BMT

Manning River
Floodplain Risk Management Study and Plan
Final Report

September 2020

MIDCOAST council

Document Control Sheet

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Synopsis: **This report documents the Manning River Floodplain Risk Management Study and Plan which investigates and presents a flood risk management strategy for the catchment. The study identifies the existing flooding characteristics and canvasses various measures to mitigate the effects of flooding. The product is the Floodplain Risk Management Plan, which describes how flood liable lands within the Manning River catchment are to be managed now and in the future.**

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Executive Summary

Study Background

The Manning River Floodplain Risk Management Study and Plan has been prepared for MidCoast Council (Council). The Floodplain Risk Management Study (FRMS) has derived an appropriate mix of management measures and strategies to manage flood risk in accordance with the NSW Government Floodplain Development Manual. The findings of the study will be incorporated in a Plan of recommended works and measures and program for implementation.

The study area encompasses the low-lying, expansive Manning River floodplain area downstream of Wingham. The principal source of flooding considered within the study is mainstream flooding of the Manning River. The impact of climate change in the form of increased rainfall intensities and sea level rise has also been considered.

Community Consultation

Community consultation has been an important component of this floodplain risk management study. The consultation has aimed to inform the community about the development of the floodplain risk management study and its likely outcome as a precursor to the development of the floodplain risk management plan. It has provided an opportunity to collect information on their flood experience, their concern on flooding issues and to collect feedback and ideas on potential floodplain management measures and other related issues.

Existing Flood Behaviour

The existing flood behaviour was defined in the Manning River Flood Study (BMT WBM, 2016) the development of computer models. The performance of the computer models has been assessed against historic flood events to confirm that the simulated results match the observed conditions, where suitable data is available. The models are then simulated with hypothetical future flood scenarios of prescribed probabilities or rarities. These ‘design’ modelling results are mapped and assessed to inform the overall flood risk throughout the study area and to guide future floodplain management activities, such as flood mitigation, flood planning and flood emergency response.

Downstream of Taree, the topography opens into a vast, flat, low-lying floodplain area. The Manning River splits into two arms and enters the ocean at two locations – the principal outlet being at Harrington with a secondary outlet at Farquhar Inlet, which is located just north of the Old Bar township. The floodplain will become inundated once floodwater breaks the banks of the Manning River at Taree. The depth of flood water on the floodplain is generally lower and slower moving than within the main Manning River channel.

Flood Risk Mapping

The principal output from the flood modelling is a comprehensive set of flood risk mapping products. The design flood results are presented in a separate flood mapping compendium. For the simulated design events mapping of peak flood level, depth and velocity is presented for the study area.

The flood function (or hydraulic categorisation) of a floodplain helps describe the nature of flooding in a spatial context and from a flood planning perspective can determine what can and can’t be developed in areas of the floodplain. Mapping of flood function is derived from the modelled depth and velocities and includes floodways, flood storage areas and flood fringe.

Flood hazard mapping is also produced from the modelled flood depths and velocities. The flood hazard is a six-tiered classification that is linked to the risk to people, vehicles and property that are presented by the flood conditions. A high flood depth will cause a hazardous situation while a low depth may only cause an inconvenience. High flood velocities are dangerous and may cause structural damage while low velocities generally have no major threat.

This study has also identified a Flood Planning Area for the Manning River floodplain. Development of land within the Flood Planning Area is restricted and controlled by Council due to the hazard of flooding. In defining the Flood Planning Area in the MidCoast LGA, Council has considered a future flood scenario that has accounted for climate change in the form of increased rainfall and sea level rise.

Classification of communities mapping is utilised by the State Emergency Service (SES) to assist them in aiding the community during a flood event. Each suburb is classed based on the impact flooding has on them and the implications for evacuation, resupply and rescue during a flood event.

Flood planning constraint categories aim to prevent the existing flood risk within a floodplain from getting worse. These categories help to identify areas that are and are not suitable for future development.

Flood Damages Assessment

A flood damages assessment has been undertaken to identify properties affected by flooding. The assessment aims to put a monetary cost on the expected damage due to flooding in the study area. Key results from the flood damages database indicate:

- Approximately 1400 buildings and garages were included in the property database, and
- The estimated cost of flood damage, when averaged out as a cost per year, is $1 940 000.

Floodplain Management Options

The flood modelling results were reviewed to identify options that could be implemented to reduce the existing flood risk. Options that can reduce flood risk can be separated into three categories.

- **Flood modification measures** change the flood behaviour through construction of structures. Options considered in this study include:
  - Various levee alignments, located in Taree (CBD and Browns Creek), Cundletown and Croki
  - Road upgrades to the Pacific Highway, Harrington Road, Manning Point Road, Croki Road and Barton Street
  - Broad scale redevelopment
  - Entrance management.
- **Property modification measures** change the way properties are built and developed to ensure they are compatible with flood risk. Options considered in this study include:
  - Planning and development controls
  - Flood planning levels
  - Local land filling

    - Flood proofing
    - House raising.

- **Response modification measures** change the way the community can respond during a flood event. Options considered in this study include:
    - Flood warning
    - Emergency response
    - Community education and awareness.

Recommended Floodplain Risk Management Plan

A recommended floodplain risk management plan outlining the preferred floodplain risk management measures for the study area is presented in Section 8 of the main body of this report. The key features of the plan are tabulated on the following page with indicative costs, priorities and responsibilities for implementation.

The steps in progressing the floodplain risk management process from this point forward are as follows:

- Council allocates priorities to components of the Plan, based on available sources of funding and budgetary constraints
- Council negotiates other sources of funding as required through various sources including the NSW Department of Planning, Industry and Environment
- As funds become available, implementation of the Plan proceeds in accordance with established priorities.

The plan should be regarded as a dynamic instrument requiring review and modification over time. The catalyst for change could include new flood events and experiences, legislative change, alterations in the availability of funding or changes to the area's planning strategies. In any event, a thorough review every five years is warranted to ensure the ongoing relevance of the plan.

Option	Estimated Cost	Responsibility	Priority	BCR
Recommended options that modify flood behaviour				
Taree CBD levee feasibility study and heritage impact assessment	$125k*	Council	High	1.74
Harrington Road raising feasibility study	$100k*	Council	Medium	NA
Pacific Highway and other local access road raising	TBC	Council / TfNSW	Low	NA
Flood gate maintenance	Ongoing maintenance ($16k)	Council	High	NA
Recommended options that modify property				
Update LEP and DCP	Staff costs	Council	High	NA
Review LEP Zone Boundaries	Staff costs	Council	High	NA
Update Flood Planning Levels	Staff costs	Council	High	NA
Recommended options that modify flood response				
Update LFP and investigate establishing a CFERP	Staff costs	Council / SES	High	NA
Ongoing community education and awareness	Staff costs and promotional material ($20k)	Council / SES	High	NA

Notes: NA – Not a capital cost orientated option or benefits difficult/impossible to quantify in financial terms.

** Cost for study only and does not include further design investigations or construction.*

Acknowledgments

MidCoast Council has prepared this document with financial assistance from the NSW Government through its Floodplain Management Program. The assistance of the following parties in providing data, guidance and support to the study is appreciatively acknowledged:

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1 Introduction

The Manning River Flood Study was prepared for Greater Taree City Council (now MidCoast Council) by BMT WBM in 2016, to define the flood behaviour of the catchment. Through the establishment of appropriate numerical models, the study produced information on flood flows, velocities, levels and extents for a range of flood event magnitudes under existing catchment and floodplain conditions.

The outcomes of the Manning River Flood Study established the basis for subsequent floodplain management activities in the catchment. This Floodplain Risk Management Study (FRMS) aims to derive an appropriate mix of management measures and strategies to effectively manage flood risk in accordance with the NSW Government's Floodplain Development Manual, April 2005. The findings of this study will be incorporated in a Plan of recommended works and measures and a program for implementation.

The objectives of the Manning River Floodplain Risk Management Study and Plan are to:

- identify and assess measures for the mitigation of existing flood risk
- identify and assess planning and development controls to reduce future flood risks
- present a recommended floodplain management plan that outlines the best possible measures to reduce flood damage to the small number of residential and industrial properties, and sections of public road with an identified flooding hazard.

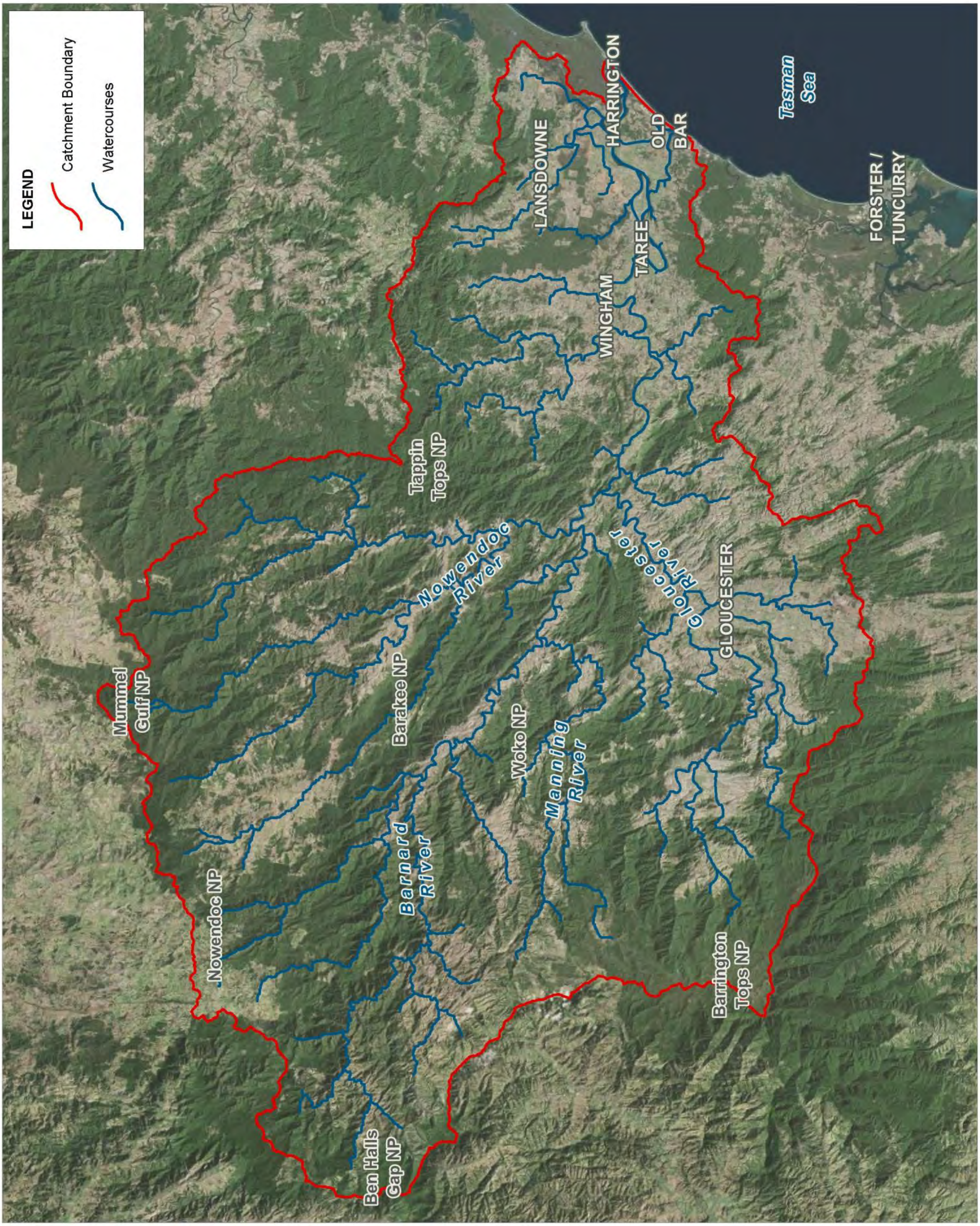
This report documents the Floodplain Risk Management Study and presents a recommended Floodplain Risk Management Plan for Manning River catchment.

This project has been conducted under the State Assisted Floodplain Management Program and received NSW Government financial support.

1.1 Study Location

The Manning River catchment drains to the Tasman Sea on the New South Wales mid-north coast as shown in Figure 1-1. The townships of Gloucester, Wingham, Taree, Harrington and Old Bar are the largest communities within the Manning River catchment. Taree is the largest of these and has a population of around 20 000.

This study will investigate floodplain risk management for low-lying, expansive Manning River floodplain area downstream of Wingham.



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Study Locality

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Approx. Scale

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1.2 The Need for Floodplain Management in the Manning River Catchment

There is a long history of flooding within the lower Manning River catchment. During these events, extensive damage has been caused across the catchment and in the case of the 1929 flood, has resulted in the loss of two lives. Flooding in the catchment has isolated people and properties and caused significant damage to both residential properties and commercial businesses. In the 1929 flood two lives were lost in the Manning River catchment.

The historic flooding has highlighted the risk to people and properties situated within the floodplain of the Manning River and its contributing creeks. Future sea level rise predictions put further pressure on both the current and planned development situated within low-lying coastal areas.

Current practice in floodplain management generally requires consideration of the impact of potential climate change scenarios on design flood conditions. For the Manning River catchment this includes both increases in design rainfall intensities and sea level rise scenarios impacting on ocean boundary conditions. Accordingly, these potential changes will translate into increased design flood inundation, such that future planning and floodplain management in the catchment will need to take due consideration of this increased flood risk.

Floodplain risk management considers the consequences of flooding on the community and aims to develop appropriate floodplain management measures to minimise and mitigate the impact of flooding. This incorporates the existing flood risk associated with current development, and future flood risk associated with future development and changes in land use.

Accordingly, Council desires to approach local floodplain management in a considered and systematic manner as outlined in the Floodplain Development Manual (NSW Government, 2005). The approach will allow for more informed planning decisions within the floodplain of the Manning, Nowendoc and Gloucester Rivers and their contributing creeks.

1.3 The Floodplain Management Process

The State Government's Flood Prone Land Policy is directed towards providing solutions to existing flooding problems in developed areas and ensuring that new development is compatible with the flood hazard and does not create additional flooding problems in other areas. Policy and practice are defined in the Government's Floodplain Development Manual (2005).

Under the Policy the management of flood liable land remains the responsibility of Local Government. The State Government subsidises flood mitigation works to alleviate existing problems and provides specialist technical advice to assist Councils in the discharge of their floodplain management responsibilities.

The Policy provides for technical and financial support by the State Government through the following four sequential stages:

Table 1-1 Stages of Floodplain Management

	Stage	Description
1	Formation of a Floodplain Management Committee	Established by Council and includes specialist Council staff, Councillors, community group representatives and State agency specialists.
2	Data Collection	Past data such as flood levels, rainfall records, land use, soil types etc.
3	Flood Study	Determines the nature and extent of the flood problem.
4	**Floodplain Risk Management Study**	**Evaluates management options for the floodplain in respect of both existing and proposed developments.**
5	**Floodplain Risk Management Plan**	**Involves formal adoption by Council of a plan of management for the floodplain.**
6	Implementation of the Floodplain Risk Management Plan	Construction of flood mitigation works to protect existing development. Use of local environmental plans to ensure new development is compatible with the flood hazard.

The Manning River Flood Study (BMT WBM, 2016) defined the existing flood behaviour and establishes the basis for future floodplain management activities.

The Manning River Floodplain Risk Management Study and Plan (this document) constitutes the fourth and fifth sequential stages of the floodplain management process. It has been prepared for MidCoast Council to provide the basis for future management of flood liable land within the catchment.

1.4 Structure of Report

This report documents the Study's objectives, results and recommendations.

Section 1 introduces the study.

Section 2 provides background information including a catchment description, history of flooding and previous investigations.

Section 3 outlines the community consultation program undertaken.

Section 4 describes the flooding behaviour in the catchment including climate change analysis.

Section 5 provides a summary of the flood damages assessment including identification of property potentially affected by flooding.

Section 6 provides a review of relevant existing planning measures and controls.

Section 7 provides an overview of potential floodplain risk management measures.

Section 8 presents the recommended measures and an implementation plan.

2 Background

2.1 Catchment Description

The Manning River basin encompasses an area of just over 8100 km^2 and drains to the Tasman Sea on the NSW mid-north coast. The Gloucester River, Barnard River and Nowendoc River join the Manning River upstream of Mount George. The lower Manning River floodplain is some 2060 km^2 in size and includes the catchments of Dingo Creek and the Lansdowne River. The upper catchment is predominantly densely vegetated forest and the lower floodplain is occupied by rural pasture lands.

The Great Dividing Range forms the upper limit of the Manning River catchment, where elevations of around 1200 m AHD are typical. The Barrington Tops, located in the south-west of the catchment, peak at just below 1600 m AHD. The Manning River spills onto a vast, low-lying (elevated to less than 2 m AHD) floodplain area downstream of Taree. This study focuses on flood behaviour in the lower Manning River catchment area, downstream of Wingham and Lansdowne.

Downstream of Taree, the Manning River splits into two arms and enters the ocean at two locations – the principal outlet being at Harrington with a secondary outlet at Farquhar Inlet, which is located just north of the Old Bar township. Both entrances are dynamic. Farquhar Inlet can become severely restricted and is known to have closed on many occasions historically. The entrance at Harrington is permanently open but can become significantly shoaled, particularly in periods between large floods. A break wall was constructed along the northern channel bank in 1884 to offer protection to shipping.

The topography of the Manning River catchment is shown in Figure 2-1. Land use within the catchment consists largely of forested areas or pastureland and other cultivated areas. There is little urban development within the catchment.

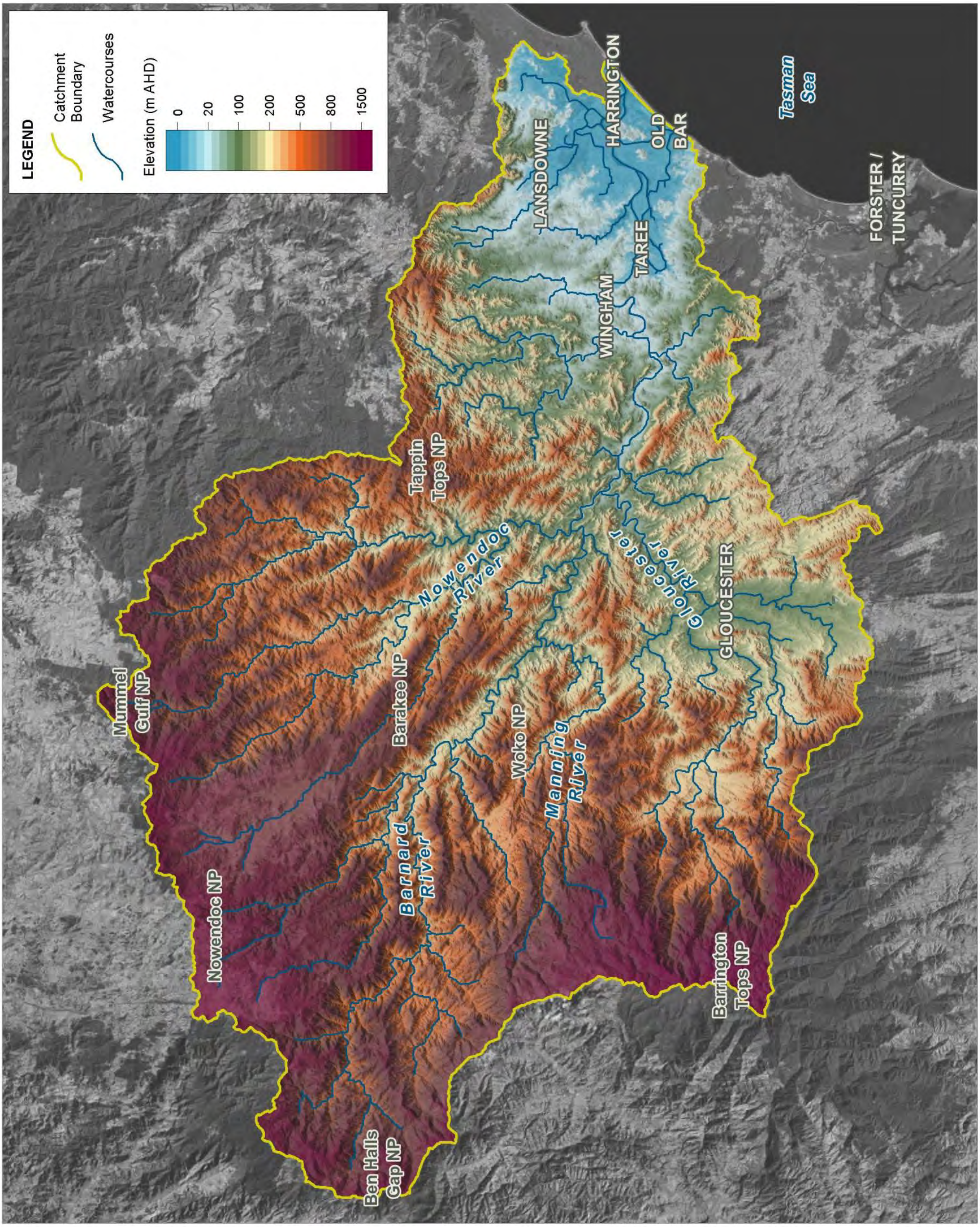
The townships of Tinonee, Taree, Cundletown, Croki, Coopernook, Harrington and Manning Point are located within the study area. The towns of Wingham, Taree, Harrington and Old Bar are the largest communities, with Taree the largest of these, having a population of around 20 000.

There are several major transport routes through the catchment including the Pacific Highway, Thunderbolts Way, Bucketts Way and the North Coast Railway Line. The Pacific Highway Taree Bypass was constructed between 1993 and 2000. It crosses both the north and south arms of the Manning River just downstream of Cundletown.

2.2 History of Flooding

There is a long and relatively frequent history of flooding within the lower Manning River catchment. The three largest floods on record occurred in 1866, 1929 and 1978. In more recent years, large flood events have occurred in 1990 and 2011, with a smaller event in 2013.

Flooding in the catchment is known to cause extensive flood damages and considerable disruption to residents. Access roads readily become inundated, isolating people and properties. Helicopters have been required to assist in the safe evacuation of residents in the past. Flooding has resulted in significant damage to residential properties and commercial businesses, with substantial loss of livestock a major impact of past flood events. Two lives were lost in the Manning River catchment during the 1929 flood.



Title:
Catchment Topography

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2-1

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Due to the large size of the catchment and spatial variation in rainfall, the relative magnitude of historical flood events is not necessarily the same across the whole catchment area. At Taree (Macquarie Street), the 1929 event resulted in the highest flood on record, with a peak level of 5.6 m AHD. Peak flood levels of 5.45 m AHD and 5.15 m AHD were recorded during the 1978 and 1866 events respectively and make up the second and third highest levels on record.

In addition to the anecdotal evidence of previous flooding, Council records provide several flood levels throughout the catchment. Further data has also been sought through questionnaires as part of the community consultation for the study.

The major events for which most of the collected data relates to include February 1929, March 1978, February 1990, June 2011 and March 2013.

2.3 Previous Studies

There have been numerous studies into the flooding characteristics of the Manning River catchment over the past 20 years. The first major investigation into determining design flood levels, for planning and flood management, was completed in 1991.

A summary of the relevant previous studies is provided below.

2.3.1 Manning River Flood Study (BMT WBM, 2016)

MidCoast Council (formerly Greater Taree City Council) commissioned BMT to define the flood behaviour of the lower Manning River floodplain and establish the basis for subsequent floodplain management activities. The study focuses on the Manning River catchment area downstream of Wingham.

Hydrologic and hydraulic models were developed to simulate flood conditions in the catchment. A hydrologic model was developed using the XP-RAFTS software to simulate the rainfall-runoff process for the lower catchment. Two hydraulic models were developed using the TUFLOW two-dimensional (2D) software:

- a TULFOW Classic model provides a 2D representation of the channel and floodplain of the Manning River extending from Killawarra to the ocean
- a TUFLOW-FV model provides a 2D representation of the ocean entrances at Harrington and Old Bar, with the purpose of simulating the sediment transport processes occurring during flood events.

The hydrologic and hydraulic models were calibrated to the June 2011 flood event. Data from the February 1929, February 1990 and March 2013 events used for model verification.

Design floods were based on a combination of flood frequency and design rainfall estimates. The TUFLOW FLIKE extreme value analysis package was used to undertake the flood frequency analyses at two gauge sites on the Manning River (Killawarra and Taree).

The TUFLOW models derive a detailed representation of the lower Manning River floodplain for the 20% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP design event conditions, as well as the Probable Maximum Flood (PMF) event. Consideration was given to flood events driven by both catchment and ocean processes, with the potential impact of climate change on flood behaviour within the catchment also been considered. Following completion of the study, Council adopted the 1% AEP design event with 2100 climate change projections for future floodplain management planning in the lower Manning River catchment area.

2.3.2 Manning River Floodplain Risk Management Study (Willing and Partners, 1996)

Willing and Partners completed the Floodplain Risk Management Study for the Manning River in 1996, following completion of a Flood Study in 1991. The study area includes the localities in the lower Manning River floodplain downstream of Wingham.

The total annual average damages estimated in the study was in the order of $566 000. To mitigate the effects of flooding, various structural and non-structural measures were considered, along with entrance and dune maintenance works.

Structural measures included various levee alignments in Taree CBD, Taree West, Manning Point and Harrington, modification to existing bridge crossings at Wards Creek (Harrington) and Edinburgh Drive (Taree West) and inclusion of landfill in Harrington. The investigation found that a levee alignment along the Victoria Street frontage of Fortherington Park in Taree CBD, protecting to the 5% AEP design flood level, had a near favourable BCR of 0.98. Non-structural measures included house-raising, voluntary property purchase, building and development controls, access improvements (road works and roadside flood markers), zoning changes, flood warning systems, public education, evacuation planning and provision of additional community flood refuge centres.

The study recommended that the 1% AEP design flood level with an additional 0.5 m freeboard allowance be adopted as the flood planning level for floodplain management activities in the lower Manning River floodplain.

2.3.3 Wingham Floodplain Risk Management Study and Plan (WorleyParsons, 2011)

The Wingham Floodplain Risk Management Study and Plan was completed by WorleyParsons in 2011. The study recommended that the 1% AEP design event plus 0.5 m freeboard be adopted for flood planning purposes.

Floodplain management strategies recommended in the Plan include improved evacuation routes (both on public and private land), installation of guide posts along primary evacuation routes to assist if night-time evacuation is required, voluntary house purchase (identified 6 properties in “extreme” flood hazard during the 1% AEP event, and 31 properties within the “high” hazard zone that would be suitable for purchase), land use zoning and development controls, voluntary house-raising (identified three properties as suitable), improved flood warning (through the inclusion of an additional streamflow gauge site on Cedar Party Creek), flood education and community awareness and revision of the SES Local Flood Plan to reflect current flood information and mapping outputs.

Hydraulic hazards are classed as low, medium, high, very high and extreme, with depth, velocity and velocity-depth product thresholds used to define each category.

2.3.4 Lansdowne Floodplain Risk Management Study and Plan (WorleyParsons, 2015)

The Lansdowne Floodplain Risk Management Study and Plan was completed by WorleyParsons in 2015. The study recommended that the 1% AEP design event plus 0.5 m freeboard be adopted for flood planning purposes.

Floodplain management strategies recommended in the Plan include further investigation for local drainage works, improved evacuation routes, land use zoning and development controls, improved flood warning (through the inclusion of a rainfall gauge within the Lansdowne River catchment), flood education and community awareness, revision of the SES Local Flood Plan to reflect current flood information and mapping outputs.

Suggested development controls include ensuring future development is compatible with the flood risk of the area (e.g. development within high hazard flood areas is limited to farm-type uses). In low hazard flood areas, controls are implemented to ensure development adequately addresses and manages potential risk to property and risk to life through reasonable flood access, adequate floor levels, no unfavourable impact to flooding on neighbouring properties and that construction is compatible with the hydraulic forces expected during a flood event.

Hazard categorisation is based on high hazard floodway, low and high hazard flood storage, low and high hazard flood fringe.

2.3.5 Farquhar Inlet, Old Bar Entrance Opening Management Plan (WorleyParsons, 2010)

Following completion of the Manning River Estuary Management Study, WorleyParsons were engaged by Council to investigate management options for Farquhar Inlet, to address water quality issues in the estuary to assist the shellfish and oyster harvesting industries. The recommended action involves adopting triggers to artificially open the entrance when critical water quality and flooding conditions occur. The recommended triggers are:

1) A water level of 1.6 m AHD is recorded at the Farquhar Inlet gauge,
2) Salinity levels in the inlet fall below 12 ppt, or
3) The Scotts Creek shellfish harvesting area is closed for more than 120 consecutive days, combined with a weekly rainfall reading at Taree Airport of more than 80 mm.

The suitability of excavating a pilot channel to encourage tidal exchange between the ocean and estuary was also investigated.

3 Community Consultation

The success of a Floodplain Management Plan hinges on its acceptance by the community and other stake-holders. This can be achieved by involving the local community at all stages of the decision-making process.

Community consultation has been an important component of this floodplain risk management study. The consultation has aimed to inform the community about the development of the floodplain risk management study and its likely outcome as a precursor to the development of the floodplain risk management plan. It has provided an opportunity to collect information on their flood experience, their concern on flooding issues and to collect feedback and ideas on potential floodplain management measures and other related issues.

The key elements of the consultation process have included:

- Issue of a questionnaire to obtain historical flood data and community perspective on flooding issues (undertaken during the Flood Study stage);
- Consultation with Council's Floodplain Management Committee through meetings and presentations;
- Public exhibition of the Draft Floodplain Risk Management Study and Plan (TBC); and
- Community information sessions to present and discuss the potential and recommended floodplain risk management options (TBC).

3.1 The Floodplain Management Committee

The study has been overseen by the MidCoast Council Floodplain Management Advisory Committee (Committee). The Committee has assisted and advised Council in the development of the Manning River Floodplain Risk Management Study and Plan.

The Committee is responsible for recommending the outcomes of the study for formal consideration by Council.

Members of the Floodplain Management Committee include representatives from the following:

- MidCoast Council – Councillors;
- MidCoast Council – specialist staff;
- Community representatives;
- Government bodies:
    - NSW State Emergency Service;
    - NSW Department of Planning Infrastructure and Environment;
    - Other State Government agencies as appropriate, co-opted on a needs basis; and
- Industry and Research representatives.

3.2 Public Exhibition

The Draft Manning River Floodplain Risk Management Study was placed on public exhibition for 28 days between 28 February 2020 and 27 March 2020. The Draft Report was made available on Council's website. Landowners, residents and businesses were invited to participate in the study by providing comment on the Draft Report with submissions closing at the conclusion of the public exhibition period.

As part of the public exhibition of the Draft Report, a community information session was held at the Taree Council chambers on 12 March 2020. The session was attended by two residents. Discussion during the session was largely focused on a recent rainfall event and the resultant temporary road closures and prolonged nuisance inundation within the Oxley Island and Mitchel Island area.

No submissions were received from the community during the public exhibition period.

4 Existing Flood Behaviour

4.1 Flood Behaviour

The Manning River channel is wide and deep and has considerable flow conveyance capacity. On exceeding flow capacity, flood water spills onto the floodplain. The resulting flood behaviour is dependent on the nature of the floodplain and is consequently vastly different upstream and downstream of Taree, where there is a notable transition between a relatively confined river valley to an expansive floodplain.

Between Killawarra and Wingham, the floodplain is relatively narrow (approximately 300 m wide) and well-defined with steep valley sides. Flood behaviour here is characterised by deep and rapidly rising flood waters.

Downstream of Taree, the topography opens into a vast, flat, low-lying floodplain area. Flood waters readily break the southern bank of the channel at Taree during the 5% AEP event, almost completely inundating Dumaresq Island. Due to the considerable storage area offered by the floodplain, the depth of flood water generally is much lower and slower moving. For the 1% AEP, the depth of water on the floodplain is typically less than 2 m. Interconnection across the floodplain between the entrances at Harrington and Farquhar Inlet is initiated during the 2% AEP event.

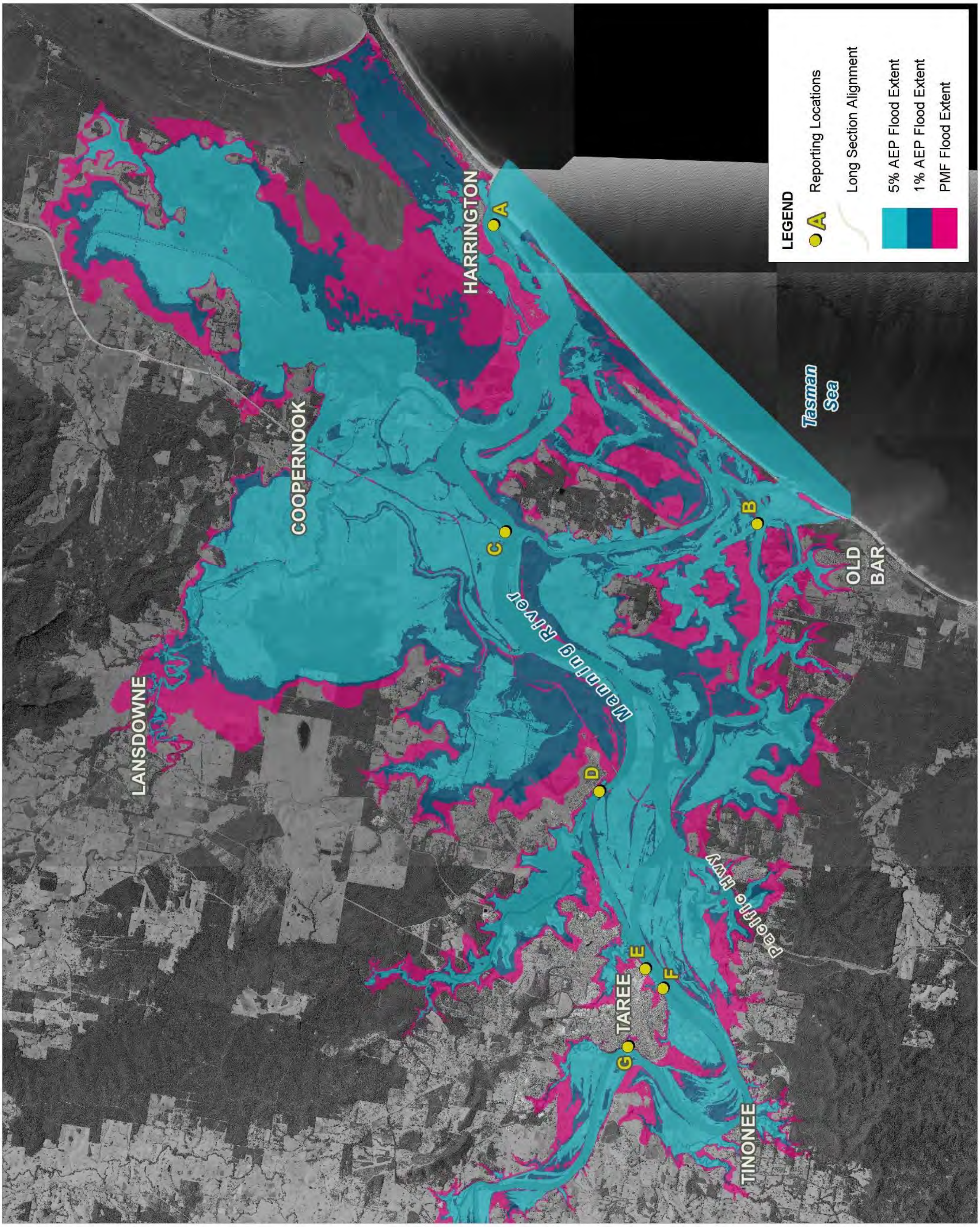
Many of the smaller tributaries of the Manning River are perched above the floodplain. The in-channel capacity of the Lansdowne River is breached upstream of Coopernook during the 20% AEP event and significant floodplain inundation occurs downstream of Lansdowne and around Coopernook and Moorland.

In addition to the range of design events considered in the Flood Study, the 10% AEP was simulated for this study to assist in the Flood Damages estimation. Adopted design peak flow rates are summarised in Table 4-1.

Table 4-1 Design Peak Flow Rates

Design Event	Killawarra		Taree
	FFA Flow Rate (m^3/s)	Adopted Flow Rate (m^3/s)	FFA Flow Rate (m^3/s)
20% AEP	4100	4100	4600
10% AEP	5300	5450	6100
5% AEP	6500	6700	7500
2% AEP	8100	8150	9300
1% AEP	9200	9150	10 600
0.5% AEP	10 400	10 250	12 000
0.2% AEP	11 900	11 900	13 800

Modelled peak flood levels at selected locations (as presented in Figure 4-1) are shown in Table 4-2 for the full range of design flood events considered.



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Design Flood Inundation Extents and Reporting Locations

Figure: 4-1

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Table 4-2 Modelled Peak Flood Levels (m AHD) for Design Flood Events

ID	Location	Design Event Frequency							
		20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	0.2% AEP	PMF
A	Harrington	1.1	1.1	1.2	2.0	2.0	2.1	2.1	2.3
B	Farquhar Inlet	1.4	1.6	1.8	2.1	2.2	2.3	2.4	4.4
C	Croki	1.4	1.7	1.9	2.5	2.7	3.0	3.4	5.4
D	Dumaresq Island	2.0	2.5	3.1	3.8	4.1	4.5	4.9	7.3
E	Taree, Macquarie St	2.7	3.4	4.1	4.8	5.2	5.6	6.0	8.6
F	Taree, Martin Bridge	2.9	3.7	4.4	5.1	5.5	5.8	6.2	9.2
G	Taree West	5.3	6.8	7.8	8.9	9.5	10.0	10.7	15.5

There is a relatively flat flood gradient between the entrance and Cundletown (Dumaresq Island). For reference, the distance between the Harrington and Dumaresq Island reporting locations is around 22.7 km. For the 1% AEP event, this equates to a flood grade of less than 0.01% and is indicative of the vast floodplain storage area that becomes active during large flood events.

4.1.1 Climate Change

Longitudinal profiles showing the impacts of increased rainfall intensity, sea level rise and coincident climate change scenarios for the Manning River are shown in Figure 4-2 and Figure 4-3. Peak Flood levels for climate change scenarios are summarised in Table 4-3.

Table 4-3 Modelled Peak Flood Levels (m AHD) for Climate Change Scenarios

ID	Location	Design Event Frequency								
		1% AEP	2050 SLR	2100 SLR	+10% Flow	+30% Flow	+10% Flow w/ 2050 SLR	+30% Flow w/ 2050 SLR	+10% Flow w/ 2100 SLR	+30% Flow w/ 2100 SLR
A	Harrington	2.0	2.2	2.9	2.0	2.0	2.2	2.3	2.9	2.9
B	Farquhar Inlet	2.2	2.3	2.9	2.3	2.4	2.4	2.5	2.9	3.0
C	Croki	2.8	2.8	3.2	3.0	3.4	3.1	3.5	3.4	3.7
D	Dumaresq Island	4.1	4.2	4.3	4.5	4.9	4.5	4.9	4.6	4.9
E	Taree, Macquarie St	5.2	5.2	5.3	5.6	6.0	5.6	6.0	5.6	6.0
F	Taree, Martin Bridge	5.5	5.5	5.6	5.8	6.3	5.8	6.3	5.8	6.3
G	Taree West	9.5	9.5	9.5	10.0	10.7	10.0	10.7	10.0	10.7

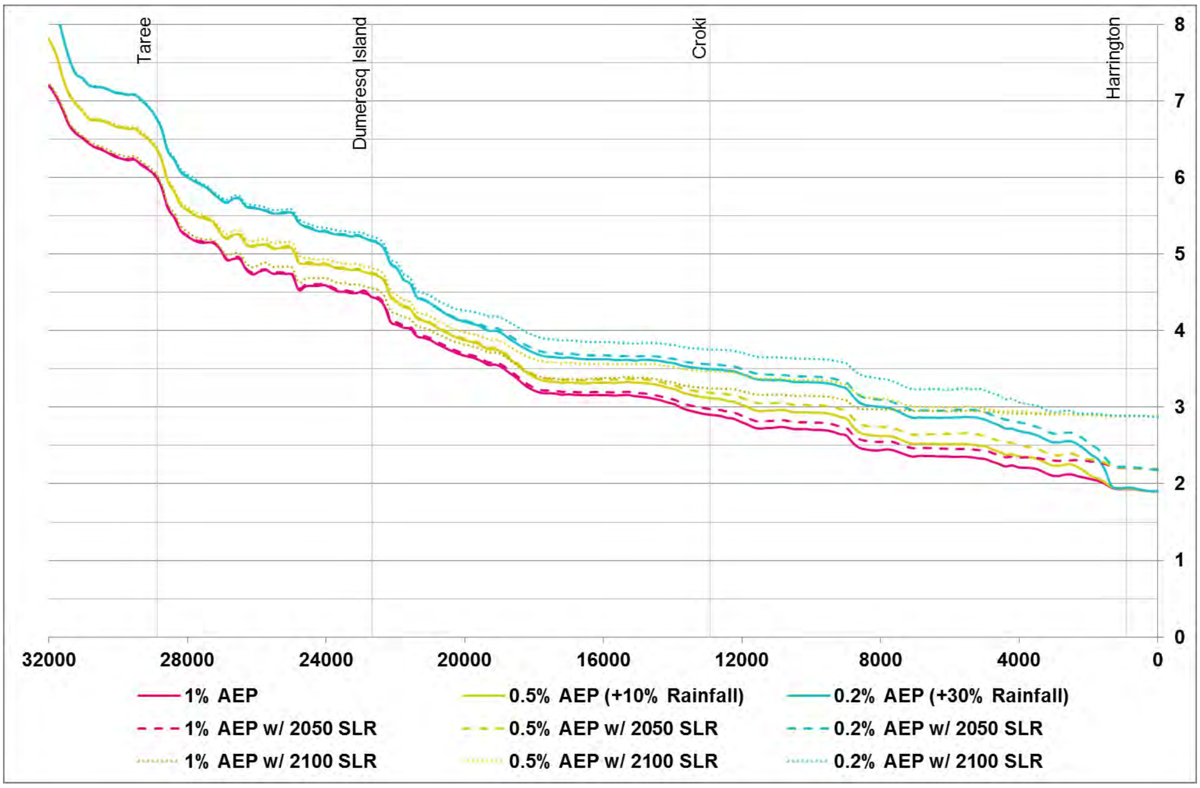


Figure 4-2 Manning River Peak Flood Levels for Climate Change Scenarios, Main Alignment from Harrington

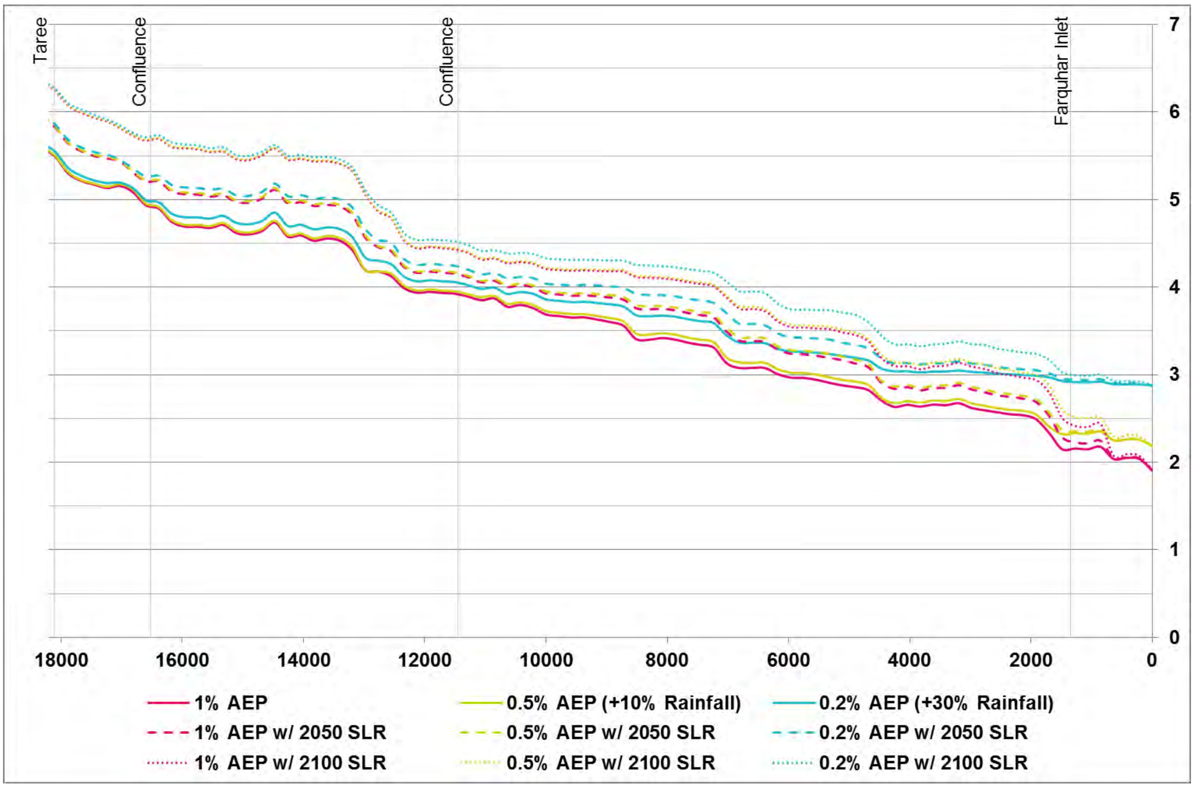


Figure 4-3 Manning River Peak Flood Levels for Climate Change Scenarios, Main Alignment from Harrington

4.1.1.1 Increased Rainfall Intensity

The NSW Government released a guideline for Practical Consideration of Climate Change (DECCW, 2007) in the floodplain management process that advocates consideration of increased design rainfall intensities of up to 30%.

In line with this guidance note, additional tests incorporating a 10% increase to design rainfall at 2050 and a 30% increase to design rainfall at 2100 were undertaken in the Flood Study. The design flows for the 0.5% AEP and 0.2% AEP event are around 10% and 30% higher, respectively, than those of the 1% AEP, so comparison of these two events provides an appropriate assessment for potential impacts of increased design rainfall depths.

Increases in rainfall intensities of around 10% result in an increase in peak flood levels of around 0.3 m for the 1% AEP event at Taree. For a 30% increase in rainfall intensity, peak flood levels increase by around 0.8 m at Taree.

4.1.1.2 Sea Level Rise

Current guidelines predict that a likely outcome of future climatic change will be an increase in mean sea level. Council does not have an adopted policy on sea level rise projections; however, their acting position is that sea level rise increases of 0.28 m by 2050 and 0.98 m by 2100 be considered. These parameters were therefore adopted for use in the Flood Study.

Sea level rise impacts largely diminish upstream of Dumaresq Island. At Taree, a difference of 0.1 m is observed between the baseline 1% AEP peak flood levels and the 2100 sea level rise scenario.

4.2 Flood Risk Mapping

The Manning River TUFLOW model developed for the Flood Study was updated to:

- improve representation of Crowdy Bay National Park ground surface elevations (informed by detailed survey and model development undertaken following completion of the Flood Study for an independent flood assessment in the Harrington locality)
- improve definition of the Harrington Road crest elevations
- improve entrance breakout representation for climate change (sea level rise) scenarios.

The Flood Study presented a mapping series for each design event magnitude simulated, incorporating outputs of:

- peak flood depth, velocity and water levels
- flood function (or hydraulic categorisation)
- provisional flood hazard
- true hazard.

Following updates to the hydraulic model configuration, the peak flood behaviour maps have been reproduced and are contained in the attached Mapping Compendium (Map Series A-H). Changes to the model configuration have resulted in only minor changes to modelled flood behaviour.

This study will refine the definition of flood function and flood hazard as presented in the Flood Study. Details are contained in Section 4.3 and Section 4.4.

4.3 Flood Function

The flood function (or hydraulic categorisation) of a floodplain helps describe the nature of flooding in a spatial context and from a flood planning perspective can determine what can and can't be developed in areas of the floodplain. The hydraulic categories as defined in the Floodplain Development Manual are:

- **Floodway** - Areas that convey a significant portion of the flow. These are areas that, even if partially blocked, would cause a significant increase in flood levels or a significant redistribution of flood flows, which may adversely affect other areas.
- **Flood Storage** - Areas that are important in the temporary storage of the floodwater during the passage of the flood. If the area is substantially removed by levees or fill it will result in elevated water levels and/or elevated discharges. Flood storage areas, if completely blocked would cause peak flood levels to increase by 0.1 m and/or would cause the peak discharge to increase by more than 10%.
- **Flood Fringe** - Remaining area of flood prone land, after floodway and flood storage areas have been defined. Blockage or filling of this area will not have any significant effect on the flood pattern or flood levels.

There are no prescriptive methods for determining what parts of the floodplain constitute floodways, flood storages and flood fringe. Descriptions of these terms within the Floodplain Development Manual are essentially qualitative in nature. Of difficulty is the fact that a definition of flood behaviour and associated impacts is likely to vary from one floodplain to another depending on the circumstances and nature of flooding within the catchment.

An approach that is becoming increasingly accepted is to define the floodway extent as the area of floodplain conveying around 80% of the total flood flow, as defined by Thomas (2012). This is typically undertaken for the 1% AEP design flood event. The modelled velocity-depth results were analysed through several floodplain cross-sections, to identify the extent of the area conveying around 80% of the total flow. This process is used to identify a suitable VxD threshold with which to map the 80% flow extent throughout the study area and is an approach that has been applied successfully by BMT in recent studies. However, when applied to the lower Manning River floodplain, the velocity-depth product threshold identified at each cross-section was inconsistent and did not produce reasonable mapping outputs. This is due to the nature of the estuary having two ocean entrances, complex floodplain flow distribution and large storage areas. An alternative approach was therefore adopted whereby 80% of the 1% AEP flood flow was simulated and areas with a VxD threshold exceeding 0.1 were identified as floodways.

To differentiate between flood storage and flood fringe areas, a depth threshold of 0.5 m was adopted, which is a typically adopted approach for mainstream flooding. Sensitivity testing was undertaken by using a threshold of 0.3 m and 1.0 m, which produced only a relatively minor change to the mapped flood storage extents. Within the 1% AEP design flood extent, most of the floodplain is inundated and given the nature of the Manning River floodplain it is appropriate that it is considered as flood storage. Areas flooded by depths of less than 0.5 m constitute a small portion of the floodplain perimeter, do not convey flow and can therefore be classes as flood fringe.

The adopted flood function categorisation is defined in Table 4-4.

Table 4-4 Flood Function Categories

Floodway	Velocity * Depth > 0.1 at an 80% flow rate of the 1% AEP event	Areas and flow paths where a significant proportion of floodwaters are conveyed (including all bank-to-bank creek sections).
Flood Storage	Depth > 0.5 m at the 1% AEP event (unless already classified as floodway)	Areas where floodwaters accumulate before being conveyed downstream. These areas are important for detention and attenuation of flood peaks.
Flood Fringe	The extent of the 1% AEP floodplain not classified as floodway or flood storage	Areas that are low-velocity backwaters within the floodplain. Filling of these areas generally has little consequence to overall flood behaviour.

Flood function mapping for the study area is included in the attached Mapping Compendium for the 1% AEP event (Map Series I). Floodways are largely confined to channels and major spillways, with much of the inundated floodplain area classified as flood storage.

4.4 Flood Hazard

In Guideline 7-3 of the Australian Disaster Relief Resilience Handbook (AIDF, 2017b), the National Flood Risk Advisory Group (NFRAG) considers a holistic approach to consider flood hazards to people, vehicles and structures. It recommends a composite six-tiered hazard classification, reproduced in Figure 4-4. The six hazard classifications are summarised in Table 4-5.

Table 4-5 Combined Flood Hazard Curves – Vulnerability Thresholds

Hazard Classification	Description
H1	Relatively benign flow conditions. No vulnerability constraints.
H2	Unsafe for small vehicles.
H3	Unsafe for all vehicles, children and the elderly.
H4	Unsafe for all people and vehicles.
H5	Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
H6	Unconditionally dangerous. Not suitable for any type of development or evacuation access. All building types considered vulnerable to failure.

The flood hazard level is determined based on the predicted flood depth and velocity. This is conveniently done through the analysis of flood model results. A high flood depth will cause a hazardous situation while a low depth may only cause an inconvenience. High flood velocities are dangerous and may cause structural damage while low velocities generally have no major threat.

Peak flood hazards are shown for the 1% AEP and the 1% AEP future climate change scenario adopted by Council for flood planning purposes in the attached Mapping Compendium (Series J-K).

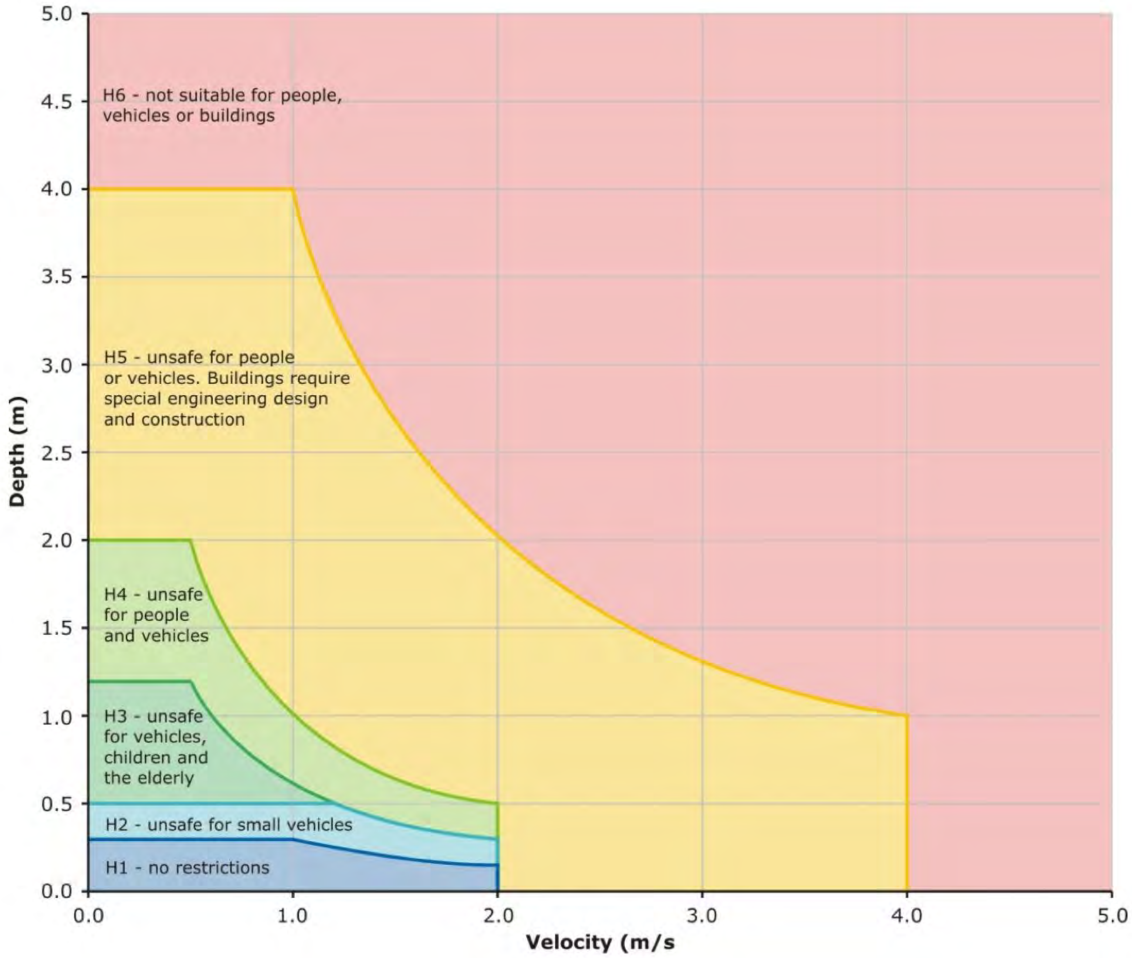


Figure 4-4 Combined Flood Hazard Curves

4.5 Flood Planning Area

Flood Planning Levels (FPLs) are used for planning purposes, and directly determine the extent of the Flood Planning Area (FPA), which is the area of land subject to flood-related development controls. The FPL is the level below which Council places restrictions on development due to the hazard of flooding.

It is typical for the flood planning level to be derived from a designated design flood event plus a 0.5 m freeboard allowance, to account for underlying uncertainties. The 1% AEP event is usually adopted as the designated flood, however the FPL and FPA can include allowances for future climate change conditions (i.e. sea level rise and rainfall intensity increase).

The 1% AEP future climate change scenario considering the present day 0.5% AEP flood flow condition (representing around a 10% increase in design rainfall from the 1% AEP event) and a 0.98 m increase in sea level (representing an estimated 2100 condition) has been adopted by Council to define the FPL and FPA in the Lower Manning.

4.6 Classification of Communities

The SES classifies communities according to the impact that flooding has on them. The primary purpose for doing this is to assist SES in the planning and implementation of response strategies. Flood impacts relate to where the normal functioning of services is altered due to a flood, either directly or indirectly, and relates specifically to the operational issues of evacuation, resupply and rescue.

Flood Islands

Flood Islands are inhabited areas of high ground within a floodplain which are linked to the flood free valley sides by only one access / egress route. If the road is cut by floodwaters, the community becomes an island, and access to the area may only be gained by boat or aircraft. Flood islands are classified according to what can happen after the evacuation route is cut as and are typically separated into:

- High Flood Islands
- Low Flood Islands

A *High Flood Island* include sufficient land located at a level higher than the limit of flooding (i.e. above the PMF) to provide refuge to occupants. During flood events properties may be inundated and the community isolated, however, as there is an opportunity for occupants to retreat to high ground, the direct risk to life is limited. If it will not be possible to provide adequate support during the period of isolation, evacuation will have to take place before isolation occurs.

The highest point of a *Low Flood Island* is lower than the limit of flooding (i.e. below the PMF) or does not provide sufficient land above the limit of flooding to provide refuge to the occupants of the area. During flood events properties may be inundated and the community isolated. If floodwater continues to rise after it is isolated, the island will eventually be completely covered. People left stranded on the island may drown.

Trapped Perimeter Areas

Trapped Perimeter Areas are inhabited areas located at the fringe of the floodplain where the only practical road or overland access is through flood prone land and unavailable during a flood event. The ability to retreat to higher ground does not exist due to topography or impassable structures. Trapped perimeter areas are classified according to what can happen after the evacuation route is cut as follows.

High Trapped Perimeter Areas include sufficient land located at a level higher than the limit of flooding (i.e. above the PMF) to provide refuge to occupants. During flood events properties may be inundated and the community isolated, however, as there is an opportunity for occupants to retreat to high ground, the direct risk to life is limited. If it will not be possible to provide adequate support during the period of isolation, evacuation will have to take place before isolation occurs.

Low Trapped Perimeter Areas is lower than the limit of flooding (i.e. below the PMF) or does not provide sufficient land above the limit of flooding to provide refuge to the occupants of the area. During a flood event, the area is isolated by floodwater and property may be inundated. If floodwater continues to rise after it is isolated, the area will eventually be completely covered. People trapped in the area may drown.

Areas Able to be Evacuated

These are inhabited areas on flood prone fringe areas that can be evacuated. However, their categorisation depends upon the type of evacuation access available, as follows.

Areas with Overland Escape Route are those areas where access roads to flood free land cross lower lying flood prone land. Evacuation can take place by road only until access roads are closed by floodwater. Escape from rising floodwater is possible but by walking overland to higher ground. Anyone not able to walk out must be reached by using boats and aircraft. If people cannot get out before inundation, rescue will most likely be from rooftops.

Areas with Rising Road Access are those areas where access roads rising steadily uphill and away from the rising floodwaters. The community cannot be completely isolated before inundation reaches its maximum extent, even in the PMF. Evacuation can take place by vehicle or on foot along the road as floodwater advances. People should not be trapped unless they delay their evacuation from their homes. For example, people living in two storey homes may initially decide to stay but reconsider after water surrounds them.

These communities contain low-lying areas from which people will be progressively evacuated to higher ground as the level of inundation increases. This inundation could be caused either by direct flooding from the river system or by localised flooding from creeks.

Indirectly Affected Areas

These are areas which are outside the limit of flooding and therefore will not be inundated nor will they lose road access. However, they may be indirectly affected because of flood damaged infrastructure or due to the loss of transport links, electricity supply, water supply, sewage or telecommunications services and they may therefore require resupply or in the worst case, evacuation.

Overland Refuge Areas

These are areas that other areas of the floodplain may be evacuated to, at least temporarily, but which are isolated from the edge of the floodplain by floodwaters and are therefore effectively flood islands or trapped perimeter areas. They should be categorised accordingly, and these categories used to determine their vulnerability.

Note that Flood Management Communities identified as Overland Refuge Areas on Low Flood Island have been classified according to the SES Flow Chart for Flood Emergency Response Classification. These are areas where vehicular evacuation routes are inundated before residential areas of the Community.

Classification of Communities for the Lower Manning

The flood classification for communities in the Lower Manning is summarised in Table 4-6 and presented graphically in the attached Mapping Compendium (Map Series L). Flood communities have been determined for the 1% AEP and PMF events (where different to the 1% AEP classification). Community localities have been divided into sectors as presented in the Greater Taree City Local Flood Plan (SES, 2013).

Table 4-6 Flood Communities

Sector	Community	1% AEP Flood Community Classification *	Comment
3	Taree West	Low Flood Island	At the 2% AEP event, Edinburgh Dr access is cut by up to 1 m flood depth. High Flood Island to 2% AEP. Low Flood Island for 1% AEP and above.
4	Taree	Rising Road Access	Significant number of properties along Manning River and Browns Creek become inundated by the 2% AEP.
5	Tinonee	Rising Road Access	Majority of properties remain free from inundation, even in the PMF.
6	Oxley Island, Michell Island	High Flood Island	At 10% AEP, Manning Point Rd access is compromised (~0.2 m flood depth). Other local access roads in Oxley Island inundated by 0.5 - 1.0 m flood depth.
7	Jones Island, Croki, Moto	Low Flood Island	At 20% AEP, Barton St access is compromised (~0.2 m flood depth). High Flood Island to 5% AEP. Low Flood Island for 2% AEP and above.
	Coopernook township	Rising Road Access	Majority of the township remains free from inundation at the PMF.
	Coopernook rural (including Mamboo Island)	Low Flood Island	Private access roads to rural properties south-east of Pacific Highway are cut in 5% AEP and properties classed as High Flood Island. For 2% AEP and above, these rural properties are Low Flood Island.
9	Manning Point	High Flood Island (LFI > 0.5% AEP)	At 10% AEP, Manning Point Rd access is compromised (~0.2 m flood depth). Numerous properties become inundated at the 2% AEP. Township classified as High Flood Island up to the 0.5% AEP. Classified as Low Flood Island for 0.2% AEP and the PMF.
10	Harrington, Crowdy Head	High Flood Island (LFI > 0.2% AEP)	At 10% AEP, Harrington Rd (Mamboo Island) access is compromised (~0.3 m flood depth). Harrington township is classed as High Flood Island up to the 0.2% AEP event (only a small section of Harrington near Jabiru Dr is inundated). Low Flood Island for the PMF.
11	Cundletown	Rising Road Access	Majority of properties remain free from inundation up to the 0.2% AEP. Rural properties to the north-east become inundated at the PMF.

Sector	Community	1% AEP Flood Community Classification *	Comment
	Dumaresq Island	Low Flood Island	At 10% AEP, Newtons Rd access is cut by up to 1.5 m flood depth. Township classified as High Flood Island up to the 5% AEP. Classified as Low Flood Island for 2% AEP and above.
12	Pampoolah to Old Bar	Rising Road Access	Majority of properties remain free from inundation up to the 0.2% AEP.
	Cabbage Tree Island	High Flood Island (LFI > 0.2% AEP)	High Flood Island at 0.2% AEP. Low Flood Island for the PMF.
13	Glenthorne	Low Flood Island	At 20% AEP, Glenthorne Rd access is cut by up to 1 m flood depth. Majority of properties in Glenthrone are High Flood Island up to the 5% AEP event. For the 2% AEP and above, become Low Flood Island.

** Flood Community classification at the PMF in brackets where different from 1% AEP classification*

4.7 Flood Planning Constraint Categories

In Guideline 7-5 of the Australian Disaster Relief Resilience Handbook (AIDF, 2017c), the National Flood Risk Advisory Group (NFRAG) highlights the need for appropriate land use planning activities to effectively manage and limit the growth of flood risk within a floodplain. It recommends adoption of four flood planning constraint categories (FPCC), as reproduced in 4.7. The purpose of the FPCCs are to separate areas of the floodplain based on their suitability for more concentrated development or intensified land use.

Table 4-7 Flood Planning Constraint Categories (FPCC) (AIDF, 2017)

FPCC	Constraint Subcategory
1	a) Floodway or flood storage area in the DFE*, b) Flood hazard H6 in the DFE.
2	a) Floodway in events larger than the DFE, b) Flood hazard H5 in the DFE, c) Emergency response (isolated and submerged areas), d) Emergency response (isolated but elevated areas), e) Flood hazard H6 in floods large than the DFE.
3	Remaining area below the DFE plus freeboard.
4	Remaining area below the PMF or Extreme Flood.

** DFE = defined flood event. For the Manning River, this is the 2100 1% AEP design event.*

The implications and key considerations for development in each of the FPCCs, as documented by AIDR (2017), are summarised below:

- **FPCC1:**
    a) Development within the floodway area will alter flood behaviour and negatively affect the existing community and/or other property. Development is generally very limited, except where uses are compatible with the flood function.
    b) Flood conditions unsafe for vehicles and people, and all building types would be subject to structural failure. Development is generally very limited, except where uses are compatible with the flood hazard.
- **FPCC2:**
    a) Floodway areas may develop during larger flood events than the DFE. Developments should therefore be compatible with rarer flood flows in these areas.
    b) Flood conditions unsafe for vehicles and people, and buildings vulnerable to structural damage. Developments may require special development conditions where it can be satisfied that developments are compatible with flood hazard H5. Hazard could be reduced through filling (provided this does not affect local flood behaviour).
    c) The area will become fully submerged with no flood-free land in an extreme flood event, with ramifications for those who have not evacuated and unable to be rescued. Developments for vulnerable communities may be prohibited, and other developments may need to satisfy additional emergency management requirements.
    d) The area will become isolated by floodwater and those who have not evacuated may be isolated and will require rescue or resupply. Developments for vulnerable communities may be prohibited, and other developments may need to satisfy additional emergency management requirements.
    e) Flood hazard H6 may develop during larger flood events than the DFE. Developments may require additional development conditions to reduce the effect of flooding.
- **FPCC3:** Flood conditions are unsafe for vehicles and people. Standard land-use and development controls for flood prone land are likely suitable.
- **FPCC4:** During extreme flood events, emergency facilities such as hospitals and evacuation centres must remain operational. Special conditions should be enforced so emergency response facilities are compatible with the extreme flood risk.

Preliminary FPCC mapping is provided in the attached Mapping Compendium (Map Series M). This information will be used to inform land-use planning and provision of development controls within the lower Manning River floodplain area. Further detail is contained in Section 7.

5 Property Inundation and Flood Damages Assessment

A flood damage assessment has been undertaken to identify flood affected property, to quantify the extent of damages in economic terms for existing flood conditions and to enable the assessment of the relative merit of potential flood mitigation options by means of benefit-cost analysis.

The general process for undertaking a flood damages assessment incorporates:

- identifying properties subject to flooding
- determining depth of inundation above floor level for a range of design event magnitudes
- defining appropriate stage-damage relationships for various property types/uses
- estimating potential flood damage for each property
- calculating the total flood damage for a range of design events.

5.1 Types of Flood Damage

The definitions and methodology used in estimating flood damage are summarised in the Floodplain Development Manual. Figure 5-1 summarises the “types” of flood damages as considered in this study. The two main categories are 'tangible' and 'intangible' damages. Tangible flood damages are those that can be more readily evaluated in monetary terms, while intangible damages relate to the social cost of flooding and therefore are much more difficult to quantify.

Tangible flood damages are further divided into direct and indirect damages. Direct flood damages relate to the loss, or loss in value, of an object or a piece of property caused by direct contact with floodwaters. Indirect flood damages relate to loss in production or revenue, loss of wages, additional accommodation and living expenses, and any extra outlays that occur because of the flood.

The types of damages mentioned in the Floodplain Development Manual largely focus on tangible flood damage, particularly property related damages. Economic analysis for infrastructure projects within other Australian industries often includes a wider range of assessment criteria, such as the potential for fatalities, loss of transport connectivity, disruption to essential services (e.g. schools, sewerage) and other environmental values (Thomson, 2018). In certain floodplain areas, incorporation of such additional damage criteria provides for a more robust cost estimation of the consequence of flooding, hence providing a better understanding of the benefit of potential flood mitigation measures through derivation of benefit-cost-ratios (BCR).

5.2 Basis of Flood Damage Calculations

Flood damages have been calculated using a database of potentially flood affected properties and stage-damage curves derived for different types of property within the catchment. These curves relate the amount of flood damage that would potentially occur at different depths of inundation, for each property type. Residential damage curves are based on the DPIE guideline stage-damage curves for residential property.

Property floor level survey was undertaken for the Manning River Floodplain Risk Management Study (Willing and Partners, 1996) where floor level, ground level and building descriptions were obtained for all properties affected by the 1% AEP flood (~1400 buildings/garages). Each building in the dataset is identifiable by street name and number or plan label ID.

For this study, a GIS point dataset was established representing each building within the PMF extent. Where possible, the existing survey information was matched to the plan label ID. This resulted in some 830 buildings being assigned a surveyed floor level. Ground levels for the remaining buildings in the floodplain were estimated from the LiDAR DEM. Those within the 1% AEP flood extent were assigned a floor level equivalent to the FPL. Floor levels for properties outside of the 1% AEP extent were assumed to 0.3 m above the ground level.

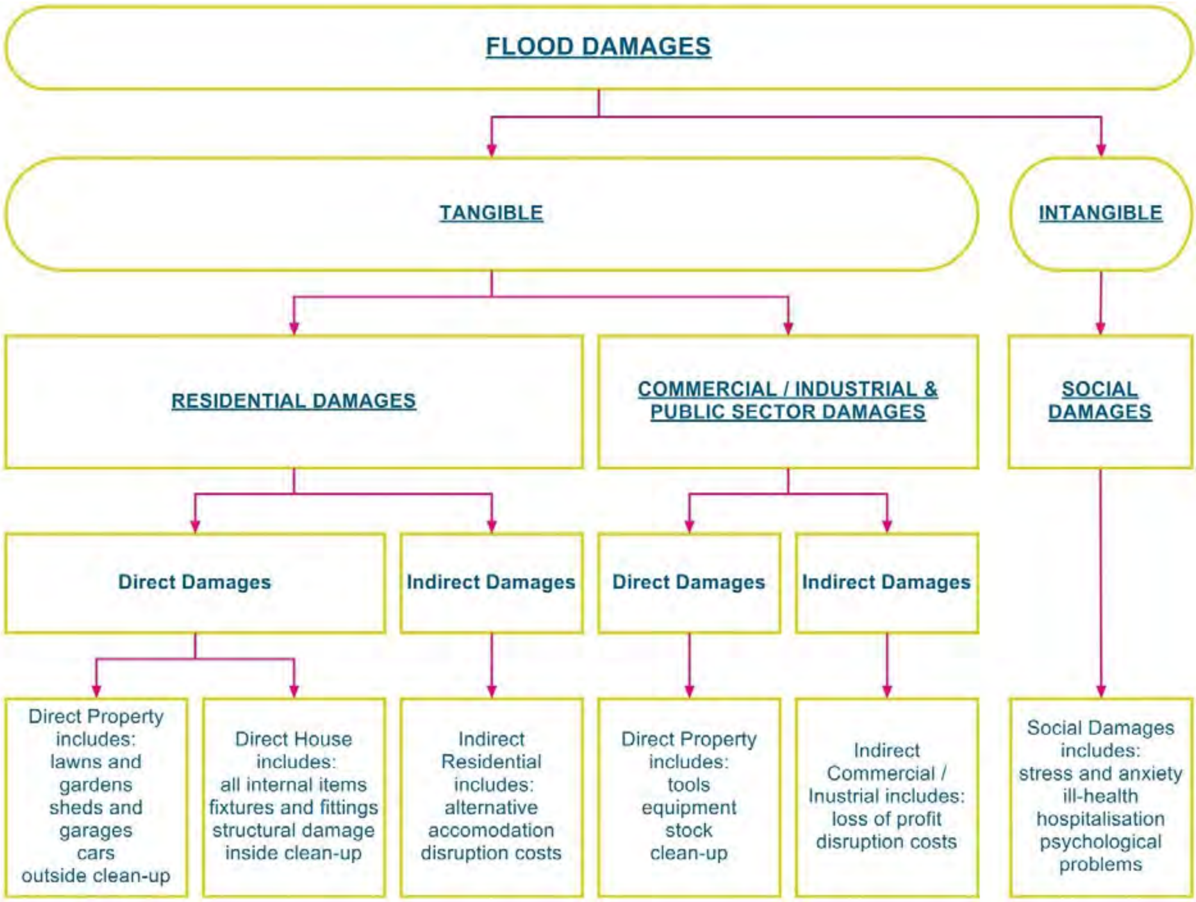


Figure 5-1 Types of Flood Damage

Different stage-damage curves for direct property damage have been derived for:

- residential dwellings (categorised into small, typical or raised categories)
- commercial premises (categorised into low, medium or high damage categories).

Apart from the direct damages calculated from the derived stage-damage curves for each flood-affected property, other forms of flood damage include:

- indirect residential, commercial and industrial damages - taken as a percentage of the direct damages

- infrastructure damage - based on a percentage of the total value of residential and business flood damage
- intangible damages that relate to the social impact of flooding and include:
    - inconvenience
    - isolation
    - disruption of family and social activities
    - anxiety, pain and suffering, trauma
    - physical ill-health
    - psychological ill-health.

Many of the floodplain management options being considered for the Lower Manning involve significant infrastructure expenditure, such as the construction of levees and upgrading of roads. Therefore, it is reasonable to consider additional benefits associated with these capital works, including the reduction of both risk to life and disruption to transport connectivity. This study will include a preliminary estimation of the benefits associated with improving these two factors. Exclusion of these potential benefits could substantially underestimate the BCR of floodplain management options in the catchment. Further detail is contained in Section 5.4.

5.3 Tangible Flood Damages

5.3.1 Assessment of Direct Damages

The peak depth of flooding was determined at each property for the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP events and the PMF event. The associated direct flood damage cost to each property was then estimated from the stage-damage relationships. The flood damage curves include a flat $11,725 cost of external damages for any level of flood inundation incurred below floor level. Total damages for each flood event were determined by summing the predicted damages for each individual property.

The Average Annual Damage (AAD) is the average damage in dollars per year that would occur in a designated area from flooding over many years. In most years there may be no flood damage, in some years there will be minor damage (caused by small, relatively frequent floods) and, in a few years, there will be major flood damage (caused by large, rare flood events). Estimation of the AAD provides a basis for comparing the effectiveness of different floodplain risk management measures (i.e. the reduction in the AAD).

5.3.2 Estimation of Indirect Damages

The indirect damages are more difficult to determine and would vary for each flood event, particularly with the duration of the flood inundation. Previous studies detailing flood damages from actual events have found that the indirect damages for residential properties are typically in the order of 20% of the direct damages. Given the relative uncertainty associated with the indirect damages a value of 20% of the direct damages has also been adopted for this study.

The indirect damages associated with commercial properties are typically higher and a value of 40% of the calculated direct damages has been adopted.

5.3.3 Public Utilities and Infrastructure

Public utilities and infrastructure include roads, railways, parklands and underground water, sewerage, power and telephone services and installations. The damages sustained by public utilities comprise the replacement or repair of assets damaged by floodwaters, the cost of clean-up of the installations, as well as the collection and disposal of clean-up material from private property.

Damage incurred to public utilities and infrastructure during a flood event has been estimated as 30% of the combined tangible (direct and indirect) damages to residential and commercial properties.

5.4 Incorporating Benefits

5.4.1 Risk to Life

WRL (2016) reviewed a range of empirical methods to calculate loss of life resulting from flooding, stemming from various causes from riverine floods to dam break scenarios. Common methods are:

- linking loss of life to the number of damaged residences (often incorporating various other components such as population distribution, time of day etc.)
- linking loss of life to catchment specific flood behaviour such as depth of water, rate of rise of floodwater, warning time, velocity, hazard categories
- linking loss of life to population at risk (PAR).

The WRL study found that none of the methods can readily be applied to a range of flood size and type, catchment types and geographic locations.

The January 2011 flood in Grantham, Queensland was a major flood event in which 12 people lost their lives. Following this event, detailed flood modelling and investigation was completed as part of the Grantham Floods Commission of Enquiry. Based on observed and modelled information, a “mortality factor” was calculated for the Grantham flood event and was derived from the number of people located within the high hazard flood zone. The high hazard flood zone is an H5 or H6 in the AIDF (2017) classification system.

A mortality factor for the lower Manning River catchment was estimated to allow for a similar calculation to be completed. Further information is contained in Section 5.5.5.

5.4.2 Transport Connectivity

Flooding can disrupt transport connections and result in delays or the need to take an alternate route. The Australian Transport Assessment and Planning (ATAP) Guidelines (2018) provide a framework for planning, assessing and developing transport systems. Included in the guidelines is a section of “parameter values” which aim to provide a consistent approach for the economic assessment of transport projects and related initiatives. A comprehensive compilation of travel time values is provided for vehicle occupants (in cost per person per hour) and freight vehicles (in cost per vehicle per hour).

The potential for transport delays on the Pacific Highway, Harrington Road, Manning Point Road and Croki Road and the economic impact associated with this has been considered for this study, using the information available in the ATAP guidelines. Further details are contained in Section 5.5.6.

5.5 Manning River Flood Damages

5.5.1 Residential Flood Damages

The assessment of the residential flood damages is presented in Table 5-1. Damages have been estimated for Taree, Harrington and "rural," which includes all other properties within the study area. From this data the AAD for residential properties was calculated as being $1 070 000 in direct damages and $214 000 in indirect damages, giving a total value of $1 284 000.

5.5.2 Commercial Flood Damages

The assessment of the commercial flood damages is presented in Table 5-2. From this data the AAD for commercial properties was calculated as being $153 000 in direct damages and $61 000 in indirect damages, giving a total value of $214 000.

5.5.3 Infrastructure and Public-Sector Flood Damages

Damage incurred to public utilities and infrastructure during a flood event was estimated as 30% of the combined tangible (direct and indirect) damages to residential and commercial properties, giving a total AAD value of $450 000.

5.5.4 Total Tangible Flood Damages

The total tangible flood damages for residential properties, commercial properties and the public sector were combined, as presented in Table 5-3. From this data, the combined AAD was calculated as being $1 940 000, comprised as follows:

- $1 284 000 from residential properties,
- $214 000 from commercial properties, and
- $450 000 from infrastructure and public sector.

Table 5-1 Residential Flood Damages

Design Event	Direct Damages ($)			Indirect Damages ($)			Total Damages ($)			
	Taree	Harrington	Rural	Taree	Harrington	Rural	Taree	Harrington	Rural	All
20% AEP	$0	$0	$10 000	$0	$0	$0	$0	$0	$10 000	$10 000
10% AEP	$120 000	$0	$180 000	$20 000	$0	$40 000	$140 000	$0	$220 000	$360 000
5% AEP	$650 000	$0	$1 330 000	$130 000	$0	$270 000	$780 000	$0	$1 600 000	$2 380 000
2% AEP	$3 330 000	$210 000	$7 200 000	$670 000	$40 000	$1 440 000	$4 000 000	$250 000	$8 640 000	$12 890 000
1% AEP	$5 240 000	$300 000	$10 770 000	$1 050 000	$60 000	$2 150 000	$6 290 000	$360 000	$12 920 000	$19 570 000
0.5% AEP	$8 060 000	$1 160 000	$16 630 000	$1 610 000	$230 000	$3 330 000	$9 670 000	$1 390 000	$19 960 000	$31 020 000
0.2% AEP	$17 740 000	$7 660 000	$39 100 000	$3 550 000	$1 530 000	$7 820 000	$21 290 000	$9 190 000	$46 920 000	$77 400 000
Extreme	$124 800 000	$86 690 000	$175 160 000	$24 960 000	$17 340 000	$35 030 000	$149 760 000	$104 030 000	$210 190 000	$463 980 000
AAD	$335 000	$112 000	$623 000	$67 000	$22 000	$125 000	$402 000	$134 000	$748 000	$1 284 000

Table 5-2 Commercial Flood Damages

Design Event	Direct Damages ($)			Indirect Damages ($)			Total Damages ($)			
	Taree	Harrington	Rural	Taree	Harrington	Rural	Taree	Harrington	Rural	All
20% AEP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10% AEP	$50 000	$0	$0	$20 000	$0	$0	$70 000	$0	$0	$70 000
5% AEP	$530 000	$0	$0	$210 000	$0	$0	$740 000	$0	$0	$740 000
2% AEP	$1 790 000	$0	$0	$720 000	$0	$0	$2 510 000	$0	$0	$2 510 000
1% AEP	$3 540 000	$0	$0	$1 420 000	$0	$0	$4 960 000	$0	$0	$4 960 000
0.5% AEP	$4 980 000	$30 000	$0	$1 990 000	$10 000	$0	$6 970 000	$40 000	$0	$7 010 000
0.2% AEP	$8 000 000	$610 000	$20 000	$3 200 000	$240 000	$10 000	$11 200 000	$850 000	$30 000	$12 080 000
Extreme	$23 300 000	$2 350 000	$270 000	$9 320 000	$940 000	$110 000	$32 620 000	$3 290 000	$380 000	$36 290 000
AAD	$149 000	$4 000	$0	$59 000	$2 000	$0	$208 000	$6 000	$0	$214 000

Table 5-3 Summary of Total Tangible Flood Damages

Design Event	Total Tangible Flood Damages ($) (including Infrastructure and Public Sector)			
	Taree	Harrington	Rural	All
20% AEP	$0	$0	$20 000	$20 000
10% AEP	$260 000	$0	$280 000	$540 000
5% AEP	$1 980 000	$0	$2 080 000	$4 060 000
2% AEP	$8 460 000	$330 000	$11 230 000	$20 020 000
1% AEP	$14 610 000	$470 000	$16 800 000	$31 880 000
0.5% AEP	$21 640 000	$1 870 000	$25 940 000	$49 450 000
0.2% AEP	$42 240 000	$13 050 000	$61 040 000	$116 330 000
PMF	$237 090 000	$139 520 000	$273 740 000	$650 350 000
AAD	**$790 000**	**$180 000**	**$970 000**	**$1 940 000**

5.5.5 Risk to Life Damages

As detailed in Section 5.4.1, a flood mortality factor will be calculated for the Manning River floodplain to estimate the risk to life damages.

The flood mortality rate calculated by WRL (2016) for the 2011 Grantham flood is likely not applicable to the Manning River due to the different nature of flooding in the catchment (i.e. Grantham had little to no warning, the lower Manning River has a long warning time in the order of days). Risk Frontiers (2016) provides a comprehensive analysis of human fatalities from floods in Australia. The study found that of all flood fatalities, 55.1% were from short duration flash flooding (such as experienced during the Grantham flood) and around 12.5% were from flood events in large catchments with longer duration flooding. The flood mortality rate for Grantham (0.06) was therefore scaled down by a factor of 0.23 to provide a simplistic estimate of expected mortality for a floodplain such as the lower Manning valley (0.014).

The total number of fatalities (N_{total}) in a flood event can then be estimated based on the number of people within the high hazard flood zone (PAP_H) with the following equation (WRL, 2016):

$$F = \frac{N_{total}}{PAP_H}$$

Table 5-4 summarises the total population at risk in the high hazard zone (PAP_H), estimated number of fatalities (N_{total}) and expected damage cost for the range of flood events considered. A fatal casualty has been estimated to cost around $6.9M (Thomson, 2018). The AAD of risk to life from flooding within the lower Manning River floodplain was calculated to be $611 000.

Table 5-4 Risk to Life Flood Damages

Design Event	Population at Risk in High Hazard Zone	Estimated # of Fatalities	Total Flood Damage ($)
20% AEP	0	0	$0
10% AEP	0	0	$0
5%	5	0	$0
2%	25	0	$0
1%	100	1	$6 900 000
0.5%	173	2	$13 800 000
0.2%	387	5	$34 500 000
PMF	4610	64	$441 600 000
AAD	**-**	**-**	**$611 000**

5.5.6 Transport Connectivity Damages

The economic impact of transport delays on the Pacific Highway, Harrington Road, Manning Point Road and Croki Road have been estimated using the ATAP (2018) framework. The key parameters influencing the cost of a traffic disruption are the number and type of vehicles affected and the length of the delay.

The NSW Roads and Maritime Services' *Traffic Volume Viewer* is available online and provides average road traffic volumes for a selection of roadside collection device stations at key locations across NSW. There are two stations on the Pacific Highway near the study area:

- 220 m north of Jack Wards Road at Kiwarrak, and
- 1.05 km north of Barton Street, Jones Island.

From the data available at these stations, the average number of vehicles per day on the Pacific Highway is 20 900 and comprises of 80% cars and 20% trucks.

In times of free-flowing traffic, the direct Pacific Highway route through the study area from the Taree Service Centre to the Port Macquarie turn-off takes around 45 minutes. With reference to the flood mapping results presented in the attached Mapping Compendium, a suggested alternate route to avoid the inundated lower Manning River floodplain is from Taree to Wauchope, via Wingham, Killabakh, Comboyne and Byabarra, re-entering the Pacific Highway near Port Macquarie.

This alternate route is expected to take just over 2 hours on a regular day. However, much of this alternate route is a relatively degraded single carriage way which would readily become congested such that the delay time would quickly increase. The road is also likely not suitable for transport of trucks and heavy vehicles. The best alternate route for freight would be the New England / Oxley Highway – a journey that would take around 7 hours (from Hexham to Port Macquarie to bypass the entire lower Manning River floodplain). It has therefore been assumed that a reasonable delay time for each vehicle disrupted by flooding on the Pacific Highway would be at least 6 hours.

For the main transport connections within the rural road network (i.e. Harrington Road, Manning Point Road and Croki Road / Barton Street), there was no data available on the *Traffic Volume Viewer* website. The number of vehicles affected by flooding of these roadways has therefore been estimated by counting the number of properties accessed via these roads and, of the average number of vehicles per property (from 2016 Census data), half of these are assumed to be impacted by flooding.

Table 5-5 summarises the assumed number of vehicles affected and the resulting total cost of a transport delay per day. The expected duration of road closure and associated damage cost for the range of flood events considered is listed in Table 5-6. The AAD of disrupted transport connectivity on the Pacific Highway resulting from flooding on the Manning River is approximately $288 000. The AAD of disrupted transport connectivity on Harrington Road, Manning Point Road and Croki Road / Barton Street is $7000, $5000 and $300, respectively.

Table 5-5 Number Vehicles Affected and Total Cost of Delay per Day

Transport Route	Number of Vehicles Affected	Cost of Delay / Day
Pacific Highway	20900	$5 790 000
Harrington Road	930	$33 500
Manning Point Road	880	$31 700
Croki Road / Barton Street	30	$1100

Table 5-6 Duration of Road Closure and Total Cost of Delay

Design Event	Pacific Hwy		Harrington Rd		Manning Point Rd		Croki Rd / Barton St	
	Duration of Closure (day)	Total Cost ($)	Duration of Closure (day)	Total Cost ($)	Duration of Closure (day)	Total Cost ($)	Duration of Closure (day)	Total Cost ($)
20% AEP	-	$0	-	$0	-	$0	0.3	$320
10% AEP	-	$0	0.8	$27 900	0.5	$15 800	0.8	$900
5% AEP	-	$0	1.2	$40 500	1.0	$31 700	1.2	$1310
2% AEP	1.2	$6 755 000	2.0	$68 400	1.8	$55 400	2.1	$2300
1% AEP	1.4	$8 202 500	2.4	$79 500	2.0	$62 000	2.3	$2520
0.5% AEP	1.8	$10 132 500	2.7	$89 300	2.1	$67 300	2.6	$2790
0.2% AEP	1.9	$11 097 400	2.9	$96 300	2.3	$73 900	2.8	$2970
Extreme*	-	$24 607 400	-	$238 600	-	$186 100	-	$7560
AAD	**-**	**$288 000**	**-**	**$7000**	**-**	**$5000**	**-**	**$300**

** PMF damages have been estimated as three times the 1% AEP damages*

5.6 Property Inundation

5.6.1 Residential and Commercial Properties

A summary of the number of properties (residential and commercial) potentially affected by above floor flooding for a range of flood magnitudes is shown in Table 5-7. Note that there are some 6200 properties in the dataset including garages and sheds.

Table 5-7 Number of Properties Affected by Above Floor Flooding

Design Event	Above floor level
20% AEP	0
10% AEP	3
5% AEP	19
2% AEP	126
1% AEP	216
0.5% AEP	426
0.2% AEP	1453
PMF	4532

5.6.2 Assets and Critical Infrastructure

Asset and critical infrastructure information was provided by MidCoast Council. The 276 assets have been grouped into the following categories:

- evacuation centres (9)
- evacuation assembly / staging area (10)
- schools (9)
- pre-schools (16)
- camping facilities (11)
- hospitals and care facilities (13)
- emergency services (23)
- utilities and transport (36)
- community (149).

The full asset register is contained in Appendix A. The location of each asset is shown in the Mapping Compendium (Figure N-01). The expected frequency of flood inundation for each site is also listed in the register. Inundation of each asset is not related to over floor flooding, rather when the site itself will become inundated.

MidCoast Water (MCW), Rural Fire Service (RFS) and various private holiday facilities operate within the floodplain, with some infrastructure becoming threatened for flood events more frequent than a 1% AEP design event.

Some of the assets represent critical or sensitive use infrastructure which typically would have more stringent planning controls with respect to flood risk. For example, the existing DCP identifies for critical use facilities to be non-suitable on any part of flood prone land affected by flooding up to the PMF (refer to Section 6.3). In this regard, critical use facilities are identified as community facilities which may provide an important contribution to the notification or evacuation of the community during flood events, emergency services and hospitals.

The following sites represent critical infrastructure that are subject to flood inundation (i.e. below PMF level) and the corresponding flood event magnitude at which inundation may initiate:

- evacuation centres
    - Harrington Function Centre (PMF)
    - Manning Point Bowling Club (PMF)
- evacuation assembly / staging area
    - Harrington Bowling Club (PMF)
- emergency services
    - Coopernook RFS (2% AEP)
    - Crowdy / Harrington Marine Rescue (PMF)
    - Harrington SES (0.2% AEP)
    - Kundle - Moto RFS (PMF)
    - Mitchells Island - Manning Point RFS Annex (2% AEP)
    - Taree Ambulance Station (PMF).

6 Review of Existing Flood Planning Provisions

Land use planning and development controls are key mechanisms by which Council can manage some of the flood related risks within flood-affected areas of MidCoast Council LGA. The Manning River FRMSP Planning Considerations report was undertaken by GLN Planning (GLN) (included as Appendix B) with the objective to:

- Review the consistency of the existing planning and development controls framework relevant to the formulation of planning instruments and the assessment of development applications within the MidCoast Council LGA
- Assist the establishment of a single comprehensive framework for floodplain risk management (FRM) planning controls
- Make specific planning recommendations regarding flood risk management, outlined in this document.

6.1 State Environment Planning Policies

The State Environmental Planning Policies (SEPPs) deal with issues significant to the State and people of New South Wales. The following SEPPs have specific relevance to flood planning within the study area.

6.1.1 SEPP Seniors Living

SEPP (Housing for Seniors or People with a Disability) 2004 applies to urban land or land adjoining urban land where dwellings, hospitals and similar uses are permissible. The Seniors Living SEPP would apply to parts of the study area and would effectively override Council's planning controls to permit residential development for older and disabled persons to a scale permitted by the SEPP. Notwithstanding, Clause 6(2)(a) of the SEPP restricts its application if land is identified as floodways or high flooding hazard in Council's LEP.

6.1.2 SEPP Codes

SEPP (Exempt and Complying Development Codes) 2008 is divided into several "Codes" that deal with exempt development and different types of complying development. Those Codes of specific relevance to the study area or LGA are the Exempt Development Codes (Part 2), the General Housing Code (Part 3), the Rural Housing Code (Part 3a) and the Commercial and Industrial (New Buildings and Additions) Code (Part 5a). Important considerations for the FRMP, in regard to establishing rules for development that could be approved as complying development requiring a Complying Development Certificate (CDC), is the defining of high-risk areas (where complying development is excluded) and setting of minimum floor levels. The objective should be to ensure that such future development does not lead to increased flood risk to property and persons as a consequence of the application of the CDC process in comparison to outcomes otherwise likely to be achieved through the full DA process. At the same time, the outcome of the FRMP should not create unnecessary administrative burdens on the public and council by requiring a DA where this would be of no likely benefit to reducing flood risk.

6.1.3 SEPP Rural Lands

SEPP (Rural Lands) 2008 is relevant to the rural zones within the study area. The SEPP is principally aimed at maintaining the agricultural potential of rural zoned land. Consequently, the Rural Lands SEPP could have the effect of restricting more intensive non-agricultural activity in locations identified as "significant agricultural land" that can in many situations coincide with the floodplain.

6.2 MidCoast Local Environment Plan

A Local Environmental Plan (LEP) is prepared in accordance with Part 3 Division 4 of the EP&A Act 1979 and operates as a local planning instrument that establishes the framework for the planning and control of land uses. The LEP defines zones, permissible land uses within those zones, and specific development standards and special considerations regarding the use or development of land.

In 2016 The MidCoast Council formed after the amalgamation of Gloucester Shire, Great Lakes Council and City of Taree Council. Currently the Land use Planning within MidCoast Council is regulated by the flowing LEPs:

- Greater Taree Local Environment Plan 2010
- Gloucester Local Environment Plan 2010
- Great Lakes Local Environment Plan 2014.

Council is working towards merging the above three LEPs into one. An overview of the current LEP FRM Planning Provisions under the three LEPs is identified in the complete GLN report (Appendix B). A key provision for FRM is the definition of the Flood Planning Level (FPL). The definition of the FPL in each of the various LEP's is summarised in Table 6-1.

Table 6-1 Flood Planning Definitions within MidCoast Council

Council Area LEP	FPL Definition
Greater Taree	1% AEP plus 0.5 m freeboard
Gloucester	1% AEP plus 0.5 m freeboard
Great Lakes	**a)** areas where flooding is affected by ocean water levels - the level of 1% AEP flood event estimated using an ocean water level 0.9 m above the 1990 mean sea level, plus 0.5 free board, *OR* **b)** in other areas - the level of 1% AEP flood event plus a 0.5 m freeboard.

In addition to the standard definition for residential development (FPL of the 1% AEP plus 0.5 m freeboard) specified in the 2007 Flood Planning Guideline, Great Lakes also factors in a climate change related sea level rise benchmark that was mandated by the state government from 2010 to 2012.

6.3 Greater Taree Development Control 2010

Similar, to the LEPs the Development Control Plans (DCP) within MidCoast Council are regulated by the existing DCPs formed prior to the amalgamation of the councils, these are:

- Greater Taree Development Control Plan 2010
- Greater Lakes Development Control Plan 2013
- Gloucester Development Control Plan 2011.

The Manning River Study area is within the former City of Taree council LGA and consequently any development in within the study area must adhere to the Greater Taree Development Control Plan 2010. It contains discrete sections for different types of development subdivision, residential, commercial, rural and environmental and industrial, and issue related matters (character statements, heritage, carparking and access, local area plans, waste, landscaping and floodplain management). Part E “Flooding Requirements” of the Greater Taree DCP contains the most relevant provisions for FRM. This part of the DCP applies to all parts of the original Taree City LGA “affected by flooding and affected by or potentially affected by overland flow” (cl.E2.3). This approach is further outlined in the GLN report (Appendix B).

To determine the DCP provisions of a development type the DCP applies a range of FPLs as outlined in Table 6-2.

Table 6-2 FPLs Used in the Greater Taree DCP

Reference	Description
FPL1	5% AEP (20 Year ARI) flood level.
1% Flood Level	1% AEP (100 Year ARI) flood level. This level is useful for insurance purposes.
FPL2	2100 1% AEP (100 Year ARI) flood level.
FPL3	2100 1% AEP (100 Year ARI) flood level plus 0.5m freeboard.
FPL4	Probable Maximum Flood (PMF) level

The following summaries the required provisions for the Hydraulic/Hazard category, Floor Levels and Evacuations controls which are further reviewed in the GLN report (Appendix B). The DCP control on the Hydraulic/ Hazard category requires that no development occurs in floodway, flood storage area or a high hazard. Allowances to these provisions is provided for alternate solutions where justified by a study. Hydraulic/ Hazard category provisions:

- FPL4 for sensitive uses and facilities
- FPL3 for residential, commercial/industrial, tourist
- FPL1 for recreation/non-urban
- FP2 for concessional development.

The provisions for the DCP control Floor Levels are listed below. Where floor levels are non-habitable, controls typically allow a lower FPL. Subdivision is restricted on land wholly inundated by flooding up to a FPL2 event. Floor level provisions are as follows:

- FPL4 for sensitive uses and facilities
- FPL2 for residential, commercial/industrial, tourist, recreation/nonurban, and concessional development.

DCP controls for evacuation specify that reliable access for pedestrians or vehicles is required from the building, commencing at a minimum level equal to the lowest habitable floor level to a refuge area above FPL4 for sensitive uses. A flood emergency response plan (FERP) is required for all other uses.

6.4 Development Contributions

Section 7.11 (formerly section 94) Contributions Plans under the EPA Act provide a basis for the levying of development contributions to construct drainage and flood mitigation works required as a result of future development. where such works are required to ensure the acceptability of development and where it would be unreasonable to expect it to be provided in association with an individual development. Examples of such works could be the construction of a levee, a regional detention basin or upgrading of evacuation routes or evacuation centres.

The study area falls within the former Taree LGA and is subject to the Greater Taree S94 and S94A Contributions Plans (both prepared by GLN and dated 2016). These plans are based on an anticipated growth of about 2,230 dwellings (15,800 persons) between 2016 and 2031. The works program in the S94 and S94A Contributions Plans do not include any FRM related works. However, some of the road works provided for in these plans could indirectly improve evacuation capabilities in some areas. In principle, Contribution Plans could be established within the study area, where it is necessary or appropriate to fund flood mitigation works through such plans. This would be relevant in new greenfield release areas or substantial urban renewal areas where such works are required to ensure the acceptability of the development (e.g. for the upgrading of evacuation routes or evacuation centres to cater for increased population densities, or regional stormwater detention basins).

Where works are required for both existing and future development the cost could be apportioned between future development (within a Contributions Plan) and existing development (to be funded by Council through general revenue or other sources such as special grants).

It is expected that new development will be planned with current knowledge of flood liability and will be exposed to minimal (residual) risks compared to the flood liability of existing development. Accordingly, the potential to use developer contributions to fund FRM mitigations options is likely to be limited. For further information on development contributions see GLN report (Appendix B).

7 Potential Floodplain Management Measures

Measures which can be employed to mitigate flooding and reduce flood damages can be separated into three broad categories:

- **Flood modification measures**: modify the flood's physical behaviour (depth, velocity) and includes flood mitigation dams, retarding basins, on-site detention, channel improvements, levees, floodways or catchment treatment;
- **Property modification measures**: modify property and land use including development controls. This is generally accomplished through such means as flood proofing (house raising or sealing entrances), planning and building regulations (zoning) or voluntary purchase; and
- **Response modification measures**: modify the community's response to flood hazard by informing flood-affected property owners about the nature of flooding so that they can make informed decisions. Examples of such measures include provision of flood warning and emergency services, improved information, awareness and education of the community and provision of flood insurance.

The following sections provide a first pass assessment of options by determining if they would be applicable / suitable to the flooding characteristics of Manning River.

7.1 Flood Modification Measures

The principal flooding mechanism in the study area is major flooding of the Manning River. Much of the affected area is rural floodplain, with limited opportunity for flood modification options to mitigate flooding on a catchment scale. Under climate change scenarios, existing flooding conditions are expected to gradually exacerbate in the study area.

There are a few locations with a significant concentration of properties for which flood modification measures may provide a practical solution, including the Taree CBD, around Browns Creek and at Cundletown and Croki. The provision of a levee construction has been assessed for each of these locations.

For much of the rural floodplain area, the existing flood risk exposure to existing property is high and largely emanates from evacuation and accessibility issues, due to the road network readily becoming inundated. Raising of the road network within the study area including the Pacific Highway and local access roads has been assessed.

7.1.1 Levee Options

Levees are built to exclude potentially inundated areas of the foreshore from flooding up to a prescribed design event level. Provided the integrity of the levee can be assured, levees are very effective in providing direct protection of property to flood inundation to the levee design height. Structural failure of the levee or overtopping of the levee from a flood event larger than the design standard, can result in rapid inundation of areas behind the levee. This can in fact provide a greater flood hazard to both people and property.

Different types of levee construction are available, e.g. earthen levee or flood wall arrangement. In terms of their function for floodwater exclusion they perform comparably. However, there is considerable variation in construction costs, land area requirements, visual impact and impact on foreshore access.

The construction of a levee is a significant investment and involves a range of challenges that need to be overcome, including:

- potential adverse impacts to property situated outside of the levee extent
- constraint of potential future development outside of the levee extent
- existing land ownership and required easement acquisition
- relocation of existing services
- clearing of native vegetation
- provision of a freeboard allowance and failure mechanism for floods exceeding the standard of protection.

Any levee alignment will be required to tie into existing high ground to ensure no bypass of the levee system by floodwater. Four locations in the study area have been identified for potential levee protection:

LV1) Taree CBD

LV2) Taree at Browns Creek

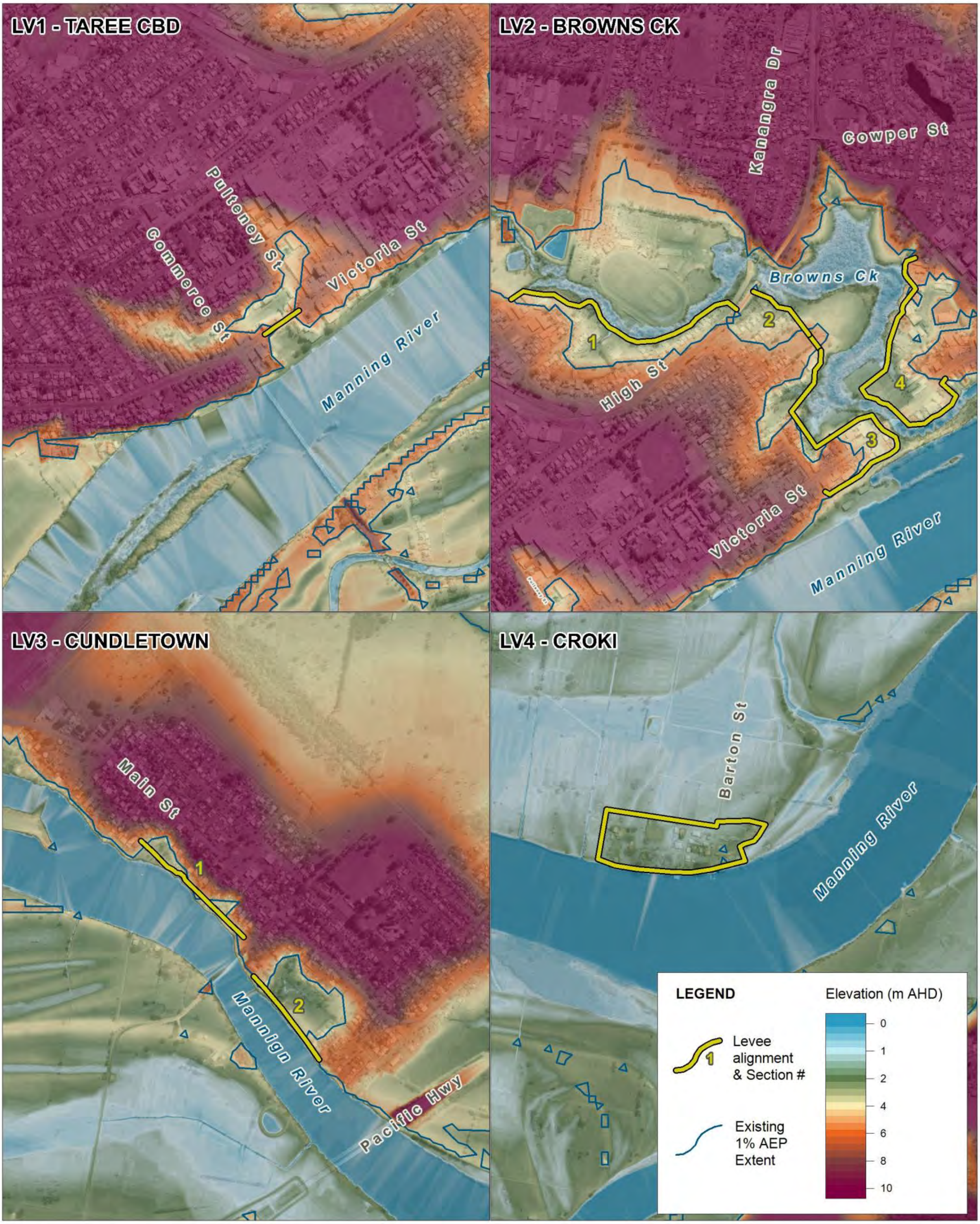
LV3) Cundletown

LV4) Croki.

Each of these locations is shown on Figure 7-1. An initial assessment of viability was undertaken for each of the levee sections, to determine approximate construction costs and reductions in the cost of flood affectation (see Section 7.1.1.2). This provides an indicative Benefit-Cost Ratio (BCR) with which to measure the viability of individual sections of levee, with the most beneficial levees being considered for more detailed investigation.

Part of the Taree CBD (situated between Commerce Street and Pulteney Street) is relatively low-lying and was flooded during the 1978 event. The construction of a levee offers the potential to reduce flood affectation and damages. Any levee works would need to be accompanied by local drainage upgrades to prevent the ingress of water behind the levee through the stormwater pipe network. Only a relatively short length of levee would be required to protect the CBD. To the east of the Taree CBD, there are many properties located along Browns Creek that are impacted by backwater flooding from the Manning River. The Browns Creek levee can be considered in multiple sections. Indicative levee alignments for Taree CBD and Browns Creek are seen on Figure 7-1.

The communities of Cundletown and Croki are situated adjacent to the northern bank of the Manning River. Within each community there are numerous properties impacted by mainstream Manning River flooding. With reference to Figure 7-1, the Cundletown levee can be considered in two separate linear sections. At Croki, a ring levee would be required to completely exclude all floodwater.



Title:
Indicative Levee Alignments

Figure: 7-1

Rev: A

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

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Approx. Scale

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7.1.1.1 Levee Design Considerations

A levee offers protection for flood events up to the magnitude of event to which it is designed. A suitable level of freeboard is identified, and the levee crest height is set at the level of the design flood plus the freeboard allowance. Whilst the constructed crest height might be higher than larger flood events than the design magnitude, the levee does not guarantee protection against them and this needs to be considered when designing and undertaking modelling assessments of the levee.

The level of freeboard selected during levee design typically ranges from 0.5 m to 1.0 m and considers factors such as flood depth, duration and length of fetch across the floodplain. The design of a levee also needs to consider failure mechanisms for flood events greater than the design flood magnitude. For existing levees, modelling assessments include breaching of the levee for the larger flood events. For the design and construction of new levees it is standard practice to incorporate controlled breaching into the design through the construction of spillways set at a lower height than the broader levee crest.

To achieve the desired standard of protection the levee spillway crest is set at the chosen design flood level plus the freeboard level and the broader levee crest is constructed to a higher level. Therefore, a levee with a 1% AEP standard of protection requires spillways 0.5 m higher than the post-levee 1% AEP flood level and a broader levee crest height say 0.8 m higher than the 1% AEP flood.

The Office of Environment and Heritage (OEH) Guidelines require a reasonably significant levee height, regardless to what standard of protection the levee is constructed. The 0.5% AEP flood level across the lower Manning River floodplain is around 0.2 to 0.4 m higher than that of the 1% AEP flood level. To maximise the benefit of this investment in terms of reducing flood risk, it is assumed a minimum levee design standard would be at the existing 0.5% AEP flood level plus an 0.5 m freeboard allowance.

Depending on the existing topography and the required height of levee construction, levees can provide for a marked change to the foreshore landscape. An earthen levee construction would typically have a top width of 1 – 2 m (greater if vehicular access was required) and sloping side batters (e.g. 1:4 vertical: horizontal). Just the space required to construct an earthen levee represents a substantial footprint and land take area. In areas where there is limited width of public space on the foreshore, current private land would be required to construct the levee. The footprint for a wall type construction would be considerably less but may still require some private land acquisition.

Local drainage behind levees is also an important consideration in the design. Flood gates allow local run-off to be drained from areas behind the levee when water levels in the river channel are low and prevent floodwaters from entering under elevated water level conditions. Pumps may also be used to remove local runoff behind levees when flood gates are closed.

7.1.1.2 Preliminary Assessment of Levee Performance

Assuming the integrity of the levee is sustained to the design standard, the levees would be effective in eliminating flood damage to protected properties for events up to the nominal design height (i.e. 0.5% AEP design event). The number of properties protected for each of the levee scenarios is summarised in Table 7-1.

Table 7-1 Number of Properties Protected by Each Levee Section

Design Event	LV1	LV2 (1)	LV2 (2-3)	LV2 (4)	LV3 (1)	LV3 (2)	LV4
5% AEP	0	2	3	2	0	2	1
2% AEP	0	8	14	12	0	3	2
1% AEP	11	14	21	18	1	4	2
0.5% AEP	23	22	30	22	4	6	3

The reduction in property flood damages afforded by the levee system in summarised in Table 7-2. The damages calculations assume flood protection up the existing 0.5% AEP design flood level.

Table 7-2 Reduction in Annual Average Flood Damages for Levee Sections

Levee Section	AAD Reduction
LV1	$29 900
LV2 (1)	$107 300
LV2 (2-3)	$89 300
LV2 (4)	$133 300
LV3 (1)	$5 300
LV3 (2)	$26 100
LV4	$18 800

Levees are not a failsafe management option in terms of eliminating inundation from protected areas, noting potential failure or overtopping by a larger event. The available storage volume in the area protected behind the levee is very small relative to the overall flood volumes being conveyed through the lower Manning River floodplain and would be expected to fill quickly once overtopping occurs.

There is also potential for flood behaviour to be modified due to levee construction. Where peak flood levels impacts do arise, they are localised to within the Manning River reach adjacent to the levee itself and are typically less than 0.05 m.

7.1.1.3 Cost Estimate and BCR

The planning, design and construction effort involved in implementing a levee protection system is a substantial investment. The cost of a levee system can vary significantly and will depend on factors such as construction material, levee height, acquisition of land, undertaking of feasibility studies, resolving of internal drainage issues, legislative costs and machinery and labour costs.

An indicative cost of levee construction has been based on data presented by BMT (2018) and WMA water (2015). A linear relationship was developed to provide a cost estimate based on average levee height. Expected costs range from around $1400 per metre length for a levee with an average height of 0.5 m, to around $1800 per metre length for a levee with an average height of 4 m.

These cost estimates are indicative only. Many factors such location of levee construction (e.g. foreshore environment or within the Taree CBD) may result in significantly higher levee construction costs. In addition to the capital cost, a levee system also requires regular inspections for erosion/failure and maintenance for vegetated banks.

As mentioned, substantial additional capital cost could be incurred through acquisition of property to construct the levee. This may be required where there is little buffer between the property boundaries and the foreshore/waterway. Dependent on the alignment and construction technique, acquisition of part or full property would be required. The cost of acquisition could potentially exceed the levee construction cost, and has not been accounted for in this cost estimate.

Table 7-3 summarises the peak flood levels at each of the levee locations, the required height and length of each of the levee options and a preliminary cost estimate for levee construction.

Table 7-3 Preliminary Levee Details and Cost Estimate

Location	Length (m)	Peak flood levels (m AHD)			Height of levee (m)		Cost estimate / m	Total cost (with 30% contingency)
		1% AEP	0.5% AEP	0.5% AEP + 0.5 m	Max.	Avg.		
LV1	130	5.3	5.7	6.2	1.3	0.9	$1400	$236 600
LV2 (1)	1095	4.9	5.3	5.8	5.0	2.6	$1600	$2 277 600
LV2 (2-3)	1540	5.1	5.4	5.9	5.8	2.0	$1600	$3 203 200
LV2 (4)	985	5.0	5.3	5.8	4.1	2.3	$1600	$2 048 800
LV3 (1)	450	4.5	4.8	5.3	2	1.1	$1500	$877 500
LV3 (2)	340	4.1	4.5	5.0	5.3	1.4	$1500	$663 000
LV4	1315	2.9	3.1	3.6	2.6	1.9	$1500	$2 564 250

With reference to the reductions in flood damages afforded by the levee system (under existing flood conditions) along with the expected capital cost of levee construction, the benefit-cost ratio (BCR) for each levee section is calculated in Table 7-4. When assessing the performance of a levee scheme over a standard 50-year life span, the reduction in damages must be reduced to a net present-day value. BCRs have therefore been calculated by adopting a discount rate of 4%, 7% and 11%.

Table 7-4 Benefit-Cost Ratio (BCR) of Levee Sections

Location	BCR @ 7%	BCR @ 4%	BCR @ 11%
LV1	1.74	2.71	1.14
LV2 (1)	0.65	1.01	0.43
LV2 (2-3)	0.38	0.60	0.25
LV2 (4)	0.90	1.40	0.59
LV3 (1)	0.08	0.13	0.05
LV3 (2)	0.54	0.85	0.36
LV4	0.10	0.16	0.07

The benefit-cost comparison would indicate that levee construction in the Taree CBD (LV1) is economically viable. Two of the Browns Creek levee construction sections (LV2 1 and 4) are also potentially feasible.

7.1.2 Road Upgrades

In the flood planning context for the lower Manning River floodplain area, the elevation of major transport routes and local access roads directly influence the definition of the roads flood immunity and accordingly its flood access and evacuation potential. The existing flood immunity of transport routes will lessen under the influence of climate change as design flood levels progressively increase. Works to improve the flood immunity of roadways can be done as stand-alone construction work or incorporated into the ongoing maintenance and resurfacing of the road network.

Roads within the study area that have been identified to benefit from potential road raising works are:

RR1) Pacific Highway

RR2) Harrington Road

RR3) Manning Point Road

RR4) Croki Road and Barton Street

The location of each identified road alignment is shown on Figure 7-2 along with longitudinal chainages and floodplain topography (as defined by available LiDAR data).

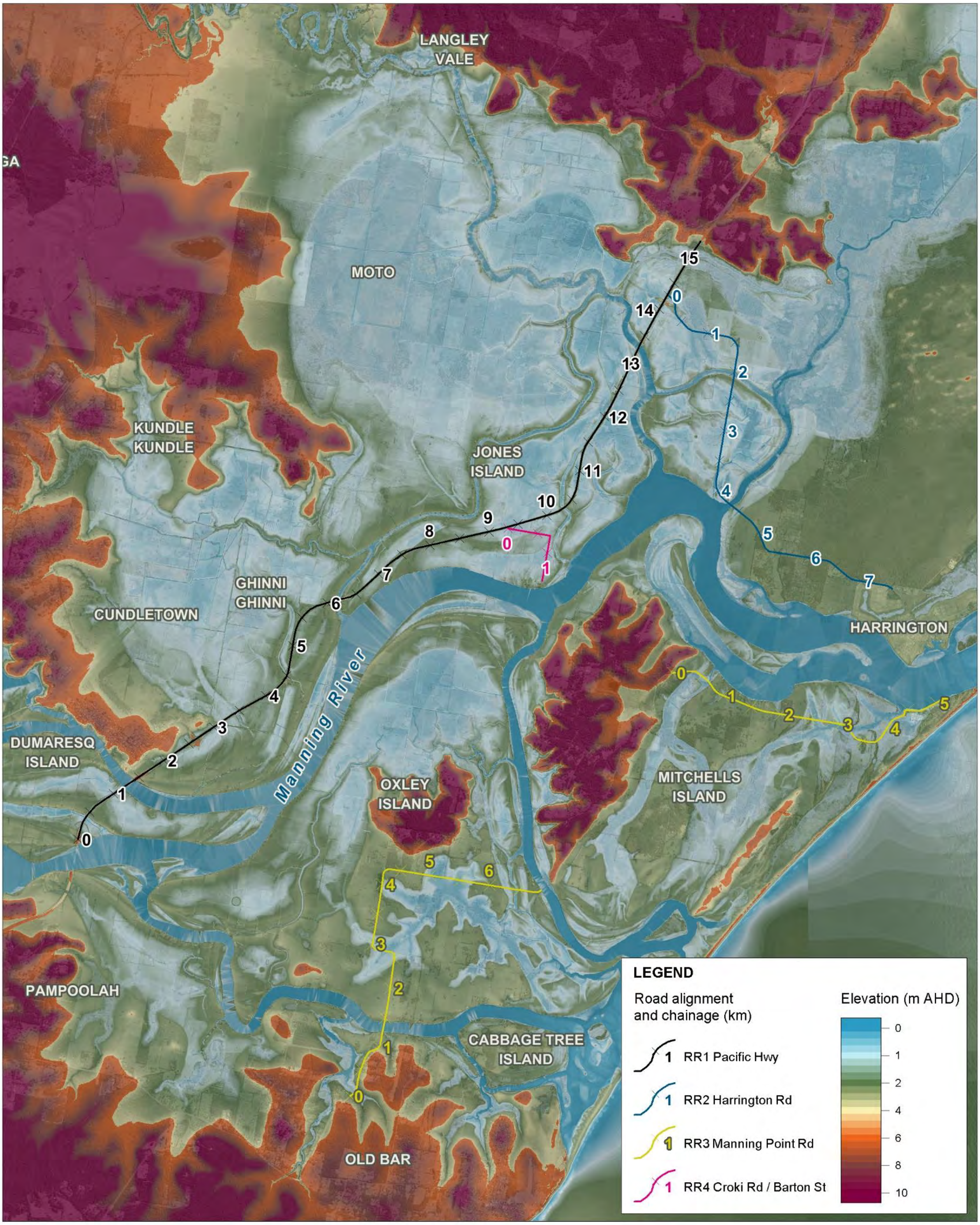
The Pacific Highway is a major transport route servicing the NSW east coast. The Pacific Highway Taree Bypass was constructed between 1993 and 2000 and crosses both the north and south arms of the Manning River just downstream of Cundletown. The section of Pacific Highway between the Taree South Service Centre and Johns River is constructed on an elevated embankment, typically some 1.0 - 2.0 m above floodplain levels. The Pacific Highway is known to have flooded during past flood events, such as June 2011.

Harrington Road, Manning Point Road and Croki Road / Barton Street have been highlighted as significant local connection routes that can become closed during flood events. Figure 7-2 shows the location of these road connections linking communities within the lower Manning River floodplain.

7.1.2.1 Existing Flood Immunity of Road Network

The long-section profiles along the Pacific Highway route are presented in Figure 7-3 and Figure 7-4 to demonstrate relative flood levels and identify lengths of the routes susceptible to inundation under existing flooding conditions. The lowest lying portion of the highway is between Ghinni Ghinni Creek and Coopernook Creek where the road profile provides for at least a 5% AEP flood immunity under existing flood conditions. The remaining section of highway has between a 2% AEP and 0.2% flood immunity.

Harrington Road is the main access road for the population of Harrington. From the Pacific Highway exit, the 7.5 km length of road is flood prone to varying levels of immunity, as depicted in the long-section profile of Figure 7-5. The lowest lying section of road falls between the Tappin Creek and Cattai Creek crossings. Under existing flood conditions, this has immunity to a 20% AEP Manning River flood event. At the 10% AEP design flood event, the depth of overtopping is in the order of 0.2 m. By the 2% AEP event, depths of inundation of over 1.0 m are expected to occur. The 2 km section of road from the Pacific Highway exit to Tappin Creek is immune to the 5% AEP design event (only minor flooding was simulated at the 5% AEP design event).



Title:
Road Network

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BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

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At the 2% AEP design event, depths of flooding across the road of up to 0.7 m are modelled. The length of road between Cattai Creek and Harrington is positioned on higher land and will first become inundated during flood events of rarer magnitude than the 0.5% AEP design event.

Manning Point Road is the only transport route into the township of Manning Point and provides connection to the localities of Mitchells Island and Oxley Island. Figure 7-6 shows the long-section profile along the 7 km stretch of Manning Point Road, from south of Bohnock to the Scotts Creek crossing, traversing the Manning River South Arm channel and Oxley Island. The lowest point along Manning Point Road is the area on either side of the Tea Tree Lane intersection. Comparison of the design peak flood levels with the elevation along the road indicate this low point will overtop under existing Manning River 10% AEP design peak flood levels. Depth of inundation will be by less than 0.2 m of floodwater. At the 2% AEP design event much of the length of road is inundated with depths of over 1.0 m modelled.

A second approximately 5 km section of Manning Point Road linking Mitchells Island with Manning Point (shown in Figure 7-7) is also very low-lying. The existing road profile provides for immunity to the 5% AEP deign flood event under existing flood conditions. A small section of the road near Millers Creek and the length between Oystercatchers Road and Ocean Parade will overtop at the 2% AEP with depth of 0.25 – 0.35 m modelled. The stretch of Manning Point Road between these two low-points (i.e. between Scotts Creek and Millers Creek) is aligned along high ground that is elevated well above the floodplain area and remains dry even at the PMF event.

One of the first communities to become isolated during a flood event on the Manning River is Croki. Access to the township from the Pacific Highway is via Croki Road and Barton Street. The long-section along this route is shown in Figure 7-8. Road elevations here are between 1.3 - 1.9 m AHD. Under existing flood conditions, the 20% AEP and 10% AEP design flood levels are 1.5 m AHD and 1.8 m AHD, resulting in depth of inundation on the road reserve of up to 0.2 m and 0.5 m, respectively. At the 1% AEP design flood event, the roadway and surrounding floodplain area is inundated by around 1.5 m of floodwater.

Significant lengths of Manning Point Road, Harrington Road and Croki Road are subject to inundation for relatively frequent flood events (i.e. the 20% AEP, 10% AEP and 5% AEP design events). The safety and trafficability of the local road network for private access as well as flood evacuation purposes is significantly compromised.

Table 7-5 provides a summary of the approximate length and duration of inundating that each roadway will be subject to at various design levels for existing, 2050 and 2100 planning conditions. This provides an indication of the extent of road raising works that would be required to maintain a given flood immunity along the highway and demonstrates how the flood immunity of the road network will gradually reduce with the influence of climate change.

7.1.2.2 Preliminary Assessment of Road Raising

Raising of each of these low-lying road sections has been considered as a potential management option to improve safety and serviceability of the road network within the study area, as well as assisting to combat the impacts of progressive climate change. The performance of raising each of the identified transport routes to a 1% AEP flood immunity is assessed in this Section.

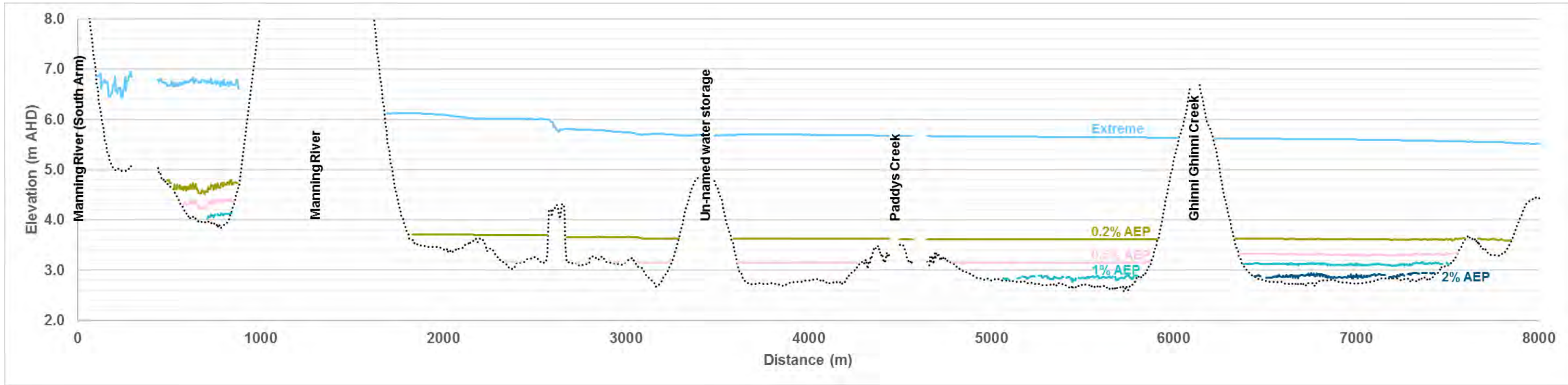


Figure 7-3 Pacific Highway Profile and Peak Flood Level Surfaces – Manning River South Arm to Jones Island

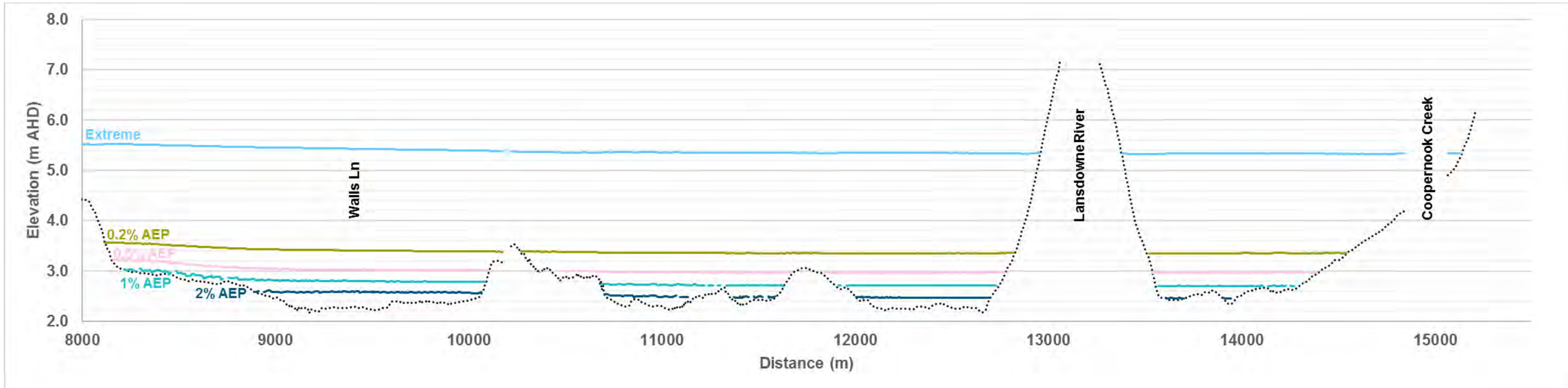


Figure 7-4 Pacific Highway Profile and Peak Flood Level Surfaces – Jones Island to Coopernook Creek

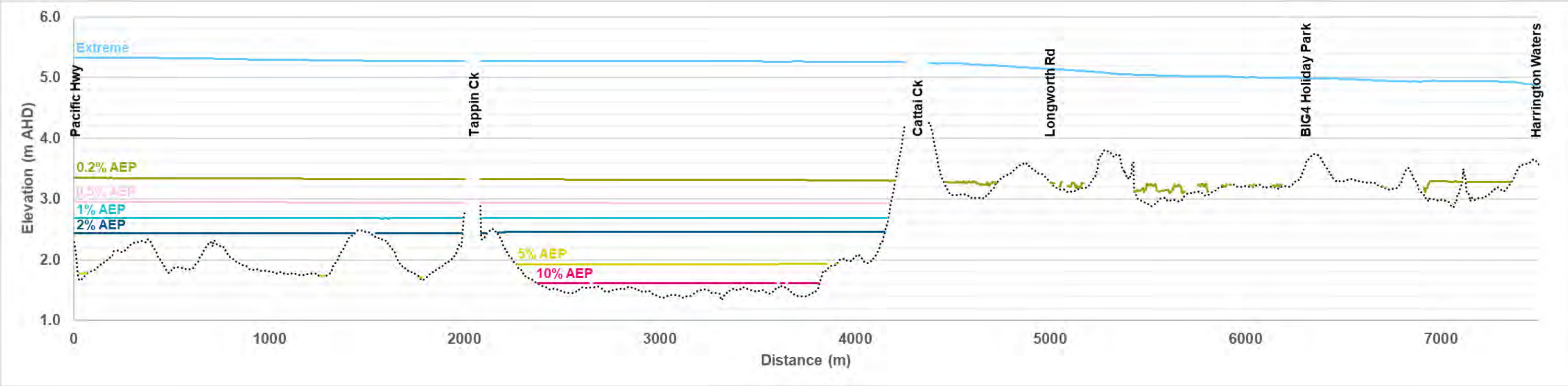


Figure 7-5 Harrington Road Profile and Peak Flood Level Surfaces – Pacific Highway to Harrington Waters

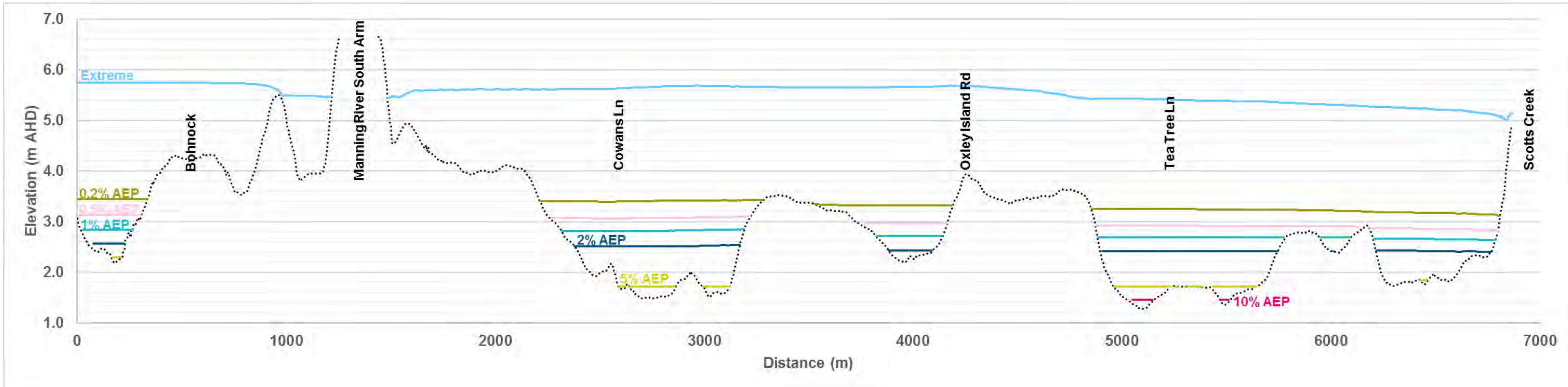


Figure 7-6 Manning Point Road Profile and Peak Flood Level Surfaces – Bohnock to Scotts Creek

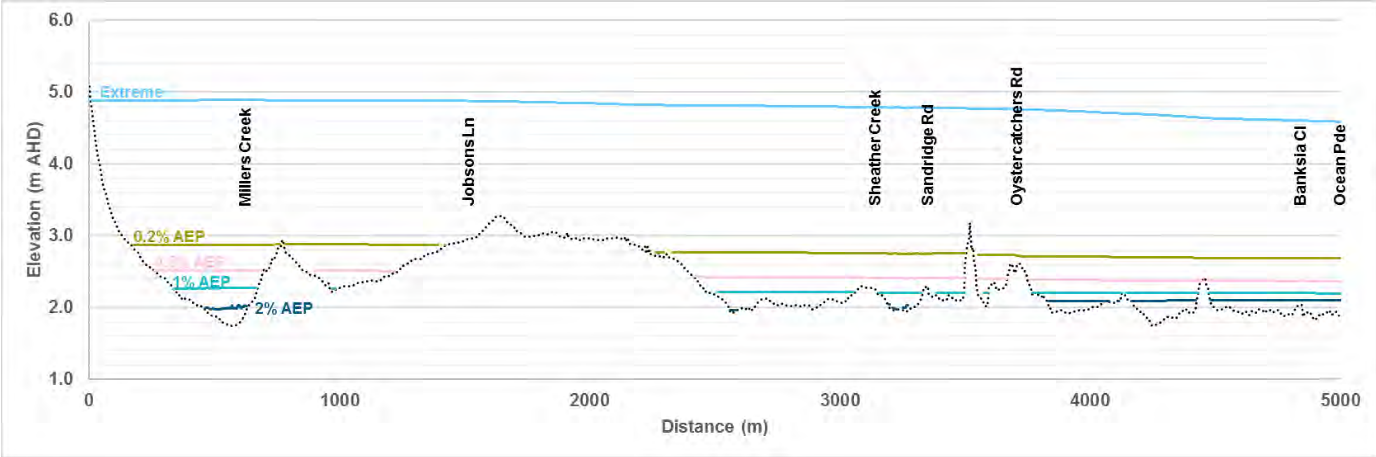


Figure 7-7 Manning Point Road Profile and Peak Flood Level Surfaces – Scotts Creek to Manning Point

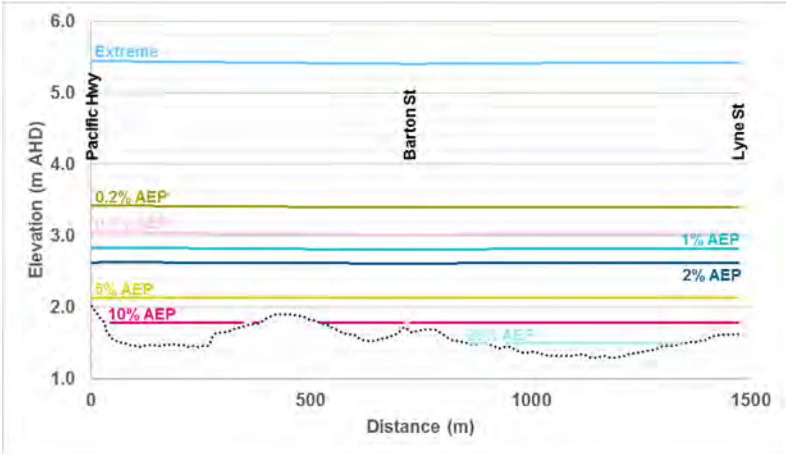


Figure 7-8 Croki Road / Barton Street Profile and Peak Flood Level Surfaces – Pacific Highway to Croki

Table 7-5 Local Road Inundation Summary – Length and Duration of Road Overtopped

Design Event	Pacific Highway		Manning Point Road		Harrington Road		Croki Road / Barton Street	
	Length (km)	Duration (h)	Length (km)	Duration (h)	Length (km)	Duration (h)	Length (km)	Duration (h)
Current 20% AEP	-	-	-	-	-	-	0.5	7
Current 10% AEP	-	-	0.2	12	1.6	20	1.3	20
Current 5% AEP	-	-	1.8	24	2.5	29	1.5	29
Current 2% AEP	4.2	28	5.0	42	4.1	49	1.5	51
Current 1% AEP	6.7	34	6.3	47	4.2	57	1.5	56
Current 0.5% AEP	9.3	42	7.2	51	4.3	64	1.5	62
Current 0.2% AEP	11.2	46	8.7	56	6.2	69	1.5	66
Future 2050 1% AEP	7.8	38	7.0	54	4.3	65	1.5	60
Future 2050 0.5% AEP	9.8	42	7.4	57	4.6	69	1.5	65
Future 2050 0.2% AEP	11.3	48	8.9	63	6.4	72	1.5	69
Future 2100 1% AEP	10.2	52	8.3	99	5.6	95	1.5	94
Future 2100 0.5% AEP	11.0	56	8.6	99	6.4	95	1.5	94
Future 2100 0.2% AEP	11.7	60	10.1	99	7.0	95	1.5	94

The peak 1% AEP design flood level impact resulting from raising the identified routes to a 1% AEP immunity is shown in Figure 7-9 to Figure 7-12.

With reference to Figure 7-9, raising of the Pacific Highway results in peak flood level impacts in the order of 0.05 m, extending upstream to Cundletown and through Oxley Island. Impacts of up to 0.25 m are simulated south of the highway between Cundletown and Ghinni Ghinni. At the 2% AEP design event (not shown), the modelling indicates that an approximate 3.5 km length of increased flood levels extends south of the highway near Croki. Local impacts are also modelled south of Ghinni Ghinni around Paddys Creek.

Raising of Harrington Road to provide a 1% AEP design flood immunity results in a reduction in peak flood levels east of the road, within the Crowdy Bay National Park area. A localised area of increased levels of less than 0.03 m is modelled on the western side of the road south of Coopernook. These results are shown on Figure 7-10. Similar results are simulated for the more frequent events, albeit to a lesser extent.

Provision of a 1% AEP design flood immunity along Manning Point Road impacts flood levels across a significant portion of the floodplain area downstream of Cundletown, as see on Figure 7-11. Due to the nature of the distribution of floodwater across the lower floodplain between the main channel and south arm of the Manning River (i.e. Oxley Island and Mitchells Island), raising of the two sections of road limit the volume of floodwater entering this area and therefore result in a decrease in peak flood levels by up to 0.4 m. Upstream of the road raising in Oxley Island, peak flood levels increase by around 0.05 - 0.1 m. Directly upstream of Manning Point Road, increases of up to 0.5 m are modelled.

With reference to Figure 7-12, the most significant increases in peak flood levels resulting from raising Croki Road and Barton Street to a 1% AEP design flood immunity is modelled directly upstream of the road embankment where levels increase by around 0.15 m. The impacted area extends around 3.6 km upstream along the Manning River channel. Peak flood levels also increase on the northern floodplain near Cundletown and Ghinni Ghinni – typically by around 0.03 m but up to 0.07 m.

The number of properties affected by either an increase or decrease in peak flood levels are summarised in Table 7-6 for each of the road raising scenarios considered.

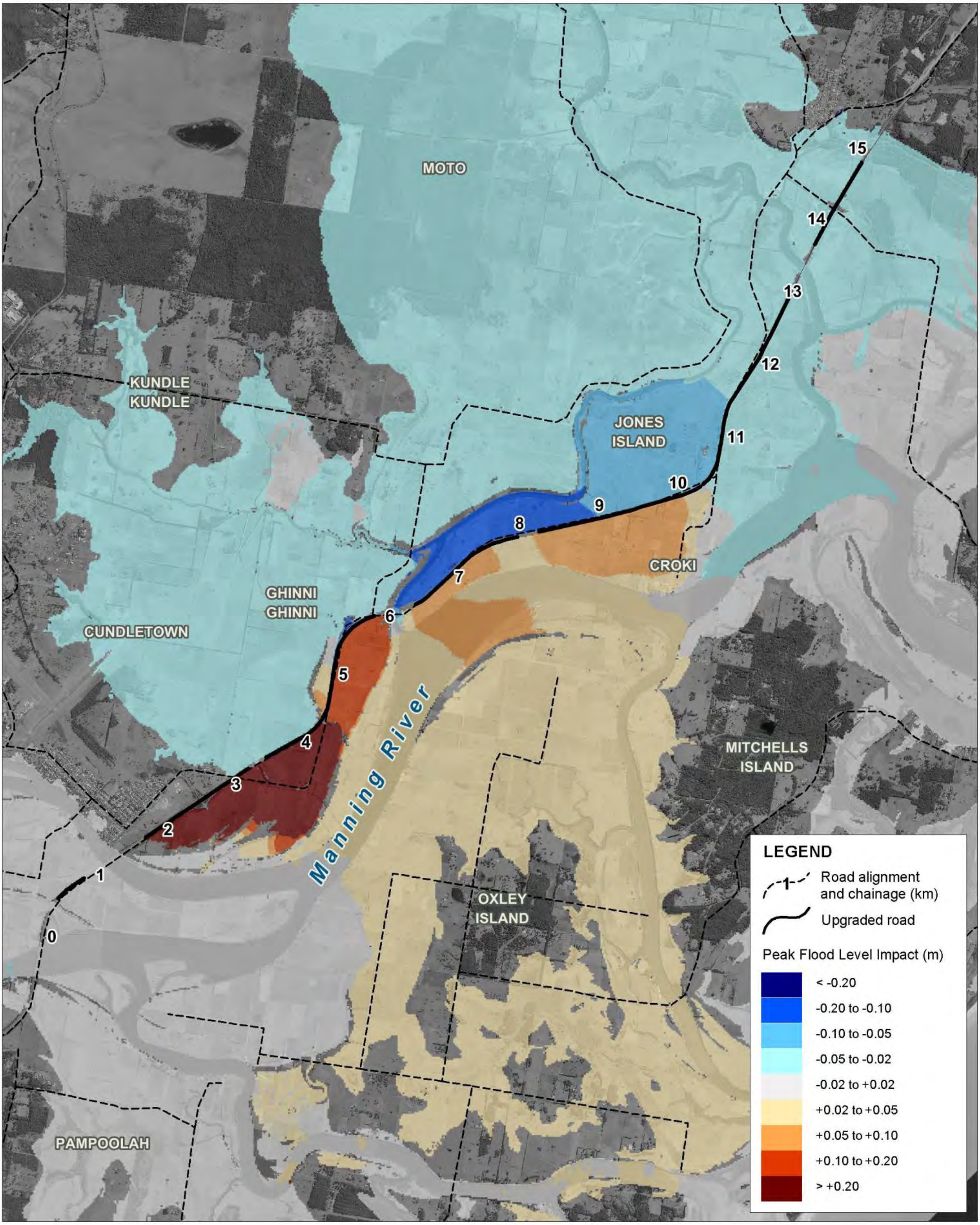
Table 7-6 Number of Properties Impacted with an Increase or Decrease in Peak Flood Level for Road Raising Scenarios

Design Event	RR1		RR2		RR3		RR4	
	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease
20% AEP	0	0	6	0	11	2	9	0
10% AEP	12	11	58	5	17	6	62	3
5% AEP	99	134	84	90	140	93	172	66
2% AEP	480	260	479	265	572	155	465	295
1% AEP	713	271	916	93	882	110	666	331
0.5% AEP	1021	330	1147	123	1203	113	684	631
0.2% AEP	1101	803	1533	333	1655	210	1079	744

Although a significant number of properties are affected by either an increase or decrease in peak flood level, this does translate to any major change to overall number of properties flooded above floor level. Table 7-7 summarises the total number of properties affected by above floor flooding under each road raising scenario. In some cases, the number of properties flooded above floor levels has reduced post-road raising and is due to the higher road crest acting in the same way as a levee would to protect surrounding properties from inundation.

Table 7-7 Number of Properties with Above Floor Flooding for Road Raising Scenarios

Design Event	Existing	RR1	RR2	RR3	RR4
20% AEP	0	0	0	0	0
10% AEP	3	3	3	3	3
5% AEP	21	19	19	19	21
2% AEP	126	125	126	130	126
1% AEP	221	218	221	225	221
0.5% AEP	426	433	425	425	420
0.2% AEP	1455	1483	1449	1468	1447



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Pacific Highway Raising to 1% AEP Immunity
Peak Flood Level Impact at the 1% AEP Design Event

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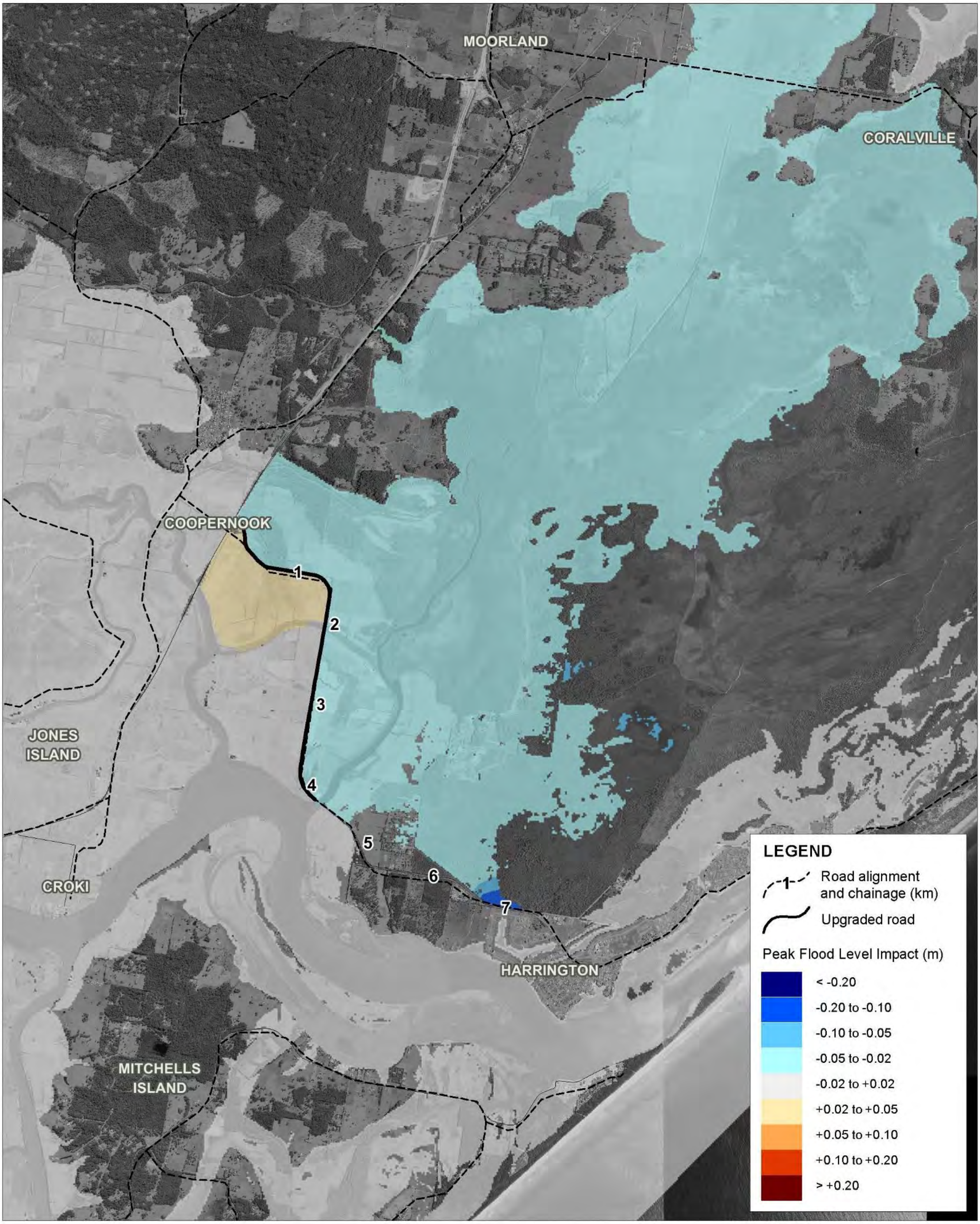

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Harrington Road Raising to 1% AEP Immunity
Peak Flood Level Impact at the 1% AEP Design Event

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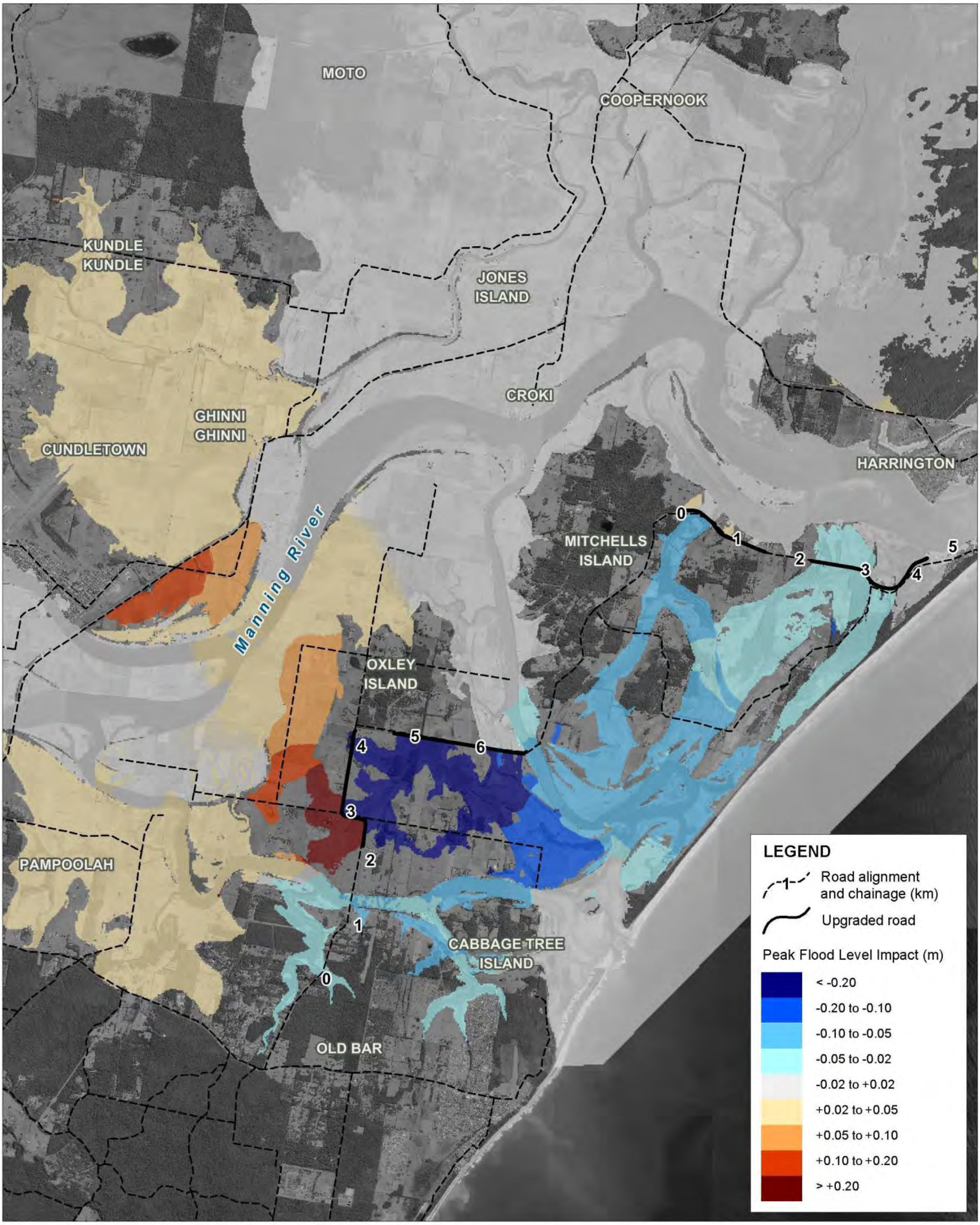

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Manning Point Road Raising to 1% AEP Immunity
Peak Flood Level Impact at the 1% AEP Design Event

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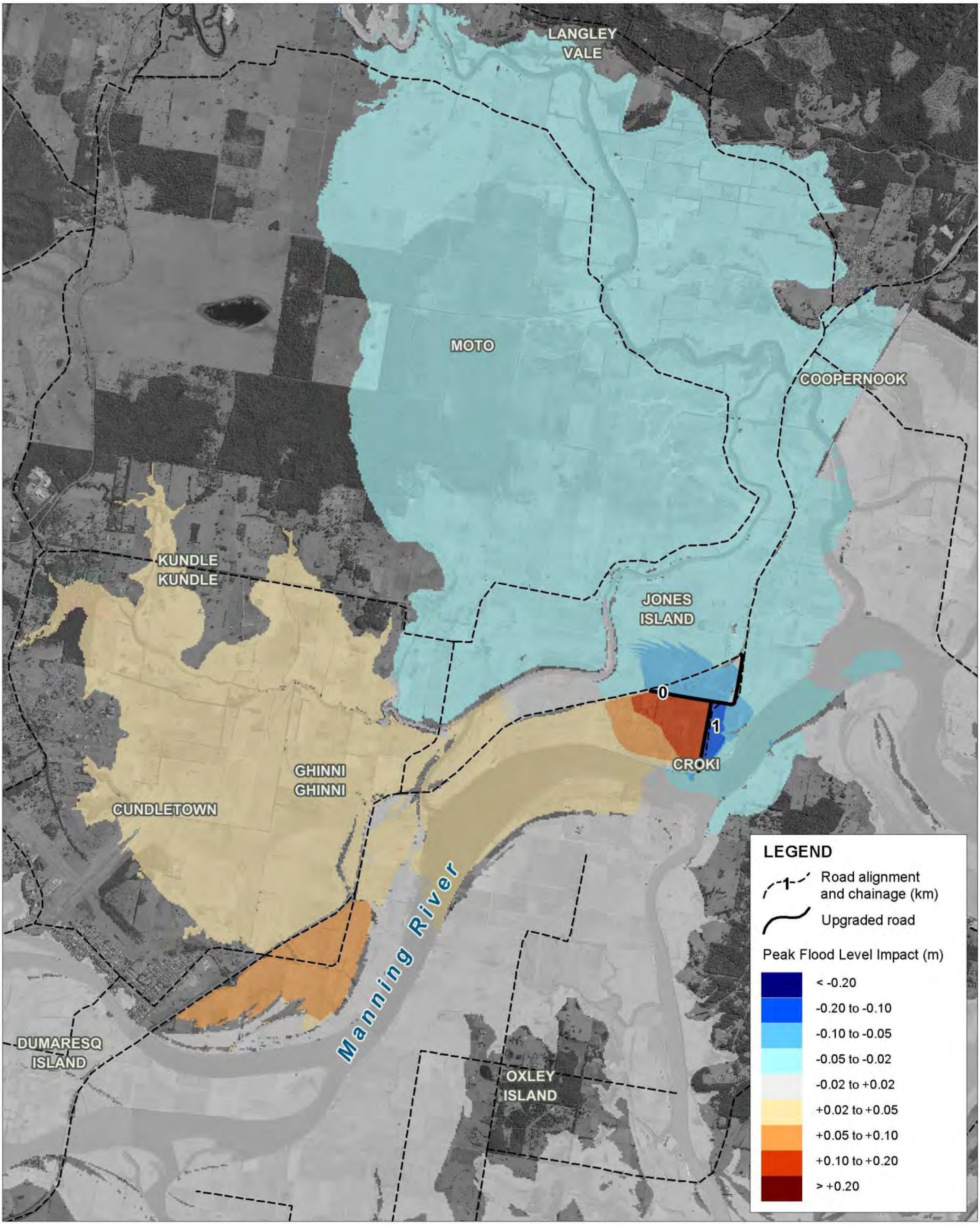

Title:

Croki Road / Barton Street Raising to 1% AEP Immunity Peak Flood Level Impact at the 1% AEP Design Event

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It should also be noted that the modelling undertaken is preliminary in nature and has not considered the potential to offset these impacts through upgrade of existing cross drainage structures or by provision of additional cross drainage structures.

The change (reduction or increase) in property flood damages afforded by each of the road raising scenarios in summarised in Table 7-8.

Table 7-8 Change in Annual Average Property Damages for Road Raising Sections

Road Section	AAD Change
RR1	-$10 000
RR2	$0
RR3	+$10 000
RR4	$0

An additional benefit to be considered is the improvement on travel disruption resulting from increasing the flood immunity of each roadway. The cost of the delay has been estimated based on the Australian Transport Assessment and Planning Guidelines (2018) as described in Section 5.5.6. The combined total AAD reduction (comprised of property damages plus transport disruption) is listed in Table 7-9.

Table 7-9 Reduction in Annual Average Flood Damages for Road Raising Sections

Levee Section	AAD Reduction
RR1	$298 000
RR2	$7000
RR3	+$5000
RR4	$300

7.1.2.3 Cost Estimate and BCR

Whilst not specifically requiring immediate works, road upgrades may be undertaken in association with regular maintenance programs (e.g. resurfacing) to provide progressive lifting of the existing road surface profile.

The cost of works to raise the road crest have been estimated using the BITRE (2017) benchmark datasheets for road construction. The document provides estimate for a “whole-of-project” cost per lane kilometre by road class based on a sample of real world road construction projects. Road classes are as follows:

- Class 1: Arterial roads forming the principle connection between major regions, such as capital cities e.g. Pacific Highway.
- Class 3: Arterial roads forming connection between town centres e.g. Harrington Road, Manning Point Road, Croki Road.

The average cost per unit project by road class is summarised in Table 7-10. These costs do not include property acquisition and supplementary items.

Table 7-10 Average Road Construction Cost by Road Class

Road Class	Cost ($M / lane km)
Class 1	5.0
Class 3	0.9

Although the costs presented in Table 7-10 are for construction of new roads, it is assumed that they provide a reasonable first pass cost estimate for road raising works within the study area.

Table 7-11 summarises the length of road raising required and a preliminary cost estimate for the works. Also included is a maximum and average height of road raising, to give an indication to the scale of works required.

Table 7-11 Preliminary Road Raising Cost Estimate

Location	Length (km)	Height of road raising (m)		Total cost
		Max.	Avg.	
RR1	6.7	0.7	0.3	$134 000 000
RR2	4.2	1.4	0.9	$7 560 000
RR3	6.3	1.4	0.5	$11 340 000
RR4	1.5	1.5	1.3	$2 700 000

The benefit-cost ratio (BCR) for improving the flood immunity of the Pacific Highway is calculated in Table 7-12. When assessing the performance of the scheme over a standard 50-year life span, the reduction in damages must be reduced to a net present-day value. BCRs have therefore been calculated by adopting a discount rate of 4%, 7% and 11%.

Table 7-12 Benefit-Cost Ratio (BCR) of Road Raising

Location	BCR @ 7%	BCR @ 4%	BCR @ 11%
RR1	0.03	0.05	0.02
RR2	0.01	0.02	0.01
RR3	-0.01	-0.01	0.01
RR4	0.00	0.00	0.00

The benefit-cost comparison would indicate that works to improve the flood immunity of the highway are not viable in an economic sense. Although attempt has been made to qualitative measure the impact of traffic disruption on the Pacific Highway, there are many other intangible flood damages that have not been measures in monetary terms.

7.1.3 Broad Scale Redevelopment

The nature of flooding in some parts of the floodplain within the study area may present an opportunity for potential broad scale development. Development in this regard may include large scale filling of some floodplain areas to elevate the landform above design flood levels whilst providing suitable provisions for management of floodwaters and local drainage.

In identifying suitable areas for potential redevelopment, initial consideration can be given to the flood function (or hydraulic categorisation) of the floodplain as discussed in Section 4.3. Hydraulic categorisation is one of the tools used to identify flood behaviour and risk. The categorisation is not used to assess individual developments, but rather to give a catchment-scale overview of which areas may be appropriate for various types of land use and accordingly can be used to inform future land use planning.

Regarding the hydraulic categorisation of the floodplain, typically the flood fringe areas are more suitable for development in which filling or blocking of these areas is expected to have no significant effect on the flood pattern or flood levels. In areas identified as flood storage, i.e. areas that are important in the temporary storage of the floodwater during the passage of the flood, substantially filling or leveeing of these areas is likely to result in elevated water levels and/or elevated discharges elsewhere on the floodplain. Floodway areas are typically “no-go” areas for development given the important function of flood conveyance.

The flood function mapping for the 1% AEP design flood conditions is provided in the attached Mapping Compendium. Much of the study area floodplain is either flood storage or floodway. Typically, the only extensive flood fringe areas are the local catchment runoff areas elevated above the mainstream flood extents. In this context, there would appear limited broad scale development opportunity within the lower floodplain area of the Manning River.

7.1.4 Entrance Management

Manning River is a mature barrier estuary and thus classified as a riverine estuary. It has large estuarine and alluvial plains with relatively constricted estuary channels and no central mud basin. The large marine delta is characterised by dynamic dual estuary entrances at Harrington and Farquhar Inlet.

Harrington entrance forms the main tidal inlet to the Manning River estuary system and is a trained opened tidal inlet which is typically around 500 m wide. There is an extensive training wall along the northern bank of the Harrington entrance, which extends seaward of Harrington Beach as a breakwater. The training wall has partially isolated Harrington Lagoon and Harrington Back Channel, for which the residential suburb of Harrington is located behind. The Harrington Waters Estate marina is located along the northern banks of the tidal inlet. An isolated bedrock high point at around 20 m AHD, known as Pilot Hill Lookout, is located within the township. All surrounding residential areas are positioned on a low-lying estuarine plain.

The Harrington entrance channel holds vast volumes of sand in the form of tidal delta deposits, which can be seen as extensive shoals adjacent to the coastline. A low narrow sand spit attached to Manning Point grows northwards across part of the ocean entrance. The estuary mouth is a highly dynamic environment with the sand shoals being regularly reworked (tidal and river flows, channel migration, wave action) and becoming scoured out during periods of flood (e.g. 1974, 1990, 2011).

Farquhar Inlet is the second smaller tidal inlet to the Manning River system. It has a high energy, south-east facing entrance region that extends for some 2 km between Old Bar and Mitchells Island. The coastal waterway behaves as an intermittently open and closed lagoon (ICOLL). The entrance is known to periodically become either partially shoaled or completely closed by a wide (and often vegetated) sand berm. When open, the location of the entrance fluctuates along Old Bar Beach.

Farquhar Inlet is connected to the Manning River via the Manning River Channel South and Scotts Channel, which together encompass Oxley Island. Farquhar Inlet contains a significant volume of sediment within the marine delta and entrance berm. Sand shoals become scoured out during periods of significant flood. The entrance is mechanically assisted to open on an occasional basis to manage flooding and water quality issues.

Review of historical photos and other information (Sinclair Knight and Partners, 1982 and WorleyParsons, 2010), suggests that the Farquhar Inlet entrance is open around 70-80% of the time. Design flood modelling has therefore assumed an open entrance condition at Farquhar Inlet at the onset of a flood event. Calibration of the flood models to historical events, such as 1978, 1990, 2011 and 2013, indicated that the entrance was likely in an "open" state at the onset of these floods, confirming that this is an appropriate assumption for modelling theoretical large flood events.

However, as there is potential for Farquhar Inlet to become "closed" by a sand berm, sensitivity testing was undertaken to understand the influence of a more restrictive berm geometry at Farquhar Inlet on expected flood behaviour, for present conditions and with sea level rise projections. Consideration of the prevalence of open or closed entrance conditions at Farquhar Inlet and the impact on flood conditions and expected damages will inform review and recommendations around the current entrance management protocols.

7.1.4.1 Modelled Entrance Berm Geometry

For design events, the adopted initial condition at Farquhar Inlet consisted of a 2.0 m AHD berm, with the main channel defined at -1.4 m AHD (approximately 180 m wide). For the entrance sensitivity scenarios, the impact of a more restrictive berm geometry at Farquhar Inlet is considered. The simulated berm scenarios considered a moderate increase to the channel bed elevation (representing a "shoaled" condition) through to raising the entire berm to an elevation of 3 m AHD, as this was determined to be the maximum berm level likely to be generated assuming no human intervention (representing a "closed" condition). Initial entrance geometry at Farquhar Inlet was altered within the TUFLOW models developed for the Flood Study (BMT, 2016) to represent the range of berm scenarios considered.

Current State guidelines predict that a likely outcome of future climate change will be an increase in mean sea level. Council has adopted sea level rise increases of 0.28 m by 2050 and 0.98 m by 2100. With sea level rise, it is expected that coastal sands will also increase by a similar magnitude. Modelling of climate change scenarios has therefore considered an equivalent rise in excepted entrance berm conditions, in addition to increased sea levels. Table 7-13 summarises the range of Farquhar Inlet entrance conditions modelled for the analysis.

Table 7-13 Modelled Farquhar Inlet Entrance Conditions

Scenario	Channel or berm height ~180 m wide (m AHD)			Remaining berm height (m AHD)		
	Present	2050	2100	Present	2050	2100
Open	-1.4	-1.12	-0.42	2.0	2.28	2.98
Shoaled	1.8	2.08	2.78	2.0	2.28	2.98
Closed	3.0	3.28	3.98	3.0	3.28	3.98

7.1.4.2 Flood Damages

The results of the various modelled scenarios were used to inform a flood damages assessment to calculate to total tangible flood damages (combining damage to residential properties, commercial properties and the public sector) for the entire study area. A combined Annual Average Damage (AAD) was also derived for each scenario. The total tangible flood damage and AAD is detailed for the present, 2050 and 2100 scenarios in

Table 7-14, Table 7-15 and Table 7-16, respectively, for each entrance scenario considered.

Table 7-14 Total Tangible Flood Damages - Modelled Present Farquhar Entrance Condition

Design Event	Total Damages ($)		
	Open	Shoaled	Closed
20% AEP	$20 000	$200 000	$3 000 000
10% AEP	$540 000	$2 510 000	$8 900 000
5% AEP	$4 060 000	$5 170 000	$14 610 000
2% AEP	$20 020 000	$22 500 000	$24 000 000
1% AEP	$31 880 000	$31 530 000	$40 880 000
0.5% AEP	$49 450 000	$57 000 000	$62 000 000
0.2% AEP	$116 330 000	$138 720 000	$135 980 000
Extreme	$650 350 000	$672 740 000	$670 000 000
AAD	**$1 940 000**	**$2 330 000**	**$3 860 000**

Table 7-15 Total Tangible Flood Damages - Modelled 2050 Farquhar Entrance Condition

Design Event	Total Damages ($)		
	Open	Shoaled	Closed
20% AEP	$2 500 000	$3 000 000	$4 000 000
10% AEP	$4 000 000	$4 000 000	$9 600 000
5% AEP	$5 800 000	$6 880 000	$15 860 000
2% AEP	$25 020 000	$26 500 000	$29 000 000
1% AEP	$38 370 000	$37 590 000	$52 580 000
0.5% AEP	$66 500 000	$67 000 000	$82 580 000
0.2% AEP	$147 090 000	$148 980 000	$167 830 000
Extreme	$681 110 000	$683 000 000	$701 850 000
AAD	**$3 090 000**	**$3 270 000**	**$4 540 000**

Table 7-16 Total Tangible Flood Damages - Modelled 2100 Farquhar Entrance Condition

Design Event	Total Damages ($)		
	Open	Shoaled	Closed
20% AEP	$10 000 000	$4 800 000	$5 000 000
10% AEP	$17 500 000	$10 000 000	$12 000 000
5% AEP	$36 960 000	$19 410 000	$23 040 000
2% AEP	$60 000 000	$48 000 000	$68 900 000
1% AEP	$101 070 000	$97 250 000	$172 330 000
0.5% AEP	$132 500 000	$127 000 000	$190 000 000
0.2% AEP	$221 380 000	$222 760 000	$244 230 000
Extreme	$755 410 000	$756 780 000	$778 250 000
AAD	**$8 540 000**	**$5 950 000**	**$7 590 000**

7.1.4.3 Current Entrance Management

In addition to flood management, a key component of the current entrance management regime is to address water quality issues in the estuary to assist the shellfish and oyster harvesting industries.

The current recommended entrance management process involves artificially opening the entrance at Farquhar Inlet when critical water quality and flooding conditions occur (WorleyParsons, 2010). It is understood that the current triggers are:

- A water level of 1.6 m AHD is recorded at the Farquhar Inlet gauge,
- Salinity levels in the inlet fall below 12 ppt, or
- The Scotts Creek shellfish harvesting area is closed for more than 120 consecutive days, combined with a weekly rainfall reading at Taree Airport of more than 80 mm.

A combination of the modelled open and shoaled scenarios will best represent the range of entrance conditions expected to occur under current management practices, i.e. mostly open but is known to shoal periodically. The closed scenario would not be expected to occur, as the current trigger levels (either water quality of flooding) will be initiated prior to berm heights reaching 3.0 m AHD.

A comparison of the calculated AADs assuming current management procedures are maintained for the present, 2050 and 2100 scenarios are plotted on Figure 7-13. For present conditions, the expected AADs range from $1.9M - $2.3M, increasing to around $6.0M - $8.5M by 2100. Future (i.e. 2050 and 2100) damage estimates have not considered any progressive climate change adaptation within the lower Manning River catchment, nor have they considered potential future development in the floodplain.

7.1.4.4 No Entrance Management

As an alternative, a situation was considered where no human intervention is undertaken at Farquhar Inlet. It is assumed that entrance conditions would range from open, through shoaled to closed. The extent of influence on peak flood levels resulting from a closed entrance at Farquhar Inlet (a modelled initial berm height of 3 m AHD), is presented in Figure 7-14. Compared against the baseline 1% AEP design event, the impact of increased flood levels extends to downstream of Dumaresq Island.

A comparison of the calculated AADs assuming no entrance intervention for the present, 2050 and 2100 scenarios are plotted on Figure 7-13. For present conditions, the expected AADs range from \$1.9M - \$3.9M, increasing to around \$6.0M - \$8.5M by 2100.

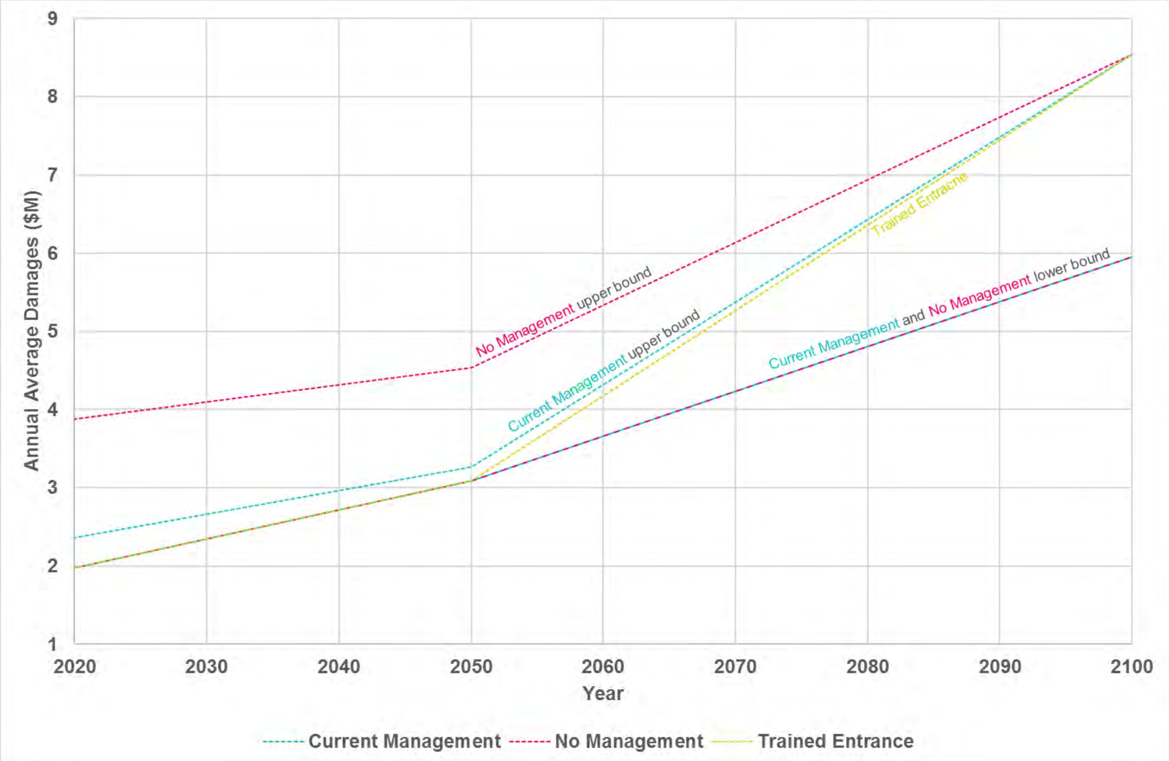


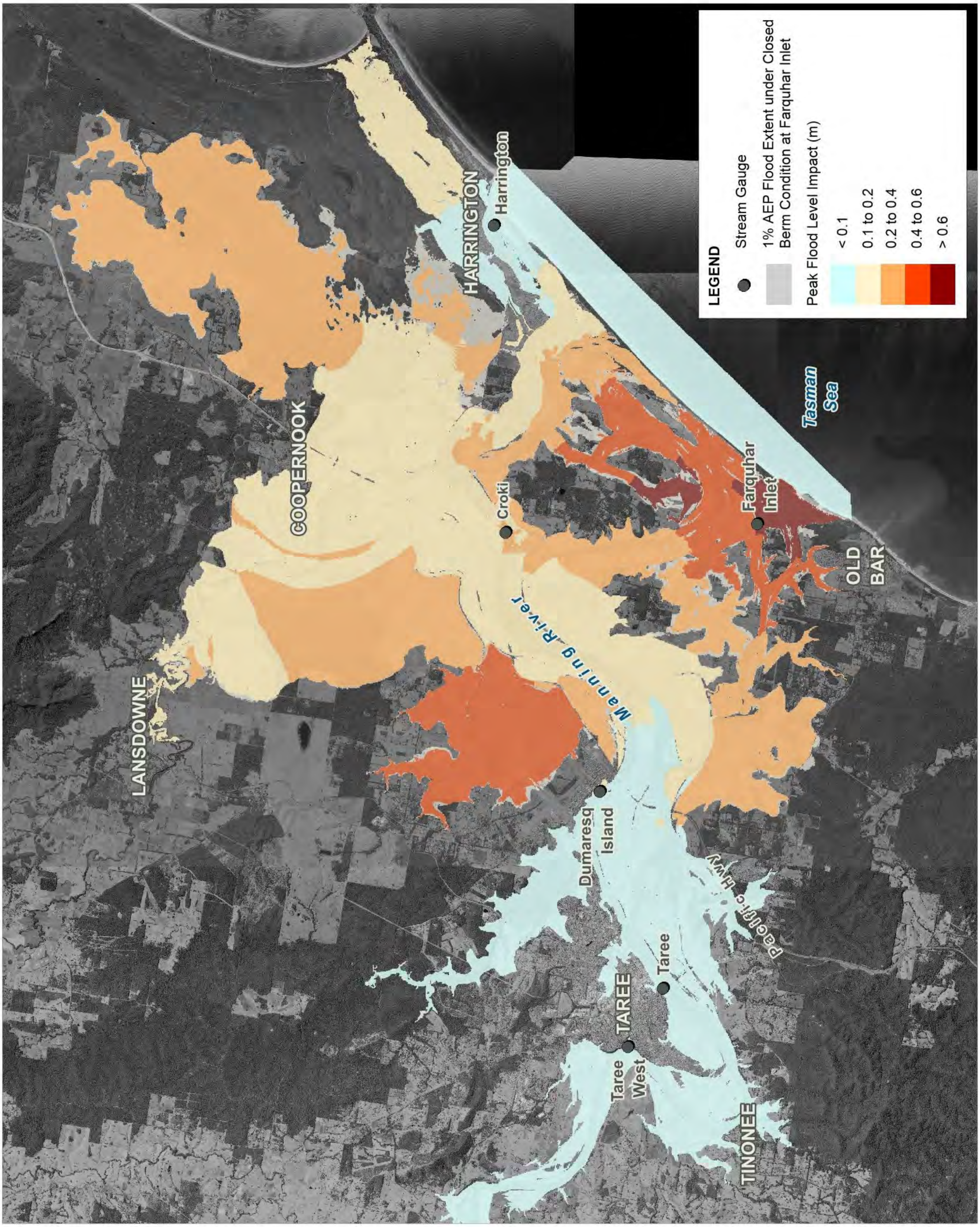
Figure 7-13 Summary of Annual Average Damage for Entrance Management Scenarios

7.1.4.5 Trained Entrance

Establishing a trained entrance at Farquhar Inlet has been suggested by community members as a potential option to improve amenity of the area. Providing training walls will result in a permanent entrance opening at Farquhar Inlet, for present day conditions and into the future. Although potentially improving estuary flushing, water quality and channel navigation, breakwaters constructed at entrances can significantly alter coastal and estuary processes, affecting sand and sediment transport along the coast. The detrimental environmental impacts of training walls have resulted in them becoming less preferred in recent years.

The capital cost associated with the construction of breakwater and training wall construction is typically high. Depending on the required dimensions, it is expected that the total cost of a trained entrance at Farquhar Inlet may be in the order of \$50-100M, so a value of \$75M has been assumed.

A comparison of the calculated AADs assuming a fully trained entrance at Farquhar Inlet for the present, 2050 and 2100 scenarios are plotted on Figure 7-13. For present conditions, the expected AADs is \$1.9M, increasing to around \$8.5M by 2100.



Title:

Extent of Influence of a "Closed" Berm (3.0 m AHD) at Farquhar Inlet for the 1% AEP Event (Present Timeframe)

Figure: 7-14

Rev: A

N

0 2.5 5km

Approx. Scale

BMT

www.bmt.org

Filepath : K:\N20836_ManningRiver_FRMS&P\MapInfo\Workspaces\Figures\DWG_010_FI_Closed_Influence.WOR

The reduction in AAD resulting from training wall implementation when compared to current entrance management is summarised in Table 7-17 for the various timeframes considered. When assessing the performance of the training walls over a standard 50-year life span, the reduction in damages must be reduced to a net present-day value. BCRs have therefore been calculated by adopting a discount rate of 4%, 7% and 11%.

The benefit-cost comparison would indicate that training wall construction at Farquhar Inlet is not economically viable, particularly when considering the ongoing maintenance costs. The detrimental environmental impacts associated with the works are also substantial.

Table 7-17 Benefit-Cost Ratio (BCR) of Trained Entrance at Farquhar Inlet

Timeframe	AAD Reduction	BCR @ 7%	BCR @ 4%	BCR @ 11%
Present	$390 000	0.08	0.12	0.04
2050	$180 000	0.04	0.06	0.02
2100	$0	0.0	0.0	0.0

7.1.5 Flood Gates

Flood gates are fitted in several locations in the lower Manning estuary to limit inundation from both riverine flooding and tidal inundation. The gates provide immunity from more regular events and impede saltwater flow into stormwater infrastructure. Some of these gates contribute to a significant reduction in flood risk; for example, the large western piped culvert under Manning Point Road at Manning Point is fitted with gates which provide immunity up to the 20% AEP event. Another example is the historic flood gate on Croakers Creek, Oxley Island which provides protection from daily tidal inundation and from minor, more frequent riverine flooding events to a significant portion of Oxley Island.

As these infrastructure are mechanical devices, the constant exposure to a marine environment means they have a finite life. Both floodgates identified currently require significant maintenance or replacement. With the increasing risk of climate change related sea level rise and more frequent tidal inundation events, flood gates will take on even greater importance. It is recommended that all floodgate infrastructure is surveyed and regular maintenance undertaken with gates being replaced or upgraded, as required.

The cost of on-going maintenance has been estimated assuming two Council staff members would conduct four maintenance visits per year (each visit comprising a full working day) over a five-year period. The capital cost associated with any replacement works has not been included.

7.2 Property Modification Measures

For this study, classification of the floodplain into flood planning constraint categories based on guidelines presented by ADRI (2017) has been undertaken. Further information can be found in Section 4.7. It is envisaged that this information will support and inform the review and revision of Council’s land-use planning and development controls applicable to the study area.

7.2.1 Planning and Development Controls

Land use planning and development controls are key mechanisms by which Council can manage flood-affected areas within the lower Manning River floodplain. Such mechanisms will influence future development (and redevelopment) and therefore the benefits will accrue gradually over time. Without comprehensive floodplain planning, existing problems may be exacerbated and opportunities to reduce flood risks may be lost.

As discussed in Section 5.6, Council currently has land use planning and development controls in place to manage flood-affected areas within the MidCoast LGA. Various flood risk mapping outputs updated for the current study are recommended to be adopted by Council and used in the development assessment process.

It is recommended that the design flood level conditions for planning purposes be based on the updated design flood results established in the preceding Flood Study (BMT, 2016). These results incorporate the updated Flood Frequency Analysis at Killawarra and Taree to define flood flows along the Manning River, development of a 2D hydraulic model (in place of the previous 1D hydraulic model) including integrated simulation of dynamic entrance breakout mechanism during flood events.

The GLN report provided recommendations for the future Planning Controls appropriate for FRM (Appendix B). It is expected that Council will ultimately prepare a single new DCP and LEP for the entire LGA.

Key recommendations for the LEP provisions as per the GLN report include:

- Ideally the flood planning LEP clause should apply to the whole of the floodplain (i.e. up to the PMF) by changing the definition of flood prone land.
- Mapping could be omitted from the LEP and included in an external form referred to in the LEP, ideally the DCP.
- A more detailed investigation be undertaken to determine whether adjustments are required to LEP zone boundaries and/or DCP controls, within South Taree, Tinonee, Cundletown, Croki, Coopernook, Harrington and Oxley Island.

Key recommendations for the DCP provisions include:

- Planning matrix approach (as previously adopted by City of Taree Council) for the entire LGA - this approach provides a matrix of controls that change to reflect the vulnerability of different land uses to flooding and the risk associated with the location of a development within different parts of the floodplain.
- Mapping of flood risk precincts - this will involve dividing the floodplain into areas with similar risks e.g. low, medium, high.
- Categorising land uses - this involves identifying categories of land uses with similar vulnerabilities to flood hazard.
- Identifying controls to modify building form and response to flooding - this will apply to areas where the planning process determines land uses are appropriate, but still subject to flood.

Different planning controls can be imposed to minimise potential damages and to maximise the ability of the community to respond during a flood.

It is also noted that in March 2018, amendments to the EP&A Act introduced a new requirement for local councils to prepare a Local Strategic Planning Statements (LSPS). The statement is to set out the 20-year vision for land-use in the local area, identifying special character and values that are to be preserved and how growth and change will be managed into the future. In the preparation of LSPSs, Council should ensure that the intended character of an area is reflective of what could be acceptably achieved while considering flood planning control restraints. Regional NSW Councils are required to have submitted their LSPS by July 2020.

It is expected that the recommended updates to the LEP and DCP would provide a consistent basis for providing S10.7(2) notifications within the LGA. Further detail around suggested requirements for S10.7(2) certificates can be found in the GLN report (Appendix B).

7.2.2 Flood Planning Levels

Council has adopted the 1% AEP design event for 2100 conditions (incorporating 10% increase in flow and 0.98 m sea level rise) as the basis for setting Flood Planning Levels (with the addition of a 0.5 m freeboard). For much of the study area, this flood planning condition is consistent with the previously adopted flood planning level.

7.2.3 Local Land Filling

Filling of flood prone land is an option to remove or reduce the flood affectation on a site, typically to provide for development potential. With any development on the floodplain there is potential for significant changes to existing flood conditions through:

- redistribution of flow arising from works on the floodplain
- concentration discharges and subsequent impact on downstream areas
- increase in flood levels through impedance of overland flow paths and loss of temporary flood storage.

In the DCP Part E (adopted 2017) – Section E5.4 Earthworks and Filling, the objective is to ensure that proposed filling does not exacerbate flooding on other properties. This is aimed to be achieved through the following development controls:

- Filling on flood-controlled land is not permitted unless it can be certified that the development will not increase flood affectation elsewhere.
- Filling of floodway areas is not permitted.
- Filling on individual sites in isolation, without consideration of the cumulative effects is not permitted. Any proposal to fill a site must be accompanied by an analysis of the effect on flood levels of similar filling of developable sites in the area.

The existing controls are qualitative in nature and do not provide any definitive guidance on limits of fill volumes or quantification of impacts. The existing controls do however appropriately trigger the requirement for an assessment (via a flood report) of the impact of filling within existing flood storage and flood fringe areas.

Consideration has been given in the current study to defining more quantitative fill controls. Some examples of these in DCPs of other Councils include limits on volume of fill on either a cubic metre volume basis or as a percentage of existing flood storage on a lot.

Outside of Taree and Harrington, the current lot distribution in the study area provides for typically large-scale, rural residential lots. Higher density residential development within the townships of Cundletown, Croki, Manning Point and Old Bar provides for smaller scale residential lots.

The large lot sizes typically within the floodplain mean that even relatively small percentage fill limits based on area represent a substantial volume of filling. Large scale filling in the existing floodplain is not considered appropriate given the potential impact of lost floodplain storage volume. Large scale filling would also provide for a redistribution of flow and likely therefore to impact directly on neighbouring properties.

The potential impacts of large-scale lot filling are difficult to estimate given the flow redistribution will be dependent on the location and configuration of a fill platform. To illustrate the potential impacts of large-scale lot filling outside of the defined floodway, TUFLOW model simulations were run whereby the available storage of each model cell classified as flood storage or flood fringe was reduced by 5% or 10%. Smaller, discrete storage areas isolated by topographic controls such as perched channel banks or elevated road embankments are more sensitive to filling.

The model testing has found that flood levels within the storage area around Cundletown, bounded by Paddys Creek and the Pacific Highway may increase by over 0.05 m if 5% of the total storage is removed. When 10% of floodplain storage is removed, modelled flood levels here increase by around 0.08 m. Impacts across the broader floodplain area are also likely to occur when 10% of storage is removed. The modelling has indicated that peak flood levels may increase in the order of between 0.02 and 0.05 m around the localities of Croki, Mamboo Island, Coopernook, Lansdowne and Crowdy Bay National Park.

A smaller scale of filling, somewhat representative of a fill platform for a residential dwelling, is unlikely to have significant impacts in terms of loss of floodplain storage. For example, filling 5% of the average rural lot to the 1% AEP design flood level would involve fill of around 15,000 to 25,000 m^3 and is similar to the level of fill expected a typical building pad. The cumulative volume of a fill pad on each cadastral parcel represents only a small proportion of the total available floodplain storage volume and would not result in any significant impacts across the broader floodplain area, as identified by the modelling undertaken.

Whilst unlikely to require development controls from a flood storage perspective, the impact of any filling on the floodplain may need to be considered for its potential for a local redistribution of flow and impacts on neighbouring lots. As noted, this will be dependent on the location and configuration of the development and proximity to other property boundaries and infrastructure. Accordingly, Council's existing triggers in the DCP for a flood assessment report to support a development application remains appropriate.

7.2.4 Flood Proofing

Flood proofing refers to the design and construction of buildings with appropriate water-resistant materials such that flood damage is minimised should the building be inundated. Flood proofing is more effectively achieved during construction with appropriate selection of materials and design. Council's Development Control Plan already includes requirements for flood-proofing of buildings for new development. However, there are several non-structural options that can be retrofit to existing property to help reduce flood damage including changes to joinery and fittings, floor coverings and electrical services.

These measures would be applicable for all new developments in this area and redevelopment of existing property. These measures offer an effective mitigation for much of the existing property constructed across natural overland flow paths. Whereas the expense of house raising provides for minimal return in terms of loss reduction compared to the capital expense, flood proofing measures on an individual property scale can be effective in reducing flood damages for a significantly lower cost.

The extent of damage, cost of repairs, inconvenience and cleaning required following a flood event will depend on many factors including depth and velocity of water, period of inundation, amount of debris and silt in floodwater, and type of materials and construction. If floodwaters cannot be excluded from a property through other measures, flood proofing may provide a direct benefit in terms of reduced economic damages and social disruption.

Property owners would be expected to undertake works at their own convenience. A public awareness campaign may help to inform the community of flood proofing measures and could be supplemented with individual building inspections and property owner interviews. Encouragement to make a property more flood-resilient can be linked to the recommended Community Awareness Program.

Direct consultation with landholders with potential for house raising/flood proofing must be undertaken initially to establish the level of support, with explanation of:

- conditions of any subsidy offer (to be determined)
- susceptibility of the house to flooding (following confirmation of floor levels)
- anticipated benefits of raising the floor level or flood proofing house
- potential funding arrangements.

7.2.5 House Raising

Voluntary house raising is aimed at reducing the flood damage to houses by raising the habitable floor level of individual buildings above an acceptable design standard, typically the Flood Planning Level. Voluntary house raising generally only provides a benefit in terms of reduced economic damages but does not eliminate the risk. Larger floods than the design flood (used to establish minimum floor level) will still provide building damages and the option does not address personal safety aspects. These risks are still present as the property and surrounds are subject to inundation.

Only a limited number of existing residential properties may be suitable for house raising, noting that slab on ground and brick type construction is typically unsuitable for house raising. Additionally, house raising in the study area may not be effective given:

- houses that can be raised may be approaching the end of their useful life
- rebuilding rather than renovations may be more cost-effective and potentially the preferred option of landholders
- flood proofing existing property provides a cheaper alternative.

The viability of a house raising scheme is dependent on establishing a suitable funding model and the uptake of the scheme given that it is on a voluntary basis. Further investigation may be undertaken to establish the level of landowner support and therefore uptake potential, to assess the merit of including a Voluntary House Raising scheme in future revisions of the Floodplain Risk Management Plan. The requirement for and viability of a house raising scheme is likely to increase with climate change influences. However, given the timeframes involved, it is considered that future flood risk would be more effectively managed through redevelopment.

Given limited need under existing flood conditions for a VHR scheme, it is recommended that the opportunity/requirement for a scheme is reinvestigated in a 5-year timeframe or following significant updates in climate challenge knowledge as we progress towards the 2050 planning horizon.

7.3 Response Modification Measures

7.3.1 Flood Warning

The Bureau of Meteorology (BoM) prepares and disseminates flood forecasts and warnings and information to the public in close cooperation with state, territory and local government agencies and other stakeholders. Users of flood warning services include emergency management agencies and members of the public, particularly those in flood-prone areas. More detailed local interpretation of BoM flood warning products and information is provided directly to the public by flood response agencies. BoM warning products include early alerts to the possibility of flooding through a flood watch product, with site-specific forecasts of river height and the expected impact in terms of minor, moderate or major flooding in specific river basins.

Where dedicated flood forecasting systems have not been installed, more generalised products are issued on a regional basis. However, there are several general warning services provided by the BoM including:

- **Severe Thunderstorm Warnings –** typically provide 0.5 to 2-hour notice. These short-range forecasts are issued by the Bureau's severe weather team and are based upon radar, data from field stations, reports from storm spotters as well as synoptic forecasts.
- **Severe Weather Warnings –** for synoptic scale events that cause a range of hazards, including flooding. Examples of synoptic scale events are the deep low-pressure systems off the NSW coast that often result in significant flooding in eastern catchments.

- **Flood Watches –** typically provide 24 to 48-hour notice. These are issued by the NSW Flood Warning Centre providing initial warnings of potential flooding based upon current catchment conditions and future rainfall predictions.

An established flood warning network for the Manning River provides official Flood Warning notifications for the study area. A Flood Warning is a gauge specific forecast of actual or imminent flooding. Flood Warnings specify the river valley, the locations expected to be flooded, the likely severity of flooding and when it will occur.

The issuing of flood warnings in the broader Manning River catchment is the responsibility of the NSW State Emergency Services (SES). Flood warnings and estimates of the time of arrival of the flood peak are based on floodwater levels at gauges located on the Manning River at the Martin Bridge, Taree. Another gauge is located further upstream at Wingham. Typically, water levels at the gauges are communicated to the SES, where they are compared with stage hydrographs for recorded floods.

Flood classifications in the form of locally-defined flood levels are used in flood warnings to give an indication of the severity of flooding (minor, moderate or major) expected. These levels are used by the SES and the BoM in flood bulletins and flood warnings. The flood classification levels are described by:

- **Minor flooding**: flooding which causes inconvenience such as closing of minor roads and the submergence of low-level bridges. The lower limit of this class of flooding, on the reference gauge, is the initial flood level at which landholders and/or townspeople begin to be affected in a significant manner that necessitates the issuing of a public flood warning by the BoM.

- **Moderate flooding**: flooding which inundates low-lying areas, requiring removal of stock and/or evacuation of some houses. Main traffic routes may be flooded.

- **Major flooding**: flooding which causes inundation of extensive rural areas, with properties, villages and towns isolated and/or appreciable urban areas flooded.

The SES classifies minor, moderate and major flooding according to the gauge height values at the Taree water level gauge as detailed in Table 7-18. Design flood levels and historic flood levels are also included for reference.

The NSW State Flood Plan notes target warning lead time at Taree of 12 hours for levels exceeding 2.1 m AHD (between a minor and moderate flood) and 24 hours for levels exceeding 4.0 m AHD (major flooding).

The existing flood warning system for the lower Manning River is quite robust due to the large size of the catchment and many rainfall and streamflow gauges. In addition to the water level gauge at Taree, the SES also classify flood height values at the Wingham, Croki and Harrington gauge sites. The warning times available to residents in the lower floodplain area provide sufficient time for planning and evacuation of resident during flood events; as such, no changes to the existing Manning River warning system are recommended.

At the Harrington water level gauge site, the minor, moderate and major flood levels are quite high relative to predicted design flood levels at the gauge site. The minor flood level (1.9 m AHD) is just below the 2% AEP flood level for the gauge site, the moderate flood level (2.2 m AHD) is 0.1 m below the PMF level, and the major flood level (2.8 m AHD) is over 0.5 m above the PMF level. As ocean levels dominate the peak flood levels at the Harrington gauge, this gauge is not considered to be a reliable indicator for predicting flood behaviour at Harrington. The Taree or Croki gauges are better indicators for flood conditions at Harrington (e.g. overtopping of Harrington Road), where conditions are driven by flood flows in the Manning. Although this context is incorporated into the SES Local Flood Plan (LFP), revision of the SES flood classification level at Harrington could provide for improved warning of local nuisance flooding from elevated ocean levels.

Table 7-18 Flood Classification Levels, Design Flood Levels and Historic Flood Levels at Taree (Martin Bridge)

Flood Classification	Peak Flood Level (m AHD)
Minor Flood Warning	*1.8*
Moderate Flood Warning	*2.4*
20% AEP	2.9
2013	**3.37**
Major Flood Warning	*3.7*
1990	**4.37**
5% AEP	4.4
2011	**4.5**
2% AEP	5.1
1% AEP	5.5
1978	**5.75**
0.5% AEP	5.8
1929	**5.9**
0.2% AEP	6.3
PMF	9.4

7.3.2 Emergency Response

The SES has formal responsibility for emergency management operations in response to flooding. Other organisations normally provide assistance, including the Bureau of Meteorology, council, police, fire brigade, ambulance and community groups. Emergency management operations are usually outlined in a Local Flood Plan (LFP).

Information contained in the LFP is largely derived via local knowledge, historical record and completed flood studies. The SES follows the LFP, using information from Flood Intelligence and BoM’s predictions, to respond in actual flood events.

It is important that the SES Plan incorporates all relevant technical data and specific community vulnerabilities (including addresses of areas at highest risk) that have been determined through the Floodplain Risk Management process. Provision of this data is particularly important regarding to those areas that may become isolated or where key transport routes are subject to closure.

During times of flood on the Manning River, it would not be realistic to expect the SES to be able to undertake much in the way of emergency response for several reasons:

- the SES is principally a volunteer organisation and the time required to mobilise personnel could exceed the warning time available,
- a major flood event on the Manning River is likely to coincide with major flooding across the broader catchment area, further stretching already limited emergency response resources.

In Guideline 7-2 of the Australian Disaster Relief Resilience Handbook (AIDF, 2017a), the National Flood Risk Advisory Group (NFRAG) recommends the classification of the floodplain based on flood emergency response categories (FERC). These categories adopt a similar concept to the SES classification of communities (see Section 4.6). FERC mapping for the lower Manning River floodplain is included in the Mapping Compendium (Figure O-01). Also shown on the map is the location of facilities identified by MidCoast Council or the LFP as evacuation centres, along with likelihood of inundation of key transport routes. Further detail surrounding access road flood immunity is contained in Section 7.1.2.1.

Estimating the ability for a community to evacuate in a safe and timely manner during a flood event can be an extremely challenging task for emergency personnel. Many tasks such as prediction, warning and evacuation must be performed simultaneously. Planning for an evacuation can be especially difficult for floodplains with multiple population centres and linked evacuation routes, such as the lower Manning River floodplain. Due to difficulties in capturing the high degree of spatial and temporal complexities in evacuation operations, it is recommended that flood evacuation modelling be undertaken. GIS-based evacuation planning models can dynamically link flood behaviour to population statistics and evacuation route information. Models can assess interacting populations and routes in a way that is consistent with existing emergency management methodology while incorporating expected flooding characteristics.

Although already identified in the LFP, both the Harrington and Manning Point communities will become significantly inundated during a PMF event. Further investigation into the suitability of the Harrington Function Centre and the Manning Point Bowling Club as evacuation centres should be undertaken, as residents seeking shelter at these locations could be isolated for a number of days.

Business operators and occupants of premises within the flood prone areas should be encouraged to have private flood emergency response plans which have evacuation as the preferred initial response if that is practical. Should evacuation not be possible before floodwaters cut off evacuation routes then remaining in the building should be the alternative. While the NSW SES does not encourage people to stay inside flooding buildings, it acknowledges that circumstances can prevent evacuation in some situations, and once trapped in a building, it is generally safer to stay inside than to exit into high hazard floodwaters.

The concept of a "Community Flood Emergency Response Plan (CFERP)" should be explored. The Plan would provide information regarding evacuation routes, refuge areas, what to do/not to do during a flood event etc. If such a plan is developed and embraced at a community level, the self-sufficiency in terms of flood response would maximise potential for effective emergency response and a non-reliance on formal emergency services. Council and the SES would be expected to have a key role in developing the CFERP.

7.3.3 Community Education and Awareness

Raising and maintaining flood awareness provides residents with an appreciation of the flood problem and what measures can be taken to reduce potential flood damage and to minimise personal risk during future floods.

The basic objectives of the awareness program are to ensure that the community are:

- Aware they are living / working in a flood zone
- Receiving, understanding and reacting to flood warnings
- Taking appropriate actions such as protecting property and are mindful of vehicular and pedestrian access during floods.

Community awareness is an on-going process and there is also the inherent danger of complacency between events. A lack of general community awareness may also be exacerbated by new residents in the area having little knowledge or appreciation of flood risk. This would also apply to any transient population (e.g. holiday makers) who may be in the locality at a time of major flood.

There are numerous mechanisms to inform the community, such as.

- Flood mapping availability (on Councils website) - Consolidation of the recent flood risk mapping, flood data and flood damages database prepared during the floodplain risk management study into Council's existing GIS system. This will provide Council with valuable flood information that can be easily retrieved and will form the basis of information that can be supplied to the public when requests are made, or on a periodic basis.
- Section 10.7(2) certificates (previously known as Section 149 certificates) or flood certificates – In addition to being provided whenever flood information is requested for a specific property, the certificates could be provided on a regular basis to all residents in the study area.
- Flood information page on community websites - For example, this could include links to BoM rainfall and flood warning pages and a "how to" guide in understanding and reacting to flood warnings. This may be extended to other media including community newsletters/publications, with Council providing regular input regarding flood awareness/preparedness and commemoration of historic events.
- Undertake a formal flood education, awareness and resilience program - Education is required to build a flood-resilient community who is prepared for flooding and able to respond to and recover from actual flooding. There are few planning or administrative barriers that would delay the development and implementation of a community education plan. Education and flood awareness should be a key role for combat agencies such as the SES, with Council having a

key supporting role to play in assisting SES with the technical elements of flood characteristics of overland flooding in the catchments. Direct consultation with residents in high flood risk areas may be beneficial to increase engagement and awareness. The asset register in Appendix A can be used to highlight community businesses at risk (e.g. day care centres).

Given the relatively high level of flood risk to existing communities in the lower Manning River floodplain, an extensive community education and awareness program could be of significant value.

7.4 Analysis of Recommended Actions

A simple matrix has been developed to assess the positive and negative benefits and costs of the recommended actions. The criteria are based on a "traffic light" colour system to clearly display if an aspect of an option should be cause to "stop" and reconsider, "slow" to proceed with caution or "go" with few trade-offs expected.

The aim of the rapid analysis is to provide a straightforward overview of the various actions applicable for the lower Manning River floodplain, presenting quickly and clearly to community the benefits and trade-offs of each action, to assist in the prioritising and ordering of works within the immediate, medium and longer terms.

The criteria used for the rapid analysis is described below and summarised in Table 7-19.

Performance

The performance criterion considers how well the action would address the risks it is specifically targeting. The performance criterion also factors whether the action provides a long-term solution or is just a short-term fix.

The criterion for performance is based on a scale from high to low, where high performance represents effectiveness of the action in addressing flood risks, and low performance represents low performance or uncertainty in the outcomes.

Practicality / Technical Feasibility

The practicality criterion considers how easy and practical the action will be to implement. If the action can be considered standard process for Council or other agencies with minimal delays and hurdles, then the practicality would be high. If there are some barriers or delays to the option being implemented, then the practicality would be lower. With reducing practicality, it is expected that the effort (and costs) required to implement the action would increase.

Community Acceptance

The community acceptance criterion aims to reflect the general support for the action by the community. It is recognised that some actions may have a small section of the community that is most affected, however, it is the expected opinions of community at large that have been captured by this criterion.

Environmental Impacts

The environmental criterion aims to reflect the scale of potential impacts on the environment. Measures with major impacts are likely to trigger a requirement for formal environmental assessments (REF or EIS). Some measures may have a positive environmental effect (e.g. pollution prevention, habitat creation).

Costs / Resource Needs

Floodplain Risk Management actions can be inherently costly, especially when dealing with engineered works or property modifications. Planning controls are the exception to this, although these can still require significant effort from Council and others.

The costs / resource needs criterion represents a rating wherein a High rating reflects the lowest costs, while a Low rating reflects the highest costs. This has been adopted for consistency with the other criteria.

Table 7-19 Rapid Analysis Assessment Criteria

	LOW (STOP / reassess)	MEDIUM (SLOW)	HIGH (GO)
Performance	Action is not particularly effective over the short or longer terms	Action provides only a short-term fix, or is only partly effective over the long term	Action provides an effective long term solution to the risks identified
Practicality	Acton would be difficult to implement through existing constraints, approvals required etc. Would be very demanding to successfully implement	Action would have some hurdles for implementation, which may take longer and demand more effort to overcome.	Action is straightforward to implement with few barriers or uncertainties
Community Acceptability	Unlikely to be acceptable to the majority of the community and politically unpalatable. Significant championing required by Council and State.	Would be palatable to some, not to others. Briefing by Councillors, GM and community education required.	Is very politically palatable, acceptable to community. Minimal education required
Environmental Impacts	Likely to have significant adverse environmental impacts unable to be effectively managed	Likely to manageable environmental impacts through appropriate assessment and planning	No significant environmental impact identified. Environmental / ecological benefit through measure implementation
Costs / Resources	Very Expensive (more than \$1,000,000) and/or very high (unmanageable) resource demands on authorities	Moderately expensive (e.g. \$100,000 - \$1,000,000) and/or high resource demands on authorities	Manageable costs (< \$100,000) and manageable resource demands on authorities

The results of the rapid analysis are presented in Table 7-20. This table also gives a Total Score for each action. The score is calculated based on the following points system:

- All HIGH (go) criteria have a score of +1
- All MEDIUM (slow) criteria have a score of 0
- All LOW (stop and reassess) criteria have a score of -1.

The scoring in the rapid analysis provides some indication on the recommended prioritisation of the recommended measures. The higher scoring options typically have few barriers to implementation whilst providing effective floodplain risk management benefit.

Of the various structural measures assessed the levee for the Taree CBD is the most straightforward and cost-effective. Sections of the levee proposed for Browns Creek is also relatively cost-effective when considered against the benefit they provide. While these options are effective at reducing the flood impacts for the local areas they protect, they do not address the significant social and economic impacts to the broader community.

Flood planning controls, flood emergency response planning and flood awareness/education measures are all readily implementable and therefore score highly.

Table 7-20 Assessment of Management Options

Performance	Performance	Practicality	Community Acceptability	Environmental	Costs/ Resources	Total Score
Flood Modification Measures						
Taree CBD levee (LV1)	HIGH	MED	HIGH	MED	MED	2
Browns Creek levee (LV2)	HIGH	MED	MED	MED	LOW	0
Cundletown levee (LV3)	HIGH	MED	MED	MED	LOW	0
Croki ring levee (LV4)	HIGH	MED	MED	MED	LOW	0
Pacific Highway raising (RR1)	HIGH	LOW	HIGH	MED	LOW	0
Harrington Road raising (RR2)	HIGH	MED	HIGH	HIGH	LOW	2
Manning Point Road raising (RR3)	HIGH	MED	HIGH	MED	LOW	1
Croki Road / Barton Street raising (RR4)	HIGH	MED	HIGH	MED	LOW	1
Broad Scale Redevelopment	HIGH	MED	MED	LOW	LOW	-1
Property Modification						
Planning and Development Controls	HIGH	HIGH	MED	HIGH	HIGH	4
Flood Planning Levels	HIGH	HIGH	MED	HIGH	HIGH	4
Voluntary house-raising scheme	MED	MED	MED	HIGH	LOW	0
Response Modification						
Update to Local Flood Plan	HIGH	HIGH	HIGH	HIGH	HIGH	5
Ongoing community education and awareness	MED	HIGH	HIGH	HIGH	HIGH	4

8 Recommended Floodplain Management Plan

8.1 Introduction

The Floodplain Risk Management Study and Plan has been developed to direct and coordinate the future management of flood prone land across the lower Manning River floodplain. It also aims to educate the community about flood risks across the study area, so that they can make more appropriate and informed decisions regarding their individual exposure and responses to flood risks. The Plan sets out a strategy of short term and long term actions and initiatives that are to be pursued by agencies and the community in order to address the risks posed by flooding.

Statutory responsibility for land use planning and management under the EP&A Act rests with Council. As part of their normal planning responsibilities, Council need to plan and manage flood prone land in accordance with its flood exposure. The State Emergency Service (SES) has formal responsibility for emergency management operations in response to flooding. Assistance is provided by other organisations including the Bureau of Meteorology, NSW Department of Planning, Infrastructure and Environment (DPIE), Council, police, fire brigade, ambulance and community groups. Emergency management operations are usually outlined in a Local Flood Plan. Accordingly, there are some shared responsibilities across a number of agencies in a Plan of this nature, requiring an integrated and collaborative engagement of stakeholders.

8.2 Recommended Measures

8.2.1 Flood Modification Measures

8.2.1.1 Taree CBD Levee

Of the levee options assessed in the Floodplain Risk Management Study (FRMS), the only levee section to score favourably in the rapid options analysis was the Taree CBD levee (see Section 7.4).

The Taree CBD levee would offer protection to the low-lying commercial areas between Commerce Street and Pulteney Street from mainstream Manning River flooding. The exact location and type of levee most suited to the Taree CBD is to be confirmed. Possible options include an earthen or wall-type levee within the public open space of Fotheringham Park or a wall-type construction along the Victoria Street road median. Any levee works would need to be accompanied by local drainage upgrades to prevent stormwater impacts from occurring behind the levee.

Whilst the preliminary assessment has identified the Taree CBD levee as being favourable in an economic sense (BCR of 1.74, assuming a 50-year lifespan and 7% discount rate), a number of additional factors need to be considered such as community acceptance, impact on local amenity from an aesthetic perspective and requirement for stormwater drainage upgrades. Due to limited feedback on the study during the public exhibition period, the level of community support for the Taree CBD levee is uncertain.

It is recommended that a levee feasibility study be undertaken to assess and select the preferred levee alignment and construction type for further investigation and design, if warranted. A preferred levee option should be identified that best serves current and future needs of the community. As such, the feasibility study should include a community engagement component. A heritage impact assessment is also recommended to assess any heritage sites at risk.

Taree CBD Levee Feasibility Study and Concept Design

Estimated Cost: $100,000

Responsibility: Council

Priority: High

Taree CBD Levee Heritage Impact Assessment

Estimated Cost: $25,000

Responsibility: Council

Priority: High

8.2.1.2 Raising of Harrington Road

Harrington Road is the principal access route into the township of Harrington. The road has quite low existing flood immunity, with a significant stretch of the road being inundated by 0.2 – 0.3 m of floodwater at the 10% AEP flood event. At the 5% AEP, the road becomes un-trafficable with flood depths of up to 0.6 m. Additionally, the existing flood immunity of the road is expected to gradually decrease with progressive sea level rise.

Provision of increased flood immunity along the road would improve access to and evacuation from the community during times of flood. To provide immunity to the 1% AEP design flood event, the road would need to be raised by up to 1.3 m over a length of 4.2 km. Due to the scale of works required, the potential for increasing the road crest by up to 0.6 m over a length of 1.7 km to provide immunity to the 5% AEP flood event may be a more practical and economic option.

It is recommended that a feasibility study be undertaken to assess the suitability of undertaking stand-alone construction work to improve the existing flood immunity of Harrington Road.

Harrington Road Raising Feasibility Study

Estimated Cost: $100,000

Responsibility: Council

Priority: Medium

8.2.1.3 Raising of Pacific Highway and other local access roads

The elevation of major transport routes (Pacific Highway) and local access roads (including Manning Point Road, Croki Road and Barton Street) directly influence the roads flood immunity and accordingly its flood access and evacuation potential. As for Harrington Road, the existing flood immunity of transport routes will lessen under the influence of climate change as design flood levels progressively increase.

To combat the influence of climate change and maintain the existing level of flood immunity, progressive upgrades of the road network should be continued. Whilst not specifically requiring immediate works, road upgrades may be undertaken in association with regular maintenance programs (e.g. resurfacing) to provide progressive lifting of the existing road surface profile to gradually improve flood immunity over time.

Estimated Cost: To be confirmed (future works)

Responsibility: Council / TfNSW

Priority: Low

8.2.1.4 Flood Gate Maintenance

Flood gates are fitted in several locations in the lower Manning estuary to limit inundation from both riverine flooding and tidal inundation. With climate change related sea level rise and more frequent tidal inundation events, the reliance on flood gates will increase.

It is recommended that all floodgate infrastructure is surveyed, and regular maintenance undertaken with gates being replaced or upgraded, as required.

Estimated Cost: On-going maintenance costs ($16,000)

Responsibility: Council

Priority: High

8.2.2 Property Modification Measures

8.2.2.1 Planning and Development Controls

Land use planning and development controls are key mechanisms by which Council can manage flood-affected areas within the lower Manning River floodplain. This will ensure that new development is compatible with the flood risk and allows for existing problems to be gradually reduced over time through appropriate redevelopment.

Update LEP and DCP

The amalgamation of the Greater Taree, Great Lakes and Gloucester LGAs into MidCoast Council occurred in May 2016. Modification to existing planning and development controls detailed in the LEP and DCP are recommended to provide a consolidated floodplain management approached across the whole MidCoast LGA.

Key recommendations for updates to the LEP include:

- The flood planning clause be updated to apply to the whole of the floodplain (i.e. up to the PMF) by changing the definition of flood prone land
- Mapping be omitted from the LEP and included in an external form, ideally the DCP, to be referred to in the LEP

Key recommendations for development of a consolidated MidCoast DCP:

- Planning matrix approach (as previously adopted by City of Taree Council) for the entire LGA
- Mapping of flood risk precincts, to divide the floodplain into areas with similar risks

- Categorisation of land uses, to identify categories of land uses with similar vulnerabilities to flood hazard
- Review of planning controls to modify building form and response to flooding.

It is expected that the recommended updates to the LEP and DCP would provide a consistent basis for providing S10.7(2) notifications within the LGA.

Estimated Cost: Staff costs

Responsibility: Council

Priority: High

Review LEP Zone Boundaries

The alignment of zone boundaries within flood affected areas should be reviewed against the extent of flood constraints. A detailed investigation is recommended to determine whether adjustments are required to LEP zone boundaries and/or DCP controls within South Taree, Tinonee, Cundletown, Croki, Coopernook, Harrington and Oxley Island.

Estimated Cost: Staff costs

Responsibility: Council

Priority: High

Flood Planning Levels

The previous Greater Taree DCP adopted the 2100 planning horizon 1% AEP design event (i.e. the 1% AEP present day design flood event incorporating 10% increase in flow and 0.98 m sea level rise), with the addition of a 0.5 m freeboard, as the Flood Planning Levels (FPL) for the lower Manning River floodplain. It is recommended that the updated DCP reflect this revised FPL.

Estimated Cost: Staff costs

Responsibility: Council

Priority: High

8.2.3 Response Modification Measures

8.2.3.1 Emergency Response

The information provided in the Floodplain Risk Management Study (FRMS) will aid the SES in prioritising the areas within the LGA with the highest flood risk and allow for updating of the Local Flood Plans (LFP). The flood mapping and property database including property locations, floor levels and expected inundation levels will be provided to the SES for incorporation into existing systems and emergency management procedures.

Although already identified in the LFP, the designated SES evacuation centres in Harrington (Harrington Function Centre) and Manning Point (Manning Point Bowling Club) will become inundated and isolated during the PMF event. The ongoing use and operation of these facilities as emergency evacuation centres should be reviewed with respect to the identified flood risk, with appropriate review/update of SES emergency response procedures.

A Flood Action Card for the water level gauge at Harrington is currently included in the LFP. The SES flood classification levels at Harrington are quite high relative to design flood levels at the site. As water levels at the Harrington gauge are largely driven by elevated ocean levels, the gauge is not a reliable indicator of potential flooding at Harrington. The existing SES flood level classification at the Harrington gauge could be updated as although providing limited benefit in terms of improving the warning for mainstream Manning River flood events to the Harrington community, it could provide for improved warning of local nuisance flooding from elevated ocean levels.

Additionally, the potential for a “Community Flood Emergency Response Plan (CFERP)” should be investigated. The CFER would aim to encourage landowners to develop their own Flood Plan for appropriate emergency response in lieu of reliance on Emergency Services.

Estimated Cost: Staff costs

Responsibility: Council / SES

Priority: High

8.2.3.2 Community Education

Raising and maintaining flood awareness will provide the community with an appreciation of the flood problem and what can be expected during flood events. An ongoing flood awareness program should be pursued through collaboration of the SES and Council.

Estimated Cost: Staff costs and promotional material ($20,000)

Responsibility: Council / SES

Priority: High

8.3 Funding and Implementation

The timing of the implementation of recommended measures will depend on the available resources, overall budgetary commitments of Council and the availability of funds and support from other sources. It is envisaged that the Floodplain Risk Management Plan (FRMP) would be implemented progressively over a 2 to 5-year time frame as funding becomes available.

There are a variety of sources of potential funding that could be considered to implement the Plan. These include:

- Council funds
- Other stakeholder funds
- Section 94 contributions
- State funding for flood risk management measures through the Department of Planning, Industry and Environment
- State Emergency Service, either through volunteered time or funding assistance for emergency management measures.

State funds are available to implement measures that contribute to reducing existing flood problems. The level of funding assistance varies between different Councils. Although much of the FRMP may be eligible for Government assistance, funding cannot be guaranteed. Government funds are allocated on an annual basis to competing projects throughout the State. Measures that receive Government funding must be of significant benefit to the community. Funding is usually available for the investigation, design and construction of flood mitigation works included in the FRMP.

8.4 Plan Summary

The recommendations of the Manning River FRMP have been summarised in Table 8-1 including estimated cost, responsible body and priority for implementation.

Table 8-1 Summary of Plan Recommendations

Option	Estimated Cost	Responsibility	Priority	BCR
Recommended options that modify flood behaviour				
Taree CBD levee feasibility study and heritage impact assessment	$125k*	Council	High	1.74
Harrington Road raising feasibility study	$100k*	Council	Medium	NA
Pacific Highway and other local access road raising	TBC	Council / TfNSW	Low	NA
Flood gate maintenance	Ongoing maintenance ($16k)	Council	High	NA
Recommended options that modify property				
Update LEP and DCP	Staff costs	Council	High	NA
Review LEP Zone Boundaries	Staff costs	Council	High	NA
Update Flood Planning Levels	Staff costs	Council	High	NA
Recommended options that modify flood response				
Update LFP and investigate establishing a CFERP	Staff costs	Council / SES	High	NA
Ongoing community education and awareness	Staff costs and promotional material ($20k)	Council / SES	High	NA

Notes: NA – Not a capital cost orientated option or benefits difficult/impossible to quantify in financial terms.

** Cost for study only and does not include further design investigations or construction.*

8.5 Plan Review

The FRMP should be regarded as a dynamic instrument requiring review and modification over time. The catalyst for change could include new flood events and experiences, legislative change, alterations in the availability of funding, or changes to the area's planning strategies.

A thorough review every five years is warranted to ensure the ongoing relevance of the FRMP.

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Appendix A Assets and Critical Infrastructure Register

ID	Asset	Event Inundated	ID	Asset	Event Inundated
Evacuation Centres			**Day care/Pre schools**		
1	Chatham High School	-	29	Bright Beginning Children's Centre	-
2	Club Taree	-	30	Cundletown Pre-School and Long Day Care Centre	-
3	Harrington Function Centre	PMF	31	Earth Angels Child Care Centre	0.2% AEP
4	Manning Point Bowling Club	PMF	32	Five Star Family Day Care Centre	1% AEP
5	Old Bar Bowling Club	-	33	Girrawong Pre-School	-
6	Old Bar Public School	-	34	Goodstart Early Learning Centre	-
7	Taree PCYC	-	35	Happy Rompers Day Care Centre	-
8	Wingham Golf Club	-	36	Jabiru Pre-School Harrington	0.2% AEP
9	Wingham Services Club	-	37	Little Flippers Pre-School	-
Evacuation Assembly / Staging Areas			38	Little Seedlings Family Day Care	-
10	Coopernook Public School	-	39	Manning Gardens Public School Pre-School	-
11	Harrington Bowling Club	PMF	40	Old Bar Beach Child Care and Early Learning Centre	-
12	Harrington Memorial Hall	-	41	Old Bar Community Pre-School	-
13	Harrington Public School	-	42	Sea Urchins Childcare Centre Harrington	PMF
14	Lansdowne Bowling and Recreation Club	-	43	Snugglepot Day Care Centre	-
15	Lansdowne Public School	-	44	The Cubbyhouse Childcare Centre	-
16	Mitchells Island Public School	-	**Hospitals & Aged Care**		
17	Oxley Island Public School	-	45	Alma Place Aged Care	-
18	Taree High School	-	46	Banyula Lodge and Banyula Village Aged Care	-
19	WIngham Town Hall	-	47	Biripi Aboriginal Medical Centre	-
Schools			48	Bushland Place Care Units	0.5% AEP
20	Chatham Public School	PMF	49	Cc Drury Retirement Villas	-
21	Cundletown Public School	-	50	Dundaloo Mens Shelter for Disabled	-
22	Manning Adventist School	-	51	Dundaloo Womens Shelter for Disabled	-
23	Manning Gardens Public School	-	52	Manning Base Hospital	-
24	Manning River Steiner School	-	53	Mayo Private Hospital	-
25	Manning Valley Anglican College	-	54	Ormsby House Manning Valley Senior Citizens Home	-
26	Taree Public School	-	55	St Pauls Aged Care	PMF
27	Taree TAFE College	PMF	56	Taree Gardens Aged Care	PMF
28	Tinonee Public School	-	57	Warrana Place Retirement Village	-

ID	Asset	Event Inundated	ID	Asset	Event Inundated
Emergency Services			**Energy, Utilities & Transport**		
58	Burrell Creek RFS	-	87	Essential Energy Johns River 66/11kv Zone Substation	-
59	Coopernook Police Station	-	88	Essential Energy Kanagra Drive 33/11kv Zone Substation	-
60	Coopernook RFS	2% AEP	89	Essential Energy Taree Depot	PMF
61	Crowdy / Harrington Marine Rescue	PMF	90	Essential Energy Whitbread Street 66/11kv Zone Substation	PMF
62	Harrington RFS	-	91	Essential Energy Wingham 33/11kv Zone Substation	-
63	Harrington SES	0.2% AEP	92	MCW Bootawa Dam Water Treatment Works	-
64	Johns River RFS	-	93	MCW Communications Pole	-
65	Kundle - MOTO RFS	PMF	94	MCW Cornwall Street Sewer Pump Station	20% AEP
66	Lansdowne RFS	-	95	MCW Cundletown Water Reservoir	-
67	Macquarie Barracks Army Reserve Training Depot	-	96	MCW Dawson River Sewer Treatment Works Brimbin	-
68	Mitchells Island RFS	-	97	MCW Gipps St Sewer Pump Station	2% AEP
69	Mitchells Island - Manning Point RFS	2% AEP	98	MCW Kiwarrak State Forest Water Pump Station	-
70	Moorland RFS	-	99	MCW Kiwarrak State Forest Water Reservoir	-
71	Old Bar RFS	-	100	MCW Old Bar Sewer Treatment Works	-
72	SES Oxley Region Headquarters	-	101	MCW Sewer Treatment Plant Coopernook	-
73	Taree Ambulance Station	PMF	102	MCW Sewer Treatment Works Harrington	-
74	Taree Fire Station	-	103	MCW Sewer Treatment Works Lansdowne	-
75	Taree Police Station	-	104	MCW Sewer Treatment Works Manning Point	PMF
76	Taree RFS	-	105	MCW Taree Administration Centre	-
77	Taree RFS Fire Control Centre	-	106	MCW Taree North Sewer Pump station	2% AEP
78	Taree SES	-	107	MCW Water Reservoir	-
79	Taree Volunteer Rescue Association	-	108	MCW Water Reservoir	-
80	Tinonee RFS	-	109	MCW Water Reservoir	-
Energy, Utilities & Transport			110	MCW Water Reservoir	-
81	Caltex Energy Bulk Distribution Site	PMF	111	MCW Wingham Sewer Treatment Works	5% AEP
82	Communications Tower	-	112	Taree Airport	-
83	Essential Energy Bohnock 66/11kv Zone Substation	PMF	113	Taree Airport Air Park	-
84	Essential Energy Bootawa Dam 33/11kv Zone Substation	-	114	Taree Railway Station	-
85	Essential Energy Coopernook 33/11kv Zone Substation	-	115	Taree TransGrid Sub transmission Substation	-
86	Essential Energy Harrington 33/11kv Zone Substation	PMF	116	Waste Transfer Station	-

ID	Asset	Event Inundated	ID	Asset	Event Inundated
Community			Community		
117	2BOB Radio Station	-	150	Ferry Road Scotts Creek Boat Ramp	20% AEP
118	Andrews Reserve Taree	10% AEP	151	Harrington Beach - Pedestrian Access 1	-
119	Bishop Tyrrell Place	-	152	Harrington Beach - Pedestrian Access 2	-
120	Bo Bo Cemetery	-	153	Harrington Beach - Pedestrian Access 3	-
121	Boat Ramp	20% AEP	154	Harrington Community Centre	-
122	Bohnock Boat Ramp	20% AEP	155	Harrington Hotel	PMF
123	Bootawa Dam	-	156	Harrington Lagoon - Pedestrian Access 1	2% AEP
124	Burrell Creek Public Hall	-	157	Harrington Lagoon - Pedestrian Access 2	20% AEP
125	Bushland Activity Centre	-	158	Harrington Lagoon - Pedestrian Access 3	2% AEP
126	Bushland Tavern	-	159	Harrington Post Office	-
127	Chatham Methodist Church	PMF	160	Harrington Uniting Church	-
128	Chatham Post Office	-	161	Harrington Waters Golf Club	PMF
129	Coopernook Cemetery	-	162	Jehovah's Witnesses Church	PMF
130	Coopernook Forestry Headquarters	-	163	Johnny Martin Oval	-
131	Coopernook Hotel	5% AEP	164	Johns River Tavern	-
132	Coopernook Post Office	-	165	Kolodong Baptist Church	-
133	Coopernook Uniting Church	-	166	Lansdowne Catholic Church	-
134	Coptic Orthodox Church Cundletown	-	167	Lansdowne Cemetery	-
135	Crowdy Head Beach - Pedestrian Access	-	168	Lansdowne Church of The Epiphany	-
136	Crowdy Head Beach - Pedestrian Access	-	169	Lansdowne Community Hall	-
137	Crowdy Head Beach - Vehicle / Pedestrian Access	-	170	Lansdowne Post Office	-
138	Crowdy Head Boat Harbour	-	171	Lansdowne Uniting Church	-
139	Crowdy Head Harbour Boat Ramp	-	172	Manning Entertainment Centre	PMF
140	Crowdy Head Lighthouse	-	173	Manning Entertainment Centre	PMF
141	Crowdy Head Surf Club - Pedestrian / Surf Boat Access	-	174	Manning Gardens Crematorium	-
142	Crowdy Head Water Reservoir	-	175	Manning Mall Shopping Complex	-
143	Crowdy Southside - Pedestrian Access	-	176	Manning Point Beach - Pedestrian / Vehicle Access	-
144	Crowdy Southside - Vehicle / Pedestrian Access	-	177	Manning Point General Store	0.2% AEP
145	Cundletown Post Office	-	178	Manning Regional Art Gallery	-
146	Cundletown Scout Hall	0.2% AEP	179	Manning River Rowing Club	20% AEP
147	Cundletown Uniting Church	-	180	Manning River Sailing Club	20% AEP
148	Dawson River Cemetery	-	181	Manning Uniting Church	-
149	Farquhar Park - Vehicle / Pedestrian Access	2% AEP	182	Manning Visitor Centre	PMF

ID	Asset	Event Inundated	ID	Asset	Event Inundated
Community			Community		
183	MidCo ast Council Kolodong Works Depot	-	216	St Johns Hall Taree	-
184	MidCoast Council Taree Office	20% AEP	217	St Luke's Church Coopernook	-
185	MidCoast Water Taree Works Depot	-	218	St Marks Anglican Church Mitchells Island	-
186	Mitchells Island - Vehicle / Pedestrian Access	-	219	St Marys Hall Taree	-
187	Mitchells Island Anglican Church	-	220	St Peters Anglican Church Harrington	-
188	Mitchells Island Cemetery	-	221	Taree Aquatic Club	20% AEP
189	Mitchells Island Hall	-	222	Taree Basketball Stadium	2% AEP
190	Moorland Cemetery	-	223	Taree Catholic Church	-
191	Moorland Post Office	-	224	Taree Christian Outreach Centre	-
192	Mud Bishops Reserve	PMF	225	Taree Church of Christ Church	-
193	Mudbishops Point Boat Ramp	PMF	226	Taree City Centre Shopping Complex	-
194	Nulama Village	PMF	227	Taree Community College	-
195	Old Bar Beach - Pedestrian Access	PMF	228	Taree Court House	-
196	Old Bar Beach - Pedestrian Access	-	229	Taree Girl Guides Hall	-
197	Old Bar Beach - Pedestrian Access	-	230	Taree League and Sports Club	PMF
198	Old Bar Beach - Pedestrian Access	-	231	Taree Legacy Village	-
199	Old Bar Beach - Pedestrian Access	-	232	Taree Library	2% AEP
200	Old Bar Beach - Pedestrian Access	-	233	Taree Mormon Church	-
201	Old Bar Beach - Pedestrian Access	-	234	Taree Motorcycle Club Racetrack and Grounds	-
202	Old Bar Beach - Viewing Platform and Pedestrian Access	-	235	Taree Old Bar SLSC	-
203	Old Bar Beach Surf Club - Vehicle / Pedestrian Access (Non-Public)	-	236	Taree Pistol Club	2% AEP
204	Old Bar Catholic Church	-	237	Taree Presbyterian Church	-
205	Old Bar Library	-	238	Taree Presbyterian Church and Hall	-
206	Old Bar Pool	-	239	Taree Racecourse	-
207	Old Bar Post Office	-	240	Taree Rail Yards	-
208	Old Bar Public School Beach Access	-	241	Taree Railway Institute Bowling Club	-
209	Old Bar Soldiers Memorial Hall	-	242	Taree Recreation Centre Sporting Grounds	PMF
210	Our Lady Star of The Sea Catholic Church Harrington	-	243	Taree Salvation Army Hall	-
211	Pilot Hill Lookout	-	244	Taree Scout Hall	-
212	Radio 2RE / Max FM	PMF	245	Taree Seventh Day Adventist Church	PMF
213	Redbank Cemetery	-	246	Taree Showground	5% AEP
214	Salvation Army Church Harrington	PMF	247	Taree South Service Centre	-
215	St Johns Anglican Church Taree	-	248	Taree Stock Saleyard	-

ID	Asset	Event Inundated
Community		
249	Taree Tennis Centre	-
250	Taree Tenpin Bowl Centre	-
251	Taree Wesleyan Methodist Church	-
252	Taree West Bowling Club	-
253	Taree West Post Office	-
254	Taree West Public School	-
255	The Bight Cemetery	-
256	Timber Mill	-
257	Timber Mill	-
258	Tinonee Anglican Church	-
259	Tinonee Cemetery	-
260	Tinonee Free Presbyterian Church	-
261	Tinonee Historical Museum	-
262	Tinonee Memorial School of Arts Hall	-
263	Water Reservoir	-
264	Wingham Cemetery	-
265	Woola Cemetery	-
Campground		
266	Big 4 Harrington Beach Holiday Park	PMF
267	Colonial Holiday Park and Leisure Village Harrington	PMF
268	Dawson River Tourist and Caravan Park	-
269	Farquhar Park Campground	10% AEP
270	Lanis on the Beach Caravan Park	-
271	Manning Point Hideaway Holiday Cabins	PMF
272	Ocean Shores Holiday Park Manning Point	PMF
273	Oxley Anchorage Caravan Park Harrington	0.2% AEP
274	Riverside Caravan Park - Croki	5% AEP
275	Twilight Caravan Park Taree South	-
276	Weeroona Holiday Park Manning Point	2% AEP

Appendix B Manning River FRMSP Planning Considerations

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MANNING RIVER

Floodplain Risk Management Study & Plan

Planning Considerations

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Floodplain Risk Management Study & Plan

Manning River, MidCoast Council

Prepared for

BMT on Behalf of MidCoast Council

By

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1 Introduction

BMT WBM engaged GLN Planning, to provide town planning input into the preparation of the Manning River Floodplain Risk Management Study (FRMS) and Floodplain Risk Management Plan (FRMP) being prepared on behalf of MidCoast Council (Council).

The brief requires the following land use planning matters to be addressed:

- the consistency of current or proposed future strategic planning directions for the community in relation to addressing floodplain management objectives.

- the adequacy of current land use planning and building controls for specific development areas or developments in relation to addressing floodplain management objectives and managing flood risk to both new development and limiting impacts upon the existing community.

- the suitability of different land uses in different areas of the floodplain considering their use and community response to flooding.

- the suitability of different land uses in different areas of the floodplain, considering the vulnerability of these uses and their users to flooding.

- the residual flood risk, following the instigation of general constraints and in relation to the need for additional constraints, where warranted, in specific areas of the floodplain.

- provide recommendations for changes in land use planning directions or controls to address any identified shortcomings.

In order to address the above matters, we outline the planning context of the study area, focusing on aspects that are specifically relevant to flood risk management (FRM). While the FRMS relates to a part of the local government area (LGA) it will be important for recommendations regarding the preparation of planning controls be structured so that they can also be easily applied to other floodplains in the LGA.

2 Purpose of Report

2.1 The Role of Planning in Flood Risk Management

The key benefits that planning can provide within the suite of strategies delivered by an FRMP are:

- Providing guidance through the strategic planning process where development should occur based on flood risk management (FRM) considerations.

- Provide development controls to minimise the risk to people, private property and public infrastructure where development occurs within the floodplain.

- Ensure that the communication of flood risk, as may be interpreted by the community through planning documents, is not misleading. Planning documents typically deal with where flood related planning controls apply rather than where flood risks exist.

While flood risk management can be relevant to the preparation of a plan for an area or in the assessment of a development application (DA), there will also be other non-FRM considerations that will be relevant.

Flood risk management will ultimately need to be weighed with other relevant planning considerations to achieve balanced outcomes that meet community expectations. Despite this, there are baseline standards or community expectations relating to safety, exposure of property and infrastructure to costly repairs and avoidance of disruption to the occupation of homes and the operation of businesses that should be considered when making planning decisions.

2.2 Objectives of this report

Having regard to the brief, the objectives for this report are to:

- Outline and review the state and local planning policy context (including existing environmental planning polices and instruments and long term planning strategies for the area);

- Identify the planning issues associated with implementing a flood risk management strategy for the study area;

- Discuss options to address these planning issues; and

- Make recommendations for incorporation into the FRMP.

The planning recommendations for the Manning River FRMP will focus on providing advice to Council on changes that can be made to the planning controls to better achieve development that minimises flood risks to as low as reasonably and practically achievable. Advice will also be provided on principles to be applied when considering changes to land use zoning plans in the future and the presentation of planning information, including flood maps prepared for planning purposes. These considerations will take into account the potential impacts of climate change.

2.3 Other Studies

The following FRMPs and related studies provide some background understanding of the planning related FRM context of the study area.

Table 1 Previous Flood Investigations

Study Name	Author	Year
Lansdowne Flood Risk Management Study and Plan	Worley Parsons	2015
Wingham Flood Study - Review and Update	Worley Parsons	2011
Wingham Floodplain Risk Management Study and Plan	Worley Parsons	2011
Manning River Floodplain Management Study	Willing and Partners Consulting Engineers	1996

In addition, Council has produced several strategic planning documents (Table 2) that contribute to an understanding of the existing and future economic, social and environmental characteristics of the study area.

Table 2 Strategic Planning Studies

Study Name	Author	Date
MidCoast Regional Economic Development Strategy (REDS) 2018-2022	Balmoral Group Australia c/- Department of Premier and Cabinet	July 2018
Rural Issues Overview Summary Paper	MidCoast Council	2018
Community Strategic Plan 2018-2030	MidCoast Council	2018

Council is also in the process of reviewing the different local environmental plans (LEPs) applying to its former regions and preparing a single updated consolidated LEP. This process had only recently commenced at the time of preparing this report, and will include the preparation of a Housing Strategy, a Rural Strategy, a CBD Precinct Plan for Taree and an overall review of employment, infrastructure and recreation zoning provisions. The consolidated MidCoast LEP is programmed for completion by December 2021.

This report will have regard to these other studies in order to contribute to establishing a framework for input to strategic planning, planning controls and flood maps for planning purposes that can be applied to other floodplains in the LGA. This includes differentiation in flood risk associated with overland flow flooding as opposed to riverine flooding. The primary focus of this report is to address the planning aspects of the existing, future and continuing flood risks in the study area.

3 Study Area

3.1 Physical Setting

The Manning River is located on the Mid-North Coast of New South Wales (Figure 1). The main mouth of the river system is Harrington with the second opening is located at Old Bar.

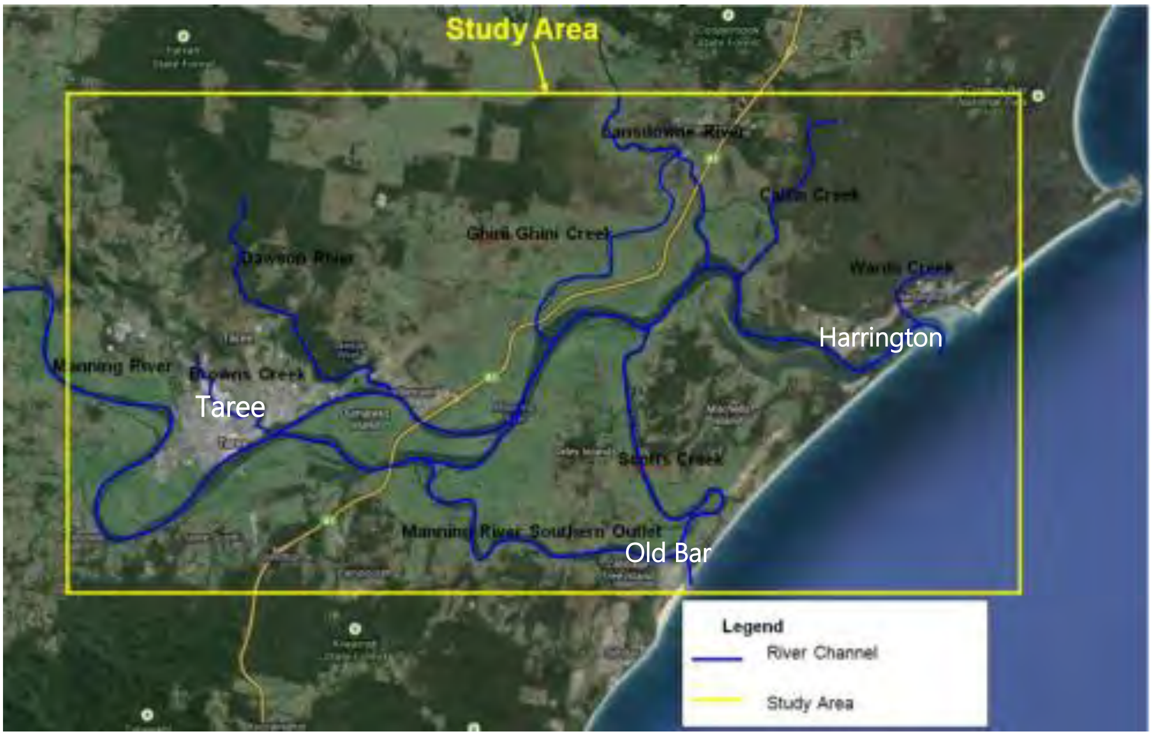

Figure 1: Location (Base Map Source: Study Brief)

The Manning River basin encompasses an area of over 8,100km^2 and drains to the Tasman Sea on the Mid-North Coast. The Manning River catchment also comprises the Gloucester River, Barnard River and Nowendoc River. The lower Manning River floodplain is approximately 2,060km^2 and includes the catchments of Dingo Creek and the Lansdowne River.

The study area comprises the lower floodplain of Manning River from downstream of Wingham to the coast including the township of Tinonee, Taree, Cundletown, Harrington and the adjacent semi-rural and rural areas.

The catchment includes several villages and towns interspersed with rural and environmental lands, and comprises parts of the localities of Mondrook, Tinonee, Taree, Glenthorne, Pampoolah, Dumaresq Island, Oxley Island, Old Bar, Cabbage Tree Island, Mitchells Island, Harrington, Mambo Island, Croki, Ghinni Ghinni, Coopernook and Kundle Kundle.

3.2 Population Characteristics

Characteristics of the permanent population of the area, that could be relevant to assessing flood risk, can be drawn from various sources, mainly the 2016 Census. These include:

- The population of the whole of MidCoast Council LGA was 90,303, based on place of usual residence. The permanent resident population of the study area would be in the order of 30,000 persons.
- Most of the population in the Study Area is contained in the following suburbs/localities:
  - Taree – 16,197
  - Old Bar - 3,795
  - Harrington - 2,896
  - Cundletown - 2,054
  - Tinonee - 757
  - Mitchells Island - 468
  - Pampoolah - 393
  - Coopernook - 341
  - Taree South – 315
  - Manning Point - 239
  - Croki - 43
- The median age in the LGA was 52, being substantially higher than the Australian median age of 38. The median age varies across the study area from 45 in Taree and Tinonee to 61 in Harrington. Just over 38% of the LGA population is aged 60 or over. There is a large shift of people aged 45+ to the Region from other parts of NSW.
- In the LGA 24% of household are renting, 23% have a mortgage and 46% of dwellings were owned outright.
- 84.9% of dwellings in the LGA had one or more motor vehicle (compared to 87.1% for NSW). The remainder had no motor vehicles, or the number was unstated.
- The percentage of persons in the LGA who required assistance with core activities, excluding unstated responses, was 8.7%. This varied across the study area from 5.5% in Tinonee to 10.1% and 10.4% in Harrington and Taree respectively. This reflects the variation in median age across the study area.
- The percentage of persons in the LGA reported as speaking English "not well or not at all" was 8.9% of the population.

The Manning River and its tributaries is an area that attracts a substantial transient population, being marketed as the 'Manning Valley'.

Visitation to the Manning Valley has been increasing since June 2012 and at 2014 averaged approximately 700,000 visitors per year, staying an average of three nights. 56% of visitors travelled from regional NSW, 32% from Sydney and the remainder visit from interstate. Couples are the most common type of travel group, followed by couples with children at 29% and 22% travelling alone. (Manning River Destination Management Plan 2014)

The catchment area of the Manning River is quite large and has a larger percentage of persons in older age groups that could require assistance if required to evacuate, or have no access to a motor vehicle. Most of the population that resides in the Manning River catchment are competent English speakers. A substantial proportion of the persons within the area at any one time will be tourists, who are less likely to be flood aware.

Council's Rural Strategy discussion paper identifies emerging planning issues including an increasing demand for rural housing and rural based tourism.

This data is important in understanding potential emergency management issues and flood awareness education.

3.3 Economic Base

The North Coast Rail Line connects Gloucester, Wingham and Taree to both Sydney and Brisbane. The Pacific Highway is a national connector route running through the LGA.

Taree is a key regional centre that includes a large regional public hospital, other health facilities in addition to the direct rail access and a local airport.

The largest industries in the area are tourism, agriculture, forestry and fishing. Visitors to the LGA spent an estimated $505 million in 2016 making 'tourism' the largest export industry in the MidCoast region. Tourism can be significantly disrupted during and when recovering from floods.

The highest industry sector of employment is health care and social assistance.

The unemployment rate is 9% compared to 6.3% over New South Wales. Approximately 91% of the population is employed, and of those 38,038 persons, 52% work full time and 46% part time.

Approximately 75% of employed people travelled to work by car, truck or motor bike only as a driver or passenger. About 6% worked from home and 4% walked (only) to work. The remainder of employed people cycled or used public transport and taxis only or in combination with other modes.

3.4 Natural Environment

The study area comprises the lower floodplain of Manning River from downstream of Wingham to the coast including the township of Tinonee, Taree, Cundletown, Harrington and the adjacent semi-rural and rural areas. Taree is one of the major towns in the lower floodplain of Manning River and is located 16 km from the coast adjacent the River. The Manning River has two branches downstream of Taree and has two entrances to the ocean; one at Farquhar/Old bar and the other at Harrington.

The natural environment is recognised in Council's strategic plans as an important asset that underpins a broad range of economic activities particularly its tourism industry. Council's Rural Strategy discussion paper identifies emerging planning issues, including the need to manage marine activities and rural waterways to minimise the impact of growth.

4 General Planning Policy Framework

4.1 Overview

The formulation and implementation of FRMPs is the cornerstone of the NSW Government's Flood Prone Land Policy. As with other local planning processes, the preparation of FRMPs is a Council responsibility. The planning recommendations ultimately incorporated within a FRMP and adopted by Council will subsequently require implementation through the separate planning processes, principally governed by the Environmental Planning and Assessment Act 1979 (EPA Act).

The imposition of planning controls can be an effective means of managing flood risks associated with future development (including redevelopment). Such controls might vary from prohibiting certain land uses in areas of high flood risk to specifying development controls such as minimum floor levels and building materials.

In principle, the degree of restriction that is imposed on development due to flooding should relate to the level of risk that the community is prepared to accept after balancing economic, environmental and social considerations (i.e. the application of the merits based approach required by the FDM). In practice, the planning controls that may ultimately be imposed are influenced by a complex array of considerations including state imposed planning policy and directions, existing local planning strategies and policies and ultimately the acceptability of conditions that could be imposed through the development application process.

The following provides an outline of policy that is potentially relevant because it either directs the flood risk management (FRM) planning controls that could be adopted or affects the way flood risk is identified in the planning controls.

4.2 The FRMP Relationship with EP&A Legislation

In 1984 the NSW State Flood Policy was first introduced disbanding the mandatory application of a singular 100 year flood standard and required local Councils to prepare individual floodplain management plans based on a 'merit based approach'. The first Floodplain Development Manual (FDM) was published in 1986 to assist Councils in this task.

While the policy has evolved over time it has remained fundamentally the same, with a new Manual being published but not gazetted in 2001 and the current policy and Manual published and gazetted in 2005. The current FDM is under review but this process is unlikely to be completed within the timeframe of this study.

The changes in the Manual and policy over time are not considered to be fundamentally significant, and have principally retained the following key principles:

a. Local Government is responsible for FRM in NSW with financial and technical support being provided by the State Government. The actions, decisions and information provided by Council and exercised in this duty are indemnified through the provisions of Section 733 of the *Local Government Act, 2003*. Indemnity is provided where Council acts in good faith, which is deemed to be in accordance with the principles of the FDM unless proven otherwise.

b. A merit approach is to be adopted for the purposes of formulating a FRMP that provides a basis for decision making in the floodplain. This is in recognition that flood prone land is a valuable resource which should not be unnecessarily sterilised by the rigid application of prescriptive criteria, and to avoid the approval of inappropriate proposals. The merit approach is defined as follows:

c. "The merit approach weighs socio-economic, ecological and cultural impacts of land use options for different flood prone land areas together with flood damage, hazard and behaviour implications, and environmental protection and wellbeing of the State's rivers and floodplains."[1]

The level of flood risk acceptable to the community is to be determined through a process typically overseen by a committee comprised of local elected representatives, community members and State and Local Government officials (including the SES). This process is shown in Figure 2.

The ultimate intent is to prepare FRMPs for individual floodplains that are adopted by Councils. FRMPs should have an integrated mix of management measures that address existing, future and continuing risk.

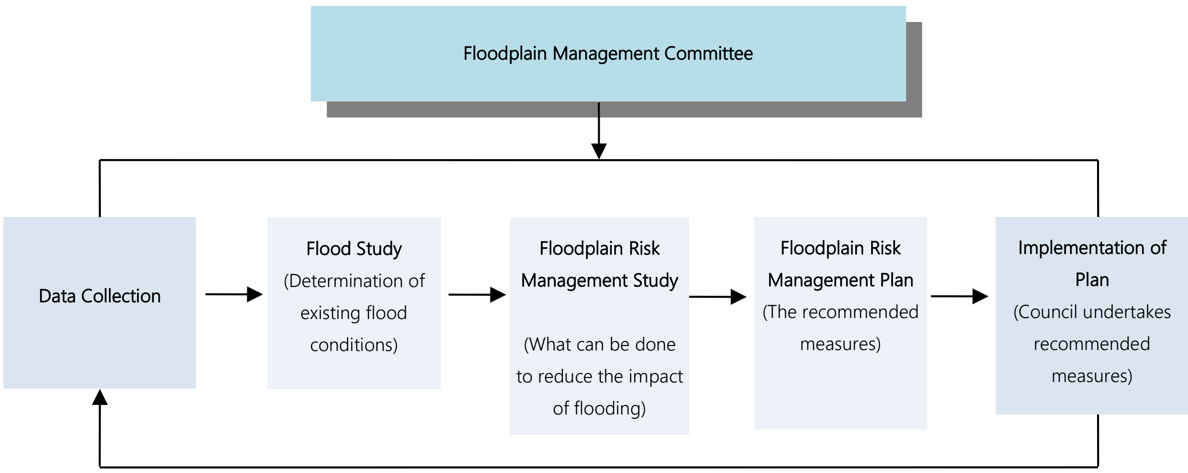

Figure 2: NSW FRM Process (Adapted from FDM 2005, pg.6)

The FDM and planning controls under the EPA Act should not be considered as providing alternate approaches.

The Flood Prone Lands Policy and Manual are separate to the principal planning legislation in NSW, being that contained within the EP&A Act and associated Regulations. Ultimately, the planning recommendations of a FRMP may be reflected in planning instruments and policies brought into force in accordance with the EP&A Act. While the EP&A Act and Regulation refers to flooding as an issue requiring consideration in some circumstances[2] this legislation does not refer to the Flood

[1] 2005 Manual, NSW Government, 2005, page 23.

[2] For example in the determination of what is designated development for the purposes of the Act and therefore requiring the preparation of an Environmental Impact Statement.

Prone Lands Policy or the FPDM. The plans prepared under the EPA Act provide the relevant considerations for the assessment of development applications.

The FRMP can provide appropriate input to the EPA Act planning processes in 3 ways:

- Providing direction at a local and state strategic planning level in addressing FRM (e.g. where new urban areas should be located and the distribution of land uses therein);
- Recommendation of development controls to be incorporated in appropriate planning instruments (e.g. LEPs and DCPs) to mitigate the risk to development where permitted in the floodplain; and
- Ensuring that the planning controls and associated documents (e.g. S10.7 Planning Certificates) contribute to ensuring the community is appropriately informed about the flood risk.

To understand how these outcomes may be best achieved, it is important to consider the existing EPA Act framework and guidelines that relate to FRM.

4.3 2007 Flood Planning Guideline

On January 31, 2007 the NSW Planning Minister announced a new guideline for development control on floodplains (the "Flood Planning Guideline"). An overview of the new Guideline and associated changes to the EPA Act and Regulation was issued by the (then) Department of Planning in a Circular dated January 31, 2007 (Reference PS 07-003). The Flood Planning Guideline issued by the Minister in effect relates to a package of directions and changes to the EPA Act, Regulation and FDM.

This Flood Planning Guideline provides an amendment to the FDM. The Guideline confirms that unless there are "exceptional circumstances", Councils are to adopt the 100 year flood as the flood planning level (FPL) for residential development, with the exception of some sensitive forms of residential development such as seniors living housing. The Guideline does provide that controls on residential development different to the 100 year flood may be imposed subject to an "exceptional circumstances" justification being agreed to by the Department of Planning (now the Department of Planning, Industry and Environment- DPIE) and the Department of Natural Resources (subsequently the Office of Environment and Heritage – OEH and now subsumed into the DPIE agency cluster) prior to the exhibition of a Draft LEP or Draft DCP.

The reference to the FPL in the Guideline is a reference to the 100 year flood plus freeboard (typically 0.5 metres).

The DPIE is currently reviewing the Guideline. The review is expected to be completed during 2020.

4.4 Section 9.1 Directions (Formerly Section 117)

Ministerial directions pursuant to Section 9.1(2) of the EPA Act specify matters which local councils must take into consideration in the preparation of LEPs. Direction 4.3, as currently applies, deals specifically with flood [liable] prone land. The Direction applies to all councils that contain flood prone land when an LEP proposes to "create, remove or alter a zone or provision that affects flood prone land." In such cases, the Direction requires draft LEPs to ensure the following:

- Consistency with the principles of the FDM (including the Planning 2007 Flood Guideline).
- Do not rezone flood prone land zoned special use areas, recreation, rural or environmental protection to a residential, business, industrial or special use area zone;
- Do not permit development in floodways that would result in significant flood impacts on others, permit a significant increase in development on the floodplain, require substantial government spending on flood mitigation, or allow development without consent except for agriculture or flood mitigation works.
- That flood related development controls are not imposed on residential development above the "residential flood planning level" unless adequate justification to the satisfaction of DPIE is provided.
- Flood planning levels must be consistent with the FDM and 2007 Flood Planning Guideline.

Clause (6) of the Direction specifies that a variation to the Direction may be permitted where it is minor or accords with an FRMP.

While Section 9.1 Directions are not relevant to DCPs, the Flood Planning Guideline does indicate the approval of DPIE is required prior to the exhibition of a draft DCP that varies from the Guideline.

4.5 Climate Change Considerations

The FDM highlights the need for climate change to be considered in an FRMS to understand both the potential effects on flood behaviour and as a factor when evaluating management strategies.

The (then) NSW Department of Environment & Climate Change issued an FRM Guideline entitled "Practical Consideration of Climate Change" (25.10.2007). The Guideline addresses the consequences of potential changes in sea levels and rainfall intensities associated with climate change predictions. Due to some level of uncertainty with the timing and magnitude of climate change effects, this Guideline recommends undertaking sensitivity analysis to understand the potential implications of climate change when modelling flood behaviour and frequency and to test the robustness of management strategies.

As part of the management strategies for future development, the 2007 Guideline recommends that where climate change ramifications are considered minor that either existing FPLs be adopted and the potential for risk to increase over time be documented and the community informed, or higher FPLs that include a climate change factor be used. The decision for which option to adopt is a matter for the FRMS process. In a practical sense, the adoption of the higher FPL could be appropriate for new areas or major developments where additional filling or higher floor levels can be readily achieved with marginal additional cost and minimal impacts on surrounding development. Conversely it could be difficult to implement materially higher FPLs for minor development within established areas where there could be amenity, streetscape or drainage impacts.

Where climate change ramifications are likely to be significant, the 2007 Guideline recommends additional measures, including considering:

- Alternate locations for new residential development

- Applying a combination of higher fill and floor levels to maximise the height of habitable floors with minimal environmental impacts
- Consideration of uses more compatible with the long term risk (eg recreation areas, agriculture or environmental purposes)
- Promoting types of development that have a limited life span or are more capable of relocation (eg tourist or short term caravan parks, and tourist or commercial development where investment decisions are based upon known conditions of abandonment and removal)
- Designing developments with more vulnerable components in less exposed parts of the site
- Building-in the potential for retrofit solutions in the future.

The above measures will vary depending on whether considered as part of strategic planning exercise or for incorporation into an LEP or DCP. The measures need to be assessed against a number of evaluation criteria set out in the 2007 Guideline, such as impacts on existing and future flood behaviour, cost/benefit, additional emergency management requirements, aesthetic and environmental issues, and the potential to adapt with changed climate change information.

The impact of climate change on individual sites and development scenarios needs to also be considered for the broader planning area. If roads and services could become inundated in the future this could significantly constrain the viability of development in the long term.

4.6 Regional Planning Strategies

The former DPE published the *Hunter Regional Plan 2036* in 2016. The priorities set for the MidCoast area (pgs 73-74) are to

- grow the economy - enhance tourism infrastructure and connectivity and to provide a broader economic base (see also Action 6.3)
- Protect agricultural land and industries
- Manage development within sensitive water catchments and protect environments that sustain the oyster industry
- Assist long term employment though education/training and by capitalising intra- and inter-regional connections
- Provide housing, services and facilities, as well as accessible public spaces for an ageing population

The Hunter Regional Plan identifies Taree as a strategic centre, which is the largest populated town within the Manning River catchment area. Harrington and Old Bar are identified as areas of "Residential and Employment Land." No part of the study area is identified as a "growth area."

Direction 16 of the Regional Plan seeks to "increase resilience to hazards and climate change". The following actions specified under Direction 16 (pg. 14) are particularly relevant:

> *16.1 Manage the risks of climate change and improve the region's resilience to flooding, sea level rise, bushfire, mine subsidence and land contamination*
>
> *16.2 Review and consistently update flood risk and coastal zone management plans, particularly where urban growth is being investigated.*
>
> *16.3 Incorporate new knowledge on regional climate projections and related cumulative impacts in local plans for new urban development.*

The Plan states that climate change is likely to result in varying rainfall, higher temperatures and prolonged dry periods or drought with Coastal communities likely to be more vulnerable to the threat of coastal recession and, over the longer term, sea level rise.

Managing flooding is an important priority for the NSW Government and councils. Most councils currently include, or refer to, flood planning area mapping in local plans and hydraulic and hazard category mapping of flood prone land, which provides government, developers and landowners with a level of certainty about the risk for particular sites.

4.7 State Environmental Planning Policies (SEPPs)

A State Environmental Planning Policy (SEPP) is a planning document prepared in accordance with the EP&A Act by DPIE and eventually approved by the Minister, which deals with matters of significance for environmental planning for the State.

Regional Environmental Plans (REPs) were previously a type of environmental planning instrument prepared under the Act (since repealed) and existing REPs are now deemed SEPPs. No SEPP has been prepared dealing specifically with the issue of flooding, but some regulate development in response to potential flood risks.

Those SEPPs of potential relevance are discussed below.

Seniors Living SEPP

SEPP (Housing for Seniors or People with a Disability) 2004 (Seniors Living SEPP) applies to urban land or land adjoining urban land where dwellings, hospitals and similar uses are permissible.

The Seniors Living SEPP would apply to parts of the study area, and would effectively override Council's planning controls to permit residential development for older and disabled persons to a scale permitted by the SEPP. Notwithstanding, Clause 6(2)(a) of the SEPP restricts its application if land is identified as "floodways" or "high flooding hazard" in Council's LEP.

Codes SEPP

The specification of exempt and complying development is primarily governed by *State Environmental Planning Policy (Exempt and Complying Development Codes) 2008* (the Codes SEPP).

The Codes SEPP is divided into a number of "Codes" that deal with exempt development and different types of complying development. Those Codes of specific relevance to the study area or LGA are the Exempt Development Codes (Part 2), the General Housing Code (Part 3), the Rural Housing Code (Part 3a) and the Commercial and Industrial (New Buildings and Additions) Code (Part 5a). The relevant clauses of the Codes SEPP apply to "flood control lots" defined as:

flood control lot *means a lot to which flood related development controls apply in respect of development for the purposes of industrial buildings, commercial premises, dwelling houses, dual occupancies, multi dwelling housing or residential flat buildings (other than development for the purposes of group homes or seniors housing).*

Note. *This information is a prescribed matter for the purpose of a certificate under section 149 (2) of the Act.*

The Exempt Development Code in the Codes SEPP provides a number of exclusions to what can be considered exempt development on a flood control lot. The General Housing, Rural Housing and Commercial and Industrial (New Buildings and Additions) Codes also provide a number of exclusions as to what can be complying development on a flood control lot (i.e. must not be on any part of a flood control lot which is a storage area, a floodway area, a flow path, a high hazard area or a high risk area). Where otherwise permitted on a flood control lot, specified flood related development controls must, in most circumstances, be imposed on a Complying Development Certificate (CDC).

The manner in which these exemption criteria and development controls apply are summarised by Figure 3.

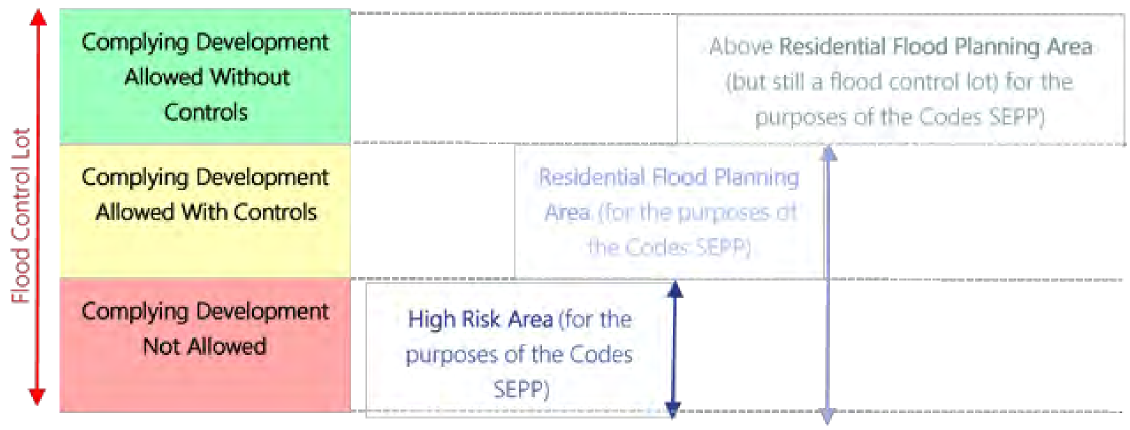

Figure 3: Application of the Codes SEPP to Flood Liable Land

Important considerations for the FRMP, in regard to establishing rules for development that could be approved as complying development, is the defining of high risk areas (where complying development is excluded) and setting of minimum floor levels. The objective should be to ensure that such future development does not lead to increased flood risk to property and persons as a consequence of the application of the CDC process in comparison to outcomes otherwise likely to be achieved through the full DA process. At the same time, the outcome of the FRMP should not create unnecessary administrative burdens on the public and council by requiring a DA where this would be of no likely benefit to reducing flood risk.

Council could proactively provide advice to the public as to where the Codes SEPP applies. The flood maps produced for planning purposes could achieve this by aligning areas identified as high risk areas with those areas within which complying development is excluded under the Codes SEPP.

Rural Lands SEPP

State Environmental Planning Policy (Rural Lands) 2008 (Rural Lands SEPP) is relevant to the rural zones within the study area. The SEPP is principally aimed at maintaining the agricultural potential of rural zoned land. Consequently, the Rural Lands SEPP could have the effect of restricting more intensive non-agricultural activity in locations identified as "significant agricultural land" that can in many situations coincide with the floodplain.

4.8 Local Planning Strategies

MidCoast Council is presently undertaking, or recently completed, several strategic planning projects including the review of existing planning instruments and formulation of plans to guide growth in different parts of the LGA. Those of relevance to the study area are:

- The most significant growth in the LGA is set to occur in Brimbin. Brimbin is located 8km north-east of Taree and extends from the Lansdowne River to the east through to the Dawson River in the west, straddles Lansdowne Road and covers an area of around 3,700ha. The first stage of zone changes has been implemented which will lead to the development of a new town for approximately 22,000 people and 8,000 dwellings, a mixed-use centre, 3 neighbourhood centres, 4 schools, 112 hectares of employment and industrial, and environmental and open space lands. This growth area is subject to minimal flooding issues, and is well suited for growth in regard to FRM criteria.

- The “Figtrees” development on the Manning River is located on the northern bank of the Manning River, approximately 2km east of the Taree town centre. The site is around 20ha in size and includes a disused dairy factory. The site is intended to support about 500 residential units and a range of commercial buildings for cafes, restaurants and other businesses. A voluntary planning agreement outlines public outcomes the landowners are required to provide.

- Three major precincts have been rezoned that provides for the growth of Old Bar. Precinct. 1 is located immediately north of Old Bar and was rezoned to allow tourist facilities. Precinct 2B is located immediately west of the existing Old Bar township on both sides of Old Bar Road providing about 1,400 potential residential lots. Precinct 3 is located directly south of Precinct 2B, providing for an additional 525 residential lots and a 9 hole golf course.

- Coopernook is a village on the banks of the Lansdowne River, to the north of the study area. Approximately 18ha of land bounded by Macquarie and West Streets in Coopernook was rezoned on 31 March 2017 predominantly from rural (RU1) to village (RU5) to provide for rural residential lots to cater for the growth of the village of Coopernook.

These areas have been rezoned and the FRM planning implications are discussed below as part of the review of the current LEPs.

4.9 Local Environmental Plans

The EPA Act facilitates the reproduction of planning instruments into a standardised format known as the 'standard instrument'. Section 3.20 of the EPA Act deals with the prescribing of the standard instrument for LEPs. The standard instrument contains no compulsory clauses or map requirements specifically relevant to addressing flood hazards. However, DPIE have adopted a model local clause in regard to flooding. A model local clause is one which has been settled by Parliamentary Counsel as acceptable and the DPI encourage that it is used as is. A model clause may be varied with justification to suit local circumstances.

The Manning River catchment area falls under the MidCoast Council LGA. The MidCoast Council was formed on 12 May 2016 after the Gloucester Shire, Great Lakes and City of Taree councils were merged. Land Use planning within the Manning River catchment area is regulated by way of the following LEPs:

- Greater Taree Local Environmental Plan 2010
- Great Lakes Local Environmental Plan 2014
- Gloucester Local Environmental Plan 2010

The LEPs above are based on the Standard Instrument. Figure 4 shows the general land use zoning pattern across the Manning River catchment area.

As previously noted, Council is working towards merging the 3 LEPs into one LEP. Irrespective of this outcome, it would be preferable to establish a single comprehensive framework for FRM planning controls for the LGA. Table 1 provides a review of the relevant current LEP provisions before making recommendations as to how they might be rationalised to improve FRM outcomes.

Table 1: LEP FRM Planning Provisions

LEP Clauses	Gloucester LEP 2010	Great Lakes LEP 2014	Greater Taree LEP 2010
1.2 (2) Aims of Plan	*(d) to embrace and promote the principles of ecologically sustainable development, conservation of biological diversity and sustainable water management, and to recognise the cumulative impacts of climate change,*	NA	*(f) to minimise the exposure of development to natural hazards and natural risks,*
	For FRM purposes we recommend including objective (f) of the Greater Taree LEP within in a future consolidated LEP. Objective (d) of the Gloucester LEP would be appropriate but not essential.		
6.1(1)/7.3(1)/7.2(1) Flood Planning - Objectives	All 3 LEPs have the same objectives for this clause. The objectives are consistent with the model clause and appropriate and sufficiently comprehensive.		
6.1(2)/7.3(2)/7.2(2) Flood Planning - Application	The clause can apply to either land shown as "flood planning area" on the flood planning map or land below the FPL as defined below.	The clause can apply only to land below the FPL as defined below. The LEP does not incorporate flood planning maps.	The clause can apply to either land shown as "flood planning area" on the flood planning map or land below the FPL as defined below.

LEP Clauses	Gloucester LEP 2010	Great Lakes LEP 2014	Greater Taree LEP 2010
	The LEP provides flood planning maps but these appear to have limited coverage.		The LEP provides flood planning maps which appear to have extensive coverage.
6.1(3)/7.3(3)/7.2(3) Flood Planning - Considerations	All 3 LEPs have the same considerations for a development, subject to the clause. The considerations are consistent with the model clause and appropriate and sufficiently comprehensive.		
6.1(5)/7.3(5)/7.2(5) Flood Planning - FPL Definition	*flood planning level means the level of a 1:100 ARI (average recurrent interval) flood event plus 0.5 metre freeboard.*	*flood planning level means:* *(a) in areas where flooding is affected by ocean water levels—the level of a 1% AEP (annual exceedance probability) flood event estimated using an ocean water level 0.9 metres above the 1990 mean sea level, plus a 0.5 metre freeboard, or* *(b) in all other areas—the level of a 1% AEP (annual exceedance probability) flood event plus a 0.5 metre freeboard.*	*flood planning level means the level of a 1:100 ARI (average recurrent interval) flood event plus 0.5 metres freeboard.*
	This definition adopts the 2007 Flood Planning guideline default FPL for standard residential development.	This definition is similar to that adopted by the other 2 LEPs except it factors in the climate change related sea level rise benchmark that was mandated by the state government from 2010 to 2012 and remains a generally accepted benchmark.	This definition adopts the 2007 Flood Planning guideline default FPL for standard residential development.
6.3 Development Control Plan (DCP) - Requires the preparation of a DCP for an urban release area before consent can be issued.	NA	One matter required to be addressed by the DCP is: *(f) amelioration of natural and environmental hazards, including bushfire, flooding and site contamination and, in relation to natural hazards, the safe occupation of, and the evacuation from, any land so affected,*	One matter required to be addressed by the DCP is: *(f) amelioration of natural and environmental hazards, including bushfire, flooding and site contamination and, in relation to natural hazards, the safe occupation of, and the evacuation from, any land so affected,*

LEP Clauses	Gloucester LEP 2010	Great Lakes LEP 2014	Greater Taree LEP 2010
		This covers both general flood impact and emergency management (evacuation) considerations.	This covers both general flood impact and emergency management (evacuation) considerations.
7.10 Limited development on foreshore area	NA	NA	This clause applies to - " *foreshore area means the land identified as "Foreshore Area" on the Foreshore Building Line Map.* The clause triggers proposed building within foreshore areas and requires consideration of various matters including: *(3)(h) sea level rise or change of flooding patterns as a result of climate change has been considered.*
Schedule 1 Additional permitted uses	NA	NA	This relates to specific sites where development in addition to that otherwise allowed in the zoning of the land is permitted with consent. Item 1 applies to land at Forster, Forster South, Smiths Lake and Tea Gardens and requires consideration of the "adverse impact on flooding upstream of the land" amongst other matters.

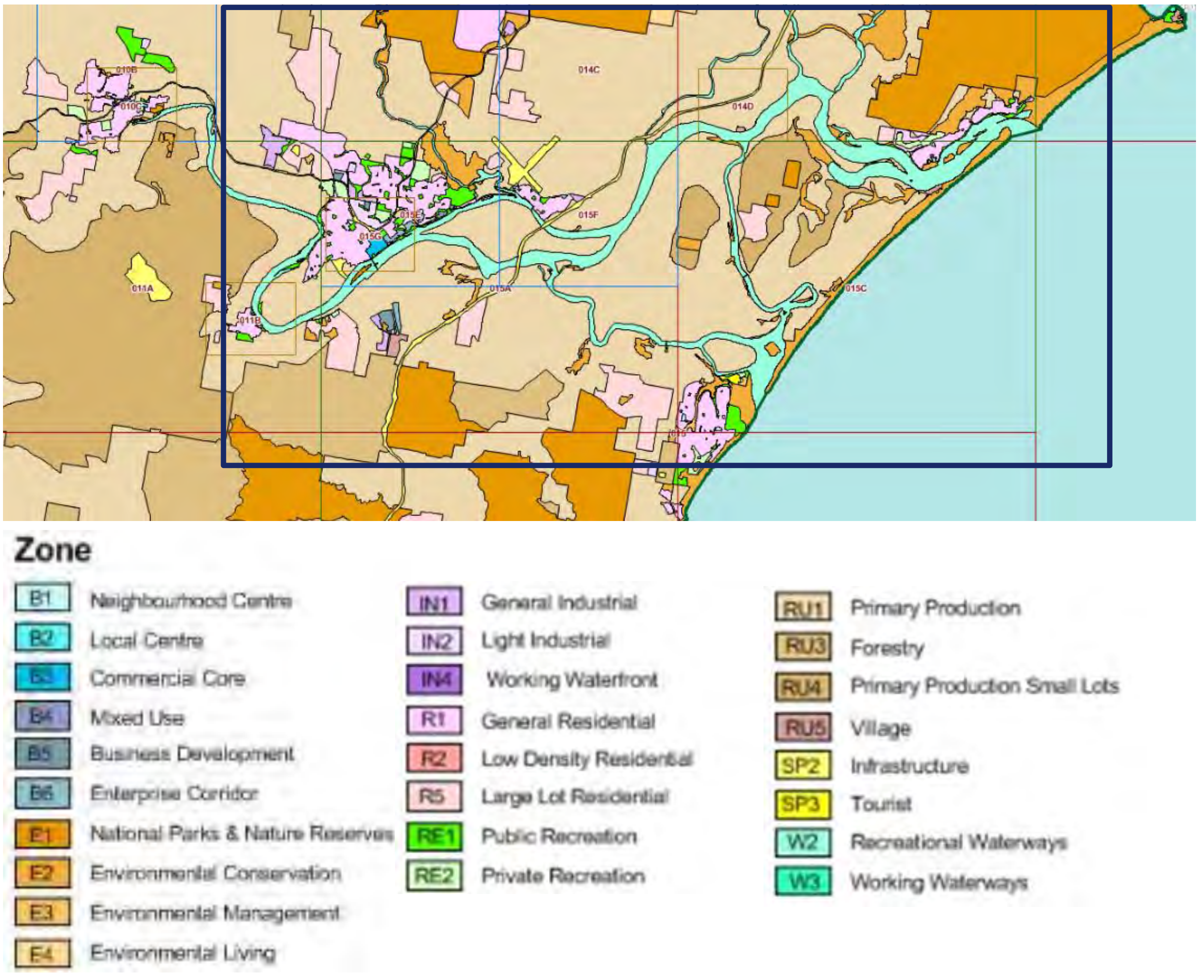

Figure 4: General Land Use Zones Across the Catchment (Source Council on-line mapping)

The issues with the flood planning clause 7.2 to be addressed by the recommendations of this plan include the need to have a consistent and comprehensive basis to trigger the application of the clause. This could involve a combination of maps and a defined extent as occurs with 2 of the three LEPs at present. There also needs to be consideration as to whether the extent of the application of the clause should be limited to the default FPL for standard residential development (ie the 100 year flood plus freeboard). The latter consideration mainly relates to whether the LEP should trigger consideration of flood risks (in particular evacuation) beyond the currently adopted FPL.

A series of maps were prepared by BMT, showing flood planning constraint extents overlain on the LEP land use zone maps (Appendix A). These maps were prepared to facilitate a high level review of whether existing land use zones were appropriately aligned with the extent of flood constraints and to identify areas where potential development permitted within the zones could be incompatible with flood hazards.

A series of 6 planning overlay maps were prepared. Each map overlays a different flood planning constraint based on increasing levels of hazard. The methodology for the preparation of these flood planning constraint maps, and the implications for development in each constraint category, is discussed at section 4.7 of the FRMS prepared by BMT. The categories are based on Guideline 7-5 of the *Australian Disaster Relief Resilience Handbook* (AIDF, 2017), which recommends adoption of four flood planning constraint categories (FPCC), as reproduced in Table 3 below:

Table 2: Flood Planning Constraint Categories (FPCC) (AIDF, 2017)

FPCC	Constraint Subcategory
1	a) Floodway or flood storage area in the DFE*, b) Flood hazard H6 in the DFE.
2	a) Floodway in events larger than the DFE, b) Flood hazard H5 in the DFE, c) Emergency response (isolated and submerged areas), d) Emergency response (isolated but elevated areas), e) Flood hazard H6 in floods large than the DFE.
3	Remaining area below the DFE plus freeboard.
4	Remaining area below the PMF or Extreme Flood.

* DFE = defined flood event more commonly referred to as the flood planning level in NSW. For the Manning River, this is the 2100 1% AEP design event.

Consistent with best practice (as set out in the planning and FRM policies outlined above) development should be avoided in the FPCC 1 areas and in the FPCC 3 areas where mitigation works such as filling work could not be acceptably implemented with no material external impacts on others in the floodplain. In FPCC areas 1 and 2 it is preferable not to encourage flood sensitive land uses or critical infrastructure and to ensure suitable access for evacuation purposes is available.

A high level review of the planning overlay maps indicates the following matters for review, with regard to the separate towns, villages and localities within the study area.

Taree

Areas of a floodway/flood storage and high hazard in a 100 year flood fringe the Residential R1 zoned lands in the western side of Taree and marginally affect the B4 Mixed Use zoned land at the interface of the CBD with the Manning River and extending Browns Creek into IN2 Light Industrial zoned land. The areas, including the Figtrees development, fringing the western, southern and eastern edges of the zoned urban areas of Taree contain land affected by flooding in events more extreme than the 100 year flood, where it is preferable not to encourage flood sensitive land uses or critical infrastructure and to ensure suitable access for evacuation purposes is available.

No review of zoning is currently warranted but these flood hazards should be taken into consideration if reviewing any Planning Proposal for the intensification of uses.

South Taree

Areas of floodway/flood storage extend up the tributaries of Carter Creek into land zoned R5 Large Lot Residential. There are minimal existing dwellings in this area, but it appears that as this area is subject to a minimum 4,000m^2 lot size standard further subdivision is possible.

Closer interrogation is required to determine if this minimum lot size can be realised while providing suitable building platforms and whether it should be increased. These areas are not potentially isolated but parts are affected by flooding in events greater than the 100 year flood.

Tinonee

Areas of floodway/flood storage, and in part high hazard, extend through the R1 zoned land immediately to the west of Claxton Street. This area is presently undeveloped large holdings but subject to a minimum 450m^2 lot size standard. Further development in this area is likely to have unacceptable flood risk and impacts and the current zoning and/or minimum lots size standards should be reviewed.

Detailed analysis should be undertaken of the extent of floodway that affects R1 zoned land along the eastern fringe of the village and the zoning and/or minimum lot size standard should be reviewed to curtail further development where appropriate. Minimal development has yet occurred within the R5 zoned area to the northwest of Tinonee along Tinonee Road. The eastern part of this area along Peg Leg Creek is floodway/ flood storage and high flood hazard in a 100 year flood. These areas are partly affected by flooding in events greater than the 100 year flood.

Pampoolah

Areas of floodway/flood storage and flood hazard in a 100 year flood along Halls Creek affect the rear of lots at the end of Graceland Place and Jonnel Heights Place. A further area of high flood hazard also extends along the creek line that extends down the rear boundary of lots fronting Malcom Road and Mullalone Place. Building areas appear unaffected by these areas of floodway/flood storage, and in part high hazard and not potentially isolated. This area is zoned R5 and is subject to a 1.5ha minimum lots size standard, and is already substantially developed.

Accordingly further review of the zoning of this area does not appear warranted.

Cundletown

Land along the river edge is residential zoned R1, public and private recreation RE1 and RE2 and rural RU1. This interface comprises long residential lots extending down from River Street to the Manning River, which in some cases have been subdivided to create battle-axe lots which front the river. Minor areas of R1 zoned land near the River are affected by the 100 year flood and a floodway extends within a confined area along the boundary of residential lots and the river. These residential properties are not subject to isolation.

It is unlikely that a review of zoning provisions is warranted but more detailed interrogation of the flood maps could be undertaken to determine whether further battle-axe lot subdivisions where not yet approved can provide suitable building platforms outside of the FPL and floodway, and if not a DCP provision could be applied to restrict such further subdivision.

Croki

This is a small village comprising a few scattered houses and a caravan park adjacent the Manning river, zoned R5. The area is subject to a 1,000m^2 minimum lots size standard. Croki is substantially affected by a floodway/flood storage and high flood hazard in a 100 year flood. Consideration should be given to a more restrictive zone and or minimum lot size standard to prevent the intensification of uses within the village, particularly within the more severely flood affected parts.

Coopernook

This area is located on the northern fringe of the study area, to the north of Coopernook Creek and Lansdowne River. There are no parts affected by floodway/flood storage and high flood hazard in a 100 year flood. The village area is zoned rural RU5 with a minimum lot size standard of 1,000m^2 and public recreation RE1.

Only a small area at the far southern eastern end of the village is below the FPL. Consideration should be given to a larger minimum lot size standard to prevent the intensification of uses within this part of the village.

Harrington

Only small areas along creek lines are affected by a floodway/flood storage in a 100 year flood and a few minor additional areas are below the FPL, but all these areas appear to be zoned for open space purposes or rural RU1. However most of the town of Harrington, zoned residential R1, is located below the PMF.

Accordingly the planning controls should include some consideration of evacuation capability in the assessment. This should also be a primary FRM consideration for any Planning Proposal involving the intensification of development.

Manning Point

This area is zoned rural R5 and subject to a 1,000m^2 minimum lot size standard. The area is substantially developed and mostly comprises urban housing, a caravan park, local shops and bowling club. Parts are below the FPL and the western end is within a floodway/flood storage in a 100 year flood.

Based on the extent of existing development and the existing rural zoning there is no apparent need to review the current zoning. However, any planning proposals should avoid intensification unless FRM issues have been addressed.

Mitchells Island

This area comprises rural R5 zoned land subject to a 1.5ha minimum lot size standard, backing onto Scotts Creek. Parts of the western side of this area are below the FPL, and small areas along the edge of the area near the creek, are within a floodway/flood storage in a 100 year flood.

Given the current zoning and minimum lots size a review of the zoning is not warranted.

Oxley Island

This area is zoned rural RU4 and is subject to a 20ha minimum lot size standard. The northern half of this area is affected by a floodway/flood storage in a 100 year flood. This part of the area comprises scattered houses and agricultural uses. Land holdings are quite large and there appears to be potential to pursue further subdivision.

A review of the lot size standard within the area affected by the floodway should be undertaken in the aim of preventing further intensification of houses within the floodway.

Old Bar

The eastern side of Old Bar is mostly zoned residential R1 with the coastal area and creek corridors zoned E2, E3 and RE1 Public recreation. The R1 zoned part is largely unaffected by flooding, with only small parts along the creek corridors being subject to floods up to the PMF. No parts of this area are affected by a floodway/flood storage function in a 100 year flood. Accordingly no review of the zoning appears warranted.

The western part of Old Bar is zoned R5 with a 1.5ha minimum lots size standard and comprises scattered housing on large lots. A narrow corridor of a floodway/flood storage in a 100 year flood extends north-south through this part of Old Bar along Warwiba Creek. The rear boundary of lots have mostly followed Warwiba Creek allowing for house platforms to avoid the floodway.

While no review of zoning appears warranted, careful consideration is required for any future subdivision and building application in this area to avoid flood risks and impacts, particularly those associated with the floodway.

Conclusion

Some of the issues in these areas could warrant further investigation and review of zone boundaries and the flood planning overlay maps as part of Councils program for the review and consolidation of all existing LEPs. Some issues, if identified, could be resolved with specific DCP controls.

A discussion of alternate approaches for adoption flood planning maps is provided later as part of the review of management options.

4.10 Development Control Plans (DCPs)

Separate DCPs provide more detailed controls for each of the 3 LEPs in the LGA. While the study area is wholly contained within the area subject to the Manning region DCP, the FRM provisions of each are reviewed below.

Gloucester DCP

The Gloucester DCP was adopted by the Gloucester Shire Council in November 2011 and applies to all land subject to Gloucester LEP 2010. Its contains discrete sections for different types of development (residential, industrial, tourist, local centres, subdivision and signage) and issue related matters (building lines, setbacks, carparking, waste, cut and fill, and floodplain management).

Section 4.10 "Floodplain Management Guidelines" contains the most relevant provisions. The following table provides a review of the pertinent provisions.

Table 3: Review of Existing Gloucester DCP Provisions

Clause	Provision	Comment
1.1	The DCP applies only to land zoned R2, R3, R5, B2, B4, E3, SP1, RE1 and RE2 in the Gloucester LEP.	The DCP FRM provisions do not apply to Industrial, Rural and Environmental zones. Ideally DCP FRM provisions should apply to the whole LGA.

Clause	Provision	Comment
5.1	States "1. Development of flood-liable land shall not be encouraged" but may be permitted where no off-site impacts are demonstrated, which may require acceptable ameliorative works.	A broader range of FRM considerations would be relevant including on-site impacts and emergency management capability. Phrasing of the provisions could be more definitive and reflective of Council's obligation to accept and assess development applications.
5.2	States "No development shall be allowed in "High Hazard - Floodway" areas."	While the outcome sought is understood, a DCP has no effect where inconsistent with an LEP, which for example provides that development is permissible with consent (s.3.43(5) of the EP&A Act). Issues could arise where a property is substantially affected by a floodway. Consequently, the review of zone boundary extents as outlined above is important to ensure, zoning (and therefore expectations for development) reflect what could be acceptable having regard to FRM considerations.
5.3	Control 1 states: "Council shall require confirmation that the individual evacuation plans are incorporated into SES planning."	It is understood that the SES practice is not to get involved with individual evacuation plans. However the onus could be put on applicants to ensure that individual plans are consistent with SES flood plans
5.4	Provisions 2 and 3 state: "2. Filling of flood-liable land may be permitted provided that evidence is submitted, in the form of a flood study by a suitably qualified engineer, which will substantiate that the proposed development will not alter flood behaviour to the detriment of any other property. 3. Remedial works shall be provided where the increase in flood level for the Designated Flood event exceeds 0.1 m or as determined by Council."	These provisions imply that an off-site impact involving the raising of flood levels by up to 100mm would be acceptable (ie not detrimental). That might not always be the case and the cumulative impacts of several developments that have such an impact could result in significant impacts. This needs to be reviewed on a floodplain wide basis to determine what level of filling (for different types of uses if relevant) could be acceptable.
	Control 6 requires: Filling for residential buildings shall provide a minimum building platform having a minimum area of 700 m^2 or the whole lot, whichever is the lesser."	This could provide a reasonable benchmark standard that could be applied to elevated house pads in rural areas.
5.5	The provisions regarding levees are: "1. The construction of levees to provide flood protection for proposed development shall not be encouraged. 2. Construction of a flood levee may be approved by Council where it is not feasible to fill the site to Designated Flood Level, subject to conditions.	As above, Provision No.1 reflects a Council policy provision that could conflict with a duty to consider applications. In principle, levees are not considered appropriate to facilitate new development (because of residual risks associated with levee failure and over-topping) but may be an appropriate solution to address existing risks to development. The acceptability of a levee should include an assessment of off-site impacts.

Clause	Provision	Comment
	3. Levees shall not be constructed to protect flood liable land where flood depths exceed 1 metre."	
	Control 2 states "2. The whole extent of the levee structure, including access for maintenance purposes, shall be located within a Drainage Reserve, dedicated to Council. Vehicular access to the full length of the levee is to be provided from a public road."	This may be an issue requiring review by Council at a corporate policy level. Taking on the maintenance responsibility of a levee could represent a significant liability.
5.6	These provisions and controls require minimum floor levels to be 0.5m above the "Designated Flood Level". Exemptions may be considered for additions where the extra floor area will be less than 20% of that existing. Reference is also made to the FPL and a requirement that flood compatible building methods be applied where below the FPL.	Terminology should be made consistent – ie use of FPL rather than designated flood. Refinement of the controls could also involve introducing multiple FPLs for different land uses and different building elements (ie habitable and non-habitable floors and car parking). Provision could also be included for a variable freeboard particularly for part of the LGA where only low level overland flow flooding may apply.
5.7	This part of the DCP outlines where exemptions to the above DCP controls could be exercised – mainly in heritage conservation and commercial areas.	There can be appropriate reasons to relax FRM controls in these areas. Raised floor levels may not be sympathetic to the heritage significance of an area. Raised floor levels of individual shops in a traditional street shopping strip would unlikely be compatible with the streetscape and functionality of the shop (including access for persons with disabilities). Where exemptions are provided these could be offset with other controls to provide alternate ways of reducing flood risks – such as those already incorporated in the DCP requiring raised storage areas, use of flood compatible materials and raised service connections. Consideration could also be given to requiring the preparation of a site flood emergency response plan (FERP) to increase the preparedness of occupants and readiness to evacuate.

In addition to the above, other parts of the DCP provide FRM controls for specific uses. Clause 13.2 restricts caravan parks and camping grounds on land affected by a 10 year flood and permanent residents in caravan parks on land affected by a 100 year flood. No freeboard is mentioned. These reflect reasonable requirements, but considerations could also be given to applying standard residential FRM controls to permanent residents (eg that [habitable] floor levels are to be above the 100 year flood (plus freeboard).

This DCP also provides drainage requirements, inclusive of overland flow paths. However, these controls do not relate specifically to FRM matters.

Great Lakes DCP

The Great Lakes DCP was adopted by the Great Lakes Council on 12 November 2013 and came into operation on 4 April 2014. This DCP applies to all land to which Great Lakes LEP 2014 applies. It contains discrete sections for different types of development (low scale residential, apartments and mixed use developments, industrial and subdivision and issue related matters (character statements, environmental considerations, heritage, carparking, access and transport, water sensitive design, tree preservation, landscaping, waste, signage and site specific controls).

Clause 4.2 of Part 4 (Environmental Considerations) of the DCP provides specific flood related provisions. This Part of the DCP also includes provisions regarding coastal hazard management, and while these are related to coastal flooding issues to some extent, they are beyond the scope of this report and are not reviewed.

The FRM requirements of clause 4.2 are succinctly provided under 7 headings. These are summarised and reviewed below.

Table 4: Review of Existing Great Lakes DCP Provisions

Topic	Requirement	Comment
Objectives	The following 5 objectives are provided: • *The risk of impacts from flooding on people and assets are avoided or otherwise minimised.* • *Development is located in response to the identified flood hazard and designed to accommodate flood conveyance and storage.* • *Environmental impacts of development on flood prone land are avoided or otherwise minimised.* • *Development on flood prone land does not adversely impact neighbouring properties or visual amenity.* • *The potential for financial loss or cost to the community as a result of development on flood prone land is limited.* This section also includes a diagram derived from climate change guidelines prepared by the former DECC.	The objectives could be refined and expanded upon. For example clarity about to what extent or to what end financial loss should be limited (5th objective) would be desirable. The DECC based diagram is out of place given it was prepared to illustrate how to consider potential flood related climate change consequences and confusing as to what policy position it seeks to impose. It is recommended that this diagram not be used in the DCP.
Flood Studies	Provides a basic statement that flood studies may be required and a broad outline of what they are to document.	These requirements could be made clearer.
Subdivision Controls	These provisions provide 6 controls for subdivision of flood prone land referring to FPLs inclusive of climate change forecasts (ie to the year 2100).	The ability to rely on a climate change derived 1% AEP FPL without an exceptional circumstances variation is unclear given the terms of the 2007 Flood Planning Guideline. Clarification from the Department should be sought.

Topic	Requirement	Comment
		The provisions could be expanded and made clearer. For example further clarity could be provided to understand what is an acceptable limit of impact caused by filling (control (5).
Building Controls – General	Any building to be certified as structurally sound in a 21000 1 % AEP flood. Definition of habitable floor area is provided.	This provision is considered appropriate except if the building might be required for sheltering in place, in which case structural soundness up to the PMF should be required and clarification regarding reliance on a 2100 1% flood level for residential development is required. Defining of habitable floor area is desirable but needs to be revised to cover off on all forms of development, not just residential.
Building Controls – New Buildings	1. *New buildings are to be designed and located entirely outside of the 2100 flood planning area wherever possible.* 2. *New buildings are to be designed with habitable floor levels above the 2100 1% AEP flood planning level.* 3. *In circumstances where construction of a new building at the 2100 1% flood planning level is likely to have an adverse impact on the adjoining property or the visual amenity of the location, a variation may be sought. If supported by Council, the new building may be designed with habitable floor levels above the 2060 1% AEP flood planning level.* 4. *Vehicle access to new buildings is to be designed to so that ingress and egress from the site is provided above the 2100 1% AEP flood planning level.*	These provisions are generally appropriate, however the following should be considered: • Differential FPLs based on habitable and non-habitable floor areas and different types of land uses can provide practical outcomes. • The ability to rely on a climate change derived 1% AEP FPL without an exceptional circumstances variation is unclear given the terms of the 2007 Flood Planning Guideline. Clarification from the Department should be sought.
Building Controls – Alterations and Additions	1. *Additions and alterations having a gross floor area of 30sqm or less may be constructed at the existing floor level of the building.* 2. *Additions and alterations having a gross floor area greater than 30sqm are to be designed and located so that any new habitable areas have floor levels located above the 2060 1% AEP flood planning level. Note: Any replacement or refurbishment of existing floor areas where structural changes are proposed will be considered as part of the 30sqm addition or alteration gross floor area calculation.* 3. *In circumstances where construction of new habitable areas at the 2060 1%*	These controls are generally appropriate for residential development but not necessarily non-residential development. As above, the ability to rely on a climate change derived 1% AEP FPL without an exceptional circumstances variation is unclear given the terms of the 2007 Flood Planning Guideline. Clarification from the Department should be sought. The control 3 requirement that allows for a reduced level of flood protection to off-set external impacts should be reviewed. Consideration should be given as to whether the off-site impacts could otherwise be expected to be addressed by skilful design.

Topic	Requirement	Comment
	AEP flood planning level is likely to have an adverse impact on adjoining properties or the visual amenity of the location, a variation may be sought. If supported by Council, the habitable areas may be located 500mm below the 2060 1% AEP flood planning level.	
Fencing	*Fences within a floodway are to be of an open-style design to minimise impacts on flood conveyance.*	This is an appropriate control. Similar requirements can also be appropriate in locations other than floodways (eg overland flow paths).
Additional Resources	Hyperlinks to the FDM and SES Subdivision and Building Guidelines are provided	The NSW Flood Prone Lands Policy and FDM is separate to the principal planning legislation in NSW, being that contained within the EPA Act. Ultimately, the planning recommendations of a FRMP will need to be reflected in planning instruments and policies brought into force in accordance with the EPA Act. The FDM provides guidance for the preparation of a FRMP that is expected to include recommendations for planning policies and controls but does not provide planning controls specifically applicable to the assessment and determination of a development application (DA). The FDM (pg. 9, paragraph 2.6) does purport to impose development guidelines to be applied by a consent authority in the assessment of a DA. However while reliance on the Manual might be appropriate in the absence of policy documents prepared under the Act (ie the LEP or DCP) are to be given greater weight than the FDM. As discussed by Pain J [22] in *Neate v Shellharbour City Council [2007] NSWLEC 526*, the FDM and planning controls under the EP&A Act should not be considered as providing alternate approaches. The FDM is in effect intended to inform the preparation of planning controls under the Act. As part of the DCP preparation process it could be appropriate to refer to specific guidelines provided by DPIE that could be relevant to determine an appropriate methodology for flood impact assessment or to adopt definitions in the FDM. It is assumed that the hyperlinks labelled with reference to SES guidelines related to those published by the former Department of Environment and Climate Change in 2007 prepared specifically for the Hawkesbury Nepean Floodplain. The hyperlinks are no longer operative. These guidelines provide a useful source of information but this needs to be distilled into policy relevant to the LGA.

Greater Taree DCP

The Greater Taree DCP was adopted by the Greater Taree City Council in October 2009 and came into operation on 25 June 2010. This DCP applies to all land in the Greater Taree LGA. Its contains discrete sections for different types of development (subdivision, residential, commercial, rural and environmental and industrial, and issue related matters (character statements, heritage, carparking and access, local area plans, waste, landscaping and floodplain management).

Part B provides character statements for some of the localities within the original Taree LGA. These could have peripheral relevance where outlining the desired character of floodplain land (eg the river front areas within Coopernook). It is expected that with any further consolidation of planning controls within the amalgamated MidCoast LGA such character statements could be rolled into the "Local Strategic Planning Statements" (LSPSs) currently being prepared by all Councils. In the preparation of LSPSs, Council should ensure that the intended character of an area is reflective of what could be acceptably achieved having regard to FRM constraints

Part E "Flooding Requirements" contains the most relevant provisions. This part of the DCP applies to all parts of the original Taree City LGA "affected by flooding and affected by or potentially affected by overland flow" (cl.E2.3). This Part of the DCP is structured adopting a performance based approach.

The FRM provisions in Part E of the DCP adopt an approach that is an adaptation of the "planning matrix approach"[3] This approach essentially has 3 elements:

1. Determining what land is flood affected (ie up to a PMF) and mapping the area based on differing levels of hazard or risk). This DCP provides that either the land has been mapped as flood liable or based on high level criteria (distance from and height above watercourses) may be identified as "potentially flood prone land" which requires a flood study. Land could be considered flood affected if not affected by flooding but is isolated during a flood ("flood constrained"). If flood affected, then the flood risk precinct (hazard and hydraulic category) of the site is determined (cl.3.2).

2. Grouping development types/ land uses into categories with similar levels of vulnerability to flood hazards with regard to both property damages and risk to life. The land use categories adopted are: critical use facilities; sensitive sues and facilities; subdivision; residential; commercial or industrial; tourist related development; recreation or non-urban uses; and concessional development. Concessional development is small scale development (alterations and additions and some change of uses) where development controls are proportionally relaxed. Fencing is addressed separately.

3. Development controls are then formulated for different land use categories within different flood risk precincts. The types of controls relate to: hydraulic/hazard category; floor levels; building components and methods; structural soundness; flood effects; car parking and driveway access; evacuation and management and design. The stringency of the controls reflects the vulnerability

[3] Bewsher, D & P Grech, May 1997, A New Approach to the Development of Floodplain Controls for Floodplains, paper presented to the 37th Annual Floodplain Management Conference, Maitland.

of the land use and the severity of the flood hazard (ie what flood risk precinct the site is located within).

The DCP applies a range of FPLS as set out in Table 2 (cl.E2.3.1) as outlined below.

Table 5: FPLs Used in Greater Taree DCP

Reference	Description
FPL1	5% AEP (20 Year ARI) flood level.
1% Flood Level	1% AEP (100 Year ARI) flood level. This level is useful for insurance purposes.
FPL2	2100 1% AEP (100 Year ARI) flood level.
FPL3	2100 1% AEP (100 Year ARI) flood level plus 0.5m Freeboard. FPL4
FPL4	Probable Maximum Flood (PMF) level.

The above FPLs incorporate consideration of climate change by assigning some FPLs based on predicted 2100 conditions.

The following table provides a summary of the pertinent provisions per type of control. Note Critical use facilities are blanketly specified as inappropriate on flood prone land.

Table 6: Review of Existing Greater Taree DCP Provisions

Control	Provision	Comment
Hydraulic/Hazard Category	No development in floodway, flood storage area, or a high hazard area, up to: • FPL4 for sensitive uses and facilities. • FPL3 for residential, commercial/industrial, tourist; • FPL1 for recreation/ non-urban; and • FP2 for concessional development Allowance is provided for alternate solutions where justified by a site specific study.	These seem to be practical requirements based on what a site specific flood assessment is likely to determine but allows the opportunity for applicants to test acceptability with more detailed investigations. Further guidance as to the performance outcome sought to be achieved when preparing a site specific assessment, with or without ameliorative measures, would be desirable. The performance outcome presented in clause E3 of the DCP provide information requirements rather than performance criteria and should be renamed. Note, it is not clear under the 2007 Flood Planning Guideline as to whether a residential FPL can be based on a future climate change based scenario with exceptional circumstances approval. Clarification with the Department should be sought.
Floor Levels	Habitable floor levels to be: • FPL4 for sensitive uses and facilities. • FPL2 for residential, commercial/industrial,	The concept of using multiple floor level FPLs depending on the sensitive of the land use appropriately reflects a risk based approach to managing flood risk.

Control	Provision	Comment
	tourist; recreation/ non-urban; and concessional development The controls typically allow non-habitable floor levels at a lower FPL. Subdivision is restricted on land wholly inundated by flooding up to a FPL2 event.	Could benefit from defining key terms such as habitable and non-habitable floors. This could in part be done by a reference back to the FDM. DCP is not clear as to whether proposed changes to flood levels based on acceptable ameliorative work would be relevant to applying the restriction on subdivision.
Building Components and Method	All structures to have flood compatible building components below the prescribed habitable floor level FPL.	This provision is considered appropriate but further guidance as to what are appropriate flood compatible building components and methods is desirable.
Structural Soundness	Engineers report that shows any structure can withstand the forces of floodwater, debris and buoyancy up to the prescribed habitable floor level FPL.	This provision is considered appropriate except if the building might be required for sheltering in place, in which case structural soundness up to FPL4 (the PMF) should be required.
Flood Effects	Engineer's report required to certify that the development will not increase flood effects elsewhere, having regard to: • Loss of flood storage. • Changes in flood levels, flows and velocities caused by alterations to the flood conveyance. • The cumulative impact of multiple potential developments in the floodplain	The considerations are considered appropriate but further consideration could be warranted as to whether an engineer's report is required in all cases or whether a qualitative assessment could be made by Council in the case of minor developments.
Car Parking and Driveway Access	Variable levels of protection are required dependent on whether: • On surface (FPL1) • Enclosed (FPL2) • Number of spaces (FPL3 where > 20 spaces) • Depth of flooding on driveway and level relative to road.	These provisions are generally appropriate. Should basement car parking become more typical in the major centres then further requirements regarding establishing warning systems and evacuation paths from within enclosed car parks would be warranted.
Evacuation	Reliable access for pedestrians or vehicles is required from the building, commencing at a minimum level equal to the lowest habitable floor level to a refuge area above FPL4 for sensitive uses. A flood emergency response plan (FERP) is required for all other uses.	The adequacy of simply requiring a FERP should be reviewed. The review should have regard to whether the locality of any development site is evacuation constrained or subject to inadequate warning time to allow for out of floodplain self-evacuation (particularly in areas subject to flash flooding) and whether requiring shelter in place could be acceptable.

Control	Provision	Comment
Management and Design	Provide an area to store goods above FPL3 (FPL4 for sensitive uses) and do not store hazardous material below FPL3 (FPL4 for sensitive uses).	These provisions could be expanded based on post flood reviews of actual issues that were experienced. Input from the SES and insurance companies could be of assistance.

All FRM provisions of the 3 DCPs have some attributes that could be transferred to a consolidated DCP applying across the LGA. The Greater Taree DCP provides the format with the greatest flexibility to accommodate a range of flood issues and development contexts. However, the preparation of new FRM DCP provision should ideally commence afresh to provide the optimum structure and policy coverage. Relevant recommendations are provided later in this report.

4.11 Developer Contributions

Section 7.11 (formerly section 94) Contributions Plans under the EPA Act provide a basis for the levying of development contributions to construct drainage and flood mitigation works required as a result of future development. where such works are required to ensure the acceptability of development and where it would be unreasonable to expect it to be provided in association with an individual development. Examples of such works could be the construction of a levee, a regional detention basin or upgrading of evacuation routes or evacuation centres.

Standard Section 7.11 contributions can only be applied to fund works with a direct nexus to the new development and cannot be applied for the purposes of rectifying past inadequacies. Section 7.12 (formerly 94A) Contributions Plans are an alternative where no nexus is required but the quantum of the contribution is basically capped at 1% of development costs, unless otherwise approved by the Minister for Planning.

The study area falls within the former Taree LGA and is subject to the Greater Taree S94 and S94A Contributions Plans (both prepared by GLN and dated 2016). These plans are based on an anticipated growth of about 2,230 dwellings (15,800 persons) between 2016 and 2031. The works program in the S94 and S94A Contributions Plans do not include any FRM related works. However, some of the road works provided for in these plans could indirectly improve evacuation capabilities in some areas.

In principle, Contribution Plans could be established within the study area, where it is necessary or appropriate to fund flood mitigation works through such plans. This would be relevant in new greenfield release areas or substantial urban renewal areas where such works are required to ensure the acceptability of the development (e.g. for the upgrading of evacuation routes or evacuation centres to cater for increased population densities, or regional stormwater detention basins).

Where works are required for both existing and future development the cost could be apportioned between future development (within a Contributions Plan) and existing development (to be funded by Council through general revenue or other sources such as special grants).

Future section 7.11 or section 7.12 schemes will also require consideration of the various Ministerial Directions and advisory documents issued by DPIE. These Directions and advices are ostensibly intended to limit costs to development imposed through development levies.

It is expected that new development will be planned with current knowledge of flood liability and will be exposed to minimal (residual) risks compared to the flood liability of existing development. Accordingly, the potential to use developer contributions to fund FRM mitigations options is likely to be limited.

5 Management Options & Recommendations

5.1 Strategic Planning Input

5.1.1 Context

The planning recommendations for the Manning River FRMP focuses on providing advice on principles to be applied when considering changes to land use zoning plans in the future, the presentation of planning information and changes that can be made to the planning controls to better achieve development that minimises flood risks to as low as reasonably and practically achievable. FRM will ultimately need to be weighed with other relevant planning considerations to achieve balanced outcomes that meet community expectations. While the FRMS relates to a part of the LGA it will be important for recommendations regarding the preparation of planning controls be structured so that they can also be easily applied to other floodplains in the LGA.

The catchment area of the Manning River is quite large and has a larger percentage of persons in older age groups that could require assistance if required to evacuate, or have no access to a motor vehicle. Most of the population that resides in the Manning River catchment are competent English speakers. A substantial proportion of the persons within the area at any one time will be tourists, who are less likely to be flood aware. This is important in understanding potential emergency management issues and flood awareness education.

The largest industries in the area are tourism. This this has been a factor in focussing development in locations that take advantage of the extensive river system within the study area. The natural environment is recognised in Council's strategic plans as an important asset that underpins a broad range of economic activities particularly its tourism industry

The strategic planning process requires the consideration of a wide range of factors to produce or review plans that guide land use management and development in an area. FRM is one of these factors.

The planning recommendations ultimately incorporated within a FRMP and adopted by Council will subsequently require implementation through the separate planning processes, principally governed by the EPA Act. In practice, the planning controls that may ultimately be imposed are influenced by a complex array of considerations including state imposed planning policy and directions, existing local planning strategies and policies and ultimately the acceptability of conditions that could be imposed through the development application process.

5.1.2 General Principles

The primary objective of the 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".

At the same time, the policy recognises the benefits flowing from the use, occupation and development of flood prone land.

The only way to completely remove flood risks from a development is for it to be located outside the extent of the PMF. This is a very risk-averse approach to floodplain management which is not supported by the FDM. In particular one of the principal tenants of the Flood Prone Lands Policy is that “flood prone land is a valuable resource that should not be sterilised by unnecessarily precluding its development”.

When considering future development, both the Policy and the FDM promote the use of a “merit approach which balances social, economic, environmental and flood risk parameters to determine whether particular development or use of the floodplain is appropriate and sustainable. In this way the policy avoids the unnecessary sterilisation of flood prone land. Equally it ensures that flood prone land is not the subject of uncontrolled development inconsistent with its exposure to flooding.

As a general rule, almost any development involves some risks to property or people. For example, construction of a new subdivision introduces traffic risks which may be managed (e.g. through construction of traffic lights, signage, etc) but are not completely eliminated. Rather the risks are reduced to a level which is considered acceptable to the community. Flood risks are managed in a similar fashion. Nevertheless in some situations if the residual risks remain unacceptably high, alternative safer forms of development should be pursued.

Best practice FRM in planning involves applying a risk management approach. This requires an understanding or risk management principles and their application to FRM, as discussed below.

5.1.3 Understanding Flood Risk

Within the context of this report, ‘flood risk’ is defined as the combination of probabilities and consequences that may occur over the full spectrum of floods that are possible at a particular location.

It is important not to confuse ‘flood risk’ with ‘flood hazard’ or ‘provisional flood hazard’. The terms ‘hazard’ and ‘provisional hazard’ are defined in the FDM and are associated with the magnitude of a specific flood. For example, a site may experience high hazard conditions in a 100 year flood and low hazard conditions in a 5 year flood. On the other hand, the term flood risk used in this report does not relate to a single flood, but rather to all floods. It presents a single measure of a site’s exposure to its flood threats.

As flood risk combines all the probabilities and consequences of flooding over the full spectrum of flood frequencies that might occur at a site, it can be expressed in mathematical notation as follows:

$$\textit{Flood Risk} = \int_{\textit{all floods}} \textit{Probability x Consequence}$$

where probability is the chance of a flood occurring, and consequence is the property damage and personal danger resulting from the site’s flood characteristics.

5.1.4 Flood Mapping

In order to understand the severity of flood risk, it is therefore necessary to consider the potential hazards that can occur to people and property in various flood magnitudes which have different probabilities of occurrence. To assist in this task, analyses typically undertaken as part of the FRMS to better understand these hazards include:

- depth of inundation;

- flood velocities;
- duration of inundation;
- rates of rise of flood waters;
- warning times available;
- evacuation capabilities given potential closure of routes due to flooding or traffic congestion on the available routes; and
- isolation of areas into 'islands' as flood waters rise,

This information is mostly reflected in the maps discussed at section 4.9 of this report (and included as Appendix A) and is valuable in understanding FRM issues when undertaking strategic planning exercises. Such maps are different to maps produced for an LEP or DCP – the intention of those maps being to trigger approval pathways and consideration requirements for the assessment of development proposals.

5.1.5 Overview of Methods for Managing Flood Risks

There are three principal options for managing flood risks:

1. avoiding the risk – land use zoning is the key management option by which the flood risk avoided. Inappropriate flood risks can be avoided by ensuring that only development compatible with the flood hazard is located in the floodplain;
2. reducing the likelihood – construction of detention basins, levies and other structural measures can reduce the probability of flooding; and
3. reducing the consequences –

In reducing the consequences of flood risks, a range of measures are available including:

- setting floor levels and other development controls;
- using flood compatible building materials and methods;
- ensuring buildings are structurally sound if exposed to flooding;
- raising flood awareness amongst communities;
- improved emergency management;
- improved flood warning;
- transferring some of the consequences to others through insurance; and
- provision of disaster relief.

In every situation, avoiding the risk through effective land use planning is the preferred option, if possible. Nevertheless pressures for land development, the lack of suitable land outside the floodplain, and a range of other non-flood related issues mean that use of some floodplain land may still be the best option for the community. The FDM guides Councils and consent authorities to use the 'merit approach' in making these land use decisions, balancing flood risk with other social, environmental and economic considerations.

As flood risk comprises risk to property and risk to life, the management of flood risk considers options for managing both the risk to property and risks to personal safety.

5.1.6 Risks to Property

The most common method of reducing the consequences to property is by controlling the height of floor levels relative to a given probability flood. A range of flood planning levels (FPLs) are usually established by councils for this purpose that relate to different land uses and different building components (eg habitable floors, non-habitable floors and car parking). Research associated with numerous other FRMSs we have been involved with has identified that a community would typically accept higher levels of property damage for rural and recreational buildings as opposed to community uses such as hospitals and schools.

Traditionally the 100 year flood (plus freeboard) FPL has been considered to be an acceptable level of risk for most residential, commercial and industrial properties in NSW. It is the default FPL mandated for standard residential development in NSW under the Flood Planning Guideline, without an exceptional circumstances variation.

In addition other complementary controls are used to manage property risks including the use of flood compatible building materials and methods as well as ensuring buildings are strong enough to withstand the forces of flood waters without collapse. These types of controls are discussed as part of the DCP recommendations.

5.1.7 Risks to People

Risk to life should be seen as a key flood constraint when undertaking strategic planning for potential new development. Planning can assist in managing risks to people with a range of measures including recognising evacuation and emergency management constraints, and increasing the community's awareness and preparedness for flooding.

Consideration of flood risks to life are is a requirement of the standard LEP flood clause, incorporated into each of the 3 LEPs applying in the LGA. More detailed considerations are discussed as part of the DCP recommendations. The following provides general principles for consideration for planning purposes.

Emergency management is a principal mechanism that requires consideration within the planning process as it can influence the:

- location of new development – in areas free of flood risk or where evacuation away from the flood risk is possible;
- type of development – for example developments such as seniors housing and child care centres can have limited capacity for self-evacuation and may induce risky action with guardians seeking to travel into flood affected areas to retrieve seniors or children.
- form of development – so that it is designed to allow for pedestrian and/or vehicular evacuation, and buildings that are structurally resilient to the forces of floodwaters if unavoidably required to provide a refuge; and
- connections between developments and safe refuges or support facilities – to ensure that pedestrian paths and road systems are designed to facilitate evacuation and access to safe refuges, support facilities and/or evacuation centres.

The evacuation risks are determined by considering the flood characteristics of the site together with its topography, its proposed uses and demographics of its occupants, and the capacity of evacuation routes.

In most situations it is preferable for residents subject to potential inundation, to evacuate to areas beyond the floodplain prior to the onset of flooding. When for whatever reason this is not possible, and floodwaters overwhelm an inhabited area, the provision of an elevated refuge can provide a safe haven that reduces risk to life. It may also provide an area above the reach of flood waters where valuable goods and personal memorabilia can be stored.

There is some debate in the flood risk management profession as to whether the provision of an on-site refuge is appropriate as it may provide a disincentive for communities to flee the floodplain and may be subject to other risks when sheltering on site. Nevertheless the compelling evidence from numerous recent flood evacuations is that even when adequate time for evacuation exists, residents may not heed the evacuation advice given to them. In some cases, such as for flash flood situations, warning time may not be sufficient to allow for a safe evacuation. Consequently in some situations a requirement for elevated on-site refuges for sheltering in place may be warranted.

A critical issue encountered by people who take refuge in such facilities is the potential isolation. Isolation can be accompanied by additional safety risks to the occupants including the inability to reach medical assistance, lack of food, sanitation, potential for additional fire risks, trauma induced isolation, exposure to extremes of temperature, etc.

To some extent these isolation risks can be mitigated by the provision of adequate support facilities within the refuge. In some instances these support facilities might be comparable to those available at an evacuation centre. The scope of facilities that could potentially be provided is dependent on the scale of development involved. Such facilities need to ensure the health and safety of occupants for the likely duration of flood emergencies and must recognise the age, health, mobility, medical needs and the level of resilience of the occupants. Such support facilities could be made a requirement in a DCP, where on-site refuges are deemed an acceptable option.

5.2 Review of Planning Controls

As noted above flooding is one consideration relevant to the formulation of planning policies and controls.

5.2.1 Flood Planning Maps

The purpose of maps prepared for a planning instrument (LEP) or supporting code (DCP) is to trigger approval pathways and consideration requirements for the assessment of development proposals. The approval pathways could vary from being permitted without consent, exempt development, complying development or a full DA. In some cases an environmental impact statement could be triggered as required for a DA (where as discussed above certain proposals are deemed “designated development” when located on flood prone land).

In order to manage the 2 sets of flood planning area mapping from two of the existing LEPs and the absence of such mapping from the third LEP, the mapping could be omitted from the LEP, but included in an external form referred to in the LEP. Ideally the external form would be adoption as part of the DCP which provides a structured opportunity for community consultation. The adoption of flood maps external to the LEP provides greater ease for on-going updating as more flood studies are prepared and mapping is refined, including overland flow flooding. It also allows for greater flexibility in the format of mapping to for example include multiple flood risk precincts (as discussed in regard to DCP recommendations).

Council could proactively provide advice to the public as to where the Codes SEPP applies. The flood maps produced for planning purposes could achieve this by adopting a flood risk precinct approach and aligning areas identified as high risk areas with those areas within which complying development is excluded under the Codes SEPP.

5.2.2 LEP provisions

The three LEPs that were prepared prior to Council amalgamations remain applicable to the LGA. Council is working towards merging the 3 LEPs into one LEP. Irrespective of this outcome, it would be preferable to establish a single comprehensive framework for FRM planning controls for the LGA. A review of the 3 LEPs was undertaken, as documented above, from which the following four key recommendations are derived:

1. Ideally the flood planning LEP clause should apply to the whole of the floodplain (ie up to the PMF) by changing the definition of the flood planning area. This would allow for the full range of flood risks across the full range of development possibilities to be considered as required. This would require obtaining an exceptional circumstances variation from DPIE, to the extent it imposed a flood related planning control on standard residential development. The broader application of the clause only extends where the broad FRM considerations in the clause apply, and would not impact on the permissibility of development or detailed considerations such as floor levels which is set by the DCP. If required, the LEP flood clause could be adapted so that only evacuation considerations applied above the 100 year flood level (plus freeboard) and there are examples of LEPs that have adopted a second flood LEP clause aimed at achieving a similar outcome. It is recognised that obtaining exceptional circumstances approval will involve a separate exercise of preparing a justification and applying, and if not pursued, would not be critical to the implementation of the FRMP planning recommendations.

2. As discussed above, the mapping could be omitted from the LEP, and included in an external form referred to in the LEP, ideally the DCP.

3. Zone boundaries within flood affected areas were subject to a high level review of alignment with the extent of flood constraints. This will require a more detailed investigation, to determine whether adjustments are required to LEP zone boundaries and/or DCP controls, within the following areas:

    - South Taree
    - Tinonee
    - Cundletown
    - Croki
    - Coopernook
    - Harrington
    - Oxley Island

Additionally, it is expected that with any further consolidation of planning controls within the amalgamated MidCoast LGA relating to character statements such as those currently in DCPs would be rolled into the "Local Strategic Planning Statements" (LSPSs) or possible a future consolidated DCP. LSPSs are currently being prepared by all Councils in NSW in accordance with guidelines issued by the DPE (now DPIE) and will provide a key guide for the formulation of future LEPs. In the preparation of LSPSs, Council should ensure that the intended character of an area is reflective of what could be acceptably achieved having regard to FRM constraints.

5.2.3 DCP Provisions

It is assumed that in conjunction with working towards a consolidated LEP, Council will ultimately prepare a consolidated DCP for the current LGA. This will provide an opportunity to prepare a single and set of comprehensive DCP FRM provisions.

This report has provided a detailed review of existing FRM provisions within the 3 DCPs (see Tables 3, 4 and 6). The comments provided in this review should be taken into consideration to ensure they are addressed within any future DCP.

All FRM provisions of the 3 DCPs have some attributes that could be transferred to a consolidated DCP applying across the LGA. The Greater Taree DCP, provides the approach with the greatest flexibility to accommodate a range of flood issues and development contexts. However, the preparation of new FRM DCP provisions should ideally commence afresh to provide the optimum structure and policy coverage. The following outlines the recommended principles to be applied when preparing the new FRM DCP provisions.

Overview to Preparation of DCP Controls

The Greater Taree DCP is consistent with the planning the "planning matrix approach." The key component of this approach is the preparation of a planning matrix, which provides a matrix of controls that change to reflect the vulnerability of different land uses to flooding and the risk associated with the location of a development within different parts of the floodplain.

The planning matrix approach is well documented and has been applied by over 30 Councils in NSW. The approach is diagrammatically shown in the figure below.

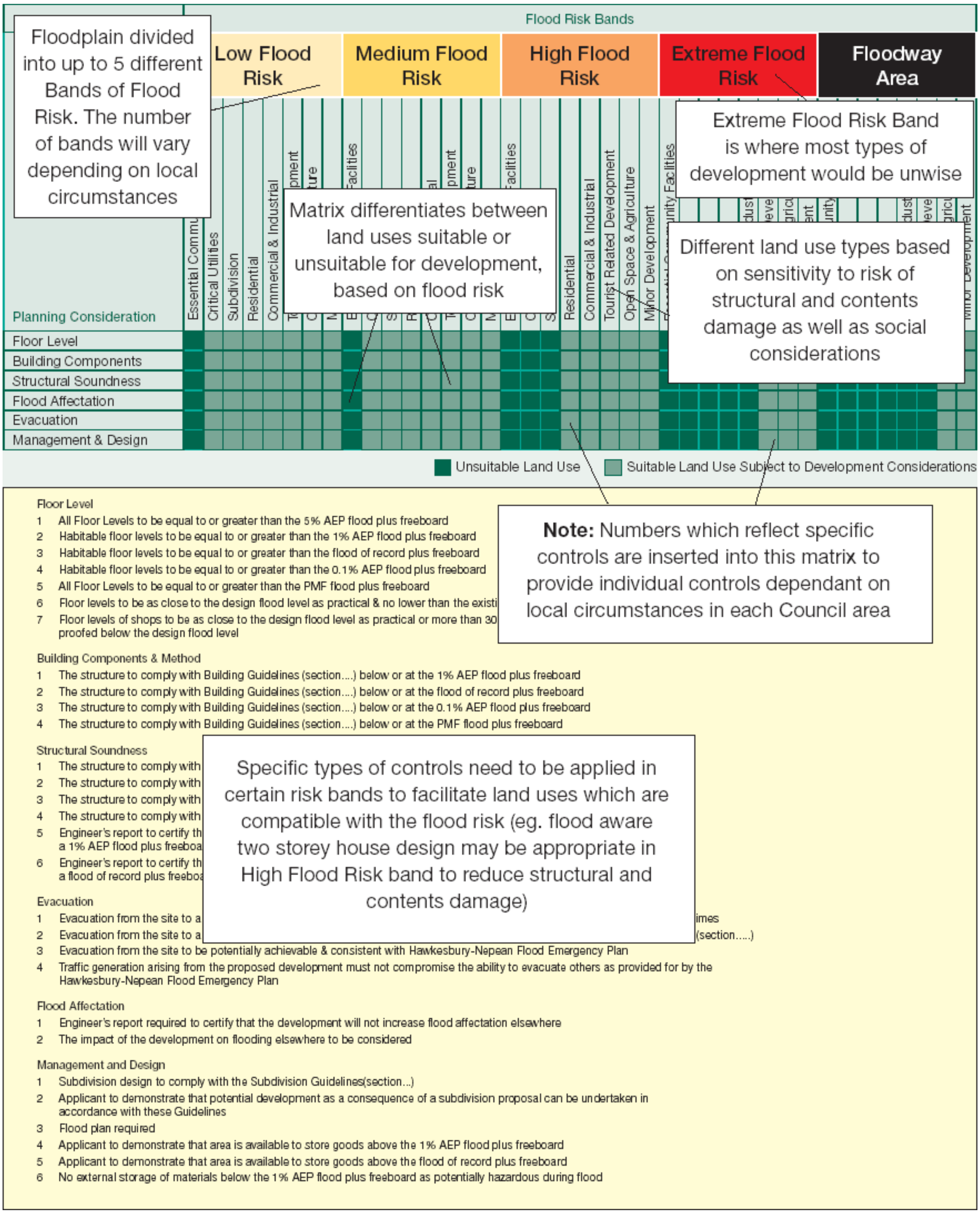

Figure 5: Sample Flood Planning Matrix (Land Use Guidelines, HNFMSC, 2006a, p.114)

While this approach has typically involved presentation in matrix table, it can be written "long hand" as in the case of the Greater Taree DCP.

The intent should be to develop a matrix of controls that would be relevant to the whole LGA. Where different floodplains within the same LGA have materially different flood characteristics or different FRM strategies as a consequence of the recommendations of separate FRMPs, multiple matrices could be prepared. As this report is associated with a FRMP for only part of the LGA, the following is therefore only a summary of the process for applying this approach in preparing FRM DCP controls.

Mapping of flood risk precincts

This involves dividing the floodplain (i.e. all land affected up to the PMF) into areas with similar levels of risk. The number of precincts may vary between different floodplains. A three tier category of low, medium and high is typically adopted for riverine flooding. A further category for "overland flow" can be added for parts of catchments affected by stormwater flooding.

The primary purpose for these maps is to identify the planning controls and information requirements that would apply to individual development proposals. The maps could also have secondary purposes, including to:

1. Identify where the flood LEP clause applies if the LEP maps were not to include a flood overlay series. This is a recommended option (see above).

2. Provide a consolidated source of information to determine whether a development may be excluded from being considered complying development under the Codes SEPP. For example, the DCP maps could ensure that areas mapped "high risk" and possibly also "overland flow" could collectively represent all the categories in the Codes SEPP excluded from the application of the complying development codes.

3. Provide a source of information about flood risk, commonly accessed by the community, that provides a message about flood risk that is consistent with that which may be provided through flood awareness programs by Council or the SES, and what might ultimately be experienced. The use of descriptive terms such as high, medium and low, together with other carefully scripted non-DCP messaging can be important in ensuring the community is properly and fully informed about flood risks without being unnecessarily alarmed.

While the criteria for the formulation of flood risk precincts can vary the following represent those that can serve the above purposes and are often used to produce such maps.

Flood Risk Precinct	Typical Primary Mapping Criteria	Planning Control Outcome
Low	All other and within the floodplain (i.e. within the extent of the probable maximum flood) not identified as being within a high, medium or overland flow precinct.	• Risk of damages are low and modifications to most building structures are unlikely to be cost effective. • Potential for impact on others in the floodplain is low. • No controls are imposed on most development other than emergency management considerations. • Controls on building structures for sensitive uses and facilities critical in a flood emergency should be imposed.
Overland Flow	Depth of inundation of between 50mm to 250mm arising from overland flow in a 100 year flood. Note where the depth of inundation is less than 50mm it is not mapped and would generally	• Risk of damages varies and the potential to impact on others due to the blocking of flood flows could be high.

	be dealt with as part of normal BCA construction requirements.	• Controls to be imposed on most development. • Unlikely to be suitable for complying development.
Medium	Land below the 100 year flood level but excluding that land identified as being within a high or overland flow precinct.	• High risk of flood damages without substantial modifications to building structures & other planning controls. • Impact on others should be manageable • Controls to be imposed on most development.
High	The area of land below the 100 year flood that is either subject to a high hydraulic hazard or where there are significant evacuation difficulties.	• Significant risk of building collapse, evacuation constraints, unmanageable impact on others &/or unsustainable risk to communities • Zoning should preclude most development but where permitted significant ameliorative measures would be required that are unlikely to be acceptable due to amenity or environmental impacts. Controls should recognise these difficulties and discourage development on lands mapped as high risk. • Unlikely to be suitable for complying development approval pathways.

Figure 6: Potential Flood Risk Precincts

It is important to note that these criteria are used because they can be readily applied to produce maps with minimal subjective input. However, this does not mean that the other extensive information prepared as part of the FRMS should not be considered. For example an analysis of high hazard extents in floods marginally rarer than the 1% AEP might identify an additional flood runner that should be mapped as medium or high flood risk. The most important consideration is to satisfy the primary intent of the mapping for flood purposes to ensure all appropriate considerations are covered in the development assessment process.

The separation of overland flow areas from the other flood risk precincts allows for the introduction of controls that do not impose excessive requirements on development compared to controls designed for more mainstream flooding. For example, an FPL for floor levels could be based on a lower freeboard in recognition of the lower depth associated with overland flow flooding.

Categorising Land Uses

This involves identifying discreet categories of land uses with similar levels of vulnerability to the flood hazard. The land use categories used in the Greater Taree DCP are appropriate but should be reviewed to ensure they capture all development types defined by the LEP and any other applicable SEPP.

Identifying controls to modify building form and response to flooding

Where the planning process determines land uses are appropriate, but still subject to flood risk. Different planning controls can be imposed to minimise potential damages and to maximise the ability of the community to respond (i.e. preparedness and capacity to evacuate) during a flood. The potential damages that can arise from development relates to both upon the proposed development and on other property as a consequence of external flood effects.

Consistent with the Greater Taree DCP, controls applied to development within a floodplain would typically relate to the following seven considerations:

- Floor level
- Building components and method
- Structural soundness
- External flood effects
- Car parking and driveway access
- Evacuation; and
- Management and design.

Floor level FPLs for residential development is a key control in reducing flood damages and to maximise potential for buildings to survive after flood inundation. The latter consideration is important to the economic and social impact on individuals and consequently the community. These FRM controls need not be complex and can be based on the following basic types of FRM development controls:

- Multiple FPLs can be applied to reflect the vulnerability of different land uses to flood risk (eg a school could be subject to a higher level than a house) different parts of development (eg habitable or non-habitable floor space) could also be subject to different levels.
- The default standard residential habitable floor level (as directed by the Flood Planning Guideline) being the 100 year flood level plus 0.5m freeboard would be expected to be suitable throughout the LGA for most types of development except sensitive uses and critical facilities.
- Despite the above, where a building is intended to provide for shelter in place during a flood, a suitably sized and equipped part of the building should have a floor level at or above the probable maximum flood (PMF).

- Lower FPLs could be applied in situations such as non-habitable floors, open car parking, and low value and robust non-urban and recreational buildings.

There may be parts of the LGA where minimum site levels (as opposed to floor levels) to provide flood protection for external uses or components of uses is important. On larger rural properties where an alternate suitable flood free location cannot be obtained, fill pads constructed to meet the minimum FPL for the proposed use could be an option, subject to satisfying the remaining FRM considerations.

Typically, all structures below the habitable floor level should comprise flood compatible materials and methods of construction.

Appropriate levels of assessment should be applied to ensure a structure can withstand the forces of floodwater, debris and buoyancy up to and including the design floor level. Where a building is intended to provide for shelter in place during a flood, the building should be structurally sound for floods up to and including a PMF.

In regard to external flood effects, appropriate levels of assessment should be applied to ensure development will not materially increase flood affects elsewhere in the floodplain.

For emergency management reasons, reliable access for pedestrians or vehicles should be required from the building, commencing at a minimum level equal to the lowest habitable floor level to a refuge area above the PMF. While evacuation to an area outside of the floodplain is preferable, there can be situations where provision for sheltering in place could be acceptable (for example where warning times are insufficient and an evacuation routes cannot be practically secured).

Environmental management measure will vary dependent on the proposed land use. For example, there may be a need to manage the storage of hazardous materials to avoid pollution spills during floods and secure material that could become uncontrolled floating debris. Additionally, where development is proximate to a waterway, it can be important to addressing the environmental impacts (ecological and scenic) on the riverine corridor.

<u>Summary</u>

It is expected that Council will ultimately prepare a single new DCP for the LGA. This might provide a revised DCP structure and an opportunity to incorporate comprehensive flood related planning controls that can provide basic direction and assistance to both applicants and Council assessment officers. This will also ensure that Council has exercised its duty to consider FRM issues as required by the FRM LEP clause and could contribute to demonstrating that Council has acted in accordance with the principles of the FDM if ever needing to defend any actions, advice or decisions of council, under section 733 of the *Local Government Act , 1993*.

A starting point for managing risk through land use planning is to classify risks throughout the floodplain. The imposition of planning controls is aimed at managing flood risks of development that is permissible by current zoning controls, including redevelopment of existing flood affected property. The above outlines a methodology for mapping risk precincts and preparing controls based on the likelihood and consequences of flooding – ie applying a risk management approach.

5.2.4 Climate Change

The consideration of climate change effects requires determining what would be reasonable standards to apply today to ensure that a development has an acceptable level of flood immunity in the future based on projected climate change flood effects. The aim is to take a precautionary approach to contain flood risks at those levels otherwise considered acceptable today where this can be practically achieved. The time period for consideration of the future is typically year 2100, as already adopted by Council, based on 100 year international forecasts for sea level rise provided from a year 2000 base.

The 2010 NSW Sea Level Rise Policy recommends that strategic and statutory planning documents could respond to the coastal flood risk area affected by projected 2050 and 2100 levels by restricting the intensification of development in areas subject to predicted climate change flood risk or applying planning controls to manage the additional risk. The mechanisms that might be applied include:

- adopting climate change design flood design levels where assessing the suitability of rural land for future urban purposes at the strategic planning stage;
- increasing the design flood levels that would otherwise apply to buildings and land required of development to take into account predicted climate change effects. This would typically be practical in greenfield developments but often impractical for developments within established areas; and
- imposing time-limited consents to provide the potential to remove, replace or adapt development in the future.

The first mechanism relates to strategic planning outcomes, as discussed above.

Regarding the second mechanism multiple FPLs can be used that take into consideration the vulnerability of different land uses, the expected life of development and the practicality of developing at higher levels. This can be integrated into the planning matrix approach.

In a practical sense, the adoption of the higher FPL could be appropriate for new areas or major developments where additional filling or higher floor levels can be readily achieved with marginal additional cost and minimal impacts on surrounding development. Conversely it could be difficult to implement higher FPLs for minor development within established areas where there could be amenity, streetscape or drainage impacts.

The Court has been reluctant to accept time related consents (see for eg *Newton and anor v Great Lakes Council [2013] NSWLEC 1248*). However, if to be considered for inclusion in a future DCP, it should be accompanied with clear objectives and criteria for how it would be applied, what happens at the expiration of the consent period, and opportunities to extend the consent period if circumstances change. The expiration date should also be event trigged (eg the reaching of a certain mean sea level) as opposed to calendar date triggered.

The ability to rely on a climate change derived 1% AEP FPL when apply controls on residential development, without an exceptional circumstances variation is unclear given the terms of the 2007 Flood Planning Guideline. Clarification form the Department should be sought.

5.3 Notifications (communication)

While planning documents are not the principal means to advise people of flood risks for the purposes of creating a flood aware and prepared community, they nonetheless form a component of information sources. To ensure that council exercises an appropriate duty of care of responsibly informing the public of flood risks and to avoid undermining floor awareness education campaigns, it is important to ensure a consistent message is provided by:

- The FRMS and FRMP
- General planning studies and strategies
- Definitions, mapping and controls within planning policies (i.e. LEP and DCP); and
- S10.7 (formerly) S149 Planning Certificates

Adopting the planning matrix approach discussed above, including flood risk mapping, provides a sound basis to ensure the appropriate communication of flood risk within the planning system.

A Section 10.7 Planning Certificate is basically a zoning certificate issued under the provisions of the EPA Act that is generally available to any person on request and must be attached to a contract prepared for the sale of property. The matters to be contained within the Section 10.7(2) Certificate are prescribed within Schedule 4 of the Environmental Planning and Assessment Regulation, 2000 and generally relate to whether planning controls [and not necessarily flood related risks] apply to a property.

A Section 10.7(5) Certificate, being a more complete but more expensive certificate, requires councils to advise of "other relevant matters affecting the land of which it may be aware". These more complete certificates are not mandatory for inclusion with property sale contracts – a Section 10.7(2) Certificate being the minimum required. Where a Section 10.7(5) Certificate is obtained, this could require a council to notify of all flood risks of which it is aware.

It is recognised that S10.7 certificates should not be solely relied upon as community education tools as they have only limited circulation. The majority of flood-affected properties would not be reached in a given year. However, information on a S10.7 Certificate can reflect information that may be provided to people making general enquiries, and together are important sources of information for the community that influence what is the understood (or perceived) flood risk of property that a person owns and/or occupies or operates a business from. With the existing system of notifications on S10.7(2) certificates, if no notification appears, then it is often misunderstood to mean that property is "flood free" rather than there are no flood related development controls. For the purposes of FRM, S10.7 certificates should not confuse or mislead those people who have access to them, with regard to understanding whether there are any risks of floods affecting a particular property.

Schedule 4 of the Regulation was amended, commencing on February 16, 2007, to specify flood related information that can be shown on Section 10.7(2) Certificates. The amendment provisions require the following

7A Flood related development controls information

(1) Whether or not development on that land or part of the land for the purposes of dwelling houses, dual occupancies, multi dwelling housing or residential flat buildings (not including

development for the purposes of group homes or seniors housing) is subject to flood related development controls.

(2) Whether or not development on that land or part of the land for any other purpose is subject to flood related development controls.

(3) Words and expressions in this clause have the same meanings as in the instrument set out in the Schedule to the Standard Instrument (Local Environmental Plans) Order 2006.

As stated in the 2007 Flood Planning Guideline, the new Clause 7(A)(1) of Schedule 4 of the Regulation means that Council should not include a notation for residential development on Section 10.7(2) Certificates in "low risk areas" if no flood related development controls apply to the land. Under Clause 7(A)(2) Council can include a notation for critical infrastructure or more flood sensitive development on Section 10.7(2) Certificates in low flood risk areas if flood related development controls apply. "Low flood risk" areas are undefined, but in the context of the Flood Planning Guideline it is assumed to be a reference to that part of the floodplain between the 100 year flood (plus freeboard) and the PMF.

These provisions require council to distinguish between the situation where there are flood related development controls on nominated types of "residential development" and all other development. More sensitive land uses such as group homes or seniors living is excluded from the limitation of notations for residential development. Importantly, a S10.7(2) Certificate must identify where any flood related development controls apply to any form of development, including residential development on land between the 100 year FPL and PMF if existing prior to the 2007 Flood Planning Guideline or if exceptional circumstances dispensation has been granted.

The relevant notifications placed on S10.7(2) certificates are required to advise on whether "flood related planning controls" apply to the land for which the certificate applies. "Flood related planning controls" is an undefined term. However the relevant form and content recommended for Council's forthcoming LEP and new DCP provisions would provide a consistent basis for providing S10.7(2) notifications, as follows:

- All properties known to be in the PMF would be notified that flood related planning controls apply. This would reduce to the area within the 100 year flood extent (plus freeboard) for standard residential properties if an exceptional circumstances variation is not obtained.

- All properties noted as being subject to flood controls would also be noted as "flood control lots" for the purposes of the Codes SEPP.

- Where flood risk precinct (FRP) mapping has been undertaken the applicable FRP could be noted, with an explanation as to its meaning and application under the DCP provisions. This would exclude standard residential properties being advised of the low flood risk precinct if an exceptional circumstances variation is not obtained.

- Where Council is unsure of whether a property contains flood liable land (due to the lack of flood investigations and mapping in particular areas) a general notation to this effect can be placed with an explanation that a flood study could identify that the land is subject to flooding, in which case flood related controls would apply. This would be relevant where the definition of the flood planning area in the LEP or DCP is based on an FPL and does not refer to a map, in which case the application of the LEP or DCP cannot be certain without further investigation.

Appropriate wording for the notifications should be determined based on legal advice. This should occur concurrently with the adoption of the new LEP and FRM DCP provisions.

6 Conclusion

This report has been prepared to review the planning considerations relevant to the FRMS and FRMP prepared for the Manning River catchment. To provide a meaningful review it was important to review the planning controls as they apply to the whole LGA as now represented by the amalgamated MidCoast Council.

The review outlined within this report has provided recommendations regarding:

- Guidance for how to consider FRM matters when undertaking strategic planning including determining the suitability of different land uses in different areas of the floodplain.
- A detailed review of existing LEP and DCP development controls and an approach and base principles that can be applied when preparing an updated and consolidated LEP and DCP, to address residual flood risks where development is permitted in the floodplain.
- Principles to be applied to ensure the appropriate communication of flood risk through planning documents, is not misleading, including S10.7 Planning Certificates.

Importantly, both planning and FRM are dynamic processes and will require on-going monitoring and review as new information and issues emerge.

7 Glossary

Abbreviation	
Council	MidCoast Council
DA	Development Application
DCP	Development Control Plan
DPIE	Department of Planning Industry & Environment (formerly Department of Planning & Environment)
EPA Act	Environmental Planning and Assessment Act 1979
EPA Regulation	Environmental Planning and Assessment Regulation 2000
FDM	Floodplain Development Manual
FRMP	Floodplain Risk Management Plan
FRMS	Floodplain Risk Management Study
GLN	GLN Planning
LEP	Local Environmental Plan
LGA	Local Government Area
OEH	NSW Office of Environment and Heritage (Formerly Department of Environment and Climate Change) which ceased as a separate agency in July 2019 to become part of DPIE.
SEPP	State Environmental Planning Policy

APPENDIX A: FLOOD CONSTRAINTS OVERLAY – LAND USE ZONE MAPS


FPCC1(a)
RU1
RU3
RU4
E4
E2
E1
R5
R1
IN1
RU5
B4
SP2
SP3
RE2
RE1
B1
W2
B6
B5
B3


FPCC2(a)
RU1
RU3
RU4
E4
E2
E1
R5
R1
IN1
RU5
B4
SP2
SP3
RE2
RE1
B1
W2
B6
B5
B3

FPCC2(b)
RU1
RU3
RU4
E4
E2
E1
R5
R1
IN1
RU5
B4
SP2
SP3
RE2
RE1
B1
W2
B6
B5
B3


FPCC2(d)
RU1
RU3
RU4
E4
E2
E1
R5
R1
IN1
RU5
B4
SP2
SP3
RE2
RE1
B1
W2
B6
B5
B3


FPCC3
RU1
RU3
RU4
E4
E2
E1
R5
R1
IN1
RU5
B4
SP2
SP3
RE2
RE1
B1
W2
B6
B5
B3

FPCC4
RU1
RU3
RU4
E4
E2
E1
R5
R1
IN1
RU5
B4
SP2
SP3
RE2
RE1
B1
W2
B6
B5
B3

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