

Part 1: Assessing flood risks and sharing information

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Flood risk is a combination of the likelihood of a flood and its consequences when it does occur. Flood risk analysis involves understanding:

- the probability of flood events
- the population at risk
- the average annual damages associated with different events.

Future flood maps will consider a range of floods and be updated periodically to take account of changes to flood risk.

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Flood studies use various available tools to analyse the magnitude, frequency and impact of floods, as well as the damages they cause and potential risk treatment options.

Flood study outputs will be tailored for use by various stakeholders, including individuals, communities, emergency response organisations, government agencies, and others. They will provide concrete information about the real world consequences of floods of different sizes that can be used to make informed decisions.

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The Strategy identifies opportunities to share flood risk information with communities, businesses and emergency response agencies so that they can each better manage their risks.

It recognises the value of local knowledge through community involvement in the flood studies that develop flood maps and gathering data before, during and after floods. Department of Environment, Land, Water & Planning will:

- set flood mapping standards to meet the purposes of a range of users
- maintain and continually improve Victoria's flood intelligence platform.

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10. Flood risk metrics

Flood risk is a combination of the likelihood of a flood occurring, the consequences when it does occur and the vulnerability of those affected. Flood risks are the result of the ways in which people choose to use those parts of the landscape that flood.

Flood risks vary with the frequency of exposure to flood hazards, the severity of the hazard, and the vulnerability of the community, the built environment and farming systems. Understanding these interactions can inform decisions about how to manage flood risks.

Flood risks must be quantified to be able to rank their relative seriousness. This involves being able to measure:

- the probability of flood events
- the population exposed to flood hazard
- the economic damage associated with different events.

10.1 Annual Exceedance Probability

Floods of different sizes cause different amounts of damage and the size of a flood is linked to the probability of its occurrence. That probability can be expressed in several ways. Floodplain managers tend now to refer to the probability each year of a certain size flood being equalled or exceeded; they refer to this as the percentage Annual Exceedance Probability (AEP).

Annual Exceedance Probability (AEP)

The likelihood of the occurrence of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood flow of 500 m³/s has an AEP of 5%, it means that there is a 5% chance (i.e. a one-in-20 chance) of a flow of 500 m³/s or larger occurring in any one year.

The term AEP reinforces the fact that there is an ongoing flood risk every year – regardless of how recently there was a similar flood. In contrast, the term Average Recurrence Interval (ARI), where probability is expressed as a return period in years, is now actively discouraged.

Technically, these terms are interchangeable, but psychologically ARI can be misleading. People can be tempted to think that if they experience a ‘1-in-100-year’ flood, their property will then be safe for another 100 years. In reality, there is a 1% chance that they will experience a flood of the same size the next year.

Flood studies (Section 11.1) provide a sound technical basis for developing calibrated and verified computer models that consider historic floods. These models help us understand the probability of floods of different sizes occurring and the impacts of floods of different probabilities. Models can also help us understand the probability that floods of a similar size to past events will recur.

The estimated probability of a flood of a given size occurring remains the same from year to year – unless the flood regime is altered (e.g. by the presence of a new dam or levee system) or new data leads to statistical estimates being revised. Because both continue to change, flood studies must be renewed periodically and flood maps updated.

Priorities for new and revised flood mapping will be identified through Regional Floodplain Management Strategies (Section 26).

Policy 10a

- The Victorian Government will apply mapping standards for all future flood maps included in Victoria’s flood databases. Future flood maps will be designed to meet the needs of land use planning, flood emergency planning, Aboriginal cultural heritage considerations, insurance assessments and the declaration of minor, moderate and major flood warnings where those flood class levels have been defined.
- Flood mapping will be linked to flood monitoring gauges, where they exist.

10.2 Population exposed to flood hazard

Floods put people who live, work or travel on the floodplain at risk of social disruption, financial loss, disease, injury or possibly death. The nature of these risks can change with demographic trends and with the effectiveness of flood warnings and emergency responses.

There are different ways to measure the population at risk, depending on the detail required. In general, the larger the population at risk, the more people who need to be warned and, if necessary, evacuated.

The population at risk is not just about total numbers however, the relative vulnerability of the people at risk is also important. Strategic land use planning and emergency management planning therefore need to consider vulnerable sectors of the community at the local level. People in hospitals, nursing homes, schools, childcare facilities and corrective facilities are particularly vulnerable to flood hazards, as are older people and people with limited mobility.

10.3 Average Annual Damage

Floods are generally regarded as causing three types of damage:

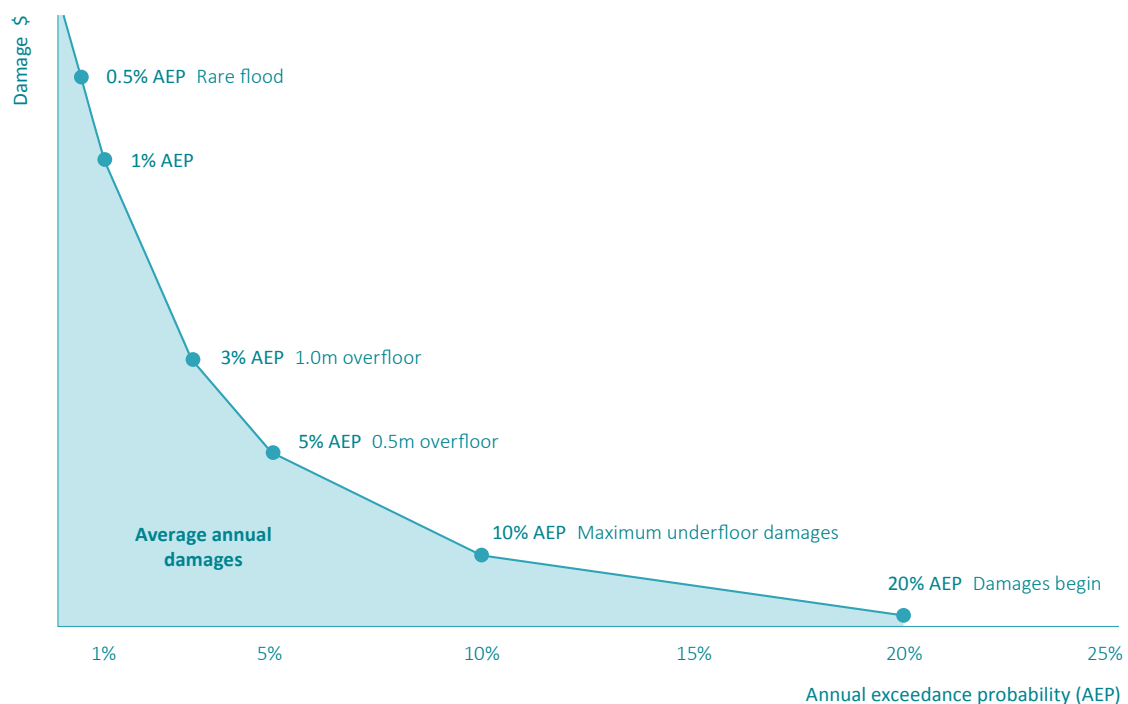
- Direct tangible damages include damage to the structure and contents of buildings, agricultural enterprises and regional infrastructure.
- Indirect tangible damages arise from disruptions to community wellbeing, economic activities and social activities. They include the costs of emergency response, clean-up, community support and lost production, as well as disruptions to transport, commerce and employment.
- Intangible damages cannot be quantified in monetary terms, despite their significance. They include trauma, stress and the loss of cultural heritage, biodiversity and threatened habitats.

Floods of different sizes cause different amounts of damage (Figure 7). For a given flood-prone area, the damage caused by floods of various magnitudes can be averaged to determine the Average Annual Damage (AAD).

AAD provides a basis for comparing the economic effectiveness of different structural and non-structural mitigation measures, allowing the costs of mitigation to be compared with its benefits.

Figure 7: Melbourne Water flood damage curve

The estimated contribution to annual average damage by floods of decreasing magnitude. The shaded area shows the total estimated damage in any given year. (AED damage calculation only includes tangible impacts).



11. Evaluating flood risk

11.1 Detailed flood risk evaluations (flood studies)

Floods are potentially one of the most predictable disasters confronting Victoria. Tools are available to analyse their magnitude, frequency and impact on the landscape. The length of time before rain falling on a catchment aggregates into flooding on the floodplain can be predicted, with varying degrees of precision.

While some areas can be protected from flooding or floor levels can be raised, it is not economical, feasible or even desirable to eliminate flooding. Protecting part of a floodplain from flooding will often increase flood impacts elsewhere.

Flood damages and trauma can be reduced by using credible data about flood behaviour, such as flood heights, flood extents and flood probabilities. To collect that data, continual improvement of contemporary knowledge of flood behaviour is required.

Detailed risk evaluations, in the form of flood studies, can fill gaps in knowledge and help communities consider flood management options. Their usefulness depends on their technical rigour. High standards apply for complex flood situations with high – and potentially increasing – risk exposure. Less detailed assessments are used in areas of lower population density and the AAD are low. Flood studies are not just an assessment of flood behaviour, they also analyse risk treatment options (Table 4).

Figure 8: Roles of different levels of government



Melbourne Water works in partnership with LGAs in the preparation of flood studies. Outside the Melbourne Water area, LGAs usually lead the preparation of flood studies, with the CMAs providing technical support. The individual roles in any given flood study depend on their capacity and their history of teamwork. The level of support varies with the capacity of the LGA with smaller LGAs being given more support. Regional Floodplain Management Strategies will provide clarity about how the roles will generally be shared in each region. The costs are shared equally between LGAs, and the Victorian and Australian Governments (Figure 8).

Flood studies must consider all sources of flooding in the study area, as well as the interactions between them.

Case study: Natimuk Flood Investigation

On 12 January 2011, more than 115 mm of rain fell on the Natimuk Creek catchment. Within a day, the small Wimmera town of Natimuk, between Horsham and Edenhope, was flooded.

Residents tried to hold the floodwaters back with sandbags, but despite their best efforts water flowed through many homes and businesses. The rapidly rising water took everyone by surprise.

The people of Natimuk were frustrated by the lack of information about how bad the flood was going

to get; it came as a shock when authorities began to advise them to leave their homes.

Wimmera CMA and Horsham Rural City Council have moved to better prepare Natimuk's 700 residents for future flooding. The Natimuk flood investigation was finished in early 2013. Between them, Horsham City Council, the Victorian Government (through the CMA) and the Australian Government shared the total cost of \$150,000. The people of Natimuk played an active part in the investigation, providing local knowledge at community project meetings, sharing ideas on the local

Facebook page and debating options at the town's pub.

The Natimuk community now has access to detailed flood mapping and information about a range of floods. The VICSES local flood guide shows accurate local flood maps and other information drawn from the investigation. Horsham City Council has worked with the Victorian Government and Wimmera CMA to install a stream flow gauge and rain gauge on the creek upstream of town. These gauges will send real time alerts about rising creek flows to a central location for dissemination to the community.

They must seek to:

- model the hydrologic inputs – including rainfall and runoff – that lead to floods of different sizes and calibrate these models against historic floods
- model the hydraulic behaviour of floods – including flood heights, extents and velocities as they vary with time – and calibrate these models against historical floods
- understand the varying hydraulic nature of the floodplain being studied
- understand the varying flood hazards within the floodplain
- assess the scale of potential flood damages for the existing community
- assess the potential for flood damage on areas of the floodplain that may be considered for future development
- analyse risk treatment options
- consult with local communities to take advantage of local knowledge
- consult with local Aboriginal communities to ensure cultural values are considered in assessing and mapping flood risks
- assess the consequences of floods of different sizes
- capture the local community’s experience and knowledge of floods.

Flood study outputs must be capable of being used by a variety of stakeholders. They are useful only if individuals, communities, government agencies and



Road closed due to floodwater at Narre Warren in 2011.

Source: Darren Dashwood

other organisations have access to, can understand, and act on high-quality information about the risks of flooding. The outputs should be integrated into the relevant flood database, where they can be made readily accessible.

Table 4: Flood risk evaluations

The process of developing flood studies showing the data required, how it is processed and benefits to community.

Inputs	Assessment	Outcomes
Rainfall records	Review data	Informed community
Streamflow data	Construct hydrologic and hydraulic models	Emergency planning guidance
Local knowledge	Calibrate/validate models using historic flood records	Guidance for land use planning management and building regulation
Historic flood records	Assess the impacts of a range of floods, including smaller, frequent floods to large, rare floods	Total flood warning system requirements
Landuse information	Assess the consequences of flooding for important infrastructure	Options for flood mitigation works
Aboriginal cultural heritage advice	Assess the costs of floods	
Topographic data	Assess the potential benefits of flood mitigation, including physical works and community actions	
Hydraulic structures and dams		
Previous studies		
Coastal hazard data		

11.2 Evaluating mitigation options

There are several steps in moving from a flood study to on-ground action. In practice, the challenge is to determine how much of this work can and should be done in parallel rather than in sequence. This varies with the degree of difficulty involved in securing:

- viable risk management options
- consistency with legislation and with the policies of the partners involved
- integration with statutory and strategic planning
- community support
- priority in capital funding programs
- ongoing funding for management and maintenance
- inter-agency commitment to seeing the action plan implemented.

As a general rule, the process should be condensed as much as practicable. It is important to capitalise on community receptiveness to flood mitigation options (including planning controls) – especially if the planning is being done soon after a flood. If the process drags out too long, the risk is that essential community support will diminish.

These processes are being accelerated significantly by ensuring that flood studies provide more than maps of flood levels for different flood events. Flood study outputs will now include:

- draft Planning Scheme Amendments (Section 13.3)
- preferred elements for a Total Flood Warning System (Section 16)
- preferred options for flood mitigation measures (Section 17.4.1)
- drafts of the relevant components of the Municipal Flood Emergency Plan (MFEP) (Section 22).

Not every flood study will require all these outputs. For example, in sparsely populated rural areas, the main outputs might be flood maps and a draft Planning Scheme Amendment. In such areas, individual actions could involve planning permits for constructing levees around dwellings and curtilages (with minimal third-party impacts), or a landowner applying for a permit to maintain existing infrastructure on Crown land (Section 17.4.3).

Flood study outputs must provide flood-prone communities with concrete information about the real-world consequences of floods of different sizes. They must help the VICSES engage with flood-prone communities as they think through their mitigation options, and engage with culturally and linguistically diverse communities through VICSES's FloodSafe Program. They must also help the VICSES to prepare Local Flood Guides that explain local flood risks and provide advice on how to prepare for and respond to floods.

Policy 11a

- All flood studies will, unless there are compelling reasons to the contrary, include the following outputs:
 - draft Planning Scheme Amendments
 - preferred elements for a Total Flood Warning System
 - preferred options for flood mitigation measures
 - drafts of the relevant components of the Municipal Flood Emergency Plan.

Case study: Corangamite Planning Scheme flood controls at Skipton

The township of Skipton straddles Mount Emu Creek about 50 kilometres west of Ballarat where the Hamilton Highway crosses the creek. The town's commercial centre and many residential properties were severely flooded in September 2010 and January 2011. The 2011 flood was the worst on record and residents had limited information to guide them in preparing their properties for the impact.

In early 2013, Glenelg Hopkins CMA and Corangamite Shire Council worked with the Skipton community to complete the Skipton Flood Investigation. Corangamite Shire Council, the Australian Government and the Victorian Government (through the CMA) jointly invested \$140,000 in the project. The project showed that the construction of a physical flood barrier was not feasible – it would have required a levee more than two metres high along the entire creek frontage.

The Skipton community instead supported introducing floodplain planning controls to guide future development in the town and to help people identify areas at risk. Corangamite Shire Council and Glenelg Hopkins CMA worked together to develop controls tailored to the flood conditions at Skipton. Council moved forward in 2013 with a proposed amendment to the Corangamite Planning Scheme to introduce new flood overlay controls, which were approved in early 2014.

12. Sharing flood risk information

In carrying out their statutory responsibilities for floodplain management, the CMAs and Melbourne Water collect and process flood risk information. This Section outlines the ways in which information about flood risks is shared with individuals, government agencies and other organisations so that each can play its part in flood emergency management.

Action 12a

- DELWP will develop guidelines to encourage consistent standards and planning arrangements for post-flood data collection.
- CMAs and Melbourne Water will use these guidelines to update their protocols and standards for data collection.

12.1 Flood data

Flood data collected after a flood provides valuable information on flood behaviour. Records of flood flows, flood depths, flood extents and flood behaviour are important for calibrating and validating computer models. They are collected from a variety of sources.

Traditionally CMAs, Melbourne Water and DELWP have had significant roles in collecting and collating flood data and this needs to continue. Other agencies and individuals also collect data. A starting point for mapping the flood risk is to identify what flood data is available and where it can be obtained.

Accountability 12a

- CMAs and Melbourne Water are accountable for identifying and prioritising post-flood data needs, in collaboration with DELWP.



Mallee CMA public meeting at Nyah, 2011. Source: Mallee CMA

12.2 Flood maps

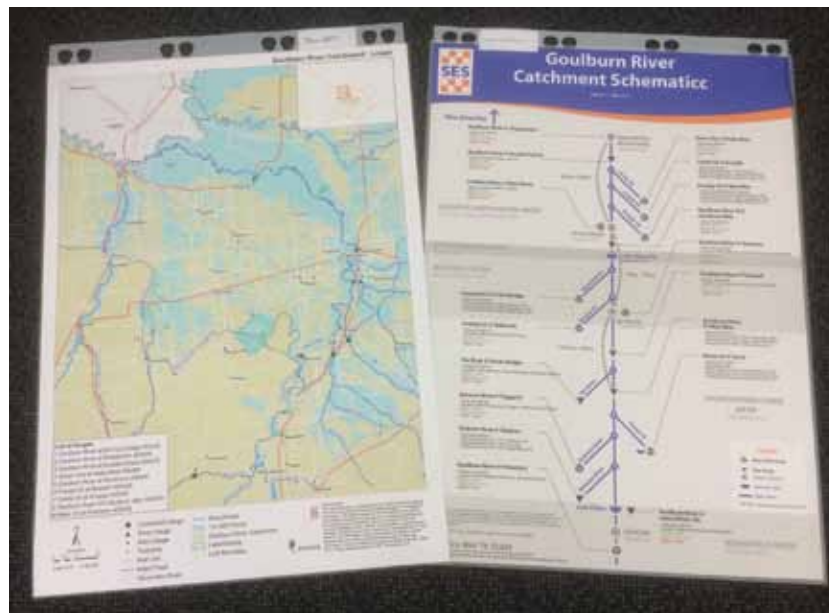
Flood maps are an output of flood studies (Section 11.1). DELWP is responsible for developing consistent standards for flood mapping. Those standards now extend to flood mapping for a range of floods, not just the information required for planning and building controls. The standards will include requirements for local consultation during the preparation of flood maps and the incorporation of local knowledge. They will include Melbourne Water and the CMAs' role in vetting and approving flood maps and other flood study outputs.

Accountability 12b

- DELWP is accountable for preparing flood mapping standards to meet the needs of a range of uses, including land use planning, insurance and emergency response.
- DELWP and Melbourne Water are accountable for storage and custodianship of flood maps developed as part of government-funded flood studies and vetted by the relevant CMA or Melbourne Water.
- VICSES is accountable for providing DELWP with its requirements and specifications for flood mapping for emergency planning, emergency response and community education.

Policy 12a

- DELWP will ensure that all new flood maps for urban and regional areas prepared with government financial assistance will:
 - meet the needs of a range of uses, including land use planning, insurance and emergency response
 - be developed in consultation with local communities to make use of local knowledge in conjunction with flood studies
 - be informed by the most recent edition of Australian Rainfall and Runoff
 - be of sufficient quality for inclusion in Municipal Planning Schemes
 - take account, as relevant, the State Planning Policy Framework (Section 13.2.1) strategies, including “to plan for and manage the potential coastal impacts of climate change” (Section 15.4.2)
 - be quality assured
 - be stored in Victoria’s flood databases.



Goulburn River flood map and catchment schematic. Source: DELWP

12.3 Victorian flood databases

The Victoria Flood Database (VFD) and Melbourne Water's Flood Database provide for the systematic collection, collation, analysis and presentation of Victoria's quality-assured flood information. That information is available in geographic information system (GIS) formats.

The quality of existing data is variable; it ranges from basic, historic and interpreted data through to the outputs of recent flood studies. Older flood study data and flood maps are updated as newer information becomes available. The databases are continually being improved.

Consultants producing flood studies are required to deliver data to the VFD as GIS layers in particular coverage formats. The VFD consists of data layers that provide flood levels for a range of events, from moderate to extreme, as well as historic levels. One layer of particular importance for land use planning shows the 1% AEP flood extent (Figure 9). Other layers show levels and extents that are critical for emergency management planning and response. These layers are also critically important in enabling insurance premiums to reflect risk accurately.

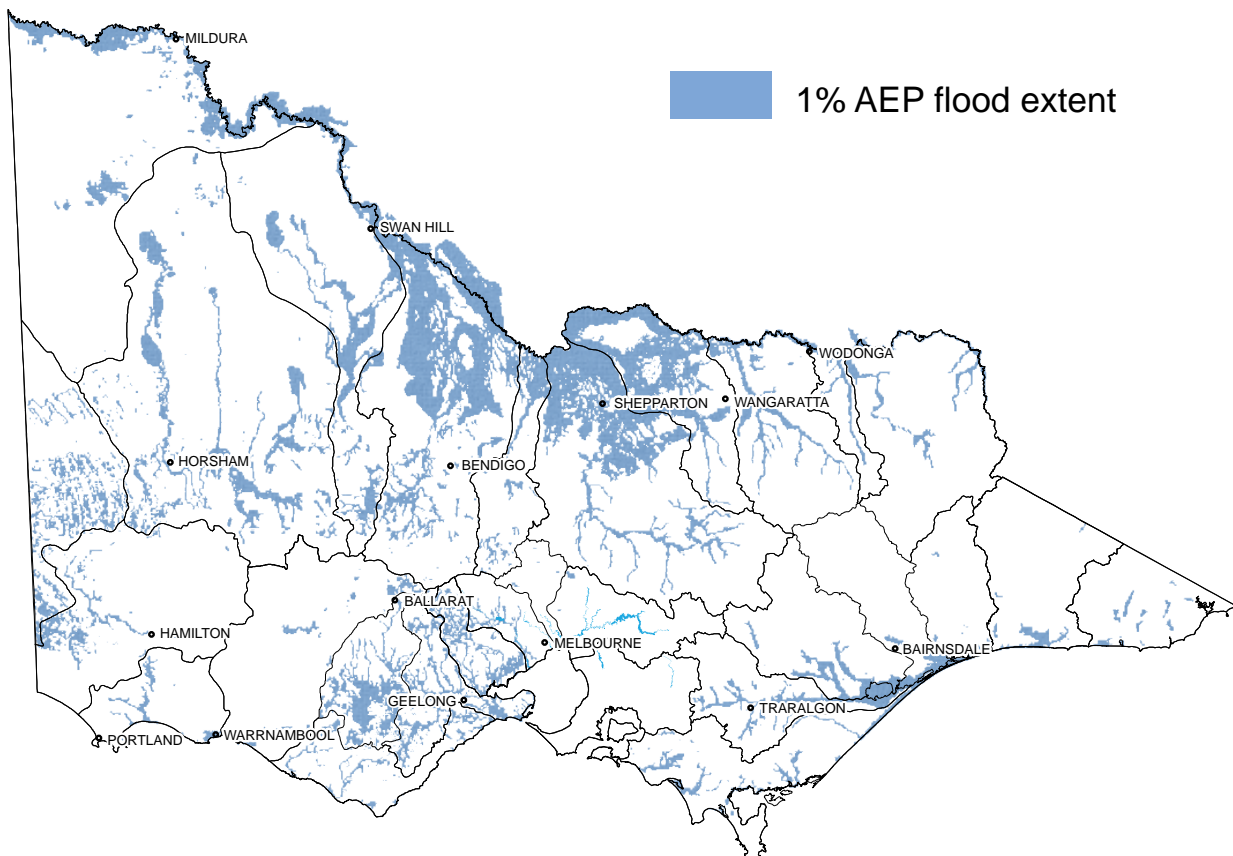
Accountability 12c

- DELWP and Melbourne Water are accountable for maintaining and continually improving guidelines for the management of Victoria's flood databases.
- DELWP is accountable for maintaining and continually improving protocols for updating the data in the Victoria Flood Database.

Action 12b

- DELWP and Melbourne Water will integrate the two existing databases to provide Victorians with a single point of entry to readily accessible and authoritative records of flood data in Victoria.

Figure 9: Proportion of Victoria affected by significant riverine flooding based on current mapping



12.4 Victoria's flood intelligence platform

DELWP has developed and will continue to improve a web-based flood intelligence platform (known as FloodZoom) to be the authoritative source of flood intelligence before, during and after floods. It brings together the outputs of weather forecast models, hydrologic models, hydraulic models, satellite observations, stream gauge data and other information stored in the VFD.

Most importantly, the flood intelligence platform provides flood-consequence information at the property scale, where possible. As with other web-based mapping services, it will help agencies with flood emergency management functions to quickly and accurately visualise the problems they must manage in terms of both time and space.

The platform will help improve flood warning, preparedness and response activities for at-risk towns. It will also enable emergency management agencies to share information during floods. It will support them in making real-time interpretations of likely flood behaviour, coordinating flood responses and assessing flood impacts. It will help them provide better messaging to flood-affected communities.

The flood intelligence platform will underpin, streamline and improve the efficiency of the flood interpretative

services provided by DELWP, Melbourne Water and the CMAs to VICSES and LGAs. These agencies will use the information coming out of the flood intelligence platform to provide advice to flood-affected communities.

Accountability 12d

- DELWP is accountable for maintaining and continually improving Victoria's flood intelligence platform.

Action 12c

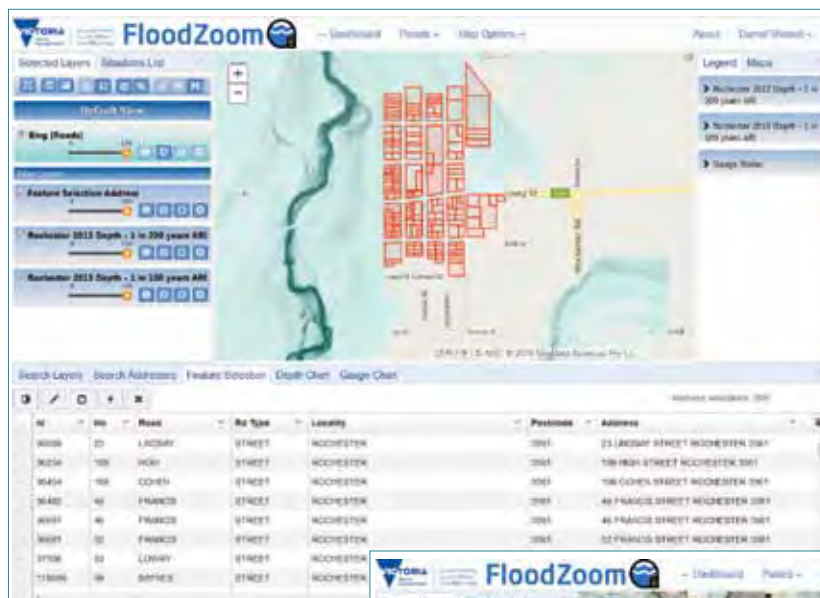
- DELWP, in consultation with Melbourne Water, CMAs, LGAs and the VICSES, will ensure the information in Victoria's flood intelligence platform remains current.

All agencies carrying out self-funded flood mapping exercises will be encouraged to follow existing DELWP guidelines. On completion of such maps, LGAs will advise DELWP and provide a copy of the mapping for inclusion in the VFD. Once DELWP is assured that the quality of the data represents an improvement over that already in the VFD, it will make that information available to support emergency preparation and response through 'FloodZoom'.



Flood gauges on Reedy Creek. Source: North Central CMA

Part 1



1

2



Interpretive information prepared using FloodZoom:

3

1. Properties in flood risk area.
2. Floor height of properties at risk.
3. Depth of flooding.
4. River gauge data.

4





Flooding on Yarra River 2010.
Source: Melbourne Water

Part 2: Avoiding or minimising future risks

13 Avoiding or minimising flood risks through the planning and building systems 40

Community resilience can be improved by using a mix of strategic and statutory planning tools. Land use planning and building controls are generally more cost effective than flood mitigation infrastructure, flood warning systems, flood education programs or flood emergency responses.

The Strategy clarifies that the 1% Annual Exceedance Probability (AEP) flood will remain the design flood event to regulate new development and construction standards in Victoria, and that local government authorities (LGAs) will remain responsible for ensuring that their planning schemes identify the areas at risk of a 1% AEP flood. Draft Planning Scheme Amendments will be prepared for the 1% AEP as outputs of local flood studies.

This chapter outlines a strategic and statutory approach to land use planning and development in flood prone area. DELWP, in consultation with VICSES, the CMAs and Melbourne Water will develop guidance for the CMAs and Melbourne Water to draw on when advising LGAs on individual planning permit applications and strategic plans.

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14. Managing stormwater and urban flooding 46

Integrated water management provides opportunities to manage urban flooding through, for example, stormwater and rainwater harvesting and reduced connection of hard surfaces to drainage systems.

This chapter reiterates the requirements in Clause 56 of the Victoria Planning Provisions for new subdivisions and identifies a need for further work to ensure that developments do not increase flows downstream of the site.

There are also potential additional benefits to consider associated with the reuse of any

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15. Managing coastal flooding 49

The primary causes of coastal inundation are storm surges combining with high tides (storm tides). Flooding can be worsened in estuaries by rainfall in coastal catchments and seasonal river mouth closures. Climate change will contribute to a progressive permanent increase in sea level that will increase the extent and duration of storm-induced coastal inundation.

This Strategy aligns with the Victorian Coastal Strategy (2014) and the regional coastal plans. LGAs will continue to make locally based decisions about managing the risk of coastal flooding in their role in assessing planning permit applications. Strategic and statutory local-based planning will be informed by relevant government policies and advice from government departments, agencies, experts and local communities from local communities and experts on coastal flooding and coastal erosion.

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13 Avoiding or minimising flood risks through the planning and building systems

All levels of government have recognised that land use planning can help mitigate the threat from natural hazards. The Council of Australian Governments' *National Strategy for Disaster Resilience* recognised that "responsible land use planning can prevent or reduce the likelihood of hazards impacting communities", especially for new development.

The Victorian Government's Emergency Management Reform White Paper explains that: "Community resilience can be improved by using planning approaches that consider likely risk factors and vulnerabilities, and identify how to mitigate against those risks. Land use planning policy must fully account for a location's risk profile to properly determine the nature and extent of new developments."

The Victorian Floods Review noted that land use planning and building controls were generally more cost effective than flood mitigation infrastructure, flood warning systems, education programs or emergency responses.

One of the objectives of the *Planning and Environment Act 1987* is to "provide for the fair, orderly, economic and sustainable use and development of land". The Act also

provides for "planning schemes to regulate or prohibit any use or development in hazardous areas or in areas which are likely to become hazardous areas". In this context, land use planning involves strategic planning, statutory planning and building regulations.

Because it is possible to predict which land is likely to be flooded, it is prudent to regulate development and building in those areas to ensure any impacts are known and managed. In so doing, the aim is to avoid or minimise the increase in future flood risks.

In order to identify the areas that need to be subject to planning and building controls, it is necessary to decide an appropriate threshold frequency of flooding. This frequency is known as the 'design flood event' (DFE).

The Victorian Floods Review questioned if the 1% AEP flood should still be used as the DFE in Victoria. The Victorian Government has determined that the 1% AEP flood is the appropriate standard to regulate and protect most forms of development through the planning and building systems.

The State Planning Policy Framework floodplain management policy currently uses the terminology of 'a 1-in-100-year flood', and this policy will be updated to reflect the preferred terminology of the 1% AEP flood (see Section 10.1).



Flooded homes at Rupanyup 2011. Source: Wimmera CMA

Policy 13a

- The 1% Annual Exceedance Probability flood will remain the design flood event for the land use planning and building systems in Victoria.

Action 13a

- DELWP, in consultation with LGAs, CMAs and Melbourne Water, will update the State Planning Policy Framework's floodplain management policy to use the 1% Annual Exceedance Probability flood as the terminology for the design flood event to replace the current reference to the 1-in-100-year design flood event.

13.1 State and regional planning in Victoria

As shown in Figure 10, land use planning starts with strategic planning. In Victoria, Regional Strategic Plans are prepared collaboratively by LGAs in each defined region. They aim to provide advice and make recommendations to inform long-term decision making and investment. They provide a framework to drive improved regional capability. Consideration is given to a wide range of land uses including agriculture, tourism, protection of environmental assets, commercial uses and residential uses, and threats from natural hazards, e.g. bushfire and floods.

The next stage, Regional Growth Plans, plan for growth, land use change and environmental protection, providing land use planning responses to the directions identified in the Regional Strategic Plan. They are developed

in partnership between LGAs, state agencies and government authorities, and reflect state and local government objectives. They provide broad direction for land use and development across Victoria and more detailed planning frameworks for key regional cities and centres.

Regional Growth Plans, together with *Plan Melbourne*, the metropolitan planning strategy, are aligned in ways that build on the interdependence of urban settlements to facilitate a networked 'state of cities'. Collectively, they aim to ensure that growth is carefully managed to achieve desirable social, economic and environmental outcomes.

Policy 13b

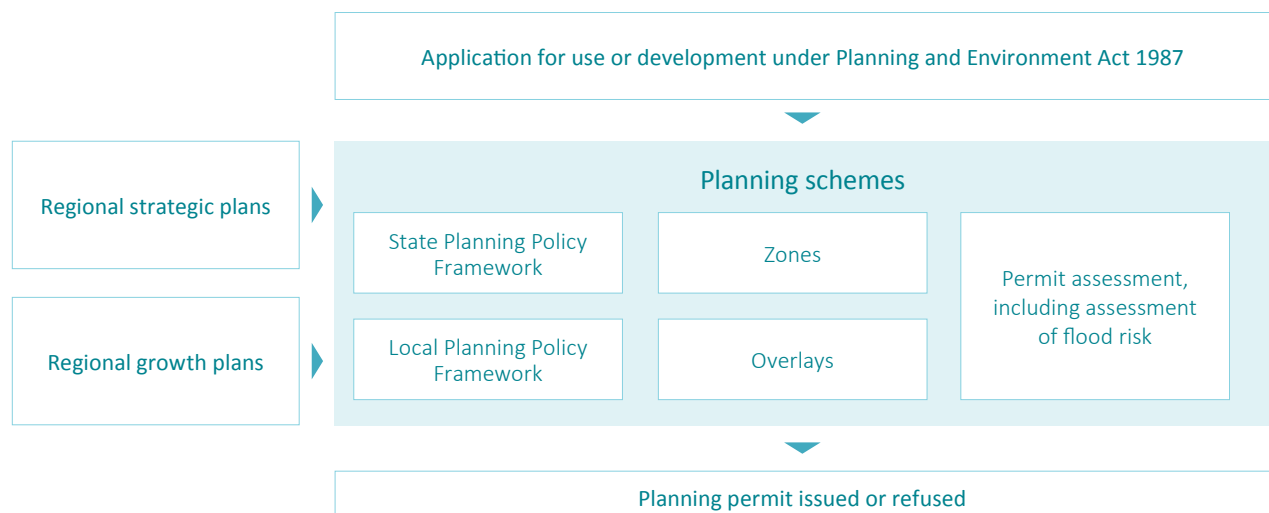
- The strategic planning framework must give due consideration to flooding and its impacts on land use potential.

Figure 10: Planning framework

The elements and legislative context of planning schemes in Victoria.



Avoiding or minimising flood risks through the planning system.



13.2 Statutory land use planning system

Victoria's statutory land use planning system operates through Planning Schemes, which are subordinate legislation under the *Planning and Environment Act 1987*. Planning Schemes set out policies and provisions for the use, development and protection of land. They are legal documents administered by the LGA or other planning authority specified in the Planning Schemes.

Planning Schemes must be prepared using the Victoria Planning Provisions (VPPs). The VPPs contain a comprehensive set of planning provisions for Victoria, including compulsory state and local policies and strategies, and zones and overlays used locally. This approach helps ensure that Planning Schemes are prepared in a consistent way. Planning Schemes must also be consistent with the associated Regional Growth Plans.

13.2.1 State Planning Policy Framework

Planning Schemes include a compulsory State Planning Policy Framework (SPPF), which sets out the statewide principles, policies and strategies for how land is used and developed. The SPPF recognises the impacts of natural hazards, including flood, and sets strategies for development to be located away from flood hazard areas and, where relevant, areas prone to future coastal inundation as a result of climate change.

State planning policies provide the basis for land use planning, including settlements. For example, the SPPF floodplain management policy is to protect life, property and community infrastructure and while also protecting areas of environmental significance and river health.

13.2.1 Local Planning Policy Framework

The VPPs require LGAs to consider flood risks when preparing Planning Schemes (strategic planning), and in making land use planning decisions (statutory planning). Statutory land use planning is an integral part of the optimum suite of flood mitigation measures for every flood-prone area.

Planning Schemes contain a Local Planning Policy Framework that includes a Municipal Strategic Statement explaining an LGA's objectives and strategies in exercising land use controls in its Planning Scheme.

Municipal Strategic Statements provide LGAs with an opportunity to achieve an integrated approach to planning across all areas of council. This is reinforced by clearly expressed links to the LGA's corporate plan. The Statements are deliberately dynamic; they enable community involvement in their ongoing review.

Responsible LGAs develop and refine their strategic directions in response to the changing needs of their communities. LGAs need to be able to accommodate these changing needs by taking direct responsibility for their Planning Schemes.

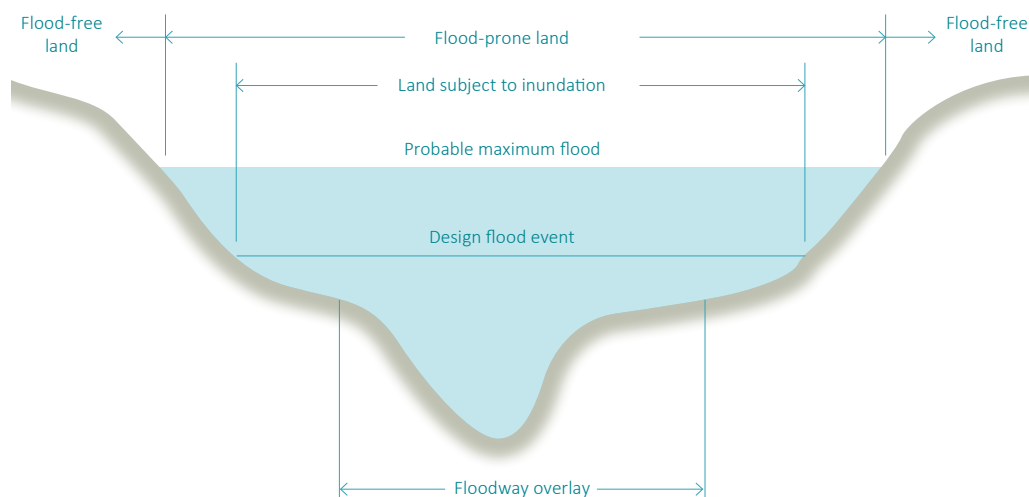
Statutory planning controls include zones and overlays that regulate the use and development of land. The VPPs include one zone (urban floodway zone) and three overlays (floodway, special building and land subject to inundation overlays) directly relevant to flood-prone areas (Figure 11).

Policy 13c

- LGAs with areas at risk of a 1% Annual Exceedance Probability flood must ensure that their Planning Scheme contains:
 - the objectives and strategies for managing the risk in the Municipal Strategic Statement
 - the appropriate zone and overlays.

Figure 11: Defining flood-prone land

Schematic of floodway zones as they apply to planning schemes.



Accountability 13a

- LGAs are accountable for ensuring that their Planning Schemes correctly identify the areas at risk of a 1% Annual Exceedance Probability flood, and contain the appropriate objectives and strategies to guide decisions in exercising land use controls in regard to flooding.

Action 13b

- The CMAs and Melbourne Water will work with LGAs to ensure that Planning Schemes use the planning controls that align with their flood risks.

Melbourne Water and the CMAs are referral authorities under the *Planning and Environment Act 1987*. Under changes to the nature of referral authorities in August 2013, the CMAs became ‘recommending authorities’ while Melbourne Water remained a ‘determining authority’. Referral advice from a ‘determining authority’ is binding on the LGA as a responsible authority under the *Planning and Environment Act 1987*. Referral advice from a ‘recommending authority’ is not binding on the LGA.

An assessment of the referral advice from CMAs to LGAs between August 2013 and June 2015 indicates that LGAs followed the CMAs’ advice for 96% of referrals. Given this current referral status arrangement has been operating for a relatively short time, it will be periodically reviewed. The reviews will examine the trends and the particular circumstances where the CMAs’ advice is not being followed by LGAs.

Policy 13d

- The CMAs will retain their ‘recommending’ referral status.
- Melbourne Water will retain its ‘determining’ referral status.

Action 13c

- DELWP will periodically review the treatment of flood-related referral advice from CMAs to LGAs. This review will examine the trends and the particular circumstances where the CMAs’ advice is not being followed by LGAs.

13.3 The planning system for floodplain management

This section of the Strategy is concerned with how the planning system should be applied to floodplain management. Section 15 describes how the planning system will be applied to coastal flooding, where the effects of climate change are better understood and are more predictable.

13.3.1 Streamlining Planning Scheme amendments

Recommendation 86 of the Victorian Flood Review called for Victoria to “adopt a strategy to expedite incorporation of updated flood mapping or modelling into planning schemes”.

About 11.5% of Victoria’s land mass is prone to a 1% AEP flood, fortunately not all at the same time. Figure 6 shows a map of the total 1% AEP flood extent for Victoria. It excludes stormwater flooding for Melbourne and other urban centres, it also excludes the land subject to coastal flooding.

Only about 2.5% of Victoria is urbanised, but urban areas are home to most of the population, with about 75% of Victorians living in Greater Melbourne. Only 5% of Victoria’s urban areas are affected by 1% AEP flooding.

While Victoria’s flood databases indicate that 11.5% of the Victorian landmass is prone to a 1% AEP flood, the planning system records 7.5% of the landmass as being covered by Flood Overlays. This leaves 4% of the landmass without appropriate Planning Scheme Overlays to account for riverine flooding. The area at risk of coastal flooding is of a similar order of magnitude and little of it is currently covered by appropriate Planning Scheme Overlays.

As discussed in Section 3, land use planning has not realised its potential in minimising or avoiding the growth in future flood risk. Until now, including flood overlays in Planning Schemes has depended on the capacity and willingness of LGAs to do so. Where that capacity and willingness has been deployed, land use planning is working well. Melbourne Water has made it possible for land use planning to work throughout metropolitan Melbourne. It also works well in regional areas that are subject to frequent flooding. However, there are large areas of rural and regional Victoria that remain inadequately covered.

DELWP, the CMAs and Melbourne Water must help resolve this issue by collaborating with LGAs to overcome remaining capacity issues. They must also help identify and use any potential economies of scale in the panel processes that are a necessary part of Planning Scheme amendments.

Policy 13e

- Regional Floodplain Management Strategies will document and report on all urban and rural areas with known flood risks; they will also document and report on those townships that do not have planning controls to regulate any use or development within the 1% Annual Exceedance Probability flood.

The flood study process has evolved significantly to help address the capacity issues. This Strategy takes that trend further.

Action 13d

- DELWP will work with key stakeholders to understand significant constraints to implementing appropriate Municipal Planning Scheme amendments.
- DELWP will work with LGAs to streamline the process of converting flood study outputs into Planning Scheme amendments, e.g. by exploring opportunities to use the processes prescribed for amendments to consult with local communities during the flood study.
- The CMAs and Melbourne Water will develop implementation plans for their Regional Floodplain Management Strategies that will seek to either:
 - help convert existing flood study data into Planning Scheme amendments; or
 - conduct new flood studies to provide draft Planning Scheme amendments.

As part of the monitoring and review process for Regional Floodplain Management Strategies, the CMAs and Melbourne Water will report to DELWP on progress towards priority outcomes. In the event that a CMA or Melbourne Water reports a lack of progress on a priority Planning Scheme amendment – where the relevant LGA has been provided with a draft Planning Scheme amendment – DELWP will explore potential processes to help the LGA expedite the amendment. If DELWP is unsuccessful in helping to expedite the amendment, it will raise the issue in the appropriate regional or statewide emergency management processes. If DELWP is unable to resolve the issue in this way, it will advise the Risk and Resilience Sub-committee of the State Crisis and Resilience Committee of the lack of progress on a priority outcome. This approach is in keeping with the importance placed on land use planning by the Victorian Flood Review.

Policy 13f

- Catchment Management Authorities and Melbourne Water will report to DELWP on progress towards Planning Scheme amendments identified as priority outcomes in their Regional Floodplain Management Strategies.
- Where there is insufficient progress towards a priority Planning Scheme amendment, DELWP will work with the relevant LGA to help expedite the amendment.
- If DELWP is unsuccessful in its efforts to help expedite a priority Planning Scheme amendment it will raise the issue through the appropriate regional or statewide emergency management processes and if necessary it will advise the Risk and Resilience Sub-committee of the State Crisis and Resilience Committee.

13.3.2 Providing consistent floodplain management advice to LGAs

Consultation on the drafts of this Strategy revealed that LGAs desire greater consistency from the CMAs and Melbourne Water in the application of flood-related zones and overlays. They also need more consistent advice from the CMAs and Melbourne Water when making decisions on development applications within those zones and overlays. They want to reduce community uncertainty about what a flood zone or overlay means for their property.

LGAs are seeking clarity within the flood-related VPPs with regard to what those planning controls are intended to achieve and, more importantly how they can be used to achieve those outcomes. Greater clarity would help applicants design their developments in ways that are likely to receive approval.

LGAs also want advice about what development assessment framework they should be adhering to; there is currently no prescribed Victorian standard for floodplain development. DELWP will develop statewide Floodplain Development Guidelines to rectify this situation.

Action 13e

- DELWP in consultation with LGAs, CMAs and Melbourne Water will prepare statewide Floodplain Development Guidelines.

Policy 13g

- CMAs and Melbourne Water will apply the Floodplain Development Guidelines in delivering their referral advice to LGAs.

13.3.3 Reviewing and refining the VPPs for flooding

It is important to regularly review the VPPs in light of the need for applicants and decision-makers to be able to design or assess development proposals against the flood provisions. The VPPs should make clear the matters to be considered when applying for a permit within a floodplain and guidelines should be prepared to show how applicants can design a development to be compatible with the flood hazard.

The next revision of the VPPs will consider the controls available to delineate flooding within Planning Schemes and seek to ensure that the appropriate planning controls are applied consistently across Victoria. This review will include the State and Local Planning Policy Frameworks.

Action 13f

- DELWP in consultation with LGAs, CMAs and Melbourne Water will regularly review and, if necessary, revise the Victoria Planning Provisions to ensure they support this Strategy's objectives and policies.

13.4 The building system

Building work in Victoria is controlled under the *Building Act 1993* and the Building Regulations 2006. One objective of the Building Act is to protect the safety and health of people who use buildings. The Regulations adopt the Building Code of Australia (BCA) for the minimum technical standards for the construction of buildings. States and Territories have committed to support a nationally consistent BCA and to limit variations wherever practical. In Victoria, the Victorian Building Authority regulates building practitioners.

Certain developments require a planning permit and a building permit is required for the construction or significant alteration of most buildings in Victoria. If a planning permit is not required, a building permit applicant must obtain the 'report and consent' of the LGA if the site is on an allotment that is in an area liable to flooding.

Under this process, LGAs must consult with the relevant CMA or Melbourne Water.

The Regulations define when land is in an area liable to flooding. Such areas can be determined from Planning Schemes or from descriptions on a certified or sealed plan of subdivision. They can also be otherwise designated by an LGA.

On 1 May 2013, the Australian Building Codes Board introduced technical standards to the BCA for flood areas. These standards require certain new building work to be designed to resist structural damage during a flood, taking into consideration the expected depth and velocity of floodwaters. As part of a building permit application, the builder or designer must provide evidence to the relevant building surveyor that the building design complies with the BCA. Evidence must be based on advice on the flood level and water velocity of the site from the relevant CMA or a hydraulic engineer. Further opportunities will arise from time to time to improve the efficiency and effectiveness of building controls and standards.

Action 13g

- DELWP and the Victorian Building Authority will work together to improve the effectiveness of the flooding provisions of the Building Code of Australia.

14. Managing stormwater and urban flooding

Urban stormwater flooding affects properties across metropolitan Melbourne and regional centres. Generally, stormwater flooding risk arises from the legacy of previous drainage infrastructure design and planning practices.

Urban planning can take stormwater flooding risks into account. The resulting improved community outcomes may include enhanced open space, alternative water supplies and improved water quality. The realisation of these outcomes is founded on clear accountabilities, community engagement, and transparent assessment of costs and benefits.

14.1 Roles and accountabilities

In the Port Phillip and Westernport region, Melbourne Water is accountable for managing urban stormwater flooding in catchments greater than 60 hectares, with LGAs accountable for catchments of less than 60 hectares.

In practice, this management requires a collaborative approach between Melbourne Water and LGAs, reflecting the need for holistic management of flood risk across the entire catchment. This includes flood risk mapping, flood mitigation infrastructure assessment, community engagement, and land use planning controls.

Melbourne Water and LGAs are accountable for the operation and maintenance of their own stormwater infrastructure.

The 60-hectare arrangement has been in practice since 1927. During the formal consultation for this Strategy, some LGAs asked for a review of the existing arrangements. It is important to note that management accountabilities aside, drainage systems function as a whole; each component needs to be managed with reference to the broader catchment.

Action 14a

- DELWP, in consultation with Melbourne Water and metropolitan LGAs, will review the institutional arrangements governing the accountabilities for urban stormwater flood risk management for the Port Phillip and Westernport region.

Accountability 14a

- Subject to the outcome of the review of institutional arrangements for urban stormwater flood risk management within the Port Phillip and Westernport region, the accountabilities for flood risk management will remain with the current management agencies:
 - LGAs are accountable for managing urban stormwater flood risk within catchments of less than 60 hectares. Melbourne Water is accountable for managing urban stormwater flood risk within catchments greater than 60 hectares.
 - In some rural catchments, LGAs are accountable for managing stormwater flood risk within catchments of less than 200 hectares and Melbourne Water is accountable for managing stormwater risks within drainage catchments greater than 200 hectares.
 - Outside the Port Phillip and Westernport region, LGAs are accountable for managing urban stormwater flood risk.

Action 14b

- Melbourne Water will work with LGAs to:
 - identify areas of stormwater and urban flooding in Melbourne in the implementation of its Regional Floodplain Management Strategy
 - assess and quantify different types (scales and frequencies) of stormwater flooding across Melbourne and refine the process for identifying and prioritising areas subject to stormwater and urban flooding
 - evaluate the treatment options
 - discuss and seek agreement from beneficiaries for the treatment option that best manages the flood risk and provides other benefits.
- CMAs, in developing their Regional Floodplain Management Strategies, will work with LGAs to identify areas with a history of stormwater and urban flooding in regional centres.

14.2 Stormwater flood risk management and urban planning

The improved management of urban stormwater flooding is a central component of integrated water management. This represents a holistic approach to the management of all forms of water, including rainwater, stormwater, recycled wastewater and groundwater. It results in resilient urban water systems that deliver a range of social, environmental and economic benefits.

Integrated water management brings together the community, LGAs, water corporations, catchment managers and land developers to help design Victoria's towns and cities with water in mind. Improved stormwater management will ensure that future impacts of climate change, population growth and new development will not reduce amenity or increase flooding.

The cumulative effect of the stormwater management initiatives can help reduce the risk of flooding in urban areas. In particular, rainwater and stormwater harvesting and a reduction in the connection of hard surfaces to drainage systems can reduce stormwater flows in some rainfall events. Similarly, soil moisture retention strategies such as rain gardens, tree plantings and wetlands can contribute to reduce urban stormwater flood risk.



Urban flooding in Melbourne 2010. Source: Melbourne Water

Policy 14a

- Melbourne Water and LGAs, in exercising their urban stormwater flood risk accountabilities, will consider integrated water management options in developing and evaluating measures to manage the urban stormwater flood risks.

It is important that new greenfield development, infill development and urban renewal areas are designed to mitigate property damage and other flood impacts. Developments must be planned and constructed to ensure they do not cause downstream flooding and avoid increases in the infrastructure or maintenance costs of managing flooding.

Increased density of development in urban areas can increase the proportion of impervious surfaces. That, in turn, increases the volume of surface run-off. Urban run-off needs to be managed to minimise the risk of flooding to third parties and to protect downstream waterways and environment. Clause 56 of the Victoria Planning Provisions (VPP) requires new residential subdivisions to be designed to a standard that ensures flows downstream of the subdivision site are restricted

to pre-development levels, unless otherwise approved where there are no downstream impacts. New sites are also required to comply with current stormwater quality objectives. The VPP Practice Note no. 39 provides guidance on meeting the integrated water management provisions required under clause 56 for residential subdivisions in an urban area.

At this stage, the Practice Note does not provide sufficient guidance on how to manage the potential flood impacts of infill developments, urban renewal projects or non-residential developments. Nor does it help determine when a significant redevelopment in an area serviced by pre-1970s drainage systems should trigger the need to upgrade the drainage system.

A number of LGAs have indicated that clause 56 does not provide certainty that runoff from infill development, urban renewal or non-residential development within established areas will be restricted to predevelopment levels. Some LGAs have introduced local planning policies that enable them to consider integrated water management approaches to stormwater management in their areas, but there is no consistent approach. The challenges with these sorts of developments need to be overcome.

Flood retarding basins can provide significant flood mitigation benefits in urban areas. They are often used in new developments to comply with clause 56 requirements. Current design criteria for such structures require them to withstand a 1% AEP flood, and they must also safely deal with the consequences of passing flows of larger floods. Melbourne Water manages about 235 larger retarding basins, while LGAs construct and operate them in regional areas.

The design of retarding basins should consider broader community benefits, including water resource, recreational and environmental benefits. Water captured in retarding basins can be reused if the arrangements meet the design and management standards of the water or drainage authority.

Action 14c

- DELWP will lead a review of how the Victoria Planning Provisions, particularly clause 56, could better manage the potential urban stormwater flood impacts from infill development, urban renewal and non-residential development within established areas.

Accountability 14b

- LGAs are accountable for applying the planning requirements of Clause 56 of the Victoria Planning Provisions' Practice Note 39 to ensure that new developments do not have significant third party impacts as a result of increased runoff from impervious surfaces.



Retarding basin on Middleborough Road in Blackburn 2010. Source: Melbourne Water

15. Managing coastal flooding

The Victorian Coastal Strategy 2014 establishes the long term framework for the planning and management of our coast, and sets out the state's policies on coastal hazards and benchmark for planning for sea level rise.

The *Victorian Coastal Hazard Guide* (2012) says coastal flooding "... may occur during extreme weather, when higher water levels cause seawater to flood land that is normally dry. The primary causes of inundation are storm surges combining with high tides (storm tides) and extreme wave events. Flooding can be worsened in estuaries by rainfall in coastal catchments."

The Guide goes on to say: "Additionally, the effects of climate change are contributing to a progressive permanent increase in sea level that will increase the extent and duration of storm-induced coastal inundation."

This section focuses on how to prepare for, and respond to, coastal flooding.

15.1 Clarifying the accountabilities for coastal flooding

Until now, the complex interactions between coastal processes and coastal flooding have blurred the accountabilities for coastal flood management. This Strategy clarifies where those accountabilities lie with respect to:

- sharing coastal flood risk information
- assessing specific coastal hazards
- mapping coastal inundation at different scales
- land use planning and coastal flooding
- emergency management for coastal flooding.

This is graphically represented in Figure 12.



Coastal storm, Middle Brighton Beach 2014. Source: Melbourne Water

15.1.1 Sharing coastal flood risk information

Policy 15a

- Victoria's coastal flooding risks will be identified progressively through coastal hazard assessments.

Accountability 15a

- DELWP is accountable for developing the criteria and process for identifying priorities for undertaking coastal hazard assessments
- DELWP is accountable for the development and maintenance of standards for modelling and mapping coastal flooding
- DELWP is accountable for undertaking coastal hazard assessments for the priority areas identified through Regional Coastal Plans
- The CMAs and Melbourne Water are accountable for supporting the flood risk components of coastal hazard assessments
- The CMAs and Melbourne Water are accountable for collecting data following coastal flooding and storm surges
- DELWP and Melbourne Water are accountable for storing coastal flood information in Victoria's flood databases.

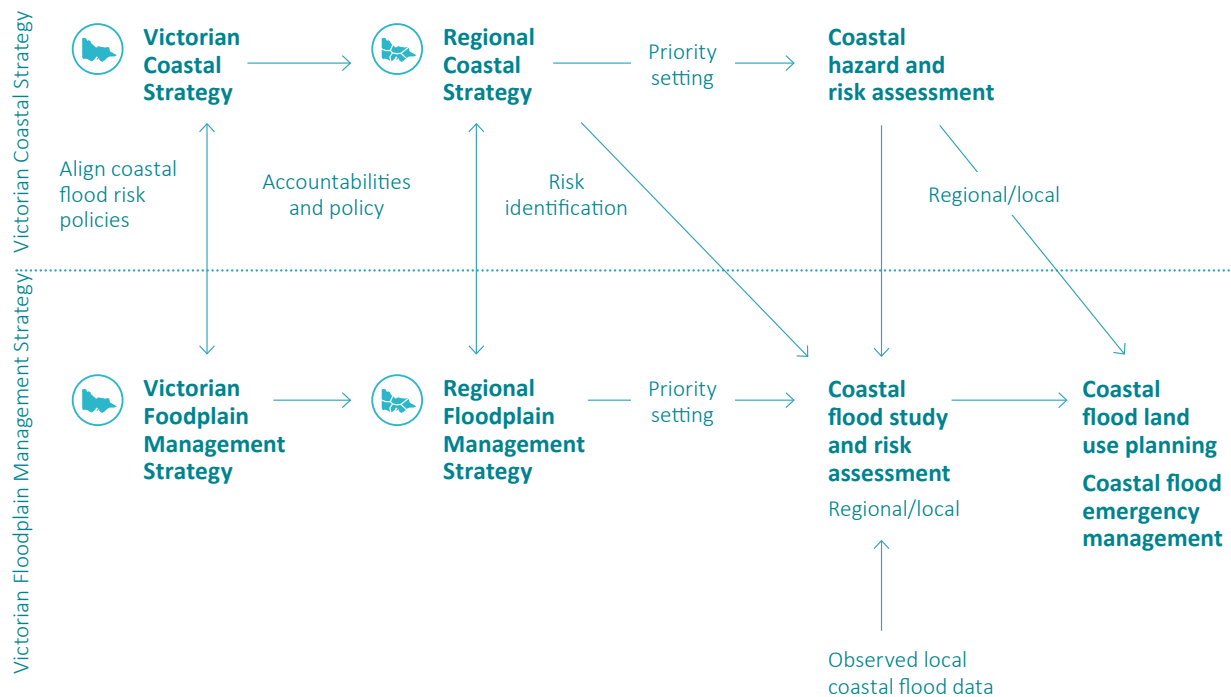
Action 15a

- DELWP will expand the standards for flood mapping to include coastal flooding.
- DELWP will support LGAs in preparing coastal flood studies for the priority areas identified through coastal hazard assessments and Regional Floodplain Management Strategies.

15.1.2 Land use planning and coastal flooding

CMAs and Melbourne Water advise LGAs on coastal inundation levels and extents in relation to planning applications and Planning Scheme amendments. They do not provide advice on matters relating to coastal erosion or geomorphic change. They provide planning advice on the existing flood risks from storm surges, assuming that the land remains static, and advise on what the future risk is likely to be, given sea level rise and predicted increases in wind.

Figure 12: Coastal flood management framework



Policy 15b

- LGAs with areas at risk of coastal flooding must ensure that their Planning Scheme contains:
 - the objectives and strategies for managing the risk in the Municipal Strategic Statement
 - the appropriate zones and overlays.

Action 15b

- DELWP will review the flood-related overlays to determine the most appropriate planning tools in relation to coastal flooding.

Accountability 15b

- LGAs are accountable for ensuring that their Planning Schemes correctly identify the areas at risk of coastal flooding, and contain the appropriate objectives and strategies to guide decisions in exercising land use controls relating to flooding.

15.1.3 Emergency management for coastal flooding

The emergency management arrangements for coastal flooding have not previously been formalised. More certainty is needed about each agency's roles, capacities, responsibilities and accountabilities. VICSES has indicated it is willing to assume the accountability for emergency services in the event of storm surges and coastal flooding – provided it receives appropriate technical advice. VICSES will take time to build its capacity to address this accountability, so Regional Floodplain Management Strategies will need to outline appropriate timeframes for these services to be developed and supported.

Accountability 15c

- VICSES is accountable for emergency planning and response in the event of storm surges and coastal flooding.
- DELWP is accountable for including coastal flooding in Victoria's Total Flood Warning System.

15.2 Identifying coastal flooding risks at the state level

The coast is naturally dynamic; it is constantly changing and evolving in response to coastal processes such as waves, tides, and wind. When these processes adversely affect the built and natural assets they are defined as coastal hazards.

This Strategy is only concerned with coastal flooding where it adversely affects life, safety, property or aspects of the natural environment. Issues surrounding other coastal hazards, such as managing erosion, are outside the scope of this Strategy. The *Victorian Coastal Strategy 2014* (VCS) sets out high-level policies and actions to respond to coastal hazards and three Regional Coastal Plans focus on implementation. This Strategy integrates with the Regional Coastal Plans in those areas where coastal flooding is identified as a priority coastal hazard.

The VCS identifies the continued need to help coastal communities understand and respond to flood risks. It also supports collaboration across agencies and communities to enable effective adaptation planning. It intends to achieve this in a range of ways. For example, the VCS sets the planning benchmarks for sea level rise. It calls for the findings and learnings from four pilot coastal hazards assessments to be shared and used to identify further areas across Victoria where this kind of assessment is needed. It envisages the development of a strategic and consistent approach to assessing risks from coastal hazards to regionally significant coastal public assets. The VCS also establishes the framework for Regional Coastal Plans to consider natural and built assets at risk of coastal hazards including coastal flooding.

15.3 Identifying coastal flooding risks at the regional level

The Victorian Government's *Future Coasts* program has developed tools to help understand coastal risks under existing climatic conditions and future sea level rise scenarios. These tools included high-resolution coastal digital elevation models, coastal flood mapping, the Coastal Hazard Guide, the Coastal Asset Information Library, and four pilot local coastal hazard assessments.

Future Coasts flood data is being integrated into the Victorian Flood Database. This data is aimed at regional strategic planning. Using a simple 'bathtub' approach, it identifies areas below the elevation that corresponds with a sea level rise of 0.8 metres so they can be prioritised for further assessment. By itself, this data may not be sufficient to enable local planning responses.

Those parts of DELWP responsible for coastal management will continue to work with Victoria's Regional Coastal Boards to implement the Regional Coastal Plans that establish these priorities. Those plans include actions to:

- develop a systematic approach to prioritise areas for detailed coastal hazard assessments and coastal flood risk analysis
- refine methodologies for conducting detailed coastal hazard assessments and integrating flood studies in coastal areas to identify high risk areas
- undertake coastal hazard assessments in priority areas to a standard similar to those provided in the four pilot assessments.

Policy 15c

- DELWP will ensure that the approaches and methodologies developed through the implementation of Regional Coastal Plans will be designed to ensure that coastal hazard assessments meet the business needs of LGAs and government agencies for such things as Planning Scheme amendments, and municipal flood emergency management plans.

Action 15c

- The CMAs and Melbourne Water will document, in Regional Floodplain Management Strategies or implementation plans, areas with identified coastal flood risks. This will inform priorities for future coastal hazard assessments and provide an input into flood risk assessments along the coast.
- DELWP will work with the CMAs, Melbourne Water and LGAs to:
 - support the implementation of Regional Coastal Plans by developing a systematic approach to prioritising areas for detailed coastal hazard assessments including flooding
 - develop a strategic and consistent approach to assessing risks to regionally significant coastal public assets from coastal hazards, including flooding.



Storm surge damage at Port Fairy, 2009. Source: DELWP

Planning for Sea Level Rise Bass Coast Amendment C82

For the first time in Victoria, planning controls have been proposed to identify and manage land use and development in areas at risk of inundation associated with predicted sea level rise and storm surge.

Bass Coast Shire Council, Melbourne Water and West Gippsland Catchment Management Authority have worked to address such climate-related factors by preparing a planning scheme

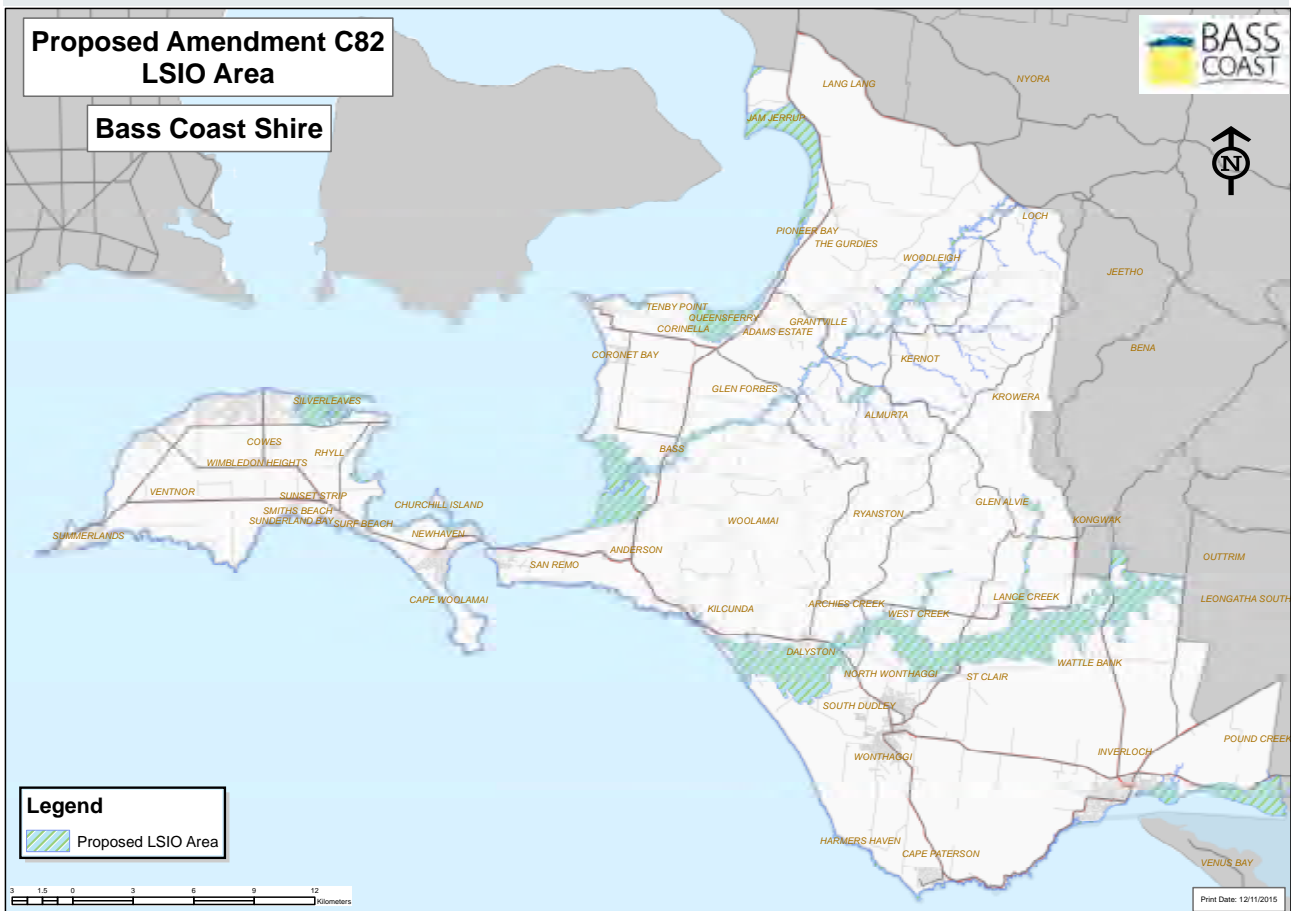
amendment for affected parts of the municipality.

The amendment applies a Land Subject to Inundation Overlay (LSIO) to all areas across the municipality that will be a risk of inundation as result of 0.8m sea level rise, as required under Victorian state planning policy and the Victorian Coastal Strategy 2014.

Mapping for the amendment was based on the State Coastal Inundation Dataset developed by the Government's Future Coasts program

and the Westernport Local Coastal Hazard Assessment.

The application of the LSIO will ensure that new development is assessed against known inundation risk and that the relevant floodplain management authority (i.e. Melbourne Water or West Gippsland Catchment Management Authority) is provided with an opportunity to comment and, if necessary, place conditions on proposed development to ensure the safe and sustainable use of affected properties.



15.4 Managing coastal flooding risks at the local level

LGAs and CMAs will work in partnership with Australian and Victorian government agencies to attract funding for detailed hazard assessments, flood studies, land use planning and adaptation planning and in priority areas.

At the local level, this Strategy is primarily concerned with establishing the appropriate framework for:

- coastal flood studies
- land use planning for coastal flood risks.

15.4.1 Coastal flood studies

While coastal hazards assessment will identify broad issues relating to the coast, there are areas where storm surge or coastal flooding has already been identified as a key issue. As with riverine flooding, LGAs may wish to attract funding for coastal flood studies for the priority areas identified in Regional Floodplain Management Strategies.

The appropriate outputs for coastal flood studies are similar but not identical to those for riverine flood studies. The main difference is that the outputs for coastal flood studies will not include preferred options for flood mitigation measures. Such measures can only be meaningfully considered in the broader context of managing coastal hazards, so they will be considered in adaptation plans (Section 15.5).

Policy 15d

- All flood studies for coastal areas will, unless there are compelling reasons to the contrary, include the following outputs:
 - draft Planning Scheme Amendments
 - preferred elements for a Total Flood Warning System
 - drafts of the relevant components of the Municipal Flood Emergency Plan.

15.4.2 Land use planning for coastal flood risks

The CMAs and Melbourne Water provide LGAs with advice on coastal inundation levels and extents in relation to planning assessments and planning scheme amendments. They do not provide advice on matters relating to coastal erosion or geomorphic change. In providing planning advice on flood levels and extents, they assume that the land remains static. In that context, they provide planning advice on the existing flood risks from storm surges, and on top of that, they advise on what the future risk is likely to be, given predicted rises in sea level and predicted increases in the occurrence of severe winds.

The Australian and Victorian Governments will need to resource agencies to build their capacity to advise on coastal erosion or geomorphic change in the future. The sophisticated techniques needed to assess the effects of coastal erosion are beyond the scope of most LGAs.

The CMAs and Melbourne Water will support LGAs wishing to conduct flood studies or amend Planning Schemes in response to the risk of coastal flooding. LGAs can seek assistance from DELWP and the CMAs or Melbourne Water as appropriate.

Where LGAs amend their Planning Schemes to show land subject to inundation by coastal flooding, the CMAs and Melbourne Water will act as referral authorities for applications to use and develop land.

The State Planning Policy Framework (SPPF) documents strategies “to plan for and manage the potential coastal impacts of climate change” in the following terms:

- “Plan for possible sea level rise of 0.8 metres by 2100, and allow for the combined effects of tides, storm surges, coastal processes and local conditions such as topography and geology when assessing risks and coastal impacts associated with climate change.”
- “In planning for possible sea level rise, an increase of 0.2 metres over current [1% AEP] flood levels by 2040 may be used for new development in close proximity to existing development (urban infill).”
- “For new greenfield development outside of town boundaries, plan for not less than 0.8 metre sea level rise by 2100.”

Currently, the State Planning Policy Framework guidance on planning for sea level rise in urbanised areas is being interpreted differently across the state. It is important that this Strategy makes it clear how they should be applied consistently.

Policy 15e

- Planning scheme controls must be applied to all priority coastal areas, identified through Regional Floodplain Management Strategies, expected to be at risk of inundation by the 1% AEP flood level, taking into account a rise in mean sea level of at least 0.8 metres.
- Statutory planning decisions for planning permits triggered by the relevant planning scheme controls:
 - must be based on the risk of inundation taking into account a rise in mean sea level of at least 0.8 metres for subdivisions outside existing town boundaries and for all development accommodating emergency and community facilities
 - may be based on the current 1% AEP flood level for all other development inside town boundaries and for development on existing lots outside town boundaries
 - should include an additional 0.2 metres on top of the normal freeboard applied for decisions based on the current 1% AEP flood level.

DELWP and Melbourne Water have both produced ministerially endorsed guidelines to ensure that the SPPF strategies can be applied to Municipal Planning Schemes using clear and consistent principles. Those guidelines allow for the application of the planning benchmarks at the regional and local levels. The guidelines will be reviewed in 2017 or earlier if there are advances in adaptation planning.

The guidelines aim to provide flexibility for coastal communities by enabling appropriate infill development over the next few decades, adjusted as certainty on the degree of sea level rise increases. If the intention is to transform land use from rural to urban purposes, however, longer-term planning controls should be used and the proposal should be assessed against long-term risks from projected sea level rise of not less than 0.8 metres by 2100.

The CMAs and Melbourne Water have discretion to recommend more- or less-stringent freeboard requirements in some circumstances. For example, they might recommend less-stringent requirements if the proposal were to result in a small increase in flood risk relative to existing risks (e.g. small building extensions). Similarly, they might waive the requirements where flood damage was seen as an acceptable business risk; this might apply to some industrial and commercial land uses.

Accountability 15d

- DELWP and Melbourne Water are accountable for maintaining reference data sets and guidelines on how to apply those clauses of the State Planning Policy Framework that relate to projected rises in sea level.

DELWP and Melbourne Water's guidelines for dealing with sea level rise apply unless alternative arrangements have been made in agreement with the relevant CMA or Melbourne Water. Adaptation plans will provide the instrument through which communities can plan for the complexities of coastal change – both for infill development in urban-zoned land within established settlements and for a change from rural to urban land use.



Flooding at Loch Sport June 2012. Source: West Gippsland CMA

15.5 Adaptation planning

Adapting to climate change involves reducing risks, increasing resilience and taking advantage of opportunities. Everyone in coastal communities needs to play a part in adapting to coastal change in this way. LGAs, and the land managers appointed by government, need to make wise land use decisions, which balance current use and development opportunities with longer-term use and sustainability of the coast.

The Victorian Climate Change Adaptation Plan sets out the government's priorities to build Victoria's climate resilience. It provides a framework for adaptation planning across the Victorian Government.

Many adaptation responses are possible; the best response will vary from place to place depending on the physical issues and community's values. Some responses could be delayed until predetermined triggers are met and risks in particular locations are more certain. The local community needs to consider the risks and trade-offs in adapting to climate change risks. Therefore, determining the best way to go about adaptation planning is best led at the local level in close consultation with the affected community, supported by all levels of government.

Thinking about adaptation needs to start now especially for proposed new long-term assets, but in most cases urgent action is not required for existing assets. There is time to evaluate the risks and mitigation options properly; there is also time to determine the trigger points for action and to gain community support for those actions. Communities should be involved in identifying the important values of an area, understanding the impact of coastal hazards on those values, and developing options to manage the impact.

Some adaptation plans may focus on understanding the extent of current and future coastal flooding.

Many adaptation responses are possible, and the optimal response will vary from place to place.

As our understanding of coastal flooding and possible adaptation pathways continues to evolve, different responses may emerge. Similarly, as the community's understanding and experience of coastal inundation changes, different responses may become acceptable. Therefore, we need to keep testing and exploring different adaptation responses regarding coastal inundation.

The outcomes of four pilot local coastal hazard assessment projects (in Port Fairy, the Bellarine Peninsula, Western Port and the Gippsland Lakes), and related adaptation projects, are being used to guide the practical application of further coastal hazard assessments and adaptation planning for coastal inundation.

Policy 15f

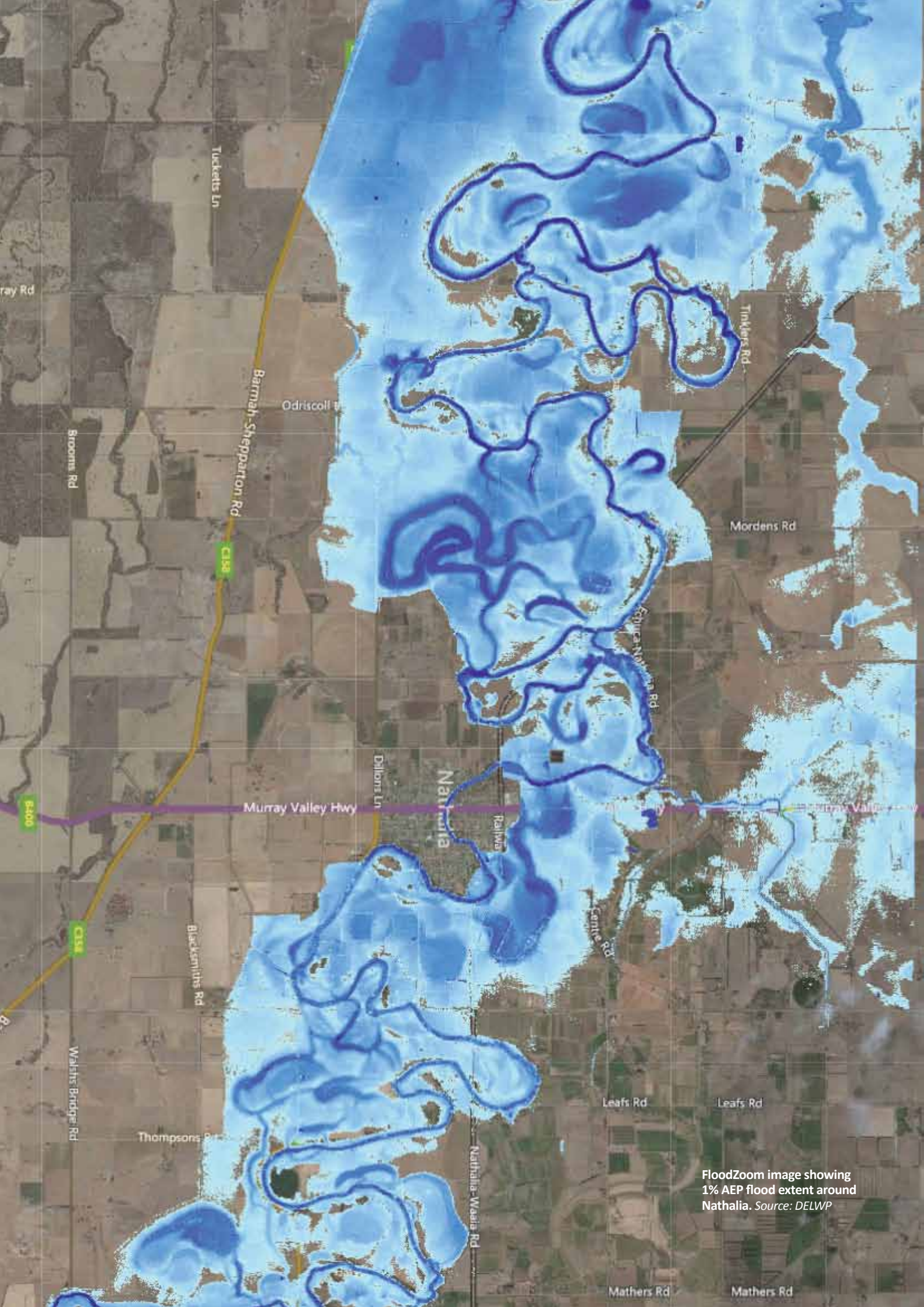
- DELWP will support LGAs to strengthen their community's capacity to adapt to the effects of coastal flooding.

Action 15d

- DELWP will support local government responses by:
 - working with LGAs to develop adaptation responses from the hazard assessment pilot projects
 - identifying other areas where this process can be used through the implementation of Regional Coastal Plans
 - undertaking coastal hazard assessment to the standard of the pilot projects for new priority locations identified through the Regional Coastal plans
 - continuing to work in partnership with LGAs, CMAs land managers and communities to support adaptation planning.



Flooding in Myrtleford, September 2010. *Source: North East CMA*



FloodZoom image showing 1% AEP flood extent around Nathalia. Source: DELWP

Part 3: Reducing existing risks

16. Flood warnings 60

This Strategy sets the framework to assess, establish, revise, operate, maintain and review Total Flood Warning Systems (TFWSs) tailored to flood risks and community need across Victoria. The Strategy identifies the roles of the various agencies involved in operating and maintaining a TFWS.

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17. Flood mitigation infrastructure 66

This section describes the roles of various agencies in managing flood mitigation infrastructure, and highlights the importance of formal management arrangements.

The arrangements for Kerang and Nathalia, with the three levels of government contributing to the capital costs of the levee and LGAs paying for ongoing maintenance, should be seen as best practice where regional urban levees are required. Local communities should be involved in decision-making about the need for flood mitigation infrastructure.

The Strategy identifies the circumstances where government may contribute to the capital costs of levees, sets out the process for assessing the need, and identifies the role of LGAs and the community in committing to the ongoing management and maintenance.

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18. Flood mitigation activities on waterways 79

The Victorian Waterway Management Strategy 2013 (VWMS) provides the framework for maintaining and improving the condition of Victoria's rivers, estuaries and wetlands. It aims to ensure that waterways continue to support environmental, social, cultural and economic values for all Victorians.

Works on waterways undertaken for flood mitigation purposes (such as vegetation clearance, debris removal and sediment removal) need a CMA Works on Waterways permit. The Strategy proposes that DELWP will prepare guidelines for the CMAs to consider when assessing permit applications.

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19. Risk management planning for critical infrastructure 81

The operators of critical infrastructure are responsible for developing and implementing site-specific strategies to mitigate all risks to business continuity. The operators of critical infrastructure are accountable for:

- assessing the risks and consequences posed to their operations by flooding
- developing and implementing fit-for-purpose flood risk mitigation plans for each facility at risk of flooding
- developing fit-for-purpose flood response plans.

16. Flood warnings

A flood is only manageable if real-time assessments can be made about its behaviour and its consequences. Armed with such assessments, it is possible to coordinate appropriate responses, and advise and educate communities.

Flood warnings provide communities, and emergency management agencies, with information about when flooding may occur, its likely severity and what to do to reduce damages.

16.1 The Total Flood Warning System concept

Total Flood Warning Systems (TFWSs) encompass all the elements needed to maximise the effectiveness flood responses by the community and emergency service agencies. Each element of the TFWS (Figure 13) plays a part in the effectiveness of flood warnings in reducing property damage and threats to life.

Victoria's TFWSs are designed and implemented in the context of the national flood warning arrangements outlined in Section 6. Each locally specific TFWS will be designed and implemented in accordance with priorities identified in the relevant Regional Floodplain Management Strategy (Section 26) or local flood study (Section 11.1).

The TFWS service requires the combined efforts of a number of agencies to deliver effectively for communities. The TFWS concept is explained in the Australian Emergency Management Manual Series, Manual 21 Flood Warning.

Figure 13: The elements of a Total Flood Warning System



16.2 An overview of the future arrangements

Policy 16a outlines the future arrangements for flood warnings in Victoria:

Policy 16a

- The Bureau of Meteorology (BoM) will develop new flood prediction services using a cost-recovery model that involves DELWP covering the capital costs of initial model development and BoM the cost of operating, maintaining and continually improving those models.
- Existing flood prediction services will continue to be operated, maintained and improved by BoM.
- Where a flood study identifies the need for new rain or stream monitoring gauges to support a TFWS for a community within Melbourne Water's region, Melbourne Water will cover the capital and maintenance costs of those gauges.
- Where a flood study or a regional floodplain management strategy outside Melbourne Water's region identifies the need for a TFWS and that service has community support, the capital costs of new rain or stream monitoring gauges will be shared between the Victorian and Australian Governments. The local community, through its LGA, will fund ongoing maintenance costs for the gauges.
- Where existing rain and stream monitoring gauges are providing flood warning services, the Victorian Government expects existing cost-sharing arrangements to continue until a regional floodplain management strategy or a local flood study assesses the need for a TFWS service.
- Where existing gauges are assessed as being an essential component of a TFWS, the costs of maintaining those gauges will be shared between the LGA and the CMA if it is also used for water quality monitoring, or with a water corporation if it is also used for water resource assessments. In some cases the costs may be shared between all three agencies.

16.3 Flood warning services for all Victorians

All Victorian communities receive BoM warnings, such as Flood Watches and Severe Weather Warnings, that advise on weather conditions that have the potential for heavy rainfall and flooding.

The BoM's website provides near real-time river height data and rainfall data for most major rivers at risk of flooding. This information allows people to assess the local impacts and take appropriate action.

All communities receive general safety messages, such as 'do not drive, walk or ride through floodwaters' from VICSES. Everyone also has access to guidance on appropriate flood responses. For example, VICSES issues FloodSafe guides to help local communities prepare for and respond to floods.

Communities with high potential for flood damage receive more sophisticated flood warning services. These can include local predictions about the rise and fall of floodwaters, details on the roads and properties likely to be inundated, and local advice about how to prepare for and respond to predicted floods.

Regional Floodplain Management Strategies and local flood studies may identify additional communities where more sophisticated services are warranted. The ongoing review of Regional Floodplain Management Strategies will enable continual assessment of flood warning services to communities.

16.4 Assessing Total Flood Warning System services at state, regional and local levels

The 2010-12 floods exposed serious deficiencies with the management of TFWS services; no one agency had overall accountability for the coordination of, or performance reporting on, TFWSs at the state level.

To rectify this, the Victorian Government has made DELWP accountable for the coordination of TFWS services at the state level. It is also accountable for documenting a state-level TFWS service development plan. DELWP will do this in consultation with VICSES, BoM, Melbourne Water, CMAs, LGAs, water corporations and other stakeholders as required.

The TFWS service development plan will be informed by the rolling three-year implementation plans coming out of the Regional Floodplain Management Strategies. In preparing those regional strategies, the CMAs and Melbourne Water will systematically assess the existing TFWS services provided to the flood-prone communities in their region, using the statewide assessment framework developed by DELWP. They will also assess the TFWS service needs of each flood-prone community.

16.5 Matching Total Flood Warning System services with community needs

Following their assessments, the CMAs and Melbourne Water will identify those TFWSs that need to be modified. DELWP will then prioritise these TFWS service needs at the state level. They will also clarify the accountabilities for each TFWS element with the agencies involved.

In general terms, the roles and responsibilities in operating and maintaining the overall service can be summarised as follows:

Data collection network infrastructure: Across Victoria, there are some 780 active river level and rainfall gauges maintained through two Regional Water Monitoring Partnerships. The partnerships involve DELWP, LGAs, CMAs or Melbourne Water, and other water corporations with an interest in the use of gauge data. The partnership approach allows data to be collected to a well-defined standard once. It also allows data to be used for multiple business needs, such as water resource assessments, water allocation management, river health management, compliance monitoring and flood warnings. DELWP manages the Partnership contracts and Melbourne Water manages equivalent contracts within the Port Phillip and Westernport region.



Gouburn River at Murchison. Source: DELWP

Of the 780 active gauges, 237 are used in the delivery of flood warning services. About 180 of these are also used by CMAs and water corporations for other purposes (such as environmental flows, bulk entitlements and infrastructure operations). The multiple uses of gauges enable the operational costs to be minimised and shared between partner organisations.

Flood prediction service maintenance: BoM (outside the Port Phillip and Westernport region) or Melbourne Water (within the Port Phillip and Westernport region) maintains and funds the prediction services for locations defined in the BoM Service Level Specification for Flood Forecasting and Warning Services. Maintenance includes continually improving prediction techniques.

Interpretation (flood mapping): Local flood studies produce updated flood mapping. DELWP includes updated flood mapping and flood behaviour information in the flood intelligence platform.

Message construction and dissemination: BoM and Melbourne Water maintain appropriate flood warning messages and associated dissemination channels for locations noted in the BoM Service Level Specification. VICSES maintains its dissemination channels for flood bulletins. VICSES will develop appropriate flood bulletin messages using available flood behaviour and intelligence material. DELWP maintains the flood intelligence platform to enable access to appropriate information for messages and bulletins. LGAs use locally specific dissemination systems to support VICSES services.

Flood emergency planning and community awareness: VICSES maintains flood emergency plans and community education material. CMAs and Melbourne Water supply VICSES with any significant updates of the flood mapping and flood behaviour information.

Policy 16b

- With leadership and guidance from DELWP, each of Victoria's Total Flood Warning System services will require active cooperation and collaboration between DELWP, BoM, VICSES, water corporations, LGAs and CMAs.

Accountability 16a

- DELWP is accountable for coordinating the process to strengthen agencies' cooperation and collaboration in preparing Total Flood Warning System (TFWS) services and reporting any problems to the Inspector General for Emergency Management.
- DELWP is accountable for maintaining and continually improving the framework for assessing existing TFWS services in the context of the relevant community's identified flood risks.
- Melbourne Water and the CMAs, in consultation with relevant communities, LGAs, water corporations, VICSES and BoM are accountable for coordinating the assessment and implementation of fit-for purpose TFWS services that align with identified flood risks.
- VICSES is accountable for providing opportunities for local knowledge to be incorporated into flood emergency planning and community education as part of the TFWS services.
- DELWP is accountable for providing assurance that all Victoria's TFWS services are being maintained in a state of operational readiness.
- VICSES and LGAs are accountable for documenting local TFWS services in Municipal Flood Emergency Plans.
- DELWP is accountable for documenting a state-level TFWS service development plan. DELWP will consult with VICSES, BoM, Melbourne Water, CMAs, LGAs, water corporations and other stakeholders as required.
- DELWP is accountable for coordinating revisions of flood class levels with relevant agencies.
- Melbourne Water and the CMAs, in consultation with relevant communities, LGAs, VICSES and BoM, are accountable for determining appropriate flood class levels (minor, moderate and major) for flood-prone communities.
- LGAs are accountable for the maintenance of those stream gauges whose sole purpose is to serve as an element in a TFWS service.

Action 16a

- DELWP will:
 - establish a framework to assess TFWS services in the context of the relevant community's identified flood risks
 - prepare a rolling three-year State TFWS services development plan informed by the implementation plans coming out of Regional Floodplain Management Strategies and the outputs of local flood studies.

16.6 Review

The Inspector General for Emergency Management has developed an assurance regime to meet its obligation to develop an audit framework for the Total Flood Warning System (TFWS) service. The assurance regime includes:

- a mapping process to describe the TFWS service
- a framework to facilitate the collection of consistent, relevant and quantifiable information or data to support rigorous monitoring and assessment of the performance of the TFWS
- a three-year schedule of assurance activities, including proactive and reactive reviews to test all aspects of the TFWS service.

As well as the proactive reviews undertaken as part of the Regional Floodplain Management Strategies, DELWP will monitor and review how each TFWS performs when it is needed. Each TFWS service will, as a matter of course, be reviewed after a major flood.

Policy 16c

- Local Total Flood Warning Systems will be operationally reviewed locally after each major flood where an incident control centre has been established.

Accountability 16b

- The relevant CMA or Melbourne Water is accountable, after each major flood involving the establishment of an incident control centre, for convening a meeting of all agencies accountable for providing input to the relevant Total Flood Warning System to review its operation during the incident and determine whether a more detailed system review is required.
- The Inspector General for Emergency Management is accountable for establishing a Total Flood Warning System service assurance regime and conducting the systematic assurance reviews.

16.7 Working towards flash flood warning services

Flash floods can threaten life and property in the upper parts of many catchments and some urban locations. Regional Floodplain Management Strategies will identify locations where there is a history of flash flooding.

Flash floods require expedited warning processes. The TFWSs for riverine flooding are based around having at least six hours to collect data, run prediction models, interpret flood mapping, determine potential consequences, and construct and disseminate warnings. Flash floods do not allow time to run those processes; they call for a different approach.

BoM already issues Severe Weather Warnings. The warnings describe the area under threat and the expected hazards, which can include very heavy rain that may lead to flash flooding. Warnings are issued with varying lead-times, from an hour or two up to about 24 hours, depending on the weather situation. Severe Weather Warnings offer a potential basis for the development of flash flood warning services.

Given the short timeframes associated with flash flooding, more certainty is needed about each agency's roles, capacities, responsibilities and accountabilities, and the community's capacity to respond appropriately. VICSES says it is willing to issue bulletins for flash flooding if there is an approved predictive service available. It will take time for VICSES to build its capacity to address this accountability, so Regional Floodplain Management Strategies will need to outline appropriate timeframes for these services to be developed.

Policy 16d

- The CMAs and Melbourne Water, with the support of VICSES and LGAs, will progressively identify areas with a history of flash flooding and include them in their Regional Floodplain Management Strategies and implementation plans.
- Cost-sharing arrangements for flash flood warnings will be the same as for riverine flooding (Policy 16a).

Action 16b

- DELWP will work with the Emergency Management Commissioner to evaluate the potential to disseminate generalised district-scale flash flood warning services based around BoM's existing severe weather warning services, using similar dissemination approaches employed for bushfires.
- DELWP will work with BoM, the Emergency Management Commissioner and VICSES to evaluate the potential to provide localised neighbourhood-scale flash flood warning services where there is a history of flash flooding.



Car partially submerged by floodwaters in Traralgon, 2012. *Source: West Gippsland CMA*

17. Flood mitigation infrastructure

A number of structural measures are used to mitigate the effects of flooding, including levees, channel modifications, bypass floodways, retention basins, dams and floodgates. Collectively, these measures are referred to as flood mitigation infrastructure.

The management arrangements for flood mitigation infrastructure in Melbourne are outlined in Section 18. This section outlines relevant governance arrangements and policy settings for large-scale flood mitigation infrastructure in regional Victoria.

The 2010-12 floods revealed serious deficiencies in the management arrangements for flood mitigation infrastructure outside Melbourne. Responsibilities were either non-existent or blurred between Catchment Management Authorities (CMAs) and Local Government Authorities (LGAs), and accountabilities were not assigned consistently across the state. However, a number of LGAs and their communities have been proactive in leading activities to reduce flood risk.

17.1 A successful model

The benefits of well-managed flood mitigation infrastructure were demonstrated in the 2010-12 floods. For example, levees had been constructed in the towns of Kerang and Nathalia in response to previous large floods and, importantly, those levees had been well managed and regularly maintained by the relevant LGA. As a result, both towns were spared extensive flood damage. The lessons from those floods have led both LGAs to reinforce their flood defences.

In recognition of the public benefits of those levees, the Victorian and Australian Governments shared the construction costs with those LGAs, and the LGAs took responsibility for ongoing maintenance. This approach has been applied successfully in other towns, such as Creswick (see case study), since the 2010-12 floods.

Unfortunately, such arrangements have not been applied consistently across the state. There are many towns where existing flood mitigation infrastructure is unmanaged to the point where it could fail during a flood due to the lack of maintenance – despite the three tiers of government having invested, in good faith, in building the infrastructure in the first place.



House protection levee at Culgoa. Source: Mallee CMA

There are several reasons why this inconsistent approach cannot continue:

- there is no certainty that unmanaged mitigation infrastructure would perform to its design standards in a flood (if indeed those standards are known)
- the benefits of the mitigation works are not well understood and do not necessarily match expectations
- emergency service agencies lack sufficient information to predict whether or not a levee is likely to fail
- the downstream impacts are not understood and may be worse as a result of floodwaters being channelled by the levees
- insurance premiums may be higher than they need to be because, in the absence of reliable information about the ownership and maintenance of flood mitigation infrastructure, insurers are assuming that it is not in place.

The Victorian Government is determined to remove uncertainty and inconsistency in the management of flood mitigation infrastructure. The work involved in developing a more robust and more consistent management framework is complex, and it will require a number of steps before formal management arrangements can be put in place. Nonetheless, the government is determined that the management arrangements in place for Kerang and Nathalia should be seen as ‘best practice’.

17.2 Government investment criteria for flood mitigation infrastructure

As outlined in the Victorian Government’s response to the Environment and Natural Resources Committee (ENRC) inquiry into flood mitigation infrastructure, the ‘beneficiary pays’ principle will determine the management and funding arrangements for flood mitigation infrastructure into the future.

Most of Victoria’s flood mitigation infrastructure is in rural areas, where it provides private benefits by protecting agricultural production. Some infrastructure does provide public benefits, and in that context the Commonwealth Government, the Victorian Government and LGAs can legitimately be described as beneficiaries. This section of the strategy explains the criteria each level of government will apply in deciding whether to invest in flood mitigation infrastructure for public benefits.

Government identifies two main types of public benefits: community and environmental benefits.

17.2.1 Community benefits

The Australian and Victorian Governments and LGAs recognise that they have an important role to play in protecting health and safety, in helping to avoid disruptions to social services and in helping individuals take collective action where necessary. In doing so, the Victorian Government is guided by the following principles when deciding whether or not to invest in large-scale flood mitigation infrastructure:

- Due process – Communities will be consulted so that their concerns, their local knowledge and their ideas about flood mitigation options can be considered.
- Due diligence – Decision-making processes will set clear objectives, be evidence-based and will examine all reasonable options to mitigate flood risks.

Case Study: Establishing flood mitigation infrastructure at Creswick

Creswick, at the confluence of Creswick and Slaty Creeks, was flooded four times between September 2010 and February 2011. The flooding was extensive in September 2010 and January 2011.

In February 2011, the Victorian Government moved to help the local community develop and implement a flood mitigation plan. Funding was made available to clear creek blockages and to increase the town’s resilience to flooding.

Hepburn Shire Council and North Central CMA consulted with the Creswick community to capture the local understanding of the floods’ impacts on the town. Local knowledge was combined with technical information to design works to ensure that if a flood the size of January 2011 hit again, the impacts would be much lower.

With funding available through the Victorian Government’s FloodZoom initiative and the Australian Government’s Natural Disaster Resilience Grants Scheme, Hepburn Shire Council started implementing the

flood mitigation plan in 2013. Levee bank and creek works began that year. The Shire, and the Victorian and Australian Governments shared the capital costs of \$650,000.

The last stage of the plan’s implementation was completed in 2015, with VicRoads providing design and construction services to replace two road crossings on the creek. The \$800,000 cost was shared between the Shire and the Victorian Government.

- Cost effectiveness – The three tiers of government will only invest in building or upgrading flood mitigation infrastructure if the benefits are greater than the total costs (including both capital and ongoing costs).
- Supporting analysis – This will include consideration of the economic value of flood mitigation infrastructure to local economies, including local industries and businesses.
- Community benefits – The three tiers of government will only invest in building or upgrading flood mitigation infrastructure where the primary benefits are the protection of:
 - human life and safety
 - community safety, by ensuring major evacuation routes are maintained
 - community welfare, by ensuring the continuity of social services, particularly those provided by public infrastructure
 - existing dwellings, where it is only feasible to protect them through collective action.
- Accountability for ongoing management – The three tiers of government will only invest in building or upgrading flood mitigation infrastructure if the accountability arrangements for ongoing management, maintenance and assurance are agreed and clearly documented. These arrangements should allow for measurable outcomes to be established, evaluated and reported.

In practice, it is easier to demonstrate a *prima facie* case for these community benefits for urban areas than it is for rural areas, therefore the three tiers of government, working together, will continue to fund flood studies and cost-effective mitigation measures for urban areas. Large-scale flood mitigation infrastructure is no longer considered best practice for rural areas.

17.2.2 Environmental benefits

The Australian and Victorian Governments recognise that healthy waterways and healthy floodplain ecosystems provide significant public benefits. In that context they have made large investments in restoring waterway and floodplain health.

Environmental water managers now hold large volumes of water entitlements. They actively release water from storages to improve the environmental condition of waterways and floodplains. In particular, they aim to mimic some of the natural flows that would have occurred if those storages did not exist. Apart from some major floodplains on public land (such as the Living Murray icon sites), environmental water management

has so far largely focussed on in-stream flows. In the future however, there will be more focus on watering floodplains. In effect, this will require the use of ‘managed floods’.

Floodplains are often a mix of both public and private land. The Victorian Government’s policy is that private land will only be inundated by environmental water with the landholder’s agreement. Environmental water managers must make use of a range of risk management tools to avoid inundating private land without agreement. Levees are one of the potential tools available to them. Other options include short-term agreements with landholders or longer-term easements. Alternatively, they can reduce their environmental objectives, thereby reducing flow levels to the point where they avoid the risk of flooding private land.

To the extent that levees will be used for environmental water management, it will be important to include environmental water managers in the ‘beneficiary pays’ framework outlined in this Strategy. In that context, it is important to outline the rules and costs associated with providing services to environmental water managers from existing and new levees.

Provided the benefits exceed the costs, decisions about the levels of service to be derived from levees should be determined by the beneficiaries of the levee. This principle applies as much to environmental water managers as it does to urban communities or rural landholders. It will be important for environmental water managers to define the level of service they require from specific levees (if any).

In some circumstances, environmental water managers may choose to build new levees. In others, they may wish to use a levee that is already being used for different purposes. Existing levees may offer a much higher level of service than is required by environmental water managers. For example, a particular levee may provide community protection against natural flooding (from say a 5% to 1% AEP flood); if it were to be used for environmental watering (say a 30% AEP ‘managed flood’) the water may only reach the toe of the levee.

Given this range of possibilities, the Australian and Victorian Governments will be guided by the following principles when deciding whether or not to invest in levees for environmental watering:

- If a new or existing levee is required solely to protect against managed floods, the Victorian or Australian Government, as environmental water managers, will bear all capital costs (construction or upgrade) and all ongoing maintenance costs.

- If a formally managed levee is also used for a managed flood, the Victorian or Australian Governments, as environmental water managers, will negotiate to pay an appropriate share of the maintenance costs. Consistent with the criteria for government investment (Section 17.2), the cost of building or upgrading the levee to bring it into formal management arrangements would already have been shared between the Australian and Victorian Governments and the LGA, so the environmental water manager would not need to contribute to capital costs.
- If an unmanaged levee on Crown land is required for a managed flood, the environmental water manager could upgrade any section of the levee through the CMA licensing framework (Section 17.4.3).
- If an unmanaged levee on private land is required for a managed flood, the environmental water manager will negotiate with the landholder to obtain the permission necessary to carry out maintenance works.
- There is no need for anyone to own an existing unmanaged levee. But, if it were currently being used for managed floods, the environmental water managers would need to be assured that it was fit-for-purpose in terms of risk management.

17.3 Water Management Schemes

17.3.1 Current Water Management Scheme arrangements

The *Water Act 1989* contains provisions for the implementation of Water Management Schemes. These have been used to evaluate, design and construct flood mitigation infrastructure. These Schemes provide considerable potential to help satisfy the government investment criteria outlined in Section 17.2. In particular, they provide clear steps for:

- community ownership of the decision-making process, through a community-based committee
- information gathering, through investigations
- community engagement, through the public display of proposed schemes
- applications for reviews by affected persons to the Victorian Civil and Administrative Tribunal
- Ministerial determinations.

Water Management Schemes offer LGAs benefits that alternative arrangements under the *Local Government Act 1989* do not. In particular, the potential to share any liability for the effects a scheme that has been implemented through these processes may have on the flow of water. They offer the Victorian Government the potential to bring the management of flood mitigation infrastructure into an assurance framework that can be overseen by the Inspector General for Emergency Management.

Water Management Schemes satisfy the government investment criteria set out in Section 17.2 and therefore are the preferred arrangements for designing and implementing large-scale flood mitigation infrastructure.



River Red Gums flooded under environmental flows at Barmah State Forest. Source: Keith Ward

Its preference is for LGAs, as the tier of government closest to flood-prone communities, to implement Water Management Schemes for flood mitigation infrastructure.

Action 17a

- DELWP will provide guidelines and assistance to LGAs and other authorities to help them develop and implement Water Management Schemes.
- DELWP will provide guidance for LGAs on seeking the relevant skills and expertise for the design, construction and management of any infrastructure implemented under a WMS.
- DELWP will maintain a management framework for flood mitigation infrastructure.

17.3.2 Improving Water Management Schemes

The processes surrounding Water Management Schemes are not perfect – several issues have been identified for improvement. These include:

- The liability framework – The Victorian Government’s policy is that immunity provisions are rarely appropriate for government and its agencies because they remove the legal rights of redress of a person who has suffered loss and can weaken the incentives for a person or body to exercise a reasonable level of care. However, a different liability framework currently operates with respect to council versus water corporation works in a Water Management Scheme. It seems reasonable that the same standard should apply to both.
- Bringing existing infrastructure into Water Management Scheme arrangements – This process should be made simpler, without compromising the principles of good governance.
- Assurance about ongoing management – Currently, there are no provisions to allow conditions on, or obligations for, the implementation of Water Management Schemes. Where the Australian and Victorian Governments have invested in flood mitigation infrastructure, it seems reasonable for them to be assured that the infrastructure is being managed and maintained to its design standards.

Action 17b

- DELWP will prepare, for government consideration, a proposal to amend the *Water Act 1989* to clarify and simplify the liability and assurance arrangements for LGAs when they construct or maintain flood mitigation infrastructure through the implementation of Water Management Schemes.

17.4 Implementing Water Management Schemes

17.4.1 New flood mitigation infrastructure

The process for building any new flood mitigation infrastructure will begin with Regional Floodplain Management Strategies (Section 26). They will identify areas where there is a *prima facie* case to investigate the need for flood mitigation infrastructure. In order of statewide priority, Water Management Schemes will progressively be prepared for these areas by committees established as part of each Scheme. Each committee will include representation from the community, the LGA and any public statutory body (such as a CMA) directly affected by the proposal.

A flood study (described in Section 11) may be conducted as part of the Water Management Scheme Committee’s investigation. The flood study will consider the options for flood mitigation. It will also assess the costs associated with flooding for a range of AEPs to determine the locality’s actual flood risk.

The committee will use this information to determine those areas where the investment criteria in Section 17.2 are met. It will also use the information to determine the benefits (in terms of reduced flood damage) and compare these to the costs of constructing flood mitigation works. These assessments will then in turn be used to request funding support from the Victorian and Australian Governments.

Flood-prone communities, through their LGAs, will be free to choose the design flood event for their flood mitigation infrastructure; this may be for floods smaller than the 1% AEP flood event used for land use planning. Once the infrastructure is built, information will be made available to property buyers so they are aware of the level of protection it provides.

Policy 17a

- All new large-scale flood mitigation infrastructure outside Melbourne Water’s region will be implemented as Water Management Schemes under the *Water Act 1989*.
- The costs of designing and constructing new large-scale flood mitigation infrastructure that meets the government investment criteria will be shared equally between the Australian and Victorian Governments and the relevant LGAs.
- The maintenance and management of new flood mitigation infrastructure under formal arrangements will be funded by beneficiaries (through relevant LGAs) and will be subject to third-party auditing arrangements to ensure it continues to be maintained.

Accountability 17a

- LGAs (outside Melbourne Water's region) are accountable for:
 - leading the processes to determine and implement new flood mitigation infrastructure, through flood studies and Water Management Schemes
 - the ongoing maintenance and management of new infrastructure through flood studies and Water Management Schemes.
- CMAs are accountable for:
 - supporting LGAs to lead the processes to determine and implement, through flood studies and Water Management Schemes (where appropriate), the assessment of new flood mitigation infrastructure.

Action 17c

- DEWLP will provide:
 - guidance on the positioning of new flood mitigating infrastructure in accordance with the Victorian Waterway Management Strategy 2013, which is to avoid high-energy flows
 - guidance on developing levee management and maintenance arrangements
 - guidance on inspection and auditing requirements and provision for third party inspections.

While large-scale flood mitigation infrastructure is not considered best practice, there may be limited circumstances in which new rural levee systems may be considered. For example, they might be necessary for environmental watering or to reduce the risk of avulsions.

The government will not explicitly rule out the construction of new rural levee systems. However, any such levee system would need to be fully evaluated under a Water Management Scheme, with an investigation by a committee led by an LGA and supported by flood studies that take into account the associated social, cultural, economic and environmental costs and benefits (Figure 14).

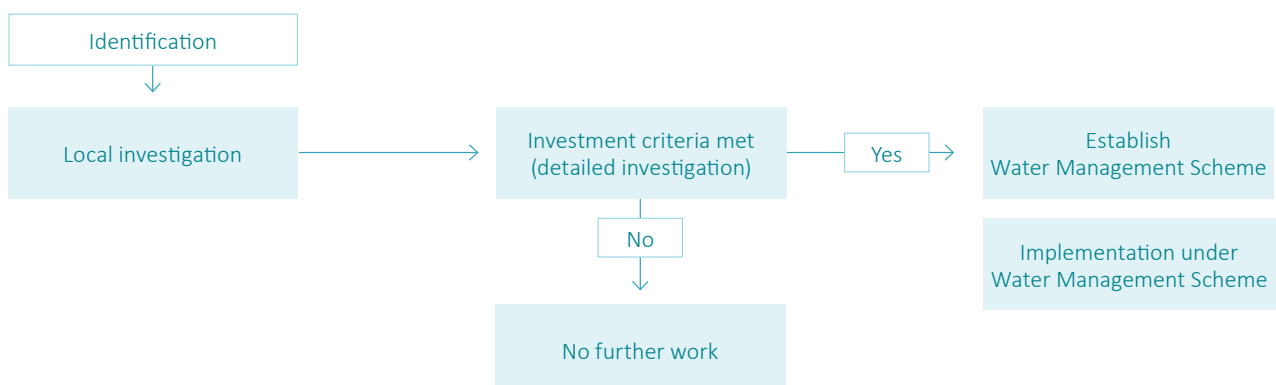
The government will not fund construction of new rural levee systems that do not meet the investment criteria outlined in Section 17.2.

The Victorian Critical Infrastructure Resilience Strategy provides a model for critical infrastructure owners and operators to engage with government. Where the installation of new, or the maintenance of existing, critical infrastructure has the potential to affect flood behaviour, the Victorian Government expects critical infrastructure providers to collaborate with LGAs and

Figure 14: New flood mitigation infrastructure



Regional Floodplain Management Strategy





Urban levee at Echuca. Source: DELWP

CMAs to minimise the impacts of their infrastructure on flood risks. The government also expects them to collaborate with LGAs and CMAs where new or updated essential-service infrastructure has the potential to provide flood mitigation benefits.

An alternative way to reduce existing flood risks to private assets in rural areas is to allow landholders to build ring levees to protect individual buildings and curtilages (the enclosed area of land adjacent to a building or dwelling). These are often small enough not to have significant third party or environmental impacts. However, individual levee protection should not be a substitute for setting floor levels above the 1% AEP flood level for new dwellings.

New levees on private land must comply with relevant planning approvals to enable third party impacts to be considered. The landholder will be responsible for construction and maintenance of these works.

Policy 17b

- New, large-scale rural flood mitigation infrastructure will only attract government funding if it satisfies the investment criteria outlined in this Strategy.

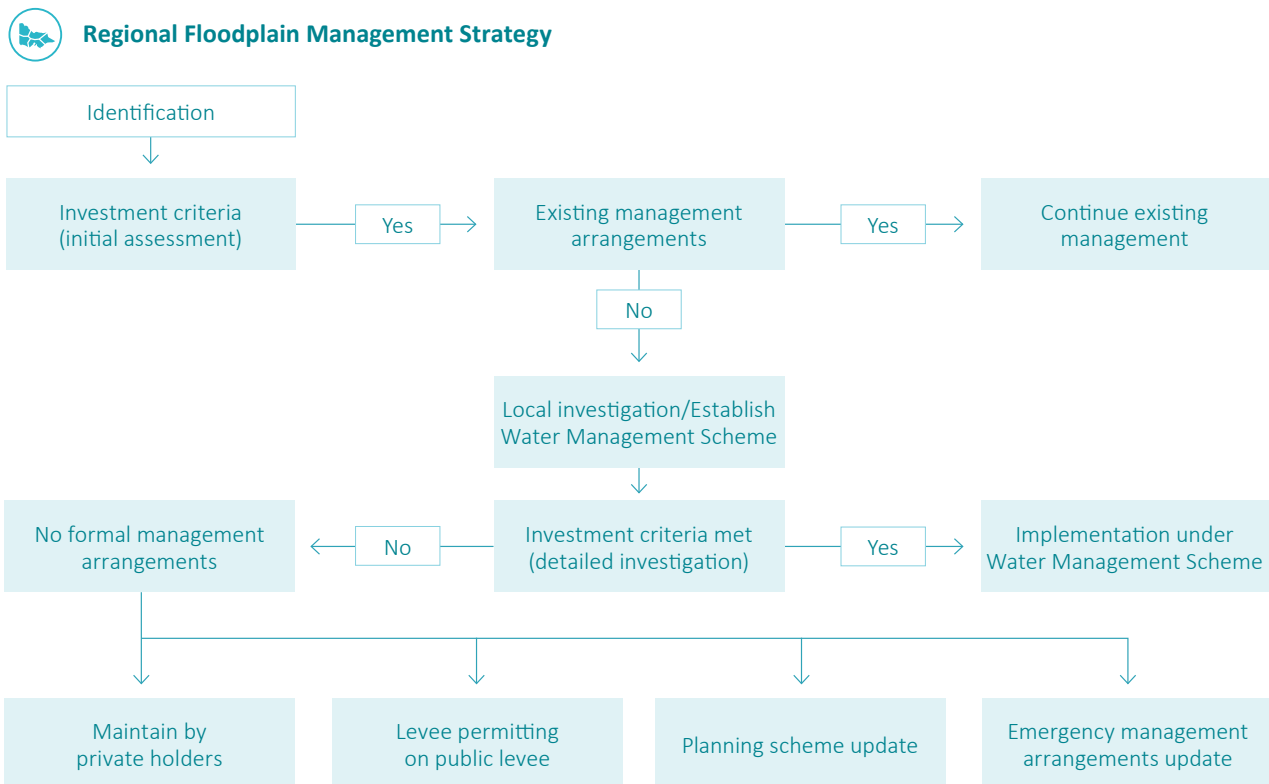
17.4.2 Existing flood mitigation infrastructure

The process for improving management arrangements for existing flood mitigation infrastructure (Figure 15) will also begin with Regional Floodplain Management Strategies (Section 26). They will identify areas where there is a *prima facie* case to investigate the need for existing flood mitigation infrastructure to be brought into Water Management Schemes. In order of state wide priority, Water Management Schemes will then progressively be prepared for these areas by committees established as part of each Scheme. Each committee will include representation from the community, the LGA and any public statutory body (such as the relevant CMA) directly affected by the proposal. Specifically, Regional Floodplain Management Strategies will make *prima facie* considerations of:

- the current governance arrangements against the investment criteria (Section 17.2)
- the costs of restoring the infrastructure (if required) to a reasonable standard of protection
- the benefits of restoring and maintaining the infrastructure
- the costs of ongoing management and maintenance
- the costs and benefits of alternative solutions
- the community's willingness to pay.

The Regional Floodplain Management Strategy may identify the need for a detailed local assessment of these aspects.

Figure 15: Existing flood mitigation infrastructure



Case Studies: Linking flood mitigation infrastructure and critical infrastructure – Ballarat and Euroa

Ballarat is at the junction of five major catchments. A flood study on the Yarrowee catchment that flows south through the city, identified that a 1% AEP flood would have serious consequences and that retarding basins in the catchment upstream of the CBD would reduce the flood hazard.

The then Shire of Ballarat, working in collaboration with VicRoads and the Rural Water Corporation, redesigned

the Western Highway Bypass road embankments to increase their height and to add low flow structures that created two retarding basins. The basins have been successfully operated since 1992.

Euroa has two significant creeks running through it. Several flood investigations in the 1990s led to the preparation of a Water Management Scheme in 2000. The proposed works included extending and upgrading a levee along one side of Castle Creek to protect the town.

In implementing the scheme, concerns were raised about the potential

impact of a new section of levee near the Melbourne-Sydney railway line. Strathbogie Shire Council worked together with the Goulburn Broken CMA and VicTrack on a compromise. It was agreed to lower and strengthen the section of the levee adjoining the railway line, so that floodwater would not flow through the track ballast and weaken the tracks, but would instead overtop at the low point of the levee and be diverted into an adjoining paddock. The solution did not compromise the level of flood protection for the town.

Policy 17c

- Flood mitigation infrastructure outside Melbourne Water's region that is not currently subject to formal management arrangements will remain that way unless the relevant LGA (through a Regional Floodplain Management Strategy or local assessment) determines that the infrastructure should be brought into formal management arrangements through a Water Management Scheme or other appropriate arrangements.
- The costs of restoring or upgrading existing flood mitigation infrastructure to bring it into formal management arrangements will, if it meets the government investment criteria (Section 17.2), be shared equally between the Australian and Victorian Governments, and the relevant LGAs.
- The maintenance and management of existing flood mitigation infrastructure under formal arrangements will be funded by beneficiaries (through relevant LGAs) and will be subject to third-party auditing arrangements to ensure it continues to be maintained.
- Where there is flood mitigation infrastructure that is not being formally managed:
 - the relevant Municipal Planning Scheme must not assume that the infrastructure will provide flood protection
 - the relevant Municipal Flood Emergency Plan must provide for the potential for sudden and complete failure of that infrastructure.

Victoria has 32 existing regional urban levees, 12 of which are managed under Water Management Schemes.

While Water Management Schemes are the Victorian Government's preferred arrangement for flood mitigation infrastructure, there may be instances where alternative arrangements are demonstrably more appropriate. In such cases, as with all flood mitigation infrastructure that attracts government funding, the beneficiaries will be required, through their LGA, to meet the ongoing costs of management, maintenance and auditing in line with the upgrade.

Action 17d

- DELWP will consult and collaborate with relevant LGAs to develop a process to convert existing flood mitigation infrastructure to Water Management Schemes. That process will:
 - begin with an assessment of the condition of the infrastructure and its standard of protection, based on the best available information derived from flood studies
 - consider options to upgrade the infrastructure to contemporary design standards
 - identify, in consultation with the benefiting community, the most cost-effective option in keeping with community's willingness and ability to pay for ongoing management and maintenance
 - establish ongoing management arrangements.
- DELWP will develop principles to guide LGAs on the option to leave existing infrastructure unmanaged and unmaintained or only maintained to a low standard.

Accountability 17b

- LGAs (outside Melbourne Water's region) are accountable for:
 - leading the processes to determine and implement, through flood studies and Water Management Schemes (where appropriate), the assessment of existing flood mitigation infrastructure necessary to meet the needs of their communities, taking into account economic, social, cultural and environmental issues
 - the ongoing maintenance and management of existing infrastructure under formal management arrangements.
- DELWP is accountable for maintaining a management framework for flood mitigation infrastructure.

Large-scale rural flood mitigation systems are no longer considered best practice. Most of the existing systems were not subject to planning controls or engineering standards and were built with little understanding of their ongoing maintenance needs. As a result, the floods of 2010-12 revealed serious deficiencies with the existing rural flood mitigation infrastructure.

Most of Victoria's 4,000 kilometres of levees are in rural areas. Given their poor construction, their potential negative impact on third parties and the environment,



Rural levee near Barmah. Source: DELWP

and the prohibitive cost of maintaining them relative to the benefits they provide, it is unlikely that many, if any, will be maintained formally into the future.

Nonetheless, if a Regional Floodplain Management Strategy identifies that existing government-built rural infrastructure is providing significant benefits that meet the investment criteria outlined in Section 17.2, it may be possible to bring that infrastructure into formal management arrangements, but any investment by the three tiers of government would be limited to the value of the community and environmental benefits described in Section 17.2.

17.4.3 Maintaining existing infrastructure without formal management arrangements

While the benefits of a particular rural levee may not meet the investment criteria outlined in Section 17.2 (and therefore will not be managed through a formal Water Management Scheme), there may be individuals who see benefit in that levee and wish to maintain it themselves.

Where the levee is on private land, it will be for the beneficiaries to negotiate with landholders about management arrangements. Landholders opting to jointly manage their own scheme may request LGA assistance, on terms negotiated directly between the LGA and the group. DELWP will work with local government to determine how these arrangements could work.

Where the levee is on Crown land, a new permit scheme created by legislation in 2014 means that beneficiaries are able to maintain that levee themselves. Previously, if they wanted to maintain the levee they needed to seek a variety of Crown land manager approvals and, in some instances, to have approval from multiple land managers, some of who did not have the power to give any approval at all. Under the new scheme, people will only need a single permit from their local CMA.

Permit holders will be authorised to access the Crown land and maintain the levee in accordance with conditions on the permit. Permit holders will not be authorised to change the levee's original location, height and width, build a new levee or remove an old one, as this could affect third parties. CMAs and land managers, such as DELWP and Parks Victoria, will set reasonable conditions on the permit to minimise the impact of maintenance activities on Crown land values. In most instances, a person holding a Crown land levee maintenance permit will not be required to also apply for a permit under the relevant Municipal Planning Scheme. Nonetheless, their maintenance activities must comply with other legal obligations, such as those that protect Aboriginal cultural heritage.

DELWP is working to streamline environmental approvals in relation to levee maintenance, to reduce the burden on permit applicants.

Policy 17d

- Levees on Crown land that are not being formally managed will be allowed to weather away unless those benefiting from them decide to repair and maintain the levee (or part of the levee) under a levee maintenance permit.
- If no formal arrangements are put in place for a levee on Crown land and a local beneficiary sees benefit in that levee, they may apply to maintain it themselves – at their own expense – via a Levee Maintenance Permit issued by a CMA or Melbourne Water.
- Permits to maintain levees on Crown land will be subject to conditions specified by both the Crown land manager and the Minister for Water or a delegate such as a CMA.
- Applicants for levee maintenance permits will need to ensure their activities comply with all relevant approvals, including Aboriginal cultural heritage requirements.

Action 17e

- DELWP will prepare guidance material, including an Application Kit, on how to apply for a permit to maintain levees on Crown land. This will include practical advice on how to meet their obligations to protect environmental values. CMAs will make these guidelines available at their offices and on their websites.

17.5 Cross-border issues

The 2010-11 floods brought into focus long-standing issues about the lack of integration across state borders for the management of flood mitigation infrastructure. Border communities in both Victoria and NSW expressed concerns that levees on one side had aggravated flood impacts on the other. They also had concerns that neither state was doing enough to share floodwaters and flood storage capacity through the integrated operation of regulators.

Cross-border issues are complex. Efforts to resolve these issues date back to 1910, when NSW and Victoria entered a formal Interstate Levees Agreement. Centralised efforts to coordinate levee construction persisted, nominally at least, until 2008 when the Murray-Darling Basin Commission was abolished. They were not successful, partly because flood behaviour is more complex than envisaged more than a century ago.

The trade-offs involved in floodplain management can really only be resolved at the local level.

This Strategy aims to foster greater cooperation across the border at the local level. Building trust and goodwill at the local level starts with an understanding of the differences in institutional arrangements that govern floodplain management in each state. For example:

- levees in NSW are licensed, in Victoria they are not
- levee approval is centrally regulated in NSW (via the *NSW Water Management Act 2000*), but approval processes in Victoria are more diffuse
- the statutory planning roles of LGAs are different.

While there are differences in the framework and accountabilities in each state, the overall objectives and desired outcomes are similar.

Future Regional Floodplain Management Strategies with cross-border components will be prepared in consultation with relevant agencies from both states. In meeting this commitment, some basic protocols will need to be established.

DELWP will work with its NSW counterparts, and consult with relevant agencies and organisations, to establish processes for integrated floodplain management across borders. For example, NSW and Victoria should agree that:

- all future flood studies for the Murray will consider both sides of the river
- all committees established to oversee the development of flood studies on the Murray will include representatives from both states
- all flood maps for the Murray will be made available to both states

- flood intelligence from both sides of the border will be shared and made available to emergency management planners and to incident managers from both states
- emergency managers on both sides of the border should conduct joint training exercises and the preparation of flood emergency management plans should include representation from both states
- upgrades to flood warning systems on cross-border systems, including the Snowy, should involve the relevant authorities from both states
- the operating procedures for all dams, weirs, locks and regulators capable of influencing flood behaviour on cross-border systems, including the Snowy, should be documented in emergency plans on both sides of the river
- there should be no increase in the height or length of existing levees on the Murray without triggering a cross-border referral
- both states should revise their approval processes to include cross-border referrals.

All proposals for flood mitigation activities on the Victorian side of the river, other than for minor works such as a ring levee around a house and curtilage, will be referred to appropriate NSW agencies for advice.

Relevant NSW agencies will be encouraged to actively participate in the development of relevant Regional Floodplain Management Strategies.

Existing forums, such as the Murray Group of Councils, will continue to be used to share information across the NSW and Victorian border.

Policy 17e

- The Victorian Government will take a 'no borders' approach to floodplain management on the Murray River:
 - all proposals for flood mitigation activities on the Victorian side of the river, other than for minor works such as a ring levee around a house and curtilage, will be referred to appropriate NSW agencies for advice
 - relevant NSW agencies will be encouraged to actively participate in the development of relevant Regional Floodplain Management Strategies
 - existing forums, such as the Murray Group of Councils, will continue to be used to share information across the NSW and Victorian border.

Action 17f

- DELWP will approach the NSW Government with a view to establishing formal arrangements for:
 - constructing and managing new flood mitigation infrastructure
 - sharing information
 - improving floodplain management planning processes
 - considering joint studies and strategies
 - considering whether the MDBA or some other group could act as a sounding board for major initiatives or issues
 - coordinating floodplain management.
- DELWP's guidelines will require Regional Floodplain Management Strategies to take account of cross-border issues and actively seek participation from NSW counterparts.
- DELWP will work with NSW agencies to review the need for flood warning upgrades along the River Murray.
- Municipal Flood Emergency Plans will include cross-border issues.



Laanecoorie Reservoir overtopping March 2011. Source: DELWP

17.6 Dam operations

Victoria's large dams are designed to provide water supply and irrigation services, not to mitigate floods. Any flood mitigation from a Victorian dam is incidental and opportunistic; it depends on the water level in the dam at the time of flood-inducing rain. Dams with regulating gates are operated to protect the safety of the dam and to maximise the storage of water. Fixed spillways also keep large dams at safe operating levels and allow floodwaters to pass. The management arrangements for large flow releases from dams are articulated in an attachment to the State Flood Emergency Plan: Management of flooding downstream of dams.

Although it is unlikely that a well-constructed and maintained dam would fail, this extremely rare event could release large volumes of water. Owners of large dams have produced 'flood inundation maps' showing predicted flow paths and levels of the water that could be released in these unlikely circumstances. Dam owners are required to maintain these maps and make them available to Incident Controllers during emergencies.

17.7 Decommissioning flood mitigation infrastructure

On rare occasions, LGAs may choose, after consultation with their local communities, to decommission existing flood mitigation infrastructure. The process for decommissioning will involve:

- commissioning a flood study to evaluate impacts
- developing a strategy to manage those impacts in consultation with the local community
- communicating the results of the decision, giving due consideration to the benefits of decommissioning the flood mitigation infrastructure against the costs and disadvantages.

In most situations, it may be more appropriate to leave existing flood mitigation infrastructure unmanaged, particularly if the infrastructure has not been formally maintained for some time.

In some cases, individual landowners may wish to decommission a private levee. This would require a planning permit to enable third party impacts to be considered and objections to be heard.



Ring levee protecting farm house and private infrastructure from floodwater. Source: North Central CMA

18. Flood mitigation activities on waterways

The *Victorian Waterway Management Strategy* (2013) provides the framework for maintaining and improving the condition of Victoria's rivers, estuaries and wetlands. It aims to ensure that waterways continue to support environmental, social, cultural and economic values for all Victorians. Flood mitigation activities on waterways (such as the construction of levees and flood ways, changes to culvert arrangements, debris clearance, sediment removal and vegetation management must be carried out in ways that are consistent with the VWMS.

The CMAs and Melbourne Water have statutory responsibilities for waterway health and waterway management. Their regional waterway strategies outline regional goals for waterway management and result in works programs developed in consultation with local communities.

Policy 18a

- Regional Floodplain Management Strategies will be aligned, as closely as practicable, with the policies and objectives of relevant Regional Waterway Management Strategies.

The CMAs and Melbourne Water also have a regulatory role, under the *Water Act 1989*, in authorising individuals and organisations to carry out flood mitigation activities on waterways. However, they do not have a responsibility to carry out flood mitigation activities on waterways themselves. If the beneficiaries are willing to cover these ongoing costs, Melbourne Water and the CMAs will help to enable those activities in accordance with state and regional waterway management strategies.

Accountability 18a

- Melbourne Water and the CMAs are accountable, on a priority basis, for works to manage large-scale waterway erosion consistent with regional waterway management strategies.
- Melbourne Water and the CMAs are accountable for providing advice to minimise identified risks of avulsions.

18.1 An authorisation framework for flood mitigation activities on waterways

The Victorian Government is putting in place a framework to enable individuals, infrastructure managers, LGAs and other authorities to carry out flood mitigation activities on or adjacent to waterways. The framework will deal with large-scale projects that typically benefit urban communities, as well as small-scale activities that may benefit individual landholders.

18.2 Authorisation for larger-scale activities for urban areas

For larger-scale flood mitigation activities on or adjacent to waterways, intended to reduce flood risks at the township scale, a flood study will be required before authorisation is granted.

If a flood study demonstrates that flood risks can be materially reduced by flood mitigation works or activities on waterways, it is likely that regular maintenance will be needed. It is rare for these activities to be one-off jobs; vegetation regrows and sediments are always being deposited in streams.

It is important for the beneficiaries to consider whether they are willing and able to meet those ongoing costs. The costs to waterway health, in terms of biodiversity and geomorphology would also need to be understood.

If an LGA wants to carry out flood mitigation works or activities that have demonstrated benefits, it will be able to apply to the relevant CMA or Melbourne Water for authorisation. Authorisation will be subject to conditions designed to ensure that the costs to waterway health, if any, are commensurate with the demonstrated flood mitigation benefits. Authorisation will include a requirement to complete works or activities within a defined timeframe – typically 12 months.

If an LGA wants to secure approvals for longer-term ongoing works or activities, it will also have the option to apply to implement them as Water Management Schemes under the *Water Act 1989*. The processes involved in establishing a Water Management Scheme are described in Section 17.4.1.

Policy 18b

- Where flood studies demonstrate that flood risks can be materially reduced by large-scale flood mitigation activities on waterways, individuals or LGAs may be able to carry out those activities subject to authorisation granted by the CMAs or Melbourne Water.
- If a waterway is to be modified or an activity undertaken on or adjacent to a waterway for flood mitigation purposes, and these activities are to be implemented as Water Management Schemes, the relevant LGA will be responsible for undertaking the activity/work (in compliance with any relevant conditions) and for all ongoing maintenance.
- Large-scale flood mitigation activities or works on waterways must be demonstrated, through a flood study, to be cost effective, i.e. have demonstrable benefits in terms of reduced average annual damage (AAD) that are greater than any costs to waterway health.

Action 18a

- DELWP will prepare guidelines on how to apply to a CMA or Melbourne Water for authorisation to carry out works on waterways. These guidelines will include practical advice on how to meet Aboriginal and cultural heritage protection requirements and environmental protection requirements.
- CMAs and Melbourne Water will make the guidelines available at their offices and on their websites.

18.3 Authorisation for small-scale activities

Where individuals, groups of landholders, infrastructure managers, LGAs or other authorities propose small-scale activities, CMAs will use risk assessment guidelines prepared by DELWP to help them determine whether these activities can be authorised without the need for a flood study.

Policy 18c

- Unless they are formally exempt, individuals or groups of landholders, infrastructure managers, LGAs or other authorities proposing small-scale activities on waterways must obtain authorisation from the relevant CMA or Melbourne Water.
- When determining whether to grant authorisation for proposed activities, the relevant CMA or Melbourne Water must consider potential risks to waterway health. The CMA or Melbourne Water may require the proponent to undertake alternative activities to minimise any risks.

18.4 Rural drainage strategy linkage

DELWP will prepare a rural drainage strategy that will provide strategic guidance for matters relating to rural drainage. This will include consideration of clearing a stream of debris or sediment that may have multiple benefits (e.g. flood mitigation, rural drainage and waterway management) and involve the same activities and potential costs.



Erosion of the Tambo River following flooding in 1998. Source: East Gippsland CMA

19. Risk management planning for critical infrastructure

Some infrastructure is critical to the health, safety and prosperity of the Victorian community. The Victorian Critical Infrastructure Resilience Strategy and Part 7A of the *Emergency Management Act 2013*, outline measures that owners and operators of critical infrastructure should take to manage the emergency risks that will affect service delivery.

Critical infrastructure is specifically defined in the Emergency Management Act. Not all managers of dams, roads and other critical assets are subject to the requirements of the Act.

The owners and operators of critical infrastructure will be responsible for developing and implementing site-specific strategies to mitigate and manage the effects of risks (including risks from natural hazards such as flooding) to the continuity of essential services. Government departments also have responsibilities in assisting and monitoring the performance of critical infrastructure.

The operators of critical infrastructure may need to undertake a flood risk assessment. DELWP will make available any relevant flood-related material for this assessment.

It is possible that some critical infrastructure, despite being covered by adequate flood risk mitigation plans in the short to medium term, is at long-term risk from waterway processes. For example, it may be that the functioning of a bridge or weir is at risk from a river avulsion due to natural flood-related processes. In these cases, Melbourne Water and the CMAs can provide relevant information to enable the infrastructure operator to develop longer-term risk management strategies.

Action 19a

- DELWP in consultation with the CMAs and Melbourne Water and representative asset owners will develop principles for managing serious risks to critical infrastructure from waterway processes (see Victorian Waterway Management Strategy [2013] Action 4.2), in accordance with the principles and obligations outlined in the Victorian Critical Infrastructure Resilience Strategy and any relevant legislation.

Accountability 19a

- The operators of critical infrastructure are accountable for:
 - assessing the risks posed to their operations by flooding
 - managing these risks in accordance with Part 7A of the *Emergency Management Act 2013*.



Kerang power station protected by ring levee during the 2011 flood. Source: North Central CMA



Levee Breach Benjeroop January 2011.
Source: North Central CMA

Part 4: Managing residual risks

20. Flood insurance 84

Governments have a role in ensuring that:

- individuals and communities affected by floods are able to recover and rebuild as quickly as possible
- people are able to choose where they live in an informed way (the relative size of flood insurance premiums in different locations provide an important signal)
- individuals and communities at risk of future flooding are aware of the risks and are able to obtain suitable protection against those risks – both in terms of having access to insurance and in benefiting from appropriate mitigation strategies.

DELWP will work with the insurance industry to facilitate exchange of mapping and other flood risk information in order to ensure fair pricing of insurance.

21. Disclosing flood risk information 86

Floods with a probability lower than the 1% AEP flood event will cause significant damage. While the costs of mandating higher floor levels for new buildings would be hard to justify outside the 1% AEP flood, it is important for people living and working in those flood-prone areas to be able make informed decisions about risk management.

Emergency services and their communities need to be able to plan for flooding beyond the 1% AEP event. They need to be able to issue accurate and timely warnings.

To encourage property owners to take an active interest in ensuring that their insurance premiums are tailored to their flood risks, the Victorian Government will seek to provide flood risk information beyond the 1% AEP. The Strategy supports Consumer Affairs Victoria in providing a trigger for individuals to complete due diligence relating to the flood risk before buying a property.

21.1 Comprehensive flood mapping 86

21.2 Vendor disclosure statements 87

22. Integrated flood emergency management 88

Victorian emergency management has been structured around three interdependent components:

Prevention: reducing or eliminating the incidence or severity of emergencies and mitigating their effects

Response: combating emergencies and providing rescue and immediate relief services

Recovery: assisting of people and communities affected by emergencies to achieve an effective level of functioning.

23. Incident control 90

VICSES has a lead role in flood response, with advice from DELWP, CMAs, Melbourne Water and the Bureau of Meteorology. VICSES, with support from DELWP, is accountable for setting the requirements for flood interpretative services to support incident controllers during floods. VICSES is accountable for ensuring arrangements are in place to access flood specialist expertise during floods.

24. Managing residual floodwater 92

DELWP is accountable for maintaining guidelines for managing water that remains after flood peaks have passed. The risks to health, community wellbeing and regional economies mean that key decisions may be needed on if and when to remove residual water and when to stop. Interventions should stop once the risks have been reduced to tolerable levels.

20. Flood insurance

The Federal Productivity Commission Draft Report on Natural Disaster Funding Arrangements, released on 25 September 2014, supports the need for greater emphasis on mitigation and recognition of the role of government in fostering the establishment and development of an appropriate flood insurance regime for Australia.

At the most fundamental level, governments have a role in ensuring that:

- individuals and communities affected by floods are able to recover and rebuild as quickly as possible
- people are able to choose where they live in an informed way (the inference being that the relative size of flood insurance premiums in different locations provides an important signal)
- individuals and communities at risk of future flooding are aware of the risks and are able to obtain suitable protection against those risks both in terms of having access to insurance and in benefiting from appropriate mitigation strategies. These key elements are shown in Figure 16.

The Australian Government commissioned the independent Natural Disaster Insurance Review (NDIR) into disaster insurance in Australia following the Victorian floods in January 2011. In response to the NDIR's 47 recommendations, the Australian Government:

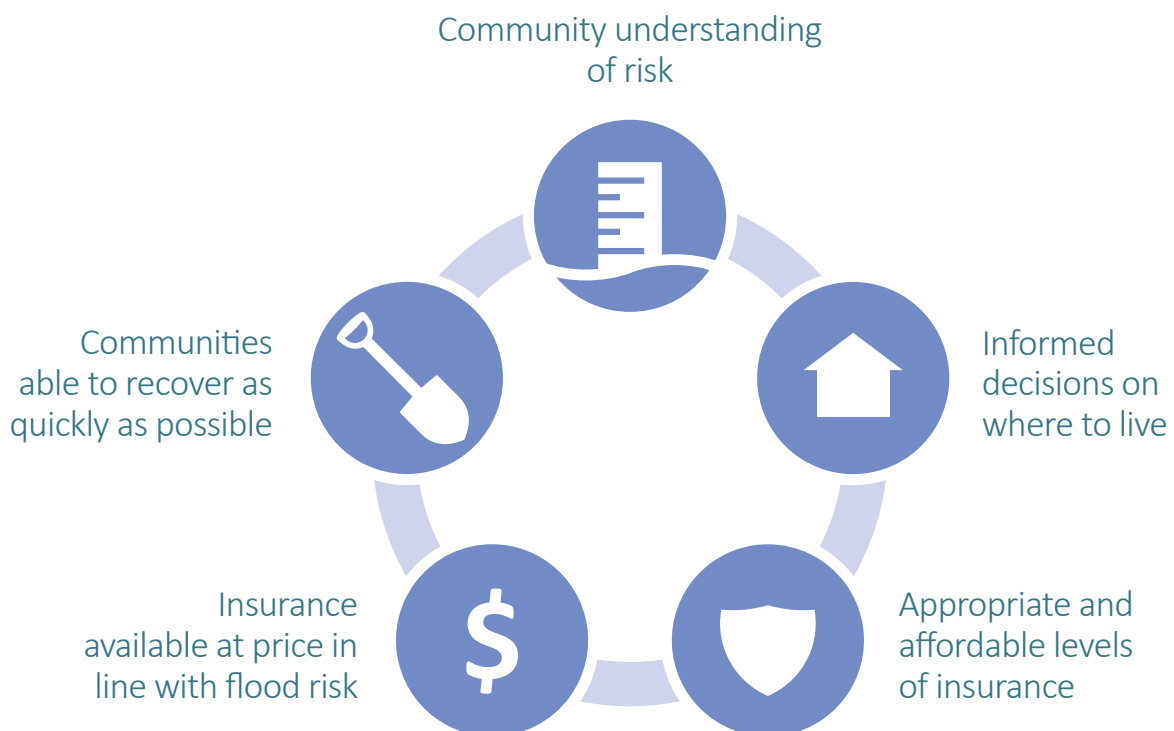
- introduced a standard definition of flood for inclusion in all insurance policies offering flood cover
- committed to the introduction of a national portal to improve the coordination, and the public availability, of flood risk information
- undertook to consult with relevant stakeholders on other recommendations.

The Insurance Council of Australia (ICA), which represents more than 90% of the total premium income written by private sector general insurers, released a 10-point plan aimed at developing a more effective and sustainable response to disasters in Australia.

The ICA believes that government has three key roles in supporting flood insurance:

- ensure the availability of high-quality information about flood risk (Section 12)
- mitigate the legacy of existing flooding exposure (Part 3)
- prevent the flood-prone population expanding (Section 13).

Figure 16: Key elements for a fair and equitable flood insurance framework



These three roles have long been seen as core business for government. Nonetheless, the NDIR, the Environment and Natural Resources Committee (ENRC) inquiry into flood mitigation infrastructure and the Victorian Floods Review revealed considerable scope for improvement in how each of those roles was being fulfilled prior to the 2010-12 floods. This Strategy addresses those necessary improvements. Of those three roles, it seems likely that there is particular scope for improving the availability of, and access to, high-quality information about flood risk. Partly this is a result of the ongoing revolution in information management, but partly it is a consequence of the relative infancy of the flood insurance industry in Australia.

Policy 20a

- The Victorian Government will work with the insurance industry to share flood data in an efficient and practical manner, including access to digital elevation data and flood mapping held by DELWP.

Action 20a

- DELWP will seek ongoing access to the National Flood Information Database, used by most insurers as a core input when assessing flood risk at the address level across Victoria.
- DELWP will work with the insurance industry to ensure that insurance premiums take into account the benefits of formally managed flood mitigation infrastructure as well as the mapped flood risk profiles for individual properties.
- DELWP will approach the Insurance Council of Australia with a view to developing a code-of-practice that recognises the benefits of flood mitigation infrastructure when determining premiums.



Urban flooding in Traralgon, 2012. Source: West Gippsland CMA

21. Disclosing flood risk information

As outlined in Section 13, land use planning provisions do not apply to land subject to inundation by floods less likely than the 1% AEP flood. When they do occur, floods larger than a 1% AEP will cause significant damage and considerable associated costs. It is important for people living and working in those flood-prone areas to be able to make informed decisions about risk management. It is also important to ensure that essential infrastructure, such as roads, telecommunications and gas lines are sited in locations commensurate with the flood risk.

In many places, flooding in 2010-12 extended well beyond the 1% AEP flood. Emergency management agencies need to be able to plan with their communities for such flooding; they also need to be able to issue accurate and timely warnings.

This flood information needs to be provided in a manner that does not unnecessarily alarm communities, particularly where flooding beyond the 1% AEP flood may cause short-term inconvenience or nuisance rather than a risk to property, livestock or safety.

21.1 Comprehensive flood mapping

The Victorian Flood Database (Section 12.3) contains several layers of modelled flood extents for a range of floods from moderate to extreme. The starting point for disclosing flood risk information is to make sure that these maps are in the public domain and readily accessible.

Individuals armed with high-quality information about their exposure to flood risks ought to be in a position to negotiate insurance premiums that reflect that risk. They can now seek this information from CMAs.

In an ideal world, insurance premiums would vary with the mapped range of flood probabilities from moderate to extreme. Insurers would, however, have to take into account the less certain risk of flooding associated with urban drainage systems on top of the better-understood risks of riverine flooding.

Policy 21a

- The Victorian Government will seek to ensure that individuals can have full disclosure of the flood risks associated with their property, not just information relating to the 1% Annual Exceedance Probability flood.



Flood waters at Crossley, near Warrnambool, 2011. Source: Lisa Gervasoni

21.2 Vendor disclosure statements

One of the guiding principles underpinning this Strategy is that people living on floodplains should be able to make informed choices about the risks they face. Similarly, people considering whether to buy properties on floodplains should be informed about flood risks before deciding to buy.

Making this information more accessible is important in enabling individuals to make informed choices about managing their own risks. It will also ensure economic efficiency in the insurance market and the land market. Where flood risks are mapped, those risks should be priced into land values. Developers in these situations should be able to identify the full costs of their proposals, including costs in the form of average annual damage (AAD). Where flood risks are not mapped, those risks are unlikely to be priced into land values because the flood risks (and potential development constraints) are not recognised.

The dilemma for governments is that once flood risks are mapped, if those risks are not adequately communicated then, in economic terms, they make for information asymmetry. That is, people selling land on floodplains may have more information than potential buyers. This distorts land markets.

One way to avoid distorting the land market would be to include the probability of flooding on the vendor statements required by the *Sale of Land Act 1962*. At their most fundamental level, these statements are intended to ensure the disclosure of information that may have a bearing on the decision to buy the property or the price to be offered. Bush fire risks are now disclosed on these statements.

Planning controls in the form of zones or overlays must also be disclosed. People buying land in municipalities that incorporate flood provisions into their local Planning Schemes already receive this information on disclosure statements. Assuming that all relevant Planning Schemes will eventually include appropriate flood zones and overlays, including the probability of flooding on the vendor statement would be aimed at people buying properties outside the 1% AEP flood level.

One option could be to designate flood-prone areas in Building Regulations. Such designated areas, which would extend beyond the 1% AEP flood level, would need to be referenced to flood maps made publicly available on the land channel website (www.land.vic.gov.au). This would require a different format to the maps currently held in the relevant flood databases. Another approach could involve adding a simple statement to the list of those already included on the vendor statement. For example, this could be similar to the one that currently applies to commercial agricultural production. It serves to advise the purchaser that it is in their interest to investigate the impacts of the local agricultural practices and processes. The right words could encourage individuals to actively involve themselves in understanding their own flood risks; it would not increase the administrative burden on CMAs or LGAs.

Either approach would require legislative change. Each would also increase the demand to make flood maps publicly available.

Consumer Affairs Victoria currently produces a Due Diligence Checklist for prospective buyers that includes the question: “Does this property experience flooding ... ?” It goes on to say: “Properties are sometimes subject to the risk of ... flooding due to their location. You should properly investigate these risks and consider their implications for land management, buildings and insurance premiums.”

Action 21a

- DELWP will consult with Consumer Affairs Victoria to review the application of the Due Diligence Checklist. The aim will be to determine the administrative and legislative issues involved in including flood risk information on vendor disclosure statements.

22. Integrated flood emergency management

In Victoria, emergency management has been structured around three separate but interdependent components:

Prevention: reducing or eliminating the incidence or severity of emergencies and mitigating their effects.

Response: combating emergencies and providing rescue and immediate relief services.

Recovery: assisting people and communities affected by emergencies to achieve a proper and effective level of functioning.

Statewide accountability for these three components needs to be assigned and tailored for particular hazards and organisations. DELWP, Melbourne Water and the CMAs have primary responsibility to work with LGAs and VICSES on prevention activities. VICSES is the control agency for flood response in Victoria. The Emergency Management Commissioner is responsible for coordinating recovery activities for all emergencies at the state level.

VICSES is responsible for the community education and awareness that underpins flood preparedness. This includes its Flood Safe Program. Acting in support of Municipal Emergency Management Planning Committees, VICSES is also responsible for facilitating the preparation of Municipal Flood Emergency Plans with support from the relevant LGA.

The PRR approach (prevention, response and recovery) used in Victoria is a variation of the PPRR approach (prevention, preparedness, response and recovery) to emergency management used in some other jurisdictions.

Accountability 22a

- VICSES is accountable for engaging infrastructure managers and technical experts in the development of flood emergency planning. This includes the development of a State Flood Emergency Plan, Regional Flood Emergency Plans and Municipal Flood Emergency Plans.

Emergency management agencies are informed by the flood mitigation measures in place; these are then incorporated into flood emergency plans. Those flood mitigation measures should be designed and implemented in the expectation that emergency management accessways and evacuation routes may be needed.

Floodplain management services must seek to address the needs of other agencies. For example, DELWP is responsible for flood mapping but the maps must meet a range of business requirements. Those maps must be designed to:

- underpin land use planning
- identify high flood risk areas for targeted mitigation works
- support emergency warnings issued by incident controllers
- underpin emergency management arrangements developed by VICSES and LGAs
- indicate priority areas for recovery efforts.

Flood studies by Melbourne Water and the CMAs should deliver outputs suitable to include in VICSES's template for Municipal Flood Emergency Plans. Specifically, they should aim to provide maps and describe:

- flood threats
- typical flood peak travel times
- an overview of flooding consequences
- an overview of existing flood mitigation
- infrastructure
- an overview of flood impacts and required actions
- flood warning systems.

The institutional challenge is to make sure all these things are integrated. The Inspector General for Emergency Management has a role to provide assurance to the government and the community regarding Victoria's emergency management arrangements.



Emergency services supplying sandbags at Nathalia. Source: Goulburn Broken CMA

Accountability 22b

- Melbourne Water, CMAs and LGAs are accountable for making sure that the outputs of their floodplain management activities can be integrated with other emergency management functions.

Levees are critical to the management of floods in some localities. Where there is a significant risk that a levee could fail suddenly and completely during a flood event due to overtopping or breaching, emergency management plans must include evacuation options.

Action 22a

- LGAs will work with VICSES to ensure that Municipal Flood Emergency Plans include the best available information about the condition of flood mitigation infrastructure, including levees.
- LGAs will provide VICSES with the outputs of flood studies, the management arrangements for Water Management Schemes and the condition assessments for flood mitigation infrastructure.
- Flood emergency plans will make reference to the overtopping or failure of flood levees and their possible consequences.
- Incident Controllers will determine how best to deal with the issue of a levee overtopping or failing.
- DELWP, CMAs and Melbourne Water will provide technical advice to assist Incident Controllers in planning around levee failure, including overtopping.

23. Incident control

During flood incidents, DELWP, LGAs, the CMAs and Melbourne Water will provide Incident Controllers with advice and support, in accordance with the Emergency Management Manual Victoria.

The roles of the CMAs and DELWP are interdependent. In broad terms, DELWP relies on the CMAs for detailed advice about specific incidents; the CMAs rely on DELWP for strategic advice and assistance.

Flood response activities in Victoria are managed under the State Emergency Response Plan (Part 3 of the Emergency Management Manual Victoria). Using an Incident Management System, the Incident Controller establishes a control structure to suit the circumstances and leads the development of a multi-agency Incident Action Plan, including objectives and strategies to manage the incident.

Incident control operates at three tiers, incident, regional and state. Collaborative multi-agency forums (e.g. Emergency Management Teams) are used during emergencies to identify and discuss the risks and likely consequences of the emergency and assist the controller to establish priorities. Such teams generally include DELWP (at the state tier) or CMA (at regional level) to provide flood information interpretive services. Traditional owners need to be included in flood emergency management arrangements, from prevention to response to recovery.

Policy 23a

- Emergency service agencies will work with Traditional Owners to help ensure Victoria's emergency management arrangements take into account the risks to Aboriginal cultural heritage. They will do this in ways that are consistent with the State strategic control priorities (which form the basis of the Incident Strategy and Incident Action Planning processes), which make explicit reference to cultural values.

Action 23a

- DELWP will work with the Emergency Management Commissioner and the Office of Aboriginal Affairs Victoria to develop a process for the involvement of Traditional Owner representatives during the management of flood emergencies to consider risks to Aboriginal cultural heritage.



Staff managing a flood emergency at an incident control centre. Source: DELWP

Accountability 23a

- VICSES, with support from DELWP, is accountable for determining the necessary qualifications and competencies required to provide specialist services to Incident Controllers during floods.
- DELWP, Melbourne Water and CMAs are accountable for maintaining the expertise to provide flood-specialist services to Incident Controllers during floods.
- VICSES is accountable for ensuring arrangements are in place to access flood-specialist services during floods.

The *State Emergency Services Act 2005* includes provisions to protect VICSES directors, employees, registered members, probationary members and volunteer emergency workers from liability for actions taken in good faith in the performance of their functions and duties. The State and its agencies, however, may be liable for actions that lead to injury or damage.

DELWP, CMAs Melbourne Water and other water corporations may be requested to provide additional resources, under the direction of the Incident Controller, to help manage the flood response. For example, acting in providing additional resources, Melbourne Water and the CMAs may be asked to help clear debris during or immediately after a flood, provided the working conditions are safe.

Similarly, Incident Controllers may request support agencies to build temporary levees, or modify or breach existing levees, subject to safety considerations. Such actions hold the potential to adversely affect individuals, even though they are intended to increase the overall public good.

Individuals may also wish to take measures to mitigate against risks to their private property or infrastructure. Individuals should do so with regard to the liability for any actions that may lead to injury or damage.

Policy 23b

- The construction of temporary levees, diversion of waterways or alteration of existing flood mitigation infrastructure will only be undertaken during floods under the direction of Incident Controllers.

Action 23b

- VICSES will develop a process to enable the evaluation and authorisation of emergency works for flood response.

A large part of flood response and recovery cost relates to impacts from high-energy flows in rivers and streams. They include accumulation of flood debris, erosion of the bed and banks, siltation and avulsions. Often, fences protecting riparian vegetation may also be lost or damaged.

Melbourne Water and the CMAs may, if requested, provide surge capacity to the Incident Controller during flood events to help deal with these issues in the context of the emergency. In the first instance though, asset owners are accountable for the functioning of their assets. For example, if debris builds up against a bridge or culvert, or behind a dam, the manager of the asset is expected to remove the debris.



Demountable levee at Nathalia, March 2012. Source: Moira Shire Council

24. Managing residual floodwater

Water remaining in the landscape after flood peaks have passed can pose risks to human health, community wellbeing and the functioning of regional economies. Emergency managers sometimes need to take steps to manage this residual floodwater.

The response component of the emergency management system is focused on managing the impacts of the flood peak. Once the flood peak has passed, there is a transition from response to recovery activities. Decisions about the management of residual floodwater are likely to be required during the transition period.

Planning for the management of residual floodwater can begin during the response period, provided it does not interfere with response activities.

The key decisions are when (and if) to start pumping floodwater and when to stop. Intervention is required if existing drainage is not expected to remove the water in time to prevent unacceptable risks to life, human health, community wellbeing, or economic activity. Intervention should stop once these risks have been reduced to tolerable levels.

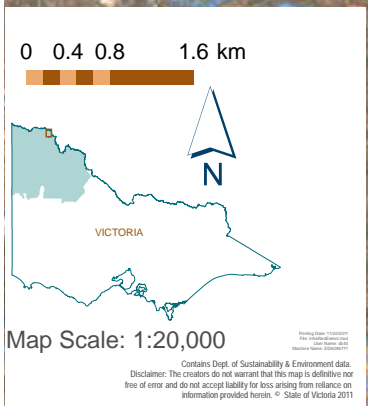
Intervention also involves risks. These include workplace safety, and damage to property and the environment. Intervention can also create community expectations that pumping will continue until all floodwaters have been removed, which may not be practical or possible.

Accountability 24a

- DELWP is accountable for maintaining guidelines for managing residual floodwater.



Pumping residual flood water back to the Murray River. Source: Mallee CMA





Extensive flooding on the Avoca River at Charlton, 2010. Source: North Central CMA

Part 5: From planning to action

25. Delivering the Strategy 96

This chapter outlines the arrangements for the next steps of the Victorian Floodplain Management Strategy, including details for implementation of the Strategy at the state, regional and local levels.

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25.2	Cooperation and collaboration	97
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26. Regional Floodplain Management Strategies 99

Regional Floodplain Management Strategies will provide the basis for assessing flood risk and setting regional priorities. DELWP is developing a risk assessment framework and guidance material to support catchment management authorities and Melbourne Water in developing regional strategies.

This will include an assessment of:

- whether individual Total Flood Warning Systems (TFWS) are appropriately tailored to flood risks areas where flood risk is not considered in land use planning
- the potential needs for flood mitigation infrastructure
- areas that may require detailed flood risk evaluations.

Regional strategies will be developed in consultation with key stakeholders. It should be noted that while CMAs are currently in the early stages of developing Regional Floodplain Management Strategies, Melbourne Water released its regional strategy in December 2015.

26.1	Involving all stakeholders	100
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25. Delivering the Strategy

It will take time to achieve the outcomes defined by the policy statements in this Strategy. In some instances, LGAs and government agencies will need time and resources to build the capacity necessary for them to fully meet the accountabilities. However, they must be able to demonstrate that they are on a credible path to developing that capacity.

The accountabilities, policies and actions outlined in this Strategy have been developed in close consultation with floodplain management stakeholders. This section provides an overview of the Strategy implementation governance process.

25.1 Context

This Strategy outlines the vision and objectives for floodplain management in Victoria that communities and agencies will be guided towards over the coming 10 years.

Significant floodplain management activities have been initiated since the 2010-11 floods. These activities will continue while the Strategy's implementation plan is being written, and will be referenced in the plan.

Through the combination of clear accountabilities, strong community engagement and technical rigour in assessing and treating flood risks, floodplain management activities will continue to be based on community acceptance and sustainable ongoing resourcing. Regional Floodplain Management Strategies and local flood studies will be used to test community and government acceptance of specific local floodplain management activities and to secure ongoing resourcing for them.



Flooding over road near Dimboola 2011. *Source: Wimmera CMA*

The Regional Floodplain Management Strategies will inform the investment needs for individual LGAs. The accountability framework outlined in this Strategy will strengthen each LGA's arguments for securing the revenue necessary to resource its floodplain management roles within the rate-capping environment being introduced by the Victorian Government. The cost of implementing this Strategy will be modest and aligned with the community's acceptance of its capacity to contribute.

The Australian Government is currently considering the Productivity Commission report on the Natural Disaster Funding Arrangements. This report notes:

- Australia is exposed to natural disasters on a recurring basis. Effective planning and mitigation of risks is an essential task for governments, businesses and households.
- Governments overinvest in post-disaster reconstruction and underinvest in mitigation that would limit the impact of natural disasters in the first place. As such, natural disaster costs have become a growing, unfunded liability for governments.
- Governments can do better in terms of policies that enable people to understand natural disaster risks and also to give them the incentive to manage the risks effectively.

This Strategy's vision and objectives align with the Productivity Commission's report direction and intent, and demonstrates Victoria's commitment to leading practice for floodplain management. The Australian Government's initial response suggests a cautious and limited approach to realising the Commission's vision. The Australian Government's contribution to floodplain management and mitigation activities is modest, and any reduction would erode the collaborative approach underpinning the implementation of this Strategy.

Floodplain management activities have national benefits (e.g. through reduced relief payments) and so the Australian Government should contribute to the actions outlined in this Strategy.

25.2 Cooperation and collaboration

Floodplain management is achieved through the cooperation and collaboration of a number of agencies and authorities across all tiers of government.

The Actions in this Strategy can be broken into three groups:

- Policy guidelines – preparation of guidance for the practical application of policies and accountabilities
- Regional Floodplain Management Strategies – preparation of regional rolling programs of prioritised floodplain management activities aligned with investment and resourcing across agencies
- Implementation of local floodplain management activities identified through flood studies.

The preparation of various policy guidelines will be led by DELWP in partnership with LGAs, VICSES, the CMAs, Melbourne Water, and other stakeholders as appropriate. The guidelines will explore the practical aspects of policy implementation considering capability, capacity and costs. Modest in-kind contributions will be required from stakeholders throughout the preparation.

Regional Floodplain Management Strategies will be coordinated by CMAs and Melbourne Water. These regional strategies will identify flood risks and prioritise activities to treat them, where necessary. The regional strategies will draw on the policy guidelines to enable effective and consistent preparation and application. The regional strategies are future business cases for investment by all tiers of government in floodplain management activities. The Victorian Government is funding the preparation of Regional Floodplain Management Strategies. Modest in-kind contributions will be required from stakeholders throughout the preparation.

It is not possible to estimate the funding required for all local floodplain management activities identified and agreed to through Regional Floodplain Management Strategies and local flood studies. However, the application of this Strategy's cost sharing principles, such as beneficiary pays, and positive public benefit, will ensure the activities and services are targeted and maximise investment from any stakeholder.

25.3 Implementing the Strategy

DELWP will lead the establishment of an implementation committee with representatives from organisations such as:

- government departments (e.g. DELWP, DPC)
- catchment management authorities
- water corporations
- local government agencies
- Municipal Association of Victoria
- Bureau of Meteorology
- Emergency Management Victoria
- Victoria State Emergency Service.

The implementation committee will prepare an implementation plan in line with the policies, accountabilities and actions defined in this Strategy, a communications and engagement plan, and an appropriate monitoring, evaluation and review (MER) framework.

The implementation plan will include:

- priority actions and timelines for policy guidance and regional strategies
- funding sources
- information sharing requirements.

The communication and engagement plan will include:

- consultation opportunities for participating organisations
- a process for sharing information on implementation progress.

The MER framework will include:

- processes for monitoring and reporting delivery of actions at the local, regional and state levels
- a process to update the Strategy if required
- a five-yearly progress review of the Strategy's implementation.

The process must be outcome focused, and must enable flexibility for agencies within their available capacity and capability.

Action 25a

- DELWP will establish a committee to prepare an implementation plan and support implementation of the VFMS.



Local people kept a close on flood waters at Dimboola in 2011. Source: Wimmera CMA

26. Regional Floodplain Management Strategies

Regional Floodplain Management Strategies interpret and apply the policies, actions and accountabilities outlined in this Strategy at the regional and local levels. They align the efforts of various agencies and communities to deliver the outcomes called for by this Strategy.

Regional strategies start with an assessment of flood risks across the region. Those risks are then assessed against the regional community's tolerance for flood risks. A range of mitigation measures for intolerable risks are then explored. At the regional level, mitigation measures might include strategic plans for land use, and for flood warning and response arrangements.

Regional strategies prioritise the actions necessary to put preferred mitigation measures in place. Priority is given to measures that do most to narrow the difference between existing flood risks and the community's willingness to accept those risks.

The main role of regional strategies is to help all agencies with flood emergency management functions align their priorities. This process enables those partner agencies to align their potential to source and allocate funds towards priority actions over a three-year rolling implementation plan.

At the local level, flood mitigation measures are usually investigated and assessed through detailed flood studies (Section 11.1). Local mitigation measures might include improvements to total flood warning systems (TFWSs), changes to land use planning controls, changes to Municipal Flood Emergency Plans or improvements to flood mitigation infrastructure.

The CMAs and Melbourne Water lead the development of Regional Floodplain Management Strategies in collaboration with their local communities, LGAs, VICSES, water corporations and other partner agencies. It is important that agencies take into account local knowledge when aligning their priorities.

DELWP will develop guidelines for the preparation of Regional Floodplain Management Strategies. These guidelines will outline consistent methods for assessing flood risks and assessing the community's tolerance for those risks. The methods will align with the principles of the National Emergency Risk Assessment Guidelines.

Policy 26a

- Victoria's floodplain management priorities will be established through Regional Floodplain Management Strategies.

Accountability 26a

- DELWP is accountable for developing and maintaining guidelines for the preparation and review of Regional Floodplain Management Strategies.
- Melbourne Water and the CMAs are accountable for developing and periodically reviewing Regional Floodplain Management Strategies in partnership with LGAs, VICSES and their local communities.

Action 26a

- DELWP will develop guidelines to enable the preparation and review of Regional Floodplain Management Strategies.
- The CMAs and Melbourne Water will each prepare Regional Floodplain Management Strategies for their regions.

26.1 Involving all stakeholders

- The Victorian Emergency Management Reform White Paper makes it clear that: “effective emergency response relies strongly on pre-existing cooperative networks built and maintained during preceding years”.
- Preparing a regional floodplain management strategy provides Melbourne Water and the CMAs with an opportunity to foster networks and a culture of shared responsibility. It provides an opportunity to establish and align regional priorities for VICSES, LGAs, water corporations and community representatives. It also provides an opportunity to foster greater community involvement in the development and ownership of local plans. This is consistent with the National Strategy for Disaster Resilience.
- As part of the broader emergency management reforms it is necessary to ensure that the approach for floodplain management aligns with the approach taken for other emergencies. CMAs and Melbourne Water will need to engage with emergency management agencies as emergency management planning frameworks evolve. Their Regional Floodplain Management Strategies will be part of, and make use of, existing emergency management planning arrangements.

26.2 Matching regional floodplain management priorities with regional flood risks

As discussed in Section 4, DELWP has developed a rapid and robust methodology for establishing regional floodplain management priorities. That methodology focuses on the social impacts of flooding at different locations in the region. It provides relative risk rankings for different locations based primarily on annual average damages and the population at risk.

The secondary issues involved in the risk ranking include the potential for key infrastructure to be damaged or disrupted by flooding (up to and including the 1% AEP event), the relative vulnerability of the population at risk, and any access or egress issues that may limit safe evacuations.

The first task for the interagency group responsible for developing a regional strategy is to assess and rank regional flood risks using this methodology. The second task is to work systematically through DELWP’s guidelines to determine how well the existing Planning Schemes, existing flood mitigation infrastructure, existing Municipal Flood Emergency Plans and existing TFWSs are aligned with the flood risk ranking for each community at risk. In the long term, each flood-prone community should be serviced by a Planning Scheme, flood mitigation infrastructure, TFWS and an emergency plan tailored to match its risks.

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Adaptation

Adjustment in response to actual or expected climate change or its effects, which moderates harm or exploits beneficial opportunities.

Annual Exceedance Probability (AEP)

The likelihood of the occurrence of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood flow of 500 m³/s has an AEP of 5%, it means that there is a 5% (one-in-20) chance of a flow of 500 m³/s or larger occurring in any one year (see also average recurrence interval, flood risk, likelihood of occurrence, probability).

Average annual damage (AAD)

Depending on its size (or severity), each flood will cause a different amount of flood damage to a flood-prone area. AAD is the average damage per year that would occur in a nominated development situation from flooding over a very long period of time. If the damage associated with various annual events is plotted against their probability of occurrence, the AAD is equal to the area under the consequence–probability curve. AAD provides a basis for comparing the economic effectiveness of different management measures (i.e. their ability to reduce the AAD).

Average Recurrence Interval (ARI)

A statistical estimate of the average number of years between floods of a given size or larger than a selected event. For example, floods with a flow as great as or greater than the 20-year ARI (5% AEP) flood event will occur, on average, once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event (see also Annual Exceedance Probability).

Australian Rainfall and Runoff (ARR)

ARR is a national guideline for the estimation of design flood characteristics in Australia published by Engineers Australia. ARR aims to provide reliable (robust) estimates of flood risk to ensure that development does not occur in high risk areas and that infrastructure is appropriately designed. The edition is currently being revised. The revision process includes 21 research projects, which have been designed to fill knowledge gaps that have arisen since the 1987 edition was published.

Avulsion

The rapid abandonment of a river channel and the formation of a new river channel. Avulsions occur as a result of channel slopes that are much lower than the slope that the river could travel if it took a new course. Avulsions typically occur during large floods that carry the power necessary to rapidly change the landscape.

Catchment

The area of land draining to a particular site. It is related to a specific location and includes the catchment of the main waterway as well as any tributary streams.

Coastal erosion

Short-term retreat of sandy shorelines as a result of storm effects and climatic variations.

Coastal flooding (inundation)

Flooding of low-lying areas by ocean waters, caused by higher than normal sea level, due to tidal or storm-driven coastal events, including storm surges in lower coastal waterways.

Coastal hazard assessments

Coastal hazard assessments commonly define the extent of land expected to be threatened by coastal hazards (inundation, coastal erosion, coastal recession) over specific planning periods. They are typically used for development assessment purposes and to inform land-use planning considerations. In particular such assessments include consideration of future sea level rise scenarios, typically to the year 2100.

Consequence

The outcome 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.

Curtilage

The land occupied by a dwelling and its yard, outbuildings, etc, actually enclosed or considered as enclosed.

Design flood event (DFE)

In order to identify the areas that the planning and building systems should protect new development from the risk of flood, it is necessary to decide which level of flood risk should be used. This risk is known as the design flood event.

Development

Development may be defined in jurisdictional legislation or regulation. It may include erecting a building or carrying out work, including the placement of fill; the use of land, or a building or work; or the subdivision of land.

New development is intensification of use with development of a completely different nature to that associated with the former land use or zoning (e.g. the urban subdivision of an area previously used for rural purposes). New developments generally involve rezoning, and associated consents and approvals. Major extensions of existing urban services, such as roads, water supply, sewerage and electric power may also be required.

Infill development refers to the development of vacant blocks of land within an existing subdivision that are generally surrounded by developed properties and is permissible under the current zoning of the land.

Redevelopment refers to rebuilding in an existing developed area. For example, as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either rezoning or major extensions to urban services.

Greenfield development refers to building in a currently undeveloped area or development that is unrestrained by prior work.

Flash flooding

Flooding that is sudden and unexpected, often caused by sudden local or nearby heavy rainfall. It is generally not possible to issue detailed flood warnings for flash flooding. However, generalised warnings may be possible. It is often defined as flooding that peaks within six hours of the causative rain.

Flood

A natural phenomenon that occurs when water covers land that is normally dry. It may result from coastal or catchment flooding, or a combination of both (see also catchment flooding and coastal flooding).

Flood awareness

An appreciation of the likely effects of flooding, and a knowledge of the relevant flood warning, response and evacuation procedures. In communities with a high degree of flood awareness, the response to flood warnings is prompt and effective. In communities with a low degree of flood awareness, flood warnings are liable to be ignored or misunderstood, and residents are often confused about what they should do, when to evacuate, what to take with them and where it should be taken.

Flood class levels

The terms minor, moderate and major flooding are used in flood warnings to give a general indication of the types of problems expected with a flood

Minor flooding: Causes inconvenience. Low-lying areas next to watercourses are inundated. Minor roads may be closed and low-level bridges submerged. In urban areas inundation may affect some backyards and buildings below the floor level as well as bicycle and pedestrian paths. In rural areas removal of stock and equipment may be required.

Moderate flooding: In addition to the above, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood-affected areas may be required. In rural areas removal of stock is required.

Major flooding: In addition to the above, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood-affected areas may be required. Utility services may be impacted.

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 and possessions, loss of income or services in the flood aftermath). 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 flooding episode.

Flood education

Education that raises awareness of the flood problem to help individuals understand how to manage themselves and their property in response to flood warnings and in a flood event. It invokes a state of flood readiness.

Flood emergency management

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

Flood hazard

Potential loss of life, injury and economic loss caused by future flood events. The degree of hazard varies with the severity of flooding and is affected by flood behaviour (extent, depth, velocity, isolation, rate of rise of floodwaters, duration), topography and emergency management.

Flood peaks

The maximum flow occurring during a flood event past a given point in the river system (see also flow and hydrograph). The term may also refer to storm-induced flood peaks and peak ocean or peak estuarine conditions.

Flood-prone land

Land susceptible to flooding by the largest probable flood event. Flood-prone land is synonymous with the floodplain. Floodplain management plans should encompass all flood-prone land rather than being restricted to areas affected by defined flood events.

Flood proofing of buildings

A combination of measures incorporated in the design, construction and alteration of individual buildings or structures that are subject to flooding, to reduce structural damage and potentially, in some cases, reduce contents damage.

Flood readiness

An ability to react within the effective warning time (see also flood awareness and flood education).

Flood risk

The potential risk of flooding to people, their social setting, and their built and natural environment. The degree of risk varies with circumstances across the full range of floods. Flood risk is divided into three types – existing, future and residual. Existing flood risk refers to the risk a community is exposed to as a result of its location on the floodplain. Future flood risk refers to the risk that new development within a community is exposed to as a result of developing on the floodplain. Residual flood risk refers to the risk a community is exposed to after treatment measures have been implemented. For example: a town protected by a levee, the residual flood risk is the consequences of the levee being overtopped

by floods larger than the design flood; for an area where flood risk is managed by land-use planning controls, the residual flood risk is the risk associated with the consequences of floods larger than the DFE on the community.

Flood severity

A qualitative indication of the 'size' of a flood and its hazard potential. Severity varies inversely with likelihood of occurrence (i.e. the greater the likelihood of occurrence, the more frequently an event will occur, but the less severe it will be). Reference is often made to major, moderate and minor flooding (see also flood class levels).

Flood study

A comprehensive technical assessment of flood behaviour. It defines the nature of flood hazard across the floodplain by providing information on the extent, depth and velocity of floodwaters, and on the distribution of flood flows. The flood study forms the basis for subsequent management studies and needs to take into account a full range of flood events up to and including the largest probable flood. Flood studies should provide new flood mapping for Planning Scheme inclusion, data and mapping for MEMPs, and a preliminary assessment into possible structural and non-structural flood mitigation measures.

Flood warning

A Total Flood Warning System (TFWS) encompasses all the elements necessary to maximise the effectiveness of the response to floods. These are data collection and prediction, interpretation, message construction, communication and response. Effective warning time refers to the time available to a flood-prone community between the communication of an official warning to prepare for imminent flooding and the loss of evacuation routes due to flooding. The effective warning time is typically used for people to move farm equipment, move stock, raise furniture, transport their possessions and self-evacuate.

Floodplain

An area of land that is subject to inundation by floods up to, and including, the largest probable flood event.

Floodplain management

The prevention activities of flood management together with related environmental activities (see also floodplain).

Flow

The rate of flow of water measured in volume per unit time, for example, megalitres per day (ML/day) or cubic metres per second (m³/sec). Flow is different from the speed or velocity of flow, which is a measure of how fast the water is moving, for example, metres per second (m/s).

Freeboard

The height above the DFE or design flood used, in consideration of local and design factors, to provide reasonable certainty that the risk exposure selected in

deciding on a particular DFE or design flood is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest heights and so on. Freeboard compensates for a range of factors, including wave action, localised hydraulic behaviour and levee settlement, all of which increase water levels or reduce the level of protection provided by levees. Freeboard should not be relied upon to provide protection for flood events larger than the relevant design flood event. Freeboard is included in the flood planning controls applied to developments by LGAs.

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% Annual Exceedance Probability or five-year average recurrence interval flood event is once every five years on average (see also Annual Exceedance Probability, Average Recurrence Interval, likelihood and probability).

Hazard

A source of potential harm or a situation with a potential to cause loss.

Hydraulics

The study of water flow in waterways; in particular, the evaluation of flow parameters such as water level, extent and velocity.

Hydrology

The study of the rainfall and runoff process, including the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.

Intolerable risk

A risk that, following understanding of the likelihood and consequences of flooding, is so high that it requires consideration of implementation of treatments or actions to improve understanding of, avoid, transfer or reduce the risk.

Likelihood

A qualitative description of probability and frequency (see also frequency and probability).

Likelihood of occurrence

The likelihood that a specified event will occur (see also Annual Exceedance Probability and average recurrence interval).

Local overland flooding

Inundation by local runoff on its way to a waterway, rather than overbank flow from a stream, river, estuary, lake or dam. Can be considered synonymous with stormwater flooding.

Mitigation

Permanent or temporary measures (structural and non-structural) taken in advance of a flood aimed at reducing its impacts.

Municipal Flood Emergency Plan

A sub-plan of a flood-prone municipality's Municipal Emergency Management Plan. It is a step-by-step sequence of previously agreed roles, responsibilities, functions, actions and management arrangements for the conduct of a single or series of connected emergency operations. The objective is to ensure a coordinated response by all agencies having responsibilities and functions in emergencies

Planning Scheme zones and overlays

Planning Schemes set out the planning rules – the state and local policies, zones, overlays and provisions about specific land uses that inform planning decisions. Land use zones specify what type of development is allowed in an area (e.g. urban (residential, commercial, industrial), rural, environmental protection). Overlays specify extra conditions for developments that are allowed in a zone. For example, flooding overlays specify that developments must not affect flood flow and storage capacity of a site, must adhere to freeboard requirements, and not compromise site safety and access.

Probability

A statistical measure of the expected chance of flooding. It is the likelihood of a specific outcome, as measured by the ratio of specific outcomes to the total number of possible outcomes. Probability is expressed as a number between zero and unity, zero indicating an impossible outcome and unity an outcome that is certain. Probabilities are commonly expressed in terms of percentage. For example, the probability of 'throwing a six on a single roll of a dice is one in six, or 0.167 or 16.7% (see also Annual Exceedance Probability).

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 (see also temporal pattern).

Regional Coastal Boards

Members of Victoria's three coastal boards have been appointed by the Minister for Environment and Climate Change because of their experience and expertise in areas such as local government, coastal planning and management, tourism and recreational use of the coast. The functions of the Western, Central and Gippsland Coastal Boards, set out under the *Coastal Management Act 1995*, include developing regional coastal plans and providing advice to the Minister on regional coastal development issues.

Risk analysis

Risk is usually expressed in terms of a combination of the consequences of an event and the associated likelihood of its occurrence. Flood risk is based upon the consideration of the consequences of the full range of flood events on communities and their social settings, and the natural and

built environment. Risk analysis in term of flooding is a combination of defining what threat exists (see flood risk) and what steps are taken (see risk management) (see also likelihood and consequence).

Risk management

The systematic application of management policies, procedures and practices to the tasks of identifying, analysing, assessing, treating and monitoring flood risk.

Riverine flooding

Inundation of normally dry land when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam. Riverine flooding generally excludes watercourses constructed with pipes or artificial channels considered as stormwater channels.

Runoff

The amount of rainfall that drains into the surface drainage network to become stream flow; also known as rainfall excess.

Storm surge

The increases in coastal water levels above the predicted tide level resulting from a range of location dependent factors such as wind and waves, together with any other factors that increase tidal water level.

Stormwater flooding

The inundation by local runoff caused by heavier than usual rainfall. It can be caused by local runoff exceeding the capacity of an urban stormwater drainage systems, flow overland on the way to waterways or by the backwater effects of mainstream flooding causing urban stormwater drainage systems to overflow (see also local overland flooding).

Vulnerability

The degree of susceptibility and resilience of a community, its social setting, and the natural and built environments to flood hazards. Vulnerability is assessed in terms of ability of the community and environment to anticipate, cope and recover from flood events. Flood awareness is an important indicator of vulnerability (see also flood awareness).

Water Management Scheme

The formal process set out in the *Water Act 1989* that can be applied to a flood mitigation infrastructure development and its ongoing management. It can be based on and carried out in parallel with a floodplain management study.

Acronyms

AAD	Average Annual Damage
AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
BCA	Building Code of Australia
BoM	Bureau of Meteorology
CMA	Catchment Management Authority
DELWP	Department of Environment, Land, Water and Planning
DFE	design flood event
LGA	Local Government Authority
LPPF	Local Planning Policy Framework
MFEP	Municipal Flood Emergency Plan
SPPF	State Planning Policy Framework
TFWS	Total Flood Warning System
VCS	Victorian Coastal Strategy
VFD	Victorian Flood Database
VFMS	<i>Victorian Floodplain Management Strategy</i>
VICSES	Victoria State Emergency Service
VPP	Victoria Planning Provisions
WMS	Water Management Scheme

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