Floodplain Development Manual

the management of flood liable land

April 2005



New South Wales Government

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FOREWORD

The primary objective of the NSW Government's Flood Prone Land Policy is to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods. At the same time, the policy recognises the benefits flowing from the use, occupation and development of flood prone land.

The policy promotes the use of a merit approach which balances social, economic, environmental and flood risk parameters to determine whether particular development or use of the floodplain is appropriate and sustainable.

In this way the policy avoids the unnecessary sterilisation of flood prone land. Equally it ensures that flood prone land is not the subject of uncontrolled development inconsistent with its exposure to flooding.

The policy highlights that primary responsibility for floodplain risk management rests with councils, which are provided with financial and technical support by the State Government. The Commonwealth has also historically shown a willingness to be involved by providing financial assistance to local government in partnership with the State Government.

This manual has been prepared in accordance with the NSW Government's Flood Prone Land Policy. It guides councils in the development and implementation of detailed local floodplain risk management plans to produce robust and effective floodplain risk management outcomes. The manual also outlines the technical assistance provided by the State Government throughout the floodplain risk management process.

The manual is concerned with the management of the consequences of flooding as they relate to the human occupation of the floodplain for both urban development and agricultural production. It addresses flood risk in full recognition of the fact that management decisions taken in respect of the human occupation of the floodplain need to satisfy the social and economic needs of the community as well as being compatible with the maintenance or enhancement of the natural ecosystems that the floodplain sustains.

In 1986 the NSW Government released the first Floodplain Development Manual to assist consent authorities to deal with flood liable land. It represented the practical expression of the Government's merit based Flood Prone Land Policy which had been introduced in 1984 to overcome the sterilisation of floodplains resulting from rigorous planning controls introduced in the 1977 Environment and Planning Circular No.15.

The 1986 manual was very successful in assisting local councils in their management of the use and development of flood prone land. In 2001, a revised Floodplain Management Manual was prepared to update the 1986 manual to make it consistent with a series of improvements to both policy and practice which has been introduced in the intervening period. Specifically the 2001 manual emphasised the need:

- to explicitly consider the full range of flood sizes up to and including the probable maximum flood (PMF) when developing a floodplain risk management plan;
- to recognise existing, future and continuing flood risk on a strategic rather than on an ad hoc individual proposal basis;
- for local councils, with support from State Government, to manage local overland flooding in a similar manner to riverine flooding; and
- to promote the preparation and adoption of local flood plans (prepared under the guidance of SES) that address flood readiness, response and recovery.

In 2003 major changes were made to the composition of agencies with responsibilities for floodplain risk management. In particular the creation of the Department of Infrastructure, Planning and Natural Resources means that one agency now has responsibility for both land use planning and natural resource functions on the floodplain.

This necessitated changes to the 2001 Manual and provided an opportunity, in light of experience with the 2001 Manual, to further clarify the intent of the policy. In particular, this clarification will reduce the potential for inconsistent interpretation by consent authorities, particularly with respect to the interaction between the determination of flood planning levels and the consideration of rare floods up to the PMF.

The 2005 Floodplain Development Manual replaces the 1986 Floodplain Development Manual as the NSW Government's Manual relating to the management of flood liable land in accordance with Section 733 of the Local Government Act 1993.

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LIST OF ABBREVIATIONS

1986 Manual	1986 Floodplain Development Manual
2001 Manual	2001 Floodplain Development Manual: the management of flood liable land
AAD	Annual Average Damages
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
AWRC	Australian Water Resources Council
BoM	Bureau of Meteorology
CMA	Catchment Management Authority
CMB	Catchment Management Board
Council	can be read as including councils and other consent authorities
DCP	Development Control Plan
DEC	Department of Environment and Conservation
DISPLAN	Local Disaster Plan
DIPNR	Department of Infrastructure, Planning and Natural Resources
DPI	Department of Primary Industries
EP&A Act	Environmental Planning and Assessment Act, 1979
EPAR	Environmental Planning and Assessment Regulation, 2000
EPI	Environmental Planning Instruments including SEPPs and LEPs
ESD	Ecologically Sustainable Development
FPL	Flood Planning Level
LEP	Local Environmental Plan
LG Act	Local Government Act, 1993
Local Policy	Local flood risk management policy
Management Committee	Floodplain Risk Management Committee
Management Plan	Floodplain Risk Management Plan
Management Study	Floodplain Risk Management Study
Manual	Floodplain Development Manual, 2005
NP&W Act	National Parks and Wildlife Act, 1974
NSW	New South Wales
NVC Act	Native Vegetation Conservation Act, 1997
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
Policy	NSW Government's Flood Prone Land Policy
SEPP	State Environmental Planning Policy
SES	State Emergency Service
TSC Act	Threatened Species Conservation Act, 1995
Water Act	Water Act, 1912
Water Management Act	Water Management Act, 2000
149(2)	Section 149 part 2 of the Environmental Planning and Assessment Act
149(5)	Section 149 part 5 of the Environmental Planning and Assessment Act

1. FLOOD RISK MANAGEMENT IN NSW

1.1 Flood Prone Land Policy

The primary objective of the New South Wales Flood Prone Land Policy, as outlined below, recognises the following two important facts:

- flood prone land is a valuable resource that should not be sterilised by unnecessarily precluding its development; and
- if all development applications and proposals for rezoning of flood prone land are assessed according to rigid and prescriptive criteria, some appropriate proposals may be unreasonably disallowed or restricted, and equally, quite inappropriate proposals may be approved.

1.1.1 The Policy Statement

The primary objective of the policy is to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible. That is:

- a merit approach shall be adopted for all development decisions in the floodplain to take into account social, economic and ecological factors, as well as flooding considerations;
- both mainstream and overland flooding shall be addressed, using the merit approach, in preparation and implementation by councils of strategically generated floodplain risk management plans;
- the impact of flooding and flood liability on existing developed areas identified in floodplain risk management plans shall be reduced by flood mitigation works and measures, including on-going emergency management measures, the raising of houses where appropriate and by development controls; and
- the potential for flood losses in all areas proposed for development or redevelopment shall be contained by the application of ecologically sensitive planning and development controls.

To achieve its primary objective, the policy provides for:

- financial assistance by the NSW Government for works to reduce potential flood damage and personal danger in existing developed areas;
- technical support from the State Government to local councils in ensuring that the management of flood prone land is consistent with flood risk and that such development does not cause undue future distress to individuals nor unduly increase potential flood liability to them or the community;
- emergency management and flood recovery programs and their linkage with the floodplain risk management process; and
- the protection of councils, government agencies, and their staff against claims for damages resulting from their issuing advice or granting approvals on floodplains, providing such action was taken in accordance with the principles and guidelines in this manual.

The policy shall be implemented in the following manner:

- The management of flood prone land is, primarily, the responsibility of councils. In addition, the Department of Infrastructure Planning and Natural Resources (DIPNR) has a lead role in the development of regional strategies and plans under the Environmental Planning and Assessment Act (EP&A Act). Therefore, councils need to be cognisant of regional strategies and plans, when determining standards and implementation arrangements for flood prone land in their service areas.
- The NSW Government, through DIPNR and the State Emergency Service (SES), shall provide specialist technical assistance on all flooding and land use planning matters. This manual is provided to assist councils in the preparation of floodplain risk management plans.

- The establishment of local floodplain risk management committees by councils, through which local community groups and individuals can effectively communicate their aspirations concerning the management of the flooding problem.
- The State Government continuing to subsidise flood risk management studies, works and measures.

1.1.2 Policy Provisions

The policy provides for:

- a flexible merit based approach to be followed by councils, when dealing with development or redevelopment of flood prone land;
- high government priority for flood risk mitigation programs;
- a merit based approach to selection of appropriate flood planning levels (FPLs). This recognises the need to consider the full range of flood sizes, up to and including the probable maximum flood (PMF) and the corresponding risks associated with each flood, whilst noting that with few exceptions, it is neither feasible nor socially or economically justifiable to adopt the PMF as the basis for FPLs. FPLs for typical residential development would generally be based around the 1% AEP flood event plus an appropriate freeboard (typically 0.5m);
- councils to be responsible for the determination of appropriate planning and development controls, including FPLs, to manage future flood risk to an acceptable level based on social, economic and ecological, as well as flooding considerations. These controls should be cognisant of the relevant regional planning and any associated controls;
- an emphasis on the importance of developing and implementing floodplain risk management plans based on an integrated mix of management measures that address existing, future and continuing risk;
- the provision of NSW government technical and financial support to councils in relation to flooding matters;
- floodway definition to be based on hydraulic, hazard and potential damage considerations related to the effect of loss of flow conveyance on flood conditions, with provision for restricted development depending on circumstances;
- explicit recognition that flood risk management needs to take into account the principles of ecologically sustainable development (ESD) through consideration of relevant government policies and legislation allowing for the sustainable use of the floodplain as a natural resource. Planning and assessment requirements laid down in these policies and legislation must be complied with by all agencies associated with the use, development and management of the floodplain;
- recognition of the need to consider ways of maintaining and enhancing riverine and floodplain ecology in the development of floodplain risk management plans;
- recognition of the importance of the continuing flood risk addressed in the State Emergency Service Act 1989 and State Flood Plan, and the close relationship between the emergency management and floodplain risk management processes;
- recognition of the potential implications of climate change on flooding behaviour;
- detailed implementation arrangements as outlined in this manual;
- protection of councils and other public authorities and their staff against claims for damages, providing they act in accordance with the government's policy at the time; and
- relief from land tax, council rates and water and sewerage rates where vacant land cannot be developed because of its flood prone nature.

1.1.3 Enquiries

Enquiries should be directed as follows:

- general enquiries on the policy, its currency, and implementation to DIPNR;
- enquiries on flood liability of individual properties and proposals for development should be directed to the relevant council; and

- enquiries on flood warning, evacuation and community education matters should be directed to the SES.

1.2 Purpose of the Manual

The manual supports the NSW Government's Flood Prone Land Policy in providing for the development of sustainable strategies for managing human occupation and use of the floodplain considering the risk management principles outlined in Appendix B. These are based upon a hierarchy of avoidance, minimisation (using planning controls) and mitigation works.

This manual provides councils with a framework for implementing the policy to achieve its primary objective. It considers the costs and benefits of floodplain occupation in full recognition that associated management decisions need to consider broader issues in an integrated approach.

This manual updates the 2001 Floodplain Management Manual to reflect the significant change in the roles of State Agencies and to clarify some planning issues which have led to inconsistent interpretations. It replaces the 1986 Floodplain Development Manual as the Government's manual relating to the management of flood liable land in accordance with Section 733 of the Local Government Act 1993. This provides councils and statutory authorities, and their staff, with indemnity for decisions made and information provided in good faith from the outcomes of the management process.

The manual also presents general principles and a process for floodplain risk management to enable councils and their floodplain risk management committees to understand flood behaviour and impacts. It provides for evaluation of strategies and formulation of plans that achieve effective floodplain risk management outcomes accounting for social, economic, ecological and cultural factors, together with community aspirations for the use of flood prone land. This provides for sustainable use and development of the floodplain in a wise and rational manner on a flexible merit basis.

1.3 Who is the Manual for?

The Manual is written principally for local government, including councillors, senior managers, engineers, planners, environment officers, development assessors, reserve managers and others. However, the manual will also be of interest to other organisations and individuals involved in floodplain risk management such as government agencies, landholders, community groups and consultants.

1.4 Where does the Manual Apply?

The manual applies to floodplains across NSW, in both urban and rural areas. It is also used to manage major drainage issues in local overland flooding areas. As the 1986 manual was directed principally to mainstream flooding in urban areas Appendix C provides more details on the application of the manual to rural and local overland flooding.

1.5 How to Use the Manual

The manual is to be read and interpreted in a global sense with reference to the overall objectives of the policy, with particular reference to the primary objective.

The manual and policy are targeted at a strategic management level. To ensure that the underlying philosophies are applied in each case, without exception, individual portions or sections of the manual should not be interpreted outside:

- the overall philosophy of the manual and its application of strategic management; and
- the policy, as outlined in Section 1.1.

In the case of any inconsistency the main body of the manual takes precedence over the appendices.

The manual is broken down into sections as follows:

- Section 1 outlines the policy, the role of the manual in policy interpretation, and the principles and objectives of floodplain risk management;
- Section 2 describes the floodplain risk management process;
- Section 3 deals with the roles and responsibilities of participants in floodplain risk management; and
- Section 4 provides a glossary of terms used.

Appendices support the text in implementing the management process. Key appendices include:

- Appendix A discusses the history of policy development, improvements on previous manuals, and the cost of flooding in NSW;
- Appendix B provides a background on risk management;
- Appendix C outlines the floodplain risk management process, as shown in Figure 2.1, and references other relevant appendices;
- Appendix D discusses the need for, and role and make up of management committees;
- Appendix E outlines the necessary data and its collection;
- Appendix F outlines flood study preparation;
- Appendix G discusses issues addressed in, and preparation of, a floodplain risk management study;
- Appendix H discusses preparation and formalisation of a floodplain risk management plan;
- Appendix I discusses management plan implementation;
- Appendix J discusses floodplain risk management options;
- Appendix K discusses derivation of flood planning levels;
- Appendix L outlines hazard and hydraulic categorisation;
- Appendix M discussed flood damages; and
- Appendix N discusses emergency response planning for floods.



PLATE 1 - South Murwillumbah, 1954

1.6 Effective Floodplain Risk Management

Floodplain risk management specifically considers the consequences of flooding as they relate to human occupation of the floodplain. The policy and manual focus on this risk whilst recognising that natural resource management policies and legislation need consideration by all agencies managing floodplain development and use.

The policy and manual use a broad risk management hierarchy of avoidance, minimisation and mitigation, as discussed in Appendix B, to:

- reduce the social and financial costs from the risks associated with occupying the floodplain;
- increase the sustainable benefits of using the floodplain; and
- improve or maintain floodplain ecosystems dependent on flood inundation.

The most effective means of achieving sound flood risk management outcomes is to formulate and implement management plans through the floodplain risk management process, discussed in Section 2.

The process enables decisions to be made on a balanced consideration of economic, social and environmental issues from a flood risk management perspective so as to achieve effective robust outcomes in an informed and consultative manner.

Management plans need to be specific to individual floodplain and specific locations within the floodplain due to variation in flood hazard, exposure and vulnerability.

Balanced management plans must address each of the three types of flood risk, discussed below, in a comprehensive manner and evaluate all factors (including social, economic, ecological and cultural impacts and flood risk) that affect the use of flood prone land. The three types of flood risk are:

- **existing flood risk**, associated with current development on flood prone land. For example, this may be the risk to existing development areas that can be effectively managed by the construction of a levee;

- **future flood risk**, associated with any new development on flood prone land. For example, this may be the risk to future development areas that can be managed by adopting appropriate development limits, and minimum fill levels for lots and minimum floor levels for buildings; and
- **continuing flood risk**, is the risk remaining, in both existing and future development areas, after floodplain risk management measures, such as works and planning controls, are implemented. This is the risk from rarer floods which may result in levee overtopping or flooding of buildings with minimum floor levels. The consequences of these rarer floods may include danger to personal safety and damages to infrastructure, and both public and private property.

A balanced management plan therefore requires a range of different management measures. These measures (including both works and planning controls) and their cumulative impacts, need to be considered strategically. This involves:

- consideration of future development scenarios for a reasonable timeframe (say 20 years). Considering only existing planning or development scenarios cannot generally account for this future growth;
- cumulative assessment of decisions relating to mitigation works and measures, future development and environmental consequences on a long term strategic basis; and
- accounting for future growth in the numbers of occupants in the floodplain. Such growth increases the pressure on response and recovery agencies should an emergency occur.

Incorporating future land use elements of management plans into Environmental Planning Instruments (EPIs) and development control plans and policies will facilitate effective management of the floodplain.

Case-by-case decision making cannot account for the cumulative impacts on flood behaviour and risks, caused by individual developments or works. This form of ad hoc assessment contravenes the principles of the manual.



PLATE 2 - Nyngan, 1990
(Continuing Flood Risk - Floodplain Risk Management Measures Overwhelmed)

2. THE FLOODPLAIN RISK MANAGEMENT PROCESS

2.1 Introduction

The formulation and implementation of floodplain risk management plans is the cornerstone of the policy. Management plans can eliminate the ad hoc decision making which has contributed to many present day flooding problems.

As with other local planning processes, management plan formulation and implementation is generally a council responsibility. However, DIPNR has an expanded role in regional planning and in specific rural areas, as indicated in Section 3.2. To avoid confusion, Section 2 has been written assuming that council is the responsible authority. The process is identical where this role is performed by DIPNR.

The manual has been prepared to assist councils in formulating management plans through the floodplain risk management process, as depicted in Figure 2.1. This process is directly linked to council's strategic planning process as council needs to examine the merit (including impacts on personal safety and property damage) of different types and extents of development in the various flood prone areas. Formulation of strategic plans provides for proper and full consideration of the complete range of land use and management options and their interaction with flood risk.

Broad community involvement in the plan preparation, from the beginning, should produce the best prospect for community acceptance of, and commitment to, the resulting management plan.

The remainder of Section 2 discusses the steps in the management process with more detailed information provided in the relevant Appendices. Appendix C links together the steps in the management process and the other appendices.

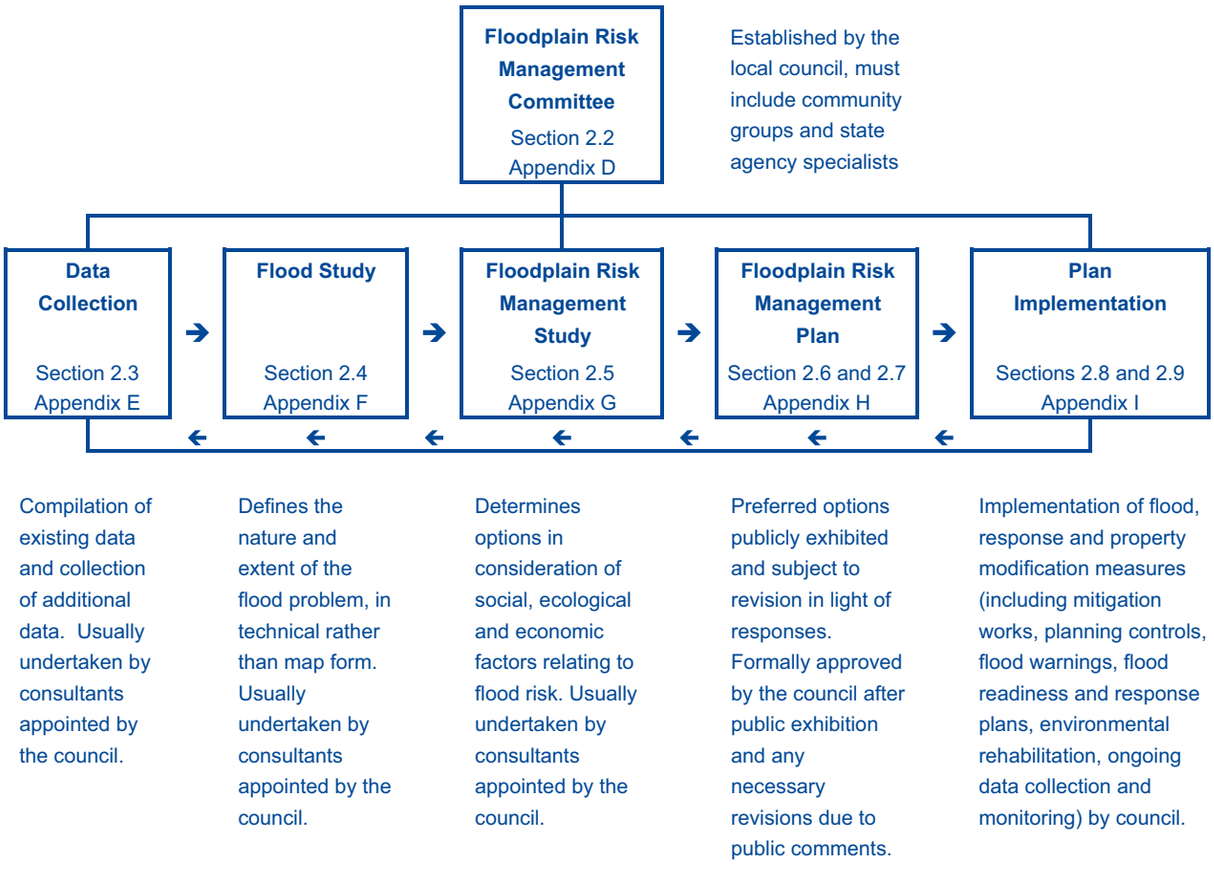


FIGURE 2.1 - The Floodplain Risk Management Process

2.2 Floodplain Risk Management Committee

The first formal step in the process is the formation of a committee chaired by council. It is advisory in nature, as responsibility for planning matters lies with council as a whole. Therefore it should report directly to council or its appropriate executive committee.

Membership of and the role of the committee are discussed in Appendix D. It's principal objective is to assist council in the development and implementation of one or more floodplain risk management plans for it's service area. The committee is both the focus of, and a forum for, the discussion of technical, social, economic and ecological issues and for the distillation of possibly differing viewpoints on these issues.

Local government boundaries rarely follow catchment boundaries, therefore it may be necessary to establish a committee involving a number of adjoining councils. One instance is where floodplain risk management measures in one council area are likely to influence the effectiveness of management measures or flooding behaviour in another council area. The establishment of a committee representing a number of council areas can result in a more holistic appraisal of flooding, social and ecological issues, successful implementation of risk management strategies, and more efficient use of expertise.

Once the committee has completed the prime task of developing the management plan including its implementation strategy, and council has adopted these, it is suggested that a limited group remain to oversee implementation.

2.3 Data Collection

A variety of data are required to assess flood behaviour and the effectiveness, costs and benefits of management measures. It is important to define the data currently available and that needed for the study, to identify information gaps. The management committee should initiate studies, where gaps exist, to collect the social, economic, flooding, ecological, land use, cultural, and emergency management data required in management studies. Where relevant data exists (discussed in Appendix E) this should be collated and referred to in investigations.

Data collection should not be seen as an end in itself, but as input to enable preparation of properly informed studies, management plans and floodplan risk management decisions.

2.4 Flood Study

A flood study is a comprehensive technical investigation of flood behaviour (Appendix F). It defines the nature of flood risk by providing information on the extent, level and velocity of floodwaters and on the distribution of flood flows across various sections of the floodplain (shown in Figure 2.2) for the full range of flood events up to and including the PMF.

Major components of a flood study involve determining discharge (hydrologic aspects) and water levels, velocities, etc (hydraulic aspects) for floods of varying severity.

A variety of analytical tools can be used in flood studies, depending on the data available, the flow situation, the nature and extent of development, and the level of detail required. Detailed studies are generally necessary in both urban and rural areas, because knowledge of flood characteristics is required to deal with existing problems, future development and the continuing flood risk.

The flood study also determines hydraulic and hazard categories within the floodplain for the potential range of floods and land use scenarios in order to consider cumulative affects. The manual recognises three hydraulic categories (floodways, flood storage and flood fringe) and two hazard categories (high and low), as described in Appendix L.

Investigating the full range of flood events up to and including the PMF enables changes in the nature and consequences of flooding to be assessed as flood severity increases. These may include increases in velocity and depth, changes in hazard category, the creation of 'islands' (which may be completely inundated in larger events), and the number of properties inundated etc.

Determining appropriate areas for and types of development generally depend upon flood exposure of the land, as defined by hydraulic and hazard categorisation in consideration of isolation (see Appendix L6).

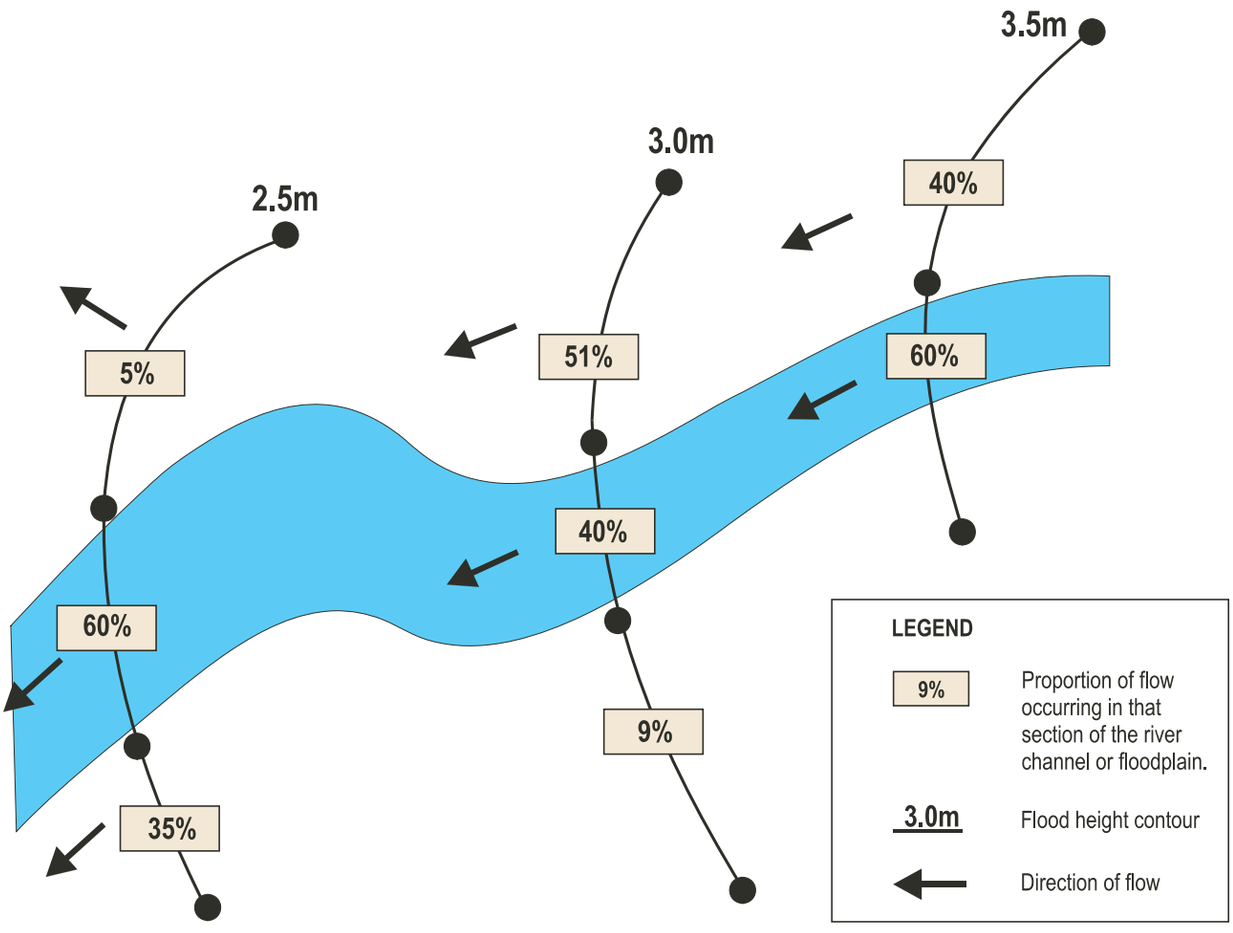


FIGURE 2.2 - Example of Basic Flood Study Information Presentation

This information is also weighed objectively in selecting FPLs (see Appendix K).

Finally, climate change which is postulated to occur due to the enhanced greenhouse effect will affect flood behaviour as sea levels may rise and the pattern of flood producing storms may intensify. The potential impacts need to be considered as discussed in Appendix F.

2.5 Floodplain Risk Management Study

The purpose of a management study is to identify, assess and compare various risk management options and consider opportunities for environmental enhancement as part of mitigation works, as outlined in Appendix G.

The management study draws together the results of the flood study and data collection exercises. It provides information and tools to allow strategic assessment of the impacts of management options for existing, future and continuing flood risk on flood behaviour and hazard and the social, economic, ecological and cultural costs and benefits of options. It also provides the basis for robust decision making in the management plan.

A management plan generally involves a mix of options as it is unusual for a single management option to manage the full range of flood risk. Determining the optimum mix of measures can require complex studies, exercise of professional judgement and extensive community consultation. Typical options considered are indicated in Table 2.1 and should include:

- property modification measures including development controls in new areas, and voluntary purchase and house raising in developed areas;
- response modification measures such as evacuation and associated operational logistics; and
- flood modification measures including levees and bypass channels.

Property Modification Measures	Response Modification Measures	Flood Modification Measures
Zoning	Community Awareness	Flood Control Dams
Voluntary Purchase	Community Readiness	Retarding Basins
Voluntary House Raising	Flood Prediction and Warning	Levees
Building and Development Controls	Local Flood Plans	Bypass Floodways
Flood Proofing Buildings	Evacuation Arrangements	Channel Improvements
Flood Access	Recovery Plans	Flood Gates

TABLE 2.1 - Typical Floodplain Risk Management Measures

The impact of management works or proposed developments on flooding behaviour elsewhere, should be assessed on a cumulative rather than individual or ad hoc basis within the context of the management plan. This includes both the effect of development on flood behaviour and the number of people who may require evacuation, particularly in rare flood events. Where mitigation works are considered, they should be designed to produce nett positive ecological outcomes, where practical and feasible.

Appendices J to M provide additional advice to aid in management study preparation including Appendix L, which provides advice on hydraulic and hazard categorisation and Appendix M, which has advice on flood damage determination. Appendix J provides details on the typical management options available to address the full range of risk, as indicated in Table 2.1.

Appendix K discusses the derivation of FPLs for works and development controls. FPLs can indicate the level of the protection provided by flood or property modification measures. As noted previously, it is generally neither feasible nor socially or economically justifiable to adopt the PMF as the basis for such FPLs. The FPL for residential dwellings would generally be based around the 1% AEP flood event plus an appropriate freeboard (typically 0.5m) unless there are clearly identified benefits from a higher FPL which outweigh the associated costs. The FPL for protection works, such as a levee, may be different due to the economics of the situation, ecological impacts, the physical limitations of the site, community concerns, and the height floods can rise above ground level in the area.

Unless the PMF is used as the basis for any FPL, a larger flood than the one used to determine the FPL, can always occur. It is not a matter of if but when. The difference in flood levels, damages, and the area of inundation and the number of dwellings to be evacuated in the PMF event relative to the event upon which the FPL is based, serves to alert a council to the upper limit of the costs and consequences of flooding.

2.6 Floodplain Risk Management Plan

The purpose of a management plan is to provide input into the strategic and statutory planning roles of councils. It does not, by intent, purport to be the only document relevant to development of flood prone land. The management plan provides the type of information necessary for adequate forward planning for flood prone land.

The advantages to both councils and the community in general of having a properly considered management plan in place include:

- having a proper basis for managing and using flood prone land to provide a balance between danger to personal safety and economic losses due to flooding, and social, ecological and cultural interests. This provides the current and future community best value from managing and using its floodplains;
- optimising use of community infrastructure, such as roads, water supply and sewerage;
- minimising personal danger to residents, visitors and emergency response personnel and community flood damage;
- strategically assessing future developable land so the impacts of its development on flooding and the affects of flooding on the development can be effectively considered. This provides a sound basis for incorporating floodplain

risk management outcomes in revising council's EPIs and development controls. It allows the community to grow in a responsible and socially cohesive fashion in consideration of flood issues. It also provides for increased certainty, from a flood perspective, for development applications in line with the relevant EPI requirements; and

- having a basis for more timely assessment of development applications for flood prone land, especially where council's EPIs and development control plans and/or policies have been altered, in light of the management plan, to incorporate appropriate zonings, and flood related controls. Individual development applications are thus limited to the best way to achieve the required outcomes on individual sites.

Preparation and finalisation of the plan is discussed in Appendix H.

2.7 Review of an Adopted Management Plan

Review of management plans should be triggered by the following instances:

- time, review regularly, around every 5 years;
- after significant flood events which provide additional data on flood behaviour;
- where significant changes occur to the factors influencing the decisions in the plan, including changes to local flood plans;
- where impediments to implementation exist that warrant a review; and
- where changes in future land use trends outside those considered in the management plan are proposed.

This review should account for changes across the full range of issues originally addressed and consider any associated emergent issues.

2.8 Plan Implementation

Once a management plan has been adopted, it needs to be implemented, as discussed in Appendix I.

Certain components can be implemented relatively quickly, such as incorporating flood related development controls into policy and EPIs and flood education including public awareness programs. Others require additional investigations and design, and funding.

It is unlikely that any management plan could be implemented immediately in its entirety. For example, availability of funding will determine when mitigation works can commence. Consequently, an implementation strategy is required to stage components dependent on funding availability and the management plan needs to consider adoption of interim measures. The implementation strategy should be developed during the preparation of the management plan and incorporated in the plan.

2.9 Funding for Management Measures

If a council seeks State Government financial assistance for implementation measures, it is required to provide the following advice which may be derived from the management study, as a minimum:

- methods used to seek public comment and take account of submissions received;
- methods used to formulate a balanced, community acceptable management plan; and
- details of environmental and cultural assessment of mitigation works and safeguards proposed to minimise any adverse impacts and maximise positive ecological opportunities. All proposed works are subject to environmental assessment under the EP&A Act.

3. ROLES & RESPONSIBILITIES

The roles of councils (including other local government authorities ie county councils), State agencies, the Commonwealth Government, the Land and Environment Court, property developers and flood affected individuals in the management of flood prone land are discussed below.

3.1 Councils

Statutory responsibility for land use planning and management under the EP&A Act rest with councils. Councils need to be cognisant of regional planning in local planning.

In specific rural areas, defined under the Water and Water Management Acts, DIPNR has responsibility for development and implementation of floodplain risk management plans and licensing flood control works, as discussed in Section 3.2. Specific areas of responsibility of councils are outlined below.

3.1.1 Preparation of Floodplain Risk Management Plans

Floodplain risk management involves the planning and management of land subject to varying degrees of flood risk. As part of their normal planning responsibilities, councils need to plan and manage flood prone land in accordance with its flood exposure. Preparation of a management plan and associated studies (as described in Section 2) is an important step in this process.

3.1.2 Preparation of Local Environmental Plans

Councils are responsible for the preparation of LEPs under the EP&A Act. These local EPIs are normally required to be consistent with SEPPs, regional planning and strategies, directions made under Section 117(2) of the EP&A Act, and circulars issued from time to time by DIPNR. Directions have encouraged LEPs to be consistent with the principles of the manual.

Councils are encouraged to incorporate appropriate planning provisions of floodplain risk management plans into LEPs, DCPs and development control policies. The EP&A Act requires the public exhibition of draft LEPs, along with explanatory and supporting information.

3.1.3 Local Development Under Part 4 of the EP&A Act

Development types that are “exempt” and “complying” developments are introduced and need to be listed in EPIs. Until Councils develop their own exempt and complying development DCP and amend SEPP60 they are covered by SEPP60.

SEPP 60 lists a number of areas that are to be excluded from its operation. For example, SEPP 60 is excluded from land within 40 metres of a waterway. In addition, SEPP 60 provides councils covered by it, the opportunity to map and exclude areas they believe are unsuitable for these types of development.

It is recommended that councils exclude complying development from areas that require flood related development controls. Councils will need to consider the affect of flooding, among other factors, when preparing their LEPs.

(a) Exempt Development

Exempt development is minor development that will have minimal environmental impact and does not need development consent. It could include fencing, storage areas, sheds, carports, garages, pergolas and repair of existing structures. Careful consideration is needed to ensure that exempt developments do not have a significant environmental impact regarding flooding in the specific areas proposed.

The EPI will incorporate a list of the standard requirements that must be met to ensure that only development that is of minimal environmental impact can be exempt.

(b) Complying Development

Complying development is development that is permissible with consent and can be assessed against preset standards to gain approval. Complying developments depend upon the EPI that applies to the area, but may include dwelling houses and large sheds. Councils need to carefully consider suitable standards to apply to complying development to ensure minimal flood damage to property.



PLATE 3 - Mount Pleasant Street, Maitland, 1955
(20 houses stood in this street before the flood)

The EP&A Act provides for complying development to be excluded from environmentally sensitive areas identified in an EPI. All areas below the FPL for residential development should be considered environmentally sensitive.

(c) Development Requiring Consent

Council LEPs usually specify the development permissible on any area of land and whether council consent is required. Councils, when considering development applications, must have regard to the matters set out in Section 79C of the EP&A Act.

A fundamental principle of floodplain risk management is to assess development applications within the strategic framework of a floodplain risk management plan and not in isolation or individually. The relevant sections of the management plan are to be included in councils LEPs, and flood related DCPs and policy. If a type of development, outside those identified as appropriate in the management plan is approved, as discussed in Appendix I, the management plan should be altered to reflect this change.

3.1.4 Planning Certificates

When property is sold in NSW, the vendor must attach to the contract documents a copy of a planning certificate for the property issued by the local council under Section 149 of the EP&A Act. Schedule 4 of the Environmental Planning and Assessment Regulation (EPAR), 2000 lists the prescribed matters to be included in certificates. Councils should seek their own independent legal advice on the information they include, however, the following recommendations are made:

- in relation to item (12) in Schedule 4 of the EPAR, councils should only provide information under section 149(2) in relation to land subject to flood related development controls (land at or below an FPL for development control) where such controls are imposed by policies adopted by council in accordance with statutory requirements under the Local Government Act 1993;
- councils should not include such policies or extracts thereof in planning certificates. Copies of these policies should be available to potential purchasers and/or their solicitors upon request from council;
- for land above the FPL, councils may consider including “notes” on flood risk in planning certificates, which must be clearly distinguished from information relating to prescribed matters. Advice on possible wording is included in Appendix I;
- councils could also indicate, under section 149(5), that land above the FPL may be subject to flooding, (see Appendix I); and
- planning certificates are not, and therefore should not be used as, a general community education tool. Emergency response considerations are inappropriate matters for inclusion on planning certificates.

It is important that flood related information on planning certificates is clear and unambiguous. Care is needed to ensure that information provided is not interpreted by the general public to mean the land is flood free when in fact it is only free of development constraints. This is a common misunderstanding of the threat of rare flooding.

Planning certificates, whilst also satisfying their primary statutory requirements can, if used as indicated in Appendix I, be a supplementary means of informing prospective purchasers of the nature and extent of the flood risk for a property.

Under section 149(6) of the Act councils are provided with an indemnity from liability in respect of advice provided in good faith under section 149(5) (refer Section 3.8).

3.1.5 Asset Management

Councils are generally responsible for the investigation, design, construction and maintenance of flood mitigation works. The Commonwealth and State Governments provide financial assistance for some of these activities under programs administered by DIPNR.

Floodplain risk management measures, whether structural or otherwise, constitute a valuable community asset. As such, these measures need to be effectively managed and maintained to ensure that they will perform as required on those rare occasions they are needed.

Thus, as an essential part of ongoing floodplain risk management, each council needs to put in place a formal asset management program for management measures. This not only applies to structural mitigation works but is equally applicable to planning measures, local flood plans, and the biophysical environment in which public involvement, education and co-operation are essential.

3.1.6 Flood Education

In an attempt to reduce the social disruption and damage caused by floods, councils should promote flood readiness in their community. There are two separate target audiences for education.

The first is those residents who are not normally affected by floods. They require education targeted at preparing and reacting in rare events.

The second target audience is those people on the floodplain who are normally affected by floods. The thrust of this education campaign needs to consider the need to act differently (and more quickly) in rare floods compared to the more frequent floods they suffer from time to time.

Councils, in conjunction with the SES, should promote community flood readiness by supplying flood data and advice. Councils should focus on issues relating to land use, supplying data and advice to property owners, residents, visitors, potential purchasers and investors, whereas the SES focuses on the issues of public safety and property protection when flooding occurs. This information should be provided regularly due to resident turnover. The key is to promote a realisation of the extent and impacts of floods of different recurrence intervals.

Flood education, and appropriate tools for achieving this, are discussed in Section J3.



PLATE 4 - Inverell, 1991
(Evacuation during an event)

3.1.7 Emergency Response and Public Infrastructure

Council is a representative on the local emergency management committee, and has a role in the preparation of the local flood plan under the guidance of the SES and supporting SES with resources during flood emergencies in accordance with the plan. This role also requires council and SES to identify critical public infrastructure for:

- protection during the flood (for example, sewage and water supply facilities) and ready return to operation in the flood's aftermath; and
- use during the flood, for example, evacuation centres and associated key access routes.

This greatly facilitates flood response, clean up and recovery operations. Appendix N discusses emergency response planning for floods and the role of the community, councils, the SES and other agencies.

3.1.8 Post Flood Data Collection and Reviews

Councils should undertake post flood appraisals (to collect data on flood impacts (including flood damages refer Section M4), to assist future investigations into flood behaviour and to assist with review of local flood plans.

Reviews into flood behaviour are common after a major flood event. For example, reviews were completed following floods in Nyngan 1990, Coffs Harbour 1996 and Wollongong 1998.



PLATE 5 – Lismore 1974
(Clean up of debris)

3.2 State Government

In broad terms the State's role is:

- support of policy through legislation, as required;
- definition of broad policy objectives, such as this manual;
- provision of specialised technical advice;
- provision of financial assistance through a subsidised program of floodplain risk management works and measures; and
- provision of emergency management including recovery.

The prime responsibility for local planning and land management, including floodplain risk management, rests with councils. A floodplain risk management plan requires the integration of engineering, science, planning, and emergency management factors. This is a complex process requiring input of specialised technical knowledge and assistance provided by State agencies.

The principal agencies in the floodplain risk management process are addressed below.

3.2.1 Department of Infrastructure, Planning and Natural Resources

DIPNR has specific roles in both floodplain risk management and land use planning, as discussed separately below.

The role of DIPNR in floodplain risk management varies across the State. In urban areas and rural areas not designated under Part VIII of the Water Act or under the regulations of the Water Management Act, DIPNR is the State agency responsible for providing specialist technical advice and information on flooding to councils and their flood risk management committees. Specifically, DIPNR:

- employs professional engineers and scientists specialising in flood and environmental matters;
- collects and maintains flood data including heights, velocities and discharges;
- assists councils with the preparation of management plans and implementation of mitigation measures;
- advises and assists councils on evaluation of significant development proposals; and
- administers programs of financial assistance for studies and mitigation measures.

The role of DIPNR in floodplain risk management is fundamentally different in rural areas designated under Part VIII of the Water Act or under the regulations of the Water Management Act. In these areas DIPNR has prime responsibility for floodplain risk management and uses its statutory powers under these Acts in a similar manner to councils who have responsibility for land use planning under the EP&A Act. This involves DIPNR in approving controlled works (earthworks, embankments or levees) which can affect distribution of flood waters using licensing powers under these Acts. This results in DIPNR:

- having responsibility for preparation of management plans, including the background investigations and studies with extensive community involvement, that are strategic and consistent with stakeholder requirements and natural resource policies. These are statutory plans under these Acts and form the basis of assessing approval; and
- acting as an determining authority under Part 5 of the EP&A Act for approvals under the Water Act or the Water Management Act for controlled works including:

- assessment and approval of controlled work;
- issue and renewal of licenses for certain controlled work; and
- objections and appeals processes to ensure the protection of the interests of all landholders and other stakeholder groups.



PLATE 6 - Rural Flooding
Confluence Niemur River & Murrain Yarrein Creek

DIPNR also has a lead role in land use planning. This involves:

- leading the development of regional strategies and plans. DIPNR has responsibility for considering flood risk and development impacts in preparing regional strategies and plans. Technical advice would be sought from State Agencies and relevant local councils would be consulted. Decisions made at State Government level would consider the outcomes of floodplain risk management investigations and associated consultation;

  Councils retain ongoing responsibility for management of flood risk in accordance with the Flood Prone Land Policy in areas covered by regional strategies and plans; and
- dealing with the planning, policy and regulation of our natural and built environment, rural and urban management, including urban growth, renewal and consolidation. DIPNR is responsible for administering the EP&A Act.

From time to time SEPPS, regional strategies or plans, or S117 directions may be released which may have implications for the planning and management of flood prone land. DIPNR also issues rulings and explanatory information about EPIs and S117 directions to councils.

3.2.2 State Emergency Service

The State Emergency Service Act 1989 states that the SES is to act as the combat agency for dealing with floods (including the establishment of flood warning systems) and to coordinate the evacuation and welfare of affected communities.

This combat agency role has been recognised in the State Disaster Plan developed in accordance with the State Emergency and Rescue Management Act 1989. It places a responsibility on the SES to lead the development and maintenance of local flood plans for flood affected communities across the State. These plans address preparation for, response to, and initial recovery from, the effects of flooding. The responsibilities of the SES with regard to flooding matters are described in detail in Appendix N.

3.2.3 Other Relevant Agencies

Other relevant agencies in the floodplain risk management process are:

- the Department of Community Services provides welfare and relief services in the aftermath of a flood;
- the Department of Environment and Conservation (DEC) provides specialist environmental advice on water quality and flora and fauna conservation, particularly threatened species and Aboriginal heritage;
- Department of Primary Industries (DPI) provide specialist ecological advice on fish, particularly threatened species, and other riverine and estuarine fish and their habitats; and
- The Office for Emergency Services coordinates natural disaster mitigation program funding from the Commonwealth for the State Emergency Management Committee.

3.3 Commonwealth Government

The Commonwealth Government's role in floodplain risk management is limited to the immediate financial relief of natural flood disasters, provision of financial assistance for floodplain management investigations and mitigation measures, and flood forecasting and warning system development.

The Bureau of Meteorology provides flood forecasting in non-flash flooding catchments. These forecasts are essential to the SES in providing warnings to local communities and conducting flood response operations.

3.4 Other State Agencies

State agencies concerned with use, development and management of flood prone land must:

- comply with the provisions of the Flood Prone Land Policy;
- comply with State, regional and local EPIs;
- comply with DCPs, local floodplain risk management policies and floodplain risk management plans and liaise with councils accordingly;
- adhere to other relevant government policies; and
- comply with all relevant legislation.

They must also take into account the principles of sound floodplain risk management, which includes consideration of:

- the nature and extent of flooding across the whole range of floods;
- the impact of the proposed use or development on flood behaviour;
- the cumulative impacts of development;
- the social, economic and ecological impacts of the proposed development; and
- the impact that flooding may have on the proposed use or development and on any existing development in the vicinity.

State agencies are also to have regard for the need:

- to avoid causing any increase in the threat to personal safety and to property;
- to avoid any unwarranted increase in the potential for damage to public property and services;
- to protect and enhance the river and floodplain environment, including threatened species and ecological communities, in accordance with relevant State policies, legislation and EPIs; and
- to ensure that, where necessary, government services can be available during floods and that appropriate government developments and infrastructure can be used for flood emergency purposes.

In addition to liaison with councils, the advice of the DIPNR should be sought with respect to flood behaviour and planning, the SES with respect to flood response and readiness procedures, and DEC and DPI regarding threatened species.

The principles and guidelines described in this manual should be used in decision making by all government authorities in relation to flood prone land.

3.5 The Courts

The Land and Environment Court determines disputes between councils, objectors and applicants over development applications. In these matters the court will generally be presented with specialist technical evidence through expert witnesses.

Appeals in respect to matters relating to Part VIII of the Water Act or the regulations under the Water Management Act are in certain circumstances dealt with by the Land and Environment Court.

Claims from the victims of floods based on duty of care considerations should be dealt with in the Local, District or Supreme Court. As in the Land and Environment Court, the Supreme Court may hear specialist expert witness advice.

3.6 Developers

Councils determine developments under the EP&A Act. To assist councils in setting development conditions they should require developers of flood prone land to provide ground level information over the proposed development site. This information should be obtained by a certified surveyor and be used to assist in the determination of the site's vulnerability to flooding.

Where a development type is proposed that is outside those identified as appropriate in the EPI or management plan, a developer must have a detailed study undertaken, by suitably qualified consultants, to determine the impact of the proposed development. This study needs to address a broad range of issues to the same depth as the existing management plan and associated studies. Cumulative impact must be addressed at the global rather than development specific level. The study will form the basis for review, by council and the floodplain risk management committee, to determine whether the management plan can be altered to accommodate the proposal without affecting it's integrity.

The proponent should seek advice from council on the scope and detail of issues to be addressed in the study. If there are potentially significant adverse impacts, the development proposal must specify mitigation measures that will reduce the adverse impacts to acceptable levels. Any mitigation measures will require environmental approval and be subject to approval by consent authorities. Council should be satisfied that it is acceptable to alter the management plan to include this proposal for it to proceed.

It should be noted that a private or site specific flood plan (see Section N7) for the proposed development is not an appropriate measure to rectify adverse impacts or to manage the consequences of inappropriate decisions.

Where determined by council, developers may be required to contribute to the costs of management measures arising from the effects of their development.

3.7 Flood Affected Individuals

In existing flood affected areas floodplain risk management measures should be undertaken to reduce the flood risk, where ecologically and economically viable. However, in some areas, it will not be possible to undertake such works. In such areas it is important that individuals recognise the extent of the flood risk and be aware of evacuation routes and procedures in the event of major flooding. Councils and the SES should be approached for advice in this regard.

It is essential that management plans make specific allowance for regular education programs designed at creating community readiness for the risks associated with flooding. A wide range of educational measures are available as discussed in Appendices J and N. Their suitability needs to be assessed in management plan development.

In areas where flood or property modification measures (examples in Table 2.1) are undertaken, individuals should be made aware that these measures do not entirely eliminate flood risk, and that problems can arise when floods greater than the flood used to derive the FPL for measures or development control occur. This is particularly important in areas where flood and property modification measures do not exclude very large floods and where floodways can develop, levees can be overtopped, water levels can rise quickly, or evacuation routes are cut.

All of these issues should be addressed in the local flood plan for the area. These plans should make flood affected individuals aware of the flood threat, the existing flood warning and evacuation systems, and appropriate actions to take when warnings are issued. This information is freely available from the SES and council. The general community, including flood prone and flood free individuals, should inform themselves of flooding matters in their area and keep up to date with appropriate action in the event of a flood.

3.8 Legal Responsibility and Indemnities

Section 733 of the Local Government Act, 1993 (LG Act) states:

(1) A council does not incur any liability in respect of:

(a) any advice furnished in good faith by the council relating to the likelihood of any land being flooded or the nature or extent of any such flooding; or

(b) anything done or omitted to be done in good faith by the council in so far as it relates to the likelihood of land being flooded or the nature or extent of any such flooding.

This indemnity is also extended, in Section (3) of the Act without limiting sections 1(a) and 1(b), to: making an EPI or DCP, granting,

conditioning and refusal of development consent, determining complying development certificate applications, advice in section 149 certificates, and carrying out flood mitigation works. The indemnity applies not only to councils, but also to council employees and statutory authorities representing the Crown and their employees.

Most relevantly, S733(4) and (5) relate to this manual, once it is notified, as follows:

(4) Without limiting any other circumstances in which a council may have acted in good faith, a council is, unless the contrary is proved, taken to have acted in good faith for the purposes of this section if the advice was furnished, or the thing was done or omitted to be done, substantially in accordance with the principles contained in the relevant manual most recently notified under subsection (5) at that time.

(5) For the purposes of this section, the Minister for Planning may, from time to time, give notification in the Gazette of the publication of:

(a) a manual relating to the management of flood liable land; or

(b) a manual relating to the management of the coastline.

The notification must specify where and when copies of the manual may be inspected.

It should be recognised that the indemnity offered by Section 733 is limited. For example, if a Council fails to make a real attempt to perform a task relating to the likelihood of any land being flooded, then the indemnity is not available (see *Mid Density v Rockdale Council* (1993) 44 FCR 290 and *Attrill v Richmond River Shire Council* (1995) 38 NSWLR 545). It should also be noted that mere adherence to this manual, without proper use of relevant statutory powers, could potentially void this statutory indemnity.

3.9 Changes in Policy, Legislation and Case Law

Considering the changing climate in floodplain risk and natural resource management and land use planning this manual will be subject to a 5 year review, as is the case for a number of major government initiatives.

During this period it is essential that councils be alert to changes in legislation, policy and legal precedent that impact on the application of this manual. As such, councils should ensure that any action taken pursuant to the manual accords with the legislation applying at the time the action is undertaken.

4. GLOSSARY

acid sulfate soils

are sediments which contain sulfidic mineral pyrite which may become extremely acid following disturbance or drainage as sulfur compounds react when exposed to oxygen to form sulfuric acid. More detailed explanation and definition can be found in the NSW Government Acid Sulfate Soil Manual published by Acid Sulfate Soil Management Advisory Committee.

annual exceedance probability (AEP)

the chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. Eg, if a peak flood discharge of 500 m^3/s has an AEP of 5%, it means that there is a 5% chance (that is one-in-20 chance) of a 500 m^3/s or larger events occurring in any one year (see ARI).

Australian Height Datum (AHD)

a common national surface level datum approximately corresponding to mean sea level.

average annual damage (AAD)

depending on its size (or severity), each flood will cause a different amount of flood damage to a flood prone area. AAD is the average damage per year that would occur in a nominated development situation from flooding over a very long period of time. Refer Appendix M.

average recurrence interval (ARI)

the long-term average number of years between the occurrence of a flood as big as or larger than the selected event. For example, floods with a discharge as great as or greater than the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.

caravan and moveable home parks

caravans and moveable dwellings are being increasingly used for long-term and permanent accommodation purposes. Standards relating to their siting, design, construction and management can be found in the Regulations under the LG Act.

catchment

the land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.

consent authority

the council, government agency or person having the function to determine a development application for land use under the EP&A Act. The consent authority is most often the council, however legislation or an EPI may specify a Minister or public authority (other than a council), or the Director General of DIPNR, as having the function to determine an application.

development

is defined in Part 4 of the EP&A Act

infill development: refers to the development of vacant blocks of land that are generally surrounded by developed properties and is permissible under the current zoning of the land. Conditions such as minimum floor levels may be imposed on infill development

new development: refers to development of a completely different nature to that associated with the former land use. Eg, the urban subdivision of an area previously used

for rural purposes. New developments involve re-zoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power.

redevelopment: refers to rebuilding in an area. Eg, as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either re-zoning or major extensions to urban services.

disaster plan (DISPLAN) — a step by step sequence of previously agreed roles, responsibilities, functions, actions and management arrangements for the conduct of a single or series of connected emergency operations, with the object of ensuring the coordinated response by all agencies having responsibilities and functions in emergencies.

discharge — the rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).

ESD — using, conserving and enhancing natural resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be maintained or increased. A more detailed definition is included in the Local Government Act, 1993. The use of sustainability and sustainable in this manual relate to ESD.

effective warning time — the time available after receiving advice of an impending flood and before the floodwaters prevent appropriate flood response actions being undertaken. The effective warning time is typically used to move farm equipment, move stock, raise furniture, evacuate people and transport their possessions.

emergency management — a range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding.

flash flooding — flooding which is sudden and unexpected. It is often caused by sudden local or nearby heavy rainfall. Often defined as flooding which peaks within six hours of the causative rain.

flood — relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage (refer Section C6) before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.

flood awareness — Awareness is an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and evacuation procedures.

flood education — flood education seeks to provide information to raise awareness of the flood problem so as to enable individuals

	to understand how to manage themselves and their property in response to flood warnings and in a flood event. It invokes a state of flood readiness.
flood fringe areas	the remaining area of flood prone land after floodway and flood storage areas have been defined.
flood liable land	is synonymous with flood prone land (ie) land susceptible to flooding by the PMF event. Note that the term flood liable land covers the whole floodplain, not just that part below the FPL (see flood planning area).
flood mitigation standard	the average recurrence interval of the flood, selected as part of the floodplain risk management process that forms the basis for physical works to modify the impacts of flooding.
floodplain	area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land.
floodplain risk management options	the measures that might be feasible for the management of a particular area of the floodplain. Preparation of a floodplain risk management plan requires a detailed evaluation of floodplain risk management options.
floodplain risk management plan	a management plan developed in accordance with the principles and guidelines in this manual. Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives.
flood plan (local)	A sub-plan of a disaster plan that deals specifically with flooding. They can exist at state, division and local levels. Local flood plans are prepared under the leadership of the SES.
flood planning area	the area of land below the FPL and thus subject to flood related development controls. The concept of flood planning area generally supersedes the “flood liable land” concept in the 1986 Manual.
flood planning levels (FPLs)	are the combinations of flood levels (derived from significant historical flood events or floods of specific AEPs) and freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans. FPLs supersede the “standard flood event” in the 1986 manual.
flood proofing	a combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding, to reduce or eliminate flood damages.
flood prone land	land susceptible to flooding by the PMF event. Flood prone land is synonymous with flood liable land.
flood readiness	Readiness is an ability to react within the effective warning time.
flood risk	potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future and continuing risks. They are described below.

existing flood risk: the risk a community is exposed to as a result of its location on the floodplain.

future flood risk: the risk a community may be exposed to as a result of new development on the floodplain.

continuing flood risk: the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.

flood storage areas — those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.

floodway areas — those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.

freeboard — provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the FPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. (See Section K5). Freeboard is included in the flood planning level.

habitable room — in a residential situation: a living or working area, such as a lounge room, dining room, rumpus room, kitchen, bedroom or workroom.

in an industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.

hazard — a source of potential harm or a situation with a potential to cause loss. In relation to this manual the hazard is flooding which has the potential to cause damage to the community. Definitions of high and low hazard categories are provided in Appendix L.

hydraulics — term given to the study of water flow in waterways; in particular, the evaluation of flow parameters such as water level and velocity.

hydrograph — a graph which shows how the discharge or stage/flood level at any particular location varies with time during a flood.

hydrology — term given to the study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.

local overland flooding — inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.

local drainage

smaller scale problems in urban areas. They are outside the definition of major drainage in this glossary.

mainstream flooding

inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.

major drainage

councils have discretion in determining whether urban drainage problems are associated with major or local drainage. For the purposes of this manual major drainage involves:

- the floodplains of original watercourses (which may now be piped, channelised or diverted), or sloping areas where overland flows develop along alternative paths once system capacity is exceeded; and/or
- water depths generally in excess of 0.3m (in the major system design storm as defined in the current version of Australian Rainfall and Runoff). These conditions may result in danger to personal safety and property damage to both premises and vehicles; and/or
- major overland flowpaths through developed areas outside of defined drainage reserves; and/or
- the potential to affect a number of buildings along the major flow path.

mathematical/computer models

the mathematical representation of the physical processes involved in runoff generation and stream flow. These models are often run on computers due to the complexity of the mathematical relationships between runoff, stream flow and the distribution of flows across the floodplain.

merit approach

the merit approach weighs social, economic, ecological and cultural impacts of land use options for different flood prone areas together with flood damage, hazard and behaviour implications, and environmental protection and well being of the State's rivers and floodplains.

The merit approach operates at two levels. At the strategic level it allows for the consideration of social, economic, ecological, cultural and flooding issues to determine strategies for the management of future flood risk which are formulated into council plans, policy, and EPIs. At a site specific level, it involves consideration of the best way of conditioning development allowable under the floodplain risk management plan, local flood risk management policy and EPIs.

minor, moderate and major flooding

both the SES and the BoM use the following definitions in flood warnings to give a general indication of the types of problems expected with a flood:

minor flooding: causes inconvenience such as closing of minor roads and the submergence of low level bridges. The lower limit of this class of flooding on the reference gauge is the initial flood level at which landholders and townspeople begin to be flooded.

	moderate flooding: low-lying areas are inundated requiring removal of stock and/or evacuation of some houses. Main traffic routes may be covered. major flooding: appreciable urban areas are flooded and/or extensive rural areas are flooded. Properties, villages and towns can be isolated.
modification measures	measures that modify either the flood, the property or the response to flooding. Examples are provided in Table 2.1 with further discussion in Appendix J.
peak discharge	the maximum discharge occurring during a flood event.
probable maximum flood	the PMF is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain. The extent, nature and potential consequences of flooding associated with a range of events rarer than the flood used for designing mitigation works and controlling development, up to and including the PMF event should be addressed in a floodplain risk management study.
probable maximum precipitation	the PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to PMF estimation.
probability	a statistical measure of the expected chance of flooding (see AEP).
risk	chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
runoff	the amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
stage	equivalent to water level (both measured with reference to a specified datum).
stage hydrograph	a graph that shows how the water level at a particular location changes with time during a flood. It must be referenced to a particular datum.
survey plan	a plan prepared by a registered surveyor.
water surface profile	a graph showing the flood stage at any given location along a watercourse at a particular time.
wind fetch	the horizontal distance in the direction of wind over which wind waves are generated.