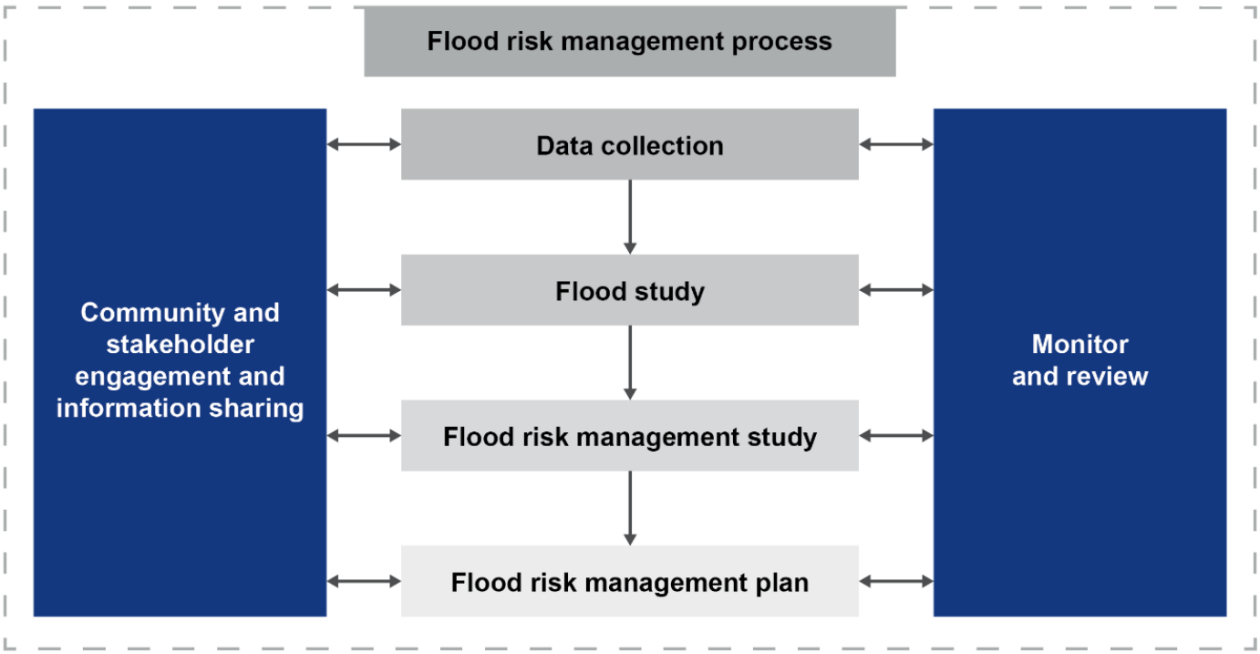

Figure F1. The Floodplain Risk Management Process (source: NSW Government, 2023a)

Executive Summary

The Combined Macdonald River, Colo River, Webbs Creek and Greens Creek Flood Study has been prepared for Hawkesbury City Council (Council) to refine the understanding of flood risk in the study area.

Flooding is a known risk within the study area, affecting private and public property and access during and after flood events. The flooding of key crossings also restricts the response of emergency personnel during emergencies. Each catchment is also affected by backwater flooding from the Hawkesbury River, which can also exacerbate the isolation risk.

Study Area

The study area includes four catchments: the Macdonald River, Colo River, Webbs Creek, and Greens Creek. Each catchment discharges into the Hawkesbury River. The catchments within the study area are varied, with the Colo River covering 4,640 km², the Macdonald River 1,845 km², Webbs Creek 363 km², and Greens Creek 10 km².

The topography throughout the study area is predominantly steep, with the river flowing through valleys that are semi confined by sandstone. Due to the semi-confined valley topography, flood levels, particularly in the Colo and MacDonald Rivers, can reach significant heights.

Objectives

The overall objective of this study is to improve understanding of flood behaviour and impacts, and better inform management of flood risk in the study area in consideration of the available information, and relevant standards and guidelines. The project will also assist Council with planning for future development and will provide flood intelligence to the SES to enable them to progress their emergency management planning for the region.

The floodplain risk management study will provide an understanding of the impacts of floods on the existing and future community. Testing and investigation of practical, feasible and economic management measures to treat existing, future, and residual risk has also been undertaken. Recommendations for the implementation and staging of these measures will be detailed in the floodplain risk management plan (FRMP).

The outcomes of the FRMS will be presented in the FRMP which documents and conveys the decisions on the management of flood risk into the future. The FRMP outlines a range of measures to manage existing, future, and residual flood risk effectively and efficiently. This includes a prioritised implementation strategy; what measures are proposed and how they will be implemented.

Consultation

Community and stakeholder consultation is an important element of understanding and managing flood risk. The engagement approach undertaken as part of this study was in accordance with the IAP2 framework and the requirements of the NSW Government's Flood Risk Management Manual (2023).

The community and stakeholders have been engaged through a public exhibition process to provide input on flooding issues experienced in the catchment and how they could be addressed.

Flood Risk Management Study

The Combined Catchments Flood Risk Management Study (Rhelm, 2025) provided a comprehensive evaluation of the flood risks in the catchment and identified potential options to mitigate these risks.

The key outcomes of the FRMS include:

- Evaluation of flood risk to the community based on the flood behaviour of the catchment. This analysis included flood hazard and emergency response mapping, and economic damages assessments.
- Review of flood planning policy, including flood-related controls covered by the Local Environment Plan (LEP), relevant Council policies and plans. The recommendations proposed as an outcome of this review are presented in this FRMP.
- Identification of a range of flood mitigation measures to address existing and future flood risk and evaluation of these measures with the use of a Multi-Criteria Assessment (MCA) approach. The MCA enabled the comparative assessment of all options based on their economic, and social aspects, as well as on their effectiveness in mitigating flood risk.

This floodplain risk management plan draws from the conclusions of the analysis undertaken in the FRMS and present the recommended measures for managing flood risk within the catchment, as well as the strategy to implement these measures.

Recommended Floodplain Risk Management Measures and Implementation Program

The outcomes of the options analysis undertaken in the FRMS form the basis of this FRMP. A detailed description of the recommended floodplain risk management measures is provided in **Section 2**.

Table i summarises the measures recommended as part of this FRMP.

Table i Summary of Recommended Floodplain Risk Management Measures

Management Scenario	ID	Name	Priority
Emergency Response Management Measures	EM1	Data handover to SES	High
	EM2	Update of Emergency response documentation	High
	EM3	Installation of additional gauges	High
	EM4	Flood education	High
	EM5	Campground education program	Medium
	EM6	Flood depth markers	Medium
	EM8	Online reporting of road closures	Medium
	EM14	Improve Immunity of Flood Crossings	Low
Property Management Measures	FP1	Planning and Development Controls	High
	FP4	Voluntary house purchase	Low
	FP5	Voluntary house relocation	Low
	FP6	Post flood data collection	Medium

To achieve the implementation of relevant management actions, a program of implementation has been developed. The proposed implementation strategy is presented in **Section 3**. The proposed

program provides information on the estimated costs of each measure, the agency / organisation responsible for the action, as well as the priority and timeline for implementation.

It is recommended that 2 – 5 year monitoring of the plan be undertaken for progress against the recommended actions, and to ensure that the findings of the plan continue to be referenced as development is undertaken in the catchment.

It is also recommended that the Plan be reviewed every 10 years for relevance and ongoing suitability. This would be a modest review, as opposed to a revision of the full FRMSP.

Conclusions and Recommendations

This FRMP provides a practical framework and implementation plan for managing existing, future, and continuing flood risk within the study area.

The effective implementation of development controls will be of key importance in reducing the damages and risk to life associated with flooding into the future through the construction of flood compatible buildings and assets. Improving emergency response, and improved community awareness of flooding, is critical to reducing the risks associated with flooding in the study area.

This FRMP fulfils its objectives in accordance with the NSW Flood Prone Land Policy (NSW Government, 2023) and the principles of the Flood Risk Management Manual (DPE, 2023).

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1 Introduction

The Combined Macdonald River, Colo River, Webbs Creek and Greens Creek Flood Study and Flood Risk Management Study and Plan (FRMSP) has been prepared for the Hawkesbury City Council (Council) in accordance with the New South Wales (NSW) Flood Prone Land Policy and the Flood Risk Management Manual (NSW Government, 2023a) and its supporting guidelines.

The overall objective of this study is to improve the understanding of flood behaviour and impacts to inform the management of flood risk in the study area.

The project incorporates three key components:

- **The Flood Study.** The flood study will define flood behaviour to better inform flood risk management. The flood study will consider available information, previous studies and relevant standards and guidelines including Australian Rainfall and Runoff (2019) and the latest climate change guidance.
- **Floodplain Risk Management Study.** The FRMS will evaluate a range of measures (including emergency response, property modification and flood modification measures) to address the flood risk and inform the development of a Floodplain Risk Management Plan.
- **Floodplain Risk Management Plan.** The FRMP will provide a strategic level plan for Council to manage the flood risk in the study areas moving into the future.

The FRMP (this document) provides a suggested implementation schedule for Council to action the recommended risk mitigation strategies that were developed in the Floodplain Risk Management Study.

The Flood Study, FRMS and FRMP, together provide an understanding of, and information on, flood behaviour and associated risk to inform:

- relevant government information systems
- government and strategic decision makers on flood risk
- the community and key stakeholders on flood risk
- flood risk management planning for existing and future development
- emergency management planning for existing and future development, and strategic and development scale land-use planning to manage growth in flood risk
- decisions on insurance pricing (for the insurance industry)
- selection of practical, feasible and economic measures for treatment of risk
- development of a floodplain risk management plan
- development of a prioritised implementation strategy.

The outputs of the studies and plan will assist this by:

- Providing a better understanding of the:
    - variation in flood behaviour, flood function, flood hazard and flood risk in the study area
    - impacts and costs for a range of flood events or risks on the existing and future community
    - impacts of changes in climate on flood risk
    - emergency response situation and limitations
    - effectiveness of current management measures.
- Facilitating flood risk information sharing across government and with the community.

The Flood Study, FRMS and FRMP also inform decision making for investing in the floodplain; managing flood risk through prevention, preparedness, response and recovery activities, and informing and educating the community on flood risk and response to floods.

The intended end user groups which the Flood Study, FRMS and FRMP aim to support include:

- high level strategic decision makers
- the local community
- flood risk management professionals
- engineers involved in designing, constructing and maintaining mitigation works
- emergency management planners
- land-use planners
- hydrologists and meteorologists involved in flood protection and forecasting
- insurers.

1.1 Study Area

The study area incorporates four key catchments:

- Macdonald River;
- Colo River;
- Webbs Creek; and,
- Greens Creek.

An overview of the catchments and corresponding study areas is provided in the Flood Study. Each catchment drains in a general south easterly direction into the Hawkesbury River and is described in further detail below. The study areas cover the lower reaches of each catchment and encompass most of the developed and rural land relevant to the Hawkesbury City Council LGA.

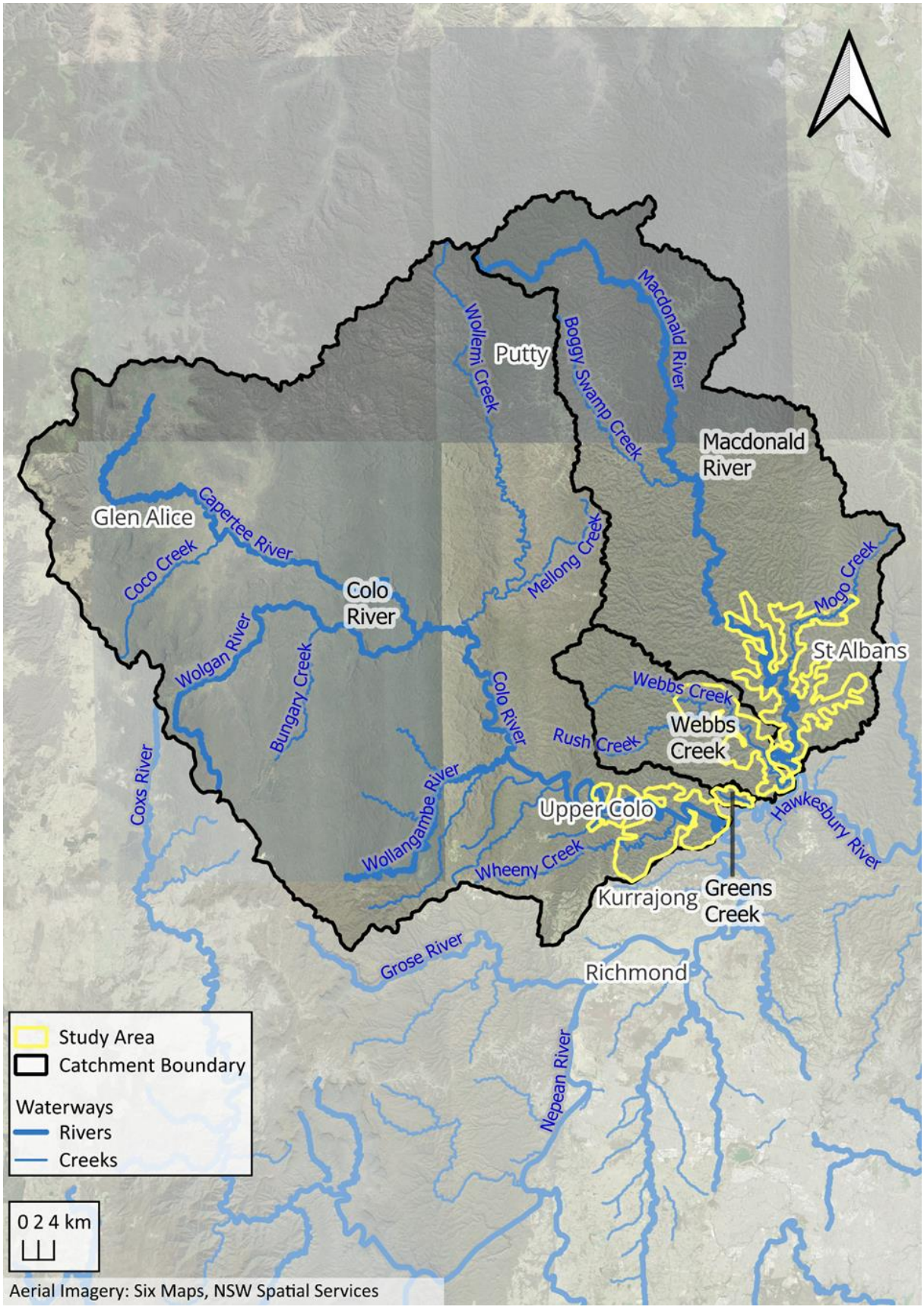

Figure 1-1 Study Area and Regional Context

1.2 Study Objectives

The overall objective of this study is to improve understanding of flood behaviour and impacts, better informing the management of flood risk in the study area in consideration of the available information, and relevant standards and guidelines. The project will also assist Council with planning for future development and will provide flood information to the SES to enable them to progress their emergency management planning for the region.

The FRMS provided an understanding of the impacts of floods on the existing and future community. Testing and investigation of practical, feasible and economic management measures to treat existing, future, and residual risk was also undertaken. Recommendations for the implementation and staging of these measures are detailed in the FRMP (this document).

The FRMP documents and conveys the decisions on the management of flood risk into the future. The FRMP outlines a range of measures to manage existing, future, and residual flood risk effectively and efficiently. This includes a prioritised implementation strategy; what measures are proposed and how they will be implemented.

1.3 Floodplain Risk Management Plan Structure

The FRMP provides a summary of the management options recommended in the FRMS (**Section 2**). An implementation program and prioritised options are provided in **Section 3** of this Plan.

2 Floodplain Risk Management Options

2.1 Background

Flood risk is a combination of the likelihood of occurrence of a flood event and the consequences of that event when it occurs. It is the human interaction with a flood that results in a flood risk to the community. This risk will vary with the frequency of exposure to this hazard, the severity of the hazard, and the vulnerability of the community and its supporting infrastructure to the hazard. Understanding this interaction can inform decisions on which treatments to use in managing flood risk.

As defined in the *Australian Disaster Resilience Handbook 7 – Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia* (AIDR, 2017), there are three types of flood risk:

- Existing flood risk – the risk associated with current development in the floodplain. Knowing the likelihood and consequences of various scales of floods can assist with decisions on whether to treat this risk and, if so, how.
- Future flood risk – the risk associated with any new development of the floodplain. Knowing the likelihood and consequences of flooding can inform decisions on where not to develop and where and how to develop the floodplain to ensure risks to new development and its occupants are acceptable. This information can feed into strategic land-use planning.
- Residual flood risk – the risk remaining in both existing and future development areas after management measures, such as works and land-use planning and development controls, are implemented. This is the risk from rarer floods like the PMF, which may exceed the management measures. Residual risk can vary significantly within and between floodplains. Emergency management and recovery planning, supported by systems and infrastructure, can assist to reduce residual risk.

Measures available for the management of flood risk can be categorised according to the way in which the risk is managed. There are three broad categories of management:

- Flood modification measures – options aimed at preventing/avoiding or reducing the likelihood of flood risks through modification of flood behaviour in the catchment.
- Property modification measures – options focused on preventing/avoiding or reducing the consequences of flood risk through modification to existing properties (e.g. by house raising) and/or impose controls on property and infrastructure development. Property modification measures, such as effective land use planning and development controls for future properties, are essential for ensuring that future flood damages are appropriately contained, while at the same time allowing ongoing development and use of the floodplain.
- Response and recovery modification measures – options focused on reducing the consequences of flood risks, by generally aiming to modify the behaviour of people during a flood event.

A comprehensive range of possible flood risk management measures for study area were examined, as part of the Floodplain Risk Management Study (2024). The identified measures were a product of an extensive investigation of the flood risks in the study area, which included flood behaviour, flood hazard, emergency response mapping, and economic damages assessments undertaken as part of the Flood Study and FRMS, and inputs obtained through workshops with stakeholders and community engagement activities.

The identified measures were then evaluated through a Multi-Criteria Assessment (MCA) approach, which enabled the comparative assessment of all options based on their economic, social, and environmental aspects, as well as on their effectiveness in mitigating flood risk.

As an outcome of this assessment, the options that were identified as being the most advantageous have been recommended as part of this FRMP and are further discussed below.

A range of flood risk management measures are recommended as part of this FRMP.

The recommended measures are presented in:

- **Section 2.1.1** for emergency response options; and.
- **Section 2.1.2** for property modification options.

No flood modification options (structural options) were found suitable for inclusion in the FRMP.

2.1.1 Emergency Response Options

Emergency response modification measures aim to reduce the consequences of flood risks by:

- Increasing the effective warning time, such as via the use of flood warning systems
- Planning the evacuation of an area so that it proceeds smoothly during a flood event;
- Preparing for a flood event (e.g., stockpiling sand and sandbags for future deployment); and,
- Enabling recovery following a flood event.

Of all the floodplain risk management options available for consideration, it is only emergency management modifications (which includes community planning) that addresses the residual flood risk after all the flood and property modification options have been implemented. Emergency management and education measures are an effective ongoing flood risk management tool.

Table 2-1 summarises the emergency response measures that were found in the FRMS to be beneficial in a program of flood risk management.

Table 2-1 Recommended Measures – Emergency Response

Option ID	Option Name	Reference Section
EM1	Data handover to SES	**Section2.1.1.1**
EM2	Update of emergency response documentation	**Section 2.1.1.2**
EM3	Flood Warning System and Gauges	**Section 2.1.1.3**
EM4	Emergency response plans	**Section 2.1.1.4**
EM5	Flood Warning Signs and Information	**Section 2.1.1.5**
EM6	Community Education and Awareness	**Section2.1.1.6**
EM7	Campground Education Program	**Section 2.1.1.7**
EM9	Data Collection Following Flood Events	**Section2.1.1.8**
EM11	Scoping Study to Improve Flood Immunity and Resilient of Crossings	**Section 2.1.1.9**

2.1.1.1 *EM1 – Data handover to SES*

EM1: Data Handover to the NSW SES		
Flood Management Type: Emergency Response	**Responsibility: Council / SES**	
MCA Priority: High	**Costs to Council**	**Initial Cost:** $2,000
		Recurrent Cost: $0
Overview and flooding issue addressed: The flood data developed as part of the Flood Study and Floodplain Risk Management Study should be transferred to the SES for incorporation into their own flood intelligence database. This would be facilitated by the NSW Government Flood Data Portal following the completion of these flood investigations. The provision of the hazard mapping and flood emergency response classifications would also assist the SES in prioritising and scheduling actions as a flood event progresses through the catchment. The flood data developed as part of the FRMS could potentially assist the SES to plan and carry out emergency actions. All flood data will be uploaded to the SES Data Portal at the conclusion of the study.		
Expected mitigation outcomes: The flood data developed as part of the flood study and FRMS will assist the SES in prioritising and scheduling actions, as a flood event progresses through the catchment area.	**Considerations:** The provision of flood information to the SES should also be ongoing. For example, if Council collects any post-flood survey, or receives reports of local flooding issues, this should also be passed to the SES for their consideration. This would be achieved by uploading this data to the NSW Flood Data Portal.	

2.1.1.2 *EM2 – Update of Emergency Response Documentation*

<table>
<tr><th colspan="3">EM2: Update of Emergency Response Documentation</th></tr>
<tr><td>Flood Management Type: Emergency Response</td><td colspan="2">Responsibility: SES</td></tr>
<tr><td rowspan="2">MCA Priority: High</td><td rowspan="2">Costs to Council</td><td>Initial Cost: $0</td></tr>
<tr><td>Recurrent Cost: $0</td></tr>
<tr><td colspan="3">Overview and flooding issue addressed:
The Hawkesbury-Nepean Valley Flood Emergency Sub-Plan (2020), establishes the framework for managing flood emergencies within the Hawkesbury-Nepean area. This plan focuses exclusively on flood-related incidents and provides a clear delineation of roles and responsibilities for stakeholders during a flood event. Additionally, the plan identifies key roads susceptible to flooding.
To enhance the effectiveness of the Sub-Plan, it is recommended that the following updates be incorporated based on the findings of this study:
Critical Flood Heights: Table 5 should be reviewed and updated to reflect the flood information from this study.
NSW SES Divisions and Strategies: Annex C, detailing NSW State Emergency Service (SES) Divisions, Sectors, Sub-Sectors, and Evacuation Strategy Selection Considerations, should be revised to integrate these findings.
Broader Flood Context: The Sub-Plan should explicitly address:
Catchment-specific flooding within the study area.
General flood dynamics across the Hawkesbury-Nepean Valley.
Additionally, relevant annexures should be systematically reviewed and updated to ensure consistency with the latest flood risk information and strategic insights.
The Hawkesbury City Local Flood Plan should also be updated based on the flood information and recommendations and within the Flood Study and Flood Risk Management Study. This includes updated design flood levels and information related to recent flood events in 2020, March 2022 and July 2022.</td></tr>
<tr><td colspan="2">Expected mitigation outcomes:
Improved flood response from emergency responders.</td><td>Considerations:
If other risk management studies have been undertaken, but have not yet been incorporated into these documents, this opportunity should be taken to do so.</td></tr>
</table>

2.1.1.3 *EM3 –Flood Warning System Scoping Study*

EM3: Flood Warning System Scoping Study		
Flood Management Type: Emergency Response	**Responsibility: Council / SES / BoM**	
MCA Priority: High	**Costs to Council**	**Initial Cost:** $150,000 **Ongoing Cost:** $10,000
Overview and flooding issue addressed: Rainfall and stream gauges serve to improve flood forecasting and flood warning options. There are limited flow and rainfall gauges within the study area. Communities throughout the study area can become isolated from relatively small flood events. It is recommended that Council undertake a flood warning system scoping study in conjunction with NSW SES and the BOM. The study should consider additional rainfall and water level gauges be placed at key crossings in the MacDonald River, Colo River and Webbs Creek catchments. The community be given access to live water level gauge data where possible. It is also recommended the BOM upgrade the St Albans gauge to a standard that will allow flood warnings to be issued at St Albans.		
Expected mitigation outcomes: The installation of these gauges would provide improved flood warning for the upper catchment, as well as a better definition of the orographic effects of the western range.	**Considerations:** Gauge ownership and management. Public access to live water level and rainfall data.	

2.1.1.4 *EM4 - Emergency Response Plans*

EM4: Emergency Response Plans		
Flood Management Type: Emergency Response	**Responsibility: Council / SES / Operators**	
MCA Priority: High	**Costs to Council**	**Initial Cost:** $50,000 **Ongoing Cost:** $5,000 every 5 years
Overview and flooding issue addressed: Flood-affected locations within the study area, including tourist accommodations and schools, pose a heightened risk to vulnerable demographics. To ensure safety during flood events, it is recommended that these sites develop and implement comprehensive flood response plans. These plans should: • Clearly define roles and responsibilities. • Specify sources of flood-related information. • Include trigger levels or rainfall thresholds for activating the plan. • Outline alternative meeting or accommodation arrangements for affected individuals. While the responsibility for these plans lies with property owners, it is advised that the Council communicates the study's findings and collaborates with property owners and the State Emergency Service (SES) to create these plans.		
Expected mitigation outcomes: Enhanced preparedness reduces the risk of injury or loss of life among tourists, school children, and staff during flood events. Clear roles, responsibilities, and pre-defined actions enable faster, more coordinated responses, during emergencies. Timely evacuation and preventive measures lower the impact of flooding on physical infrastructure and operations. Property owners gain a clear understanding of their responsibilities, fostering proactive planning and risk management. Collaboration between property owners, Council, and SES creates a unified approach to flood management, improving the overall community's capacity to handle disasters.		

2.1.1.5 *EM5 – Flood Warning Signs and Information*

EM: Flood Warning Signs		
Flood Management Type: Emergency Response	**Responsibility: Council**	
MCA Priority: High	**Costs to Council**	**Initial Cost:** $40,000 **Ongoing Cost:** $5,000 as required
Overview and flooding issue addressed: Flood warning and information signs may be used to educate the community on flood risk, or to provide them with flood information during a flood event (such as depth markers) to allow them to make informed decisions. Due to the significant flood depths that can occur at these crossings, a depth mark showing overtopping depth up to rare or extreme flood events is not feasible. Rather, a series of markers would be staggered up the bank to a depth of up to 10m. Beyond this, it would be apparent from the river conditions that crossing is not advisable. It is recommended that depth markers be placed at those roads which are subject to frequent inundation, as identified in **Section 7.2** of the FRMS. It is also recommended that these works be aligned with the installation of any new rainfall or stream gauges installed at the same location as part of other risk management measures recommended by this Plan.		
Expected Mitigation Outcomes: Improved awareness of flood risk by the community. The depth gauges will assist in preventing people driving into flood waters.		

2.1.1.6 *EM6 – Community Education and Awareness*

EM6: Flood Education		
Flood Management Type: Emergency Response	**Responsibility: Council / SES**	
MCA Priority: High	**Costs to Council**	**Initial Cost:** $50,000 **Ongoing Cost:** $5,000 every 5 years.
Overview and flooding issue addressed: Community awareness and behaviour is an important aspect of reducing flood risk within a catchment. If a community is aware of how flood risks develop within their local area, and the correct ways in which to respond, risk to life can be substantially reduced. It is recommended that Council take the exhibition and adoption of the Flood Study and Floodplain Risk Management Study and Plan as an opportunity to engage with the community in discussions relating to flood risk, management, and responses. At a minimum, it is recommended that Council's website be updated with the outcomes and recommendations of the Flood Study and Floodplain Risk Management Study and Plan. Further community awareness could be raised by issuing media releases. The involvement of NSW SES members in community engagement and educations programs has been successful in engagement activities across NSW. SES members could be invited to participate in face-to-face education activities at community events or pop up stalls.		
Expected Mitigation Outcomes: Improved awareness of flood risk by the community, who will be empowered to make better and safer decisions during flood events.	**Considerations:** Awareness will reduce in the community over time. The education campaign should be refreshed every 2-5 years, and especially during forecast La Niña years, to maintain awareness.	

2.1.1.7 EM7 – Campground Education Program

EM7: Campground Education Program		
Flood Management Type: Emergency Response	**Responsibility: Council / National Parks**	
MCA Priority: High	**Costs to Council**	**Initial Cost:** $50,000 **Ongoing Cost:** $10,000 every 5 years
Overview and flooding issue addressed: Several campgrounds are located within the study area, and they face a significant flood risk and isolation during flood events. Campers and tourists are generally less familiar with the area's flood behaviour and associated risks compared to long-term residents. Additionally, they typically rely on less robust shelters, such as tents, and are less equipped to endure prolonged isolation during emergencies. To address these vulnerabilities, the Hawkesbury-Nepean Valley Flood Risk Management Directorate recently implemented a project aimed at enhancing flood preparedness and responsiveness among caravan park operators along the Hawkesbury-Nepean River. A key component of this initiative was the establishment of a highly collaborative working group, which brought together essential stakeholders, including local councils, communications and engagement specialists, the NSW SES, local SES volunteers, and flood experts. It is recommended that the Council share the findings of this study with campground owners to help them better plan for and mitigate flood risks. Furthermore, the Council may consider inviting campground owners to participate in ongoing consultations, enabling them to seek guidance and provide input on future flood management strategies. Council should also support camp ground managers to develop site based flood emergency response plans. This could be through education and the development of standard templates.		
Expected mitigation outcomes: The dissemination of this information may also serve as a starting point for an ongoing conversation with these operators about how they could improve their campground's flood risk profile.		

2.1.1.8 *EM9 – Data Collection Following Flood Events*

EM9 – Data Collection Following Flood Events		
Flood Management Type: Emergency Response	**Responsibility: Council**	
MCA Priority: High	**Costs to Council**	**Initial Cost:** $0 **Ongoing Cost:** $20,000 (after each event)
Overview and flooding issue addressed: The availability of historical flood data benefits the Council and SES by helping to identify areas with frequent flooding issues, confirming the accuracy of existing records and enabling better calibration and validation of future flood models. To complement existing data, it is recommended that flood data be collected as soon as practical after flood events. This data collection should consider community reports, photographs, road inundation details, and flood marks. A formal process should be developed to guide data collection, outlining required information, methods, and safety measures. Assistance is available from DCCEEW, including templates and guidance on data to be collected. Additionally, Council assets should be inspected after flooding, and a post-flood asset inspection checklist should be created to ensure key structures are surveyed and reliable flood marks are recorded		
Expected mitigation outcomes: Improved identification of high-risk flood areas and validation of existing records. It will enhance the accuracy of flood modelling and enable better decision-making for flood management. Additionally, it will support systematic post-flood inspections of Council assets to identify damage and inform necessary repairs.	**Considerations:** Post flood event data collection can be resource intensive and survey costs can be expensive. Council should consider setting aside funds within the operation budget for post flood event data collection.	

2.1.1.9 *EM11 – Scoping Study to Improve flood Immunity of crossings*

EM11: Scoping Study to Improve Flood Immunity of Crossings		
Flood Management Type: Emergency Response	**Responsibility: Council**	
MCA Priority: Medium	**Associated Costs:**	**Initial Cost:** $80,000
Overview and flooding issue addressed: This option involves upgrading road surfaces and structures to ensure they can be reopened quickly after flooding. The upgrades would use materials resistant to hydraulic forces, such as concrete pavement. Initially, it is recommended to conduct a scoping study to evaluate the condition of assets and prioritise upgrades based on their condition and the importance of the crossings for access during and after flood events This option would not significantly improve access during a flood event, but may allow key access roads to be reopened sooner following flooding. Road surface updates may be considered for sections of Settlers Road, St Albans Road and Upper Colo Road damaged by flooding in April and June 2022. Upgraded crossings should be constructed as high as practicable, and some wooden structures may need replacement. It is recognised achieving a specific flood immunity is not possible at many crossings due to the very high flood depths in events in frequent (e.g. 20% AEP) flood events.		
Expected Mitigation Outcomes: Improved road resilience and reduced isolation times following flood events.		

2.1.2 Property Modification Options

Property modification measures refer to modifications to existing development and / or development controls on property and community infrastructure for future development. These are aimed at steering inappropriate development away from areas with a high potential for damage and ensuring that potential damage to development likely to be affected by flooding is limited to acceptable levels by means of measures such as minimum floor levels, and flood proofing requirements.

Table 2-2 summarises the property modification measures that were found in the FRMS to be beneficial in a program of flood risk management.

Table 2-2 Recommended Measures – Property Modification Options

Option ID	Option Name	Reference Section
PM1	Land Use Planning and Building Controls	**Section 2.1.2.1**
PM3	VP/VHR Scoping Study	**Section 2.1.2.2**

2.1.2.1 PM1 – Land Use Planning and Building Controls

PM1: Land Use Planning and Building Controls		
Flood Management Type: Property Modification	**Responsibility:** Council	
MCA Priority: High	**Costs to Council**	**Initial Cost:** $50,000
		Recurrent Cost: 0
Overview: Council's existing land use planning and building controls were reviewed in the FRMS. As an outcome of this review, a series of recommendations have been made to assist Council in achieving best practice flood planning in the catchment and across the LGA. Recommended planning controls updates are described in **Section 8.4.1** of the FRMS.		

2.1.2.2 PM3 – VP/VHR Scoping Study

PM3: Voluntary Purchase and Voluntary House Raising Scoping Study		
Flood Management Type: Property Modification	**Responsibility:** Council/DCCEEW	
MCA Priority: Medium	**Costs to Council**	**Initial Cost:** $80,000 for study area.
Overview: 170 properties within the study area are affected by overfloor flooding in a 1% AEP event with 138 properties affected by H4 flooding and above. The wider Hawkesbury LGA includes many additional properties that are affected by hazards flooding. The very high flood depths and velocities in major flood events may be a risk to life. It is recommended that Council undertake a scoping study to further investigate properties for voluntary purchase (**See Section 8.4.3** of the FRMS) and voluntary house raising (See **Section 8.4.4** of the FRMS).		

3 Implementation Program

The actions listed in **Table 3-1** are recommended for implementation as an outcome of the NSW Government Floodplain Risk Management Process. To achieve the implementation of relevant management actions, a program of implementation has been developed.

Table 3-1 provides the following information relevant to the implementation of the management actions:

- An estimate of capital and recurrent costs for each action (this may, in some cases, include existing staff and funding);
- The agency or organisation likely to be responsible for the action;
- The timeline for implementation (immediate or staged) and priority for implementation (high, medium, or low).

The following provides further detail on the implementation timelines:

- **Short** – this indicates actions that could be implemented in the short term (less than 5 years) if funding and resources permit.
- **Mid** – this indicates actions that could be implemented in the mid- term (5 to 10 years) if funding and resourcing permits. Feasibility of the action is generally high and additional investigations or further development of the management strategy would be minimal.
- **Long** – this indicates actions that could be undertaken in the long term (up to 10 years plus). However, additional investigations, feasibility studies or further development of the management strategy are likely to be required. Where appropriate, interim policy and planning measures could be employed in the intervening time.

The following provides further detail on the priorities:

- **High priority:**
  - Typically (but not always) require relatively low implementation effort and cost.
  - Achieved a high priority rating in the MCA.
- **Medium Priority:**
  - Require a substantial effort and cost.
  - Achieved a medium priority rating in the MCA.
- **Low:**
  - Require highly significant effort and cost.
  - Achieved a relatively low priority rating in the MCA.

It is recommended the progress of the plan be continually monitored for progress against the recommended actions, and to ensure that the findings of the plan continue to be referenced as development is undertaken in the catchment. The Plan also requires review every 5 years per DCCEEW recommendations.

Table 3-1 Implementation Action List

ID	Recommended Action	Indicative Costs		Potential Funding / Responsibility	Time Frame	Priority
		Initial	Recurrent			
EM1	Data handover to SES	$2000	$0	Council / SES	Short	High
EM2	Update of Emergency response documentation	$0	$0	Council / SES	Mid	High
EM3	Expansion of Flood Warning System	$150,000	$10,000	Council / SES / BoM	Mid	High
EM4	Emergency Response Plans	$50,000	$5,000 every 5 years	Council	Mid	High
EM5	Flood Warning Signs and Information	$40,000	$5,000 every 5 years	Council / SES	Mid	High
EM6	Community Education and Awareness	$50,000	$5,000 as required	Council / SES	Mid	High
EM7	Campground Education Program	$50,000	$10,000	Council / National Parks / SES	Mid	High
EM9	Data Collection following Flood Events	$0	$20,000 post event	Council	Long	High
EM11	Scoping Study to Improve Flood Immunity of Crossings	$80,000	0	Council	Long	Medium
PM1	Land Use Planning and Building Controls	$50,000	0	Council	Mid	High
PM3	Voluntary Purchase and Voluntary House Raising Scoping Study	$80,000 for study area.	0	Council/DCCEEW	Long	Medium

4 Conclusions

This FRMP provides a practical framework and implementation plan for managing existing, future, and continuing flood risk within the study area.

Overall, it is considered that existing catchment flooding risks to the study area can be managed appropriately through the implementation of development controls, and emergency response measures.

The isolated nature of development within the catchment will rely heavily on emergency response measures to ensure the safety of residents and visitors during times of flooding. The effective implementation of development controls will be of key importance in reducing the damages and risk to life associated with flooding through the construction of flood compatible buildings and assets.

To achieve the implementation of relevant management actions, a program of implementation has been developed. The actions listed in **Section 2** are recommended for implementation.

The steps in progressing the floodplain risk management process from this point onwards are:

- Council will consider adopting the final FRMP and submit applications for funding assistance to relevant State and Commonwealth agencies, as appropriate and within Council's available resources;
- The flood management actions will be prioritised for funding through the Integrated Planning and Reporting Process; and
- As funds become available from NSW DCCEEW, the Commonwealth, other state government agencies and/or from Council's own resources, recommended management actions will be implemented in accordance with the established priorities.

This FRMP fulfils its objectives in accordance with the New South Wales (NSW) Flood Prone Land Policy (NSW Government, 2023) and the principles of the Flood Risk Management Manual (DPE, 2023).

5 References

AIDR. (2017). *Australian Disaster Resilience Handbook 7: Managing the Floodplain: A guide to best practice in flood risk management in Australia.* East Melbourne VIC: AIDR, on behalf of the Australian Government Attorney-General's Department.

DPE. (2023). *Flood Risk Management Manual: The policy and manual for the management of flood liable land.* Parramatta NSW: Environment and Heritage Group, Department of Planning and Environment.

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