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VICTORIAN GOVERNMENT'S RESPONSE TO THE VICTORIAN FLOODS REVIEW

IMPROVING FLOOD WARNING SYSTEMS IMPLEMENTATION PLAN

State Government Victoria

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FOREWORD

Sharing information, experience and responsibility is the key to successfully managing flood threats across Victoria.

Floods can be life-threatening and devastating and even low-level flooding can be highly disruptive to the well-being and economies of communities.

It's vital to better prepare for these events – and this can only be done by upgrading the complete flood management process, from flood warnings to emergency response.

To do this, the Victorian Government is drawing together the expertise and resources of several departments to work with communities and councils in planning, co-ordinating and delivering effective flood management.

We are now taking the next step in this partnership approach through this formal Government response to the Review of the 2010–11 Flood Warnings and Response.

It responds to the 31 recommendations directed at, or which have a strong connection to, the Government's water portfolio by outlining a comprehensive implementation plan with new initiatives and actions building on other recent work.

A key focus of this implementation plan is to ensure planning for floods is better integrated and aligned with other emergency management planning to improve coordination at state, regional and local levels.

Sharing information is a major requirement for better planning and co-ordination and, by further developing a web-based information system, we will provide more comprehensive information to emergency services and communities about flood risk.

Importantly, this implementation plan provides the opportunity for local solutions to particular needs. The Government values the skills and knowledge of regional Victorians and has opened up opportunities for locals to shape the way flood warning systems work in their communities.

By getting actively involved in planning for floods, communities will be better prepared and able to respond more effectively to flood threats.

I look forward to seeing these important steps put into action to strengthen resilience to floods across Victoria.

Peter Walsh MLA
Minister for Water
Minister for Agriculture and Food Security

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1 INTRODUCTION

This implementation plan outlines how the Victorian Coalition Government will respond to those recommendations of the Victorian Floods Review that relate to flood warning systems and flood risk planning, including flood mapping and flood emergency plans.

At the state, regional and local levels, the Victorian Coalition Government is committed to helping all Victorians build resilience in the face of disasters. It recognises that this is a responsibility that must be shared by individuals, households, businesses and communities, as well as by governments and government agencies.

Our goal is to help Victorians prepare for, respond to and recover from emergencies like flood events in a way that reduces cost and trauma, and empowers communities to recover quickly.

1.1 The Victorian Floods Review

From September 2010 through February 2011, Victoria experienced some of the worst floods in its history. The impact was far reaching: about one-third of Victoria (including 70 local government areas) experienced some form of flooding or storm damage resulting in significant cost and disruption to regional, urban and rural communities.

In response, the Victorian Government established a review to examine the adequacy and efficacy of the state's arrangements for flood response, flood recovery, emergency warnings and evacuations. The Review of the 2010–11 Flood Warnings and Response (Victorian Floods Review) led by Mr Neil Comrie AO APM was provided to the Premier on 1 December 2011.

The final report of the Victorian Floods Review summarised the impact of the floods. It noted that the extensive damage, both tangible and non-tangible, included:

- nearly 4,000 houses damaged
- 4,000 businesses and primary producers affected
- 10,000 personal hardship grants made
- more than $269 million in agriculture sector losses
- about $176 million in lost tourism revenue
- about 1,500 kilometres of local roads closed during the floods
- rail services disrupted
- an ongoing psychological toll.

In all, gross damages as at October 2011 were estimated at $1.3 billion (Victorian Floods Review, page 11).

1.2 Review outcomes

On 8 December 2011, the Premier and Deputy Premier released the final report of the review. The majority of the report's 93 recommendations relate to how Victoria can better prevent, mitigate, respond to and recover from major flood events. These recommendations are being addressed as part of an emergency management white paper due to be completed in the second half of 2012.

There are 31 recommendations that deal specifically with flood warning systems for riverine and flash flooding, and with flood risk planning (including flood mapping and flood emergency plans). These recommendations (which largely cover planning for the prevention of damage) are the focus of this implementation plan.

Thirty of these recommendations are contained in Chapter 1 of the Review's report. One further recommendation—Recommendation 86 in Chapter 6—links the use of flood warning information to statutory planning and building controls, and is therefore included in this plan.

The Victorian Floods Review recommendations concerning flood warnings identified four general areas of weakness.

- The community were inadequately involved in many aspects of flood warning systems. Local knowledge was not used effectively and many communities were poorly prepared and unable to adequately respond to the threat of flooding.
- There was lack of clarity over the roles, ownership and accountabilities of flood warning systems. Flood warning systems require the interaction of Commonwealth, state and local governments, statutory authorities and water corporations. There is a lack of consistency across Victoria in how systems work and how flood warnings are delivered. Several organisations own parts of the stream and rain gauge networks with some, but not all, of the gauges linked to flood prediction modelling by the Bureau of Meteorology (BoM).

- Gaps in the flood warning system network across the state became apparent during the Victorian Floods Review (which identified a clear need to improve real-time streamflow and rainfall information) and to make the system more resistant to damage during major flood events.
- Victoria depended on out-of-date flood plans, and flood planning was generally inconsistent and inadequate. Reliable appraisals of flood risk did not exist for many parts of Victoria and the associated flood mapping did not provide adequate information for emergency services or local communities.

While much work has already been done to address these shortcomings, long-term planning is required to embed new processes in the flood management arrangements for the state. Victoria depends on effective cooperation and flow of information between numerous organisations—Commonwealth, state and local governments, statutory authorities and water corporations—for effective flood warning systems. This implementation plan sets out what has already been done, as well as arrangements to safeguard Victoria from any future failure of flood warning systems.

1.3 The need for change

This implementation plan is part of the Victorian Government's emergency management reform agenda. Governments across Australia have recognised that a national, coordinated and whole-of-nation, resilience-based approach to disaster management is needed to enhance Australia's capacity to withstand and recover from disasters. The National Strategy for Disaster Resilience (Council of Australian Governments, 2011) has been developed to help governments at all levels, community groups and individuals address the consequences of natural disasters like flooding.

Historically, the Australian Government has played a significant part in disaster management, and this will continue. Many flood studies and flood mitigation works rely on funding support provided through cost-sharing programs, and many of the flood warning improvements that will form part of this implementation plan are likewise co-funded.

The Victorian Government will continue to seek the cooperation and commitment of Commonwealth agencies in pursuing activities that support our goal. This in turn should lower the cost of recovery to the community and to governments, through reduced disaster relief payments.

The Victoria Floods Review is not without precedent. In July 2005, the Victorian Auditor-General released *Managing Stormwater Flooding Risks in Melbourne*. This report examined the performance of Melbourne's stormwater system after heavy rain and widespread flooding over a number of years. These earlier recommendations complement those of the Victorian Floods Review, and Melbourne Water also considered them in its *Flood Management and Drainage Strategy*.

The issue of urban drainage is a feature of the Coalition Government's Living Victoria, Living Melbourne initiative which provides a new approach to planning and managing Victoria's urban water resources. An important aspect of the approach is to ensure that the water system is able to continue to meet the community's need for improvements to the quality of local waterways, as well as reduced risk of flooding.

Building on our existing emergency planning arrangements, it is critical that we focus more on resilience planning to strengthen local capacity and capability. These aspects will also be informed through the emergency management white paper, which will drive reforms to the state's crisis and emergency management arrangements, to create a more disaster-resilient and safer Victoria.

This implementation plan supports the need for flood planning to be integrated and better aligned with other emergency management planning to ensure better coordination at the state, regional and local levels.

1.4 Structure of the implementation plan

This implementation plan addresses the Victorian Floods Review recommendations by providing:

- an overview of the implementation approach, which outlines improvements to flood warning and mitigation planning in Victoria
- detailed responses to each of the 31 recommendations relating either directly or indirectly to flood warning systems.

2 OVERVIEW OF THE IMPLEMENTATION APPROACH

2.1 Actions to address the four areas of improvement

As explained in the introduction, the Victorian Floods Review identified four areas for improvement. Actions required for each area are overviewed below.

2.1.1 Greater community involvement in flood planning and flood response

- Ensure local knowledge of flooding is captured, and updated flood information is utilised, when undertaking flood studies that investigate and quantify flood risk.
- Incorporate local knowledge in emergency management plans related to flooding, where such plans have been developed.
- Ensure the use of local knowledge in flood operations.
- Involve local communities in flood planning through flood education programs, recognising that active community involvement in planning will also help the community be better prepared for floods, and better able to respond effectively during future flood events.
- Make sure flood warnings can meet the needs of local communities, which may change over time.
- Progressively update and deliver community flood education programs (such as FloodSafe).

2.1.2 Clarify the roles, ownership and accountabilities of flood warning systems

- Review and update arrangements for flood warning systems in Victoria, including further clarifying the service provided by the Commonwealth Government through the BoM.
- Develop flood warning systems that are fit for the purpose intended.
- Develop equitable and sustainable cost-sharing arrangements that allow for the beneficiaries to contribute to their upkeep.
- Develop arrangements for auditing flood warning systems and related activities.
- Review the current arrangements for providing flood warnings in Melbourne, with a view to improving the warnings.

2.1.3 Address gaps in the flood warning system network across the state

- Fix gauges and related infrastructure damaged by floods.
- Assess flood warning systems across each river basin, to identify gaps and areas for improvement.
- Update flood warning systems where there is an identified need.
- Develop service-level agreements specifying the level of service to be provided by, and the roles of, organisations involved in flood warnings.
- Review the technology available for flash flooding warning systems, and identify areas most at risk.

- Establish flash flood detection systems that rely on local alarms where there is a clear need, and where costs are integrally linked to the levels of service needed.
- Improve quality control processes for river gauges, and contingency measures to monitor flows or flood levels at important locations when gauges are damaged.
- Encourage organisations outside Melbourne to join the relevant regional water monitoring partnership.
- Put in place robust and sustainable frameworks or processes to improve and expand flood warning systems for all river basins.
- Improve the dissemination of information and communications processes between dam owner/operators, flood response agencies and the community.

2.1.4 Improve flood planning and flood intelligence capabilities

- Improve the quality of flood information for 25 communities in Victoria, through flood studies that examine the flood risk.
- Clarify the role of floodplain management specialists and the use of consultants in providing flood intelligence to incident controllers, and ensure they are adequately trained to perform critical functions during flood incidents.
- Ensure that regional and municipal flood emergency plans incorporate all available flood mapping and intelligence.
- Assess the condition of levees and improve arrangements for constructing temporary levees.
- Improve flood mapping standards and flood data collection arrangements and incorporate Melbourne Water's riverine flood data into the comprehensive database of flood information that the Department of Sustainability and Environment (DSE) maintains.
- Ensure flood information is available electronically to statutory authorities to help them process planning applications, and to incident control centres so they have timely and usable information to support responses during incidents and can also provide individuals with accurate information to manage immediate or longer-term flood risks.
- Improve the quality of flood information and its incorporation into municipal planning schemes.

Flood risk planning provides a vital link between flood warning messages and actions taken to reduce flood damage and trauma. This link is achieved by:

- Using flood provisions in planning schemes to avoid inappropriate development or require appropriate development responses and apply design responses through the building code (e.g. to raise the floor levels of buildings). Land use planning is one of a suit of flood management measures that operate to minimise the risk to life, property, community infrastructure and the natural environment from natural hazards. Planning authorities rely on tailored flood mapping for strategic land use planning and decision making.
- Assessing the impacts of a range of floods to inform emergency response planning and implementation (flood intelligence). Without flood risk planning, the capacity of communities to know what to do shortly before and after a flood will be compromised, and the effectiveness of emergency response agencies will be limited.

Actions to support these processes are set out in this implementation plan.

2.2 Benefits to communities

The benefits to the community and to the state of better flood warning systems are well-documented. However, the benefits of using community knowledge (together with greater participation in preparedness planning and education activities) are much greater than receiving a warning during a flood event. The processes outlined in this implementation plan seek to provide enhanced opportunities for community involvement in flood risk planning with benefits including:

- well-informed and prepared communities that are more resilient to the effects of flooding, thereby reducing economic costs to the community
- reduced fear and emotional stress through improved understanding of the flood risk at an individual and community level
- increased community confidence in emergency management arrangements as a result of better access to, and documentation of, real-time flood information
- better land-use planning decisions, with communities understanding their flood risk and making sound decisions about appropriate new land use and development.

2.3 Implementation framework

Implementation of the Victorian Floods Review recommendations will be underpinned by:

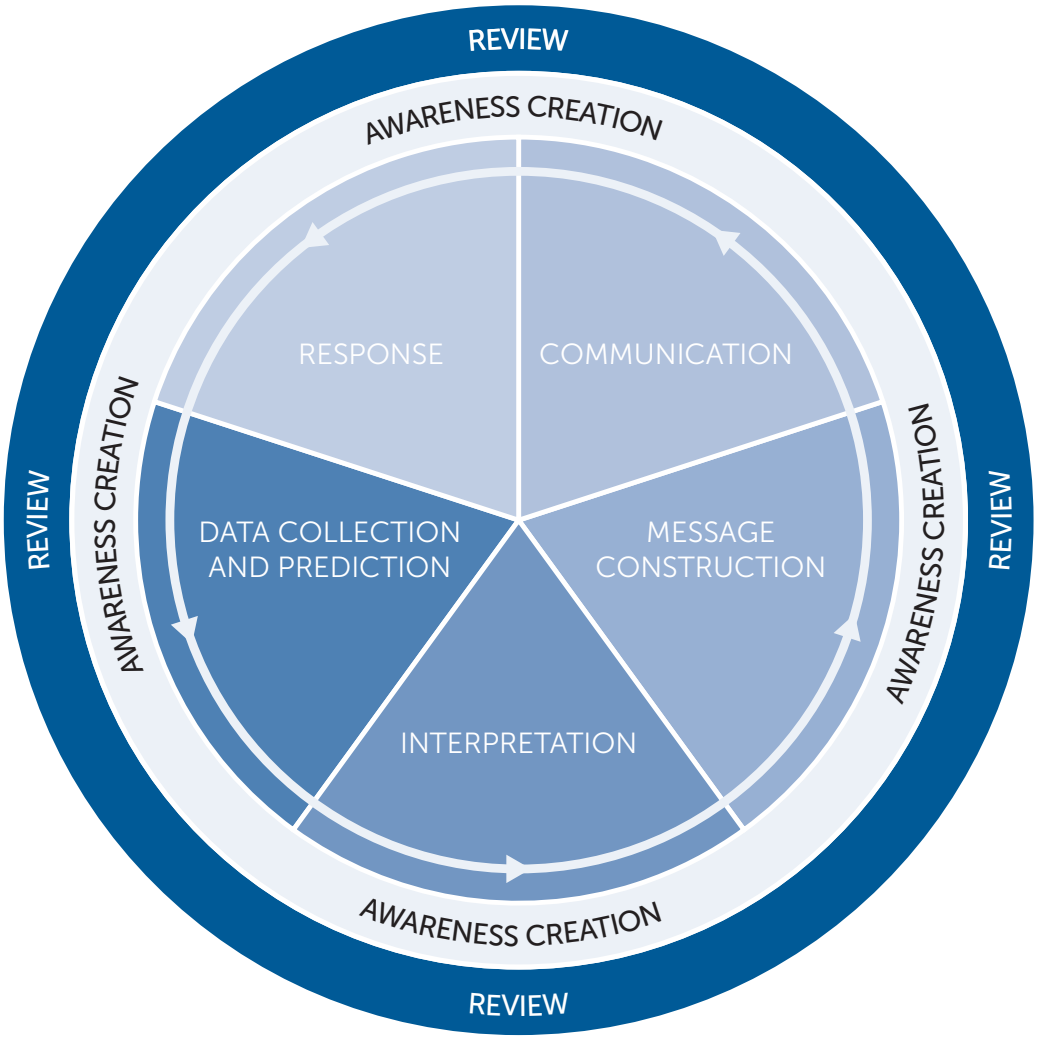
- continued adoption of the Total Flood Warning System as a conceptual model for linking together seven interlinked activities (flood warning systems are complex and they are far more than the gauges that collect information on rainfall and river heights: they require the coordination and cooperation of a number of agencies)
- developing a continual improvement program by updating the Victorian Flood Management Strategy and ten regional floodplain management strategies to provide the framework for community and agency involvement in planning, prioritising and implementing flood mitigation activities: each regional strategy will be reviewed over time to incorporate new knowledge and community needs for flood warning and other mitigation activities)
- taking advantage of existing initiatives to immediately improve flood intelligence, including mapping and warning systems
- working closely with the BoM to ensure weather forecast and flood prediction services to Victorian communities match their expectations
- integrating the Government's response to the findings of the Environment and Natural Resources Committee's Parliamentary Inquiry into Flood Mitigation Infrastructure in Victoria into an improved flood planning framework.

2.3.1 Total Flood Warning System

The four areas for improvement are underpinned by the Total Flood Warning System.

This system has seven interrelated components, described in the Victorian Floods Review final report and illustrated in Diagram 1.

DIAGRAM 1: TOTAL FLOOD WARNING SYSTEM



While not well understood by the community, the diagram shows that flood warning systems are complex. Impacts of flooding on the community need to be reduced not just by the flood gauges and flood prediction processes but also with flood maps, flood intelligence records, flood emergency plans, flood warning message dissemination, flood education programs and other measures that complement flood warning messages.

Important components of the flood warning network include:

- rainfall and stream gauges
- radar and satellite images to detect and quantify weather phenomena
- models that convert rainfall into potential river heights
- flood mapping (which converts river heights into areas and assets likely to be flooded)

- flood intelligence to underpin response planning and operational decisions, as well as agency and community awareness
- statewide, regional and community flood planning.

Total flood warning system effectiveness can be measured by considering whether people have:

- received timely and accurate information
- understood that information and appreciated what it means for them
- been prompted by the information to take action to reduce damage or enhance safety (for example, by avoiding flooded or closed roads, moving property and/or livestock, and by evacuating to a safe location)
- been prompted within timeframes appropriate to the circumstances.

2.3.2 An improved statewide planning framework - state & regional flood strategies

A long-term planning framework is required to systematically identify and prioritise needs, to clarify roles and responsibilities, and to engage the local community. Such a framework already exists in Victoria, but the Victorian Floods Review has highlighted a number of gaps and need for improvement.

The Victoria Flood Management Strategy, prepared for the Victorian Government by the State Flood Policy Committee, was launched in July 1998. The purpose of the strategy was to:

- enable effective flood management for the next 10 years, by providing a consistent statewide framework for the management of flood-related issues by relevant authorities, agencies and groups
- set out objectives, provide a statewide policy framework for best-practice principles and guidelines, establish priorities for statewide action and identify the roles and responsibilities of key stakeholders
- provide the statewide context for the development of regional floodplain management strategies, floodplain management plans and guidelines
- provide a process of continual assessment and improvement for flood management in Victoria, through the implementation and periodic revision of the strategy.

At the local level, the strategy has been implemented by service providers including Melbourne Water, catchment management authorities (CMAs), rural water authorities, local governments and DSE regions.

While the framework was a good basis for managing floods, community interest in floods waned during the long drought while funding and resources were directed to securing water supplies, although a number of flood studies were completed and some flood warnings systems upgraded. The focus on preparing for the next flood was lost, together with community and institutional memory.

The Victorian Floods Review highlighted the need for a contemporary, statewide flood management strategy that will provide a strong basis for consistent and coherent regional floodplain management strategies, including the incorporation of local knowledge. Technology needed for flood warnings has also improved.

The purpose of regional floodplain management strategies is to enable each CMA, and Melbourne Water, to carry out its statutory floodplain management role effectively. Such strategies establish priority flood mitigation activities, using technical information and risk assessments to meet community's expectations and priorities for flood management in their region. They provide a long-term framework for floodplain management activities and detail roles, responsibilities, cost-sharing arrangements and key programs for floodplain management stakeholders.

A regional floodplain management strategy sets out tasks, priorities, timeframes, costs and lead agency/support agency roles for:

- asset management
- information management
- local flood studies and floodplain management plans
- flood warning and emergency planning
- statutory land use planning
- education, training and community awareness.

The current regional floodplain strategies are nearing the end of their term and will need to be refreshed in light of the revised Victorian Floodplain Management Strategy and new information provided by the return to wet conditions. Revision of the Victorian Flood Management Strategy will start in the first half of 2013 and will address relevant recommendations of the Victorian Floods Review, of the parliamentary Inquiry into Flood Mitigation Infrastructure in Victoria (provided to the Victorian Government in August 2012) and the emergency management white paper (due to be completed in the second half of 2012). The revision of regional strategies will follow the Victorian Flood Management Strategy.

At the same time, DSE will work with Melbourne Water (which manages Melbourne's water supply catchments and waterways and major drainage systems in the Port Phillip and Westernport region) to ensure there is access to integrated flood management data for the whole of Victoria.

Community input will be sought in revising the Victorian Flood Management Strategy and the ten regional floodplain management strategies.

In terms of this implementation plan, state and regional strategies will:

- promote a basin-wide policy on flood warning gauges, to ensure that costs are apportioned with regard for the beneficiaries of the flood warnings, and not just by the stream gauge's physical location (for example, an upstream stream gauge located in one municipality may provide more benefits to a downstream municipality)
- provide greater clarity around responsibilities for floodplain management at the local level: for several decades, many local governments have commissioned flood studies, constructed works to mitigate flooding, maintained flood warning gauges, collected data on flood behaviour and carried out other floodplain management activities, but their roles have not been clearly identified in legislation or sufficiently clarified in policy frameworks
- provide a strong technical and information base to enable communities to establish their priorities for floodplain management
- encourage local governments and CMAs/ Melbourne Water to work together for the good of the community
- enable communities to establish priorities for mitigating their flood risk.

2.3.3 Flood gauging repair and improved flood intelligence

After the 2010-11 floods, the Victorian Coalition Government provided funding to immediately repair damage to the flood gauging network, and for the collection and assessment of flood data (including data about flood extents and flood levels), to improve mapping and knowledge of flood behaviour.

The complementary FloodZoom initiative announced in the 2011-12 budget will expand and modernise Victoria's flood data collection and analysis capability. It will enhance the knowledge base of the behaviour and consequences of flooding. This will help address the lack of comprehensive flood information encountered in the 2010-11 floods, and the problems with the way information was provided to emergency responders and the community.

Under FloodZoom, existing flood gauges will be upgraded to provide real-time river height data, and additional real-time rainfall and stream flow gauges will be installed at priority locations.

Additional flood studies (which include flood mapping for a range of flood events) are being progressively undertaken for 25 communities, to expand the knowledge of flood behaviour.

Through a flood intelligence platform, flood forecasts will be linked with information about flood behaviour and the location of community and private assets, to help assess consequences for, and impacts on, the community. Information from the flood studies (for example, flood maps, flood photography and maps showing houses and buildings affected) will be integrated with the flood intelligence platform. Much of this information will be available to local communities through local government and community education programs (such as FloodSafe).

2.4 Interactions with the Bureau of Meteorology

The contribution of the BoM, a Commonwealth Government agency that provides weather forecasting and warning services, is an integral part of Victoria's flood warning system.

Eleven recommendations in the Victorian Floods Review relate, in full or in part, to the functions undertaken by the Commonwealth. They are recommendations 4, 5, 6, 8, 10, 12, 13, 20, 24, 71 and 72.

In June 2012, the Commonwealth Government issued a response to the Victorian Floods Review through the Attorney-General and Minister for Emergency Management the Hon. Nicola Roxon. The response indicated that it supports, in full or part, all but one of the relevant recommendations relating to the functions undertaken by the Commonwealth, to the extent that costs can be met from within the current resources of the relevant Commonwealth agencies.

The decision by the Commonwealth not to increase its level of service to ensure major gaps in Victoria's flood warning system are addressed is a major concern. The Victorian Government will formally write to the Commonwealth to highlight the risks to Victorian communities as a consequence of this position.

The Commonwealth did not support recommendation 10, which relates to presenting water levels in both local datum and Australian Height Datum for all its published information and warnings. However, the BoM has indicated that it will provide this information on its website where available and provided to the BoM.

The Commonwealth as part of the 2012-13 budget made an initial response to the highest priority recommendations by providing funding in the 2012-13 financial year for up to 40 staff including seven frontline hydrologists. The increase in staff will be utilised largely to meet a backlog of work rather than provide new flood warning services. The BoM has also developed a plan for upgrading its flood monitoring and forecasting system, which will provide it with a next generation, state-of-the-art flood forecasting system within two to three years. Other activities underway include improving the documentation and clarity of services that BoM provide, and to develop a competency-based training program.

As part of a separate process, the Commonwealth reviewed the BoM's capacity to respond to extreme weather events and natural disasters, and to provide seasonal forecasting services to the states and territories. The review, led by Ms Chloe Munro, recommended (among other things) that the BoM prioritise boosting its flood warning capacity by increasing the number of frontline hydrologists and by upgrading the flood monitoring system.

2.5 Parliamentary Inquiry into Flood Mitigation Infrastructure in Victoria

Flood warning is one of several activities that can reduce the potential damage from flooding. Flood risk management planning focuses on identifying and analysing flood risks, and on evaluating and recommending appropriate flood risk treatment options. Measures that can reduce the impact of flooding on the community include:

- flood warning systems, which provide information to communities in a form that they understand, before a flood arrives, and enable them to undertake their own emergency response; and that also inform emergency service organisations
- planning controls to ensure that new development or redevelopment in floodplains are compatible with the flood risk
- building regulations that require floor level heights (freeboard) to be set above the applicable flood level, or as otherwise determined by the floodplain management authority
- flood education and awareness programs, which help communities understand the potential impacts on them of flooding
- flood mitigation infrastructure (such as levees and retarding basins) and property-specific structural measures (such as flood proofing of individual houses)
- flood emergency plans, which record arrangements for preparedness, response and recovery from flood: these are linked to flood emergency planning.

The Victorian Floods Review made recommendations in relation to a number of the measures above. However, flood mitigation infrastructure was outside the Victorian Floods Review's terms of reference.

The parliamentary Inquiry into Flood Mitigation Infrastructure in Victoria, undertaken by the Environment and Natural Resources Committee, concluded in August 2012. The Victorian Government has six months to prepare a response. The committee focused on structural flood mitigation measures, including the management of levees and clearing of waterways, but did make some references to flood warning infrastructure. This implementation plan will be amended if required by the government's response to the committee's report.

A note about emergency response arrangements

A number of recommendations about flood warning systems refer to emergency management roles. In this implementation plan, the term emergency management is defined as emergency response and does not necessarily include mitigation or recovery activities. The following notes provide background on Victoria's emergency response arrangements.

- Victoria State Emergency Service (VICSES) is Victoria's control agency for floods and storms. Its roles and responsibilities are explained in *Emergency Management Manual Victoria* and derive from the *Emergency Management Act 1986*. Following the Victorian Floods Review, its roles are being reviewed in the context of the emergency management white paper.
- VICSES is supported by other agencies, including the Country Fire Authority and DSE. Their roles are explained in the *Emergency Management Manual Victoria*.
- Incident management teams are formed at a local level to deal with floods. Typically, there will be numerous incident management teams for a major, sustained flood event. Each team is led by an incident controller. For major floods like those in 2010-11, the State Control Centre will also be used and will be led by the State Controller.
- The roles of incident management teams include providing public information, planning, and providing flood intelligence, operations and logistics. Providing public information, planning and providing flood intelligence are particularly important for effective flood warning systems.
- Incident management teams operate out of incident control centres, which are set up as close as practicable to the floods to ensure an integrated emergency management response. The State Control Centre is in Melbourne's CBD and has oversight of the total flood response.

3 RESPONSE TO RECOMMENDATIONS

Recommendation 1

The state take the necessary measures to clarify roles, responsibilities and cost-sharing arrangements for flood warning systems, including tasking state and regional bodies to be responsible for the flood warning system. This will require engaging with the commonwealth to amend the 2001 arrangements, updating the 1998 floodplain management strategy accordingly and continuing to support commonwealth initiatives designed to improve flood mapping standards and associated issues.

Victorian Floods Review findings

A flood warning system depends on collecting, interpreting and disseminating flood information in a manner and form that the community can understand and act on. A more accurate or more timely flood prediction for a location is of little value if it is not disseminated to those who need it, in a manner that is easily understood, or if it does not prompt an appropriate response.

The components of flood warning systems are currently described in *Arrangements for Flood Warning Services in Victoria* (2001). They include principles, responsibilities and cost sharing arrangements for achieving the effective development and performance of flood warning services.

The arrangements are complex. For example, river and rain gauges can be co-owned by a number of organisations, including the BoM, DSE, CMAs, local governments and water authorities, each of which use them for a variety of purposes, not just for flood warnings. The organisations that then interpret the information for flood warning purposes and disseminate it are different again, making the overall flood warning system vulnerable to misinterpretation and miscommunication.

The Victorian Floods Review noted that a lack of clarity about roles and responsibilities was a major impediment to the establishment of adequate warning systems in many regions. Specific input will be required from the relevant agencies that have the specialist skills and knowledge required to make the flood warning system work. The Victorian Floods Review considered it appropriate and timely to review the current arrangements for the establishment, evaluation and maintenance of flood warning systems in Victoria.

The Victorian Floods Review considered flood warning arrangements in the broader context of the 1998 Victoria Flood Management Strategy, which was developed as a long-term plan to address Victoria's flood risks. The strategy provided the framework to collate the available data on floodplains, and to implement measures to reduce the flood risk to communities (Victorian Floods Review pages 39–42).

What has been done

The Commonwealth has agreed to work with the Victorian Government, through the BoM, to review and amend *Arrangements for Flood Warning Services in Victoria* and the Victoria Flood Management Strategy.

What will be done

The Victorian Government accepts that it has a role to ensure that flood warning systems improve and the deficiencies are addressed. Flood warning systems will remain a shared responsibility between agencies at the Commonwealth, state, regional and local levels.

Flood warning arrangements

The BoM has advised that it will be undertaking a review and update of the flood warning arrangements documentation across Australia to provide greater role clarity of roles and responsibilities of those agencies involved in flood warning systems including the inter-relationship between the Commonwealth and all States and Territories. Arrangements for Flood Warning Services in Victoria will most likely be replaced by a document which sets out a nationally-consistent description of flood warning arrangements as well as unique aspects of arrangements in each State including Victoria. Following agreement by the State and Commonwealth, the document would form the basis of service-level agreements for flood forecasting and warning services provided by the BoM.

The State's view is that the amended documents need to consider:

- the various beneficiaries (such as local landowners; business owners; local, regional, state and Commonwealth government agencies and organisations; visitors; and owners of critical infrastructure)
- the need to plan flood warning systems strategically, given that flood warning gauges located in the upper reaches of the catchment also benefit communities in other areas
- what is required to operate and maintain all aspects of the total flood warning system—not just the gauges and telemetry—and how requirements can be resourced
- sustainable cost-sharing arrangements, taking into account capital and maintenance costs over a long period of time.

Victoria Flood Management Strategy

A comprehensive revision and update of the Victoria Flood Management Strategy is to commence in early 2013. This will address the Victorian Government's commitments in this implementation plan, relevant parts of the emergency management white paper and the Government's response to the recommendations of the Inquiry into Flood Mitigation Infrastructure in Victoria.

DSE will lead the revision of the Victoria Flood Management Strategy. It will involve all major stakeholders and aim to incorporate community knowledge into local and regional flood management arrangements. It will be a comprehensive document that will underpin updating of the ten regional floodplain management strategies, to ensure that it continues to reflect existing organisational and community flood experience.

Regional floodplain management strategies

Regional floodplain management strategies will include prioritised and interlinked activities such as flood studies, asset management, land use planning and emergency planning. They will also review the flood warning system for each basin (which is further explained in the response to Recommendation 3).

The ten regional floodplain management strategies and the updated flood warning arrangements will provide documented flood warning arrangements between the state, regional authorities and local governments for Victoria's 29 river basins. In addition, the strategies will provide an improved knowledge base to inform statutory planning decisions.

Related recommendations

Recommendations 2, 3, 4, 5, 8, 11, 13, 14 and 29

Recommendation 2

The state task the Emergency Services Commissioner with the responsibility to establish an effective audit regime of the total flood warning system.

Victorian Floods Review findings

Currently, there are no rigorous audit processes to help identify flood management gaps and progress monitoring the components of a total flood warning system, nor the related components that also need to be undertaken to reduce the flood risk. These include flood data acquisition, flood studies, flood mapping, flood emergency planning, systems for dissemination of warnings and community education. Similarly, there has been no audit of the *Flood Warning Service Development Plan for Victoria*, which was endorsed in 2005. The Victorian Floods Review considered that a single body should be responsible for such audits, rather than oversight of standards and performance being spread, ineffectively, over a number of bodies (Victorian Floods Review page 42).

What has been done

At the request of the Minister for Police and Emergency Services, the Emergency Services Commissioner is conducting two separate reviews: one into flooding in north-east Victoria in March 2012, the other into flooding in Gippsland in June 2012.

What will be done

The Office of Emergency Services Commissioner will develop an audit framework for the total flood warning system by June 2013.

In the meantime, DSE, VICSES and other agencies responsible for flood warning will participate in the two reviews being undertaken by the Office of Emergency Services Commissioner.

Related recommendations

Recommendations 1, 3, 6 and 25

Recommendation 3

The state develop a flood warning system for each basin and location with community input and make relevant documents publicly available. Each warning system should include key performance indicators.

Victorian Floods Review findings

The Victorian Floods Review found there was a piecemeal approach to developing and managing flood warning systems. This resulted in flood warning systems for an entire river system or basin being the sum of individual components, often of a variable standard and with notable blind spots. A strategic approach is required, which would consider prediction and warning needs across an entire river system or basin covering both upland and lowland communities, simultaneously and within the one plan. (Victorian Floods Review pages 42–43).

The need to tailor the flood warning system to community requirements was reflected in the following extracts from the Victorian Floods Review:

> *"Accurate and timely emergency warnings to communities are critical in the saving of lives and mitigation of property damage. Improvements are required to Victoria's Total Flood Warning System (TFWS) which needs to be better tailored to meet local requirements. This requires involvement and contribution from those it is intended to serve.*
>
> *"There are gaps in the gauging network, however, more flood gauges will be of limited benefit without communities knowing what warnings mean for them so that they can take the necessary steps to ensure their safety and reduce property damage. Enhanced flood risk planning, including coverage and quality of mapping, coupled with community education is required" (Victorian Floods Review page 4).*

The Victorian Floods Review found that the providing flood warnings was not the sole responsibility of one organisation but rather depended on arrangements across local, state and Commonwealth governments: responsibility for gauging, flood mapping, emergency planning, prediction modelling, community education and warning dissemination rested with different organisations.

The flood warning system consists of the following elements:

- data collection (monitoring of rainfall and river heights and flows that may lead to flooding)
- prediction (forecasting flood severity and the time of onset of particular levels of flooding)
- interpretation (assessing flood forecasts to determine the likely flood impacts on the community, supported by flood mapping)
- message construction and dissemination (describing what is happening and what will happen, the expected impacts and what actions should be taken)
- response (undertaking protective actions by agencies and communities to reduce the impacts of floods)
- awareness (educating communities to understand floods and their impacts at a local scale)
- review (reviewing warning system performance after a flood event).

The implementation of this recommendation requires consideration of each of the above elements.

What has been done

Repair of stream gauges

Damage to Victoria's stream gauging network as a result of the 2010-11 floods has been repaired. The flood warning network of river height and rainfall gauges in the northern and western parts of the state is fully operational and is being improved to be more resistant to future damage. In some instances, stream gauges have been moved higher on the embankment or re-constructed using more resilient building materials.

Improvements to stream gauging network

Improvements at seven stream gauges in the Glenelg–Hopkins region have enabled real-time access to river flow and height data. Funding has been provided to ensure real-time access is also available at stream gauges in other regions, including the Wimmera and North Central Victoria.

Collection of new flood information

Information collected during and immediately after a flood event provides invaluable knowledge of flood behaviour that can guide preparation for, and responses to, future flood events. Data on flood extents and flood heights taken from the 2010-11 floods has been collected using aerial imagery or extensive on-ground surveys across the entire flooded region. The CMAs have largely lead this activity, with support from DSE.

New flood studies for communities at risk

Building on the data collection, funding has been provided to undertake up to 25 flood studies for flood-affected communities. Of these:

- A flood risk assessment for Creswick has been completed and funding to construct flood mitigation works (including a levee to reduce the impact of future flooding) has been provided.
- A further fifteen studies are currently underway for Skipton, Wickliffe, Burrumbeet Creek, Casterton, Bendigo, Rochester, Clunes, Donald, Charlton, Upper Wimmera, Natimuk, Latrobe, Nagambie, Shepparton and Carisbrook. This follows extensive work undertaken by VICSES, Melbourne Water and local governments to develop flood management and emergency plans for priority regions within Melbourne.

These studies will further refine mapping, and provide information for flood emergency responses and investigations of flood mitigation options (including land use planning, enhancements to flood warning or, where appropriate, structural mitigation works). Local governments and CMAs are leading these studies, with financial support from the Commonwealth and state governments.

Improved information dissemination

VICSES has adopted the 'One Source One Message' warning tool (which is used by the Country Fire Authority for bushfire warnings) to improve the speed and consistency of emergency information to the community. VICSES has also re-developed its public website, allowing an improved platform to provide emergency information before and during emergencies.

VICSES has developed a template for flood emergency plans at the local government level.

VICSES conducted a State Wide FloodSafe Week in April 2012, to raise the awareness of how prepare for flooding.

Evaluation of adequacy of flood warning at a regional scale

A framework to assess the current state of the total flood warning system at basin scale is underway. This framework will inform the evaluation of total flood warning needs and benefits at basin and location scale, with priorities established through future regional flood management strategies led by CMAs. DSE is leading the initial assessment.

What will be done

As noted above, the flood warning system consists of a number of elements. The effective performance of the flood warning system relies on the strengths of each element and their interactions. The effective implementation of this recommendation requires contributions from a number of agencies, including local governments, DSE, VICSES, CMAs and the BoM.

The following approach responds to the identified gaps in the flood warning network and provides a framework that enables strategic and continuous improvement process in the network:

- closing known gaps in flood warning systems identified in the 2010-11 floods through improved data collection, flood prediction, flood mapping, community education and flood emergency planning
- documenting flood warning arrangements for each basin, including clarity of organisational and community roles and responsibilities
- ensuring regional floodplain management strategies provide the forum through which communities and agencies agree to significant changes to the flood warning network across the river basin
- undertaking reviews following any significant flood event to assess the performance of the flood warning system, to inform any immediate improvements required: local communities can seek to enhance the flood warning system where the flood warning system does not meet local requirements.

VICSES, in consultation with stakeholders such as local governments, will progressively develop flood emergency plans and educate the community about their flood risks, ensuring that these programs extend to communities affected by the 2010-11 floods. The catchments include the Glenelg–Hopkins, Wimmera, Avon–Richardson, Loddon and Campaspe basins.

Upgraded gauging and flood mapping will be conducted by DSE with priority catchments including the Glenelg-Hopkins, Wimmera; Avon-Richardson; and Loddon-Campaspe.

The BoM is responsible for the provision of flood forecasting and warning services as part of a total flood warning system. While the BoM has agreed to work with the State in identifying areas where flood warning improvements are required, they have not committed to increase their services to ensure flood warnings are improved.

Due to the integral role the BoM has in flood warning systems, it is imperative that the BoM also increase prediction services at these locations. The Government will write to the Commonwealth to seek a commitment to increase its flood warning service for Victorian communities.

Documentation of the flood warning system for each basin will be complete by the end of 2013.

Strategic assessment of flood warning systems will seek to align the flood warning system to the flood risk at the local, basin and state scales. The implementation of these further refinements will be prioritised through regional flood management strategies.

This process will see flood warning services continually reviewed and matched to community requirements. This may result in flood warning services enhanced in high–flood risk areas, but reduced in some areas where the flood risk and potential consequences for communities are low.

Related recommendations

Recommendation 8 and 11

Recommendation 4

The state and commonwealth undertake a review into the appropriate institutional arrangements for the forecasting and predictions function currently undertaken by Melbourne Water for the Port Phillip and Westernport region.

Victorian Floods Review findings

Flood forecasts are provided to emergency management agencies and the public by the BoM for most of Victoria, and by Melbourne Water for the Port Phillip and Westernport region. Both organisations prepare flood predictions and develop flood warning messages for streams in their delegated areas. Flood warning messages are disseminated by the BoM, but the BoM relies on Melbourne Water to prepare messages for its area.

The Victorian Floods Review considered this separation of functions needed revisiting, to provide a single point of contact for emergency management agencies and communities, and to reduce duplication of communication. The aim of revisiting these arrangements should be to improve services to communities (Victorian Floods Review pages 34–41).

What has been done

Melbourne Water and the BoM have agreed to review these arrangements.

What will be done

Melbourne Water and the BoM will investigate ways of improving service delivery to communities. The Chair of the State Flood Policy Committee will facilitate the review, which will be completed by May 2013. Stakeholders (including VICSES) will be consulted.

The review will:

- look at the current arrangements and requirements of Melbourne Water and the BoM, including staffing arrangements
- identify options for undertaking the different elements of the flood forecasting and prediction roles, including better processes to improve the quality, speed and accuracy of flood predictions and flood warnings
- evaluate the options against performance criteria based on benefit, cost, accuracy, speed and reliability
- focus on the best outcome for the community.

Any revised arrangements will be formalised in agreements between the Commonwealth and the State (e.g. by revising current MoU between Melbourne Water and the BoM). In any case Melbourne Water will continue to manage and maintain the flood gauging network and hydrologic models required to operate the water supply and river health components of its business.

Without prejudging the outcome of the review, it is the State's preference that any additional BoM resources be initially focussed on addressing major gaps in the flood forecasting services in regional Victoria as a priority rather than taking on the flood forecasting role currently undertaken by Melbourne Water.

Recommendation 5

The state engage with the Bureau of Meteorology to establish a joint initiative to review existing flash flood warning systems in Victoria and identify where additional systems are needed, with a particular focus on urban centres with a history of flash flooding. This review should seek to achieve outcomes similar to those implemented in NSW. Subject to those outcomes being implemented, the state should determine which agency is responsible for flash flood warnings.

Victorian Floods Review findings

Flash flooding is defined as flooding that occurs within six hours of the start of the rain that caused it.

According to the Victorian Flood Warning Consultative Committee's *Arrangements for Flood Warning Services in Victoria*, local governments have the prime responsibility for installing, operating and maintaining flash flood warning systems. Local governments are also responsible for providing predictions of stream levels as a result of flash flooding. For the urban areas of greater Melbourne, Melbourne Water can provide assistance.

The BoM's responsibilities are to provide predictions of weather conditions that might lead to flash flooding, and for the provision of technical assistance and advice to local governments.

If these responsibilities are taken at face value then, if a local flash flood prediction need is identified, it should be funded and developed locally. The BoM may provide technical assistance.

The Victorian Floods Review heard that local governments do not necessarily have the expertise or capability to develop and operate such systems, and that they have been reluctant to take on the ongoing costs associated with maintaining data collection and warning systems. These typically consist of a network of rain and river gauges, flow measurement equipment, telecommunications, data storage and display facilities. Consequently, even though the formal arrangements are longstanding, there are actually only a few places in Victoria with such systems.

The Victorian Floods Review was also of the view that flash flood system arrangements were not couched in the terms of total flood warning systems that apply to riverine flooding.

> *"A flood warning system (and investments in their implementation) that overemphasises the collection of input data and/or the production of forecasts to the attention given to other elements (such as message construction, the information provided in the messages and the education of flood prone communities about floods and flood warnings) will invariably fail to fully meet the needs of the at risk communities they have been set up to serve."*

In NSW, the BoM provides the warnings service for a number of high-risk areas, and there is currently a trial to shorten the lead time for flash flooding warnings from six to three hours (Victorian Floods Review pages 45–47).

What has been done

At the state level, work is continuing on a number of fronts. Through FloodZoom, CMAs (together with local governments, VICSES and communities) are undertaking flood studies for key towns including Creswick (completed), Carisbrook and Clunes. The locations of these towns in the upper parts of their catchments means they are potentially subject to flash flooding.

Secondly, Melbourne Water is trialling flash flood warning systems in a number of high-risk locations in Melbourne, as one of the implementation tasks in its Flood Management and Drainage Strategy. Melbourne Water, in partnership with VICSES and local governments, has identified regions which are subject to flood risk, and are working to establish community education programs and, where feasible, implement flood mitigation works.

The Commonwealth Government has agreed to support the recommendation in part. The BoM's position is reflected below. The BoM supports the review of existing Victorian flash flood warning systems, subject to further clarification of roles and responsibilities and local governments' financial and technical capacity to establish, maintain and operate an effective flood warning system; availability and accessibility of weather radar and timely local access to raw information on the likelihood of rainfall likely to lead to flash flooding; flash flood awareness by the at-risk community, and adequate dissemination of warning messages.

The Commonwealth has also indicated its view that differing governance arrangements and responsibilities between emergency services and local governments in each state and territory should be acknowledged.

What will be done

Roles and responsibilities for flash flood warning systems require further clarification. The BoM supports working with the State and local government to undertake the review. In particular, the review will take into consideration organisations' capabilities and roles in the state flood warning protocols, and consistency with the concept of the total flood warning system as for riverine flooding.

CMAs and local governments will continue to undertake flood studies for key towns whose locations in the upper parts of their catchments means they are potentially subject to flash flooding. These contribute to the Victorian Government's commitment of undertaking 25 new flood studies, to provide high quality mapping and mitigation options.

In addition to the flood studies, DSE will undertake, in conjunction with VICSES, local governments and CMAs, an investigation to identify areas susceptible to flash flooding, noting that Melbourne Water has already identified areas subject to flash flooding in the metropolitan area. This will be based on historical evidence of events and will have regard for the flood damage potential and the population affected. The investigation will be completed by April 2013. The information will be provided to organisations for their consideration in the management of flash flooding including:

- strategic planning or prioritising of urban drainage works by local governments
- prioritising flood education and flood emergency planning programs by VICSES
- developing future flood studies.

DSE, together with Melbourne Water, VICSES, local governments and the BoM, will continue to monitor the effectiveness of existing flash flood warning systems in Victoria and interstate, and will assess their applicability for high-priority areas.

Location-specific flash flood warning systems, beyond those provided through existing radar and severe weather warning processes, will be progressively installed (based on their cost-benefit) and supported financially by those benefiting from the service.

The identification of communities at risk from flash flooding will be continually reviewed through the regional flood management strategy process, or through reviews of significant flooding events. This will enable communities to be involved in decision about the necessity of altering their flood warning measures.

Related recommendations

Recommendations 1, 8, 12, 18, 21, 29, 3, 31 and 32

Recommendation 6

The state and the Bureau of Meteorology liaise to ensure the existence of appropriate quality control processes for gauges and contingency measures in the event that gauges are damaged during flood events.

Victorian Floods Review findings

Stream and rain gauges provide critical information during a flood event. Incident controllers and the community access this information from the BoM's website. During the 2010-11 floods, a significant proportion of the 585 gauges in Victoria were damaged. A small number of gauges continued to send incorrect information to the BoM, indicating lower flood levels than actual levels: many others stopped sending information altogether. Processes are needed to ensure that the information being received from gauges is correct.

When gauges fail, or when flow information is required to monitor flooding, alternative arrangements are needed. This could be done by having manually read gauges as a backup for critical areas (provided they can be read safely), or it could be more sophisticated, such as taking flow measurements at specific locations (Victorian Floods Review pages 50–51).

What has been done

As indicated in relation to Recommendation 3, damage to the gauge system resulting from the 2010-11 floods has been fixed, and an extension of the network has commenced.

DSE and the BoM are investigating quality assurance processes that will minimise the likelihood of incorrect readings being recorded on the BoM's website in the event that damaged gauges continue to send incorrect information to the BoM. Among other measures, this is likely to involve:

> a feedback loop to the BoM from incident management teams that have access to local information

> formal standards for locating gauges, reading the gauges and recording information.

As part of the implementation process in Recommendation 20, the feasibility of direct access to rainfall and river data for incident control centres is being considered. Comparing the live feed of gauge information with other information held at an incident control centre (such as observations by emergency responders and the local community) would provide a basis for quickly identifying faulty information, and the relevant gauge locations.

Ten portable automated logger systems (PALS) were purchased after the 2010-11 floods. The loggers enable monitoring of flood levels at locations where no permanent gauges are available. They were successfully deployed in March 2012, when major flooding affected the Broken River catchment in north-east Victoria.

Over the past twelve months, Victoria has also used two portable acoustic doppler flow meters to measure flows at critical locations during flood events, and to validate rating tables at river gauges, to improve flow estimates. These measure flow velocities directly and do not require a rating table to convert levels to flows.

Rating tables (which enable the height of a river to be converted to flow rate) are being reviewed across basins in the North Central Victoria, Wimmera and Glenelg–Hopkins regions. Similar work has been scheduled when existing gauges in other regions are upgraded. This will improve the accuracy of flow measurement during floods.

What will be done

The results of the DSE and BoM investigation will be incorporated into the formal service-level agreements with the Commonwealth.

The provision of real-time streamflow data to incident control centres through the FloodZoom IT platform will enable emergency services to monitor flood events, providing an increased ability to detect damaged gauges. This will commence in June 2013, in line with the development of the FloodZoom IT platform.

In addition, DSE will work with the managing contractor for Regional Water Monitoring Partnerships to develop an operational contingency plan in the event that gauges are damaged. The plan will be developed by December 2012. This will build on the current contractual arrangements with Thiess to respond to damaged gauges. The following approaches will be considered:

> providing on-site redundancy at known hot spots, prior to the advance of flood waters

> pre-planning in high-risk areas for the use of portable devices to supplement fixed gauges

> at critical locations, the installation of dopplers to measure flood velocity and assist in better predicting flood behaviour.

Related recommendations

Recommendations 2, 3, 7, 8 and 20

Recommendation 7

The state expand the Regional Water Monitoring Partnerships model to include all flood warning gauges.

Victorian Floods Review findings

Stream gauges and many of the rain gauges that have been installed specifically for flood warning services are maintained and repaired by four regional water monitoring partnerships in regional Victoria. These partnerships have reduced overall costs and resulted in more efficient use of resources and better data access, especially where multiple agencies need access to gauge data. However, there are still a number of gauges installed and maintained in regional Victoria by organisations for their particular use, or for a purpose not covered by partnership arrangements. These gauges do not currently benefit from the streamlined arrangements in place to maintain and repair them, especially during major flood events. Additionally, the gauges in the Melbourne metropolitan area are part of Melbourne Water's system and are maintained and repaired by Melbourne Water (Victorian Floods Review pages 50–51).

What has been done

The four regional water monitoring partnerships that were in place at the time of the Victorian Floods Review have now been consolidated into two, and improvements have been made to management arrangements. These partnerships provide services for 44 public and private organisations with water monitoring at more than 770 sites in regional Victoria. Organisations that are currently not part of a partnership can become involved at any time by approaching the partnership for approval to join.

The benefits of the new partnership arrangements are:

- knowledge and better assistance for organisations from regional coordinators
- consistent and reliable data, with coordinated data collection supported by standards for maintenance, repair and data collection, thereby improving data quality and reducing data uncertainty
- single consolidated data submission to the BoM
- audited methodologies and service standards
- economies of scale, with cost sharing opportunities at monitoring sites
- centralised contract management and procurement, and reduced administrative expenses.

Outside the regional water monitoring partnership arrangements, Melbourne Water has developed its own agreements with its service provider to ensure consistent gauge maintenance and repair in Melbourne Water's jurisdiction.

What will be done

As the central contract manager, DSE will work with the Regional Water Monitoring Partnerships' coordinators and regional organisations outside Melbourne that are not currently members of the partnerships, to assess the costs and benefits to them of joining the partnerships. Membership will continue to be voluntary.

It is not proposed to join Melbourne Water to the partnerships unless this is an outcome of the review of the appropriate institutional arrangements for the forecasting and predictions function currently undertaken by Melbourne Water for the Port Phillip and Westernport region in Recommendation 4.

The BoM is a member of Regional Water Monitoring Partnerships. It has advised that it will continue to provide advice through the partnerships on the most appropriate technology to be used for data monitoring, and will assist the state with setting priorities as to which flood warning gauges should be included.

Related recommendations

Recommendation 6

Recommendation 8

The state:

> undertake a strategic review to identify areas at risk from flash or riverine flooding. Shortcomings in the flood gauging networks identified in the review should then be the focus of remedial action

> seek to address as a priority any notable gaps in the total flood warning system as apparent in the 2010–11 floods (including south west Victoria, Wimmera and north central region) by enhancing mapping, gauging and education programs; and

> seek a commitment from the Bureau of Meteorology to ensure any new gauges installed are utilised to enhance flood prediction capability and coverage.

Victorian Floods Review findings

At the time of the Victorian Floods Review, there were no formal continual improvement processes with sufficient rigour to address statewide gaps in flood study requirements, flood warning systems or to identify linkages and processes that are not working as intended. Additional gauges will, however, only be of use if the resulting data is incorporated into flood prediction modelling managed by the BoM. Community education campaigns are an essential component of a total flood warning system and have been trialled and found to be effective, but were not available in most areas prone to flooding due to funding constraints (Victorian Floods Review pages 42, 52).

What has been done

Initial FloodSafe education programs have been delivered in Melbourne, Gippsland, north-east Victoria and south-west Victoria. VICSES has established a partnership with Melbourne Water to provide flood and storm education to Melbourne residents, which involved door-knocking at some 4000 properties in high-risk areas. VICSES has provided libraries and schools across the state with information about how residents can be better-prepared for emergencies.

The Victorian Government has provided funding to VICSES to employ 12 community resilience coordinators and 12 command and control managers, over three years from 2011–12.

As part of the FloodZoom initiative, flood warning system upgrades are being investigated systematically; complementary flood studies are also being prepared (see the response to Recommendation 3).

What will be done

The Commonwealth will provide assistance through the BoM in supporting assessment of the adequacy of flood gauging networks, and in any required remedial action to be undertaken by the responsible state and local government agencies.

As indicated in the response to Recommendation 3, the strategic review and fixing notable gaps in the flood warning system will be undertaken. Documentation of the flood warning system for each basin will commence after immediate improvements have been made, and will be complete by 2013.

The initial focus will be on riverine flood warning systems. This foundation will be built on in subsequent years through the implementation of regional floodplain management strategies (as discussed in Recommendation 1), and also as a result of the identification of areas in need of a local flash flooding system (as discussed in Recommendation 5). This will allow for a process of continual improvement over time, of a scale and quality that is affordable to the community. A regular review cycle will ensure emerging problems are identified and resolved, and systems are continuously improved.

With respect to the third part of the recommendation, the Commonwealth has advised that it will be able to use new gauges installed by state and local government agencies to enhance flood prediction capability only if:

> the data collection network provides sufficient spatial coverage to support flood modelling leading to generating warnings (that is, in riverine systems that support a basin-wide flood modelling approach)

- the communications systems providing real-time data are compatible with the BoM's communications system
- an agreement is in place through the Victorian Water Monitoring Partnerships for appropriate arrangements for ongoing operations and maintenance of the new networks.

The BoM has advised that current funding constraints reduce their ability to implement of this action.

VICSES received a grant for 2012–13 through the Natural Disaster Resilience Grant Scheme to develop localised community flood guides for some high-risk communities across the state by the end of 2013. VICSES will also work closely with these communities during 2012–13 to improve community preparedness and for the delivery of emergency warnings and information during floods.

Related recommendations

Recommendation 3, 5 and 11

Recommendation 9

The state, in consultation with Bureau of Meteorology and Melbourne Water, take the necessary action to ensure that all flood warnings issued are linked to the geographical location of the gauge the data was derived from.

Victorian Floods Review findings

The Victorian Floods Review found that community understanding of stream gauge information could be improved by ensuring that this information was linked to a description of its geographical location, in addition to mentioning the specific stream with which it is associated (Victorian Floods Review pages 52–53).

What has been done

The BoM has advised that it provides extensive information on flood networks and gauge locations on its website. The BoM's experience has been that many members of the public in risk areas are well informed, and use this website and local government information accordingly. The BoM also endeavours to provide catchment-based location maps and network details on its website. The BoM has already commenced assessing the ease of accessibility of this information, and will consider any improvements in its review.

What will be done

Implementation will occur as flood warning systems are progressively upgraded (see recommendations 3 and 8), allowing reference to the physical location of each flood warning gauge so that the geographical reference is clear and unambiguous. FloodSafe programs (see Recommendation 8) will also potentially provide a link between impacts for a local community and the relevant gauge.

Flood warning messages are put out by the BoM, but state agencies and local governments have a responsibility to ensure people at risk are aware of the gauge locations relevant to their situation. The BoM has stated that it is willing to assist in this community education process.

With regard to including additional information on flood warning messages, warnings will be developed appropriate to the medium being used, so as not to create confusion or inconsistencies. For example, warnings for a town may be derived from several gauges which may be confusing for the public if both were used for warnings.

Related recommendations

Recommendations 3 and 8

Recommendation 10

The Bureau of Meteorology should present water levels in both local datum and Australian Height Datum (gauge zero) for all its published information and warnings.

Victorian Floods Review findings

The Victorian Floods Review found that there was an inconsistency in the way stream heights are described. Two measures are currently in use for stream height: the height of the water above the stream bed, and the height of the water above sea level. Local communities also need to be advised of the meaning of these levels for their individual circumstances. (Victorian Floods Review pages 52–53).

What will be done

The BoM does not support this recommendation and will only provide a single reference to a datum in the flood warning messages it provides. However, the BoM will update the part of its website that relates to information on the gauges to include both local datum and Australian Height Datum where this information is available. This will enable emergency service organisations, agencies or community members to convert to Australian Height Datum flood levels provided in local datum.

As the BoM has observed (taking into account its experience in issuing flood warnings nationally), the difference between local river heights and the river levels adjusted to the Australian Height Datum is generally misunderstood. Changing the local gauge datum to Australian Height Datum could lead to further misinterpretation.

This lack of understanding can be better addressed through programs like FloodSafe, where the meaning of gauge heights at locations remote from settlements can be better explained. Also, during a flood event, more tailored and appropriate responses can be given by value-adding flood warnings put out by the BoM through community messaging.

Related recommendations

Recommendation 3 and 8

Recommendation 11

The state take the necessary measures to upgrade existing manual stream and rain gauges and ensure that all future gauges provide a seamless transfer of data from the gauges to the Bureau of Meteorology.

Victorian Floods Review findings

There are a small number of stream and rain gauges that are read manually. The majority of gauges are equipped with telemetry that enables the BoM (and others) to access data in real-time or near-real time. There are some limits to when manual gauges can be read (daylight hours, while the gauge is accessible) and there are inevitable delays in sending the relevant information to the BoM or other agencies. The Victorian Floods Review heard that the BoM intends to seek to replace or upgrade manually read gauges, to ensure real-time information is available to assist flood forecasting (Victorian Floods Review page 49).

What has been done

The Commonwealth through the BoM has funded the automation of the river height gauges in the Glenelg basin which had previously been read manually.

What will be done

As flood warning systems are reviewed and upgraded through FloodZoom, the relatively small number of gauges that need to be read manually will be progressively automated. DSE will lead the process. The actions set out under Recommendation 3 will replace these manual gauges.

The BoM will provide advice to relevant stakeholders when required on the most appropriate technology for automating the rainfall and river monitoring gauges, and the communication requirements for a seamless transfer of data.

Related recommendations

Recommendations 3 and 8

Recommendation 12

The Bureau of Meteorology undertake a review of its radar coverage in the context of flash and riverine flood warnings for Victoria, with a particular focus on known gap areas such as the Horsham/Nhill region.

Victorian Floods Review findings

Weather radar equipment is owned by the BoM and is a core component of its forecasting tools. Weather watch radars are very effective tools for the detection of rain. Radar is equally important for riverine and flash flooding prediction. The Victorian Floods Review became aware of a radar blind spot in the Horsham–Nhill region, and that the Mildura radar is not able to detect accurately the strength of storms located behind the closest storms. Addressing these shortcomings would improve the BoM's flood warning service to Victorian communities (Victorian Floods Review pages 46, 56).

What has been done

The BoM undertakes a continuous rolling review of its radar network in the context of local, state and national service requirements. This rolling review captures changing priorities across the nation, such as gaps in tropical cyclone monitoring, severe weather events and hydrological requirements.

What will be done

The BoM does not plan to update the radar coverage for Victoria in the near future. However, the BoM will consider the Victorian Floods Review recommendation in the context of its continuous rolling review, having regard to current responsibilities, the national context and the Commonwealth's priorities.

Recommendation 13

The Bureau of Meteorology adjust its flood prediction models to incorporate water storage conditions (to enable it to issue more timely and useful flood predictions for communities based downstream of water storages).

Victorian Floods Review findings

The Victorian Floods Review heard that lead times for flood warnings downstream of water storages were inadequate. During the 2010–11 floods, dam storage levels could not be easily incorporated into flood prediction models. Nevertheless, available information was considered by incident controllers before warnings were issued.

The Victorian Floods Review found that technology exists to incorporate such information in flood prediction models, but also observes that the time and cost involved in doing so may outweigh benefits for some water storages; and that the cost-benefit balance would need to be assessed for each river basin where dams are located (Victorian Floods Review page 55–56).

What has been done

The BoM supports this recommendation, and currently includes the effects of dams on its flood prediction models. However, its current ability to do so relies on the cooperation of storage operators.

What will be done

This recommendation relates to larger water corporation storages on major river systems. As part of the process of upgrading flood warning systems outlined in Recommendation 3, DSE will assess the ability and benefits of incorporating gauged data and storage information directly into the BoM's prediction modelling. Where there is a material benefit in enhanced flood warning for downstream communities, DSE will approach the BoM to incorporate the information into their modelling. Incorporation of storage communication protocols will also be reviewed (see Recommendation 26). Any improvements will be formalised through service-level agreements between the state and the Commonwealth.

Related recommendations

Recommendations 3, 26 and 28

Recommendation 14

The state clarify the role of intelligence cell staff (for example, hydrologists and/or Catchment Management Authority) who are utilised in Incident Control Centres during flood events.

Victorian Floods Review findings

Flood intelligence translates rainfall and river height information into more meaningful information (such as predictions of flood behaviour and predictive maps) which are needed by incident controllers to plan and deliver emergency responses, and to provide better warnings to local communities. CMAs, Melbourne Water, DSE and consultant hydrologists provided most of this expertise during the 2010–11 floods. However, there was inconsistency in the requirements of the role and uncertainty about how this function was managed in the incident management system used in incident control centres. A clear statement of the role of the intelligence function would clarify expectations and maximise the value of flood intelligence information for emergency responses and warnings (Victorian Floods Review pages 57–58).

What has been done

Victoria has adopted the Australasian Inter-service Incident Management System that includes dedicated functions for intelligence and public information. These are all-hazards, all-agency arrangements, ensuring that personnel of all emergency services agencies are familiar with these functions as part of their incident management systems.

A state multi-agency working group has been established by the Chief Officers Group to develop a consistent set of principles for the intelligence cells at both the state and incident levels. The Chief Officers Group comprises senior representatives of the various emergency response agencies, and is chaired by the Fire Services Commissioner.

What will be done

VICSES will develop a position description by December 2012 to clarify the intelligence role within the incident control centres.

Related recommendations

Recommendations 15, 16 and 17

Recommendation 15

The state ensure that all personnel who, because of their particular flood expertise, are likely to be potential participants in an Incident Control Centre are familiar with the requirements of the Australasian Inter-service Incident Management System structure.

Victorian Floods Review findings

Many of the CMA personnel and private hydrologists who undertook the flood intelligence function during the 2010–11 floods were unfamiliar with incident management and the way incident control centres operate, and did not understand the Australasian Inter-service Incident Management System. Consequently, at times they were unsure of their roles and information did not flow as effectively as it could have (Victorian Floods Review pages 57–58).

What has been done

VICSES has developed a one-day course to meet the needs of external specialists and to provide a basic understanding of the Australasian Inter-service Incident Management System. Ten private hydrologists have completed the course.

What will be done

VICSES will continue to provide training to private hydrologists and CMAs about the requirements of the Australasian Inter-service Incident Management System.

Related recommendations

Recommendation 14 and 17

Recommendation 16

The state ensure that all personnel who are likely to become involved in incident management teams for floods receive basic flood awareness training prior to such involvement.

Victorian Floods Review findings

During major flood events, some incident management roles may be filled by personnel from support agencies (such as the Country Fire Authority) who are familiar with the Australasian Inter-service Incident Management System but who are not familiar with flood behaviour. It was the view of the Victorian Floods Review that the planning and operational roles in incident management teams would benefit from an improved technical understanding of flood behaviour, which would improve information transfer within incident control centres (Victorian Floods Review page 58).

What has been done

VICSES has developed a draft flood and storm awareness course for incident controllers and personnel likely to be involved on the ground, including sector and divisional commanders.

What will be done

VICSES will pilot the course and explore opportunities, in partnership with other agencies, to deliver flood awareness training to stakeholders likely to be involved in incident management teams (such as the Country Fire Authority). The focus will be on incident control centre and state control centre staff.

Recommendation 17

The state establish appropriate arrangements to ensure the capacity to maintain technical expertise for flood intelligence is initiated, including appropriate agreements with commercial experts.

Victorian Floods Review findings

Assistance during the 2010–11 floods was a significant drain on CMA resources. There was also inconsistency about what services were to be provided, and uncertainty about the level of resourcing that would be necessary over a sustained period. Clarification and formalisation of the currently ad hoc arrangements would assist with managing the availability and capacity of these resources (Victorian Floods Review page 58).

VICSES, as the state's control agency for flood emergencies, relies on non-VICSES personnel to provide expert technical advice on flood behaviour, and to interpret gauge data and other observations. These personnel are mainly from DSE, CMAs, engineering organisations and water corporations.

What has been done

VICSES is developing formal agreements with organisations with flood specialist expertise to utilise their services during events. Ten expert flood engineers have already attended Australasian Inter-service Incident Management System awareness training.

What will be done

VICSES will finalise formal agreements with organisations about the terms and conditions of access to these services. The agreements will ensure there is a common understanding between VICSES and CMAs, DSE and commercial hydrologists about the roles to be filled, the expectations of personnel, and processes for enlisting this assistance.

Technical experts covered by agreements with VICSES will be provided with Australasian Inter-service Incident Management System training so that they understand how to function effectively as part of incident management teams, and to ensure the advice they provide is well-targeted to emergency management needs.

Related recommendations

Recommendations 14, 15 and 16

Recommendation 18

The state ensure that regional and local flood plans incorporate all available flood mapping and intelligence, including assessments of levees and flood consequence information

Victorian Floods Review findings

Under the *Emergency Management Act 1986*, a municipal emergency planning committee must prepare a municipal emergency management plan. The preparation of a local flood plan is not mandatory, even in high-risk areas. Where these plans do exist, there was considerable variation in their standard and considerable time was wasted in seeking information that could have been incorporated into regional and local flood plans.

Flood intelligence was significantly better in areas where extensive flood mapping had been undertaken, and where a wide range of flood information (such as water levels at which community assets and essential infrastructure is threatened) was readily available to incident controllers. However, this was not necessarily incorporated into regional and local emergency plans. The Victorian Floods Review repeatedly heard of the frustrations arising from gaps in knowledge or intelligence, which can be gathered well in advance of an event (Victorian Floods Review page 59).

What has been done

VICSES, through its partnership with Melbourne Water, has started to develop municipal flood emergency plans for high-risk zones in the Melbourne area, and for some regional areas.

VICSES has completed a review of the State Flood Emergency Plan which provides the strategic guidance for effective emergency response to a flood event in Victoria. The Plan was released in February 2012.

Outside Melbourne, the FloodZoom initiative is collecting background information required for updated emergency management planning. DSE has:

- acquired aerial photography and satellite imagery of the 2010–11 floods: this has provided a visual record of the floods and is valuable for emergency response, statutory planning, community education and validating computer modelling
- pegged flood levels and undertaken field surveys of these levels: this information has been coupled with ground surface information and flow information to determine the peak flood extent
- collated and incorporated the information into the Victorian Flood Database.

Improved flood mapping now exists, and will support better real-time monitoring during future floods by identifying potential community and private assets at risk. Such mapping will extend the capacity of emergency services agencies to plan flood response activities before a flood arrives. It will also provide the community with access to information about predicted flood behaviour, so they can act to reduce their risks.

All available information can be used by VICSES and local governments as input to their emergency management planning processes. VICSES has also developed a template to assist in the development of municipal flood emergency plans.

What will be done

VICSES will address the following:

- review its existing regional flood emergency plans and ensure that relevant flood intelligence is included
- continue to develop, through its partnership agreement with Melbourne Water, flood emergency plans in the Melbourne area
- develop, through Natural Disaster Resilience Grant funding work with local governments and CMAs, eight municipal flood emergency plans in high-risk areas by the end of 2013.

VICSES will continue to explore opportunities to enhance its flood planning capabilities.

At the local level, the update and improvement process will be informed by activities funded through FloodZoom. As indicated previously, the Victorian Government has funded or is funding sixteen flood studies, and has committed funding for an additional nine flood studies. They involve:

> collecting and processing high-resolution digital terrain data

> collecting information on the location, elevation, value and vulnerability of assets (for example, the floor levels of houses and key water, power and telecommunication assets)

> assessing and mapping flood behaviour (such as depth, extent and speed) for a range of flood magnitudes

> assessing the consequences of flooding for the community.

Melbourne Water will continue to facilitate flood management plans for high-risk zones in its area of responsibility.

This work is regarded as an ongoing area of activity, with the intent to progressively improve flood emergency planning and local knowledge, and to improve information available to planners and emergency services agencies.

Related recommendations

Recommendation 21 and 29

Recommendation 19

The state develop an efficient process to ensure that, during flood events, temporary construction of flood mitigation works, such as levees, is controlled so as not to unacceptably impact on flood intelligence.

Victorian Floods Review findings

There were numerous instances where temporary levees were constructed during the floods. These actions were undertaken with a poor understanding of broader consequences, such as unforeseen impacts on flood levels elsewhere. While temporary levees are likely to be necessary during major flood events, it is paramount that such high-risk activities be approved through appropriate processes to ensure due consideration is given to the potential effects of redirecting flood water (Victorian Floods Review page 59).

What has been done

To avoid undesirable consequences of temporary levees diverting floodwater into other areas and therefore harming others, three things are necessary:

> flow behaviour needs to be understood, so that the consequences of blocking off a flowpath can be evaluated

> local emergency management arrangements must be put into place to ensure that the construction of temporary levees is consistent with a recognised plan, or is authorised by a central authority

> the community needs to be educated about the process and the need to seek permission for levee construction.

As indicated in the response to Recommendation 18, through the FloodZoom initiative, flood studies (which enable flood behaviour to be understood) have commenced for towns impacted by flooding, and valuable flood data has been collated. Mapping improvements have also been undertaken, extending the capacity of emergency services agencies to plan flood response activities before a flood arrives.

Pre-planning was shown to be invaluable to Nathalia during the March 2012 floods, where demountable levees were used in conjunction with conventional levees, as part of formal flood defences. The demountable levees at Nathalia were not required for the 2010-11 floods, but successfully protected Nathalia from severe flooding in March 2012. The Nathalia demountable levees were specifically designed as part of the flood defences and cannot be transferred to other sites.

What will be done

Due to the potential negative consequences of constructing levees, it is appropriate that, wherever possible, decisions on where to construct levees are made prior to flooding as part of the flood planning processes. This includes working with Aboriginal Affairs Victoria and Heritage Victoria to refine mechanisms to identify and address risks to Aboriginal cultural heritage and non-Indigenous heritage assets.

The review of the Victoria Flood Management Strategy and the regional floodplain management strategies will provide an opportunity to reduce the potential for avoidable harm through inappropriate planning measures and works procedures associated with flood mitigation, incident response and recovery strategies.

The FloodZoom initiative will address flood behaviour for 25 communities and investigate levees as part of flood risk assessment and planning. This work is regarded as an ongoing activity and is recognised as one of the ways that ad hoc levee building and breaching can be avoided during major flood events. Incorporation of local knowledge and experience and community consultation during these processes will assist local people to understand why levees are located, where they should be located, and the implications of ad hoc building or breaching of levees.

In order to address the issue of the management of informal temporary levees during or immediately before a flood event, a process to enable the evaluation and authorisation of emergency works for flood mitigation will be developed by DSE in consultation with VICSES, Municipal Association of Victoria and CMAs. This will be informed by the Victorian Government's response to the parliamentary Inquiry into Flood Mitigation Infrastructure in Victoria and will need to take into account the fact that, at present, authorities are usually not indemnified against the unforeseen consequences of emergency actions.

Related recommendations

Recommendation 18

Recommendation 20

The Bureau of Meteorology provide Incident Control Centres with real-time access to flood data held by the Bureau of Meteorology. This will require Bureau of Meteorology staff making themselves available to respond to enquiries from Incident Control Centres during a flood event.

Victorian Floods Review findings

Incident controllers relied on the BoM's website for rain and stream gauge information. This information is usually updated at regular intervals (up to three hours), and after quality assurance processes have been implemented. Currently, incident controllers access the same website as the public, which means they do not have access to the data in real time.

The Victorian Floods Review also noted that one gauge, after sustaining damage, continued to transmit incorrect information. The fault was not discovered for about 12 hours. This finding needs to be understood in the context that a large number of gauges failed and communications between incident control centres, the State Control Centre and the BoM usually identified faulty gauges and initiated actions to overcome the problem.

Real-time access to the BoM's data feed from the gauge network would allow incident control centres to make operational decisions more confidently, and could potentially lead to earlier identification of faulty readings.

At one stage, access to the BoM was not available during the 2010–11 floods. During major flood events, it is also vital that incident controllers (and particularly the State Controller) have 24/7 access to the BoM's expertise, to ensure a shared understanding of real-time flood behaviour and so that ambiguous flood data can be reviewed (Victorian Floods Review page 61).

What has been done

The Commonwealth supports the recommendation, but notes that care has to be taken when using raw data that has not been subject to quality control processes. Its support is contingent upon technical arrangements

being implemented to provide incident control centres with real-time access to flood data held by the BoM.

What will be done

The issue of providing 24/7 access to BoM's expertise during flood events will be addressed by the BoM as part of its service-level agreement between the state and Commonwealth. The Victorian Government acknowledges that the BoM has a high commitment to maintaining a 24/7 presence to support emergency services.

Real-time access to BoM flood data by flood specialists in incident control centres will be provided as part of the development of the FloodZoom IT platform, by June 2013.

Related recommendations

Recommendations 4 and 6

Recommendation 21

The state establish standards for flood mapping to ensure they are kept contemporary and meet the purposes of land use risk planning and emergency response. In doing so, maps should extend where appropriate to include Probable Maximum Flood, over a range of Annual Exceedence Probability levels and be explicitly linked to a stream gauge.

Victorian Floods Review findings

Flood maps available to incident controllers were of variable quality because of the level of detail incorporated into the maps, and variations in the quality and quantity of data available. For example, not all maps enabled prediction of where roads would be cut, and some maps in one area were derived from aerial photography that was not flood-related.

The quality and availability of flood maps has also been sporadic. This is because current funding arrangements allow local governments to undertake flood mapping without conforming to standards about the range of events being mapped, consultation requirements, calibration, validation of models and peer review.

The Victorian Floods Review noted that DSE is applying better standards that will address these gaps through the FloodZoom initiative. It also acknowledged that, as flood maps are required for a range of purposes including flood response and land use planning, they should occur for a range of flood events.

The Victorian Floods Review also noted that there are no ongoing processes to update existing maps. Over time, landscapes change with significant alterations to farming practices, construction of roads and highways, development of floodplains, and levees no longer functioning as intended (Victorian Floods Review pages 62 – 63).

What has been done

Victoria is participating in the National Flood Mapping and Modelling Work Program aimed at developing principles to guide flood mapping.

As indicated earlier, the mapping work commenced as part of FloodZoom is being done to a high standard, to meet the purposes of both land use planning and emergency response.

Consistency in mapping standards across the state has been achieved in the following areas:

- consultation requirements to capture local knowledge and verify flood maps
- multiple annual exceedence probability (AEP)[1] events to be incorporated as appropriate (for example, 10%, 5%, 2%, 1%, 0.5% and rarer events[2] that identify where flooding could still affect critical infrastructure)

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1 This is the likelihood of a flood of a given size or larger occurring in any one year. For example, if a flood has an AEP of 1%, there is a 1% probability of it being equalled or exceeded in any one year. A 1% AEP flood is equivalent to the 'one-in-100-year' standard used in planning schemes.

2 While the Victorian Floods Review recommended that flood maps extend to the probable maximum flood (which is the largest flood that could conceivably occur), there are practical difficulties with delineating such a large event. There are many areas of the state where the probable maximum flood extent would cover the entire study area. Mapping of a lesser-magnitude extreme flood is considered more appropriate for emergency response planning.

- linking maps to flood warning gauges, where available
- identifying impacts of flooding on key assets (such as roads, levees and railway lines).

These requirements will ensure consistency in flood mapping in Victoria, pending the development of a mapping protocol after the completion of the national guidelines.

What will be done

The Australian Government Attorney-General's Department is developing guidelines to inform a national approach to improving the communication of risk information, and to facilitate better decision making in a range of areas including emergency management, land use planning and insurance (see Recommendation 30). DSE will ensure that implementation of Recommendation 21 will be consistent with the national approach, noting that the national guidelines will not be prescriptive because different states and territories have different needs and issues.

In the short-to-medium term, continuation of FloodZoom will allow flood mapping to be updated for up to 25 urban and rural communities. In the longer term, an update of the Victorian Flood Management Strategy and the new regional floodplain management strategies will provide a framework for updating flood mapping, incorporate new agreed standards and recommend a regular review cycle for updating flood mapping.

Related recommendations

Recommendation 22, 30 and 86

Recommendation 22

The state take the necessary measures to require that local knowledge is considered in flood risk planning, including verification of flood maps and flood response plans.

Victorian Floods Review findings

It was widely agreed by agencies involved in the flood response, and by local communities, that local knowledge should be utilised to add value to other information used to predict flood behaviour. In areas where formal flood intelligence did not exist, there was heavy reliance on local knowledge. As part of future arrangements, locals should be involved in flood planning and management. Such involvement improves the likelihood that people will understand flood behaviour and respond effectively to warnings (Victorian Floods Review pages 64–65).

What has been done

When undertaking flood studies through FloodZoom, CMAs and local governments are holding public information meetings and requesting local flood data. They have also been seeking community input to verify the maps produced through computer modelling.

The development of FloodSafe programs for at-risk communities ensures community involvement in planning and response. VICSES has already delivered FloodSafe programs to some communities in Melbourne, Gippsland, north-east Victoria and south-west Victoria.

What will be done

The processes used by CMAs to update regional floodplain management strategies will include mandatory consultation with, and provision of information to, local communities. VICSES, in developing flood emergency plans in some high-risk areas, will seek community input through the FloodSafe programs.

Related recommendations

Recommendations 8, 21 and 23

Recommendation 23

The state establish a process for volunteer community member accreditation to allow volunteers to provide flood information to the control agency during a flood event. This process should establish a base competency standard and provide appropriate emergency management and Australasian Inter-service Incident Management System training to accredited community volunteers.

Victorian Floods Review findings

During the 2010–11 floods, community members contributed important information about the current flood behaviour, and about historical flood behaviour. The Victorian Floods Review considered that local knowledge should inform the decisions of those responsible for response activities within the emergency management framework, but that this information should not be utilised inappropriately.

For example, several community members at Kerang noted that information they could provide about flooding would be best captured after a flood event and incorporated into flood emergency plans, in preparation for future flooding. The Victorian Floods Review heard that community members had very valuable information about flood behaviour that did not directly affect flood response operations, and recognised that it is highly valued information. The Review also found that some people in flood-prone communities had a great influence on local community decision making during the floods, but their knowledge of the consequences of actions taken to alleviate local flooding did not match the influence they had. Some decisions were made without authority and often without the knowledge of emergency management agencies.

The Victorian Floods Review also considered that accreditation of community members would strengthen the communication and information sharing processes. This should include an understanding of the Australasian Inter-service Incident Management System framework and training in data collection.

In conclusion, processes for community members to inform either flood planning or flood management responses need to be improved, and processes for training or recognising the competency of these volunteers developed (Victorian Floods Review pages 64–65).

What has been done

As indicated in the response to Recommendation 22, CMAs are holding public information meetings and requesting local data to inform the 25 flood studies undertaken through FloodZoom. This will help ensure that critical information on flood behaviour is not lost.

VICSES has started to scope the potential role of accredited flood observers to provide information to emergency management agencies during flood events. VICSES has also been promoting the use of local knowledge in strategic decision-making processes related to emergency management planning.

What will be done

The Victorian Government supports the utilisation of appropriately accredited and trained volunteer flood monitors in the provision of flood information prior to flooding and during a flood event. Local knowledge will be captured through flood studies and mapping being undertaken through FloodZoom which is then incorporated into VICSES flood emergency plans.

VICSES will develop a strategy to incorporate local knowledge in its flood response operations and investigate options for its implementation.

Related recommendations

Recommendation 22

Recommendation 24

The Bureau of Meteorology expand its volunteer amateur weather watch groups to enhance its weather and flood information gathering procedures.

Victorian Floods Review findings

The Victorian Floods Review endorsed the involvement of local people in flood planning and management because they can provide important information and improve the likelihood that communities will understand flood behaviour and respond to warnings. The BoM utilises volunteer amateur weather observers (for example, storm spotter, rainfall and river height networks) and intends, in response to the Queensland Floods Commission, to expand and support the volunteer network in Queensland. The Victorian Floods Review recommended that this expansion extend to Victoria as well (Victorian Floods Review pages 64–65).

What has been done

The BoM has acknowledged the important role of volunteer amateur weather watch groups supporting its collection of weather data, but has not committed to expand the groups. In reference to flood monitoring roles (such as river height observers), the BoM relies on the services of staff from emergency services and local governments during an emergency event. The BoM has advised that all volunteers reporting to it (as distinct from reporting to other organisations) would require training from the BoM.

What will be done

This recommendation applies to the BoM. DSE will continue discussions with the BoM about expanding the volunteer amateur weather watch groups in Victoria.

Recommendation 25

The state require dam owners and operators to review storage operating manuals to incorporate lessons from the 2010–11 floods and make this information publicly available. The manuals should include a clear policy on dam surcharging and pre-release.

Victorian Floods Review findings

The Victorian Floods Review was aware that storage operators may have limited ability to provide significant airspace for flood mitigation, and lead times may be short for releases of water from storages during flood events. In addition, communities were confused about the management and role of storages, with concern principally about larger irrigation or power supply storages. Consequently, the Review considered that communities should have access to as much information as possible prior to flooding and during flood events to make informed decisions about their risks. Better availability of information prior to a flood event will inform community action during the event. Part of the information that should be made available to the public includes policies on dam surcharging and pre-release (Victorian Floods Review page 66).

What has been done

The owners and operators of large irrigation dams with gated spillways have revised their storage operations and operating manuals to reflect the learnings of the 2010–11 floods and explicitly state their policies on dam surcharging and pre-release.

Large storages with gates have been specifically targeted as they have the capacity to significantly influence flooding. These storages permit large outflows in a controlled fashion. Most Victorian storages have fixed crest spillways (that is, no gates) and, depending on their outlet pipe capacity and water resource requirements, require pre-release strategies to create enough air space in the dam to reduce downstream flooding.

A statement of obligation is a regulatory instrument between the Minister for Water and each water corporation that specifies obligations (such as risk management and emergency responses). DSE is currently revising the statement of obligations to include, among other things, a requirement for dam owners and operators to develop, implement and make available to the public a policy on pre-releasing water from a dam, and on surcharging the water level in response to flood events.

Revised summary operating manuals are now available for public perusal on the relevant water corporation website.

What will be done

Any future change to storage operating manuals will be made publicly available by water corporations.

Related recommendations

Recommendation 2

Recommendation 26

The state require that dam owners and operators inform the control agency and the Bureau of Meteorology about the management and operation of dams and weirs consistent with the flood warning requirements of the relevant river systems, including providing telemetry at sites as necessary. This may require the state proactively liaising with other states to ensure equivalent obligations are placed on interstate dam operators where the dam may impact Victorian communities.

Victorian Floods Review findings

The Victorian Floods Review considered information about water storages to be an important element of the critical information needed by the BoM and incident controllers during major flood events. At the time of the 2010–11 floods, different water corporations had different practices for collecting information and making it available to the BoM and incident controllers. Consistent practices, including the requirement for universal use of telemetry on water level gauges, are needed and should be developed as part of the review of basin-wide flood warning systems (Victorian Floods Review page 66).

What has been done

This recommendation relates principally to the owners and operators of large dams that have the capacity to influence flood behaviour.

The larger water corporation dam operators have existing telemetry sites that are used to inform dam and weir operations. Information from the hydrological data collection is being shared with the BoM as a matter of course and formalised in agreements, memorandums of understanding and in the Regional Water Monitoring Partnerships.

The BoM currently includes the effects of dams in its forecasting models, where there are forecast locations affected by operational releases from upstream dams. Any installation of telemetry needs to be compatible with the BoM's data communication systems for the information to be of use in forecasting floods.

The Murray–Darling Basin Authority advise that they, together with the NSW State Emergency Service and the BoM, have conducted a review of the warning arrangements for the River Murray.

What will be done

In relation to other states, DSE will liaise with stakeholders to agree on arrangements for information sharing and the coordination of information about dam operations relevant to flood prediction and flood warning messages. Stakeholders include relevant interstate dam owners (for example, the Murray–Darling Basin Authority, NSW State Water and Snowy Hydro), VICSES (the control agency), local governments (because of the impact on local communities) and the BoM. Arrangements will be regularly tested during joint emergency training exercises conducted by Victorian and relevant interstate dam owners and operators.

DSE will write to the Murray–Darling Basin Authority asking that state agencies, including VICSES, be included in any future reviews of warning systems for the River Murray as well as exercises of emergency dam operation plans, including flood warnings. This will ensure that the warning requirements of Victorian communities along the River Murray are appropriately considered.

DSE and VICSES have commenced working with relevant dam operators to develop a protocol for the provision of information to the BoM and incident controllers. Once developed, this protocol will be appended to the State Flood Emergency Plan. This will provide clarity about who has responsibility for managing the structure, who has the technical expertise to advise on appropriate emergency actions (for example, releasing water), and any legal implications.

Related recommendations

Recommendation 13 and 28

Recommendation 27

The state require that dam owners and operators inform people situated downstream of water storages if the owners/operators become aware of an immediate threat arising from the dam to the safety of those people. The owner/operators should provide this information as soon as the owner/operators become aware of the threat.

Victorian Floods Review findings

The Victorian Floods Review found that the importance of providing time-critical information about impending floods to communities immediately downstream of storages cannot be overstated. During the 2010–11 floods, inconsistent policies and practice resulted in some communities downstream of a water storage receiving advice while other communities did not. The Victorian Floods Review considered information provision obligations should be formalised (Victorian Floods Review page 66).

What has been done

This recommendation affects the owners and operators of large dams, or dams that could impact on communities immediately downstream with little warning time of an impending flood.

Where a water corporation manages a dam, the statement of obligation between the corporation and the Minister for Water requires it to have an emergency management plan which it exercises periodically. The plan must include arrangements to advise people downstream of the dam. Water corporations have dam safety emergency management plans that comply with industry guidelines and that identify emergency services organisations and the information to be provided. These plans will be reviewed once local advisory arrangements are agreed between relevant agencies (as discussed below).

Where there are working arrangements in place, the dam owners and operators currently operate advisory systems. These address local impacts and concerns.

What will be done

DSE and VICSES are working with water corporations and other relevant dam owners and operators to review existing local advisory arrangements to address the concerns raised by the Victorian Floods Review. The outcomes will be incorporated into dam operator manuals and in protocols with stakeholders. It is important not to confuse the role of VICSES as the Control Agency who is responsible for issuing warnings with the support role of dam owners in the provision of information. The need, practicality and process of water corporations informing communities immediately below storages in a time critical environment will be assessed during catchment specific review and documentation of flood warning arrangements for that system.

The validity and timeliness of the information to be provided to the people situated downstream of a water body will be tested during regular exercises conducted by dam owners and operators, in conjunction with stakeholders.

Related recommendations

Recommendation 25

Recommendation 28

The state require dam owners and operators to provide regular situational reports to the relevant control agency where dam issues may impact incident management.

Victorian Floods Review findings

The Victorian Floods Review noted that water corporations actively participated in providing information to the BoM and incident controllers during the floods. This information was essential for effective emergency response. It considered that the obligation to provide such information should be formalised (Victorian Floods Review page 66).

What has been done

This recommendation affects the owners and operators of large dams and weirs that have the capacity to influence flood behaviour and/or threaten communities downstream if they spill.

To formalise the information flow between dam owners and operators and emergency services agencies, standard templates have been prepared by DSE. These were provided to relevant dam operators in December 2011 to notify an event and to provide regular updates through situation reports.

What will be done

The revised model templates will be tested during emergency exercises conducted by dam operators, in conjunction with the control agency and other stakeholders.

Related recommendations

Recommendation 13 and 26

Recommendation 29

The state clarify which agency is responsible for collecting post-flood extent and related data. This should include:

> the development of guidelines to ensure consistent standards are applied to post-flood data collection; and

> an appropriate process to ensure funding availability for such activities.

Victorian Floods Review findings

The collection of data about flood extents and depths commences immediately after the onset of a flood. For the 2010–11 floods, information was collected primarily by CMAs, with DSE and some local governments collecting information as well. Clarity is needed about which agency is responsible for collecting information, and the type of information collected. The extent of the information collection should also be revised to ensure, for example, that properties and infrastructure that were inundated are identified and relevant depth levels recorded. Consistency in the collection of this information requires standards to be established.

The Victorian Floods Review was also of the opinion that the uncertainty and ad hoc arrangements for funding the collection of flood data are undesirable, and surety of funding needs to be prioritised (Victorian Floods Review pages 69–70).

What has been done

DSE has generic processes for the collection of flood data by CMAs and has developed processes for coordinating some activities that can be better managed statewide (for example, aerial flood photography).

As was noted by the Victoria Floods Review, DSE underwrote the collection of flood data undertaken by CMAs. This was achieved through FloodZoom, which has systematically collected data from the 2010–11 floods and incorporated them into the Victorian floods database and flood maps.

In the March 2012 flood event in the Broken River system, the CMA collected data on the riverine flood extent. This data was complemented by information collected by the local government on the impact of the flood event on the township.

What will be done

DSE will continue to support flood data collection during major flood events by CMAs, where the information will materially enhance the flood knowledge base underpinning future land use and flood response planning.

DSE, in conjunction with Municipal Association of Victoria and CMAs, will review the procedures for the collection of flood data, and ensure that they include clearer protocols and standards. This will be completed by June 2013. The statement of obligations for CMAs will also be reviewed to recognise the importance of collecting flood data.

Related recommendations

Recommendations 1 and 18

Recommendation 30

The state take into account any outcomes from the Commonwealth Government's flood mapping reviews in the continual development of the Victorian flood database and to incorporate into the database flood data currently held by Melbourne Water.

Victorian Floods Review findings

The Victorian floods database is owned and managed by DSE and is a consolidation of data, spatial flood mapping and modelling collected and used by agencies in Victoria involved in flood management and response. Melbourne Water has a similar database for its jurisdiction.

The Victorian Floods Review noted that there are two Commonwealth reviews that involve flood mapping and modelling, and that the potential outcomes of the two reviews, in which Victoria is a participant, may require the Victoria flood database to be modified (Victorian Floods Review pages 70–71).

What has been done

The Commonwealth reviews have progressed since the findings of the Victorian Floods Review were released in December 2011.

A national work program for flood mapping has been developed by the Australia-New Zealand Emergency Management Committee and will be considered by the Standing Council for Police and Emergency Management. The work program will assess the current scope and granularity of flood risk mapping in Australia, and will provide national guidance about how flood risk mapping should be undertaken.

The National Disaster Insurance Review was released in November 2011. As part of its response to the review, the Commonwealth is developing a flood risk information portal, hosted by Geoscience Australia, to provide a single access point to existing flood mapping. The portal will be complemented by the development of national guidelines covering the collection, comparability and reporting of flood risk information. Once endorsed, these guidelines will contribute to improved data quality and consistency. The Commonwealth will drive this process in close consultation with state and territory governments.

The National Flood Risk Advisory Group is a reference group of the Australia-New Zealand Emergency Management Committee and is responsible for promoting national best practice in flood risk management. It is currently leading the development of a new floodplain management manual that will supersede two dated but related publications about floodplain management. This new publication on managing the floodplain is scheduled for completion in November 2012. A number of supporting guidelines are scheduled for later completion.

In November 2011, DSE participated in a national workshop to identify high-level principles for flood mapping. DSE and other agencies have provided input into the development of draft national guidelines for the national flood risk information portal that is being developed as part of the National Flood Risk Information Project. Geoscience Australia and the Australian Government Attorney-General's Department held a workshop with local government representatives about the proposed National Flood Risk Information Project in early 2012.

What will be done

DSE will continue to provide input into the development of national mapping standards, in consultation with VICSES and other agencies as required. It is expected that the national guidelines will be flexible enough to allow for fit-for-purpose mapping standards without being overly prescriptive about how each state and territory accomplishes the task.

DSE will establish processes for incorporating Melbourne Water's riverine flood mapping into the Victoria Flood Database, which is the repository of flood data for the rest of the state.

DSE will regularly review the protocols and standards developed for the Victoria Flood Database, in response to learnings from the implementation of FloodZoom and the revised national guidelines. Beneficiaries of the data include:

- local governments, which need to identify the impacts on infrastructure they manage (such as roads, drains, buildings and parks), as well as the communities with which they interact
- owners of critical infrastructure (such as power, water supply, sewage and telecommunications facilities) so they can appraise and manage their risk
- insurance agencies, which require a robust flood risk profile to set premiums for flood insurance
- CMAs, which provide flood advice to others and have waterway management functions
- Melbourne Water, which provides flood advice and needs to manage the flood risk to their assets (such as waterways, drains, parks, water and sewage infrastructure)
- emergency response agencies, which require information when planning for emergencies.

The database will be made available to these parties on request.

Recommendation 86

The state:

- adopt a strategy to expedite incorporation of updated flood mapping or modelling into planning schemes
- reconsider in what circumstances the '1 in 100 year event' is the appropriate design event
- actively support the Australian Building Code Board in its development of a new national standard for residential buildings in flood prone areas. Until such time as any new standard is incorporated into Victorian law, provide advice to householders about appropriate building materials for flood prone areas and ways that houses can be designed or adapted to mitigate flood risk; and
- retain the ability of a Catchment Management Authority to require a council to refuse a planning permit or impose particular conditions when the Catchment Management Authority considers the flooding risk to be unacceptable.

Victorian Floods Review findings

The Victorian Floods Review noted that reducing flood risk in established areas is costly, and that it is much easier to impose proactive mitigation measures (such as land use planning and building standards to prevent or control development before it occurs) than to apply more expensive structural measures (such as building levees). The Victorian Floods Review considered that activities to modify people's behaviour (such as developing flood warning systems, delivering public education programs and providing emergency responses) were also less cost-effective than land use planning and building controls.

Decisions about specific proposals for the use and development of land are made by responsible authorities (usually local governments), with advice from referral agencies (which for flood controls are CMAs and Melbourne Water). Two things need to occur:

- areas known to be subject to flooding need to be incorporated as a flood zone or as overlays into planning schemes (which requires suitable flood mapping from flood studies and provides the trigger for referral): this can be regarded as a strategic planning function

> local governments need to decide on specific proposals through the referrals process, having regard to advice from referral authorities and the decision guidelines embedded in the relevant zone and overlay.

The Review found that local governments often had poor access to flood information; and even where information existed, it was not always incorporated in planning schemes in a timely manner. More effective measures were needed to ensure that local governments make planning decisions based on the best available information.

The Victorian Floods Review also questioned the use of the one-in-100-year benchmark for planning purposes, arguing that in some circumstances tougher measures are justified.

The Australian Building Codes Board is developing a national standard for housing and other low-rise residential buildings in flood-prone areas. This provides an opportunity to address the ability of buildings to resist flooding. The current building controls only apply to the setting of floor levels (Victorian Floods Review pages 191–197).

What has been done

Flood maps are being updated as part of a continuous process of gathering flood information and ensuring that new information is available to the community as well as for planning and emergency response purposes (see the response to Recommendation 21). DSE is also implementing a program to undertake targeted flood studies for 25 communities.

Most of the floodplains across Victoria have been mapped. However, some flood mapping is now over ten years old and should be updated using the most current information, to improve the accuracy and utility of the maps.

What will be done

Flood mapping

As part of an ongoing strategy, the Department of Planning and Community Development (DPCD) will work with DSE, CMAs, Melbourne Water, the Municipal Association of Victoria and local governments to ensure that all relevant planning schemes include up-to-date flood information and mapping. Flood mapping will be fit-for-purpose, and areas where the risk to life, property and community infrastructure is greatest will be prioritised.

The Victorian Government's mapping strategy has three components.

Although flood mapping covers most of the State, there are still some gaps in the extent to which this information is incorporated into local planning schemes. DSE will work with local government to ensure the currently available flooding information is available to support the update of planning schemes. DPCD will provide support where it is demonstrated that resources limit the ability for Councils to update flood mapping into local planning schemes in a timely manner.

A further component is detailed flood studies of targeted areas based on new flood modelling. For the 25 targeted flood studies, DSE will support local governments to include up-to-date flood maps in revised planning schemes as soon as possible after the completion of each flood risk assessment. Once again DPCD will provide support where it is demonstrated that resources limit the ability of local governments to update flood provisions into local planning schemes in a timely manner.

To date, one flood risk assessment has been completed and a further 15 are underway. The remaining risk assessments will be completed over the next four years.

The third component is ongoing improvement of flood mapping. In the medium term, regional priorities for improved flood mapping (including flash flooding) will be identified through regional flood management strategies. In addition, CMAs and local governments will continue to collect flood data to enhance flood mapping during and after future flood events. Expert advice and assistance from CMAs and Melbourne Water will continue to support local government processes for inclusion of relevant information into planning schemes.

DSE will review the quality of flood information against the current one-in-100-year event standard by August 2013. As part of this process, DSE will consult with DPCD, CMAs, Melbourne Water, VICSES and the Municipal Association of Victoria. Consideration will be given by these agencies to the work being undertaken at a national level on flood mapping.

Building controls

Key Victorian agencies will provide advice to the Australian Building Code Board, which is developing a handbook and an Australian standard for the construction of certain classes of buildings, including dwellings in flood hazard areas. As noted by the Victorian Floods Review, changes to the National Construction Code are currently being developed for residential buildings in flood- prone areas. The changes reflect the primary focus of the standard on structural safety and life safety from flood hazards. If the new Australian Standard is adopted in the National Construction Code, it will be applied in Victoria through the Victorian building regulations.

Flood provisions in the Victorian building regulations will complement flood-related planning controls in municipal planning schemes. Planning controls are more related to land use and other related off-site aspects (such as site access and emergency management requirements) than to the structural integrity of buildings. It should be noted that local governments also have emergency management responsibilities under the *Local Government Act 1989* and the *Emergency Management Act 1986* during times of declared disasters, however it is acknowledged that a disaster has never been declared in Victoria.

Providing flood advice

The Victorian Government does not support the last part of this recommendation. The Victorian Government has committed to altering the CMAs power as referral authorities under the planning scheme to enable local governments to make decisions about planning permits or conditions, and that CMAs will provide non-binding advice to local governments.

It is important that municipal councils receive comprehensive data and information from CMAs and Melbourne Water regarding flood risks to the relevant area, to ensure good planning and decision making occurs in relation to development.

Related recommendations

Recommendation 21

Accessibility

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