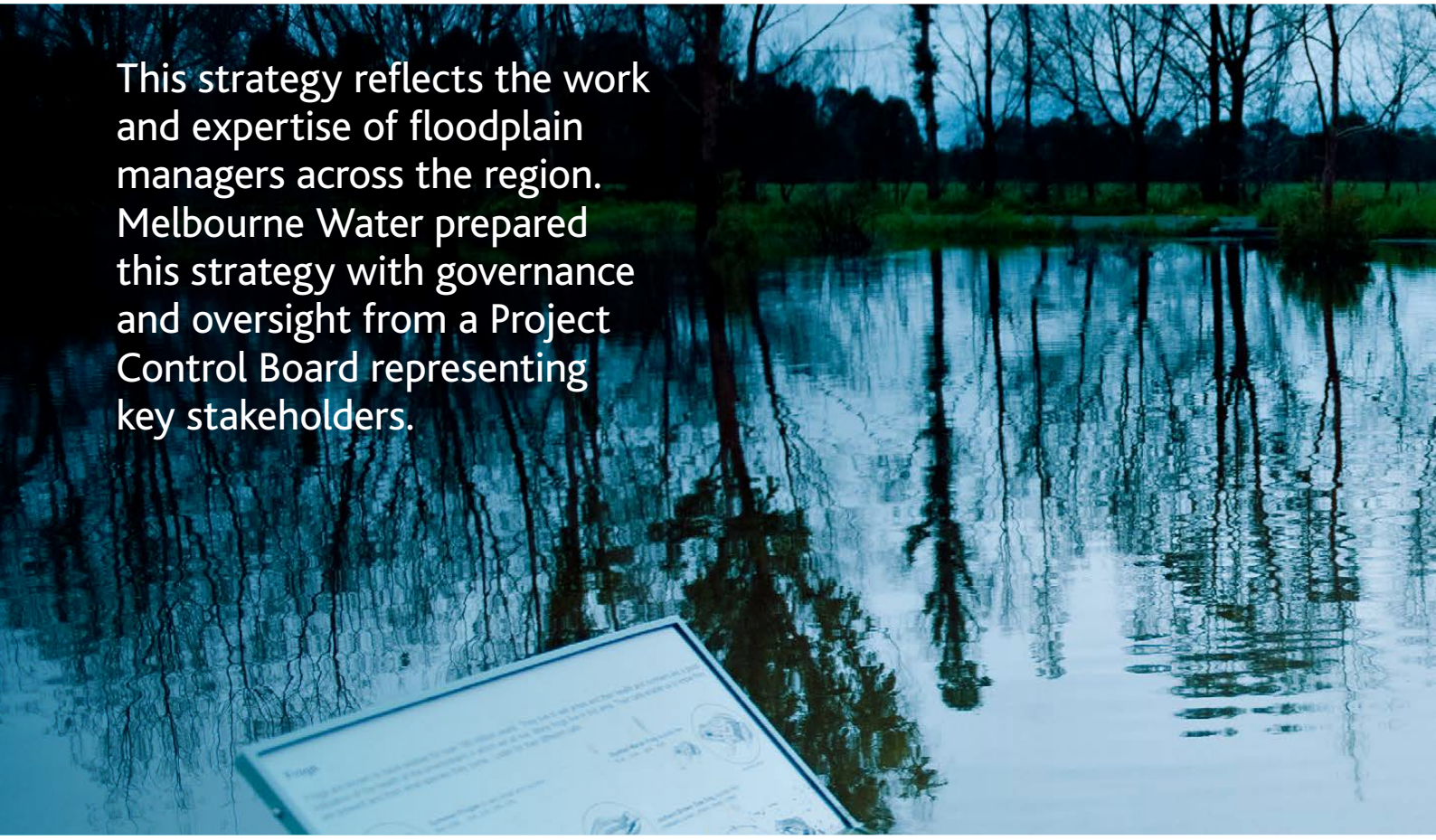
Flood Management Strategy

Port Phillip and Westernport

VICTORIA State Government

Melbourne Water



This strategy reflects the work and expertise of floodplain managers across the region. Melbourne Water prepared this strategy with governance and oversight from a Project Control Board representing key stakeholders.

ACKNOWLEDGEMENTS

Our Flood Strategy Project Control Board included representatives from:

- Bureau of Meteorology
- City of Kingston
- City of Melbourne
- City West Water
- Department of Environment, Land, Water and Planning
- Department of Health and Human Services
- Emergency Management Victoria
- Insurance Council of Australia
- Melbourne Water
- Metropolitan Planning Authority
- Municipal Association of Victoria
- South East Water
- Victoria State Emergency Service
- Wyndham City Council

Melbourne Water thanks these organisations for their involvement; it means we now share a vision and an understanding of the challenges facing our region and the best ways to address them.

Cover: Wayne Hawkins/Fairfax Syndication

Contents

Preface

Melbourne Water prepared this strategy by consulting widely with those involved in delivering flood management, and people affected by floods. Consultation included discussions and workshops with many stakeholders including state government departments, councils, emergency services, and communities.

This strategy reflects the effort and activities of all organisations contributing to floodplain management across the region. Throughout this strategy, 'we' refers to all relevant flood management agencies, including those who help to manage floods through policy, urban planning and development, emergency response, and water management activities.

Most government organisations with a role in flood management for the Port Phillip and Westernport region have contributed their expertise through research and consultation, and development of the draft and final strategy. They will be invited to contribute to implementing this strategy, and monitoring its progress.

Urban growth and climate change will increase flood risks facing the region.

Flooded road, Narre Warren
Image by David Dashwood

Executive summary

A new strategy

This strategy builds on many years of flood management experience, to improve how we manage and reduce flood risks across Port Phillip and Westernport. It is aligned with the Victorian Floodplain Management Strategy, emergency management arrangements and planning policy.

Through this strategy we will continue building our collective knowledge and capability, drawing on a wide range of flood management approaches to better address community concerns, minimise the effects of floods, and manage the challenges of urban growth and climate change. Through this work we can make an important contribution to the liveability of our region.

Flooding in our region

The Port Phillip and Westernport region houses approximately 4 million people, and the population is expected to almost double in size by 2050.

The region is unique in Victoria for the large number of organisations that have flood and drainage responsibilities.

Approximately 232,000 properties are estimated to be at risk of flooding (with at least a 1% chance per year). The annual average damage caused by flooding is estimated to be $399 million.

As well as being our most expensive natural disaster, flooding creates serious hazards for some communities.

Climate scientists project that the intensity of heavy rainfall events will increase and that the sea level will continue to rise, increasing the severity and regularity of flood events[1]. Climate change increases the challenges we face in managing flood risk in the region.

1. CSIRO and Bureau of Meteorology *Climate Change in Australia Projections Cluster Report – Southern Slopes*, 2015.

New directions

Through delivering flood management services, and through consultation to develop this strategy, we have identified key challenges and opportunities for our region. This strategy outlines improvements we will make to meet them:

- A better understanding of the impact of climate change is essential to planning ahead. We must use this information to inform the decisions we make and support our adaptation planning. We will work together to produce the right information for all decision makers and consider it in our flood risk management activities.
- We recognise that flooding cannot be physically 'fixed' or removed entirely; in many locations the cost of works would be far greater than the value of the properties they would protect. Therefore we will continue working to manage the risk, and to reduce the consequences of floods when they do happen.
- There are many different ways to reduce and manage flood risks, from education to urban planning, insurance, flood warning systems and sometimes structural measures. Finding the right mix of flood management solutions for each location is essential. Increasing opportunities for community and stakeholder input will help us to identify the issues of most concern, and develop appropriate solutions for each area.
- Managing urban growth and development well is critical to avoid creating new risks. By improving how we manage extra stormwater from new developments and urban consolidation, we will help avoid new risks while also achieving other benefits for the region.
- Many organisations contribute to flood risk management through their work in urban planning, managing drainage and civil infrastructure, planning for coasts and open space, and responding to emergencies. By ensuring the right information is available to everyone and improving coordination, we can improve the effectiveness of all these activities.

How we will deliver flood management services

This strategy sets out a shared vision for flood management in the region:

"Together we are aware, responsive and resilient. Communities, business and government understand flooding, plan for challenges, and take action to manage risks."

Three key objectives and a program of actions are set out to deliver the vision and address the challenges and opportunities for our region:

OBJECTIVE 1 ***The right information is available at the right time to people who need it.***

Activities to deliver objective 1 include:

- Developing a better understanding of flood risks by updating our flood mapping and risk assessment approaches, and improving opportunities for the community to help set flood management priorities
- Sharing information and skills to better enable all flood managers to be as effective as possible
- Engaging communities and building their awareness to support resilience and preparedness, and reduce the consequences of floods.

OBJECTIVE 2 ***Flood risks are addressed to reduce impact and get the best social, economic and environmental outcomes.***

Activities to deliver objective 2 include:

- Managing existing flood risks using a wide range of management approaches to address the issues of most concern to communities, and to reduce the consequences when a flood does occur
- Managing urban development and growth to avoid new risks in known floodplains, and manage new urban stormwater runoff
- Building our understanding of how climate change will affect flooding, and ensuring the best-available information is used to support good decisions and adaptation planning.

OBJECTIVE 3 ***Land, water and emergency agencies work together to manage flooding effectively.***

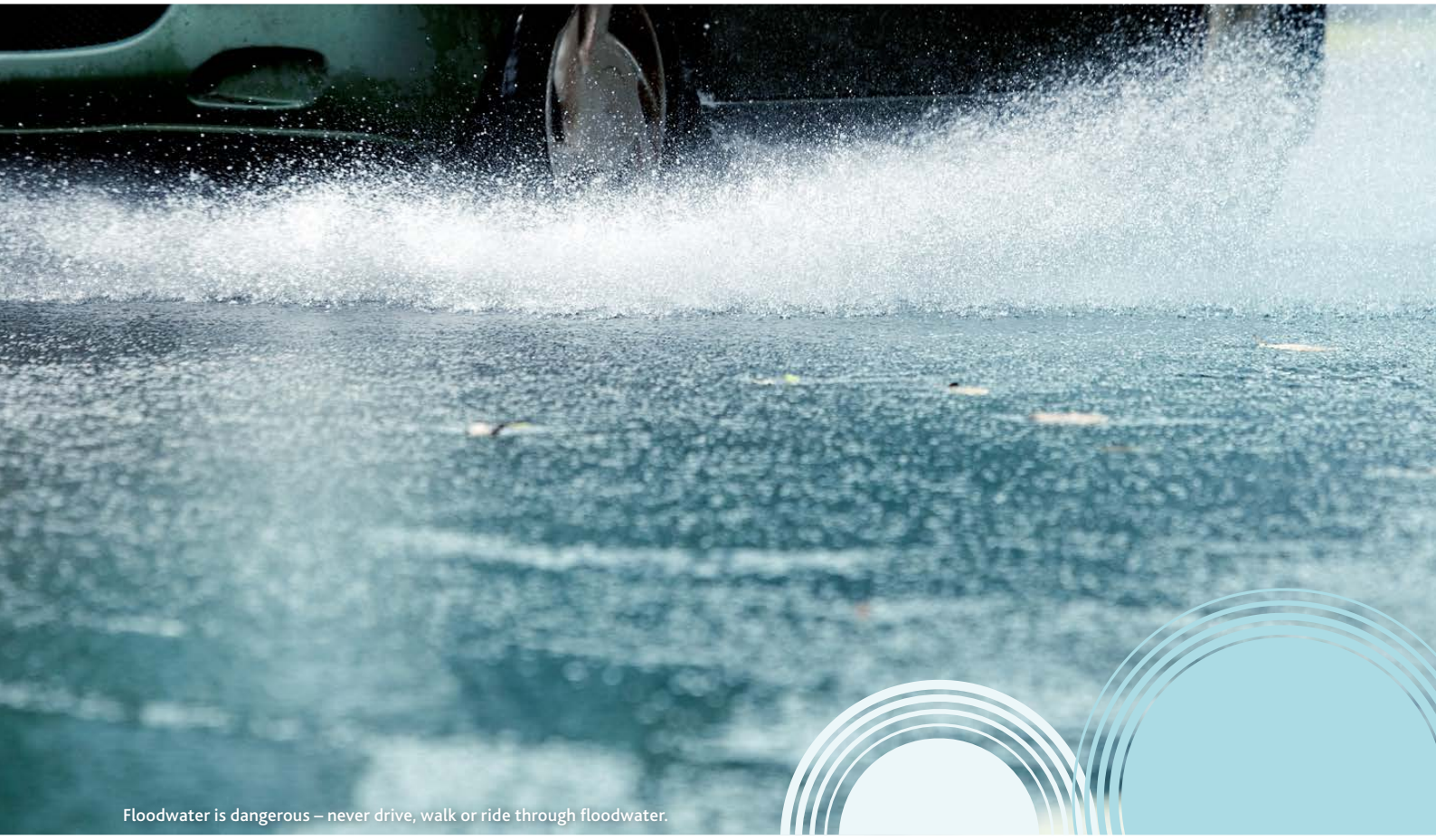
Activities to deliver objective 3 include:

- Clarifying roles, responsibilities and accountabilities within the Port Phillip and Westernport region to support effective service delivery in the region
- Coordinating activity and management approaches across waterways, water supply systems and catchments.

Delivering the strategy

Melbourne Water and the many contributing organisations will deliver the actions and outcomes set out in this strategy.

Governance and implementation plans will be developed to support ongoing oversight by key stakeholders and to support monitoring, reporting and review activities.



Floodwater is dangerous – never drive, walk or ride through floodwater.

SECTION 1

Introduction

This section outlines the impact of flooding in our region, and the scope of this strategy.

Why we need a flood strategy

Flooding is natural and inevitable. Like fire and other natural hazards, it is a part of the Australian landscape. Climate change will increase flood risks.

Floods are a natural occurrence in the Port Phillip and Westernport region. We can't stop them happening, but we can plan for and manage the risk, and reduce the consequences.

This strategy sets out how we will work to understand, avoid and reduce flood risks, and how we can support flood emergency preparation and response, across the region.

It sets out a vision for flood management across Port Phillip and Westernport, and creates a framework to help guide the work of the many organisations who participate in preventing or managing flood risks to deliver on this vision.

This strategy is part of the Victorian 'all hazards, all agencies' approach to emergency risk assessment, prevention, preparedness, response and recovery.

The focus of this flood management strategy

The focus of this strategy is the prevention and preparation aspects of flood management (highlighted in blue in the diagram below). This work supports flood emergency response and recovery activities.

Flood management: prevention, response and recovery

Flood prevention and preparation activities help reduce the impact of floods, and in some places, the likelihood. They also support emergency response and recovery activities.

(There is more information about the activities contributing to prevention, response and recovery throughout this document. Appendix 1 shows a summary of flood management roles).

About the Port Phillip and Westernport region

Our region covers approximately 13,000 square kilometres, extending from high in the Yarra Ranges to the east, to Ballan in the west, to Kinglake in the north, and south to include Mornington Peninsula, and Phillip and French Islands.

Our region is home to over four million people. It is densely covered with homes, businesses, farms and infrastructure.

The region's population is expected to almost double by 2050.[2] This means that floods have the potential to affect a great number of people and assets.

It is estimated that approximately 232,000 properties have at least a 1% chance of flooding in any given year. The annual average damage caused by floods in our region is estimated to be approximately $399 million (you will find more information about the number of properties at risk on page 10).

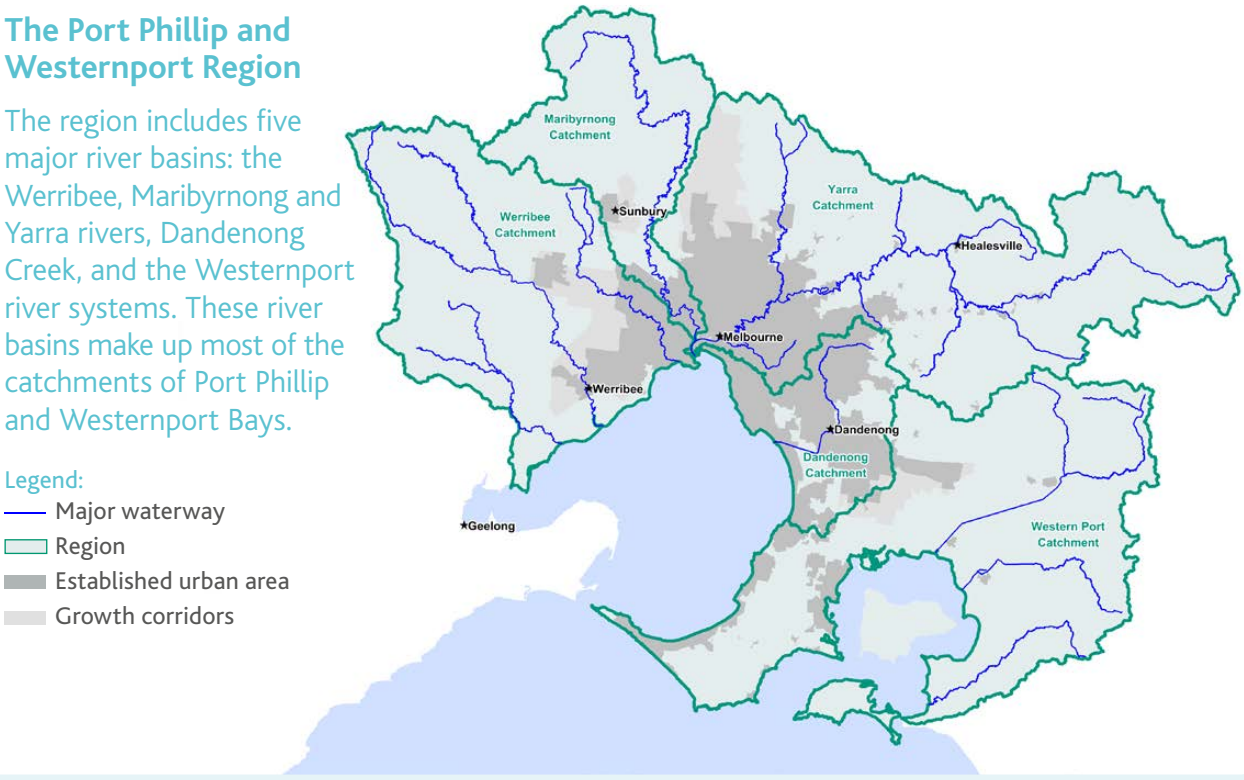
The consequences of floods are serious for people living in affected areas, and can have major economic repercussions for the state. As the region continues to grow, we need to manage the risks to avoid new or increased hazards to people, and minimise property and environmental damage, economic costs, and disruption to communities.

Our region is unique in Victoria because of the many different organisations that work together to manage flood risks: 38 councils, water authorities, policy and urban planning organisations, and emergency response and recovery agencies.

2. *Plan Melbourne* 2013, *Victoria in Future* 2014.

The Port Phillip and Westernport Region

The region includes five major river basins: the Werribee, Maribyrnong and Yarra rivers, Dandenong Creek, and the Westernport river systems. These river basins make up most of the catchments of Port Phillip and Westernport Bays.



A short history of flooding in the Port Phillip and Westernport Region

Floods are a part of the natural water cycle and have always occurred in our region. Urban and agricultural development has changed the landscape, affecting how water moves through catchments, and placing people and buildings in the path of floodwaters.

Aboriginal inhabitants of our region harvested food and other resources from waterways and floodplains. Floodplains retain important cultural significance.

Because of their fertile soils and access to water and rivers, later European settlement and urban development often occurred on floodplains.

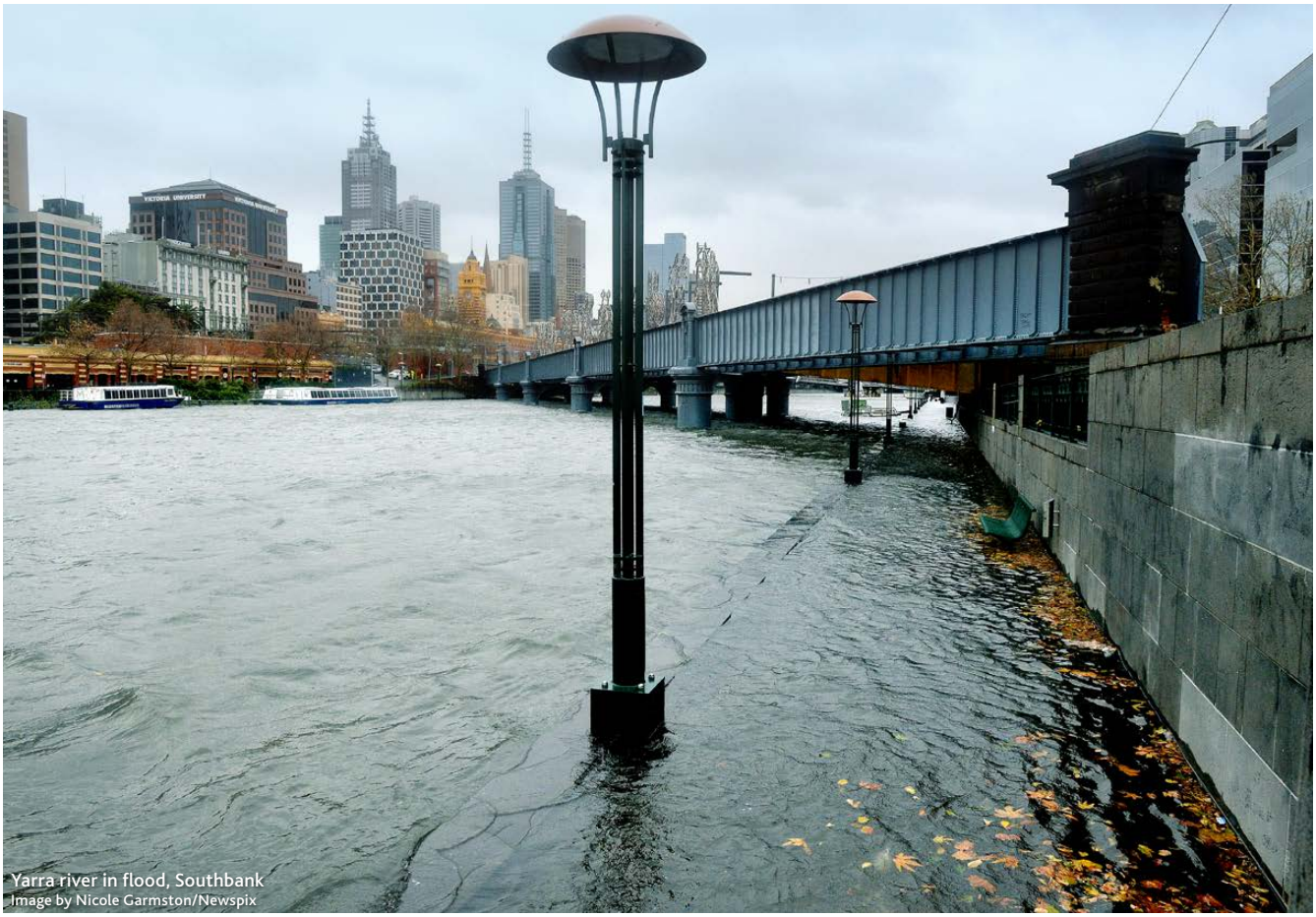
This has placed buildings and people in the path of flooding. We have also increased the volume of floodwater by clearing forests and developing land; water now flows more swiftly off the surface of cleared and paved landscapes, instead of filtering into soils. This increases flooding along waterways and on low-lying land.

Drainage systems built as part of early developments were not designed to hold the volumes of water we now know can flow through our landscape. When there is more runoff than underground drains can carry, water can overflow onto surrounding land, flooding roads and properties. Where development has occurred without appropriate overland flood pathways, new drainage or flood management infrastructure can be very expensive to retrofit.

Urban development standards for flooding were improved in the 1970s when new suburbs were required to provide space for floodwaters to be stored and space to flow overland. Suburbs developed since then have a much lower risk of flood damage.

The history of the Port Phillip and Westernport region has been marked by many serious and damaging floods. In some locations small, frequent flooding causes significant local damage, inconvenience and disruption.

Approaches like stormwater capture and integrated water management (IWM) will enhance our ability to respond to climate change.

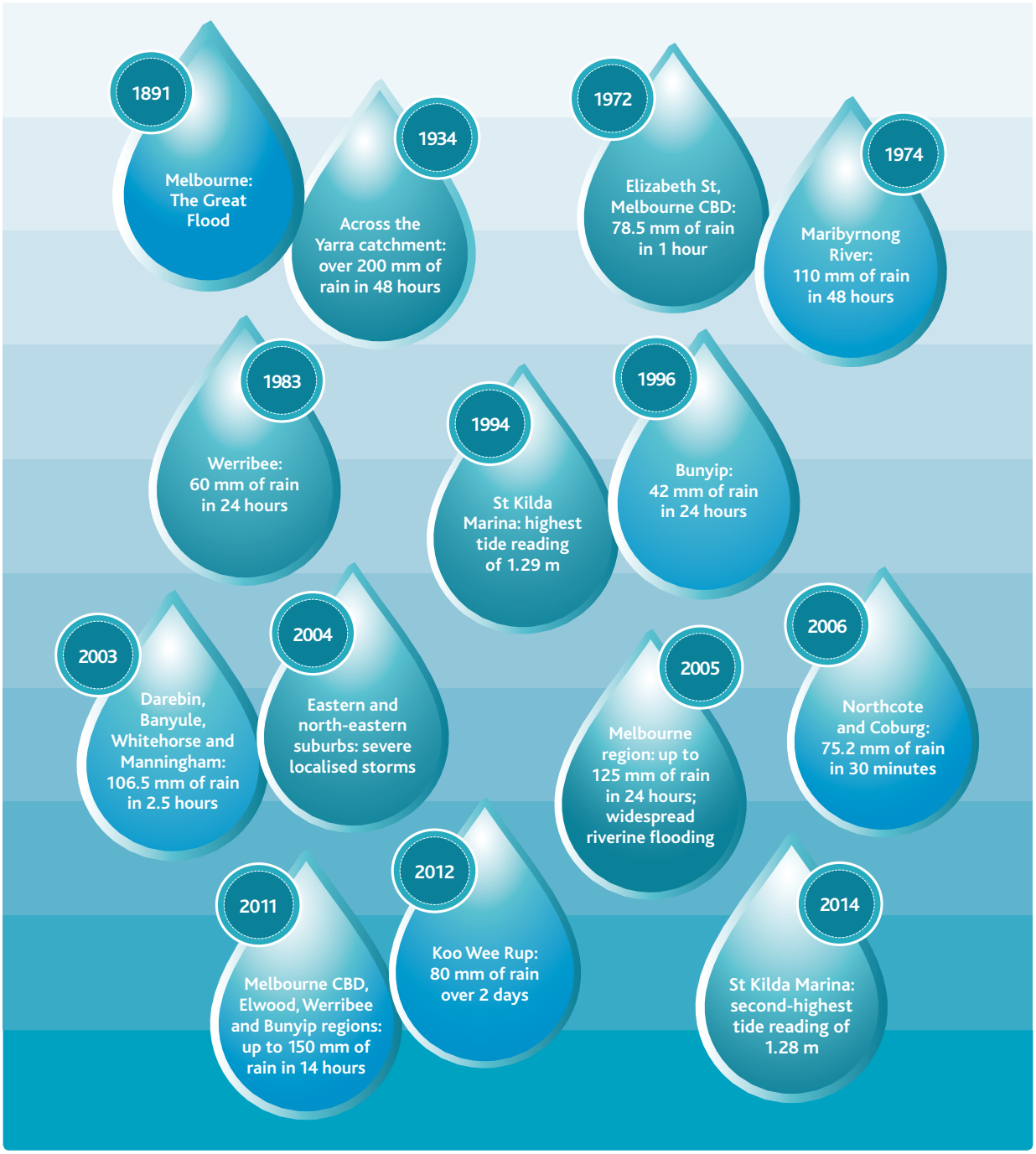


Yarra river in flood, Southbank
Image by Nicole Garmston/Newspix

HISTORY OF FLOODING

This diagram shows a number of key flood events throughout Melbourne's history. There are more recent events included because flood records have become more accurate over the past few decades.

Port Phillip and Westernport Flooding



The impact of floods

Floods are dangerous to people. Drownings and injuries can occur, and floodwaters can become contaminated with sewage and other pollutants that pose health risks to people.

It is estimated that there are approximately 232,000 properties across the region that have at least a 1% chance of flooding in any given year.[3] It is estimated that approximately 50,000 buildings have at least a 1% chance of flooding above floor level in any given year.[4]

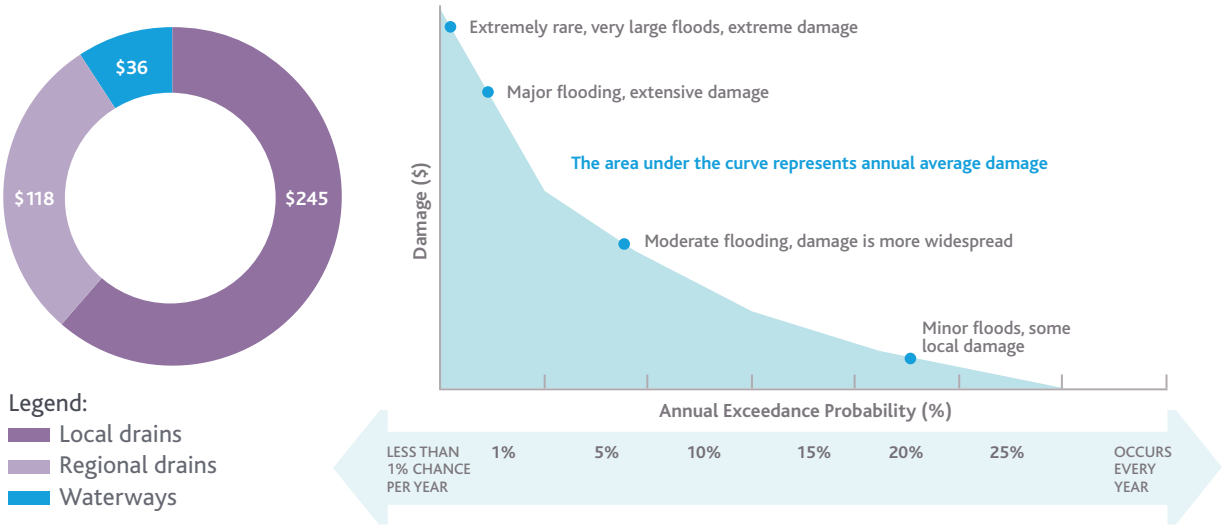
The annual average damage (AAD) costs of flooding in the Port Phillip and Westernport region are estimated to be approximately $399 million. Insurance industry information indicates that floods are our most expensive natural hazard.

More properties will be affected in the future if flood patterns change as a result of predicted climate change or unmanaged urban growth.

Estimating annual average damage (AAD)

The estimated annual average damage cost across the Port Phillip and Westernport Region is $399 million. This AAD estimate includes damage to residential and commercial buildings and properties, damage to roads, and some of the broader economic consequences of floods.

Coastal flooding, environmental damage, some agricultural damage and the intangible personal effects of flooding are not directly included in this figure because accurate dollar values cannot be easily determined.



Annual average damage ($ millions)

Annual average damage is calculated for all flooding across the region. The pie chart shows the estimated contribution of flooding along waterways and drainage systems.

The area chart shows the estimated contribution to annual average damage by large, infrequent floods and smaller, frequent floods. The area in blue is the total estimated damage in any given year. (Note that the annual average damage calculation does not include intangible effects such as stress).

3. This estimate has been developed using existing and extrapolated data. Existing data included mapping of 1% Annual Exceedance Probability (AEP) flood extents (that is, a flood with a 1% chance of occurring in any given year) along waterways and regional drainage systems, and mapping of local drainage systems where available. This data was then used to make estimates of the number of properties likely to be affected in areas that are yet to be mapped for flooding. It will be revised as more data is collected over time.
4. This estimate has been developed using existing and extrapolated data. Floor level data has been gathered through surveys of building floor levels in some flood mapped areas. This information has been extrapolated to estimate the number of floors that may be affected on all properties where flooding may occur. This estimate will be revised as more data is collected over time.

Major floods can cause significant damage because floodwaters can be deep, fast moving and widespread. Flooding deep enough to cover ground floors can cause extensive damage to buildings and public infrastructure over large areas; however, such large events are typically quite rare.

Smaller, more frequent floods do not generally cause such widespread physical impacts, but the cumulative cost of repeated local damage, disruption and social effects (such as emotional stress) can be significant where they occur.

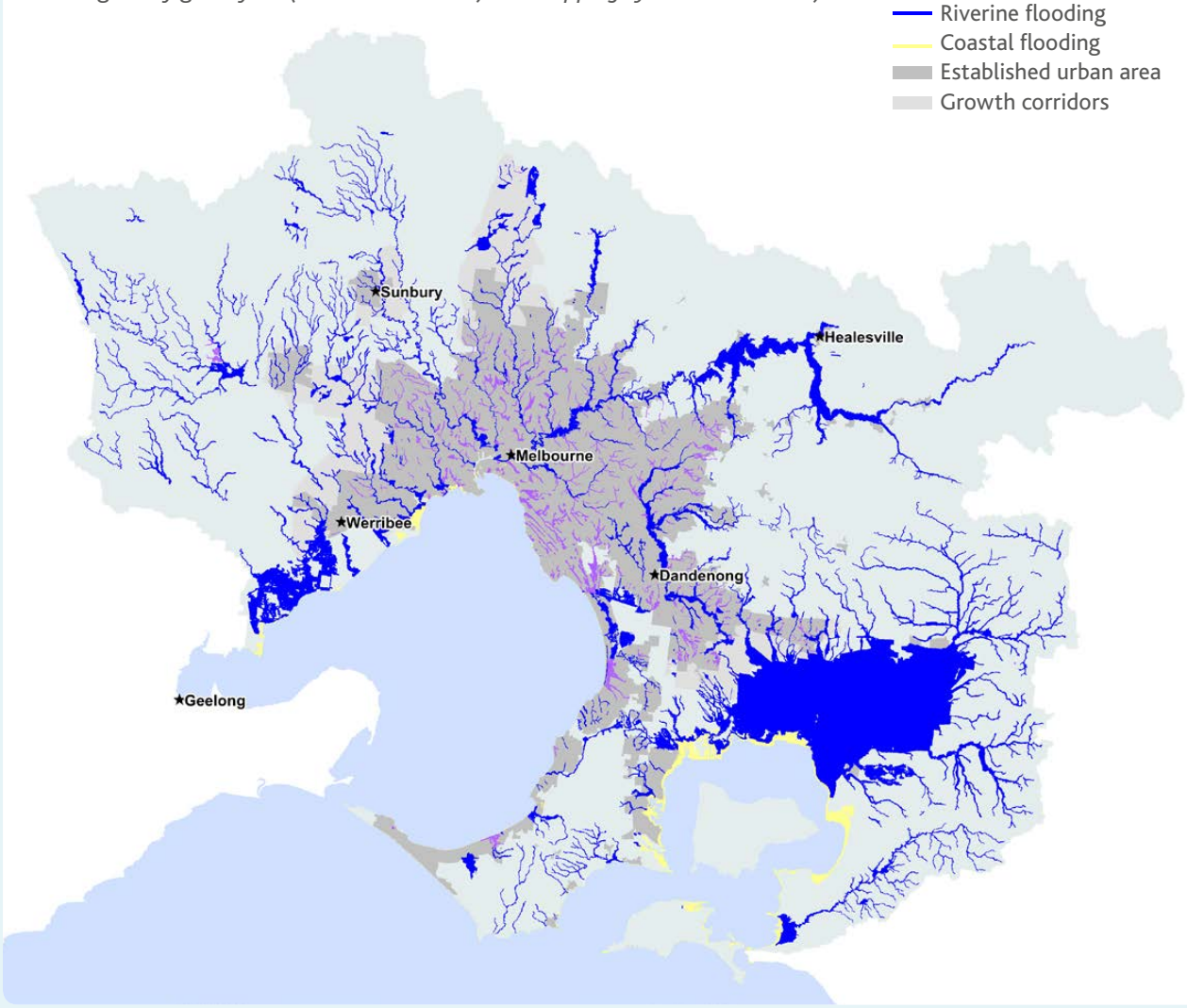
The personal and social costs of flooding are difficult to quantify in monetary terms, but should not be overlooked. Those who have experienced floods report that the long-term stress and disruption arising from damage to homes and vehicles, and the loss of pets and possessions of personal value, were the most serious negative consequences.

Floods can also damage the natural environment, causing erosion, pollution, and ecological losses to waterways, wetlands and natural floodplains. Such damage may take far longer to repair than damage to buildings and infrastructure and in some cases it is permanent. Environmental damage may cause further recreational and economic effects such as damage to fisheries.

In some areas, floodwaters have environmental benefits; for example, providing natural seasonal changes in streamflow, replenishing water to natural wetlands and floodplains, and supporting native vegetation.

Mapped flooding in Port Phillip and Westernport

This diagram shows Melbourne Water flood mapping for areas with a 1% chance of flooding in any given year. *(It does not include flood mapping by other authorities).*



What happens when it floods

**Flooding is a part of the natural environment.
We can't stop it, but we can manage the risk.**

The Port Phillip and Westernport region is at risk of flooding and if we don't continue to manage these risks it could get worse. Within our region we know of approximately 232,000 properties at risk of flooding. Flooding is our most expensive natural hazard.

Floodwaters flow from the top of the catchment down into floodplains and waterway systems to the bays. On the way, they affect people and properties.

Flooded house, Elwood
Image by Paul Loughnan/Newspix

SECTION 2

Managing flooding in our region

Although we cannot stop floods occurring altogether, we can work to reduce the likelihood in some locations, and to minimise the impact of flooding by being well prepared and ready to manage the consequences. We can also plan ahead to understand, adapt to, or avoid future risks.

Who participates in floodplain management?

Many organisations have a role in preparing for and managing flood risks, including activities in prevention, preparation, response and recovery.

Melbourne Water is the designated floodplain manager for the region. Melbourne Water develops flood information for use by all organisations with a role in flood management, to help reduce the likelihood and consequences of floods. Melbourne Water also leads projects to address existing and future flood risks across the region. Many other organisations lead projects to better understand and reduce flood risks within their areas of operation.

Urban planning, development, and land and waterway managers have a role in helping to reduce the impacts of floods by preserving natural floodplains and ensuring new development doesn't make flooding worse. Managers of local and regional infrastructure, including drains and roads, ensure systems are designed and maintained to carry away most stormwater safely, without damage to properties. Emergency response and recovery organisations respond to floods, helping to reduce safety risks to people and damage to property, and to clean up and repair damage.

Summary of activities and responsibilities

Melbourne Water (regional drainage and floodplain management authority)

- Coordinates planning and delivery of flood management and drainage services across the region
- Undertakes catchment and coastal flood modelling and mapping
- Provides flood advice for new land use and development as a Referral Authority
- Contributes information to warning services
- Manages waterways
- Contributes to development and use of integrated water management (IWM) knowledge and tools
- Undertakes technical research.

The 38 councils in the region

- Manage local municipal planning schemes and policies
- Manage local drainage systems
- Support local flood planning and coordinate local emergency planning
- Support development of local community resilience
- Support implementation of state policies and regional strategies through local flood management activities
- Can develop local water management strategies and plans.

Retail water authorities

- Manage urban water supply and sewage services
- Undertake technical research
- Develop and implement IWM infrastructure and tools with other stakeholders.

Victorian State Government departments and agencies

- Set policies, guidelines and standards for floodplain management, urban planning and development, and water resource management
- Support recovery from floods.

Emergency services agencies

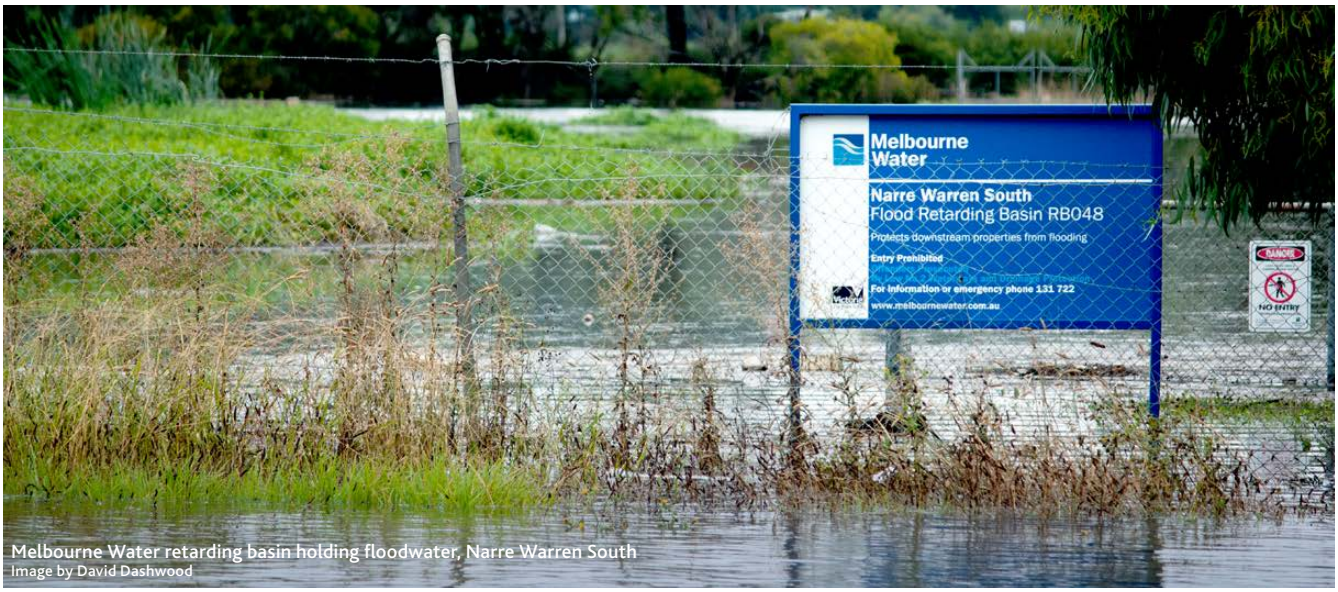
- Lead emergency preparation and response
- Deliver community awareness and education programs.

Federal Government organisations

- Set national policies and guidelines for flood and emergency management
- Coordinate national research and data on a range of flooding, weather and climate change issues
- Contribute to delivery of warning services
- Contribute funding to flood prevention and recovery activities.

Communities, individuals and businesses

- Responsible for understanding personal and local risks, and being prepared for floods
- Can contribute to development of local flood management projects and plans.



Melbourne Water retarding basin holding floodwater, Narre Warren South
Image by David Dashwood

Policies and strategies influencing flood management

This strategy sits within a framework of related policies and strategies that work together to help prevent and manage flooding, and support response and recovery. Many organisations are involved in delivering these policies and strategies.

Flood management and related policies and strategies:

	LAND & INFRASTRUCTURE	WATER & WATERWAYS	FLOODPLAIN MANAGEMENT	EMERGENCY MANAGEMENT
State	• Victorian Climate Change Adaption Plan • Victorian Coastal Strategy	• Water supply policy and IWM policies and plans • Victorian Waterway Management Strategy	• Victorian Floodplain Management Strategy	• Victorian Emergency Management Strategic Action Plan
Regional	• Plan Melbourne • Central Regional Coastal Plan	• Regional Healthy Waterways and Stormwater Strategies	• Flood Management Strategy – Port Phillip and Westernport	• Central Region Flood Emergency Plan
Local	• Precinct structure plans • Municipal planning policies	• Municipal water strategies (where applicable)	• Municipal flood management plans	• Municipal flood emergency plans

Implementation

A VICSES worker exits a flooded underground car park, St Kilda
Image by James Croucher/Newspix

How flooding is managed

Flood risks across the Port Phillip and Westernport region are managed according to national and state best practice standards and guidelines.[5]

The flood management process in Port Phillip and Westernport

COLLABORATE AND CONSULT

Work with stakeholders to gather information, understand needs across the region, and improve processes for flood management

UNDERSTAND THE RISK OF FLOODS

Model and map floods and assess the risks they could pose

Share information with those who need it

Engage communities to understand risk

MANAGE CURRENT AND FUTURE RISKS

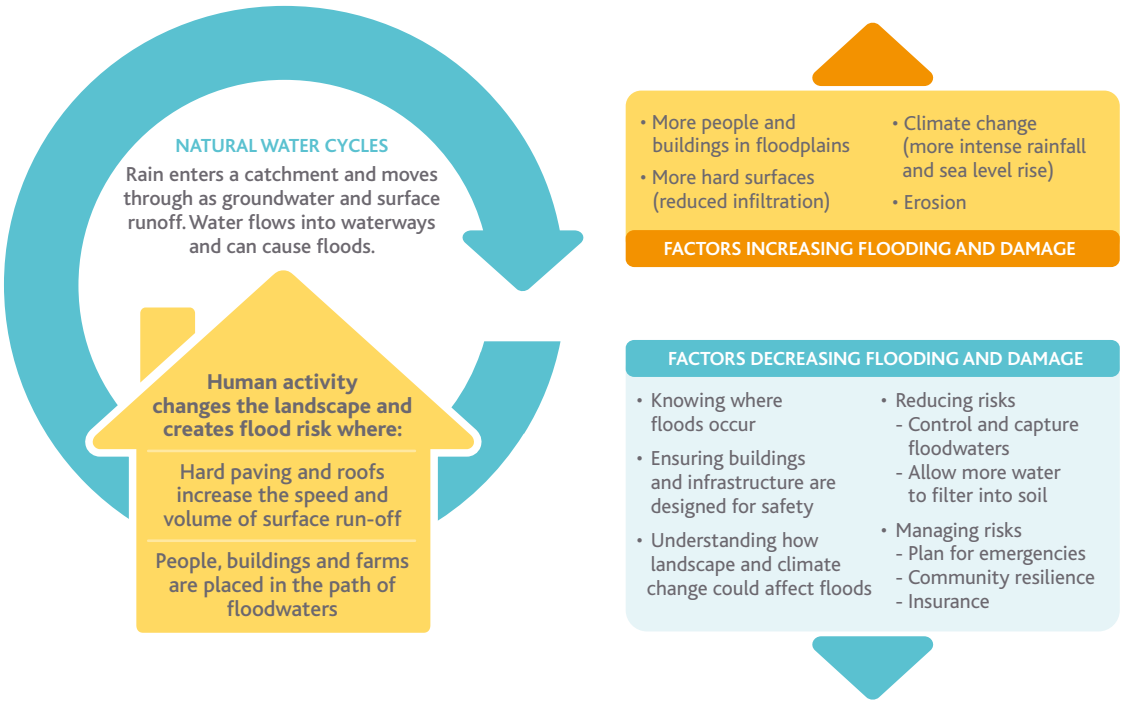
Manage the flood risks we face now, focusing first on areas where risks are most serious, and on activities that provide good value for money

Build community resilience

Avoid new risks by managing new urban development appropriately

Plan ahead to understand and prepare for future risks

Managing flood risks



5. Best practice and standards for our region are set out in the *Draft Victorian Floodplain Management Strategy*, 2015 and *Managing the Floodplain: a guide to best-practice flood risk management in Australia*, 2013.

SECTION 3

A shared vision for Port Phillip and Westernport

This section outlines the vision and direction for flood management, progress we have made, and how we will build on past achievements to continue providing effective flood management services to the community.

The following table sets out our shared vision, the supporting objectives and the detailed outcomes that will be delivered.

On the following page is an outline of the key performance indicators that will be used to track our progress against the vision, objectives and outcomes.

VISION	Together we are aware, responsive and resilient. Communities, business and government understand flooding, plan for challenges, and take action to manage risks.

OBJECTIVE 1	OBJECTIVE 2	OBJECTIVE 3
The right information is available at the right time to people who need it.	Flood risks are addressed to reduce impacts and get the best social, economic and environmental outcomes.	Land, water and emergency agencies work together to manage flooding effectively.
OUTCOMES		
• Flood data and risk information is produced and shared to meet Port Phillip and Westernport priorities and needs. • Flood decision makers have up-to-date information, and the skills and capacity they need to be effective. • Communities understand their flood risks and how they can manage them.	• Flood risk management programs and solutions are delivered for the best value, focusing on highest-priority areas first. • Future risks are identified and included in flood management planning. • New developments and suburbs are well planned, to avoid increases in flood risk. • Urban growth is consistent with state government policies and strategies. • Risks associated with climate change and urban development are planned for and managed.	• Ongoing floodplain management activities are supported by clear roles and responsibilities. • Land, water and emergency planning activities are well coordinated to help reduce and manage risks more effectively.

Key performance indicators

We have developed key performance indicators (KPIs) to track the progress of the strategy. While each indicator has a primary relationship with one objective, they work together to track how implementation of the overall strategy is delivering the vision. The performance indicators in this strategy will be used to track progress over the five years to 2021.

The objectives and desired performance against each key indicator will be delivered through the contributions of all participating organisations.

Objectives:		
1. The right information is available at the right time to people who need it.	*2. Flood risks are addressed to reduce impacts and get the best social, economic and environmental outcomes.*	*3. Land, water and emergency agencies work together to manage flooding and improve effectiveness.*
Key performance indicators (all relative to 2015 baselines)		
By 2021		
1. A 100% increase in the number of catchments that are flood mapped to understand current and future risks. *To meet this KPI, mapping will be:* *• Completed for the whole of the catchment* *• Completed to agreed standards* *• Delivered for priority catchments* *• Made publicly available.* 2. A 40% increase in the number of people, directly affected by flooding, who are aware of their risk.	3. A 20% reduction in flood effects. *Reduced flood effects will be measured against data and models of possible social, economic and environmental impacts.*	4. A 100% increase in number of areas for which there are collaboratively developed plans for flood management.
Long term outcomes		
These indicators measure progress toward the long term outcome of ensuring that flood managers and communities understand the risk of floods across the region, and can use this information in decision making. Good public awareness of flood risk is an essential first step toward preparedness and resilience.	*This indicator measures progress toward the long term outcome of reducing the negative effects of floods as far as is practicably possible.*	*This indicator measures progress toward the long term outcome of continuous and active collaboration and joint problem solving across the region.*
Melbourne Water's component of key performance indicators		
1. A 100% increase in number of catchments that are flood mapped by Melbourne Water or in partnership with councils, to understand current and future risks. To meet this KPI, mapping will be: • Completed for the whole of the catchment • Completed to agreed standards • Delivered for priority catchments • Made publicly available. 2. A 20% increase in the number of people, directly affected by flooding, who are aware of their risk.	3. A 15% reduction in flood effects, achieved by implementing Melbourne Water programs and projects.	4. Lead collaborative development of 50% of new flood management options and delivery plans for the region.

The Melbourne Water component of these KPIs has been determined using feedback obtained through the development of this strategy and Melbourne Water's Price Submission. More information on these KPIs (including baselines and key assumptions) is included in the Measuring our Progress fact sheet, available at www.melbournewater.com.au.

Progress so far

This strategy builds on a long history of flood and drainage management and investments by Melbourne Water, councils, the Victoria State Emergency Service (VICSES) and others.

The *2007 Port Phillip and Westernport Flood Management and Drainage strategy* (the 2007 strategy) was the first comprehensive flood management strategy for the region. Through delivery of the 2007 strategy, a strong foundation of flood data, decision making processes and collaborative planning has been established. (This progress is outlined below).

Understanding the risk of floods

Improved knowledge

A Melbourne Water program of flood modelling and mapping has produced information about where floods could occur for much of the region. Flood maps are shared with government agencies to support urban development and emergency planning. Flood information about individual properties is shared when land is bought and sold, and on request.

A standardised Flood Risk Assessment Framework (FRAF) for the region was developed in 2010. This enables the safety, social and economic impacts of floods to be quantified and understood in a systematic way.

Ongoing urban development and climate change could increase the likelihood and extent of floods in the future. Research and modelling is being undertaken to better understand and help manage these issues.

Improved community education, awareness and preparedness

VICSES, Melbourne Water and councils have delivered broad community flood education programs to 12,000 at-risk households. Knowledge gained from delivering and evaluating these programs will be used to develop new education campaigns on flood risks and how to prepare for them.

Managing flood risks

Reduction in 'intolerable' flooding

Major drainage upgrades, warning and education programs have been delivered to reduce flood risks. These programs have been directed primarily towards locations where flood risks were determined as 'intolerable'. They have reduced intolerable risks by 10% over each of the previous five-year Melbourne Water financial planning periods. (Intolerable risk has been defined as catchments rated as having an 'extreme' risk using the FRAF. More information is included in the following sections and the Risk Assessment fact sheet, available at www.melbournewater.com.au).

Flood and drainage infrastructure

Flood and drainage infrastructure has been maintained, and in some locations upgraded to ensure it stores and removes stormwater that would otherwise cause flooding. New flood and drainage infrastructure has been constructed in new subdivisions to ensure they are protected from floods and to avoid increased flood levels downstream.

Expanded network of streamflow gauges and flood warning services

A flood warning service is provided on major waterways through the work of BoM, VICSES and Melbourne Water. New rapid warning services are being piloted in several locations at risk of serious flash flooding. Warning services rely on a network of streamflow gauges, flood models, weather and rainfall forecasts, and warning message development and dissemination services.

Managing new development

Melbourne Water and councils have worked together to include information about flooding along waterways and major drainage systems in most planning schemes across the region. Several councils have now also included information about flooding along local drainage infrastructure in planning schemes, and some have included coastal inundation mapping. (More information about flood information in planning schemes is included in the Flood Information and Planning Schemes fact sheet available at www.melbournewater.com.au).

Technical flood information is provided to councils to support appropriate development on flood prone land. Information and strategic flood planning for growth corridor catchments is provided to the Metropolitan Planning Authority (MPA) to support appropriate greenfield development.

Improving collaboration

Flood management plans

Flood management plans and flood emergency plans have been developed for each local municipality, documenting the most important flood issues, challenges and risks in each area, and setting out activities required to help address them.

Developing these plans has enabled local and state government organisations to share information and better understand respective priorities and investment programs.

Improved collaboration

A number of collaborative projects have been delivered over the past eight years, including research projects, trials and joint flood risk reduction projects.

Key challenges and opportunities

The experience and working relationships developed through delivering the 2007 strategy have highlighted challenges and opportunities to improve how we manage floods and plan for the future.

Getting the best outcomes from our investments

Melbourne Water and councils have delivered a number of programs and projects to reduce the risk of flooding. These have included several significant infrastructure upgrades.

Major infrastructure projects have been targeted at areas with 'extreme' risk (assessed using the Melbourne Water Flood Risk Assessment Framework),[6] and designed to benefit as many people as possible; however, they are generally very expensive. In many places where flood risks are very high, the cost of infrastructure works would likely outweigh the benefits they provide. Reducing flood risks cost-effectively, and within the timeframes expected by the community, is a significant challenge.

To continue reducing risks across the region, with the resources available, we will consider all possible tools to manage floods and reduce consequences. We will also continue working to build community resilience. (You will find more about these challenges and how we can meet them, next, and in Section 4).

More collaborative decision making

Melbourne Water and other flood managers regularly make decisions about where to undertake flood modelling and mapping, and where and how to invest in flood risk management.

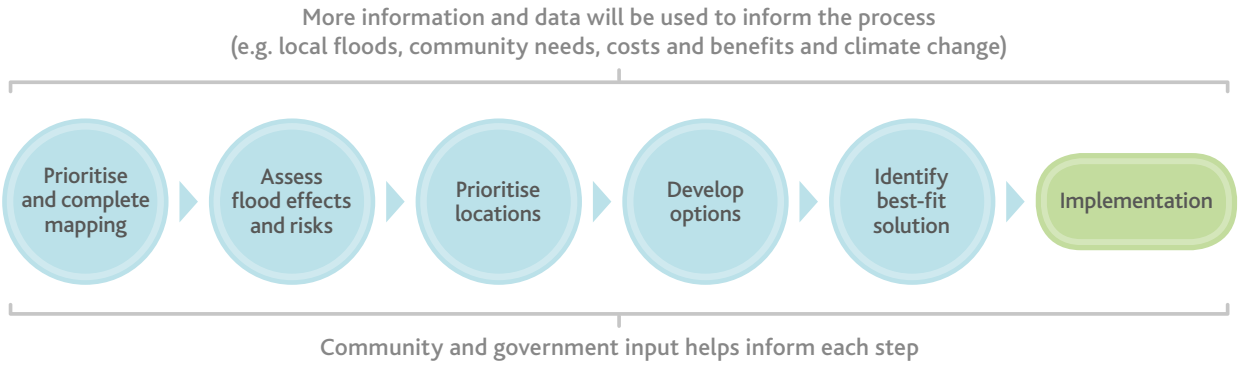
The processes and tools used to make these decisions will be updated and expanded to better enable input by all stakeholders including communities, and to make the best use of the increasing quantity and quality of information available.

Improvements to decision making processes outlined in the actions in this strategy include:

- Updates to the way stakeholder input is used to prioritise flood mapping projects
- Updated risk assessment tools to better understand the impact of localised flooding
- Improved processes to understand all benefits and costs when developing best-fit solutions
- Improved community input to option development and choosing the right solutions.

6. More information on the Flood Risk Assessment Framework is available in Section 4 and in the Flood Risk Assessment fact sheet, available at www.melbournewater.com.au.

The flood management decision making framework



This diagram shows the decision making framework outlined in this strategy, and how improved information will be included.

Whole of catchment flood management

Flooding can be increased or reduced by new land use and development occurring across catchments when they affect the volume and flow of stormwater.

Managing floods across a whole catchment could include activities such as:

- Managing all urban development (including consolidation), to ensure any extra runoff is appropriately treated
- Using integrated water management approaches that better link management of stormwater runoff to management of other water services.

These approaches may enable more efficient or effective management of current and future flood risks, and better overall community outcomes in the long term. (You will find more about these approaches on page 23).

Managing all types of floods

Though large, infrequent floods are expected to cause widespread direct damage to buildings and infrastructure, smaller and more frequent floods can also have serious impacts including some direct damage, disruption, and intangible consequences such as stress.

Current risk assessment and investment frameworks are focused on very large floods. Targeting risk management efforts more broadly to include areas of most concern to communities (for example, by addressing more frequent floods where the consequences are serious), will help to ensure all stakeholder priorities are being addressed. It may help to manage the intangible consequences of flooding as well as managing direct damage costs.

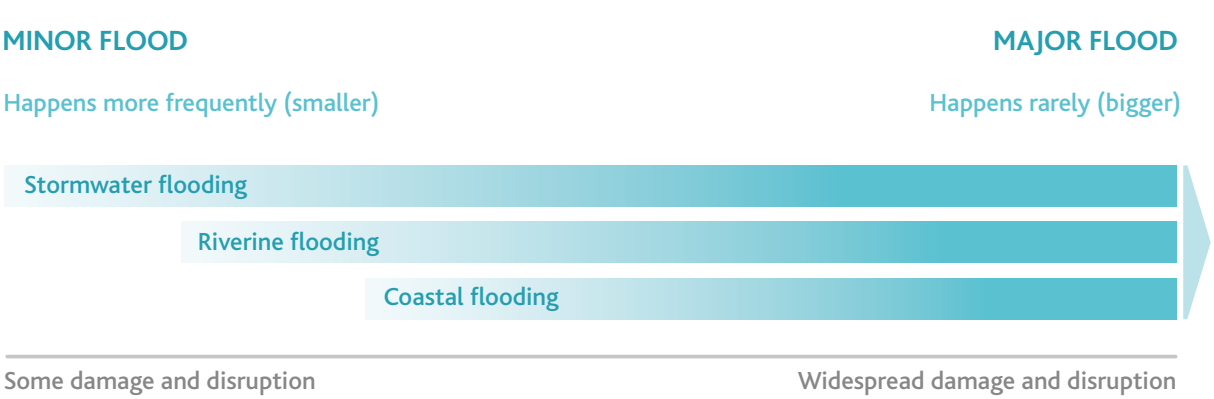
Climate change

Climate change is expected to increase flood risks due to more frequent intense rainstorms, and rising sea levels.

Some progress has been made toward understanding the effects of climate change on flooding. Improved climate change projections for our region can continue to build our understanding of the likely impacts.

Though the precise impacts in each location are still uncertain, flood managers can use the information we do have to start planning ahead now. By planning early, we can help communities reduce or adapt to risks at the lowest possible cost.

Types of flooding and common terms:



This strategy focuses on all floods that have serious consequences for the community.

Disruption caused by flooding, Princes Highway near Pakenham
Image by Ian Currie/Newspix

SECTION 4

Actions

This section outlines the actions required to deliver the vision and objectives of this strategy and to make progress against the key performance indicators.

You will see that all the actions have a lead or several leading organisations, and most have some participants providing support or input. (You will find more on these terms in the Glossary).

Understanding the risk and sharing information

OBJECTIVE 1

The right information is available at the right time to people who need it.

This covers:

- Understanding risks – flood mapping and risk assessments
- Sharing information and skills
- Engaging communities to build resilience and preparedness.

Key performance indicators:

1. A 100% increase in the number of catchments that are flood mapped to understand current and future risks.

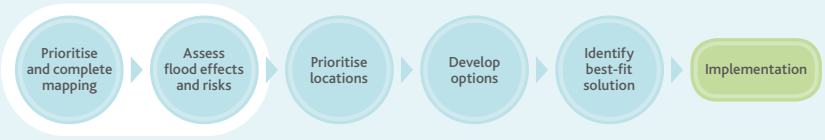
To meet this KPI, mapping will be:

- *Completed for the whole of the catchment*
- *Completed to agreed standards*
- *Delivered for priority catchments*
- *Made publicly available.*

2. A 40% increase in the number of people, directly affected by flooding, who are aware of their risk.

Understanding the risk

The following discussion and actions are relevant to the flood mapping and assessing flood risk stages of the decision making framework.



The first step to managing floods is to understand where floods could happen, and what the impacts could be. Mapping and risk assessments are used to understand these issues.

Flood mapping

Potential flooding is modelled and mapped to understand where floodwaters are likely to collect and flow across the landscape, how fast they might rise and fall, and how often.

Flood mapping has been undertaken across growth corridor catchments, along most waterways and drainage systems managed by Melbourne Water, and along some drainage systems managed by councils. Approximately 75% of catchments across the region have some degree of flood mapping completed.[7]

Because standards and technologies have been improving over time, more recent mapping provides greater accuracy and more detail, including a greater range of extents for different magnitudes of flooding.

Melbourne Water's flood mapping activity has generally focused on locations where urban development is expected to take place, or areas where flooding causes significant damage or disruption. Flood mapping has also been undertaken by some councils to identify where flooding could occur in the upper reaches of local catchments.

Much of the flood mapping undertaken to date has focused on assets owned by a particular agency, and does not consider the whole catchment. Collaborative whole of catchment flood mapping will be more accurate and efficient, and will support improved outcomes and decision making in the long term. Whole of catchment mapping should be undertaken whenever possible.

The State Government Future Coasts program has mapped coastal flood risks from storm tides and future sea level rise for the whole Port Phillip and Westernport coastline.[8] (You will find more information about understanding future coastal risks on pages 39–40).

We need further mapping to fill gaps and to update older information.

New mapping should be undertaken and verified using:

- A whole catchment approach, considering all parts of the drainage system and all waterways together
- Up-to-date landscape and drainage system data
- Data from actual floods where available.

Risk assessment

Risk is the combination of the likelihood and consequence of flooding.[9]

Risk is calculated for each catchment by combining the likelihood of flooding and information about the local consequences of floods using the Melbourne Water FRAF. (You will find more information about risk assessments in the Flood Risk Assessment fact sheet, available at www.melbournewater.com.au).

Risk calculations enable us to prioritise investment, and understand how much various flood management measures may reduce risks. Detailed risk assessments have been completed in catchments where mapping is available. Flood risks are currently assessed at a catchment or sub-catchment scale. They generally include a large land area and many individual properties.

We need a new tool and processes to better quantify impacts of local-scale floods (for example, an area consisting of a few properties) to ensure all scales of flooding are well understood, and considered together. A recent review of the existing FRAF has provided many recommendations that can be considered in updating processes and the development of a new tool.

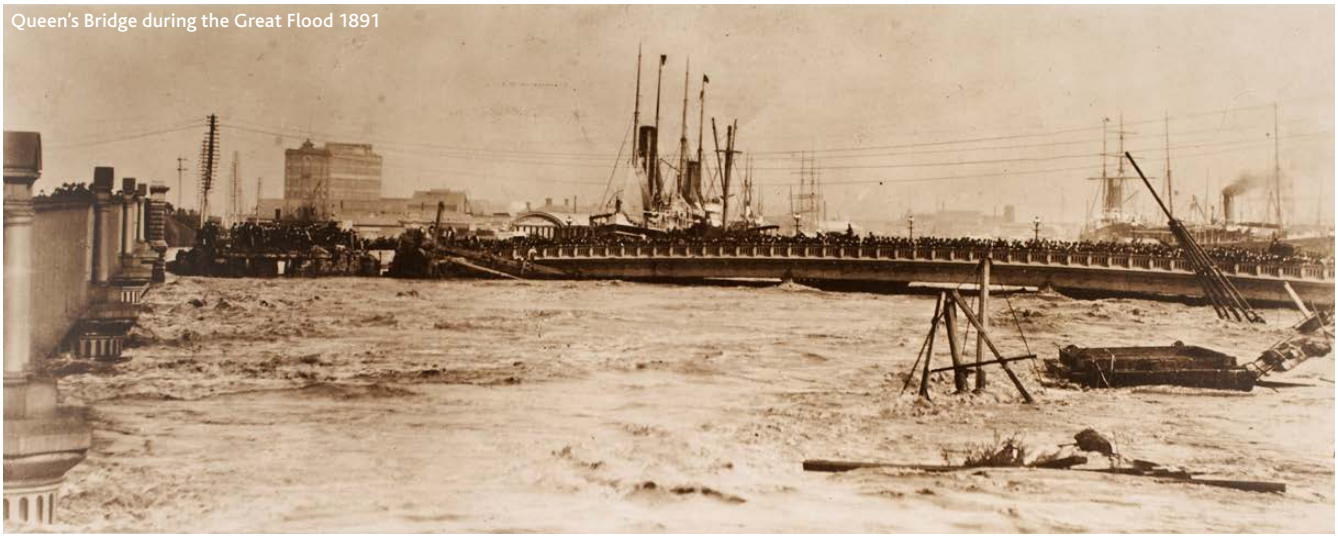
7. The region is divided into approximately 950 small catchments for the purpose of understanding and managing flooding. These small catchments can then be grouped to understand flooding across a large catchment, such as the Maribyrnong river basin.
8. The Victorian Coastal Inundation Dataset, produced through the government's Future Coasts program, models and maps current and possible future coastal flooding. Melbourne Water has also completed additional coastal flood mapping for Port Phillip and Westernport.
9. *Managing the Floodplain: a guide to best-practice flood risk management in Australia*, 2013.

Update mapping guidelines and complete priority mapping and risk assessment

This includes updating standards and guidelines for the Port Phillip and Westernport region, and understanding what level of information is required in different locations. New mapping and risk assessment projects will be prioritised to address the most urgent information gaps first.

Action	Lead	Key participants
1.1 Review and update flood modelling and mapping guidelines and processes for our region, in alignment with state and national standards, and in consultation with stakeholders *(considering whole of catchment mapping approaches where possible)*.	MW	BoM, Councils, DELWP, VICSES, and other regional and technical authorities as required
1.2 Update flood risk assessment tools to better understand impacts in areas where localised flooding occurs, in consultation with stakeholders.	MW	BoM, Councils, DELWP, VICSES, and other regional and technical authorities as required
1.3 Develop new tools to prioritise locations for mapping, and for risk assessment, in consultation with stakeholders.	MW	Councils, DELWP, MAV, MPA, VICSES
1.4 Identify and deliver priority flood mapping and risk assessment projects for the region, in collaboration with stakeholders, and share outcomes *(considering whole of catchment mapping approaches where possible)*.	MW	Councils, MPA, VICSES
1.5 Identify local flood mapping and risk assessment priorities, and contribute to project delivery, in partnership with Melbourne Water where possible.	Councils	Councils, MPA, VICSES, MW

(Information sharing is an essential aspect of these processes. You will find actions on information sharing on page 27. Climate change is an important issue to consider in new regional guidelines. You will find more information on climate change and mapping on pages 39–40).



Queen's Bridge during the Great Flood 1891

Collect full and up-to-date data on existing drainage and flood assets and land

Current and more comprehensive data is needed to inform ongoing asset management, and to underpin all flood management decisions.

Records of drainage infrastructure were not always kept during the early development of our region, leading to gaps in our knowledge now.

Action	Lead
2.1 Continue and enhance the collection of flood, drainage and land asset information to inform management programs for: • Regional flood and drainage assets and waterways • Local flood and drainage assets • Retail water authority assets.	*For assets under each agency's control:* • Melbourne Water • Councils • Retail water authorities

Learn from floods

Gathering information about floods when they do occur allows flood models and maps to be checked against real data, and supports ongoing improvement of emergency response and management processes. We need ongoing information gathering by all participating authorities to keep data up to date.

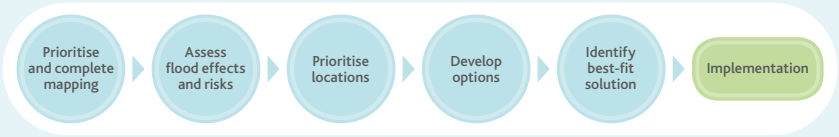
Action	Lead	Key participants
3.1 Review what data is being collected by different organisations during and after floods, and identify further opportunities to collect and share data.	MW	Councils, MAV, VICSES
3.2 Continue collecting information during and after floods to assist with mapping, better decision making, and improving emergency response.	*For assets and issues relevant to agency:* • BoM • Councils • MW • VICSES	

Outcome:

Flood data and risk information will be produced and shared to meet priorities and needs for the region.

Sharing information and skills

The following discussion and actions are relevant to all steps of the flood management process; in particular, flood mapping, risk assessment and developing flood solutions.



It takes the actions of many stakeholders to manage existing flood risks, provide for appropriate urban planning, prepare for emergencies and educate communities. All require access to good quality information to inform flood management decision making.

Critical infrastructure and service providers require detailed flood information to enable them to design and provide resilient services.

Up-to-date information can also help insurance companies to understand true risks, enabling appropriate insurance policy pricing.

Sharing information

State government departments, councils, and emergency services share and use flood mapping and risk information to support flood risk reduction activities and to plan for flood emergencies.

Information is currently shared through many channels including:

- Annual flood map updates for councils provided by Melbourne Water
- Asset data information sharing between drainage and infrastructure managers
- Collaborative development of Local Flood Management and Flood Emergency Plans
- Ongoing knowledge sharing and capacity building programs run by government and research organisations
- Flood information included in municipal planning schemes and policies
- Melbourne Water provision of flood mapping information to the Victorian Flood Database
- Ongoing flood information updates from Melbourne Water to VICSES
- Flood warning systems
- Emergency planning processes
- Project-based information sharing between Melbourne Water, councils, BoM, and VICSES and other organisations (such as VicRoads and community groups)
- Development advice to landowners and planning permit referrals
- Statutory processes such as including flood maps in planning schemes
- Providing property information statements and flood level advice
- Urban growth planning processes such as Developer Services Schemes for greenfield areas
- Provision of flood mapping to the insurance industry through the Insurance Council of Australia (ICA)
- During coastal hazard and vulnerability assessments.

Continued information sharing is essential, and there are opportunities to improve current processes.

Data is produced and stored in a range of qualities and formats that may not always be easily shared across different systems.

Some information could be shared more rapidly or regularly, such as updated flood maps, and works and investment planning by owners of interconnecting drainage assets.

Sharing skills and building capacity

Ongoing skill sharing and capacity building is required across the region. Melbourne Water as the regional floodplain manager has technical flood management skills that could be better shared with other organisations. Many councils share knowledge and skills across areas such as flood and stormwater asset design and management, community engagement, and integrated water management.

If more information is shared, such as more detailed flood mapping and risk assessment outcomes, interpretive material and guidance on when and how to use it, would assist some stakeholders.

Review and update information sharing programs

Review is required to make sure that up-to-date information and data is as accessible as possible, and can be used by those who need it.

Action	Lead	Key participants
4.1 Review current information sharing processes for our region, in consultation with stakeholders, and identify where the type, format, and timeframe of information sharing could be improved.	MW	Councils, DELWP, MAV, VICSES, retail water authorities
4.2 Regularly share flood data and information with all relevant stakeholders including: • Outcomes of flood studies (e.g. modelling, mapping and risk assessments) • Asset and land data • Information on investment priorities and planning • Findings from research, analysis and trials • Standards and guidelines for the region • Information gathered during and after floods • Information for use by critical infrastructure providers.	*For information produced by each agency:* • Councils • DELWP • MW • VICSES	ICA, critical infrastructure providers

Build knowledge and skills of all participants in flood management

Improving the capacity of all stakeholders will help us work together to better address the known challenges, respond to the changing environment, and provide good value and effective flood management services to the community.

Action	Lead	Key participants
5.1 Identify and prioritise flood management knowledge and capacity gaps for the region, using stakeholder input.	MW	Councils, DELWP, MAV, VICSES
5.2 Lead targeted knowledge and capacity building programs to address priority gaps.	MW	Councils, DELWP, MAV, VICSES

Outcome:
Flood decision makers have up-to-date information, and the skills and capacity they need, to be effective.

Engaging communities to build resilience and preparedness

Resilience enables 'cities, organisations, and communities to better prepare for, respond to, and transform from disruption'.[10] Flood awareness and readiness is an important aspect of resilience, and ultimately supports liveability in flood prone areas.

Engaged and aware communities

Communities and businesses have an important role in managing their own risks.

'Flood ready' communities and individuals understand their risks, are prepared for flooding, and respond to warnings. They can make informed investment and insurance decisions to reduce their risk exposure. Flood ready communities that have taken steps to prepare for and manage risks are likely to experience less loss, damage, stress and disruption, and recover faster.

Community flood awareness is currently supported through local flood guides and education programs. VICSES (Victoria State Emergency Service), in partnership with Melbourne Water, has delivered flood information to 12,000 households. Councils have delivered targeted education and emergency preparation support in some locations where risks are most serious. General flood information is also available in planning schemes and through property information statements. Melbourne Water also provides flood level advice on request.

Some communities may be particularly vulnerable to floods due to socio-economic factors or high local flood risks. Communities with particular risks or needs can be supported through appropriately targeted education, and tailored support from community services providers.

Effective engagement requires accessible, locally relevant information. We need sustainable resourcing for ongoing delivery, and regular evaluation and updates, to ensure programs are effective.

Flood warnings

Flood warnings are in place for flood risk areas along major river systems, and pilot warning systems have been developed for two locations at risk of severe flash flooding. Further early warning systems for several urban areas identified as having an extreme risk of flooding are currently in development.

Providing more information to the community (such as rapid and real-time information) may help them be well prepared, and make better decisions about when to take action.

Flood warning services are maintained by the Bureau of Meteorology, Melbourne Water and VICSES, in line with standards and guidelines set by the state and federal governments (for example the Victorian Total Flood Warning Service Guidelines and Bureau of Meteorology Service Level Specifications). They require periodic review against community needs to ensure warning services are well targeted and effective.

10. Rockefeller Foundation 2015.

Flooded car, North Melbourne
Image by Jay Town/Newspix

Community engagement and public information sharing

Engagement and education programs help people understand their risks and the benefits of being prepared, and to know what to do before, during and after a flood.

Making clear flood risk information easily accessible to people and businesses enables them to understand their risk, and helps them to make appropriate emergency preparations and flood insurance decisions.

Action	Lead	Key participants
6.1 Identify the highest-priority locations and communities for flood risk awareness and engagement programs, with input from relevant authorities.	MW	Councils, DHHS, VICSES
6.2 Develop and regularly evaluate Melbourne Water funded awareness and preparedness programs, with input from relevant authorities.	MW	Councils, DHHS, EMV, VICSES
6.3 Continue to deliver targeted education and awareness raising programs with support from delivery partners.	VICSES	Councils, MW
6.4 Where necessary, deliver targeted education for vulnerable communities with input from community service organisations.	*According to respective priorities:* • Councils • DHHS	MW, VICSES
6.5 Contribute local knowledge as required to education and awareness planning to benefit local communities.	Councils	MW, VICSES
6.6 Review existing public information sharing processes for accessibility and, where necessary, improve them in consultation with stakeholders. *(This could include local flood guides, property information statements, flood level advice and planning scheme information).*	MW	Councils, DELWP, VICSES

Provide flood warnings

Warning services can help communities take action to reduce the effects of floods. Effective warning services for areas prone to rapid urban stormwater flooding are a particular challenge for our region. Urban stormwater floods can happen very quickly, so emergency services and communities need to be prepared to act in time.

Action	Lead	Key participants
7.1 Review flood warning programs across the region to ensure alignment with updated state and national standards and guidelines.	MW	BoM, Councils, DELWP, EMV, VICSES
7.2 Review flood warning systems across the region to ensure they provide a fit-for-purpose service proportionate with risks, including urban stormwater and flash flooding, and update or expand where appropriate.	MW	BoM, Councils, DELWP, EMV, VICSES
7.3 Continue to operate stream and rainfall gauging networks and data management systems, to support flood prediction and warning services.	MW	

Outcome:
Communities understand their flood risks and how they can manage them.

Taking action to manage current and future risks

OBJECTIVE 2

Flood risks are addressed to reduce impacts and get the best social, economic and environmental outcomes.

This covers:

- Manage existing risks – making the best use of the resources we have
- Avoid new risks – managing urban development
- Plan ahead for future risks.

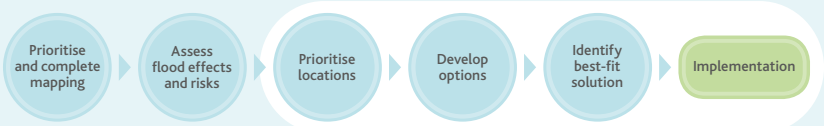
Key performance indicator:

3. A 20% reduction in flood effects.

Reduced flood effects will be measured against data and models of possible social, economic and environmental impacts.

Managing existing flood risks

The following discussion and actions are relevant to prioritising flood prone areas, and developing and delivering solutions.



To make the best use of the resources we have, flood managers work to find the best-value approaches to manage the most serious flood risks. Understanding 'value' requires information on the economic, social and environmental aspects of flooding and the various management options over their full lifecycle.

There are many measures that can be used to manage and reduce existing flood risks, including community education and awareness programs, flood warning systems, making good planning and building decisions, and taking steps to capture more water across landscapes through infiltration or in distributed water storage systems. In some locations small or large infrastructure upgrades may also be an appropriate response to managing flood risks.

By understanding the causes and impacts of flooding in a particular area, and understanding local community concerns, we can develop the most appropriate measures to manage or reduce flood risks.

Identifying the highest priority risks

Melbourne Water uses a FRAF to help identify where flood management activity is most urgently required. Where flood risk (including both the likelihood and consequence) has been assessed by Melbourne Water, it is categorised as 'extreme', 'high' or 'medium'. Through the 2007 strategy 'extreme' risks were deemed intolerable, and prioritised for management.

As we develop a better understanding of all the effects of flooding across each part of a catchment, the process for setting priorities for the Port Phillip and Westernport region will be updated to consider this additional information.

Identifying and delivering the best-value approaches

Flood management activities can range from the protection of natural floodplains to managing urban development, providing community education, emergency response and recovery support, flood insurance, stormwater management and harvesting, and major infrastructure works. These activities can have widely varying costs and benefits in different locations.

We generally have good information on the construction and operating costs of flood and drainage infrastructure, and can make good estimates of the reduction in property damage that can be achieved. More information is required to better understand the full effects of some non-structural flood management tools (such as public education). We also require more work to better understand the environmental, social and water-supply value of some new flood management approaches (such as using distributed water storages).

More work is also required to understand the likely long-term service standards provided by infrastructure solutions, as climate change and urban consolidation change the environment around them.

Engaging local communities in the process of developing flood management solutions is essential to ensure they are appropriate, and to support communities to understand their risks.

To develop and deliver agreed flood management solutions, regional and local authorities need to work together to develop information on the full costs and benefits of different flood management actions, appropriate funding sources, and delivery plans.

It is not possible to remove all flood risks completely. Even where the likelihood or extent of flooding can be reduced, some risk is likely to remain. A range of other measures may also be needed to minimise the possible consequences of floods in these locations.

In all areas, existing flood and drainage infrastructure and services must be maintained to ensure they continue to operate safely and effectively.

Flood management plans and flood emergency plans have been developed for each local municipality, documenting local challenges and risks, priority local flood issues, and activities required to help address them. These plans will continue to improve as new data becomes available.

Making best use of resources – choosing the right approach in each location

To develop the right response to managing flood risks in each area, flood managers need to understand local community concerns, and the costs and effects of each flood management option.

Identify the highest priority areas for action

To target our activities in the most urgent areas over the next five years, we will review and update our current prioritisation frameworks to make use of new knowledge on risks and on the local effects of flooding across the region.

Action	Lead	Key participants
8.1 Expand the process for prioritising flood management locations to consider local-scale flood risks and effects, in consultation with stakeholders.	MW	Councils, DELWP, EMV, EPA, MAV, VICSES
8.2 Regularly prioritise flood risks across the region in consultation with stakeholders and communities, and share outcomes.	MW	Councils, VICSES
8.3 Where local flood management priorities are identified, share this information with stakeholders.	Council	MW, VICSES

Develop the right mix of solutions

Identifying the best approach for each priority area requires an understanding of local needs, broader environmental and catchment conditions, possible future risks, and the lifecycle costs and additional benefits (or drawbacks) of each potential flood management solution. This information is used to develop the best-fit solution for each location.

Action	Lead	Key participants
9.1 Expand framework for identifying best-fit flood management solutions, and use to identify the best approaches in each priority area *(considering social, economic and environmental outcomes and community preferences*).	MW	BoM, Councils, DELWP, retail water authorities, VICSES
9.2 Contribute local and technical knowledge to the development and identification of best-fit solutions as required: • Community requirements and local knowledge • Emergency management and response • Weather forecasting information and data • Water supply and sewer infrastructure.	*For relevant areas of expertise:* • BoM • Councils • Retail water authorities • VICSES	MW

Implement flood management solutions

Flood managers document agreed approaches and develop programs to deliver them over time. Melbourne Water will progressively deliver agreed solutions to address priority areas across the region.

Other organisations, such as councils and VICSES, may also choose to deliver additional flood management projects to meet local community needs or agency objectives.

Action	Lead	Key participants
10.1 Deliver agreed solutions for Port Phillip and Westernport priorities, and share work planning with stakeholders.	MW	
10.2 Work with stakeholders to update municipal flood management plans reflecting new information, local priorities, and agreed flood management solutions.	MW	Councils, VICSES
10.3 Work with stakeholders to update municipal Flood Emergency Plans reflecting new information, local priorities, and agreed emergency management measures.	VICSES	Councils, MW
10.4 Deliver agreed actions to help address local priority flooding, as developed through flood management plans and flood emergency plans.	Councils	MW, VICSES

Ongoing management of flood and drainage infrastructure

Maintenance and management is necessary to ensure existing systems remain safe, and function to agreed operating standards. To get the best performance from assets, maintenance and upgrade activities, we need to consider flood and drainage functions together, along with information about the broader catchment.

Action	Lead	Key participants
11.1 Continue managing and planning ahead for existing regional flood and drainage assets (generally those serving catchments greater than 60ha).*	MW	Councils, MPA, retail water authorities, VICSES
11.2 Continue managing and planning ahead for existing local flood and drainage assets (generally those serving catchments smaller than 60ha).*	Councils	MW, retail water authorities, VICSES

*(You will find more information on local and regional catchments in the discussion of roles on page 42 and in the Glossary).

Outcomes:

Flood risk management programs and solutions are delivered for the best value and focus on highest priority areas first.

Future risks are identified and included in flood management planning.

Avoiding new risks by managing urban development

The population of Port Phillip and Westernport is expected to grow by 3.5 million by 2050, adding 1.6 million new households.[11] Managing additional run-off from new urban development is critical to avoid creating new flood risks.

Avoiding new risks within floodplains

Because we generally have good knowledge of where flooding is likely to occur, we can ensure new development is located and designed so that buildings and infrastructure are not at risk. State planning policies and regulations require planning authorities to consider the 1% annual exceedance probability of flood when assessing new development in floodplains.

Urban development terms

Greenfield development

Development of new residential and commercial areas on undeveloped land located on the metropolitan fringe. In our region much greenfield development occurs in designated urban growth corridors.

Infill development

Development of higher-density buildings within existing urban areas. This includes building a second dwelling on a residential backyard, extending existing buildings, or replacing one building on a lot with more or larger buildings. Infill development happens in residential and commercial areas. This is often called urban consolidation.

Infill development also includes major redevelopments such as conversion of old industrial sites to residential land. These are sometimes known as 'brownfield' developments.

Development of established lots

Development of established lots within floodplains is currently managed by including flood management planning controls in municipal planning schemes (e.g. Special Building or Land Subject to Inundation Overlays). These controls enable Melbourne Water and councils to assess new developments so that new buildings, extensions or works will have a lower risk of flood damage, their occupants will be safer, and increases in nearby flood levels are avoided. Planning controls work together with building regulations to ensure new development responds to identified flood risks.

Melbourne Water and councils have worked together to include mapped flood extents of waterways and major drainage systems in almost all planning schemes across the region. Several councils have also included mapped flood extents of local drainage infrastructure.

(More information on flood mapping for the region is available on page 23. More information on flood mapping and planning schemes is available in the Flood Information and Planning Schemes fact sheet, available at www.melbournewater.com.au).

Technical flood advice is provided by Melbourne Water to councils and the Metropolitan Planning Authority (MPA) to support appropriate development on an ongoing basis.

When flood mapping is added to planning schemes, communities are notified to ensure they can participate in the planning scheme amendment process and provide additional local knowledge as required.

Information for developers on how to meet the safety requirements for building in floodplains is provided in Melbourne Water's *Guidelines for Development in Flood Prone Areas*.

11. *Plan Melbourne* 2013, *Victoria in Future* 2014.

New greenfield subdivisions

When building new greenfield subdivisions, developers are required to locate new lots outside floodplains[12] to ensure new properties are safe, to preserve natural floodplains, and preserve the storage and safe passage of floodwaters. They are also required to avoid increasing flood levels downstream. This is usually achieved by providing flood and drainage infrastructure including channels and retarding basins that hold and store new stormwater runoff. Urban runoff management objectives for new residential subdivisions are prescribed in standard C25 of Clause 56.07–4 of all planning schemes.

In some greenfield and brownfield subdivisions, consideration is now being given to the potential for rainwater tanks to hold and store water, and to play a role in flood prevention.

In Port Phillip and Westernport, flood and drainage planning for new greenfield developments is generally integrated with water quality and waterway protection planning during the Precinct Structure Plan (PSP) process for growth corridors. Flood and drainage infrastructure are generally delivered by developers through Melbourne Water Development Services Schemes.

Detailed flood management requirements for new greenfield developments are set out in Melbourne Water's *Land Development Manual*.

12. For planning purposes, the floodplain is defined as the area that would be inundated in a 1% AEP flood. Floodplains can sometimes be modified to reduce their size, provided that flood carrying and storage capacity is retained, and there are no downstream impacts.

Regular updates to planning schemes and development guidelines

Melbourne Water works with councils to ensure new and updated flood mapping is included in local planning schemes. Where necessary, councils can also add local policies to their planning schemes to help manage local flood risks.

Melbourne Water keeps urban development guidelines up-to-date through periodic review.

Action	Lead	Key participants
12.1 Provide new and updated flood maps to Planning Authorities as available.	MW	Councils, DELWP
12.2 Include relevant flood maps and information in local planning schemes, planning policies and precinct structure plans.	Councils	MW
12.3 Support the inclusion of flood mapping in planning schemes.	MW	Councils
12.4 Include flood information in growth area precinct structure plans.	MPA	Councils, MW
12.5 Maintain and continually improve planning and development guidelines for flood prone land in Port Phillip and Westernport.	MW	Councils, DELWP, MPA, retail water authorities, VICSES
12.6 Provide planning and development advice as a statutory referral authority.	MW	

Outcomes:

Urban growth is consistent with state policies and strategies.

New development and suburbs are well planned to avoid increases in flood risk.

Planning for future growth

As the region grows, redevelopment and infill development is occurring across established urban areas. The increase in impervious surfaces (for example, roofs and paving) associated with new development increases the volume of stormwater runoff contributing to downstream floods. Unless well managed, infill development across a catchment may increase flood risks downstream.

Research and analysis of the potential flood impacts of urban consolidation is now underway. We need further work to understand how best to avoid and manage any impacts, including input from planning, floodplain and drainage authorities.

Improve our understanding of the long term effects of development

Urban development, particularly infill development, needs to be better understood.

More detailed knowledge on the locations where new infill development is likely to occur and what the effects are likely to be in different kinds of catchment will support appropriate flood management steps.

Action	Lead	Key participants
13.1 Continue research and modelling to understand the possible flood effects of urban growth and consolidation across the region.	MW	Councils, DELWP, MPA, technical and research organisations as required
13.2 Contribute development information and forecasts to research and planning for the region: • Municipal development information • Growth area development information • Population growth information.	*For relevant areas of expertise:* • Councils • DELWP • MPA	

Integrated water management

Integrated water management (IWM) is a way of considering the natural water cycle and all our water supply and management systems, together.

It provides new opportunities to reduce or better manage flood risks.

The aim of integrated water management is to bring all relevant factors together when making water management decisions. We use this approach to help us contribute to a more sustainable, prosperous, liveable and healthy community. By planning and delivering flooding, drainage, waterway, water supply and sewage services together, there are opportunities to reduce costs, improve amenity and environmental outcomes, and help make our water supplies as secure and efficient as possible.

Harvesting or simply slowing down the flow of water that runs quickly off hard surfaces can help to reduce flooding. Harvested water can be used to keep public spaces and gardens green. Using stormwater and floodwater increases our total water supply, and helps reduce the damage that they can do to waterways and the bays.

Land used to hold or slow floodwaters can offer extra benefits by providing space for native plants and animals, and increasing the green open space available for recreation.

Community participation in the development of IWM tools is essential to understand the value of local benefits, and to understand when it is appropriate for local residents to participate in delivering infrastructure that can help manage floods (such as rainwater tanks on properties).

Yarra River in flood

Developing new tools to manage the effects of infill urban development

Upgrading downstream flood and drainage systems to cope with extra stormwater is extremely expensive, and often unfeasible due to various construction constraints. New tools to manage extra stormwater, such as onsite or local water harvesting, are now being developed using integrated water management approaches. Ongoing studies and trials will enable us to understand the effectiveness, costs and benefits of new flood management tools.

Action	Lead	Key participants
14.1 Continue research and analysis to understand the life cycle costs and benefits of new IWM tools for flood management (such as rainwater tanks or distributed water storages).	DELWP	Councils, EPA, MAV, MPA, MW, retail water authorities, technical and research authorities as required
14.2 Provide local and specialist knowledge to IWM research, modelling and analysis projects.	*For relevant areas of expertise:* • Councils • MW • Retail water authorities	

Implement new flood management tools

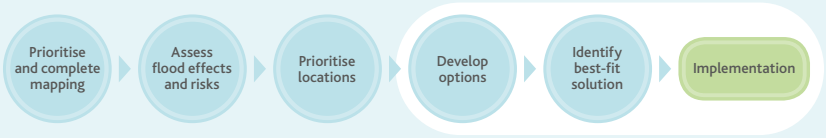
Appropriate and sustainable funding sources and updates to planning and building systems may be necessary in order to implement new flood management tools. This is particularly likely where new tools provide wider benefits, or require participation by organisations who have not traditionally participated in flood management. State government, urban planning, water authorities and floodplain managers need to work together to resolve these issues.

Action	Lead	Key participants
15.1 Identify approaches for planning, delivery and funding of new types of flood management activity.	DELWP	Councils, DHHS, MAV, MPA, MW, retail water authorities
15.2 Contribute local and technical knowledge to the review of funding and delivery of new flood management activities.	*For relevant areas of expertise:* • Councils • MAV • MPA • MW • Retail water authorities	
15.3 Ensure any changes to planning or building regulations to implement new tools are aligned.	DELWP	

Flooded street, Boronia
Image by Wayne Hawkins/Fairfax Syndication

Planning for climate change

The following discussion and actions relate to producing the right information to enable planning and investing for future risks.



Flood managers have identified climate change as one of the most important challenges we face. Planning ahead and taking appropriate action early is likely to help avoid unnecessary cost and disruption.[13]

Climate scientists project that, while climate change will likely result in a decrease in overall rainfall in the region, the intensity of heavy rainfall events will increase and the sea level will continue to rise. This can increase severity and frequency of flood event.[14] Climate change increases the flooding challenges for the region.

Changing rainfall

Climate change is expected to produce more frequent, heavy rainstorms in the south east of Australia.[15] This will likely lead to bigger floods, more often.

Flood models and mapping currently produced by Melbourne Water use estimates of possible changes to local rainfall to understand how flood extents could change.

The CSIRO periodically updates local climate and rainfall scenarios for our region. National guidelines on how to incorporate future scenarios in flood mapping projects are being developed by the Australian Institute of Engineers in their review of Australian Rainfall and Runoff.

Sea level rise

It is essential that we have a clearer understanding of the impact of climate change on rainfall patterns to allow us to plan ahead. This information will inform the risk management and investment decisions we make. We will work together to enhance understanding of changes in rainfall patterns and ensure decision makers consider this in a consistent way.

Very high tides and storm surges can create or exacerbate coastal flooding. Predicted sea level rise is expected to increase this risk. The effects of sea level rise are being considered in state planning policy with the Victoria State Planning Policy Framework requiring decision makers to plan for a rise of not less than 0.8 meters by 2100.[16]

Melbourne Water has produced guidelines for assessing development in areas that are at risk of tidal inundation to support planning authorities in applying state policy.

Melbourne Water and the Victorian State Government have produced flood mapping along coasts in Port Phillip and Westernport Bays. Possible flood risks related to sea level rise are now included in property information statements for the region.

The Central Coastal Board (CCB) and coastal councils have highlighted a need for further mapping of future sea level rise and rainfall scenarios, to inform detailed coastal risk assessments and future adaptation planning.

Local coastal hazard assessment has been completed for Westernport Bay and is yet to be completed for Port Phillip Bay.

Coastal risk assessments are required for both bays to inform adaptation planning.

We need a coordinated and well informed approach to managing long-term flood risks from sea level rise. All Port Phillip and Westernport stakeholders will need to contribute local and technical knowledge to develop new risk assessments, adaptation plans, and updated state policy and guidelines on managing future risks.

13. Victorian Climate Change Adaptation Plan, Victorian Government 2013.
14. CSIRO and Bureau of Meteorology *Climate Change in Australia Projections Cluster Report – Southern Slopes*, 2015.
15. ibid.
16. Victoria State Planning Policy Framework & Victoria Coastal Council 2014.

Understand the flood effects of climate change

The best available data and consistent standards are required to model future scenarios for our region. National guidelines on how to include climate change scenarios in flood modelling are in development. These will be used to understand and map the possible flood effects of climate change on coastal and catchment flooding.

Action	Lead	Key participants
16.1 Update Port Phillip and Westernport catchment and coastal flood mapping guidelines to reflect new climate projections and scenarios, and to meet information needs of stakeholders.	MW	ABM, BoM, CCB, Councils, DELWP
16.2 Include climate change scenarios in new mapping projects to meet stakeholder information needs, considering both changing rainfall and sea level rise.	MW	ABM, BoM, Councils, DELWP

(You will find more on mapping guidelines for the Port Phillip and Westernport region on pages 23–24).

Risk assessment and adaptation planning for climate change

Understanding future risks and planning ahead for them will require all flood managers to work together.

Climate change scenarios will be included in flood mapping and research to support coastal risk assessment and adaptation plan requirements for the region, including urban development planning. To support coordinated adaptation activities in our region, guidelines on how new climate change information can be applied in decision making will be developed.

Action	Lead	Key participants
17.1 Document current and future coastal flood risks identified by communities for Port Phillip Bay and Westernport Bay.	MW	ABM, Councils, CCB, DELWP, VICSES
17.2 Contribute flood mapping and flood management expertise to Port Phillip and Westernport coastal hazard and risk assessments and adaptation plans as required.	MW	
17.3 In consultation with stakeholders, develop guidelines for the region on how new climate change information, both for changing rainfall and sea level rise, can be considered in projects and plans.	MW	ABM, CCB, Councils, DELWP
17.4 Consider Port Phillip and Westernport stakeholder input in new State policies on climate change adaptation for both changing rainfall and sea level rise.	DELWP	
17.5 Contribute to development of state guidelines and policy on managing the long-term effects of sea level rise.	MW	ABM, CCB, Councils
17.6 Maintain guidelines for urban development in areas at risk of tidal inundation from sea level rise.	MW	Councils, DELWP
17.7 Provide planning and development advice as a statutory referral authority for areas identified in planning schemes as at risk of tidal inundation from sea level rise.	MW	

Outcome:
Risks associated with climate change and urban development are planned for and managed.

Working together to improve our effectiveness

OBJECTIVE 3

Land, water and emergency agencies work together to manage flooding effectively.

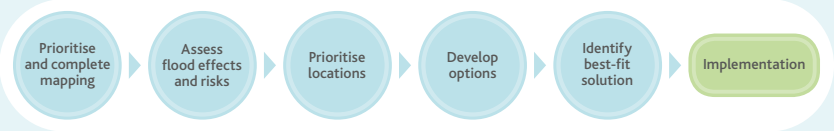
This covers:

- Clarifying roles and accountabilities
- Coordinating activity across catchments
- Supporting emergency response and recovery services.

Key performance indicator:

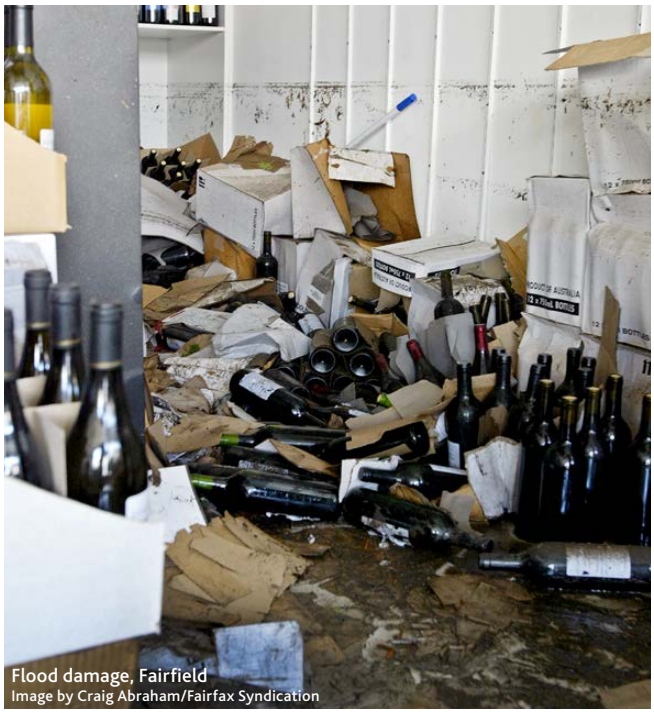
4. A 100 % increase in the number of areas for which there are collaboratively developed plans for flood management.

The following discussion and actions are relevant to all steps in the decision making framework. These collaborative actions support delivery of all actions outlined in preceding sections.



Because a large number of organisations either work toward or influence flood management in Port Phillip and Westernport, flood managers see improved cooperation and collaboration as one of the best ways to improve effectiveness.

Australian and Victorian disaster and emergency management strategies confirm the importance of improving collaboration and cooperation to better plan for and manage risks.


Flood damage, Fairfield
Image by Craig Abraham/Fairfax Syndication

Clearer roles and improved coordination

Clear roles and responsibilities empower flood managers to address the challenges of climate change in a responsive and adaptive manner.

Roles and accountabilities for some aspects of flood management are not agreed upon by all organisations, and emerging issues such as climate change and new approaches to flood management may necessitate a review of existing roles. There may also be ways to improve the efficiency and effectiveness of some flood management activities by refining existing planning, delivery and communication practices.

The 60ha threshold and flood management accountabilities

In our region responsibility for drainage activities has traditionally been divided between local and regional authorities. One way of allocating accountabilities is to understand the size and function of catchments. Smaller catchments (generally less than 60ha) are deemed to provide a local drainage service and larger catchments (generally 60ha and greater) are deemed to provide a regional drainage service. This catchment threshold is the main factor in deciding drainage infrastructure management accountabilities in the region. Not all stakeholders are comfortable with this approach to defining flood infrastructure and risk management accountabilities.

We need ongoing dialogue to establish whether existing practices should be revised to support more efficient delivery of flood and drainage management services.

More information on local and regional catchments is included in the Glossary.

Drain outlet and flood retarding basin at Kennedy Creek, Pakenham

There are also opportunities to improve communication, and opportunities for flood managers to work more effectively with decision makers across related disciplines (such as waterway management, coastal management and water supply and disposal) to ensure complementary outcomes from our work.

Supporting emergency response and recovery

Emergency services can be supported by producing and sharing information relevant to emergency planning, contributing to warning services, and considering emergency management requirements when making urban development and floodplain management decisions.

Flood information can be better shared with operators of critical infrastructure (such as transport and energy networks) to help them plan for emergencies and minimise disruption.

Clarify roles and accountabilities

Floodplain managers need to work with state government departments and each other to make sure roles are clear.

Action	Lead	Key participants
18.1 Continue dialogue on the 60ha threshold approach to delineating accountabilities for flood and drainage infrastructure and flood management services.	DELWP	Councils, MAV, MW
18.2 Contribute local knowledge and perspectives to dialogue on flood management roles, accountabilities and practices in Port Phillip and Westernport.	Councils	MAV
18.3 Contribute information to development of state government policies, accountabilities and guidelines for flood management, as outlined in the Victorian Flood Management Strategy.	*For relevant areas of expertise:* • MW • Councils	
18.4 Consider the outcomes of any dialogue on flood management practices in new state government policies and guidelines on roles and accountabilities for the Port Phillip and Westernport region.	DELWP	Councils, MAV, MW
18.5 Enhance transparency on how the 60ha threshold is currently applied through MW's planning and decision making.	MW	

Outcome:
Ongoing floodplain management activities are supported by clearer roles and accountabilities.

Improve coordination across catchments

Complementary and collaborative land, urban development and waterway planning will support effective and efficient flood management. Communication is particularly useful in early stages of project planning.

Action	Lead	Key participants
19.1 Identify where more information sharing and collaborative planning could support coordinated activities across land, waterway, and water supply planning.	MW	Councils, DELWP, MPA, MAV, PPWCMA, retail water authorities
19.2 Continue sharing flood information with waterway, coastal and water supply managers, and consulting on specific projects.	MW	Councils, MPA, PPWCMA, retail water authorities

Support for emergency response and recovery agencies

Flood risk managers can support emergency services to further reduce the impact of floods and support response and recovery.

Action	Lead	Key participants
20.1 Work with stakeholders to identify opportunities to improve communication and collaboration.	VICSES	BoM, Councils, EMV, MAV, MW
20.2 Include new flood mapping and other relevant information in emergency response planning as it becomes available.	VICSES	Councils, EMV, MW
20.3 Make flood information available to critical infrastructure providers.	MW	EMV, Councils, VICSES
20.4 Continue consulting with emergency services agencies when undertaking flood mapping and management projects.	MW, Councils	VICSES
20.5 Continue undertaking joint emergency response training exercises, with input from relevant stakeholders.	VICSES	Councils, EMV, MW
20.6 Continue leading regional and local emergency response and recovery planning, with input from relevant stakeholders (including communities).	VICSES	Councils, EMV, MW

Outcome:
Land, water and emergency activities are well coordinated to help reduce risks.

Little River in flood

SECTION 5

Delivering this strategy

The vision, objectives, actions, and KPIs outlined in this strategy have been developed in close consultation with floodplain management stakeholders. They reflect the work and responsibilities of many government authorities, and delivering them will require participation from everyone involved.

This section provides an overview of the strategy governance and implementation processes. Melbourne Water will coordinate governance and implementation with the input and participation of endorsing organisations, and this will be overseen by an implementation committee (to be established) including representation from endorsing organisations.

Endorsement and participation

Melbourne Water will be seeking endorsement of the strategy by relevant organisations. Endorsees will agree to:

- Work together to deliver the vision, objectives and outcomes outlined in this strategy
- Participate in strategy governance and reporting processes
- Advocate both within their organisation and externally for delivery of the vision, objectives and outcomes outlined in this strategy.

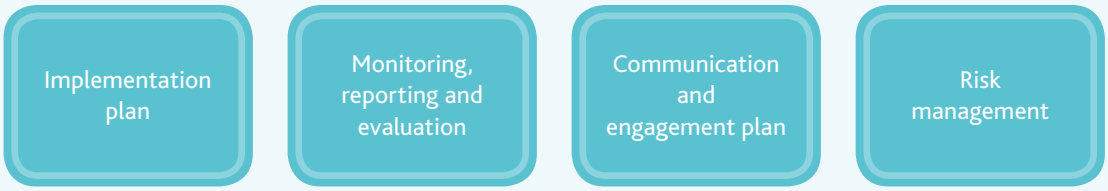
(You will find more information about strategy endorsement in the Endorsement fact sheet available at www.melbournewater.com.au).

Implementation

Detailed governance and implementation plans will be developed to support delivery of this strategy.

Strategy governance framework

An implementation advisory committee made up of endorsees will oversee:



An implementation program will include:

- Action priorities and timelines for Melbourne Water
- Work programs for Melbourne Water
- State strategy requirements and priorities
- Implementation information shared by participating organisations.

Monitoring, reporting and evaluation processes will include:

- Processes for monitoring and reporting delivery of actions and KPIs
- Measurement metrics for the strategy's KPIs
- A process to ensure content of the strategy can be updated if required to remain appropriate
- A five-yearly review of the strategy.

A communication and engagement plan will include:

- Project consultation and input opportunities for participating organisations
- Communication of Melbourne Water work programs
- A process for sharing information on progress.

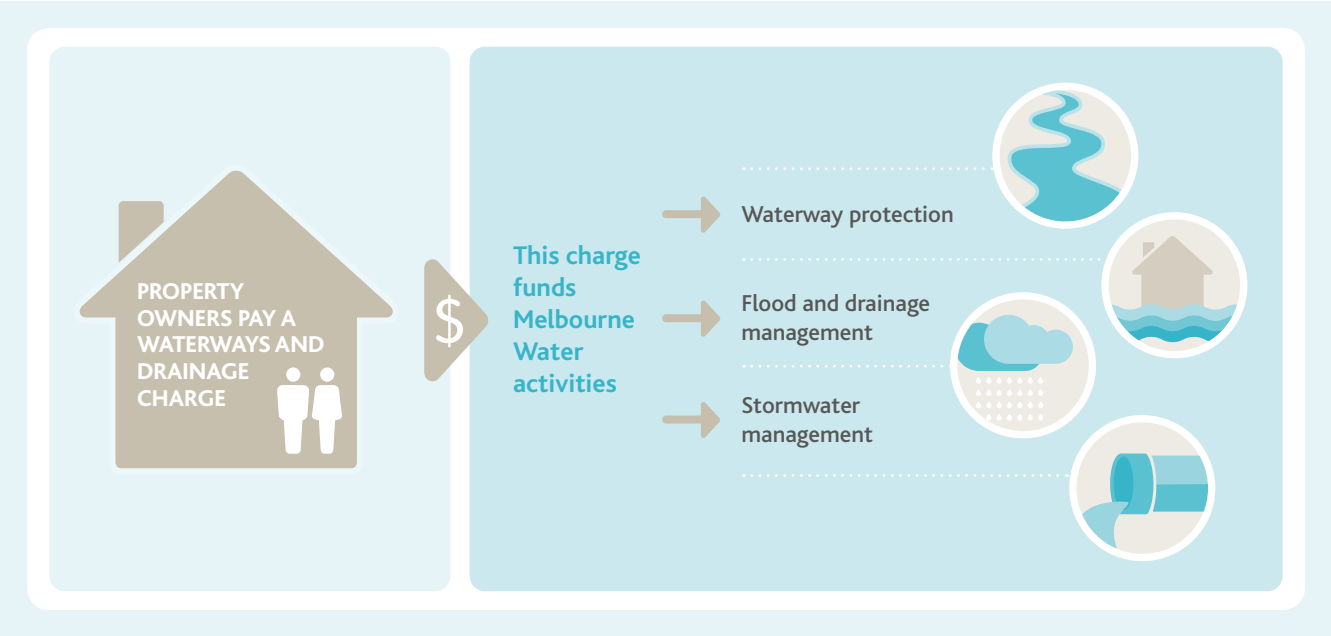
Melbourne Water and a governance body will identify risks and risk management approaches.

Governance, monitoring and review

Melbourne Water funding and work programs

Melbourne Water's work program is guided by this strategy and by delivery obligations set by the Statement of Obligations and the Essential Services Commission. A five-year work program will be established to deliver strategy outcomes. Annual work plans will guide consultation, delivery of actions, and regular monitoring and reporting. (Organisations participating in the delivery of this strategy will have individual prioritisation, planning and budgeting processes and programs that will guide their work).

Melbourne Water's budget for all flood management, drainage and waterways services is created through the Waterways and Drainage charge. This is levied on most properties across the region. The price of this charge is set through periodic research of consumer willingness to pay, and by the Essential Services Commission.



More information on delivery of this strategy including governance, progress reporting and endorsing agencies is available at www.melbournewater.com.au.

Yarra River in flood

APPENDIX 1

Flood management roles

Federal Government

Includes Attorney-General's Department – Emergency Management, BoM, and CSIRO

- Set national best practice standards and frameworks for floodplain and emergency management
- Support development of state strategies and build capacity
- Undertake weather forecasting and establish flood warning services
- Carry out technical research and generate data
- Contribute funding to flood resilience and recovery
- Regulate the insurance industry.

Victorian State Government

Includes DELWP, DHHS, EMV, MPA, Department of Economic Development, Jobs, Transport and Resources, Victorian Coastal Council

- Set state policies and strategies for managing floodplains, natural resources, land and coasts
- Set state policies and strategies for emergency response and recovery
- Lead regional flood relief and recovery
- Set state policy and standards for urban planning and building
- Develop regional and precinct urban growth plans
- Develop local standards and tools for flood management (such as warning systems and messages, risk assessments, and adaptation frameworks).

Floodplain management authorities

Melbourne Water or regional Catchment Management Authority

- Prepare and implement regional floodplain strategies in line with national and state strategies
- Develop flood data and information
- Undertake flood risk assessments and risk-reduction studies
- Prioritise and implement regional risk-reduction projects in consultation with stakeholders
- Support emergency response planning and provision of warning services in line with national and state standards and frameworks
- Advise and support planning authorities on planning for flood prone land
- Manage urban development through statutory referral functions
- Support coastal adaptation planning
- Contribute to flood emergency response and clean up where regional water assets are affected
- Own and maintain regional drainage infrastructure. (In the Port Phillip and Westernport region this generally refers to drainage systems servicing a catchment of greater than 60ha)
- Manage drainage function and environmental health of waterways and floodplains
- Help conserve and protect cultural heritage values of waterways and floodplains.

Regional water authorities

- Manage retail water supply and sewage infrastructure
- Manage flood risks to retail water and sewer infrastructure
- Participate in integrated water management research, projects and planning.

Emergency services agencies

Includes Victoria Police, VICSES

- Lead flood emergency planning
- Coordinate responses to flood emergencies
- Appoint and support local and regional emergency controllers
- Build and support community awareness and preparedness (with others)
- Participate in providing warning services (constructing messages and publishing warnings).

Councils

- Administer local planning schemes and building regulations, applying and enforcing standards for land use and development on flood prone land
- Develop local policies as appropriate to support management of local flood risks
- Support the conservation of natural and cultural values of floodplains through land use planning and land management
- Contribute local knowledge to risk assessment processes
- Contribute to development of local flood management plans and flood emergency plans
- Contribute to local flood mapping and risk reduction studies, and project prioritisation
- Support public awareness and access to flood risk and preparation information
- Provide and manage local drainage infrastructure. (In our region this generally refers to infrastructure serving an area of less than 60ha)
- Help coordinate local relief, recovery and clean-up activities
- Play a key role in planning for climate change and sea level rise.

Communities

- Contribute local knowledge to flood studies, risk assessment and risk-reduction projects
- Participate in reducing personal risks by understanding local risk, emergency preparation, and considering insurance
- Assist with local recovery from flood events.

Insurance industry

- Contribute to setting industry standards on flood insurance
- Use current information to set premium prices.

Glossary

Adaptation

Adjustment in response to actual and expected climate change and or effects, to reduce harm or take advantage of opportunities.

Annual average damage (AAD)

Represents the average yearly cost of flooding in a particular area. It is calculated by taking the total damage caused by all flooding over a period of time and dividing it by the number of years in that period.

Annual exceedance probability (AEP)

This is the likelihood of a flood of a given size happening in any one year. AEP is usually expressed as a percentage; for example, if a flood of a particular size (volume of water) has an AEP of 5%, that means there is a 5% (or 1 in 20) chance of a flood of that size happening in any given year.

Avoid

Stopping or preventing a flood risk occurring or getting worse.

Catchment

A catchment is an area of land that drains to a particular point. All runoff within a given catchment will flow down to the same outlet.

The Port Phillip and Westernport Region includes two major catchments: the areas draining to Port Phillip and Westernport. These major catchments can be divided into smaller river basin catchments. River basin catchments can be further divided by topography into smaller subcatchments, draining to particular waterways or pipes. The region includes approximately 950 subcatchments that drain to Melbourne Water managed waterways and pipes. These subcatchments can be divided again into the smaller areas that drain into particular local gullies or pipes.

Coastal and storm surge flooding

Very high ocean tides occurring during storms can cause flooding along coasts and the lower reaches of rivers, particularly when combined with high rainfall.

Decision makers

The people, organisations and agencies responsible for setting the priorities for flood management in the Port Phillip and Westernport region.

Direct damage

The direct physical damage caused by flooding. This includes damage to property, buildings, possessions, agricultural land and infrastructure.

Flood

Flooding is a natural phenomenon that occurs when water covers land that is normally dry.

(There is a range of terms describing the scale or severity of floods. The following terms from the Bureau of Meteorology describe the size of floods and are used in flood warning services and other public communication about floods).

Minor flooding

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

Moderate flooding

In moderate flooding main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood affected areas may be required. In rural areas removal of stock is required.

Major flooding

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

Flood-aware people

People who understand their flood risks, and know what actions they can take to minimise them, such as building appropriately, taking out insurance and being emergency ready.

Flood management options

The range of methods and tools that can be used to reduce or manage the likelihood or consequences of floods. These include:

- Urban planning and development to avoid placing buildings or people at risk of floodwaters, avoid increasing or changing the flow of floodwaters, and locate appropriate land uses within known floodplains
- Flood emergency preparation and planning by individuals and emergency services organisations
- Private risk-management such as insurance
- Building and managing physical infrastructure to reduce or control floodwaters such as water storage and drainage infrastructure.

Flood map

Maps showing the geographic extent of possible flooding. Maps are informed by hydrologic and hydraulic modelling, and can be produced to show the possible flooding that would arise from rainfall of a given intensity.

Flood Plan

Plans primarily focused on managing or reducing known or possible flooding, or reducing the negative effects of floods. Flood plans include information about the source or causes of flooding, the likely effects, and the steps required to reduce or manage flooding or flood effects. Plans can be made for a specific site, a catchment area or a local government area.

Flood risk

A combination of the likelihood of a flood occurring and the consequence of the flood when it does occur. Melbourne Water has developed a Flood Risk Assessment Framework (FRAF) that enables us to assess and compare risks at a whole-of-catchment scale. The FRAF rates risks as 'Extreme', 'High', or 'Medium'. The current FRAF does not quantify risk at a local or property scale.

Greenfield

The development of new residential and employment precincts on undeveloped land located on the metropolitan fringe.

Highest-priority areas

Locations where floods have the potential to have a significant social, environmental or economic impact on the local community. This includes:

- Catchments with an 'Extreme Risk' (includes assessment of critical infrastructure, number of properties and buildings affected, and vulnerable communities)
- Buildings flooded above floor and/or individual damage threshold
- A community-informed understanding of what is highest priority (including willingness to pay).

The flood management organisations helping to deliver this strategy will develop detailed assessment criteria to support this definition.

Hot-spot flooding

An area that has a history of repeat flooding that causes disruption or damage to properties, buildings, roads or crossings. These areas are typically identified through advice from council and customer complaints.

Indirect damages

The damage arising from disruptions to economic and social activities. Includes the cost associated with emergency response, clean-up, community support, as well as disruptions to transport, commerce and employment.

Intangible damages

Damages that are hard to quantify or measure in monetary terms. These include stress and anxiety, sadness due to loss of pets or items of personal and sentimental value, and the loss of feelings of safety and security in one's home. A particularly important aspect of intangible damages is the effect on people and families when loss of life or serious injury occurs during a flood.

Integrated water management (IWM)

A water management approach which considers all components of the water cycle as a whole to maximise social, environmental and economic outcomes. It achieves this through the coordinated management of drainage, flooding, waterways, water supply and sewerage services.

Lead [action]

Action leaders coordinate the delivery of an action. They may complete all work components of an action, or work with stakeholders to collect knowledge and expertise, or organise multi-agency delivery of an action that relies on implementation through many channels.

Actions that apply to several organisations within their own purview may have several leads.

Local catchment

Generally a small catchment, where local drainage services are provided and managed by councils. Generally includes catchments smaller than 60ha, though in some rural areas, due to historical arrangements, councils manage flood and drainage infrastructure for catchments of up to 200ha in size. Floodwaters and stormwater from local catchments discharge into pipes, channels, waterways and flood management infrastructure managed by Melbourne Water.

Locally and regionally appropriate flood management approaches

The approaches chosen to minimise current or future flood risks in a local area, through flood managers working with the local community to determine the most effective and commercially viable approaches to reducing flood risks and their impacts. (This includes consideration of regional needs).

Minimise

Taking measures to lessen the impact of a flood event.

Mitigate

Taking measures to reduce the likelihood or consequence of a flood event.

Non-structural solutions

Any non-physical measure used to reduce the consequences of flooding. This includes community education programs, training, insurance, planning and development controls, warning and emergency planning and emergency response.

Participant [actions]

Participants in actions contribute to aspects of delivery; for example, providing local or technical knowledge. They may deliver parts of an activity for example relating to activities on their own infrastructure.

People directly affected by flooding

People living, working or operating businesses within known flood prone areas, who could sustain loss or damage if a flood occurs. (For assessing KPI 2, page 18, in this strategy, flood prone areas includes all land we have identified as having a 1% or greater chance of flooding in any given year).

Prevention, preparation, response, recovery (PPRR)

An approach to emergency risk management that aims to reduce the likelihood and consequences of emergency situations like floods.

A summary of the PPRR approach is:

- **Prevention:** the actions taken to reduce or eliminate the impacts of an emergency before it happens
- **Preparation:** the steps taken to minimise the consequences of an incident and ensure effective response and recovery times
- **Response:** activities undertaken to combat emergencies and provide rescue and immediate relief services
- **Recovery:** taking steps to help affected people and communities achieve a proper and effective level of functioning.

The PPRR approach is used by emergency services in Victoria to respond quickly and effectively to emergency flood events.

Regional catchment

A catchment, often including several local catchments (or subcatchments), larger than 60ha or greater in size. (In some rural areas, due to historical agreements, councils manage flood and drainage infrastructure for areas up to 200ha in size).

Residual risk

The level of risk a community is exposed to after flood mitigation measures have been put in place.

Resilient

People or communities who have a strong understanding of their risks and take active steps to prevent or reduce the impact of floods. A resilient community is better able to withstand a crisis event and has an enhanced ability to recover from the impacts.

Risk assessment

The process used to determine the level of risk at a particular location by quantifying both likelihood and impact of floods. Flood managers use this process to determine management priorities.

Riverine flooding

Occurs when runoff from storms exceeds the capacity of a river or creek and overflows onto surrounding land.

Stormwater flooding

Occurs when runoff from storms exceeds the capacity of our drains and pipes and overflows onto surrounding properties. Overland flooding can happen very quickly. Floods that rise very rapidly are often known as 'flash floods'. Stormwater flooding is sometimes referred to as 'overland flooding'.

Structural solutions

Physical measures used to minimise the likelihood and impacts of flooding. This includes channels, retarding basins and water storage, house raising, flood gates and more.

Tangible damage

The financial and practical impacts of flooding – things that have been affected or destroyed that can be measured in financial terms. This includes damage to property, cars and infrastructure, lost or interrupted utilities, income lost due to disruption, and public clean-up costs.

Urban infill/consolidation

The development of higher-density residential and commercial properties in existing urbanised areas of the city.

Whole of catchment flood maps

Flood maps that are produced by modelling water flows through an entire catchment area, including all land and all natural and constructed drainage systems.

Acronyms

AAD	Annual average damage
ABM	Association of Bayside Municipalities
AEP	Annual exceedance probability
BoM	Bureau of Meteorology
CCB	Central Coastal Board
EMV	Emergency Management Victoria
DEDJTR	Department of Economic Development, Jobs, Transport and Resources
DELWP	Department of Environment, Land, Water and Planning
DHHS	Department of Health and Human Services
FRAF	Flood risk assessment framework
ICA	Insurance Council of Australia
IWM	Integrated water management
MAV	Municipal Association of Victoria
MPA	Metropolitan Planning Authority
MW	Melbourne Water
PPRR	Prevention, preparation, response, recovery
PSP	Precinct structure plan
VCC	Victorian Coastal Council
VICSES	Victoria State Emergency Service

Bibliography

Australian Government Attorney-General's Department – Emergency Management 2013, *Managing the Floodplain: a guide to best-practice flood risk management in Australia*, Handbook 7, 2nd ed, Australian Emergency Management Institute, Victoria.

Bureau of Meteorology 2015, Flood Warnings–*Definitions and Terminology* http://www.bom.gov.au/water/floods/floodWarningServices.shtml

Council of Australian Governments 2011, *National Strategy for Disaster Resilience*, Commonwealth of Australia, ACT.

Department of Environment, Land, Water & Planning 2015, Draft *Victorian Floodplain Management Strategy*, Victorian Government, Melbourne.

Department of Environment, Land, Water & Planning, *Victoria Planning Provisions*, http://planningschemes.dpcd.vic.gov.au/schemes/vpps.

Department of Environment, Land, Water & Planning, *State Planning Policy Framework*, http://planningschemes.dpcd.vic.gov.au/schemes/vpps.

Department of Environment, Land, Water & Planning, Victorian Coastal Inundation Dataset, http://services.land.vic.gov.au/spatialdatamart/.

Department of Transport Planning and Local Infrastructure 2013, *Plan Melbourne: Metropolitan Planning Strategy 2014*, Victorian Government, Melbourne.

Grose, M. et al., 2015, *Southern Slopes Cluster Report, Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports*, eds. Ekström, M. et al., CSIRO and Bureau of Meteorology, Australia.

Pilgrim, DH (ed) 1987, *Australian Rainfall and Runoff – A Guide to Flood Estimation, The Institution of Engineers*, Barton, ACT.

Rockefeller Foundation 2015, Resilience Description, http://www.rockefellerfoundation.org/our-work/topics/resilience/

Victoria Coastal Council 2014, *Victorian Coastal Strategy 2014*, Victorian Government, Melbourne.

Victorian Government 2013, *Victorian Climate Change Adaptation Plan*, Victorian Government, Melbourne.

Victorian Government 2014, *Victoria in Future 2014*, Victorian Government, Melbourne.

Victoria State Emergency Services 2012, *State Flood Emergency Plan*, Victoria.

Melbourne Water
990 La Trobe Street, Docklands, Vic 3008
PO Box 4342 Melbourne Victoria 3001
Telephone 131 722 Facsimile 03 9679 7099
melbournewater.com.au

ISBN 978-1-921911-91-0

All actions in this strategy will be delivered subject to funding.

VICTORIA State Government

Melbourne Water