PORT STEPHENS COUNCIL AND DUNGOG COUNCIL

Paterson River Floodplain Management Study and Plan

Paterson River, March 1978, viewing downstream to Iona and Woodville

FINAL REPORT

Volume 1 — Management Assessment and Plan

November 2001

Bewsher Consulting Pty Ltd

PORT STEPHENS COUNCIL AND DUNGOG COUNCIL

PATERSON RIVER FLOODPLAIN MANAGEMENT STUDY AND PLAN

VOLUME 1 - MANAGEMENT ASSESSMENT AND PLAN

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FOREWORD

The Government's Flood Policy is directed at providing solutions to existing flooding problems in developed areas, and ensuring that new development is compatible with the flood hazard and does not create additional flooding problems in other areas. Under the Policy, the management of flood liable land remains the responsibility of local government.

The Policy provides for a floodplain management system comprising the following four sequential stages:

1. Flood Study — Determines the nature and extent of the flood problem.

2. Floodplain Management Study — Evaluates management options for the floodplain with respect to both existing and future development.

3. Floodplain Management Plan — Involves formal adoption by Council of a plan of management for the floodplain.

4. Implementation of the Plan — Involves construction of flood mitigation works, where viable, to protect existing development.

   — Uses planning controls to ensure that future development is compatible with flood hazard.

This Floodplain Management Study and Plan constitutes the second and third stages of the management process for the Paterson River floodplain and has been prepared for Port Stephens Shire Council and Dungog Shire Council by Bewsher Consulting Pty Ltd.

The Study is presented in three volumes:

Volume 1 — The Management Assessment and Plan;
Volume 2 — The Town Planning Context and Strategy; and
Volume 3 — Extension of Flood Study and Hydraulic Investigations.

The results of the Study and the Floodplain Management Plan contained in this report will provide each Council with a sound basis from which to manage the urban areas along the Paterson River floodplain, extending from the Hunter River at Hinton to Gostwyck Bridge.

TABLE OF CONTENTS - VOLUME 1

TABLE OF CONTENTS - VOLUME 1

Page

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS - VOLUME 1

Page

FIGURES

Page

TABLES

APPENDICES

GLOSSARY

AHD Australian Height Datum. A common national plain of level approximately equivalent to the height above sea level. Most flood levels, floor levels and ground levels in this study have been provided in mAHD.

AEP Annual Exceedance Probability. AEP (measured in percentage) is the long term probability between floods of a certain magnitude. For example, a 1% AEP flood is the flood which occurs or is exceeded on average every 100 years. It is also referred to as the '100 year flood' or the '1 in 100 year flood'.

ARI Average Recurrence Interval. ARI (measured in years) is a means of describing how likely a flood is to occur. In this report, the frequency of different sized floods has been described using AEP not ARI.

BC Bewsher Consulting Pty Ltd.

CALM Department of Conservation and Land Management (NSW) (previously the Soil Conservation Service) became a major component of the Department of Land and Water Conservation (DLWC) in May 1995.

DA Development application.

DCP Development Control Plan. A plan prepared in accordance with Section 72 of the *Environmental Planning Assessment Act, 1979*, which provides detailed guidelines for the assessment of development applications.

Design flood A flood used as a standard for design.

Designated flood The size of flood selected for planning purposes. Traditionally only one 'designated flood' has been adopted for a particular locality. However, more than one 'designated flood' can be used for planning, building and development controls. Unless the designated flood is a PMF, floods larger than the designated flood can occur. This term is now referred to as the flood planning level (FPL).

DLWC Department of Land and Water Conservation (NSW). Since May 1995, this is the new name for Department of Water Resources (DWR), the Department of Conservation and Land Management (CALM) and flood sections of the Public Works Department (PWD). DLWC has been used in this report, except for work and/or studies carried out by these departments prior to May 1995.

DP Deposited Plan.

DUAP Department of Urban Affairs and Planning (NSW). Formerly the Department of Planning (NSW).

DWR Department of Water Resources (NSW). This department became a major component of the Department of Land and Water Conservation (DLWC) in May 1995.

EP&A Act *Environmental Planning and Assessment Act, 1979*.

Extreme Flood A very large flood approximately equal to the PMF.

Floodplain Management Study	The current study. These studies assess options for minimising the danger to life and property during floods. The options try to achieve an equitable balance between environmental, social, economic, financial and engineering considerations.
Flood Standard	See designated flood.
FPL	Flood planning level. (See designated flood.).
FPM	Floodplain Management.
Flood hazard	The potential for damage to property or risk to persons during a flood.
Flood Planning Level	See designated flood.
Flood Study	A study which identifies the flood levels for a range of flood events.
Floodway	The *Floodplain Development Manual* (PWD, 1986) defines floodways as: *"those areas where a significant volume of water flows during floods. They are often aligned with obvious naturally defined channels. Floodways are areas which, even if only partially blocked, would cause a significant redistribution of flood flow, which may in turn adversely affect other areas. They are often, but not necessarily, the areas of deeper flow or the areas where higher velocities occur"*.
FMA	Flood Mitigation Authorities of NSW.
Freeboard	A factor of safety usually expressed as a height above a particular flood. Freeboard also takes into account wave action, local increases in flood level between buildings and `wash' from passing vehicles during a flood, i.e. it is an allowance to protect against the design flood.
Gl	Gigalitre (1Gl = 1,000 Megalitres = 1,000,000,000 litres).
ha	Hectares. Measurement of land area (1ha = 10,000m^2 = 100m x 100m = 2.5 acres).
LGA	Local Government Area.
MIKE-11	A computer program used to generate water surface profiles. WBM Oceanics Australia used this program to investigate the flood profiles along the Paterson River.
High hazard	For a particular size flood, there is a possible danger to life and limb as well as structural damage.
km	Kilometres (1km = 1,000m = 0.62 miles).
km^2	Square kilometres. (1km^2 = 1,000,000m^2 = 100ha = 250 acres).
Low hazard	For a particular size flood, able-bodied adults would be able to wade and trucks can be used for evacuation.

LEP	Local Environmental Plan. A Local Environmental Plan is a plan prepared in accordance with the *Environmental Planning and Assessment Act*, 1979, which defines zones, permissible uses within those zones and specifies development standards and other special matters for consideration with regard to the use or development of land.
mAHD	Metres Australian Height Datum (see AHD).
m^2	Square metres ($1m^2$ = 10.8 square feet).
m^3/s	Cubic metres per second or 'cumecs'. A unit of measurement of flows or discharges.
BoM	Commonwealth Bureau of Meteorology.
mm	Millimetres.
Outer floodplain	Refers to that part of the floodplain between the extent of 1% AEP level flood (plus 0.5m) and the extent of the EF.
Peak discharge	The maximum flow during a flood.
PMF	Probable maximum flood — the largest flood likely to ever occur.
PWD	Public Works Department. The sections dealing with flooding in this department were amalgamated into the Department of Land and Water Conservation (DLWC) in May 1995.
Rating curve	A relationship that relates river height with the flow for a particular stream location.
SES	State Emergency Service of New South Wales.
Stage	Equivalent to 'water level',
Stage-damage curve	A relationship between different water depths and the predicted flood damage at that depth.
Strategic planning	An assessment of the future need for rural, residential, commercial, industrial and open space land.
>	Greater than, e.g. >2.0m = greater than 2.0m.
<	Less than, e.g. <0.5m = less than 0.5m.

SUMMARY

This report has identified practical measures to minimise the impacts of floods on the community of the Paterson River valley. A range of possible measures was examined to find those most suited based on economic, technical, social and environmental criteria, and the likely level of community support. As a result of this process, Floodplain Management Plans for the Paterson River floodplain within the Dungog and Port Stephens Council areas have been prepared. Within the Dungog LGA the cost of the recommended measures totals $100,000, and within the Port Stephens Council area the measures will cost $1.2 million to $2.4 million.

THE DRAFT FLOODPLAIN MANAGEMENT PLAN FOR DUNGOG COUNCIL

OPTION NO.	DESCRIPTION	CAPITAL COST (to Council)	MAINTENANCE COST per annum	PRIORITY
MEASURES WHICH MODIFY FLOOD BEHAVIOUR				
1.8	Council endorsement of scour protection, bank stabilisation works and vegetation management by the HCMT and DLWC	Nil(2)	Nil(2)	High
1.9	Council endorsement of levee maintenance by the HCMT and DLWC	Nil(2)	Nil(2)	Medium
1.10	Council endorsement of drainage channel maintenance by the Drainage Union, HCMT and DLWC	Nil(2)	Nil(2)	Medium
MEASURES WHICH MODIFY PROPERTIES				
2.2	Flood proofing of individual houses/commercial buildings	Nil	Nil	High
2.3	Improve existing building and development controls	Nil(2)	Nil(2)	High
MEASURES WHICH MODIFY PEOPLE'S RESPONSES TO FLOODING				
3.2	Improve emergency planning and management	Nil(2)	Nil(2)	Medium

3.3	Increase community education and flood awareness [1]	$75K	$10K	Medium
3.4	Improve flood warning systems	$25K	Nil	High
TOTAL		**$100K**	**$10K**	

[1] For whole of Dungog local government area.

[2] Whilst no capital or maintenance costs are shown against this item, a commitment by Council to meet the internal administrative costs for this option is required if the option is to be successfully resourced and implemented.

THE DRAFT FLOODPLAIN MANAGEMENT PLAN FOR PORT STEPHENS COUNCIL

OPTION NO.	DESCRIPTION	CAPITAL COST (to Council)	MAINTENANCE COST per annum	PRIORITY
MEASURES WHICH MODIFY FLOOD BEHAVIOUR				
1.8	Council endorsement of scour protection, bank stabilisation works and vegetation management by the HCMT and DLWC	Nil[4]	Nil[4]	High
1.9	Council endorsement of levee maintenance by the HCMT	Nil[4]	Nil[4]	Medium
1.10	Council endorsement of drainage channel maintenance by the Drainage Union, HCMT and DLWC	Nil[4]	Nil[4]	Medium
MEASURES WHICH MODIFY PROPERTIES				
2.1	Voluntary house raising, relocation or demolish/reconstruct 10 to 20 severely flood affected properties	$0.7M - $1.4M	Nil	High
2.2	Flood proofing of individual houses/commercial buildings [1]	Nil	Nil	High
2.3	Improve existing building and	Nil[4]	Nil[4]	High

	development controls			
2.4	Voluntary acquisition of 2 to 5 severely flood affected houses by Council (urban areas only) (2)	$0.3M - $0.75M	Nil	High
MEASURES WHICH MODIFY PEOPLE'S RESPONSES TO FLOODING				
3.2	Improve emergency planning and management	$100K	$5K	Medium
3.3	Increase community education and flood awareness (3)	$75K	$10K	Medium
3.4	Improve flood warning systems	$25K	Nil	High
	TOTAL (rounded)	**$1.2M - $2.4M**	**$15K**	

(1) Option 2.2 only recommended where Options 2.1 and/or 2.4 cannot be implemented.

(2) Option 2.4 only recommended where Option 2.1 cannot be implemented.

(3) For whole of Port Stephens local government area.

(4) Whilst no capital or maintenance costs are shown against this item, a commitment by Council to meet the internal administrative costs for this option is required if the option is to be successfully resourced and implemented.

Report Structure

The Paterson River Floodplain Management Study is presented in three volumes:

Volume 1 — The Management Assessment and Plan (this document);
Volume 2 — The Town Planning Context and Strategy; and
Volume 3 — Extension to Flood Study and Hydraulic Investigations.

Study Area

This floodplain management study covers the floodplain of the Paterson River between the Gostwyck bridge and the Hunter River, in the Dungog Council and Port Stephens Council areas. The Hunter River floodplain south of Hinton to the east of the Paterson River extending to Green Rocks is also included in the study area. The floodplain in the Upper Paterson River from Gostwyck Bridge upstream to Vacy is not included in the management study, but was included in the extension to the flood study (**Volume 3**).

Community Involvement

This study was prepared under the State Government's Flood Prone Lands Policy in accordance with the Floodplain Development Manual (**References 1** and **2**). The progress of the study and all its major findings were vetted by the Councils' Floodplain Management Committee — a group representing staff from each of the two Councils, the Woodville Drainage Union (WDU), the State Emergency Service (SES), the Hunter Catchment Management Trust (HCMT) and the Department of Land and Water Conservation (DLWC). Two public meetings, a community newsletter, a questionnaire and personal interviews were undertaken to seek community input.

Flood Behaviour (Volume 3)

A description of the flood behaviour along the Paterson River floodplain was available from the 1997 flood study carried out for Port Stephens Council, Dungog Council and Maitland Council by WBM Oceanics Australia (**Reference 3**). Additional work was carried out as part of the current floodplain management study to provide flood behaviour information upstream of Paterson township (extending to Vacy) for the 20%, 10%, 2%, 1% and 0.2% annual exceedance probability (AEP) events and the extreme flood (EF).

Potential Flood Losses (Volume 3)

For the residences and urban parts of the study area, the cost of flood damage has been calculated in dollar terms. The analysis indicated that the total damage cost to the community in 5% and 1% AEP floods would be about $0.1 million and $0.5 million respectively. This could increase to $1.5 million in a 0.2% AEP event. The cost of rural losses in the study area would be additional and have not been assessed in the current study.

When all future damages from both rare and frequent flood events are considered, the average annual damage (urban) is estimated to be $40,000. This is the amount of money one would need to put in the bank each year (forever) to meet the costs of all future flood damages.

These flood losses will increase significantly if inappropriate development occurs within flood prone land in the future.

The Flood Planning Level

The flood planning level (FPL, also called the 'designated flood' or the 'flood standard') is the level adopted by a Council to determine where development controls relating to flooding should be applied. Both Port Stephens Council and Dungog Council have previously adopted the 1% AEP flood level as the interim FPL for all areas on the Paterson River floodplain.

Use of a singular FPL can lead to difficulties given that different FPL's may be required in different areas, and that different FPL's may need to be applied to control different land uses. In addition, the community may not understand that areas of the floodplain above the FPL are still at risk from flooding. This is particularly relevant to areas above the Paterson township where the difference between the 1% AEP flood level and the EF level may exceed seven metres (or three building storeys).

Within the study, a new approach involving a graded set of planning controls has been recommended, which does not rely on the definition of a singular FPL. The new approach is consistent with the Government's Floodplain Development Manual and its proposed revision, the Floodplain Management Manual (**Reference 2**). The new approach is discussed in detail in **Volume 2**.

The approach defines planning controls for various land uses and flood risks using a planning matrix. The controls would apply to the whole of the floodplain (i.e. all areas inundated in an extreme flood) and include areas that are isolated by floodwater during major events (e.g. Hinton). The proposed matrix for the Paterson River floodplain is presented in **Figure 6** for the Port Stephens Council area and **Figure 7** for the Dungog Council area. The matrix for each Council area is consistent with the other and will ensure uniform planning controls are applied in the study area.

Previously, residential floor levels (minimum) were set at 0.5m above the 1% AEP flood level. After considering a range of issues, the current study has recommended residential floor levels be set at the 0.5% AEP flood level (with no freeboard). In the mid-river section of the valley, between Woodville and Paterson, this results in a similar

floor level to the old standard. In the lower valley the resulting floor level is slightly lower than the old standard, and in the upper valley above Paterson, higher residential floor levels will result. The net result however will be a more consistent standard throughout the valley.

Floor levels for land uses other than residential have been set at differing levels depending on the potential consequences of inundation.

Floodplain Management Options

A range of works and measures to reduce the impact of flooding were evaluated. A list of all the 20 options which received serious consideration is included below. Those options which were recommended are presented in the Floodplain Management Plans. In some cases, further consideration of the recommended options by the Councils will be required before implementation can begin.

Options which Modify Flood Behaviour

- Raise the existing levees (Option 1.1 — not recommended);
- Lower the existing levees (Option 1.2 — not recommended);
- Remove/modify Scotts Dam (Option 1.3 — not recommended);
- Widen and deepen the Paterson River (Option 1.4 — not recommended);
- Dredge the Hunter River downstream of the Paterson River (Option 1.5 — not investigated, no recommendation possible);
- Construct upstream flood retarding storages (Option 1.6 — not recommended);
- Create a flood storage compartment in Lostock Dam (Option 1.7 — not recommended);
- Council endorse scour protection, bank stabilisation works and vegetation management by the HCMT and DLWC (Option 1.8 — recommended);
- Council endorse levee maintenance by the HCMT and DLWC (Option 1.9 — recommended);
- Council endorse drainage channel maintenance by the Drainage Union, HCMT and DLWC (Option 1.10 — recommended).

Options which Modify Properties

- Voluntarily raise, relocate or demolish/reconstruct severely flood affected houses (Option 2.1 — recommended);

- Flood proof individual properties (Option 2.2 — recommended);
- Improve building and development controls (Option 2.3 — recommended);
- Voluntarily acquire severely affected flood liable properties (Option 2.4 — recommended but unlikely to be required).

Options which Modify People's Response to Flooding

- Issue flood certificates to property owners (Option 3.1 — not recommended);
- Improve emergency planning and management (Option 3.2 — recommended);
- Increase community education and flood awareness (Option 3.3 — recommended);
- Improve flood warning systems (Option 3.4 — recommended);
- Prepare flood action plans for individual properties (Option 3.5 — not recommended);
- Raise road access (Option 3.6 — not recommended).

Changes to each Council's Floodplain Management Practice

Implementing the recommendations of this Study will require some changes to each of the Councils' current floodplain management practices, particularly in relation to building and development controls. New floodplain DCPs and amendments to the existing LEPs have been drafted to facilitate these changes.

Introducing these changes for other flood prone areas along the Paterson River (or other river valleys) on an interim basis, until such time as floodplain management studies of these areas are carried out, may be prudent and would allow the Councils to maintain a consistent approach to floodplain management across the whole of their local government areas. (Draft floodplain DCPs for the other areas have also been prepared and are presented in Volume 2).

Implementation

Plans for Dungog and Port Stephens Councils for managing the Paterson River floodplain below Gostwyck Bridge have been prepared in consultation with the local community. The plans are consistent with the Government's Flood Prone Land Policy and provide a sound basis for future floodplain management involving structural works, planning controls, emergency management, and measures for increasing and maintaining the community's awareness of flood issues. The plans are also consistent with each other.

It is recommended that each Council implements all components of its plan. Initially, each Council should submit a funding application to the Department of Land and Water Conservation and apply its own funding to ensure the plan is implemented.

1. INTRODUCTION

This Section discusses the principal aims of the Study and its relationship to the Government's Flood Prone Land Policy.

Other relevant studies are briefly reviewed and the structure of the present document is summarised.

The objective of this study has been to develop a practical plan to minimise the impact of flooding on the urban areas located on the floodplain of the Paterson River between the Gostwyck Bridge and the Hunter River, in the Dungog Council and Port Stephens Council areas. The study area also includes a portion of the Hunter River floodplain south of Hinton to the east of the Paterson River extending to Green Rocks.

In order to deal with the flooding problems on the floodplain of the Paterson River, Port Stephens Council and Dungog Council have been implementing the guidelines set out in the New South Wales Government's *Floodplain Development Manual* (**Reference 1** and **2**), under the guidance of the Department of Land and Water Conservation (DLWC).

In accordance with the *Floodplain Development Manual*, the Councils commissioned this Floodplain Management Study (FPMS), in July 1998. The study has been undertaken by Bewsher Consulting Pty Ltd with the assistance of Don Fox Planning Pty Ltd (town planning issues) and WBM Oceanics Australia (flood study and hydraulic investigations). Floodplain Management Plans for each Council have also been prepared.

1.1 THE FLOODPLAIN MANAGEMENT SYSTEM

1.1.1 NSW Flood Prone Land Policy

In New South Wales (NSW), the prime responsibility for local planning and the management of flood liable lands rests with local government. The NSW Government has issued a *Flood Prone Land Policy* and a *Floodplain Development Manual* to assist local government with these responsibilities.

The primary objective of the Flood Prone Land Policy (which is detailed in Appendix A of the *Floodplain Development Manual*) is to reduce the impact of flooding and flood liability on individual owners and occupiers, and to reduce private and public losses resulting from flooding (**Reference 1** and **2**). The policy recognises that as well as protecting existing development, growth in flood losses can only be contained by

ensuring that new development takes into account the susceptibility of land to flooding. In particular, new development should be designed and constructed so that flood damage can be reduced and flood conditions at neighbouring properties are not made worse.

The policy states that:

- *"the impact of flooding and flood liability on existing developed areas shall be reduced by flood mitigation works and measures, the removal of unnecessary development, building controls, and the voluntary acquisition of property in hazardous areas;*

- *the potential for flood losses in all new developed areas shall be contained by the application of effective planning and development controls;*

- *a merits approach to all development and building decisions which takes account of social, economic and ecological as well as flooding considerations, shall be followed".*

To help achieve its objectives, the policy provides for the protection of a council and other public authorities and their staff, against claims for damages resulting from them issuing advice or granting approvals on floodplains, providing they have acted substantially in accordance with the principles contained in the *Floodplain Development Manual*.

1.1.2 The Floodplain Management Process

The implementation of the Flood Prone Land Policy culminates in the formulation, adoption and execution of a Floodplain Management (FPM) Plan. The steps generally followed in the floodplain management process are presented in **Figure 1**. **Figure 1** also shows those steps already completed by each Council, steps included as part of this report and steps which have yet to be completed.

1.2 PRINCIPAL AIMS OF THIS STUDY

The principal aim of this Study has been to develop a Floodplain Management Plan along the Paterson River within the Dungog Council and Port Stephens Council areas that addresses the existing, future and residual flood problems, and meets community expectations.

Figure 1 - Floodplain Management Process
(A4 B&W)

Key components of this study have included:

- collection and review all previous reports, surveys and maps relevant to the study;
- development and implementation of a community consultation strategy, to ensure community input is obtained at key times throughout the study;
- identification of the flood behaviour along the Paterson River between Vacy and Paterson township and a review of the available flood behaviour information downstream of Paterson;
- assessment of the flood problems, the flood hazards and the cost to the community that can be expected from flood damage;
- review of the existing land use within the study area, having regard to the flood hazard;
- review of the existing framework of planning and development controls that are relevant to assessments within the floodplain;
- analysis of the population characteristics and the demand for urban growth in order to determine an appropriate planning response to the identified flood hazard;
- identification of a number of flood modification options (such as ongoing bank stabilisation and scour protection works and levee maintenance), property modification options (such as house raising, voluntary purchase and building controls) and response modification options (such as flood warning and community education) to mitigate the effects of flooding on existing and proposed development;
- assessment of how effective these mitigation options would be in reducing the impact of flooding on existing and new development;
- examination of the economic, social and environmental impacts (both negative and positive) of any proposed works and/or measures;
- formulation of an overview of strategic planning issues to help develop appropriate planning controls;
- assessment of appropriate flood planning levels along the Paterson River floodplain within Dungog Council and Port Stephens Council areas; and
- development of a Floodplain Management Plan in accordance with the guidelines of the Flood Prone Land Policy (see **Section 1.1**).

1.3 PREVIOUS STUDIES

There have been a number of previous studies carried out in the area which have provided useful information for the current study.

1.3.1 New South Wales Coastal Rivers Flood Plain Management Studies — Hunter Valley (1981)

Sinclair Knight & Partners Pty Ltd completed this study (**Reference 4**) in March 1981 for the NSW Coastal Rivers Flood Plain Management Studies steering Committee.

This was one of a series of thirteen studies carried out on the major coastal river valleys of New South Wales.

The study:

- reported on floodplain management measures in operation within the valley;
- identified areas of continuing potential for flood losses, assessed their significance and evaluated mitigation measures;
- recommended a program of proposals for floodplain management; and
- reported on economic constraints to the implementation of recommended floodplain management measures.

1.3.2 Lower Hunter Valley Flood Mitigation Scheme — Rehabilitation of Rock Spillways and Control Banks (1990)

Sinclair Knight & Partners Pty Ltd completed this study (**Reference 5**) in January 1990 for the Public Works Department, NSW.

Within the Lower Hunter Valley Mitigation Scheme several rock spillways exist which allow inbank flood waters to overtop the levee system that protects the floodplain and major towns. This includes the spillway at Swan Reach. The condition of these spillway structures had deteriorated since construction. The report estimated the remaining useful life of the rock armour structures and presented rehabilitation options.

1.3.3 Lower Hunter River Geomorphology Study (1996)

Paterson Britton & Partners conducted this study (**Reference 6**) in 1996 for the Hunter Catchment Management Trust. The study determined the underlying

causes for the widespread bank erosion and channel instability of the Lower Hunter River (i.e. Oakhampton to Hexham).

1.3.4 A Compilation Final Draft Report of Maitland City Council Floodplain Management Studies (1996)

This document (**Reference 7**) contains the following final draft reports prepared by Webb McKeown & Associates:

- Development Control Plan No.28;
- Lower Hunter Valley Floodplain Management Study; and
- Lower Hunter Valley Supplementary Flood Study.

The flood study established design flood levels across the floodplain from Oakhampton to Green Rocks whilst the Floodplain Management Study identified and evaluated the various strategies for managing flood effected areas. Development Control Plan No.28 was the outcome of these investigations and presented the agreed strategy for future management and development of flood liable lands within the Maitland City Council area of the Lower Hunter Valley.

1.3.5 Paterson River Flood Study (1997)

The Paterson River Flood Study report (**Reference 3**) has been the primary reference document for the current study. The Flood Study was carried out by WBM Oceanics Australia for Dungog Council, Port Stephens Council and Maitland City Council as the first step in the implementation of the Government's Flood Prone Land Policy (refer **Section 1.1** and **Figure 1**). It provides a comprehensive description of flood behaviour of the Paterson River within the Port Stephens Council area from just south of Paterson to the Hunter River.

Flows and flood levels were also determined in the Dungog Council area from south of Paterson to the Gostwyck bridge, however there was insufficient topographic information for the study to define flood depths, extent, velocities and hazard in this area. Also, the characteristics of flooding in the Dungog Council area north of Gostwyck bridge to Vacy were not included.

1.4 STRUCTURE OF THIS REPORT

This study is presented in three volumes:

Volume 1 — Management Assessment and Plan (this document);
Volume 2 — Town Planning Context and Strategy, prepared by Don Fox Planning;
Volume 3 — Extension to Flood Study and Hydraulic Investigations, prepared by WBM Oceanics Australia.

Volume 1 has the following structure.

Within **Chapter 2** the characteristics of the study area are described, including land use and floodplain features. Agencies responsible for managing the floodplain, and their roles, are also discussed.

Chapter 3 outlines the community consultation strategy utilised in this study and presents the results of the community questionnaire.

Chapter 4 provides an overview of floodplain management including existing management measures, the selection of the flood planning level and funding. **Chapter 4** also describes the criteria used for the assessment of floodplain management options.

The range of floodplain management options examined is described in **Chapter 5**.

Chapter 6 outlines the Floodplain Management Plans for the Paterson floodplain within Dungog Council and Port Stephens Council areas, and summarises the recommendations of the study.

A full list of references is provided in **Chapter 7**, followed by a number of appendices.

2. THE STUDY AREA

*This Section describes the study area (shown in **Figure 2**) and its flooding characteristics.*

The roles of the main agencies responsible for floodplain works within the study area are also described

*A more detailed description of the study area's land uses, people, heritage values and vegetation is included in **Volume 2**.* Similarly, **Volume 3** and the 1997 Flood Study (**Reference 3)** provide a more detailed description of the flood behaviour of the study area.

2.1 THE LOCAL GOVERNMENT AREAS

The study area (shown in **Figure 2**) is divided between Dungog Council and Port Stephens Council. The Dungog Council part encompasses the Paterson River floodplain between Vacy (located approximately 35km north-west of the Gostwyck bridge) and the LGA boundary which is just south of Paterson.

The Port Stephens Council area is the eastern floodplain from just south of Paterson to the confluence with the Hunter River, and the area north of the Hunter River down to Green Rocks.

Maitland City Council control the western floodplain of the Paterson River, south of the Dungog LGA, and the southern portion of the Hunter River floodplain, as shown on **Figure 2**. Whilst all three councils and the DLWC contributed to the 1997 Flood Study of the Paterson River (**Reference 3**) which provides essential flooding information for the current study, only Port Stephens and Dungog Councils and the DLWC contributed to the current study.

2.2 THE CATCHMENT

The Paterson River is located within the Lower Hunter Valley. The river's source is in the Barrington Tops and flows in a general north-south direction to its confluence with the Hunter River near Morpeth. It's largest tributary, the Allyn River, is also sourced in the Barrington plateau and flows parallel to the Paterson River before joining at Vacy.

The Paterson River catchment is long and narrow and covers an area of approximately 1,000km^2. The steeper areas are characterised by forests, with pastures in the remainder of the catchment.

Initially a steep mountain stream, the river flattens out with major floodplains starting to develop downstream of Paterson township. These floodplains occur intermittently, separated by ridges which have a controlling influence on flood flows. From a few kilometres upstream of Woodville, the floodplains are substantial all the way downstream to the Hunter River.

2.3 FLOODING CHARACTERISTICS

2.3.1 Sources of Flooding

The Paterson River can flood from a number of sources:

- one source of flooding results from high rainfalls over the Paterson River catchment, which can often lead to short duration floods, with little warning time. This type of flooding is more commonly experienced in the upper catchment.

- a second source of flooding results from widespread rainfall over the Hunter Valley, which produces elevated flood levels in the Hunter River that can flood the lower reaches of the Paterson River, and also restrict the free flow of water from the Paterson.

- a third source of flooding results from localised rainfall occurring over low lying areas within the lower parts of the study area, where drainage to the river is hindered by elevated river levels or other restrictions.

Flooding can and does occur through a combination of the above sources.

2.3.2 Previous Floods and Flood Mitigation Works

Flooding affects the townships of Paterson, Woodville and Hinton, and the various rural residences dispersed throughout the floodplain. The valley's rich alluvial soils support a highly productive agricultural community and there is significant potential for destruction of crops, pasture and infrastructure by inundation, and the loss of alluvial land by river bank erosion.

The largest flood recorded in the upstream catchment, at Paterson, was the 1978 flood. This resulted from high rainfall over the Paterson River catchment. The duration of flooding was relatively short, and there was little warning of the flood.

The largest flood recorded in the lower catchment, around Woodville and Hinton, occurred in 1955 when the worst flood in living memory was experienced on the Hunter River.

Figure 2 - Study area (a4 colour - front)

Figure 2 - Study area (a4 colour - back of page)

Following the 1955 flood, a series of flood mitigation works were constructed, as part of the Lower Hunter Valley flood mitigation scheme. The scheme includes 160 km of levees and spillways, 175 floodgates and 40 km of control and diversion banks and drains throughout the Lower Hunter, Paterson and Williams Valleys. However the levees serve only to provide flood protection in the smaller more frequent floods.

One of the components of the Lower Hunter Valley Flood Mitigation Scheme is the Swan Reach spillway, which is located on the banks of the Lower Paterson River. This spillway is 650–700 m long and operates when floods in the Hunter River restrict the discharge of floodwaters from the Paterson River. The spillway controls the discharge of floodwaters over the eastern bank of the Paterson River into low lying farmland and swamps behind the levee system. Rehabilitation of the spillway has previously been necessary to maintain its structural integrity.

Another feature that has an influence on flood behaviour is Scotts dam, located on the eastern floodplain just upstream of Hinton. Flood levels in the vicinity of Woodville appear to be strongly influenced by this feature, which restricts the free flow of floodwaters on the eastern floodplain from draining to McClement Swamp.

2.3.3 Simulation of Design Floods

A comprehensive description of flooding in the study area is available for selected design flood events, namely the 5%, 2%, 1%, 0.5%, 0.2% annual exceedance probability (AEP) and extreme flood (EF) events. This has been derived from the 1997 flood study (**Reference 3**) and the recent extension to this flood study (**Volume 3**).

As would be expected, flooding characteristics within the upper portion of the study area are dominated by floods originating from the Paterson catchment whilst the lower study area is dominated by Hunter River flooding.

Depth and velocity details at the peak of each of the design floods have been mapped as part of a geographical information system (GIS) set up for this study. At the time of preparation of this report, digital data from the GIS was being transferred to each Council's computer system for future reference. Examples of the range of flood mapping possible from the GIS are provided in **Volume 3**.

The frequencies of flood levels at four key locations within the study area are shown in **Figure 3**. Of particular importance is:

- the extensive flood range in the upper part of the study area. At Gostwyck Bridge for example, the difference between the 1% AEP flood level and the extreme flood level is 7.5m, i.e. over three building storeys. This could lead to extensive building damage (including complete destruction). It also has important ramifications for emergency management, given the propensity for evacuation routes from isolated houses to be cut and, where these houses are

located on low 'islands', the possibility that total inundation of the island may subsequently occur in very large flood events;

- the variation in the flood range between the upper and lower parts of the study area. At Hinton for example, the difference between the 1% AEP level and the extreme flood level is only about one building storey (2.6m). As both Councils have previously applied a 0.5m freeboard when setting floor levels, the resulting floor level has a differing probability of inundation in the lower and upper parts of the study area.

2.3.4 Hazardous Flood Areas

Velocities of up to 3m/sec can occur in the River and floodplain during a 1% AEP event. Generally the higher velocities are located close to the River and lower velocities occur on the floodplains away from the River. In addition there are many backwater areas such as McClement and Woodville swamps which act as large storage areas for floodwaters and may have negligible flow velocities during the peak of a river flood.

Some of the overbank areas can carry significant flows during major flood events and these areas have been classified as 'floodway' (refer Floodplain Development Manual, **Reference 1**).

Further, where the product of depth and velocity exceeds threshold values as defined in **Reference 1**, conditions hazardous to property and persons will exist. The extent of these areas has also been defined for a range of flood events and mapped in **Volume 3**.

2.3.5 Inundation of House Floor Levels

Estimates of the numbers of houses inundated in the urban and rural parts of the study area have been prepared as part of the work reported in **Volume 3**. (Maps of the location of these properties have been provided directly to each Council).

During the 1% AEP flood event, approximately 51 houses are inundated above floor level, with 44 of these located in the Port Stephens LGA and 7 in the Dungog LGA.

Within the Port Stephens LGA, at the 5% and 20% AEP flood levels, 20 and 4 houses, respectively, have their floors inundated. However in the Dungog LGA, there appear to be no house floors inundated at these AEP flood levels within the study area.

2.4 TOWNS AND VILLAGES WITHIN THE STUDY AREA

The township of Paterson and the smaller villages of Woodville, Iona and Hinton are located within the study area and are affected by flooding. Other villages at Martins

Creek and Vacy are also affected however whilst flood information is presented for these villages within **Volume 3**, these villages lie outside the study area for the Floodplain Management Study.

figure 3 front

fig 3 back

The town of Wallawong lies on higher ground to the north of Hinton and is largely unaffected by flooding.

2.4.1 Paterson

Paterson is the largest of the flood affected settlements within the study area. It is a rural village located on a bend of the Paterson River, about 23km upstream of the confluence of the Paterson and Hunter Rivers. Paterson was first established as a private town in the 1830s, and has many fine historic buildings. The township is located on generally higher ground and there appears to be only two houses on the outskirts that are inundated above floor level during the 1% AEP event.

Most importantly, access into and out of the town during flood events is not possible in moderate flood events (one metre of floodwaters over road to south and two metres over road to north in 5% AEP events).

2.4.2 Woodville and Iona

Woodville, which was once a river port, is a smaller rural community located on the Paterson River about 9km upstream of the confluence with the Hunter River. Iona is located about two kilometres to the north of Woodville and both areas are extensively inundated during 1% AEP events. Iona contains some pockets of higher ground which may be surrounded by flood waters (and form islands) during large and extreme flood events.

There are approximately 20 residences that are flooded above floor level in a 1% AEP event in the area. The principal evacuation route is to the east (Seaham Road) however this is cut on the eastern and western fringes of Woodville during a 5% AEP event.

2.4.3 Hinton

Hinton is located to the north-east of the confluence of the Paterson and Hunter Rivers.

The town has a population of several hundred people. All but approximately 10 houses have their floor levels located above the 1% AEP flood level. Whilst most of the town is on higher ground above the extreme flood level, it can be surrounded by floodwaters during events smaller than 5% AEP. For example, during a small flood in 1998, the town was isolated for 8 days and access was only possible by boat.

2.5 AGENCIES RESPONSIBLE FOR FLOODPLAIN WORKS

Those agencies responsible for managing the floodplain, and their respective roles, are:

- Hunter Catchment Management Trust (HCMT) — The HCMT is responsible for coordinating and facilitating a range of activities within the Hunter River catchment including flood mitigation, forestry, soil conservation, water quality and supply, and resource uses (including agriculture, mining, parks, wilderness and human settlement).

  Their primary source of income is a catchment contribution paid by landowners, and collected by councils. Funds for specific projects or activities are generally provided by the State, Federal and Local Government, normally on a cost sharing basis.

- Department of Land and Water Conservation (DLWC) — The DLWC's responsibilities overlap with many of those listed above for the HCMT, however within the Paterson River catchment the DLWC provides technical input to the HCMT, and carries out maintenance of the extensive levee and drainage system.

  Funding for maintenance of the levees and drains is provided by the HCMT.

- Local Councils — Maitland City Council, Port Stephens Council and Dungog Council each border onto the Paterson River (however only Port Stephens Council and Dungog Council areas are included in this floodplain management study). For each council, their major floodplain management responsibilities are exercised through the application of controls on new development.

- Woodville Drainage Union — is a union of local landholders, set up under an Act of Parliament, to maintain drains in the area. The Woodville Drainage Union has been responsible for drainage in the area between Stradbroke and Hinton (4,264 acres) since 1954. Drainage rates are levied annually after being set by the Board of Directors, who are elected every three years.

3. COMMUNITY CONSULTATION

The views of the community on floodplain management issues in the study area are presented in this section.

These were obtained from a variety of sources including a community questionnaire, liaison with the Floodplain Management Committee, two public meetings, and numerous personal interviews with affected landowners.

The success of any floodplain management plan hinges on community acceptance of the proposals. This can be achieved by involving the local community at all stages of the decision-making process, and includes the collection of their ideas and information, together with informing them of the issues and outcomes of the study.

All residents, business owners and landlords within the floodplain were consulted during the study. It was important to gain the community's input for the options available for minimising the danger to life and property during floods within the study area. It was also important to seek comments and feedback on the preferred options once the analyses had been carried out. Ultimately, the proposals to be adopted in the Floodplain Management Plan will need to be accepted, endorsed and 'owned' by the local people if the ultimate plan is to succeed.

3.1 COMMUNITY CONSULTATION STRATEGY

The key elements of the Community Consultation Strategy for this study were as follows:

- the preparation, distribution and analysis of a community questionnaire (see **Appendix C**) and newsletter (see **Appendix B**);
- regular meetings and discussions with the Floodplain Management Committee and Committee representatives;
- press releases in the local paper (see **Appendix E**) and coverage on the local radio station;

- an initial public meeting at Paterson to formally introduce the floodplain management process and to obtain comments and information from the community regarding floodplain issues and concerns;

- an afternoon poster display in Paterson;

- a second public meeting in Hinton to present the results of the questionnaire and explain the analysed options to the community (and other interested parties), and to seek feedback on the proposed ranking and prioritising of the options;

- interviews with business and land owners in the catchment prior to the second public meeting.

Some of the key components of the community consultation strategy are described below in more detail.

3.2 FLOODPLAIN MANAGEMENT COMMITTEE

The Paterson River Floodplain Management Committee (FPMC) was the principal link between the Consultant, the Councils, the DLWC and the community. The FPMC together with the Councils' Project Manager, overviewed the study. The following were present on the Committee:

- Port Stephens Council:
  - Deputy Mayor;
  - Councillor;
  - Senior Strategic Planner;
  - Strategic Planning Manager;
  - Strategic Engineer;
  - Drainage Engineer;

- Dungog Council:
  - Mayor;
  - Executive Manager Engineering and Environment;

- Department of Land and Water Conservation (Newcastle Office);

- Hunter Catchment Management Trust;

- State Emergency Services;

- Woodville Drainage Union.

3.3 COMMUNITY QUESTIONNAIRE

The community questionnaire was provided to all properties potentially impacted by flooding of the Paterson River within the study area. A total of 687 questionaries were distributed. An addressed, postage-paid envelope was provided to facilitate the return of the completed questionnaires. The number of responses received was 123 (or about 18%). This response is considered reasonable, particularly as the questionnaire was distributed to many properties which have never experienced flooding.

The questionnaire was divided into the following four parts:

- Part A — General Information about the Community:
- Part B — Flood Experience;
- Part C — Attitudes to Floodplain Management Options;
- General comments.

A blank copy of the questionnaire and the results from the questionnaire have been reproduced in **Appendix C** (and the newsletter distributed with the questionnaire is included in **Appendix B**). The results for Part A and Part B are discussed below. The results for Part C and comments associated with floodplain management options are discussed in **Section 4.6**.

3.3.1 Part A — General Information about the Local Community

The results from Part A of the questionnaire highlighted the fact that a large proportion of the population are long-term residents. Over 34%of the respondents have lived in the area for more than 20 years, while more than 64% of the respondents have lived in their homes for more than five years. Approximately 80% of the respondents either own or are paying off their house. With respect to land development, 25% indicated that they have taken steps to obtain approvals for further development.

3.3.2 Part B — Flood Experience

The questionnaire revealed the following information about the flood experiences of respondents:

- 52% of respondents had experienced their property being flooded;
- 3% of respondents had experienced a flood above floor level;
- 41% of respondents either had no warning of the arrival of the biggest flood or witnessed it with their own eyes; and
- 3% of respondents were evacuated from their homes in the biggest flood experienced.

Only 7% of respondents received flood information about their property through ‘official' sources such as Council Section 149 Certificates.

3.4 COMMUNITY CONCERNS

Based on the questionnaire responses, interviews and the initial public meeting (held on 2 September 1998), the principal comments and concerns voiced by the community have been summarised below.

River Bank Stability

Stability has been adversely impacted by:

- removing of willows before replacement vegetation has been established;
- speed boats;
- cattle on the river banks;
- black plastic used for bank stabilisation was stopping vegetation growth;
- mowing/slashing of the levees/banks removing vegetation.

Sediment Transport/Deposition

- sediment deposition has reduced the capacity of the river channel to convey flows, and sediment deposition has been exacerbated by upstream straightening of the Allyn River.

Flood Warning

- flood warning is critical for reducing property damage and losses;
- recent flood warning has been inadequate and unreliable.

Development on the Floodplain

- new residents are uninformed of the flooding problems;
- there should not be any development on the floodplain;
- development on/near the floodplain inhibits the refuge of stock in times of flood.
- urban development close to rural areas causes conflicts (e.g. noise, smell, traffic disruption etc).

Levee and Local Drainage Issues

- there should be local raising of levees to provide greater protection;
- drainage from behind the levees needs to be improved.

It has not been possible or appropriate for the current study to address all of the above issues. In particular, the current study is focussed on providing solutions to existing flooding problems in developed areas and ensuring that new development is compatible with the flood hazard and does not create additional problems. There are various other studies and programs (funded by the Government and the Councils) which are considering many floodplain issues, including those listed above.

4. OVERVIEW OF FLOODPLAIN MANAGEMENT

Key items discussed in this Section include:

- *existing floodplain management measures (**Section 4.1**);*
- *the proposed approach to setting flood planning levels (FPL). This is to be based on a 'graded' set of controls defined in a 'planning matrix' (rather than the traditional approach of using controls based on a single FPL). Refer to **Section 4.2**;*
- *sources of floodplain management funding and how to apply for it (**Section 4.3**). A funding application pro forma is provided in **Appendix D**. Applications are to be submitted to the DLWC before April each year ;*
- *assessment criteria used for the evaluation of floodplain management options (**Section 4.5**); and*
- *community perceptions of the various options (see **Tables 2** and **3**).*

4.1 EXISTING FLOODPLAIN MANAGEMENT MEASURES

There are a range of works and measures already in place in the study area. These are briefly discussed below.

4.1.1 Planning and Development Controls

The following planning instruments and policies apply to the study area and influence the management of development on the floodplain. Many of these are reviewed in **Volume 2**. Flooding is a consideration, but is not generally the principal focus of these instruments/policies.

- State Environmental Planning Policies (SEPP's);
- Regional Environmental Plans (REP's);
- Advisory Circulars (issued by DUAP);
- Section 117 Directions covering the rezoning of land;
- Environmental Planning Instruments (LEP's);
- Development Control Plans (DCP'S);
- Council Policies;
- Development Application Assessment.

4.1.2 On-Site Stormwater Detention (OSD)

Neither Port Stephens Council nor Dungog Council currently have general OSD requirements. However OSD may be required in special circumstances.

4.1.3 Flood Warning

A flood warning system has been established in the Lower Hunter Valley for many years. Part of the system includes telemetered stream gauges located at Gostwyck Bridge (on the Paterson River) and Maitland and Oakhampton on the Hunter River.

Gauge information from the Lower Hunter system is communicated to the Manly Hydraulics Laboratory in Sydney, and the information is also accessed by the Bureau of Meteorology.

The Bureau of Meteorology provides flood warnings for the Gostwyck and Maitland areas, however not for those areas on the Paterson River downstream of Gostwyck, which include Paterson township, Woodville and Hinton. Flood levels in this lower area of the Paterson River are a function of both the Paterson River and Hunter River flows and at present there is no reliable flood prediction system. As a result, flood warnings are not available for the lower Paterson River.

4.1.4 House Raising/Moving

A number of houses on the lower Paterson River floodplain, particularly around Woodville and Hinton, have been raised or relocated to higher ground. In some instances mounds have been constructed and then the houses have been relocated to these mounds.

4.1.5 Lower Hunter Valley Flood Mitigation Scheme

Various works were constructed in the lower Hunter and lower Paterson valleys following the devastating floods of 1955. The flood mitigation basis and precis function of all of the works is not clearly understood. The principal works within the study area comprise:

- Swan Reach spillway — this allows controlled overtopping of the eastern bank of the Paterson River between Hinton and Woodville apparently to maximise overbank storage of flood waters and to reduce downstream flood levels;

- Scotts Dam — a barrier to flood flows on the eastern overbank of the Paterson River about two kilometres upstream of Hinton. The structure increases floodwater pondage apparently to reduce flood impacts downstream; and

- various river levees. These are constructed in many locations in the study area. The original year of construction is not known in most cases, and many

may have existed in some form prior to the 1955 flood. Ongoing maintenance and remedial works have also been carried out at various times since 1955. Whilst numerous enquiries have been made with the DLWC and the HCMT, it has not been possible to definitely establish the standard of flood protection afforded by the existing levee system. However, it appears to be generally accepted that the levees overtop on average every two to ten years.

4.2 SELECTION OF THE FLOOD PLANNING LEVEL

4.2.1 Issues Affecting Selection of FPL

The flood planning level (FPL) (previously known as the 'designated flood' level or 'flood standard') is the flood level selected for planning purposes, and will directly determine the area of land that should be subject to flood-related building and development controls (**Reference 1** and **2**).

Selection of the FPL is one of the most critical decisions in floodplain management, and is not an easy one. It should be based on an understanding of the flood behaviour, together with the balancing of social, economic and environmental consequences of flooding (including the potential for property damage and the risk to human life). Traditionally, only one FPL has been selected for a particular area, but current thinking is to consider more than one FPL for different types of development or locations within the floodplain.

Selection of the FPL needs to balance short-term gains against long-term problems, for example:

- if the FPL is too low — large numbers of properties may suffer quite frequent inundation with corresponding high flood damage bills. As more and more development occurs, damage bills will get higher and higher over time;

- if the FPL is too high — properties that would be rarely flooded may be subjected to unnecessarily restrictive development and building controls.

The 1% AEP flood was adopted as a mandatory FPL in New South Wales in 1977 following a series of major floods that caused considerable devastation. The majority of these floods had annual exceedance probabilities between 2% and 1%. The 1% AEP flood was therefore seen as indicative of a 'big flood' with a potentially high damage bill. However, in late 1984, the NSW Government abandoned the policy that the 1% AEP flood should be the mandatory FPL. At that time it became the responsibility of local councils to determine a FPL appropriate to local conditions and the local community (**Reference 1** and **2**).

Both Dungog and Port Stephens Councils have previously adopted the 1% AEP flood as their FPL on an interim basis for the study area, pending the outcome of a future floodplain management study (i.e. the current study).

4.2.2 Shortcomings of the Singular FPL Approach

The adoption of a singular FPL which is much higher than the 1% AEP level may be unduly restrictive for some types of land uses. For example, whilst it may be appropriate for some land uses, such as a hospital, to be located above a PMF flood, it could be argued that residential, agricultural or recreational land uses do not require such restrictive controls.

Also, the adoption of a FPL causes misconceptions by the community regarding flood risk. Most importantly, residents within the floodplain (i.e. the area below the PMF) but above the FPL, often mistakenly believe they are not at risk from flooding.

As a result, consideration has been given to a new approach which does not rely on the definition of a singular FPL.

4.2.3 Proposed Approach for the Study Area

To overcome the shortcomings noted above, a 'graded' set of controls which consider the variation of damage risk with flood frequency and land use, has been proposed for the study area. These are contained in a 'Planning Matrix' which is presented in **Volume 2** (Appendix B for the Port Stephens Council area and Appendix C for the Dungog Council area — the matrix for each Council area is consistent with the other).

A description of these controls is also provided in **Volume 2**. The controls do not rely on the definition of a singular FPL. In essence, the approach makes use of a range of FPL's for various land uses within the flood prone land below the PMF, without specifically referring to this term.

Within the planning matrix, the selection of the controls and the various flood conditions at which the controls apply, has been based on:

- the procedures and philosophy espoused in the Government's Floodplain Development Manual (**Reference 1** and **2**);
- consideration of the social, economic and environmental impacts of flooding and the proposed controls;
- investigations carried out within the current study;
- views expressed by the Floodplain Management Committee and various senior officers within each Council and the DLWC;
- community attitudes expressed during the current study;
- minimising both Councils' exposure to legal actions in relation to flooding;
- the Councils' existing interim flood policies and FPLs; and
- experience gained from the development of planning controls and flood policies for various communities across NSW in recent years.

4.2.4 Proposed Changes to the FPLs

Some of the most significant changes within the new controls are the revisions to FPLs. A detailed description of the implications of these changes is presented in Section 5.5 of **Volume 2**. In particular, in relation to floor and pad levels:

- the existing minimum floor level of 0.5m above the 1% AEP flood level for most residential development will be altered to the 0.5% AEP flood level. This will have different implications across the floodplain because of the differing gradients of the 1% AEP and 0.5% AEP floods, as shown on **Figure 3**. In effect, minimum floor levels will be lowered at Hinton by about 0.3m and raised at Gostwyck by about 1m;

- land uses which may be more sensitive to flood impacts will have higher FPLs and less sensitive land uses will have lower FPLs when compared with residential developments. For example, critical utilities and essential community services will be required to have their floor levels equal to or above the extreme flood level, whereas the floor levels of recreational or agricultural buildings will be required to be at or above the 5% flood level;

- fill pads to the 5% AEP level will be required for residential development in rural areas. However such pads will not be required in urban areas due to local amenity and town planning impacts.

It needs to be recognised that even after the proposed controls are implemented, new development may still be subject to flooding albeit on very rare occasions. For example at Gostwyck, the extreme flood level is approximately 6m above the 0.5% AEP level proposed as the minimum residential floor level. As one moves downstream, this differential reduces to approximately 2m at Hinton.

4.3 SOURCES OF FUNDING FOR FLOODPLAIN MANAGEMENT

4.3.1 Council Funding

Due to the role of the HCMT and the DLWC in managing the Paterson River floodplain it has not been necessary for Port Stephens Council or Dungog Council to commit expenditure on flood control works along the Paterson River in recent years.

4.3.2 Traditional State and Federal Government Funding

The NSW Government provides subsidies to Councils for the implementation of flood mitigation works and measures recommended in a Council's floodplain management plans through two sub-programs:

- the Commonwealth Subsidised Flood Mitigation Program where the project is funded through a partnership agreement between the Commonwealth, State and Local Government. Traditionally this has been on a 2:2:1 basis (Commonwealth: State: Council), however more recently funding ratios have varied with the Commonwealth Government generally funding 33% and the State Government between 33% and 44%, and Councils between 22% and 33%; and

- the State Only Capital Sub-Program where the project is funded through a partnership agreement between the State and Local Government. Traditionally this has been on a 2:1 basis (State: Council).

The partnership agreement between the Commonwealth, State and Local Government is subject to ongoing review and the traditional funding ratios outlined above, along with the funding commitments, can not be guaranteed into the future.

The annual contribution to flood mitigation programmes is limited and there is strong competition for these funds. Dungog Council and Port Stephens Council would have to compete for funding alongside other flood-affected local government areas. At this stage it is unknown how Dungog's and Port Stephens' proposed projects would be prioritised.

4.3.3 New Funding from Department of Transport and Regional Services

In 1999/2000 a new Commonwealth Government Flood program commenced. The Commonwealth Department of Transport and Regional Services (DTRS) runs this program, called the Regional Flood Mitigation Program, in conjunction with the DLWC in NSW. It is concerned with the funding of flood mitigation works and flood warning systems. The grant application process is as follows:

- The DTRS sends advice to all local government authorities calling for expressions of interest in submitting applications for projects under the program. This advice is also advertised in the major newspapers;
- expressions of interest are received (in February) by the DLWC on behalf of DTRS. These applications are processed and additional information gathered, where necessary, and collated;

- the applications are then assessed by a State Assessment Panel (SAP) and a short list is produced from which Councils are invited to submit a full application;

- full applications are submitted and assessed by the panel with the SAP making recommendations to the Minister for Land and Water Conservation who then makes recommendation to his Commonwealth counterpart.

Considerations include such issues as overall project benefits and costs, project readiness, environmental clearance and relative priorities statewide.

4.3.4 Applications for Funding

When applying for funding for works recommended in floodplain management studies, councils have to complete a pro forma that describes the proposed project. The format of the pro forma changes slightly from year-to-year, however the basic assessment criteria tend to remain the same. The following information needs to be included in the pro forma:

- project identification, description and costs;
- benefit-cost ratio;
- flood hazard level;
- average annual damage;
- damage in the project design flood;
- community involvement;
- strategic planning implications;
- local contribution to funding;
- total catchment management compatibility;
- summary of benefits and costs associated with the works;
- method used for estimation of flood damages;
- project readiness.

A copy of the year 2000 pro forma has been provided in **Appendix D**. When Councils complete this, consideration should be made into separating independent portions of projects in funding requests. This allows priority works with better benefit–cost ratios to be placed higher on the priority list.

Completed pro formas need to be submitted to the DLWC before April each year. These are passed on to the Floodplain Management Authorities (FMA) working group who review and collate the information for all submitted projects.

Prioritisation of the projects is undertaken at the annual FMA conference in May. The collation of all submissions then becomes part of the overall State bid for funding from the Commonwealth.

4.4 RANGE OF MANAGEMENT OPTIONS AVAILABLE

Potential floodplain management options for the study area can be divided into three categories:

- options which modify the way a flood behaves by reducing flows (e.g. changing the operation of Lostock Dam), increasing the conveyance of the channel and floodplain (e.g. channel widening and deepening), or restricting the flood extent (e.g. levees);

- options which minimise the damage at individual properties by modifying the properties (e.g. house raising or flood proofing); and

- options which reduce damages by improving the way that people and organisations respond to floods (e.g. providing improved flood warning).

Within these three categories, twenty different options have been identified for closer investigation. Each option is described and evaluated in Chapter 5.

The twenty options have been identified from:

- suggestions put forward by the community in their questionnaire responses, at the public meetings or through personal contact;

- consultation with the Floodplain Management Committee and senior officers of the Councils and the DLWC; and

- the experience of the Consultant team and investigations carried out during the study and in previous studies.

The generic criteria against which each of the options have been evaluated (in **Chapter 5**) are discussed in the following section.

4.5 CRITERIA FOR EVALUATION OF OPTIONS

In evaluating potential floodplain management options within the study area, a range of assessment criteria have been used. These include:

- ***financial feasibility***.

  Options proposed within the floodplain management plan must be capable of being funded. Sources of funds for implementation of the plan have been discussed in **Section 4.3**.

- ***economic merit***

  The ratio of the benefit divided by the cost (i.e. the benefit–cost ratio) is a common measure of assessing economic feasibility. Theoretically, no investment should be made on an option if the benefit/cost ratio does not exceed unity (i.e. if the benefits do not exceed the costs). However, traditionally many floodplain management options have been undertaken where this is not the case because the intangible benefits, (i.e. those not able

to be quantified), are considerable. Benefit–cost ratios can also be useful in ranking competing options.

- ***community acceptance***

  Assessment of possible community attitudes towards any proposed floodplain management options is essential. If community attitudes are strongly negative, this is often enough to deter the implementation of the proposals which otherwise may have significant merit. The community's attitude to the various options are discussed in the following section.

- ***environmental impact***

  Floodplain management options involving structural works may often have significant environmental impacts. Impacts on vegetation, visual amenity and soil erosion/sedimentation, are issues which must commonly be addressed when evaluating works within watercourses.

- ***impact on flood behaviour***

  The impact on flood behaviour caused by the option needs to be considered for upstream and downstream locations. These impacts can include such things as changes in flood levels, changes in velocities or alteration of flow directions.

- ***performance during large floods***

  All options must be assessed in the knowledge that large floods, i.e. larger than (say) the 1% AEP flood, or larger than any known historical flood, will happen at some time in the future. It is therefore imperative that the options do not expose the community to unacceptable risks by providing a false sense of security.

- ***technical feasibility***

  If the proposed options involve structural works, these works must be able to be constructed and be free from major technical constraints.

- ***political/administrative impact***

  Any recommended option will have more chance of success if it involves little if any disruption to current political and administrative structures, attitudes and responsibilities. There are also various strategic objectives which the Councils and other authorities have concerning development within the study area.

4.6 COMMUNITY PERCEPTIONS OF THE FLOODPLAIN MANAGEMENT OPTIONS

Community concerns regarding the future management of the floodplain are discussed in **Section 3**, and in particular, **Section 3.4**. Their attitudes to the range of potential floodplain management options under consideration within the study have been assessed through:

- community representation on the Floodplain Management Committee;
- the community questionnaire;
- the afternoon display in Paterson;
- public meetings at Paterson and Hinton; and
- personal discussions with individuals.

4.6.1 Community Questionnaire

Part C of the community questionnaire asked people to indicate which floodplain management options they favoured. Their responses have been collated and are presented in **Tables 1** and **2**. **Table 1** lists the options from the questionnaire which were most favoured by the community, while **Table 2** lists the options which were opposed most strongly.

The most highly favoured options related to the provision of flood information to residents. These options are aimed at raising the flood awareness of the community. There appears to be no doubt that the community wants to know what the flood risk is in the valley and are concerned that new residents who have not experienced flooding first-hand may be ill-informed of the potential risks.

Improvements to the drainage system ranked highest on the list of possible works identified from the questionnaire responses. Whilst the levee system provides important flood protection to rural activities, in some cases the levees inhibit drainage of the floodwaters after a flood and this increases damage to crops and prevents access to and restoration of flood affected land.

Improved planning controls to provide an equitable assessment of future development in a manner consistent with the flood risks was also highly favoured by the community, as was improved flood warning.

Respondents to the questionnaire were opposed to flood proofing of individual properties or other temporary measures to provide protection to individual

properties. Council purchase of flood affected dwellings and house raising were also opposed.

TABLE 1: QUESTIONNAIRE OPTIONS MOST FAVOURED BY THE COMMUNITY(TO MINIMISE THE EFFECTS OF FLOODING)

OPTION	PERCENTAGE OF RESPONDENTS IN FAVOUR
Providing information about the potential risks of flooding to all residents and business owners	81%
Installation of flood marker poles	80%
Controls on future development in flood-liable areas	67%
Improvements to the drainage system behind the river banks	67%
Make sure residents and business owners have flood action plans	67%
Improvements to flood warning	67%
Public education	60%
Provide flood affectation certificates to all residents	59%
Construction of permanent levees	56%
Widening/dredging of the river	51%

TABLE 2: QUESTIONNAIRE OPTIONS OPPOSED BY THE COMMUNITY (TO MINIMISE THE EFFECTS OF FLOODING)

OPTION	PERCENTAGE OF RESPONDENTS AGAINST
Flood proofing of individual properties	41%
Building of temporary levees during floods	37%
Council purchase of the most severely affected flood-liable land	37%
Raising of houses above the 100 year flood level	28%
Widening/dredging of the river	20%
Improve emergency plan	19%
Use of infiltration trenches	15%
Construction of permanent levees	14%

4.6.2 Public Meetings

Community perceptions were also obtained from the two public meetings. The initial public meeting was held on 2 September 1998 at the Paterson School of Arts Hall, and was attended by approximately forty residents and Council representatives. The floodplain management process was explained and community concerns and input received with respect to flooding and floodplain management (summarised in **Section 3.4**).

A second public meeting was held on 11 March 1999 at the Hinton Hall which was attended by approximately fifty residents and Council representatives. Floodplain management options were described and preliminary recommendations presented. Feedback was sought on the community's attitudes to these options and recommendations.

The response at this second meeting was a general appreciation of the flooding problems in the catchment and favoured most of the recommendations presented. None of the option recommendations presented elicited a negative response. However, the following responses were noted:

- a few people considered that the levees should be raised, with others commenting that the levees should be lowered (the recommendation is to maintain the levels of existing levees — Options 1.1 and 1.2, see **Sections 5.1.1** and **5.1.2**);

- several people commented that Scotts Dam should be removed (the recommendation is to retain Scotts Dam — Option 1.3, see **Section 5.1.3**);

- a number of people considered that a flood storage compartment should be created in Lostock Dam (the study has shown that it is not practical to create sufficient flood storage in Lostock Dam to have a noticeable impact on flood behaviour — Option 1.7, see **Section 5.1.7**);

- a number of people considered that there should be no new development on the floodplain (the recommendation is development should be controlled in accordance with the proposed building and development controls — Option 2.3, see **Section 5.2.3**);

- it was questioned whether flood free road/bridge access for Hinton could be constructed, and whether the proposed option of "no further development in Hinton" was appropriate (the study has shown that it is not practical to improve road access to Hinton — Option 3.6, see **Section 5.3.6**, and that further development of Hinton should be constrained in accordance with the proposed planning controls — Option 2.3).

- a request was also made that the installation of pumps to improve local drainage in the rural areas be examined. The Councils' technical subcommittee considered that analysis of the option would be of assistance to the community and the Woodville Drainage Union in particular. However as the pumping option was not something the Councils would fund and was outside the scope of the Floodplain Management Study, the analysis of this option has been presented in **Appendix G**, and has not been formally included within the options evaluated in **Chapter 5**, or the draft Floodplain Management Plans prepared for each Council.

5. ASSESSMENT OF OPTIONS

The assessment of the twenty floodplain management options considered during the study and the recommendation of those options to be included in the Floodplain Management Plans are presented in this Section.

5.1 OPTIONS WHICH MODIFY FLOOD BEHAVIOUR

5.1.1 Raise Existing Levees (Option 1.1)

Findings — Option 1.1 is not recommended for further consideration.

The lower Hunter, Williams and Paterson Valleys are protected from high probability flood events by a complex levee system built and maintained by the Public Works Department (now DLWC) under the Hunter Valley Flood Mitigation Act 1956 (see **Section 4.1.5**).

The DLWC has assumed overall control for the design and maintenance of the scheme which includes over 160km of levees and spillways, 175 floodgates and 40km of control and diversion banks.

To provide a higher level of flood protection for properties along the Paterson River, raising the existing levee system along the banks of the lower reaches of the Paterson River was assessed. The assessment was carried out by modifying the hydraulic model (developed for the flood study component of this study) to represent levee raising for events up to the 10% AEP (see **Volume 3**,Section 4.6.4), and determining the changes in floodplain inundation.

The model results indicate that the raising of the levees would provide little if any decrease in the area of land inundated, since much of the inundation is caused by local catchment flows from behind the levees.
Other factors which dissuade implementation of this option are that:

- the DLWC carried out a major review and reconstruction program on the Lower Hunter levee system in the 1980s, and consider that the existing levee levels are appropriately designed;
- locally raising sections of the levee would provide selective protection only and may disadvantage landowners within adjacent areas where levees were not raised; and
- a recent geomorphological study carried out on the Lower Hunter River (**Reference 6**) recommends that the levees should be selectively lowered to reduce sediment transportation along the rivers.

There appears to be little if any advantage in implementing this option, and it is therefore not recommended.

5.1.2 Lowering Existing Levees (Option 1.2)

Findings — Option 1.2 is not recommended for further consideration.

Lowering of the levees could provide benefits such as:

- reducing sediment transportation along the Paterson River, in accordance with a recent geomorphological study carried out on the Lower Hunter River (**Reference 6**);
- enriching floodplain fertility by allowing increased sediment and nutrient deposition; and
- improving drainage of areas behind levees.

However, lowering of the levees is not recommended since it would increase the inundation frequency of rural lands, and as discussed in **Section 5.1.1**, it is contrary to the levee design of the DLWC. It may also expose a Council to liability claims if damage was exacerbated by such action.

5.1.3 Remove/Modify Scotts Dam (Option 1.3)

Findings — Option 1.3 is not recommended for further consideration.

Scotts Dam is a levee which forms part of the Lower Hunter flood mitigation scheme (discussed in **Section 4.1.5**) and is located at the downstream extent of the Woodville-Wallalong levee and immediately upstream of Swan Reach Spillway.

Scotts Dam obstructs flows on the eastern floodplain of the Paterson River, and the hydraulic impacts of its removal were assessed by modifying the hydraulic model developed for the flood study component of this study (see **Volume 3**, Section 4.6.2).
The model results indicate that removal of Scotts Dam would provide significant lowering of upstream flood levels (0.6m in the 1% AEP flood), however, as a consequence downstream flood levels would be increased (0.3m in the 1% AEP flood).

In addition to increasing downstream flooding, other disadvantages of removing Scotts Dam include:

- altering the overall flooding ‘balance' established by the Lower Hunter Valley flood mitigation scheme;

- impacting on road access (i.e. Clarence Street) for the Wallalong area, which is currently along the crest of Scotts Dam. (This however is not a major issue as Wallalong Road would also likely be flooded).

Although the cost of removing Scotts would be low, it is considered that the reasons for retaining Scotts Dam outweigh the benefits which would be gained by its removal, and therefore this option is not recommended.

5.1.4 Widening and Deepening of the Paterson River (Option 1.4)

Findings — Option 1.4 is not recommended for further consideration.

An option to reduce inundation of the floodplain would be to increase the waterway capacity by dredging of the Paterson River. This could be achieved by widening and deepening of the River. The hydraulic effects of this option were assessed by modifying the hydraulic model developed for the flood study component of this study (see **Volume 3**, Section 4.6.3).

The model results indicate that major dredging of the Paterson River, involving a 30% increase in cross sectional area between the river banks (1.1 million m^3 of excavation) would provide only limited flood benefits with the number of houses inundated in the 1% AEP event only reduced by three (from fifty one for existing conditions, to forty eight).

The initial dredging cost alone would be approximately $10M to $20M, and ongoing dredging would be necessary to maintain the enlarged waterway area. The geomorphological impacts would need to be considered before such works could be undertaken, and it is considered that such a dredging program would not be approved by the DLWC.

This option is therefore not recommended for further consideration.

5.1.5 Dredging of the Hunter River (Option 1.5)

Findings — Option 1.5 is beyond the scope of this study.

A recent study on the geomorphology of the Lower Hunter River (**Reference 6**) indicates that large volumes of sediment are transported along the river system with significant deposition (four metres of sand for more than one kilometre over the past 20 years) having occurred at Green Rocks.

This option is beyond the scope of this study as the works and benefits are largely outside the study area. However we understand that the HCMT and DLWC are considering selective excavation of point bar deposits along the Hunter River as a measure to control scouring (which would have little impact on reducing flood levels).

5.1.6 Constructing Upstream Flood Retarding Storages (Option 1.6)

Findings — Option 1.6 is not recommended for further consideration.

Preliminary assessment of providing a flood retarding storage upstream of Vacy to mitigate flows up to the 1% AEP event, indicates that two very large basin structures would be necessary, one on the Paterson River and the other on the Allyn River.

The required combined flood storage volume would be of the order of 134GL (which is more than six times the storage capacity of existing upstream water supply dam Lostock Dam).

Provision of such a large storage would effectively only reduce flooding upstream of Iona since further downstream flooding is dominated by the Hunter River.

It is estimated that construction of the storages (with PMF spillway capacity requirements) would cost in excess of $50M.

Based on construction cost, limited downstream benefit and environmental concerns, this option is not favoured.

5.1.7 Creating a Flood Storage Compartment in Lostock Dam (Option 1.7)

Findings — Option 1.7 is not recommended for further consideration.

Lostock Dam is located on the Paterson River and commands approximately 25% of the catchment upstream of Vacy.

By itself, this dam is unlikely to provide sufficient flood storage to have any noticeable impact on downstream flood behaviour because:

- flows from the large upstream catchment of the Allyn River would remain uncontrolled; and

- as discussed in **Section 5.1.6**, the volume of storage required to effectively mitigate the 1% AEP flood is approximately six times the storage capacity of Lostock Dam.

Apart from the cost of providing the additional storage, Lostock Dam is a dedicated water supply dam and providing flood storage in the dam may compromise its water supply capacity.

This option is not favoured based on cost, the limited downstream benefit and the loss of water supply

5.1.8 Council Endorsement of Scour Protection, Bank Stabilisation Works and Vegetation Management (Option 1.8)

Findings — Option 1.8 is recommended.

Concern regarding these matters has been expressed by the community during the course of this study, and these works are considered to be of significant importance with respect to flooding along the Paterson River.

However, scour protection, bank stabilisation works and vegetation management are currently funded and carried out by the HCMT and DLWC, and are outside the core responsibility of the Councils.

Therefore it is recommended that the Councils fully endorse the operations of the HMCT and DLWC in these areas of work. In doing so it would be considered advantageous for the Councils to formalise procedures so as to have regular and ongoing liaison with the HCMT and DLWC, to inform them of any specific works which may be necessary, and to receive progress information on maintenance programs that could be conveyed to local landholders.

5.1.9 Council Endorsement of Levee Maintenance (Option 1.9)

Findings — Option 1.9 is recommended.

In a similar manner to the works outlined for Option 1.8 above, ongoing levee maintenance is a major community concern identified during the course of this study. This work is important to maintaining the integrity of the lower Hunter Valley flood mitigation scheme along the Paterson River.

Levee maintenance is currently funded by the HCMT and carried out by the DLWC, and is outside the responsibility of the Councils.

As for Option 1.8, it is recommended that both Councils fully endorse the operations of the HMCT and DLWC in this work. Again, in doing so it would be considered advantageous for the Councils to formalise procedures so as to have regular and ongoing liaison with the HCMT and DLWC, to inform them of any specific works, and to receive progress information on maintenance programs from these departments that could be conveyed to residents.

5.1.10 Council Endorsement of Drainage Channel Maintenance (Option 1.10)

Findings — Option 1.10 is recommended.

Many of the landholders expressed concern during the course of this study about prolonged land inundation and the need for regular drainage channel maintenance and drainage improvements. (Following a request from the Woodville Drainage Union (WDU) to comment on the option of providing pumps to reduce inundation time, a preliminary assessment is included in **Appendix G**).

Drainage channel maintenance is currently funded by the HCMT and carried out by the DLWC in the areas immediately adjacent to the Paterson River. Beyond those areas channel maintenance is carried out by the WDU (south of Stradbroke extending towards Hinton). As such drainage channel maintenance is outside the responsibility of the Councils.

The issue of drainage is considered to be of significant importance with respect to landuse and productivity, therefore it is recommended that the Councils fully endorse the operations of the HMCT, DLWC and WDU in this work.

It is considered appropriate that the WDU apply for funding from Port Stephens Council (on say an annual basis). Such funding would allow the WDU to extend and improve drainage.

5.2 PROPERTY MODIFICATION OPTIONS

5.2.1 Voluntary House Raising, Relocating or Demolishing/Reconstructing Severely Flood Affected Properties (Option 2.1)

Findings — Option 2.1 is recommended for further consideration, and is expected to only be applicable within the Port Stephens Council area.

The raising of timber and fibro houses has proved to be an effective floodplain management option for various locations throughout NSW. Fairfield Council has been implementing a successful house raising program in Prospect Creek for many years now, with over 100 houses being successfully raised. House raising has also been carried out in the Lake Macquarie City Council area and other parts of northern New South Wales. It has also been proposed in several recently completed

floodplain management plans, such as the Woronora River, Manly Lagoon and Wyong River floodplain management plans.

There are various forms of house raising schemes that can be considered. Obviously, the easiest form of house raising will be where houses are of either timber or fibro construction. Experience by Fairfield Council in Prospect Creek has shown that such houses can be raised by 1m-2m for an average cost of $37,000.

House relocation can be considered as a special form of house raising, except it also involves a relocation of the house to higher ground. In the Hinton district a number of houses have already been relocated to higher ground or constructed mounds.

Where houses are of brick veneer or full brick construction, the physical raising of these houses is more costly, and in most cases, impractical. Under these circumstances, variations to the traditional house raising concept may need to be considered. One solution is to build a first floor extension on top of the existing building, and convert the lower floor to a non-habitable form. A disadvantage of this option is that there will be a temptation by the owner to occupy both floors, and the objective of minimising flood damage may be lost. A second solution is to completely rebuild the house at a higher level, which may or may not be accompanied by a change in home ownership. With a change in home ownership, Council would acquire the property (if offered for sale), demolish the existing house, and sell the vacant building lot with appropriate floor level controls. Typical net costs for these options are likely to range between $60,000 to $80,000 per house.

The State and Commonwealth Government provides two forms of financial subsidy for house raising schemes. The first scheme involves a subsidy based on the full cost of house raising, where this is shown to be economically justified. This is generally the case for timber or fibro houses that are located below or close to the 5% AEP flood level. In other cases, the subsidy will be based on the first $10,000 cost to raise a particular house, with the homeowner expected to pay the difference. The rationale behind this decision is based on the assumption that it is not economical, from a flood benefit point of view, for the Government to invest addition expenditure to raise houses that are flooded infrequently, or may be expensive to raise.

There are various disadvantages associated with house raising, for example:

- steps to gain access to the house may not be suitable for older people or those with disabilities;
- other property damage within the property, e.g. damage to parked cars and equipment, may still occur;
- after raising, residents may ‘close in' any downstairs area to create further habitable areas (without Council approval) and thus increase future damage potential;
- there may be aesthetic and town planning restrictions associated with raising some houses. For example, isolated raising of some properties in a street may

not be appropriate, and it may be necessary to raise a group of properties in a street.

The above problems aside, along the Paterson River floodplain there are between 10 and 20 residences in the Port Stephens area which would currently be flooded above floor level in the 5% AEP event. Most of these residences appear to be of weather board/fibro construction, and could be raised with little difficulty. (There appear to be no residences flooded above floor level in the Dungog LGA at the 5% AEP flood level.)

Final lists for voluntary house raising are still to be determined and will require additional field survey to determine floor levels, but are likely to include houses in the Woodville and Hinton areas.

Since there is little scope for structural options to adequately modify flood behaviour, the protection of a number of residences by voluntary house raising is an option which should be considered.

5.2.2 Flood Proofing of Individual Properties (Option 2.2)

Findings — Option 2.2 is recommended where Option 2.1 and/or option 2.4 cannot be implemented.

Individual properties can be modified to reduce the impacts of flooding by the construction of flood retaining walls outside the house (similar to levees in function), waterproofing walls of houses and by placing shutters across doors and other openings. This option would be most effective for short duration floods as extended periods of inundation increase the likelihood of leaks through the waterproofing measures.

Properties which may be suited to flood proofing are largely limited to commercial properties and may be appropriate for the Hinton Hotel or Woodville garage/shop.

Measures which could be adopted include waterproof barriers, doors and gates supplemented by sandbagging.

It is recognised that this may be a labour intensive process and therefore owners may only erect these structures when wet weather is imminent. As many flood events may occur in the night or on weekends, such measures could not be relied upon to provide total protection for properties.

The works could be at no cost to the Councils, or with some Council contribution.

This option should be considered in the urban areas where option 2.1 (voluntary raising) and/or option 2.4 (voluntary purchase) is not applicable.

5.2.3 Improve Existing Building and Development Controls (Option 2.3)

Findings — Option 2.3 is recommended for further consideration.

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

Land use planning and development controls have been given significant attention in **Volume 2** of this study, and a brief summary of the principal findings and recommended planning measures is provided below:

(a) a graded set of planning controls are proposed for the floodplains within the study area. These are tailored to the proposed land use and flood level, and recognise flood risks up to and including the extreme event. **Figures 6** and **7** show the proposed planning matrices for Port Stephens Council and Dungog Council;

(b) the floodplain has been divided into four new floodplain management zones to which the controls noted in (a) would apply (see **Figures 4** and **5**);

(c) amendments to both Councils LEPs are proposed to bring them in line with the new floodplain controls;

(d) modifications to notifications on Section 149(2) certificates to identify affectation by the new floodplain policies.

Given that the format and management approach presented in the new Paterson River floodplain policies are different from those currently being used by both Councils, the policies have been prepared in a generic format to allow wider application within the LGAs outside the study area.

A full explanation of the basis for the floodplain controls together with copies of the draft floodplain DCPs are provided in Volume 2. Significant changes to the existing policies which are worthy of note include:

- most residential floor levels to be set at a minimum of the 0.5% AEP flood level. (The existing minimum floor level for both Councils is the 1% AEP flood level plus 0.5m freeboard);
- in rural areas, houses are to be constructed on raised pads with minimum ground levels equal to the 5% AEP flood level.
- hospitals and other critical community facilities or essential services to have floor levels above the extreme flood level;

- residential development in floodways, excessively deep areas or hazardous areas will generally not be permitted, or if permitted, only with very stringent controls;
- where isolated islands are formed during major floods (e.g. Hinton), subdivision controls will restrict development to halt an increase in population within these areas, given the evacuation and access constraints during extended flood periods; and
- all of the floodplain areas below the extreme flood level (not just below the 1% AEP flood level), will be the subject of the new floodplain DCPs.

5.2.4 Voluntary Acquisition of Severely Flood Affected Houses by Council (Option 2.4)

Findings — Option 2.4 is recommended for further consideration where Option 2.1 cannot be implemented, and is expected to only be applicable within the Port Stephens Council area. A final list for voluntary acquisition will require survey to determine floor levels.

Under a voluntary purchase scheme, Council would offer to purchase flood liable properties if and when they became available for purchase, subject to the availability of funds at the time. Voluntary purchase is not compulsory acquisition and affected property owners can expect to receive market values, or higher than market values, for their properties (i.e. values assume no voluntary acquisition scheme is in place and disregard development constraints that may apply on that land due to its flood prone nature).

Voluntary purchase schemes, by their very nature, cannot be implemented immediately. To be successful, the majority of owners in the area need to take up the offer and a suitable allocation of funds must be available to purchase the properties. There needs to be an ongoing commitment from Council to continue to purchase properties into the future as they become available.

Only those houses that are subject to extreme flood hazard are usually considered for inclusion in voluntary purchase schemes. Such houses would typically be well below the 5% AEP flood, or may be inundated by over 1m of floodwaters in a 1% AEP flood.
As well as residential properties, there are a number of commercial premises affected by flooding. State and Federal Government funding is not available for voluntary purchase of commercial properties, so Council would have to meet the full cost of these purchases if a voluntary purchase scheme involving commercial property was considered.

It is anticipated that between 2 to 5 properties within the Port Stephens portion of the study area (and none in Dungog) would experience flooding of the magnitude to warrant voluntary purchase. A final list for voluntary acquisition will require survey to determine floor levels.

It is noted that the cost of this option is high and it does not address flooding problems elsewhere in the catchment, nor was it favoured by respondents to the community questionnaire. However, there appears to be little scope for structural options to adequately modify flood behaviour, and Option 2.1 (voluntary house raising) may not be practical in some areas (particularly in the urban areas of Woodville and Hinton).

FIGURE 4 A4 COLOUR

BACK FIGURE 4 A4 COLOUR

Fig 5 flood hazard definition

Fig 5 flood hazard definition - back ??

fig 6 front

fig 6 back

fig7 front

fig 7 back

Therefore, voluntary acquisition of some severely flood affected properties is an option which should be considered where Option 2.1 is not applicable.

5.3 OPTIONS WHICH MODIFY PEOPLE'S RESPONSE TO FLOODING

5.3.1 Issue Flood Certificates to all Property Owners on a Regular Basis (Option 3.1)

Findings — Option 3.1 is not recommended.

Flood certificates could be issued for all properties in the floodplain. The objective of the certificate would be to clearly and unambiguously inform all landowners of the flood risk on their property. In this regard, the certificates could be a principal means of raising and maintaining flood awareness in the community.

Two forms of certificates are possible:

(a) providing only flood level, e.g. for 5%, 1%, 0.5%, 0.2% AEP and extreme flood events; or;

(b) as for type (a), but also including surveyed ground levels to allow provision of depths. When combined with velocities, information about hazard could also be provided.

Flood certificates are currently issued by some Sydney councils (e.g. Fairfield, Penrith) and are being considered by others (e.g. Liverpool and other councils within the Western Sydney Regional Organisation of Councils and the WestPool insurance group). The councils could charge for issuing such certificates, especially for type (b) which would require survey by a registered surveyor.

Type (a) certificates could be appended to S149(2) and S149(5) certificates and issued to owners on a regular basis (say with rates notices every three years).

During the course of the study, there was much discussion with the Councils' technical sub-committee concerning the merits of flood certificates. Whilst the consultants believed the certificates were a worthwhile proposal and had the support of the community, the Councils' officers saw administrative difficulties involved with implementing a certificate system , and were also concerned that such certificates may increase a Council's exposure to liability claims. The consultants, on the other hand, were concerned that the Councils may not be properly exercising their duty of care if they chose not to disseminate flood data which they had in their possession (following completion of the flood study and the management study), and saw the certificates as an effective tool to achieve this.

Given the issues raised by the technical sub-committee, the option could not be recommended.

5.3.2 Improved Emergency Planning and Management (Option 3.2)

Findings — Option 3.2 is recommended for further consideration.

The State Emergency Service (SES) is the State's 'combat' agency for flooding and fulfils a vital role in emergency planning and management.

As part of the current study, the SES has been made aware of the existing flood problems in the study area and has participated in the public meeting held to discuss potential floodplain management options. In addition, details of flood frequency, depth, velocity and hazard (**Volume 3**) should be forwarded by each Council to the SES, together with details of the most severely affected properties, as a means of improving the SES's 'flood intelligence' in the study area.

These measures will assist the SES develop an improved Local Flood Plan for the Paterson River floodplain, comprising preparedness measures, the conduct of response operations, and the coordination of immediate recovery measures.

The SES has fulfilled an important role in the current study and been closely involved in identifying potential floodplain management options to be included within the Paterson River floodplain management plan. In particular, the SES has identified the need for:

- an improved flood warning system (which is discussed in **Section 5.3.4)**; and
- developing formal boat evacuation pick up points to assist in the evacuation and supply of areas isolated by flooding. The areas where this is needed most are those that become isolated by flooding and include:
  - Iona and Woodville (and surrounding areas); and particularly
  - Hinton.

The largest area is Hinton with a population of several hundred people. Most of the town is above the extreme flood level, however it becomes isolated in events smaller than the 5% AEP flood. Most recently in 1998 the town was isolated for about 8 days and boats were required for all personal access and for general supplies.

To facilitate evacuation, constructing a hard stand access and floating wharf for Hinton may cost in the order of $100,000. For other more localised areas, smaller stepped hard stand pick up points may be suitable, and Council could share in the cost of the structures (possibly by assisting with design). Further consultation with the SES and the local community is required before preliminary engineering designs for such work could be prepared. For the purpose of the draft Floodplain Management Plan, a capital cost of $100,000 has been allowed at this stage. As

the potential evacuation sites are within the Port Stephens LGA, the costs have been allocated against their plan.

An alternative to evacuation pick-up points is improving road access, which is discussed in **Section 5.3.6** (Option 3.6).

Continued and increased cooperation with the SES, such as that initiated during the current study, will have significant benefits to the study area.

5.3.3 Increased Community Education and Flood Awareness (Option 3.3)

Findings — Option 3.3 is recommended for further consideration

Actual flood damages can be reduced if community awareness of flood issues is raised. According to the results of the questionnaire, residents have experienced low to moderate flooding in the recent past and should therefore be reasonably flood aware. Their awareness of the risks of larger floods is expected to be limited however.

The development and implementation of an effective flood awareness and education programme in the study area has the opportunity to improve the knowledge and experience of residents to mitigate flood hazards. A flood awareness and education programme could include various components:

- the use of local media. Regular reminders of past flood events help to maintain flood awareness. **Appendix E** contains an example of a newspaper feature about flooding and floodplain management which was published during the course of the current study;

- contact with local schools and community groups. This could include talks given by Council staff and handouts containing general flood information;

- notification on Section 149 certificates. The questionnaire responses indicate that very few people have obtained information about flooding at their property from the Council. As discussed in Section 5.8 of **Volume 2**, notification of the proposed floodplain DCPs (which will apply to all property below the extreme flood level) will be required on S149(2) certificates. Whilst this is an indirect means of informing owners and prospective purchasers of the flood risks, it may alert some diligent readers of S149 certificates to seek further information from the Councils on the actual flood risks at the property (and not only the existence of the DCP to which the S149(2) certificate will refer). A better system (in the opinion of the Consultant) would be to also attach a flood certificate to the S149 certificate (see **Section 5.3.1**) however it is noted that this system has not been recommended with the floodplain management plans for each Council;

- printing leaflets. These could describe the flood risks throughout the floodplain and alert residents to the specific flood information held by each Council. The leaflets could be distributed together with similar leaflets from the SES which could advise residents of what to do before, during and after a flood. Coordination of the information by the Councils, the SES and the DLWC will assist in ensuring consistent, reliable and practical information is provided to residents;

- public displays. Public displays on flooding could be set up in public buildings such as the Council chambers, libraries or shopping centres. Such displays could contain information about each Council's Floodplain Management Plan as well as information from the SES;

- flood marker poles. The marking of past flood levels on telephone poles (or on specially constructed flood totem poles — see **References 9** and **11**) will also provide constant reminders of flooding risks.

For the flood awareness program to be successful and cost-effective, it should be implemented by the two Councils over the whole of the Paterson River district. To ensure the program is on-going, responsibilities need to be identified and allocated to key individuals within each Council.

Such a program could cost approximately $150,000 to develop and implement, and about $20,000 per annum to maintain.

5.3.4 Improved Flood Warning Systems (Option 3.4)

Findings — Option 3.4 is recommended for further consideration.

Actual flood damages can be reduced if there is sufficient warning time for the community to take appropriate damage reduction measures.

Telemetered river gauging stations are located at Gostwyck and Paterson township on the Paterson River, and at Maitland and Oakhampton on the Hunter River. Additionally there are stick gauges at Woodville and Hinton.

The Bureau of Meteorology (BoM) currently issues flood warnings at Gostwyck and Maitland. However, due to the complexity of flooding along the lower Paterson River (being influenced by flows in the Paterson River and Hunter River) there is no reliable flooding warning for Paterson township, Woodville or Hinton.

The SES has identified the need to improve the operation and reliability of the Paterson River flood warning system. To achieve this it is proposed that a study be carried out to:

- prepare a relationship which sets out flood level estimates at Paterson township, Woodville and Hinton based on various flood level combinations on

the Hunter River at Oakhampton (and/or Maitland) and on the Paterson River at Gostwyck;

- relate flood frequency and flood level estimates at Paterson township, Woodville and Hinton with inundation of critical infrastructure, such as overtopping of the Swan Reach levee and evacuation routes/road low points.

In preparing a study brief, it is recommended that Council clarify the necessary approach for such a study with the BoM, and have discussions with the SES to identify key locations to be assessed. The DLWC and PWD (Manly Laboratory) should also be consulted as they are key players with respect to funding and technical advice. This matter should be given a high priority.

A cost estimate for the study would be of the order of $50,000. For assistance with funding, an application should be submitted to the NSW Flood Warning Consultative Committee. An application procedure form is included in **Appendix F**.

5.3.5 Preparation of Flood Action Plans (Option 3.5)

Findings — Option 3.5 is not recommended.

Flood action plans comprise instructions for people at individual properties telling them what they should do before, during and after a flood, where they should go and who they should contact if there is a flood. They may be formulated for single residential properties or may apply to groups of residences such as in Hinton. They could also be developed for commercial properties such as the Woodville shop/garage and the Hinton hotel. The plans would be simple instructions, similar to those for fire emergencies or first aid, and would be posted at noticeable locations within buildings.

The Councils' technical sub-committee determined that the administrative difficulties in implementing and maintaining a system of flood action plans did not justify the marginal benefits that may arise from the plans. In addition, whilst the plans may receive some prominence at the time a development application was lodged (if the preparation of such plans were a condition of consent), there appears to be no effective means of bringing the plans to the notice of future owners and occupiers of the development.

Consequently, this option was not recommended.

5.3.6 Road and Bridge Raising (Option 3.6)

Findings — Option 3.6 is not recommended.

There are a number of local high areas and ‘islands' on the floodplain that become isolated and difficult to evacuate during floods. As an alternative to evacuation pick

up points (proposed in **Section 5.3.2**) access to these areas could be improved by providing high level roads or bridges.

Based on the flood level, depth and duration information presented in Volume 3, inundation information for the major access roads to the principal towns and villages in the floodplain have been determined and are presented in **Table 3**. These comprise Paterson, Woodville/Iona and Hinton. The depth inundation information is approximate and it is noted that more accurate information could be provided if accurate levels for road low points are obtained. (Inquiries to the Councils and the SES during the study indicated that this information was not currently available). The accuracy of the information in **Table 3** is sufficient however to confirm the significant road access problems which exist in the study area.

The Main Northern Railway Line also runs through the study area and is expected to be cut by floodwaters during major flood events. However the frequency of inundation is unknown.

TABLE 3: MAIN ROADS INUNDATED IN THE 5% AEP FLOOD *

ROAD	DEPTH OF INUNDATION	APPROXIMATE DURATION OF INUNDATION
High Street (north of Hinton)	up to approximately 1.5 m	1 week
Old Punt Road (south of Hinton)	up to approximately 1.5 m	1 week
Hinton Road (east of Hinton)	up to approximately 1.5 m	1 week
Paterson Street (west of Hinton)	up to approximately 1 m	1 week
Seaham Road (south of Woodville)	up to approximately 1.5 m	1 week
Seaham Road (east of Woodville)	up to approximately 2 m	1 week
Butterwick Road (near Green Wattle Creek)	up to approximately 1 m	1 to 2 days
Paterson Road (north of Woodville)	up to approximately 2 m	1 to 2 days
Paterson Road (between	up to approximately 1	1 to 2 days

roads to Stradbroke and Orange Grove)	m	
Tocal Road (south of Paterson)	up to approximately 1 m	1 to 2 days
King Street (north of Paterson)	up to approximately 2 m	1 to 2 days

* *Refer to **Volume 3** Figures 4-5 for location, extent and depth details. Road survey levels are necessary to determine accurate extents and depths of inundation.*

For the purposes of this management option, alternatives for providing "flood free" access (say at or above the 1% AEP flood level) were considered for:

- Paterson;
- Woodville/Iona; and
- Hinton.

For Paterson, road construction costs would be prohibitive given the extensive lengths involved (if the Tocal Road was raised) or the combined cost of road and bridging over the river if access via Seaham Road was considered.

To provide access to Woodville/Iona alone, raising of the Seaham Road for a distance of approximately 1.0km may be required. (An accurate estimate of the length can only be prepared once surveyed road levels are available). Nonetheless the cost of this road upgrading work may cost in the order of $3–$7 million.

Similarly, for Hinton, two alternative access routes have been considered and both would require extensive bridging:

- High Street, where approximately 1.5km would require bridging, or
- Brisbane Field Road with bridging to Morpeth.

The cost of either option would be in the order of $5 million to $10 million.

Because of the large construction costs, road and bridge raising to provide access to Paterson, Woodville/Iona and Hinton (in up to 1% AEP floods) is not feasible and has not been recommended. However it may be worthwhile to carry out a further feasibility assessment of this option once more accurate road level information is available, particularly as this could define the costs of providing access to the villages at lower standards (e.g. at 5% and 20% AEP).

Table 4 options - front

table 4 options - back

table 5 explanation - front

table 5 explanation - back

6. FLOODPLAIN MANAGEMENT PLAN

*Draft Floodplain Management Plans have been prepared for Dungog Council (**Table 6**), and for Port Stephens Council (**Table 7**).*

*The recommended options for the two Plans are shown on **Figure 8**.*

6.1 THE DRAFT PLAN

6.1.1 Options which Modify Flood Behaviour (Options 1.8, 1.9 & 1.10)

There is no recommended structural option to modify flood behaviour on the Paterson River floodplain within the study area. This is primarily because the magnitude of flows results in such options being economically unfeasible.

However, there are three options already in place that are the responsibility of organisations other than the Councils. It is recommended that these works (discussed below) receive the Councils' endorsement.

Scour Protection, Bank Stabilisation Works and Vegetation Management (Option 1.8).

These works are being carried out by the HCMT and DLWC and it would be considered advantageous for the Councils to formalise procedures so as to:

- have regular and ongoing liaison with the HCMT and DLWC;
- inform them of any specific necessary works; and
- to receive progress from information maintenance programs from these bodies that could be conveyed to residents.

A high priority is given to this option because of the benefits that these works can provide to the floodplain, particularly in reducing scouring and sediment load.

Levee Maintenance (Option 1.9)

These works are currently being carried out by the HCMT and DLWC and are considered to be of significant importance in maintaining the integrity of the lower Hunter Valley flood mitigation scheme along the Paterson River. As for Option 1.8, it is recommended that the Councils fully endorse the operations of the HMCT and DLWC in this work. Again it would be advantageous for the Councils to formalise procedures so as to have regular and ongoing liaison with the HCMT and DLWC.

A medium priority is given to this option.

Drainage Channel Maintenance (Option 1.10)

The HCMT, DLWC and the Woodville Drainage Union (WDU) currently maintain the existing drainage systems behind the levees to minimise the prolonged inundation

time which occurs after flooding. It is recommended that the Councils fully endorse the operations of the HMCT, DLWC and WDU in this work.

Also, it is considered appropriate that the WDU apply for funding from Port Stephens Council on an annual basis. Such funding would allow the WDU to extend and improve drainage.

A medium priority is given to this option.

6.1.2 Property Modification Options (Options 2.1–2.4)

As there are no feasible structural options available to protect the study area from flooding, a number of property modification options are recommended to increase the level of protection expected by the community.

The raising of ten to twenty houses (Option 2.1) is recommended for residences in the Port Stephens area which would currently be flooded above floor level in the 5% AEP event. Final lists for voluntary house raising are still to be determined and will require survey to determine floor levels, but are likely to include houses in the Woodville and Hinton areas.

The flood proofing of individual buildings (Option 2.2) is considered as a protection option for commercial properties in urban areas where Option 2.1 (voluntary raising) and/or Option 2.4 (voluntary purchase) is not applicable.

Where house Option 2.1 raising/moving is not appropriate, voluntary acquisition (Option 2.4) is recommended. This is expected to be limited to two to five houses in the urban areas of Woodville and Hinton which would currently be flooded above floor level in the 5% AEP event.

The principal measure included within the plans for both Councils are upgraded controls on new development and redevelopment of residential or industrial/commercial properties (Option 2.3). These controls will ensure that the flooding problem is not made worse and that the new development itself is not significantly affected by flooding. In this regard, draft floodplain DCPs from both Councils have been prepared and four floodplain management zones are proposed to which the controls will apply. The DCPs have been prepared in a generic format to allow each Council to conveniently apply them to all floodplains in their LGA.

6.1.3 Options Which Modify People's Responses To Flooding (Options 3.1–3.5)

A range of options which modify people's responses to flooding, are recommended in this Plan. These options involve public education and enable people to be more prepared for the likelihood of flooding and to be better able to deal with floods and their aftermath.

Assistance and encouragement to the SES will improve the existing evacuation emergency management procedures (Option 3.2). In particular it is recommended that formal boat evacuation pick up points are constructed in areas isolated by flooding. The largest such area is Hinton, where the construction cost of a hard stand area and floating wharf pick up point is estimated to be approximately $100,000.

A community flood education program is proposed for the whole of the Paterson River floodplain within the Port Stephens and Dungog areas at a cost of $150,000 (Option 3.3). This may also have benefits in catchments outside of the Paterson River. The costs of this program are considered to be small compared to the potential benefits that would accrue.

A study (with a cost estimate of $50,000) is recommended to provide a reliable flood warning system for the Lower Paterson River (Option 3.4). Lobbying of the State and Federal Governments will assist in implementation of the proposed study.

6.2 FUNDING AND IMPLEMENTATION

Councils could expect assistance with implementing parts of the Plan from the State Government and possibly the Federal Government. Various funding schemes are available and a Council could typically contribute one third of the total capital costs. Special grant money may also be available in some cases.

For options to receive Government funding, they must be of significant benefit to the community. Funding of investigation and design activities as well as any works and ongoing programmes such as voluntary purchase, is normally available. Maintenance however would be the responsibility of the Councils.

TABLE 6: DRAFT FLOODPLAIN MANAGEMENT PLAN FOR DUNGOG COUNCIL

OPTION NO.	DESCRIPTION	CAPITAL COST (to Council)	MAINTENANCE COST per annum	PRIORITY
MEASURES WHICH MODIFY FLOOD BEHAVIOUR				
1.8	Council endorsement of scour protection, bank stabilisation works and vegetation management by the HCMT and DLWC	Nil	Nil	High
1.9	Council endorsement of levee maintenance by the HCMT and DLWC	Nil	Nil	Medium
1.10	Council endorsement of drainage channel maintenance by the Drainage Union, HCMT and DLWC	Nil	Nil	Medium
MEASURES WHICH MODIFY PROPERTIES				
2.2	Flood proofing of individual houses/commercial buildings	Nil	Nil	High
2.3	Improve existing building and development controls	Nil	Nil	High
MEASURES WHICH MODIFY PEOPLE'S RESPONSES TO FLOODING				
3.2	Improve emergency planning and management	Nil	Nil	Medium
3.3	Increase community education and flood awareness [(1)]	$75K	$10K	Medium
3.4	Improve flood warning systems	$25K	Nil	High
	TOTAL	**$100K**	**$10K**	

[(1)] For whole of Dungog local government area.

TABLE 7: DRAFT FLOODPLAIN MANAGEMENT PLAN FOR PORT STEPHENS COUNCIL

OPTION NO.	DESCRIPTION	CAPITAL COST (to Council)	MAINTENANCE COST per annum	PRIORITY
MEASURES WHICH MODIFY FLOOD BEHAVIOUR				
1.8	Council endorsement of scour protection, bank stabilisation works and vegetation management by the HCMT and DLWC	Nil	Nil	High
1.9	Council endorsement of levee maintenance by the HCMT and DLWC	Nil	Nil	Medium
1.10	Council endorsement of drainage channel maintenance by the Drainage Union, HCMT and DLWC	Nil	Nil	Medium
MEASURES WHICH MODIFY PROPERTIES				
2.1	Voluntary house raising, relocation or demolish/reconstruct 10 to 20 severely flood affected properties	$0.7M - $1.4M	Nil	High
2.2	Flood proofing of individual houses/commercial buildings (1)	Nil	Nil	High
2.3	Improve existing building and development controls	Nil	Nil	High
2.4	Voluntary acquisition of 2 to 5 severely flood affected houses by Council (urban areas only) (2)	$0.3M - $0.75M	Nil	Medium
MEASURES WHICH MODIFY PEOPLE'S RESPONSES TO FLOODING				
3.2	Improve emergency planning and management	$100K	$5K	Medium
	Increase community			

3.3	education and flood awareness [3]	$75K	$10K	Medium
3.4	Improve flood warning systems	$25K	Nil	High
	TOTAL (rounded)	**$1.2M - $2.4M**	**$15K**	

[1] Option 2.2 only recommended where Options 2.1 and/or 2.4 cannot be implemented.
[2] Option 2.4 only recommended where Option 2.1 cannot be implemented.
[3] For whole of Port Stephens local government area.

Eligibility for funding does not guarantee that funding will be forthcoming. Funding is available on a competitive basis against other floodplain management projects elsewhere in the State.

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

- the Floodplain Management Committee considers the Study report and Plans and present them to the Councils;
- each Council resolves to put the Study report and their Plan on public exhibition;
- the Floodplain Management Committee reviews the comments and submissions received and the Study and Plans are finalised. The Floodplain Management Committee presents the Study and Plans to both Councils for adoption;
- each Council allocates priorities to components of their Plan, based on local considerations and budgetary constraints;
- both the Councils submit applications for funding assistance to the DLWC;
- as funds become available from the DLWC and/or Council's own resources, each Council commences to implement their Plan in accordance with the established priorities. Implementation will necessarily involve ongoing input from the Floodplain Management Committee.

The absence of State and Federal Government funding for a particular option should not preclude each Council from independently funding the work, if it has significant benefits for the community and is cost effective.

6.3 ON-GOING REVIEW OF PLAN

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

Fig 6 A3 FMP front

Fig 8

7. REFERENCES

1. New South Wales Government. 1986. Floodplain Development Manual.

2. New South Wales Government. March 1999. Draft Floodplain Development Manual.

3. WBM Oceanics Australia. February 1997. Paterson River Flood Study.

4. Sinclair Knight & Partners Pty Ltd. March 1981. New South Wales Coastal Flood Plain Management Studies - Hunter Valley. Prepared for the NSW Coastal Rivers Flood plain Management Studies Steering Committee.

5. Sinclair Knight & Partners Pty Ltd. January 1990. Lower Hunter Valley Flood Mitigation Scheme — Rehabilitation of Rock Spillways and Control Banks. Prepared for the Public works Department, NSW.

6. Patterson Britton & Partners Pty Ltd. 1996. Lower Hunter River Geomorphological Study. Prepared for the Hunter Catchment Management Trust.

7. Webb, McKeown & Associates Pty Ltd. 30 August 1996. Maitland City Council Floodplain Management Studies (Final Draft Reports). Prepared for Maitland City Council.

8. Bewsher Consulting Pty Ltd and Don Fox Planning Pty Ltd. 1997. Land Use Planning and Development Control Measures — raft Report. Hawkesbury Nepean Flood Management Strategy. Prepared for the Hawkesbury Nepean Flood Management Advisory Committee.

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10. Bewsher, D; Grech, P and Maddocks, J. May 1998. Using Flood Certificates to Raise Flood Awareness. Prepared for the 38th Annual Floodplain Management Conference, Moama, NSW.

11. Shepherd, D; Chapman, B and Bewsher, D. May 1996. Increasing Flood Awareness in Blacktown. Prepared for the 36th Annual Flood Mitigation Conference, Grafton, NSW.

APPENDIX A

RELEVANT AGENCIES

Table A summarises the main agencies who are likely to be affected by issues relating to flooding along the Paterson River (and hence this Floodplain Management Study). This list is by no means exhaustive but gives some indication of the wide cross-section of agencies which need to consider flood issues.

TABLE A: AGENCIES LIKELY TO BE AFFECTED BY FLOOD ISSUES ALONG THE PATERSON RIVER

ISSUES RELATING TO FLOODING	KEY PLAYERS AND RESPONSIBLE AGENCIES	COMMENTS
Planning and Development Controls	Department of Urban Affairs and Planning (DUAP)	Regional planning powers and overview of zoning matters
	Dungog Council	Administration of LEP and Floodplain Management Plan
	Port Stephens Council	
Floodplain Management	Department of Land and Water Conservation (DLWC), Head Office and Newcastle Region	Administration of State Government's Flood Prone Land Policy and Floodplain Management Plan. Jointly responsible with the HCMT for the levees, spillways and floodgates on the lower Paterson River
	Hunter Catchment Management Trust (HCMT)	Advisory and funding organisation for natural resources within the Hunter Valley. Jointly responsible with the DLWC for the levees, spillways and floodgates on the lower Paterson River
	Dungog Council	Local administration of Floodplain Management Plan
	Port Stephens Council	
Floodplain Management Funding	National Landcare Project (Commonwealth Government)	Any request for funding for floodplain management works is submitted to the

	Department of Land and Water Conservation, Head Office	DLWC via the FMA. The FMA is responsible for prioritising those projects (see **Section 4.3**)
	Flood Mitigation Authorities of NSW (FMA)	
	Dungog Council	
	Port Stephens Council	
	Hunter Catchment Management Trust	Advisory and funding organisation for natural resources within the Hunter Valley
	Woodville Drainage Union	A union of local landholders established to maintain drainage of private lands in the Woodville district

TABLE A: AGENCIES LIKELY TO BE AFFECTED BY FLOOD ISSUES ALONG THE PATERSON RIVER (continued)

ISSUES RELATING TO FLOODING	KEY PLAYERS AND RESPONSIBLE AGENCIES	COMMENTS
Flood Warning	Bureau of Meteorology (Met. Bureau)	Met Bureau do not issue warnings for Paterson, Woodville or Hinton but are looking at regional warning systems
	State Emergency Service (SES)	Issuing and coordination of local warnings
Emergency Response	State Emergency Service	SES is responsible for coordination and action relating to flood emergencies.
	Police	
	Dungog Council	
	Port Stephens Council	

	Fire Brigade	
	Ambulance Service	
Welfare Management	Department of Community Services	A range of service groups is also involved in welfare management
	Department of Housing	
	State Emergency Service	
	Police	
	Dungog Council	
	Port Stephens Council	
Utilities and Services	Dungog and Port Stephens Councils	Water supply and distribution; sewage collection, treatment and disposal, garbage collection and disposal
	Energy Australia	Electricity supply and distribution
	Optus	Telecommunications
	Telstra	Telecommunications
Floodplain Crossings	Roads and Traffic Authority	Highways
	Dungog and Port Stephens Councils	Streets
	Rail Services Authority	The North Coast Railway Line

APPENDIX B

COMMUNITY NEWSLETTER

APPENDIX C

COMMUNITY QUESTIONNAIRE AND SUMMARY OF RESULTS

APPENDIX D

PRO FORMA FOR APPLICATION FOR FUNDING OF FLOOD MITIGATION PROJECTS

APPENDIX E

NEWSPAPER FEATURE ABOUT FLOODING

APPENDIX F

NSW FLOOD WARNING CONSULTATIVE COMMITTEE

APPLICATION PROCEDURE FOR DEVELOPMENT OF IMPROVED FLOOD WARNING SERVICES

APPENDIX G

PRELIMINARY PUMPOUT ASSESSMENT TO REDUCE INUNDATION TIME BEHIND LEVEES

(Consideration of this option is outside the formal scope of the study and therefore has not been included in the main body of the report)

PRELIMINARY PUMPOUT ASSESSMENT TO REDUCE INUNDATION TIME BEHIND LEVEES

Two pumpout options have been assessed to reduce inundation time behind the levees once river levels drop to below top of levee level.

1. Inundation Relief for all Areas within the WDU Area

This appendix has been prepared in response to a request from the Woodville Drainage Union (WDU) during the course of the Floodplain Management Study. It assesses the option of providing pumps to reduce inundation time on the agricultural lands located within the study area and generally under the control of the WDU.

1.0 EXISTING DRAINAGE

There is are two extensive drainage systems which serve the agricultural areas covered by the WDU:

- one for the Wallalong area, with an outlet to the Paterson River located approximately 1 km north of Scotts Dam; and
- one for the Albion/Woodville area, with an outlet to the Paterson River located approximately 0.5 km north of Woodville.

Although the drainage systems are quite efficient when river levels are low, extended periods of inundation have been experienced when river levels are high, and the period of inundation has been exacerbated by construction of the levee system.

Once the levees are overtopped the area of inundation within the WDU area is of the order of 10 km^2 with a minimum average depth of approximately 2m.
Past experience (in say the 1998 flood) has been that the Paterson River remains high and prohibits drainage of areas behind the levee (for 3 to 4 days in 1998), and as the River level drops it takes another 4 to 5 days before the areas behind the levee drain.
Also, drainage of the Wallalong area generally takes longer than for the Albion/Woodville area since the Wallalong area is more directly influenced by the Hunter River (which generally remains high for a longer time than the Paterson River).

2.0 CROP LOSSES AND INUNDATION

Most crops are destroyed within a relatively short inundation period (approximately 24 hours). Therefore floods where the river level rises above the top of levee incur major crop loss.

Additional farming losses result from prolonged inundation (say days to weeks) which delays the opportunity to rework the land.

3.0 PUMPOUT OPTIONS

An option to reduce inundation time behind the levees could be to provide high capacity/low head pumps which would operate once river levels dropped to below the levee crest level.

Preliminary assessment of two options follows.

3.1 Inundation Relief for all Areas within the WDU Area

To effectively reduce the inundation time of the 10 km^2 inundated area behind the levee to say two days (once the Paterson River level had dropped), would require a pump capacity of approximately 30m^3/s. The supply cost alone of the pumps and engines would be about $1.5M, with additional installation and commissioning costs of a say a further 20%.

Based on cost this option is not recommended for further consideration.

3.2 Inundation Relief for the Lowest Lying Areas within the WDU Area

It may be most feasible to provide a pumpout system for the lowest lying areas which experience prolonged inundation. (That area would seem to be within the Wallalong area which is more directly impacted by the Hunter River, than the Albion/Woodville area which is located further upstream along the Paterson River.)

Assuming an average depth of 0.25m covers an area of approximately 1 km^2, then a pumpout capacity of 2m^3/s could remove this water in 1.5 to 2 days. The supply cost of the pumps and engines would be about $100K, with additional installation and commissioning costs of a say a further 50%.

Once installed it is envisaged that drainage pumps could be maintained and operated by the local land holders.

This option may be feasible and is recommended for further consideration. (This should include quantifying the area of inundation relief and the benefit of being able to work the land say five days earlier than for current conditions).

APPENDIX H

MAPPING USED IN THE STUDY

APPENDIX I

STUDY BRIEF

Maps used in the study and their source are listed in **Table H1**.

TABLE H1: MAPS USED IN STUDY

MAP	SOURCE	SCALE
Newcastle 9232 Topographic Map	DLWC	1:100000
Maitland 9232-IV-S Topographic Map	DLWC	1:25000
Paterson 9232-4-N Topographic Map	DLWC	1:25000
Digital Aerial Photogrammetry Maps of the Study Area	DLWC	-
Cadastral Plans of Study Area	Council	Varying

A colour aerial photograph of Paterson township and the neighbouring areas, enlarged to a scale of approximately 1:2000, was obtained from the Department of Land and Water Conservation (DLWC) and used throughout the study.

TABLE 4: SUMMARY OF FLOODPLAIN MANAGEMENT OPTIONS — QUALITATIVE ASSESSMENT MATRIX

OPTION NO.	DESCRIPTION OF OPTION	AIM OR CRITERIA OF OPTION	COUNCIL INVOLVED	COMMENTS AND RELATIVE SCORE FOR EACH CRITERIA									RECOMMENDED FOR INCLUSION IN PLAN
				Financial feasibility	Economic merit	Community acceptance	Environmental Impacts	Impacts on flood behaviour	Consequences in extreme flood	Reduction in number of homes / commercial buildings flooded in 1%AEP flood	Technical feasibility / difficulty	Administrative / political / legal impacts	
1	**OPTIONS WHICH MODIFY FLOOD BEHAVIOUR**												
1.1	Raise existing levees	Provide additional flood protection up to the 20%AEP flood.	Port Stephens & Dungog	–	– –	+	–	–	O	0	++	– –	no
1.2	Lower existing levees	Reduce sediment transportation.	Port Stephens & Dungog	O	O	– –	+	+	O	0	++	– –	no
1.3	Remove/modify Scotts Dam.	Reduce flooding upstream of Scotts Dam.	Port Stephens	O	B/C > 1 O	+	O	–	+	approx. 10	++	– –	no
1.4	Widening and deepening of the Paterson River.	Reduce flood levels in the Paterson River.	Port Stephens & Dungog	$10M - $20M – –	B/C < 0.1 –	+	O	+	O	3	–	–	no
1.5	Dredging of the Hunter River downstream of the Paterson River.	Reduce flood levels in the Paterson River.	Port Stephens	n.a.	n.a.	+	O	+	O	n.a.	–	–	#
1.6	Construction of upstream flood retarding storages.	Reduce flood levels in the Paterson River.	Port Stephens & Dungog	>$50M – –	B/C < 0.1 – –	+	–	+	O	approx. 40	O	–	no
1.7	Creating a flood storage compartment in Lostock Dam.	Reduce flood levels in the Paterson River.	Port Stephens & Dungog	n.a.	–	+	O	O	O	0	+	–	no
1.8	Council endorsement of scour protection, bank stabilisation works and vegetation management by the HCMT and DLWC.	Stabilise channel by reduce scouring and sediment deposition.	Port Stephens & Dungog	+	n.a.	+ +	+	+	O	0	–	O	yes
1.9	Council endorsement of levee maintenance by the HCMT and DLWC.	Ensure standard of protection provided by existing levees is not compromised.	Port Stephens & Dungog	+	n.a.	+ +	–	O	O	0	+	O	yes
1.10	Council endorsement of drainage channel maintenance by the Drainage Union, HCMT and DLWC.	Reduce inundation time.	Port Stephens & Dungog	+	n.a.	+ +	O	+	O	0	+	–	yes
2	**OPTIONS WHICH MODIFY THE WAY EXISTING OR FUTURE PROPERTIES ARE AFFECTED BY FLOODING**												
2.1	Voluntary house raising, relocation or demolish/reconstruct severely flood affected properties.	Raise 10 to 20 existing most severely flood impacted houses so that floor levels are above the 1%AEP flood level.	Port Stephens	$0.7M - $1.4M +	B/C = 0.1 - 0.2 –	O	–	O	–	10 - 20	O	O	yes
2.2	Flood proofing of individual properties.	Reduce the impact of flooding on individual properties by waterproofing walls, putting shutters across doors and using materials that are relatively unaffected by submersion etc.	Port Stephens & Dungog	No cost to Council n.a.	n.a.	–	O	O	O	n.a.	–	O	yes
2.3	Improve existing building and development controls.	Control potential impacts of future development within the floodplain.	Port Stephens & Dungog	No capital cost n.a.	n.a.	+ +	+	O	+	n.a.	+	–	yes
2.4	Voluntary acquisition of severely flood affected houses by Council (urban areas only).	Purchase & demolition of 2 to 5 residential properties which are known to have been flooded to above floor level ($150K/house).	Port Stephens	$0.3M - $0.75M –	B/C ~ 0.1 –	–	+	O	+	2 - 5	+	O	yes
3	**OPTIONS WHICH MODIFY THE WAY PEOPLE RESPOND TO FLOODS**												
3.1	Issue flood certificates for all property owners on a regular basis.	To raise flood awareness of property owners.	Port Stephens & Dungog	No capital cost n.a.	n.a.	+ +	O	O	+	O	–	––	no
3.2	Improve emergency planning and management.	Assist SES to upgrade current emergency management plans.	Port Stephens & Dungog	$0.10M ## n.a.	n.a.	+ +	O	O	+	O	+	O	yes
3.3	Increase community education and flood awareness.	To make the public more aware of flooding issues, eg. through construction of flood marker poles.	Port Stephens & Dungog	$0.15M +	n.a.	+ +	O	O	+	O	+	–	yes
3.4	Improve flood warning systems.	To provide an indication to the SES, Council or the Police of conditions likely to cause flooding.	Port Stephens & Dungog	$0.05M +	n.a.	+ +	O	O	+	O	+	O	yes
3.5	Prepare flood action plans for individual properties.	To tell residents what they should do, where they should go and who they should contact if there is a flood.	Port Stephens & Dungog	No capital cost n.a.	n.a.	+ +	O	O	+	O	––	–	no
3.6	Road and bridge raising.	Improve road access.	Port Stephens & Dungog	– –	n.a.	+	–	O	+	O	+	O	no

Notes: For description for relative scores for each criteria refer to Table 5.
n.a. = not assessed, not available or not applicable.

\# Beyond the scope of this study
Cost estimate for Port Stephens Council to construct a floating wharf at Hinton to assist with evacuation

TABLE 5: EXPLANATION OF ASSESSMENT SCORES FOR QUALITATIVE ASSESSMENT MATRIX

CRITERIA	– –	–	O	+	+ +
FINANCIAL FEASIBILITY	Very unlikely to receive funding	May not receive funding	Neutral	Would possibly receive funding	Very likely to receive funding
ECONOMIC MERIT	B/C less than 0.1	B/C = 0.1–0.3	B/C = 0.3–0.7	B/C = 0.7–1.0	B/C greater than 1.0
COMMUNITY ACCEPTANCE	Strongly against	Generally against	Neutral	Some support	Strongly supported
ENVIRONMENTAL IMPACT	Significant negative impact	Some negative impact	No impact	Some positive impact	Significant positive impact
IMPACT ON FLOOD BEHAVIOUR	Significantly increase flood levels and/or velocities	Some increase in flood levels and/or velocities	No change	Some reduction in flood levels and/or velocities	Significantly reduces flood levels and/or velocities
PERFORMANCE DURING LARGE FLOODS	Significantly increases risk	Some increase in risk	No change in risk	Some reduction in risk	Significant reduction in risk
TECHNICAL FEASIBILITY	Very difficult	Difficult	Neutral	Easy	Very easy and straight forward
POLITICAL/ ADMINISTRATIVE / LEGAL IMPACT	Significant changes required which are very unlikely to be supported	Some changes required which may not be supported	No changes or impact	Some changes required are likely to be supported	Significant changes required which are likely to be strongly supported

B/C = Benefit Cost Ratio

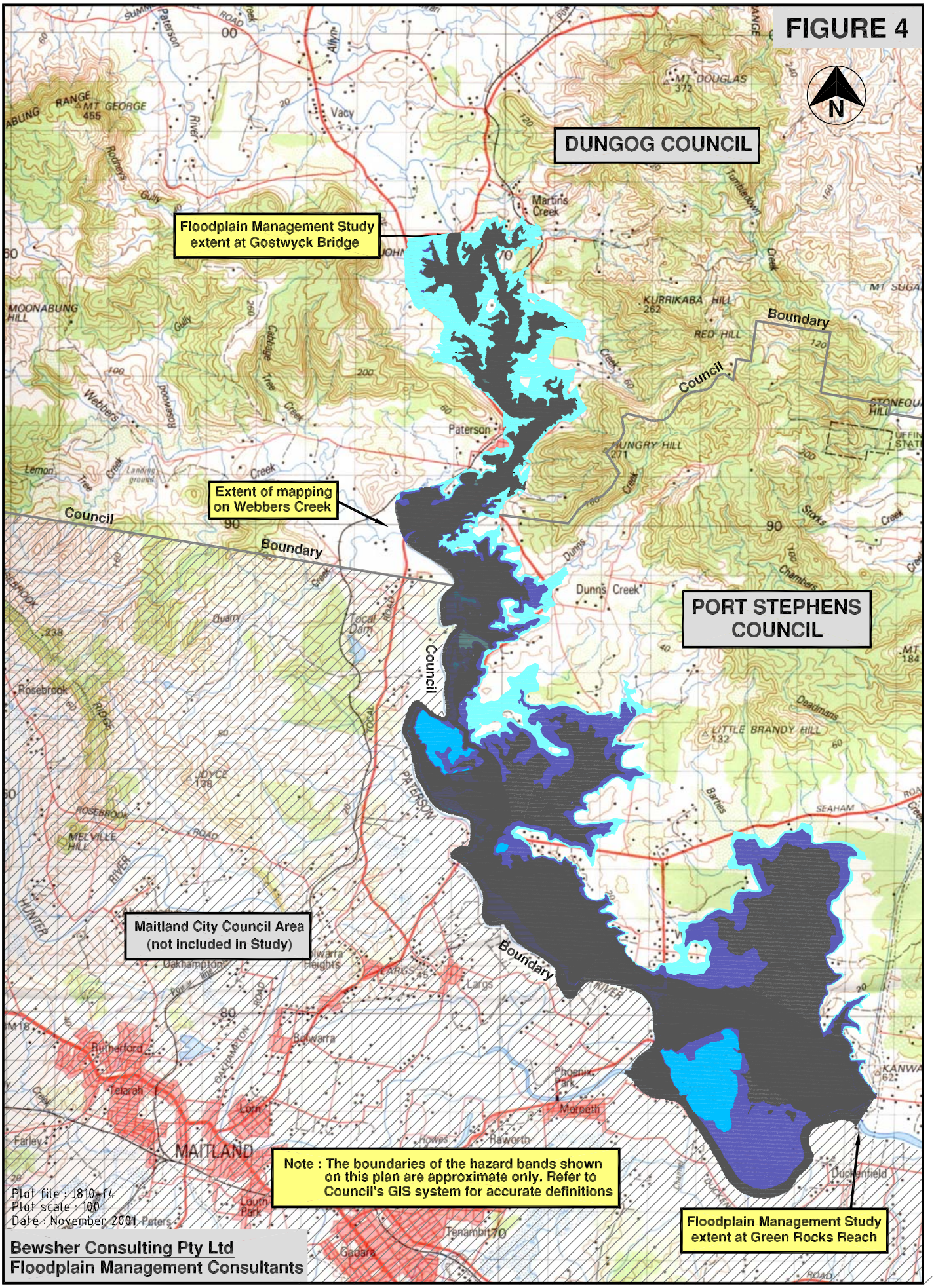
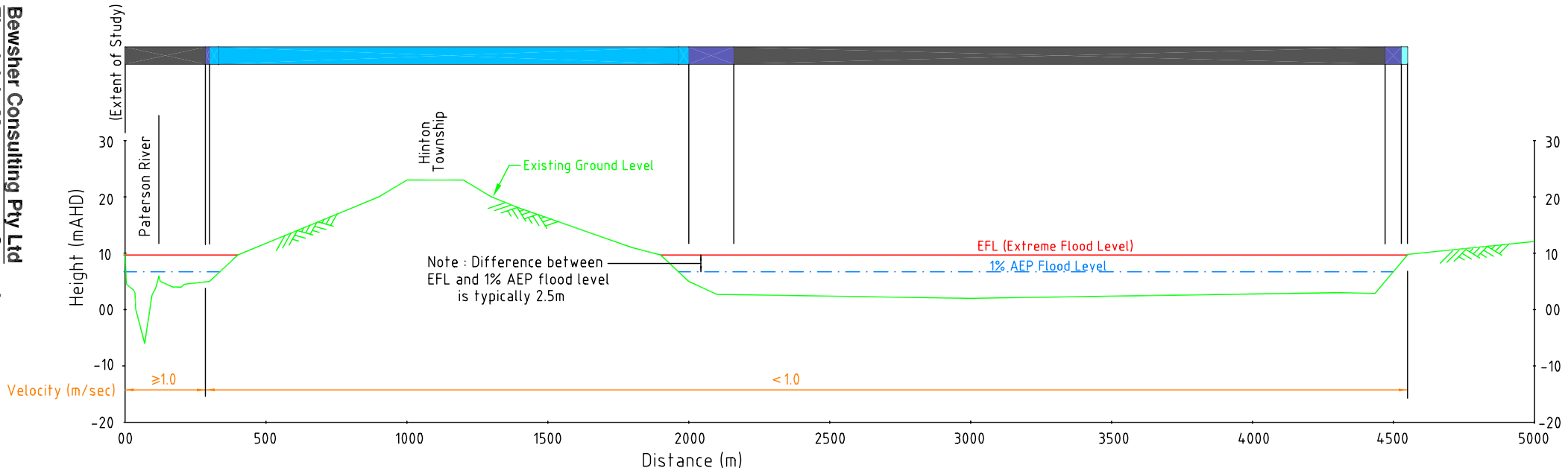


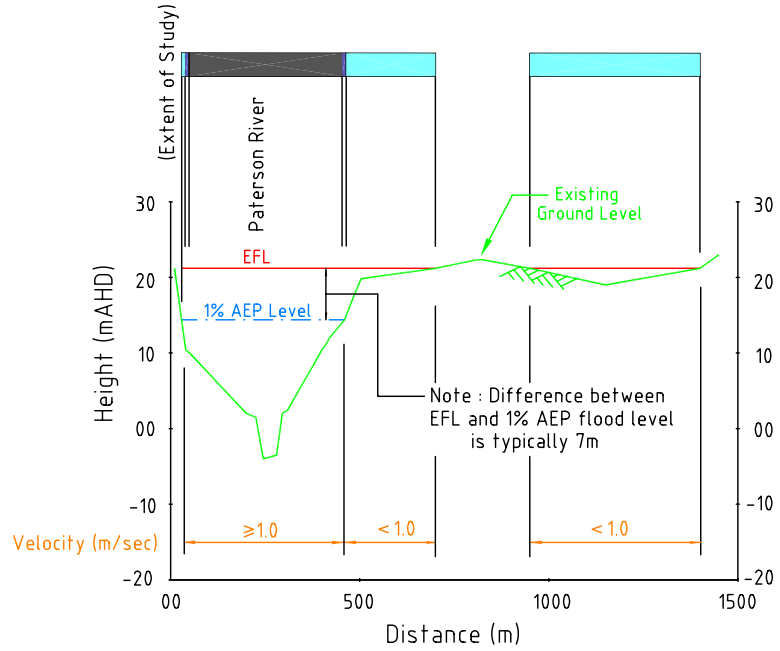
FIGURE 4
N
DUNGOG COUNCIL
Floodplain Management Study extent at Gostwyck Bridge
Extent of mapping on Webbers Creek
Boundary
Council
PORT STEPHENS COUNCIL
Maitland City Council Area (not included in Study)
Note : The boundaries of the hazard bands shown on this plan are approximate only. Refer to Council's GIS system for accurate definitions
Floodplain Management Study extent at Green Rocks Reach
Plot file : J810-f4
Plot scale : 100
Date : November 2001
Bewsher Consulting Pty Ltd
Floodplain Management Consultants
LEGEND
1. Floodway and Excessive Depth Zone
2. High Risk (Velocity and Depth) Zone
3. Isolated Islands Zone
4. Low Risk Zone
0 1 2 3 4 5 km
Scale
PATERSON RIVER FLOODPLAIN MANAGEMENT STUDY AND PLAN
FLOODPLAIN MANAGEMENT ZONES

Bewsher Consulting Pty Ltd
Floodplain Management Consultants



Typical Floodplain Section near Hinton

Scales H 1 : 20000
V 1 : 1000



Typical River Section Upstream of Paterson

Scales H 1 : 20000
V 1 : 1000

FLOODPLAIN MANAGEMENT ZONES	CRITERIA
1. Floodway and Excessive Depth Zone	Floodway or depth >4m in 1% AEP event
2. High Risk (Velocity and Depth) Zone	Remaining area where provisional hazard is high in 1%AEP event
3. Isolated Islands Zone	Remaining area where evacuation is possible only through Zones 1 or 2
4. Low Risk Zone	Remaining area below extreme flood level

FIGURE 5

PATERSON RIVER FLOODPLAIN MANAGEMENT STUDY AND PLAN

TYPICAL CROSS SECTIONS SHOWING FLOODPLAIN MANAGEMENT ZONES

Plot file : J810-f5
Plot scale : 1
Date : November 2001

FIGURE 8

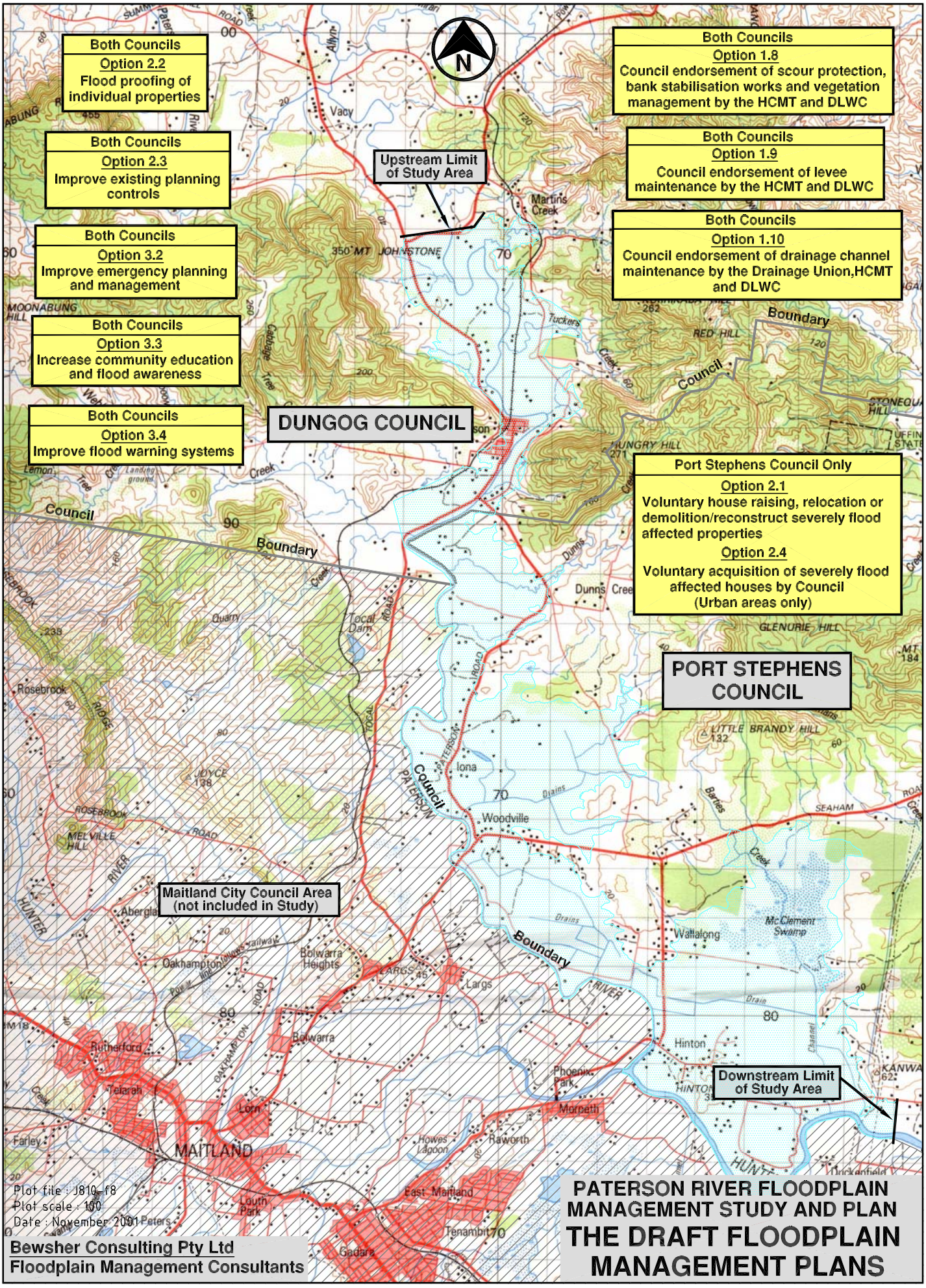
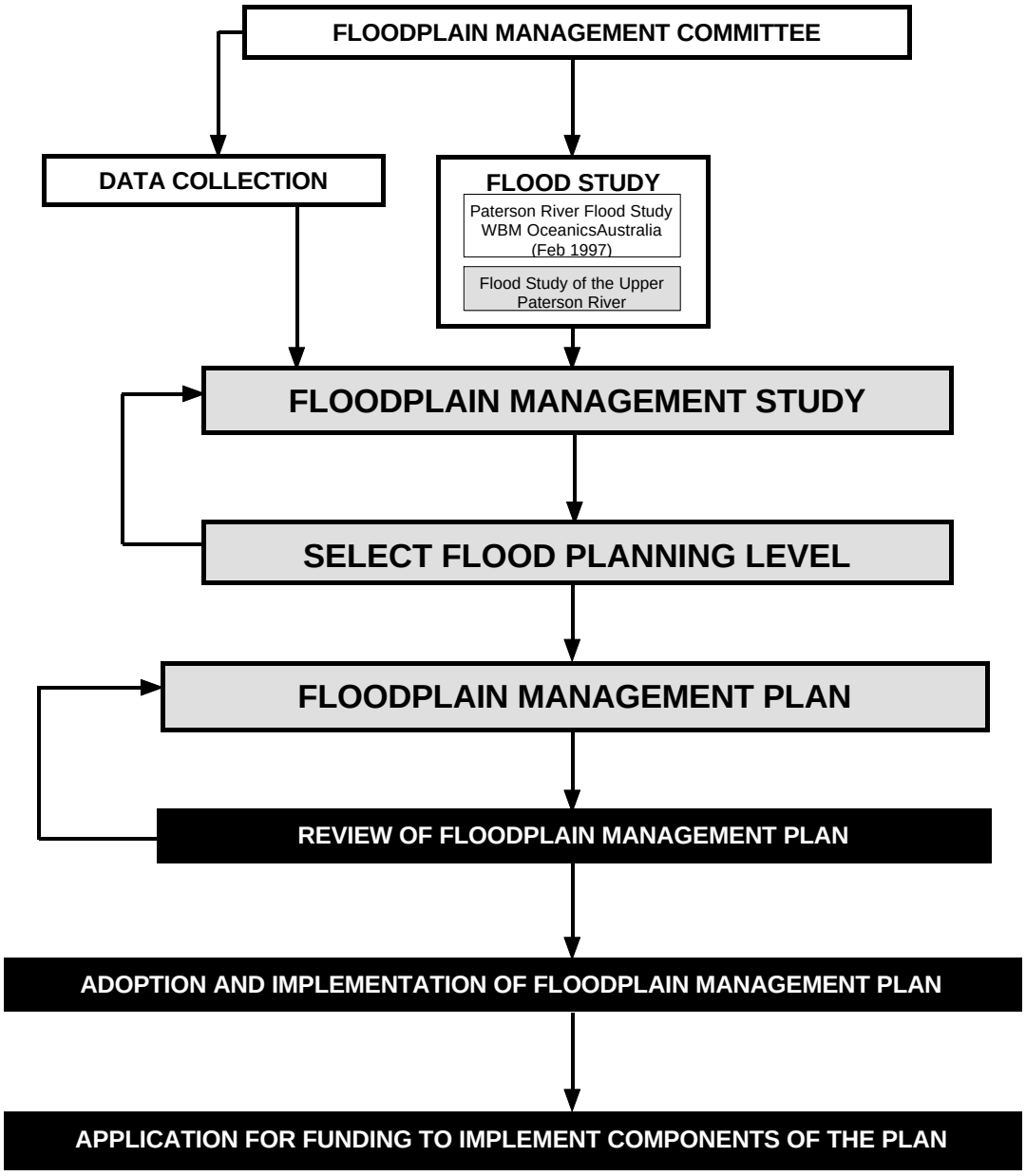

Both Councils
Option 2.2
Flood proofing of individual properties
Both Councils
Option 2.3
Improve existing planning controls
Both Councils
Option 3.2
Improve emergency planning and management
Both Councils
Option 3.3
Increase community education and flood awareness
Both Councils
Option 3.4
Improve flood warning systems
Both Councils
Option 1.8
Council endorsement of scour protection, bank stabilisation works and vegetation management by the HCMT and DLWC
Both Councils
Option 1.9
Council endorsement of levee maintenance by the HCMT and DLWC
Both Councils
Option 1.10
Council endorsement of drainage channel maintenance by the Drainage Union,HCMT and DLWC
Port Stephens Council Only
Option 2.1
Voluntary house raising, relocation or demolition/reconstruct severely flood affected properties
Option 2.4
Voluntary acquisition of severely flood affected houses by Council (Urban areas only)
Upstream Limit of Study Area
Downstream Limit of Study Area
DUNGOG COUNCIL
PORT STEPHENS COUNCIL
Maitland City Council Area (not included in Study)
N
Boundary
Council
Vacy
Martins Creek
Woodville
Iona
Wallalong
Hinton
Largs
Bolwarra
Bolwarra Heights
Oakhampton
Rutherford
Telarah
Lorn
MAITLAND
Farley
Louth Park
East Maitland
Tenambit
Gadara
Raworth
Morpeth
Phoenix Park
Rosebrook
Dunns Creek
Paterson River
Hunter River
Plot file : J810_f8
Plot scale : 1:00
Date : November 2001 Peters
Bewsher Consulting Pty Ltd
Floodplain Management Consultants
PATERSON RIVER FLOODPLAIN MANAGEMENT STUDY AND PLAN
THE DRAFT FLOODPLAIN MANAGEMENT PLANS
LEGEND
Extent of floodplain within study area
0 1 2 3 4 5 km
Scale

FIGURE 1



KEY:

Steps in the Floodplain Management Process already completed by each Council

Steps in the Floodplain Management Process undertaken as part of this study

Steps in the Floodplain Management Process yet to be completed by each Council

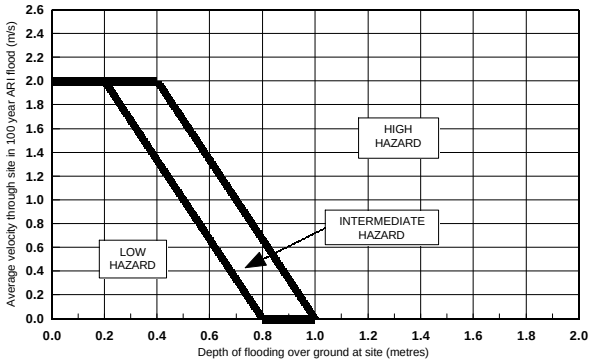
Source: adapted from Reference 1

THE FLOODPLAIN MANAGEMENT PROCESS

Narrabri Floodplain Management Study

depth	velocity	
0	2	2
0.2	2	2
0.4	2	1.33
0.8	0.67	0
1	0	0

Figure 4.12
CALCULATION OF PROVISIONAL FLOOD HAZARD



Source: Floodplain Development Manual (PWD, 1986)

Notes:

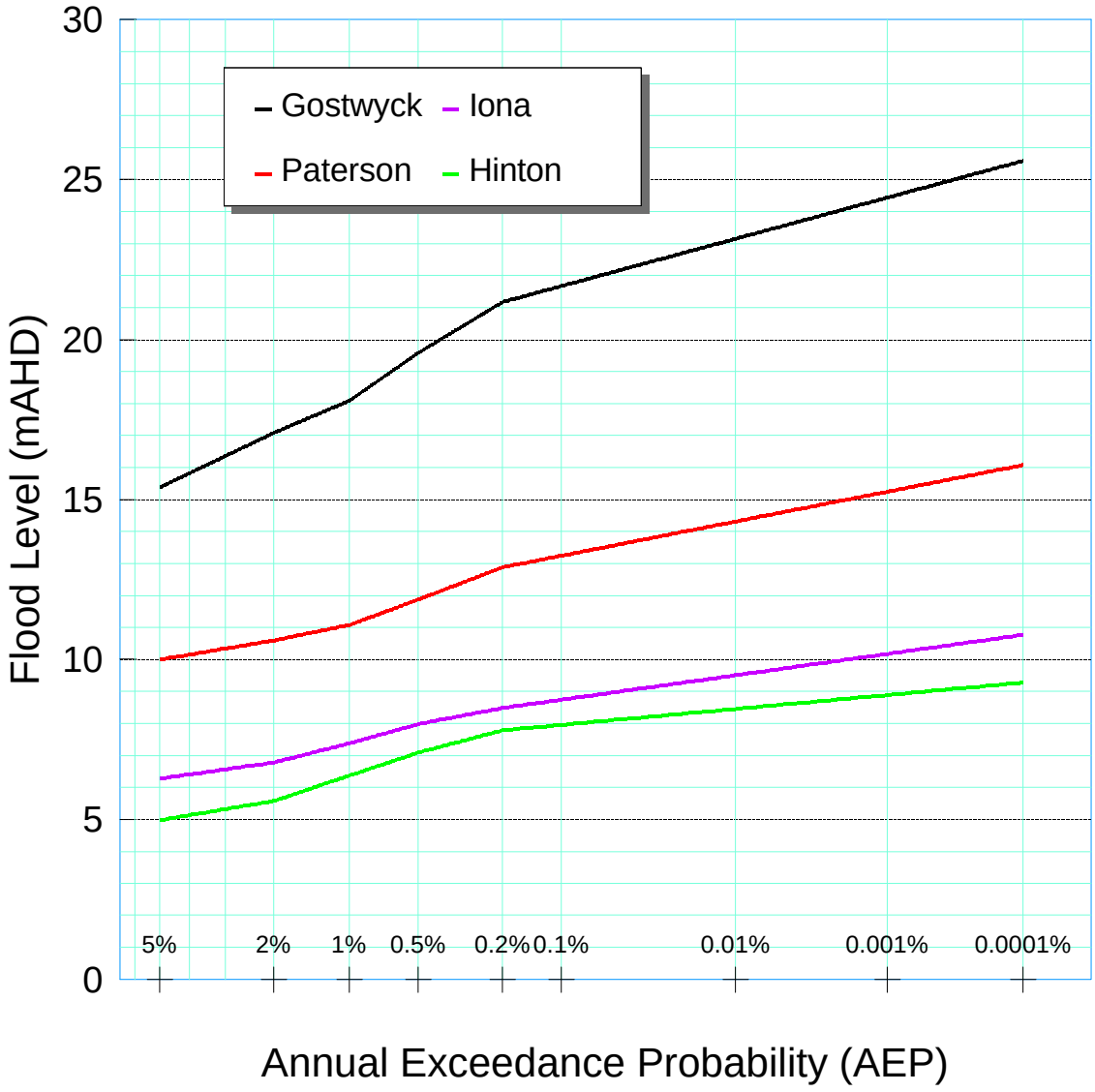
This is a provisional flood hazard diagram. The degree of hazard may be either:

- reduced by the establishment of an effective flood evacuation procedure
- increased if evacuation difficulties exist

Example:

If the depth of flood water over the ground of the property is 1.2m, and the average velocity is 0.8m/s, in a 100 year ARI flood event, then the provisional flood hazard would be high.

PATERSON RIVER FLOOD LEVEL FREQUENCY AT VARIOUS LOCATIONS



Note: The AEP of the extreme flood has been assumed to be 1:1000000 in any year

SCHEDULE 3

PORT STEPHENS COUNCIL

PATERSON RIVER FLOODPLAIN MANAGEMENT PLAN - PLANNING MATRIX CONTROLS

DEVELOPMENT CONTROL CONSIDERATION	FLOODPLAIN MANAGEMENT ZONES																												
	LOW RISK ZONE							ISOLATED ISLANDS ZONE							HIGH RISK: VELOCITY & DEPTH ZONE								FLOODWAY & EXCESSIVE DEPTH ZONE							
	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION	RESIDENTIAL IN URBAN ZONES	RESIDENTIAL IN RURAL ZONES	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT
FLOOR & GROUND LEVELS	3	3		2	2or5	1	4		3		2	2or5	1	4					2		1	4						1	4
BUILDING COMPONENTS	2	2		1	1	1	1		2		1	1	1	1					1		1	1						1	1
STRUCTURAL SOUNDNESS	2	2	1	1	1	1	1		2		1	1	1	1					1		1	1						1	1
FLOOD AFFECTATION	2	2	1	2	2	2	2		2		2	2	2	2					1		1	1						1	1
EVACUATION/ACCESS	2	2	1,3	1,3	3	3	3		2		1,3	3	3	3					3		3	3						3	3
FLOOD AWARENESS	2	2	1,2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
MANAGEMENT & DESIGN			3	1,2	1,2	1,2	1,2				1,2	1,2	1,2	1,2					1,2		1,2	1,2						1,2	1,2

NOTES

NOT RELEVANT

UNSUITABLE LAND USE

IF GROUND LEVEL ABOVE EF LEVEL - NOT RELEVANT OR IF GROUND LEVEL BELOW EF LEVEL, USE DEVELOPMENT CONTROL CONSIDERATION INDICATED BY NUMBER

EF REFERS TO THE EXTREME FLOOD AS DEFINED IN THE GLOSSARY

FLOOR & PAD LEVELS

1. ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 5%AEP FLOOD LEVEL UNLESS DETERMINED BY A RISK ASSESSMENT
2. GROUND LEVEL OR A RAISED FILL PAD WITH A SURFACE LEVEL TO BE EQUAL TO OR GREATER THAN THE 5% AEP FLOOD LEVEL ON RURAL OR OTHER NON URBAN ZONED LANDS, AND HABITABLE FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 0.5% AEP FLOOD LEVEL.
3. ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE EF LEVEL
4. FLOOR LEVELS TO BE AS CLOSE TO THE DESIGN FLOOR OR GROUND LEVEL AS PRACTICAL & NO LOWER THAN THE EXISTING FLOOR LEVEL WHEN AN ADDITION TO AN EXISTING BUILDING
5. FLOOR LEVELS OF SHOPS & OFFICES TO BE AS CLOSE TO THE 0.5% AEP FLOOD LEVEL OR GROUND LEVEL AS PRACTICAL, OR MORE THAN 30% OF FLOOR AREA OR EQUIVALENT STORAGE SPACE TO BE ABOVE THE 0.5% AEP FLOOD LEVEL OR PREMISES TO BE FLOOD PROOFED (EG.FLOOD SHUTTERS FOR SHOPS) BELOW THE DESIGN FLOOR OR GROUND LEVEL

FLOOD COMPATIBLE BUILDING COMPONENTS

1. ALL STRUCTURES TO HAVE FLOOD COMPATIBLE BUILDING COMPONENTS BELOW OR AT THE 0.5%AEP FLOOD LEVEL
2. ALL STRUCTURES TO BE CONSTRUCTED OF FLOOD COMPATIBLE MATERIALS BELOW OR AT THE EF LEVEL

STRUCTURAL SOUNDNESS

1. ENGINEERS CERTIFICATE TO CONFIRM ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCL. THE 0.5%AEP FLOOD LEVEL CAN WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY
2. ENGINEERS CERFIFICATE TO CONFIRM THAT ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCLUDING THE EF LEVEL CAN WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY

FLOOD EFFECT ON OTHERS

1. ENGINEERS REPORT REQUIRED TO PROVE THAT THE DEVELOPMENT OF AN EXISTING ALLOTMENT WILL NOT INCREASE FLOOD AFFECTATION ELSEWHERE
2. THE IMPACT OF THE DEVELOPMENT ON FLOOD AFFECTATION ELSEWHERE TO BE CONSIDERED

EVACUATION/ACCESS

1. RELIABLE ACCESS FOR PEDESTRIANS REQUIRED DURING A 0.5%AEP FLOOD
2. RELIABLE ACCESS FOR PEDESTRIANS & VEHICLES REQUIRED AT OR ABOVE THE EF LEVEL
3. PEDESTRIAN /VEHICULAR ACCESS ROUTE FOR BOTH BEFORE & DURING A FLOOD TO BE AVAILABLE IN ACCORDANCE WITH AN ADOPTED FLOOD EVACUATION STRATEGY, INCLUDING PROVISION TO EVACUATE CAMPING & CARAVAN SITES WITHIN AVAILABLE WARNING TIMES

FLOOD AWARENESS

1. RESTRICTIONS TO BE PLACED ON TITLE ADVISING OF MINIMUM FLOOR LEVELS REQUIRED RELATIVE TO THE FLOOD LEVEL
2. S149(2) CERTIFICATES TO NOTIFY OF APPLICABILITY OF THIS DCP

MANAGEMENT & DESIGN

1. APPLICANT TO DEMONSTRATE THAT THERE IS AN AREA WHERE GOODS MAY BE STORED ABOVE THE 0.5%AEP FLOOD LEVEL
2. APPLICANT TO PROVIDE CONTROLS WHERE NECESSARY TO PREVENT THE DISCHARGE OF POLLUTION DURING FLOODS, INCLUDING COMPLIANCE WITH THE "ENVIRONMENT & HEALTH PROTECTION GUIDELINES - ON-SITE SEWAGE MANAGMENT FOR SINGLE HOUSEHOLDS" DATED FEBRUARY 1998 AND PUBLISHED BY THE STATE GOVERNMENT
3. APPLICANT TO DEMONSTRATE THAT POTENTIAL DEVELOPMENT AS A CONSEQUENCE OF A SUBDIVISION PROPOSAL CAN BE UNDERTAKEN WITHOUT ANY SIGNIFICANT FLOOD EFFECT ELSEWHERE AND CAN ACCESS AN APPROPRIATE PEDESTRIAN/VEHICULAR ROUTE AS PART OF A FLOOD EVACUATION STRATEGY IF REQUIRED

SCHEDULE 4
PORT STEPHENS COUNCIL
OTHER FLOODPLAIN AREAS
PLANNING MATRIX CONTROLS

DEVELOPMENT CONTROL CONSIDERATION	FLOODPLAIN MANAGEMENT BAND																				
	OUTER FLOODPLAIN ABOVE 1% AEP FLOOD (PLUS 0.5m FREEBOARD) TO EF							FLOOD FRINGE BETWEEN HIGH HAZARD AREA TO 1% AEP FLOOD(PLUS 0.5m FREEBOARD)							FLOODWAY HIGH HAZARD AREA						
	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION & FILLING	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION & FILLING	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION & FILLING	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT
FLOOR LEVEL	3	3									2	2or 5	1	4						1	4
BUILDING COMPONENTS	2	2									1	1	1	1						1	1
STRUCTURAL SOUNDNESS	2	2								1	1	1	1	1						1	1
FLOOD AFFECTATION	2	2	2		2					1	2	2	2	2						1	1
EVACUATION/ACCESS	2	2	3		3					1,3	3	3	3							1,3	3
FLOOD AWARENESS	2	2	2	2	2	2	2			1,2	2	2	2	2						2	2
MANAGEMENT & DESIGN	1	1	4							4	1,2,3	1,2,3	1,2,3	1,3						1,2,3	1,2,3

NOTES

NOT RELEVANT

UNSUITABLE LAND USE

EF REFERS TO THE PROBABLE MAXIMUM OR EXTREME FLOOD AS DEFINED IN THE GLOSSARY

FLOOR LEVEL

1 ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 5%AEP FLOOD PLUS 0.5M (FREEBOARD) UNLESS DETERMINED BY A RISK ASSESSMENT

2 FLOOR LEVELS (EXCLUDING NON-HABITABLE RESIDENTIAL FLOORSPACE) TO BE EQUAL TO OR GREATER THAN THE 1%AEP FLOOD PLUS 0.5M (FREEBOARD) AND OTHER FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 1% AEP FLOOD (NO FREEBOARD)

3 ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE EF LEVEL

4 FLOOR LEVELS TO BE AS CLOSE TO THE DESIGN FLOOR LEVEL AS PRACTICAL & NO LOWER THAN THE EXISTING FLOOR LEVEL WHEN AN ADDITION TO AN EXISTING BUILDING

5 FLOOR LEVELS OF SHOPS & OFFICES TO BE AS CLOSE TO THE 1% AEP FLOOD LEVEL PLUS 0.5M (FREEBOARD) AS PRACTICAL, OR MORE THAN 30% OF FLOOR AREA OR EQUIVALENT STORAGE SPACE TO BE ABOVE THE 1% AEP FLOOD LEVEL PLUS 0.5M (FREEBOARD) OR PREMISES TO BE FLOOD PROOFED (EG.FLOOD SHUTTERS FOR SHOPS) BELOW THE DESIGN FLOOR LEVEL

FLOOD COMPATIBLE BUILDING COMPONENTS

1 ALL STRUCTURES TO HAVE FLOOD COMPATIBLE BUILDING COMPONENTS BELOW OR AT THE 1%AEP FLOOD LEVEL PLUS 0.5M(FREEBOARD)

2 ALL STRUCTURES TO BE CONSTRUCTED OF FLOOD COMPATIBLE MATERIALS BELOW OR AT THE EF LEVEL

STRUCTURAL SOUNDNESS

1 ENGINEERS CERTIFICATE TO CONFIRM ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCL. THE 1% AEP FLOOD LEVEL CAN WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY

2 ENGINEERS CERTIFICATE TO CONFIRM THAT ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCLUDING THE EF LEVEL CAN WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY

FLOOD EFFECT ON OTHERS

1 ENGINEERS REPORT REQUIRED TO PROVE THAT THE DEVELOPMENT OF AN EXISTING ALLOTMENT WILL NOT INCREASE FLOOD AFFECTATION ELSEWHERE

2 THE IMPACT OF THE DEVELOPMENT ON FLOOD AFFECTATION ELSEWHERE TO BE CONSIDERED

EVACUATION/ACCESS

1 RELIABLE ACCESS FOR PEDESTRIANS REQUIRED DURING A 1%AEP FLOOD

2 RELIABLE ACCESS FOR PEDESTRIANS & VEHICLES REQUIRED AT OR ABOVE THE EF LEVEL

3 CONSIDERATION REQUIRED REGARDING AN APPROPIATE FLOOD EVACUATION STRATEGY & PEDESTRIAN /VEHICULAR ACCESS ROUTE FOR BOTH BEFORE & DURING A FLOOD

FLOOD AWARENESS

1 RESTRICTIONS TO BE PLACED ON TITLE ADVISING OF MINIMUM FLOOR LEVELS REQUIRED RELATIVE TO THE FLOOD LEVEL

2 S149(2) CERTIFICATES TO NOTIFY OF APPLICABILITY OF THIS DCP

MANAGEMENT & DESIGN

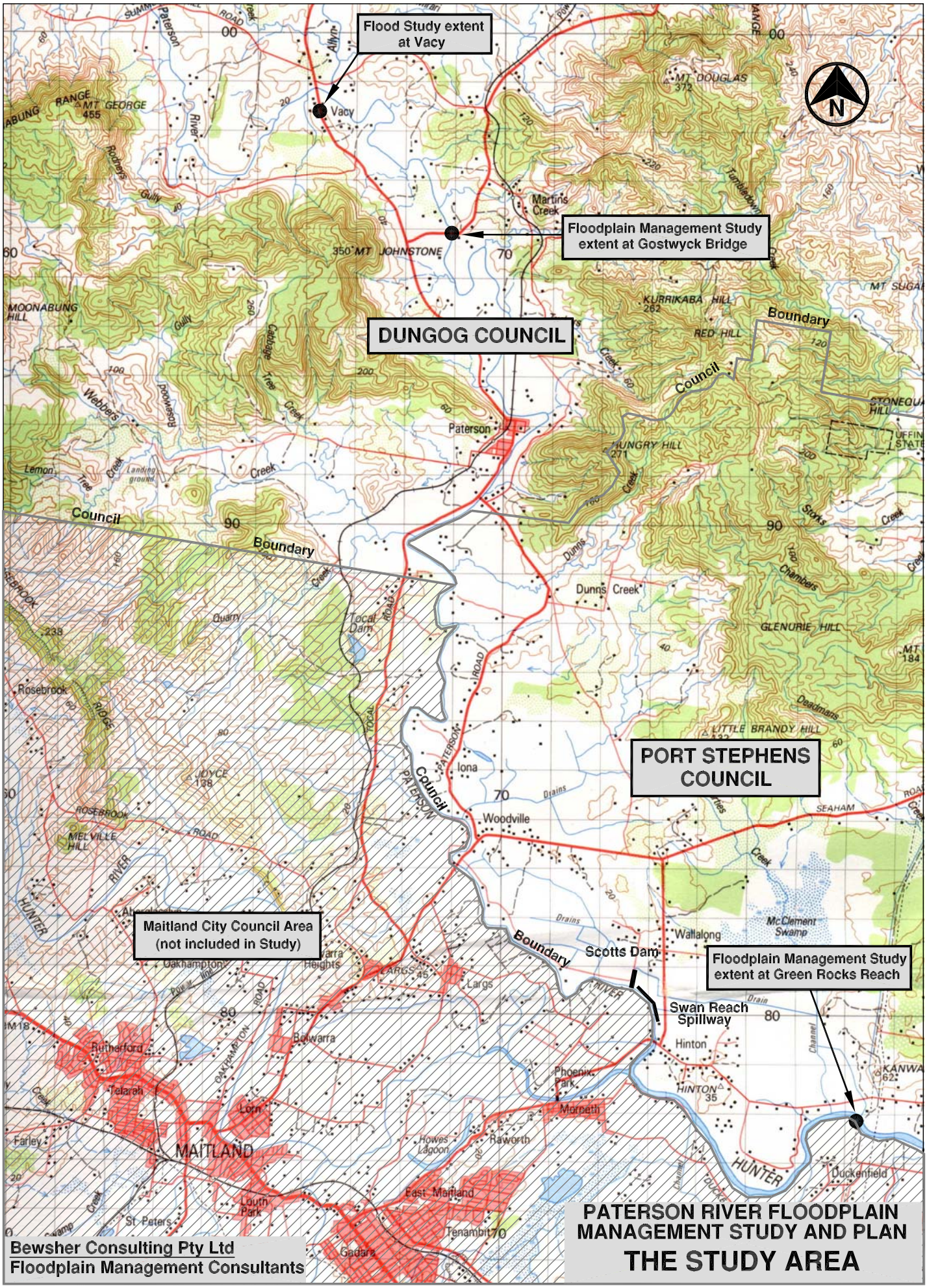
1 FLOOD PLAN REQUIRED WHERE FLOOR LEVELS ARE BELOW THE DESIGN FLOOR LEVEL

2 APPLICANT TO DEMONSTRATE THAT THERE IS AN AREA WHERE GOODS MAY BE STORED ABOVE THE 1%AEP FLOOD LEVEL PLUS 0,5M(FREEBOARD) DURING FLOODS.

3 APPLICANT TO PROVIDE CONTROLS WHERE NECESSARY TO PREVENT THE DISCHARGE OF POLLUTION DURING FLOODS, INCLUDING COMPLIANCE WITH THE "ENVIRONMENT & HEALTH PROTECTION GUIDELINES - ON-SITE SEWAGE MANAGEMENT FOR SINGLE HOUSEHOLDS" DATED FEBRUARY 1998 AND PUBLISHED BY THE STATE GOVERNMENT

4 APPLICANT TO DEMONSTRATE THAT POTENTIAL DEVELOPMENT AS A CONSEQUENCE OF A SUBDIVISION PROPOSAL CAN BE UNDERTAKEN WITHOUT ANY SIGNIFICANT FLOOD EFFECT ELSEWHERE AND CAN ACCESS AN APPROPRIATE PEDESTRIAN/VEHICULAR ROUTE AS PART OF A FLOOD EVACUATION STRATEGY IF REQUIRED

FIGURE 2



PATERSON RIVER FLOODPLAIN MANAGEMENT STUDY AND PLAN

THE STUDY AREA

Bewsher Consulting Pty Ltd
Floodplain Management Consultants

Plot file : J810-f2
Plot scale : 100
Date : November 2001

DUNGOG COUNCIL

PATERSON RIVER FLOODPLAIN MANAGEMENT PLAN - PLANNING MATRIX CONTROLS

DEVELOPMENT CONTROL CONSIDERATION	FLOODPLAIN MANAGEMENT ZONES																										
	LOW RISK ZONE							ISOLATED ISLANDS ZONE							HIGH RISK: VELOCITY & DEPTH ZONE							FLOODWAY & EXCESSIVE DEPTH ZONE						
	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION	RESIDENTIAL IN URBAN ZONES	RESIDENTIAL IN RURAL ZONES	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT
FLOOR & GROUND LEVELS	3	3		2	2or5	1	4		3		2	2or5	1	4					2		1	4						1	4
BUILDING COMPONENTS	2	2		1	1	1	1		2		1	1	1	1					1		1	1						1	1
STRUCTURAL SOUNDNESS	2	2	1	1	1	1	1		2		1	1	1	1					1		1	1						1	1
FLOOD AFFECTATION	2	2	1	2	2	2	2		2		2	2	2	2					1		1	1						1	1
EVACUATION/ACCESS	2	2	1,3	1,3	3	3	3		2		1,3	3	3	3					3		3	3						3	3
FLOOD AWARENESS	2	2	1,2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
MANAGEMENT & DESIGN			3	1,2	1,2	1,2	1,2				1,2	1,2	1,2	1,2					1,2		1,2	1,2						1,2	1,2

NOTES

NOT RELEVANT

UNSUITABLE LAND USE

IF GROUND LEVEL ABOVE EF LEVEL - NOT RELEVANT OR IF GROUND LEVEL BELOW EF LEVEL, USE DEVELOPMENT CONTROL CONSIDERATION INDICATED BY NUMBER

EF REFERS TO THE EXTREME FLOOD AS DEFINED IN THE GLOSSARY

FLOOR & PAD LEVELS

1. ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 5%AEP FLOOD LEVEL UNLESS DETERMINED BY A RISK ASSESSMENT
2. GROUND LEVEL OR A RAISED FILL PAD WITH A SURFACE LEVEL TO BE EQUAL TO OR GREATER THAN THE 5% AEP FLOOD LEVEL ON RURAL OR OTHER NON-URBAN ZONED LANDS, AND HABITABLE FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 0.5% AEP FLOOD LEVEL
3. ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE EF LEVEL
4. FLOOR LEVELS TO BE AS CLOSE TO THE DESIGN FLOOR OR GROUND LEVEL AS PRACTICAL & NO LOWER THAN THE EXISTING FLOOR LEVEL WHEN AN ADDITION TO AN EXISTING BUILDING
5. FLOOR LEVELS OF SHOPS & OFFICES TO BE AS CLOSE TO THE 0.5% AEP FLOOD LEVEL OR GROUND LEVEL AS PRACTICAL, OR MORE THAN 30% OF FLOOR AREA OR EQUIVALENT STORAGE SPACE TO BE ABOVE THE 0.5% AEP FLOOD LEVEL OR PREMISES TO BE FLOOD PROOFED (EG.FLOOD SHUTTERS FOR SHOPS) BELOW THE DESIGN FLOOR OR GROUND LEVEL

FLOOD COMPATIBLE BUILDING COMPONENTS

1. ALL STRUCTURES TO HAVE FLOOD COMPATIBLE BUILDING COMPONENTS BELOW OR AT THE 0.5%AEP FLOOD LEVEL.
2. ALL STRUCTURES TO BE CONSTRUCTED OF FLOOD COMPATIBLE MATERIALS BELOW OR AT THE EF LEVEL

STRUCTURAL SOUNDNESS

1. ENGINEERS CERTIFICATE TO CONFIRM ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCL. THE 0.5% AEP FLOOD LEVEL CAN WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY
2. ENGINEERS CERFIFICATE TO CONFIRM THAT ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCLUDING THE EF LEVEL CAN WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY

FLOOD EFFECT ON OTHERS

1. ENGINEERS REPORT REQUIRED TO PROVE THAT THE DEVELOPMENT OF AN EXISTING ALLOTMENT WILL NOT INCREASE FLOOD AFFECTATION ELSEWHERE
2. THE IMPACT OF THE DEVELOPMENT ON FLOOD AFFECTATION ELSEWHERE TO BE CONSIDERED

EVACUATION/ACCESS

1. RELIABLE ACCESS FOR PEDESTRIANS REQUIRED DURING AN 0.5%AEP FLOOD LEVEL
2. RELIABLE ACCESS FOR PEDESTRIANS & VEHICLES REQUIRED AT OR ABOVE THE EF LEVEL
3. PEDESTRIAN /VEHICULAR ACCESS ROUTE FOR BOTH BEFORE & DURING A FLOOD TO BE AVAILABLE IN ACCORDANCE WITH AN ADOPTED FLOOD EVACUATION STRATEGY, INCLUDING PROVISION TO EVACUATE CAMPING & CARAVAN SITES WITHIN AVAILABLE WARNING TIMES

FLOOD AWARENESS

1. RESTRICTIONS TO BE PLACED ON TITLE ADVISING OF MINIMUM FLOOR LEVELS REQUIRED RELATIVE TO THE FLOOD LEVEL
2. S149(2) CERTIFICATES TO NOTIFY OF APPLICABILITY OF THIS DCP

MANAGEMENT & DESIGN

1. APPLICANT TO DEMONSTRATE THAT THERE IS AN AREA WHERE GOODS MAY BE STORED ABOVE THE 0.5%AEP FLOOD LEVEL DURING FLOODS.
2. APPLICANT TO PROVIDE CONTROLS WHERE NECESSARY TO PREVENT THE DISCHARGE OF POLLUTION DURING FLOODS, INCLUDING COMPLIANCE WITH THE "ENVIRONMENT & HEALTH PROTECTION GUIDELINES - ON-SITE SEWAGE MANAGMENT FOR SINGLE HOUSEHOLDS" DATED FEBRUARY 1998 AND PUBLISHED BY THE STATE GOVERNMENT
3. APPLICANT TO DEMONSTRATE THAT POTENTIAL DEVELOPMENT AS A CONSEQUENCE OF A SUBDIVISION PROPOSAL CAN BE UNDERTAKEN WITHOUT ANY SIGNIFICANT FLOOD EFFECT ELSEWHERE AND CAN ACCESS AN APPROPRIATE PEDESTRIAN/VEHICULAR ROUTE AS PART OF A FLOOD EVACUATION STRATEGY IF REQUIRED

PORT STEPHENS COUNCIL

PATERSON RIVER FLOODPLAIN MANAGEMENT PLAN - PLANNING MATRIX CONTROLS

DEVELOPMENT CONTROL CONSIDERATION	FLOODPLAIN MANAGEMENT ZONES																										
	LOW RISK ZONE							ISOLATED ISLANDS ZONE							HIGH RISK: VELOCITY & DEPTH ZONE							FLOODWAY & EXCESSIVE DEPTH ZONE						
	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION	RESIDENTIAL IN URBAN ZONES	RESIDENTIAL IN RURAL ZONES	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT
FLOOR & GROUND LEVELS	3	3		2	2or5	1	4		3		2	2or5	1	4					2		1	4					1	4
BUILDING COMPONENTS	2	2		1	1	1	1		2		1	1	1	1					1		1	1					1	1
STRUCTURAL SOUNDNESS	2	2	1	1	1	1	1		2		1	1	1	1					1		1	1					1	1
FLOOD AFFECTATION	2	2	1	2	2	2	2		2		2	2	2	2					1		1	1					1	1
EVACUATION/ACCESS	2	2	1,3	1,3	3	3	3		2		1,3	3	3	3					3		3	3					3	3
FLOOD AWARENESS	2	2	1,2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
MANAGEMENT & DESIGN			3	1,2	1,2	1,2	1,2				1,2	1,2	1,2	1,2					1,2		1,2	1,2					1,2	1,2

NOTES

NOT RELEVANT

UNSUITABLE LAND USE

IF GROUND LEVEL ABOVE EF LEVEL - NOT RELEVANT OR IF GROUND LEVEL BELOW EF LEVEL, USE DEVELOPMENT CONTROL CONSIDERATION INDICATED BY NUMBER

EF REFERS TO THE EXTREME FLOOD AS DEFINED IN THE GLOSSARY

FLOOR & PAD LEVELS

1 ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 5%AEP FLOOD LEVEL UNLESS DETERMINED BY A RISK ASSESSMENT

2 GROUND LEVEL OR A RAISED FILL PAD WITH A SURFACE LEVEL TO BE EQUAL TO OR GREATER THAN THE 5% AEP FLOOD LEVEL ON RURAL OR OTHER NON URBAN ZONED LANDS, AND HABITABLE FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 0.5% AEP FLOOD LEVEL.

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4 FLOOR LEVELS TO BE AS CLOSE TO THE DESIGN FLOOR OR GROUND LEVEL AS PRACTICAL & NO LOWER THAN THE EXISTING FLOOR LEVEL WHEN AN ADDITION TO AN EXISTING BUILDING

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PORT STEPHENS COUNCIL AND DUNGOG COUNCIL

Paterson River Floodplain Management Study and Plan

Paterson River, March 1978, viewing downstream to Iona and Woodville

FINAL REPORT

Volume 2 — Town Planning Context and Strategy

November 2001

Prepared by Don Fox Planning Pty Ltd for Bewsher Consulting Pty Ltd

PATERSON RIVER
FLOODPLAIN MANAGEMENT STUDY
AND PLAN
VOLUME II
TOWN PLANNING CONTEXT AND STRATEGY

Prepared for

BEWSHER CONSULTING PTY LTD

on behalf of

PORT STEPHENS COUNCIL

&

DUNGOG COUNCIL

PROJECT NO: 4044

APRIL 2000
(Finalised November 2001)
(Printed February 2002)

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TABLE OF CONTENTS

TABLE OF ILLUSTRATIONS

TABLE OF APPENDICES

1.0 INTRODUCTION

1.1 Background and Study Scope

Don Fox Planning Pty Ltd has been engaged by Bewsher Consulting Pty Ltd to form part of a consultant team to prepare a Floodplain Management Study (FPMS) and Plan (FPMP). The FPMS and FPMP is to be prepared for those floodplains within the Port Stephens and Dungog Local Government Areas (LGA's) adjacent to the Paterson River from the Gostwyck Bridge downstream to the confluence with the Hunter River and the area adjacent to the Hunter River between its confluence with the Paterson River and Green Rocks.

The purpose of this component of the study is to undertake the following tasks:

- Describe the characteristics of the study area with particular regard to land use, population characteristics, vegetation and heritage with particular regard to implications for the management of the floodplain.

- Discuss the role of planning in the preparation of the FPMP and the implications and the choice of an appropriate designated flood standard or standards.

- Review the existing framework of planning and development controls which are relevant to the formulation of planning instruments and the assessment of building and development applications within the study area.

- Comment on potential structural mitigation measures having regard to possible planning and environmental implications and impacts associated with implementing such measures.

- Discuss the proposed approach and philosophy to floodplain planning and how it may be implemented within the Paterson River Floodplain, particularly having regard to the joint responsibility held by two councils and other FPMP's prepared for remaining components of their respective LGA's and planning controls emanating from these FPMP's.

- Discuss options and review strategic planning issues to guide the formulation of appropriate planning controls for inclusion within the FPMP.

- To make specific planning recommendations in regard to the above, including an outline of suggested planning controls.

It is recognised that the flood hazard is one component for consideration in any town planning exercise. It is not considered appropriate to produce a variety of planning controls within the FPMP which responds to the planning hazard identified by hydraulic studies in isolation to this strategic planning context. Accordingly, this component of the FPMP considers the strategic planning context for the study area as a prelude to formulating planning recommendations for the FPMP.

1.2 Study Area

The Paterson River is a tributary of the Hunter River, and its confluence with the Hunter River is located approximately 10 kilometres north-east of Maitland and 35 kilometres north-west of Newcastle. The regional location of the Paterson River and general study area is depicted upon **Illustration 1**.

The study area comprises that part of the Paterson River Floodplain located within the Port Stephens and Dungog Council's LGA's from the Gostwyck Bridge downstream to the confluence with the Hunter River (a river length of about 29 km). That part of the floodplain of the Hunter River which is located within the Port Stephens LGA, between its confluence with the Paterson River and Green Rocks (a river length of about 8 km), is also included within the study area. This lower extent of the study area meets the boundary of the Lower Hunter River FPMS. The total extent of the study area is depicted upon **Illustration 2**.

As required by the brief, hydrologic investigations are to consider the total Paterson River catchment area when assessing options affecting the floodplain. Floodplain planning controls relevant to this component of the study will be pertinent to only the floodplain and not to the whole of the catchment. The floodplain referred to in this context is that area of land inundated by the extreme flood (EF) which is generally accepted to be reflective of the true extent of the potential floodplain. A "*top down approach*" is to be applied in the following investigations within this report to determine the appropriate land uses and

building controls to be applied to future development in the floodplain or parts of the floodplain.

2.0 THE PLANNING CONTEXT

2.1 Characteristics of the Study Area

2.1.1 Existing Land Use

Port Stephens LGA

The component of the study area within the Port Stephens LGA is comprised predominantly of rural land with two villages. The villages are Wallalong and Hinton which are substantially urban zoned and developed. Immediately to the north-east of Wallalong is a rural residential area, which is effectively an extension of this village. A larger, rural residential area exists immediately to the north of the southern extent of the study area on the higher lands flanking the eastern side of McClement Swamp.

The rural areas of the study area within the Port Stephens LGA include a variety of agricultural activities varying from grazing to more intensive agricultural pursuits. A number of poultry farms exist within proximity to Wallalong. The railway line also traverses the study area in a north/south direction passing through Hinton within the Port Stephens LGA.

The McClement Swamp area is a large natural wetland area occupying an extensive component of the study area within the Port Stephens LGA. The McClement Swamp is located north of the two villages and just south of the boundary between the Port Stephens LGA and the Dungog Shire LGA.

Dungog Shire LGA

Similar to Port Stephens LGA, the part of the study area within the Dungog Shire LGA is comprised substantially of rural areas with two villages. The first of the two villages is the town of Paterson which is a substantial village with an extensive urban zoned area. The

town of Paterson is located immediately on the western banks of the Paterson River. The second village is known as Martins Creek which is a relatively small village located just north of a tributary of the Paterson River known as Martins Creek.

There are a number of rural residential areas within that part of the study area within the Dungog Shire LGA, however these are dispersed and vary in size. Some of the larger rural residential areas include those located immediately to the south of Martins Creek and to the north-west of the town of Paterson. There are also areas developed for small farms (ie. hobby farms) which are contained within a 1(d) Rural Farmlets zone. There are numerous areas developed and zoned in this fashion, with the largest areas being located immediately to the west and north of Martins Creek, which in part abut the Paterson River.

The study area has extensive areas of bushland, and a number of parcels of land are zoned 7(c) Rural Environmental Protection (Habitat) zone.

2.1.2 Existing Vegetation

An analysis of the vegetation within the study area is of importance for the following three main reasons:

- To provide an understanding of the ecological characteristics and value of vegetation within the study area in order that floodplain management decisions are sympathetic to the conservation values of the vegetation and, where appropriate, take advantage of the opportunities provided by existing vegetation to form open space areas and linkages.

- To ensure that any flood mitigation measures, in particular structural measures, are not fundamentally unacceptable due to their potential impact upon important vegetation areas.

- To provide a basis for the removal of exotic vegetation or weed species from the river corridor, to improve the river hydraulics (and provide other ecological benefits) which may reduce flood levels or prevent the redirection of the flow path of floodwaters.

With regard to the subject study area, the existence or potential impact of exotic vegetation on the hydraulics of the river is understood not to be a significant issue. Accordingly, the relevance of the vegetation assessment is to ensure that there is a reasonable understanding of the extent of known important vegetation areas to provide a preliminary assessment of potential structural mitigation options and to assist in the determination of land use preferences having regarding to the floodplain management objectives of the study. The significance of the vegetation issue has been taken into consideration in the review of potential flood mitigation measures reported within Section 4.0 of this study.

Minimal detailed vegetation surveys have been undertaken within the study area. The most comprehensive vegetation survey data sourced is that contained within the "*Dungog Biological Diversity Study - Paterson Planning District*" (ERM Mitchell McCotter, 1998), although this relates only to the Dungog LGA and not the Port Stephens LGA. The slopes and lower slopes flanking the floodplain of the Paterson district are comprised predominantly of woodland communities. Some wetland areas have also been identified to the south-west of the Paterson township, while discontinuous riparian vegetation and plantations have been identified.

The woodland community is comprised predominantly of remnants of open forest that existed over much of the Paterson Valley prior to settlement occurring in the early 1800's. The clearing which has resulted has left a woodland community over much of the valley floor. This vegetation community is reported to contain a high degree of weed invasion as a result of pasture sowing (ERM Mitchell McCotter, 1998, p.3.10).

The dominant species within the woodland community include Grey Box (*Eucalyptus moluccana*), Grey Iron Bark, Narrow Leafed Iron Bark (*Eucalyptus crebra*), Spotted Gum (*Eucalyptus maculata*), Forest Red Gum (*Eucalyptus tereticornis*), Bastard White Mahogany and Blakely's Red Gum (*Eucalyptus blakelyi*). The grass layer is dominated by pasture species such as Couch, Kikuyu, and weed species such as Cud Weed, Fleabane, Flat Weed and Small Flower Mallow.

Rare or threatened species identified within the dominant vegetation community include Slaty Red Gum and terrestrial Orchid species such as *Diurus pedunculata.* Additionally, some of the communities comprising Grey Box associations are considered to be poorly conserved in the locality and region and are considered to have some conservation significance (refer to ERM Mitchell McCotter, p.3.11).

Non-indigenous vegetation such as plantations (orchards and other forms of agriculture) are located along the alluvial flats of the Paterson River. The plantations do not always extend to the river bank and in places the natural indigenous vegetation remains in small sections along the Paterson River containing better quality vegetation, although in bands of less than 20 metres wide.

The plantation communities comprise Poplar plantations which have been planted as wind breaks along the Paterson River. While of no ecological conservation significance, these plantations may have some historical or aesthetic value. Notwithstanding, in other parts of New South Wales, Poplar has spread as a riverine weed causing infestations and river flow blockages in some cases. Monitoring and control of such potential weed invasion is highly recommended.

A number of wetlands exist in the study area. The emergent vegetation along the tributary creeks consists of Swamp Oak *(Casuarina glauca)* and some Forest Red Gum (*Eucalyptus tereticornis),* with the wetland areas consisting of a fringe of weeds and rushes such as *Typha sp.*, *Eleocharis sp.* and *Juncus sp.* for those wetlands discussed within the Dungog Biodiversity Study - Paterson Planning District (ERM Mitchell McCotter, p.3.6).

Located along the river bank is a riparian forest founded on moist well drained soil with a low degree of fire severity, some grazing and weed invasion (ERM Mitchell McCotter, 1998, p.3.7). This community is a narrow band of vegetation which is rarely more than 50 metres wide, and in heavily grazed areas along the river the canopy has been reduced or in places removed entirely. In these areas, dense growths of rushes or pasture sometimes exist and extend to the river bank. The ERM Mitchell McCotter report (1998, p.3.8) did not record any rare or threatened species within the riparian community, but noted that epiphytic orchids and *Cynanchum elegans* may be expected to occur in less disturbed areas.

Generally, the historical land use in the area has resulted in substantial clearing or modification of indigenous vegetation, resulting in the remnant vegetation often having a local significance. The riparian vegetation community, in particular, provides significant potential for maintaining some vegetation corridors, as does many of the existing remnant vegetation areas scattered through the floodplain. Any flood mitigation option which results in extensive clearing of remnant vegetation areas should be evaluated carefully due to the

significant potential impact that the loss of this vegetation could have, and while minimal rare and endangered species have been identified, this would also need to be investigated.

Weed infestation in the floodplain and, in particular, along the river corridor has been identified due to past pastoral plantings, and plantations such as those consisting of Poplars. It would be desirable to ensure that the weed infestation along the river corridor is monitored and if necessary a detailed vegetation management strategy and associated action plans could be prepared to address this issue. A detailed management strategy should include additional information, detailed specifications and a timetable/work program.

2.1.3 Heritage

Settlement began in the area now known as Newcastle in 1801. In 1811, Governor Macquarie visited the Newcastle settlement and subsequently inspected land some 20 miles up the river. This resulted in a few farms being established on what is now known as the Paterson Plains. The first settlers where John Tucker Jnr, George Pell and John Swan, who produced wheat, maze, barley and other produce for the settlement of Newcastle (Archer, 1986, p.3). Notwithstanding, the first major product from the Paterson district was Red Cedar cut principally by convicts and floated as logs down the Paterson River.

In the 1820's, the penal settlement at Newcastle was transferred to Port Macquarie, and with the decline in Red Cedar availability in the valley, activity in the Paterson district became concentrated on farming. Farm settlements were large, being available primarily to wealthy and/or well-connected individuals who had influence in government circles to obtain land grants. The farming economy of the district has substantially remained the land use focus up to recent times, with the development of townships, generally in locations where they remain today.

The issue of heritage is of significance in regard to forming an understanding of the social and cultural context of the floodplain and to ensure that any flood mitigation measures do not impact upon the heritage of the study area. Both the Dungog LEP 1990 and Port Stephens Draft LEP 1999 contain an extensive listing of heritage items and conservation areas. Both planning instruments also contain detailed provisions to control development which may impact upon these heritage items and conservation areas. Some items which are of particular significance to this study include the Gostwyck Bridge and the Paterson Bridge

(along Paterson Road) and the Hinton Bridge over the Hunter River. Other heritage items within the study area relate to various forms of buildings including homesteads, community buildings such as schools and banks, significant trees and cemeteries.

The historic significance of the floodplain and the particular heritage items which it contains will be taken into consideration in the formulation of eventual land use and planning controls and the assessment of the impact of potential structural flood mitigation measures.

2.2 Population and Development Trends

2.2.1 Changing Population and Characteristics and Projections

The population of the Dungog and Port Stephens LGA's, and the Paterson township (being the largest township within the study area) during the years 1981 to 1996 are depicted upon **Table 1**. This table also provides projections to the year 2011, as available.

Table 1: Population Growth & Projections

Year	Paterson Township	Dungog LGA	Port Stephens LGA
1981 (1)	1064	6325	28,700
1986 (1)	1107	6578	36,000
1991 (1)	1255	7357	43,100
1996 (1)	1636	7632	50,200
2001	1500 (3)	9100 (2)	59,300 (2)
2006	NA	9800 (2)	66,000 (2)
2011	NA	10,400 (2)	72,600 (2)

(1) Determined from ABS Census Data
(2) Sourced from DOP 1994
(3) Sourced from Dungog Shire Council, Sept. 1998

While population growth within the Dungog LGA is expected to continue, at a relatively high annual rate, population within the Paterson township is expected to decline. This would be consistent with other findings of our investigations, which indicate that there is

limited opportunity or expectations for further urban development within the study area (other than dispersed rural residential housing). This factor together with a national trend in declining household sizes, could contribute to a decline in population for the study area.

There is an expectation for further population growth within the Port Stephens LGA up to the year 2011. However, the majority of the growth in the Port Stephens LGA is planned to occur within areas outside of the study area, and consistent with the scenario for the Dungog LGA, further population growth within the Port Stephens component of the study area is considered unlikely to occur or unlikely to occur at any significant level. Notwithstanding, there is increasing pressure for rural residential development in the study area which will at least contribute to maintaining existing population levels.

An initial analysis of general population variables within the subject LGA's do not reveal any particular characteristics or trends which would have any specific implications in regard to the subject FPMS or FPMP.

2.2.2 Recent Development Activity and Strategic Planning Directions

Dungog LGA

The majority of the recent development activity within the study area has focussed on rural residential properties and associated housing. The Dungog LGA has experienced a numerically small but steady increase in the population within that part of the Shire containing the study area. This is considered to be a primary result of its proximity to Newcastle and Maitland and because of the quality and range of rural allotments available. The villages of Paterson and Clarence Town (Clarence Town is not in the study area) have provided the focus for much of this growth, which has concentrated primarily on rural residential or hobby farm allotments.

Dungog Shire Council prepared a strategy for small rural lots in 1984 which formed the basis to the Dungog LEP 1990. Since the introduction of Dungog LEP 1990, Council has reported continual pressure to release further rural residential development potential within the southern portion of the Shire, partially within the study area. Between 1981 and 1993, Dungog Council granted approval for an average of 25 new rural allotments per annum and 19 new dwellings per annum, in the Paterson district. The `*Dungog Rural Strategy Review* -

Paterson Area' (Hilltop Planners, 1994) was aimed at establishing a rural land strategy to provide for legitimate demand for small rural allotments in the Paterson area.

The *Dungog Rural Strategy Review* briefly discusses the constraint imposed by flooding. The Review notes that accurate flood studies identifying the extent of the 1% AEP (Annual Exceedence Probability) flood were not available at the time, but as a general rule could be associated with the rich fertile river flats otherwise constrained because of their agricultural value. Taking into consideration all constraints assessed by the Review, a strategy was prepared which identified the capacity to generate approximately an additional 600 small rural lots (3 to 5 hectares in size) within the Paterson area. Having regard to the current annual demand of 30 lots, this represents approximately 20 years supply.

While the risk of damage to dwellings as a result of flooding may be substantially satisfactorily addressed by excluding dwellings from the 1% AEP floodplain, issues associated with evacuation and risk to human life may not have been adequately addressed by the Strategy. The scenario where dwellings are by default located on land marginally higher than the 1% AEP flood level accessed by roads which traverse terrain much lower than the 1% AEP flood level may create disastrous circumstances in the following ways.

* Persons located in houses have a misconception that they are located on flood-free land when in reality they may be only marginally above the 1% AEP flood level and subject to significant risk. The EF level is about 3 metres higher than the 1% AEP level at Hinton and about 7m higher at Gostwyck (refer Section 5.5 of this report). Therefore a flood slightly greater than 1% AEP flood can cause significant damage and create risk to human life, without the community being prepared.

* Persons needing to evacuate from an area may be prevented from doing so due to roads being inundated. This creates dangers to both those wanting to move out of the flood affected area, and for rescuers (i.e. in particular the SES and Police).

* Those located on higher land, but below the EF may chose to stay within their home regardless of the fact that the surrounding area is in flood. As flood waters rise and danger is becoming more immediate, persons are unable to evacuate themselves due to roads being blocked, and thereafter become subject to the danger of continually rising flood waters which could eventually inundate the higher land up to the EF

("the shrinking islands syndrome").

These risks become increasingly more serious with the increase in population of the flood affected area. Such scenarios are real concerns which have been investigated as part of other FPMS's (e.g. the Hawkesbury/Nepean Flood Management Strategy). Subsequent to a balanced consideration, if it is considered that further housing within such an area is considered desirable, this should be off-set by improved warning systems, evacuation routes, and evacuation resources, to ensure that major catastrophes do not result.

Port Stephens LGA

The Port Stephens Council has prepared a number of urban settlement strategies, the most recent being "*The Port Stephens Area Urban Settlement Strategy Stage II, updated April 1998").* The Port Stephens LGA is expected to have significant growth expanding from a population base of 51,288 at the 1996 Census to approximately 92,000 persons in the year 2021 (25 years). The Port Stephens Settlement Strategy aims to provide a non-statutory framework to guide future land use planning in the LGA well beyond the year 2000.

The outer rural areas of the Port Stephens LGA (west of the Williams River) has approximately 7% of the total LGA population (approx. 3800 persons). This population is expected to increase to approximately 7,400 by the year 2021.

The strategy anticipates that the demand for rural residential development will continue to increase, and this demand is presently satisfied in the Port Stephens LGA by the rural area west of the Williams River and the Medowie area (outside of the study area). The Strategy (p. 15) states that all *flood liable land* has been excluded for consideration for future urban development. It is assumed that reference to flood liable land is that land below the 1% AEP flood level and accordingly issues associated with the Dungog rural residential release areas may still be relevant. The Strategy anticipates that the zoned housing potential for the rural west area of the LGA (encompassing the study area) will be reached sometime after the year 2004.

Accordingly, the Strategy places a relatively high priority on investigating the potential for further urban development within this area. Such a review should take into consideration the findings of this FPMS and FPMP, and in particular should avoid the evacuation difficulties

associated with allowing dispersed rural residential development locating on land marginally higher than the 1% AEP flood level with road access traversing lower levels.

2.3 Existing Planning and Development Controls

2.3.1 Introduction

This section of the report identifies and examines various forms of planning instruments and associated controls which apply to the study area and may have potential for use for the purposes of implementing planning controls to guide future development within the study area. Not all of these planning instruments will be applicable, but are reviewed for the purposes of completeness and to provide a general overview of planning controls and strategic planning direction for the area.

2.3.2 State Environmental Planning Policies

A State Environmental Planning Policy (SEPP) is a planning document prepared in accordance with the Environmental Planning & Assessment Act (EPA Act) by the Department or Urban Affairs & Planning and eventually approved by the Minister, which deals with matters of significance for environmental planning for the State. Examples of SEPP's that have been prepared include SEPP No. 19 - Bushland in Urban Areas, and SEPP No. 35 - Maintenance Dredging of Tidal Waterways, to name just a couple.

No State Environmental Planning Policy has been prepared dealing specifically with the issue of flooding.

2.3.3 Regional Environmental Plans (REP's)

A Regional Environmental Plan (REP) is prepared in accordance with EPA Act by the Department of Urban Affairs & Planning and eventually approved by the Minister. An REP provides objectives and controls for environmental planning for a region, or part of a region. The extent of a region will vary depending upon the issue to be addressed but normally refers to more than one LGA. The Hunter Regional Environmental Plan, 1989 (Hunter REP) and accompanying Background Report is one such REP, and this has the following implications in regard to the Floodplain Management Study:

(a) Flooding is identified as the prime natural hazard to development in the region, causing economic loss to both urban development and rural activity during major floods. The Background Report outlines that the prime responsibility for management of the floodplain rests with local government in accordance with the principles outlined by the Floodplain Development Manual.

(b) The first listed aim of the Hunter REP is consistent with the objectives of a Floodplain Management Plan being:

> *"2(1)(a)To promote the balanced development of the region, the improvement of its urban and rural environments and the orderly and economic development and optimum use of its land and other resources, consistent with conservation of natural and manmade features and so as to meet the needs and aspirations of the community".*

(c) Division 3 of Part 7 of the REP identifies various matters for consideration in the preparation of Local Environmental Plans (LEP's - rezoning plans) by individual Councils. The objective provided at Clause 52(b) is as follows:

> *"Control development on flood liable lands and encourage floodplain management which ensure maximum personal safety and appropriate land uses".*

Clause 54(2) outlining principles to act on the above objective include a requirement that Council should prepare management plans and introduce appropriate planning controls for flood liable lands.

(d) Flood liable land is not defined by the REP, and accordingly could be considered in its wider sense to include the whole of the floodplain.

While not applying to the subject study area, both Port Stephens and Dungog LGA's are subject to the *"Williams River Catchment Regional Environmental Plan 1997"*. This REP

applies to the catchment area immediately adjoining to the east of the catchment of the Paterson River. This REP amends Dungog LEP 1990 and Port Stephens LEP 1987. The REP provides only cursory provisions regarding the issue of flooding, supplemented by some additional discussion within an associated Action Plan and Regional Environmental Study (RES). Importantly, the Williams River REP and associated documents demonstrate the value of a cooperative approach between the two Councils when dealing with issues of relevance to a defined catchment area as opposed to nominal administrative boundaries.

2.3.4 Advisory Circulars

The DUAP is responsible for providing advice to local councils to ensure that best practice is maintained in the planning process. A Planning and Environment Commission (PEC) Circular was issued in 1977 advocating prescriptive floodplain planning controls and the adoption of the 1% AEP flood standard. Subsequently, a Departmental Circular (No. 122) was issued by the former Department of Planning (DOP) and more recently as Circular No. C9 to assist Councils to relate the current flood policy of the State Government and the Floodplain Development Manual (FPDM), to the requirements of the EPA Act and the Department's general approach to floodplain planning.

The current State Flood Policy (1984) disbanded the 1% AEP flood standard and requires local Councils to implement floodplain management based on a merits based approach. The Circular states that in accordance with the FPDM, Councils should prepare single comprehensive local environmental plans to implement their floodplain management plans, and so avoid an ad hoc, piecemeal approach to planning within the floodplains.

In recognition that the preparation of such LEP's may take some time, Councils were advised that in the interim, adequate supporting data for decision making should be obtained inclusive of:

- any relevant floodplain management plan or interim policy;
- details of flooding in the area;
- social and economic impact of flooding;

- environmental impacts of development in the floodplain (eg. on water quality, flood behaviour, etc);

- the availability of alternative flood free sites and reasonable alternative uses for the subject site;

- cumulative adverse impacts;

- matters of state and regional significance (eg. the impact of development on a floodplain beyond local government boundaries); and

- increased risk of flood damage to regional infrastructure, reduction in flood storage capacity, etc.

In particular, the Circular states the following:

> *"A further matter of regional significance is that of consistency of standards for floodplain development, particularly adjoining councils or councils on the same floodplain. Neighbouring councils should, therefore, consult with each other prior to the imposition of flood standards through a local environmental plan."*

There is presently a lack of consistency between the two Councils involved in floodplain planning in the study area, which is understandable having regard to the nature of flooding and complexity of the issues involved. This highlights the appropriateness of the joint approach to this FPMS and the potential benefits that could be derived from a common FPMP.

2.3.5 Local Environmental Plans (LEP's)

A Local Environmental Plan (LEP) is a plan prepared in accordance with the EPA Act which defines zones, permissible uses within those zones and specific development standards and other special matters for consideration with regard to the use or development of land. LEP's are normally, and in this case, specific to individual LGA's and the relevant LEP's are outlined and discussed below.

Port Stephens Council

The zoning controls for the Port Stephens LGA are currently provided by Port Stephens Local Environmental Plan 1987 (PS LEP 1987) but these are in the process of being superseded by PS LEP 1999.

PS LEP 1987 provides the following definitions of relevance to this study:

> "*Flood fringe means land between the 1 in 20 year flood level and the 1 in 100 year AEP flood level.*
>
> *Flood prone land means land below the 1 in 100 year flood level.*
>
> *Floodway means land below the 1 in 20 year flood level."*

This LEP contains a Rural Floodplain zone No.1 (g). The 1(g) zone generally covers the majority of the floodplain in the Port Stephens LGA. The objectives of this zone and the uses permissible in the zone, without consent, and those prohibited are contained the LEP. The primary differences between this zone and the other general rural zones include the requirement for development consent for dwelling houses, and no development consent being required for flood mitigation works.

Additionally, some land is zoned within the General Rural 1(a) zone and there are two areas of Urban zones comprising the villages of Wallalong and Hinton.

Clause 12 and 13 of the LEP provides specific requirements for the subdivision of land within the 1(g) zone. Generally, these clauses prevent subdivision for most purposes on 1(g) zoned land east of the Williams River. West of the Williams River (which relates to the study area) land zoned 1(g) can be subdivided to sizes between 4000m^2 and 2 hectares at an overall density of 1 allotment per 10 hectares, subject to a number of criteria being satisfied, including that each allotment is not subject to the 1% AEP flood.

PS LEP 1999 has obtained a Section 65 Certificate from the DUAP to enable its exhibition and eventual final consideration by Council and the Minister. PS LEP 1999 will remove the

1(g) zone, and the areas subject to the zoning will revert to the standard Rural 1(a) zone with other provisions regarding flood affectation being applied. Objective 2(e) of the proposed 1(a) Rural Agricultural zone in the draft LEP is as follows:

> *"Reducing the incidence of loss of lives and damage to property and the environment in areas subject to flooding and to enable uses and developments consistent with floodplain management practices."*

Within this zone, flood mitigation works authorised by the Hunter Valley Flood Mitigation Act 1956 remain permissible without development consent. Having regard to the recent changes to the EPA Act, a number of developments are proposed to be identified as exempt development (ie. will not require development consent or a construction certificate) including:

- fences, provided that they do not interfere with the natural flow of stormwater
- garden sheds with a maximum area of $10m^2$
- minor internal alterations to single dwellings.

Additionally, the LEP is to identify various forms of development as "*complying development*" (ie. not requiring development approval but will require a construction certificate subject to certain conditions). Various conditions exclude development from being considered as "*complying development*" including the identification of the land, the subject of the application, as "*flood liable*" by the proposed DCP.

The draft LEP does not provide a definition of flood liable land but provides the following definitions:

> *"Flood prone land means land which in the opinion of the Council would be inundated as a result of a 1% probability flood event*"

> *"Floodway means an area where in the opinion of the Council, significant volume of water flows during a flood*"

Clause 35 of Draft PS LEP 1999 provides specific provisions in regard to development on flood prone land. The words used within this Clause requires development consent for any proposed purpose on flood prone land or within a floodway and stipulates criteria to determine the acceptability of any such proposal. It would be desirable to have these criteria consistent across the entire floodplain, that is, consistent with both the Port Stephens and Dungog LEP's. Further, the definitions provided in the Draft LEP relate primarily to Clause 35, and are not necessarily consistent with other references to flooding contained elsewhere in the LEP.

Dungog Shire Council

The zoning controls for Dungog Shire Council are provided by Local Environmental Plan 1990 (LEP 1990). The majority of the land within the study area is zoned 1(d)(Rural Farmlets Zone), 1(b)(General Rural Zone) and 1(c)(Rural Residential Zone). In addition, there are other small areas of specific zonings such as the Urban zones within the village of Paterson, and a 7(a)(Rural Environmental Protection - Flood Liable Land Zone) located immediately north of the village of Paterson.

The 1(b) zone is a general rural zone primarily aimed towards maintaining land for agricultural purposes and preserving the rural character of the area. Housing within this zone has a general requirement for allotments of minimum 60 hectares in area with some limited provisions for concessional allotments.

The 1(c) zone is a rural residential zone aimed at permitting rural residential lots generally within a 10 kilometre radius of existing urban areas with allotment sizes ranging from 8000m^2 to 10 hectares. The 1(d) zone is aimed at permitting development of rural farmlets accessible to the urban areas within the Shire and which are suitable for small scale hobby farming. This zone permits rural farmlets on allotments not less than 10 hectares in area.

The 7(a) zone is a rural environmental protection (flood liable land) zone aimed at specifically identifying flood liable land generally within or adjacent to existing urban areas. The range of uses permissible within the zone is significantly restricted, and include uses such as agriculture and forestry without consent, and intense agricultural pursuits, open space, plant nurseries, recreation areas, roads and utility stations with development consent only. Extractive industries and mines are permissible with development consent subject to

advertisement requirements, while dwelling houses and other more intensive uses are prohibited within this zone. The specific term "*flood liable land*" referred to within the Land Use Table for the 7(a) zone is undefined by the LEP and may cause some confusion and creates inconsistencies with references to flooding elsewhere within the LEP.

Clause 52 of the LEP refers specifically to controls for land subject to flooding. Sub-clause 52(6) defines "*land subject to flooding*" in that clause as that land below the 1% AEP flood level. This clause specifies various criteria for Council's consideration in the assessment of applications on land subject to flooding (by the 1% AEP flood) including a requirement that new buildings be located on land above the 1% AEP flood and has "*flood-free*" access. Flood-free access is not defined but it could implicitly be assumed to be vehicular access available in a 1% AEP flood.

Clause 23 provides provisions in regard to the subdivision and erection of dwelling houses within the closer rural settlement zone 1(b). This clause requires that the applicant demonstrate compliance with development standards specified in Schedule 5 which include that dwellings not be erected on land affected by flooding. Again, flooding is undefined by the LEP, and although Clause 52 makes reference to the 1% AEP flood level, that applies only to Clause 52. Therefore, there is the potential for misunderstanding as to the extent of flooding referred to in Schedule 5, and if literally interpreted could refer to all land effected by the EF, which may not necessarily be the intent of Council.

2.3.6 Development Control Plans (DCP's)

A Development Control Plan (DCP) is a plan prepared in accordance with Section 72 of the Environmental Planning & Assessment Act which provides detailed guidelines for the assessment of development applications. The following are relevant to this study.

Port Stephens Shire Council

Port Stephens Shire Council has adopted Development Control Plan No. 14 (DCP 14) to provide guidelines for development generally within the land zoned Special Uses "Urban Floodplain" 5(g). The main features of this DCP are summarised as follows:

- Council will assess applications based on specific merit considerations related to

flooding.

- Dwellings must have access to "flood free land" (assumingly above the 1% AEP flood) and be built at least 0.5 metres above the 1% AEP flood level.

- No development in the floodway.

- Preferred land uses are identified on the DCP map.

- Extensions to existing development will not be considered where it is inconsistent with the DCP.

- The DCP defines high hazard and low hazard flood affected areas and requires special consideration of land in the hazard categories in the assessment of some applications.

As with a number of Floodplain DCPs, this DCP often refers to "flood free" and "flood liable land" without defining these terms. As alluded to previously in this report, it is becoming clearer and more important in floodplain management planning that an understanding of the whole of the floodplain be achieved from which more detailed controls may be applied to specific areas within the floodplain subject to varying levels of risk. This provides a holistic and informed basis for the management of the floodplain as discussed further within the latter sections of this report.

Council does not have any other specific DCP for the control of development on flood liable land. However, specific recommendations have been included within the Lower Hunter Valley Floodplain Management Study (prepared for Newcastle City Council and Port Stephens Council by Patterson Britton & Partners (Issue No. 2, August 1998, Volume B)). As the outcome of individual FPMP's need to be afforded the ability to be implemented equally to comply with the State Government Flood Policy and guidelines provided by the FPDM, an approach needs to be adopted which will allow for the integration of a number of FPMP's into a single, comprehensive policy document or DCP. Such an approach is outlined and discussed later in this report.

Dungog Shire

Dungog Shire does not have any specific DCP for the control of development on flood liable land. However, Council has had prepared "*Draft DCP No. 20 - Guidelines for Rural Smallholding Development*" (dated September 3, 1998). This Draft DCP is intended to apply to a future Rural Smallholdings zone recommended by the Paterson Closer Rural Settlements Strategy Report (September 1998) discussed at Section 2.2.4 of this report.

Clause 4.7 of this Draft DCP requires that dwelling houses and effluent treatment areas be located outside the land affected by the 1% AEP flood. Clause 7.5 requires that all habitable buildings be located above the 1% AEP flood (where known) and access to all lots and house sites must be "*flood-free*". Both these clauses refer to the 1% AEP but continue to make reference to flooding generally and refer to terms such as "*flood-free*". Land above the 1% AEP but still affected by the EF is not flood-free and in some cases could be subject to significant risk associated with the flood hazard. Further, it is understood that significant areas of the proposed Rural 1(e) zone may be constrained by access which can be cut during times of flood which may create a necessity for remedial measures such as alternate and improved roads to address this issue.

2.3.7 Council Policies

In addition to formal regulations such as a DCP or an LEP, Councils may from time to time adopt specific policies with regard to their long term vision for development within the floodplain or to deal with specific matters such as flooding. Normally, such policies are translated into DCP's or other planning instruments such as an LEP.

Port Stephens Council has commenced the preparation of a policy for areas effected by flooding (Reference File No. 9600-02). The intention of this policy was to translate the findings of the Lower Hunter FPMP into a DCP document.

Dungog Shire Council has adopted a brief policy in regard to development on flood prone land. This policy is stated as follows:

> *"(1) The 1 in 100 year criteria for defining flood liable land be retained pending receipt of further information from the State Government.*

(2) The requirement that the floor level of residential dwellings to be erected on flood liable land be not less than 1 metre above the 1 in 100 year flood level be retained."

(Minute No. 21205 - Council Meeting of 15.1.85)

The above policy would presumably have arisen as a result of the introduction of the State Government Flood Policy in 1984. The State Government Flood Policy specifically abandoned the application of the 1% AEP flood standard as the designated flood standard for the State of New South Wales, and required each LGA to determine their flood standard or standards based on merit. The FPDM introduced in 1986 provided guidelines to assist councils in determining the relevant standards and policies, through the preparation of FPMS's and FPMP's. Until the adoption of an FPMP, Councils were required to produce interim flood policies, an example which would be the Dungog Flood Policy referred to above.

This procedure provides Council with indemnity pursuant to the limitations provided by Section 733 of the Local Government Act 1993, and accordingly is very important to Council's overall risk management procedures. The eventual outcome of all FPMP's, including this FPMP for the Paterson River and the Lower Hunter River FPMP, will be to translate relevant planning recommendations of these documents into the instruments available through the EP & A Act, principally the LEP and DCP. Recommendations for translating relevant recommendations of these documents into these instruments are made later within this report.

2.3.8 Development Application Assessment

Development applications for proposals which are permissible with consent must have regard to the relevant 'Matters for Consideration' contained in Section 79C of the Environmental Planning and Assessment Act 1979.

Section 79C(1)(a)(i) of the Act requires the consent authority to take into consideration, when determining a development application, the provisions of any environmental planning instrument. Accordingly, Council is required to have regard to the provisions of the applicable LEP's which specify various matters to consider with respect to flood liable land.

Section 79C(1)(a)(iii) requires that Council also consider any DCP in force. While no DCP is presently in force which deals with the issue of flooding, such an instrument would provide a desirable mechanism for Council to comprehensively assess development applications with respect to the issue of flooding.

The Environmental Planning and Assessment Act and accompanying Regulations also identify certain developments which are deemed to be "designated development". Designated developments are generally large scale developments which have been identified as potentially causing greater impacts on the environment. Hence, designated development proposals require the preparation of an Environmental Impact Statement (EIS) and more specialised assessment procedures including statutory notification of the development application with third party rights of appeal for any objectors.

Schedule 3 of the Environmental Planning and Assessment Regulation identifies those developments which are designated development by virtue of their processing capacity, site requirements or location near environmentally sensitive features. Developments such as "agricultural produce industries, aquaculture or mariculture, artificial water bodies, extractive industries, large stock processing industries, turf farms and the like are permissible in the zoning of the study area and adjoining land. Some of these developments may be regarded as designated development when located within a certain distance of a natural water body or wetlands or on flood prone land or a floodplain.

Schedule 3 of the EPA Regulation defines floodplain as follows:

> *"Floodplain means the floodplain level nominated in a Local Environmental Plan or those areas inundated as a result of a 100 year flood event if no level has been nominated."*

Accordingly, there are a number of potential outcomes of the FPMP process which may have implications in regard to the manner in which Development Applications are dealt with.

2.3.9 Section 149 Certificates

A Section 149 Certificate is basically a zoning certificate issued under the provisions of the

EPA Act, and must be attached to a contract prepared for the sale of property. The matters to be contained within the Section 149(2) Certificate are prescribed within Schedule 4 of the Environmental Planning and Assessment Regulation, which includes the following specific matters in regard to flooding.

> *"12. Whether or not the Council has by resolution adopted a policy to restrict the development of land because of the likelihood of landslip, bushfire,* ***flooding****, tidal inundation, subsidence or any other risk".* [Our emphasis]

The wording of the above prescribed matter is such that inconsistencies arise between local councils in regard to the extent of information they provide on flooding. It has been argued that on literal interpretation, councils are only required to provide a 'yes' or 'no' answer as to whether such a policy exists. Further, there is potential equivocation when a council is aware of a flood risk, (eg. that a property is known to be located between the 1% AEP and EF flood extents), and there are no policies restricting development subject to the risk. A principal issue which arises is whether there is a legal or moral obligation for council to advise of the risk (Mawson J, Prior N, and Bewsher D, 1994).

A certificate issued under Section 149(5) of the Act simply requires that Council "include advice on such other relevant matter affecting the land of which it may be aware". While this certificate type would necessitate Council advising of all flood information it holds, it is a more expensive certificate and is not mandatorily attached to property sale contracts.

In terms of the notation under the heading "*Flooding*" contained within the Dungog Section 149 Certificates, the following standard wording is used:

> *"The land is subject to flooding - see Clause 52 of Dungog LEP 1990 relative to development."*

The wording of this notation is potentially confusing as in reality the land may be subject to only flooding from the 1% AEP flood, and not necessarily all land subject to flood risk (up to the EF) will receive this notation. Further, as outlined previously there are various provisions within Council's LEP and associated DCP's, including the proposed DCP No. 20 for rural smallholding development, which will have implications in regard to development in the floodplains.

The Section 149 Certificates provided by Port Stephens Shire Council identify the whole land use table relevant to individual zones, which may be specifically relevant if the subject land is located within the Rural 1(g) Floodprone Land Zone, for example. Additionally, with regard to the issue of flooding specifically, the Section 149 Certificate may contain the following standard clause:

> *"Council's records indicate that the land may be wholly or partly subject to the 1% Annual Exceedence Probability Flood. On 27 January, 1998 Council adopted a policy which restricts development on land so effected, therefore this risk of flooding may restrict the development of the land. Information as to the extent of the 1% AEP flood is available from Council's Strategic Planning Section and you are advised to make further enquiries. See further advice regarding flooding of the Port Stephens Foreshore Area."*

Similar to the Dungog notation, this notation has the potential to allow the public to interpret that the absence of this standard clause means that the land is subject to no flood risk. However, as stated above, if the land is located between the 100 year flood and the EF, substantial risk may exist.

A preferred approach may be for Council to notify everyone of the applicability of the proposed DCP, where relevant. This would mean that all property located within the EF (where known or suspected) would be subject to the DCP. The reader could be invited to obtain a Flood Certificate (being a measure considered within Volume 1) which could confirm which FPM Management Zone contained in the planning matrix is relevant to the subject site, and thereby allow the reader to determine the extent of planning controls which may apply. Reference to the relevant provisions of Council's LEP would also be necessary.
Historical and current anecdotal evidence suggests that any moves to increase the extent of properties noted as being flood affected upon Section 149 Certificates would be subject to significant community opposition due to the perceived impact of reduced land values. This operates as a strong force against increasing public awareness of the known flood risk which has flow on effects in regard to flood preparedness and ease of implementing evacuation strategies, being important factors in floodplain management.
This emphasises the need for local councils to undertake a floodplain management study in a way that ensures the community would own the outcome and the description on Section 149

Certificates.

2.3.10 Section 94 Contributions Plans

Section 94 Contributions Plans under the EPA Act provide a basis for the levying of development contributions to construct drainage and flood mitigation works required as a result of future development. Section 94 contributions can only be applied to fund works associated with the new development and cannot be applied for purposes of rectifying past inadequacies. There is minimal potential for the application of Section 94 Plans as mechanisms for funding and implementing floodplain management plans as part of this project, other than to fund upgrading road access within the proposed Dungog rural residential area.

3.0 PROPOSED APPROACH TO FLOODPLAIN PLANNING

3.1 General Philosophy

3.1.1 Traditional Approach to Floodplain Planning

In general terms, the real flood hazard within floodplains is poorly understood and appreciated by the community.

Often the community considers there to be a flood hazard only on land below the flood planning level (FPL) which is the level below which councils place restrictions on development. This FPL is commonly the 1% AEP flood. In fact, floods can occur well above this level within the study area.

Illustration 3 presents the view of flood hazard generally held by the community. The flood hazard extent relates only to the FPL (in this case the 1% AEP flood). In the community's mind, there is no flood hazard above the 1% AEP flood level.

Illustration 3: Typical View of Flood Hazard Currently Held by Community

Confusion over the nature of the flood hazard has not been helped by the current procedures for flood notations on Section 149 Certificates under the EPA Act. As previously discussed, the certificates are often misinterpreted by the community as a statement of whether or not a flood hazard exists at the property. Most importantly, when a council does not mention flooding on a certificate, the community may incorrectly assume that there is no flood hazard when in fact (e.g. for properties just above the FPL), the flood hazard may be significant in dimension albeit rare in occurrence.

3.1.2 Objectives of Floodplain Planning

Floodplain management is about occupying the floodplain and optimising its use in a manner which is compatible with the flood hazard and at a level of risk which is accepted by the community.

Floodplain management involves more than setting a FPL. It is about comprehensively managing the risk to people and assets both below and above the FPL, by applying and integrating a range of available measures.

There are different types of flood risks and a range of ways in which each type of flood risk can be managed. This includes floor level controls, flood awareness and warning, evacuation facilities, building design, distributing land uses in a flood compatible manner, subdivision design (eg road layouts), structural works, etc.

Traditional floodplain planning has relied almost entirely on the definition of a singular FPL, which has usually been the 1% AEP flood level. While such an approach has often been adequate, the approach has not worked well everywhere and has led to a number of problems including:

- creation of a 'hard edge' to development at the FPL;
- distribution of development within the floodplain in a manner which does not recognise the risks to life or the economic costs of flood damage;
- unnecessary restriction of some land uses from occurring below the FPL, while allowing other inappropriate land uses to occur immediately above the FPL;

- polarisation of the floodplain into perceived 'flood prone' and 'flood free' areas;

- lack of recognition of the significant flood hazard that may exist above the FPL (and as a result, there are very few measures in place to manage the consequences of flooding above the FPL);

- creation of a political climate where the redefinition of the FPL (due to the availability of more accurate flood behaviour data, or for other reasons) is fiercely opposed by some parts of the community, due to concern about significant impacts on land values — i.e. land which was previously perceived to be 'flood free' will now be made 'flood prone' — (despite the likelihood that such concerns may only be short term).

Accordingly, continuation of the sole reliance on the 1% AEP FPL is inappropriate if a generic approach is to be developed for both Dungog and Port Stephens LGA's.

The current approach to floodplain planning discussed above may be typified by the example shown in **Illustration 4**, which flows from the inappropriate view of flood hazard presented in Illustration 3. No development is permitted below the FPL (ie 1% AEP flood) because of an acknowledgement of the flood hazard. Above the FPL, no flood hazard is perceived and therefore there are no flood-related controls on development. Thus an abrupt change in development control occurs at the FPL.

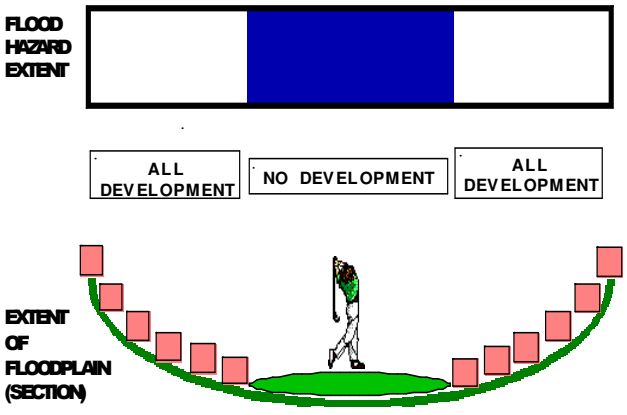


Illustration 4: Current Floodplain Planning
(Derived from an inappropriate view of flood hazard and the use of a singular flood planning level)

In addition, it is rare to find councils which have determined their FPL using the procedures suggested in the State Government's FPDM (1986), ie. by:

> *"balancing the social, economic and ecological considerations against the consequences of flooding, with a view to minimising the potential for property damage and the risk to life and limb."*

By default, most councils have adopted the 1% AEP FPL, given that this FPL has been widely used across the State and that councils have been unable to carry out the assessment necessary to establish appropriate alternatives. The process suggested in the Manual, being complex and without detailed guidelines for town planners, has been difficult for councils to follow.

3.1.3 Flood Planning Levels (FPL's)

The flood planning level (FPL) is the level below which Council places restrictions on development due to the hazard of flooding. FPL is the current preferred terminology in place of the flood standard or the designated flood, referred to commonly within the FPDM. This new terminology is used extensively within the *Floodplain Management Manual*, the proposed replacement for the FPDM, prepared by the DLWC and currently on public exhibition.

Consistent with the above philosophy, the danger in adopting FPL's below the EF is that they are recognised by the community as definitive advice as to whether flood risk exists or not. Further, there has traditionally been an approach where a singular FPL (or flood standard) has been chosen which creates significant limitations on the availability for a holistic approach to managing the flood risk in the floodplain. The reality is that various land uses are subject to alternate consequences from the flood risk (eg. the consequences of the flooding of a hospital is much different to the consequences of the flooding of an amenities block in parkland). Accordingly, there needs to be a simplistic approach of reflecting the different flood risk to different land uses within the floodplain, while maintaining an understanding that flood risks still occur, regardless that flood controls may not be imposed. The planning matrix approach discussed below is one such methodology of addressing these issues.

Some changes to the FPL's currently applied by the respective Council's are to be proposed. The nature of these changes have been decided upon by the Floodplain Management Committee and a discussion of the consequences of the changes is provided at Section 5.5 of this report.

3.1.4 The Planning Matrix Approach

Given that some floodplains have an extensive flood range, and given the difficulty in addressing the associated variability in flood risks with simple rules, the use of the planning matrix approach (D. Bewsher and P.Grech, 1997) is recommended.

The approach distributes land uses within the floodplain and controls development to minimise the flood consequences as depicted in **Illustration 5** below.

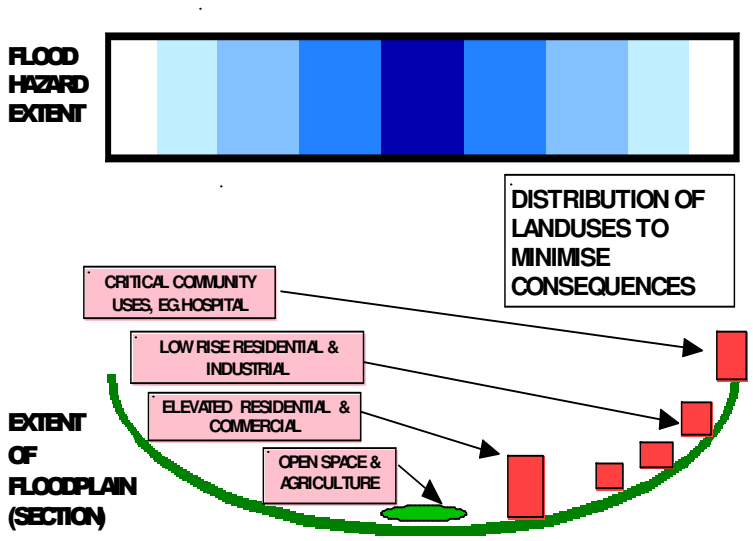


Illustration 5: Distributing Land Uses under the Planning Matrix Approach

Using this approach, a matrix of development controls, based on the flood hazard and the land use, can be developed which balances the risk exposure across the floodplain. This approach has been adopted as part of the recent Hawkesbury–Nepean Flood Management Strategy. It has also been previously applied within the Blacktown, Narrabri, Cabramatta Creek and Molong Floodplain Management Studies, and the resulting matrix has been pivotal in the new draft DCPs and LEP's recommended for implementation as part of these floodplain management plans (see **Illustration 6**).

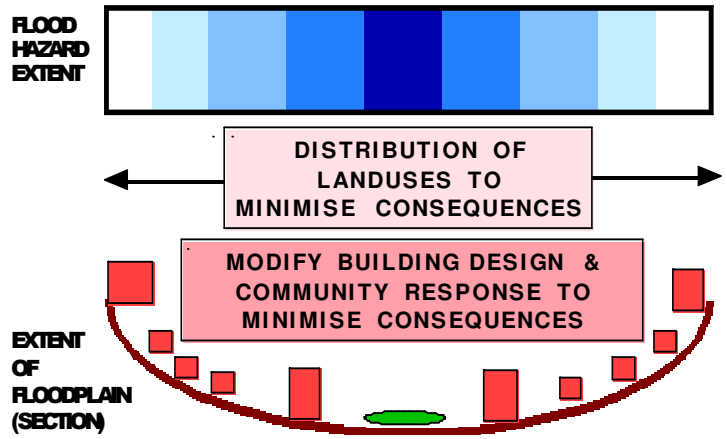


Illustration 6: The Planning Matrix Approach to Floodplain Planning

The approach is summarised in **Illustration 6**. It is fully consistent with the current FPDM or its prospective replacement, the Floodplain Management Manual.

3.2 Categorising the Floodplain

The first stage in developing a "*planning matrix*" for each of the subject LGA's is to identify the floodplains to which the overall policy document is to be applied, while the second stage is to divide the floodplains into areas of differing hazard.

In regard to the first stage, it is noted that this FPMS relates only to the Paterson River Floodplain. Notwithstanding, it is our approach that both Councils would benefit considerably by having a singular policy document which applies to all, or the majority of, floodplains within their LGA's. Additionally, as both Council's share management responsibilities for at least two of their floodplains referred to previously in this report (the Williams River and Paterson River Floodplains), it would be desirable for both Councils to have a consistent document.

The approach intended to be adopted to satisfy the above objective, is to prepare a singular policy document which has a common preamble, objectives and general policies, while specific controls for each floodplain are reflected within a planning matrix prepared for each individual floodplain and annexed to the principal document. This approach has been adopted and recommended elsewhere for the management of floodplains jointly

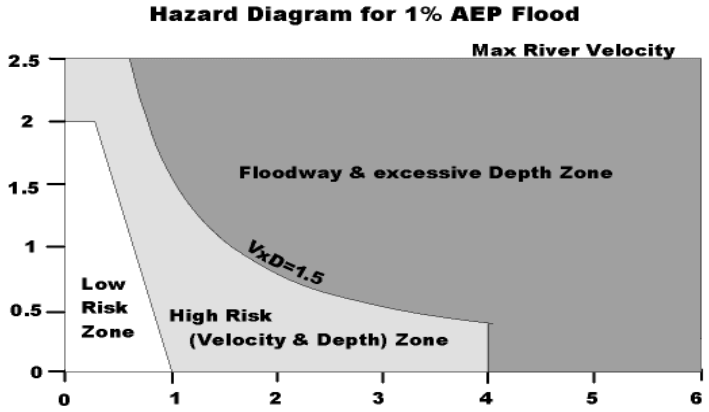
administered by more than one local council (eg. Cabramatta Creek FPMS where its management is jointly the responsibility of Fairfield and Liverpool City Councils).

The second stage in the preparation of the planning matrix is to identify different floodplain management zones (FPM zones), reflective of variable flood hazard within each of the separate floodplains.

In regard to the subject study, the following four FPM zones are proposed in accordance with the corresponding summary of criteria (refer to volume 3 for detailed definitions):

FLOODPLAIN MANAGEMENT ZONES	CRITERIA
1. Floodway and Excessive Depth Zone	Floodway or depth >4m in 1% AEP event
2. High Risk (Velocity and Depth) Zone	Remaining area where provisional hazard is high in 1% AEP event
3. Isolated Islands Zone	Remaining area where evacuation is possible only through Zones 1 or 2
4. Low Risk Zone	Remaining area below extreme flood level

The FPM zones delineated above have been formulated to provide a basis for strategic planning and development control having regard to the specific characteristics of the Paterson River Floodplain. The hydraulic basis to the delineation of these zones is provided in Volume 3 and is depicted by the following diagram.



The **Floodway and Excessive Depth FPM Zone** identifies that part of the floodplain where there is considered to be no potential to implement ameliorative measures and allow for any structures or intensive activity at a level of risk which would be considered acceptable to the community. The principal risk criterion in this extreme FPM zone category is when velocities exceed levels which may threaten the integrity of built structures or the safety of persons. The other criteria which captures an area within this FPM zone is that of depth which, in the case of the Paterson River Floodplain, expansive areas are subject to deep level flooding during a 1% AEP flood, and evacuation problems may arise due to floods up to and Extreme Flood.

The **High Risk (Velocity and Depth) FPM zone** category is that area which is subject to the traditional provisional hazard categories outlined in the FPDM due to flood flow velocities and depth of flooding. These areas would allow for the limited development of rural dwellings, but where further development potential through subdivision, or increased residential densities or more intensive developmental land use activity should not be permitted. Those limited development forms and land use activities that would be appropriate in this FPM zone would need to be subject to various flood-related ameliorative measures.

Whilst substantial areas are subject to deep level flooding during a 1% AEP flood, much of the High Risk (Velocity and Depth) zone is subject to only back water flooding where flow velocities are small. In these cases it is possible, and has occurred elsewhere in the floodplain, to construct elevated fill pads where dwellings and a reasonable curtilage can be constructed for the purposes of establishing a rural dwelling. Assuming that the minimum size of a rural or rural residential property is to be in the order of 4000m^2 and a 1000m^2 elevated building pad area would be appropriate for the construction of a rural dwelling and surrounding curtilage, together with necessary batters, landscaping potential and the like, an absolute maximum height of fill of approximately 4 metres would be possible. Due to the flood gradient and fill only being permissible to the 5% level, in the floodplain, this maximum fill level would be achieved at Hinton decreasing to about 1.8m at Gostwyck. This would nonetheless be subject to other controls including emergency evacuation provisions.

The **Isolated Islands FPM zone** is that which identifies a number of pockets (or "islands") within various elevated pockets encompassed by the overall floodplain but are at ground

levels mostly above the calculated EF and are, therefore, generally not directly subject to flooding. It is noted that only some minor parts of this FPM zone are potentially affected by a 1% AEP flood or EF. However, these areas are nonetheless subject to significant disruption and potential risk when flooding occurs in the Paterson River Floodplain cutting land access routes for extended periods. During such times, access to and from these elevated areas (eg. Hinton) is available only by boat. Apart from the inconvenience, disruption to normal daily activities and resultant economic loss, there are some risks associated with the transport of persons (particularly for medical emergencies) across floodwaters. Accordingly, this area has been specifically identified in order to provide strategic planning direction and development control limiting further development and increased land use activity, in particular by recommending no further urban releases or subdivision in this FPM Zone. Other flood-related ameliorative controls on building and land use activities (eg. floor level control) would not be necessary in the areas of this zone which are not flooded.

The **Low Risk FPM zone** is that remaining area which is potentially subject to a EF, but is not included in any of the other FPM zones. This area is still subject to some flood-related risk and those uses which may be considered critical or essential during a flood emergency, or should be afforded maximum protection against risk from flooding, are specifically dealt with in terms of strategic planning intent and development controls. The other major purpose for this FPM zone is to identify and recognise the potential flood risk for all persons and properties effected by the EF, regardless of whether any specific development controls are to be applied. This provides a basis for flood awareness programs, evacuation and emergency planning and to maximise the preparedness of the community.

3.3 Prioritising Land Uses in the Floodplain

The next component in the preparation of the planning matrix is to prioritise land uses within the floodplain. This is achieved by identifying discreet categories of land uses, of similar levels of sensitivity to the flood hazard. In this case the following categories have been adopted:

- Essential community facilities
- Critical utilities
- Subdivision and filling

- Residential
- Commercial or industrial
- Recreation or agriculture
- Minor development.

Subsequent to forming the above major land use categories, defined land uses, as specified by the relevant LEP's, are included within each of the above categories depending on relevance having regard to the issue of flooding.

These categories are subsequently listed under each FPM Zone in the planning matrix dependent upon the level of flood risk which is considerable acceptable. This provides a basis to specifying whether certain categories are unsuitable land uses in different parts of the floodplain or whether they are suitable subject to varying degrees of development control. This approach is basically the application of the philosophy previously described within this report.

To assist in determining the land use priorities throughout the floodplain, the questionnaire survey distributed to residents within the floodplain was specifically tailored to provide answers which have been used in balance with other criteria (such as orderly and efficient planning) to determine the final distribution of land uses categories. As a general summary, the land use categories referred to in the questionnaire survey were ranked as follows:

Land Use Category	**Average Priority (1 = greatest priority and 7 = least priority)**
Critical Utilities	2
Residential	1
Essential Community Facilities	3
Commercial or Industrial	4
Recreation or Agricultural Land	7
New Residential Subdivisions	5
Minor Development and Additions	6

As stated previously, the results of the questionnaire need to be balanced with other criteria

to produce the final matrix.

3.4 Controls to Modify Building Form and Community Response

The next component in the preparation of the planning matrix is to assign different planning controls to seek to modify building form and the ability of the community to respond in times of flooding, depending upon the type of land use and the location of that land use within the floodplain. The type of controls can be categorised under seven main headings, being:

- Floor levels
- Flood compatible building components
- Structural soundness
- Flood effect on others
- Evacuation/access
- Flood awareness
- Management and design.

There will be varying severity of development controls reflecting the sensitivity of the land use category to the flood hazard, and the location of the land use within the floodplain.

3.5 Implementation

The most appropriate mechanism for the implementation of the proposed flood policy is its adoption by each of the Councils as a DCP. This DCP could also include general policies of Council's such as their criteria for rezoning applications within the floodplain, which while not specifically relevant to the assessment of development applications, provide a holistic approach to Council's policies for the management of the floodplain. There would be no legal impediment to the inclusion of such additional matters within the DCP document.

For each of the two Councils, a singular planning matrix will be prepared as a component of this FPMS for the Paterson River Floodplain. Each Council will need to incorporate a separate matrix for floodplains for residual floodplains in their LGA's, as required. The residual floodplains, being those floodplains for which FPMP's have not been prepared to

date, should be the subject of an interim flood policy as required by the FPDM. For the purposes of preparing such an interim policy, it is recommended that the planning matrix prepared for the Paterson River Floodplain also be adopted for the residual areas, but this should be a separate matrix able to be monitored and modified over time depending upon any further studies and reviews undertaken by Council.

In addition to the preparation of the DCP's, each Council will need to undertake discreet changes to its LEP in order to ensure consistency with definitions, land use prohibitions, special flood development control clauses, and to modify boundaries which have been based on previous flood lines. These changes are outlined and discussed further in a later section of this report.

4.0 PLANNING IMPLICATIONS OF STRUCTURAL MITIGATION OPTIONS

The following provides some comment in regard to the planning implications associated with potential structural flood mitigation options considered within Volume 1.

Option No.	Description	Planning Comment
1.1	Raise or extend existing levees	It would appear that in most cases development approval or Part 5 approval under the EPA Act may be required - further investigation is necessary. That is, it would appear that in a number of cases some form of environmental assessment such as a review of environmental factors (REF) or more likely an environmental impact statement (EIS) would be required. There will be a number of issues which will need to be addressed by such an assessment including changes to the ecological environment and the benefits and disbenefits this option may produce, and the impacts on development which has occurred since construction of levees, on the basis of the protection provided by those levees which may now be altered or removed.
1.2	Lower existing levees	This is likely to require assessment under Part 5 of the EPA Act. Potential issues would include reducing protection to development which has relied on the flood mitigation effects of the levees.
1.3	Remove/modify Scotts Dam	This is likely to be subject to assessment under Part 5 of the EPA Act, and may require an REF and possibly an EIS. Potential impacts would relate to both those associated with the physical construction of changes to the dam and the impact it may have upon downstream development which has

Option No.	Description	Planning Comment
		relied on protection provided by the dam.
1.4	Widening and deepening of Paterson River	The significant likely environmental effects of such an option will more than likely necessitate the preparation of an EIS. Such an option is likely to have significant impacts associated with an altered ecological regime, in addition to changes to the scenic and landscape quality of the rural area. This option is unlikely to be acceptable.
1.5	Dredging of the Hunter River downstream of the Paterson River	Comments in regard to Option 1.3 above would apply.
1.6	Construction of upstream flood retarding storages	This option is likely to require either an REF and/or an EIS. The potential impacts to be assessed are likely to include both the impacts associated with the construction of the basins, and the effect on changed flood levels. The specific issues would include matters such as loss of vegetation and fauna habitat, constraint to agricultural activities, and alteration to the landscape and scenic quality of the rural area. Additionally, issues associated with property acquisition, if land is not publicly available, will need to be addressed. In this case, Council may wish to seek potential funding through Section 94 Contributions if it could be justified that such an option is imperative to future development being undertaken in an acceptable manner. Notwithstanding, due to limited future development potential in the floodplain, the proportioning of costs between existing and future development will limit the practicality of applying Section 94.
1.7	Creating a flood storage compartment in Lostock Dam	Not particularly relevant to planning. However, a concern relevant to planning would include any loss in water supply capacity required for future development.
1.8	Council endorsement of scour protection and bank stabilisation works	This is obviously a desirable option. Planning can have some input in ensuring that future development does not result in any additional erosion to the river bank, and require rehabilitation works as part of development adjoining the river bank, where reasonable.
1.9	Council endorsement of levee maintenance	Not specifically relevant to planning. Notwithstanding, safety associated with the levee maintenance would be important where development has proceeded based on the protection provided by the levees.
1.10	Council endorsement of drainage chemical maintenance	Not particularly relevant to planning.

5.0 REVIEW OF PLANNING OPTIONS

5.1 General

There are a number of alternate mechanisms by which land use planning may have a role in implementing non-structural measures for the control of development within the floodplain. These measures may vary from a fairly broad strategic overview of future and intended development or detailed building and development controls applicable to various forms of development in different zones.

Town planning can also have an input in regard to providing appropriate mechanisms for the implementation of structural measures, such as the adoption of a Section 94 contributions plan to provide developer funding towards broader scale flood mitigation works (although not likely to be a worthwhile mechanism in this case). Town planning can also assist in regard to flood awareness initiatives through notations on Section 149 Certificates (zoning information certificates).

It is noted that the following outline of planning measures have been finalised subsequent to numerous reviews by the Councils and DLWC of draft reports. Comments received resulted in the deletion of measures such as requirements for flood certificates and more extensive notifications through the Section 149 Certificate process. Also, more stringent requirements on ground and floor levels were preferred, and as this provided a higher level of protection, the required changes were made. Many other changes were made on request which involved matters such as terminology used.

5.2 State Environmental Planning Policies (SEPP's)

As the State Government's FPDM is aimed at encouraging a merit based approach to floodplain planning for individual areas, it is unlikely to be desirable to establish a global policy for floodplain development through the application of a SEPP. Accordingly, the pursuance of this option is not discussed further.

5.3 Regional Environmental Plans (REP's)

Potential would exist to refine the provisions of the Hunter REP to provide more definite guidelines and objectives in regard to the management of the floodplain having regard to the findings of this study. This may have substantial benefit in ensuring a more consistent regional approach to planning within the floodplain (which could include all the floodplains in the Hunter Valley, depending on the availability of similar studies) while allowing the more detail outcomes of FPMP's to be implemented by LEP's and DCP's. This is particularly important as the plan currently has some flood control measures, and a number of floodplains (such as the study area) are managed by multiple local councils.

Controls at the REP level would be particularly relevant if a flood standard greater than the 1% AEP flood was pursued as the adoption of a different standard within the floodplains could produce inconsistencies in standards for development, conflict between development potential over LGA boundaries and potential confusion and uncertainty in evacuation needs and flood awareness programmes.

Specific matters that could be addressed within an amendment of the Hunter REP may include the following:

(a) A recognition that the management of the floodplain needs to extend to the whole of the floodplain as recognised by the EF.

(b) Objectives for the management of the floodplain which could be common to the whole area.

(c) Specific matters for consideration for rezoning of land within the floodplain (which in part is discussed later in this report).

(d) General matters for consideration in the assessment of development applications (refer also to guidelines outlined later in this report).

These options would need to be pursued by the Department of Urban Affairs & Planning in consultation with relevant government authorities and local Councils. Council could refer this FPMS to the Department to initiate consideration of the above recommendations.

5.4 Local Environmental Plans (LEP's)

There are various aspects of both Council's current LEP's and other potential applications of these LEP's which can be appropriately structured to form a component in the application of the FPMP. It is noted that the structure of the LEP should be such that it provides the necessary flexibility for the adoption of other FPMP's and their associated planning recommendations which may be prepared from time to time elsewhere within the respective LGA's. In this regard, the importance of the LEP can be summarised as follows.

- To provide objectives for the application of floodplain management principles in the assessment of development applications.

- To appropriately identify areas subject to flooding in order that development applications in such areas may be specially considered and that Council has a basis for notifying the public of the potential for flooding on individual parcels of land in accordance with Section 149 Certificates issued under the Act.

- To outline general matters for consideration with more detailed controls being the subject of a DCP in accordance with accepted practice.

- To ensure that the permissibility and prohibition of uses is consistent with the FPMP, in order that flood sensitive land uses are clearly prohibited within areas subject to significant and hazardous levels of flooding. In this regard we note that the prohibition of land uses is a matter which must be clearly outlined within LEP's as this function cannot legally be transferred to a DCP.

The recommendations for alterations to LEP's will relate to the Dungog LEP 1990 and the Draft Port Stephens LEP 1999. Having regard to the likely timetable for the consideration of the FPMP by the Committee, its public exhibition and final adoption and implementation, it is considered appropriate that the planning recommendations be directed towards this later Draft LEP for Port Stephens as opposed to the current LEP which is likely to be superceded.

Objectives

While Dungog LEP 1990 contains some general objectives and Schedule 1 relating to provision of subdivision of land affected by flooding, as well as other standards, more specific objectives for the plan may be beneficial. Some recommended standard objectives are included within **Appendix A**. The structure of Draft Port Stephens LEP 1999 would not allow the logical inclusion of the standard objectives at Appendix A within the general objectives of the LEP at Clause 10. However, the standard recommended objectives, or derivations thereof, may be incorporated as part of the zone objectives for individual zones where flood liable land exists.

Definitions

It is considered preferable that the consideration of the flood hazard be a manner applicable to the whole of the floodplain (ie. up to the EF) albeit that the considerations will vary considerably across the floodplain depending upon the sensitivity of individual land uses and the extent of the flood hazard in any particular area. Accordingly, it is considered appropriate that a definition of *"Flood Prone land"* consistent with the Port Stephens Draft LEP and the intent of the Draft Floodplain Management Manual be adopted. Defining of a flood standard or FPL is irrelevant due to the proposal to apply a graded set of planning controls applicable to the whole of the floodplain.

Identifying "Flood Prone Land" as the whole of the floodplain (ie, up to the EF) would allow the acknowledgement of all potential flood risks. This can be progressively done on a map by the Councils as information becomes available. This does not mean that it is proposed to reduce development potential in the floodplain. A detailed DCP will provide a gradation of planning controls relative to position of land in the floodplain and consequent flood risk. Various FPM zones are to be identified in the floodplain, as previously described. Other FPM zones may be identified as part of other FPMS's and FPMP's.

In the consideration of adopting appropriate definitions regard must be made to other FPMP's which may be undertaken in the same LGA in the future. That is, the structure of the definitions must allow for the logical application of two or more FPMP's and must not complicate Council's duties in regard to areas which are not covered by a FPMP. The standard definitions provided at **Appendix A** are considered to achieve the aim.

It would be preferable to identify the extent of the EF on an LEP Map (possibly as a

separate map series to the land use zonings), in order that there would be clear recognition of potential flood risk and an understanding of the application of the DCP. The identification of the EF would also provide context to the definitions to be recommended for inclusion within the LEP's.

It is also considered desirable that the component of flood prone land which is clearly unsuitable to specific uses due to the extent of the hazard, be identified and defined in order to provide a basis to prohibit inappropriate land uses from this area. This hazardous component of flood prone land may be defined under various terms depending upon the contents of the FPMS and local area. The hazardous component of the Paterson River Floodplain is extensive and would include three FPM Management Zones, although the prohibition of land uses in this area would be variable depending on the type of use and zoning. Accordingly, it is recommended that a definition of "*Hazardous Floodplain Areas*" be adopted.

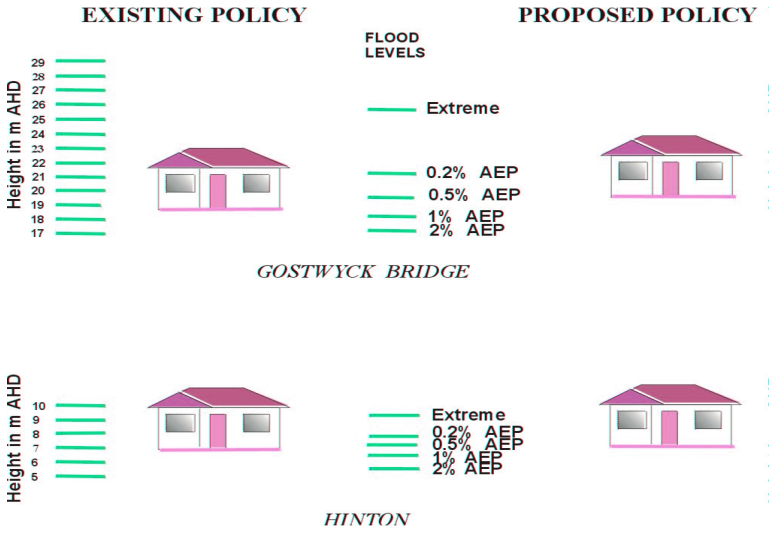
To give purpose to defining the extent of the "*Hazardous Floodplain Areas*" which is that area identified by the planning matrix where the majority of land use types are considered unsuitable, it would be desirable to introduce a clause into the LEP's that prohibits the majority of land uses activities other than minor development and some essential public utilities which cannot be located elsewhere. A recommended standard clause is provided within **Appendix A**, for discussions purposes.

For the purposes of consistency, it is recommended that the above approach replace the existing practice of zoning some land "Special Uses (Flood Liable Land)". That is, these areas should be zoned in a manner which best reflects their most appropriate use (should flooding not be an issue) such as "Rural" but with the overriding clause as outlined in **Appendix A**.

As required by the Council Project Officer, consideration has been given to the prohibition of any further dwellings within the floodplain (i.e. below the EF). This would remove any flood risk associated with new dwellings but would not provide a balanced approach which equally considered the economic and social impact of sterilising the floodplain. Acceptably minimised flood risks can be achieved by implementing the planning matrix approach.

5.5 Development Control Plans

The appropriate mechanism for specifying detailed controls to be applied for new development would be a DCP. This document could form an overall comprehensive flood



management policy of each Council and a suggested draft Policy is contained within **Appendices B** and **C** while the main areas of control are discussed below.

There are seven areas of development control consideration relevant to floodplain planning which may be applied to development in the study area. The following provides a discussion of the controls that would be appropriately considered under each of these headings.

5.5.1 Floor and Pad Levels

Various alternatives for floor and pad levels were considered by the Floodplain Management Committee at its meeting of the 18 January, 2001. Such consideration was made with regard to existing standards and relative differences between potential flood levels. These parameters are conceptually indicated by the following **Illustration 7**.

Illustration 7
Comparison of Existing and Proposed Minimum Floor Levels
for Residential Development on Floodplains
(outside Floodway and Excessive Depth Zone)

The proposed controls adopted by the Committee require a minimum ground level or pad level equal to the 5% AEP flood level in rural areas. The minimum floor level that would be required is the 0.5% AEP flood level in all areas.

Basis for Committee's Decision

The rationale for choosing these flood planning levels includes the following considerations:

(a) The present controls require a minimum floor level equal to the 1% AEP level plus 0.5 metres freeboard. This level presently approximates the 0.5% AEP level in the lower reaches of the study area, and is only marginally higher in the upper reaches (eg. plus 0.5 metre at Vacy). By adopting this Flood Planning Level, rather than including a fixed freeboard, the same degree of flood level risk exists over the flood study area. (1% AEP plus 0.5 metre equates to a 0.5% AEP flood level at Raymond Terrace vs 0.8% AEP flood level at Gostwyk).

The committee considered that the increased standard would not have significant nor adverse impacts for development (see Illustration 7).

(b) Council wants to control the minimum ground level for residential dwellings, as well as floor level in rural situations where the creation of raised pads would not have major amenity consequences. The construction of raised fill pads in urban

areas would not be desirable for amenity and urban design reasons. They are also uncomfortable with a fixed freeboard throughout the study area given that the slope of the flood stage frequency curve gets steeper as you move upstream of Hinton. Reference regarding this matter should also be made to Volume 1 (in particular, Figure 3).

(c) Control of the minimum ground level in rural areas, as well as the minimum habitable floor level, will minimise damages to motor vehicles, structures and goods stored below the minimum habitable floor level and is the same level as Council requirements for effluent disposal.

Less "flood sensitive" land uses such as building associated with *recreation areas* or *agriculture* could have buildings located with floor levels at the 5% AEP level sufficient to avoid nuisance flooding. Critical utilities and essential community facilities (such as hospitals and public halls, etc) should have floor levels close to the extreme flood level, as this will be essential to ensuring minimal disruption to the community during major floods.

Implications of New FPL's

The above recommended FPL's will have a number of consequences, which will vary for different land uses in different parts of the floodplain, consistent with the philosophical approach outlined at Section 3.0 of this report. At present both Council's apply a policy, specifically directed to residential dwellings requiring that their floor levels be constructed above the 1% AEP flood level, plus 0.5m freeboard. The changes recommended may have a number of implications including the following:-

(a) The application of floor level controls over the full range of possible land uses, not only residential dwellings.

(b) The floor level control varies depending upon the sensitivity of the land use, for eg. critical utilities and essential community facilities are required to have a floor level equal to or greater than the extreme flood level and recreation/agricultural buildings are required to have a floor level equal to or greater than the 5% AEP flood level (unless otherwise determined by a risk assessment).

(c) In regard to residential dwellings, required floor levels will change across the floodplain (eg. floor levels will be lowered at Hinton by 0.3m and increased by about 1m at Gostwyck) (refer Illustration 7).

(d) Existing development which has been lawfully constructed in accordance with the pre-existing controls will be covered by their existing approvals. Any redevelopment, or alterations and additions to such existing development will need to conform with the new controls, and the recommended DCP provides controls which are cognisant of the need to consider existing floor levels when undertaking alterations and additions.

(e) The proposed controls aim at controlling only floor levels in urban areas and both floor levels and ground levels in rural areas. A requirement to raise ground areas in urban areas is not considered practical due to the amenity and visual impact of batters or retaining walls on smaller lots. While the construction of raised fill pads will give rise to increased initial housing costs, the committee concluded that it would result in reduced damages to motor vehicles, structures and goods stored below the FPL and on balance is, therefore, desirable.

(f) Fill pads in rural areas will not be permitted in floodways. Therefore, in the rural areas where the fill pads are required for new residential development, there will normally be a negligible impact on flood behaviour, particularly given the large lot sizes involved.

(g) Evacuation of residents from new residential development in the floodplain has been reviewed with the local SES. The SES are satisfied with the proposals noting the improvements to flood warning and emergency management which are proposed, and the fact that new residential development will only be allowed in areas where flood boat operation is possible (due to slow water velocities).

Floor level controls provide a major mechanism to limit damages arising from floods. It must be emphasised that the floor level controls proposed (or those that exist) do not eliminate all risk of flood damage to properties, as this could only be achieved by requiring

floor levels to be above the extreme flood level.

To require floor levels above the extreme flood level for all land uses (particularly dwelling houses) would not be practical or consistent with economic, social and environmental considerations and, accordingly, the Floodplain Management Committee has recommended FPL's based on a balanced consideration of the issues. The recommended FPL also aims to provide a more consistent level of risk to property across the whole of the floodplain. Illustration 7 depicts a range of possible flood levels across the floodplain and the recommended FPL's for dwelling houses.

The following controls provide additional mechanisms aimed at reducing risks to property and persons in the floodplain, and are complementary to the recommended floor and ground level controls.

5.5.2 Flood Compatible Building Components

All structures below the design flood level for individual land uses should be constructed of flood compatible materials. With regard to the identification of appropriate flood compatible materials, an appropriate general list of materials and fittings is provided within the recommended DCP. However, we note that the Department of Land & Water Conservation is currently having a detailed study undertaken by the CSIRO and others which will identify appropriate flood compatible materials, (including methods of construction) applicable to Australian conditions. The CSIRO study is understood to not yet be completed but is expected to be completed some time during this year. It is recommended that the DCP be reviewed upon completion and availability of this CSIRO study.

5.5.3 Structural Soundness

The Council's technical subcommittee for the project considered it necessary that an engineer's report should be obtained for most new development in the floodplain, where the proposed building footprint was inundated by a flood sufficient to inundate the proposed pad/floor level.

Consideration was given to various alternatives to an engineer's report (eg. other forms of assessment by applicant, or engineer's report required at the discretion of the Council

officers). However, the committee considered such alternatives would be impractical to administer.

5.5.4 External Flood Effects

In a similar manner to the requirements for "Structural Soundness" discussed above, the committee considered that the requirement for an engineer's report was the most practical means of establishing that the proposed development would not adversely affect flood behaviour within other parts of the floodplain.

5.5.5 Evacuation/Access

Having regard to the short warning time and the isolated nature of parts of the study area careful consideration of evacuation measures and available access to existing and new development is important. Accordingly, a number of controls regarding the provision of reliable access and the preparation of flood evacuation strategies are recommended.

5.5.6 Flood Awareness

The planning mechanisms available to assist in increasing flood awareness include the provision of notations upon Section 149(2) Certificates (zoning certificates) and imposition of restrictions on titles of new allotments created through subdivision advising of minimum floor levels relative to the flood level and of Council's flood prone land policy. Such mechanisms are recommended as outlined later in this report.

5.5.7 Management and Design

Special consideration of the design and management of individual proposals can also reduce the flood risk and potential damage to property and persons. These measures may involve the provision of a flood plan for individual sites which ensures that individuals consider and plan means to minimise the likelihood of flood damage, including providing for the movement of goods above the flood level within the likely available flood warning time. Other specific considerations are for the storage of certain goods above the design flood level and requiring the implementation of mitigating measures to prevent pollution of the floodplain potentially occurring during floods.

5.6 Policies

In addition to formal regulations such as the DCP, Council may wish to identify and adopt specific policies with regard to their long term vision for development within the floodplain. This may be a stand alone document or form a component of the DCP for the purposes of providing one comprehensive document.

5.7 Section 94 Contributions Plans

A Section 94 Contributions Plan includes detail in regard to anticipated increase of demand for public services and amenities arising from projected new development and provides calculations for developer contributions in order to fund the additional public services and amenities in accordance with an identified schedule of works. Section 94 Contributions Plans have an implication in regard to the Floodplain Management Study, where it is necessary or appropriate to fund flood mitigation works through such plans.

Having regard to the minimal expected further development in the floodplain, the option of using a Section 94 Contributions Plan to fund or partially fund any flood mitigation works is limited. The area of greatest potential application could be to fund improved road access for the proposed Paterson rural residential area in the Dungog Shire to provide satisfactory evacuation routes.

5.8 Section 149 Certificates

Consistent with recommendations regarding both Councils' LEP maps, it is recommended that all areas located within the known EF extent (Flood Prone lands) be advised of the applicability of Council's Floodplain Management Policy. The proposed DCP (which will act as Council's Floodplain Management Policy) will provide controls for development within the floodplain (up to the EF). The controls will not necessarily provide an outright restriction to development, but will provide varying degrees of development control measures required to ensure that land uses are acceptable having regard to their sensitivity to the flood hazard, and their location within the floodplain.

During the preparation of the study, various alternatives for using certificates issued under S149(2) and/or S149(5) to advise owners and prospective purchasers of flood risk (ie. via

levels, depths, hazards, etc. in addition to advice on policies) were also considered. These additional measures were aimed at increasing the community's awareness of flood risk, rather than providing notifications of policy alone as required by the S149 regulations. In addition, the option of preparing and issuing flood certificates was considered (refer to Bewsher, Grech & Maddocks, 1998). These latter certificates could be appended to S149(2) and S149(5) certificates, and/or distributed to all affected property owners on a regular basis (say every 3 years). However, the Council's subcommittee considered these alternatives would be difficult to administer and may increase the Council's exposure to liability claims in respect of the information issued. Therefore, these other alternatives were not recommended.

6.0 RECOMMENDED PLANNING MEASURES

Having regard to the above discussion, the following planning measures are recommended:

(a) That consideration be given to the application of a graded set of planning controls for different land uses relative to different predicted flood levels within the study area.

(b) That the planning implications for each of the structural mitigation options be addressed, having regard to the issues outlined within this report, should any of these options be seriously considered in the future.

(c) That the Councils amend their LEP's in the following manner:

- Inclusion of the standard definition, objectives and standard clauses as outlined in **Appendix A**, subject to modification as required to suit the circumstances of Council's individual LEP's.

- Identify on Council's LEP maps the extent of the EF (to be known as Flood Prone lands) and the Hazardous Floodplain Areas.

(d) A Development Control Plan be adopted outlining appropriate measures to be applied to development in the floodplain. In this regard, **Appendix B** and **Appendix**

C provide a suggested Draft Development Control Plan for each Council's consideration and adoption in accordance with the process required under the EPA Act.

(e) That the Councils consider revising LEP's to prohibit unsuitable land uses within areas subject to certain predicted flood levels, in a manner which is consistent with the suggested DCP provided at **Appendix B** and **Appendix C**.

(f) For future development, that the Councils ensure that consideration be given to the necessity for evacuation from rural residential areas, and the capacity and adequacy of the road system to enable this to occur during periods of floods ranging up to the EF. In this regard, the proposed Paterson rural residential area within the Dungog Shire may require review to ensure that appropriate road access can be obtained during periods of flood for evacuation purposes, and if found not to be adequate, which would appear to be the case, alternate evacuation routes and improved warning systems may need to be investigated. Council could investigate the funding of these measures through the application of Section 94 contributions provided for by the EP & A Act.

(g) That Council incorporate notations upon Section 149(2) Certificates which identify the affectation by the DCP's.

(h) That the Councils support the preparation of a Vegetation Management Strategy and Plan for the river corridor consistent with the principles outlined in this report.

It is considered that the above recommendations provide appropriate responses to the issues raised and evaluated within the context of the FPMS and the legislative framework associated with planning. The planning controls by their nature provide measures to address the flooding issue associated with new development, and other measures may be recommended elsewhere within the FPMP dealing with existing development.

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APPENDIX A

STANDARD INCLUSIONS FOR LEP's

DEFINITIONS

Hazardous Floodplain Areas means land indicated as "Hazardous Floodplain Area" on a map marked "Flood Prone land" deposited in the office of Council being those parts of Flood Prone land where the depth and velocity of floodwaters and evacuation difficulties would pose an unacceptable risk to types of development and activity.

Flood Prone land means land indicated on the map marked "Flood Prone land" deposited in the office of Council as amended from time to time.

OBJECTIVES

The objectives for development on flood prone land are:

(a) to minimise risk to human life and damage to property caused by flooding and inundation through controlling development,

(b) to ensure that the nature and extent of the flooding and inundation hazard are considered prior to development taking place, and

(c) to provide flexibility in controlling development in flood prone localities so that the new information or approaches to hazard management can be employed where appropriate.

STANDARD CLAUSES [1]

Development in Hazardous Floodplain Areas

[1] Note the standard clauses provided are based on defined terms derived from Port Stephens Draft LEP 2000 and may require minor tailoring to accord with defined terms adopted in the Dungog LEP

Notwithstanding any other provision of this plan, development for the following purposes are prohibited:

(a) Floodway and Excessive Depth Floodplain Management Zone - abattoirs; airport; animal establishments; bed & breakfast establishments; boarding houses; brothel; bulky goods sales rooms or showrooms; bus station; camp or caravan site; child care centres; club, commercial premises, community facilities; depots; dual occupancy housing; dwelling houses; earthworks or filling operations covering 100m^2 or more than 0.3m deep; education establishments; exhibition homes; group homes; generating works; hazardous industry, hazardous storage establishment; health consulting room; heliports; home employment; home occupations; housing for aged or disabled persons; hospitals; hotel; industry; institutions; liquid fuel depot; materials recycling facility; medical centre, mortuary; motor showroom; offensive industry; offensive storage establishment; place of assembly; place of public worship; recreation facility; research facilities; restaurant; roadside stalls; road transport terminal; rural industries; service stations; shop; subdivision of land which involves the creation of new allotments for any particular purpose; telecommunication facilities; urban housing; utility installations; veterinary hospitals; warehouse.

(b) High Risk (Velocity and Depth) Floodplain Management Zone - abattoirs; airport; animal establishments; bed & breakfast establishments; boarding houses; brothel; bulky goods sales rooms or showrooms; bus station; camp or caravan site; child care centres; club, commercial premises, community facilities; depots; dual occupancy housing; dwelling houses (other than in rural zone); education establishments; exhibition homes; group homes; generating works; hazardous industry, hazardous storage establishment; health consulting room; heliports; home employment; home occupations; housing for aged or disabled persons; hospitals; hotel; industry; institutions; liquid fuel depot; materials recycling facility; medical centre, mortuary; motor showroom; offensive industry; offensive storage establishment; place of assembly; place of public worship; recreation facility; research facilities; restaurant; roadside stalls; road transport terminal; rural industries; service stations; shop; subdivision of land which involves the creation of new allotments for any particular purpose; telecommunication facilities; urban housing; utility installations; veterinary hospitals; warehouse.

(c) Isolated Islands Floodplain Management Zone - subdivision which would create the potential for an additional dwelling.

Development on Flood Prone land

.... (1) The Council may refuse consent to the carrying out of any development on flood prone land unless exempt or complying development, where, in its opinion, the development may:

(a) be inconsistent with any interim flood policy or floodplain management plan adopted by Council in accordance with the principles contained in the Manual entitled "Floodplain Development Manual" dated December 1986 (Reference No. PWD86010);

(b) detrimentally increase the potential flood affectation on other development or property;

(c) result, to a substantial degree, an increased risk to human life;

(d) be likely to result in additional economic and social cost which could not reasonably be managed by potentially affected persons and the general community; or

(e) adversely affect the environment of the floodplain by causing avoidable erosion, siltation, unnecessary destruction of river bank vegetation, a reduction in the stability of the river bank;

2. For the purposes of this plan, the Council may consult with and take into consideration advice of the Department of land and Water Conservation and the State Emergency Service in relation to:

(a) the nature of the flood hazard;
(b) the necessity and capacity to evacuate persons;
(c) the consequence and suitability of the development;

(d) whether it may be reasonably mitigated; and

(e) whether conditions should be imposed on any consent to further the objectives of this plan.

DRAFT

MANAGING OUR FLOODPLAINS

Port Stephens Council
Development Control Plan (DCP) No. .....
(Environmental Planning and Assessment Act, 1979)
and Policy Statement

Prepared by
Don Fox Planning
Bewsher Consulting

April 2000
(Finalised November 2001)
(Printed February 2002)

APPENDIX B

TABLE OF CONTENTS

LIST OF ATTACHED SCHEDULES

1.0 GENERAL

1.1 What is the Policy?

This document is to be known as the "Floodplain Management Policy". This Policy has been adopted by Council at its meeting of ..... in accordance with Section 72 of the Environmental Planning and Assessment Act, 1979 (Development Control Plans).

1.2 Why is this Policy Required?

The Floodplain Development Manual requires that Councils prepare Floodplain Management Studies as a prelude to the formulation of a Floodplain Management Plan which, among other things, would control development and other activity within the floodplain. In the absence of a Floodplain Management Study and Floodplain Management Plan the Manual requires that Council adopts an Interim Flood Policy.

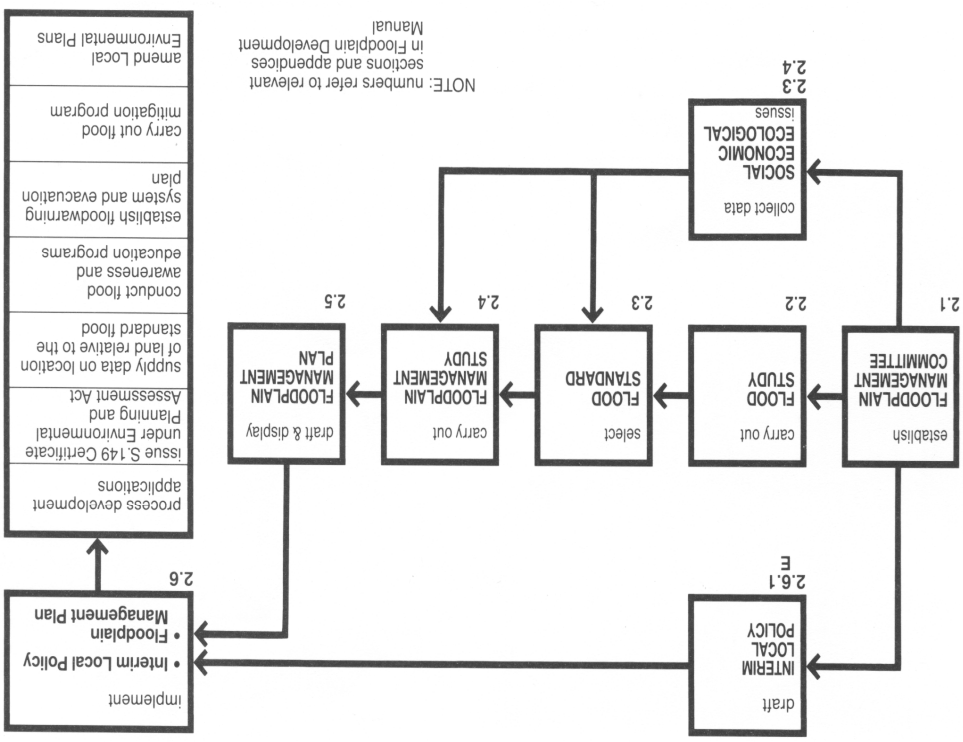
INSERT PHOTO

This Policy is consistent with the State Government's "Flood Prone Land Policy" which can be found at Appendix A of the Floodplain Development Manual. This Policy is an application of the State Policy which reflects local circumstances.

1.3 What Applications does the Policy Apply to?

Council will take into consideration this policy when determining development applications received in accordance with the Environmental Planning and Assessment Act, 1979. Council will also take into consideration this document when reviewing general policy issues, including proposals to rezone land.

This Policy does not propose to exempt any applications from the necessity to obtain a particular approval of the Council or other government agencies, where such a requirement would otherwise exist.



Existing NSW Floodplain Management System
(Source: Floodplain Development Manual, pg. 5)

1.4 Where Does the Policy Apply?

The Policy applies to whole of the Local Government area, as depicted upon the following Policy Map.

There are a number of floodplains within the LGA, and this Policy will provide general provisions relating to all the floodplains and specific provisions relating to individual floodplains which are subject to a Floodplain Management Plan.

1.5 How does the Policy relate to Other Legislation and Regulations?

This Policy should be read in conjunction with the relevant provisions of the NSW Government Floodplain Development Manual, the Environmental Planning and Assessment Act, 1979, and Regulations thereto, applicable Environmental Planning Instruments (inclusive of Port Stephens Local Environmental Plan 1987) and other relevant Development Control Plans adopted by Council.

1.6 What are the Aims and Objectives of the Policy?

This Policy aims to:-

(a) Provide detailed controls for the assessment of applications on land affected by potential floods.

(b) To minimise the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterway corridors.

(c) Specify criteria for consideration of applications lodged in accordance with the Environmental Planning and Assessment Act 1979.

(d) Alert the community to the hazard and extent of land affected by potential floods.

(e) Inform the community of Council's policy in relation to the use and development of land affected by potential floods.

(f) Reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods.

(g) Deal equitably and consistently with applications for development on land affected by potential floods, in accordance with the principles in the Floodplain Development Manual issued by the New South Wales Government.

(h) Increase public awareness of the potential of floods greater than the 1% AEP Flood and to ensure essential services and landuses are planned in recognition of all potential floods.

(i) Encourage the development and use of land which is compatible with the indicated flood hazard.

(j) Provide different guidelines, for the use and development of land subject to all potential floods in the floodplain, which reflect the probability of the flood occurring and the potential hazard within different areas.

(k) Apply a "merits-based approach" to all development decisions which takes account of social, economic and ecological as well as flooding considerations;

(l) To control development and other activity within each of the individual floodplains having regard to the characteristics and level of information available for each of the floodplains, in particular the availability of floodplain management studies and floodplain

management plans prepared in accordance with the Floodplain Development Manual.

POLICY MAP

INSERT LGA BOUNDARY MAP FROM COUNCIL

1.7 Glossary

For the purpose of this Policy the following definitions have been adopted:

Australian Height Datum (AHD) is a common national plain of level corresponding approximately to mean sea level.

Design floor level or *ground level* means the level specified in this Policy which applies to the relevant land use type within the relevant Floodplain Management Zone.

Effective warning time is equal to the available warning time, less the time taken to alert flood-effected people (by radio, television, loud-hailer or word of mouth) and have them commence effective evacuation procedures.

Flood awareness is an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning and evacuation procedures.

Flood compatible building components means a combination of measures incorporated in the design and/or construction and alteration of individual buildings or structures subject to flooding, and the use of flood compatible materials for the reduction or elimination of flood damage as indicated in the Floodplain Development Manual.

Flood compatible materials include those materials used in building which are resistant to damage when inundated. A list of flood compatible materials is attached in **Schedule 1**.

Flood evacuation strategy means the proposed strategy for the evacuation of areas during periods of flood as specified within any policy of Council, the Floodplain Management Plan, the relevant (SES) Flood Plan, by advices received from the SES or as determined in the assessment of individual proposals.

Flood prone land means land indicated on the map marked 'Flood Prone land' deposited in the office of Council and amended from time to time.

"Flood Proofing with Habitable Areas on Upper Floors"
(Source: Floodplain Development Manual, pg: 50)

Floodplain Development Manual (FPDM) refers to the document dated December 1986. (Reference No PWD86010), published by the New South Wales Government.

Floodplain Management Plan means a plan prepared for one or more floodplains in accordance with the requirements of the Floodplain Development Manual.

Floodplain Management Study means a study prepared for one or more floodplains in accordance with the requirements of the Floodplain Development Manual.

Habitable floor area refers to a room (other than a bathroom, laundry, W.C. or the like) that is constructed or adapted for domestic living such as a lounge room, dining room, rumpus room, kitchen or bedroom.

Hazardous Floodplain Areas means land indicated as"Hazardous Floodplain Area" on a map marked "Flood Prone land" deposited in the office of Council being those parts of potentially flooded areas where the depth and velocity of floodwaters and evacuation difficulties would pose an unacceptable risk to types of development and activity.

Outbuilding means a building which is ancillary to a principal residential building and includes sheds, garages, car ports and similar buildings.

Raised fill pad level is a raised area of ground upon which a dwelling or ancillary buildings must be constructed on rural or other non urban zoned lands.

Reliable access during a flood means the ability for people to safely evacuate an area subject to imminent flooding within effective warning time and without a need to travel through areas where water depths increase.

Site Emergency Response Flood Plan is a management plan prepared in consultation with the State Emergency Services (SES) and approved by Council which demonstrates the means to minimise the likelihood of flood damage, including demonstrated ability to move goods above flood level within the likely available flood warning time and a requirement for flood drills for larger commercial/industrial premises. This could be in the form of an individual Flood Plan.

Survey plan is a plan prepared by a registered surveyor which shows the information required for the assessment of an application in accordance with the provisions of this Policy.

The extreme flood (EF) means the flood calculated to be the maximum likely to occur.

2.0 WHAT ARE THE CRITERIA FOR DETERMINING APPLICATIONS?

2.1 General

The criteria for determining applications for proposals potentially affected by flooding recognise that different controls are applicable to different land uses and levels of potential flood inundation and hazard.

The procedure to determine what controls apply to proposed development involve identifying:

(a) the land use category of the development (Schedule 2);

(b) what part of the floodplain the land is located within (Clause 2.3); and

(c) then apply the controls outlined at Clause 2.4.

Clause 2.5 provides specific requirements for fencing in the floodplain, while Clause 2.6 identifies special considerations which will apply only to some development in specific circumstances.

Clauses 2.4 and 2.5 which provide controls for development and fencing in the floodplain contain objectives, performance criteria and prescriptive controls, with the following purpose:

1. ***The objectives*** represent the outcomes that the Council wishes to achieve from each control.

2. ***The performance criteria*** represent a means of assessing whether the desired outcomes will be achieved.

3. ***The prescriptive controls*** are preferred ways of achieving the outcome. While adherence to the prescriptive controls may be important, it is paramount that the objectives of the performance criteria are clearly satisfied.

Clause 2.6 and 2.7 outline Council's

policies in regard to dealing with proposals for rezoning of land within the floodplain or those involving properties identified for voluntary purchase due to their location in high hazard areas in the urban floodplain.

2.2 Land Use Categories

Seven major land use categories have been adopted. The specific uses, as defined by the applicable Environmental Planning Instruments, which may be included in each category, are listed in **Schedule 2.**

2.3 Floodplain Management Zones

Each of the floodplains within the local government area have been divided based on different levels of potential flood hazard. The relevant Floodplain Management Zones for each of the floodplains are outlined below.

Paterson River Floodplain

FLOODPLAIN MANAGEMENT ZONES	CRITERIA
1. Floodway and Excessive Depth Zone	Floodway or depth _ 4m in 1% AEP event
2. High Risk (Velocity and Depth) Zone	Remaining area where provisional hazard is high in 1% AEP event
3. Isolated Islands Zone	Remaining area where evacuation is possible only through Zones 1 or 2
4. Low Risk Zone	Remaining area below extreme flood level

(Refer to Volume 3 of the Floodplain Management Study for detailed explanation of zone criteria)

All Other Floodplains

Floodway means that part of the floodplain which conveys significant quantities of flow path and would pose a significant hazard to property and persons as determined by an application of the principles contained within the Floodplain Development Manual.

Flood fringe means that area of the floodplain between the floodway and the 1% AEP flood plus 0.5 metres (free board).

Outer floodplain means that part of the floodplain above the 1% AEP flood plus 0.5 metres (free board) up to the extreme flood.

2.4 What Controls Apply to Proposed Developments?

The development controls apply to all known potentially flooded areas (that is up to the largest estimated flood including the EF flood when known). The type and stringency of controls have been graded relative to the severity and frequency of potential floods, having regard to categories determined by the relevant Floodplain Management Study. The categories applicable to each floodplain are depicted on the planning matrices contained in the following schedules:

- Schedule 3 - Paterson River Floodplain
- Schedule 4- All other floodplains.

2.4.1 Objectives

(a) To ensure the proponents of development and the community in general are fully aware of the potential flood hazard and consequent risk associated with the use and development of land within the floodplain.

(b) To require developments of high sensitivity to flood risk (eg. critical public utilities) be sited and designed such that they are subject to no or minimal risk from flooding.

(c) Allowing development with a lower sensitivity to the flood

hazard within the floodplain, subject to appropriate design and siting controls, provided that the potential consequences that could still arise from flooding remain acceptable having regard to the State Government's Flood Policy and the likely expectations of the community

(e) To ensure that design and siting controls required to address the flood hazard do not result in unreasonable impacts upon the amenity or ecology of an area.

2.4.2 Performance Criteria

(a) The proposed development should not result in any increased risk to human life.

(b) The additional economic and social costs which may arise from damage to property from flooding should not be greater than that which can reasonably be managed by the property owner and general community.

(c) The proposal should only be permitted where effective warning time and reliable access is available for the evacuation of an area potentially affected by floods, where likely to be required.

(d) Development should not detrimentally increase the potential flood affectation on other development or properties.

2.4.3 Prescriptive Controls

Schedules 3 and 4 outline the controls relevant to each of the floodplains to which this Policy applies.

2.5 Are there Special Requirements for Fencing?

2.5.1 Objectives

(a) To ensure that fencing does not result in the undesirable obstruction of the free flow of floodwaters.

(b) To ensure that fencing does not become unsafe during floods and potentially become moving debris which threatens the integrity of structures or the safety of people.

in general.

(d) To prevent any intensification of the use of floodways, and wherever possible allow for their conversion to natural waterway corridors.

2.5.2 Performance Criteria

(a) Fencing is to be constructed in a manner which does not affect the flow of floods so as to detrimentally increase flood affection on surrounding land.

(b) Ability to be certified by a suitably qualified engineer, that the proposed fencing is adequately constructed so as to withstand the forces of floodwaters.

2.5.3 Prescriptive Controls

2.5.3.1 Fencing within the floodway will not be permissible except for security/permeable/safety fences of a type approved by Council.

2.5.3.2 Council will require a Development Application for all new solid (non-porous) and continuous fences above 0.6m high, in the area affected by floods up to the 1% AEP flood unless otherwise stated by exempt and complying development provisions which may be incorporated into Council's Environmental Planning Instruments from time to time.

2.5.3.3 An applicant will need to demonstrate that the

fence would create no impediment to the flow of floodwaters. Appropriate fences may include:-

(a) An open collapsible hinged fence structure or pool type fence;

2.5.3.4 Other forms of fencing will be considered by Council on merit.

2.6 Special Considerations

When assessing proposals for development or other activity within the area to which this Policy applies, Council will take into consideration the following specific matters.

(a) The proposal does not have a significant detrimental impact on:

i) Water quality
ii) Native bushland vegetation
iii) Riparian vegetation
iv) Estuaries, wetlands, lakes or other water bodies
v) Aquatic and terrestrial ecosystems
vi) Indigenous flora and fauna
vii) Fluvial geomorphology

(b) Development pursued to mitigate the potential impact of flooding (eg. house raising) is undertaken in a manner which minimises the impact upon the amenity and character of the locality.

(c) The proposal will not constrain the orderly and efficient utilisation of the waterways for multiple purposes.

(d) The proposal does not adversely impact upon the recreational, ecological, aesthetic or utilitarian use of the waterway corridors, and where possible, provides for their enhancement.

(e) Proposals for house raising must provide appropriate documentation including a report from a suitably qualified engineer to demonstrate the raised structure will not be at risk of failure from the forces of floodwaters and the provision of details such as landscaping and architectural enhancements which ensure that the resultant structure will not result in significant adverse impacts upon the amenity and character of an area.

(b) Other than a brick or other masonry type fence (which will generally not be permitted); or

(c) A fence type and siting criteria as prescribed by Council.

2.7 Voluntary Purchase

In certain high hazard areas in the urban floodplain where it is impractical or uneconomic to mitigate the flood hazard, it may be appropriate to cease occupation of the land to minimise risk to both residents and potential rescuers. In such situations, Council may instigate a voluntary purchase scheme of affected properties in consultation with the Department of Land & Water Conservation and the affected landowners, after consideration of other relevant matters outlined by the Floodplain Development Manual.

Where Schedules 3 and 4 indicate that Council will consider minor developments within areas subject to voluntary purchase schemes, the following shall apply:

(a) In the event that house alterations or additions are approved by Council, the applicant will need to provide a written agreement to Council to the effect that any increase in the value of the property will not be included in any possible acquisition valuation.

(b) Such properties are to be placed at the end of the voluntary acquisition list.

3.0 WHAT INFORMATION IS REQUIRED WITH AN APPLICATION TO ADDRESS THIS POLICY?

3.1 Applications must include information which addresses all relevant controls listed above, and the following matters as applicable.

3.2 Applications for minor additions (see Schedule 2) to an existing dwelling on Flood Prone Land shall be accompanied by documentation from a registered surveyor confirming existing floor levels.

3.3 Development applications for Flood Prone Land shall be accompanied by a survey plan showing:-

(a) The position of the existing building/s or proposed building/s;

(b) The existing ground levels to Australian height datum around the perimeter of the building and contours of the site; and

(c) The existing or proposed floor levels to Australian height datum.

3.4 Applications for earthworks, filling of land and subdivision shall be accompanied by a survey plan (with a contour interval of 0.25m) showing relative levels to Australian height datum.

3.5 For large scale developments, or developments in critical situations, particularly where an existing catchment based Flood Study is not available, a flood study using a fully dynamic one or two dimensional computer model may be required. For smaller developments the existing flood study may be used if available and suitable (eg it contains sufficient local detail), or otherwise a Rational Method flood estimation, or similar method, will be required.

SCHEDULE 1
FLOOD COMPATIBLE MATERIALS

BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL	BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL
Flooring and Sub-floor Structure	❍ concrete slab-on-ground monolith construction ❍ suspension reinforced concrete slab.	**Doors**	❍ solid panel with water proof adhesives ❍ flush door with marine ply filled with closed cell foam ❍ painted metal construction ❍ aluminium or galvanised steel frame
Floor Covering	❍ clay tiles ❍ concrete, precast or in situ ❍ concrete tiles ❍ epoxy, formed-in-place ❍ mastic flooring, formed-in-place ❍ rubber sheets or tiles with chemical-set adhesives ❍ silicone floors formed-in-place ❍ vinyl sheets or tiles with chemical-set adhesive ❍ ceramic tiles, fixed with mortar or chemical-set adhesive ❍ asphalt tiles, fixed with water resistant adhesive	**Wall and Ceiling Linings**	❍ fibro-cement board ❍ brick, face or glazed ❍ clay tile glazed in waterproof mortar ❍ concrete ❍ concrete block ❍ steel with waterproof applications ❍ stone, natural solid or veneer, waterproof grout ❍ glass blocks ❍ glass ❍ plastic sheeting or wall with waterproof adhesive
Wall Structure	❍ solid brickwork, blockwork, reinforced, concrete or mass concrete	**Insulation** **Windows**	❍ foam (closed cell types) ❍ aluminium frame with stainless steel rollers or similar corrosion and water resistant material.
Roofing Structure (for Situations Where the Relevant Flood Level is Above the Ceiling)	❍ reinforced concrete construction ❍ galvanised metal construction	**Nails, Bolts, Hinges and Fittings**	❍ brass, nylon or stainless steel ❍ removable pin hinges ❍ hot dipped galvanised steer wire nails or similar

Electrical and Mechanical Equipment For dwellings constructed on land to which this Policy	**Heating and Air Conditioning Systems** Heating and air conditioning systems should, to the

applies, the electrical and mechanical materials, equipment and installation should conform to the following requirements.	maximum extent possible, be installed in areas and spaces of the house above the relevant flood level. When this is not feasible every precaution should be taken to minimise the damage caused by submersion according to the following guidelines.
Main power supply - Subject to the approval of the relevant authority the incoming main commercial power service equipment, including all metering equipment, shall be located above the relevant flood level. Means shall be available to easily disconnect the dwelling from the main power supply.	**Fuel -** Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off.
Wiring - All wiring, power outlets, switches, etc., should, to the maximum extent possible, be located above the relevant flood level. All electrical wiring installed below the relevant flood level should be suitable for continuous submergence in water and should contain no fibrous components. Earth core linkage systems (or safety switches) are to be installed. Only submersible-type splices should be used below the relevant flood level. All conduits located below the relevant designated flood level should be so installed that they will be self-draining if subjected to flooding.	**Installation -** The heating equipment and fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line. All storage tanks should be vented to an elevation of 600 millimetres above the relevant flood level.
Equipment - All equipment installed below or partially below the relevant flood level should be capable of disconnection by a single plug and socket assembly.	**Ducting -** All ductwork located below the relevant flood level should be provided with openings for drainage and cleaning. Self draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a water-tight wall or floor below the relevant flood level, the ductwork should be protected by a closure assembly operated from above relevant flood level.
Reconnection - Should any electrical device and/or part of the wiring be flooded it should be thoroughly cleaned or replaced and checked by an approved electrical contractor before reconnection.	

SCHEDULE 2
LAND USE CATEGORIES

Essential Community Facilities	**Critical Utilities**	**Subdivision and Filling**	**Residential**	**Commercial or Industrial**	**Recreation or Agriculture**	**Minor Development**
Place of assembly; community facility which may provide an important contribution to the notification and evacuation of the community during flood events, Hospitals; institutions; and Education establish-men ts.	Telecom-muni cation facilities; Generating works; Liquid fuel depot or Utility Installations which may cause pollution of waterways during flooding, are essential to evacuation during periods of flood or if affected during flood events would unreasonably affect the ability of the community to return to normal activities after flood events.	Landfill; Subdivision of land which involves the creation of new allotments for any particular purpose; and, earthworks or filling operations covering 100m^2 or more than 0.3m deep.	Bed & Breakfast establishments; Boarding Houses; Camp or Caravan site; Child care centre; Dual occupancy housing; Dwelling; Dwelling houses; Exhibition homes; Home employment; Home occupations; Housing for Aged or Disabled persons; Group homes; Urban housing; Utility installations (other than critical utilities).	Abattoirs; Airport; Animal establishments; Brothels; Bulky goods sales rooms or showrooms; Bus station; Club; Commercial premises; Community facilities; Depots; Hazardous industry; Hazardous storage establishment; Health consulting room; Heliports; Hotel; Industry; Materials recycling facility; Medical centre, Mortuary; Motor showroom; Offensive industry; Offensive storage establishment; Place of public worship; Recreation facility; Research facilities; Restaurant; Roadside stalls; Road transport terminal; Rural industries; Service station; Shop; Veterinary hospitals; Warehouse.	Agriculture; Aquaculture; Dams; Extractive industry; Forestry Helicopter landing site; Intensive agriculture; Intensive agricultural pursuit; Intensive animal husbandry; Marinas; Mine; Race Track; Recreation areas and minor ancillary structures (eg toilet blocks or Kiosks); Retail plant nursery; Sanctuary; and Tourist boat; Tourist facility.	(a) In the case of residential development: (i) an addition or alteration to an existing dwelling of not more than 10% or 35m^2 (whichever is the lesser) of the habitable floor area which existed at the date of commencement of this policy; (ii) the construction of an outbuilding with a maximum floor area of 20m^2; or (iii) redevelopment for the purposes of substantially reducing the extent of flood affectation to the existing building. (b) In the case of other development: (i) an addition to existing premises of not more than 10% of the floor area which existed at the date of commencement of this policy; or (ii) redevelopment for the purposes of substantially reducing the extent of flood affectation to the existing building.

DRAFT

MANAGING OUR FLOODPLAINS

Dungog Shire Council
Development Control Plan (DCP) No. .....
(Environmental Planning and Assessment Act, 1979)
and Policy Statement

Prepared by
Don Fox Planning
Bewsher Consulting

April 2000
(Finalised November 2001)
(Printed February 2002)

APPENDIX C

TABLE OF CONTENTS

LIST OF ATTACHED SCHEDULES

1.0 GENERAL

1.1 What is the Policy?

This document is to be known as the "Floodplain Management Policy". This Policy has been adopted by Council at its meeting of ..... in accordance with Section 72 of the Environmental Planning and Assessment Act, 1979 (Development Control Plans).

1.2 Why is this Policy Required?

The Floodplain Development Manual requires that Councils prepare Floodplain Management Studies as a prelude to the formulation of a Floodplain Management Plan which, among other things, would control development and other activity within the floodplain. In the absence of a Floodplain Management Study and Floodplain Management Plan the Manual requires that Council adopts an Interim Flood Policy.

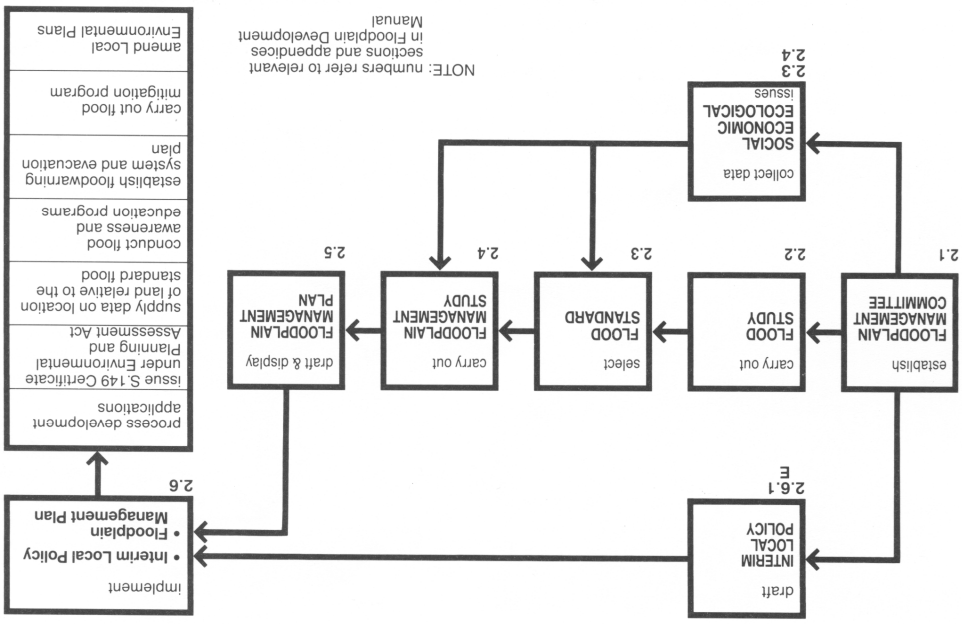
This Policy is consistent with the State Government's "Flood Prone Land Policy" which can be found at Appendix A of the Floodplain Development Manual. This Policy is an application of the State Policy which reflects local circumstances.

INSERT PHOTO

1.3 What Applications does the Policy Apply to?

Council will take into consideration this policy when determining development applications received in accordance with the Environmental Planning and Assessment Act, 1979. Council will also take into consideration this document when reviewing general policy issues, including proposals to rezone land.

This Policy does not propose to exempt any applications from the necessity to obtain a particular approval of the Council or other government agencies, where such a requirement would otherwise exist.



Existing NSW Floodplain Management System

(Source: Floodplain Development Manual, pg. 5

1.4 Where Does the Policy Apply?

The Policy applies to whole of the Local Government area, as depicted upon the following Policy Map.

There are a number of floodplains within the LGA, and this Policy will provide general provisions relating to all the floodplains and specific provisions relating to individual floodplains which are subject to a Floodplain Management Plan.

1.5 How does the Policy relate to Other Legislation and Regulations?

This Policy should be read in conjunction with the relevant provisions of the NSW Government Floodplain Development Manual, the Environmental Planning and Assessment Act, 1979, and Regulations thereto, applicable Environmental Planning Instruments and other relevant Development Control Plans adopted by Council.

1.6 What are the Aims and Objectives of the Policy?

This Policy aims to:-

(a) Provide detailed controls for the assessment of applications on land affected by potential floods.

(b) To minimise the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterway corridors.

(c) Specify criteria for consideration of applications lodged in accordance with the Environmental Planning and Assessment Act 1979.

(d) Alert the community to the hazard and extent of land affected by potential floods.

(e) Inform the community of Council's policy in relation to the use and development of land affected by potential floods.

(f) Reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods.

(g) Deal equitably and consistently with applications for development on land affected by potential floods, in accordance with the principles in the Floodplain Development Manual issued by the New South Wales Government.

(h) Increase public awareness of the potential of floods greater than the 1% AEP flood and to ensure essential services and landuses are planned in recognition of all potential floods.

(i) Encourage the development and use of land which is compatible with the indicated flood hazard.

(j) Provide different guidelines, for the use and development of land subject to all potential floods in the floodplain, which reflect the probability of the flood occurring and the potential hazard within different areas.

(k) Apply a "merits-based approach" to all development decisions which takes account of social, economic and ecological as well as flooding considerations;

(l) To control development and other activity within each of the individual floodplains having regard to the characteristics and level of information available for each of the floodplains, in particular the availability of floodplain management studies and floodplain management plans prepared in accordance with the Floodplain

Development Manual.

POLICY MAP

INSERT LGA BOUNDARY MAP FROM COUNCIL

1.7 Glossary

For the purpose of this Policy the following definitions have been adopted:

Australian Height Datum (AHD) is a common national plain of level corresponding approximately to mean sea level.

Design floor level or *ground level* means the level specified in this Policy which applies to the relevant land use type within the relevant Floodplain Management Zone.

Effective warning time is equal to the available warning time, less the time taken to alert flood-effected people (by radio, television, loud-hailer or word of mouth) and have them commence effective evacuation procedures.

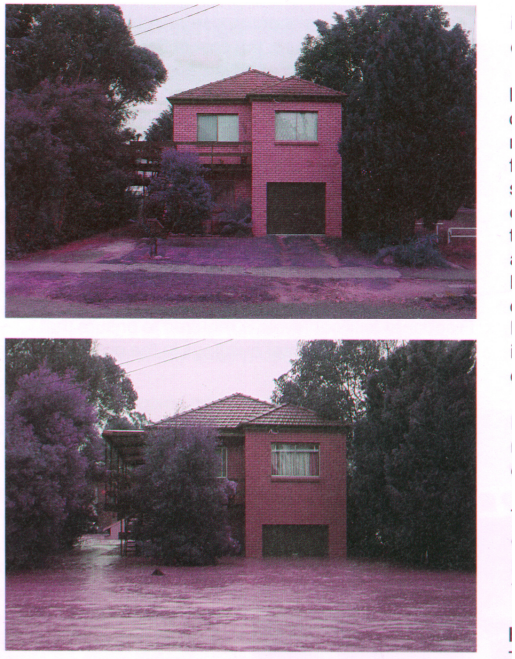
Flood awareness is an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning and evacuation procedures.

Flood compatible building components means a combination of measures incorporated in the design and/or construction and alteration of individual buildings or structures subject to flooding, and the use of flood compatible materials for the reduction or elimination of flood damage as indicated in the Floodplain Development Manual.

Flood compatible materials include those materials used in building which are resistant to damage when inundated. A list of flood compatible materials is attached in **Schedule 1**.

Flood evacuation strategy means the proposed strategy for the evacuation of areas during periods of flood as specified within any policy of Council, the Floodplain Management Plan, the relevant (SES) Flood Plan, by advices received from the SES or as determined in the assessment of individual proposals.

Flood prone land means land indicated on the map marked 'Flood Prone land' deposited in the office of Council and amended from time to time.



"Flood Proofing with Habitable Areas on Upper Floors"
(Source: Floodplain Development Manual, pg: 50)

Floodplain Development Manual (FPDM) refers to the document dated December 1986. (Reference No PWD86010), published by the New South Wales Government.

Floodplain Management Plan means a plan prepared for one or more floodplains in accordance with the requirements of the Floodplain Development Manual.

Floodplain Management Study means a study prepared for one or more floodplains in accordance with the requirements of the Floodplain Development Manual.

Habitable floor area refers to a room (other than a bathroom, laundry, W.C. or the like) that is constructed or adapted for domestic living such as a lounge room, dining room, rumpus room, kitchen or bedroom.

Hazardous Floodplain Areas means land is indicated as "Hazardous Floodplain Area" on a map marked "Flood Prone land" deposited in the office of Council being those parts of potentially flooded areas where the depth and velocity of floodwaters and evacuation difficulties would pose an unacceptable risk to types of development and activity.

Outbuilding means a building which is ancillary to a principal residential building and includes sheds, garages, car ports and similar buildings.

Raised fill pad level is a raised area of ground upon which a dwelling or ancillary building must be constructed on rural or other non-urban zoned lands.

Reliable access during a flood means the ability for people to safely evacuate an area subject to imminent flooding within effective warning time and without a need to travel through areas where water depths increase.

Site Emergency Response Flood Plan is a management plan prepared in consultation with the State Emergency Services (SES) and approved by Council which demonstrates the means to minimise the likelihood of flood damage, including demonstrated ability to move goods above flood level within the likely available flood warning time and a requirement for flood drills for larger commercial/industrial premises. This could be in the form of an individual Flood Plan.

Survey plan is a plan prepared by a registered surveyor which shows the information required for the assessment of an application in accordance with the provisions of this Policy.

The extreme flood (EF) means the flood calculated to be the maximum likely to occur.

2.0 WHAT ARE THE CRITERIA FOR DETERMINING APPLICATIONS?

2.1 General

The criteria for determining applications for proposals potentially affected by flooding recognise that different controls are applicable to different land uses and levels of potential flood inundation and hazard.

The procedure to determine what controls apply to proposed development involve identifying:

(a) the land use category of the development (Schedule 2)

(b) what part of the floodplain the land is located within (Clause 2.3) and,

(c) then apply the controls outlined at Clause 2.4.

Clause 2.5 provides specific requirements for fencing in the floodplain, while Clause 2.6 identifies special considerations which will apply only to some development in specific circumstances.

Clauses 2.4 and 2.5 which provide controls for development and fencing in the floodplain contain objectives, performance criteria and prescriptive controls, with the following purpose:

1. ***The objectives*** represent the outcomes that the Council wishes to achieve from each control.

2. ***The performance criteria*** represent a means of assessing whether the desired outcomes will be achieved.

3. ***The prescriptive controls*** are preferred ways of achieving the outcome. While adherence to the prescriptive controls may be important, it is paramount that the objectives of the performance criteria are clearly satisfied.

Clause 2.6 and 2.7 outline Council's

policies in regard to dealing with proposals for rezoning of land within the floodplain or those involving properties identified for voluntary purchase due to their location in high hazard areas in the urban floodplain.

2.2 Land Use Categories

Seven major land use categories have been adopted. The specific uses, as defined by the applicable Environmental Planning Instruments, which may be included in each category, are listed in **Schedule 2.**

2.3 Floodplain Management Zones

Each of the floodplains within the local government area have been divided based on different levels of potential flood hazard. The relevant Floodplain Management Zones for each of the floodplains are outlined below.

Paterson River Floodplain

FLOODPLAIN MANAGEMENT ZONES	CRITERIA
1. Floodway and Excessive Depth Zone	Floodway or depth _ 4m in 1% AEP event
2. High Risk (Velocity and Depth) Zone	Remaining area where provisional hazard is high in 1% AEP event
3. Isolated Islands Zone	Remaining area where evacuation is possible only through Zones 1 or 2
4. Low Risk Zone	Remaining area below extreme flood level

(Refer to Volume 3 of the Floodplain Management Study for detailed explanation of zone criteria).

All Other Floodplains

Floodway means that part of the floodplain which conveys significant quantities of flow path and would pose a significant hazard to property and persons as determined by an application of the principles contained within the Floodplain Development Manual.

Flood fringe means that area of the floodplain between the floodway and the 1% AEP flood plus 0.5 metres (free board).

Outer floodplain means that part of the floodplain above the 1% AEP flood plus 0.5 metres (free board) up to the extreme flood.

2.4 What Controls Apply to Proposed Developments?

The development controls apply to all known potentially flooded areas (that is up to the largest estimated flood including the EF flood when known). The type and stringency of controls have been graded relative to the severity and frequency of potential floods, having regard to categories determined by the relevant Floodplain Management Study. The categories applicable to each floodplain are depicted on the planning matrices contained in the following schedules:

- Schedule 3 - Paterson River Floodplain
- Schedule 4 - All other floodplains.

2.4.1 Objectives

(a) To ensure the proponents of development and the community in general are fully aware of the potential flood hazard and consequent risk associated with the use and development of land within the floodplain.

(b) To require developments of high sensitivity to flood risk (eg. critical public utilities) be sited and designed such that they are subject to no or minimal risk from flooding.

(c) Allowing development with a

lower sensitivity to the flood hazard within the floodplain, subject to appropriate design and siting controls, provided that the potential consequences that could still arise from flooding remain acceptable having regard to the State Government's Flood Policy and the likely expectations of the community in general.

(e) To ensure that design and siting controls required to address the flood hazard do not result in unreasonable impacts upon the amenity or ecology of an area.

2.4.2 Performance Criteria

(a) The proposed development should not result in any increased risk to human life.

(b) The additional economic and social costs which may arise from damage to property from flooding should not be greater than that which can reasonably be managed by the property owner and general community.

(c) The proposal should only be permitted where effective warning time and reliable access is available for the evacuation of an area potentially affected by floods, where likely to be required.

(d) Development should not detrimentally increase the potential flood affectation on other development or properties.

2.4.3 Prescriptive Controls

Schedules 3 to 4 outlines the controls relevant to each of the floodplains to which this Policy applies.

2.5 Are there Special Requirements for Fencing?

2.5.1 Objectives

(a) To ensure that fencing does not result in the undesirable obstruction of the free flow of floodwaters.

(d) To prevent any intensification of the use of floodways, and wherever possible allow for their conversion to natural waterway corridors.

(b) To ensure that fencing does not become unsafe during floods and potentially become moving debris which threatens the integrity of structures or the safety of people.

2.5.2 Performance Criteria

(a) Fencing is to be constructed in a manner which does not affect the flow of floods so as to detrimentally increase flood affection on surrounding land.

(b) Ability to be certified by a suitably qualified engineer, that the proposed fencing is adequately constructed so as to withstand the forces of floodwaters.

2.5.3 Prescriptive Controls

2.5.3.1 Fencing within the floodway will not be permissible except for security/permeable/safety fences of a type approved by Council.

2.5.3.2 Council will require a Development Application for all new solid (non-porous) and continuous fences above 0.6m high, in the area affected by floods up to the 1% AEP flood unless otherwise stated by exempt and complying development provisions which may be incorporated into Council's Environmental Planning Instruments from time to time.

2.5.3.3 An applicant will need to demonstrate that the fence would create no impediment to the flow of floodwaters. Appropriate fences may include:-

(a) An open collapsible hinged fence structure or pool type fence;

2.5.3.4 Other forms of fencing will be considered by Council on merit.

2.6 Special Considerations

When assessing proposals for development or other activity within the area to which this Policy applies, Council will take into consideration the following specific matters.

(a) The proposal does not have a significant detrimental impact on:

i) Water quality
ii) Native bushland vegetation
iii) Riparian vegetation
iv) Estuaries, wetlands, lakes or other water bodies
v) Aquatic and terrestrial ecosystems
vi) Indigenous flora and fauna
vii) Fluvial geomorphology

(b) Development pursued to mitigate the potential impact of flooding (eg. house raising) is undertaken in a manner which minimises the impact upon the amenity and character of the locality.

(c) The proposal will not constrain the orderly and efficient utilisation of the waterways for multiple purposes.

(d) The proposal does not adversely impact upon the recreational, ecological, aesthetic or utilitarian use of the waterway corridors, and where possible, provides for their enhancement.

(e) Proposals for house raising must provide appropriate documentation including a report from a suitably qualified engineer to demonstrate

(b) Other than a brick or other masonry type fence (which will generally not be permitted); or

(c) A fence type and siting criteria as prescribed by Council.

the raised structure will not be at risk of failure from the forces of floodwaters and the provision of details such as landscaping and architectural enhancements which ensure that the resultant structure will not result in significant adverse impacts upon the amenity and character of an area.

2.7 Voluntary Purchase

In certain high hazard areas in the urban floodplain where it is impractical or uneconomic to mitigate the flood hazard, it may be appropriate to cease occupation of the land to minimise risk to both residents and potential rescuers. In such situations, Council may instigate a voluntary purchase scheme of affected properties in consultation with the Department of Land & Water Conservation and the affected landowners, after consideration of other relevant matters outlined by the Floodplain Development Manual.

Where Schedules 3 and 4 indicate that Council will consider minor developments within areas subject to voluntary purchase schemes, the following shall apply:

(a) In the event that house alterations or additions are approved by Council, the applicant will need to provide a written agreement to Council to the effect that any increase in the value of the property will not be included in any possible acquisition valuation.

(b) Such properties are to be placed at the end of the voluntary acquisition list.

3.0 WHAT INFORMATION IS REQUIRED WITH AN APPLICATION TO ADDRESS THIS POLICY?

3.1 Applications must include information which addresses all relevant controls listed above, and the following matters as applicable.

3.2 Applications for minor additions (see Schedule 2) to an existing dwelling on Flood Prone Land shall be accompanied by documentation from a registered surveyor confirming existing floor levels.

3.3 Development applications for Flood Prone Land shall be accompanied by a survey plan showing:-

(a) The position of the existing building/s or proposed building/s;

(b) The existing ground levels to Australian height datum around the perimeter of the building and contours of the site; and

(c) The existing or proposed floor levels to Australian height datum.

3.4 Applications for earthworks, filling of land and subdivision shall be accompanied by a survey plan (with a contour interval of 0.25m) showing relative levels to Australian height datum.

3.5 For large scale developments, or developments in critical situations, particularly where an existing catchment based Flood Study is not available, a flood study using a fully dynamic one or two dimensional computer model may be required. For smaller developments the existing flood study may be used if available and suitable (eg it contains sufficient local detail), or otherwise a Rational Method flood estimation, or similar method, will be required.

SCHEDULE 1
FLOOD COMPATIBLE MATERIALS

BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL	BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL
Flooring and Sub-floor Structure	❍ concrete slab-on-ground monolith construction ❍ suspension reinforced concrete slab.	**Doors**	❍ solid panel with water proof adhesives ❍ flush door with marine ply filled with closed cell foam ❍ painted metal construction ❍ aluminium or galvanised steel frame
Floor Covering	❍ clay tiles ❍ concrete, precast or in situ ❍ concrete tiles ❍ epoxy, formed-in-place ❍ mastic flooring, formed-in-place ❍ rubber sheets or tiles with chemical-set adhesives ❍ silicone floors formed-in-place ❍ vinyl sheets or tiles with chemical-set adhesive ❍ ceramic tiles, fixed with mortar or chemical-set adhesive ❍ asphalt tiles, fixed with water resistant adhesive	**Wall and Ceiling Linings**	❍ fibro-cement board ❍ brick, face or glazed ❍ clay tile glazed in waterproof mortar ❍ concrete ❍ concrete block ❍ steel with waterproof applications ❍ stone, natural solid or veneer, waterproof grout ❍ glass blocks ❍ glass ❍ plastic sheeting or wall with waterproof adhesive
Wall Structure	❍ solid brickwork, blockwork, reinforced, concrete or mass concrete	**Insulation** **Windows**	❍ foam (closed cell types) ❍ aluminium frame with stainless steel rollers or similar corrosion and water resistant material.
Roofing Structure (for Situations Where the Relevant Flood Level is Above the Ceiling)	❍ reinforced concrete construction ❍ galvanised metal construction	**Nails, Bolts, Hinges and Fittings**	❍ brass, nylon or stainless steel ❍ removable pin hinges ❍ hot dipped galvanised steer wire nails or similar

Electrical and Mechanical Equipment For dwellings constructed on land to which this Policy applies, the electrical and mechanical materials, equipment and installation should conform to the following	**Heating and Air Conditioning Systems** Heating and air conditioning systems should, to the maximum extent possible, be installed in areas and spaces of the house above the relevant flood level. When this is

requirements.	not feasible every precaution should be taken to minimise the damage caused by submersion according to the following guidelines.
Main power supply - Subject to the approval of the relevant authority the incoming main commercial power service equipment, including all metering equipment, shall be located above the relevant flood level. Means shall be available to easily disconnect the dwelling from the main power supply.	**Fuel** - Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off.
Wiring - All wiring, power outlets, switches, etc., should, to the maximum extent possible, be located above the relevant flood level. All electrical wiring installed below the relevant flood level should be suitable for continuous submergence in water and should contain no fibrous components. Earth core linkage systems (or safety switches) are to be installed. Only submersible-type splices should be used below the relevant flood level. All conduits located below the relevant designated flood level should be so installed that they will be self-draining if subjected to flooding.	**Installation** - The heating equipment and fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line. All storage tanks should be vented to an elevation of 600 millimetres above the relevant flood level.
Equipment - All equipment installed below or partially below the relevant flood level should be capable of disconnection by a single plug and socket assembly.	**Ducting** - All ductwork located below the relevant flood level should be provided with openings for drainage and cleaning. Self draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a water-tight wall or floor below the relevant flood level, the ductwork should be protected by a closure assembly operated from above relevant flood level.
Reconnection - Should any electrical device and/or part of the wiring be flooded it should be thoroughly cleaned or replaced and checked by an approved electrical contractor before reconnection.	

SCHEDULE 2
LAND USE CATEGORIES

Essential Community Facilities	**Critical Utilities**	**Subdivision and Filling**	**Residential**	**Commercial or Industrial**	**Recreation or Agriculture**	**Minor Development**
Place of Assembly; Public buildings or community centre which may provide an important contribution to the notification and evacuation of the community during flood events, Hospitals; institutions; and Education establish-ments.	Communication facilities; Generating works; Liquid fuel depot or Public Utility Undertakings or Utility Installations which may cause pollution of waterways during flooding, are essential to evacuation during periods of flood or if affected during flood events would unreasonably affect the ability of the community to return to normal activities after flood events.	Landfill; Subdivision of land which involves the creation of new allotments for any particular purpose and earthworks or filling operations covering 100m² or more than 0.3m deep.	Bed & Breakfast premises; Boarding Houses; Caravan Parks; Dwelling; Dwelling houses; Generating works (other than critical utilities); Group homes; Holiday cabin; Home occupations; Housing for Aged or Disabled persons; Integrated housing; Medium density housing or multi-unit housing; Residential flat building; Rural workers dwelling; Utility installations and undertakings (other than critical utilities).	Airline terminal; Automotive business; Bulky goods showrooms or retailing; Bus depot; Bus station; Child care centre; Cinemas; Civic centre; Club; Commercial premises; Community centre (other than essential community facilities); Feed lot; Hazardous industry; Hazardous storage establishment; Heliports; Hotel; Industry; Intensive agricultural pursuits; Junk yard; Motel; Motor showroom; Offensive or hazardous industry; Offensive or hazardous storage establishment; Place of public worship; Plant depot; Private hotel; Public building (other than essential community facilities); Professional consulting rooms; Reception establishment; Recreation Facility; Refreshment rooms; Roadside stalls; Road transport terminal; Rural industries; Saw mill; Self storage units; Service station; Shop; Tavern; Transport terminal; Veterinary establishments; Warehouse.	Agriculture; Extractive industry; Forestry Helipads; Intensive animal husbandry; Mine; Piggery; Plant nursery; Poultry farming establishment; Recreation areas and minor ancillary structures (eg toilet blocks or Kiosks); Retail or wholesale plant nursery; Riding school; Sanctuary; Stable; Stock and Sale Yard; Tourist facility.	(a) In the case of residential development: (i) an addition or alteration to an existing dwelling of not more than 10% or 35m² (whichever is the lesser) of the habitable floor area which existed at the date of commencement of this policy; (ii) the construction of an outbuilding with a maximum floor area of 20m²; or (iii) redevelopment for the purposes of substantially reducing the extent of flood affectation to the existing building. (b) In the case of other development: (i) an addition to existing premises of not more than 10% of the floor area which existed at the date of commencement of this policy; or (ii) redevelopment for the purposes of substantially reducing the extent of flood affectation to the existing building.

PORT STEPHENS COUNCIL AND DUNGOG COUNCIL

Paterson River Floodplain Management Study and Plan

Paterson River, March 1978, viewing downstream to Iona and Woodville

FINAL REPORT

Volume 3 — Extension of Flood Study and Hydraulic Investigations

November 2001

Prepared by WBM Oceanics Australia for Bewsher Consulting Pty Ltd

PATERSON RIVER FLOODPLAIN MANAGEMENT STUDY

EXTENSION TO FLOOD STUDY AND HYDRAULIC INVESTIGATIONS

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Author:	Greg Rogencamp
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Client Contact:	Drew Bewsher
Client Reference:	

Synopsis:

This document forms Volume 3 of the Paterson River Floodplain Management Study. It discusses the flood studies carried out as part of the study to investigate various floodplain management options.

REVISION/CHECKING HISTORY

REVISION NUMBER	DATE	CHECKED BY		ISSUED BY	
0	4/4/2000	MAJ		GJR	
5	27/6/2001	MAJ		GJR	
6	21/02/02	MAJ		GJR	

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
AR&R	Australian Rainfall and Runoff
cm	centimetre
DHI	Danish Hydraulics Institute
DLWC	Department of Land and Water Conservation
DTM	Digital Terrain Model
EF	Extreme Flood
FPM	Floodplain Management
GIS	Geographic Information System
km	kilometre
m	metre
m^3/s	cubic metres per second
PMP	Probable Maximum Precipitation
PSC	Port Stephens Council
PWD	Public Works Department (NSW)
TIN	Triangular Irregular Network

1 INTRODUCTION

This document forms Volume 3 of the Paterson River Floodplain Management Study. It documents the following tasks carried out by WBM Oceanics Australia for the Paterson River Floodplain Management Study:

- extension of the hydraulic model from Gostwyck Bridge to Vacy;
- extension of flood mapping from Gostwyck Bridge to Vacy;
- derivation and consideration of the 0.2 % AEP flood event;
- development of a relationship between flood levels and flood damages to produce the average annual damages from flooding in the study area;
- assessment of the benefits and impact of three structural flood mitigation options.

WBM Oceanics Australia was directed by Bewsher Consulting Pty Ltd to carry out these tasks as part of the Paterson River Floodplain Management Study. Bewsher Consulting Pty Ltd were commissioned by Port Stephens Council and Dungog Council to carry out the overall study.

2 PREVIOUS FLOOD MODELS

2.1 The Paterson River Flood Study (1997)

A Flood Study is a study which aims to define the flooding characteristics of a river system. It is usually one of the initial steps in developing a Floodplain Management Plan.

WBM Oceanics Australia was commissioned by Port Stephens Council to carry out the Paterson River Flood Study (WBM Oceanics Australia, 1997). The study involved the development of hydrological and hydraulic models of the river and its catchment. These models allowed the quantification of flood flows, velocities and levels along the Paterson River extending from Gostwyck Bridge south to the Hunter River. Further, the use of a digital terrain model for this part of the study area allowed the quantification of flood depths, flood extents and flood hazards.

2.1.1 Models Developed and Used for the Flood Study

2.1.1.1 Hydrologic Model

The hydrologic model simulates the runoff from the catchment. The amount of runoff from the rainfall and the attenuation of the flood wave as it travels down the river is dependent on the catchment's slope, area, vegetation and other characteristics. Structures such as Lostock Dam also influence the runoff process and are simulated.

The output from the hydrologic model is a series of flow hydrographs at selected locations such as at the boundaries of the hydraulic model. These hydrographs are used by the hydraulic model to simulate the passage of the flood down the Paterson River and over the floodplains.

Lostock Dam's spillway and lake storage characteristics were included in the model.

The RAFTS-XP Version 5.1 (WPS, 1994) software was used to develop the hydrologic model

2.1.1.2 Hydraulic Model

The hydraulic model simulates the dynamic flooding behaviour between the Paterson and Hunter Rivers, minor creeks and the floodplains. The substantial levee system of the Paterson and Hunter Rivers requires that the model must be capable of simulating the dynamic interaction between river and floodplain.

The one-dimensional river modelling software, MIKE 11 Version 3.2 (DHI, 1995), was used to setup the quasi two-dimensional hydraulic model. MIKE 11 represents a river system as a set of interconnected branches, each branch representing a flowpath. Hydraulic structures were incorporated to represent the five Paterson River bridge crossings, the artificial levees and the flood drainage culverts.

The flood model developed for the Paterson River Flood Study extends from Gostwyck Bridge to the Hunter River confluence, and includes the eastern and western floodplains and the McClement Swamp floodplains. The model includes sections of the existing Hunter River model extending from approximately 2km upstream of Morpeth to Green Rocks.

Inputs at the model's boundaries are:

- runoff from the Paterson River catchment;
- river flows in the Hunter River upstream of Morpeth;
- flows on the northern and southern Hunter River floodplains upstream of Morpeth; and
- water levels in the Hunter River at Green Rocks.

Model outputs are flood levels, flows and velocities describing the flood behaviour over time for a given flood event. Flood events may be historical (eg. the March 1978 flood) or statistical (eg. the 100 year or 1% AEP event).

The lower reaches of the Paterson River are heavily influenced by the flow conditions in the Hunter River. The hydraulic model therefore includes sections of the Hunter River and its floodplains based on the Hunter River Model developed for the Hunter River studies.

2.2 Model Validation to Historic Floods

The hydrologic and hydraulic models were calibrated to recorded flows and flood levels during the floods of March 1977 and March 1978 and verified using the March 1995 event.

These events were selected on the following basis:

- The March 1978 flood is the largest Paterson River flood on record and has one of the better hydrographic data sets. It was therefore selected as the primary calibration event.
- The March 1977 flood was a smaller flood than 1978, but also had one of the better data sets. It represents a good calibration event, given its different magnitude, to compliment the 1978 flood.
- The March 1995 flood was of similar magnitude to 1977. It was selected as the best verification event on the grounds of the data set available and its recent occurrence. This flood has not been simulated in the Hunter River model, necessitating the use of recorded stage hydrographs at Morpeth and Green Rocks as model boundaries. There was little or no major overland flow in the Hunter during this event.

Other historical floods were examined, but were rejected because of insufficient data.

The results of the 1978 and 1977 calibration and 1995 verification show that the hydrologic and hydraulic models satisfactorily reproduce historical floods (WBM Oceanics Australia, 1997). There was also agreement between flooding patterns in the hydraulic model and

comments on flood behaviour received during the historic flood information survey. The most prominent of these is the issue of Scotts Dam and its influence on flooding around Woodville, discussed further below.

2.2.1 Flooding Around Woodville

Based on historical observations and the hydraulic model results, floodplain levels in the Woodville area are significantly controlled by the damming effect of Scotts Dam and backwater effects from the Hunter River. The flood typically first breaks the Paterson River levees between Woodville and Scotts Dam. Once the floodplain is full and Scotts Dam begins to flow, the flood level at Woodville is around 6.2mAHD. This is due to the high crest level of Scotts Dam (5.8mAHD) and possible backwater effects from the Hunter River. It should be noted that during major floods, the floodplain becomes a major flowpath and higher flood levels will occur at Woodville.

The hydraulic effect of Scotts Dam is substantial. The crests of the river levees upstream and downstream both lie well below that of Scotts Dam (5.3 and 5.1 versus 5.8mAHD) and carry most of the overflow to and from the floodplains. For waters which break the river levees downstream of Scotts Dam the water escapes to McClement Swamp and out to the Hunter River. For waters which break upstream of Scotts Dam, the waters can not escape towards McClement Swamp and therefore back up all the way through to Woodville. The result is that flood levels upstream of Scotts Dam can be more than a metre higher than flood levels downstream.

3 FLOOD STUDY EXTENSIONS: GOSTWYCK TO VACY

3.1 General

The hydrological and hydraulic models developed for the Paterson River Flood Study (WBM Oceanics Australia, 1997) were both modified and extended for the Paterson River Floodplain Management Study.

The hydrological model was modified to more accurately represent inflows from the Paterson and Allyn Rivers at Vacy.

The MIKE 11 hydraulic model was extended from upstream of Gostwyck Bridge to the junction of the Paterson and Allyn Rivers at Vacy.

3.2 Additional Data

Photogrammetry already existed from Gostwyck Bridge to Green Rocks on the Hunter River as part of the Paterson River Flood Study (WBM Oceanics Australia, 1997). Additional photogrammetry was carried out by the Department of Land and Water Conservation (DLWC) in December 1998. This photogrammetry covered the area from Gostwyck Bridge upstream to the junction of the Paterson and Allyn Rivers at Vacy. Its coverage included up to the 30 mAHD ground contour at Vacy.

A Geographical Information System (GIS) was subsequently used to create a digital terrain model (DTM) from the photogrammetry. A digital terrain model is a three-dimensional (3D) representation of the ground surface.

The DTM allows the mapping of flood depths and extents, hazard mapping and damages assessments to be carried out.

3.3 Extension of Hydraulic Flood Model

As part of the Paterson River Floodplain Management Study, the hydraulic flood model was extended upstream from Gostwyck Bridge to Vacy. This model extension relied upon topographical data collected using recent photogrammetry discussed in Section 3.2.

An additional 25 cross-sections were extracted from the Digital Terrain Model (DTM) and imported to the MIKE 11 hydraulic model. Additional flow paths were also incorporated in the extended model to allow for possible flow breakthroughs in large flooding events. Figure 3-1 shows the added model cross-sections and branches as well as those associated with the Flood Study model.

The hydrological model developed and calibrated for the Paterson River Flood Study was used to provide flow inputs for the Floodplain Management Study. Due to the upstream limit of the hydraulic flood model being extended for the Floodplain Management Study, a sensitivity analysis was carried out to determine if the minor decrease in catchment area at the upstream

end was significant. The sensitivity analysis indicated that the effect of placing the inflows from the catchment upstream Gostwyck Bridge at Vacy resulted in a 7mm increase in flood levels which are in the order of 25 mAHD. Hence, it was concluded that the minor decrease in catchment area did not result in a significant change in flood levels between Gostwyck Bridge at Vacy. Hence, the inflows derived for the Flood Study were adopted for the Floodplain Management Study hydraulic model assessments.

3.4 Calibration of Extended Hydraulic Flood Model

Community consultation was undertaken to obtain historical flood information in the extended area of the model. Several historical flood levels were surveyed, only one of which occurred in a year to which the model was previously calibrated. This level was used to further calibrate the extended model to the 1978 flood.

The recorded flood level from the 1978 flood event was at the base of a tree. This flood level was measured to be 20.6 mAHD from the photogrammetry data provided by DLWC. It corresponds to a point approximately 450m upstream of the model cross-section at Chainage 72.6 km on the Paterson River branch. This is the most upstream cross-section of the extended hydraulic flood model.

In order to obtain an acceptable reproduction of the recorded flood level, it was necessary to account for the bend losses of the upper parts of the Paterson River between Gostwyck Bridge and Vacy. Hence, a Manning's n of 0.10 was used for the sharp river bends in this section and a Manning's n of 0.07 was used for the remainder of the river reaches. This is consistent with the approach adopted in the Flood Study where a Manning's n of 0.07 was used for the sharper bends downstream of Gostwyck Bridge with a Manning's n of 0.05 for the straighter sections (refer to Section 11.3.2 of Paterson River Flood Study Report, WBM Oceanics Australia 1997).

The results of the extended calibration of the 1978 flood event are shown in Figure 3-2. The additional point is reasonably simulated by the model. However, it needs to be noted that the error associated with the recorded flood level of 20.6 mAHD is probably in the order of 0.5m given that it is derived from photogrammetry and is a recollection of flood peak at the base of a tree that has subsequently been moved.

4 FLOOD MODEL SIMULATIONS

4.1 Flooding Events

The modified hydrological model and extended hydraulic model were used to simulate a number of design flood events. Rainfall for the Paterson River catchment was estimated from Australian Rainfall and Runoff (Institute of Engineers, Australia, 1987). Design flood events simulated include the 1%, 2%, and 5% AEP events.

Refer to the Paterson River Flood Study (WBM Oceanics Australia, 1997) for further details.

4.2 Derivation of The Extreme Flood Event

In order to assist in defining the upper limits of flood hazards, the extreme flood event was simulated using the extended flood model. The Extreme Flood is an estimation of the maximum possible flood.

A ratio was calculated between the estimated probable maximum precipitation (PMP) depth for the 6 hour duration (Bureau of Meteorology, 1994) of 413 mm and the 100 year ARI, 6 hour duration (Institute of Engineers Australia, 1987) of 134 mm. The 1% AEP, 48 hour duration flows were then multiplied by this factor of 3.1 to estimate the extreme flood flows. These inflows were then used in the extended model to simulate the extreme flood event.

The Extreme Flood event was assessed for the existing case scenario only.

4.3 Derivation of 0.2% and 0.5% AEP Flood Events

The 0.2% and 0.5% AEP Paterson River flood events were also simulated using the extended flood model. The inflows for these events were derived by assessing the results of the flood frequency analysis of at Gostwyck Bridge carried out as part of the Paterson River Flood Study. The flood frequency curve was used to derive a factor of 1.65 relating the 0.2% AEP flows to the 1% AEP flows and 1.29 relating the 0.5% AEP flows to the 1% AEP flows.

These inflows were used in conjunction with the extended flood model to simulate the 0.2% and 0.5% AEP Paterson River flood events. The downstream boundary condition in the Hunter River for these Paterson River flood events was assumed to be the 1% AEP Hunter River flood.

The 0.2% and 0.5% AEP Hunter River flood events were simulated by factoring the 1% AEP inflows from the Hunter River MIKE-11 model. This approach is based on results of flood simulations of the MIKE-11 model from Oakhampton to Green Rocks carried out by R. Sario of DLWC.

Factors of 1.63 relating the 0.2% AEP flows to the 1% AEP flows and 1.25 relating the 0.5% AEP flows to the 1% AEP flows were applied to the Hunter River flows. The downstream boundary condition in the Hunter River was 6.15 mAHD for the Hunter River 0.2% AEP flood

event and 5.25 mAHD for the 0.5% AEP Hunter River flood event compared with 4.50 mAHD for the Hunter River 1% AEP flood event.

4.4 Paterson River and Hunter River Flood Combinations

For this floodplain management study, it was decided to adopt the combinations shown in Table 4-1, based on the approach adopted in the previous Paterson River Flood Study (WBM Oceanics Australia, 1997). For example, the 1% AEP design flood levels are based on the maximum levels derived from:

- A 1% AEP Paterson River flood combined with a 2% AEP Hunter River flood.
- A 1% AEP Hunter River flood combined with a 2% AEP Paterson River flood.

Table 4-1 Design Flood Matrix

Hunter River / Paterson River	Extreme	0.2%	0.5%	1%	2%	5%	10%
Extreme				Extreme			
0.2%				0.2% AEP			
0.5%				0.5% AEP			
1%	Extreme	0.2% AEP	0.5% AEP		1% AEP[1]		
2%				1% AEP[1]		2% AEP	
5%					2% AEP		5% AEP
10%						5% AEP	

1 For example, the 1% AEP flood is made up of two floods: a 1% Paterson combined with a 2% Hunter; and a 1% Hunter combined with a 2% Paterson.

4.5 Flood Modelling and Mapping Results

4.5.1 Flood Levels and Depths

Profiles of peak flood levels for the Extreme, 0.2%, 0.5%, 1%, 2%, and 5% AEP flood events are presented in Figure 4-1.

The resulting flood depths and extents for the Extreme, 0.2%, 0.5%, 1%, 2%, and 5% AEP flood events are presented in Figure 4-2 to Figure 4-7 respectively. A comparison between the Extreme, 1% AEP and 5% AEP flood extents is also presented in Figure 4-8.

Flood level contour diagrams, with a polygon contour interval of 0.2m, have been produced for the Extreme and 0.2% AEP flood events. For the 0.5%, 1%, 2% and 5% AEP flood events, flood levels were mapped using polylines (as opposed to the previously adopted polygons) to more accurately represent flood levels on the floodplain.

These plots are presented in Figure 4-9 to Figure 4-14 respectively. Flood depths and flood levels are mapped for the part of the study area covered by the DTM.

4.5.2 Flood Velocities and Flows

Velocities in the Paterson River for the 1% AEP flood event typically range from 1.2 m/s to 3.0 m/s. Velocities on the floodplain are typically in the range of 0.0 m/s to 0.6 m/s. It can be expected that velocities will occasionally exceed these ranges in isolated areas due to obstructions to flows and other restrictions to the flood flowpath.

Figure 4-15 to Figure 4-17 to show the peak flood velocities likely to be experienced on the floodplains for the 0.2%, 0.5% and 1% AEP flood events respectively, mapped to an interval of 0.5m/s. The velocities shown are indicative of the average water velocity across the floodplains.

Table 4-2 presents the peak design flood velocities at selected locations.

The floodplains carry a substantial proportion of the flood flows in the lower reaches of the Paterson River system. Floodplain flows are up to three times greater than river flows in some areas. Flood flows in the upper reaches of the Paterson River are typically confined to the river itself.

Table 4-3 presents the peak design flood flows at selected locations.

Table 4-2 Peak Design Flood Velocities at Selected Locations

Location	Chainage (m)	1% AEP	0.5% AEP	0.2% AEP
Paterson River	72600	1.4	1.4	1.3
Paterson River	72900	1.3	1.4	1.1
Paterson River	73570	1.4	1.4	1.3
Paterson River	73820	1.3	1.4	1.3
Paterson River	74210	1.4	1.5	1.5
Paterson River	74510	1.3	1.4	1.3
Paterson River	74970	1.3	1.4	1.3
Paterson River	75620	1.4	1.4	1.3
Paterson River	76240	1.2	1.2	0.7
Paterson River	76620	1.3	0.9	1.0
Paterson River	76820	1.3	1.1	1.3
Paterson River	77090	1.7	1.8	2.0
Paterson River	77380	1.8	1.8	2.1
Paterson River	77620	1.7	1.7	1.7
Paterson River	77950	1.6	1.4	1.5
Paterson River	78350	1.8	2.0	2.1
Paterson River	78510	2.3	2.5	2.8
Paterson River	78670	2.1	2.2	2.5
Paterson River	79100	1.6	1.7	1.8
Paterson River	79100	1.6	1.7	1.8
Paterson River	79830	1.8	1.4	1.4
Paterson River	80275	2.0	1.5	1.5
Paterson River	81220	1.9	2.0	2.2
Paterson River	81500	1.8	1.9	2.1
Paterson River	81705	1.8	1.9	2.0
Paterson River	81960	1.7	1.9	2.0
Paterson River	82200	1.7	1.8	2.0
Paterson River	82770	1.7	1.8	1.9
Paterson River	83275	1.7	1.8	2.0
Paterson River	83680	1.7	1.8	2.0
Paterson River	84300	1.7	1.8	2.0
Paterson River	84500	1.7	1.8	2.0
Paterson River	84500	1.7	1.8	2.0
Paterson River	85290	2.3	2.1	2.4
Paterson River	85310	1.9	2.1	2.4
Paterson River	86100	1.7	1.9	2.1
Paterson River	86650	2.0	2.1	2.4
Paterson River	87200	2.2	2.5	2.9
Paterson River	87750	2.3	2.6	3.0
Paterson River	88300	2.4	1.3	1.6
Left Bank of Floodplain	90000	0.8	0.7	0.9
Left Bank of Floodplain	90600	0.8	1.1	1.2
Left Bank of Floodplain	91600	0.2	0.2	0.3
Left Bank of Floodplain	92200	0.4	0.4	0.6
Left Bank of Floodplain	93000	0.3	0.1	0.1
Left Bank of Floodplain	93470	0.4	0.1	0.2

Location	Chainage (m)	1% AEP	0.5% AEP	0.2% AEP
Left Bank of Floodplain	93600	0.6	0.1	0.2
Left Bank of Floodplain	94400	0.4	0.5	0.6
Left Bank of Floodplain	94400	0.4	0.5	0.6
Left Bank of Floodplain	94400	0.4	0.5	0.6
Left Bank of Floodplain	97500	0.7	0.8	0.9
Left Bank of Floodplain	97500	0.7	0.8	0.9
Left Bank of Floodplain	97500	0.7	0.8	0.9
Left Bank of Floodplain	97500	0.7	0.8	0.9
Left Bank of Floodplain	98100	0.8	0.9	1.0
Left Bank of Floodplain	98900	0.3	0.2	0.4
Left Bank of Floodplain	98900	0.3	0.2	0.4
Left Bank of Floodplain	98900	0.3	0.2	0.4
Left Bank of Floodplain	99390	0.7	0.8	1.0
Left Bank of Floodplain	99410	0.8	0.8	1.0
Left Bank of Floodplain	99950	0.6	0.8	0.9
Left Bank of Floodplain	99950	0.6	0.8	0.9
Left Bank of Floodplain	100400	0.5	0.6	0.7
Left Bank of Floodplain	100950	0.4	0.3	0.4
Left Bank of Floodplain	102140	0.3	0.3	0.3
Left Bank of Floodplain	102500	0.3	0.5	0.5
Left Bank of Floodplain	103200	0.6	0.2	0.2
Left Bank of Floodplain	103200	0.6	0.2	0.2
Left Bank of Floodplain	103890	0.5	0.5	0.5
Left Bank of Floodplain	103910	0.5	0.7	0.7
Left Bank of Floodplain	104450	0.3	0.4	0.0
Left Bank of Floodplain	105300	0.4	0.5	0.5
Left Bank of Floodplain	106200	0.8	0.9	1.1
Right Bank of Floodplain	76500	0.2	0.1	0.1
Right Bank of Floodplain	77010	0.3	0.7	0.5
Right Bank of Floodplain	89000	0.7	1.0	1.0
Right Bank of Floodplain	89000	0.7	1.0	1.0
Right Bank of Floodplain	89500	0.5	0.5	0.6
Right Bank of Floodplain	90000	0.3	0.2	0.0
Left Bank of Hunter R	20	0.4	0.4	0.4
Left Bank of Hunter R	1300	0.4	0.5	0.4
Left Bank of Hunter R	1900	0.3	0.3	0.1
McClement Swamp	10000	0.1	0.1	0.1
McClement Swamp	10600	0.0	0.1	0.1
McClement Swamp	11200	0.0	0.1	0.0
McClement Swamp	11750	0.2	0.1	0.0
McClement Swamp	12300	0.3	0.1	0.4
McClement Swamp	12900	0.3	0.3	0.4
McClement Swamp	13500	0.3	0.3	0.3
McClement Swamp	14000	0.3	0.3	0.4
McClement Swamp	14500	0.5	0.5	0.5

Table 4-3 Peak Design Flood Flows at Selected Locations

Location	Comment	Design Flood Flows (m^3/s)				
		Extreme Flood	**0.2% AEP**	**1% AEP**	**2% AEP**	**5% AEP**
Paterson River at Vacy	River flow	7750	4120	2500	2050	1450
~3.0km d/s of Vacy	River flow	7580	4010	2440	2000	1420
~5.0km d/s of Vacy	River flow	7510	3990	2420	1990	1400
Gostwyck Bridge	River flow	7380	4210	2370	1950	1380
Paterson Railway Bridge	River flow	7140	3740	2250	1860	1320
Paterson Rd Bridge	River flow	7150	3730	2250	1860	1320
Woodville	cumulative river and floodplain flow	5700	3380	2290	1830	1010
Scotts Dam	River flow and flow over dam	4310	3170	2020	1510	890
F'plain between Woodville & Scotts Dam	Floodplain flow	4640	2380	1340	910	210
Floodplain - North of Hinton	Floodplain flow	1690	1010	610	210	50
McClement Swamp	Floodplain flow	5080	3530	2710	1170	650

4.6 Assessment of Structural Floodplain Management Options

4.6.1 General

In order to define the impacts and benefits of several structural floodplain management options, these options were simulated by modifying the physical features in the hydraulic model. A range of flood events was then simulated using the same inflows and downstream (ie. Hunter River) water levels as used in defining the existing flood characteristics. The changes in flood behaviour were assessed to quantify the impacts and benefits of the proposed measures.

Three structural floodplain management options were assessed as part of this study:

- removal of Scotts Dam;
- dredging of the Paterson River;
- raising of the levees along the Paterson River to decrease the frequency of flood damages.

The assessment of these three options is discussed below.

4.6.2 Removal of Scotts Dam - Option 1

Scotts Dam is a man-made levee across a narrow section of the left bank floodplain of the Paterson River just upstream of Hinton. Once the floodplain is full and Scotts Dam begins to overflow, the flood level at Woodville is around 6.2 mAHD. This is due to the high crest level of Scotts Dam (5.8 mAHD) and possible backwater effects from the Hunter River. It should be noted that during major floods, the floodplain becomes a major flowpath resulting in higher flood levels at Woodville.

As expected, flood simulations indicated that the removal of the Scotts Dam would result in a decrease in flood levels immediately upstream of the dam and an increase immediately downstream. Results of the 1% AEP flood event indicate floodplain levels immediately upstream would drop by up to 600 mm, while downstream flood levels would rise by 260 mm. The impacts of this option on 1% AEP flood levels are presented in Figure 4-11.

4.6.3 Dredging of Paterson River - Option 2

It was assumed for the purposes of this assessment that dredging of the Paterson River would involve decreasing river levels by 1.0m.

The total volume of dredged material from the river bed was calculated to be 1.1 million m^3. This represents an increase in within bank cross sectional area of up to 30% in the lower reaches of the Paterson River.

Results indicated a maximum decrease in the 1% AEP flood level of 170mm occurring in the lower reaches of the Paterson River, with negligible effects on the floodplains. The impacts of this option on 1% AEP flood levels are presented in Figure 4-12.

The modelling also indicated that this option would result in minor impacts in some parts of the river system. This is primarily due to the following sequence of events during the flood:

- Dredging increases the conveyance in some sections of the river resulting in lower flood levels and less flood storage / attenuation;
- This creates a slightly higher peak flow in the river system;
- These higher flows then result in minor increases in flood levels in those parts of the river where the dredging has created a proportionally smaller increase in conveyance capacity than the proportional increase in peak flows.

For example, dredging may result in a 4% increase in peak flows in a certain section of the river. The dredging of the reach downstream from this section may have only resulted in a 2% increase in conveyance. Hence, flood levels would increase in this area.

4.6.4 Increasing Height of Levees - Option 3

The levees along the banks of the lower reaches of the Paterson River and adjacent levees along the left (ie. north) bank of the Hunter River assist in protecting agricultural lands on the floodplain from inundation in some flood events.

In order to assess the effect of raising the levees (say to a 20% or 10% AEP level), the hydraulic model was run for a range of smaller floods. The inundated area for each flood event, assuming raised levees, was subsequently mapped. The effect of raising the existing levees was then assessed based on reduced inundated area on the floodplain.

The modelling indicated that raising the levees had a significant effect on flood levels in the lower parts of the floodplain. To illustrate this, the impacts of raising the levees to a 10% AEP level of protection on the 10% AEP flood levels is presented in Figure 4-13. In this flood event, flood levels decrease in the order of 3m at Iona and areas upstream of Scotts Dam. However, downstream of Scotts Dam, the impacts are less than 0.1m. As well, river levels would increase by approximately 1.0m.

Figure 4-21 shows the locations of the levees as modelled on the floodplain. As well, the height required to provide protection of the floodplain from the 10% AEP flood event is also shown.

However, more importantly, the modelling indicated that raising the levees had very little effect on floodplain inundation. This is mainly due to the fact that the Paterson River floodplains are typically quite flat, with steep sides. Therefore, the reduced inundated area resulting from raising the levees did not significantly alter the extent of inundation.

As well, a significant proportion of floodplain inundation, particularly in the smaller events, can be attributed to local runoff from catchments surrounding the floodplain as well as direct rainfall on the floodplain itself. Hence, protection from river flows will not significantly decrease the volume of water on the floodplain.

The mapping assessments of this option indicated that this option would have only a minor decrease in the number of houses inundated in the smaller flood events. This is primarily due to the low number of houses inundated in the smaller, more frequent events.

Results for this option are presented in Table 4-4.

Table 4-4 Effect of Raising Levees

Flood Event (AEP)	Inundation Area (km^2)		Number of Houses Inundated	
	Existing	**Raised Levees**	**Existing**	**Raised Levees**
10%	42.80	42.11	12	11
20%	34.95	34.35	4	4
30%	30.50	30.04	3	3
50%	25.75	25.49	2	2
70%	24.20	25.00	0	0

5 PROVISIONAL HAZARD CATEGORIES

5.1 Defining the Flood Hazard

The flood hazard or risk is based on a number of factors including:

- size of the flood;
- rate of rise - effective warning time;
- community awareness;
- flood depth and velocity;
- duration of inundation;
- obstructions to flow; and
- access and evacuation.

For a more detailed discussion of these factors, refer to the NSW Floodplain Development Manual (PWD, 1986).

5.2 Flood Hazard Mapping

The flood hazard level is often determined on the basis of the predicted flood depth and velocity. A high flood depth will cause a hazardous situation while a low depth may only cause an inconvenience. High flood velocities are dangerous and may cause structural damage while low velocities have no major threat.

The multiplication of depth and velocity gives a convenient measure of flood hazard. A small depth and small velocity gives a low hazard while a high depth and high velocity gives a larger value and a high hazard. Figure 5-1 presents the graph used for allocating provisional flood hazards relationships as presented in the NSW Floodplain Development Manual (PWD, 1986).

Figure 5-2 to Figure 5-5 present provisional flood hazard maps based on the velocity and depth conditions in Figure 5-1.

The hazard maps have been based on the hydraulic model results for the Extreme Flood, 1% AEP and 5% AEP design flood events. A comparison of the high hazard categories for the Extreme Flood, 1% AEP and 5% AEP flood events are also presented in Figure 5-6.

On the floodplains the hazard is almost entirely depth controlled as much of the depth of inundation is greater than one metre.

Localised high hazard areas can occur because of:

- obstructions to flow causing high localised velocities;
- minor creeks and drains with excessive depths (>1m).

The maps do not and can not depict these localised areas of high hazard. They only provide a preliminary overview of the general flood hazard for planning and decision making purposes.

5.3 Hydraulic Category Mapping

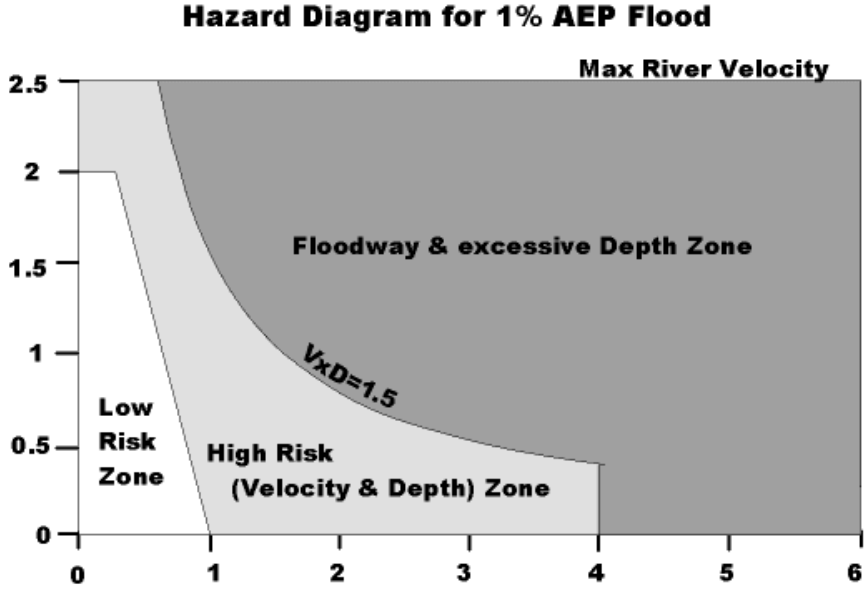
The Draft NSW Floodplain Management Manual (1998) describes three hydraulic categories of flood-prone land being:

- floodways;
- flood storage; and
- flood fringe.

The determination of hydraulic categories is based on the degree of impact on flood levels resulting from blocking flood flows. The Draft NSW Floodplain Management Manual (1998) gives some guidance in this area describing floodways as "areas conveying a significant portion of the flood flow and where partial blocking will adversely affect flood behaviour to a significant and unacceptable extent."

For the purposes of this study, hydraulic parameters such as depth and velocity were used to describe floodway and flood storage areas.

The Floodway definition (see diagram below) was generally based on those areas with more than 4m depth in a 1% AEP flood event and areas with a V x D product of more than 1.5 m^2/s in a 1% AEP flood event. As well, areas where a significant discharge of water occurs or where the depth exceeds 4m in a 1% AEP flood were also included.



The resulting floodway definition is presented in Figure 5-7. The remaining areas of the floodplain outside the floodway comprise of flood storage and flood fringe areas.

The hydraulic categorisation of the floodplain discussed above supersedes the provisional categories presented in Figure 6-5 of the Paterson River Flood Study Report (WBM Oceanics Australia, 1997).

6 FLOOD DAMAGES ASSESSMENT

6.1 General Methodology

An assessment of the flood damages associated with various flood events is an essential part of a floodplain management study as it allows a quantification of the existing flood damages and quantification of the monetary benefits of structural measures (eg. decreasing flood levels by removing obstructions) and non-structural measures (eg. house raising).

Due to the low density of houses that could potentially be inundated on the Paterson River floodplain, damages associated with house inundation were assessed using floor levels derived from aerial photogrammetry. Eaves levels were taken directly from the photogrammetry, from which habitable floor levels were derived.

In carrying out this assessment, a number of assumptions have been made. Firstly, it was assumed that all houses are of medium value. Secondly, it was assumed that the habitable floor level of each house is 3.05m (10 ft) below the level of the eaves of the house. A sensitivity analysis was also carried out assuming a habitable floor level 2.4m below the house eaves level (refer to Section 6.4).

The stage-damages relationships used for this assessment were based on those derived for the Lismore Floodplain Management Study (Environmental Management, 1999) for the Lismore area. This relationship was chosen as the frequency of flood inundation and warning times are similar.

6.2 Flood Damages Assessment of FPM Options

Using the methodology described above, the economic damages, including average annual damages, associated with flood inundation were derived for a range of flood events. The damages assessment was carried out for the existing case and for options 1 and 2 discussed in Section 4.6, and the results presented in Table 6-1.

As the Extreme Flood (EF) event was only assessed for the existing case, all Average Annual Damages (AAD) assessments have been based on this figure.

Table 6-1 Average Annual Damages (3.05m ceilings)

AEP	Existing	Option 1	Option 2
EF	$4,516,000	$4,516,000*	$4,516,000*
0.2%	$1,469,000	$1,319,000	$1,450,000
1%	$536,000	$404,000	$506,000
2%	$260,000	$176,000	$245,000
5%	$132,000	$77,000	$126,000
10%	$75,000	$54,000	$65,000
20%	$33,000	$34,000	$33,000
30%	$24,000	$25,000	$23,000
50%	$10,000	$10,000	$10,000
70%	$5,000	$5,000	$5,000
AAD	**$43,000**	**$36,000**	**$41,000**

* - assumed to be the same as existing case damages for calculation of AAD.

6.3 Houses Inundated for Various Flood Events

House habitable floor level inundation was assessed for flood events ranging from the Extreme Flood to the 70% AEP event. This assessment was carried out for the existing case and the options discussed in Section 4.6. The results are presented in Table 6-2.

Table 6-2 Houses Inundated (3.05m ceilings)

AEP	Number of Houses Inundated			
	Existing	Option 1	Option 2	Option 3
EF	174	#	#	#
0.2%	107	104	107	100
1%	51	42	48	50
2%	34	26	34	30
5%	20	12	20	20
10%	12	8	11	14
20%	4	4	4	4
30%	3	3	3	3
50%	2	2	2	2
70%	0	0	0	0

- not assessed.

6.4 Sensitivity Analysis

As discussed in Section 6.1, a sensitivity analysis was completed assuming a habitable house floor level 2.4m below the house eaves level. This figure is representative of modern building

standards. The economic damages associated with this assumption were assessed. Results are presented in Table 6-3.

Table 6-3 Damages Assesment (2.4m ceilings)

AEP	Existing	Option 1	Option 2
EF	$3,543,000*	$3,543,000*	$3,543,000*
0.2%	$830,000	$726,000	$817,000
1%	$252,000	$180,000	$235,000
2%	$129,000	$93,000	$121,000
5%	$69,000	$44,000	$66,000
10%	$38,000	$30,000	$32,000
20%	$20,000	$21,000	$20,000
30%	$10,000	$11,000	$8,000
50%	$5,000	$5,000	$5,000
70%	$5,000	$5,000	$5,000
AAD	**$24,000**	**$21,000**	**$23,000**

* - assumed to be the same as existing case damages for calculation of AAD.

The number of houses with inundated habitable floor levels for the existing case and the three options are presented in Table 6.4.

Table 6-4 Houses Inundated (2.4m ceilings)

AEP	Number of Houses Inundated			
	Existing	**Option 1**	**Option 2**	**Option 3**
EF	147	#	#	#
0.2%	72	62	71	81
1%	33	23	30	35
2%	17	12	16	23
5%	9	6	9	12
10%	4	4	4	5
20%	2	2	2	3
30%	1	1	0	1
50%	0	0	0	0
70%	0	0	0	0

- not assessed.

6.5 Areas of Inundation

Areas of inundation were assessed for the range of flood events for the existing case and all of the three options. Results are presented in Table 6-5.

Table 6-5 Areas of Inundation

AEP	Inundation Area (km2)			
	Existing	Option 1	Option 2	Option 3 ##
EF	62.68	#	#	#
0.2%	55.80	55.42	55.71	55.80
1%	51.30	50.84	51.25	51.30
2%	49.10	48.61	48.98	49.10
5%	46.35	45.60	46.18	46.35
10%	42.80	41.80	42.11	42.80
20%	34.95	36.82	34.35	32.32
30%	30.50	31.07	30.04	27.87
50%	25.75	30.31	25.49	25.55
70%	24.20	24.22	24.23	24.23

- not assessed

- top of levee at 20% AEP flood level.

7 REFERENCES

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APPENDIX A: FIGURES

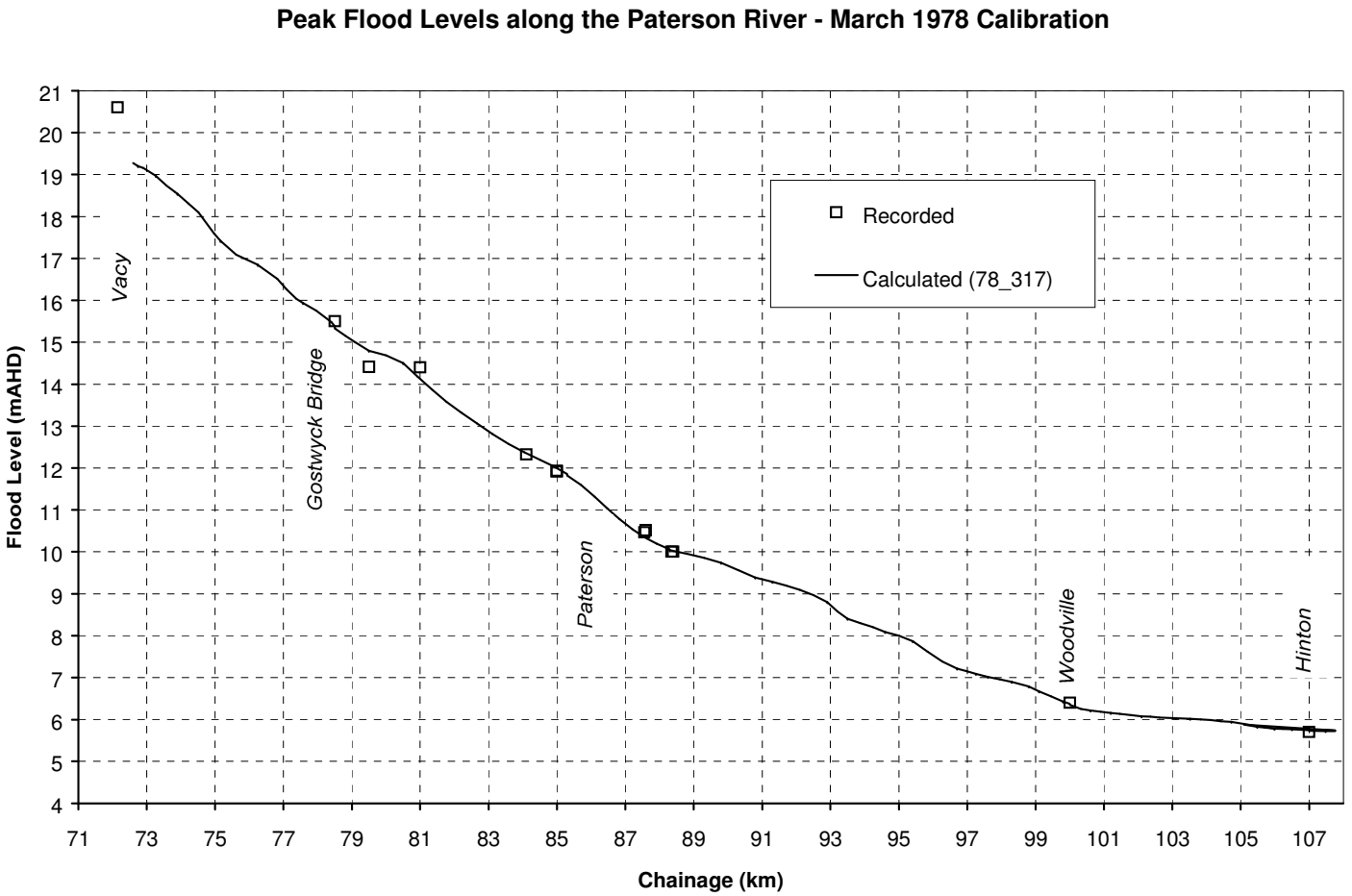


Figure 3-2 1978 Flood Calibration (including extended section)

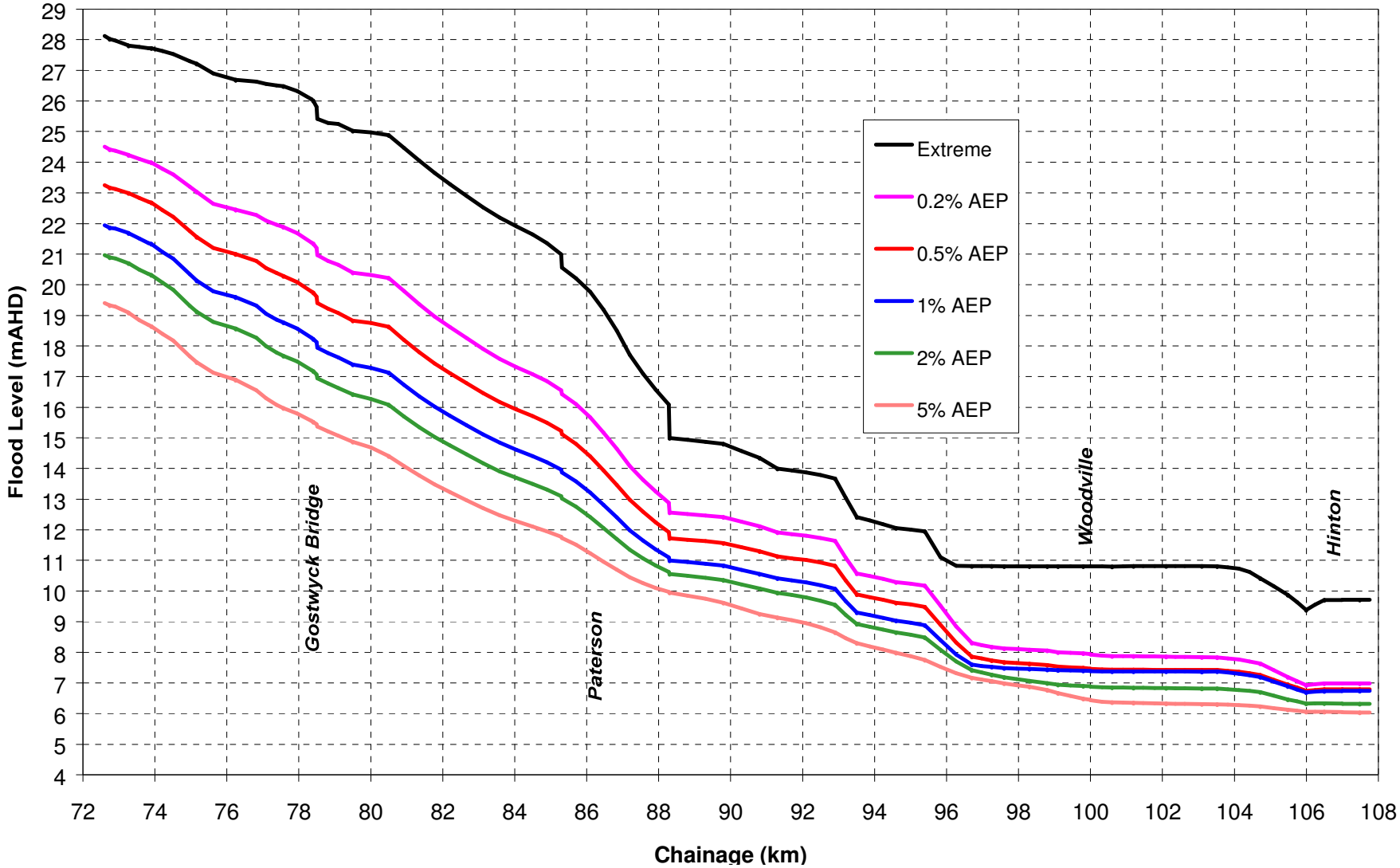
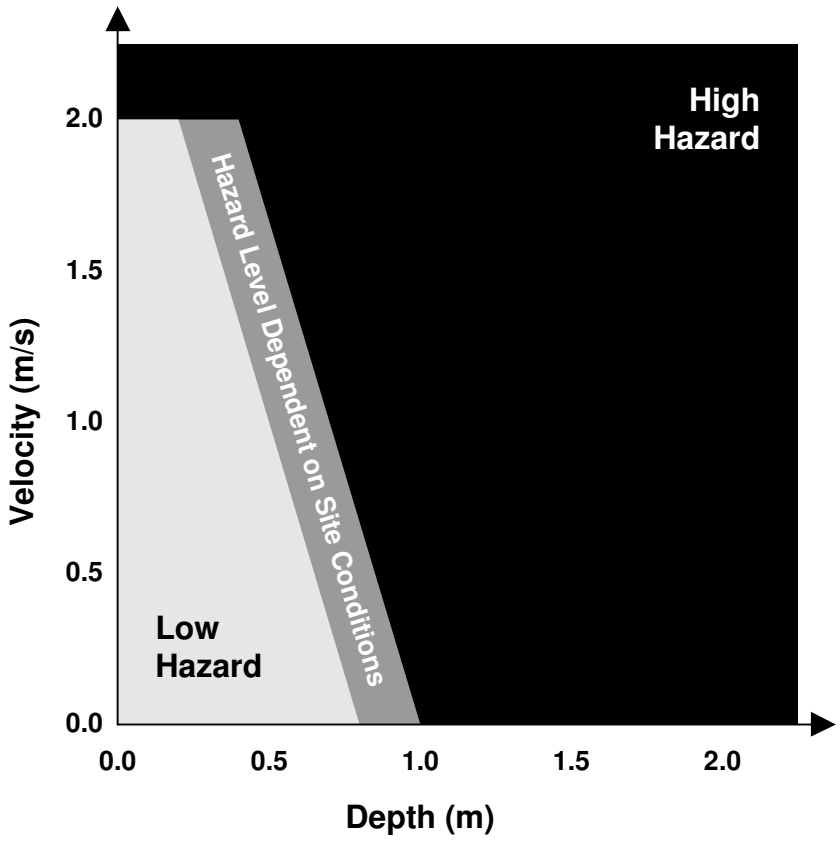


Figure 4-1 Peak Flood Level Profiles



Provisional Hazard Categories

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Figure 5-1 Provisional Hazard Categories