



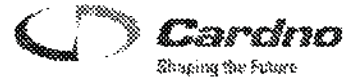
Porters Creek Floodplain Risk Management Plan Exhibition Report

Job Number: W4822

Prepared for Wyong Shire Council

September 2011

Porters Creek Floodplain Risk Management Plan – Exhibition Report
 Prepared for Wyong Shire Council



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Foreword

The NSW Government's Flood Policy is directed towards providing solutions to existing flood problems in developed areas and ensuring that new development is compatible with the flood hazard and does not create additional flooding problems in other areas or for future generations.

Under the Policy, the management of flood prone land is the responsibility of Local Government. The State Government subsidises floodplain management measures to alleviate existing flooding problems and provides specialist technical advice to assist Councils in their floodplain management responsibilities. The Commonwealth Government also assists with the subsidy of floodplain management measures.

The Policy identifies the following floodplain management 'process' for the identification and management of flood risks:

- | | |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Formation of a Committee | Established by a Local Government Body (Local Council) and includes community group representatives and State agency specialists. |
| 2. Data Collection | The collection of data such as historical flood levels, rainfall records, land use, soil types etc. |
| 3. Flood Study | Determines the nature and extent of the floodplain. |
| 4. Floodplain Risk Management Study | Examines range of flood hazards and evaluates management options for the floodplain in respect of both existing and future development. |
| 5. Floodplain Risk Management Plan | Involves formal adoption by Council of a management plan for the floodplain. |
| 6. Implementation of the Plan | Involves implementation of those measures recommended in the Plan, adopted by Council, which may include flood, property and emergency response modification measure. |

This report is the fifth stage of the above process being the Floodplain Risk Management Plan (FRMP). The FRMP has been prepared for Wyong Shire Council and the Office of Environment & Heritage (OEH) by Cardno.

The Floodplain Management Committee, which consists of representatives from Wyong Shire Council, OEH and the SES, has provided oversight and review of the project throughout its duration.

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Executive Summary

Wyong Shire Council commissioned Cardno to prepare a Floodplain Risk Management Study and Plan for Porters Creek Catchment in November 2009. As part of this engagement it was requested that the 2009 Flood Study be updated to reflect current catchment conditions. This study, in the form of a Flood Study Addendum, was completed in July 2010. Results from the Addendum have been adopted for the purposes of undertaking the Floodplain Risk Management Study. The Floodplain Risk Management Study investigates what can be done to reduce or manage the effects of flooding in the catchment. The Floodplain Risk Management Plan recommends a mix of strategies to manage the risks of flooding, based on the outcomes from the Floodplain Risk Management Study.

The flood behaviour of Porters Creek is typical of floodplains of the Tuggerah Lakes region. Broad shallow floodways dominate the lower to mid areas of the catchment, whilst more defined overland flowpaths/waterways exist in the upper reaches. Wetlands cover the lower areas of the catchment that are a floodplain of both Wyong River and Porters Creek. The wetlands temporarily store floodwaters from the catchment before flowing into Wyong River. Mechanisms for flooding are therefore by mainstream flooding in the lower to mid parts of the catchment and by overland flow in the upper catchment.

The catchment is undergoing urban development predominantly in the eastern part of the catchment, upstream of the Northern Railway. Further land release is planned in east and north parts of the catchment. It is necessary to put robust planning policies in place to ensure that flood risk is managed as the urban development progresses. Thus the Porters Creek Flood Study has been updated to incorporate the recently completed and planned development. In addition an allowance for climate change has also been included into the estimation of the 100 year ARI flood extents.

Existing development has, for the most part, been undertaken under Council's flood planning policies. As such there are a small number of properties that are prone to flood in residential and commercial areas. Rural properties that exist on the floodplain are more prone to flood. An economic damage assessment was undertaken for properties experiencing flooding in the catchment. A summary of the findings from the assessment is included in the table below.

Flood	Properties with Over-floor flooding	Flood Damage
5 Year ARI	17	\$2,363,385
10 Year ARI	17	\$2,467,744
20 Year ARI	18	\$2,654,260
50 Year ARI	19	\$2,963,465
100 Year ARI	26	\$3,763,148
200 Year ARI	29	\$4,000,155
PMF	129	\$25,181,731
Average Annual Damage		\$934,376

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A review of Council's flood planning policies was undertaken in the Floodplain Risk Management Study and recommendations for modifications were provided for policy update. Existing flood planning levels are also under review in order to select appropriate flood levels in the catchment that incorporate an allowance for the predicted impact of climate change. The flood planning level is recommended to be the designated flood level plus 500mm freeboard. The designated flood is the 100 year ARI plus 15% rainfall intensity increase. This takes into account the projected impacts of climate change according to the latest available guidelines for the NSW Central Coast. The flood planning controls are applied to building and development in the catchment through a flood planning matrix to be included in Council's Floodprone Land Development Control Plan (DCP chapter 113).

Using the merits-based approach advocated in the NSW State Government's Floodplain Development Manual (2005) a number of potential options for the management of flooding were identified in the Floodplain Risk Management Study. The following options were recommended for inclusion in the Plan.

1. Option P1 – Planning Controls
2. Option P2 – Development Controls
3. Option 1.10 - Natural Channel Maintenance
4. Option EM1 - Information Transfer to SES
5. Option EM2 – Revise the Wyong Local Flood Plan
6. Option EM3 – Wyong Community Christian School Emergency Management Plan Update
7. Option EM4 – Community Flood Awareness
8. Option EM5 – Signage at road crossings
9. Option DC1 – Data Collection Strategy
10. Option 1.5 – Raise Road Levels of Hue Hue Road at Buttonderry Creek Crossing
11. Option 1.8 - Warnervale Road Upgrade at Ebony Drive
12. Option 1.9 - Bingarah Channel Crossing at Minnesota Road
13. Option P7 – Flood Proofing Controls
14. Option P3 – House Raising for non-slab on ground houses up to the 5 year ARI
15. Option 2.1 – Lucca Road Levee Extension

Further details of the Plan are included in **Section 2**. Those options selected for inclusion in the Plan are based upon both their likely benefit and the funding available from Council, SES and the State Government. Based on the options recommended above, the cost of implementing the Plan would be an estimated capital cost of approximately \$11M and an annual recurrent cost of approximately \$620,000.

This document is a draft for exhibition to the community. The final Porters Creek Flood Risk Management Plan will be prepared based on the outcomes and comments of the public exhibition period and review by stakeholders. The final stages are the adoption and implementation of the recommendations of the Floodplain Risk Management Plan by Council.

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Glossary

Annual Exceedence Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. E.g. if a peak flood discharge of 500 m ³ /s has an AEP of 5%, it means that there is a 5% chance (that is one-in-20 chance) of a 500 m ³ /s or larger events occurring in any one year (see ARI).
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
Cadastre, cadastral base	Information in map or digital form showing the extent land parcels, streets, water courses etc.
Catchment	The area draining to a site. It always relates to a particular location and may include the catchments of tributary streams as well as the main stream.
Creek Rehabilitation	Rehabilitating the natural 'biophysical' (i.e. geomorphic and ecological) functions of the creek.
Design flood	A significant event to be considered in the design process; various works within the floodplain may have different design events. E.g. some roads may be designed to be overtopped in the 1 in 1 year or 100%AEP flood event.
Development	The erection of a building or the carrying out of work; or the use of land or of a building or work; or the subdivision of land.
Flash flooding	Flooding which is sudden and often unexpected because it is caused by sudden local heavy rainfall or rainfall in another area. Often defined as flooding which occurs within 6 hours of the rain which causes it.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or overland runoff before entering a watercourse and/or coastal inundation resulting from super elevated sea levels and/or waves overtopping coastline defences.
Flood fringe	The remaining area of flood-prone land after floodway and flood storage areas have been defined.
Flood hazard	Potential risk to life and limb caused by flooding.
Flood-prone land	Land susceptible to inundation by the probable maximum flood (PMF) event, i.e. the maximum extent of flood liable land. Floodplain Risk Management Plans encompass all flood-prone land, rather than being restricted to land subject to designated flood events.
Floodplain	Area of land which is subject to inundation by floods up to the probable maximum flood event, i.e. flood prone land.
Floodplain management	The full range of techniques available to floodplain managers.

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measures

Floodplain management options	The measures which might be feasible for the management of flooding of a particular area.
Flood planning area	The area of land below the flood planning level and thus subject to flood related development controls.
Flood planning levels	Are the combinations of flood levels (derived from significant historical flood events or floods of specific AEPs) and freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans. Selection should be based on an understanding of the full range of flood behaviour and the associated flood risk. It should also take into account the social, economic and ecological consequences associated with floods of different severities.
Flood storages	Those parts of the floodplain that is important for the temporary storage of floodwaters during the passage of a flood.
Floodway areas	Those areas of the floodplain where a significant discharge of water occurs during floods. They are often, but not always, aligned with naturally defined channels. Floodways are areas which, even if only partially blocked, would cause a significant redistribution of flood flow, or significant increase in flood levels. Floodways are often, but not necessarily, areas of deeper flow or areas where higher velocities occur. As for flood storage areas, the extent and behaviour of floodways may change with flood severity. Areas that are benign for small floods may cater for much greater and more hazardous flows during larger floods. Hence, it is necessary to investigate a range of flood sizes before adopting a design flood event to define floodway areas.
Geographical Information Systems (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.
High hazard	Flood conditions that pose a possible danger to personal safety; evacuation by trucks would be difficult; able-bodied adults would have difficulty wading to safety; potential for significant structural damage to buildings.
Hydraulics	The term given to the study of water flow in a river, channel or pipe, in particular, the evaluation of flow parameters such as stage and velocity.
Hydrology	The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
Low hazard	Flood conditions such that should it be necessary, people and their possessions could be evacuated by trucks; able-bodied adults would have little difficulty wading to safety.
Mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of the principal watercourses in a

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	catchment. Mainstream flooding generally excludes watercourses constructed with pipes or artificial channels considered as stormwater channels.
Management plan	A document including, as appropriate, both written and diagrammatic information describing how a particular area of land is to be used and managed to achieve defined objectives. It may also include description and discussion of various issues, special features and values of the area, the specific management measures which are to apply and the means and timing by which the plan will be implemented.
Mathematical/computer models	The mathematical representation of the physical processes involved in runoff and stream flow. These models are often run on computers due to the complexity of the mathematical relationships. In this report, the models referred to are mainly involved with rainfall, runoff, pipe and overland stream flow.
Overland Flow	The term overland flow is used interchangeably in this report with "flooding".
Peak discharge	The maximum discharge occurring during a flood event.
Probable maximum flood	the PMF is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain.
Probability	A statistical measure of the expected frequency or occurrence of flooding. For a fuller explanation see Annual Exceedence Probability.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. For this study, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
Runoff	The amount of rainfall that actually ends up as stream or pipe flow, also known as rainfall excess.
Stormwater flooding	Inundation by local runoff. Stormwater flooding can be caused by local runoff exceeding the capacity of an urban stormwater drainage system or by the backwater effects of mainstream flooding causing the urban stormwater drainage system to overflow.
Topography	A surface which defines the ground level of a chosen area.

* Terminology in this Glossary have been derived or adapted from the NSW Government *Floodplain Development Manual*, 2005, where available.

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Abbreviations

AAD.	Average Annual Damages
AEP	Annual Exceedence Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
DCP	Development Control Plan
FPL	Flood Planning Level
FRMC	Floodplain Risk Management Committee
FRMP	Floodplain Risk Management Plan
FRMS	Floodplain Risk Management Study
GIS	Geographic Information System
IWCM	Integrated Water Cycle Management
LEP	Local Environment Plan
LGA	Local Government Area
MCA	Multi Criteria Assessment
OEH	Office of Environment & Heritage
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
SES	State Emergency Service

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1 Introduction

Cardno was commissioned by Wyong Shire Council to undertake a floodplain risk management study of the Porters Creek catchment in December 2009. As part of this project, Cardno undertook a review and update the Flood Study that was completed in July 2010. An addendum report, which details the updates, was completed in July 2010 and should be read in conjunction with the original Flood Study report (Cardno, 2009).

Cardno subsequently prepared a Floodplain Risk Management Study to identify the potential flood risks in the catchment and recommends options for the mitigation of those risks.

This report includes the Floodplain Risk Management Plan and draws on the findings of the Flood Risk Management Study and identifies a plan of implementation to reduce the flood risk in the catchment.

A map of the study area can be found in **Figure 1**.

1.1 Plan Context

This FPRMP represents stage 5 of the multiple stages of the Floodplain Management process which includes:

- 1. Formation of a Floodplain Management Committee
- 2. Data Collection
- 3. Flood Study
- 4. Floodplain Risk Management Study
- 5. Floodplain Risk Management Plan
- 6. Implementation of Floodplain Risk Management Plan

This report will be put on exhibition to the public for comment prior to release of the final version.

1.2 Plan Objectives

The Flood Plain Risk Management Plan details how flood prone land within the study area is to be managed by the implementation of flood risk management actions.

The objectives of the *Flood Risk Management Plan* are to identify actions for implementation to:

- Reduce the flood hazard and risk to people and property in the existing community and to ensure future development is controlled in a manner consistent with the acceptable level of flood hazard and risk;
- Reduce private and public losses due to flooding and where possible enhance the creek and floodplain environment;
- Be consistent with the objectives of relevant state policies;
- Ensure that the floodplain management plan is fully integrated with Council's existing corporate, business and strategic plans, meets Council's obligations under relevant Acts and has the support of the local community;

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- ✦ Ensure actions arising out of the management plan are sustainable in social, environmental, ecological and economic terms;
- ✦ Ensure that the floodplain management plan is fully integrated with the flood response procedure and is flexible to accommodate provisions from other relevant catchment management plans;
- ✦ Establish a program for implementation and a mechanism for the funding of the plan and should include priorities, staging, funding, responsibilities, constraints and monitoring.

1.3 Plan Methodology

The report format follows the following methodology:

- ✦ Assessment of floodplain risk management options identified in the FRMS by the Floodplain Management Committee
- ✦ Presentation of the floodplain risk management options to the community
- ✦ Community ranking of the recommended floodplain risk management options
- ✦ Update of the Multi-criteria assessment of options
- ✦ Formulation of the Floodplain Risk Management Plan with the highest ranking options
- ✦ Preparation of an implementation plan for the options proposed

1.4 Stakeholders

During implementation of this Plan and through detailed design and construction of some of the options liaison should be undertaken with key Stakeholders. The key stakeholders include, but are not limited to, the following:

- ✦ SES – Particularly in regard to emergency management options
- ✦ OEH – It is likely that a number of the options would be sourced from OEH, naturally it is important that they are consulted as part of the design process
- ✦ Private Residents – in particular, those residents to be affected by the proposed works
- ✦ Critical Facilities – Schools, aged care centres and health services to be affected by the proposed works

The study was jointly funded by Council and the OEH. OEH also assists in the provision of specialist advice on flooding and related matters and has been directly involved in completion of this study.

The Floodplain Management Committee, which consists of representatives from Council, SES and OEH has provided oversight and review of the project throughout its duration.

2 Floodplain Risk Management Plan

2.1 Floodplain risk management issues

Some of the key challenges identified through the Flood Study and the Floodplain Risk Management Study are summarised below:

- ✦ Urban development is ongoing and is being managed by both State and Local Governments. As such it is important that consistent, up to date flood planning controls are applied to current and future development. Communication between the Department of Planning and Infrastructure and Council is essential to ensure that stakeholders are aware of the most up to date flood policies and development controls.
- ✦ Local flooding issues have been raised by the community in several new land release areas. Nuisance flooding is occurring where constructed wetlands, open channels and inter-allotment drainage is not being maintained. Weed invasion, litter and debris are reducing the hydraulic capacity of these systems and they are causing flooding upstream.
- ✦ Lack of maintenance in natural channels has been identified by Council and the community as of concern for flood risk. Sediment and nutrient loads from urban sub-catchments is exported to floodways of the eastern catchment. The floodways are densely vegetated and low in flow energy. Capture of sediment and nutrients is then prolific at stormwater outlets and culverts. The accumulation of sediment is supporting weed proliferation and a reduction in waterway area is the result. Waterways such as Kanwal Channel, Woongarra Creek and Bingarra Channel have been identified as requiring regular maintenance through sediment and weed removal.
- ✦ Several road crossings in the catchment are prone to flood. Some crossings are up to hundreds of meters long and regularly overtop during storms. Inconvenience to motorists is a common occurrence for local roads that are used frequently such as Warnervale Road and Minnesota Road. If motorists attempt to drive through the crossings during flood then the risks to life and vehicles are high. Upgrade to the road crossings is proposed in The Plan for Warnervale Road, Minnesota Roach and Hue Hue Road.
- ✦ A number of critical facilities are located either on the floodplain or on the flood fringe. Schools, aged care facilities and Wyong Hospital are subject to flood risk. An assessment on the level of risk to these facilities has been discussed in the FRMS. It was found that safe access to Wyong Hospital was available for all design storm events up to and including the PMF when applying the provisions of the NSW Floodplain Development Manual.
- ✦ Wyong Community Christian School is located on Alison Road Wyong and recommendations have been made to update its emergency management plan to direct students and teachers to the new school hall having a floor level above the PMF.

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2.2 The Plan

The plan is to include a number of floodplain risk management measures to reduce the flood risk in the Porters Creek catchment. Measures in the plan have been identified through the Cost-Benefit Analysis (CBA) and the Multi-Criteria Assessment (MCA) in the FPRMS (**Appendix A**). The outcomes of the CBA and the MCA provide direction for selection of options for further consideration. This was completed in the exhibition phase of the FPRMS that recommended 15 options listed below:

1. Option P1 – Planning Controls
2. Option P2 – Development Controls
3. Option 1.10 - Natural Channel Maintenance
4. Option EM1 - Information Transfer to SES
5. Option EM2 – Revise the Wyong Local Flood Plan
6. Option EM3 – Wyong Community Christian School Emergency Management Plan Update
7. Option EM4 – Community Flood Awareness
8. Option EM5 – Signage at road crossings
9. Option DC1 – Data Collection Strategy
10. Option 1.5 – Raise Road Levels of Hue Hue Road at Buttonderry Creek Crossing
11. Option 1.8 - Warnervale Road Upgrade at Ebony Drive
12. Option 1.9 - Bingarra Channel Crossing at Minnesota Road
13. Option P7 – Flood Proofing Controls
14. Option P3 – House Raising for non-slab on ground houses up to the 5 year ARI
15. Option 2.1 – Lucca Road Levee Extension

A selection of the recommended options was made in consultation with Council for presentation to the community for further refinement of the social scoring in the MCA. The options were presented to the community through delivery of a questionnaire and in a forum meeting held at Council's Civic Centre at 7pm on Wednesday 4 May 2011. The community ranked the options according to their preferences and the MCA was updated to suit. The revised MCA is included in **Appendix B** and further details of the forum are provided in the FRMS (**Appendix A**).

The final stage of the Plan preparation was to seek feedback on the options from stakeholders including; Council, the Floodplain Management Committee and OEH. The options recommended for inclusion in the plan are included in **Table 2-1**. Options 1.8 and 1.9 were previously excluded from recommendations for the Plan as they are currently on the Capital Works program for Council and are currently being designed by Council's Roads and Drainage section. The two locations suffer from low road serviceability during storms and are at the forefront of issues raised by the community. Thus it was considered appropriate to include these two additional options into the community questionnaire and forum meeting in May 2011 for ranking in comparison to other options. Options 1.8 and 1.9 ranked highly in a similar fashion to previous community questionnaires. It is therefore considered important to include these options in the Plan regardless of their inclusion in other programs within Council.

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2.3 Implementation Program

Priorities for the implementation of the options are included in **Table 2-1**. These have been selected based on the following criteria:

- ✦ Cost Benefit Ratio
- ✦ Capital cost
- ✦ Timing (i.e. construction period)
- ✦ Available resources
- ✦ Funding Source
- ✦ Community and Stakeholder expectations

It is clear that a number of options such as planning and development controls have a high priority as they are relatively low in cost and achieve good outcomes. This is also the case for emergency management options that require simple techniques to inform the community of flooding and methods to reduce flood risk. Structural options such as road and drainage works have a far lower cost benefit ratio as they require a large amount of resources and have similar levels of flood risk reduction as emergency management measures. Therefore structural options are lower in priority. Lucca Road levee is low priority as it would benefit commercial areas and funding is more readily allocated to options that directly meet the concerns of the community.

The following list of tasks summarises program for implementation of the Plan.

1. Council considers the Floodplain Management Committee's recommendations,
2. Exhibit the draft Plan report and seek community comment,
3. Consider public comment, modify the Plan if and as required, and submit the final Plan to Council,
4. Council adopt the Plan and submit an application for funding assistance to OEH and other agencies as appropriate,
5. As funds become available from OEH, other state government agencies and/or Council's own resources, implement the measures in accordance with the established priorities.

This plan should be regarded as a dynamic instrument requiring review and modification over time. The catalysts for change could include new flood events and experiences, legislative change, alterations in the availability of funding and reviews of the Council planning. In any event, a thorough review every five years is warranted to ensure the ongoing relevance of the Plan.

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Table 2-1: Recommended Floodplain Risk Management Plan

ID	Name	Description	Capital Cost	Recurring Cost	Funds source	Priority
P1	Planning Controls	Local Environmental Plan (LEP) – Wyong update	\$5,000	\$1,000	Council	High
P2	Building and Development Controls	Development Control Plan (DCP) Chapter 113 - Flooding	\$15,000	\$1,000	Council	High
P3	House raising - up to 5yr	Raising habitable building's floor above 5 year ARI flood level	\$640,000	\$35,000	Council	Low
P7	Flood proofing guidelines	Involves modification to existing structures or design and construction of new structures considering the associated risk from flooding.	\$15,000	\$1,000	Council	Medium
EM1	Information Transfer to SES	Transfer of information such as flood extent map, Hazard maps, and major roads cut-off for different ARI flood events.	\$3,000	\$0	Council/SES	High
EM2	Revisal of SES Local Flood Plan/DISPLAN	Updating DISPLAN and Local flood plan with the information provided in this report.	\$30,000	\$2,000	Council/SES	High
EM3	Flood Warning System	Introduction of alarm system based on real-time information from water level and rain gauges to warn emergency management staff that flood is imminent.	\$0	\$0	Council/SES	High
EM4	Community Flood Awareness	Community within the catchment must be aware of what to do in the event of flood, their responsibility and where to seek assistance.	\$20,000	\$5,000	Council/SES	High
EM5	Signage at road Crossings	Installation of signs that read 'Do not drive through flood water' at Alison Road near Wyong Community Christian School, Minnesota Road and Warnervale Road.	\$10,000	\$200	Council	High
1.5	Bultonderry Creek crossing at Hue Hue Road	Raise the Hue Hue Road crown to flood planning level (FPL) to make the road trafficable for flood events up to and including 100 year ARI. No culverts are proposed to retain hydraulic behaviour in the creek downstream.	\$595,200	\$5,000	Council/OEH	Medium

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ID	Name	Description	Capital Cost	Recurring Cost	Fund source	Priority
1.8	Warnervale Road Upgrade at Ebony Drive	Raise the road crown level of Warnervale Road and provide a new culvert to increase serviceability of road and reduce flood risk to adjacent property.	\$3,500,000	\$20,000	Council	Medium
1.9	Bingarrah Creek Crossing at Minnesota Road	It is proposed to raise the road crown level and provide a series of culverts to increase serviceability of road up to and including the 100 year ARI.	\$5,000,000	\$50,000	Council	Medium
1.10	Natural Channel Maintenance	A plan of management for each natural flow path will be required for 3 flow paths including Woongarran Creek, Bingarrah channel and Kanwal channel. The maintenance work involves removal of sediment and weeds at culverts or bridges in residential areas.	\$643,200	\$480,000	Council/OEH	High
2.1	Lucca Rd Levee Extension	Extension of existing levee along the rear property boundary by a earth bund up to a level of 6.5 m AHD to protect property from the 100 year ARI flood level of 6.2 m AHD	\$545,000	\$10,000	Council/OEH	Low
DC1	Data Collection	Preparation of a flood data collection form and use of this form following a flood event	\$5,000	\$3,000	Council/SES	High
Total cost of implementing the Plan			\$11,026,400	\$613,200		

3 Flood Risk Management Controls

Following review of Flood Planning Instruments undertaken in the FRMS a development control matrix has been prepared for the Porters Creek catchment. Control of development is to be managed under the shire wide Flood Prone Land DCP chapter 113, currently in DRAFT form. This DCP will supersede all existing planning controls of Council in respect to flood planning. Specific controls for each catchment within the shire are controlled through application of the development control matrix for planned development. Existing flood risks are managed through implementation of the flood mitigation measures listed in **Table 2-1**.

The development control matrix relates to three flood planning categories:

- ✦ Flood Planning Area 1: The area of land below the level of the PMF and above the level of the FPL
- ✦ Flood Planning Area 2: The area of land below the level of the FPL and above the level of a combination of the Floodway/True High Hazard Areas
- ✦ Flood Planning Area 3: The area of land below the Floodway/True High Hazard Areas

Determination of the Flood Planning Level (FPL) has been undertaken in consultation with Council and the Floodplain Management Committee. An allowance for the projected impacts of climate change to the flood levels has been incorporated to the FPL based on latest regional research by the CSIRO and OEH for the NSW Central Coast. As such the 100 year ARI plus a 15% rainfall intensity increase has been the basis for flood planning in the catchment and is referred to as the 'designated flood'. The FPL for residential development is defined by the designated flood with a freeboard of 500mm.

Alternative flood planning levels are provided for several other land uses depending on the level of flood risk. For example, the level of flood risk for a non-habitable structure is lower than that for a structure where people reside. Thus a lower flood planning level is specified for agricultural and recreational structures as it is less likely that the public will be on-site during flood than for a habitable structure, such as a house. On the other hand critical infrastructure (e.g. Hospitals) is not suitable development within flood planning areas other than flood planning Area 1. Flood risk management for these facilities is essential during an emergency and more often than not the public within these facilities are less mobile and more vulnerable. Hence the FPL for critical infrastructure and sensitive facilities is the level of the PMF.

Building components such as carparks also require specific planning controls to manage the risk of flood. Basement carparks are of particular concern due to the risk of inundation by flood having potentially high flood risk. Hence the entrance and any openings to the basement must be 500mm above the designated flood or the PMF, whichever is the higher. Above ground carparks are permissible at natural surface levels where the flood depth does not exceed 150mm during the designated flood. Inundation at larger depths can pose high flood risk to motorists, pedestrians and vehicles.

Where earthworks and subdivisions are proposed necessary flood impact assessments must be undertaken to ensure that the proposed physical changes do not have a negative impact on existing flood behaviour. This can be provided in the form of an Engineer's Report satisfying the requirements for Flood Affection. It would be appropriate for the objective of the proposal to have either nil impact or an improvement on flood behaviour in

Porters Creek Floodplain Risk Management Plan – Exhibition Report
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the vicinity. In addition cumulative impacts of the proposed development and similar developments in the vicinity need to be considered.

Emergency management plans are required where there are risks associated with the management of storms that would potentially inundate floor levels and public spaces on commercial, residential and public properties. The plans would nominate safe procedures to minimise flood risk to people within the property at the time of flood and should be prepared by a suitably qualified professional. The most viable option for management of such an emergency is for people to take refuge at a location that is higher than the PMF flood level. The duration of the PMF is no more than 1 day for areas in the lower parts of the Porters Creek floodplain and only a few hours in upper parts of the floodplain.

The development control matrix and a map of the above flood planning areas are provided in **Figure 2** and **3**.

4 Qualifications

The following qualifications apply to this report:

- ✱ This report has been prepared by Cardno for Wyong Shire Council and as such should not be used by a third party without proper reference.
- ✱ The investigation and modelling procedures adopted for this study follow industry standards and considerable care has been applied to the preparation of the results. However, model set-up and calibration depends on the quality of data available. The flow regime and the flow control structures are complicated and can only be represented by schematised model layouts. Hence there will be a level of uncertainty in the results and this should be borne in mind in their application.
- ✱ All options presented in this report are at a concept level only.
- ✱ The financial figures reported arise from preliminary estimations and further more detailed design and cost estimation is required for budgeting purposes.
- ✱ Study results should not be used for purposes other than those for which they were prepared.

Porters Creek Floodplain Risk Management Plan – Exhibition Report
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5 References

Cardno 2010, *Porters Creek Flood Study Addendum*, Prepared for Wyong Shire Council
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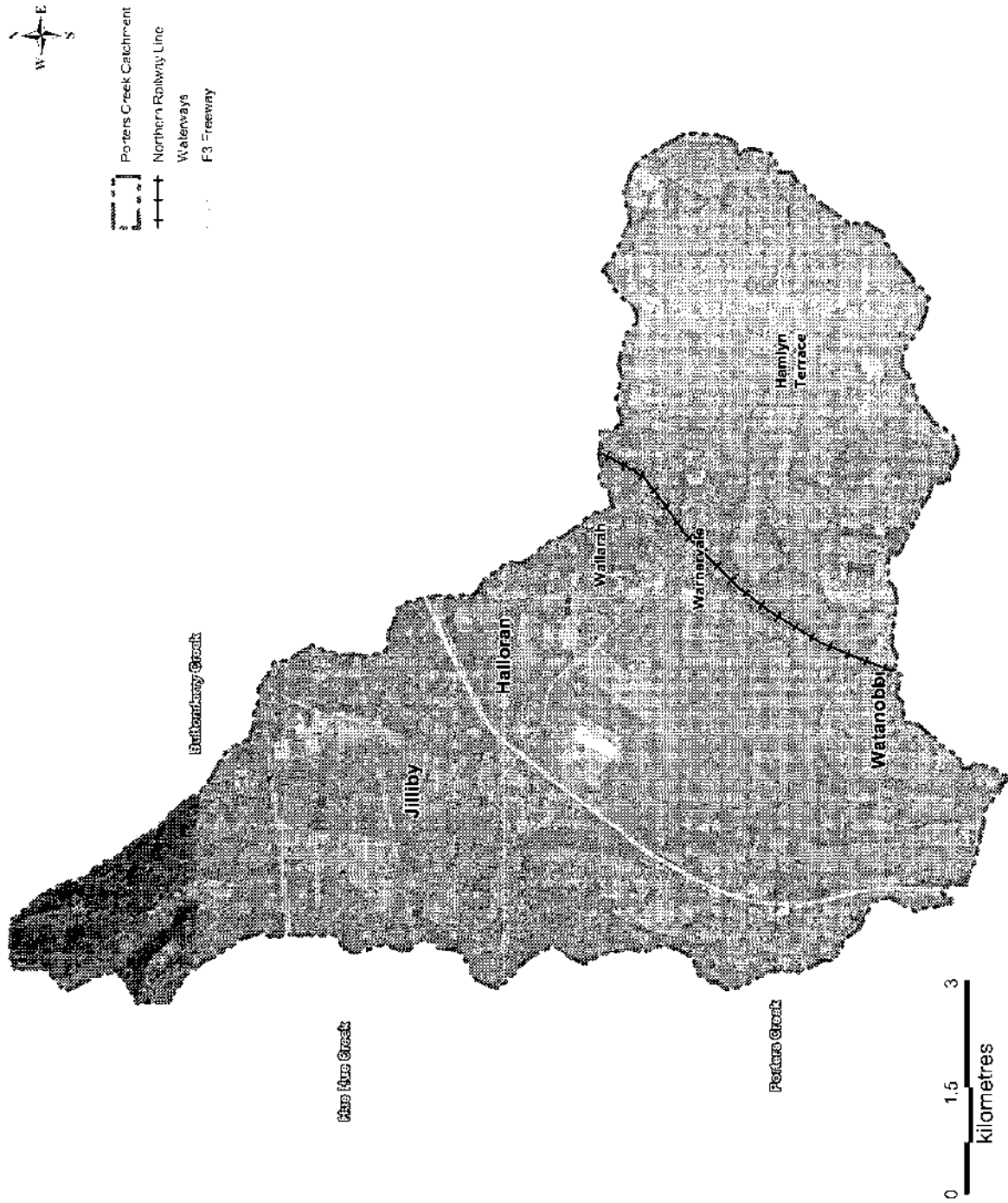





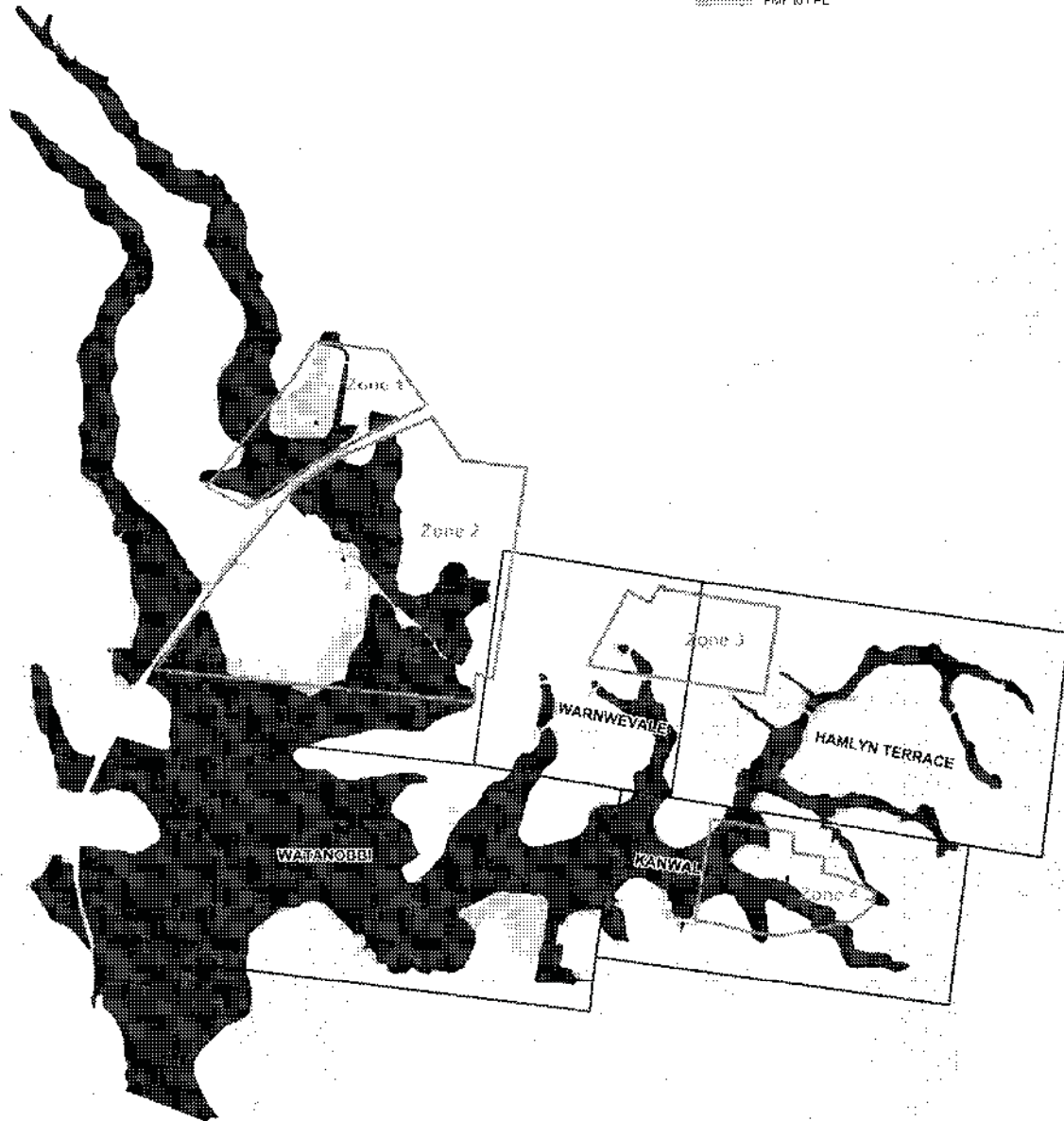
FIGURE 1
LOCALITY PLAN
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Porters Creek FRMP

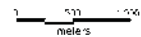


LEGEND

-  Flood Planning Area 3
Floodway plus True High Hazard Areas
-  Flood Planning Area 2
FPL to Floodway plus True High Hazard Areas
-  Flood Planning Area 1
PMF to FPL



Note: Flood Risk Management for the following areas will be managed by Site Specific Development Control Plan (DCPs)
 Zone 1: Warner Industrial Park
 Zone 2: Wyong Employment Zone
 Zone 3: Wamervale Town Centre
 Zone 4: Wamervale East and Wadalba North-West Urban release area

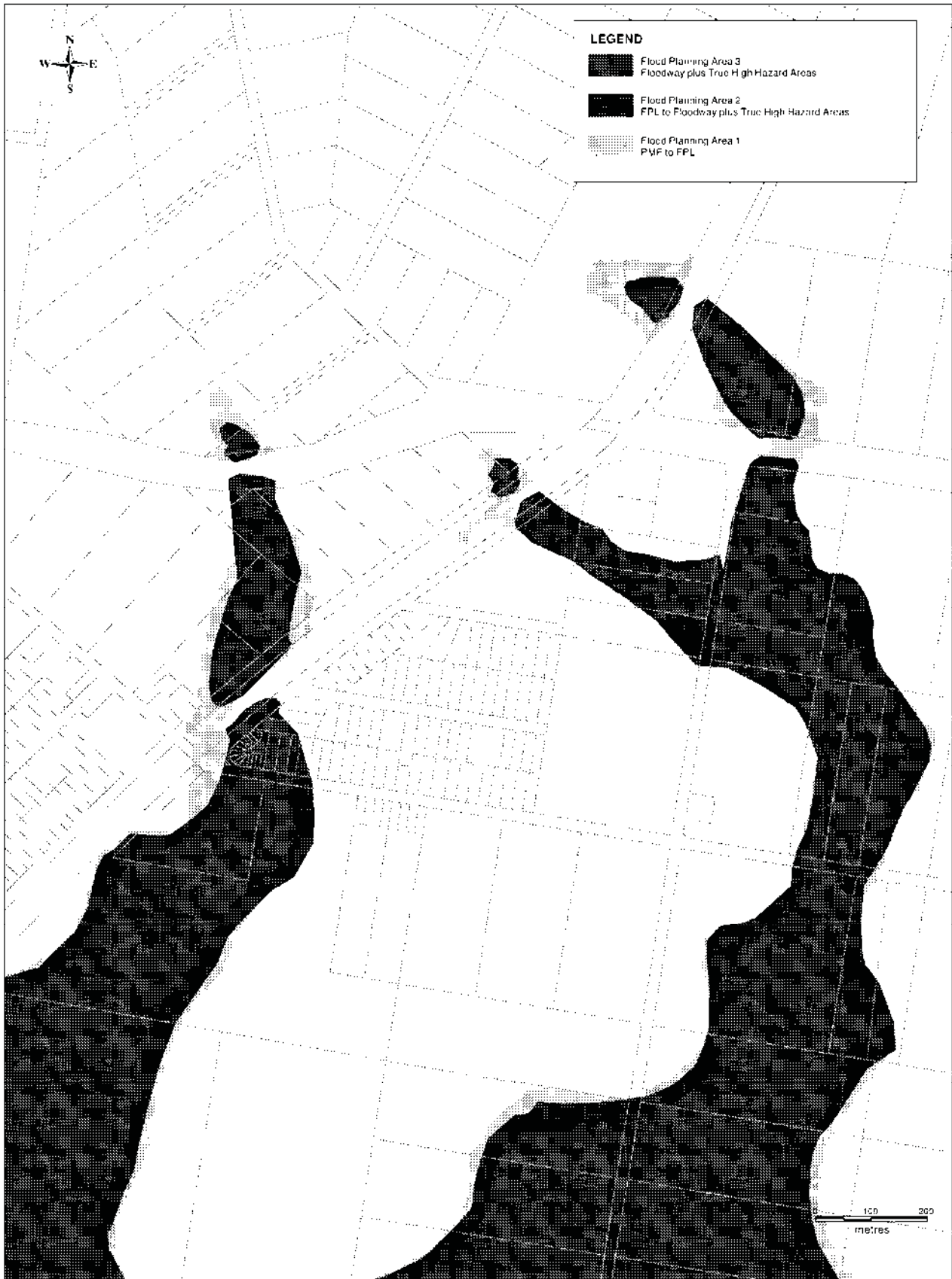


Porters Creek FRMP

FIGURE 3
Flood Planning Categories

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Porters Creek FRMP

FIGURE 4
Flood Planning Areas for Warnervale

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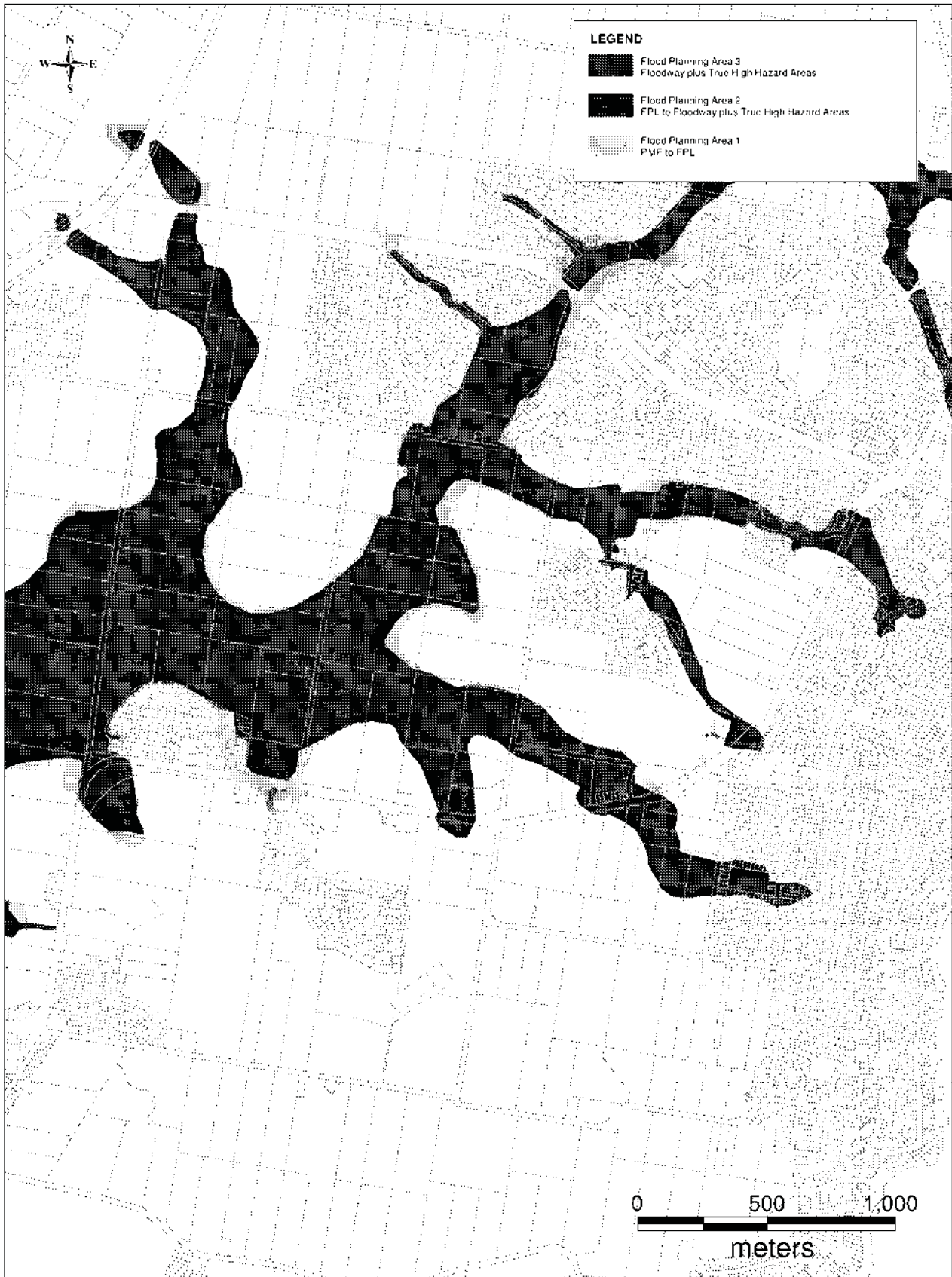


Porters Creek FRMP

FIGURE 5
Flood Planning Areas for Hamlyn Terrace

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Porters Creek FRMP

FIGURE 6
Flood Planning Areas for Kanwal

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Porters Creek FRMP

FIGURE 7
Flood Planning Areas for North Wyong/Watanobbi

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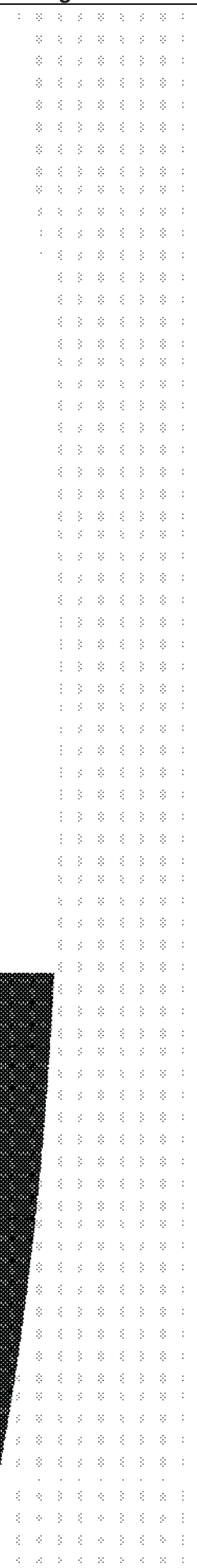
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Appendix A
FRMS

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Appendix B

Multi-Criteria Matrix

