

Melbourne Water Flood Risk Assessment:

How flood impacts are assessed in
the Port Phillip and Westernport region



INTRODUCTION

Melbourne Water is the regional drainage and floodplain management authority for the Port Phillip and Westernport Region. We manage and maintain a number of retarding basins, water quality treatment wetlands, levee banks, pump stations, flood gates and underground drains.

Spanning some 12,800 kilometres and covering major catchments including Werribee, Maribyrnong, Yarra, Dandenong and Westernport, the flood management and drainage challenges in the region are significant.

By working with a wide range of stakeholders we are constantly striving to reduce the flood risk to the community, property and infrastructure, while increasing people's understanding of and preparedness for floods.

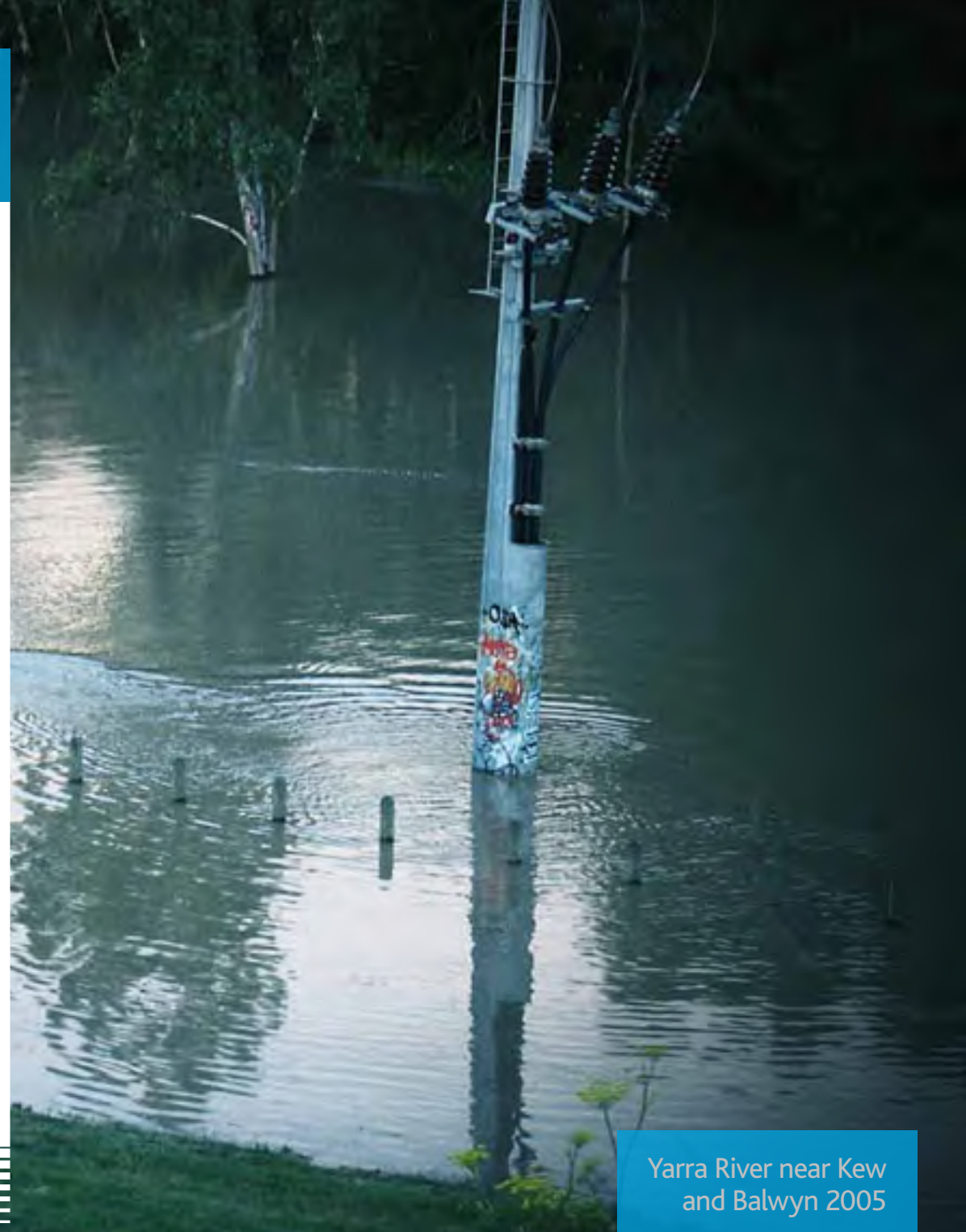
Floods are natural and we can't stop them from happening but we work to minimise the level of damage they cause to people, places and communities.

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We have developed a Flood Risk Assessment Framework to help us assess flood risks and identify the benefits of flood risk management measures over time.

This framework helps us deliver on the commitments we made in our Flood Management and Drainage Strategy, and moves us closer to achieving the targets outlined in the Waterways Operating Charter and Waterways Water Plan.

This document explains how the framework was developed, outlines its key features, and details how it's used to prioritise the management of flood risk across the region.



Yarra River near Kew and Balwyn 2005

MELBOURNE WATER: MANAGING MELBOURNE'S WATER TODAY, TOMORROW AND BEYOND

Melbourne Water is owned by the Victorian Government and responsible for \$9.4 billion of key water-related assets.

We're dedicated to working to ensure a sustainable water future for all Melburnians, and pride ourselves on building strong relationships and partnerships to achieve this common goal.

We consider social, environmental and financial effects and short term and long-term implications in all our business decisions. Our key stakeholders are customers, government, regulators, other water businesses, land developers, the community and suppliers. These stakeholders and our other strategic partners, including alliance colleagues and research organisations, help us achieve our objectives.

Our roles and responsibilities at Melbourne Water are both diverse and comprehensive. Specifically, we:

- Manage water resources sustainably and secure supplies for a range of uses in the context of population growth and climate change
- Protect public health by providing safe water, sewerage and drainage services
- Protect, conserve and improve natural assets and use natural resources sustainably
- Plan, build and manage assets efficiently by adopting innovative solutions and whole of life approaches to meet customer service, community, and environmental objectives
- Are recognised as a reliable and trustworthy organisation, willing to listen, work collaboratively and deliver on our promises.

Dry reservoir
2007

FLOODS AND FLOODING:
A NATURAL PART OF MELBOURNE

As the waterway manager for the Port Phillip and Westernport region, Melbourne Water looks after a diverse asset base:

8400 kilometres of rivers and creeks that drain into Port Phillip and Western Port

1463 kilometres of drains

305 constructed waterway treatment systems and wetlands

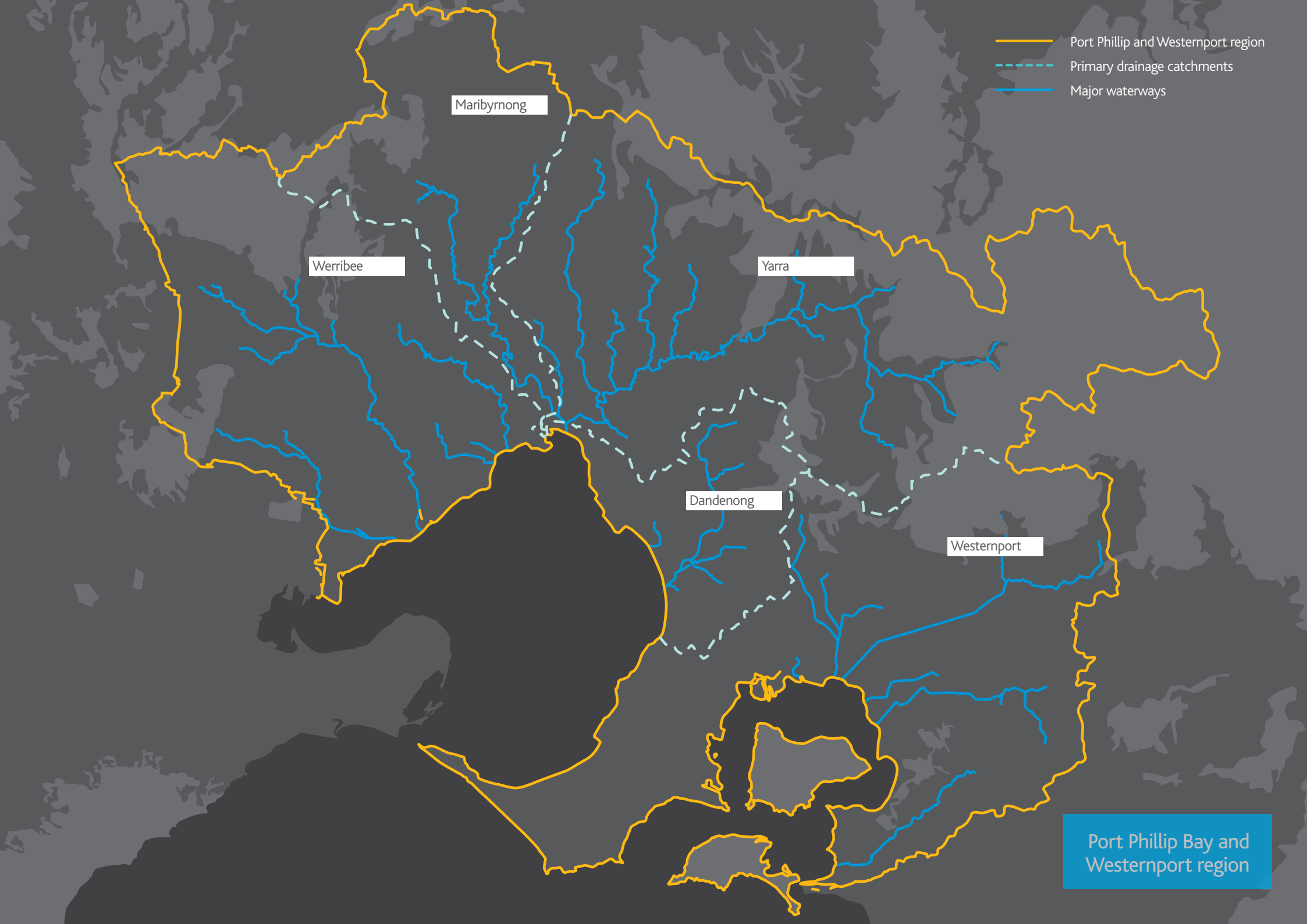
277 monitoring stations on waterways and drains

22 drainage pumping stations

213 retarding basins

174 kilometres of levee banks that restrict floodwaters in storm events

As the drainage and floodplain management authority for the region one of our key responsibilities is to protect the community from the many impacts of flooding.



- Port Phillip and Westernport region
- - - Primary drainage catchments
- Major waterways

Maribyrnong

Werribee

Yarra

Dandenong

Westernport

Port Phillip Bay and Westernport region



FLOODS AND FLOODING: A NATURAL PART OF MELBOURNE

WHAT IS FLOODING AND WHAT CAUSES IT?

Floods occur when a surge of water caused by high rainfalls breaches the banks of a river or creek, or when the amount of runoff exceeds the normal capacity of underground drainage systems and causes them to overflow.

While flooding occurs naturally, some floods are considered extreme and require measures that reduce both their risk and impact.

WHAT SORT OF FLOODING DOES THE PORT PHILLIP AND WESTERNPORT REGION EXPERIENCE?

Historically speaking, the Port Phillip and Westernport region predominantly faces three main types of flooding:

1. **Riverine flooding**, which is caused when rivers and creeks breach their banks and flow onto the surrounding floodplain.
2. **Overland flows (flash floods)**, which are caused by runoff from severe storms beyond the capacity of underground drainage systems, where water runs downhill along overland flow paths (e.g. valleys).
3. **Coastal tidal and storm surge flooding**, which is caused by extreme weather conditions or ocean tides above normal sea levels causing the coastline and nearby tidal rivers to flood.

While flooding occurs naturally, some floods are considered extreme and require measures that reduce both their risk and impact.

FLOODS AND FLOODING: A NATURAL PART OF MELBOURNE

FLOOD IMPACTS: PEOPLE, PLACES AND PROPERTY

Flooding deeply affects individuals, households, and the community long after floodwaters have subsided or receded. Therefore, the impacts of flooding and flood damage are generally classified as *tangible* and/or *intangible*.

Tangible damage is about the financial and practical impacts of flooding. It is easy to measure in monetary terms and refers to things that have been affected or destroyed, including property, services, utilities, cars and infrastructure.

Examples of tangible damage include:

- Damage to buildings and contents
- Clean-up costs for home owners
- Loss of stock for businesses
- Public clean-up costs
- Loss of business or trade
- Value of lost earnings because of the disruption.

Intangible damage, is about the indirect impact that flooding has on people and their lives. It is difficult to measure in monetary terms but is often emotionally crippling and long lasting and are the effects that most flood victims have to endure.

Examples of intangible damage include:

- Perceived loss of security at home
- Emotional suffering
- Loss of irreplaceable memorabilia.





THE HISTORY OF FLOODING IN THE REGION

1891

The Great Flood – Riverside suburbs of Collingwood, Richmond and Prahran flooded, with approximately 3,000 people left homeless.

1906

One of the largest floods to occur on the Maribyrnong River - 5.18m.

1916

Another major flood on the Maribyrnong River.

1934

350mm of rain fell in 48 hours over the Yarra catchment, with 140mm falling over metropolitan areas. 6,000 people left homeless and 18 people died.

1974

The second largest flood on the Maribyrnong River, occurring on 15 and 16 May when 110mm of rain fell on the catchment over a 48 hour period.

1975

The Maribyrnong Flood Warning System installed to continuously monitor catchment conditions, rainfall and flows.

2005

Widespread riverine flooding causing little property damage but did cause localised disruption to transport infrastructure.

2010

Flash flooding in CBD and metropolitan areas resulted in hundreds of thousands of dollars damage to property.

FLOOD MANAGEMENT: MAKING GREATER MELBOURNE SAFER

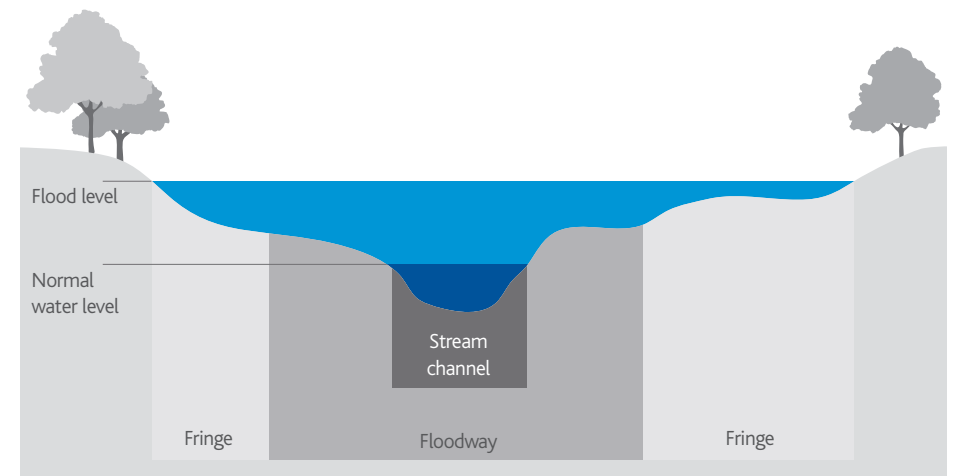
WHAT IS A FLOODPLAIN?

A floodplain is an area of mostly flat land surrounding a river, stream or creek that experiences flooding when one of these waterways overflows its banks.

Floodplains are divided into two main parts:

1. **The Floodway:** the main area affected by an overflow, where the majority of water gathers to create a new, stronger water path
2. **The Flood Fringe:** the outer area that lies beyond the floodway, where less water gathers and it moves much slower.

As defined in the Water Act 1989, Melbourne Water is responsible for managing the floodplains in the Port Phillip and Westernport region of Victoria.



FLOOD MANAGEMENT: MAKING GREATER MELBOURNE SAFER

MANAGING MELBOURNE'S DRAINAGE SYSTEM

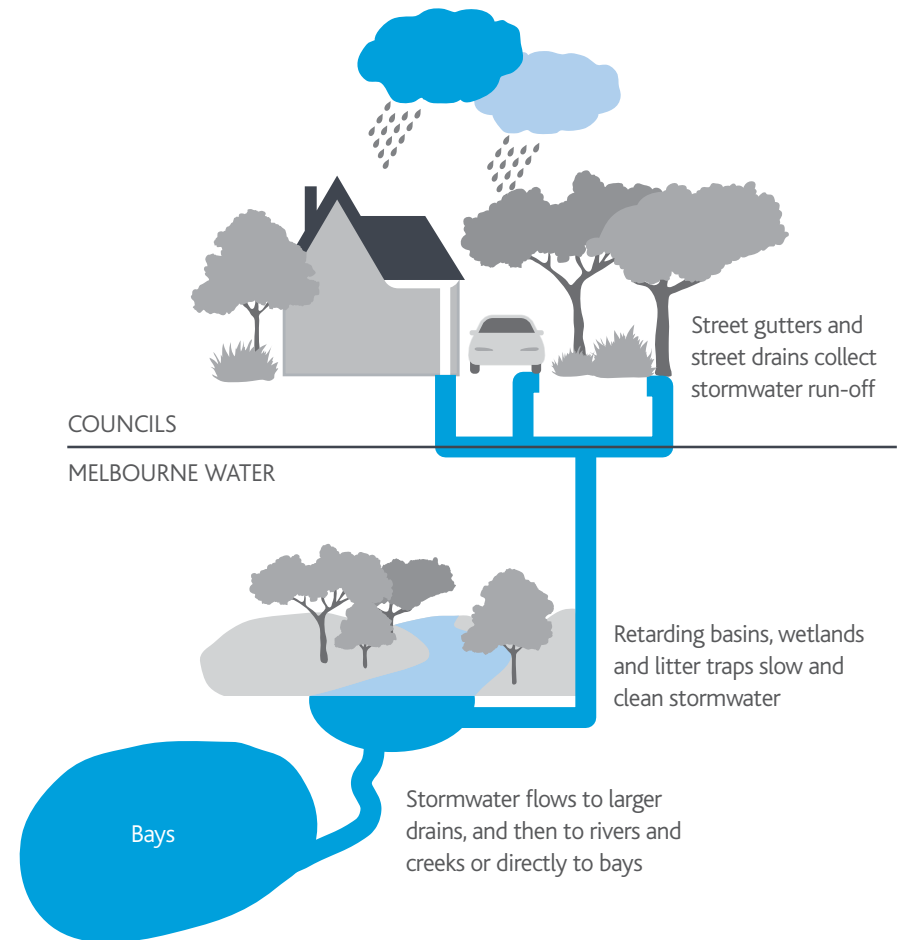
The drainage system is designed to control the flow of water by collecting and funnelling surface water to waterways and the bay.

We work closely with councils, developers and landowners to ensure that the drainage system continues to function properly as Melbourne grows. We assess new developments and redevelopments of land to make sure they are adequately designed to protect people and property from floods and to ensure the health of local waterways is not adversely affected.

A 1 in 100 year drainage standard has been adopted as it is considered an appropriate balance between the likelihood of and the consequences of flooding for most developments. This is a commonly used international standard. The standard, correctly referred to as the 100-year Average Recurrence Interval (ARI) is a statistical estimate of the average period (in years) between the occurrence of floods of this magnitude or larger. It is also expressed as a probability, such as there is a 1 per cent chance in any one year of such an event occurring.

Melbourne Water uses the 100-year ARI standard to define the extent of the overland flooding along the drainage system or along waterways, and to specify flood levels for example in flood warnings and to assess development applications.

Of the 100,000 properties that are currently at risk of flooding in the Port Phillip and Westernport Region 82,000 of these are at risk of flooding from overland flows from the drainage system.



FLOOD MANAGEMENT: MAKING GREATER MELBOURNE SAFER

OUR ROLE IN FLOODPLAIN MANAGEMENT

By working with Victorian government departments, local councils, emergency service organisations and the community, we're able to combine knowledge, skills and understanding to create solutions that help protect people from the effects of flooding.

Our primary floodplain management activities are flood mapping and flood mitigation.

1. Flood mapping: Monitoring the past and present to predict the future

To help plan and provide a safe, high quality level of flood protection and management for the community, Melbourne Water actively maps the region's floodplains and overland flow paths.

This floodplain and overland flow mapping of the Port Phillip and Westernport region enables us to:

- Determine how far floodwaters are likely to extend and how high they're likely to rise
- Identify current and future flood risks
- Undertake more informed, effective flood management
- Work with other agencies to develop improved responses to flooding.

2. Flood mitigation: preparing people for, and managing, risk

Because floods are natural events, we can't remove all flood risks. Through mitigation measures, we work at reducing the economic, social and community impacts of flooding.

Our flood mitigation measures in the Port Phillip and Westernport region include:

- Management of the drainage system
- Community education about how to prepare for floods
- Issuing flood warnings for major rivers and creeks
- Maintenance of flood protection infrastructure (e.g. pipelines, floodgates, levees)
- Ensure the development occurs with appropriate levels of flood protection
- Carrying out flood protection works.

EXAMPLE OF FLOOD MAPPING: BASS RIVER, BASS, VICTORIA



Flood mapping of the Bass River shows the river floodplain winding through the township of Bass in southern Victoria.

FLOOD RISK ASSESSMENT: THE KEY TO COMMUNITY SAFETY

WHAT IS FLOOD RISK?

'Flood risk' refers to the potential that flooding has to cause danger, stress, social disruption, property damage and financial impacts.

Melbourne Water measures flood risk by determining the likelihood of a hazardous flood and the nature and severity of its consequences i.e. where is flooding most likely to occur, what sorts of impacts would it have, and how much damage could a flood cause?

WHY IS FLOOD RISK ASSESSMENT IMPORTANT?

Even though floods are a natural and inevitable event, Melbourne Water is continually working to find ways of managing the risks they pose to public health, safety, property and infrastructure.

Our current assessments tell us that there are currently more than 100,000 properties in the Port Phillip and Westernport region that are at risk of flooding – 82,00 of these properties are at risk of flooding from overland flows, and more than 40,000 of them contain buildings or dwellings that are at risk of flooding above floor level.

Our long-term aim is to use this information to help minimise extreme flooding risks and significantly increase community understanding of, and preparedness for, floods in the region.



Yarra Valley Racing Centre
Yarra Glen 1996

MELBOURNE WATER'S FLOOD RISK ASSESSMENT FRAMEWORK:

A NEW FRAMEWORK, A CHANGE IN APPROACH

While the focus of flood risk assessment in the Port Phillip and Westernport region has traditionally been placed on economic consequences, Melbourne Water has recognised the need to place equal emphasis on the social and safety impacts of flooding. This change in approach has been realised in our Flood Risk Assessment Framework, which gives equal consideration to all these factors in the assessment of flood risks for in the region.



Templestowe
1991

DEVELOPMENT OF THE FRAMEWORK

Developed in consultation with a variety of stakeholders (including government departments, emergency services, regional authorities and local government), the Flood Risk Assessment Framework features valuable input from several key sources, including:

- Professor John Handmer's 2008 RMIT University Report - commissioned by Melbourne Water;
- A social research study conducted by the Klein Partnership (2008); and
- The International Risk Management standard ISO31000 – which underpins the framework's methodology to ensure global best practice.

Melbourne Gun Club
Lilydale 1996

MELBOURNE WATER'S FLOOD RISK ASSESSMENT FRAMEWORK:

Key to the development of the Flood Risk Assessment Framework was both the collaborative formulation of criteria to determine flood risk tolerability thresholds, and, perhaps most importantly, an increased focus on *three* key factors for flood risk assessment. These factors are:

- 1. Consideration of the social impacts of flooding:** The framework factors in the effects of social impacts for people and the community when determining appropriate flood risk priorities and responses.
- 2. Defining and assessing extreme flood risk:** The framework clearly defines what constitutes an extreme flood risk, and enables area assessments to allow flood mitigation activities to be properly targeted and prioritised.
- 3. Minimising flood impact through preventative measures:** The framework includes a range of preventative measures to be used to reduce flood impacts. For example, public awareness programs, education initiatives, flood warning systems, land use planning and emergency management plans.

HOW IS FLOOD RISK ASSESSED USING THE FRAMEWORK?

The framework is used to identify and evaluate flood risks by using the following process:

- 1. Establish the risk context:** what sort of flood risk is involved?
- 2. Identify the risk:** which drains and waterways are flood risks?
- 3. Analyse the risks:** what's the likelihood of severe rainfall to cause a flood?
- 4. Evaluate the risks:** is this flood risk low or extreme?
- 5. Treat the risks:** which mitigation measures should be used (structural and/or non-structural)?
- 6. Monitor and review:** what's happening in the region right now?
- 7. Communicate and consult:** have we engaged and consulted internal expertise, stakeholders, council and the community?

MELBOURNE WATER'S FLOOD RISK ASSESSMENT FRAMEWORK:

APPLYING THE FRAMEWORK

The framework uses a Flood Risk Matrix to determine levels of flood risk for each catchment in the region. The matrix works by adding the ratings for the 'likelihood' of flooding with ratings for predicted 'consequences', giving an overall risk score. This risk score is then used to rank the flood risks. This risk ranking is then used to inform our flood protection program.

Here's how it works...

		5	Medium	Medium	High	Extreme	Extreme
		4	Medium	Medium	Medium	High	Extreme
Consequence		3	Low	Medium	Medium	Medium	High
		2	Low	Low	Medium	Medium	Medium
		1	Low	Low	Low	Medium	Medium
			1	2	3	4	5
			Likelihood				

Major storm activity
2007

MELBOURNE WATER'S FLOOD RISK ASSESSMENT FRAMEWORK:

Stage 1

First, we assess and rate the likelihood of severe rainfall to cause a flood. To do this, we consider the probability of storms or rainfall to cause flooding in the review period – which is 100 years. Because severe rainfalls are a one-in-100 year event, it's likely that a catchment in the region will be affected in the next 100 years. The likelihood of flooding, therefore, is rated as 'almost certain' – or, 5 on a scale of 1 to 5.

Stage 2

Next, we measure the potential consequences of a severe rainfall event (e.g. flooding and property damage). To do this, we start by assessing the social, economic and safety impacts of a flood event in each of the region's catchment areas. These impacts are assessed against criteria in the Flood Risk Matrix and scored from low (1) to high (5).

Stage 3

Once the social, economic and safety impacts have been scored, we then assess the community preparedness of each catchment (or study) area in the region, and adjust the economic and social impact scores accordingly. For example if a community is well prepared for a flood (e.g. familiar with local flood emergency plans) and well informed of relevant risks, then the consequences of a flood are likely to be reduced.

Stage 4

We then finalise the overall consequence score by adding the adjusted economic, safety and social impact scores together, and dividing this total by three. The result is a consequence score that ranges from low (1) to high (5).

Stage 5

With both the likelihood and consequence scores finalised, we add them together to arrive at an overall flood risk score. If this score is between 6-7 then the risk is deemed 'medium', if the score is between 7-8 then the risk is deemed 'high'. If it is between 9-10 then it is deemed 'extreme'.

THE FUTURE: A NEW FRAMEWORK FOR A NEW ERA

The Flood Risk Assessment Framework is a new approach in Melbourne Water's flood management of the Port Phillip and Westernport region. It puts protecting people and property at the heart of the process.

The framework provides a well defined process for reviewing the region's flood risks and assessing the ongoing effectiveness of flood management measures. The framework will be instrumental in helping Melbourne Water achieve its long term aim of minimising all known extreme flooding risks.

Importantly, this framework also represents a shift in the thinking that surrounds flood risk assessment. Previous assessment tools have largely focused on the economic cost of floods. This new approach places equal emphasis on the personal 'social' and 'safety' affects of floods.

Central to this new approach is increasing the community's awareness of, and personal preparedness for floods.

To ensure that the framework is functioning well and achieving its objectives, the Flood Risk Matrix that underpins it will be annually reviewed, maintained and updated accordingly. As with all of our flood management activities, this process will be undertaken in collaboration with our key stakeholders as part of our ongoing effort to deliver integrated flood management programs.

Ultimately, Melbourne Water's long-term aim is to minimise all known extreme flood risks to public health and safety in the region.

Likelihood



Consequence
(social/economic/safety)



**Community
Preparedness Rating**



Adjusted Consequence
(social/economic/safety)



Likelihood



Risk Score



Relevant Actions



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**Melbourne
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