# Flood risk management in Australia

*The National Flood Risk Advisory Group introduces and discusses the National Flood Risk Management Guideline.*


## Abstract

This paper introduces the work of the National Flood Risk Advisory Group in providing advice and guidance on the management of flood risk in Australia, in particular its work on the development of a set of national guidelines. The guidelines are included as an appendix and they highlight that communities utilise the support and cooperation of departments and agencies across all levels of government to effectively access the broad range of skills and the funding essential to implement flood risk management solutions. The paper discusses the more important flood risk considerations embodied in the guidelines.


## Introduction

Floods are the most expensive natural hazard experienced in Australia leading to an average annual damage bill of over $300M (BTE 2001). This has been evidenced in the past 18 months, where major flood episodes on the east coast of Australia resulted in several billion dollars in damage to public infrastructure and private property with major impacts on the national economy.

## Flood behaviour

Flood behaviour and therefore hazard is influenced by a range of factors (including the catchment and floodplain topography, discussed below) that vary significantly with location and need to be understood and managed locally.

### *The catchment*

Catchment size, shape, slope, development and vegetation all significantly influence the hydrological processes, in particular the conversion of rainfall into runoff. The speed of conversion from rainfall to runoff, the volume and peak runoff and the speed of rise of water, all influence flood behaviour and the length of time a flood will last.

### *The topography of the floodplain*

Floodplain shape, slope, storage, development, vegetation and flood controls, both natural (gorges, ocean levels in tidal areas) and man made (roads and structures), all have a significant influence on the routing of flood flows (i.e. hydraulic processes) and therefore the derivation of flood behaviour from hydrological analyses. These factors significantly influence flood hazard to people and property.

## Flood risk

Flood risk at a location depends upon the frequency of flooding and the associated consequences to the community. Management of flood risk usually involves reducing the impacts on people and on public and private infrastructure by reducing either the frequency of flooding, or its consequences, or both.

Urban expansion and consolidation and changing demographics within floodplains, along with changes in flood behaviour due to development of catchments as well as the influence of climate change on flood producing rainfall events and sea levels, act to increase the exposure of the community to flood risk. Without effective flood risk management, the scale of these impacts on people, property, local industry and economies will increase.

Management of flood risk to reduce the devastating impacts on the community has evolved significantly since the 1950s when the main focus was on reducing risk through mitigation works where they were cost effective. Today an effective flood risk reduction strategy requires consideration of existing and future communities and a combination of the following options.

### *Reducing the exposure of the community to flood risk*

For existing communities this may require structural flood mitigation measures such as: levees that protect existing development from flooding, detention basins that reduce downstream flows, or works to increase the flow capacity in the floodplain. Where such measures are proposed careful consideration needs to be given to any potential environmental impacts to ensure that these

measures are sustainable. In addition, consideration should be given to the potential to undertake environmental enhancement as part of the project. Voluntary purchase of houses in areas where the flood situation is particularly hazardous to occupants and potential rescuers can effectively remove the exposure of these properties and their inhabitants to flood hazard.

For communities that will occupy new land release areas this can be effectively undertaken through land use planning, subdivision layout and development controls to exclude development from the most hazardous areas and enable development to proceed in less hazardous areas having regard for the flood risk. The most common application of the latter in urban areas is to set minimum floor levels. Land use zoning can also be used to restrict certain types of development. For example having a rural or open space zone in a high hazard area will prevent the number of people at risk of flooding from increasing as a result of urban encroachment.

Structural measures, and in some cases land use planning controls, require establishing a standard beyond which they no longer provide protection and this is usually linked to the frequency of flooding. The standard is ideally established in consultation with the community, and it needs to be both acceptable and affordable. Consideration needs to be given to situations in which the standard is exceeded (see below).

### *Reducing the vulnerability of people and property to flood risk*

Reducing the exposure of existing communities may involve options including voluntary house raising in less hazardous areas to reduce the frequency of damage due to flooding.

For future communities this may involve considering the potential vulnerability of future occupants of buildings when utilising land use planning and development controls. What might be considered an acceptable level of risk to the general community may not be acceptable to the aged or infirm. Therefore aged care homes, hospitals or other buildings associated with more vulnerable members of the community shouldn't be placed in areas exposed to flooding if evacuation is difficult, if there is little flood warning, or if the facilities cannot be self evacuated within the available timeframe.

For all communities, reducing the vulnerability of people and property involves a combination of:

- flood awareness and readiness. This aims to ensure that people in the community clearly understand their risks of flooding, are ready and able to listen to emergency services and are prepared for the actions they may need to take in the lead up to a flood event. This includes consideration of situations in which the design standard for structural mitigation works is exceeded or when floods exceed minimum floor levels established through development or planning controls.
- flood forecasting and warning. These enable the community to be made aware of a potential flood situation and how they should act in response to the flood threat.
- assistance in flood response. Emergency service organisations assist the community with responding to flooding in a planned manner with an understanding of the scale of flood risk and the logistical and access problems that exist. Emergency response planning requires essential logistical and risk exposure information that can be derived from the floodplain management process.
- availability of infrastructure critical in response to and recovery from flood events.
- appropriate technical specifications for buildings. Requirements are set out in the Building Code of Australia, and in relevant Standards and State and Territory Building Legislation. Additional guidance emphasising the use of materials that can reduce flood damages in new development and in renovations and extensions could include advice on:
  - structural and non-structural design practices and durable materials that reduce the effects of inundation.
  - structural design practices that reduce the impacts of flood debris and maintain structural integrity after a flood event.
- the ability to recover financially after a flood event. Previous studies (Cox et al, 2001) have indicated that households feel that they cannot readily recover from a financial shock of more than $10,000 from their own resources. Given that only minor over floor flooding is likely to cause significantly more than $10,000 damage (an above floor flood depth of 1 metre is likely to result in around $80,000 damage, (from Figure 1, McLuckie et al 2007)) a flood event can be financially devastating. The recent interest rate rises and the associated financial toll on the community highlight the limited ability of individuals within the community to recover from financial shocks.
- insurance is an important tool in the recovery of the community after a flood event that needs to be encouraged and the insurance industry is understood to be working on making flood insurance more available to the community. However, the insurance premiums necessary to cover the risks faced by the worst affected properties may be unaffordable for their occupants. The alternative of subsidised insurance to those worst affected properties may give a false indication of the level of risk these properties and their inhabitants face from flooding.

## The guidelines

The complexity of floodplain management today highlights the need to utilise a range of different skills and disciplines including floodplain management, civil and water engineering, hydrology and hydraulics, emergency management, land use planning, research, policy making and insurance in an integrated manner. To effectively access these skills and the funding essential to implement costly solutions means that communities rely upon the support and cooperation of all levels of government and the different departments and agencies within government.

The benefits of cooperation between all levels of government and the different jurisdictions was highlighted by the 2002 Council of Australian Governments (COAG) review of Natural Disaster Mitigation, Relief and Recovery Arrangements (COAG 2004). This led to the formation of the National Flood Risk Advisory Group (NFRAG), a working group of the Australian Emergency Management Committee (AEMC), in late 2006. The membership of NFRAG includes representatives of each of the States and Territories, the Australian Government, the Australian Local Government Association, the research community, the Australian Building Code Board, and the Insurance Council of Australia.

The role of NFRAG is to provide expert advice to the AEMC and its other committees on flood risk management in general and in the implementation and subsequent follow up of the COAG reform commitments. As part of its role, the NFRAG has prepared its vision and objectives for flood risk management in Australia, a copy of which is appended. It provides guidance on the responsibility of government and the community for the effective management of flood risk. The guideline also discusses the importance of understanding both flood risk and flood behaviour for decision-making with respect to managing risk for both future as well as existing developments.

This guideline will form part of the work NFRAG is leading to provide national guidance on flood risk management through an update of the Australian Emergency Manuals on flood management published by Emergency Management Australia which will be consolidated with an update to "Floodplain Management in Australia: Best Practice Principles and Guidelines" (SCARM Report 73, 2000). This latter document will outline how the emergency risk management process and the associated national risk assessment framework can be used for floodplain management in an effective and robust way, for informed strategic decision-making on flood risk management at a local level with effective community involvement. Progress on updating this manual along with the other flood manuals in this series is continuing. Revision of the full range of manuals is expected to be completed in 2009.

## References

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## About the authors

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The National Flood Risk Advisory Group provides expert advice to the Australian Emergency Management Committee and its other committees on flood risk management and in the implementation and follow up of the COAG reform commitments.

For further information on the committee, or to provide feedback on the document Flood Risk Management in Australia: Vision, Objectives and Guidance, please contact the NFRAG Secretariat (j.elliott@bom.gov.au or Miriam.middelmann@ga.gov.au).

# FLOOD RISK MANAGEMENT IN AUSTRALIA VISION, OBJECTIVES AND GUIDANCE

The National Flood Risk Advisory Group has prepared this document to outline the vision and objectives of flood risk management and provide guidance on the responsibility of government and the community in the effective management of flood risk for local communities. This flood risk may come from several sources including rainfall events which impacts on rivers, estuaries and stormwater systems, storm driven ocean events including storm surge, and a combination of both rainfall and ocean impacts from storm events.

## FLOOD RISK MANAGEMENT VISION

Floodplains are managed for the long term benefit of the local and wider community such that hazards to people and damages to property and infrastructure are minimised and environmental values are protected.

## FLOOD RISK MANAGEMENT OBJECTIVES

To ensure that all levels of government and the local community accept their responsibilities for managing flood risk.

To ensure that flood risk and flood behaviour is understood and considered in a strategic manner in the decision-making process.

To ensure land use planning and development controls minimise both the exposure of people to flood hazard and damage costs to property and infrastructure.

To ensure a broad range of flood risk management measures (both structural and non-structural) are considered and flood mitigation measures appropriate to the location and acceptable to the local community are used to manage flood risk where economically, socially and environmentally acceptable.

To provide flood forecasting and warning systems and emergency response arrangements that cope with the impacts of flooding on the community in light of the available flood intelligence.

To aid the community in recovering from the devastating impacts of flooding.

## NATIONAL GUIDELINES FOR MEETING OBJECTIVES AND FULFILLING THE VISION

In seeking to fulfil the vision and meet the objectives of flood risk management, policy makers need to recognise that flood prone land is a valuable resource due to the historic location of our cities and towns and due to its agricultural productivity. However the use of floodplains involves an inherent risk to people, property and infrastructure due to their exposure to flood hazard. They should consider the associated flood hazards and the ability to practically and economically reduce these hazards.

Policy makers should also consider that the setting aside of areas important for flood conveyance and storage have broader benefits to the community and environment.

# 1. Responsibilities for Flood Risk Management

## *1.1 Responsibilities of Government*

All levels of Government have some responsibility for flood risk management.

Flood risk management should be based on up to date State/Territory and Local Government policies, which are supported by legislation.

The responsibility for flood risk management varies within jurisdictions but is primarily the responsibility of the local flood management authorities. However effective flood risk management requires the active participation of governments at all levels, industry and the community.

Where catchments cross boundaries of responsibility, flood management authorities need to put in place appropriate arrangements to facilitate cooperation on issues that may have cross boundary implications on flood behaviour and/or hazard.

Government has a responsibility to encourage non-government organisations to fulfil essential roles in assisting the community to recover from flood events.

### *Responsibilities and Linkages between Agencies*

The agencies which are responsible for responding to flood emergencies must be clearly identified in legislation or legally binding management arrangements.

The agencies responsible for flood response should also be responsible for flood emergency planning.

To be effective, flood risk management requires close and enduring links between the agencies responsible for mitigation, land use planning, emergency management, response and recovery.

The agencies which are responsible for flood recovery must be clearly identified in legislation or legally binding management arrangements.

Delivery of effective, timely and accurate flood warning to the community requires close and enduring links between agencies responsible for rain and river monitoring systems, floodplain management, and for flood forecasting and warning. Community understanding and ability to respond appropriately to warnings is an essential component of any warning system.

## *1.2 Community Responsibility*

Communities need to be aware of the risks they face from flooding, and what to do about them. The relevant local flood management authorities should be responsible for informing the community of their risk exposure. Agencies responsible for emergency response should be responsible for informing the community how and when to react during a flood event.

Communities have a responsibility to follow the direction of emergency response agencies during and after a flood event and to seek out their assistance where required.

Communities should be involved in flood risk management and associated decision-making.


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## 2. Understanding Flood Risk and Flood Behaviour and its Importance to Decision-making

Flood behaviour is a result of local factors and the resultant hazards to both people and property due to flooding vary across and between floodplains. Effective understanding and management of flood risk needs to be undertaken on a local basis in consideration of catchments and factors that control flood behaviour and hazard.

Developing an informed understanding of flood hazards and risk requires appropriate consideration of the full range of flood events and the associated impacts on people, property, infrastructure and the environment for the specific floodplain in question.

Local floodplain management authorities should develop and implement floodplain management plans based upon an integrated mix of management measures addressing the flood risk for a range of floods, from the minor, more frequent events to the rarer, more extreme events such as the probable maximum flood or PMF event.

Informed flood risk management needs to be undertaken on a strategic basis and consider the:

- tools and data available to assess flood risk. The importance of understanding historical flooding and in collecting flood data after an event should not be under-estimated.
- impacts of floods on the community, emergency response agencies and the environment.
- measures available to reduce or manage the existing, future and residual risk from flooding.
- exposure of the community to any ongoing flood risk and its resilience.
- long term changes that may impact upon the flood regime. These may be a result of changes in land use (increased urban development), a change in land use practices (such as changes in farming or an increase in the number of farm dams), changes to the environment (increases or decreases in riparian, floodplain and catchment vegetation), and changes to flood mitigation infrastructure.
- cumulative impacts of development of floodplains or low lying coastal areas.
- adverse affects resulting from climate change impacts upon both sea level and flood producing rainfall event frequency and severity as may be expected within reasonable planning horizons for land use change and the design life of development and infrastructure.
- requirements of all agencies involved in aspects of flood risk management.
- variation in the vulnerability of the community to flooding. This is generally dependant upon demographic trends in age, prevalence for infirmity, ability to receive and respond to warnings, and community awareness and preparedness. Particularly vulnerable sections of the community that may need additional consideration include hospitals, schools, aged care and child care facilities, essential services and remote aboriginal communities. This needs consideration in land use and risk management decisions.
- need to take into account the principles of ecologically sustainable development through consideration of relevant government policies and legislation allowing for the sustainable use of floodplains and coastal areas as a natural resource.

## 3. Managing Flood Risk to Future Development

Consideration of the flood behaviour for a range of floods from the minor, more frequent events to the rarer, more extreme events such as the PMF event, is required when determining the appropriate location of development, as well as the controls necessary to not only reduce the vulnerability of the community benefiting from the development but also to ensure that the flood risk to other areas is not increased.

Management of flood hazard to both people and property are important considerations in land use planning at all levels, from state wide and regional planning strategies to local planning regulations. Due consideration must be given to emergency response requirements in planning and development controls.

Planning and development controls should consider the vulnerability of people and property to flooding, the inherent environmental values of waterways, floodplains and coastal areas, and the need to convey and store flood waters. These will change according to land use, the specific characteristics of each floodplain, overland flow path or area subject to coastal inundation and the different types of development. Some development types may not be suitable at some locations due to the hazard to the development or its occupants from flooding.

Authorities responsible for land use planning and development at all levels should be encouraged to put in place land use planning strategies and associated development control policies or plans with appropriate development limits and controls to

manage flood hazard to both people and property. It should be recognised that controls can be expected to vary across the floodplain as the factors influencing flood hazard and the degree of flood hazard vary.

## 4. Managing Flood Risk to Existing Development

Consideration should be given to mitigating flood hazard where economic and socially acceptable; to reduce its devastating impacts on the community rather than relying on response and recovery.

Management of flood risk to existing development needs to consider the potential impacts of a range of floods from the minor, more frequent events to the rarer, more extreme events such as the PMF event in deciding upon appropriate mitigation strategies. These will generally relate to a specific area and they will need to consider future development needs or constraints as well as make provision for any flood risk that cannot be eliminated. A wide range of mitigation measures should be considered to ensure that the most appropriate and cost effective measures are selected and that there is community acceptance of the residual exposure to flood risk.

## 5. Flood Warning and Response - Enabling People to be Safe

Effective flood warning systems are required as part of flood response arrangements for the specific flood problem in question. Flood warning systems may be simple or technically complex. They must be designed to serve the particular needs of the emergency response agencies and community being warned.

Effective flood warning messages should enable the public to understand the threat posed by the flood event, the action they should take in response to this threat, and the assistance that may be available to them. The use of consistent language in flood predictions and flood warnings can assist the public understanding of warnings.

A high standard of flood emergency planning based on State/Territory guidelines is fundamental to effective flood risk management. It should be subject to regular audit.

Flood Emergency Response:

- needs to be based on flood intelligence from all credible sources. Flood intelligence should be improved through data collection after flood events and using information from flood investigations and the information gathered as part of these investigations.
- should include detailed evacuation planning where human populations are threatened.
- should identify infrastructure (such as emergency hospitals and evacuation centres and routes and services to them (including emergency water, sewerage and power supplies)) critical to emergency response and recovery and understand the limitations that flooding may place upon its operation and use during and after an event.

## 6. Recovery After a Flood Event

Flood recovery operations may involve a range of agencies from different levels of government and non-government organisations. In response to large scale events a coordinating committee of relevant agencies should be established and the lead agency for each area of recovery should be identified. “One-Stop-Shop” arrangements for government and non-government assistance may assist in the recovery of the community in the aftermath of major flood events.

The mobilisation of flood recovery operations must commence as soon as response operations begin.

Flood recovery arrangements will need to take account of the availability or otherwise of insurance within the impact area.