



Lismore City Council

LISMORE FLOODPLAIN RISK MANAGEMENT PLAN 2014



Table of Contents

ABBREVIATIONS	4
EXECUTIVE SUMMARY	5
1.0 INTRODUCTION.....	6
1.1 Need for the Floodplain Risk Management Plan	6
1.2 The plan's approach to flood risk management	7
1.3 The Area of the plan	7
1.4 Floodplain Management Committee 2008-2013.....	8
2.0 FLOOD HAZARD AND RISK CATEGORISATION	10
2.1 Introduction.....	10
2.2 Flood Behaviour in Lismore.....	10
2.3 Hydraulic and Hazard Categorisation	11
2.4 Lismore Flood Risk Precincts	11
2.4.1 Floodway Precinct	12
2.4.2 High Risk and Flood isolated (Evacuation) Precincts	12
2.4.3 Medium Risk Precinct.....	14
2.4.4 Low Risk Precinct	15
2.4.5 South Lismore Flood Isolated, CBD Flood Liable and East Lismore Flood Liable.....	15
2.5 Preferred Excavation Areas.....	16
2.6 Risk Precinct Mapping Outside the Area of the Plan	16
3.0 PLANNING, DEVELOPMENT CONTROL AND PROPERTY MODIFICATION.....	21
3.1 Introduction.....	21
3.2 Incorporating Flood Risk into the Local Environmental Plan.....	21
3.2.1 Lismore Local Environmental Plan 2012	21
3.2.2 Recognising Flood Risk in Land Use Zones	22
3.3 Controls on new development	23
3.3.1 Structural Adequacy of Buildings.....	24
3.3.2 Minimum Floor Levels.....	24
3.3.3 Filling	24
3.4 Property Modification	26
3.4.1 Voluntary House Purchase	26
3.4.2 Voluntary House Raising	28
4.0 FLOOD RESPONSE MEASURES	30
4.1 Introduction.....	30
4.2 Flood Warning	30
4.2.1 Warning Sources	30
4.2.2 Lismore Urban Warning System.....	31
4.2.3 Flood Warning Times.....	31
4.3 Evacuation Planning.....	31
4.3.1 Lismore Local Flood Plan	31
4.3.2 Need for Full Evacuation	31
4.3.3 Evacuation Zones and Routes.....	32
4.3.4 Evacuation Times	32
4.3.5 Evacuation Procedures.....	34
4.3.6 Traffic Control in the CBD.....	34
4.4 Emergency Management.....	34
4.4.1 Emergency Operations Centre	34
4.4.2 Local Radio Broadcasts.....	35
4.4.3 Road Information Website	35
4.4.4 Use of Security Cameras.....	36
4.4.5 Provision of Sandbags.....	36
4.5 Community awareness and education.....	36
4.5.1 Flood Awareness	36
4.5.2 Education and Awareness Strategies	37
4.5.2.1 SES Community Engagement and Awareness	37
4.5.2.2 Lismore City Council Education and Awareness Strategies	38

5.0	FLOOD MODIFICATION MEASURES.....	40
5.1	Introduction.....	41
5.2	Airport Floodway Bypass.....	41
5.3	Wilson's River Channel Improvement.....	41
6.0	IMPLEMENTATION.....	43
6.1	Introduction.....	43
6.2	Planning and Development Control.....	43
6.3	Property Modification.....	43
6.4	Response Modification.....	43
6.5	Flood Modification.....	44
6.6	Climate Change Scenario.....	44
6.7	Action Plan ~ Implementation of Lismore Floodplain Risk Management Plan 2013.....	45

GLOSSARY

APPENDICES

Appendix 1	Background Documents
Appendix 2	History of Floods and Flood Behaviour
Appendix 3	ARI Design Flood Events
Appendix 4	Development Controls
Appendix 5	Criteria and Priorities for Voluntary House Purchase
Appendix 6	Criteria and Priorities for Voluntary House Raising

ABBREVIATIONS

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
DCP	Development Control Plan
FMC	Floodplain Management Committee
FMP	Floodplain Management Plan
FRMP	Floodplain Risk Management Plan
LCC	Lismore City Council
LEP	Local Environmental Plan
PMF	Probable Maximum Flood
RL	Reduced Level
RRCC	Richmond River County Council
SES	State Emergency Service
VHPS	Voluntary House Purchase Scheme
VHRS	Voluntary House Raising Scheme

1989 FLOOD CLOSE TO PEAK.
Richmond River High in the foreground, CBD towards to top



EXECUTIVE SUMMARY

The NSW State Government's Flood Policy is directed towards flood hazard reduction in developed areas and to ensuring that new development is compatible with the flood hazard and does not create additional flooding problems. Under the policy, the management of flood liable land remains the responsibility of Local Government.

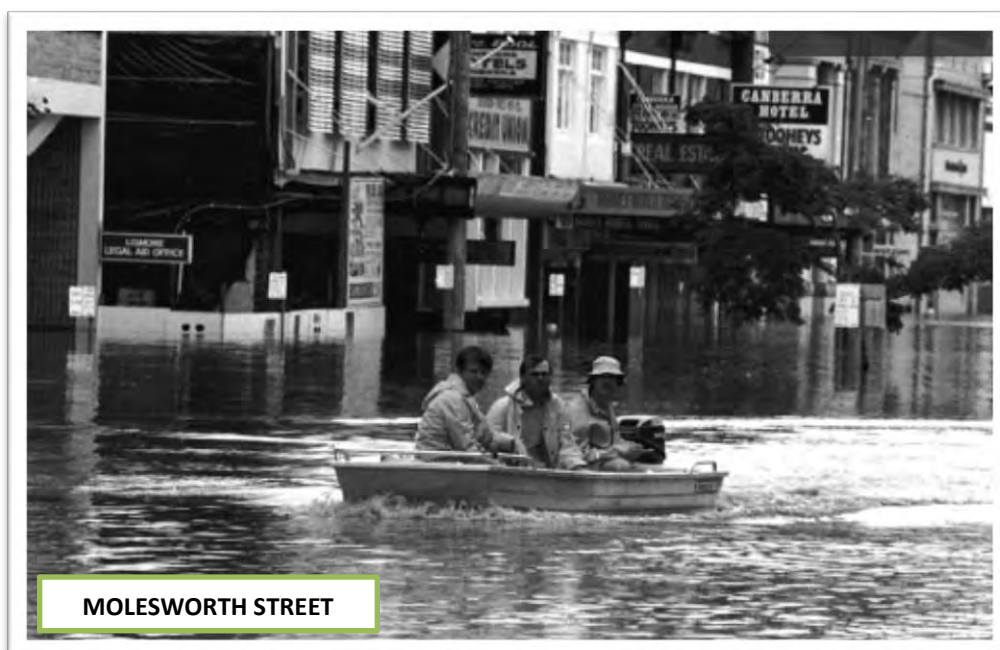
The *Floodplain Development Manual 2005* supports the State Government's Flood Prone Land Policy in providing for the development of sustainable strategies for managing human occupation and use of the floodplain. The Manual details the floodplain risk management process, which includes the preparation of a Floodplain Risk Management Plan.

The Lismore Floodplain Risk Management Plan (LFRMP) 2014 is a culmination of a review of Lismore City Council's first Floodplain Risk Management Plan, which was adopted in 2002. The review commenced in 2009 under the guidance of a Floodplain Management Committee.

The LFRMP adopts the approach to flood risk management recommended by the *Floodplain Development Manual 2005*, which is to provide a mix of flood risk management measures, as a single option is not likely to address the full range of flood risk. These measures are aimed at property modification, flood modification and response modification.

The implementation of the measures contained in the Lismore Floodplain Risk Management Plan 2014 will require:

- Updating flood related development controls to reflect revised flood hazard categorisation, flood risk precincts and other amendments to development controls;
- Consideration of extending the FRMP to the whole of the Lismore LGA;
- Undertaking flood mitigation works in the Airport Bypass floodway and the Wilsons River Channel Improvement as appropriate and as demand dictates;
- A continuation of existing programs of community education and information and support for SES and emergency management;
- An update of the Voluntary House Purchase program and Council budget allocation to support the program;
- More detailed assessment of potential impacts of climate change on flooding.



1.0 INTRODUCTION

1.1 Need for the Floodplain Risk Management Plan

Lismore has experienced a flood on average once every four years in European history. This is a reflection of Lismore's location close to the coast and at the confluence of Wilsons River and Leycester Creek. In response to these repeated, and at times severe, floods, a number of studies and flood mitigation strategies have been investigated and implemented since the late 1940s.¹

In 2001 the NSW State Government released the *Floodplain Management Manual*. In 2002 Lismore City Council adopted its first Floodplain Management Plan (FMP), prepared in accordance with the Manual. A Floodplain Management Committee oversaw the preparation of the first FMP, and worked in conjunction with the Lismore Levee Scheme committee that prepared the levee proposal to provide a 1 in 10 year ARI² level of protection to Central and South Lismore.

The levee scheme was subsequently completed in 2005 and the FMP 2002 has been progressively implemented since then.

In 2005 the NSW State Government released a revised *Floodplain Development Manual*. The Manual provides that management plans should be periodically reviewed either as a matter of course (around every five (5) years), where significant flood events occur, or where circumstances arise that warrant a review of the plan and its implementation. For Lismore, it was timely and important to review the impact of the levees and cumulative development on the floodplain, along with other options available for flood mitigation.

In 2009 the review of the Lismore FMP 2002 commenced under the guidance of the Floodplain Management Committee, whose terms of reference were to:

1. Review options to improve the hydraulic capacity of certain floodway's within the Lismore urban area that may reduce peak flood levels in the CBD and in North and South Lismore.
2. Review flood hazard mapping and revise as required.
3. Review, and if appropriate revise, development control measures on the floodplain.
4. Review, and if appropriate revise, the policies on voluntary house purchase and raising.
5. Update the Lismore FMP2002 in accordance with the *Floodplain Development Manual 2005*.

In August 2011 the committee completed the review of the Lismore FMP 2002 in accordance with the terms of reference and the *Floodplain Development Manual 2005* and in October 2011 a peer review of the Draft Floodplain Risk Management Plan 2011 was undertaken by GeoLINK. The recommendations of this review were considered in the preparation of the Draft Lismore Floodplain Risk Management Plan 2013.

The draft Floodplain Risk Management Plan 2013 was publicly exhibited for five (5) weeks during November-December 2013. Lismore City Council amended the draft Plan in response to submissions. Council adopted the Floodplain Risk Management Plan at its ordinary meeting on 13 May 2014.

¹ Detail on the background and history of flood behaviour and flood risk mitigation policy in Lismore is in Appendix 2.

² The term ARI is a way of describing flood probability and does not mean that a flood of the modeled scale will occur once every 10 years. It means there is a 10% chance that a flood equal or larger could occur in any one year. Reference should be made to section Appendix 3 for the definition of 1 in 10 ARI flood.

1.2 The plan's approach to flood risk management

The Floodplain Development Manual 2005 states that the, *'purpose of a management plan is to provide input into the strategic and statutory planning roles of councils. It does not...purport to be the only document relevant to development of flood prone land. The management plan provides the type of information necessary for adequate forward planning of flood prone land.'*



the only document relevant to development of flood prone land. The management plan provides the type of information necessary for adequate forward planning of flood prone land.' (p9) Further to this, the Manual recommends adopting a mix of flood risk management measures, as a single option is not likely to address the full range of flood risk.

This Plan is structured around the Manual's recommended approach to flood risk management. This approach commences with an assessment of the hazard and

then proceeds through the various responses available to Council to respond to the risk. This approach recognises that Council is not the only agency responsible for flood risk management, especially with respect to flood and emergency response, which relies heavily on organisations such as the SES.

The flood hazard in Lismore is assessed and categorised in Section 2 of the Plan. This assessment and categorisation of risk underlies and determines many of the responses to flood risk management. Sections 3, 4 and 5 outline the recommended measures for responding to the flood risk.

The land use planning, development control and property modification responses are outlined in Section 3. Section 4 comprises the flood response measures, including emergency management and awareness and education strategies. Recommended flood modification measures are contained in Section 5.

Section 6 summarises how the Flood Risk Management Plan will be implemented.

Commonly used terms are contained in the Glossary. The background documents referred to in preparing this plan are listed in Appendix 1.

1.3 The Area of the plan

This Plan applies to the extent of flood prone land in the urban area of the Lismore local government area. This is defined by the extent of the Probable Maximum Flood (PMF), which includes South, North and Central Lismore. Map 1 shows the area to which this Plan applies.

The FMC recommends that the study area for the Lismore FRMP extend to the non-urban part of Lismore in time, including the area covered by the Richmond River Flood Mapping Study 2010³.

³ The Richmond River Flood Mapping Study was finalised In March 2010. This Study can be viewed at Lismore City Council's Corporate Centre in Goonellabah.

1.4 Floodplain Management Committee 2008-2013

The Floodplain Management Committee is comprised of Councillors, representatives of the SES, Richmond River County Council, the Office of Environment and Heritage and the local community. The members of the Lismore Floodplain Management Committee appointed by Council in September 2008 to oversee the preparation of the Plan were as follows:

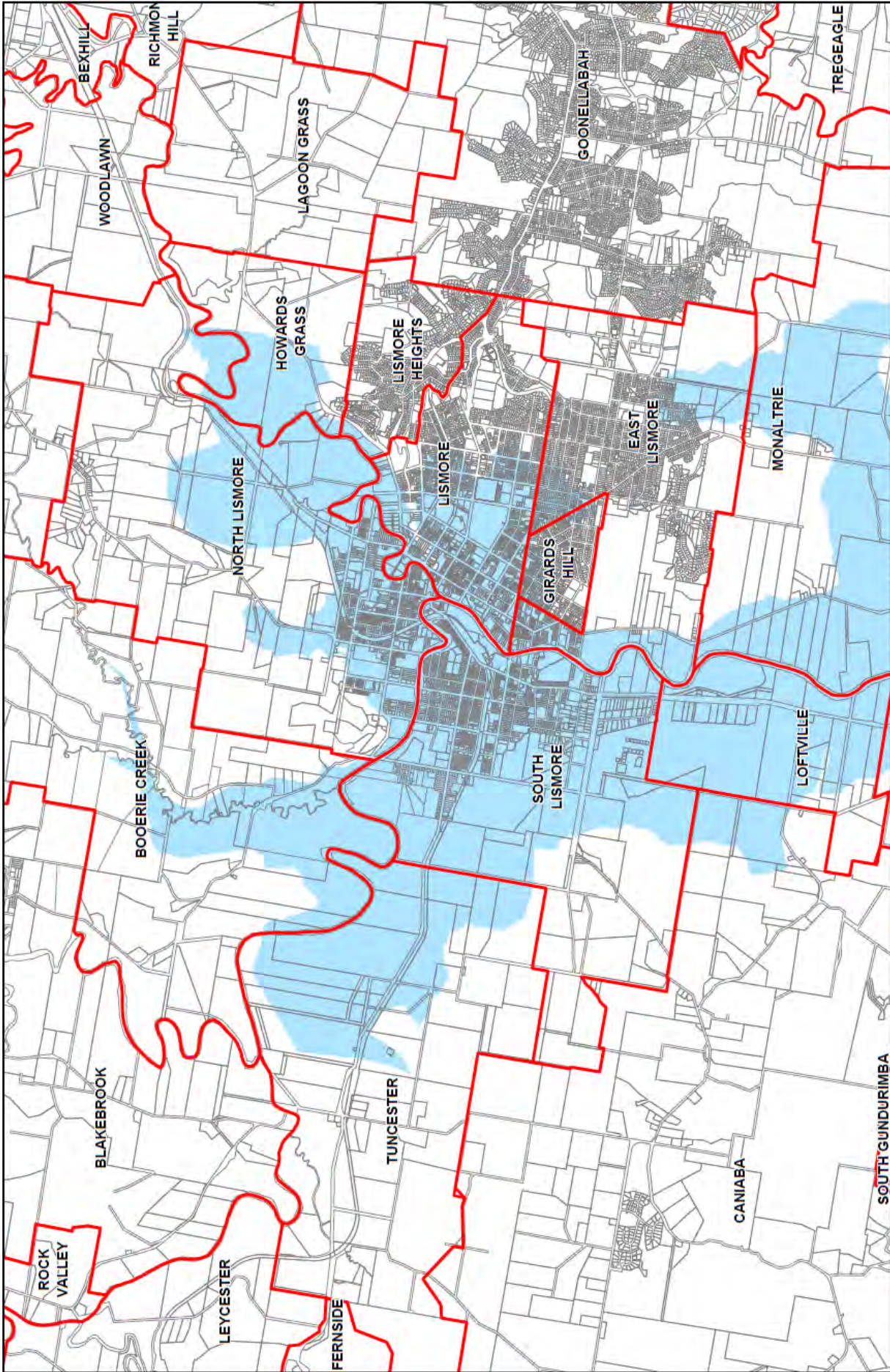
Name	Representation
Mr Simon Clough, Chair	Councillor, Lismore City Council
Mr Gianpiero Battista	Councillor, Lismore City Council
Mr Toong Chin	NSW State Govt Office of Environment & Heritage
Mr Michael Wood	Richmond River County Council (RRCC)
Mr Brian Griffin	State Emergency Services
Mr Stuart Ferguson	State Emergency Services
Mr Keith Graham	Citizen, CBD
Mr Severino DaRoit	Citizen, North Lismore
Mr Graham Askey	Citizen, South Lismore
Mr John Habib	Citizen, South Lismore
Mrs Jean Rose-Rapmund	Citizen, South Lismore

In October 2012, Councillor Vanessa Ekins replaced Cr Gianpiero Battista on the Committee. In July 2013, Brian Griffin and Stuart Ferguson were replaced by Wayne Petit, Melinda Mapstone and Lindsay Matterson to represent the SES. Mrs Jean Rose-Rapmund and Mr Keith Graham resigned from the committee in August 2013.

Council's Strategic Planning Coordinator and Manager of Assets & Support Services assisted the Committee, with the preparation of minutes, agendas and papers by the Strategic Planning Coordinator. Bill Moorhouse, RRCC, also assisted the Committee with advice regarding flood hazard categorisation and risk mapping.

LISMORE PUBLIC SCHOOL - 1989 CLOSE TO PEAK





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Map1: Area of Lismore Floodplain Risk Management Plan 2014

LISMORE CITY COUNCIL



2.0 FLOOD HAZARD AND RISK CATEGORISATION

2.1 Introduction

Flood hazard and risk categorisation underpins land use planning on the floodplain, the formulation of controls on future development, property modification and flood response and modification measures. Defining flood hazard and risk relies on a combination of hydraulic modelling, which provides data about water levels, depths and velocity in particular locations and across a range of flood events, and an assessment of risk based on flood behaviour, community awareness, location of existing development and ease of evacuation.

2.2 Flood Behaviour in Lismore

A number of factors are responsible for flooding in Lismore. Its latitude and proximity to the coast make it liable to the effects of extreme weather mechanisms, via tropical cyclones from January to April, and east coast lows from April to July.

The catchment above Lismore is fan-shaped and the valleys and streams are steep providing a relatively quick transfer of rainfall to runoff. The whole of the runoff from the 1,400km² catchment squeezes through a narrow section of floodplain at Lismore, which is located at the confluence of Wilsons River and Leycester Creek. The floodplain lies at approximately 9.5m AHD with significantly lower levels near Lismore Park in Central Lismore.



BROWNS CREEK PUMP STATION AT LEVEE SPILLWAY

At the confluence, the Leycester Creek floodplain is approximately 2 to 2.5m higher than the Wilsons River floodplain. This causes the upper section of the Wilsons River to act as a natural detention basin. During the very early rising stages of a flood it is not uncommon for floodwaters from Leycester Creek to back up into the Wilsons River, and once the storage is filled the flow reverses and discharges into the lower, southerly section of the Wilsons River.

The prospects for mitigating the effects of flooding are complicated by the city being centred around the confluence of Leycester Creek and Wilsons River, either of which may dominate in a flood event. The April 1989 flood was an example of a 1 in 100 year ARI flood occurring in Leycester Creek with only a minor flood occurring in the Wilsons River.

This flood highlights the importance of understanding the variability of rainfall across the Leycester Creek and Wilsons River sub-catchments and the impacts this has across different areas in Lismore, especially from a flood warning and evacuation planning perspective. In particular, flood warning should not just focus on the rowing club gauge height alone as the evacuation trigger. In 1989 South Lismore was flooded sooner and more severely than the gauge had indicated.

Flood behaviour is further influenced by more localised features such as Hollingworth Creek and the railway lines. Hollingworth Creek was a major floodway before European settlement. Due to the construction of the railway embankment in the 1880s and the South Lismore levee in the 1970s, it now functions more as a drain until the levee overtops when it once again becomes a major floodway. Local flooding problems in past floods, for example, in 1954, led to the construction of viaducts through the railway land to allow water to flow southwards.

Reference should be made to Appendices 2 and 3 for details on flood history and flood behaviour in the range of events from the 1 in 10 year ARI flood to the 1 in 100 year ARI flood. The Lismore Floodplain Management Study 2001 also provides useful background information and is available for viewing at Lismore City Council.

2.3 Hydraulic and Hazard Categorisation

The NSW Floodplain Development Manual 2005 describes the process for determining flood hazard. It outlines three *hydraulic* categories: floodway, flood storage and flood fringe; and two *hazard* categories, low hazard and high hazard. The Manual does not specify quantitative criteria for the hydraulic categories in terms of water depth and velocity, as these will vary depending on local floodplain characteristics. Instead these parameters are determined by a local flood study, which involves a detailed hydraulic analysis of flood behaviour for a range of flood severities up to the PMF.

The determination of flood *hazard* categories involves evaluation of hazard from pure hydraulic principles, and then refining the hydraulic hazard category in light of other relevant factors affecting the safety of individuals, including community flood awareness and ability to evacuate.

In Lismore, a local flood study was prepared in 2001 by Patterson Briton & Partners. This fine scaled modelling defined areas of differing flood hazard with the main categories of hazard being Floodway, High Flood Risk and Flood Fringe. These categories became the Lismore Flood Hazard Map, which was adopted pursuant to the LFMP 2002, and incorporated into Chapter 8 of the Lismore DCP. As each category represents a different level of flood hazard in terms of the potential risks posed to human life and property, varying levels of restriction on new development have been applied to development within each category.

In reviewing the 2002 Flood Hazard Map, the Floodplain Management Committee (FMC) considered that 'flood fringe', which is defined as the remaining area of flood liable land (within the limit of the 1 in 100 year ARI design flood event) after Floodway and High Flood Risk Areas have been defined, does not in some areas adequately describe the hazard. Further to this it was recognised that a review of hazard was needed to ensure that factors other than hydraulic hazard were fully considered, including flood warning times, ease of evacuation and effective flood access.

The FMC derived four (4) main Flood Risk Precincts to describe flood hazard in the area in which the Plan applies.

2.4 Lismore Flood Risk Precincts

The Flood Risk Precincts described in the following sections are a result of:

1. Fine scaled hydraulic modelling undertaken by Worley Parsons (formerly Patterson Briton & Pnrs);
2. 'Ground truthing' by the Office of Environment & Heritage, RRCC and LCC, with assistance from the FMC;
3. Consideration of the full range of factors that influence and define flood risk; and
4. Review of the proposed Flood Risk Precincts and land use controls by GeoLINK in October 2011.

The Flood Risk Precincts are shown on Map 2 and described in the following sections. The Map also defines flow paths, as it is important to ensure these areas remain clear of development to avoid unnecessary and undesirable impacts on residential areas in particular.

2.4.1 Floodway Precinct

Definition and Characteristics

The Floodway Precinct covers the areas of the floodplain where a significant discharge of water occurs during floods. These areas are generally aligned with naturally defined channels. The risk to humans, animals and some structures in some floods may be extreme.

Hydraulic Criteria

A depth greater than 0.5 metres **and** a velocity greater than 0.85 m/s **and** velocity multiplied by depth greater than 1 in the 1 in 100 year ARI flood.

Application of Floodway Precinct

The Extreme Risk Precinct applies along the naturally defined channels, including the Wilsons River, Leicester Creek and Hollingworth Creek, along with Gasworks Creek and Browns Creek, which become flow paths when the levee overtops. Some of these areas contain development, including housing.

2.4.2 High Risk and Flood Isolated (Evacuation) Precincts

Definition and Characteristics

The High Risk and Flood Isolated (Evacuation) Precincts cover the areas in which there is:

1. Potential for flood waters to cause danger to personal safety and/or loss or damage to light structures such as houses. Able bodies adults could have difficulty wading to safety; **and/or**
2. Possible danger to personal safety of residents and emergency personnel due to inadequate evacuation routes and time available for evacuation.

The High Risk Precinct includes those areas described by the Floodplain Development Manual as 'flood storage' areas, which are important for the temporary storage of flood waters during the passage of a flood. Flood storage areas are characterised by deep water and low velocity. The loss of flood storage, for example by filling, can increase the severity of flood impacts. In Lismore, the central basin area is a flood storage area.

Hydraulic Criteria

The hydraulic criteria reflect the different types of risk that apply to personal safety (human risk) and to light structures such as residential buildings (property risk). Most of the High Risk Precinct is characterised by the following hydraulic criteria in a 1 in 100 year ARI flood.

- Less than 0.5m deep **and** with a velocity greater than 2 m/s **OR**
- Less than 1.2m deep **and** a velocity less than 2 m/s **and** velocity multiplied by depth is 0.6 to 1.0 **OR**
- Greater than 1.2m deep **and** a velocity less than 0.85m/s.

Application of High Risk Precinct

North Lismore

Land use in North Lismore is a mix of residential, commercial and industrial although the predominant land use is residential with commercial development restricted to Bridge Street and the eastern end of Terania Street. Almost all of North Lismore is in the High Flood Risk Precinct with some existing residential areas located within the Extreme Risk Precinct. The land bound by Tweed, Terania, Bouyon and Lake Streets is zoned for industrial development. Its inclusion in the High Risk Precinct reflects hydraulic criteria related to water depth while the land remains unfilled.

The categorisation of most of North Lismore as High Risk reflects the hydraulic characteristics of the area, its lack of protection by the Lismore Levee Scheme, which means it is affected by the whole range of floods and evacuation time is reduced, along with limited evacuation routes.

Central Basin Area

Land use in the 'Central Basin Area' is predominantly public recreation space (Oakes Oval, Mortimer Oval and Lismore Park) with some commercial (including Lismore Square), educational and residential uses adjacent. This area is a High Flood Risk Area largely due to the excessive depth of water and its role as a Flood Storage area.



Application of High Risk and Flood Isolated (Evacuation) Precincts

Most of South Lismore is included in the High Risk or Flood Isolated (Evacuation) Precincts although the reasons for applying this Precinct vary across the area as described below.

South of Hollingsworth Creek

The area south of Hollingsworth Creek is isolated in a flood with a lengthy evacuation route via Union Street, the Ballina Street Bridge and Ballina Street or Conway Street to Wyrallah Road. The Hollingsworth Creek Bridge represents a low point on the evacuation route that is cut when flood waters reach 8.8 metres AHD.

The area is afforded some protection by the South Lismore Levee and adjacent pump, which provides protection to the 1 in 10 year ARI flood. The area contains a mix of industrial and residential development.

From Cook Street south to Habib Drive the land use is predominantly industrial. This area is nominated as South Lismore Flood Isolated (see 2.4.5 below), apart from industrial land to the west of Wilson Street South which is High Risk.

From Cook Street north to Hollingsworth Creek the land use is predominantly residential and is included in the High Risk Precinct due to the hydraulic characteristics as well as the risks to residents and emergency personnel due to insufficient evacuation routes and warning times.

North of Hollingsworth Creek

The areas north of Hollingsworth Creek are also afforded protection by the South Lismore Levee, up to the 1 in 10 year ARI flood. From Hollingsworth Creek north to the Railway line the land use is mostly mixed consisting of residential, industrial and commercial uses. From the Railway line north to Leicester Creek the land use is predominantly residential except for some mixed commercial/industrial development in Union Street/Casino Street.

The categorisation of a large part of this area as Flood Isolated (Evacuation) Precinct is due to hydraulic characteristics and the risk associated with evacuation of a high number of people, potentially up to 1600, and the relatively early cutting of potential evacuation routes, with the only effective route being via Union Street and the Ballina Street Bridge.



2.4.3 Medium Risk Precinct

Definition and Characteristics

The Medium Risk Precinct applies to the areas of flood liable land within the limit of the 1 in 100 year ARI design flood after the Extreme Risk and High Risk Precincts Areas have been defined. In these areas the risk of damage to buildings is not high and residents are able to evacuate with relative ease due to the proximity of higher ground, numerous possible evacuation routes and sufficient warning time.

Hydraulic Criteria

Most of the Medium Risk Precinct is characterised by depths less than 1.2m **and** velocity less than 2m/s **and** velocity multiplied by depth less than 0.6.

Application of Medium Risk Precinct

Central Lismore Area

The areas adjoining the High Risk Precinct that applies to the central basin area and includes Oakes and Mortimer Ovals and Lismore Square, are largely residential with some commercial uses on the northern side of Ballina Road. This area is subject to extensive flooding but should not create high risks to buildings or to people's lives. In these parts of Lismore, if evacuation is necessary, there are many routes available and sufficient warning time.

East Lismore/Girards Hill

The area of East Lismore and Girards Hill south of Ballina Road extending to the Wyrallah Road Shopping Centre is predominantly residential. This area is extensively flooded but should not create high risks to buildings or to people's lives. In these parts of Lismore, if evacuation is necessary, there are many routes available and sufficient warning time.

2.4.4 Low Risk Precinct

Definition and Characteristics

The Low Risk Precinct applies to the areas of flood liable land within the extent of the Probable Maximum Flood but outside the extent of the 1 in 100 year ARI design flood (ie excluding the Extreme, High Risk and Medium Risk Precinct areas). While the probability of getting a PMF is extremely low, floods between a PMF and 1 in 100 ARI events are a regular occurrence in extreme weather situations.

Hydraulic Criteria

Hydraulic modelling has been used to assist in determining the extent of a PMF. However, specific criteria relating to depth and velocity were not adopted.

Application of Low Risk Precinct

The Low Risk Precinct is generally adjacent to areas adjoining the Medium Risk Precinct or where the topography is such that it is not within the extent of the 1 in 100 year ARI flood but is within the extent of the Probable Maximum Flood (PMF).

In the southern part of East Lismore in a PMF event, it is estimated flood waters could rise to approximately 14m AHD. Therefore land (outside the 1 in 100 ARI level) up to a level of 14m AHD has been shown as Low flood Risk.

2.4.5 South Lismore Flood Isolated, CBD Flood Liable and East Lismore Flood Liable

South Lismore Flood Isolated

The industrial area south of Cook Street in South Lismore is defined on the Flood Risk Precinct map as South Lismore Flood Isolated. This is intended to distinguish land in South Lismore that has mostly been filled for industrial development purposes to the 1 in 100 year ARI level, which means many of the existing (and any future) buildings are above the 1 in 100 year ARI flood level, or contain flood refuges. Therefore, while the streets will become flow paths and be extremely risky to humans, if necessary safe refuge could be taken in some industrial buildings up to or bigger than a 1 in 100 year ARI flood.

CBD Flood Liable

The CBD is defined on the Flood Risk Precinct Map as CBD Flood Liable area. Land use in the CBD Flood Liable area is predominantly retail and service industries. Given that a large proportion of retail development in the CBD is located at or close to street level, significant disruption to commercial activity occurs during a flood. The Lismore Levee Scheme affords flood protection to the CBD up to the 1 in 10 year ARI flood.

The categorisation of the CBD as CBD Flood Liable recognises that there is the potential for flooding above the 1 in 10 year ARI flood to cause extreme danger to personal safety and/or loss or damage to light structures. Further, able bodied adults would have extreme difficulty wading to safety.

However, the existing buildings are generally not light-weight structures, the first levels of many of the existing buildings are above a 1 in 100 ARI flood, the nature of future commercial development will not be light-weight and the levee has been designed such that overtopping will occur in a controlled manner. Further, apart from reducing the frequency of nuisance flooding the levee provides a benefit in allowing greater time before the closure of Central Lismore evacuation routes.

East Lismore Flood Liable

The area of East Lismore to the south of Nielson Park is classified as East Lismore Flood Liable. The area is largely a low density residential area. Some of this area is relatively low. Hydraulic modelling has not been undertaken in this part of East Lismore. However hydraulic modelling elsewhere indicates a 1 in 100 year ARI flood level at the junction of Monaltrie Creek and Wilson River to be 11m AHD. This 'backs up' water into East Lismore to a similar level, which means dwellings in the Southern part of East Lismore with floor levels below 11m AHD to experience flooding. As the velocity will be very low there is not a high risk to buildings or people.

2.5 Preferred Excavation Areas

Although not risk precincts per se, two (2) preferred excavation areas are outlined on Map 2. These are the areas of the floodplain from which, when fill material is won the greatest benefit to floodplain management can be obtained. These Areas are in the Floodway Precinct as they are areas in which the greatest flood velocities and flood gradients are experienced. The preferred excavation areas are the Airport Floodway Bypass and the Wilsons River Channel Improvement (to the east of the Essential Energy sub-station in Three Chain Road). Further details on these are contained in Section 3 and Section 5 of this Plan.

2.6 Risk Precinct Mapping Outside the Area of the Plan

In March 2010 the Richmond River Flood Mapping Study was finalised by BWT WBM. This study covered the following areas:

- Richmond River between Casino and Broadwater (not including Casino);
- Bungawalbin Creek from approximately 3km downstream of Neileys Lagoon Road to the Richmond River;
- Wilsons River from Lismore to Coraki (not including Lismore); and
- Lower reaches of other major tributaries of the Richmond River, such as Shannon Brook (Deep Creek) and Sandy Creek.

The Richmond River Flood Mapping Study resulted in:

1. A calibrated hydrologic model covering the entire Richmond River catchment;
2. A calibrated 1D/2D hydraulic model of the floodplain between Casino, Lismore and Broadwater;
3. A comprehensive understanding of flood behaviour across the study area; and
4. Flood mapping of historical and design flood events, in particular flood levels and hazards.

The study did not extend to the categorisation of risk for particular areas. However, the Office of Environment and Heritage's Floodplain Management Program has provided funding to assist Council to undertake the work necessary to categorise risk across this study area. In addition, BWT WBM has been engaged by RRCC to prepare flood hazard mapping for areas north of the Lismore urban area. Both of these projects aim to ensure some consistency with the risk precincts and associated land use and development controls across the whole of the Lismore LGA.

When the results of these projects become available during the second half of 2013, the FMC will consider the inclusion of these areas as a future amendment of the FRMP and advise Lismore City Council accordingly.

2.7 Potential Impacts of Climate Change

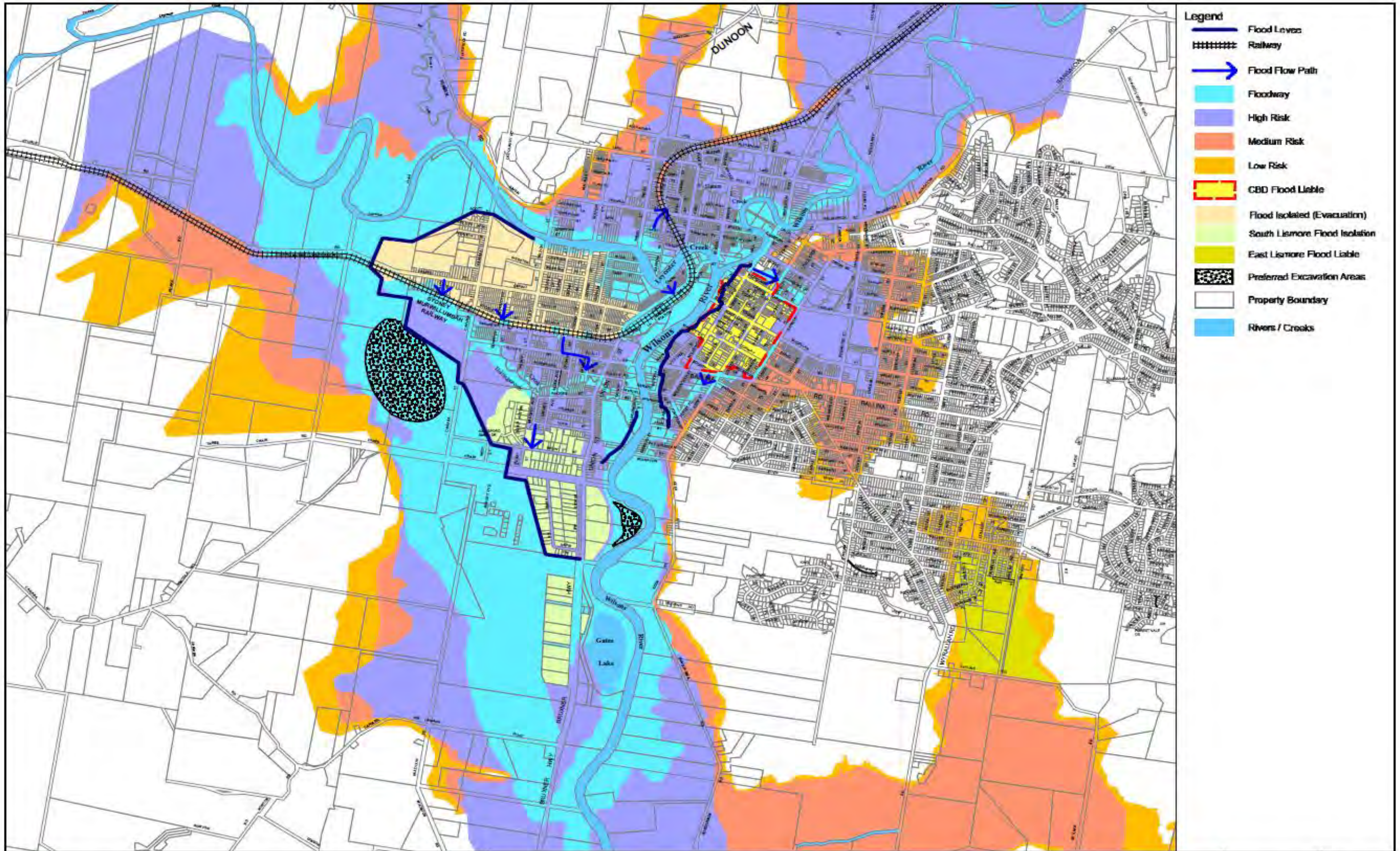
A preliminary investigation into the potential impacts of climate change on flooding in Lismore was undertaken by Worley Parsons. This investigation was based on the document prepared by the (then) Department of Environment, Climate Change and Water titled *Practical Consideration of Climate Change*, which anticipates that extreme rainfall intensities are expected to increase by between 5% and 10% by the year 2070 in the Northern Rivers region. Rising sea levels are unlikely to affect peak flood levels at Lismore.

Worley Parsons investigated the sensitivity of the floodplain to a 10% rainfall intensity increase. The aim of the investigation was to provide Council with a preliminary indication of the impact of climate change on flooding at Lismore, and act as a basis for Council to consider managing the impacts.

The results of the assessment show an increase in peak water levels of around 0.1 to 0.2m and flood hazards of 0.1m/s for the 1 in 100 year ARI flood event as a result of climate change. Increases in flow velocity are less significant.

It is noted that the assessment of climate change is preliminary only. A thorough assessment would involve assessing the sensitivity of the hydrologic modelling to an increase in rainfall of 10%, with a subsequent assessment on the hydraulic modelling and associated flood impacts (such as flood damages, properties affected and flood hazard categorisation).

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- Legend**
-  Flood Lines
 -  Railway
 -  Flood Flow Path
 -  Floodway
 -  High Risk
 -  Medium Risk
 -  Low Risk
 -  CBD Flood Liable
 -  Flood Isolated (Evacuation)
 -  South Lismore Flood Isolation
 -  East Lismore Flood Liable
 -  Preferred Excavation Areas
 -  Property Boundary
 -  Rivers / Creeks

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3.0 PLANNING, DEVELOPMENT CONTROL AND PROPERTY MODIFICATION

3.1 Introduction

Council can manage the impact of floods through appropriate planning, development controls and, where appropriate, property modification measures. The long-term benefits of appropriate development controls, voluntary house purchase and voluntary house raising are evident on the Lismore floodplain where these controls and policies have resulted in substantial areas of the more hazardous parts of the floodplain being free of development, or being developed in ways that account for the risks posed by floods.

This Chapter describes: 1) the controls that will apply to future development within the flood risk precincts; and 2) the measures to reduce flood impacts on existing properties in the most hazardous parts of the floodplain.

3.2 Incorporating Flood Risk into the Local Environmental Plan

The Local Environmental Plan is Council's primary document for controlling the location of development. It does this by defining the land uses and development that are permissible or prohibited in particular parts of Lismore. In the area of this plan, a number of different land use zones apply and flood risk is a major determinant of the types of development that are permissible.

3.2.1 Lismore Local Environmental Plan 2012

The Lismore LEP 2012 was prepared by LCC in response to the State Government's Standard Instrument (LEP) Order 2006, which was gazetted on March 31, 2006 and amended in February 2011. The Order provides a standard template that Councils must follow when preparing their LEP. The LEP was adopted by LCC on 31 May 2012

and made by the Minister for Planning and Infrastructure on 22 February, 2013.

The Standard Instrument does not contain a 'flood' zone or any other zone that is equivalent to the LEP 2000 'flood' zones. Instead flood prone land is identified on the Flood Planning Area map and controls on development in flood prone areas apply to lands that are known to be flood affected (in both the rural and urban area) as identified on the Flood Planning Area map.

The LEP Flood Planning Area map identifies the extent of the estimated 1:100 year ARI flood. In the Lismore urban area the boundaries are the extent of the Medium Risk Precinct shown on Map 2. Development that is permissible in the zones within the flood planning area will be controlled through Clause 6.3 of the LEP and Chapter 8 of the Lismore Development Control Plan.

Clause 6.3 applies to permissible development on land that is shown as "Flood planning area" on the LEP Flood Planning Map, and other land at or below the flood planning level. Unlike Council's previous LEP 2000 this clause does not allow reference to the Lismore Flood Risk Precinct Map or the Lismore Floodplain Risk Management Plan. Clause 6.3 does require that development is compatible with the flood hazard of the land and will not significantly adversely affect the flood impact on other properties.

It is noted that, while the FRMP considers the extent of flood prone land to be within the PMF, the NSW Department of Planning & Infrastructure's 2007 Section 117 Direction and EP&A Regulation on flood prone land requires that, unless there are exceptional circumstances, councils must adopt the 100-year flood plus freeboard as the Flood Planning Level (FPL) for residential development.

3.2.2 Recognising Flood Risk in Land Use Zones

In the absence of specific 'flood zones', the most appropriate zoning of flood prone land in the Lismore urban area in accordance with the Standard LEP Instrument was determined through an evaluation of LEP 2000 zones (business, residential, industrial etc), existing land uses, surrounding land uses, the level of flood hazard and access to flood evacuation routes.

The Lismore Local Environmental Study (LES) 2010 details how the zones proposed for the area affected by this FRMP were determined. The following is an overview of the application of the zones.

South Lismore

As shown on Map 2 in this Plan, the Flood Risk in South Lismore is either Floodway or High. Areas north and south of Hollingworth Creek are further categorised as Flood Isolated (Evacuation) or, in the industrial area south of Cook Street, South Lismore Flood Isolated, for the reasons outlined in Section 2.4 of this Plan. The parts of South Lismore that are currently predominantly developed for industrial or commercial purposes or are proposed to become industrial (Caniaba Street area) have been zoned for these types of development in the LEP 2012. A wide range of industrial and commercial uses are encouraged to locate in these areas, subject to incorporating measures that reflect the flood risk, for example, structural soundness, site filling and the inclusion of flood refuges.

In the areas of South Lismore that consist largely of housing, the zoning is R2 Low Density Residential. This zone recognises the established residential character of these areas. The existing housing stock is generally

of good quality, well serviced and close to a range of commercial and other facilities. While the flood risk is high, these areas generally have high residential amenity and the R2 Low Density zone is intended to maintain the low intensity and scale of residential development by restricting subdivision and not allowing more intense forms of housing such as units and dual occupancy. Replacement of, and additions to existing dwellings will be supported, subject



1974 CBD

to satisfying development controls related to flood risk.

The part of Ostrom Street and the area known as the 'Duck Pond' in the Floodway Precinct are included in the RU2 Rural Landscape zone. This reflects the flood risk and the former LEP 2000 zone, which was a rural zone, 1(r) Riverlands. The Northern end of Ostrom Street is flood isolated by a low culvert and backwater from the Duck Pond. Unless effective access to Casino Street can be provided at similar flood levels this land is not suitable for residential development.

North Lismore

The Flood Risk in North Lismore is either High or in a Floodway, apart from an area to the west of Bouyon Street (unformed), due largely to the depth and velocity of flood waters, the potential for the area to become isolated at an early stage and the limited access available in a flood event. The existing commercial precinct along Bridge and Terania Streets is included in the B1 Neighbourhood Centre zone and existing industrial areas, or areas currently zoned for industry, are included in the IN1 General Industrial or IN2 Light Industrial zone. A range of commercial and industrial uses is encouraged, subject to satisfying measures relative to the flood risk.

The R2 Low Density zone applies to small areas of existing housing for similar reasons as South Lismore, that is, it allows residential character to be maintained but does not allow for a greater intensity of residential development in recognition of the high flood risk. The RU2 Rural Landscape zone applies to other parts of North Lismore due to its High or being in a floodway, including Baillie Street and Wotherspoon Street. This zone recognises the flood risk as well as their location on the urban fringe.

Central Business District

The CBD is zoned B3 Commercial Core to recognise its role as the commercial heart of Lismore. This zone encourages a wide range of retail and commercial uses, along with housing above shops, motels and other tourist and visitor accommodation (such as serviced apartments). The controls applicable to development in the Medium Risk Precinct will apply in the CBD.

Central Basin Area

The area within the central basin in the High Risk Precinct is predominantly included in the RE1 Public Recreation zone. The parks and sporting grounds in this area are an appropriate use of the land in this high flood risk area. Council intends that the Lismore Tourist Caravan Park will be managed purely for short term accommodation, which is also appropriate as it allows easy evacuation during a flood event.

Some commercial areas close to the CBD that are in the High Risk Precinct are zoned B3, including Lismore Square. Small areas are also included in the R2 Low Density Residential zone, which reflects the low density residential nature of these areas, the high flood risk and a desire to retain this type of housing close to the CBD.

East Lismore and Girards Hill

Residential areas within the medium risk and East Lismore Flood Liable precincts in East Lismore and Girards Hill are included in the R1 General Residential zone. In this zone, a range of residential development is supported, including residential flats and dual occupancy. This recognises that an intensification of residential uses is compatible with the flood risk, which can be addressed through controls on development, such as ensuring habitable floor levels are at or above the 1 in 100 ARI event.

3.3 Controls on new development

The LEP defines the zones and the development that is permissible and prohibited. As discussed in the above section, these zones have been determined in recognition of the flood risk. The controls applicable to new development are based on the level of flood risk as defined on Map 2 in this Plan. As the precincts represent different levels of flood hazard in terms of the potential risks posed to human life and property, varying levels of restriction on new development apply. These controls are contained in the Lismore Development Control Plan (DCP).

Table 1 provides a broad summary of the controls as they apply to generic development types within each of the flood risk precincts. More detail is contained in Appendix 4. Chapter 8 of the DCP will require amendment to reflect the change in precincts.

The types of controls applicable are broadly categorised as follows.

3.3.1 Structural Adequacy of Buildings

In the High Risk and Medium Risk Precincts, commercial and industrial development is required to submit a risk analysis report prepared by a structural engineer that addresses the design criteria adopted for the building and its relative merits in the 1 in 500

ARI flood event. The risk analysis report must also certify that the design criteria adopted for the building will withstand the impact of flood waters and debris up to the 1 in 500 ARI flood event. The latter requirement is also required for residential development in the High and Medium Risk Precincts.



3.3.2 Minimum Floor Levels

In the High and Medium Risk Precincts, apart from motels, habitable floor areas for new residential development (including replacement dwellings and extensions to existing dwellings) are to be at or above the flood planning level, i.e. the 1 in 100 ARI flood level plus 500mm freeboard. New motels and other visitor accommodation require a minimum of 90% of the habitable floor area to be above the flood planning level with an approved flood evacuation plan.

Depending on the location of the development relative to Hollingworth Creek, all or part of the floor level will be required to be at or above the flood planning level for commercial and industrial development. Flood refuges are also required.

3.3.3 Filling

Fill on the floodplain is to be sourced on-site, from the preferred excavation areas or from another area on the floodplain. Map 2 outlines the location of the preferred excavation areas and section 5 of this Plan contains details about the proposed excavation of the preferred areas. No development is to occur in the preferred excavation areas.

TABLE 1: SUMMARY OF FLOOD RISK PRECINCTS & ASSOCIATED DEVELOPMENT CONTROLS *refer to Appendix 4 for more detail

Risk Precinct	Land Uses and Development Controls
Floodway	<ul style="list-style-type: none"> • No new buildings or structures except utility installations or amenities associated with recreation space • Replacement dwellings permitted, for example, where houses lost to fire • Minor or ancillary development such as small sheds may be considered for existing (as at the date of adoption of this FRMP) development, depending on site specific hydraulic characteristics • Voluntary House Purchase policy may apply – refer to the policy within this Plan
High Risk Flood Isolated (Evacuation)	<p><u>Residential</u></p> <ul style="list-style-type: none"> • No new residential development except for replacement of existing dwellings (where lost through fire etc), relocation of dwellings within the precinct where no additional dwellings will result, new motels and other forms of development that provide temporary or visitor accommodation (serviced apartments) or shop top housing • No subdivision for residential purpose ie to create new lots for housing. • Alterations and raising of existing dwellings is possible • No fill unless sourced from preferred excavation areas • No caravan parks, residential flat buildings or dual occupancy <p>Note: The Standard Instrument LEP makes it mandatory for boarding houses to be permissible with consent in the Low Density Residential zone.</p> <p><u>Commercial and Industrial</u></p> <p>Range of commercial and industrial subject to development controls on floor heights, structural adequacy of buildings and flood refuge provision.</p>
Medium East Lismore Liable	<ul style="list-style-type: none"> • A range of residential, commercial and industrial development. • Development controls applied to ensure floor levels above 1 in 100 yr. ARI plus 500mm freeboard • Reports required on structural adequacy in 1 in 500 year ARI • Controls on fill.
Low	<ul style="list-style-type: none"> • No development controls apply to residential, commercial or industrial development. • Safety of people and emergency response management is still important; this may result in restrictions on uses that may be particularly vulnerable to emergency response such as aged care homes, critical emergency response and recovery facilities, evacuation centres and hospitals.
South Lismore Flood Isolated	<p>The area is zoned for industrial development. Development controls relate to site filling, floor heights, structural adequacy of buildings and the provision of flood refuges. South of Hollingsworth Creek, greenfield industrial land must be filled to the 1 in 100 year ARI flood.</p>
CBD Flood Liable	<p>Residential development acceptable as it will be above the 1 in 100 year ARI flood event and buildings structurally adequate. Commercial development encouraged in accordance with the LEP and subject to controls related to floor heights and structural adequacy of buildings. These controls do not apply to changes of use.</p>
Preferred Excavation Areas	<ul style="list-style-type: none"> • No fill to be placed • No structures to be built • No agricultural activities that will have an adverse impact on flood flows.

3.4 Property Modification

3.4.1 Voluntary House Purchase

The voluntary purchase of houses from the most hazardous parts of the floodplain is regarded as a necessary part of floodplain risk management as it:

- provides physical retreat from high flood risk areas, reducing the direct costs (damage to buildings and infrastructure) and indirect costs (trauma and ill health effects) of flooding;
- reduces the public health and welfare costs associated with flooding;
- removes homes from locations of highest flood risk;
- reduces the demand for evacuation resources and risks to would be rescuers.

Lismore has one of the oldest Voluntary House Purchase Schemes (VHPS) in the State. Following the flood of 1954, LCC initiated the voluntary purchase of residential properties located in the more hazardous areas of the Lismore floodplain. Between 1954 and 1988 72 property settlements took place under the VHPS. Between 1982 and 1997 approximately \$1.2 million was spent on purchasing 34 houses. This translates to a purchase rate of just over 2 properties a year.

Initially the purchases were funded by LCC alone but since 1978, the VHPS has been funded jointly by the Federal and/or State Government and Council. House prices in the early 1980s ranged from \$8,300 to \$32,000 compared with an estimated current median purchase price in the order of \$180,000.

Prior to the adoption of the LFMP 2002, dwellings were acquired from designated 'acquisition areas' as and when owners offered them for sale and subject to the availability of funds. These areas were formally identified in Council's Development Control Plan No. 7 in 1985.

The use of fine scaled hydraulic modelling allowed the LFMP 2002 to more clearly identify the most hazardous areas in which dwellings would be considered for voluntary purchase. The areas defined as 'Floodway' subsequently became the areas in which houses would be considered for voluntary purchase and the DCP was amended to remove the 'acquisition area'.

Because the Central and South Lismore Levees will not mitigate the hazards associated with major floods and above, the Levee Scheme has not lessened the need for the VHPS.

Eligibility and Priorities for Voluntary House Purchases

The area in which voluntary house purchase will be considered is generally defined by the boundaries of the Floodway area on the Flood Risk Precinct Map (Map 2), with some consideration for dwellings in High Risk Precinct areas. To assist Council and the State Government to determine priorities for acquisition, criteria for prioritising the voluntary purchase of residential properties were developed.

209 properties were considered adjacent to Leycester Creek, Wilsons River and Hollingsworth Creek. These properties were then prioritised using four (4) criteria. Appendix 5 details these criteria and the resulting priorities. All 209 properties were ground-truthed to ensure that the VHPS encapsulates all flood liable dwellings in the urban area of Lismore.

Favourable consideration may be given to properties located in areas where a large number of properties are targeted for acquisition in order to consolidate the area. To this end one precinct has been identified in North Lismore.

Commercial property, industrial property and vacant land are not eligible for purchase. Vacant land was not considered although Council may consider it in the future to allow consolidation of lots and ensure that dwellings cannot be constructed.

Funding for Voluntary House Purchase

It is anticipated that the VHPS will be funded on a 2:1 basis between the State Government and Council. The availability of Council and State Government funding will determine the number of properties that are able to be purchased each year. It is estimated, at current valuations, that \$100,000 from Council would provide a total of \$300,000 and generally allow for the purchase of one (1) to two (2) properties a year.

The State Government subsidy is payable when properties are part of the approved scheme and the actual purchase price falls within the State Valuation Office's valuation. LCC's associated legal and house demolition/removal costs are eligible for the subsidy.

Solatium (compensation for emotional rather than financial or physical suffering) is not eligible for subsidy and monetary amounts are exclusive of Goods and Services Tax.

Process for Voluntary House Purchase

In recent years the State Government subsidy for the scheme has been available but Council's ability to provide a contribution has been severely limited by budgetary constraints and competing funding priorities. This has led to unrealised expectations by landowners in affected areas and an inability to implement the scheme in an acceptable way.

A better process for determining the availability of subsidies by State Government and Council is therefore required. Additionally, the committee recommends that Council work with both the State and Federal Governments to acquire additional funds or achieve an alternative funding program.

The following process for the implementation of the VHPS will generally be followed:

- On a yearly basis, RRCC will liaise with LCC to ensure that sufficient funding is available in Council's budget to implement the scheme.
- If funding is allocated in LCC's budget and State Government subsidies are available, RRCC will write to the high priority landowners to advise them that funding is available for the purchase of their properties if they decide to sell.
- Subject to the amount of funding available, RRCC will make offers to those who have indicated their intention to sell.
- The offer price will be the 'market valuation' established by the State Valuer General.
- After settlement, the dwellings will be demolished/removed, the site cleared, and the land placed in the care and control of LCC.

While Council will be proactive in supporting the VHPS, the allocation of funding is still subject to Council's four (4) year Delivery Plan and annual budget review process.

Future Action

Given the increasing budgetary pressures on local government, the FMC recommends that Council write to the State and Federal Governments to request additional assistance for the scheme or an alternative funding arrangement, for example, a 2:2:1 State/Federal/Council funding program. In light of the impact of the flood events in Queensland and Victoria in the first part of 2011, this is not an unreasonable request.

3.4.2 Voluntary House Raising

The primary purpose of house raising is to reduce the risk of flood damage associated with severe floods in some of the more hazardous areas of the floodplain. The State Government contributes to the funding of house raising, provided a house raising program is part of Council's floodplain risk management policy.

The 1 in 10 Year ARI Lismore Levee Scheme included the raising of some 15 dwellings located in North Lismore. Property owners whose dwellings were not protected by the levees and whose floor levels were below the 1 in 10 year recurrence flood level were requested to contribute \$2,500 of the actual house raising cost. The floor levels of these dwellings were raised to 0.5m above the 1 in 100 year recurrence flood level.

The VHRS is documented in the Lismore Floodplain Management Plan 2002 but in the absence of a detailed strategy that identifies and prioritises individual properties eligible for VHR, the implementation of the scheme did not progress.

Eligibility and Priorities for Voluntary House Raising

This Plan proposes that the Voluntary House Raising Scheme (VHRS) be extended to dwellings with floor levels below the 1 in 20 year ARI flood level. The area in which voluntary house raising will be considered is generally defined by the boundaries of the High Risk Precinct on the Flood Risk Precinct Map (Map 2).

100 residential properties with floor levels below the 1 in 20 year ARI flood level were considered on the basis of their location in high flood risk areas. These properties were then prioritised using three (3) criteria to allocate a total point score to each property. Appendix 5 details these criteria and the resulting number of priority properties. Excluded are properties identified as suitable for the VHPS and houses that are of slab-on-ground construction.

Commercial and industrial properties are not eligible for subsidy for raising under the VHRS.

Funding for Voluntary House Raising

The VHRS will be funded on a 2:1 basis between the State Government (2/3 share) and the property owner (1/3 share). Therefore, if the total cost of house raising, including costs associated with preparing plans, is \$60,000, the State Government's share would be \$40,000 and the property owner \$20,000.

On completion of the works the property



owner will submit all invoices to the RRCC for the 2/3rd reimbursement of the total cost of the works. Expenditure for which State Government subsidy is payable are the contractor's cost for house raising and associated development application, legal and insurance costs.

The payment of the subsidy is subject to properties being part of the approved VHRS and Council approving the Development Application and being satisfied with the works.

Process for Voluntary House Raising

Council will assist the State Government and RRCC to implement the VHRS but will not provide a monetary subsidy. The following process will generally be followed:

- On a yearly basis, if State Government subsidies are available, the RRCC will write to the landowners whose houses are on the priority list to advise them that their dwellings are eligible for assistance under the scheme.
- RRCC will make conditional offers to those who wish to have their dwellings raised.
- A Development Application will be lodged by the landowner to Council. The new floor level will be at least 0.5m above the 1 in 100 year recurrence flood level but will not exceed 3.5m above ground.
- Before work commences a signed liability waiver will be submitted whereby the property owner indemnifies LCC and the State Government from or against all claims, expenses and damages in respect of loss or damage to the dwelling or personal injury (including death) arising out of the house raising work.
- After the dwelling has been raised by an approved contractor, LCC will inspect and be satisfied with the work before the State Government's 2/3rd payment can be made, in one lump sum, to the RRCC, who then pays the property owner.



4.0 FLOOD RESPONSE MEASURES

4.1 Introduction

Effective flood warning procedures, evacuation plans and community education are essential means of reducing the risk to life and property in the existing developed flood prone areas. This chapter outlines the local warning and evacuation strategies used in Lismore, along with community awareness and education strategies.

4.2 Flood Warning

4.2.1 Warning Sources

Flood warnings are based on data and predictions provided predominantly by:

- Bureau of Meteorology (BoM), which provides flood advice, flood warnings, river height readings and forecasts for a number of gauge locations within the area. The BoM issues alerts for potential flooding based on forecast rainfall prior to any significant river rise. This alert may be half a day or more prior to peak flooding in Lismore to provide a rough estimate of the predicted peak;
- Richmond/Tweed SES Division Headquarters, whose role it to collect and disseminate information mainly within the SES.

The following Flood Advices and Warnings are issued prior to and during a flood:

Flood Watch

A Flood Watch is issued by the Bureau of Meteorology (BoM). The BoM advise that it is a 'heads up' and is not a Flood Warning. A Flood Watch means that people living or working along rivers and streams must monitor the latest weather forecasts and warnings and be ready to move to higher ground should flooding develop.

Flood Warnings

Flood Warnings often follow a Flood Watch and are issued by the BoM if the Minor Flood Level is expected to be exceeded at key sites along the rivers for which the BoM provides the flood warning service. The distribution of the warnings to the SES is detailed in the Local Flood Plan. In Lismore flood levels are predicted at the rowing club gauge (see Figure A in Appendix 2).

SES Stock and Plant Warnings

These are issued for low-lying areas on the Richmond River system by the SES Region Headquarters. The warning is distributed to the ABC Lismore Regional Office, Lismore radio stations and television stations.

Flood Warnings are supplemented by:

SES Flood Bulletins

SES Flood Bulletins contain the Flood Warnings and further supplementary information regarding floods in general. They are disseminated by Richmond/Tweed SES Division Headquarters to all SES Units in the Division and to media outlets according to the Local Flood Plan. These Bulletins are reviewed regularly to ensure their continued relevance and usefulness to the community.

SES Local Flood Advices aimed at the areas of Woodburn North and Broadwater West. Depending on flood predictions Evacuation Warnings may follow.

4.2.2 Lismore Urban Warning System

Once a flood warning has been issued, the SES mobilises and activates its emergency operations centre (see section 4.4.1 below). The public is alerted to the potential for flooding with some indication of the expected peak at the rowing club gauge. Potential flooding and the need for evacuation need not be related to river levels rising but can be a result of local flooding within the basin.

In a major flood expected to overtop the levee, at around 10.6 to 10.95m AHD on the rowing club gauge people are requested to move out of the flood affected zone. All evacuations must be completed before the levee overtops.

Radio messages will be preceded by the SEWS (Standard Emergency Warning System). Emergency Service vehicles will be deployed with sirens to ensure that people are aware of the need to evacuate. Fixed sirens have been installed in the CBD, North Lismore and South Lismore and will be activated once a major flood warning has been issued by the Bureau.

4.2.3 Flood Warning Times

Warning times are of major importance for the success of evacuations as they determine the available time for conducting an evacuation. The time available for evacuation is limited by the closure of evacuation routes.

As the river commences to rise the BoM continues to issue updates on predicted flood outcomes from forecast and actual rainfall modelling and river level gauge readings. By the time the river reaches 5m AHD the BoM will be able to provide a reasonable indication of whether the river will overtop its banks at approximately 9.4m AHD for North Lismore and approximately 10.7m AHD for South Lismore and the CBD. Evacuation routes are cut at these levels.

At the time these predictions are made (5m AHD river level), there will normally have been sufficient rise in river levels to indicate the rate of rise to assume for evacuation timing. Recorded floods (1974, 1989) and design floods up to the 1 in 100 ARI flood,

indicate an average rate of rise of around 0.5m per hour. Severe and extreme floods, rarer than the 1 in 100 ARI flood, can have average rates of rise exceeding 1.0m per hour and localised or short-term rates of 1.5m per hour. A PMF flood could produce rates of rise of up to 3.0 m per hour (SKM, 1995).

The SES decision to evacuate will include a measure of urgency based on the river level at the time the prediction of overtopping is received and the rate of rise of the river.

4.3 Evacuation Planning

4.3.1 Lismore Local Flood Plan

Evacuation warnings and procedures are described in the Lismore Local Flood Plan, a sub-plan of the Lismore Local Disaster Plan (DISPLAN). The objective of the Local Flood Plan is to establish, or identify an appropriate sequence and order of responsibilities for timely evacuation of floodprone residents, businesses and institutions in Lismore.

4.3.2 Need for Full Evacuation

Evacuation is essential if flood levels are predicted to overtop the levee. The evacuation announcement will be made by the SES Local Controller. The decision to evacuate is made on the basis of the potential flood hazards:

- depths of water over the ground in excess of 1 to 2 metres,
- fast flowing water with velocities in excess of 1 m/sec, and exceeding 3m/sec in places;
- the likelihood of properties being damaged by floating debris or by the hydraulic loads that would be experienced under severe to extreme flooding; and
- the likelihood of heavy floating debris, high winds, wave action and heavy rain at night making rescue operations dangerous.

Areas within the basin are exceptions to the above and will need to be evacuated earlier as a result of inundation due to heavy rain in the basin catchment, which is not influenced by river flooding.

4.3.3 Evacuation Zones and Routes

The floodprone areas of the city are divided into local zones that are based on the location of key evacuation routes to ensure traffic interference between districts is eliminated or minimised, ie. each zone has its own designated route. South Lismore, North Lismore and the CBD evacuation zones and routes are shown on the Map on the next page. Known as 'Last Roads Out', this map is also available on Council's website.

Evacuation warnings are issued by the Lismore City SES Local Controller using NSW SES warning protocols.

4.3.4 Evacuation Times

The time available to prepare for and carry out an evacuation will depend on rate of rise in the river, as shown below. These times assume the decision to evacuate is made when the river is at approximately 5mAHD:

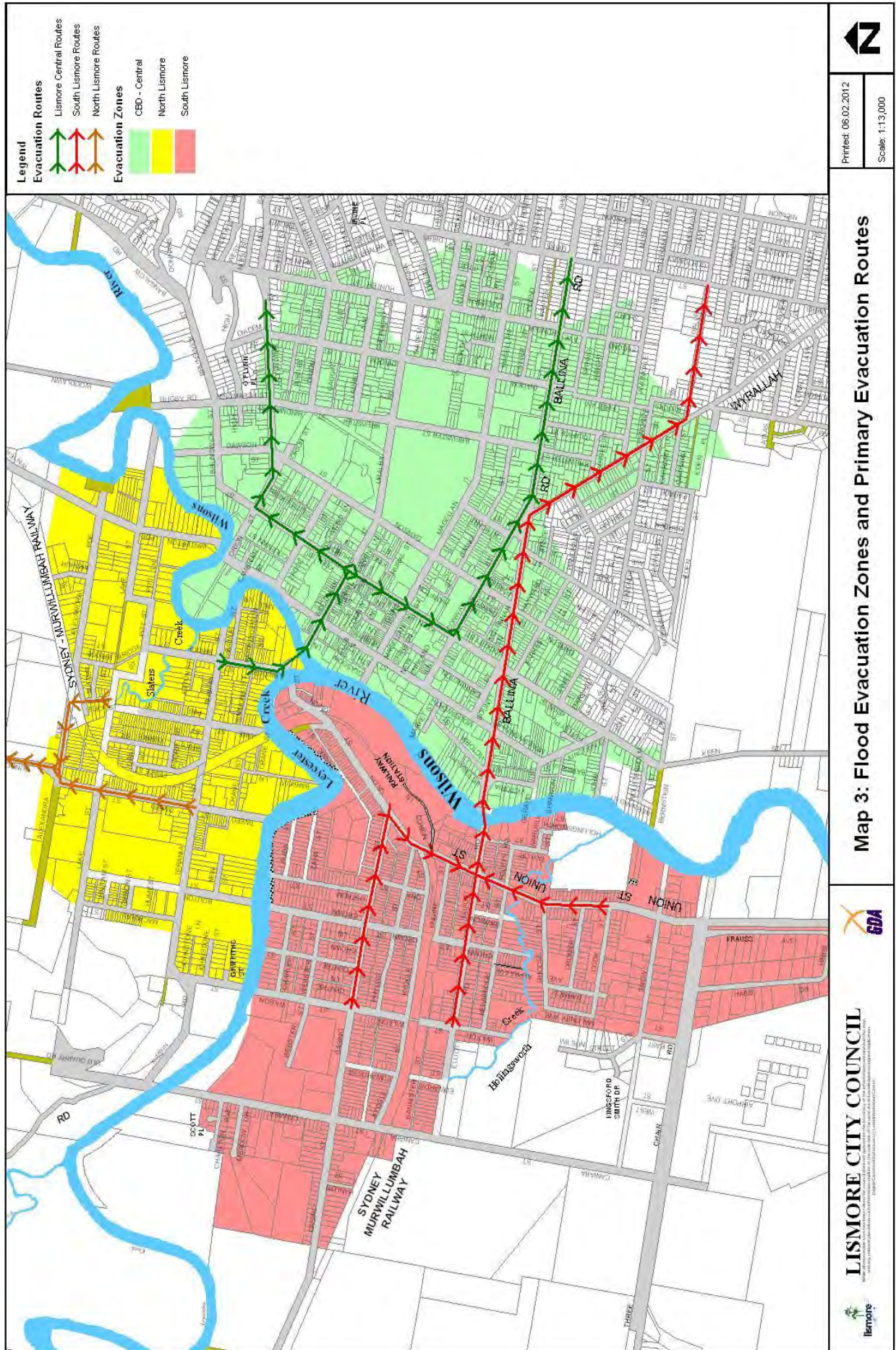
Rate of Rise In the River	Time Between Flood Warning & Overtopping of Evacuation Routes
0.5 m/hr	6.5 – 10.0 hrs
1.0 m/hr	3.0 – 5.0 hrs
1.5 m/hr	2.0 – 3.5 hrs
3.0 m/hr	1.5 hrs

These times are the maximum available times for evacuation planning, with the exact time available dependent upon the evacuation district.

The time taken to make the decision to evacuate is subtracted to indicate the time in which an evacuation must be carried out. It is clear that severe to extreme floods, where rates of rise of 1.5 m/hr could occur (*SKM, 1995*), offer no room for hesitation. This places a severe constraint on evacuation planning.

As the SES Local Controller is responsible for preparing Evacuation Warnings and controlling the evacuations the decision to initiate the evacuation is at their discretion.

The time available to evacuate residents along the prescribed evacuation route is defined by the low point along this route; Hollingworth Creek Bridge for example, is closed when the flood reaches 8.8mAHS. Once the road is flooded vehicles cannot get through and the detours that become necessary may put the evacuating population at further risk.



4.3.5 Evacuation Procedures

Having prepared and mobilised all residents, evacuation will proceed in accordance with the plan along scheduled routes to the nominated Evacuation Centre at Southern Cross University. Evacuation is organised by the SES. During evacuation, a free bus service circulates around South, North and Central Lismore to collect and take people to the Evacuation Centre, at which time the NSW Department of Community Services assumes control.

Emergency response personnel stationed along the evacuation routes manage return traffic and monitor local conditions for accidents, vehicle breakdowns, local flooding, fallen trees, downed power lines, etc so that disruptions can be quickly overcome or contingency plans put into operation if required.

The telephone communication networks may not be reliable as a result of power failure, damage to transmission towers, and exchange overload. In this case communications will be through the appropriate EMS network.

Council's mobile emergency response crews will continue to deliver evacuation warnings during the early stages of evacuation, then assist with maintaining traffic flows and emergencies and provide evacuation support.

4.4 Emergency Management

4.4.1 Emergency Operations Centre

The local DISPLAN outlines responsibilities and procedures for dealing with flood emergencies. During flood emergency the Lismore City SES unit operates from its permanent headquarters at 64 Brunswick Street. The Richmond-Tweed Division of the SES operates from its headquarters in Goonellabah, and co-ordinates the operations of the 13 SES units under its control.

Lismore City Council also has responsibility under its Local Disaster Plan for setting up an Emergency Call Centre (ECC) in situations of major crisis, including a major flood. The Council Chambers at 43 Oliver Avenue, Goonellabah are fitted out to operate as an Emergency Call Centre when required.

Priorities for evacuation based on time available to evacuate, vehicle and population numbers and route elevations are as follows:

1. North Lismore either to Dunoon Road or through the CBD
2. South Lismore along Ballina road
3. CBD with the last roads out being Keen Street and Conway Street to Wyrallah Road .

The limited time available, especially at high rates of rise does not allow for door knocking as a primary means of warning delivery. Warnings are broadcast by radio, confirming earlier alerts, and directly by emergency service vehicles with sirens and loud-hailers roving local streets in each zone. Community and neighbour support for residents requiring assistance is relied on to reduce the emergency response resourcing needs.

4.3.6 Traffic Control in the CBD

Controls on traffic moving in and out of the CBD are required during a flood emergency. As roads are progressively cut off, the free flow of traffic becomes important as residents evacuate and emergency services personnel begin assessing danger and responding to calls for assistance.

Traffic control in the CBD occurs in accordance with the Traffic Management Plan as determined by the NSW Police Force, which is responsible for managing traffic flows in and out of the CBD prior to, during and in a receding flood situation.

The ECC becomes activated when emergencies, including floods, become large enough to require a coordinated multi-organisation response. The decision to establish an ECC is made by the Local Emergency Operations Controller (LEOCON). The LEOCON is the Local Area Commander for the Richmond Local Area Police Command.

The ECC includes representatives from Lismore City Council, Police, Rural Fire Service, SES, NSW Fire Service, State Departments of Community and Health Services, Ambulance, Essential Energy, Telstra, and other agencies as required.

People with Special Needs

In a major flood people who do not move out of the flood area will have to potentially live without phones, power, water and emergency assistance for several days. Elderly people or others dependent on Meals on Wheels, those on dialysis machines or others who rely on regular medical care should not be left in these areas during a flood.

During an event NSW Health and the SES work together to ensure the special needs of such people are met, either through evacuation or ensuring medical assistance is delivered as needed.



4.4.2 Local Radio Broadcasts

During a flood event, all regional radio stations are supplied with information from SES Region HQ, police, schools, bus companies, local Councils, sporting bodies and the State and Federal Governments.

4.4.3 Road Information Website

To provide a better local service for Lismore and surrounding LGA residents and to help reduce the information overload experienced by radio stations during a flood, Lismore City Council, in conjunction with adjoining Councils, developed a website where specific information relevant to road closures can be accessed.

The website at www.myroadinfo.com.au includes an up-to-date list of road closures and road warnings within the broader Northern Rivers Region. The website is 'active', which means that it is updated regularly as new information comes to hand. The website is also available 24 hours a day.

4.4.4 Use of Security Cameras

Rising floodwaters and the need to evacuate commercial premises within the CBD can result in a greater security risk for those premises. Council has taken measures to ensure that the operation of the security cameras in the CBD will not be affected by flooding so that images are available to the police in the event of the need for law enforcement.

The cameras may also be a useful tool for assessing the level, and rate of rise, of flood water in the CBD. The images will therefore be made available to personnel at the Emergency Operations Centre and for future flood planning.

In consultation with the police and Lismore Chamber of Commerce, Council will pursue a role in providing information to CBD businesses about the precautions they should take to protect their property from theft and damage during a flood.

4.4.5 Provision of Sandbags

Lismore City Council will supply and fill sandbags on demand and at the request of the SES.

4.5 Community awareness and education

4.5.1 Flood Awareness

The Lismore community is accustomed to widespread and frequent flooding from Wilsons River and Leycester Creek. Since 1857, over 130 floods of varying size have occurred, many of which have caused significant damage and disturbance to the community.

Community awareness of the consequences of flooding, and preparedness to react effectively are important factors in the success of evacuation plans and the reduction of flood damages. Raising flood awareness and evacuation preparedness in the community is particularly important for new residents, particularly if these residents feel generally protected by the levees.

Lismore has a flood event, on average, once every 4 years. This helps to naturally maintain the community's flood awareness and keep memories of previous floods 'fresh'. People who have experienced flooding are more likely to heed flood and evacuation warnings and be familiar with previous peak flood levels, and critical flood depths. Those who have not experienced such flooding may underestimate the seriousness of these warnings, and consequently place themselves in danger.

The benefits of improving the flood awareness and preparedness of the Lismore community include:

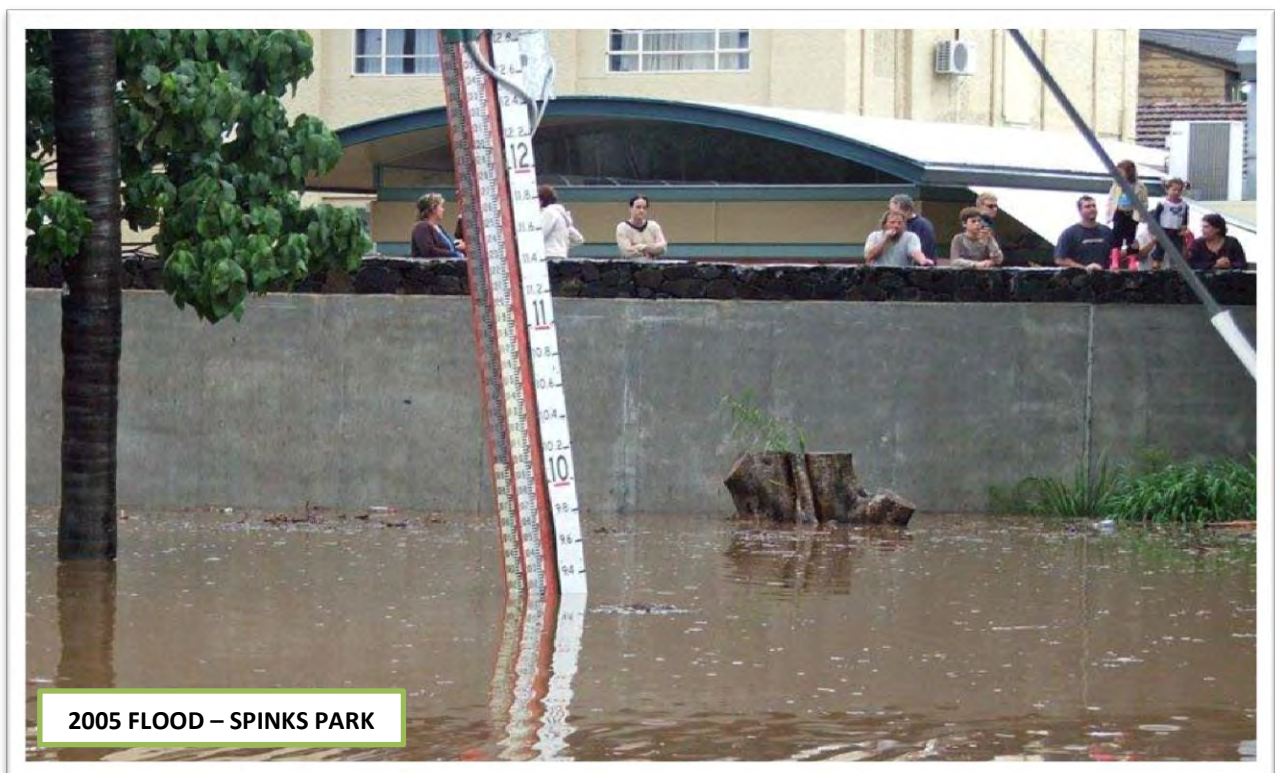
- greater chance of evacuations being successful,
- higher probability of protecting all flood affected residents,
- reduced flood damages (as belongings can be secured or relocated),
- a more informed community that is likely to suffer less anxiety in a flood;
- efficient use of safety and rescue resources, and
- reduced risk to rescue personnel.

Impact of Lismore Levees on Flood Awareness

The major impact of the Central and South Lismore Levees is that it gives residents and others more time to pack and leave, even if the levee is overtopped. This does not mean people should become more relaxed as prompt action according to an agreed plan is still essential.

It is likely that the levees will engender a sense of security for all residents within them, as the levees reduce the frequency of flooding in those areas. The levee scheme will decrease the average incidence of floods in these areas from once every 4 years to once every 10 years. This will tend to reduce the level of community preparedness for flooding.

Hence there is a real need to continue to educate the public about the limitations of the Lismore Levee and to inform new residents of the flood hazards associated with living in Lismore.



4.5.2 Education and Awareness Strategies

4.5.2.1 SES Community Engagement and Awareness

The Richmond Tweed Division of the SES appointed a Community Engagement Coordinator whose role includes:

1. Providing support to local volunteer rescue units in conducting community education.
2. Strengthening and building links between the SES and communities through a partnership approach to deal with storms, floods and tsunami.
3. Working with communities to improve community resilience through knowledge and attitudes about what individuals and groups can do to prepare for storms, floods and tsunami.

4.5.2.2 Lismore City Council Education and Awareness Strategies

Lismore City Council flood awareness and education initiatives include:

Household Flood Information

Each household within the main flood prone areas of Lismore receives a Lismore FloodSafe brochure that provides advice about the flood hazards in their locality. The bulletins are currently distributed within the area affected by the 1974 flood.

The Lismore FloodSafe brochure is an important avenue for Council to advise the most affected flood communities about flood hazards. The possibility of incorporating this brochure as a standard attachment to 'section 149 Certificates' when a property is purchased, is under consideration. The brochure contains information specific to each property, relevant levels (ground and floor levels and 100yr flood level), evacuation routes and destinations (evacuation centres, car storage areas), SES and Council telephone numbers, information about local radio stations, advice on what to include in emergency kits, and SES warning and evacuation procedures.

An extract from the Lismore FloodSafe brochure is included at the end of this Section.

Flood Markers

Markers showing the level of the 1974 flood on power poles throughout the city assist in familiarising people with significant flood levels. These markers provide an indicator of the water levels that can be reached during a major flood. The maintenance of these markers is undertaken by the Richmond River County Council.

Flood Intelligence and Warnings

Council conducts mail-outs of letters and information to promote information on flood awareness. Council also maintains a SMS alert service and maintains road closure information through the website www.myroadinfo.com.au.

In addition Council maintains a 'flood reporters' network' to provide a visual reporting system on water levels in creeks in areas outside the Lismore urban area. Due to periodic turnover of participants, Council endeavours to find new volunteers as this occurs.

FloodSafe Reference Group

The FloodSafe Reference Group was formed as a result of an identified need for additional and continuing education for the community on the effects of flooding in Lismore and the changes in patterns since the completion of the flood levee system in 2005.

Membership of the Reference Group comprised community and business representatives, and representatives from Council, SES, Richmond River County Council and the Office of Environment and Heritage. The purpose of the group was to identify, review and implement education strategies for the broader community.

As the membership of the Floodsafe Reference Group generally mirrors that of the Floodplain Management Committee, the Reference Group was disbanded in 2012 and the terms of reference for that group incorporated into the terms of reference for the Floodplain Management Committee.

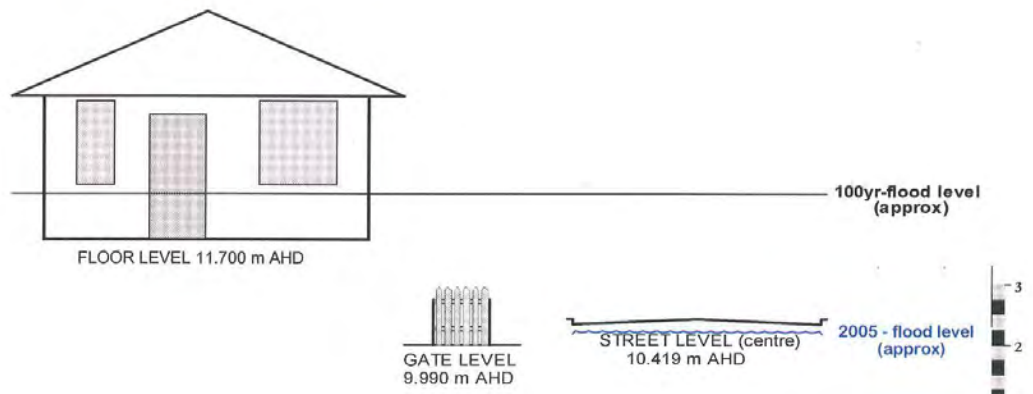
Flood Awareness Week

Council will continue to enhance its existing public education programme by considering the allocation of funding to 'Flood Awareness Week', the timing of which will be decided by the Floodplain Management Committee. Features of Flood Awareness Week may include:

- A public information stand in the Lismore CBD.
- A review and upgrade of written flood information for householders to ensure its continued relevance.
- Updating of Council's flood information website to include relevant information, such as evacuation plans for the city and the ability for ratepayers to ask questions and receive help.
- Site visits by Council staff for ratepayers who want flood information explained to them in their own homes.
- A telephone hotline to operate over the week, through which ratepayers can ask questions or make comments.
- Promotion of emergency networks, including a recruitment drive for a 'local reporters network' on local rivers, the network to be co-ordinated by the SES.
- Promotion of emergency services such as a voluntary register of residents with special needs. This would be of particular interest to the elderly, residents who live alone, or people with disabilities.
- Promotion of emergency procedures for evacuation and protection of property in the CBD.



THE PLAN BELOW PROVIDES FLOOD HEIGHT INFORMATION SPECIFICALLY FOR YOUR PROPERTY. PLEASE KEEP THIS FOR FUTURE REFERENCE



CAUTION
 This Plan should be read in conjunction with the attached Flood Information Sheet. The levels and flood heights shown on this Plan are in Australian Height Datum. These cannot be directly compared with flood gauge levels due to the surface slope of the flood waters and different measuring techniques used. It should be noted that other parts of your site may be lower than the front gate.



Last roads out to high ground

CBD Lismore
North - Keen Street then Leycester or High Street
East - Conway Street then Wyrallah Road

South Lismore
Casino Street - Ballina Street Bridge then Ballina Street and Wyrallah Road

North Lismore
Bridge Street or CBD then north through Keen Street and Leycester Streets. Residents furthest away from the river may have access to Dunoon Road through the showground.



5.0 FLOOD MODIFICATION MEASURES

5.1 Introduction

Flood modification measures include levees and bypass channels and are part of the mix of floodplain risk management policy options. The flood modification measures recommended by this Plan are also the nominated preferred excavation areas (Section 3). These are the areas where, following excavation, the greatest benefit to floodplain risk management can be obtained.

5.2 Airport Floodway Bypass

Excavation is yet to occur in the Airport Floodway Bypass. The development application to excavate the area known as the 'Airport Floodway Bypass' was approved by Council following the adoption of the Floodplain Management Plan 2002. DA06/672 approved the excavation of 410,000m³ of earth on 58 hectares of land at an average extraction rate of 49,000m³ per annum. It is anticipated this will take more than eight (8) years to implement.

5.3 Wilsons River Channel Improvement

Map 5 shows the location of a proposed flood modification measure in the Wilsons River channel. It is located on a meander bend in the Wilsons River south-east of the Essential Energy sub-station in Three Chain Road, South Lismore.

The original meander was characterised by a terrace at an RL of 9 to 10m AHD with a central depression and drainage to the south. Fill for adjacent development was excavated from the terrace leaving a levee embankment around the upstream edge of the meander. The southern portion of the terrace remains in its original state.

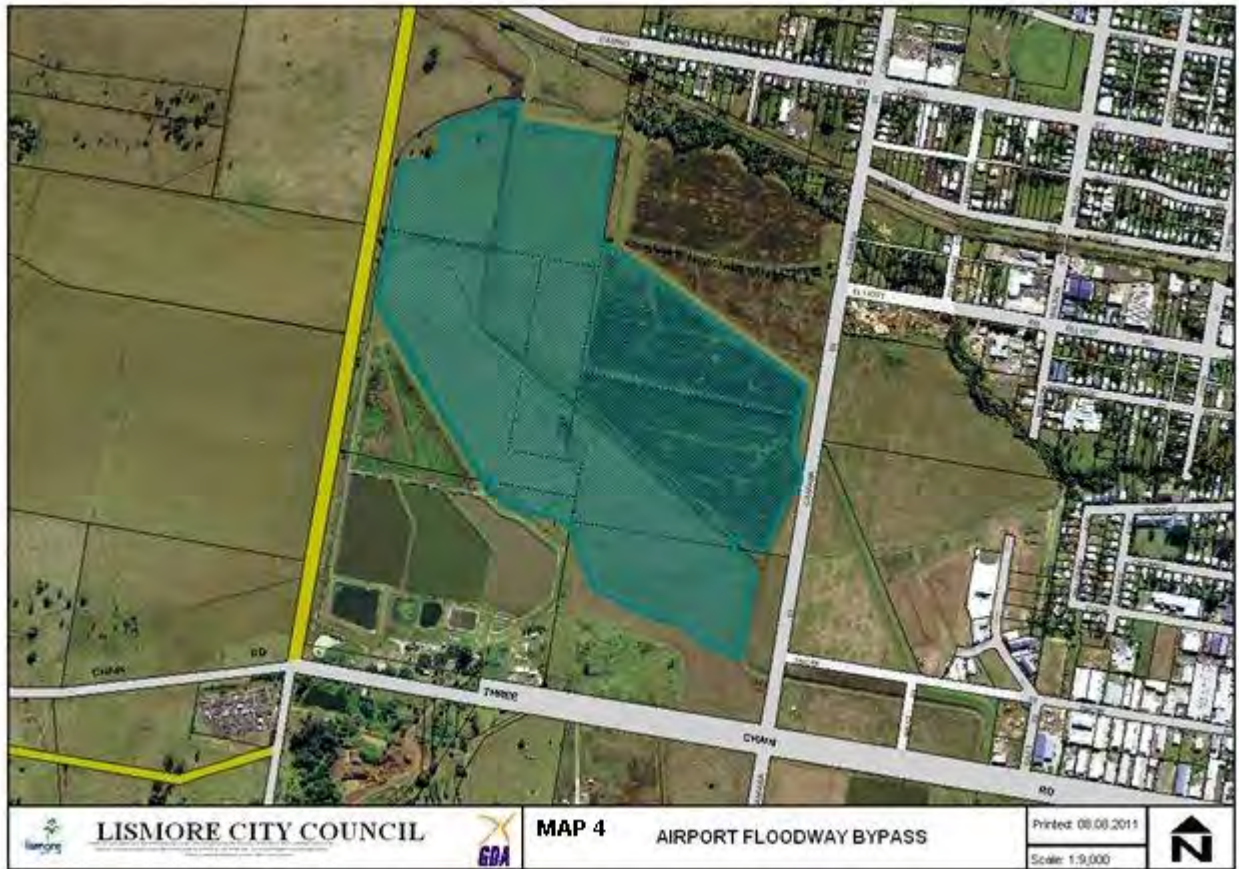
The Floodplain Management Committee considered a proposal to remove the remnant levee embankment and lowering the terrace to approximately RL 5m AHD to improve the conveyance of flood flows. The estimated amount of earth to be removed is 172,390m³. Hydraulic modelling shows that excavation in this location has a significant reduction in peak flood levels throughout Lismore across the range of design floods investigated (1 in 10 to 1 in 100 year ARI floods).

In light of these impacts, Council commissioned a benefit/cost analysis, undertaken by Worley Parsons. This analysis demonstrated that lowering the riverbank would deliver a greater benefit to the community in the reduction in flood damages than the cost of construction and maintenance of the lowered riverbank, even at the extreme of the discount rate sensitivity, where the cost/benefit ratio is 1.94.

The other benefits of this proposal, known as the Wilsons River Channel Improvement, relate to the protection provided by the Central Lismore levee. Lowering peak flood levels along the length of the levee effectively increases statistical level of protection provided in regard to frequency of overtopping by 1-2 years.

Since the cost/benefit analysis work was completed, in connection with proposed development of land adjacent to the riverbank that requires fill, a development application to undertake excavation of the riverbank was approved by the Richmond River County Council (17 July 2013). This gives approval, subject to conditions, to remove up to 80,000m³ of the riverbank, which is anticipated to occur over the next 12 months.

Further excavation over time is anticipated to provide increased flood mitigation benefits and for this reason the Wilsons River Channel Improvement project is included as a flood modification measure.



6.0 IMPLEMENTATION

6.1 Introduction

This Plan comprises a mix of floodplain risk management measures that aim to reduce the impact of flooding on the Lismore floodplain and to reduce the risk to future development in Lismore. The mix consists of property modification, response modification and flood modification measures.

This Section brings these measures together and, in section 6.7, provides an Action Plan for implementation.

6.2 Planning and Development Control

Section 2 describes the revised flood risk categorisation. Controls for future development on the floodplain are outlined in Section 3 of this plan and detailed in Appendix 4. Amendments to Chapter 8 of the Lismore Development Control Plan will occur to reflect the most recent flood risk categorisation.

These controls will ensure that all new development will only occur after adequately addressing flood risk and ensuring new development will not adversely affect flood behaviour or increase flooding impacts on adjoining land.

It is recommended that Council consider extending flood risk categorisation to the areas outside of this Plan. This will provide better information for Council and development proponents and provide the community with a greater degree of confidence about the information on which Council bases its planning and land use decisions.

6.3 Property Modification

Dwellings located in the most hazardous areas of the floodplain may be eligible for the Voluntary House Purchase Scheme (VHPS) or the Voluntary House Raising Scheme (VHRS). The VHPS will continue to be promoted to ensure that the number of at risk dwellings is reduced at a rate that is commensurate with available funding and Council will consider the allocation of funding to the program.

The VHRS will be extended to dwellings with floor levels below the 1 in 20 year recurrence flood level, with a tolerance of up to 200mm considered. This program is funded by the Office of Environment and Heritage.

Section 3.4 of this Plan outlines the criteria used to determine priorities for the voluntary house purchase and voluntary house raising schemes.

6.4 Response Modification

Sections 4.2-4.4 of this Plan detail the flood warning, evacuation and emergency management procedures that are put in place in the event of a flood. Section 4.5 identifies the need to maintain a program of ongoing community education and information. This program will be conducted both by the mail out of site specific information to residents and the updating of information on Lismore City Council's website.

In addition to the site specific residential information Lismore City Council will continue to support "Flood Awareness Week", in consultation with the SES, where possible. Council considers the allocation of funding to this programme as part of its annual budget process.

The continual updating of information by the abovementioned programmes should ensure that residents have current flood knowledge and be cognisant of changing flood characteristics into the future.

6.5 Flood Modification

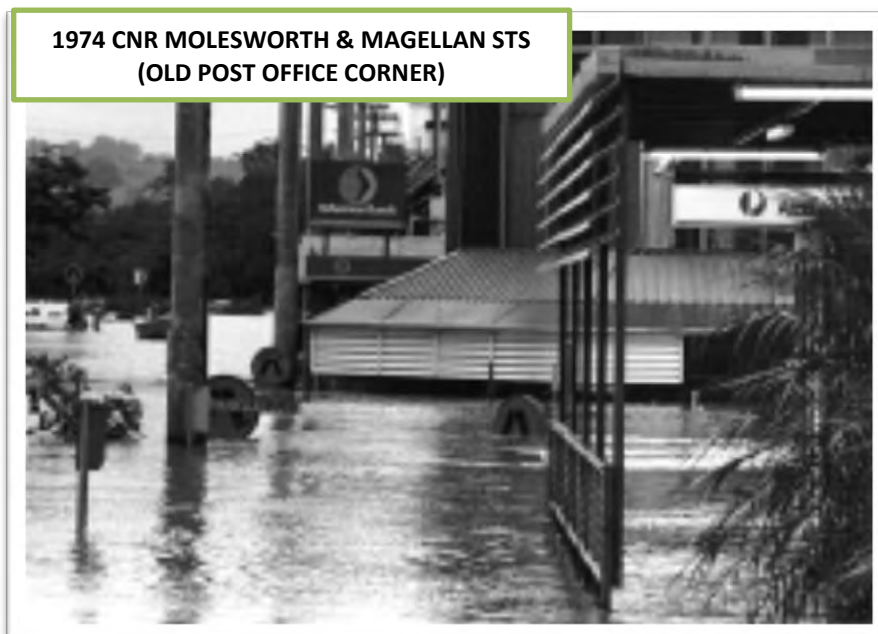
The new flood modification measure proposed by this plan is the Wilsons River Channel Improvement. The area is shown on Map 4 and hydraulic modelling shows that excavation in this location will result in a significant reduction in peak flood levels throughout Lismore across the range of design floods investigated (1 in 10 to 1 in 100 year ARI). Section 5 contains more details on this proposal.

A development application to undertake excavation of the riverbank was approved by the County Richmond River County Council at its meeting on 17 July 2013.

6.6 Climate Change Scenario

Section 2.7 of this Plan outlines the preliminary work undertaken by Worley Parson into the impacts of climate change on flooding in Lismore. As note in section 2.7, the assessment of climate change is preliminary only. A thorough assessment would involve assessing the sensitivity of the hydrologic modelling to an increase in rainfall of 10%, with a subsequent assessment on the hydraulic modelling and associated flood impacts (such as flood damages, properties affected and flood hazard categorisation).

This plan recommends that funding is sought to allow a more thorough assessment to be undertaken of the impacts.



6.7 Action Plan ~ Implementation of Lismore Floodplain Risk Management Plan 2013

The Action Plan below details the actions necessary to implement the Floodplain Risk Management Plan 2014, the agencies responsible for the actions, resources required and the indicative timing for achieving the action.

No.	Action	Responsibility	Resources	Timing
	Adopt Lismore Flood Risk Management Plan 2014. <i>Notes: LCC endorsed Draft LFRMP at October 2013 Council meeting for public exhibition purposes for at least 1 month period.</i>	Lismore City Council (LCC) <i>Note: FMC to review submissions & endorse changes</i>	1 Council staff at 0.2 EFT over 5 months with existing funding to produce final Plan	<ul style="list-style-type: none"> • Council workshop August 2013 • Public exhibition Nov-Dec 2013 • FMC review March 2014 • Councillor workshop April 2014 • Council adoption May 2014
6.2	Amend Lismore Development Control Plan to: (i) Adopt Flood Risk Precinct Map; and (ii) Amend controls as included in Appendix 4.	LCC	1 Council staff at 0.2 EFT over 4 months	Commence in August 2014
6.2	Consider extension of flood risk categorisation beyond the area of the LFRMP	LCC, Richmond River County Council (RRCC) & Office of Environment & Heritage (OEH) <i>Note: FMC to advise</i>	Existing LCC staff	Commence in March 2015
6.3	Voluntary House Purchase Scheme	OEH, RRCC & LCC	LCC funding strategy required	Funding Strategy prepared by December 2014 Ongoing subject to LCC budget allocation
6.3	Voluntary House Raising Scheme	OEH & RRCC	No Council resources but subject to OEH budget allocation	Funded by OEH & administered by RRCC

6.4	Response Modification including community awareness, emergency management etc.	SES and LCC	Ongoing	Subject to LCC budget allocation
6.5	Flood Modification Measures <ul style="list-style-type: none"> • Airport Floodway Bypass • Wilsons River Channel Improvement 	<ul style="list-style-type: none"> • LCC. DA approved • LCC & RRCC. DA Approved 	<ul style="list-style-type: none"> • Existing LCC staff • Existing LCC & RRCC staff 	<ul style="list-style-type: none"> • Subject to demand for fill • DA approved 17 July 2013 • Excavation commenced 2014
6.6	Update Climate Change Scenario	LCC, RRCC and OEH	Council staff subject to budget allocation	2014/2105 subject to OEH & LCC work priorities & budget