

Department of Planning and Environment

Flood Risk Management Manual

The management of flood liable land



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NSW Flood Prone Land Policy

Policy statement

The primary objective of the NSW Flood Prone Land Policy (this policy) is to reduce the impact of flooding and flood liability on communities and individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible. In doing so, community resilience to flooding is improved.

Achieving this involves:

- using a merit-based approach in preparing and implementing flood risk management (FRM) plans to address riverine and local overland flooding
- reducing the impact of flooding and flood liability on existing developed areas identified in FRM plans through flood mitigation works and measures including ongoing emergency management (EM) measures, and the raising of houses where appropriate, and by development controls
- the adoption of a merit-based approach for all development decisions in the floodplain, taking into account social, economic and ecological factors, as well as flooding considerations
- limiting the potential for flood losses in all areas proposed for development or redevelopment by the application of ecologically sensitive planning and development controls.

The primary objective of this policy recognises that:

- flood prone land is a valuable resource that should not be 'sterilised' by unnecessarily precluding its development
- 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, inappropriate proposals may be approved.

Policy provisions

To achieve its primary objective, this policy provides:

- a high government priority for flood risk mitigation programs
- technical support from the State Government to local councils in relation to flooding matters
- the detailed implementation arrangements outlined in the manual and its supporting guidelines
- **an emphasis on the importance of developing and implementing FRM plans** based on an integrated mix of management measures that address the full range of risks to existing and future development
- recognition of the potential implications of climate change on flooding behaviour
- recognition of the need to consider ways to maintain and enhance riverine and floodplain ecology in the development of FRM plans
- **a floodway definition based on consideration of the effect of loss of flow conveyance** on flood behaviour, hazard and flood damages. Specific development restrictions generally apply in floodways depending on the circumstances

- **recognition of the importance of emergency management in addressing continuing flood risk** in the *State Emergency Service Act 1989* and NSW State Flood Plan and the close relationship between EM planning and the FRM process and framework
- **a flexible merit-based approach to be followed by councils** in dealing with development or redevelopment of flood prone land
- **a merit-based approach to the selection of appropriate flood planning levels (FPLs)**. This recognises the need to consider the risks associated with the full range of flooding, up to and including the probable maximum flood (PMF). Note that with few exceptions, it is neither feasible nor socially or economically justifiable to use the PMF as a basis for determining FPLs. Determining the FPL for typical residential development should generally start with a defined flood event (DFE) of the 1% annual exceedance probability flood plus an appropriate freeboard (typically 0.5 metres)
- **councils to be responsible for the determination of appropriate planning and development controls**, including FPLs, to manage flood risk relating to development and redevelopment to an acceptable level based on social, economic and ecological, as well as flooding considerations. These controls should be cognisant of higher level (state, regional and district) strategies, plans and directions
- **explicit recognition that FRM 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. All agencies must comply with the planning and assessment requirements of relevant government policies and legislation associated with the use, development and management of the floodplain
- **relief from land tax, council rates and water and sewerage rates** where vacant land cannot be developed because of its flood prone nature.

Policy implementation

This policy is to be implemented in the following manner.

Local government

The management of flood prone land is, primarily, the responsibility of local councils. The role of local councils in implementing this policy needs to consider the policy provisions and involves:

- the establishment of effective FRM governance and consultation arrangements, such as local FRM committees and community engagement, to enable local community groups and individuals to input into the FRM process by effectively communicating their aspirations concerning the management of the flooding problem
- determining development standards and implementation arrangements in their service areas cognisant of higher level (state, regional and district) strategies, plans and directions.

State Government

The State Government supports councils to undertake FRM in their local government areas (LGAs) to implement this policy. State Government support for implementing the policy and its provisions includes:

- the provision of specialist technical assistance to councils for all flooding and land-use planning matters

- the provision of the manual and supporting guidelines and tools to assist councils in preparing and implementing FRM plans
- continuing to subsidise flood studies, FRM studies and plans, works and measures
- developing regional and district land-use strategies and plans under the *Environmental Planning and Assessment Act 1979*.

The relevant state government agencies undertaking these roles are identified in the FRM Administration Arrangements guide (FRM Guide AG01) that accompanies the manual.

Enquiries

Enquiries should be directed as follows:

- enquiries on flood liability of individual properties and proposals for development should be directed to the relevant local council
- general enquiries on this policy, including its currency, and implementation, can be directed to the lead FRM agency
- enquiries on flood warning, evacuation or community engagement matters should be directed to the lead flood combat and EM agency.

The relevant agencies undertaking these roles are identified in the FRM Guide AG01 that accompanies the manual.

Foreword

The primary objective of the NSW Flood Prone Land Policy (the policy) is to reduce the impact of flooding and flood liability on communities and individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible. In doing so, community resilience to flooding is improved. At the same time, the policy recognises the benefits from the use, occupation and development of flood prone land.

The policy promotes the use of a merit approach that 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 flood risk management (FRM) rests with councils, which are provided with financial and technical support by the NSW Government. The Commonwealth Government has also historically shown a willingness to be involved by providing financial assistance to local government in partnership with the NSW Government.

The Flood Risk Management Manual (the manual) has been prepared in accordance with the Policy to support its implementation.

It supports councils in the strategic management of flood risk across their local government areas (LGAs) under the FRM framework. This involves councils understanding and managing flood risk, effectively considering flood risk in their decisions, and making flood information available so that others can make informed decisions. It emphasises the importance of cooperative FRM efforts between local councils in the same catchment.

The manual supports councils in understanding current flood risks and how these may be affected by climate change and the cumulative impacts of development. This supports the development and implementation of FRM plans to produce robust, effective and adaptable FRM outcomes for their communities.

The manual also outlines the technical support provided by the NSW Government for activities under the FRM framework and FRM process as part of the partnership in improving the flood resilience of local communities.

The manual focuses on the management of the consequences of flooding as they relate to the human occupation of the floodplain for urban development, agricultural production and other industries. It addresses flood risk in full recognition 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.

The NSW Government released the first Floodplain Development Manual (NSW Government 1986) in 1986 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 introduced in 1984 (NSW Government 1984) to support the management of risk to the existing community and to overcome the sterilisation of floodplains resulting from rigorous planning controls introduced in the 1977 Environment and Planning Circular No.15.

In 2001, a revised manual was prepared to update the 1986 manual to make it consistent with a series of improvements to both policy and practice that had been introduced in the intervening period. It emphasised the need to strategically manage flood risk including considering the full range of floods up to and including the probable maximum flood, and to consider local overland flooding when developing an FRM plan. It also highlighted the importance of the development of local flood plans under NSW Government leadership to reduce residual risks by addressing continuing risks.

The manual was updated in 2005 (DIPNR 2005) to 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 probable maximum flood.

The implementation of FRM in New South Wales since 1986 has been successful in improving knowledge of flood risk, reducing the exposure of communities to flooding, providing more communities with warnings of flood threats, supporting emergency management planning, providing information to support merit-based consideration of flood risk in new and modified development.

The Flood Risk Management Manual (DPE EES 2022b) replaces the Floodplain Development Manual (DIPNR 2005) 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* (LG Act).

1. Flood Risk Management Manual: The management of flood liable land

1.1 Flood risk management in New South Wales

Floods are natural phenomena where water inundates land that is usually dry, generally due to weather systems that generate a high amount of rainfall. Flooding can be due to water flowing within, out of, or towards a waterway.

Floods vary greatly in size and frequency. Small floods may occur regularly but are often confined to waterways and flowpaths and adjacent areas and generally result in only local nuisance. The primary focus of FRM is larger to extreme floods, which result in floodwaters being conveyed in both the waterway and the broader floodplain. They can have widespread and significant impacts on the community and the environment.

Living in the floodplain has an inherent risk to the community that needs to be recognised, understood and managed. What makes up this risk is discussed in Section 3.

The NSW Government has worked in partnership with councils to manage flood risk to communities across New South Wales under the Flood Prone Land Policy (the policy) since 1984. A background on flood risk and how FRM in New South Wales has evolved to address the flood threat is provided in Appendix A.

The Flood Risk Management Manual (this manual) and its toolkit describe and provide guidance on a framework for the implementation of the policy through the combined efforts of all levels of government. Roles and responsibilities under this manual are outlined in Section 5.

This manual provides for the development and implementation of sustainable strategies for managing human occupation and use of the floodplain. It provides for evaluation of strategies and formulation of plans that achieve effective FRM 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.

These strategies can involve a range of activities that aim to achieve the primary objective of the policy through risk avoidance, minimisation and mitigation. Community flood resilience is improved if these strategies are implemented. This generally involves a combination of FRM, EM, land-use and infrastructure planning activities to manage risk related to the existing community and new or modified development.

At the same time, the policy and this manual recognise the benefits of the use, occupation and development of flood prone land. They encourage a flexible merit-based approach to setting and implementing strategic directions and statutory controls for new and modified development on the floodplain.

This manual updates the Floodplain Development Manual (DIPNR 2005) and replaces it as the government's manual relating to the management of flood liable land in accordance with s.733 of the Local government Act. This provides councils, statutory authorities, and state agencies and their staff, with indemnity for decisions made and information provided under the FRM framework outlined in Section 4 of this manual.

It builds on the success of FRM in New South Wales, which has evolved since the first policy (NSW Government 1984) was adopted and the Floodplain Development Manual (NSW Government 1986) was released (as discussed in Appendix A).

This manual outlines a vision and general principles for FRM in New South Wales.

Vision for flood risk management in New South Wales

Floodplains are strategically managed for the sustainable long-term benefit of the community and the environment, and to improve community resilience to floods.

Principles for flood risk management in New South Wales

1. Establish sustainable governance arrangements
2. Think and plan strategically
3. Be consultative
4. Make flood information available
5. Understand flood behaviour and constraints
6. Understand flood risk and how it may change
7. Consider variability and uncertainty
8. Maintain natural flood functions
9. Manage flood risk effectively
10. Continually improve the management of flood risk

This manual guides councils in the strategic management of flood risk across their local government areas (LGAs) through the FRM framework (Figure 1). This supports councils in meeting their responsibilities for a range of FRM activities and the strategic consideration of flooding in their broader responsibilities. The FRM framework, and these activities and responsibilities are discussed in Section 4.3.

The FRM process (Figure 2) is a key element of the FRM framework. Studies and plans under the process support the understanding of flooding, the examination of measures to manage flood risk and informed decisions on how to manage flood risk into the future. They also support the consideration of flooding in broader activities under the FRM framework. Further information on the FRM process is provided in Section 4.4.

A key part of the toolkit that supports the manual is the FRM Administration Arrangements (FRM Guide AG01) (DPE EES 2022c). This guide provides up-to-date advice on relevant legislation, the allocation of NSW Government responsibilities between agencies, the guides and tools that support the manual and any additional key terminology used in the toolkit that is not outlined in this manual.

FRM Guide AG01 and the rest of the toolkit will be updated and expanded as needed, in response to changes in technology, industry best practice, government agency responsibilities and the needs of end users.

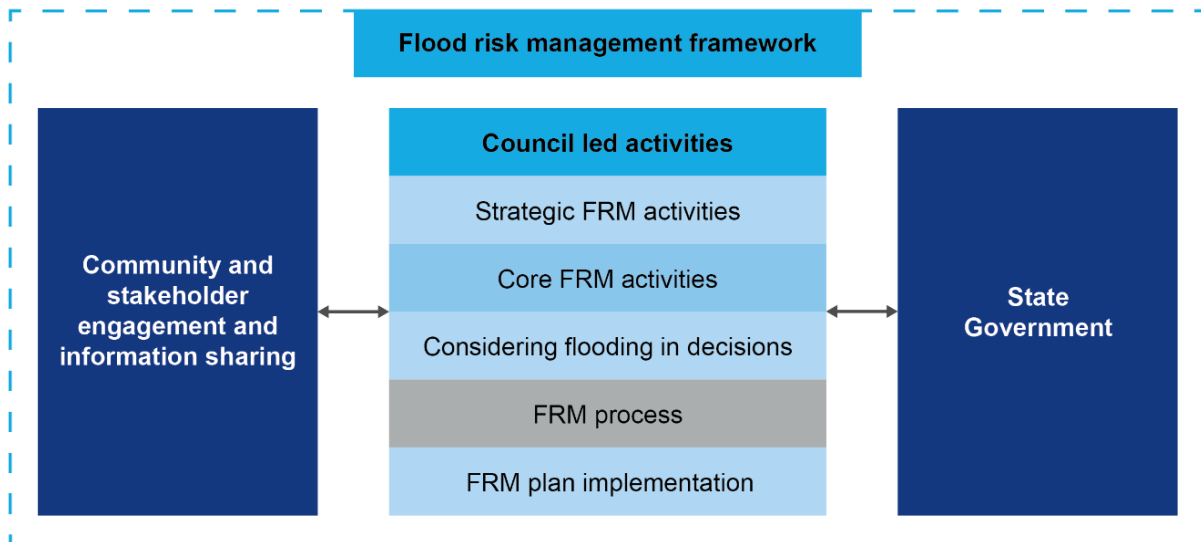


Figure 1 Flood risk management framework

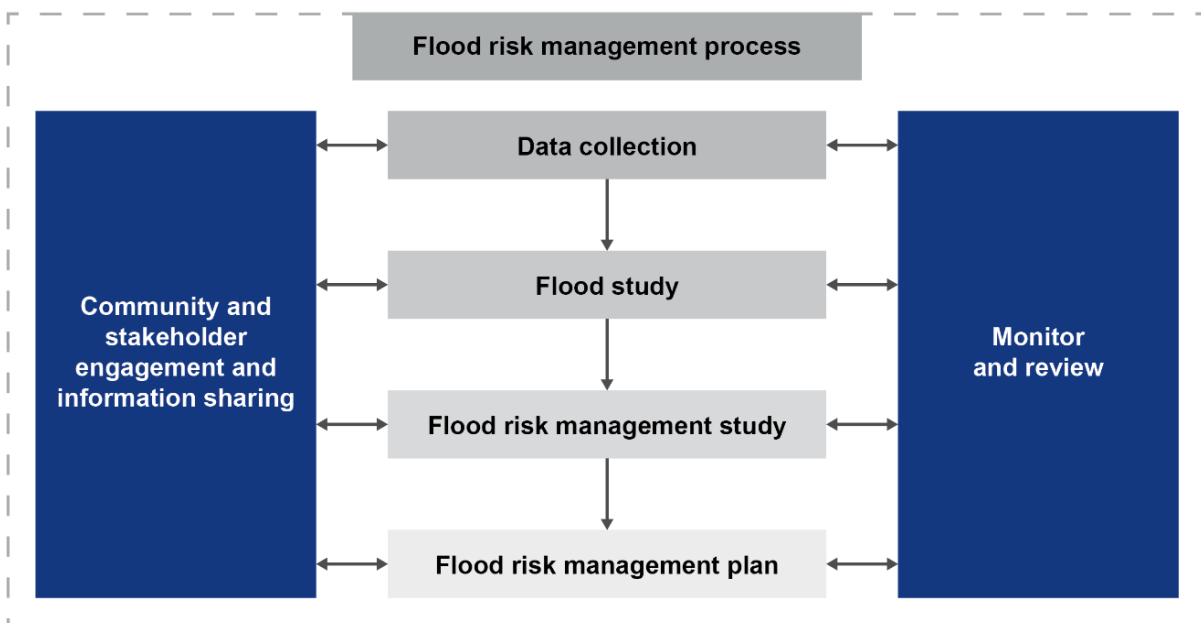


Figure 2 Flood risk management process

1.2 Who is this manual for?

This manual is written principally for local and state government. Its audience includes councillors, senior managers, engineers, flood risk managers, flood emergency managers, land-use planners, environment officers, development assessors, infrastructure providers, open space/reserve managers and others. However, this manual will also be of interest to other organisations supporting councils and state agencies or otherwise involved in FRM such as landholders, community groups and consultants.

The manual does not outline the requirements for the development of flood prone land. These requirements are provided by the relevant planning legislation and policies and by development consent authorities; however, in managing development of flood prone land, development consent authorities are to consider the principles of this manual and the advice provided by it and the supporting toolkit.

1.3 Where does this manual and its toolkit apply?

This manual and its toolkit apply to urban and rural floodplains across New South Wales. It also applies to water flowing overland to waterways in urban areas, which can result in large-scale local overland flooding impacts on people and property. As part of this it considers ocean and waterway entrance conditions as these can influence flood behaviour in lower coastal waterways.

This manual does not apply to tsunamis as these events are independent of the weather systems that generate flood producing rainfall events and require a different management response. The management of tsunamis is dealt with under established responsibilities under the *State Emergency and Rescue Management Act 1989*.

1.4 How to use this manual and its toolkit

This manual and its supporting toolkit are to be read and interpreted with reference to the policy and its primary objective.

This manual is supported by a toolkit. The toolkit is outlined in the FRM Guide AG01.

1.5 Limited legal indemnity

Section 733 of the LG Act provides local councils and statutory bodies representing the Crown, and their employees, with a limited legal indemnity for certain advice given, or things done or not done, relating to the likelihood of flooding or the extent of flooding (see extract from s.733 of the LG Act overleaf).

That section also provides that a council that acts in accordance with the manual relating to the management of flood liable land (this manual) is taken to have acted in good faith in relation to advice given, or things done or not done, relating to the likelihood of flooding or the extent of flooding.

It should be noted that the indemnity offered by s.733 is limited. A council or statutory body may not be indemnified in respect of advice, or a thing done or not done, despite being in accordance with this manual, if it is not done in good faith. Legal advice should be sought in relation to possible limitations of liability in particular cases.

Extract from s.733 of the *Local Government Act 1993*

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.

[...]

2. without limiting subsections (1), (2) and (2A), those subsections apply to —
 - a. the preparation or making of an environmental planning instrument, including a planning proposal for the proposed environmental planning instrument, or a development control plan, or the granting or refusal of consent to a development application, or the determination of an application for a complying development certificate, under the *Environmental Planning and Assessment Act 1979*, and

[...]

- b. the imposition of any condition in relation to an application referred to in paragraph (a), and
- c. advice furnished in a certificate under section 149 of the *Environmental Planning and Assessment Act 1979*, and
- d. the carrying out of flood mitigation works
- e. the failure to upgrade flood mitigation works or coastal protection works in response to projected or actual impacts of climate change, and
- f. any other thing done or omitted to be done in the exercise of a council's functions under this or any other Act.

2. Principles for flood risk management

The 10 principles for FRM outlined below are provided to guide councils in implementing the FRM framework in their LGAs to achieve the intent of the policy and the vision for FRM outlined in Section 1.

These principles have considered *Managing the floodplain* (AIDR 2017), the priorities for action in the *Sendai Framework for Disaster Risk Reduction 2015-2030* (UNISDR 2015) and the vision and key priorities for the *Natural Disaster Risk Reduction Framework* (COAG 2018).

Principle 1 Establish sustainable governance arrangements

Sustainable governance arrangements enable effective oversight and management of the full range of flood risk in an LGA. They support the consideration of flood risk in decisions within and beyond government.

Key aspects to consider in establishing effective governance for FRM for an LGA include:

- FRM in New South Wales is a partnership across all levels of government (discussed in Section 5) with local councils being primarily responsible for FRM in their LGAs. Local governance arrangements need to encourage clear and effective links with key partner agencies in FRM and EM in the NSW Government.
- Delivery of effective FRM to the community requires a cooperative multidisciplinary approach. This requires effective links between council staff. This includes flood risk managers (often engineers), information managers, emergency managers, infrastructure planners and managers, land-use planners, and community consultation managers. It also requires effective links to elected members of council.
- FRM may benefit from a cooperative approach where LGA and jurisdictional boundaries are in the same catchment. This is particularly important where the FRM activities, new or upgraded infrastructure, or land-use practices in one LGA or jurisdiction may influence the flood risk to communities in another LGA or jurisdiction. In such cases, joint investigations are encouraged.

The FRM framework identifies the establishment of effective governance arrangements as integral to support the strategic management of flood risk. This includes the establishment of an FRM committee by council to oversee the development of balanced FRM plans through the FRM process. The committee provides important links to state agencies, key stakeholders and the community. A technical working group (TWG) is also recommended to be formed to support the FRM committee.

Principle 2 Think and plan strategically

Strategic management of flood risk across an LGA requires an understanding of:

- what is known about flood behaviour, constraints and risk and how these may change over time considering future scenarios (such as those related to climate change and changes in catchments, development and infrastructure) and what gaps in knowledge exist
- how flooding is managed and gaps in management including FRM measures, EM planning and land-use planning
- how flooding is considered in decision-making and any associated gaps and limitations.

It provides the basis of understanding the need for and where to focus efforts in improving understanding and management of flood risk, including the consideration of flood risk in broader decision-making. Prioritising these efforts provides the basis for their inclusion in forward planning and for their implementation.

The FRM framework provides a sound basis for supporting strategic management of flood risk for an LGA, specific locations such as a town or floodplain in an LGA, and across LGA boundaries.

Principle 3 Be consultative

Effective FRM requires a multidisciplinary approach that connects with government agencies, stakeholder groups and the community. Consultation with these groups is an important element of understanding and managing flood risk and enabling flood risk to be considered in broader decisions. It can facilitate:

- access to knowledge of historic floods or other information relevant to FRM
- the development of sustainable FRM plans that are practical, realistic and have high priority actions that are able to be implemented in a reasonable timeframe and that have broad community support
- inclusive decisions leading to multifaceted solutions that may be more effective.

The FRM framework and the FRM process identify the importance of and encourage consultation. FRM committees and TWGs support consultation and collaboration.

Broad community consultation should encourage active engagement by using approaches tailored to the needs of the community.

Principle 4 Make flood information available

Making flood information available is a core activity under the FRM framework. The FRM process supports this by providing a basis for developing and improving this information.

The best available flood information is needed by government, stakeholders, the community and individuals so they can make informed decisions on managing flood risks and investing in infrastructure on the floodplain.

It is important that this knowledge be readily accessible, maintained, and where necessary improved. This enables lessons from previous events and information from new studies and investigations to inform decisions into the future.

It can also encourage those living in or occupying the floodplain to:

- inform themselves about flooding and subsequently influence their decision-making
- be aware of how to respond to a flood threat and to heed the advice of relevant government and EM personnel during floods
- take out appropriate insurances to cover their risks.

Principle 5 Understand flood behaviour and constraints

Effective FRM relies on understanding the full range of flooding and how flood behaviour and constraints vary between events and across the floodplain. Constraints that are important to consider relate to the flood function, flood hazard, flood range and flood EM issues.

The examination of the full range of floods provides a basis for understanding how flood behaviour, constraints and impacts vary from frequent, to rare and extreme events. This

information can then be considered in decisions on how to manage flood risk and in decisions to modify or place new development in the floodplain.

For example, the natural flood functions of flow conveyance (in floodway areas) and flood storage (in flood storage area) are important to understand. They identify areas where flood behaviour is particularly sensitive to waterway, topography, development, and in some cases vegetation changes. Changes, including development in these areas may alter flood flows, velocities, levels, flood extents, inundation time, or result in the development of new floodway areas. This in turn may result in detrimental impacts on land and communities in the floodplain.

It is important to consider flood related constraints in managing flood risk to the existing community, the increase in flood risk due to new development in the floodplain, or if undertaking other measures that may alter flood behaviour. The FRM framework provides a basis for determining where more information may be needed to support effective FRM. Studies under the FRM process provide the basis for understanding flood behaviour and the full range of flood related constraints.

Principle 6 Understand flood risk and how it may change

Flood risks result from the interaction of humans and the built environment with flooding. Understanding flood risks involves understanding the consequences of flooding on the community and the likelihood of these consequences occurring. This requires an understanding of the full range of flood behaviour and constraints as outlined in Principle 5.

The FRM framework provides a basis for establishing priorities and delivery of studies, plans, and FRM actions to better understand and manage flooding in decisions within the LGA. It incorporates the FRM process, which is a risk management approach consistent with *Managing the floodplain* (AIDR 2017) and *ISO 31000:2018 Risk Management – Guidelines* (ISO 2018).

The FRM process provides the basis for understanding flood behaviour, constraints and risks with current FRM measures and practices in place and how these vary across the community.

Flood risk may vary between different locations, the elements at risk (e.g. people and property) and within different sections of the community. Flood risk may also vary over time as flood behaviour changes with climate change, changes in the catchment and floodplain and FRM measures.

This knowledge is important so we can understand whether current FRM measures are adequate to manage flood risk now and into the future, or whether changes to or additional FRM measures may warrant investigation and implementation.

Principle 7 Consider variability and uncertainty

Effective understanding and management of flood risk needs to consider variability and uncertainty.

Waterway, floodplain and catchments conditions vary over time with development, infrastructure and climate. These changes may significantly alter flood behaviour and risks. Considering this variability in understanding and managing flood risk provides the basis for informed and robust FRM, EM, infrastructure and development decisions.

Estimation of flood behaviour has inherent uncertainties that reduce as the quality and quantity of flood data increases. Uncertainties can be further reduced by using experienced practitioners to develop fit for purpose models that are calibrated and validated considering historic flood information. These models are tools that can be used to examine the variability

in conditions (e.g. waterway entrance conditions, riparian, floodplain and catchment vegetation, and climate change) and undertake sensitivity analyses.

The FRM framework and FRM process provide the basis for understanding variability and uncertainty and considering these in decision-making. An example of accounting for uncertainty in management is the use of freeboard above the level of the DFE or design flood to provide more certainty that the desired reduction in frequency of exposure to flooding chosen by this selection is achieved.

Principle 8 Maintain natural flood functions

Understanding the key functions of the floodplain of flow conveyance and storage is important for effective management of flood risk.

Maintaining the conveyance of floodway areas and the capacity of storage areas can limit the impacts of change to the floodplain and associated flood risks to the existing community. In local overland flooding, maintaining flowpaths is important to enable water to flow from the catchment into waterways. If flowpaths are partially or fully blocked by development or fill alternative flowpaths may form, with potentially detrimental impacts to the community. In addition, identifying and maintaining local flowpaths is an important aspect of managing local overland flooding.

However, managing flood function and flowpaths alone cannot eliminate the impacts of development on flood behaviour and the existing community. Impacts can also result from changes in development, vegetation, and flowpaths outside the floodplain but within the catchment, and may require management responses.

Floodplain development can also cause adverse impacts on flood sensitive environments, including riparian land and flood-dependant ecosystems. In line with ESD principles it is important to recognise the interrelationship of flood behaviour and the natural function of waterways including hydrology and stream stability.

The FRM framework provides a basis for considering flood function and the impacts of changes in the catchment in decisions. Studies under the FRM process provide the basis for identifying floodway areas, flood storage areas and flowpaths. They also provide the basis for identifying and managing the impacts of changes in the catchment and floodplain on flood behaviour.

Principle 9 Manage flood risk effectively

The sustainable use and development of the floodplain in a wise and rational manner on a flexible merit basis requires effective management of flood risk to the community. This requires an appropriate understanding of flood behaviour and risk and how flood risk may change with the implementation of FRM measures, with decisions to invest in the floodplain, with future changes in catchments and floodplains, and with climate change. It also needs to consider social, economic, ecological and cultural factors, together with community aspirations for the use of flood prone land.

The FRM framework promotes proactive development and implementation of measures in FRM plans to manage flood risk effectively and sustainably so the existing and growing communities can be more resilient to flooding.

Effective FRM is informed by the FRM process. It starts with developing an understanding of the full range of flood behaviour, constraints (including flood function) and risks and how these may change over time.

It requires the use of this information in making decisions to:

- Manage flood risk to the existing community.

The ability to manage flood risk to the existing community can be limited by the practicality, feasibility, benefits, costs and disbenefits of FRM measures for the community. When examining FRM measures, it is important to know where these measures may significantly change flood behaviour and the likelihood or consequences of flooding. This helps identify the benefits, costs and disbenefits of FRM measures.

It is also important to understand the impacts of any proposed FRM measures on the environment, including the connectivity of flood-dependent ecosystems. This can be a particularly important issue in rural areas of the Murray–Darling Basin where works may detrimentally affect these ecosystems.

- Limit increases in flood risk related to new and modified development.

Decisions to place new development in the floodplain generally increases flood risk. This may be due to the risks to the new development and its users. It may also relate to the impacts the development may have on flood behaviour or flood and EM risks to the existing community.

Consistent with the policy a merit-based approach is recommended in developing and implementing strategic planning through local strategic planning statements (LSPSs) and planning instruments such as local environmental plans (LEPs) and development control plans (DCPs). This involves considering the risks outlined above to limit the potential for increases in flood losses and risks in areas proposed for new development.

The opportunity to effectively consider flood risk in modifying or rebuilding development should be considered in LEPs and DCPs. This may reduce or limit increases in flood and EM risks relative to the risk to the existing development and its users.

- Establish or improve EM arrangements and planning for floods to assist in managing the continuing risk that remains after FRM and land-use planning measures are implemented. This can further limit but generally cannot eliminate the residual flood risk faced by the community.
- Consider flood risks when constructing or upgrading infrastructure. Infrastructure, particularly above ground infrastructure that crosses floodplains, can impact on flood behaviour and flood risks to the community.
- Consider the influence of existing and proposed infrastructure on community flood resilience. Infrastructure can have an important role in the lead-up to, during, and in community recovery from floods. For example, it may provide support in flood warning (e.g. water level and rain gauges and communications), some protection of communities from floods (e.g. levees) and support for emergency response to a flood (evacuation routes and centres).

The ability of the community infrastructure to perform this function will vary depending on its flood vulnerability and cross dependency with other infrastructure (e.g. sewage pump stations rely on electricity supply). Therefore planning, design, construction, operation and asset management of community infrastructure that considers flooding and cross-dependencies can improve community flood resilience.

Overall, there are a wide range of FRM measures that can be used to manage flood risks; however, their practicality, feasibility and effectiveness vary with the particular situation, the community and whether it is aiming to reduce residual risks by addressing existing, future or continuing risk (as discussed in Section 3.1)

The FRM framework provides the basis for the prioritised implementation of FRM measures across an LGA. It can consider the outcomes of the FRM process, which provides a basis for

examining and making informed decisions on FRM measures that suit the particular situations and communities.

Principle 10 Continually improve the management of flood risk

The FRM framework supports improving knowledge and management of flood risk to improve community resilience to flooding. Knowledge and management of floods will change as new information becomes available from:

- floods, as lessons are learnt from these events
- studies into flood behaviour and management, as they are completed, to better understand flood behaviour and risk and the management options that may be viable in the area
- industry guidance and standards that can influence the understanding and management of floods
- new and emerging technologies that assist in understanding and managing flood risk
- improved understanding of the impacts of climate change on factors that affect flood behaviour, including sea level, flood producing rainfall events, ocean storm conditions, waterway entrance conditions, and their coincidence.

The most effective ways to understand and manage flood risk to communities can also be expected to evolve:

- as technology and practice changes
- as new FRM measures and approaches emerge
- due to lessons learnt from the impacts of floods on the community, and
- through the process of understanding and managing flood risk to communities.

As such this manual and its toolkit provide a basis for considering and adapting to these changes as needed. FRM Guide AG01 outlines the currency of the available guides and tools.

Community attitudes to flood risk can also change, particularly after a flood. Exposure to a flood often results in individuals or the community wanting protection from a recurrence of such events in future. This can result in changes to community expectations and can lead to new or a review of existing FRM studies or plans.

As such, FRM plans are 'living documents'. They need to be regularly reviewed to ensure they remain appropriate to address the flood risk to the community, can be practically implemented and consider changing information, changing management approaches and lessons learnt from any floods since their last update. Typical triggers for the update of plans are discussed in Section 4.6.

3. Flood risk

3.1 Introduction

Understanding flood risk requires an understanding of how flood behaviour and the consequences of flooding to the community varies across the full range of flood events.

Floods create risks to communities. These risks may relate to people, their social or community setting, and the built environment. Flood risk is generally expressed in terms of combinations of the likelihood (or chance) of the consequences of different flood events occurring and the severity of the consequences or impacts of these events.

No matter how likely a flood is to occur, if it has no consequences to the community, it creates no risk to it. It is the human interaction with flooding due to occupation and use of the floodplain that creates risks to communities. Flood risk can vary with a range of factors including:

- the different elements that may be at risk. These elements may include people, their social or community setting, and the built environment
- the vulnerability of different elements to flooding and how this may vary within these elements; for example, across people within the community
- the varying exposure of these elements to flooding
- flood behaviour. This is affected by the types and scale of storms that cause flooding and a range of local factors that influence flood behaviour. These can include the shape and size of the waterway, floodplain and catchment as well as the vegetation, development, and structures. Downstream conditions can also have a significant influence on flood behaviour; for example, in the lower portion of coastal waterways tides, sea levels, storm induced ocean conditions and waterway entrance conditions can all influence flooding.

Flood risk is also not static. It is influenced by climate change and by factors or decisions that can change flood behaviour (for example, changes to waterways or development), community exposure to flooding (for example, due to new development in the floodplain), or vulnerability to flooding, across the full range of flood behaviour. Flood risk can change as FRM measures and EM arrangements are put in place.

Increases in flood risk due to new or modified development can be managed by the preparation and implementation of strategic land-use planning arrangements that effectively consider the full range of flooding. However, even with FRM measures and EM and land-use planning arrangements in place, a residual risk will remain. The level of this risk will vary dependent on how exposed areas of the floodplain are to flood and how effective current FRM measures and EM and land-use planning arrangements are at managing flood risk.

It is important to understand how relative flood risk varies between and within the elements at risk, between different areas of the floodplain, and floods of different scales. Figure 3 provides an example of how issues that influence risk and management may vary.

It is also important to understand how these risks may change over time due to climate change, catchment changes and the cumulative impacts of development. This can provide a starting point for making decisions on whether existing FRM measures and practices will remain effective into the future. This information can be used to focus management efforts on where change may lead to the need to consider a review of FRM measures and practices.

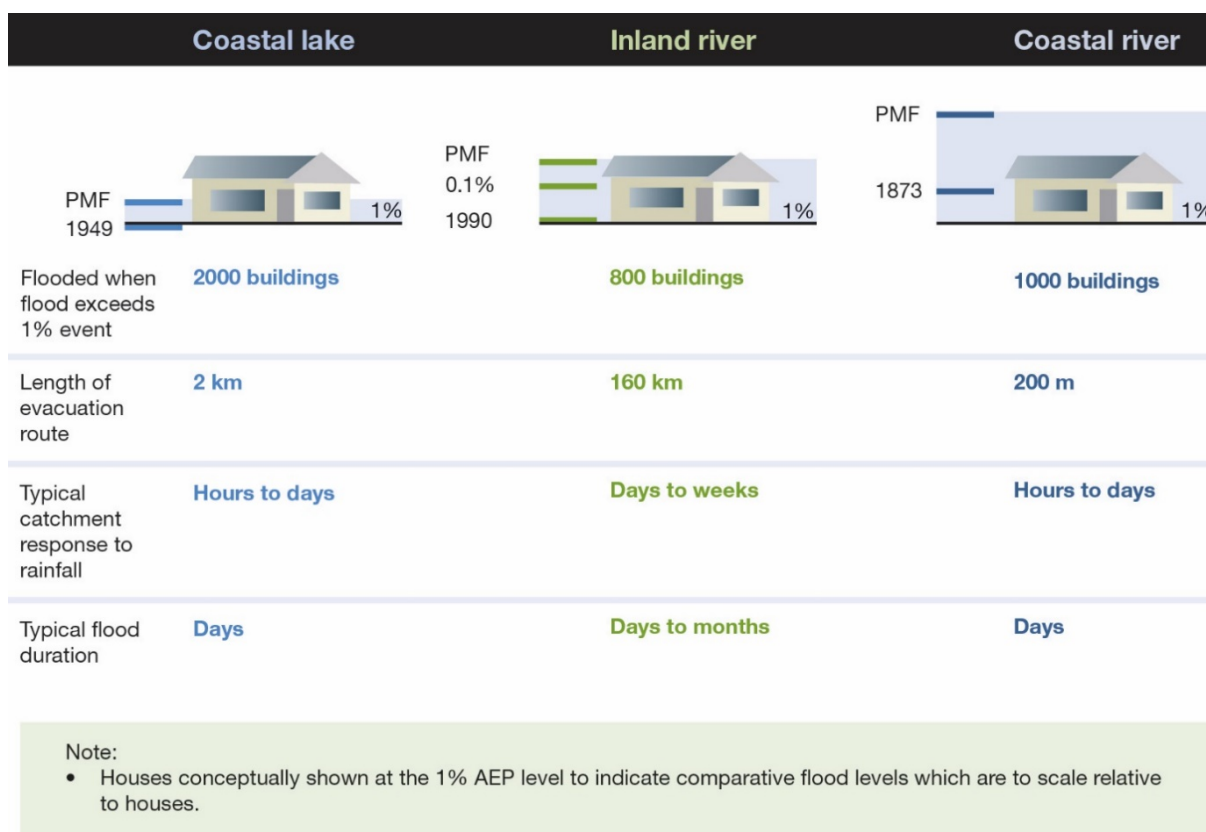


Figure 3 Variation in issues requiring consideration in management

The FRM process (discussed in Section 4.4) provides a basis for understanding the full range of flood risk and how this may change with climate change and future development, as well as examining and deciding on management measures. Flood risk can be broken down into the following types to reflect the focus for management:

- **existing flood risk** – flood risk to the elements of the existing community on flood prone land; for example, this may be the risk to existing development areas that may be able to be effectively managed by the construction of a mitigation work, such as a levee
- **future flood risk** – the increase in flood risk associated with new development. This includes any impacts development may have on flood risk to the existing community. This may be managed through the development and implementation of land-use planning instruments and policies that effectively consider the full range of floods and the cumulative impacts of development
- **continuing flood risk** – the flood risk that remains after FRM measures and land-use planning arrangements are implemented to limit existing and future flood risk. This is the risk from rarer floods that may exceed the limited protection provided by the design capacity of an FRM work, such as a levee, or by setting development standards such as minimum fill or floor levels related to the DFE.

In some cases continuing risk may be able to be addressed by EM planning and arrangements. This would typically require the support of effective flood warning arrangements, systems and infrastructure to enable the community to reach a point of safety. Where this support is not available EM planning and arrangements may not be able to effectively address these risks.

However, in all cases, even where effective EM planning and arrangements are in place to address continuing risk, a residual risk will remain that may be exacerbated where evacuation capacity or capability are compromised. For example, reduced flood

awareness can influence community response to a flood threat and lead to increased residual risk.

- **residual flood risk** – the flood risk that remains to the community and its assets after the risks above have been managed; for example, the residual risks to the community are the risks remaining where:
 - FRM works in place such as a levee have been built to reduce the likelihood of flooding to the existing community
 - land-use planning instruments and policies limit increases in flood risk due to new development. They do this by limiting the flood impacts of development on the flood risks to the existing community and by limiting the flood risk to new development and its users
 - EM planning and arrangements are in place that can effectively manage continuing flood risks to the community.

3.2 Flood risk analysis

The FRM framework provides a basis for understanding and managing flood risk in a prioritised way across an area and LGA. Risk analysis is a core element of the FRM process.

Risk analysis is a systematic approach to understanding the nature and relative level of risk. It involves developing an understanding of the nature, driver for, and level of risk to evaluate their relative seriousness. It may involve a combination of quantitative and qualitative measures to assess the relative level of risk by examining the likelihood of flooding (Section 3.2.1) and the consequences of floods when they occur (Section 3.2.2).

Risk analysis is not an outcome in itself, but can provide information on relative risks that can be used to inform:

- the understanding of the relative effectiveness of existing FRM measures and practices in limiting residual risk and how this may vary with location, the elements at risk, and over time
- decisions to effectively and efficiently allocate often scarce resources to better understand and manage risk to communities.

Understanding how the consequences on the community vary across the full range of floods, between different areas in the floodplain and to the different elements at risk, can help focus management efforts.

For example, if the key issue is risk to people, FRM measures such as flood warning, flood emergency response, supporting infrastructure, and flood awareness may assist in reducing this risk. They will however, not reduce damage to building structures and additional measures may be required if this is also an issue that needs to be addressed.

3.2.1 Likelihood of flooding

The likelihood of a flood is a measure of its relative severity in terms of the AEP or the average recurrence interval (ARI) of the flood. These terms give a measure of the chance of a flood of a given magnitude being reached or exceeded in any given year. For example, a 5% AEP flood will have a 5% or 1 in 20 chance of being exceeded in a given year. This equates to a 20-year ARI.

This can also be represented as the chance of experiencing a flood in an 80-year period, as shown in Table 1. Using this example, a person living in a location for 80 years has a 98.4% chance of experiencing one and a 91.4% chance of experiencing two 5% AEP floods.

Modelling how the full range of floods up to the PMF vary across the landscape provides an understanding of the areas of the floodplain affected by flood events of different likelihoods. It can also provide the basis for:

- assessing the severity of the consequences of flooding on the community
- understanding how effective FRM management measures may be at altering the likelihood of an area flooding and the associated consequences to the community.

Table 1 Chance of encountering a given sized flood one or more times in 80 years

Annual exceedance probability %	Average recurrence interval (1 in x years)	Chance of experiencing in an 80-year period	
		at least once %	at least twice %
20	5	100	100
10	10	99.9	99.8
5	20	98.4	91.4
2	50	80.1	47.7
1	100	55.3	19.08
0.5	200	33.0	6.11
0.2	500	14.8	1.14
0.1	1,000	7.69	0.30
0.01	10,000	0.80	0.003

3.2.2 Consequences of floods

Floods have consequences to the community due to their impacts on people, the community, and the built environment. Consequences vary:

- between floods of different magnitudes
- due to differences in exposure of the community to flooding
- due to differences in flood constraints and how flooding may impact on the community
- due to the differences in vulnerability of people, the community, and the built environment to flooding.

These consequences can also vary over time:

- where climate change impacts, such as sea level rise and intensification of flood producing rainfall events, alter flood behaviour
- due to changes in vegetation and topography in the waterway, floodplain and more broadly in the catchment. These may result in cumulative impacts on flood behaviour and risks to the community
- due to changes in the scale of development and infrastructure and any cumulative impacts of new development on the existing community.

The FRM process provides a basis for developing an understanding of the consequences of flooding on the community. These consequences and the associated risks may influence the type of FRM measure or suite of measures to be considered to manage risks to the community. Consequences and risks are influenced by:

- the depth and velocity of floodwater and therefore flood hazard; higher hazard is an indicator of higher potential risks

- the rate of rise of floodwater; quicker rates of rise can add to risks
- the availability of flood warnings; lack of availability of warnings and provision of general rather than specific warnings can increase risks
- the flood awareness and readiness of the community to respond to flood warnings; improved awareness and readiness can reduce risks
- the effective warning time. This is the time available for people to undertake protective actions in response to a flood threat; more time allows more protective actions
- population density and demographics
- effective vehicular access from a site to the road network during a flood; lack of effective flood access can reduce the ability to respond to a flood and increase flood risk
- evacuation difficulties that can impede effective community response to floods and increase flood risk
- the type and vulnerability of the development and its users; for example, flood risks for developments whose primary users are more vulnerable in emergency response (including mobility issues) are higher. Buildings whose construction is less robust to the impacts of flood (e.g. prefabricated homes) are more vulnerable to damage
- the type of use of the land; for example, the potential environmental impacts associated with flooding of hazardous industries and hazardous storage establishments.

3.3 Acceptability of risk

'The purpose of risk evaluation is to support decisions. Risk evaluation involves comparing the results of risk analysis with the established risk criteria to determine where additional action is required. This can lead to a decision to:

- do nothing further
- consider risk treatment options
- undertake further analysis to better understand the risk
- maintain existing controls
- reconsider objectives' (section 6.4.4 of ISO 31000:2018 Risk Management – Guidelines).

The need for additional FRM measures may be considered where current management measures do not result in a residual risk that is considered acceptable to the community.

The level of flood risk acceptable to a community will depend on who is asked, what their experience of floods has been and when they are asked. For example, a particular flood affected community may decide that low risks would be considered acceptable, moderate risks may be able to be tolerated for existing development in specific circumstances, whereas high or extreme risks may be considered intolerable without additional or sufficient management measures. The acceptability of risks to the different elements at risk may also be different, or more risk may only be accepted for rarer events.

Therefore, decisions on FRM measures are best made in consultation with a wide variety of stakeholders. These may include government agencies, elected council members and the community to provide a sound basis for understanding acceptability and tolerability for risk. An FRM committee and TWG and community engagement under the FRM process provides a sound basis to understanding the acceptability of risk and the willingness of the community and government to pay for FRM measures to reduce this risk. This understanding can assist in decision-making.

4. Managing flood risk

4.1 Introduction

The management of flood risk in New South Wales is a partnership across governments, with local government generally leading FRM in their LGA. The NSW Government provides council with technical and financial support for eligible FRM activities under the FRM framework under funding programs. Funding applications are considered on a statewide priority basis.

The NSW Government has an expanded FRM role in regional planning and in specific rural areas of the Murray–Darling Basin, as outlined in Section 5.2.3. The development of rural floodplain management plans in these specific areas is led by the NSW Government. It generally follows a similar process but differs in focus.

Whilst the focus of rural plans is different, their outcomes need to be considered by councils, where relevant, in FRM in their LGAs. In addition, the outcomes of council FRM plans should be considered in developing rural floodplain management plans.

As the level of state agency involvement and responsibility can vary, this section has been written assuming that council is the responsible authority for the development and implementation of FRM plans under the FRM process.

4.2 Effective management of flood risk

Effective management of the flood risk to the community requires a strategic management approach that aims to meet the objectives of the policy and achieve the vision for FRM in New South Wales while considering the principles of this manual. It involves a range of activities that relate to:

- understanding flood risk and associated uncertainties with existing management measures and practices in place
- understanding how flood risk will increase with new development and redevelopment with existing land-use planning practices in place
- understanding the impacts of climate change on flood risks to the existing community and to future development
- considering the need for changes to existing management measures and practices to manage flood risk now and into the future
- examining options and making informed decisions on changes to management measures and practices considering the associated uncertainties
- implementing changes in management measures and practices to manage flood risks to the community
- considering environmental and cultural issues when recommending and implementing management measures.

A strategic management approach supports the development and implementation of FRM plans through the FRM process (discussed in Section 4.4) and the effective consideration of FRM in EM, infrastructure and land-use planning under the FRM framework (discussed in Section 4.3). In doing so these activities should use the risk management hierarchy of avoidance, minimisation and mitigation to:

- reduce the social and financial costs of flooding for the community
- limit the risks to the community associated with occupying the floodplain

- increase the sustainable benefits of using the floodplain
- improve or maintain floodplain ecosystems dependent on flood inundation.

FRM activities under the FRM framework may relate to a specific area, floodplain or catchment or may relate to broader areas or the entire LGA. Some activities may also cross LGA boundaries.

Development of FRM plans through the FRM process overseen by an FRM committee provides the basis for understanding flood behaviour and risk in an area to support informed management decisions. This can involve:

- understanding flood behaviour and its impacts on the community and how this may change into the future considering the impacts of climate change and the cumulative impacts of development on flood behaviour
- understanding flood risk and how it varies across the community and between the different sections of the community and how this may change into the future. This involves understanding how effective current measures are, and will continue to be, at addressing existing, future and continuing risks
- examining and making informed decisions on changes to current, or the implementation of new FRM measures and practices. Management may be needed to improve the management of existing, future and continuing risks to the different elements at risk. The aim of management should be to limit residual risks to levels that are more acceptable to the community (see Section 3.3), considering how these may change over time with climate change, catchment changes and considering the cumulative impacts of development. Decisions on changing current or implementing new FRM measures or practices need to be made in a strategic manner. Decisions should consider their feasibility, practicality, cost effectiveness, acceptability to the community, consistency with industry guidance and government direction, policy and guidance and the timeframe in which they can be implemented.

The outcomes of the FRM process may support broader activities under the FRM framework, including:

- implementing management measures to address flood risk on a priority basis according to their effectiveness and ease of implementation. This may require consideration of priorities for managing risks to different areas of the community or to different communities within an LGA or catchment
- considering flood behaviour, constraints and risk and how these may change into the future due to development and climate change as an integral part of decisions to manage new and modified development, including rebuilding after disasters
- considering flood behaviour and constraints in EM planning for communities
- considering the impacts of infrastructure on flood behaviour and risk and the use of infrastructure in flood response and recovery in decisions on upgrading or building new infrastructure
- considering residual flood risks in continuity planning for infrastructure services to the community.

The most effective means of achieving sound FRM outcomes is to undertake it in accordance with the FRM framework shown in Figure 1 and outlined in Section 4.3.

4.3 Flood risk management framework

The FRM framework provides an effective basis for local and state governments working in partnership to improve FRM outcomes across an LGA and for local communities.

Councils should apply the FRM framework including the FRM process to support them in meeting their FRM responsibilities to their communities. Councils undertaking eligible activities under the FRM framework can seek technical advice and apply for financial support from the NSW Government.

The FRM framework encourages councils to undertake strategic FRM aligned to the policy and consistent with the principles of the manual (see Section 2). This includes a series of activities including the:

- strategic FRM activities across an LGA, as outlined in Table 2
- core FRM activities (outside strategic FRM activities and the FRM process) that aim to fulfil council responsibilities, as outlined in Table 3
- activities that require the effective consideration of flooding in decision-making and to work with state agencies to address risks to their local communities, as identified in Table 4
- development of FRM plans through the FRM process as discussed in Section 4.4
- implementation of FRM plans as discussed in Section 4.5. FRM plans should link to FRM forward planning (Table 2) including activities within the integrated planning and reporting framework (IP&R framework)
- review and update of FRM plans as discussed in Section 4.6.

FRM Guide AG01 outlines where additional advice is available on delivery of these activities under the FRM framework and FRM process as part of the toolkit that supports this manual.

Delivering strategic FRM outcomes for local communities through these activities requires council to have effective internal and external links. These links support:

- sharing of information on flooding so flooding can be effectively considered in decisions
- implementation of new or changes to existing management measures
- access to specialist technical advice on FRM and EM from state agencies
- cooperation with other councils that share a catchment
- connections to state agencies and stakeholders who may impact on the growth or management of flood risk to the community.

These links are required across the FRM framework as discussed below.

Table 2 Recommended local council strategic FRM activities

Activity	Aim	External links	Description
FRM governance	To deliver strategic FRM to the community through the development and continual improvement of effective governance. A key element is effective links within council (see Section 4.3.1) and external links to state and Commonwealth agencies (see section 4.3.2)	<ul style="list-style-type: none"> • State agencies • Other councils that share the same catchments • State Floodplain Management Program • Policy • Manual 	<p>Establish governance to oversee, monitor and review FRM activities:</p> <ul style="list-style-type: none"> • FRM direction • FRM status forward planning • establishing FRM committees • developing FRM plans under the FRM process • implementing FRM plans • core FRM activities outside the FRM process. <p>Consider best available flood information in decisions by linking to:</p> <ul style="list-style-type: none"> • IP&R framework including asset management and forward planning • information and notification systems • EM planning and local flood plan development • land-use planning – LSPS, LEP, DCP development and implementation considering Planning Circulars, Directions, regional and district plans.
FRM direction	To set future directions for effective FRM in the LGA	<ul style="list-style-type: none"> • Policy • Manual 	<p>Establish a vision, objective and principles for FRM in their LGA considering the policy, manual, local context and FRM status. Consider linkages to LSPSs and the IP&R framework.</p>
FRM status	To develop, maintain and report on how flood risk is being managed in the LGA and areas where further work is required	<ul style="list-style-type: none"> • Policy • Manual 	<p>Understand current FRM status in the LGA. This involves:</p> <ul style="list-style-type: none"> • FRM governance arrangements • best available knowledge of flooding and FRM in the LGA

Activity	Aim	External links	Description
FRM forward planning and resourcing	To set priorities, implement FRM activities on a priority basis, and monitor progress considering the FRM direction and status	<ul style="list-style-type: none"> • Policy • Manual 	<ul style="list-style-type: none"> • internal and external accessibility to flood information • existing knowledge and gaps in flooding, flood impacts and risk • implemented and proposed FRM measures and practices • condition of key FRM assets, e.g. levees, warning systems. <p>Set, monitor, update and deliver on LGA-wide priorities by:</p> <ul style="list-style-type: none"> • improving FRM governance arrangements • improving flood information and its accessibility and use • improving asset management and operation of FRM measures • developing or reviewing FRM measures, FRM plans and studies • implementation of FRM measures recommended in FRM plans <p>monitoring and reviewing FRM direction, status and forward plans.</p>

Table 3 Recommended core council FRM activities outside the FRM process

Activity	Aim	External links	Description
Flood information	To identify, maintain and make accessible the best available flood information to support informed decision-making	<ul style="list-style-type: none"> • Community • State agencies • Other councils in catchment 	Maintain the best available information on flooding and make this readily available so that council, government, the community and individuals can make informed decisions on managing risks and investing in public and private infrastructure in the floodplain. The scope of the information made available may vary to suit the different needs of FRM, EM, land-use planning, informing the community, community flood awareness, and information for stakeholders.
Information on FRM measures	To maintain knowledge of the intent and limitations FRM measures		It is important to understand the intent and limitations of FRM measures and to monitor their condition and consider these factors in decisions that rely on these measures.
FRM asset management, operation and condition monitoring	To maintain and operate FRM assets so they fulfil their intent and advise state agencies where this may change	<ul style="list-style-type: none"> • State agencies 	Once implemented, key FRM works and systems should be identified as key community assets with asset and operational management plans developed, resourced and implemented. The condition of key FRM measures such as levees, basins and flood warning systems, need to be monitored, as they can deteriorate. Information on changes in conditions that affect their FRM function should be made available to the NSW Government for consideration in its decision-making.
Community engagement	To have a flood aware community	<ul style="list-style-type: none"> • Community • State agencies 	Community engagement to promote flood awareness is an integral part of the FRM process. The FRM process raises awareness and can also provide base information for community flood awareness. This information can be used to support council instigating flood awareness activities suited to the needs of their community. The lead flood combat and EM agency may partner with councils in these activities.
Post flood data collection	To collect information from floods to inform FRM activities	<ul style="list-style-type: none"> • Community • State agencies 	Collecting data on flood behaviour and impacts after a flood is important to understand flood behaviour and impacts on the community so any lessons learnt can inform future FRM activities and decisions that consider flooding. State agencies may partner with councils in these activities or collect data separately.
Post flood behaviour analysis	To improve understanding of flood behaviour to inform FRM activities	<ul style="list-style-type: none"> • Community • State agencies 	This may be warranted to ensure that behaviour is understood and any lessons learnt can be considered in future FRM activities and broader decisions. The need will vary depending on the scale and impacts of the event and whether the observed behaviour aligns with expectations.

Table 4 Core council activities that are recommended to consider flood risk and the outcomes of the FRM process

Activity	Aim	External links	Description
Support for flood EM	To support development and implementation of local flood plans and local EM plans	<ul style="list-style-type: none"> State agencies 	<p>Effective flood EM planning for local communities involves a partnership between local and state governments. The NSW Government leads flood EM with support from local councils in planning and responding to floods. Council can support these activities through actions such as:</p> <ul style="list-style-type: none"> provision of flood and supporting information. Studies under the FRM process provide key information to support effective EM planning. This information should be kept up-to-date and made available identification of critical public utilities (such as sewage treatment and water supply facilities) for protection during a flood and ready return to operation in the aftermath of a flood identification of critical public assets for use during a flood (such as evacuation centres and associated access routes). <p>Undertaking agreed actions identified in local flood plans. This may include operation of flood mitigation works such as levees and flood gates, and assisting with and identifying road closures for the community.</p>
Infrastructure planning	To enable infrastructure design and operation to consider flooding and its role in community flood response and recovery	<ul style="list-style-type: none"> State agencies Infrastructure providers 	<p>Infrastructure that services the community can have an important role in the lead-up to, during and after a flood event. The design and operation of community infrastructure should consider:</p> <ul style="list-style-type: none"> the role of infrastructure in responding to and recovering from flooding the impacts of infrastructure on the flood behaviour and risks of the existing community and how these can be managed the impacts flood behaviour and risks have on the infrastructure and the costs and time to re-establish services after a flood event any service level requirements of the infrastructure.
Land-use planning	To support merit-based land-use planning decisions effectively that consider flooding, to limit increases in risk in occupying the floodplain as the community grows	<ul style="list-style-type: none"> State agencies Land developers Community 	<p>Strategic and development scale land-use planning should consider the full range of flood risk using the best available flood information, and where necessary improve this information. This involves setting and implementing strategic directions for future development while managing increases in flood risk to new development and the existing community resulting from this growth.</p> <p>Studies under the FRM process can provide information to support the development and implementation of strategic land-use planning directions including examining future scenarios to consider changes in risks due to climate change, and enable</p>

Activity	Aim	External links	Description
			consideration and management of the cumulative impacts of new development on flood risk. Master planning for new precincts should aim to minimise the impacts of development on external properties and their users and the new development. Flood impact and risk assessments (FIRAs) may be necessary to support master planning.
Rebuilding after a flood	To improve community flood resilience	<ul style="list-style-type: none"> • State agencies • Community 	Rebuilding after a disaster should consider flood risk and examine opportunities to make infrastructure, structures and communities more resilient to future natural disasters.

4.3.1 Links within council to support effective FRM

Links within council can facilitate effective FRM in an LGA and support flooding decisions by:

- identifying a process for reporting FRM matters to the council
- identifying responsibility for developing FRM plans and implementing their outcomes in council business units
- supporting forward planning for FRM projects considering the status of FRM in the LGA, priorities for actions from FRM plans, and the flood information needs of different areas of council and state agencies
- managing information systems to support internal and external access to flood information
- supporting multidisciplinary input to informed decisions on infrastructure, EM, land-use planning and rebuilding after floods
- facilitating operation and asset management of flood mitigation works such as levees and flood warning systems
- facilitating input into the scope of FRM projects from various areas of council so they can deliver outcomes suitable for the broad needs of council and the community
- supporting completion of priority studies and plans under the FRM process
- supporting community flood education and awareness activities
- supporting data collection and review of flood behaviour after events to capture lessons learnt
- supporting the monitoring and review of flood information and FRM to assess their adequacy and where necessary recommend additional work in FRM forward planning
- developing and maintaining skills and resources to support FRM activities.

4.3.2 Links external to council to support effective FRM

Input to FRM through links external to council can facilitate effective FRM in the LGA. Key external linkages include:

- state government agencies, to engage their technical support and where eligible, financial assistance, and to coordinate with or support them fulfilling their roles in FRM and in leading local flood EM planning in the LGA
- the community, to access their knowledge of flooding, to provide them with flood information to inform their decisions and to engage with them on how to manage flood risk into the future
- key stakeholders, who may influence the growth or management of flood risk to the community, including managers of land and infrastructure
- other councils that share the same catchment, whose understanding and management of flood risk may influence flood risk in the LGA
- Commonwealth agencies to connect with support for flood warning.

4.3.3 Oversight of the FRM process

A key part of strategic FRM across an LGA is to have arrangements in place to oversee and enable contribution by agencies, key stakeholders and the community to studies and the development of FRM plans under the FRM process.

Council will need to decide how to fulfil this role. It may be assigned to an existing committee of council, an existing FRM committee or a new FRM committee may be formed. The

committee may be tasked with examining FRM issues across the entire LGA or for a specific area or location, such as a town, part of a floodplain or catchment. This decision needs to facilitate input from all parties and effective FRM for the community or area being examined. To do this it needs effective links to:

- the different areas of council that have a role in FRM or need to consider flood risk in their decision-making
- NSW and Australian government agencies with a role in supporting FRM or influencing flood risk in the area
- the community, to support:
 - balanced and transparent decision-making processes
 - consultation with, and information gathering from the community, whilst noting that having community members on the committee does not negate the need for broader consultation.

Membership of the FRM committee needs to consider the scale of the study area, which may span parts of more than one LGA, or cover only part of an LGA.

An FRM committee is generally an advisory committee and does not have or exercise any formal powers of council. The committee should report through an established process to the council or to an appropriate standing committee, which has the final decision-making authority.

The principal objective of the FRM committee is to assist the council to do studies and develop an FRM plan for the study area, and provide advice on priorities for implementation. Once the committee has completed the prime task of developing an FRM plan and implementation strategy, and the council has adopted these, implementation falls back to council or the responsible authority as part of activities under the FRM framework.

The FRM committee acts as both a focus and forum for balanced discussion of technical, social, economic, environmental and cultural issues and for the distillation of any differing viewpoints on issues into studies and an FRM plan.

Membership of the FRM committee should include a balanced representation of stakeholders such as agencies, groups and/or individuals affecting, affected by or coordinating FRM. It should be flexible to ensure the right mix of interests are represented. It may draw on expertise and membership from a variety of sources, including:

- elected members of council
- council staff involved in FRM including engineering, EM, land-use planning and environmental disciplines
- representatives of the local community. This may include local flood affected landholders (residential and business), relevant industry bodies (e.g. the chamber of commerce), and environmental groups
- other key stakeholders, such as owners or managers of infrastructure or land that may influence flood behaviour
- government representatives from the lead agencies for FRM and flood combat and EM. Officers from other relevant agencies may support the committee as required
- specialist consultants, as engaged, may inform the committee where invited to meetings.

The council may also establish a TWG of relevant council and state agency technical staff to support the FRM committee and council in delivery of FRM projects.

Important roles of the FRM committee include assisting in:

- presentation and resolution of conflicting desires and requirements on the part of various community groups and individuals. By necessity, an FRM plan is a compromise aimed at having the community as a whole better off. It generally involves trade-offs as certain individuals may be disadvantaged and others advantaged
- ensuring community engagement is effective and reaches key members of the community particularly those who may be directly impacted by flooding or FRM activities including works or management measures.

More advice on the committee and the roles and responsibilities of members is included in the relevant handbook outlined in the FRM Guide AG01.

4.4 Flood risk management process

4.4.1 Introduction

The FRM process (shown in Figure 2) is a risk-based process that supports the understanding and management of flood risk in a geographic area. It aims to support FRM for the local community in line with the policy and the principles in this manual.

The FRM process provides information to support effective FRM and consideration of flooding in broader decisions, including in EM, land-use and infrastructure planning under the FRM framework. It provides a sound basis for strategic FRM across the local community, now and into the future.

The FRM process sits within the FRM framework as shown in Figure 1, which provides the basis for the process to:

- support councils' responsibilities for FRM across their LGA
- consider flood risk in broader decision-making
- make information available to support informed decision-making
- work in partnership with the NSW Government to support local FRM
- support implementation of FRM plans
- support the review and update of FRM plans (as discussed in Section 4.6).

The FRM process is generally undertaken for a location on a waterway (such as a town), an area of or the whole floodplain of a single waterway (generally including its tributaries), or a combination of the floodplains of several waterways. It also considers the influence of hydraulic controls, downstream waterways and the ocean, where flood behaviour at the location is influenced by these factors.

The study area may also include parts of more than one LGA, particularly where development, FRM decisions or related EM decisions in the catchment have impacts across LGA boundaries. Councils are encouraged to work cooperatively with other councils where this is the case.

The FRM process applies to urban and rural floodplains in New South Wales and to both flooding from waterways and local overland flooding. As such the focus of the studies can vary. Studies in towns and urban areas are primarily aimed at reducing risks to the community. They examine the full range of flood events so they can inform decisions on FRM, EM and land-use planning for the local community.

Statutory rural floodplain management plans in areas of the Murray–Darling Basin differ, in that they are developed in accordance with the floodplain management and environmental protection provisions of the *Water Management Act 2000* (NSW). These plans aim to

contribute to a sustainable, healthy and working floodplain by managing the development of new flood works and amendments to existing flood works to protect the passage of floodwater through the floodplain and to flood-dependent ecosystems. They do so while recognising the need to minimise the risk to life and property.

Whilst both planning processes have a different focus, where they overlap there should be interaction (e.g. through the relevant FRM committees) to ensure their outcomes are compatible; for example, to ensure works allowed under rural floodplain management plans do not impact on the flood risks of the urban community and vice versa.

A decision by a council to undertake the FRM process in an area is generally made as part of prioritisation processes under the FRM framework. The process is generally undertaken for a combination of reasons, including to:

- fill gaps in knowledge about flood risk
- examine management options
- make decisions on how to address flood risk to the existing and future community
- provide information to support EM and land-use planning in the study area
- respond to a specific flood and its impacts on the community.

The FRM process identifies a range of key stages in understanding and examining options to manage flood risk. These include establishing an FRM committee (discussed Section 4.3.3), data collection (Section 4.4.2), the flood study (Section 4.4.3), the FRM study (section 4.4.4) and the FRM plan (Section 4.4.5).

The delivery of studies and plans under the process is flexible so it is fit for purpose for communities and the varying flood problems they face in different areas of the state. Delivery can vary with location as does:

- the complexity of the flood problem
- the degree of exposure and vulnerability of the community to flooding
- what is known about flooding
- what studies have been undertaken and their currency
- what FRM measures have been implemented.

These factors may influence the scope of the FRM process and individual project stages, including the tasks and methods used to deliver outcomes. As such, there is no one size fits all approach to undertaking studies and developing FRM plans.

The manual and its supporting toolkit and the technical support and financial assistance provided by the NSW Government support this flexibility. Technical support can assist in ensuring the scope of studies and their outcomes are fit for purpose.

The development of an FRM plan under the process is generally delivered as two projects. Most data collection occurs in the flood study phase, and the FRM study and plan are generally combined; however, the review and update of FRM plans does not necessarily include a review of the FRM study (see Section 4.6). Community engagement occurs throughout the FRM process.

As studies and plans are completed, the information they provide and the recommendations of FRM plans can be integrated into activities under the FRM framework (see Section 4.3). This supports the implementation of FRM plans (Section 4.5). It also supports the monitoring and review of studies and plans and their implementation as part of broader activities under the FRM framework.

FRM Guide AG01 outlines guidance and tools to assist in specifying, undertaking, reporting on, and handing over data from the various stages of the FRM process.

4.4.2 Data collection

Sufficient quality data provides a robust basis for understanding flood behaviour and impacts and, in turn, making management decisions.

At the start of the FRM process or a study it is unlikely there will be sufficient quality data to meet the needs of the particular study or investigation. This data is also likely to be dispersed across different sources, including the relevant councils, state agencies and the community.

Data collection aims to gather the information needed to support the study being undertaken. It should not be seen as an end in itself, but rather as an input to help prepare properly informed studies that can facilitate informed decisions. It involves understanding and gathering data that can assist in understanding flood behaviour and managing flood risk.

Information needs will vary with the type of study, its scale and complexity, and the output needs. The types of data that may be relevant include historic, topographic, social, economic, flood, ecological, land-use, cultural and EM data. Data collection should be summarised and documented as part of study reports under the FRM process. Where data collection efforts are substantial, a stand-alone report may be warranted.

Where data collection identifies new data this may lead to an update of the best available flood information and may inform activities under the FRM framework.

4.4.3 Flood studies

A flood study aims to define flood behaviour in sufficient detail to support the understanding and management of flood risk. It can fill gaps in knowledge of flood behaviour and extrapolate this knowledge to consider the full range of flood behaviour. It also provides a platform for developing information to support FRM, EM and land-use planning, and to inform consideration of FRM measures as part of the FRM study.

Understanding flood behaviour and risk requires:

- knowledge of local flood history
- evidence of the types and scales of storm events that have previously caused problems to the community
- an understanding of current catchment and floodplain conditions (e.g. ocean conditions, landforms or built structures) that may influence flood behaviour and impacts. It is also important to understand how these have changed since key historic floods and how they may change into the future due to climate change, development and catchment changes
- an understanding the scale of impacts these events have on the community.

Studies should be fit for purpose with sufficient technical rigour to meet the needs of the council and state agencies in fulfilling their roles in FRM or considering flood risk in decision-making. The complexity of studies varies depending on the outcomes required and information needed to manage risk, the complexity of the flood situation and the exposure of the community to flooding, including the source(s) of flooding.

Flood studies generally involve examination of the following over the full range of floods:

- catchment hydrology. Hydrologic modelling using approaches such as flood frequency analysis and runoff routing models. Where data permits they are generally calibrated and validated considering historic events. Modelling can provide an understanding of flood flows and volumes and how they vary between events of different scales and with changes in catchment and climatic conditions, and with the implementation of FRM measures

- floodplain hydraulics. Hydraulic modelling provides the basis for understanding how floods behave as they flow across the landscape. Where data permits they are calibrated and validated considering historic events. This modelling enables an understanding of how flood behaviour, flood function and hazard vary across the floodplain and between events of different scales and with changes in catchment, floodplain and climatic conditions, and with the implementation of FRM measures
- post processing of model information uses this information to develop outputs (for example, mapping products) that assist in management and can support FRM, EM and land-use planning.

The completion of the study should inform other activities under the FRM framework as discussed in Section 4.3.

4.4.4 FRM studies

There is no one size fits all solution for managing flood risk. FRM generally involves a combination of measures to manage risks to the existing and growing community, people and built environment. These measures aim to limit the residual flood risk to the community and how this may change over time.

FRM measures suitable to address flood risks at a location will vary depending on the elements at risk, whether risks are to the existing community or relate to new development, dispersed or concentrated, and how they may be influenced by climate change or development.

An FRM study provides the basis for examining and recommending management measures. It aims to identify, quantify and weigh the relevant risks to the community and the potential for different options to manage these risks, considering any negative impacts they may create. It provides a basis for assessing options against a range of performance criteria related to their effectiveness, efficiency, practicality, feasibility, and community and environmental impacts. These investigations aim to provide recommendations for, in most cases, a range of management measures that together manage flood risks to the community.

A successful FRM study generally requires a comprehensive multidisciplinary approach and active consultation. It aims to recommend practical, feasible and affordable management options for the community that can be considered by council in the FRM plan. Key components of an FRM study can include:

- reviewing existing flood studies and compiling background information on flood impacts, the environment, EM planning, land-use and socioeconomic matters, and developing or updating flood damage models
- reviewing the adequacy and availability of flood information and studies and the adequacy of existing management strategies. This can identify areas where improvements may be necessary to better understand and manage flood risk
- engaging with the community to enable them to provide information, identify FRM options and provide views on options so these can be considered in decisions
- identifying, assessing, and comparing the effectiveness and suitability of FRM measures to address flood risk now and into the future considering climate change, catchment changes and future development
- assessing the cumulative impacts of potential future development in the catchment on flood risk to the existing community
- making recommendations to consider in developing an FRM plan.

At the completion of the FRM study the findings should inform other activities under the FRM framework (see Section 4.3).

4.4.5 FRM plans

A balanced FRM plan addresses existing, future and continuing risk to limit the residual risk to the community. In doing so it generally involves a range of recommendations. These recommendations generally relate to FRM measures including works, EM planning and arrangements, and land-use planning advice and the availability of improved flood information.

The FRM plan builds on the recommendations of the FRM study by clearly outlining council's decision on how it intends to effectively manage flood risk in the study area into the future for the benefit of the community. For an FRM plan to be fit for purpose, it needs to:

- be consistent with relevant legislation, policies and guidance material
- be effective in addressing the full range of flood risk to both the existing community and new and modified development
- be adequately investigated so it is clear the options are practical and achievable and can be taken forward to implementation
- be supported, on balance, by the community. This can be facilitated by an inclusive consultation engagement approach
- have actions that are sustainable in the short and long term
- have the commitment of the council to implement through adoption of the plan
- seek commitment of relevant agencies that may be requested to undertake or partner in implementing measures under the plan
- be fully integrated with the mechanisms used in delivery of the plan under the FRM framework
- consider the financial support that may be available through government programs and include information necessary to support funding bids
- acknowledge that an FRM plan cannot generally be implemented immediately in its entirety. Certain components, such as incorporating flood related development controls into DCPs, may be able to be implemented relatively quickly. Others may require investigation and design, environmental assessment and approval and successful funding applications. Where implementation is likely to require further stages or effort, interim measures may need to be put in place. Any interim measures should be incorporated in the FRM plan and considered in activities under the FRM framework.

An FRM plan should include an implementation strategy to specify how it will be delivered. This strategy should outline:

- the relative priority of different measures
- any interim measures necessary prior to the implementation of measures under the FRM plan
- the organisation responsible for implementation and what agreement exists to implement the strategy
- the timeframe for delivery, including any associated staging
- constraints such as funding, legislation and policy to delivery and how these are to be addressed
- estimated cost and the social, economic and environmental benefits and costs of the delivery of management measures
- the ramifications to the community if these measures are not delivered
- the interdependence and staging between FRM measures
- whether individual measures trigger the need to inform the community, other government agencies and/or stakeholders of changes; for example, construction of an

evacuation route may require changes to EM plans and advice to the community on how to respond to a flood threat with these changes.

The recommendations of an adopted FRM plan should be incorporated into all relevant activities under the FRM framework including FRM forward planning. FRM forward planning should identify where implementation relies on external responsibility or technical and financial support. It should also link to the IP&R framework.

4.5 Implementation of flood risk management plans

Once an FRM plan is adopted by council its recommended actions need to be implemented to gain the benefits to the community outlined in the plan. These are to be incorporated into the FRM framework with implementation overseen by council as discussed in Section 4.3. The steps involved in implementation depend on the project type, the organisation(s) responsible for implementation and the support that may be required; for example:

- making flood information available. Council is responsible for maintaining flood information and making it available to inform government and community decisions. It should consider the update and provision of information at the completion of a study or plan and where FRM measures are implemented that significantly alter flood behaviour
- land-use planning. Council should update their LSPS, LEP and DCP or supporting information and mapping considering any new information from studies and the recommendations in the FRM plan. This may involve advice to the community, including on planning certificates as required, and associated consultation where this affects property development potential
- flood EM planning and disaster recovery led by the NSW Government. The council should provide relevant flood information from studies to support the update of local flood plans
- community flood awareness, which is a council's responsibility. It is undertaken through the FRM process but needs to be maintained under the FRM framework. The FRM study and plan provide the opportunity to develop engagement and education materials to support future community flood awareness activities. These activities should also be part of any major FRM measure that alters flood behaviour, flood warning or how the community needs to respond to the flood threat. Councils may also provide information to support or may partner with the NSW Government on activities to make the community aware of how to respond to a flood threat
- for flood mitigation works projects, such as levees and flood warning systems. The FRM process is generally limited to a prefeasibility assessment of options so implementation of these measures may involve investigation, concept design (including feasibility, obtaining approvals, addressing land matters), detailed design and construction
- property modification projects such as voluntary purchase and house raising projects. These projects may require an implementation plan to confirm project scope, prioritise properties, and outline a plan for communications with affected land owners.

The implementation of FRM measures should lead to a review and update of all the relevant activities under the FRM framework.

FRM Guide AG01 outlines guidance and tools that provide further advice on implementation of management measures and the ongoing and complementary efforts required in management.

4.6 Review and update of flood risk management plans

An FRM plan may be adopted by the council as the agreed way forward to manage risk; however, social, economic and political circumstances change, as can catchment and floodplain conditions, knowledge of flood behaviour, or the effectiveness of existing FRM measures. FRM plans may be updated in response to such changes and are therefore 'living documents'.

Implementation needs to be monitored and FRM plans and their implementation strategies reviewed to ensure they remain feasible and appropriate. Where necessary a plan should be revised to address any key changes or deficiencies in the recommended measures. A range of circumstances may trigger the need to review an FRM plan, including:

- the needs of the community change significantly
- impediments to implementation of measures in the plan (including budgetary constraints) exist that may warrant a review
- significant changes in the strategic approach to land use or future land-use trends in the floodplain or catchment are proposed
- a significant flood occurs that has behaviour or impacts that are not consistent with the existing understanding of flood behaviour. This may prompt a review of modelling to examine the need for changes to management measures or practices
- new technologies may change the utility of different management measures or provide the basis for new management measures
- the viability of recommended management measures that are not implemented becomes questionable
- the effectiveness of implemented management measures does not meet expectations.

Review of an FRM plan should account for changes across the full range of issues originally addressed in the plan, consider any emergent issues and, where relevant, inform broader management reviews.

FRM plans should be reviewed at least every five years or after a major flood.

In many cases review of the plan may be simple and involve an update:

- considering the progress of plan implementation
- considering any review of the effectiveness of implementation, identifying and addressing any impediments to implementation
- clarifying that the FRM direction originally set is still appropriate to manage flood risk.

This simple review is generally undertaken with council's resources. Depending on the scope and scale of the review input may be sought from relevant state agencies and potentially an FRM committee.

Where a simple review is found to be sufficient the recommended update to the plan should be reported to and adopted by council and a copy provided to the NSW Government.

A more detailed review may be triggered where:

- the simple review identifies that the original direction in the plan needs reconsideration
- new flood information is available that may influence FRM priorities and directions. This may include where a recent flood event does not fit with the predicted flood behaviour
- the effectiveness of implemented or proposed FRM measures is to be reviewed
- FRM requirements have changed.

Where a more detailed review is triggered it may require external resources, more input from state agencies, an FRM committee and the community. It may involve a review and update of the FRM study and adoption of an FRM plan to:

- examine changes to the understanding of flood behaviour. This may involve a review of the flood study as part of the FRM study review to ensure any changes are understood and can be effectively considered in management
- examine the effectiveness of any management measures implemented from the plan
- re-examine management measures identified but not implemented in the plan, other options previously considered and new options identified in this review
- consult with the community on changes in FRM direction
- provide council with recommendations on changes to future FRM direction.

The review of FRM studies and plans should lead to a review and update of all the relevant broader activities under the FRM framework. This may include the update of flood information, changes to FRM status, priorities and forward plans including IP&R framework activities, FRM arrangements, DCPs, and EM planning.

5. Roles and responsibilities

Management of flood risk is a shared responsibility between all levels of government, the non-government sector and the community. Decision-makers at all levels need to be aware of their duty of care to the community with respect to decisions made about the use of the floodplain, and for developing and implementing plans to manage flood risk.

Whilst the policy outlines that local government is primarily responsible for managing flood risk in their LGAs, FRM is a partnership, with all levels of government sharing the responsibility for managing flood risk to local communities.

These responsibilities cover prevention, preparedness, response and recovery activities. This manual addresses prevention and preparedness activities and this section outlines the lead roles for state government agencies in prevention and preparedness, roles of the non-government sector and the community in FRM and considering flood risk in decisions.

FRM Guide AG01 outlines the legislation that underpins these responsibilities and current advice on how state and Australian government responsibilities are shared between agencies. It also refers to the relevant legislation that outlines responsibilities for response and recovery.

5.1 Local government

Local councils are primarily responsible for FRM in their LGAs with support from the NSW Government. This links with councils' service responsibilities including infrastructure management, land-use planning and land management.

Management of flood risk in a local council involves a wide range of activities under the FRM framework, as outlined in Section 4 of this manual. The FRM framework includes activities that relate to broad sections or the whole LGA as well as activities under the FRM process. Activities under the FRM process relate to a location or area of floodplain and may extend to and involve cooperation with adjacent councils in the same catchment.

Effective FRM requires the consideration of flood risk in a wide range of decisions both within and outside the council. This requires interaction between different departments of the council, government agencies, the community, non-government stakeholders and sometimes other councils within the same catchment. This requires councils to:

- coordinate strategic management of flood risk across an LGA through the FRM framework (Figure 1), including working with other councils in the same catchment where needed. Relevant strategic FRM activities are outlined in Table 2
- deliver the council's core FRM activities as outlined in Table 3 and the continued development, implementation and review of FRM plans through the FRM process under the FRM framework, as outlined in Sections 4.4 to 4.6
- deliver a range of activities that need to consider flooding in decisions, as outlined in Table 4.

5.2 NSW Government

The NSW Government supports FRM through the policy, this manual and its toolkit, legislation, and the NSW Floodplain Management Program (the program), managed by the lead FRM agency (see Section 5.2.1).

In addition, state agencies have roles that influence the management and growth of flood risk to the community. These roles are in EM for floods, rural floodplain management in the Murray–Darling Basin, and land-use planning. State agencies and state owned corporations

also have responsibilities for infrastructure management and development consent, which all influence the management and growth of flood risk to communities. These responsibilities are discussed below and in FRM Guide AG01.

5.2.1 Lead FRM agency

The lead FRM agency works with and provides specialist technical support and financial assistance to local councils to assist them in FRM for communities. It also works with other agencies to facilitate the consideration of flood risk in decisions on activities that reduce flood risk or influence increases in flood risk to NSW communities. These roles and responsibilities include leading the implementation of the policy through:

- direction and support to FRM in New South Wales through the policy, this manual and its toolkit, and legislation
- financial assistance to local councils for eligible activities for developing and implementing FRM plans under the FRM framework through the program
- technical FRM advice to government, council and state agencies through professional engineers specialising in understanding and managing flood risk and related matters; this helps councils and state agencies undertake their roles
- providing FRM advice to a range of interagency and national working groups and major projects
- providing and maintaining existing flood warning infrastructure and real time information from water level gauges in coastal areas of New South Wales. These gauges support flood predictions and warning and capture flood information to support future management.

5.2.2 Lead flood combat and EM agency

This lead agency acts as the flood combat agency and undertakes flood EM planning and response to help local communities respond to floods. Flood EM planning refers to the preparation of formal community-based plans of action that outline the threat, onset and aftermath of flooding. It is generally undertaken at different levels that may include state and local flood plans with the latter focusing on LGAs or parts of LGAs. Each of the plans include information on:

- the legislative basis for the plan and relationship with other plans
- the roles and responsibilities of each of the agencies, functional areas, councils and key stakeholders in the key EM stages of prevention, preparedness, response and recovery
- an outline of the flood threat in the area covered by the plan
- understanding the risk in different elements of the community
- strategies to manage the emergency response to flooding.

The lead flood combat and EM agency works with other agencies, including the lead agencies identified in this manual, to support the management of continuing risk to reduce the residual risks to the community. These roles and responsibilities include:

- coordinating the flood response including the evacuation and welfare of affected communities
- protecting persons from dangers to their safety and health, and protecting property from destruction or damage arising from floods, storms and tsunamis
- developing and maintaining flood intelligence systems to support flood EM planning
- undertaking and implementing flood combat and EM planning through the development and implementation of the state and local flood plans

- assisting in ongoing community awareness and education including telling the community how to prepare for, and how and when to act in response a flood threat
- assisting with the provision of flood warnings and associated response actions to the community
- providing expert flood EM planning advice to government
- working with councils to ensure flood EM is considered in setting strategic directions for the community
- participating in local EM and local FRM committees
- assisting with flood recovery arrangements.

5.2.3 Lead agency for Murray–Darling Basin rural floodplain management

The lead agency for rural floodplain management in the Murray–Darling Basin may develop and support implementation of rural floodplain management plans.

The key aim of rural floodplain management plans is to contribute to a sustainable, healthy and working floodplain by managing the development of new flood works and amendments to existing flood works to protect the passage of floodwater through the floodplain, while recognising the need to minimise the risk to life and property.

This includes preparing and implementing statutory rural floodplain management plans for priority rural areas with newer plans taking a whole-of-valley approach. These plans and associated background studies are strategic and consistent with natural resource policies and stakeholder requirements and include extensive community consultation. They can provide advice on limitations of flood control works that may influence flood behaviour; provide the framework for coordinating flood work development to minimise future changes to flooding behaviour; improve the environmental health of floodplains; and increase awareness of risk to life and property from the effects of flooding. They establish management zones with associated rules that clarify the type and location of flood works permitted to streamline the approval process for new and amended flood works.

Rural floodplain management plans are implemented by determining flood work approvals in accordance with plan rules and assessment criteria. An approval may be granted after assessing whether the work may have significant impacts on the floodplain environment, neighbouring properties, or health and safety, or whether particular conditions may be required to minimise any impacts. The government's independent regulator is responsible for the compliance and enforcement of the regulatory framework underpinning the type and location of flood works in rural areas.

5.2.4 Land-use planning lead agency

The lead agency for land-use planning works with the other agencies, including the other lead agencies identified in this section, to support the consideration of flooding, flood risk and associated EM risk in the land-use planning system. Key responsibilities include:

- preparation, review and administration of environmental planning instruments such as State Environmental Planning Policies (SEPPs) and LEPs that may identify and map flood prone land, prescribe permissible or prohibited land uses and the matters to be considered in relation to such flood prone land. As part of this role FRM information and advice is considered
- preparation and review of strategic land-use plans that identify flood hazards and outline priority land-use planning actions to mitigate risk, such as regional and district plans. As part of this role FRM information and advice is considered

- issuing of local planning directions, planning circulars and practice advice that support local councils to consider flood risk in their land-use planning activities in conjunction with the lead FRM agency
- prescription of the matters such as flood risk that are to be disclosed on planning certificates
- development and implementation of land-use planning legislation, regulation, state planning policies, planning directions and regional and district plans
- provision of land-use planning advice to local councils.

5.2.5 Responsibility for making flood information available

Local councils are responsible for providing flood information to their communities.

To support sharing of flood information the lead FRM agency and lead flood combat and EM agency work together to assist local councils to share information from flood projects completed under the program. This includes providing secure storage of all data and sharing of some data from local council flood projects and supporting state agency access to this flood information to inform decisions.

Other NSW agencies that develop and hold flood information relating to their own projects are encouraged to share this information where able.

5.2.6 NSW Government consent authorities

NSW Government consent authorities are responsible for assessment of state significant development and infrastructure that can both influence and be influenced by flooding. This should consider:

- objectives and provisions of the policy and this manual
- relevant legislation and government policies
- relevant SEPPs, LEPs and DCPs
- local flood information and FRM plans
- the need to avoid causing an increase in the threat to personal safety and to property and avoid any unwarranted increase in potential damage to public property and services
- FRM information and advice from local councils and the lead agency for FRM. This includes when considering the need for and reviewing flood impact and risk assessments (FIRAs), including the flood impacts:
 - of development decisions on new and modified developments and their users and the impacts of development on the flood risks to the existing community, and
 - on infrastructure and the impacts of infrastructure on flooding of the existing community in decisions to place, build, modify or upgrade infrastructure in the floodplain.

5.2.7 NSW Government infrastructure providers

NSW Government infrastructure providers are responsible for considering:

- the objectives the policy and principles of this manual
- relevant legislation
- relevant SEPPs, LEPs and DCPs
- local flood information and FRM plans

- the need to avoid causing an increase in the threat to personal safety and to property and avoid any unwarranted increase in potential damage to public property and services
- the availability of services to the community in the lead-up to, during and in recovery from floods
- expert FRM advice in review of FIRAs for major projects, including the flood impacts of infrastructure and the impacts of infrastructure on flooding of the existing community in decisions to place, build, modify or upgrade infrastructure in the floodplain
- the impacts of flooding and EM requirements of the community when planning new utilities or transport infrastructure.

They may also be required to:

- work with the lead flood combat and EM agency to undertake emergency planning, participate in flood operations and to maintain operability of utility services and transport infrastructure during floods
- maintain and operate state-owned flood infrastructure assets (such as levees, dams and weirs) so they can perform their intended flood function.

5.3 Australian Government roles

The Australian Government supports FRM. Some directly relevant Commonwealth agency roles are identified in FRM Guide AG01.

5.4 Roles beyond government

5.4.1 Non-government organisations and volunteers

Non-government and community organisations (often volunteers) play a role in strengthening disaster resilience. Australians often turn to them for support or advice during a disaster. The dedicated work of these organisations is critical to helping communities cope with and recover from a disaster. Governments partner with these organisations to communicate the disaster resilience message and to strengthen community disaster resilience.

5.4.2 Community responsibility

Communities are responsible for following the directions of EM and recovery agencies before, during and after a flood, and to seek their assistance where required. Therefore, it is important the community has both access to information to understand their flood risk, and input into how this risk is managed.

Individuals and households in the community share the responsibility for preventing, preparing for, responding to and recovering from floods. Active planning and preparation by community members, based on an awareness of the flood threat at their locality and local flood planning and associated advice, can assist in protecting life and property.

Individuals and households need to be aware of the flood threat they face and what to do about it. To do this they can draw on local council flood information and local flood planning and associated flood education and awareness campaigns.

Individuals are expected to remove themselves from potentially harmful situations where directed. They also need to be aware of the availability and coverage of flood insurance for their property and consider purchasing insurance to address their flood risks.

5.4.3 Insurers

Flood insurance is an important tool to help individuals and businesses recover after a flood. Where suitable information on flood risk exists, insurers have a role in facilitating the provision of flood insurance that fits within the limitations set in the insurers' individual portfolios.

5.4.4 Business

Businesses can play an important role in supporting community resilience to disasters. They provide jobs, resources, expertise, infrastructure and many essential services upon which the community depends. These roles are key in helping the community maintain continuity of services following a disaster.

Similar to households, businesses need to be aware of the flood threat they face and what to do about it. To do this they can draw on local council flood information and local flood emergency planning and associated flood education and awareness campaigns.

5.4.5 The courts

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

The Land and Environment Court can also establish legal principles that set out matters to be considered by consent authorities in land-use planning decision-making. Legal principles can lead to consequential change in the NSW planning system to address emerging or novel issues.

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.

The NSW Coroners Court may examine the circumstances and make findings in relation to flood related fatalities.

5.4.6 Developers

Consent authorities need to consider flood risk in development decisions. This includes both the flood risk to the new development and its users, and the impacts the development may have on the flood risk to the existing community.

To enable informed decisions about a proposed development, consent authorities require proponents to provide information and prepare reports on the impacts of the development on flood behaviour and the existing community, as well as the risks associated with the development and its use.

The assessment of a development proposal may result in the development proposal having to be altered and/or requiring mitigation measures that will limit the adverse impacts of the development on the flood risk or associated EM risk of the existing community to within acceptable levels. The lead flood combat and EM agency does not consider a site-specific flood response plan for a proposed development to be an effective measure to strategically and effectively manage EM risks to the community during flooding.

Proposed mitigation measures to offset impacts may require development approval and may be subject to additional approval requirements.

Developers may also be required to contribute to the costs of management measures required to limit the effects of their development on others.

6. Glossary

Term	Shortened form	Definition	Context for use/additional information
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	AEP is generally the preferred terminology. ARI is the historical way of describing a flood event; for example, a 1% AEP flood has a 1% or 1 in 100 chance of being reached or exceeded in any given year
Australian Height Datum	AHD	A common national surface level datum often used as a referenced level for ground, flood and flood levels	0.0m AHD corresponds approximately to mean sea level
Average recurrence interval	ARI	The long-term average number of years between the occurrence of a flood equal to or larger in size than the selected event	ARI is the historical way of describing a flood event. AEP is generally the preferred terminology; for example a 100-year ARI flood that has 1 in 100 chance of being reached or exceeded in any given year. It is equivalent to a 1% AEP flood
Catchment		The area of land draining to a specific location	It includes the catchment of the primary waterway as well as any tributary streams and flowpaths
Catchment flooding		Flooding due to prolonged or intense rainfall (e.g. severe thunderstorms, monsoonal rains in the tropics, tropical cyclones)	Types of catchment flooding include riverine, local overland and groundwater flooding
Chance		The likelihood of something happening that will have adverse or beneficial consequences	In FRM this generally relates to the adverse consequences of floods with chance being related to AEP; for example, 1% chance or 1 in 100 chance per year is equivalent to 1% AEP
Coastal inundation		Inundation due to tidal or storm-driven coastal events, including storm surges in lower coastal waterways. This can be exacerbated by wind-wave generation from storm events	
Consent authority		The authority or agency with the legislative power to determine the outcome of development and building applications	This may be the relevant local council or Minister

Term	Shortened form	Definition	Context for use/additional information
Consequence		The outcomes of an event or situation affecting objectives, expressed qualitatively or quantitatively	Consequences can be adverse (e.g. death or injury to people, damage to property and disruption of the community) or beneficial
Continuing flood risk		Risk to existing and future development that may be reduced by EM measures	Flood risk to the existing development and future development may be reduced by EM measures depending on flood constraints; however, these measures cannot remove all risk and a residual risk will remain
Defined flood event	DFE	The flood event selected as a general standard for the management of flooding to development	Aims to reduce the frequency of flooding but does not remove all flood risk; for example in selecting a 1% AEP flood as a DFE you are accepting that there is a 1 in 100 chance that a larger event will occur in any year. This risk is being built into the decision
Design flood		The flood selected as part of the FRM process that forms the basis for physical works to modify the impacts of flooding	The design flood may be considered the flood mitigation standard; for example, a levee may be designed to exclude a 2% AEP flood, which means that floods rarer than this may breach the structure and impact upon the protected area. In this case, the 2% AEP flood would not equate to the crest level of the levee, because this generally has a freeboard allowance, but it may be the level of the spillway to allow for controlled levee overtopping
Development		<p>May be treated differently depending on the following categorisation:</p> <p>infill development: the development of vacant blocks of land that are generally surrounded by developed properties and is permissible under current land zoning</p> <p>new development: development of a completely different nature to that associated with the former land-use (e.g. the urban subdivision of a previously rural area)</p>	<p>New developments involve rezoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power</p> <p>Redevelopment generally does not require either rezoning or major extensions to urban services</p>

Term	Shortened form	Definition	Context for use/additional information
		redevelopment: rebuilding in an area (e.g. as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale)	
Development control plan	DCP	See <i>Environmental Planning and Assessment Act 1979</i>	
Emergency management	EM	A comprehensive approach to dealing with risks to the community arising from hazards. It is a systematic method for identifying, analysing, evaluating and managing these risks	May include measures to reduce flood frequency or consequences through prevention and mitigation measures, and preparation, as well as response and recovery should a flood occur (see PPRR)
Existing flood risk		The risk an existing community is exposed to as a result of its location on the floodplain	Existing flood risk may be reduced by existing or proposed FRM measures leaving a residual flood risk to the existing community. Residual flood risk may be further reduced by addressing continuing risk
Flood		A natural phenomenon that occurs when water covers land that is normally dry. It may result from coastal inundation (excluding tsunamis) or catchment flooding, or a combination of both	Flooding results from relatively high stream flow that overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flowpaths associated with major drainage, and/or oceanic inundation resulting from super-elevated ocean levels
Flood (hydrologic and hydraulic) modelling		Hydrologic and hydraulic computer models to simulate catchment processes of rainfall, runoff, stream flow and distribution of flows across the floodplain or similar	They typically involve consideration of the local flood history, available collected data, and the development of models that are calibrated and validated, where possible, against historic flood events and extended to determine the full range of flood behaviour
Flood affected land		Equivalent to flood prone land	See the definition of flood prone land
Flood awareness		An appreciation of the likely effects of flooding, and a knowledge of the relevant flood warning, response and evacuation procedures facilitating prompt and effective community response to a flood threat	In communities with a low degree of flood awareness, flood warnings may be ignored or misunderstood, and residents confused about what they should do, when to evacuate, what to take with them and where to go
Flood constraints		Key constraints that flooding place on land	These include flood function, flood hazard, flood range, and flood emergency response classification. These can be used to inform FRM including

Term	Shortened form	Definition	Context for use/additional information
			consideration of options such as mitigation works, EM and land-use planning
Flood damage		The tangible (direct and indirect) and intangible costs (financial, opportunity costs, clean-up) of flooding	Tangible costs are quantified in monetary terms (e.g. damage to goods) Intangible damages are difficult to quantify in monetary terms and include the increased levels of physical, emotional and psychological health problems suffered by flood affected people that are attributed to a flood
Flood education		Seeks to provide information to raise awareness of flooding so as to enable individuals to understand how to manage themselves and their property in response to flood warnings	It can support a state of flood readiness
Flood evacuation		The movement of people from a place of danger to a place of relative safety, and their eventual return	People are usually evacuated to areas outside of flood prone land with access to adequate community support Livestock may be relocated to areas outside of the influence of flooding
Flood fringe areas		That part of the flood extents for the event remaining after the flood function areas of floodway and flood storage areas have been defined	
Flood function		The flood related functions of floodways, flood storage and flood fringe within the floodplain	Flood function is equivalent to hydraulic categorisation
Flood hazard		A flood that has the potential to cause harm or conditions with the potential to result in loss of life, injury and economic loss	The degree of hazard varies with the severity of flooding and is affected by flood behaviour (extent, depth, velocity, isolation, etc.)
Flood impact and risk assessment	FIRA	A study to assess flood behaviour, constraints and risk, understand off-site flood impacts on property and the community resulting from the development, and flood risks to the development and its users	These studies are generally undertaken for development and are to be prepared by a suitably qualified engineer experienced in hydrological and hydraulic analysis for FRM
Flood liable land		Equivalent to flood prone land	See the definition of flood prone land

Term	Shortened form	Definition	Context for use/additional information
Flood plan (local or state)	Local (LFP)	A subplan of an EM plan that deals specifically with flooding; they can exist at state, zone and local levels	The NSW Government develops flood plans as a legislative responsibility to determine how best to respond to floods. These community-based plans describe the risk to the community, outline agency roles and responsibilities, the agreed community emergency response strategy and how floods will be managed
Flood planning area	FPA	The area of land below the FPL	The FPA is generally developed based on the FPL for typical residential development. Different types of development may have different FPLs applied within the FPA. In addition development controls will vary across the FPA due to varying flood constraints
Flood planning level	FPL	The combination of the flood level from the DFE and freeboard selected for FRM purposes	Different FPLs may apply to different types of development Determining the FPL for typical residential development should generally start with a DFE of the 1% AEP flood plus an appropriate freeboard (typically 0.5 metres). This assists in determining the FPA
Flood prone land		Land susceptible to flooding by the PMF event	Flood prone land is also known as the floodplain, flood liable land and flood affected land
Flood risk		Risk is based on the consideration of the consequences of the full range of flood behaviour on communities and their social settings, and the natural and built environment	See also risk. The degree of risk varies with circumstances across the full range of floods. It is affected by factors including flood behaviour and hazard, topography and EM difficulties
Flood risk management	FRM	The management of flood risk to communities	
Flood Risk Management Manual	the manual	This manual	
Flood storage areas		Areas of the floodplain that are outside floodways which generally provide for temporary storage of floodwaters during the passage of a flood and where	See also flood function, floodways and flood fringe areas

Term	Shortened form	Definition	Context for use/additional information
		flood behaviour is sensitive to changes that impact on temporary storage of water during a flood.	
Flood study		<p>A comprehensive technical investigation of flood behaviour undertaken in accordance with the principles in this manual and consistent with associated guidelines</p> <p>A flood study defines the nature of flood behaviour and hazard across the floodplain by providing information on the extent, level and velocity of floodwaters, and on the distribution of flood flows considering the full range of flood events up to and including extreme events, such as the PMF</p>	A flood study is different from a flood impact and risk assessment (FIRA)
Flood warnings		Warnings issued when there is more certainty that flooding is expected, are more targeted and are issued for specific catchments	Flood warnings include more specific predictions of the severity of expected flooding and may give quantitative figures such as expected river water heights at gauge stations
Floodplain		Equivalent to flood prone land	See the definition of flood prone land
Floodways		Areas of the floodplain which generally convey a significant discharge of water during floods and are sensitive to changes that impact flow conveyance. They often align with naturally defined channels.	<p>See also flood function, floodways and flood fringe areas</p> <p>Floodways are sometimes known as flow conveyance areas</p>
Flow		The rate of flow of water measured in volume per unit time; for example, cubic metres per second (m ³ /s)	Flow is different from the speed or velocity of flow, which is a measure of how fast the water is moving
Freeboard		A factor of safety typically used in relation to the setting of minimum floor levels or levee crest levels	Freeboard aims to provide reasonable certainty that the risk exposure selected in deciding on a specific event for development controls or mitigation works is achieved. Freeboards for development controls and mitigation works will differ. In addition freeboards for development control may vary with the type of flooding and with the type of development

Term	Shortened form	Definition	Context for use/additional information
Frequency		The measure of likelihood expressed as the number of occurrences of a specified event in a given time	For example, the frequency of occurrence of a 20% AEP or 5-year ARI flood is once every five years on average
FRM measures		Measures that can reduce flood risk	FRM measures may include FRM, flood mitigation, EM and land-use planning measures
FRM options		The FRM measures that might be feasible for the management of a particular area of the floodplain	Preparation of an FRM plan requires a detailed evaluation of FRM options
FRM plan		A management plan developed in accordance with the principles in this manual and its supporting guidelines	Previously known as a floodplain risk management plan or floodplain management plan. It may describe how particular areas of flood prone land are to be used and managed to achieve defined objectives
FRM study	FRM study	A management study developed in accordance with the principles in this manual and its supporting guidelines	Previously known as a floodplain risk management study or floodplain management study
Future flood risk		The risk future development and its users are exposed to as a result of its location on the floodplain	Future flood risk may be reduced by existing or proposed FRM measures and land-use planning controls that consider the flood constraints on the land. This leaves a residual flood risk to the new development and its users. This residual flood risk may be further reduced by addressing continuing flood risk
Gauge height		The height of a flood level at a particular water level gauge site related to a specified datum	The datum may or may not be the AHD
Hazard		A source of potential harm or conditions that may result in loss of life, injury and economic loss due to flooding	
Hydraulics		The study of water flow in waterways and flow paths; in particular, the evaluation of flow parameters such as water level and velocity	

Term	Shortened form	Definition	Context for use/additional information
Hydrology		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	
Likelihood		A qualitative description of probability and frequency	See also frequency and probability
Likelihood of occurrence		The likelihood that a specified event will occur	With respect to flooding, see also AEP and ARI
Local environmental plan	LEP	See <i>Environmental Planning and Assessment Act 1979</i>	
Local overland flooding	LOF	Inundation by local runoff on its way to a waterway, rather than overbank flow from a waterway	
Loss		Any negative consequence or adverse effect, financial or otherwise	
Merit-based approach		Weights 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 wellbeing 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 environmental planning instruments At a site-specific level, it involves consideration of the merits of a development consistent with council LEPs, DCPs and local FRM policies, and consistent with FRM plans
NSW Floodplain Management Program	the program	The NSW Government's program of technical support and financial assistance to local councils to enable them to understand and manage their flood risk	The program, manual and FRM guides support the delivery of the policy through a partnership across governments
NSW Flood Prone Land Policy	the policy	The NSW Flood Prone Land Policy	
Prevention, preparedness, response and recovery	PPRR	Involves: prevention: to eliminate or reduce the level of the risk or severity of emergencies	In the flood context prevention involves FRM (including flood mitigation), EM and land-use planning measures

Term	Shortened form	Definition	Context for use/additional information
		<p>preparedness: enhances the capacity of agencies and communities to cope with the consequences of emergencies</p> <p>response: to ensure the immediate consequences of emergencies to communities are minimised</p> <p>recovery: measures that support individuals and communities affected by emergencies in the reconstruction of physical infrastructure and restoration of physical, emotional, environmental and economic wellbeing</p>	
Probability		A statistical measure of the expected chance of a flood	For example AEP
Probable maximum flood	PMF	The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation (PMP), and where applicable, snow melt, coupled with the worst flood producing catchment conditions	<p>This is equivalent to the probable maximum precipitation flood in Australian Rainfall and Runoff (ARR)</p> <p>The PMF in ARR is used for estimating dam design floods</p>
Probable maximum precipitation	PMP	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 Organization 1986)	PMP is the primary input to PMF estimation
Rainfall intensity		The rate at which rain falls, typically measured in millimetres per hour (mm/h)	Rainfall intensity varies throughout a storm in accordance with the temporal pattern of the storm
Residual flood risk		The risk to the existing and future community that remains with FRM, EM and land-use planning measures in place to address flood risk	FRM measures cannot remove all flood risk, but rather they reduce residual flood risk
Risk		'The effect of uncertainty on objectives' (ISO 2018)	See also flood risk. Note 4 of the definition in ISO31000:2018 also states that 'risk is usually expressed in terms of risk sources, potential events, their consequences and their likelihood'

Term	Shortened form	Definition	Context for use/additional information
Risk analysis		The systematic use of available information to determine how often specified (flood) events occur and the magnitude of their likely consequences	
Runoff		The amount of rainfall that ends up as streamflow, also known as rainfall excess	
State Environmental Planning Policy	SEPP	See <i>Environmental Planning and Assessment Act 1979</i>	
Scenario		A scenario may relate to current, historical or assumed future floodplain, catchment and climate conditions	Flood behaviour varies over time with changes in key catchment and floodplain (such as the scale of development) and climatic conditions (including climate change), and due to the implementation of FRM measures. A range of scenarios are generally needed to understand and assess flood behaviour
Stage		Equivalent to water level; measured with reference to a specified datum	Measurement may relate to AHD, a local datum or a local water level gauge
Storm surge		The increases in coastal water levels above predicted astronomical tide level (i.e. tidal anomaly) resulting from a range of location-dependent factors	These factors may include the inverted barometer effect, wind and wave setup and astronomical tidal waves, together with any other factors that increase tidal water level
Velocity		The speed of floodwaters, measured in metres per second (m/s)	
Vulnerability		The degree of susceptibility and resilience of a community, its social setting, and the built environment to flooding	Vulnerability is assessed in terms of ability of the community and environment to anticipate, cope and recover from flood events

7. References

Australian Institute for Disaster Resilience (AIDR) 2017, Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia, Australian Institute for Disaster Resilience, East Melbourne.

Council of Australian Governments (COAG) 2011, *National Strategy for Disaster Resilience*, Commonwealth of Australia, Canberra.

Council of Australian Governments (COAG) 2018, *National Disaster Risk Reduction Framework*, Commonwealth of Australia, Canberra.

Department of Infrastructure, Planning and Natural Resources (DIPNR) 2005, *Floodplain Development Manual: the management of flood liable land*, DIPNR 05_020, NSW Department of Infrastructure Planning and Natural Resources, Sydney.

Department of Planning and Environment (Environment Energy and Science Division), (DPE EES) 2022a, *NSW Flood Prone Land Policy*, NSW Department of Planning and Environment (Environment, Energy and Science Division), Sydney.

Department of Planning and Environment (Environment Energy and Science Division), (DPE EES) 2022b, *NSW Flood Risk Management Manual: The management of flood liable land*, NSW Department of Planning and Environment (Environment, Energy and Science Division), Sydney.

Department of Planning and Environment (Environment Energy and Science Division), (DPE EES) 2022c, *Flood Risk Management Guide: Administration Arrangements*, (AG01), NSW Department of Planning and Environment (Environment, Energy and Science Division), Sydney.

Deloitte Access Economics 2015, *Building our nation's resilience to natural disasters*, for the Australian Business Roundtable for Disaster Resilience and Safer Communities, Deloitte Access Economics.

Deloitte Access Economics 2017, *Building Australia's resilience to natural disasters*, for the Australian Business Roundtable for Disaster Resilience and Safer Communities, Deloitte Access Economics.

Handmer J, Ladds M and Magee L 2018, Updating the costs of disasters in Australia, *Australian Journal of Emergency Management*, vol.33:2, pp.40–46.

Haynes K, Coates L, Dimer de Oliveira F, Gissing A, Bird D, van den Honert R, Radford D, D'Arcy R and Smith C 2016, *An analysis of human fatalities from floods in Australia 1900–2015*, report for the Bushfire and Natural Hazard Cooperative Research Centre.

International Organization for Standardization (ISO) 2018, *ISO 31000:2018 Risk Management – Guidelines*, International Organization for Standardization, Geneva, Switzerland.

NSW Government 1984, *NSW Flood Prone Land Policy*, NSW Government.

NSW Government 1986, *NSW Floodplain Development Manual*, NSW Government.

United National Office for Disaster Risk Reduction (UNISDR) 2015, *Sendai Framework for Disaster Risk Reduction 2015-2030*, United National Office for Disaster Risk Reduction, Geneva, Switzerland.

World Meteorological Organization 1986, *Manual on Estimation of Probable Maximum Precipitation (PMP)*, 2nd edition, WMO-No. 1045, World Meteorological Organization, Geneva.

Appendix A: History of flood risk management in New South Wales

Introduction

Many NSW towns and cities and their supporting infrastructure are located on inland and coastal floodplains. This is due to early reliance on maritime and riverine transport, to provide ready access to water, to support the agricultural industry, which is located on the fertile soils of floodplains, and to utilise more gently sloping land for easier building.

These urban areas are affected to varying degrees by flooding and in some cases, the influence of the ocean, which can be exacerbated by storm events. They can also be affected by water flowing overland to waterways. They often need measures to limit the impacts of flooding on their existing communities and new and modified development to support their long-term sustainability and resilience to flooding.

Flooding in rural areas also needs to be managed to ensure floodplains can perform their natural flood function of flow conveyance and storage, including the continuity of flood flows to flood-dependent ecosystems. The protection of agricultural activities from flooding needs to consider these aspects and the benefits of flooding for the fertility of the floodplain.

Costs of flooding

Development of catchments and floodplains has not only changed their natural characteristics but has often also exposed communities to the impacts of floods and the associated risks.

Occupation of floodplains, whether due to the legacy of former decisions or from decisions to place new development in the floodplain, comes with an inherent risk.

People, communities and infrastructure are vulnerable to flooding and floodplain occupation exposes them to floods. In Australia between 1900 and 2015 there were 1859 recorded deaths due to flooding, with 683 of these in New South Wales (Haynes et al. 2016). Flood damages in Australia between 1967 and 2013 were around \$48 billion (considering only disasters above a \$10 million cost threshold) (Handmer et al. 2018).

The scale of these impacts on communities is growing due to the cumulative impacts of new development on flooding and changes in catchment and floodplain characteristics. It can also grow due to the impacts of climate change on sea levels and flood producing rainfall events. The impacts associated with climate change are expected to magnify the impacts of natural disasters and increase their frequency.

The annual cost of disasters to the Australian economy over the last 10 years has been around \$18 billion, with this expected to grow to \$39 billion per annum by 2050 (Deloitte Access Economics 2017). These costs exclude intangibles, which are estimated to be at least equal to, if not greater than, the tangible costs (Deloitte Access Economics 2015).

Evolution of flood risk management in New South Wales

Flood risk management in New South Wales has evolved over time in response to significant flood events and reviews. Going forward it is being managed strategically through the FRM framework and risk-based FRM process. This is consistent with national best practice (AIDR 2017) and international risk management standards (ISO 2018).

Focus on existing development from the 1950s to early 1970s

Modern FRM practice has evolved from an early focus on mitigating flood impacts to existing development. This approach followed a series of large floods that devastated communities across coastal and inland New South Wales in the late 1940s and 1950s. Some examples include the 1955 flood at Maitland, the 1956 flood at Wagga Wagga and the 1949 and 1950 floods at Kempsey. The focus of this approach was on undertaking mitigation works that would reduce the impacts on the existing community, or the likelihood of these impacts.

A prescriptive approach to development in the 1970s

The initial focus on mitigation was expanded in the 1970s to include uniform land-use planning controls. These were aimed at limiting the frequency and exposure of new developments and their users to floods. This change followed a government review that found that whilst mitigation works were very successful in managing risk to existing development within the community, new development was being built without effective consideration of flood risk.

Whilst this approach aimed at limiting the growing costs of flood impacts due to new development, the effectiveness of uniform planning controls based on the planning flood or historic equivalent in managing flood risk was limited due to the wide variation in flood behaviour and flood range across and between individual floodplains in New South Wales.

In some cases, the use of land in the floodplain was inappropriately constrained and potentially sterilised. In other cases, land use was not compatible with the range of flood behaviour and hazard, leading to the community being exposed to excessive flood risks.

This approach was supported by location-based flood mapping developed by the NSW Government based on available information and considering local factors and influences on flooding.

Change to a merit-based approach in the 1980s

The NSW Government introduced the merit-based NSW Flood Prone Land Policy in 1984 as it moved away from stringent uniform planning controls that had created significant limitations in the ability to manage the full range of flood risk. Primary responsibility for FRM for local communities was devolved to local councils in their LGAs. The 1984 policy was supported by:

- the 1986 Floodplain Development Manual
- the NSW Floodplain Management Program, which continues today and provides local councils with technical direction, guidance and support, and financial assistance for developing, reviewing and implementing FRM plans to better understand and make informed decisions on the management of flood risk and in developing in the floodplain
- a limited legal indemnity for decisions made and information provided, now under s.733 of the LG Act.

The 1986 Floodplain Development Manual introduced the need for further consideration of factors that influence risk to communities beyond hazard and flood function, including: size of flood, effective warning time, flood awareness, rate of rise of flood waters, depth and velocity of flood waters, duration of flooding, evacuation considerations and potential flood damages.

Further emphasis on EM planning in the 1990s

The introduction of EM legislation in the late 1980s resulted in more strategic EM planning for floods being routinely undertaken to provide an effective, strategic and informed basis for government to coordinate and inform community response to flooding. The development of these plans under NSW Government leadership used the best available flood information, including that derived from studies under the FRM process. This also recognised the importance of FRM measures to improving the emergency response for communities. This included measures such as expansion of flood warning systems and the establishment of the NSW flood warning network, which has continued to grow through the partnership between local council and state and Commonwealth agencies.

Considering rare floods and local overland flooding in the 2000s

Floods that exceeded the scale of events used for many FRM works and for limiting exposure to flooding occurred at Nyngan (1990), Coffs Harbour (1996) and Wollongong (1998). These floods highlighted the importance of the flood EM planning through local flood plans to support EM. They also resulted in an increased focus on gaining knowledge of rarer to extreme floods to develop an understanding of their impacts on the community and provide information to support flood EM planning.

The scale of impacts on communities from local overland flooding was also recognised. The processes of this manual were extended to provide local councils with access to support under the NSW Floodplain Management Program to examine and manage larger-scale local overland flood problems.

The 2005 Floodplain Development Manual was released and gazetted to address these issues and lessons learnt since 1986. This update also:

- included linkages to rural floodplain management planning processes under the *Water Management Act 2000*
- considered the principles of ESD when managing risk associated with human occupation of the floodplain
- identified the importance of considering the cultural significance of areas on the floodplain to Aboriginal communities
- recognised the potential impacts of climate change impacts on flood behaviour
- emphasised maintaining and enhancing the riverine and floodplain environments, including consideration of the needs of threatened species, population and ecological communities as part of flood modification measures.

Considering national best practice and improving flexibility – 2022

This update to the manual and its supporting guidance considers:

- the National Strategy for Disaster Resilience (COAG 2011) and its focus on community resilience and shared responsibility for managing disasters
- the National Disaster Risk Reduction Framework (COAG 2018)
- the Sendai Framework for Disaster Risk Reduction (UNISDR 2015)
- updated national best practice guidance on managing flood risk as outlined in *Managing the floodplain* (AIDR 2017) and its range of supporting guides and other AIDR handbooks
- lessons learnt in managing floods and the impacts of floods since the release of the 2005 Floodplain Development Manual. These include the impacts of rare floods, such

as the Dungog 2015 flood in New South Wales and the results of major flooding in other states and associated inquiries

- changing administrative arrangements within the NSW Government
- changing technology and improved methods to understand and manage flood risk developed in New South Wales, Australia and internationally.

Achievements of flood risk management in New South Wales

New South Wales has been very active in FRM. The policy and manual have been successfully used to assist with understanding and managing flood risk since 1986. This manual maintains the core intent and risk-based processes that led to this success. It is consistent with national guidance.

Local councils, with technical direction and assistance from the NSW Government and financial support from the state (through the NSW Floodplain Management Program and other funding programs), and in some cases the Australian Government, have:

- completed thousands of flood studies
- developed hundreds of FRM plans
- implemented many hundreds of millions of dollars of flood mitigation works
- provided valuable information to inform the community on flood risk
- provided information for consideration in EM, land-use and infrastructure planning.

The NSW Floodplain Management Program has resulted in New South Wales having:

- studies in many flood exposed urban areas
- an extensive flood warning network that gives detailed warnings to many communities
- levees constructed or upgraded to reduce how frequently floods impact on many communities
- flood mitigation works such as flood basins being constructed to reduce downstream flood impacts in many communities
- houses removed through targeted voluntary purchase from some extremely hazardous areas where flood risks cannot otherwise be effectively managed
- flood EM planning that is informed by quality flood information
- land-use planning controls that consider flooding in most LGAs.

This has led to significant reductions in flood risk to many existing communities and to consideration of flood risk in new and modified development on the floodplain.

However, substantial effort is still required to:

- improve our knowledge of flood behaviour and risk, and how these may change into the future
- implement the actions identified and adopted in FRM plans
- limit the growing risks due to new or modified development on the floodplain through strategic land-use planning and development controls that effectively consider flood constraints
- respond to changing risks due to growing population and changing demographics, limitations on land availability and climate change.

This requires a continued focus on:

- studies that provide an understanding and information on changing risks

- FRM plans that are robust, implementable and consider changing risks
- implementation of actions from FRM plans to reduce risks to the community, improving community resilience
- use of flood information and risk in decisions that can influence flood risk, such as infrastructure planning and new development on the floodplain
- use of new knowledge on flooding in EM planning.