DETAILED CONTENTS CHAPTER **FOUR**

CHAPTER **FOUR** MARINE AND COASTAL ENVIRONMENTS

BACKGROUND

Victoria's marine and coastal environment is one of the most diverse in the world.* The southern coast of Australia is one of the most significant south-facing sections of coast in the Southern Hemisphere. Victorian waters lie at the meeting point of the Southern and Pacific Oceans, creating a unique environment that supports over 12,000 species of plants and animals, with 80 per cent occurring nowhere else on earth.[1] Habitats include reefs, kelp forests, deep sponge gardens, sandy plains, seagrass meadows and open water. The Victorian coast contains approximately 120 bays, inlets and estuaries, ranging in area from 1 km^2 to 2,000 km^2.

The marine and coastal environment provides many social and economic benefits for Victorians, including recreation and tourism, commercial fisheries, oil and gas extraction, and through ports and trade activity. The coastal zone is also home to a significant and growing proportion of the Victorian population (see Part A: 5 Human Settlements) and attracts more visitors than any other area of the state, with approximately nine out of 10 Victorians visiting the coast every year.[2]

The coastal environment is the interface between catchments, rivers and the sea. Consequently, the health of coasts and estuaries is strongly influenced by the condition and management of Victoria's land and inland waters.

'Many of the headline findings in the the UN's latest climate report relate to ocean impacts from increased levels of carbon dioxide.'

IPSO Scientific Director and Professor of Conservation Biology at the Department of Zoology, University of Oxford Alex Rogers said:

'The IPCC's findings reflect exactly what we are seeing in the ocean: massive changes in the distribution of marine organisms and marine ecosystems globally. The IPCC's focus on the ocean is long over due and begins to reveal the extraordinary extent to which this critical Earth System is being impacted by climate change. There is no good news and no reason for optimism as our ocean continues to take the brunt of carbon absorption.'

Professor Rogers added,

'The combination of acidification, warming and deoxygenation that we are seeing - the so-called 'deadly trio' is unprecedented in the carbon record. It poses a serious threat not just to the ocean but to the Earth system services it supports and there can be no stronger imperative for action by governments and others to reduce greenhouse gas emissions to the lowest possible levels in the shortest amount of time.

The ocean experts at IPSO stressed that the IPCC report made clear there is not enough data to fully understand the heating effects of climate change in the oceans, and urged much more research is urgently needed to understand what is occurring.'**

* For this report, the marine and coastal environment is classed as the near-shore environment, the seabed and marine waters out to the state limit of 5.5 km. It includes the foreshore and coastal hinterland. Coastal catchments are those that drain directly to the ocean.

** International Program on the State of the Ocean and IUCN, 2013, The State of the Ocean 2013: Perils, Prognoses and proposals - link to the report through www.stateoftheocean.org/pdfs/IPSO-Summary-Oct13-FINAL.pdf <http://www.stateoftheocean.org/pdfs/IPSO-Summary-Oct13-FINAL.pdf

Pressures on Victorian marine and coastal environments

Marine and coastal environments are impacted by a range of pressures, including coastal development, inputs from catchments, invasive species, fishing and maritime activities. These pressures can interact to cause significant impacts on biodiversity and ecosystem health. The main impacts on marine and coastal environments include:

- **Development of coastal areas** – Although 96% of the Victorian coast is on public land and mostly protected in parks and reserves, much of it has been impacted by development for industry, tourism and urbanisation. These development pressures are predicted to increase in the future.

  Extensive coastal modification has resulted in the significant disturbance or loss of coastal ecosystems and biodiversity, including coastal vegetation. Most of Victoria's estuaries, particularly those around the more populated coastal centres, have been degraded and modified to the extent that only a few, in the far east of the state, remain in near-pristine condition.

  The conversion of coastal land to intensive uses also places pressure on coastal water quality.

- **Water quality** – Marine and coastal water quality is impacted by the inflow of pollutants from catchments, particularly during storm events. Pollutants include toxins, pathogens and excess nutrients from agriculture, industry and urban runoff.

  Other impacts on water quality include point-source discharges from municipal sewage treatment plants and industrial facilities, and pollution incidents such as spills from shipping. Reduced water quality not only affects marine and coastal ecosystems but also human use of the marine environment. For example, toxicity, turbidity and the presence of harmful bacteria can prevent recreational and commercial activities – including the harvesting and consumption of marine species.

- **Reduced freshwater flows** – The alteration of natural river flows due to water regulation (See Part A: 3 Inland Waters) can affect marine and coastal biodiversity, particularly estuarine species that need both fresh and salt water habitats for their lifecycle. Reduced freshwater flows to the sea can increase the salinity of bays and estuaries, reduce nutrient and other inputs, and also result in the closure of estuary mouths. These can severely affect ecosystem health and biodiversity.

- **Invasive species** – Introduced species threaten marine and coastal ecosystems by altering the structure and dynamics of ecological communities. In extreme cases, introduced species can displace native species and dramatically modify habitats. Such changes can also threaten Victoria's fisheries by severely reducing the populations of commercial species.

- **Fishing** – Commercial and recreational fishing can place pressure on the populations of marine species (both target and non-target species), particularly where large numbers of fish, crustaceans and molluscs are taken. Although regulated fishing (commercial and recreational) is subject to quotas to ensure the sustainability of fisheries, it can alter the community dynamics and trophic (food chain) relationships of marine and coastal ecosystems, and increase the impacts of other disturbances. Unregulated commercial and recreational fishing has the potential to significantly impact on species populations and ecosystem health.

- **Maritime activities** – Commercial shipping, recreational boating and port activity, increase the risk of pollution and invasion by marine pests. The use of large ships increases the demand for dredging, which can affect marine water quality and ecosystem health.

- **Litter** – The presence of litter and other waste is an ongoing problem in marine environments. Sources of litter are varied and include terrestrial (e.g. food containers, plastic bags, etc.) and maritime sources such as discarded fishing gear (e.g. nets and lines). Fish, seabirds and marine mammals can ingest or become tangled in litter, often resulting in death. Marine debris from fishing and other sources is listed as threatening process under the *Flora and Fauna Guarantee Act 1998*.
- **Recreation activities** – People visit marine environments for a range of reasons, including fishing, boating, swimming, snorkelling, diving and sightseeing. These activities can cause environmental damage such as disturbance to seagrass habitats from boat anchors, excessive or illegal harvesting of intertidal species, and trampling of plants and habitat. The extent of damage caused by many of these activities is largely unknown but could be substantial, particularly in small areas receiving large numbers of visitors.
- **Mineral exploration and extraction** – Oil and gas are currently being extracted off Victoria's coast and the exploration for new reserves is continuing. Activities associated with extraction and exploration of minerals in marine environments can disturb marine habitats and organisms. Oil and gas platforms and drilling operations directly disturb sea floor habitats in areas immediately adjacent to drilling operations. The use of seismic equipment for mineral exploration may interfere with cetaceans. Exploration and extraction of mineral resources in marine environments also increases the risk of spills of drilling fluids and hydrocarbons.

Climate change

Victorian marine waters have been identified as being extremely vulnerable to climate change. Changes to marine systems will not only affect biodiversity and ecosystem health, but also Victoria's fishing industries and coastal infrastructure.

Southern Australia has experienced some of the fastest increases in ocean temperatures globally. Influenced by the strengthening of the East Australian Current, sea surface temperatures have risen 2°C off Australia's south-east coast since 1925 with an ocean warming rate approximately four times the global average (see Part A: 1 Climate Change and Air Quality).[3, 4, 5]

Warmer sea temperatures are likely to have severe consequences for marine ecosystems, including changes to the distribution and breeding patterns of some species. Those species unable to adapt will need to migrate to more suitable habitats. However, Victoria's south-facing coastline presents a physical barrier to migration for many species. Rising sea temperatures also alter ocean currents, raise sea levels, and increase the occurrence of storms.

Other predicted climate change impacts include:

- Increasing oceanic acidification will impact on marine biodiversity, particularly crustaceans and molluscs, and the industries and communities that depend upon them. Acidification is not reversible in human time scales.
- Reductions in river flows (see Part A: 1 Climate Change and Air Quality) and terrestrial runoff will impact inshore ecosystems such as estuaries by increasing salinity, decreasing nutrients and other inputs, and altering estuary openings. This will have consequences for species that rely on inshore habitats for breeding, migrations, spawning habitats, and nursery areas.
- Climate change will compound existing pressures on Victoria's marine and coastal ecosystems.
- Coastal environments will be subject to increased storm surges in the short term and permanent sea-level rise in the longer term, these will have a significant impact on coastal form and coastal vegetation. The increased flooding and inundation of coastal settlements will also damage housing and infrastructure, and put lives at risk.

The impacts of climate change on the marine and coastal environment is discussed in Foundation Paper One, *Climate Change Victoria: The Science, Our People, and Our State of Play*.[6]

MAIN FINDINGS

Marine and coastal health

- Data on the condition of marine and coastal ecosystems is not gathered in a comprehensive manner, making assessment of the condition of coastal and marine systems difficult. A lack of knowledge and understanding of marine systems is a major hindrance to our ability to protect marine biodiversity and to report on its current condition.
- Monitoring by Parks Victoria and scientifically rigorous community monitoring undertaken for the Sea Search and the Reef Life Survey programs, has shown some positive changes in marine and coastal communities as a result of the establishment of marine parks and sanctuaries. However, changes in ecological community structure have also been observed such as a decrease in the key habitat-forming seaweed in Port Phillip Heads Marine National Park, increased presence of pests like the Long-spined Sea Urchin (*Centrostephanus rodgersii*), decline of the Southern Rock Lobster population, and a decline in Broad-leaf Seagrass (*Posidonia australis*). These changes show that marine parks and sanctuaries are subject to a range of pressures and natural variation.
- There remains little data available on the ecological condition of estuaries, although it is evident that most of Victoria's estuaries have been degraded.
- Victoria's bays and inlets are under substantial environmental pressure and so are vulnerable to environmental changes.
- The long-term impacts of the Channel Deepening Project are thought to be minimal. However, ongoing monitoring is required to determine this. Over the dredging period, the effects of climatic influences such as rainfall and temperature variations had much larger and more widespread effects on many environmental indicators than the dredging itself.

Conservation of marine and coastal areas

- Victoria has 13 marine national parks and 11 smaller marine sanctuaries covering some 123,000 hectares. These protected areas cover only 5.3% of Victoria's marine and coastal waters, compared to the protection of 18% of Victoria's land in parks and reserves. The area protected in marine parks has remained unchanged since 2002.
- There are some 75,000 hectares of coastal parks and reserves in Victoria. Coastal areas remain under threat from development, especially urbanisation.

Marine biodiversity

- Six species of marine and coastal vertebrate fauna were listed as critically endangered on the *Advisory List of Threatened Vertebrate Fauna in Victoria, 2013*. A further nine were endangered, 19 vulnerable and 13 near-threatened, and data was found to be deficient for four species. Three-quarters of the total species listed were birds.
- Between 2007 and 2013, six marine and coastal bird species declined in status and two bird species were added to the Advisory List because of decreasing populations. Only one species improved their threatened status over the period.
- Two of Victoria's marine communities, the Port Phillip Bay Entrance Deep Canyon Marine Community and the San Remo Marine Community, are listed as threatened under the *Flora and Fauna Guarantee Act 1988*.
- Assessment of threatened communities and species in marine environments is poor compared to terrestrial environments, particularly for marine flora, invertebrates and fish.
- Knowledge of the conservation status of marine and coastal invertebrates remains poor and the current number of threatened species is likely to be vastly under-reported.
- Marine and coastal ecosystems are under increased threat from invasive species. Some of Victoria's bays and inlets have been heavily invaded by introduced species. Port Phillip Bay is considered to be one of the most invaded marine ecosystems in the Southern Hemisphere. Monitoring of invasive species remains poor and is limited to Victoria's commercial ports and harbours.
- All major Victorian fisheries are considered to be either close to full exploitation or are already fully exploited, particularly those of economic importance, such as the Southern Rock Lobster. Victoria's annual commercial fishing effort has decreased significantly since the 1980s to ensure fisheries resources are harvested sustainably.

Marine and coastal water quality

- Monitoring by EPA Victoria indicates that Victoria generally has good marine and coastal water quality.
- Estuarine and bay systems such as Port Phillip Bay, Western Port and the Gippsland Lakes are subject to reduced water quality. Poor water quality usually occurs after episodic storm events when high pollutant levels are discharged from rivers and drains. Water quality is also reduced during periods when reduced mixing and flushing of water occurs.
- During the Millennium Drought (1996–2010), salinity concentrations in Port Phillip Bay exceeded neighbouring ocean levels in Bass Strait. The high rainfall in 2010–11 returned salinity levels to that recorded during the 1990s.
- A severe storm on 25 December 2011 resulted in a large volume of stormwater entering Port Phillip Bay. The resulting water-quality impacts led to algal blooms, fish deaths and elevated bacteria levels.
- Water quality in the Gippsland Lakes is generally good during dry periods but is often degraded after heavy rainfall leading to algal blooms. Poor water quality clearly reflects the negative influence of catchment inflows on the Gippsland Lakes.
- Between 2007–08 and 2011–12, recreational water quality of Port Phillip Bay was generally good during fine weather, but the number of swim advisories increase after rainfall, particularly at beaches in close proximity to rivers, creeks and stormwater drains that flush out into the bay.

INDICATOR ASSESSMENT

Indicator Summary

Indicator	Summary	Status and trends (Good | Fair | Poor | Unknown)	Data quality
MC1 Marine and coastal health	Data on the condition of marine and coastal ecosystems is not gathered in a comprehensive manner, making assessment of the condition of coastal and marine systems difficult.		
MC2 Conservation of marine and coastal areas	Victoria's 13 marine national parks and 11 marine sanctuaries protect only 5.3% of Victoria's marine and coastal waters. The area protected in marine parks has remained unchanged since 2002. Coastal land remains threatened by development, especially urbanisation.		
MC3 Marine and coastal biodiversity	Assessment of threatened communities and species in marine environments is poor compared to terrestrial environments. According to the *Advisory List of Threatened Vertebrate Fauna in Victoria* (2013), six species of marine and coastal fauna are critically endangered, nine endangered, 19 vulnerable, 13 near-threatened, and data was deficient for four species. Between 2007 and 2013, six marine and coastal bird species declined in status and two bird species were added to the Advisory List because of decreasing populations. Only one species improved its threatened status over the period. Marine and coastal ecosystems are under increased threat from invasive species.		
MC4 Marine and coastal water quality	Estuarine and bay systems such as Port Phillip Bay, Western Port and the Gippsland Lakes are subject to reduced water quality. Poor water quality usually occurs after episodic storm events when high pollutant levels are discharged from rivers and drains. This has resulted in algal blooms, high turbidity, fish kills and elevated bacteria levels. During the 1996–2009 drought, salinity concentrations in Port Phillip Bay exceeded neighbouring ocean levels in Bass Strait. Water quality is generally good in open waters.		

Indicator Assessment Legend

Status

- Environmental condition is healthy across Victoria, **OR** pressure likely to have negligible impact on environmental condition/human health, **OR** comprehensive protection of natural ecosystems and biodiversity.
- Environmental condition is neither positive or negative and may be variable across Victoria, **OR** pressure likely to have limited impact on environmental condition/human health, **OR** moderate protection of natural ecosystems and biodiversity.
- Environmental condition is under significant stress, **OR** pressure likely to have significant impact on environmental condition/ human health, **OR** inadequate protection of natural ecosystems and biodiversity.
- Data is insufficient to make an assessment of status and trends.

Data Quality

- Good — Adequate high-quality evidence and high level of consensus
- Fair — Limited evidence or limited consensus
- Poor — Evidence and consensus too low to make an assessment

Trends

NA Assessments of status, trends and data quality are not appropriate for the indicator.

INDICATOR ASSESSMENT

Indicator MC1: Marine and Coastal Health

The diversity of marine and coastal habitats and the biodiversity they support is critical for providing a range of ecosystem services. These habitats sustain stocks of fish and invertebrates that form the basis of important commercial and recreational fisheries, including aquaculture. Seagrasses, saltmarsh and mangroves stabilise soft sediments, prevent erosion and provide protection from storm surges.

Marine and coastal species process and recycle nutrients derived from terrestrial sources and also absorb large amounts of carbon, produce oxygen and help to regulate climate. In addition to these essential services, marine and coastal biodiversity creates recreational opportunities and contributes to Victoria's social and cultural amenity.

Strong links exist between many marine and coastal ecosystems, and so localised impacts on marine and coastal health can have wide-ranging implications, particularly for biodiversity. Many species are dependent on a range of different habitats, for example some fish species use estuaries, seagrass and kelp beds as well as open-water habitats; throughout their life cycles. Some species of fish and waterbirds can also depend on freshwater habitats. Consequently, the status of such species can be affected by impacts on any of the habitats they depend on. Furthermore, coastal environments are directly affected by activities in adjacent catchments.

Freshwater inputs into estuaries and bays affect water quality, habitat, and community dynamics of marine and coastal systems.

Condition of marine and coastal ecosystems

Victoria's marine and coastal ecosystems are not comprehensively monitored, making it difficult to evaluate their condition, the dynamics of marine communities, and how they change in response to environmental pressures.

Parks Victoria undertakes monitoring surveys in 11 marine national parks and 11 marine sanctuaries, mainly for subtidal and intertidal habitats.[7] This work collects baseline biological information to understand long-term changes in populations, abundances, community structures and ecological processes. This is complemented by scientifically rigorous community monitoring undertaken for the Sea Search and the Reef Life Survey programs, which partner with Deakin University and the University of Tasmania. These programs are discussed in Foundation Paper One, *Climate Change Victoria: The Science, Our People, and Our State of Play*.[6]

At this stage, results from these monitoring programs cannot be used to assess the status and trends in marine and coastal ecosystem health. However, they have revealed changes to marine and coastal communities, including:

- indications of positive changes in marine and coastal communities, such as increased fish size and abundance, in response to implementation of marine parks
- the decline of a key habitat-forming seaweed in Port Phillip Heads Marine National Park
- presence of pests like the Long-spined Sea Urchin, *Centrostephanus rodgersii*, which has extended its southern range from New South Wales to eastern Tasmania (being a voracious grazer, the urchin has consumed vegetation, such as kelp forests, leaving behind bare rock)
- decline of the Southern Rock Lobster population
- range extension of northern fish species into southern waters
- a decline in Broad-leaf Seagrass (*Posidonia australis*).

Detailed discussion of the general features of Victoria's marine and coastal habitats and a qualitative assessment of condition is provided in the 2008 State of the Environment report.[8] Main findings include the following.

- Victorian subtidal rocky reef communities generally appear to be in good condition, except in the far east of the state where some urchin barrens (areas that have been denuded of seaweed) occur. These may have been caused by over-fishing of top predators that prey on sea urchins, as well as southward movement of species of urchin that are native to NSW, possibly as a result of climate change.
- Victoria's bays and inlets are under substantial environmental pressure, and so are vulnerable to environmental changes.
- Little is known of the dynamics of subtidal reef communities in Victoria. However, the known presence of pressures (water-quality impacts, pest species, etc.) that impact on reef communities globally would indicate the potential for impacts to occur.
- Very few surveyed intertidal reefs are dominated by simplified states.
- In eastern Victoria, there are large areas of urchin barrens (*Centrostephanus rodgersii*) at Cape Howe, Gabo Island and Tullaberga Island. These have significant impacts on habitat and biodiversity.
- Port Phillip Bay is exposed to increased levels of sedimentation and nutrients because of their proximity to the entrance of the Yarra River and other freshwater drainages.
- Intertidal reefs in Port Phillip Bay may be degraded. While these reefs support relatively diverse intertidal assemblages, they tend to show more consistent signs of environmental degradation, including consistently low coverage of brown macroalgae, effects of shellfish harvesting and invasion by introduced species.
- Some reefs in northern Port Phillip Bay have also been invaded by the large brown Japanese kelp *Undaria pinnatifida*. There would appear to be strong potential for *U. pinnatifida* to expand its current range to the southern parts of Port Phillip Bay and to reefs in Western Port.
- Highly localised degradation has occurred from Boags Rocks Eastern Treatment outfall (near Gunnamatta), including substantially changed community structure on the nearby intertidal reef and soft sediment communities.
- Seagrass habitats in Victoria have shown large, shorter-term (5–10 year) fluctuations in area and also show some signs of stability over longer periods of time (over 50 years). Fluctuations in seagrass coverage observed in Victoria are difficult to interpret because changes can be caused by both human activities and natural disturbances.

Estuary condition

Data on the condition of estuaries has not been updated since the 2008 State of the Environment report. There remains little data available on the ecological condition of estuaries, although it is evident that most of Victoria's estuaries have been degraded. It is estimated that as many as half of Victoria's major estuaries are significantly modified.[9]

Victoria's most modified estuaries occur around the more populated and developed coastal centres such as Lakes Entrance, Warrnambool and around Laverton and Altona in Melbourne (Laverton Creek and Kororoit Creek). Port Phillip Bay and Western Port, two large, permanently open estuaries, are considered highly modified. The Gippsland Lakes are also considered extensively modified. The west and east coasts are characterised by many small estuaries that can be closed for much of the time.

Smaller estuaries are the dominant estuary types in Victoria and are more prone to the effects of catchment modification such as land-use change and streamflow change.

Victoria's only near-pristine estuaries are located in the far east, where there is minimal modification and development, and where the catchments retain a good cover of native vegetation. Other largely unmodified estuaries occur around South Gippsland, along the Great Ocean Road and along the south-west coast.

Case Study: Channel Deepening Project

Dredging involves the removal of sediment, rocks and other material to maintain or deepen navigable shipping channels. It is undertaken periodically in most ports on the Victorian coast, but mainly in Port Phillip Bay and at the artificial opening of Lakes Entrance in the Gippsland Lakes.

Dredging can have implications for marine ecological processes when it directly disturbs species that live in sediments. Also of concern is the impact that dredging can have on turbidity and the settling of suspended solids onto marine plants and seaweed. These impacts can result in changes in species composition, loss of biodiversity and reductions in commercial and recreational fisheries catches.

Dredging activities adjacent to urbanised or industrialised areas are also likely to mobilise contaminated substances that can degrade water quality and may be toxic to aquatic species.

Other impacts of dredging can include changes in circulation patterns, coastal zone dynamics and coastal morphology from modified coastlines and/or seabeds.

In 2008, a significant dredging program was commenced in Port Phillip Bay to provide access for larger shipping and to meet the predicted demand for increased shipping. Works started in February 2008 and ended in November 2009. Because of the potential for environmental degradation, and community concern, the Office of the Environmental Monitor was established by the Victorian Government to scrutinise the environmental performance of the project.

Monitoring (which continued for the two years after the project's completion) found that there was comprehensive compliance with all environmental approval conditions and that the health of Port Phillip Bay remains consistent with levels seen prior to the dredging work.[10, 11] Specific findings included the following.

- While increased turbidity levels were found during some of the dredging works, the effects of the project were smaller than the changes observed in response to high-rainfall events and associated catchment inputs in 2010 and 2011.
- Water quality, plants and animals, fish stocks and contaminants in fish during and for the two years following project works were within the range of natural variability.
- Some degradation of deep-reef communities were affected by rock fall but are recovering.
- Changes to tidal sea levels, currents and waves inside the bay were consistent with predictions and are minor in terms of natural variability.
- Assessment of phenomena such as fish kills, foreshore flooding and erosion, and spider crab moulting events during and following dredging were found not to be related to the project works.

The long-term impacts of the Channel Deepening Project are thought to be minimal. However, ongoing monitoring is required to confirm this. The effects of climatic influences such as rainfall and temperature variations had much larger and more widespread effects on many environmental indictors than the dredging itself. Impacts caused by dredging operations, although often highly visible, were short-lived, with no ongoing implications for critical processes and features of Port Phillip Bay such as nutrient cycling or seagrass beds.

Indicator MC2: Conservation of Marine and Coastal Areas

Conservation of marine and coastal areas is critical for the protection of ecosystems, biodiversity, and for ensuring the resilience of marine systems into the future. Fishing and other extractive industries are not permitted in marine national parks and sanctuaries.

However, the existence of protected areas alone does not ensure the effective conservation of marine and coastal ecosystems, because these areas can be compromised by a range of external pressures.

For example, sea urchins have been linked to significant damage to protected areas such as Beware Reef on the south-eastern coast. Therefore the management of pressures outside of protected areas is required.

This includes the use of quotas and controls on fishing equipment to ensure the sustainability of fisheries, and the control of invasive species, particularly through the protection and restoration of natural predators.

Coastal waters protected in marine parks

Victoria has 13 marine national parks and 11 smaller marine sanctuaries covering some 123,000 hectares. Currently these protected areas cover only 5.3% of Victoria's coastal waters, compared to the protection of 18% of Victoria's land in parks and reserves. The area protected in marine parks has remained unchanged since 2002.

Of the 81 listed rare and threatened marine fauna species recorded in Victoria (including species listed on the DEPI Advisory List, under the Victorian *Flora and Fauna Guarantee Act 1988*, and the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*), 78 (96%) were recorded in Victoria's marine parks network.

In addition to the marine parks described above, six of the 11 Victorian wetlands listed under the international convention on wetlands (the Ramsar Convention), are located on or near the coast – providing habitat for many marine and coastal bird species.

Coastal lands in protected area system

As at 2010, there were some 75,000 hectares of coastal parks and reserves in Victoria. The vast majority of coastal land (96%) is on public land, with one-third reserved as national park, coastal park, marine national park or marine sanctuary under the *National Parks Act 1975*. Despite this, Victoria's coastlines are still under threat from development, particularly urbanisation.

Development modifies the natural coastal environment with significant impacts on both marine and coastal ecosystems. Much of the development of Victoria's coast occurred prior to 1980. However, between 1980 and 2004 a further 41 km of the Victorian coastline was urbanised – an increase of 15%.[12] Many coastal urban areas, particularly those around and within a few hours drive of Melbourne, are experiencing unprecedented levels of development. Victoria has consistently had the second-highest percentage of urbanised coastline after New South Wales.[8]

Indicator MC3: Marine and Coastal Biodiversity

Marine fauna

Victorian marine ecosystems encompass a wide range of physical environments, and support representatives of more taxonomic groups than all Victorian terrestrial and freshwater habitats combined.

The true extent of Victoria's marine biodiversity is largely unknown, but southern Australia is recognised as a diversity hotspot for several taxa, including red and brown algae, lace corals, crustaceans and ascidians (sea squirts).

In addition, Victorian marine environments support diverse fish assemblages and provide critical habitat for marine mammals and seabirds, many of which are endangered.

A lack of knowledge and understanding of marine systems is a major hindrance to our ability to protect marine biodiversity and to report on its current condition. Assessment of threatened communities and species in marine environments is poor compared to terrestrial environments, particularly for marine flora, invertebrates and fish.

There is generally very little known about the population status of marine species or their response to key environmental threats, so lists of threatened species are not always a true reflection of the number or vulnerability of marine species.

It should be noted that many species of fish and waterbirds depend on a range of freshwater, estuarine and marine habitats. The status of such species can be affected by impacts on any of these habitats.

Marine communities and species listed as threatened

The Department of Environment and Primary Industries (DEPI) maintains threatened species Advisory Lists, which document the threat status for various species.[13] Information about the Advisory Lists is provided in Part A: 2 Biodiversity and Land.

As at 2013, six species of marine and coastal vertebrate fauna were critically endangered, nine endangered, 19 vulnerable, 13 near-threatened, and data was found to be deficient for four species (Figure A.4.1).

Some three-quarters of the total listed species were birds (40 species), with eight mammals, three fish, and one reptile – the critically endangered Leathery Turtle (*Dermochelys coriacea*). Other critically endangered species include the Blue Whale (*Balaenoptera musculus*), Southern Right Whale (*Eubalaena australis*), Greater Sand Plover (*Charadrius leschenaultii*), Grey-tailed Tattler (*Heteroscelus brevipes*), and the Lesser Sand Plover (*Charadrius mongolus*).

Between 2007 and 2013, six marine and coastal bird species declined in status and two bird species were added to the Advisory List because of decreasing populations. Only one species improved its threatened status over the period.

The Advisory List for threatened invertebrate fauna contains many marine and coastal species, including sea anemones, jellyfish, shellfish, squids, crustaceans, starfish and sea cucumbers.[14] The number of invertebrate species in Victorian marine and coastal systems is unknown, but it is estimated to greatly exceed the diversity of vertebrate fauna. Consequently, the knowledge of conservation status also remains poor and the current number of threatened species is likely to be vastly under-reported.

In addition, two of Victoria's marine communities are listed as threatened under the *Flora and Fauna Guarantee Act 1988* – these are the Port Phillip Bay Entrance Deep Canyon Marine Community and the San Remo Marine Community.

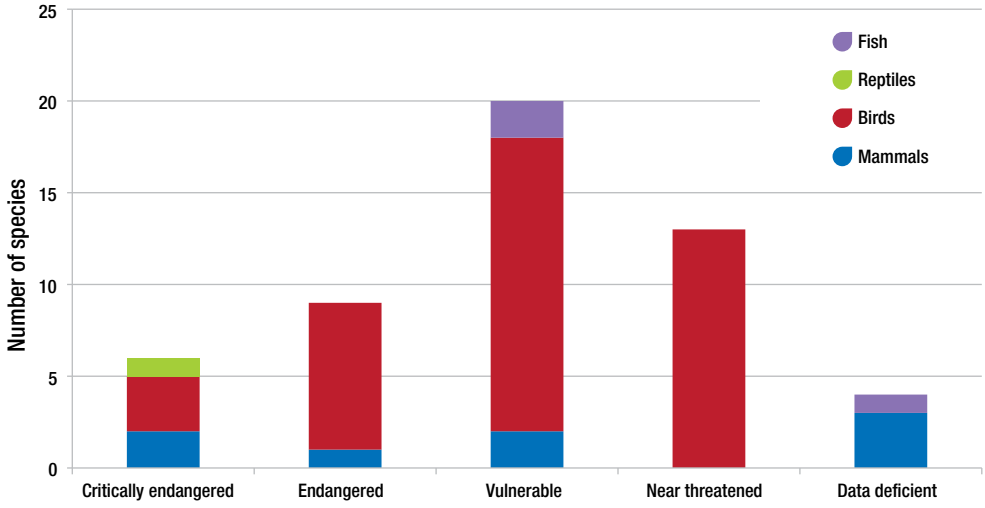


Figure A.4.1: Number of Victorian marine and coastal vertebrate species listed on the *Advisory List of Threatened Vertebrate Fauna in Victoria, 2013*

Number of introduced species in Victorian marine environments

Introduced species are a major threat to the integrity of marine ecosystems in Victoria. While the effects of many introduced species are relatively benign, some invasive species have the potential to drastically alter the structure and dynamics of marine ecological communities.

Impacts of introduced species include displacement of native species, increased competition for resources, altered nutrient cycling, changes to marine food chains, and changes to habitat structure. These changes can significantly impact on fisheries and aquaculture production.

Most introduced species are transported into and within Victorian waters via ships' ballast water or from biofouling (the accumulation of organisms on vessel hulls and internal spaces, maritime equipment and mobile marine infrastructure). Since 2004, Victoria has required vessels travelling from outside Victoria – or between Port Phillip Bay and other Victorian locations – to manage high-risk ballast water to prevent the spread of invasive species. However, Victoria has no controls over hull biofouling, which may be the main cause of the introduction of marine pests to Australia, and has been implicated in the spread of species within Victoria. Invasive species are also entering Victorian waters because of increases in sea temperatures (see Part A: 1 Climate Change and Air Quality). Other species, such as the Northern Pacific seastar (*Asterias amurensis*), may be spreading through the movement of larvae on naturally occurring eastward currents after initial translocation to Victoria via ballast water.

The source of most new incursions within Victoria is likely to be Port Phillip Bay. 'Secondary invasions', particularly those originating in Port Phillip Bay, are increasingly recognised as a significant threat to Victorian marine assets.

Monitoring of introduced species

Surveys for introduced marine pests have been undertaken in Victoria's commercial ports and harbours. Few, if any, formal surveys have been done outside these locations. There have been no formal surveys undertaken in Port Phillip Bay (including Port of Melbourne and Geelong Port) or Western Port (including Port of Hastings) since 2008.

As reported in the 2008 State of the Environment report, some of Victoria's bays and inlets, and particularly Port Phillip Bay, have been heavily invaded by introduced species.

> Port Phillip Bay is considered to be one the most invaded marine ecosystems in the Southern Hemisphere, with 161 introduced species (including 61 cryptogenic, or origin-unknown species) representing up to 13% of all benthic sediment and encrusting species recorded in the bay.[15]

Without further formal surveys in Port Phillip Bay or Western Port it is unclear whether additional undetected invasive species are present.

Although formal surveys have been limited, DEPI maintains a database of detected invasive species. Since 2008, invasive species found in Victorian waters have included the following.

- *Grateloupia turuturu* (a red seaweed) has been detected in Port Phillip Bay.
- Japanese kelp (*Undaria pinnatifida*), which was reported as being confined to the north-eastern side of Port Phillip Bay in 2008, has since spread further throughout the bay and beyond (see below).
- The Northern Pacific seastar (*Asterias amurensis*) was detected in Western Port for the first time in 2011. A small population was detected in the north of the bay near San Remo. That population is believed to have been eradicated, but larvae have since been detected in the waters of Western Port. It is likely that they are transported there naturally from Port Phillip Bay.
- A formal survey was undertaken in Port of Portland in 2011. Previously unrecorded species were detected including the European fanworm (*Sabella spallanzanii*), green seaweeds (*Caulerpa racemosa var cylindracea* and *Codium fragile fragile*), various cryptogenic bryozoans (invertebrates) and red seaweed.

Outside the commercial Victorian ports, a number of invasive species have been detected in local ports and other environments, including the following.

- Japanese kelp (*Undaria pinnatifida*) was detected in Apollo Bay harbour in 2009. It quickly became established in the harbour despite efforts to eradicate it.
- The Northern Pacific seastar (*Asterias amurensis*) and Pacific oyster (*Crassostrea gigas*) have been detected at Tidal River, Wilsons Promontory National Park, possibly due to larvae being transported eastward from established populations.
- There is a high potential for existing introduced species to extend their distribution within Victoria. This is particularly the case for Japanese kelp (*Undaria pinnatifida*) and the Northern Pacific seastar (*Asterias amurensis*).

Impacts of introduced species

While the impacts of few invasive species have been measured in Victoria, species such as the Northern Pacific seastar, Japanese kelp, European shore crab (*Carcinus maenas*) and the European fanworm (all found in Port Phillip Bay), are known to have had significant impacts in other parts of the world.

The extent of ecological impacts of introduced species in Port Phillip Bay is largely unknown. While Port Phillip Bay is considered one of the most invaded habitats in the Southern Hemisphere, most of the recorded introduced species have little demonstrable impact on the already highly modified environment of the bay.

Some introduced species are now influential components of the ecology of Port Phillip Bay. For example, the introduced East Asian bivalve (*Theora lubrica*) and the introduced crab (*Pyromaia tuberculata*) are dominant components in the diet of many bottom-dwelling fish species in the bay.[16]

Given the numbers and wide distribution of introduced species in the Victorian marine environment, their impacts on marine and coastal health are likely to be substantial, particularly on less modified systems.

Impacts of aquatic harvesting

There are several important commercial and recreational fisheries in Victoria. Commercial and recreational fishing can have widespread effects on marine ecosystems.

Fishing can directly remove large numbers of individuals of targeted species from marine environments and has the potential to impact large numbers of unwanted species (by-catch).

Removing biomass from marine habitats can also substantially alter numbers of remaining species, and the removal of adult (reproductive age) fish can lead to a decline in future generations. Regulated fishing at appropriate (sustainable) levels allows species to be harvested without impacting the ability of the species to maintain or increase population size through reproduction. Over-fishing occurs when high levels of fishing pressure reduce the ability of a targeted population to replenish itself, and so its population declines. Unregulated commercial and recreational fishing has the potential to significantly impact on species populations and ecosystem health through over-fishing.

In addition to catching targeted species, a large number of by-catch species (i.e. non-target fish species, marine invertebrates and other species such as birds and marine mammals) can be potentially caught in fishing operations. By-catch is primarily managed through a range of controls such as equipment restrictions and seasonal closures, and is considered a minor issue in most Victorian fisheries. However, by-catch can be a problem for trawl, gillnet and long-line fisheries in Victorian waters, and can sometimes represent up to 40% of the total catch.[17] There is limited information on the ecological impacts of by-catch on marine ecosystems in Victorian marine systems. Furthermore, discarded fishing gear drifts on ocean currents and can continue to catch marine species (ghostfishing). Both seabird by-catch and marine debris from fishing and other sources are listed as threatening processes under the *Flora and Fauna Guarantee Act 1998*.

Some fishing methods such as trawling and scallop dredging can directly disturb benthic habitats because the fishing gear is in direct contact with the seafloor. Deep-reef and soft-sediment habitats are most vulnerable to this impact, which is more likely to be an issue in areas of higher fishing intensity such as in far eastern and western Victoria.

Victoria also produces seafood through aquaculture industries. The potential impact of aquaculture on marine and coastal biodiversity depends on the species, management practices and legislative framework under which each facility must operate. Physical disturbance of the site can occur with the construction and maintenance of infrastructure. Other potential impacts include risk of disease from the farmed species and food supply, introduction of non-endemic species or genetically different individuals to wild populations, and increased nutrient load to water and sediment.

Aquaculture production does not harvest wild populations and is therefore not discussed further here. Information on Victoria's aquaculture production can be found on the DEPI website.

Commercial fisheries

Historically, commercial fishing has resulted in a decline in the stocks of certain key species. Today, quotas and a range of other management controls are currently in place to ensure the sustainability of fishing activities. In general, all major Victorian fisheries are currently considered to be sustainable, but either close to full exploitation or are already fully exploited – particularly those of economic importance such as the Southern Rock Lobster.[18]

This means that further exploitation or an increase in other pressures (e.g. by marine pests) may constitute a threat to the continuity of the fishery. In addition, illegal harvesting of some species is a problem, particularly for high-value species such as abalone and rock lobster.

Between 2002–03 and 2010–11, Victoria's annual total fisheries production ranged between 4,600 and 6,400 tonnes with no trends evident over the period (Figure A.4.2). Victoria's annual commercial fishing effort has decreased significantly since the 1980s resulting in a general decline in fisheries production by approximately two-thirds. This was mainly to ensure that fisheries resources were harvested sustainably, and to enhance recreational fishing opportunities. Habitat degradation in bays, inlets and harbours has also affected fisheries production by reducing populations of commercial and recreational species.

Assessments of the sustainability of commercial fish stocks have been undertaken by the Australian Government.[19] Of the 20 commercially wild-caught stocks assessed across Victoria, 15 were considered sustainable and only one (school shark) was considered to be over-fished. However, five wild-caught stocks did not have enough information to determine stock status.

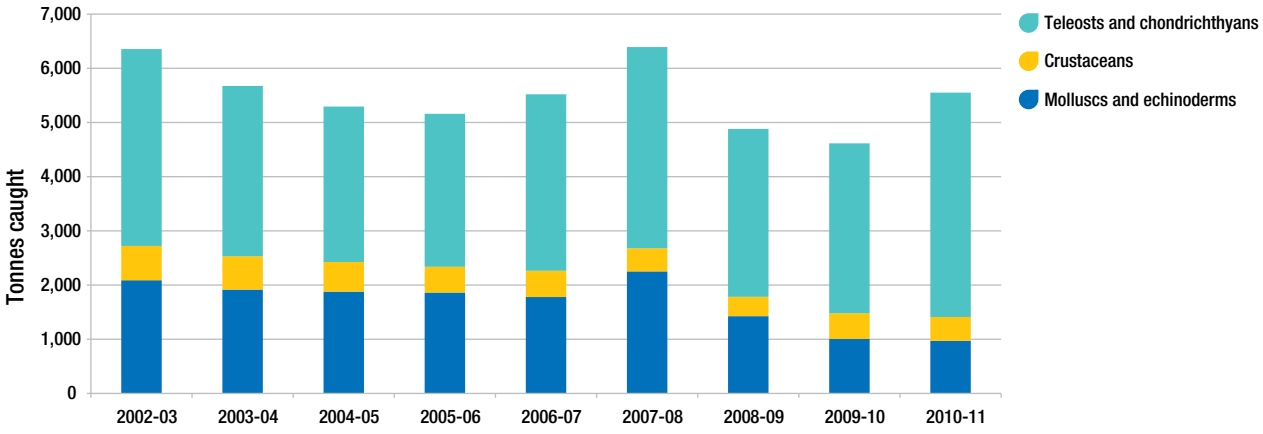


Figure A.4.2: Victorian annual fisheries production, 2002–03 to 2010–11, by type

Source: DEPI.

Indicator MC4: Marine and Coastal Water Quality

Reduced water quality in marine and coastal environments can impact on biodiversity and ecosystem health. It can also negatively affect activities such as swimming, boating, and recreational and commercial fishing.

The quality of Victoria's marine water is strongly dependent upon the activities that occur in the adjacent catchments. A large and growing proportion of Victorians live on or close to the coast. This has implications for estuarine and marine water quality, principally due to urban stormwater runoff and treated effluent discharge.

Port Phillip Bay and Western Port are the two largest and most densely populated areas of Victoria's coastline and are home to many industries. The location of these heavily urbanised centres in close proximity to the marine and estuarine environment means that activities that occur within the catchments can also have implications for the adjacent marine and coastal environment. Other settlements along the Victorian coast are also associated with local water-quality issues, particularly those on the Gippsland Lakes.

Impacts on water quality

Potentially polluting discharges from terrestrial-based urban and industrial systems are classified as 'point' and 'diffuse'.

Point-source discharges are direct discharges into the receiving environment from the pipes of industrial facilities and municipal sewage treatment plants. Point-source discharges usually introduce water from the source into a single location, are close to large population centres, and most are licensed by the EPA.

Diffuse-source pollution is often delivered to the marine environment after storms as water moves across the land. Agricultural and urban stormwater runoff that reaches the marine environment via streams and rivers is the major component of diffuse pollution, and constitutes the greatest proportion of pollution to marine and estuarine systems.

Industrial point-source discharges introduce chemical loads such as nutrients, various metals, petroleum hydrocarbons and other contaminants into the marine waters surrounding the discharge point. Victoria has 29 EPA licensed point-source discharges that enter marine environments, with the majority located within Port Phillip Bay and Western Port.

The licences set enforceable limits for pollutants that must be maintained to achieve environmental protection. Of the 29 point-source discharges, 76% of the total volume of water comes from three sources – a Shell industrial site in Corio Bay, and the two treated effluent discharges from the Western Treatment Plant (Werribee) and the Eastern Treatment Plant (near Gunnamatta).

As a result of these, areas of concern in Victoria's marine and estuarine environments include Long Reef (adjacent to Werribee) and Boags Rocks (near Gunnamatta) on the Mornington Peninsula. The point-source discharges at these two sites contribute greater than 75% of the point-source inputs of nitrogen, phosphorous and suspended solids into Victoria's marine environment. The Eastern Treatment Plant is currently undergoing an upgrade that will reduce nutrient discharges.

The desalinisation plant at Wonthaggi will constitute an additional point source of potentially polluting substances when in use. It is estimated that up to 280 GL per year of hypersaline water will be pumped back into the sea. However, the impact of this discharge on water quality is not expected to extend beyond the mixing zone (100 metres from the outlet).

Nutrients

Elevated nutrient levels can result in algal blooms (eutrophication), fluctuations in dissolved oxygen, loss of sensitive species (e.g. kelp), decreases in dissolved oxygen, and subsequent die-off of susceptible fish and invertebrates.

Some species of phytoplankton may produce toxins in water, with implications for the health of fish, other animals and humans that come into contact with the water.

Anthropogenic nitrogen loads are introduced to the marine environment via point and non-point sources. Two significant point sources of nitrogen into Victoria's waters are the outfalls associated with the Western Treatment Plant in Port Phillip Bay and the Eastern Treatment Plant at Boags Rocks near Gunnamatta Beach on the Mornington Peninsula.

The concentration of chlorophyll-a is commonly used as a measure of eutrophication because it provides an indication of the abundance of phytoplankton in the marine environment. Increases in chlorophyll-a concentrations within a marine environment are usually due to seasonal increase in temperature, increased nutrient levels and decreased flushing of bays, and can be influenced by a reduction in nitrogen cycling (denitrification efficiency).

Suspended solids

Water clarity (turbidity) is affected by the amount of particulate matter in the water column including suspended solids such as clay and silt particles, and planktonic organisms such as algae and zooplankton. In most marine and coastal ecosystems, a small amount of suspended solids in the form of nutrients is essential to the survival of microscopic plants and animals. However, high levels of suspended solids can impact on marine and coastal ecosystems by reducing light levels and making it difficult for marine plants to grow, and by smothering plants and seaweeds that grow on the sea floor. Increases in suspended solids also reduces the aesthetic value of estuaries and beaches, making them less attractive for recreational activities.

Suspended solids in marine waters can increase when there is a large inflow of suspended solids from rivers (for example, during a storm event), during tidal and seasonal variation such as strong winds, and during activities such as dredging. Shallow waters are more susceptible to increased suspended solids because of the ease with which sediments are resuspended in the water.

Salinity

Salinity concentrations in bays and estuaries reflect changes in the volume of freshwater inputs, stratification, evaporative fluxes, water circulation and exchange with adjacent ocean waters. Salinity concentrations in Victoria's bays are mainly the result of the prevailing weather and climatic variables including rainfall, wind, temperature and solar radiation. Changes in salinity have important implications for ecosystem health, as well as the transport and mixing characteristics of marine and coastal systems.

Changes in salinity can influence the distribution, abundance and composition of biological communities, as well as the breeding and hatching success of some fish, squid and prawn species.

Toxic pollutants

There are a number of potentially toxic substances from industrial and urban processes that can affect water quality and the health of animals and humans that use the marine environment. Substances include heavy metals such as copper, arsenic, mercury, lead and cadmium; and organic compounds such as pesticides and polychlorinated biphenyls (PCBs). Some pollutants can accumulate within the tissues of individual animals (bioaccumulation) and/or increase in concentration in higher trophic levels (biomagnification), both of which can lead to chronic poisoning, even if absolute levels of a toxin in the environment are low.

The influx of industrial contamination can be particularly harmful in estuarine environments where flushing is limited, and when historic deposits containing such substances are resuspended during storms or dredging.

In most cases, the presence of industrial toxins in the marine environment is the result of activities that occur, or historically occurred, upstream within catchments. Runoff from intensive uses, such as industrial and urban activities, is responsible for many substances, although in many cases substances move through the air and surface or groundwater before reaching the marine environment. Toxic substances can also enter marine environments as a result of maritime activities such as spills. Anti-fouling paints used to prevent the growth of organisms on ships and the spread of marine pests can also be a source of marine toxicity.

Heavy metal contamination from non-point sources has historically been largely confined to Port Phillip Bay.[8] Monitoring of metals in Port Phillip Bay by the EPA has shown that concentrations are typically low (below the limit of reporting) and peaks in concentrations are below levels known to be toxic to humans and biota.[20] Concentrations of metals in the bay have gradually decreased over the years, although it is likely that the Yarra continues to be a source. This decrease is due to reduced inputs of metals as awareness about their toxicity has increased and industrial processes are improved.

Victoria's marine and coastal water quality

To monitor the condition of waters in Victoria's bays and estuaries, the EPA measures water quality in Port Phillip Bay (11 sites), Western Port (three sites) and in the Gippsland Lakes at Lake Wellington, Lake Victoria, Lake King (two sites) and Shaving Point.

Monitoring by EPA Victoria indicates that Victoria generally has good marine and coastal water quality, although this varies around the state. Water quality is better in the open waters of the continental shelf of Bass Strait, although it is rarely monitored.

Poor water quality in the open ocean is usually the result of sediment plumes from rivers after storm events. Such local effects are usually rapidly dispersed, only briefly affecting recreational and commercial fisheries.

In contrast, Victorian estuarine and bay systems – such as Port Phillip Bay, Western Port and the Gippsland Lakes – are subject to reduced water quality. This is due to the high level of human activity in and around Victorian bays and estuaries and the lower rates of water mixing with open waters. Poor water quality usually occurs after episodic storm events when high pollutant levels are discharged from rivers and drains. Water quality is also reduced during periods when reduced mixing and flushing of water occurs.

Victoria's most sensitive marine systems are monitored monthly by the EPA for a range of water-quality parameters including salinity, nutrients, suspended sediments and chlorophyll-a. The main water-quality observations for Victoria's marine and coastal waters over the reporting period include the following.

Port Phillip Bay and Westernport

- During the 1996–2009 Millennium Drought (see Part A: Climate Change and Air Quality), salinity concentrations in Port Phillip Bay exceeded neighbouring ocean levels in Bass Strait. The high rainfall in 2010–11 greatly increased freshwater inflows, which returned salinity levels to that recorded during the 1990s (Figure A.4.3).
- Nutrient loads from the Yarra and Maribyrnong Rivers and Western Treatment Plant increased in 2010–11 as a result of increased rainfall and associated catchment inputs.
- The increase in nutrient input to the bay resulted in an increase in phytoplankton and corresponding chlorophyll-a levels. There was an increase in the dominance of diatom phytoplankton, with few incidents of potentially harmful phytoplankton species.
- On 25 December 2011, areas of Melbourne experienced a severe storm event, which triggered a large flow of stormwater into the rivers and tributaries of the Melbourne catchment, eventually impacting on Port Phillip Bay. Over 32,000 ML of fresh water flowed into the bay in the six days following the storm, leading to an unprecedented drop in salinity in Hobson's Bay. Resulting water-quality impacts led to the highest ever plankton (a form of algae) levels, algal blooms, associated fish deaths and elevated bacteria levels.

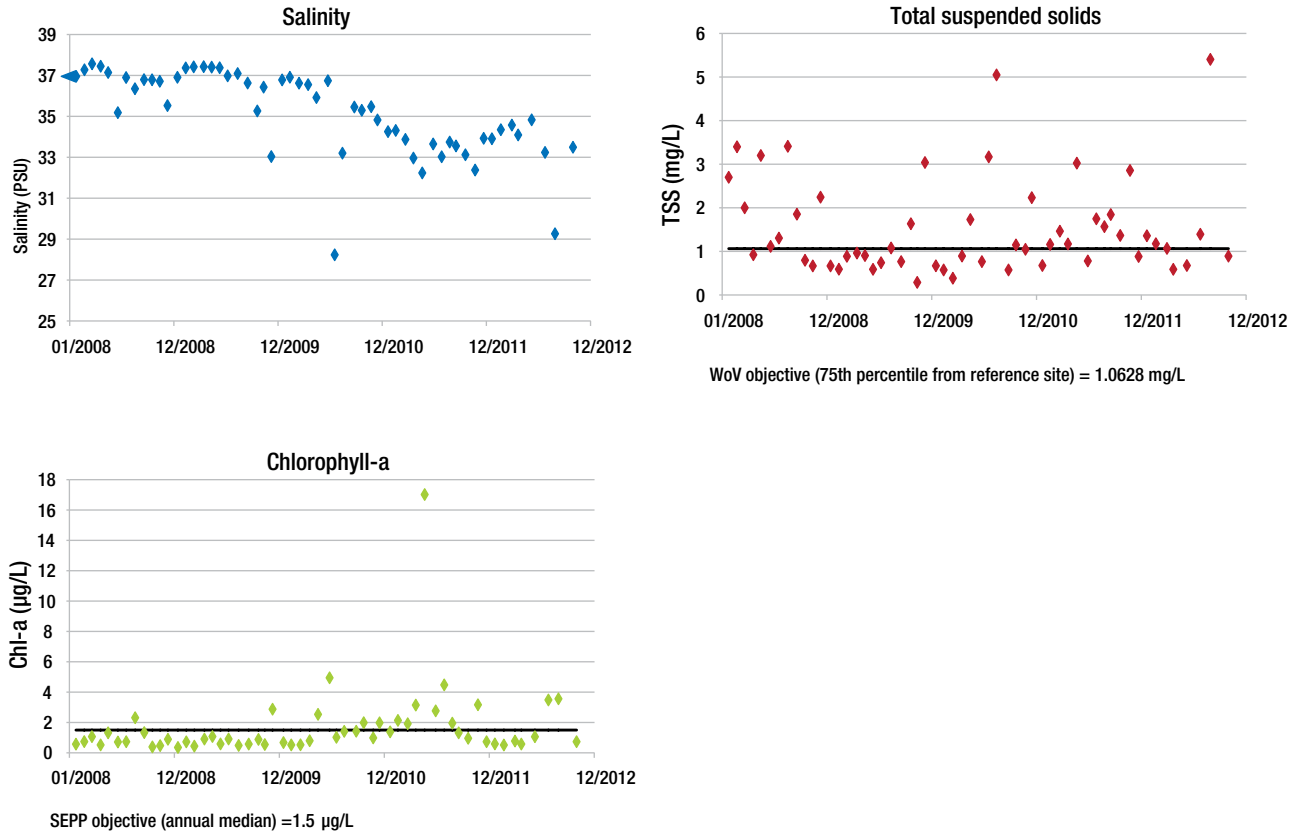


Figure A.4.3: Water-quality results off Patterson River in Port Phillip Bay 2008–2012

Source: EPA.

Western Port

- Water quality experienced in Western Port reflects recovery from drought conditions that had prevailed since 1996. A long-term trend of increasing salinity to 2009 was halted in 2010 by a return of average to above-average rainfall in the catchment.
- Overall water quality in Western Port was generally good with no algal bloom events detected.

Gippsland Lakes

- The water quality experienced in the Gippsland Lakes was generally good during the dry 2009 period but degraded slightly in 2010, and further in 2011 and 2012 when higher rainfall increased pollutant inflows (Figure A.4.4). The worst water quality was experienced at Lake Wellington where chlorophyll-a levels exceeded the annual median objective through the 2008 to 2012 period (Figure A.4.5).
- Pollutant loads increased in response to greater river inflows and resulted in exceedences of water quality objectives at all sites from 2009 to 2012. Poor water quality clearly reflects the negative influence of catchment inflows on the Gippsland Lakes.
- Climatic variation led to major variation in river inflows to the Gippsland Lakes. The total annual inflow was 1012 GL for the 2009 year. This doubled in 2010 and more than tripled in 2011.
- The increased freshwater inflows reduced salinity levels in the lakes. Salinity had increased during the 2008–09 period as a result of drought conditions.

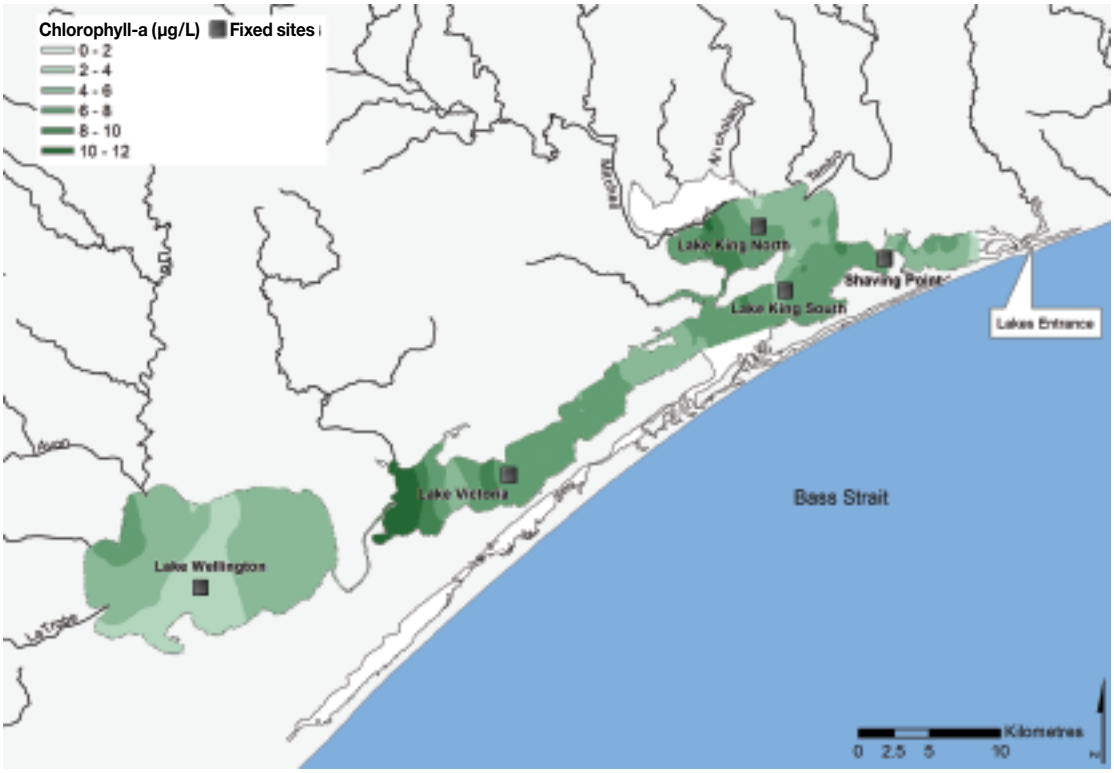


Figure A.4.5: Mapped chlorophyll-a across Gippsland Lakes in February 2012

Source: EPA.

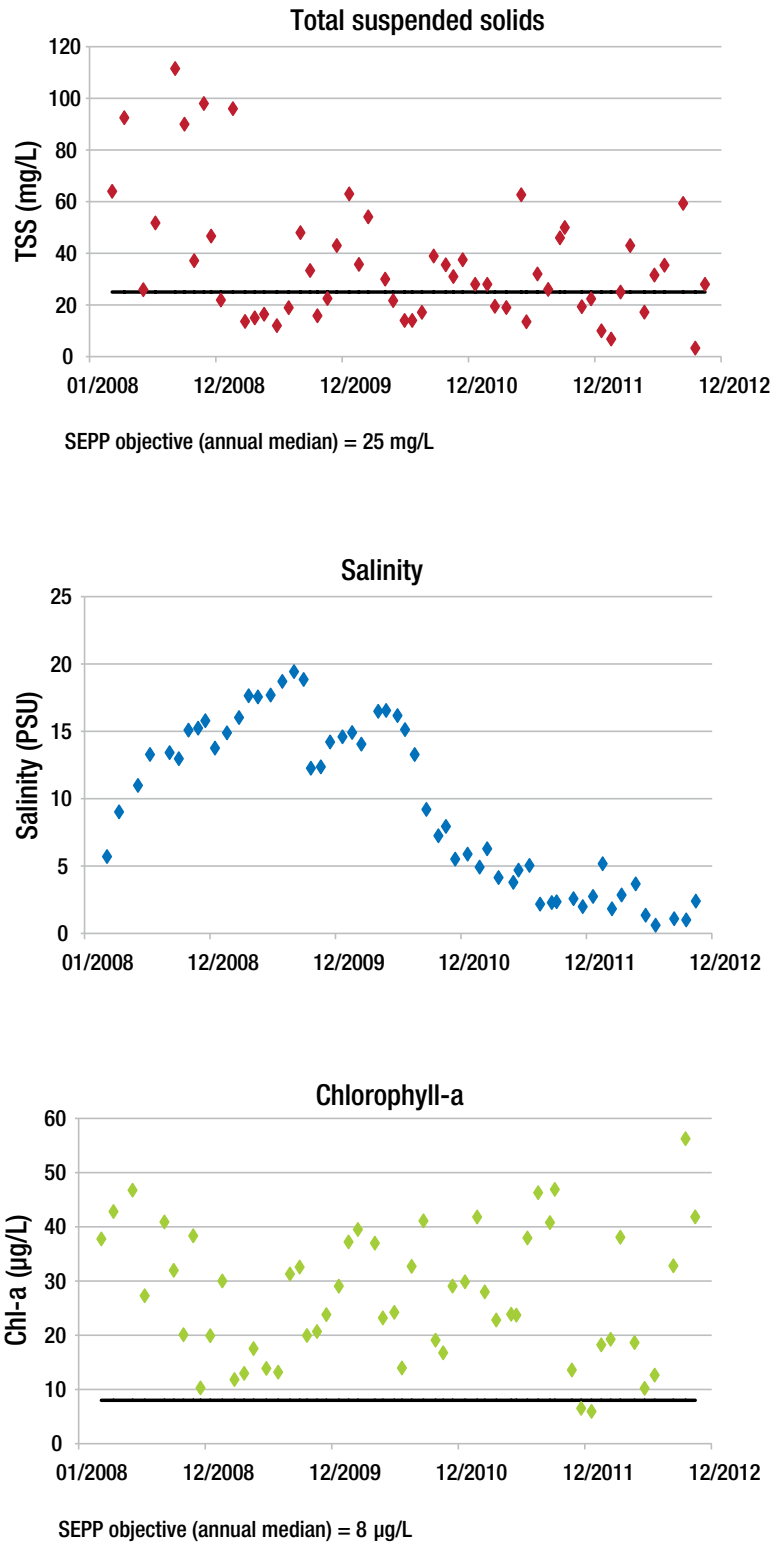


Figure A.4.4: Water-quality results from the Lake Wellington site in Gippsland Lakes 2008–2012

Source: EPA.

Case Study: Keeping an 'eye' on Port Phillip Bay [21]

In 2008, EPA engaged with the national Integrated Marine Observing System to develop and sustain continuous water-quality measurements across Port Phillip Bay. This was done using an automated monitoring system located on board the *Spirit of Tasmania I*.

Daily 80 km transects through the bay provide an ongoing window into the impact and recovery of events and activities such as floods, algal blooms, dredging in the bay, and exchange processes with Bass Strait. The data has been used to inform environmental managers and port authorities, aid fisheries research, integrate with numerical models, and investigate climate change studies.

The data obtained has highlighted Port Phillip Bay as a significantly climate-modified marine system, where reduced coastal discharges and higher evaporation causes elevated salinities higher than the adjoining ocean.

Data also shows algal bloom response to catchment nutrient inputs after storm events (see Figure A.4.6).

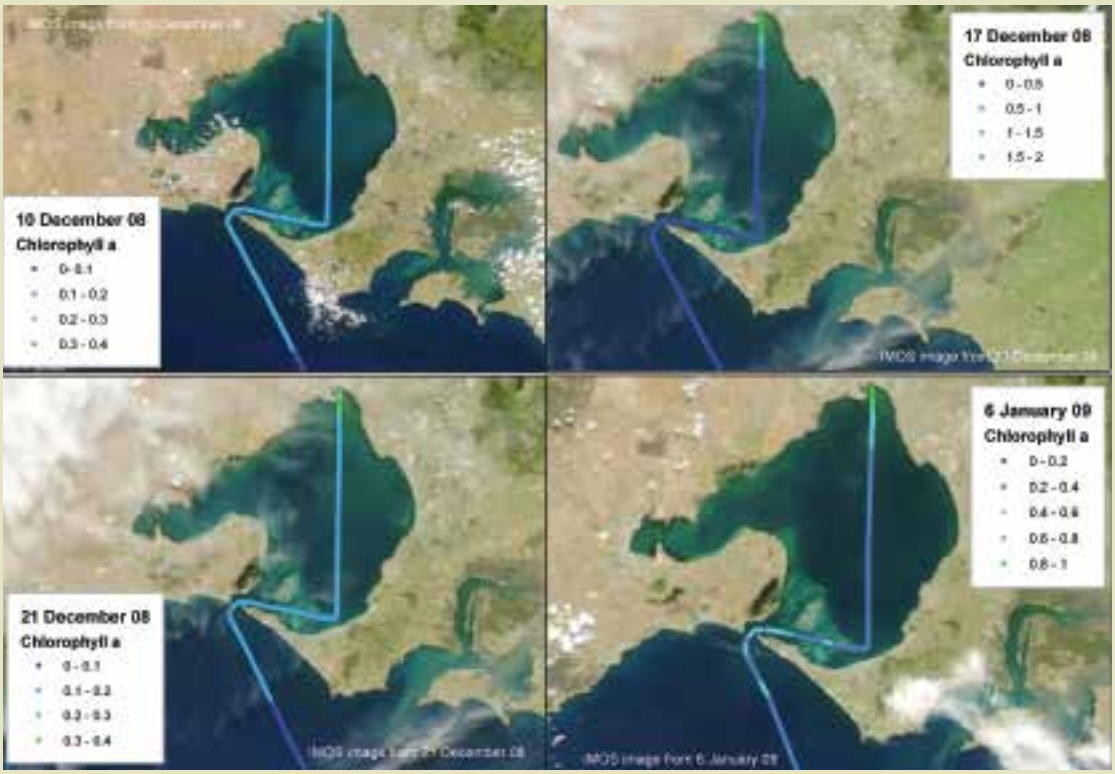


Figure A.4.6: Algal bloom response and recovery from December 2008 storm

Source: EPA.

Beach recreational water quality

Recreational water quality refers to the suitability of water for swimming and other activities that involve direct contact with the water. Recreational water quality is assessed by testing for the presence of *Enterococci* bacteria. This bacteria is commonly found in the gastrointestinal tracts of warm-blooded animals and may be present in marine waters. Animal faeces washed into the sea via rivers and stormwater drains after rain events is thought to be the principal source of *Enterococci*. Poorly managed sewage is also a source. Ingestion of these bacterial pathogens can lead to gastrointestinal illnesses such as diarrhoea.

EPA Victoria monitors the health of 36 beaches in Port Phillip Bay. Elevated levels of *Enterococci* are likely to be due to both point and non-point sources, particularly stormwater drains that discharge water at these sites on Port Phillip Bay. These stormwater inputs contribute to reduced recreational water quality at times of elevated input loadings.

Between 2007–08 and 2011–12, recreational water quality was generally good during fine weather (Figure A.4.7). However, stormwater runoff and river flows after rain resulted in an increase in the number of swim advisories (water quality deemed unsuitable for swimming) in 2010–11 and 2011–12 (Figure A.4.8). Elevated bacterial levels were usually short-lived, with bacterial levels returning to low levels within 24–48 hours after rain.

The increases in rainfall across the Port Phillip Bay catchment from 2010–11 have impacted on short-term water quality, particularly at beaches in close proximity to rivers, creeks and stormwater drains that flush out into the bay.

Of particular note was the Sunday 25 December 2011 storms, when large areas of Melbourne experienced a severe storm event. This triggered a large flow of stormwater into the rivers and tributaries of the Melbourne catchment, impacting on Port Phillip Bay. Beaches closer to the mouth of the Yarra had elevated bacterial levels after the Christmas Day storm. For Sandridge beach, the closest beach to the Yarra, a swim advisory was issued due to bacterial levels remaining high for up to 72 hours following the storm.

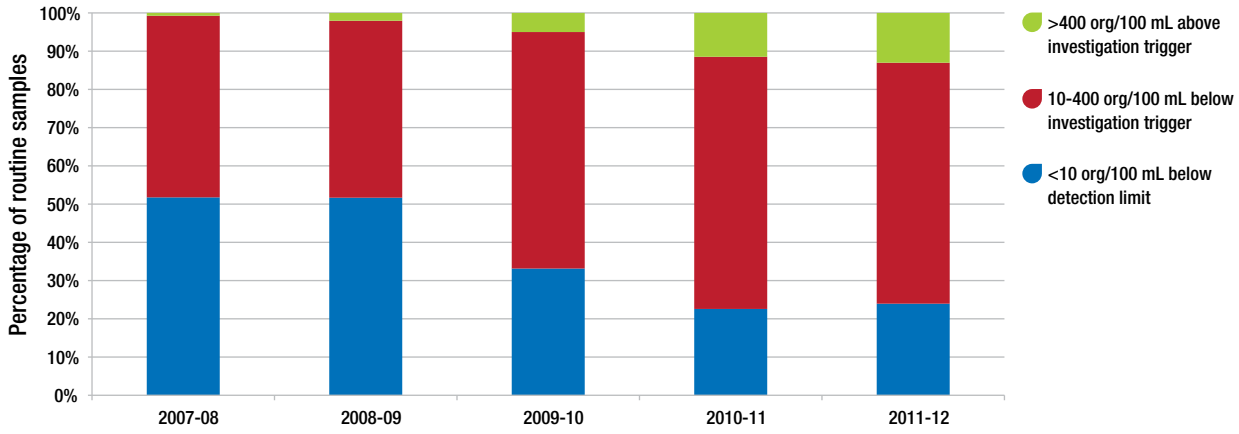


Figure A.4.7: Summary of routine *Enterococci* sampling results for Port Phillip Bay, 2007–08 to 2011–12

Source EPA.

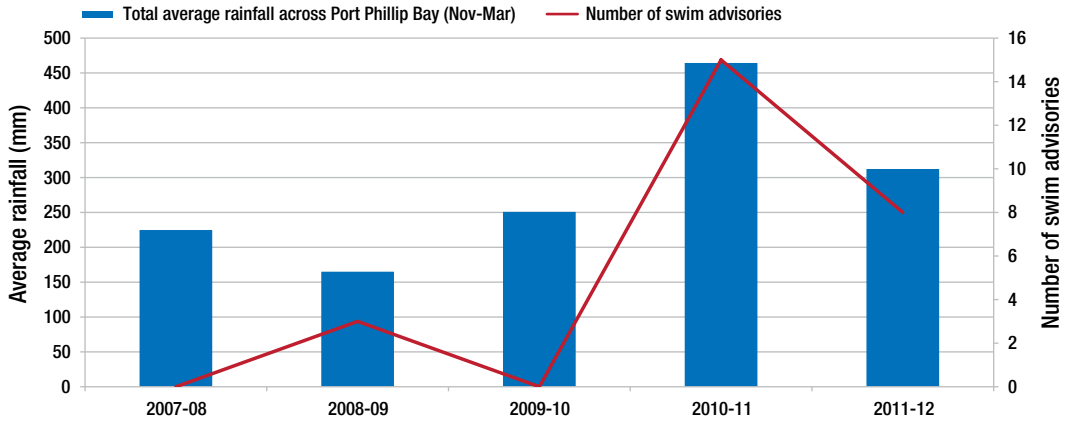


Figure A.4.8: The number of swim advisories compared to rainfall, Port Phillip Bay, 2007–08 to 2011–12

Source EPA.

The EPA no longer monitors recreational water quality outside of Port Phillip Bay. Previous data suggest that recreational water quality in Western Port is generally better than in Port Phillip Bay and this is likely to be because of the smaller population and lower density of impervious surfaces in this catchment.[8]

For beaches along the western coastline of Victoria, recreational water quality has been found to be very good, with the exception of some estuarine sites such as Wye River and Kennett River. Elevated bacterial levels in these estuaries appeared to be associated with localised stressors on river catchments partly as a result of the increased population, pressures on the townships' septic and sewerage infrastructure, and stormwater drainage.

Maritime activities and pollution incidents

Victorian marine waters are subject to pressures from a number of maritime industrial activities, including shipping, fishing, and oil and gas extraction, as well as recreational boating. Maritime activities have the potential to cause pollution in the coastal and marine environment through oil spills (including from recreational craft) and the discharge of ballast water. Maritime activity, particularly in terms of the size of ships calling into Victorian ports, has increased since 2002 and is projected to increase further. Dredging is undertaken periodically in most ports on the Victorian coast to maintain shipping channels. Dredging can have implications for marine processes, water quality and marine biodiversity (see Indicator MC1: Marine and Coastal Health).

A marine pollution incident is defined as any event that results in a chemical, oil or oily mixture, sewage or garbage entering the marine environment. Most of these occur in or around ports, but some are also of terrestrial origin. Maritime pollution spills can result in heavy metals and other toxic substances and chemicals entering the marine environment. These can have drastic impacts on freshwater and marine ecosystems. The effects may vary in severity from reducing growth and reproduction to directly killing plants and animals. The results can be particularly destructive in coastal wetlands and bays where flushing is limited.

Most incidents reported in Victoria are for small spills, less than 20 litres.

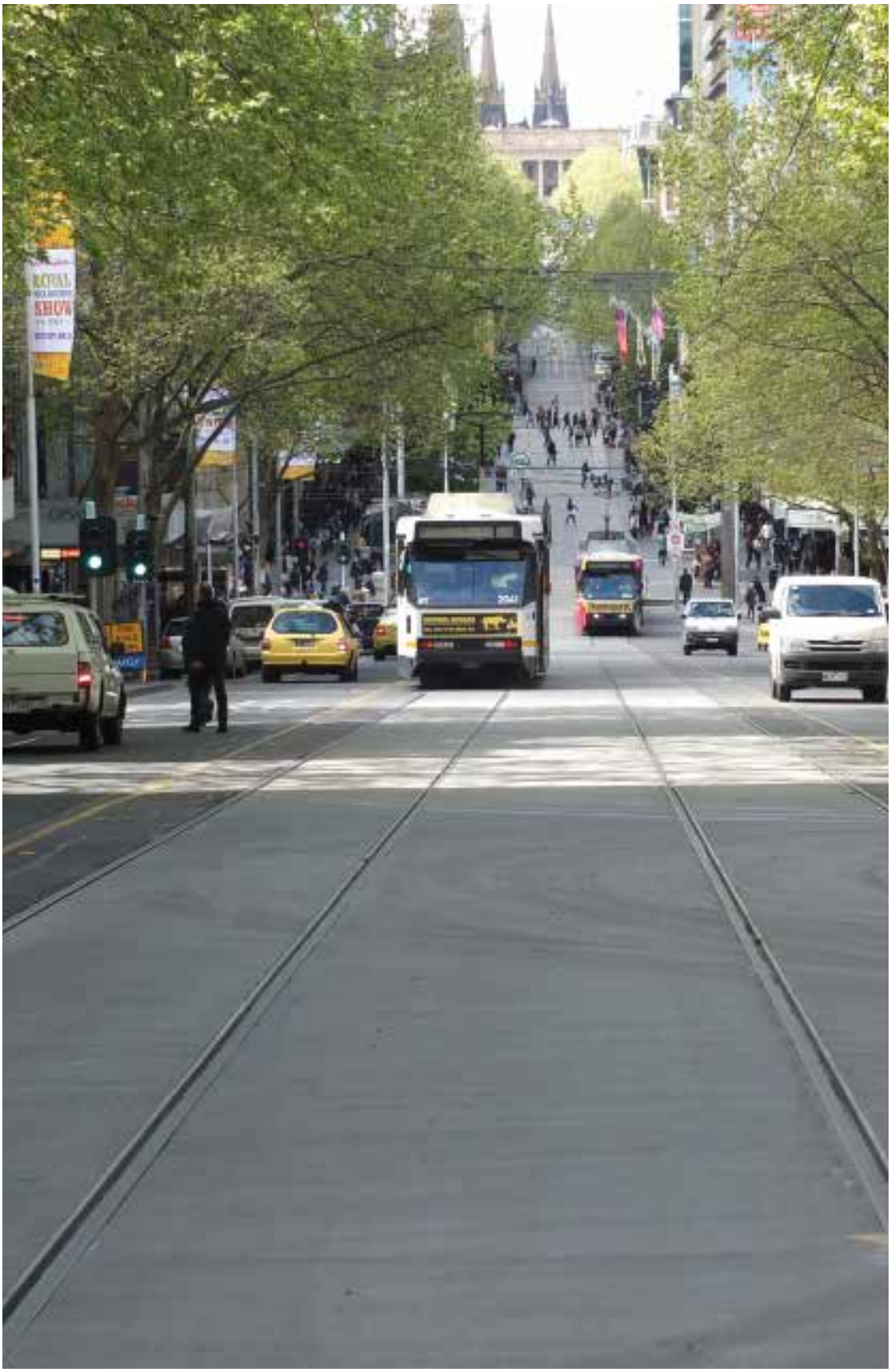
The greatest number of marine pollution incidents reported each year is in Port Phillip Bay.[8] This is probably due to the higher level of activity associated with the bay and the greater potential for sighting and reporting incidents due to the larger number of people using the area. Gippsland has the next highest number of reported incidents.

Data gaps

There is a lack of suitable data to adequately measure the condition and trends of Victoria's marine and coastal environments and the key resources they support. Despite the value of the marine and coastal environment, our knowledge and understanding – especially in regard to marine environments – is less developed than for terrestrial areas.

Marine and coastal data gaps include the following.

- Data on the condition of coastal land and marine and coastal ecosystems is not gathered in a comprehensive manner, making assessment of the condition of coastal and marine systems difficult.
- Assessment of threatened communities and species in marine environments is poor compared to terrestrial environments, particularly for marine flora, invertebrates and fish. There is generally very little known about the population status of marine species or their response to key environmental threats.
- Knowledge of the conservation status of marine and coastal invertebrates remains poor and the current number of threatened species is likely to be under-reported.
- Information about the condition of marine plants and animals is predominantly gathered in the context of maritime industries that depend on them, or in response to activities with likely impacts such as dredging.
- A lack of knowledge and understanding of marine systems is a major hindrance to protection of marine biodiversity and reporting on its current condition. For example, the large natural, spatial and temporal variability in marine and coastal ecosystems and species limits the ability to detect changes in response to known environmental threats (e.g. for seagrass and intertidal reef communities).
- While research has been conducted within Port Phillip Bay and Western Port in the last 30 years, it has only been in the past decade that larger-scale and (in some cases) longer-term monitoring programs have been established for marine and coastal systems (e.g. by Parks Victoria). Data from these programs are providing essential information about marine biodiversity in Victoria, and will become more valuable over time.
- Many studies of marine systems in Victoria are limited in spatial and temporal coverage, have collected different types of data for different requirements, and provide little information about the dynamics of marine communities and how these communities change in response to environmental pressures.
- Water quality monitoring outside the main estuaries is uncoordinated and disparate.
- Surveys for introduced marine pests are not done on a regular basis and are mainly limited to commercial ports and harbours. Few, if any, formal surveys have been done outside these locations.



Bourke Street, spring time