Port Phillip Bay Coastal Hazard Assessment

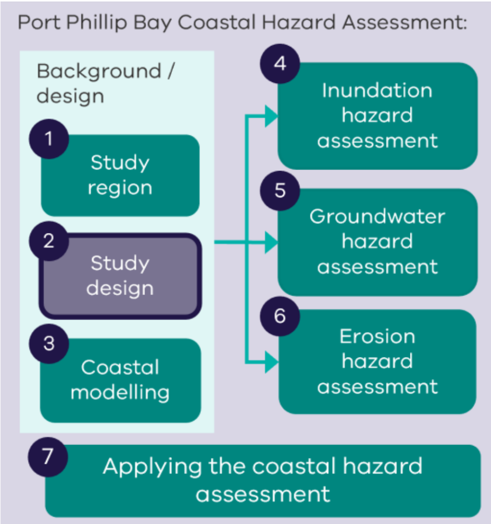
Summary #2: Study design

Seaford and Carrum, (Photo: Alluvium)

Overview

The Port Phillip Bay Coastal Hazard Assessment (PPBCHA) looks at likely coastal hazards around the Bay. Hazards include flooding, erosion and changes in groundwater. We explore these hazards for current and future climate and sea level scenarios. Results will help land managers and the community to consider climate change in future planning.

This summary provides an overview of the study design, including hazard types, scenarios considered, and outputs of the assessment. This is the second in a series of summaries providing an overview of the PPBCHA technical work.



In this summary:

The Port Phillip Bay Coastal Hazard Assessment helps us understand which parts of the Bay may be vulnerable to coastal hazards.

Based on best-available information, the assessment helps us plan and adapt to coastal hazards.

The Port Phillip Bay Coastal Hazard Assessment (PPBCHA) is a core technical investigation. The assessment is part of DEECA's Statewide program to build resilience and plan for increasing coastal hazards.

Hazards include storm tide inundation, groundwater changes and erosion. **Summary #1: Study Region Overview** provides further details on these hazards. This includes the drivers of change and hazards specific to the Bay.

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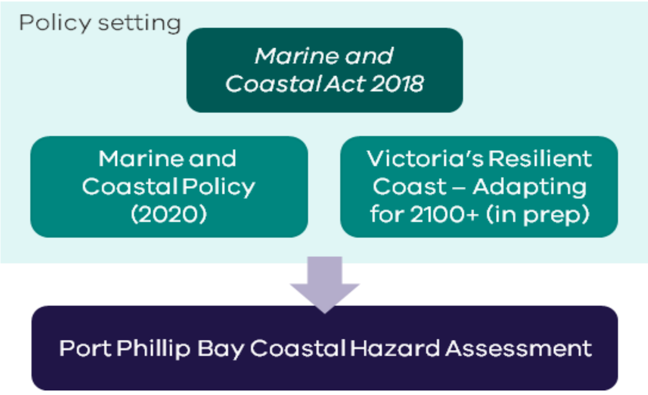
Statewide coastal hazard adaptation

Under the *Marine and Coastal Act 2018* (the Act),[1] the PPBCHA contributes to achieving intended outcomes of the Marine and Coastal Policy (2020).[2] It also aligns to relevant stages of Victoria's Resilient Coast – Adapting for 2100+ framework (Text Box 1).[3] The Assessment forms a core component of improving understanding of coastal hazards in the Port Phillip region.



There are a range of other activities across the state and in Port Phillip Bay that also contribute to achieving objectives of the Act. These involve building scientific understanding and promoting resilience to climate change. This could benefit marine and coastal ecosystems, communities and/or assets.

Some of these activities include:

- Victorian Coastal Monitoring Program – monitoring waves and sand movements to gather data and improve understanding
- Port Phillip Bay Environmental Management Plan – promoting improved ecological health
- Port Phillip Bay coastal works – including coastal protection structures and beach nourishment
- CoastKit – a tool that brings together marine and coastal scientific data, images and resources
- Coastal and Marine Management Plans – provide direction for local management of marine and coastal Crown land.

(Photo: Marcia Riederer)

Text box 1: Statewide resilience planning

Marine and Coastal Policy intended outcomes for managing coastal hazards:

- Coastal hazard risks and climate change impacts are understood and planned for.
- Communities, land managers and decision makers have the capability and capacity to respond to coastal hazards.
- The impacts of climate change on values of the marine and coastal environment are minimised.
- Adaptation is embedded as a core component of planning in the marine and coastal environment and is used to manage uncertainty and build resilience.

The Victoria's Resilient Coast - Adapting for 2100+ program builds on the policy. It provides a Victorian framework and guidelines for coastal hazard adaptation.

The framework includes seven stages:

[1] https://www.marineandcoasts.vic.gov.au/marine-and-coastal-act

[2] https://www.marineandcoasts.vic.gov.au/coastal-management/marine-and-coastal-policy

[3] https://www.marineandcoasts.vic.gov.au/coastal-management/victorias-resilient-coast-adapting-for-2100

The PPBCHA project

As part of these Statewide programs, the PPBCHA project includes:

- a review of current information and any data gaps
- sourcing further data or undertaking new research to fill data gaps
- the coastal hazard assessment itself, including modelling current and future conditions
- sharing findings from the assessment, including maps, data and reports
- working with stakeholders to build capacity and improve understanding of coastal hazards.

What information and data do we need?

Scientific data

A coastal hazard assessment uses a variety of existing data and information as inputs. It is important to find out what useful data is available, the locations and areas they cover and timeframes they represent.

Relevant data includes:

- survey of the land, coast and seafloor
- aerial imagery and photos of the coastline
- wind, wave and tide monitoring data
- rainfall and river flow data
- knowledge of sand, soil types, rock types and features along the coastline
- locations and types of protection, drainage and other structures that may influence how water flows or sand and sediment move.

(Photo: Alluvium)

Data gap analysis

At the start of this project, a 'data gap analysis' reviewed relevant research, data and mapping. This ensured that we had enough high-quality information to develop a robust technical assessment.

In some cases, we don't have all the data needed as inputs for a coastal hazard assessment. This type of gap review prompts collection of more data or targeted studies to help fill key data gaps.

For the PPBCHA, new data required included:

- survey of the coastline shape, form and type (geomorphology) to divide it into 'sectors'
- sediment (sand) sampling from 94 beach sites

Canadian Bay (Photo: Alluvium)

We then had enough data to develop comprehensive, project-specific models for wave and water levels in the Bay. These models help us understand how these levels change due to rising sea level and in storm events.

We can't fill all data and knowledge gaps. Understanding these gaps informs the technical approach and level of detail used. They can also help to inform future work.

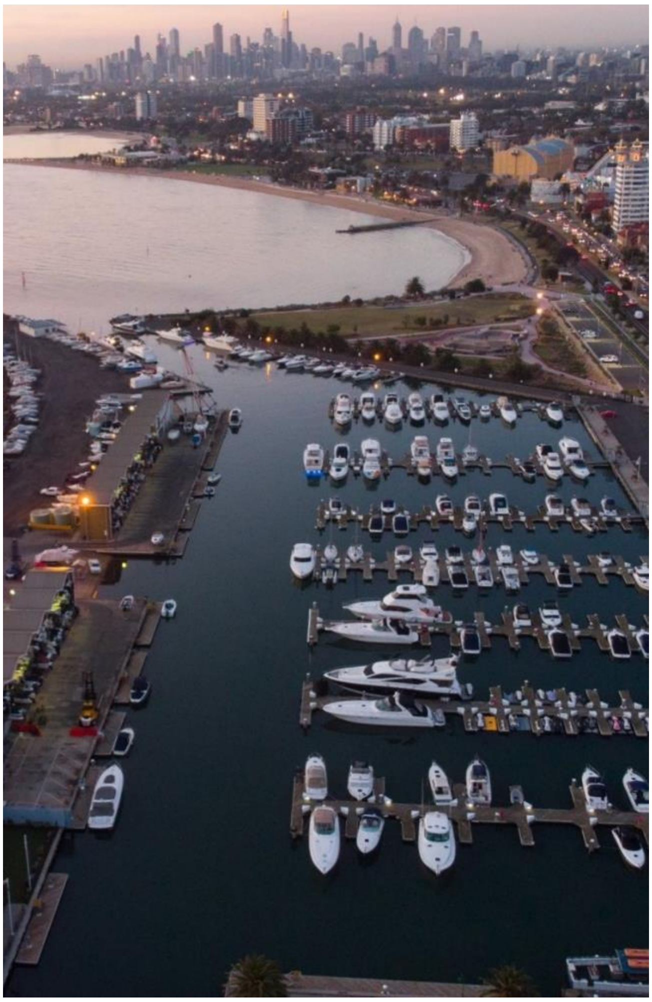
Data gaps in groundwater knowledge means modelling can only be at a high (concept) level, with some more detailed focus locations.

Stakeholder and community inputs

Stakeholders and communities are key in designing the study approach. This includes understanding their needs and how they interact with, manage and enjoy coastal areas. Relationships with stakeholders and community help design a 'fit-for-purpose' assessment. This includes appreciation of:

- shared information and data
- what we already know from spending time in, researching and managing these areas
- who might use the assessment outputs and why
- the technical information we want to gain
- the focus areas, hazards, impacts, themes and/or topics
- practical result formats and usability.

Summary #1: Study Region Overview presents a list of key stakeholders for the PBBCHA.



St Kilda (Photo: DEECA)

The Coastal Hazard Assessment

Various data and information informed the Coastal Hazard Assessment, including:

- scientific analyses of geological formation, local conditions, and historic and recent changes
- various computer models simulating local coastal processes, both past and future
- national and international coastal hazard assessment methods.

Using a 'best practice' approach, the coastal hazard modelling looks at:

- Multiple types of coastal hazards. This could be coastal erosion, storm tide inundation and groundwater changes, relevant to the Bay.
- Long-term thinking, out to at least 2100, with a suite of planning horizons (sea level rise scenarios) between the present day and 2100.
- Different hazard (storm) events and likelihoods. This considers big, but rarer (less likely) storm and flood events, and smaller, but more frequent (more likely) events.

The study must meet requirements of the Marine and Coastal Policy. Under the Policy, decision makers must:

Plan for sea level rise of not less than 0.8 metres by 2100, and allow for the combined effects of tides, storm surges, flooding, coastal processes and local conditions such as topography and geology, when assessing risks and coastal impacts associated with climate change

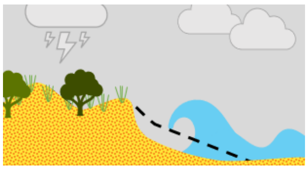
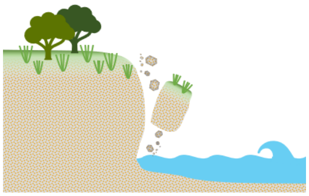
We designed the PPBCHA to these best-practice standards. The study is also place-based. It has methods, data and outputs tailored to the needs of decision-makers around the Bay.

Coastal hazard types

In a coastal hazard assessment we can consider a range of coastal hazard types. For Port Phillip Bay, the coastal hazard assessment has included:

- permanent inundation
- storm tide inundation
- change in groundwater
- short- and long-term erosion

Table 1. Coastal hazard definitions

	Category	Process/hazard	Description
Inundation		Permanent inundation	Occurs when low-lying areas are regularly flooded due to tidal processes. We need to understand the scale of inundation and associated impacts over various sea level rise scenarios.
		Storm tide inundation	Caused by a combination of predicted tides, storm-surges, and high wave action during severe storm events. Results in elevated water levels (storm surge), wave setup and wave runup, causing overtopping (e.g. of a dune or seawall) and inundation.
Groundwater		Saline intrusion Groundwater inundation / changing depth	Rising sea levels may result in movement of seawater inland. This includes elevated groundwater and extension of salt water. Groundwater could become higher (closer to the surface) near the sea and be saltier.
Erosion		Short term erosion	Event-based erosion of sediment (storm-bite) and recovery. Short term erosion is generally associated with sandy shores. Sand moves offshore during a storm and gradually recovers between storm events.
		Long-term erosion	Progressive retreat of shoreline position over time. Long-term erosion affects sandy shores and well as low earth, soft rock and hard rock cliffs. Drainage, weathering, undercutting and rock falls/slips also influence erosion in these environments.

These terms are described further in other summary documents: **Summary #4: Inundation, Summary #5: Groundwater** and **Summary #6: Erosion**

Why were these hazards chosen?

We already experience coastal flooding and erosion around the Bay. These coastal hazards, and their impacts, are likely to increase as sea levels rise and conditions change due to climate.

Erosion, inundation and groundwater changes are likely to extend across larger areas of the study region. This makes these hazards suitable to study at a Bay-wide scale.

The regional scale of the study means it's difficult to include individual estuary processes or local sand movements. Outputs of the PPBCHA can form inputs for more site-specific studies that assess these smaller-scale processes.

2009 storm at Middle Brighton Beach (Photo: DEECA)

Sea level rise scenarios

For the PPBCHA we set a series of planning horizons, based on global and local sea level rise projections.

Planning horizons - sea level rise scenarios

Period	Sea level rise (above mean sea level)
Baseline	0.0 m
Short term	0.2 m
Medium term	0.5 m
Long term	0.8 m
Sensitivity scenarios	1.1 m
	1.4 m

Why these sea level rise scenarios?

These planning horizons help us understand likely changes we will see over the short, medium and long term. Most recent Intergovernmental Panel on Climate Change (IPCC) science informed these planning horizons. State policy also requires that we plan for sea level rise of not less than 0.8 metres by 2100.

Higher (greater than 0.8 m) scenarios help test sensitivity of models. This improves understanding of changes we may see with higher sea level rise projections. Global emissions and mitigation efforts affect climate change impacts, including sea level rise.

What are coastal models?

Models come in many shapes, sizes and types. A coastal model is a simplified and/or scaled-down representation of the real world. We use models to better understand complex natural systems. We can test different 'scenarios' to look at what might happen in the future.

Summary #3: Coastal Modelling provides more information on coastal models.

(Photo: Phill Wizerbowski)

Event likelihoods

Modelling and analysis in the PPBCHA used a range of design storm 'events'. This includes smaller sized storm conditions, which are generally more frequent (more likely to occur). We also look at larger sized storm conditions that are generally less frequent (unlikely to occur). A probability called the Annual Exceedance Probability (AEP) expressed these different events.

Event – Where weather conditions affecting a specific place are notably different from typical, day-to-day conditions normally experienced at that location (for example, a storm event).

A wide variety of natural processes drive coastal storm events. These include combined effects of:

- meteorology (weather) such as wind, rainfall and temperature
- oceanography (conditions of the sea) such as tides, currents, and waves.

Events vary in magnitude (size), frequency (how often) and duration (time). They may last from hours up to several days.

Annual Exceedance Probability (AEP) – on average, the probability of an event occurring in any given year. A higher AEP means it is more likely the event will occur in any one year.

For example, a 1% AEP event represents an event that has a 1% chance of occurring in any given year.

Event probabilities may relate to:

- a storm tide event (flooding from the sea)
- a catchment or rainfall event (flooding from rivers, creeks and drains)
- a combination of both.

For each planning horizon, the PPBCHA inundation and erosion modelling has used these design events:

Storm tide AEP
5%
2%
1%

Why model different events?

Modelling different events helps us understand how hazards and potential impacts vary. This could be depending on the size, frequency and duration of different events. This understanding of different events guides how we respond with management.

Land use planning often uses defined event probabilities to determine suitable land uses for an area. Some infrastructure is also designed to withstand certain sized storm events. This might include drains, bridges and coastal protection.

Divers at Portsea (Photo: DEECA)

Limitations and assumptions

Natural systems are complex with many processes interacting with each other.

This study uses the best available information, technology, computer modelling and research. We are confident that the results give us the best knowledge to date about coastal hazards around the Bay.

Due to the challenges in modelling complex coastal systems, there are some limitations and assumptions we have to make. These include:

Groundwater hazard estimation – groundwater processes are particularly complex. We don't currently have enough information to build a detailed picture of these processes. The groundwater assessment is at a higher (conceptual) level than other hazards.

History of coastal works – It is difficult to know if observed shoreline changes are natural or artificial. They could be due to human influences (such as beach nourishment) or natural processes (such as sand movement due to wave action). We use many lines of evidence to help build understanding of what has caused these changes. This includes historic imagery, modelling, previous reports.

Knowing these limitations ensures we use the results appropriately. We can also use new data and research to improve our understanding in the future.

How will we use the PPBCHA outputs?

Building understanding of coastal hazards is an early step in the Statewide framework for coastal hazard adaptation (Text Box 1). Increased knowledge of these hazards helps us identify potentially exposed areas. This gives us time to plan and prepare for the changes we'll see.

This study means we now have some of the most up-to-date hazard modelling in Victoria. It will help reduce some of our uncertainty of the current and future coastal environment. Being proactive by completing this study allows us to make informed decisions on how we manage these coastal areas.

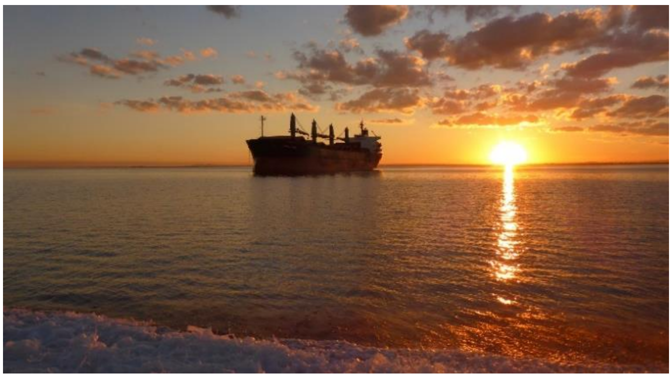
We can use information and outputs from this study to:

- assess coastal hazard vulnerability and risk, including identifying affected values, uses and infrastructure
- identify suitable adaptation options and a pathway for building resilience into the future
- assess the cost of coastal hazards with no intervention and costs/benefits of different options

Adaptation is 'the process of adjustment to actual or expected climate and its effects'.

There are a range of actions that can mitigate coastal hazard risk and assist in adapting to climate change. These may include actions associated with planning, capacity building, engineering, or other themes.

Resilience is the capacity of systems to cope with or 'bounce back' following a hazardous event or disturbance. This includes social, economic and environmental systems. Resilience means responding or reorganising to maintain essential functions, identities and structures. This occurs while also maintaining capacity to adapt and transform.



(Photo: Alluvium)

Accessing outputs and capacity building

Part of the PPBCHA is to ensure we share new findings and scientific understanding with communities and stakeholders. We designed the study in collaboration with key state and local government agencies and groups to understand their needs.

Sharing results means making information and data available and building capacity of data users. It is important that data users understand the results, limitations and assumptions. Sharing outputs and building capacity includes:

- summaries of technical studies (these document/s)
- online hazard maps through DEECA's CoastKit
- building a communications reference pack for coastal and marine management agencies
- website and media updates
- conversations with delivery partners, Traditional Owners, management agencies and community.

Building the capacity of stakeholders, groups and the community is essential. This means they can effectively use and respond to the information, data and findings of the coastal hazard assessment.

Summary #3: Coastal Models provides information about hazard types, sea level rise scenarios and event likelihood modelling.

St Kilda Promenade (Photo: DEECA)

We acknowledge Victorian Traditional Owners and their Elders past and present as the original custodians of Victoria's land and waters and commit to genuinely partnering with them and Victoria's Aboriginal community to progress their aspirations.

Accessibility

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