Elliott Lake – Little Lake Floodplain Risk Management Plan

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Contact Information

Rhelm Pty Ltd
ABN : 55 616 964 517
50 Yeo Street
Neutral Bay NSW 2089
Australia

Lead Author:
Luke Evans
contact@rhelm.com.au

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Shellharbour City Council

76 Cygnet Avenue, Shellharbour City Centre, NSW

council@shellharbour.nsw.gov.au

02 4221 6111

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

The *Flood Risk Management Manual* 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 i **The Floodplain Risk Management Process (State of NSW and Department of Planning and Environment, 2023)**

Shellharbour City Council is responsible for local land use planning in its service area, including in the Elliott Lake – Little Lake catchment. Council has committed to prepare a comprehensive floodplain risk management plan for the study area in accordance with the NSW Government's *Flood Risk Management Manual* (2023). This document relates to the floodplain risk management plan phase of the process.

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Report Structure

The reporting for the Elliott Lake Little Lake Floodplain Risk Management Study and Plan has been presented in three documents:

- The Floodplain Risk Management Study – details the assessments undertaken as part of the study.
- The Floodplain Risk Management Plan – presents an implementation strategy for Council to prioritise floodplain management options.
- The Map Compendium – a set of A3 maps as referenced in the Study and Plan.

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Executive Summary

The Elliott Lake – Little Lake Floodplain Risk Management Plan (FRMP) has been prepared for Shellharbour City Council (hereafter referred to as Council) in accordance with the New South Wales (NSW) Flood Prone Land Policy and the principles of the Floodplain Development Manual (NSW Government, 2005).

This FRMP is to be considered in conjunction with the Elliott Lake – Little Lake Floodplain Risk Management Study (FRMS), prepared as a separate document to this FRMP. The FRMS (Rhelm, 2024), examined options for managing flood risk within the study area. This FRMP outlines the floodplain management measures recommended as an outcome of the assessment undertaken in the FRMS along with the implementation strategy associated with those measures.

The overall objective of this FRMP is to document and convey the decisions on the management of flood risk into the future. Drawing on the investigations undertaken as part of the FRMS, this plan outlines a range of measures to manage existing, future, and residual risk effectively and efficiently. This document also presents a prioritised implementation strategy, to guide the implementation of the proposed measures.

Study Area

The study area is located on the NSW south coast, immediately south of Lake Illawarra, in the Shellharbour City Council LGA. The catchment covers approximately 12.4km^2 and is primarily residential, with some smaller regions serving business and light industry. Blackbutt Reserve is situated in the central portion of the study area, and straddles Tongarra and Benson Creek catchments, while a portion of Tongarra Creek extends upstream of the Princes Highway into the rural area to the west.

Historically, the lake system operated as an intermittently closed and open lake or lagoon (ICOLL), with entrance conditions changing in response to catchment flows and ocean conditions. The entrance is now partially trained with a rock groyne constructed to the north of the entrance. Previous studies have indicated that the groyne and a loss of sand from Warilla Beach generally prevents the entrance from closing completely (WBM, 2003), and that the lake now operates with a permanently open entrance.

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 Floodplain Development Manual (2005).

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.

Floodplain Risk Management Study

The Elliott Lake – Little Lake Floodplain Risk Management Study (Rhelm, 2024) 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:

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- 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 Development Control Plans (DCPs), 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, social, and environmental 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 3.2**.

Table E-1 summarises the measures recommended as part of this FRMP.

Table E-1-1 Summary of Recommended Floodplain Risk Management Measures

Management Scenario	ID	Name
Catchment Flood Management Measures	LR-1	Caravan Park Raising
	DB-8	Andrew Park Basin
	FM-7	Combined Northern Basins
Emergency Response Management Measures	EM1	Prediction Based Flash Flood Warning System
	EM2	Data handover to SES
	EM3	Flood Education
	EM4	Flood warning signs
	EM5	Flood Free Shelter in Caravan Parks
	EM6	Update of Emergency response documentation
	EM7	Post Flood Inspection Checklist
Property Management Measures	PM1	Planning and Development Controls

To achieve the implementation of relevant management actions, a program of implementation has been developed. The proposed implementation strategy is presented in **Section 4**. 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 yearly 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.

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Conclusions and Recommendations

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 risks to the Elliott Lake – Little Lake floodplain can be managed appropriately through the implementation of development controls, emergency response measures and selected ground works. 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 through flood free access, 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 New South Wales (NSW) Flood Prone Land Policy (NSW Government, 2001) and the principles of the Floodplain Development Manual (NSW Government, 2005).

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1 Introduction

The Elliott Lake – Little Lake Floodplain Risk Management Plan (FRMP) is being reviewed for Shellharbour City Council (Council) to assess and address the flood risks present in the catchment.

A Flood Study Review and subsequent Floodplain Risk Management Study was completed in 2016. The studies defined the flood and risk profile across the catchment and developed several risk management strategies in response to the local flood conditions.

While the previous study is relatively recent, significant changes have been made to Australian Rainfall and Runoff, which has the potential to alter the design flood estimation across the catchment. Furthermore, additional development and land use changes have been made throughout the catchment that, whilst undertaken in line with Council's planning policies, also are likely to have resulted in local changes to flood behaviour.

Council has therefore decided to revisit the study and undertake the flood assessment in accordance with the latest industry guidelines and incorporating the additional development within the catchment.

1.1 Background and Context

The study area is located on the NSW south coast, immediately south of Lake Illawarra, in the Shellharbour City Council LGA. The catchment covers approximately 12.4km^2 and is primarily residential, with some smaller regions serving business and light industry. Blackbutt Reserve is situated in the central portion of the study area, and straddles Tongarra and Benson Creek catchments, while a portion of Tongarra Creek extends upstream of the Princes Highway into the rural area to the west.

Historically, the lake system operated as an intermittently closed and open lake or lagoon (ICOLL), with entrance conditions changing in response to catchment flows and ocean conditions. The entrance is now partially trained with a rock groyne constructed to the north of the entrance. Previous studies have indicated that the groyne and a loss of sand from Warilla Beach generally prevents the entrance from closing completely (WBM, 2003), and that the lake now operates with a permanently open entrance.

The study area is shown in **Figure 1-1**.

The northern region of the study area is drained by Bensons Creek and Bensons Tributary. For both these watercourses, flood events as small as the 20% AEP were found to inundate property and overtop roads, several of which are major access routes such as Shellharbour Road and Lake Entrance Road.

The southern regions are drained by Tongarra Creek. The creek is open along its entire length and passes through a series of storages including Munmorah Basin and the Myimbarr Wetlands. Upstream, flows remain typically well contained in events up to the 0.5% AEP. Downstream, smaller events in the order of the 20% AEP are sufficient to cause the creek to breakout and inundate nearby properties and overtop roads.

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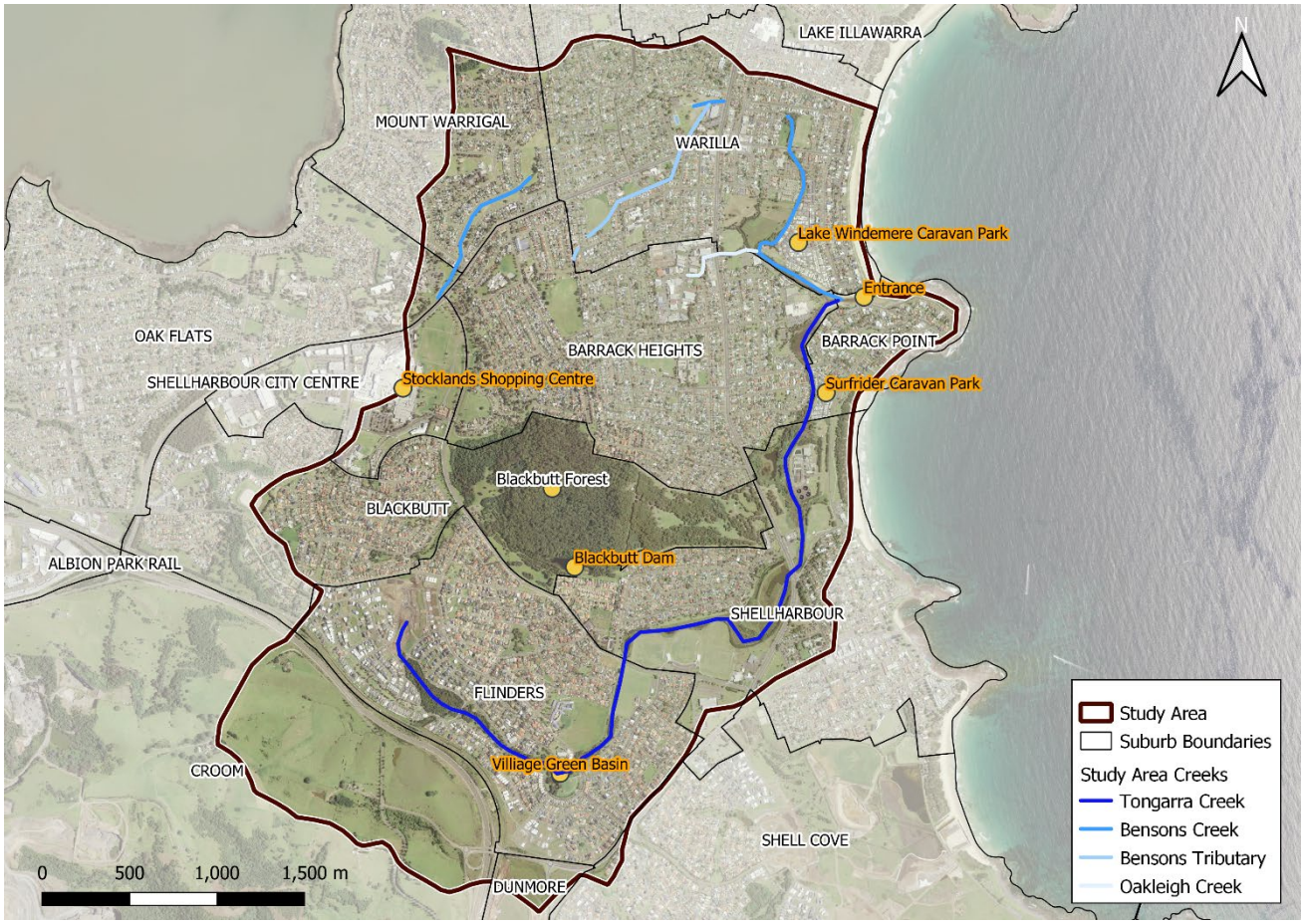

Figure 1-1 Study Area

1.2 Study 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 FRMS provides 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.

The outcomes of the FRMS are 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.

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2 Flood Risk

2.1 Background

The Elliott Lake - Little Lake catchment has a known history of flooding. Throughout the catchment flooding is known to cause property flooding in extreme events, and road inundation and closure on a regular basis.

In the last 15 years flood events have been recorded in 2024, 2020, 2017, 2016, 2014, 2013, and 2011. The largest of these events was 2011, which resulted in widespread flooding and resulted in the death of a pedestrian at the Shellharbour Road crossing of Oakleigh Creek.

2.2 Flood Affectation

The FRMS assessed flood behaviour for the 20%, 10%, 5%, 2%, 1%, 0.5%, and 0.2% AEP events and the PMF event.

The FRMS identified a number of flood affected transportation routes through the study area. Understanding when these routes are overtopped by floodwaters and the duration in which they are flooded is useful, particularly for emergency response planning.

Overtopping depths were generally modest up to the 0.2% AEP event, with peak depths typically 0.5m or less. Two exceptions were Benaud Cresent at Spofforth Street and Ocean Beach Drive at Parklands Drive, which reported depths of 0.5m in the 20% AEP. Depths increase substantially in the PMF event to typically above 1m.

2.3 Economic Flood Damages

To quantify the economic impacts of flooding, a flood damage assessment has been undertaken. A property may suffer economic impacts from flooding through several ways. These are broadly grouped into three categories, as summarised in **Table 2-1**.

Table 2-1 Types of Flood Damages

Type of Flood Damages		Description
Tangible	**Direct**	Building contents Structure (building repair and clean) External items (vehicles, contents of sheds etc.) Infrastructure
	Indirect	Clean-up (immediate removal of debris) Financial (loss of revenue, extra expenditure) Opportunity (non-provision of public services)
Intangible		Social – increased levels of insecurity, depression, stress General inconvenience in post-flood stage

Damage impacts to a property or its contents (direct damages) are only a component of the total damages accrued during a flood event. Indirect costs, while also tangible, arise because of consequences of the flood event, such as clean-up costs, opportunity costs, and other financial impacts.

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In addition to tangible damages, there are also a category of damages referred to as intangible damages. Intangible costs relate to social impacts, such as insecurity and depression, that arise because of major flood event, or general inconveniences that occur during the post-flood stage.

The damages calculated for each of design event are used to estimate the Annual Average Damages (AAD). The AAD is the typical method that is adopted in economics to annualise damage costs such as those in flooding based on their probabilities. This allows for the conversion of the different flood event damages into a singular annual average that represents (based on the overall probabilities of events) the most likely damage that is likely to be experienced in any given year.

The AAD provides a representation of the estimated amount of capital that Council would theoretically need to invest every year to address damages caused by flooding (both frequent and rare). The calculation process is described in detail in the Floodplain Risk Management Manual (2023).

The average annual damage (AAD) for the study area under existing conditions is **$2,200,000**.

Over a 50-year assessment period and under a seven per cent discount rate, this is equivalent to a Net Present Value (NPV) of **$41 million**.

Table 2-2 Existing Damages Assessment Results

AEP & Breakdown	Over Floor Flooding	Max Depth (m)	Damages ($2023) (rounded to 10,000s)	AAD per Property ($2023) (rounded to 10,000s)
PMF	1,389	3.54	$243,700,000	$210,000
Residential	1,031	3.54	$201,500,000	$180,000
Commercial	55	2.95	$22,000,000	$400,000
Caravans	303	0.37	$18,200,000	$60,000
1% AEP	216	1.25	$14,100,000	$120,000
Residential	79	1.25	$10,200,000	$100,000
Commercial	14	0.84	$2,800,000	$200,000
Caravans	123	0.50	$7,400,000	$60,000
5% AEP	29	0.82	$4,900,000	$150,000
Residential	18	0.82	$2,500,000	$100,000
Commercial	9	0.68	$2,200,000	$240,000
Caravans	2	0.01	$120,000	$60,000
20% AEP	8	0.54	$2,600,000	$290,000
Residential	3	0.31	$800,000	$180,000
Commercial	5	0.54	$1,700,000	$340,000
Caravans	0	0.00	$0	$0

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3 Floodplain Risk Management

3.1 Floodplain Risk Management Options

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 risks. Rather than necessarily modifying flood behaviour, these options aim to modify existing properties (e.g., by house raising) and/or impose controls on property and infrastructure development to modify future properties. 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.
- Emergency response 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 (Rhelm,2024). The identified measures were a product of an extensive investigation of the flood risks in the study area, which considered outcomes of all previous flood studies undertaken in the study area, flood hazard and emergency response mapping, economic damages assessments undertaken as part of the FRMS, and inputs obtained through workshops with stakeholders and community engagement activities.

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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. Flood modelling and flood damages analysis were also undertaken as part of the evaluation process and provided key inputs for the MCA.

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.

3.2 Recommended Flood Risk Management Measures

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

The recommended measures are presented in:

- **Section 3.2.1** for emergency response options;
- **Section 3.2.2**, for property modification; and,
- **Section 3.2.3** for flood modification.

3.2.1 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 3-5 summarises the emergency response measures that were found in the FRMS to be beneficial in a program of flood risk management.

Table 3-1 Recommended Measures – Emergency Response

Option ID	Option Name	Reference Section
EM1	Flash Flood Warning System	Section 3.2.1.1
EM2	Information Transfer	Section 3.2.1.2
EM3	Flood Education	Section 3.2.1.3
EM4	Flood warning signs	Section 3.2.1.4
EM5	Flood Free Shelter in Caravan Parks	Section 3.2.1.5
EM6	Update of Emergency response documentation	Section 3.2.1.6
EM7	Post-Flood Data Collection	Section 3.2.1.7

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3.2.1.1 EM1 – Flash Flood Warning System

EM1 – Flash Flood Warning Systems		
Flood Management Type: Emergency Response	**Responsibility: Council**	
MCA Priority: High	**Associated Costs:**	**Initial Cost:** $150,000
		Recurrent Cost: $25,000
Overview and Flooding issue addressed: Flood warning for short duration, flash-flood style catchments is difficult, due to the short period of time between rain falling and flooding occurring. Wollongong Council is currently working on a strategy for implementation of flash flood warning within their LGA. Presently, Wollongong Council is in the early stages of establishing a prediction-based flood warning system for the Fairy Creek catchment. Should this initial pilot project prove successful, a similar system may also be suitable for the Elliott Lake – Little Lake catchment. It is recommended that the outcome of the Fairy Creek pilot be monitored, and if successful, to expand the system into Elliott Lake – Little Lake catchment.		
Expected Mitigation Outcomes: Increasing the community's readiness for a flood event will reduce flood risk to property and life by allowing them time to take actions such as: • Moving possessions • Moving parked cars to safe locations • Evacuating, if appropriate • Checking on neighbours.	**Considerations:** The effectiveness of flood warnings and alerts will be increased through a concurrent flood education program. The wording of the issued flood warnings would be critical to increase responsiveness, without creating unnecessary alarm.	

3.2.1.2 EM2 – Data Handover to the SES

EM2: Data Handover to the NSW SES		
Flood Management Type: Emergency Response	**Responsibility: Council / SES**	
MCA Priority: High	**Associated Costs:**	**Initial Cost:** $0
		Recurrent Cost: $0
Overview and Flooding issue addressed: The flood data developed as part of this 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. The provision of the hazard mapping and flood emergency response classifications would also assist the SES is 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. However, currently there is not a procedure in place to guarantee the SES will have facilitated access to the flood risk information generated as part of the FRMS.		
Expected Mitigation Outcomes: The flood data developed as part of the FRMS will assist the SES in prioritising and scheduling actions, as a flood event progresses through the catchment area.	**Considerations:** The provision of flood intelligence 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.	

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3.2.1.3 EM3 – Flood Education

EM3: Flood Education		
Flood Management Type: Emergency Response	**Responsibility: Council**	
MCA Priority: High	**Associated Costs:**	**Initial Cost:** $50,000 **Ongoing Cost:** $2,500
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 adoption of this study 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 study. Further community awareness could be raised by issuing media releases, either through social media, in local papers or both. The involvement of NSW SES members in community engagement and educations programs has been successful in engagement activities undertaken by Council and across NSW. SES members could be invited to participate in face-to-face education activities at community events, pop up stalls, or even door knocking of key locations.		
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 fade in the community over time, and be diluted as new residents move in. The education campaign should be refreshed every 2-5 years to maintain awareness.	

3.2.1.4 EM4 – Flood Warning Signs

EM4: Flood Warning Signs and Information		
Flood Management Type: Emergency Response	**Responsibility: Council**	
MCA Priority: High	**Associated Costs:**	**Initial Cost:** $75,000 **Ongoing Cost:** $5,000
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 safer decisions. It is recommended that depth markers be placed at those roads which are subject to frequent inundation, as identified in **Section 6.6** of the FRMS.		
Expected Mitigation Outcomes: Improved awareness of flood risk by the community. The depth gauges will assist in preventing people driving into flood waters.		

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3.2.1.5 EM5 – Flood Free Shelter in Caravan Parks

EM5: Flood Free Shelter in Caravan Parks		
Flood Management Type: Emergency Response	**Responsibility: Business Owners (supported by Council and SES)**	
MCA Priority: Low	**Associated Costs:**	**Initial Cost:** Privately Funded
		Recurrent Cost: Privately Funded
Overview and Flooding issue addressed: Caravan parks are a high-risk area within the floodplain as they: • Are located adjacent to waterways which reduces the response time available to guests; • Are likely to have non-local guests who are not familiar with the flood risks of the region; and, • Caravans may become mobile in flood events which prevents their use as a shelter. A strategy to reduce the flood risk for people on the caravan site is to provide a high level, flood free shelter, that people can rapidly evacuate to in case of a flood event. This shelter may be a standalone structure or incorporated as a second storey on an existing building. The shelter should be sized to provide shelter to all guests. Costs associated with funding and maintaining a flood free shelter for the occupants of caravan parks would likely be the responsibility of the landowner or the park management. Flood evacuation planning would be undertaken in consultation with Council and the NSW State Emergency Service.		
Expected Mitigation Outcomes: Reduction in risk to life in extreme flood events.	**Considerations:** Whilst having a flood free shelter is a substantial improvement over not having one, the preferred method for managing occupants remains evacuation. The shelter should not be seen as an excuse to delay or avoid evacuation.	

3.2.1.6 EM6 – Update of Emergency Response Documentation

EM6: Update of Emergency Response Documentation		
Flood Management Type: Emergency Response	**Responsibility: Council / SES**	
MCA Priority: High	**Associated Costs:**	**Initial Cost:** $15,000
		Recurrent Cost: $0
Overview and Flooding issue addressed: The Illawarra Flood Emergency Sub-Plan (the Flood Plan) was prepared in 2017, and covers the preparation for, response to and recovery from flooding emergencies for the Wollongong City, Shellharbour City and Kiama LGAs. The Flood Plan focuses exclusively on flooding emergencies, and more explicitly defines the roles and responsibilities of parties in a flood event. It also makes note of which key roads can be flood affected. The catchment is discussed specifically in Section 2 of Volume 2. It is recommended that the Flood Plan be updated with the data from this study, specifically: • Noting the identified low and high flood islands in Section 2.11.4 of the Flood Plan; • Updating Table 27 and Table 28 of the Flood Plan with the results of the damages assessment; and, • Including the flood affected infrastructure in both Section 22.11.9 and Annex 2 of the Flood Plan.		
Expected Mitigation Outcomes: Improved flood response from emergency responders.	**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.	

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3.2.1.7 EM7 – Data Collection Following Flood Events

EM7: Data Collection Following Flood Events		
Flood Management Type: Emergency Response	**Responsibility: Council**	
MCA Priority: Medium	**Associated Costs:**	**Per Event:** $15,000
Overview and Flooding issue addressed: The availability of historical flood data provides numerous benefits to Council and the SES, namely: • Identification of areas that experience frequent flooding issues; • Confirmation (or not) that Council and SES records of high-risk locations and road overtopping behaviour is correct; • Confirmation (or not) that the flood modelling undertaken to date accurately reflects flood behaviour observed during flood events; and, • Allows for a more comprehensive calibration and validation process. To supplement the historical data already held by Council, the collection of flood data following flood events should be continuously undertaken. Depending on the size of the event, such data may include records of complaints or observations made by the community, photographs taken during or after the flood event, notes made of road inundation locations and durations, and survey of flood marks following the event.		
Expected Mitigation Outcomes: Improved historical data to increase future calibration and validation of flood models, and to assist SES in refining their data on at-risk zones.	**Considerations:** It is recommended that a formal process be developed within Council for this collection, that outlines the type of data required (location, level, etc), the steps to collect the data, and the identification of safety measures surrounding collecting the data.	

3.2.2 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.

The only property modification measure recommended was *Land use planning and building control updates*.

3.2.2.1 PM1 – Land Use Planning and Building Control Updates

PM1: Land use planning and building control updates		
Flood Management Type: Property Modification	**Responsibility: Council**	
MCA Priority: High	**Associated Costs:**	**Initial Cost:** $25,000
		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 8.3.1** of the FRMS.		

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3.2.3 Flood Modification Options

Catchment flooding occurs because of intense rainfall on the catchment. The resulting floods can damage existing development, as well as inundate roads and access corridors, impacting the ability of the community to evacuate, and for emergency responders to access people in need.

Flood modification measures are structural solutions that seek to change the way the flood waters behave to reduce flood damages and risk to life, and to improve access during flood events.

Table 3-2 summarises the management measures that were found in the FRMS to be beneficial in a program of flood risk management.

Table 3-2 Recommended Measures – Catchment Flood Risk

Option ID	Option Name	Reference Section
LR-1	Caravan Park Raising	Section 3.2.3.1
Rh-8	Andrew Park Detention Basin	Section 3.2.3.2
FM-7	Combined Northern Basins	Section 3.2.3.3

3.2.3.1 LR-1 – Caravan Park Raising

<table>
<tr><th colspan="3">LR-1: Caravan Park Raising</th></tr>
<tr><td colspan="2">Flood Management Type: Flood Modification</td><td>Responsibility: Privately Funded</td></tr>
<tr><td colspan="2">MCA Priority: Low</td><td>Associated Costs: Capital: $6,800,000</td></tr>
<tr><td colspan="3">Overview and Flooding issue addressed:
The two caravan parks located near the entrance are high risk locations, due to both the frequency and depth of flooding across the sites, as well as servicing higher-risk population groups (tourists and the elderly).
The extent of raising was in the order of 0.3 – 0.4m across the sites.
Both locations have access roads that are higher than the proposed fill level, so they are not at risk of becoming isolated due to the site raising.
The major constraints with the option relate to the difficulties in raising the landform while the caravan parks are operating due to the need to manage long term residents, as well as internal roads and fixed buildings.</td></tr>
<tr><td colspan="2">Expected Mitigation Outcomes:
Raising the terrain of the caravan parks would reduce both the frequency of flooding and the depth of flooding across the sites. Raising to the 5% AEP level was found to have minor impacts in both frequent and rare events. It is expected that these minor impacts could be resolved with adjustments to the raised extents across the caravan parks.</td><td>Considerations:
Sourcing the volume of fill required would be a substantial challenge. It would be possible to undertake the raising in stages, which would also serve to reduce the impacts on owners and occupants, as not all would be affected at once.</td></tr>
</table>

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3.2.3.2 Rh-8 – Andrew Park Detention Basin

<table>
<tr><th colspan="3">Rh8: Andrew Park Detention Basin</th></tr>
<tr><td colspan="2">Flood Management Type: Flood Modification</td><td>Responsibility: Council</td></tr>
<tr><td colspan="2" rowspan="2">MCA Priority: Medium</td><td rowspan="2">Associated Costs:</td><td>Capital Cost: $2,400,000</td></tr>
<tr><td>Ongoing Costs: $25,000 p.a.</td></tr>
<tr><td colspan="3">Overview and Flooding issue addressed:
Andrew Park lies on Bensons Creek and is the location at which the Creek transitions from an open channel to a piped reach. The park currently incorporates netball courts, a tennis court, and a playground. The park is surrounded by residential development which is flood affected in frequent events (20% AEP).
The proposed basin retains the existing creek and extends the open channel to the downstream extent of the park at Johnston Street. Offline storage areas are provided on the western side of the park at the location of the existing tennis courts, and the north-eastern region of the park at the location of the netball courts.
The proposed basin is comprised of batter slopes of 1 in 4 and a maximum depth of 1m and an estimated storage volume of 14,500m^3.
The option also incorporates an extension to the existing open channel that provides an opportunity to improve environmental value of the creek reach.</td></tr>
<tr><td colspan="2">Expected Mitigation Outcomes:
The basin provided reductions of up to 0.3m in the 10% AEP and 0.2m in the 1% AEP for properties immediately downstream of the basin. Reductions in the order of 0.05 – 0.1m in both the 10% and 1% AEP events were observed to extend downstream to Memorial Park.</td><td>Considerations:
A large proportion (approximately 30%) of the construction costs are due to disposal of fill. If disposal costs are not considered, the option has a BCR of 1. As such, if a suitable use for the excavated material can be found, the option becomes significantly more cost effective.</td></tr>
</table>

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3.2.3.3 FM-7 – Combined Northern Basins

<table>
<tr><th colspan="3">FM-7: Combined Northern Basins</th></tr>
<tr><td colspan="2">Flood Management Type: Flood Modification</td><td>Responsibility: Council</td></tr>
<tr><td colspan="2" rowspan="2">MCA Priority: Low</td><td rowspan="2">Associated Costs:</td><td>Capital Cost: $8,000,000</td></tr>
<tr><td>Ongoing Costs: $40,000 p.a.</td></tr>
<tr><td colspan="3">Overview and Flooding issue addressed:
The primary reason for constructing the northern basins as series of basins is that the individual benefits they offer may be compounded where these benefits overlap.
The option is a carry over from the prior FRMSP. The current iteration of the option incorporates:
Andrew Park;
King Memorial Park; and,
Jock Brown Oval.
The prior iteration also incorporated a fourth basin located in the Barrack Heights Sports Fields.
Assessments undertaken as part of this study indicated that the Barrak Heights Sports Field basin provided limit benefits to downstream properties. Furthermore, it is located on a separate tributary to the other basins, and so provided no opportunity for compounding benefits.
As such, it was removed from the current scheme.</td></tr>
<tr><td colspan="2">Expected Mitigation Outcomes:
In the 10% AEP, reductions of up to 0.15m were observed immediately downstream of the individual basins.
Through Warila, west of Memorial Park, reductions were typically 0.02 – 0.06m.
Reductions extended downstream to properties surrounding King Mickey Park, which experienced reductions of 0.02m.
In the 1% AEP, reductions did not occur as far downstream, but the level of reduction through Warilla was greater, with reductions of 0.05 – 0.1m observed west of Memorial Park.</td><td colspan="2">Considerations:
A large proportion (approximately 20%) of the construction costs are due to disposal of fill. As such, if a suitable use for the excavated material can be found, the option becomes significantly more cost effective.
The option also allows for relatively straighforwrd staging, as none of the components are dependent on the others from a construction or operation perspective. Council would be able to construct individual basins as funding allows, working towards full implementation of the option over time.</td></tr>
</table>

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4 Implementation Program

The actions listed in **Table 4-1** 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 development.

Table 4-1 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 2 years) if funding and resources permit.
- **Mid** – this indicates actions that could be implemented in the mid- term (2 to 5 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:**
  - 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 yearly 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.

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Table 4-1 Implementation Action List

ID	Recommended Action	Indicative Costs		Potential Funding / Responsibility	Time Frame	Priority
		Capital	Recurrent			
EM1	Flash Flood Warning System	$150,000	$25,000	Council	Mid	Medium
EM2	Data handover to SES	$0	$0	Council / SES	Short	High
EM3	Community education and awareness	$50,000	$2,500	Council	Mid	High
EM4	Flood warning signs	$75,000	$5,000	Council / TfNSW	Mid	Medium
EM5	Flood Free Shelter in Caravan Parks	Privately funded	Privately funded	Business Owners	Long	Low
EM6	Update of Emergency response documentation	$15,000	$0	Council / SES	Mid	High
EM7	Data Collection following flood events	Per event: $15,000		Council / SES	Short	Medium
PM1	Planning and Development Controls	$25,000	$0	Council	Short	High
LR1	Caravan Park Raising	Privately funded	Privately funded	Business Owners	Long	Low
Rh8	Andrew Park Detention Basin	$2,400,000	$25,000	Council	Long	Medium
FM7	Combined Northern Basins	$8,000,000	$40,000	Council	Long	Low

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5 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 Elliott Lake – Little Lake catchment can be managed appropriately through the implementation of development controls, emergency response measures and selected on ground works. 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 4** are recommended for implementation.

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

- Council will consider adopting the final Plan 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 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, 2001) and the principles of the Flood Risk Management Manual.

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6 References

AIDR (2017) *Australian Emergency Management Handbook 7: Managing the floodplain: best practice in flood risk management in Australia* (AEM Handbook 7)

State of NSW and Department of Planning and Environment. (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.

Rhelm (2024) *Elliott Lake – Little Lake Floodplain Risk Management Study* for Shellharbour City Council

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Rhelm Pty Ltd

ABN 55 616 964 517

ACN 616 964 517

Head Office

Level 1, 50 Yeo Street

Neutral Bay NSW 2089

contact@rhelm.com.au

+61 2 9098 6998

www.rhelm.com.au

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